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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Communication procedures

Control protocol for multimedia communication

Recommendation ITU-T H.245

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Recommendation ITU-T H.245

Control protocol for multimedia communication

Summary

This Recommendation specifies syntax and semantics of terminal information messages as well as procedures to use them for in-band negotiation at the start of or during communication. The messages cover receiving and transmitting capabilities as well as mode preference from the receiving end, logical channel signalling, and Control & Indication. Acknowledged signalling procedures are specified to ensure reliable audiovisual and data communication.

Products claiming compliance with Version 15 of H.245 shall comply with all of the mandatory requirements of this Recommendation. Version 15 products can be identified by H.245 TerminalCapabilitySet messages containing a protocolIdentifier value of {itu-t (0) recommendation (0) h (8) 245 version (0) 15}.

Relative to H.245 Version 14 (2008-06), this version:

- Fixed three errors in the ASN.1. These were essentially the same error three times, in depFECxxx (xxx == Mode, Data or Cap), where there was an unnecessary comma after CHOICE.
- Added ASN.1 code points for masterMCU (same as H.230 MIM) and cancelMasterMCU (same as H.230 cancel MIM), as in the H.323 Implementors' Guide.
- Added three rows to Appendix VIII, Table VIII.1, as in the H.323 Implementors' Guide.
- Added the proposed changes concerning Opening Multicast Channels in H.323, including listing the OID in Appendix VIII, Table VIII.1.
- Added T140Data and T140Audio capability OIDs to Appendix VIII, Table VIII.1.
- Added a reference to RFC 4733 and replaced references in the text to RFC 2833 with references to RFC 4733. Where the text previously referenced section 3.9 of RFC 2833, the proposed new text simply references RFC 4733.

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Recommendation ITU-T H.245

Control protocol for multimedia communication

1 Scope

This Recommendation specifies syntax and semantics of terminal information messages as well as procedures to use them for in-band negotiation at the start of or during communication. The messages cover receiving and transmitting capabilities as well as mode preference from the receiving end, logical channel signalling, and Control & Indication. Acknowledged signalling procedures are specified to ensure reliable audiovisual and data communication.

This Recommendation covers a wide range of applications, including storage/retrieval, messaging and distribution services as well as conversational. It applies to, but is not limited to, multimedia systems that use the multiplexes defined in ITU-T Recs H.222.0, H.223, and H.225.0. These different systems share the same syntax and semantics, and are therefore bit-wise compatible. Some of the procedures are applicable to all systems, while the others are more specific to particular systems.

The different systems that make use of this Recommendation may specify the use of different transport protocols. However, it is intended to be used with a reliable transport layer, that is, one that provides guaranteed delivery of correct data.

NOTE – There should be no confusion with the T.120 management system, which is carried within the data stream, and covers different functionalities from those described here – the H.245 stream and the T.120-data stream are complementary.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

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3 Definitions

This Recommendation defines the following terms:

3.1 bidirectional logical channel: A bidirectional logical channel consists of a pair of associated transmission paths between two terminals, one in each direction of transmission.

3.2 capability: A terminal has a particular capability if it is able to encode and transmit or receive and decode that particular signal.

3.3 channel: A channel is a unidirectional link between two endpoints.

3.4 command: A command is a message that requires action but no explicit response.

3.5 elementary stream: Elementary stream is a generic term for a coded video, coded audio or other coded bitstream.

3.6 entry: The word "entry" is used to refer to elements in sets or tables, such as capability sets and multiplex tables.

3.7 forward: Forward is used to refer to transmission directed from the terminal making the request for a bidirectional logical channel to the other terminal.

3.8 in-band: In-band messages are those that are transported within the channel or logical channel to which they refer.

3.9 incoming: An incoming signalling entity cannot initiate a procedure, but responds to messages from the remote signalling entity and its own user's primitives.

3.10 indication: An indication is a message that contains information but does not require action or response.

3.11 logical channel: A logical channel is a unidirectional path or bidirectional path for the transmission of information.

3.12 logical channel number: A logical channel number is a number that identifies a single logical channel.

3.13 logical channel signalling: Logical channel signalling is a set of procedures that are used to open and close logical channels.

3.14 master terminal: A master terminal is the terminal that is determined as being the master terminal by the master-slave determination procedure defined in this Recommendation, or by some other procedure.

3.15 medium type: A medium type is a single form of information that is presented to a user or the data representing that information: video, audio and text are example medium types.

3.16 mode: A mode is a set of elementary streams that a terminal is transmitting, intends to transmit, or would like to receive.

3.17 multimedia communication: Multimedia communication refers to the transmission and/or reception of signals of two or more medium types simultaneously.

3.18 non-standard: Not conforming to a national or international standard referenced in this Recommendation.

3.19 outgoing: An outgoing signalling entity is one which initiates a procedure.

3.20 multipoint: Multipoint refers to the simultaneous interconnection of three or more terminals to allow communication among several sites through the use of multipoint control units (bridges) that centrally direct the flow of information.

3.21 request: A request is a message that results in action by the remote terminal and requires an immediate response from it.

3.22 response: A response is a message that is the response to a request.

3.23 reverse: "Reverse" is used to refer to transmission directed from the terminal receiving a request for a bidirectional logical channel to the terminal making the request.

3.24 session: A session is a period of communication between two terminals which may be conversational or non-conversational (for example, retrieval from a database).

3.25 slave terminal: A slave terminal is the terminal that is determined as being the slave terminal by the master-slave determination procedure defined in this Recommendation, or by some other procedure.

3.26 support: The ability to operate in a given mode; however, a requirement to support a mode does not mean that the mode must actually be used at all times: unless prohibited, other modes may be used by mutual negotiation.

3.27 terminal: A terminal is any endpoint and may be a user's terminal or some other communication system such as an MCU or an information server.

3.28 TSAP identifier: The piece of information used to multiplex several transport connections of the same type on a single H.323 entity with all transport connections sharing the same LAN address, (e.g., the port number in a TCP/UDP/IP environment). TSAP identifiers may be (pre)assigned by some international authority or may be allocated dynamically during setup of a call. Dynamically assigned TSAP identifiers are of transient nature, i.e., their values are only valid for the duration of a single call.

3.29 unidirectional logical channel: A unidirectional logical channel is a path for the transmission of a single elementary stream from one terminal to another.

4 Abbreviations

This Recommendation uses the following abbreviations:

AAL	ATM Adaptation Layer
AL1,2,3	H.223 Adaptation Layers 1, 2 and 3
ASN.1	Abstract Syntax Notation One
ATM	Asynchronous Transfer Mode
B-LCSE	Bidirectional Logical Channel Signalling Entity
CESE	Capability Exchange Signalling Entity
CIF	Common Intermediate Format (of a video picture: refer to ITU-T Recs H.261 and H.263)
CLCSE	Close Logical Channel Signalling Entity
CPCS	Common Part Convergence Sublayer (of ATM Adaptation Layer 5)
DSM-CC	Digital Storage Media/Command and Control
DTMF	Dual Tone Multi-Frequency
GOB	Group of Blocks (of a video picture: refer to ITU-T Recs H.261 and H.263)
GSTN	General Switched Telephone Network
HDLC	High-level Data Link Control
HRD	Hypothetical Reference Decoder (refer to ITU-T Recs H.261 and H.263)
IV	Initialization Vector (used for encryption: refer to ITU-T Recs H.233 and H.234)
LAPM	Link Access Protocol for Modems
LCSE	Logical Channel Signalling Entity
MC	H.323 Multipoint Control Entity
MCU	Multipoint Control Unit
MLSE	Maintenance Loop Signalling Entity
MPI	Minimum Picture Interval
MRSE	Mode Request Signalling Entity
MSDSE	Master-Slave Determination Signalling Entity
MTSE	Multiplex Table Signalling Entity
PCR	Program Clock Reference (refer to ITU-T Rec. H.222.0 | ISO/IEC 13818-1)
PID	Packet Identifier (refer to ITU-T Rec. H.222.0 | ISO/IEC 13818-1)
QCIF	Quarter CIF
RMESE	Request Multiplex Entry Signalling Entity
RTCP	Real-time Transport Control Protocol
RTDSE	Round-Trip Delay Signalling Entity
RTP	Real-time Transport Protocol
SDL	Specification and Description Language
SDU	Service Data Unit

SE	Session Exchange Message (used for encryption: refer to ITU-T Recs H.233 and H.234)
SQCIF	Sub QCIF
STD	System Target Decoder (refer to ITU-T Rec. H.222.0 | ISO/IEC 13818-1)
VC	ATM Virtual Channel

5 General

This Recommendation provides a number of different services, some of which are expected to be applicable to all terminals that use it and some that are more specific to particular ones. Procedures are defined to allow the exchange of audiovisual and data capabilities; to request the transmission of a particular audiovisual and data mode; to manage the logical channels used to transport the audiovisual and data information; to establish which terminal is the master terminal and which is the slave terminal for the purposes of managing logical channels; to carry various control and indication signals; to control the bit rate of individual logical channels and the whole multiplex; and to measure the round-trip delay, from one terminal to the other and back. These procedures are explained in more detail below.

Following this general introduction, there are clauses detailing the message syntax and semantics and the procedures. The syntax has been defined using ASN.1 notation [40] and the semantics define the meaning of syntax elements as well as providing syntactic constraints that are not specified in the ASN.1 syntax. The procedures clause defines the protocols that use the messages defined in the other clauses.

Although not all of the messages and procedures defined in this Recommendation will be applicable to all terminals, no indication of such restrictions is given here. These restrictions are the responsibility of the recommendations that use this Recommendation.

This Recommendation has been defined to be independent of the underlying transport mechanism, but is intended to be used with a reliable transport layer, that is, one that provides guaranteed delivery of correct data.

5.1 Master-slave determination

Conflicts may arise when two terminals involved in a call initiate similar events simultaneously and only one such event is possible or desired, for example, when resources are available for only one occurrence of the event. To resolve such conflicts, one terminal shall act as a master and the other terminal shall act as a slave terminal. Rules specify how the master and slave terminal shall respond at times of conflict.

The master-slave determination procedure allows terminals in a call to determine which terminal is the master and which terminal is the slave. The terminal status may be re-determined at any time during a call; however, a terminal may only initiate the master-slave determination process if no procedure which depends upon its result is locally active.

5.2 Capability exchange

The capability exchange procedures are intended to ensure that the only multimedia signals to be transmitted are those that can be received and treated appropriately by the receive terminal. This requires that the capabilities of each terminal to receive and decode be known to the other terminal. It is not necessary that a terminal understand or store all incoming capabilities; those that are not understood, or cannot be used shall be ignored, and no fault shall be considered to have occurred. When a capability is received which contains extensions not understood by the terminal, the capability shall be accepted as if it did not contain the extensions.

The total capability of a terminal to receive and decode various signals is made known to the other terminal by transmission of its capability set.

Receive capabilities describe the terminal's ability to receive and process incoming information streams. Transmitters shall limit the content of their transmitted information to that which the receiver has indicated it is capable of receiving. The absence of a receive capability indicates that the terminal cannot receive (is a transmitter only).

Transmit capabilities describe the terminal's ability to transmit information streams. Transmit capabilities serve to offer receivers a choice of possible modes of operation, so that the receiver may request the mode which it prefers to receive. The absence of a transmit capability indicates that the terminal is not offering a choice of preferred modes to the receiver (but it may still transmit anything within the capability of the receiver).

These capability sets provide for more than one stream of a given medium type to be sent simultaneously. For example, a terminal may declare its ability to receive (or send) two independent H.262 video streams and two independent G.722 audio streams at the same time. Capability messages have been defined to allow a terminal to indicate that it does not have fixed capabilities, but that they depend on which other modes are being used simultaneously. For example, it is possible to indicate that higher resolution video can be decoded when a simpler audio algorithm is used; or that either two low resolution video sequences can be decoded or a single high resolution one. It is also possible to indicate trade-offs between the capability to transmit and the capability to receive.

Non-standard capabilities and control messages may be issued using the NonStandardParameter structure. Note that while the meaning of non-standard messages is defined by individual organizations, equipment built by any manufacturer may signal any non-standard message, if the meaning is known.

Terminals may reissue capability sets at any time.

5.3 Logical channel signalling procedures

An acknowledged protocol is defined for the opening and closing of logical channels which carry the audiovisual and data information. The aim of these procedures is to ensure that a terminal is capable of receiving and decoding the data that will be transmitted on a logical channel at the time the logical channel is opened rather than at the time the first data is transmitted on it; and to ensure that the receive terminal is ready to receive and decode the data that will be transmitted on the logical channel before that transmission starts. The OpenLogicalChannel message includes a description of the data to be transported, for example, H.262 MP@ML at 6 Mbit/s. Logical channels should only be opened when there is sufficient capability to receive data on all open logical channels simultaneously.

A part of this protocol is concerned with the opening of bidirectional channels. To avoid conflicts which may arise when two terminals initiate similar events simultaneously, one terminal is defined as the master terminal, and the other as the slave terminal. A protocol is defined to establish which terminal is the master and which is the slave. However, systems that use this Recommendation may specify the procedure specified in this Recommendation or another means of determining which terminal is the master and which is the slave.

5.4 Receive terminal close logical channel request

A logical channel is opened and closed from the transmitter side. A mechanism is defined which allows a receive terminal to request the closure of an incoming logical channel. The transmit terminal may accept or reject the logical channel closure request. A terminal may, for example, use these procedures to request the closure of an incoming logical channel which, for whatever reason, cannot be decoded. These procedures may also be used to request the closure of a bidirectional logical channel by the terminal that did not open the channel.

5.5 H.223 multiplex table entry modification

The H.223 multiplex table associates each octet within an H.223 MUX message with a particular logical channel number. The H.223 multiplex table may have up to 15 entries. A mechanism is provided that allows the transmit terminal to specify and inform the receiver of new H.223 multiplex table entries. A receive terminal may also request the retransmission of a multiplex table entry.

5.6 Audiovisual and data mode request

When the capability exchange protocol has been completed, both terminals will be aware of each other's capability to transmit and receive as specified in the capability descriptors that have been exchanged. It is not mandatory for a terminal to declare all its capabilities; it only needs to declare those that it wishes to be used.

A terminal may indicate its capabilities to transmit. A terminal that receives transmission capabilities from the remote terminal may request a particular mode to be transmitted to it. A terminal indicates that it does not want its transmission mode to be controlled by the remote terminal by sending no transmission capabilities.

5.7 Round-trip delay determination

It may be useful in some applications to have knowledge of the round-trip delay between a transmit terminal and a receive terminal. A mechanism is provided to measure this round-trip delay. This mechanism may also be useful as a means to detect whether the remote terminal is still functioning.

5.8 Maintenance loops

Procedures are specified to establish maintenance loops. It is possible to specify the loop of a single logical channel either as a digital loop or decoded loop, and the loop of the whole multiplex.

5.9 Commands and indications

Commands and indications are provided for various purposes: video/audio active/inactive signals to inform the user; fast update request for source switching in multipoint applications are some examples. Neither commands nor indications elicit response messages from the remote terminal. Commands force an action at the remote terminal whilst indications merely provide information and do not force any action.

A command is defined to allow the bit rate of logical channels and the whole multiplex to be controlled from the remote terminal. This has a number of purposes: interworking with terminals using multiplexes in which only a finite number of bit rates are available; multipoint applications where the rates from different sources should be matched; and flow control in congested networks.

Annex A

Messages: Syntax

(This annex forms an integral part of this Recommendation)

This annex specifies the syntax of messages using the notation defined in ASN.1 [40]. Messages shall be encoded for transmission by applying the packed encoding rules specified in [42] using the basic aligned variant. The first bit in each octet which is transmitted is the most significant bit of the octet as is specified in ITU-T Rec. X.691| ISO/IEC 8825-2.

```
MULTIMEDIA-SYSTEM-CONTROL {itu-t(0) recommendation(0) h(8) h245(245) version(0)
15 multimedia-system-control(0)} DEFINITIONS AUTOMATIC TAGS ::=
BEGIN

-- Export all symbols

-- =======================================================================
-- Top level Messages
-- =======================================================================

MultimediaSystemControlMessage ::= CHOICE
{
     request                          RequestMessage,
     response                         ResponseMessage,
     command                          CommandMessage,
     indication                       IndicationMessage,
     ...
}

-- A RequestMessage results in action and requires an immediate response

RequestMessage ::= CHOICE
{
     nonStandard                      NonStandardMessage,

     masterSlaveDetermination         MasterSlaveDetermination,

     terminalCapabilitySet            TerminalCapabilitySet,

     openLogicalChannel               OpenLogicalChannel,
     closeLogicalChannel              CloseLogicalChannel,

     requestChannelClose              RequestChannelClose,

     multiplexEntrySend               MultiplexEntrySend,

     requestMultiplexEntry            RequestMultiplexEntry,

     requestMode                      RequestMode,

     roundTripDelayRequest            RoundTripDelayRequest,

     maintenanceLoopRequest           MaintenanceLoopRequest,

     ...,
     communicationModeRequest         CommunicationModeRequest,
     conferenceRequest                ConferenceRequest,

     multilinkRequest                 MultilinkRequest,
     logicalChannelRateRequest        LogicalChannelRateRequest,
     genericRequest                    GenericMessage
}

-- A ResponseMessage is the response to a RequestMessage

ResponseMessage ::= CHOICE
{
     nonStandard                       NonStandardMessage,

     masterSlaveDeterminationAck       MasterSlaveDeterminationAck,
     masterSlaveDeterminationReject    MasterSlaveDeterminationReject,

     terminalCapabilitySetAck          TerminalCapabilitySetAck,
     terminalCapabilitySetReject       TerminalCapabilitySetReject,

     openLogicalChannelAck             OpenLogicalChannelAck,
     openLogicalChannelReject          OpenLogicalChannelReject,
     closeLogicalChannelAck            CloseLogicalChannelAck,

     requestChannelCloseAck            RequestChannelCloseAck,
     requestChannelCloseReject         RequestChannelCloseReject,

     multiplexEntrySendAck             MultiplexEntrySendAck,
     multiplexEntrySendReject          MultiplexEntrySendReject,

     requestMultiplexEntryAck          RequestMultiplexEntryAck,
     requestMultiplexEntryReject       RequestMultiplexEntryReject,

     requestModeAckRequestModeAck,
     requestModeReject                 RequestModeReject,

     roundTripDelayResponse            RoundTripDelayResponse,

     maintenanceLoopAck                MaintenanceLoopAck,
     maintenanceLoopReject             MaintenanceLoopReject,

     ...,
     communicationModeResponse         CommunicationModeResponse,

     conferenceResponse                ConferenceResponse,

     multilinkResponse                 MultilinkResponse,

     logicalChannelRateAcknowledge     LogicalChannelRateAcknowledge,
     logicalChannelRateReject          LogicalChannelRateReject,
     genericResponse                   GenericMessage


}

-- A CommandMessage requires action, but no explicit response

CommandMessage ::= CHOICE
{
     nonStandard                       NonStandardMessage,

     maintenanceLoopOffCommand         MaintenanceLoopOffCommand,

     sendTerminalCapabilitySet         SendTerminalCapabilitySet,

     encryptionCommand                 EncryptionCommand,

     flowControlCommand                FlowControlCommand,
    endSessionCommand                EndSessionCommand,

    miscellaneousCommand             MiscellaneousCommand,
    ...,
    communicationModeCommand         CommunicationModeCommand,

    conferenceCommand                ConferenceCommand,

    h223MultiplexReconfiguration     H223MultiplexReconfiguration,

    newATMVCCommand                  NewATMVCCommand,

    mobileMultilinkReconfigurationCommand    MobileMultilinkReconfigurationCommand,
    genericCommand                   GenericMessage

}

-- An IndicationMessage is information that does not require action or response

IndicationMessage ::= CHOICE
{
    nonStandard                      NonStandardMessage,

    functionNotUnderstood            FunctionNotUnderstood,

    masterSlaveDeterminationRelease  MasterSlaveDeterminationRelease,

    terminalCapabilitySetRelease     TerminalCapabilitySetRelease,

    openLogicalChannelConfirm        OpenLogicalChannelConfirm,

    requestChannelCloseRelease       RequestChannelCloseRelease,

    multiplexEntrySendRelease        MultiplexEntrySendRelease,

    requestMultiplexEntryRelease     RequestMultiplexEntryRelease,

    requestModeRelease               RequestModeRelease,

    miscellaneousIndication          MiscellaneousIndication,

    jitterIndication                 JitterIndication,

    h223SkewIndication               H223SkewIndication,

    newATMVCIndication               NewATMVCIndication,

    userInput                        UserInputIndication,
    ...,
    h2250MaximumSkewIndication       H2250MaximumSkewIndication,

    mcLocationIndication             MCLocationIndication,

    conferenceIndication             ConferenceIndication,

    vendorIdentification             VendorIdentification,

    functionNotSupported             FunctionNotSupported,

    multilinkIndication              MultilinkIndication,

    logicalChannelRateRelease        LogicalChannelRateRelease,

    flowControlIndication            FlowControlIndication,
    mobileMultilinkReconfigurationIndication    MobileMultilinkReconfigurationIndication,
    genericIndication                    GenericMessage

}

-- SequenceNumber is defined here as it is used in a number of Messages

SequenceNumber ::= INTEGER (0..255)

-- =============================================================================
-- Generic Message definitions
-- =============================================================================

GenericMessage ::= SEQUENCE
{
    messageIdentifier                CapabilityIdentifier,
    subMessageIdentifier             INTEGER(0..127)  OPTIONAL,

    messageContent                   SEQUENCE OF GenericParameter  OPTIONAL,
    ...
}

GenericInformation ::= GenericMessage

-- =============================================================================
-- Non-standard Message definitions
-- =============================================================================

NonStandardMessage ::= SEQUENCE
{
    nonStandardData                  NonStandardParameter,
    ...
}

NonStandardParameter ::= SEQUENCE
{
    nonStandardIdentifier            NonStandardIdentifier,
    data                             OCTET STRING
}

NonStandardIdentifier ::= CHOICE
{
    object                           OBJECT IDENTIFIER,
    h221NonStandard                  SEQUENCE
    {
        t35CountryCode               INTEGER (0..255),     -- country, per
                                                           -- Annex A/T.35
        t35Extension                 INTEGER (0..255),
                                     -- assigned nationally unless
                                     -- t35CountryCode is binary
                                     -- 1111 1111, in which case it shall
                                     -- contain the country code
                                     -- according to Annex B/T.35
        manufacturerCode             INTEGER (0..65535)    -- assigned nationally
    }
}
```

```
-- =============================================================================
-- Master-slave determination definitions
-- =============================================================================

MasterSlaveDetermination ::= SEQUENCE
{
    terminalType                    INTEGER (0..255),
    statusDeterminationNumber       INTEGER (0..16777215),
    ...
}

MasterSlaveDeterminationAck ::= SEQUENCE
{
    decision                        CHOICE
    {
        master                      NULL,
        slave                       NULL
    },
    ...
}

MasterSlaveDeterminationReject ::= SEQUENCE
{
    cause                           CHOICE
    {
        identicalNumbers            NULL,
        ...
    },
    ...
}

MasterSlaveDeterminationRelease ::= SEQUENCE
{
    ...
}

-- =============================================================================
-- Capability exchange definitions
-- =============================================================================

TerminalCapabilitySet ::= SEQUENCE
{
    sequenceNumber                  SequenceNumber,

    protocolIdentifier              OBJECT IDENTIFIER,
                                    -- shall be set to the value
                                    -- {itu-t (0) recommendation (0) h (8) 245
                                    -- version (0) 15}


    multiplexCapability             MultiplexCapability OPTIONAL,

    capabilityTable                 SET SIZE (1..256) OF CapabilityTableEntry OPTIONAL,

    capabilityDescriptors           SET SIZE (1..256) OF CapabilityDescriptor OPTIONAL,

    ...,
        genericInformation          SEQUENCE OF GenericInformation OPTIONAL
                                    -- generic information associated
                                    -- with the message
}
```

```
CapabilityTableEntry ::= SEQUENCE
{
    capabilityTableEntryNumber       CapabilityTableEntryNumber,
    capability                       Capability OPTIONAL
}

CapabilityDescriptor ::= SEQUENCE
{
    capabilityDescriptorNumber       CapabilityDescriptorNumber,
    simultaneousCapabilities         SET SIZE (1..256) OF AlternativeCapabilitySet OPTIONAL
}
AlternativeCapabilitySet ::= SEQUENCE SIZE (1..256) OF CapabilityTableEntryNumber

CapabilityTableEntryNumber ::= INTEGER (1..65535)

CapabilityDescriptorNumber ::= INTEGER (0..255)

TerminalCapabilitySetAck ::= SEQUENCE
{
    sequenceNumber                   SequenceNumber,
    ...,
        genericInformation           SEQUENCE OF GenericInformation OPTIONAL
                                     -- generic information associated
                                     -- with the message
}

TerminalCapabilitySetReject ::= SEQUENCE
{
    sequenceNumber                   SequenceNumber,
    cause                            CHOICE
    {
        unspecified                  NULL,
        undefinedTableEntryUsed      NULL,
        descriptorCapacityExceeded   NULL,
        tableEntryCapacityExceeded   CHOICE
        {
          highestEntryNumberProcessed  CapabilityTableEntryNumber,
          noneProcessed              NULL
        },
        ...
    },
    ...,
        genericInformation           SEQUENCE OF GenericInformation OPTIONAL
                                     -- generic information associated
                                     -- with the message
}

TerminalCapabilitySetRelease ::= SEQUENCE
{
    ...,
        genericInformation           SEQUENCE OF GenericInformation OPTIONAL
                                     -- generic information associated
                                     -- with the message
}

-- =============================================================================
-- Capability exchange definitions: top level capability description
-- =============================================================================

Capability ::= CHOICE
{
    nonStandard                      NonStandardParameter,
    receiveVideoCapability              VideoCapability,
    transmitVideoCapability             VideoCapability,
    receiveAndTransmitVideoCapability   VideoCapability,

    receiveAudioCapability              AudioCapability,
    transmitAudioCapability             AudioCapability,
    receiveAndTransmitAudioCapability   AudioCapability,

    receiveDataApplicationCapability    DataApplicationCapability,
    transmitDataApplicationCapability   DataApplicationCapability,
    receiveAndTransmitDataApplicationCapability   DataApplicationCapability,

    h233EncryptionTransmitCapability    BOOLEAN,
    h233EncryptionReceiveCapability     SEQUENCE
    {
      h233IVResponseTime                INTEGER (0..255),   -- units milliseconds

        ...
    },
    ...,
    conferenceCapability                ConferenceCapability,
    h235SecurityCapability              H235SecurityCapability,
    maxPendingReplacementFor            INTEGER (0..255),
    receiveUserInputCapability          UserInputCapability,
    transmitUserInputCapability         UserInputCapability,
    receiveAndTransmitUserInputCapability   UserInputCapability,

    genericControlCapability            GenericCapability,
    receiveMultiplexedStreamCapability  MultiplexedStreamCapability,
    transmitMultiplexedStreamCapability MultiplexedStreamCapability,
    receiveAndTransmitMultiplexedStreamCapability
    MultiplexedStreamCapability,
    receiveRTPAudioTelephonyEventCapability
    AudioTelephonyEventCapability,
    receiveRTPAudioToneCapability       AudioToneCapability,
    depFecCapability                    DepFECCapability, -- Deprecated, do not use
    multiplePayloadStreamCapability     MultiplePayloadStreamCapability,
    fecCapability                       FECCapability,
    redundancyEncodingCap               RedundancyEncodingCapability,
    oneOfCapabilities                   AlternativeCapabilitySet
}

H235SecurityCapability ::= SEQUENCE
{
    encryptionAuthenticationAndIntegrity    EncryptionAuthenticationAndIntegrity,

    mediaCapability                     CapabilityTableEntryNumber,
         -- NOTE – The mediaCapability shall refer to Capability Table Entries
         -- that do contain, directly or indirectly, one or more transmit,
         -- receive, or receiveAndTransmit AudioCapability, VideoCapability,
         -- DataApplicationCapability, or similar capabilities indicated by a
         -- NonStandardParameter or GenericCapability only

    ...
}

-- =============================================================================
-- Capability exchange definitions: Multiplex capabilities
-- =============================================================================

MultiplexCapability ::= CHOICE
{
    nonStandard                         NonStandardParameter,
    h222Capability                      H222Capability,
    h223Capability                      H223Capability,
    v76Capability                       V76Capability,
    ...,
    h2250Capability                 H2250Capability,

    genericMultiplexCapability      GenericCapability

}

H222Capability ::= SEQUENCE
{
    numberOfVCs                     INTEGER (1..256),
    vcCapability                    SET OF VCCapability,
    ...
}

VCCapability ::= SEQUENCE
{
    aal1                            SEQUENCE
    {
        nullClockRecovery           BOOLEAN,
        srtsClockRecovery           BOOLEAN,
        adaptiveClockRecovery       BOOLEAN,
        nullErrorCorrection         BOOLEAN,
        longInterleaver             BOOLEAN,
        shortInterleaver            BOOLEAN,
        errorCorrectionOnly         BOOLEAN,
        structuredDataTransfer      BOOLEAN,
        partiallyFilledCells        BOOLEAN,
        ...
    } OPTIONAL,
    aal5       SEQUENCE
    {
        forwardMaximumSDUSize       INTEGER (0..65535), -- units octets
        backwardMaximumSDUSize      INTEGER (0..65535), -- units octets
        ...
    } OPTIONAL,
    transportStream                 BOOLEAN,
    programStream                   BOOLEAN,
    availableBitRates               SEQUENCE
    {
        type                        CHOICE
        {
            singleBitRate           INTEGER (1..65535), -- units 64 kbit/s
            rangeOfBitRates         SEQUENCE
            {
                lowerBitRate        INTEGER (1..65535), -- units 64 kbit/s
                higherBitRate       INTEGER (1..65535)  -- units 64 kbit/s
            }
        },
        ...
    },
    ...,
    aal1ViaGateway                  SEQUENCE
    {
        gatewayAddress              SET SIZE(1..256) OF Q2931Address,
        nullClockRecovery           BOOLEAN,
        srtsClockRecovery           BOOLEAN,
        adaptiveClockRecovery       BOOLEAN,
        nullErrorCorrection         BOOLEAN,
        longInterleaver             BOOLEAN,
        shortInterleaver            BOOLEAN,
        errorCorrectionOnly         BOOLEAN,
        structuredDataTransfer      BOOLEAN,
        partiallyFilledCells        BOOLEAN,
        ...
    } OPTIONAL
```

```
}

H223Capability ::= SEQUENCE
{
    transportWithI-frames            BOOLEAN,            -- I-frame transport
                                                          -- of H.245

    videoWithAL1                     BOOLEAN,
    videoWithAL2                     BOOLEAN,
    videoWithAL3                     BOOLEAN,
    audioWithAL1                     BOOLEAN,
    audioWithAL2                     BOOLEAN,
    audioWithAL3                     BOOLEAN,
    dataWithAL1                      BOOLEAN,
    dataWithAL2                      BOOLEAN,
    dataWithAL3                      BOOLEAN,

    maximumAl2SDUSize                INTEGER (0..65535), -- units octets
    maximumAl3SDUSize                INTEGER (0..65535), -- units octets

    maximumDelayJitter               INTEGER (0..1023),  -- units milliseconds

    h223MultiplexTableCapability CHOICE
    {
        basic                        NULL,
        enhanced  SEQUENCE
        {
          maximumNestingDepth        INTEGER (1..15),
          maximumElementListSize     INTEGER (2..255),
          maximumSubElementListSize INTEGER (2..255),
            ...
        }
    },
    ...,
    maxMUXPDUSizeCapability          BOOLEAN,
    nsrpSupport                      BOOLEAN,
    mobileOperationTransmitCapability    SEQUENCE
    {
        modeChangeCapability         BOOLEAN,
        h223AnnexA                   BOOLEAN,
        h223AnnexADoubleFlag         BOOLEAN,
        h223AnnexB                   BOOLEAN,
        h223AnnexBwithHeader         BOOLEAN,
        ...
    } OPTIONAL,
    h223AnnexCCapability             H223AnnexCCapability OPTIONAL,

    bitRate                          INTEGER (1..19200) OPTIONAL, -- units of
                                                                  -- 100 bit/s
    mobileMultilinkFrameCapability   SEQUENCE
    {
        maximumSampleSize            INTEGER (1..255),      -- units octets
        maximumPayloadLength         INTEGER (1..65025), -- units octets
        ...
    } OPTIONAL

}

H223AnnexCCapability ::= SEQUENCE
{
    videoWithAL1M                    BOOLEAN,
    videoWithAL2M                    BOOLEAN,
    videoWithAL3M                    BOOLEAN,
    audioWithAL1M                    BOOLEAN,
	audioWithAL2M                      BOOLEAN,
	audioWithAL3M                      BOOLEAN,
	dataWithAL1M                       BOOLEAN,
	dataWithAL2M                       BOOLEAN,
	dataWithAL3M                       BOOLEAN,
	alpduInterleaving                  BOOLEAN,

	maximumAL1MPDUSize                 INTEGER (0..65535),    -- units octets
	maximumAL2MSDUSize                 INTEGER (0..65535),    -- units octets
	maximumAL3MSDUSize                 INTEGER (0..65535),    -- units octets
	...,
	rsCodeCapability                   BOOLEAN OPTIONAL
}

V76Capability ::= SEQUENCE
{
	suspendResumeCapabilitywAddress    BOOLEAN,
	suspendResumeCapabilitywoAddress   BOOLEAN,
	rejCapability                      BOOLEAN,
	sREJCapability                     BOOLEAN,
	mREJCapability                     BOOLEAN,
	crc8bitCapability                  BOOLEAN,
	crc16bitCapability                 BOOLEAN,
	crc32bitCapability                 BOOLEAN,
	uihCapability                      BOOLEAN,
	numOfDLCS INTEGER (2..8191),
	twoOctetAddressFieldCapability     BOOLEAN,
	loopBackTestCapability             BOOLEAN,
	n401CapabilityINTEGER (1..4095),
	maxWindowSizeCapability            INTEGER (1..127),
	v75Capability                      V75Capability,
	...
}

V75Capability ::= SEQUENCE
{
	audioHeader                        BOOLEAN,
	...
}

H2250Capability ::= SEQUENCE
{
	maximumAudioDelayJitter            INTEGER(0..1023),    -- units in
	                                                        -- milliseconds
	receiveMultipointCapability        MultipointCapability,
	transmitMultipointCapability       MultipointCapability,
	receiveAndTransmitMultipointCapability  MultipointCapability,
	mcCapability                       SEQUENCE
	{
		centralizedConferenceMC        BOOLEAN,
		decentralizedConferenceMC      BOOLEAN,
		...
	},
	rtcpVideoControlCapability         BOOLEAN,             -- FIR and NACK
	mediaPacketizationCapability       MediaPacketizationCapability,
	...,
	transportCapability                TransportCapability OPTIONAL,
	redundancyEncodingCapability       SEQUENCE SIZE(1..256) OF RedundancyEncodingCapability OPTIONAL,
	logicalChannelSwitchingCapability  BOOLEAN,
	t120DynamicPortCapability          BOOLEAN

}
```

```
MediaPacketizationCapability ::= SEQUENCE
{
    h261aVideoPacketization          BOOLEAN,
    ...,
    rtpPayloadType                   SEQUENCE SIZE(1..256) OF RTPPayloadType OPTIONAL
}

RSVPParameters ::= SEQUENCE
{
    qosMode                          QOSMode OPTIONAL,
    tokenRate                        INTEGER (1..4294967295) OPTIONAL,
                                           -- rate in bytes/s
    bucketSize                       INTEGER (1..4294967295) OPTIONAL,
                                           -- size in bytes
    peakRate                         INTEGER (1..4294967295) OPTIONAL,
                                           -- peak bandwidth bytes/s
    minPoliced                       INTEGER (1..4294967295) OPTIONAL,
                                           --
    maxPktSize                       INTEGER (1..4294967295) OPTIONAL,
                                           -- size in bytes

    ...
}

QOSMode ::= CHOICE
{
    guaranteedQOS                    NULL,
    controlledLoad                   NULL,
    ...
}

ATMParameters ::= SEQUENCE
{
    maxNTUSize                       INTEGER(0..65535), -- units in octets
    atmUBR                           BOOLEAN,           -- unspecified bit rate
    atmrtVBR                         BOOLEAN,           -- real time variable
                                                        -- bit rate
    atmnrtVBR                        BOOLEAN,           -- non real time
                                                        -- variable bit rate
    atmABR                           BOOLEAN,           -- available bit rate
    atmCBR                           BOOLEAN,           -- constant bit rate
    ...
}

ServicePriorityValue ::= SEQUENCE
{
    nonStandardParameter             NonStandardParameter OPTIONAL,
    ... ,
    value                            INTEGER(0..255)
}

ServicePriority ::= SEQUENCE
{
    nonStandardData                  NonStandardParameter OPTIONAL,
    servicePrioritySignalled         BOOLEAN,
    servicePriorityValue             ServicePriorityValue OPTIONAL,
    ... ,
    serviceClass                     INTEGER(0..4095) OPTIONAL,
    serviceSubclass                  INTEGER(0..255) OPTIONAL
}

AuthorizationParameters ::= SEQUENCE
{
    nonStandardData                  NonStandardParameter OPTIONAL,
    ...
```

```
}

QOSType ::= CHOICE
{
    desired                          NULL,
    required                         NULL,
    ...
}

QOSClass ::= CHOICE
{
    class0                           NULL,
    class1                           NULL,
    class2                           NULL,
    class3                           NULL,
    class4                           NULL,
    class5                           NULL,
    ...
}

QOSDescriptor ::= SEQUENCE
{
    nonStandardData                  NonStandardParameter OPTIONAL,
    qosType                          QOSType,
    qosClass                         QOSClass,
    ...
}

GenericTransportParameters ::= SEQUENCE
{
    nonStandardData                  NonStandardParameter OPTIONAL,
    averageRate                      INTEGER (1..4294967295) OPTIONAL,
                                          -- average bandwidth bytes/s
    burst                            INTEGER (1..4294967295) OPTIONAL,
                                          --  size in bytes
    peakRate                         INTEGER (1..4294967295) OPTIONAL,
                                          -- peak bandwidth bytes/s
    maxPktSize                       INTEGER (1..4294967295) OPTIONAL,
                                          -- size in bytes

    ...
}
QOSCapability ::= SEQUENCE
{
    nonStandardData                  NonStandardParameter OPTIONAL,
    rsvpParameters                   RSVPParameters OPTIONAL,
    atmParameters                    ATMParameters OPTIONAL,
    ...,
    localQoS                         BOOLEAN  OPTIONAL,
    genericTransportParameters       GenericTransportParameters OPTIONAL,
    servicePriority                  ServicePriority OPTIONAL,
    authorizationParameter           AuthorizationParameters OPTIONAL,
    qosDescriptor                    QOSDescriptor OPTIONAL,
    dscpValue                        INTEGER (0..63) OPTIONAL
}

MediaTransportType ::= CHOICE
{
    ip-UDP                           NULL,
    ip-TCP                           NULL,
    atm-AAL5-UNIDIR                  NULL, -- virtual circuits used as unidirectional
    atm-AAL5-BIDIR                   NULL, -- virtual circuits used as bidirectional
    ...,
    atm-AAL5-compressed              SEQUENCE
    {
          variable-delta              BOOLEAN,
          ...
     }

}

MediaChannelCapability ::= SEQUENCE
{
          mediaTransport              MediaTransportType  OPTIONAL,
               ...
}

TransportCapability ::= SEQUENCE
{
     nonStandard                      NonStandardParameter OPTIONAL,
     qOSCapabilities                  SEQUENCE SIZE(1..256) OF QOSCapability OPTIONAL,
     mediaChannelCapabilities         SEQUENCE SIZE(1..256) OF MediaChannelCapability OPTIONAL,
     ...
}

RedundancyEncodingCapability ::= SEQUENCE
{
     redundancyEncodingMethod         RedundancyEncodingMethod,
     primaryEncoding                  CapabilityTableEntryNumber,
     secondaryEncoding                SEQUENCE SIZE(1..256) OF CapabilityTableEntryNumber OPTIONAL,
            -- must be Audio, Video, or Data capabilities, not derived
            -- capabilities; redundancy order is inferred from number of
            -- secondary encodings
     ...
}

RedundancyEncodingMethod ::= CHOICE
{
     nonStandard                      NonStandardParameter,
     rtpAudioRedundancyEncoding       NULL,
     ...,
     rtpH263VideoRedundancyEncoding   RTPH263VideoRedundancyEncoding
}

RTPH263VideoRedundancyEncoding ::= SEQUENCE
{
     numberOfThreads                  INTEGER (1..16),
     framesBetweenSyncPoints          INTEGER (1..256),
     frameToThreadMapping             CHOICE
     {
               roundrobin             NULL,
               custom                 SEQUENCE SIZE(1..256) OF
                                      RTPH263VideoRedundancyFrameMapping,
                                      -- empty SEQUENCE for capability negotiation
                                      -- meaningful contents only OpenLogicalChannel
               ...
     },
     containedThreads                 SEQUENCE SIZE(1..256) OF INTEGER (0..15) OPTIONAL,
                                      -- only used for opening of logical channels
     ...
}

RTPH263VideoRedundancyFrameMapping ::= SEQUENCE
{
     threadNumber                     INTEGER (0..15),
     frameSequence                    SEQUENCE SIZE(1..256) OF INTEGER (0..255),
     ...
}
```

```
MultipointCapability ::= SEQUENCE
{
    multicastCapability             BOOLEAN,
    multiUniCastConference          BOOLEAN,
    mediaDistributionCapability     SEQUENCE OF MediaDistributionCapability,
    ...
}

MediaDistributionCapability ::= SEQUENCE
{
    centralizedControl              BOOLEAN,
    distributedControl              BOOLEAN,     -- for further study in
                                                 -- ITU-T Rec. H.323
    centralizedAudio                BOOLEAN,
    distributedAudio                BOOLEAN,
    centralizedVideo                BOOLEAN,
    distributedVideo                BOOLEAN,
    centralizedData                 SEQUENCE OF DataApplicationCapability OPTIONAL,
    distributedData                 SEQUENCE OF DataApplicationCapability OPTIONAL,
                                               -- for further study in
                                               -- ITU-T Rec. H.323
    ...
}


-- =============================================================================
-- Capability exchange definitions: Video capabilities
-- =============================================================================

VideoCapability ::= CHOICE
{
    nonStandard                     NonStandardParameter,
    h261VideoCapability             H261VideoCapability,
    h262VideoCapability             H262VideoCapability,
    h263VideoCapability             H263VideoCapability,
    is11172VideoCapability          IS11172VideoCapability,
    ...,
    genericVideoCapability          GenericCapability,
    extendedVideoCapability         ExtendedVideoCapability

}

ExtendedVideoCapability ::= SEQUENCE
{
    videoCapability                 SEQUENCE OF VideoCapability,
    videoCapabilityExtension        SEQUENCE OF GenericCapability OPTIONAL,
    ...
}

H261VideoCapability ::= SEQUENCE
{
    qcifMPI                         INTEGER (1..4) OPTIONAL, -- units 1/29.97 Hz
    cifMPI                          INTEGER (1..4) OPTIONAL, -- units 1/29.97 Hz
    temporalSpatialTradeOffCapability   BOOLEAN,
    maxBitRate                      INTEGER (1..19200),      -- units of
                                                             -- 100 bit/s
    stillImageTransmission          BOOLEAN,                 -- Annex D/H.261
    ...,
    videoBadMBsCap                  BOOLEAN
}
```

```
H262VideoCapability ::= SEQUENCE
{
     profileAndLevel-SPatML            BOOLEAN,
     profileAndLevel-MPatLL            BOOLEAN,
     profileAndLevel-MPatML            BOOLEAN,
     profileAndLevel-MPatH-14          BOOLEAN,
     profileAndLevel-MPatHL            BOOLEAN,
     profileAndLevel-SNRatLL           BOOLEAN,
     profileAndLevel-SNRatML           BOOLEAN,
     profileAndLevel-SpatialatH-14     BOOLEAN,
     profileAndLevel-HPatML            BOOLEAN,
     profileAndLevel-HPatH-14          BOOLEAN,
     profileAndLevel-HPatHL            BOOLEAN,
     videoBitRate                      INTEGER (0.. 1073741823) OPTIONAL, -- units 400 bit/s
     vbvBufferSize                     INTEGER (0.. 262143) OPTIONAL,     -- units 16 384 bits
     samplesPerLine                    INTEGER (0..16383) OPTIONAL,       -- units samples/line
     linesPerFrame                     INTEGER (0..16383) OPTIONAL,       -- units lines/frame
     framesPerSecond                   INTEGER (0..15) OPTIONAL,          -- frame_rate_code
     luminanceSampleRate               INTEGER (0..4294967295) OPTIONAL,  -- units samples/s
     ...,
     videoBadMBsCap BOOLEAN
}

H263VideoCapability ::= SEQUENCE
{
     sqcifMPI                          INTEGER (1..32) OPTIONAL, -- units 1/29.97 Hz
     qcifMPI                           INTEGER (1..32) OPTIONAL, -- units 1/29.97 Hz
     cifMPI                            INTEGER (1..32) OPTIONAL, -- units 1/29.97 Hz
     cif4MPI                           INTEGER (1..32) OPTIONAL, -- units 1/29.97 Hz
     cif16MPI                          INTEGER (1..32) OPTIONAL, -- units 1/29.97 Hz
     maxBitRate INTEGER (1..192400),                              -- units 100 bit/s
     unrestrictedVector                BOOLEAN,
     arithmeticCoding                  BOOLEAN,
     advancedPrediction                BOOLEAN,
     pbFrames                          BOOLEAN,
     temporalSpatialTradeOffCapability BOOLEAN,
     hrd-B                             INTEGER (0..524287) OPTIONAL, -- units 128 bits
     bppMaxKb                          INTEGER (0..65535) OPTIONAL, -- units 1024 bits
     ...,

     slowSqcifMPI                      INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     slowQcifMPI                       INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     slowCifMPI                        INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     slowCif4MPI                       INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     slowCif16MPI                      INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     errorCompensation                 BOOLEAN,

     enhancementLayerInfo              EnhancementLayerInfo OPTIONAL,
     h263Options                       H263Options OPTIONAL

}

EnhancementLayerInfo ::= SEQUENCE
{
     baseBitRateConstrained            BOOLEAN,
     snrEnhancement                    SET SIZE(1..14) OF EnhancementOptions OPTIONAL,
     spatialEnhancement                SET SIZE(1..14) OF EnhancementOptions OPTIONAL,
     bPictureEnhancement               SET SIZE(1..14) OF BEnhancementParameters OPTIONAL,
     ...
}

BEnhancementParameters ::= SEQUENCE
{
     enhancementOptions                EnhancementOptions,
     numberOfBPictures                 INTEGER (1..64),
     ...
}
```

```
EnhancementOptions ::= SEQUENCE
{
     sqcifMPI                            INTEGER (1..32) OPTIONAL,  -- units 1/29.97 Hz
     qcifMPI                             INTEGER (1..32) OPTIONAL,  -- units 1/29.97 Hz
     cifMPI                              INTEGER (1..32) OPTIONAL,  -- units 1/29.97 Hz
     cif4MPI                             INTEGER (1..32) OPTIONAL,  -- units 1/29.97 Hz
     cif16MPI                            INTEGER (1..32) OPTIONAL,  -- units 1/29.97 Hz
     maxBitRate                          INTEGER (1..192400),       -- units 100 bit/s
     unrestrictedVector                  BOOLEAN,
     arithmeticCoding                    BOOLEAN,
     temporalSpatialTradeOffCapability   BOOLEAN,
     slowSqcifMPI                        INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     slowQcifMPI                         INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     slowCifMPI                          INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     slowCif4MPI                         INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     slowCif16MPI                        INTEGER (1..3600) OPTIONAL, -- units seconds/frame
     errorCompensation                   BOOLEAN,
     h263Options                         H263Options OPTIONAL,
     ...
}

H263Options ::= SEQUENCE
{
     advancedIntraCodingMode             BOOLEAN,
     deblockingFilterMode                BOOLEAN,
     improvedPBFramesMode                BOOLEAN,

     unlimitedMotionVectors              BOOLEAN,

     fullPictureFreeze                   BOOLEAN,
     partialPictureFreezeAndRelease      BOOLEAN,
     resizingPartPicFreezeAndRelease     BOOLEAN,
     fullPictureSnapshot                 BOOLEAN,
     partialPictureSnapshot              BOOLEAN,
     videoSegmentTagging                 BOOLEAN,
     progressiveRefinement               BOOLEAN,

     dynamicPictureResizingByFour        BOOLEAN,
     dynamicPictureResizingSixteenthPel  BOOLEAN,
     dynamicWarpingHalfPel               BOOLEAN,
     dynamicWarpingSixteenthPel          BOOLEAN,

     independentSegmentDecoding          BOOLEAN,

     slicesInOrder-NonRect               BOOLEAN,
     slicesInOrder-Rect                  BOOLEAN,
     slicesNoOrder-NonRect               BOOLEAN,
     slicesNoOrder-Rect                  BOOLEAN,

     alternateInterVLCMode               BOOLEAN,
     modifiedQuantizationMode            BOOLEAN,
     reducedResolutionUpdate             BOOLEAN,

     transparencyParameters              TransparencyParameters OPTIONAL,
     separateVideoBackChannel            BOOLEAN,
     refPictureSelection                 RefPictureSelection OPTIONAL,
     customPictureClockFrequency         SET SIZE (1..16) OF CustomPictureClockFrequency OPTIONAL,
     customPictureFormat                 SET SIZE (1..16) OF CustomPictureFormat OPTIONAL,
     modeCombos                          SET SIZE (1..16) OF H263VideoModeCombos OPTIONAL,
     ...,
     videoBadMBsCapBOOLEAN,
     h263Version3Options                 H263Version3Options

}
```

```
TransparencyParameters ::= SEQUENCE
{
    presentationOrder                INTEGER(1..256),
    offset-x                         INTEGER(-262144..262143), -- 1/8 pixels
    offset-y                         INTEGER(-262144..262143), -- 1/8 pixels
    scale-x                          INTEGER(1..255),
    scale-y                          INTEGER(1..255),
    ...
}

RefPictureSelection ::= SEQUENCE
{
    additionalPictureMemory          SEQUENCE
    {
        sqcifAdditionalPictureMemory    INTEGER (1..256) OPTIONAL,     -- units frame
        qcifAdditionalPictureMemory     INTEGER (1..256) OPTIONAL,     -- units frame
        cifAdditionalPictureMemory      INTEGER (1..256) OPTIONAL,     -- units frame
        cif4AdditionalPictureMemory     INTEGER (1..256) OPTIONAL,     -- units frame
        cif16AdditionalPictureMemory    INTEGER (1..256) OPTIONAL,     -- units frame
        bigCpfAdditionalPictureMemory   INTEGER (1..256) OPTIONAL,     -- units frame
        ...
    } OPTIONAL,
    videoMux                         BOOLEAN,
    videoBackChannelSend             CHOICE
    {
        none                         NULL,
        ackMessageOnly               NULL,
        nackMessageOnly              NULL,
        ackOrNackMessageOnly         NULL,
        ackAndNackMessage            NULL,
        ...
    },
    ...,
    enhancedReferencePicSelect       SEQUENCE
    {
        subPictureRemovalParameters  SEQUENCE
        {
            mpuHorizMBs              INTEGER (1..128),
            mpuVertMBs               INTEGER (1..72),
            mpuTotalNumber           INTEGER (1..65536),
            ...
        } OPTIONAL,
        ...
    }
}

CustomPictureClockFrequency ::= SEQUENCE
{
    clockConversionCode              INTEGER(1000..1001),
    clockDivisor                     INTEGER(1..127),
    sqcifMPI                         INTEGER (1..2048) OPTIONAL,
    qcifMPI                          INTEGER (1..2048) OPTIONAL,
    cifMPI                           INTEGER (1..2048) OPTIONAL,
    cif4MPI                          INTEGER (1..2048) OPTIONAL,
    cif16MPI                         INTEGER (1..2048) OPTIONAL,
    ...
}

CustomPictureFormat ::= SEQUENCE
{
    maxCustomPictureWidth            INTEGER(1..2048),      -- units 4 pixels
    maxCustomPictureHeight           INTEGER(1..2048),      -- units 4 pixels
    minCustomPictureWidth            INTEGER(1..2048),      -- units 4 pixels
    minCustomPictureHeight           INTEGER(1..2048),      -- units 4 pixels
```

```
	mPI                             SEQUENCE
	{
		standardMPI                 INTEGER (1..31) OPTIONAL,
		customPCF                   SET SIZE (1..16) OF SEQUENCE
		{
			clockConversionCode     INTEGER (1000..1001),
			clockDivisor            INTEGER (1..127),
			customMPI               INTEGER (1..2048),
			...
		} OPTIONAL,
		...
	},

	pixelAspectInformation          CHOICE
	{
		anyPixelAspectRatio         BOOLEAN,
		pixelAspectCode             SET SIZE (1..14) OF INTEGER(1..14),
		extendedPAR                 SET SIZE (1..256) OF SEQUENCE
		{
			width                   INTEGER(1..255),
			height                  INTEGER(1..255),
			...
		},
		...
	} ,
	...
}

H263VideoModeCombos ::= SEQUENCE
{
	h263VideoUncoupledModes         H263ModeComboFlags,
	h263VideoCoupledModes           SET SIZE (1..16) OF H263ModeComboFlags,
	...
}

H263ModeComboFlags ::= SEQUENCE
{
	unrestrictedVector              BOOLEAN,
	arithmeticCoding                BOOLEAN,
	advancedPrediction              BOOLEAN,
	pbFrames                        BOOLEAN,
	advancedIntraCodingMode         BOOLEAN,
	deblockingFilterMode            BOOLEAN,
	unlimitedMotionVectors          BOOLEAN,
	slicesInOrder-NonRect           BOOLEAN,
	slicesInOrder-Rect              BOOLEAN,
	slicesNoOrder-NonRect           BOOLEAN,
	slicesNoOrder-Rect              BOOLEAN,
	improvedPBFramesMode            BOOLEAN,
	referencePicSelect              BOOLEAN,
	dynamicPictureResizingByFour    BOOLEAN,
	dynamicPictureResizingSixteenthPel BOOLEAN,
	dynamicWarpingHalfPel           BOOLEAN,
	dynamicWarpingSixteenthPel      BOOLEAN,
	reducedResolutionUpdate         BOOLEAN,
	independentSegmentDecoding      BOOLEAN,
	alternateInterVLCMode           BOOLEAN,
	modifiedQuantizationMode        BOOLEAN,
	...,
	enhancedReferencePicSelect      BOOLEAN,
	h263Version3Options             H263Version3Options}
```

```
H263Version3Options ::= SEQUENCE
{
     dataPartitionedSlices             BOOLEAN,
     fixedPointIDCT0                   BOOLEAN,
     interlacedFields                  BOOLEAN,
     currentPictureHeaderRepetition    BOOLEAN,
     previousPictureHeaderRepetition   BOOLEAN,
     nextPictureHeaderRepetition       BOOLEAN,
     pictureNumber                     BOOLEAN,
     spareReferencePictures            BOOLEAN,
     ...
}

IS11172VideoCapability ::= SEQUENCE
{
     constrainedBitstream              BOOLEAN,
     videoBitRate                      INTEGER (0.. 1073741823) OPTIONAL, -- units 400 bit/s
     vbvBufferSize                     INTEGER (0.. 262143) OPTIONAL,     -- units 16 384 bits
     samplesPerLine                    INTEGER (0..16383) OPTIONAL,       -- units samples/line
     linesPerFrame                     INTEGER (0..16383) OPTIONAL,       -- units lines/frame
     pictureRate                       INTEGER (0..15) OPTIONAL,
     luminanceSampleRate               INTEGER (0..4294967295) OPTIONAL,  -- units samples/s
     ...,
     videoBadMBsCap BOOLEAN
}

-- =============================================================================
-- Capability exchange definitions: Audio capabilities
-- =============================================================================

-- For an H.222 multiplex, the integers indicate the size of the STD buffer
-- in units of 256 octets
-- For an H.223 multiplex, the integers indicate the maximum number of audio
-- frames per AL-SDU
-- For an H.225.0 multiplex, the integers indicate the maximum number of audio
-- frames per packet

AudioCapability ::= CHOICE
{
     nonStandard                       NonStandardParameter,
     g711Alaw64k                       INTEGER (1..256),
     g711Alaw56k                       INTEGER (1..256),
     g711Ulaw64k                       INTEGER (1..256),
     g711Ulaw56k                       INTEGER (1..256),

     g722-64k                          INTEGER (1..256),
     g722-56k                          INTEGER (1..256),
     g722-48k                          INTEGER (1..256),

     g7231                             SEQUENCE
     {
          maxAl-sduAudioFrames         INTEGER (1..256),
          silenceSuppression           BOOLEAN
     },

     g728                              INTEGER (1..256),
     g729                              INTEGER (1..256),
     g729AnnexA                        INTEGER (1..256),
     is11172AudioCapability            IS11172AudioCapability,
     is13818AudioCapability            IS13818AudioCapability,
      ...,
     g729wAnnexB                       INTEGER(1..256),
     g729AnnexAwAnnexB                 INTEGER(1..256),
     g7231AnnexCCapability             G7231AnnexCCapability,
     gsmFullRate                      GSMAudioCapability,
     gsmHalfRate                      GSMAudioCapability,
     gsmEnhancedFullRate              GSMAudioCapability,
     genericAudioCapability           GenericCapability,
     g729Extensions                   G729Extensions,
     vbd                              VBDCapability,
     audioTelephonyEvent              NoPTAudioTelephonyEventCapability,
     audioTone                        NoPTAudioToneCapability
}

G729Extensions ::= SEQUENCE
{
     audioUnit                        INTEGER (1..256) OPTIONAL,
     annexA                           BOOLEAN,
     annexB                           BOOLEAN,
     annexD                           BOOLEAN,
     annexE                           BOOLEAN,
     annexF                           BOOLEAN,
     annexG                           BOOLEAN,
     annexH                           BOOLEAN,
     ...
}

G7231AnnexCCapability ::= SEQUENCE
{
     maxAl-sduAudioFrames             INTEGER (1..256),
     silenceSuppression               BOOLEAN,
     g723AnnexCAudioMode              SEQUENCE
     {
         highRateMode0                INTEGER (27..78),      -- units octets
         highRateMode1                INTEGER (27..78),      -- units octets
         lowRateMode0                 INTEGER (23..66),      -- units octets
         lowRateMode1                 INTEGER (23..66),      -- units octets
         sidMode0                     INTEGER (6..17),       -- units octets
         sidMode1                     INTEGER (6..17),       -- units octets
         ...
     } OPTIONAL,
     ...
}

IS11172AudioCapability ::= SEQUENCE
{
     audioLayer1                      BOOLEAN,
     audioLayer2                      BOOLEAN,
     audioLayer3                      BOOLEAN,

     audioSampling32k                 BOOLEAN,
     audioSampling44k1                BOOLEAN,
     audioSampling48k                 BOOLEAN,

     singleChannel                    BOOLEAN,
     twoChannels                      BOOLEAN,

     bitRate                          INTEGER (1..448),      -- units kbit/s
     ...
}

IS13818AudioCapability ::= SEQUENCE
{
     audioLayer1                      BOOLEAN,
     audioLayer2                      BOOLEAN,
     audioLayer3                      BOOLEAN,
     audioSampling16k                  BOOLEAN,
     audioSampling22k05                BOOLEAN,
     audioSampling24k                  BOOLEAN,
     audioSampling32k                  BOOLEAN,
     audioSampling44k1                 BOOLEAN,
     audioSampling48k                  BOOLEAN,

     singleChannel                     BOOLEAN,
     twoChannels                       BOOLEAN,
     threeChannels2-1                  BOOLEAN,
     threeChannels3-0                  BOOLEAN,
     fourChannels2-0-2-0               BOOLEAN,
     fourChannels2-2                   BOOLEAN,
     fourChannels3-1                   BOOLEAN,
     fiveChannels3-0-2-0               BOOLEAN,
     fiveChannels3-2                   BOOLEAN,

     lowFrequencyEnhancement           BOOLEAN,

     multilingual                      BOOLEAN,

     bitRate                           INTEGER (1..1130),  -- units kbit/s
     ...
}

GSMAudioCapability ::= SEQUENCE
{
     audioUnitSize                     INTEGER (1..256),
     comfortNoise                      BOOLEAN,
     scrambled                         BOOLEAN,
     ...
}

VBDCapability  ::= SEQUENCE
{
     type                              AudioCapability,    -- shall not be "vbd"
     ...
}

-- =============================================================================
-- Capability exchange definitions: Data capabilities
-- =============================================================================

DataApplicationCapability ::= SEQUENCE
{
     application                       CHOICE
     {
          nonStandard                  NonStandardParameter,
          t120                         DataProtocolCapability,
          dsm-cc                       DataProtocolCapability,
          userData                     DataProtocolCapability,
          t84                          SEQUENCE
          {
               t84Protocol             DataProtocolCapability,
               t84Profile              T84Profile
          },
          t434                         DataProtocolCapability,
          h224                         DataProtocolCapability,
          nlpid                        SEQUENCE
          {
                                       nlpidProtocol   DataProtocolCapability,
                                       nlpidData OCTET STRING
          },
          dsvdControl                 NULL,
          h222DataPartitioning        DataProtocolCapability,
          ...,
          t30fax                      DataProtocolCapability,
          t140                        DataProtocolCapability,
          t38fax                      SEQUENCE
          {
               t38FaxProtocol         DataProtocolCapability,
               t38FaxProfile          T38FaxProfile
          },
          genericDataCapability       GenericCapability
     },
     maxBitRate                       INTEGER (0..4294967295), -- units 100 bit/s
     ...
}

DataProtocolCapability ::= CHOICE
{
     nonStandard                      NonStandardParameter,
     v14buffered                      NULL,
     v42lapm                          NULL,     -- may negotiate to V.42 bis
     hdlcFrameTunnelling              NULL,
     h310SeparateVCStack              NULL,
     h310SingleVCStack                NULL,
     transparent                      NULL,
     ...,
     segmentationAndReassembly        NULL,
     hdlcFrameTunnelingwSAR           NULL,
     v120                             NULL,     -- as in H.230
     separateLANStack                 NULL,
     v76wCompression                  CHOICE
     {
          transmitCompression         CompressionType,
          receiveCompression          CompressionType,
          transmitAndReceiveCompression  CompressionType,
          ...
     },
     tcp                              NULL,
     udp                              NULL
}

CompressionType ::= CHOICE
{
     v42bis                           V42bis,
     ...
}

V42bis ::= SEQUENCE
{
     numberOfCodewords                INTEGER (1..65536),
     maximumStringLength              INTEGER (1..256),
     ...
}

T84Profile ::= CHOICE
{
     t84Unrestricted                  NULL,
     t84Restricted                    SEQUENCE
     {
          qcif                        BOOLEAN,
          cif                         BOOLEAN,
          ccir601Seq                  BOOLEAN,
          ccir601Prog                 BOOLEAN,
          hdtvSeq                      BOOLEAN,
          hdtvProg                     BOOLEAN,

          g3FacsMH200x100              BOOLEAN,
          g3FacsMH200x200              BOOLEAN,
          g4FacsMMR200x100             BOOLEAN,
          g4FacsMMR200x200             BOOLEAN,
          jbig200x200Seq               BOOLEAN,
          jbig200x200Prog              BOOLEAN,
          jbig300x300Seq               BOOLEAN,
          jbig300x300Prog              BOOLEAN,

          digPhotoLow                  BOOLEAN,
          digPhotoMedSeq               BOOLEAN,
          digPhotoMedProg              BOOLEAN,
          digPhotoHighSeq              BOOLEAN,
          digPhotoHighProg             BOOLEAN,

          ...
     }
}

T38FaxProfile ::= SEQUENCE
{
     fillBitRemoval                    BOOLEAN,
     transcodingJBIG                   BOOLEAN,
     transcodingMMR                    BOOLEAN,
     ...,
     version                           INTEGER (0..255),
                                       -- Version 0, the default, refers to
                                       -- T.38 (2005)
     t38FaxRateManagement              T38FaxRateManagement,
                                       -- The default Data Rate Management is
                                       -- determined by the choice of
                                       -- DataProtocolCapability
     t38FaxUdpOptions                  T38FaxUdpOptions OPTIONAL,
                                       -- For UDP, t38UDPRedundancy is the default
     t38FaxTcpOptions                  T38FaxTcpOptions OPTIONAL
}

T38FaxRateManagement ::= CHOICE
{
     localTCF                          NULL,
     transferredTCF                    NULL,
     ...
}

T38FaxUdpOptions ::= SEQUENCE
{
     t38FaxMaxBuffer                   INTEGER OPTIONAL,
     t38FaxMaxDatagram                 INTEGER OPTIONAL,
     t38FaxUdpEC                       CHOICE
     {
          t38UDPFEC                    NULL,
          t38UDPRedundancy             NULL,
          ...
     }
}

T38FaxTcpOptions ::= SEQUENCE
{
     t38TCPBidirectionalMode           BOOLEAN,
     ...
}
```

```
-- =============================================================================
-- Encryption Capability Definitions
-- =============================================================================

EncryptionAuthenticationAndIntegrity ::= SEQUENCE
{
    encryptionCapability             EncryptionCapability OPTIONAL,
    authenticationCapability         AuthenticationCapability OPTIONAL,
    integrityCapability              IntegrityCapability OPTIONAL,
    ...,
    genericH235SecurityCapability    GenericCapability OPTIONAL
}

EncryptionCapability ::= SEQUENCE SIZE(1..256) OF MediaEncryptionAlgorithm

MediaEncryptionAlgorithm ::= CHOICE
{
    nonStandard                      NonStandardParameter,
    algorithm                        OBJECT IDENTIFIER,     -- many defined
                                                            -- in ISO/IEC 9979
    ...
}

AuthenticationCapability ::= SEQUENCE
{
    nonStandard                      NonStandardParameter OPTIONAL,
    ...,
    antiSpamAlgorithm                OBJECT IDENTIFIER OPTIONAL
}

IntegrityCapability ::= SEQUENCE
{
    nonStandard                      NonStandardParameter OPTIONAL,
    ...
}

-- =============================================================================
-- Capability Exchange Definitions: UserInput
-- =============================================================================

UserInputCapability ::= CHOICE
{
    nonStandard                      SEQUENCE SIZE(1..16) OF NonStandardParameter,
    basicString                      NULL,   -- alphanumeric
    iA5String                        NULL,   -- alphanumeric
    generalString                    NULL,   -- alphanumeric
    dtmf                             NULL,   -- supports dtmf using signal
                                             -- and signalUpdate
    hookflash                        NULL,   -- supports hookflash using signal
    ...,
    extendedAlphanumeric             NULL,
    encryptedBasicString             NULL, -- encrypted Basic string in
                                           -- encryptedAlphanumeric
    encryptedIA5String               NULL, -- encrypted IA5 string in
                                           -- encryptedSignalType
    encryptedGeneralString           NULL, -- encrypted general string in
                                           -- extendedAlphanumeric.encryptedalphanumeric
    secureDTMF                       NULL, -- secure DTMF using encryptedSignalType
    genericUserInputCapability       GenericCapability
}
```

```
-- =============================================================================
-- Capability Exchange Definitions: Conference
-- =============================================================================

ConferenceCapability ::= SEQUENCE
{
    nonStandardData                    SEQUENCE OF NonStandardParameter OPTIONAL,
    chairControlCapability             BOOLEAN,
    ...,
    videoIndicateMixingCapability      BOOLEAN,
    multipointVisualizationCapability  BOOLEAN OPTIONAL  -- same as H.230 MVC
}
-- =============================================================================
-- Capability Exchange Definitions: Generic Capability
-- =============================================================================

GenericCapability ::= SEQUENCE
{
    capabilityIdentifier               CapabilityIdentifier,

    maxBitRate                         INTEGER (0..4294967295) OPTIONAL,
                                       -- Units 100 bit/s
    collapsing                         SEQUENCE OF GenericParameter  OPTIONAL,
    nonCollapsing                      SEQUENCE OF GenericParameter  OPTIONAL,
    nonCollapsingRaw                   OCTET STRING  OPTIONAL,
                                       -- Typically contains ASN.1
                                       -- PER encoded data describing capability
    transport                          DataProtocolCapability  OPTIONAL,
    ...
}

CapabilityIdentifier ::= CHOICE
{
    standard                           OBJECT IDENTIFIER,
                                       -- e.g., { itu-t (0) recommendation (0) h (8) 267
                                       -- version (0) 2 subIdentifier (0)}
    h221NonStandard                    NonStandardParameter,
    uuid                               OCTET STRING ( SIZE (16) ),
    domainBased                        IA5String ( SIZE (1..64) ),
    ...
}

-- NOTE – The ranges of parameter values have been selected to ensure that the
-- GenericParameter preamble, standard part of ParameterIdentifier and the
-- encoding of that choice, and the preamble of ParameterValue to fit into
-- 2 octets.

GenericParameter ::= SEQUENCE
{
    parameterIdentifier                ParameterIdentifier,
    parameterValue                     ParameterValue,
    supersedes                         SEQUENCE OF ParameterIdentifier OPTIONAL,
    ...
}

ParameterIdentifier ::= CHOICE
{
    standard                           INTEGER (0..127), -- Assigned by
                                                         -- Capability
                                                         -- specifications
    h221NonStandard                    NonStandardParameter, -- N.B.
                                                             -- NonStandardIdentifier
                                                             -- is not sufficient in
                                                             -- this case
    uuid                            OCTET STRING ( SIZE (16) ), -- For non-
                                                                -- standard
    domainBased                     IA5String ( SIZE (1..64) ),
    ...
}

ParameterValue ::= CHOICE
{
    logical                         NULL,                    -- Only acceptable if
                                                            -- all entities
                                                            -- include this option
    booleanArray                    INTEGER (0..255),        -- array of 8 logical
                                                             -- types
    unsignedMin                     INTEGER (0..65535),      -- Look for min
                                                            -- common value
    unsignedMax                     INTEGER (0..65535),      -- Look for max
                                                            -- common value
    unsigned32Min                   INTEGER (0..4294967295),-- Look for min
                                                            -- common value
    unsigned32Max                   INTEGER (0..4294967295),-- Look for max
                                                            -- common value

    octetString                     OCTET STRING,            -- non-collapsing
                                                            -- octet string

    genericParameter   SEQUENCE OF GenericParameter,
    ...
}

-- =============================================================================
-- Capability Exchange Definitions: Multiplexed Stream Capability
-- =============================================================================

MultiplexedStreamCapability ::= SEQUENCE
{
    multiplexFormat                 MultiplexFormat,
    controlOnMuxStream              BOOLEAN,
    capabilityOnMuxStream           SET SIZE (1..256) OF
AlternativeCapabilitySet OPTIONAL,
    ...
}

MultiplexFormat ::= CHOICE
{
    nonStandard                     NonStandardParameter,
    h222Capability                  H222Capability,
    h223Capability                  H223Capability,
    ...
}

-- =============================================================================
-- Capability Exchange Definitions: AudioTelephonyEventCapability and AudioToneCapability
--=============================================================================

AudioTelephonyEventCapability ::= SEQUENCE
{
    dynamicRTPPayloadType           INTEGER(96..127),
    audioTelephoneEvent             GeneralString, -- As per <list of values>
                                                   -- in RFC 4733
    ...
}

AudioToneCapability ::= SEQUENCE
{
    dynamicRTPPayloadType           INTEGER(96..127),
    ...
}

-- The following definitions are as above but without a Payload Type field.

NoPTAudioTelephonyEventCapability ::= SEQUENCE
{
    audioTelephoneEvent             GeneralString, -- As per <list of values>
                                                   -- in RFC 4733
    ...
}

NoPTAudioToneCapability ::= SEQUENCE
{
    ...
}

-- =============================================================================
-- Capability Exchange Definitions: MultiplePayloadStreamCapability
-- =============================================================================

MultiplePayloadStreamCapability ::= SEQUENCE
{
    capabilities                    SET SIZE(1..256) OF AlternativeCapabilitySet,
    ...
}

-- =============================================================================
-- Capability Exchange Definitions: FECCapability
-- =============================================================================

DepFECCapability ::= CHOICE -- Deprecated, do not use
{
    rfc2733                         SEQUENCE
    {
        redundancyEncoding          BOOLEAN,
        separateStream              SEQUENCE
        {
            separatePort            BOOLEAN,
            samePort                BOOLEAN,
            ...
        },
        ...
    },
    ...
}

FECCapability ::= SEQUENCE
{
    protectedCapability             CapabilityTableEntryNumber,
    fecScheme                       OBJECT IDENTIFIER OPTIONAL,
                                     -- identifies encoding scheme
    rfc2733Format                   CHOICE
    {
        rfc2733rfc2198              MaxRedundancy, -- RFC 2198
        rfc2733sameport             MaxRedundancy,
                                     -- separate packet, same port
        rfc2733diffport             MaxRedundancy
                                     -- separate packet and port
    } OPTIONAL,
    ...
}
```

```
MaxRedundancy ::=  INTEGER (1..MAX)

-- ===========================================================================
-- Logical channel signalling definitions
-- ===========================================================================

-- "Forward" is used to refer to transmission in the direction from the terminal
-- making the original request for a logical channel to the other terminal, and
-- "reverse" is used to refer to the opposite direction of transmission, in the
-- case of a bidirectional channel request.

OpenLogicalChannel ::= SEQUENCE
{
    forwardLogicalChannelNumber         LogicalChannelNumber,

    forwardLogicalChannelParameters     SEQUENCE
    {
        portNumber                      INTEGER (0..65535) OPTIONAL,
        dataType                        DataType,
        multiplexParameters             CHOICE
        {
            h222LogicalChannelParameters  H222LogicalChannelParameters,
            h223LogicalChannelParameters  H223LogicalChannelParameters,
            v76LogicalChannelParameters   V76LogicalChannelParameters,
            ...,
            h2250LogicalChannelParameters H2250LogicalChannelParameters,
            none                        NULL  -- for use with Separate Stack when
                                              -- multiplexParameters are not
                                              -- required or appropriate

        },
        ...,
        forwardLogicalChannelDependency     LogicalChannelNumber OPTIONAL,
                                        -- also used to refer to the primary
                                        -- logical channel when using video
                                        -- redundancy coding
        replacementFor                  LogicalChannelNumber OPTIONAL

    },

    -- Used to specify the reverse channel for bidirectional open request

    reverseLogicalChannelParameters  SEQUENCE
    {
        dataType                        DataType,
        multiplexParameters             CHOICE
        {
            -- H.222 parameters are never present in reverse direction
            h223LogicalChannelParameters  H223LogicalChannelParameters,
            v76LogicalChannelParameters   V76LogicalChannelParameters,
            ...,
            h2250LogicalChannelParameters H2250LogicalChannelParameters

        } OPTIONAL,                     -- Not present for H.222
        ...,
        reverseLogicalChannelDependency     LogicalChannelNumber OPTIONAL,
            -- also used to refer to the primary logical channel when using
            -- video redundancy coding
        replacementFor                  LogicalChannelNumber OPTIONAL

    } OPTIONAL,                         -- Not present for unidirectional channel request
    ...,
    separateStack                       NetworkAccessParameters OPTIONAL,
            -- for Open responder to establish the stack
```

```
     encryptionSync                   EncryptionSync OPTIONAL,
          genericInformation          SEQUENCE OF GenericInformation OPTIONAL
                                      -- generic information associated
                                      -- with the message


}

LogicalChannelNumber ::= INTEGER (1..65535)

NetworkAccessParameters ::= SEQUENCE
{
     distribution  CHOICE
     {
          unicast                     NULL,
          multicast NULL,             -- for further study in T.120
          ...
     } OPTIONAL,

     networkAddress                   CHOICE
     {
          q2931Address                Q2931Address,
          e164Address                 IA5String(SIZE(1..128)) (FROM ("0123456789#*,")),
          localAreaAddress            TransportAddress,
          ...
     },
     associateConference              BOOLEAN,
     externalReference                OCTET STRING(SIZE(1..255)) OPTIONAL,
     ...,
     t120SetupProcedure               CHOICE
     {

          originateCall               NULL,
          waitForCall                 NULL,
          issueQuery                  NULL,
          ...
     } OPTIONAL
}

Q2931Address ::= SEQUENCE
{
     address                          CHOICE
     {
          internationalNumber         NumericString(SIZE(1..16)),
          nsapAddress                 OCTET STRING (SIZE(1..20)),
          ...
     },
     subaddress                       OCTET STRING (SIZE(1..20)) OPTIONAL,
     ...
}

V75Parameters ::= SEQUENCE
{
     audioHeaderPresent               BOOLEAN,
      ...
}


DataType ::= CHOICE
{
     nonStandard                      NonStandardParameter,
     nullData                         NULL,
     videoData                        VideoCapability,
     audioData                        AudioCapability,
     data                              DataApplicationCapability,
     encryptionData                    EncryptionMode,
     ...,
     h235Control                       NonStandardParameter,
     h235Media                         H235Media,
     multiplexedStream                 MultiplexedStreamParameter,
     redundancyEncoding                RedundancyEncoding,
     multiplePayloadStream             MultiplePayloadStream,
     depFec                            DepFECData, -- Deprecated, do not use
     fec                               FECData
}

H235Media ::= SEQUENCE
{
     encryptionAuthenticationAndIntegrity     EncryptionAuthenticationAndIntegrity,

     mediaType                         CHOICE
     {
          nonStandard                  NonStandardParameter,
          videoData                    VideoCapability,
          audioData                    AudioCapability,
          data                         DataApplicationCapability,
          ...,
          redundancyEncoding           RedundancyEncoding,
          multiplePayloadStream        MultiplePayloadStream,
          depFec                       DepFECData, -- Deprecated, do not use
          fec                          FECData
     },

     ...
}

MultiplexedStreamParameter ::= SEQUENCE
{
     multiplexFormat                   MultiplexFormat,
     controlOnMuxStream                BOOLEAN,
     ...
}

H222LogicalChannelParameters ::= SEQUENCE
{
     resourceID                        INTEGER (0..65535),
     subChannelID                      INTEGER (0..8191),
     pcr-pid                           INTEGER (0..8191) OPTIONAL,
     programDescriptors                OCTET STRING OPTIONAL,
     streamDescriptors                 OCTET STRING OPTIONAL,
     ...
}

H223LogicalChannelParameters ::= SEQUENCE
{
     adaptationLayerType               CHOICE
     {
          nonStandard                  NonStandardParameter,
          al1Framed                    NULL,
          al1NotFramed                 NULL,
          al2WithoutSequenceNumbers    NULL,
          al2WithSequenceNumbers       NULL,
          al3                          SEQUENCE
          {
               controlFieldOctets      INTEGER (0..2),
               sendBufferSize          INTEGER (0..16777215) -- units octets
          },
          ...,
          al1M                          H223AL1MParameters,
          al2M                          H223AL2MParameters,
          al3M                          H223AL3MParameters
     },

     segmentableFlag                    BOOLEAN,
     ...
}

H223AL1MParameters ::= SEQUENCE
{
     transferMode                       CHOICE
     {
          framed                        NULL,
          unframed                      NULL,
          ...
     },
     headerFEC                          CHOICE
     {
          sebch16-7                     NULL,
          golay24-12                    NULL,
          ...
     },
     crcLength                          CHOICE
     {
          crc4bit                       NULL,
          crc12bit                      NULL,
          crc20bit                      NULL,
          crc28bit                      NULL,
          ...,
          crc8bit                       NULL,
          crc16bit                      NULL,
          crc32bit                      NULL,
          crcNotUsed                    NULL
     },

     rcpcCodeRate                       INTEGER (8..32),

     arqType                            CHOICE
     {
          noArq                         NULL,
          typeIArq                      H223AnnexCArqParameters,
          typeIIArq                     H223AnnexCArqParameters,
          ...
     },
     alpduInterleaving                  BOOLEAN,
     alsduSplitting                     BOOLEAN,
     ...,
     rsCodeCorrection                   INTEGER (0..127) OPTIONAL
}

H223AL2MParameters ::= SEQUENCE
{
     headerFEC                          CHOICE
     {
          sebch16-5                     NULL,
          golay24-12                    NULL,
          ...
     },
     alpduInterleaving                  BOOLEAN,
     ...
}
```

```
H223AL3MParameters ::= SEQUENCE
{
     headerFormat                     CHOICE
     {
          sebch16-7                   NULL,
          golay24-12                  NULL,
          ...
     },
     crcLength                        CHOICE
     {
          crc4bit                     NULL,
          crc12bit                    NULL,
          crc20bit                    NULL,
          crc28bit                    NULL,
          ...,
          crc8bit                     NULL,
          crc16bit                    NULL,
          crc32bit                    NULL,
          crcNotUsed                  NULL
     },

     rcpcCodeRate                     INTEGER (8..32),

     arqType                          CHOICE
     {
          noArq                       NULL,
          typeIArq                    H223AnnexCArqParameters,
          typeIIArq                   H223AnnexCArqParameters,
          ...
     },

     alpduInterleaving                BOOLEAN,
     ...,
     rsCodeCorrection                 INTEGER (0..127) OPTIONAL
}


H223AnnexCArqParameters ::= SEQUENCE
{
     numberOfRetransmissions          CHOICE
     {
          finite                      INTEGER (0..16),
          infinite                    NULL,
          ...
     },
     sendBufferSize                   INTEGER (0..16777215),     -- units octets
     ...
}

V76LogicalChannelParameters ::= SEQUENCE
{
     hdlcParameters                   V76HDLCParameters,
     suspendResume                    CHOICE
     {
          noSuspendResume             NULL,
          suspendResumewAddress       NULL,
          suspendResumewoAddress      NULL,
          ...
     },
     uIH                              BOOLEAN,
     mode                             CHOICE
     {
          eRM                         SEQUENCE
          {
                windowSize              INTEGER (1..127) ,
                recovery                CHOICE
                {
                    rej                 NULL,
                    sREJ                NULL,
                    mSREJ               NULL,
                    ...
                },
                ...
            },
            uNERM                       NULL,
            ...
        },
        v75Parameters                   V75Parameters,
        ...
}



V76HDLCParameters ::= SEQUENCE
{
        crcLength CRCLength,
        n401                            INTEGER (1..4095),
        loopbackTestProcedure           BOOLEAN,
        ...
}


CRCLength ::= CHOICE
{
        crc8bit                         NULL,
        crc16bit                        NULL,
        crc32bit                        NULL,
        ...
}

H2250LogicalChannelParameters ::= SEQUENCE
{
        nonStandard                     SEQUENCE OF NonStandardParameter OPTIONAL,
        sessionID INTEGER(0..255),
        associatedSessionID             INTEGER(1..255) OPTIONAL,
        mediaChannel                    TransportAddress OPTIONAL,
        mediaGuaranteedDelivery         BOOLEAN OPTIONAL,
        mediaControlChannel             TransportAddress OPTIONAL, -- reverse
                                                                   -- RTCP channel
        mediaControlGuaranteedDelivery  BOOLEAN OPTIONAL,
        silenceSuppression              BOOLEAN OPTIONAL,
        destination                     TerminalLabel OPTIONAL,

        dynamicRTPPayloadType           INTEGER(96..127) OPTIONAL,
        mediaPacketization              CHOICE
        {
            h261aVideoPacketization     NULL,
            ...,
            rtpPayloadType              RTPPayloadType
        } OPTIONAL,
        ...,
        transportCapability             TransportCapability OPTIONAL,
        redundancyEncoding              RedundancyEncoding OPTIONAL,
        source                          TerminalLabel OPTIONAL
}

RTPPayloadType ::= SEQUENCE
{
        payloadDescriptor                   CHOICE
        {
            nonStandardIdentifier           NonStandardParameter,
            rfc-number                      INTEGER (1..32768, ...),
            oid                             OBJECT IDENTIFIER,
            ...
        },
        payloadType                         INTEGER (0..127) OPTIONAL,
        ...
}

RedundancyEncoding ::= SEQUENCE
{
        redundancyEncodingMethod            RedundancyEncodingMethod,
        secondaryEncoding                   DataType OPTIONAL,    -- depends on method
        ...,

        -- The sequence below may be used in place of the above secondaryEncoding field

        rtpRedundancyEncoding               SEQUENCE
        {
            primary                         RedundancyEncodingElement OPTIONAL,
                                            -- Present when redundancyEncoding
                                            -- is selected as the dataType
                                            -- in an OpenLogicalChannel or
                                            -- as part of a MultiplePayloadSteam

            secondary SEQUENCE OF RedundancyEncodingElement OPTIONAL,
            ...
        } OPTIONAL
}

RedundancyEncodingElement ::= SEQUENCE
{
        dataType                            DataType,
        payloadType                         INTEGER(0..127) OPTIONAL,
        ...
}

MultiplePayloadStream ::= SEQUENCE
{
        elements                            SEQUENCE OF MultiplePayloadStreamElement,
        ...
}

MultiplePayloadStreamElement ::= SEQUENCE
{
        dataType                            DataType,
        payloadType                         INTEGER(0..127) OPTIONAL,
        ...
}

DepFECData ::= CHOICE -- Deprecated, do not use
{
        rfc2733                             SEQUENCE
        {
            mode                            CHOICE
            {
              redundancyEncoding            NULL,
              separateStream                CHOICE
              {
                 differentPort              SEQUENCE
                 {
                 protectedSessionID         INTEGER(1..255),
                 protectedPayloadType  INTEGER(0..127) OPTIONAL,
                   ...
                 },
                 samePort              SEQUENCE
                 {
                 protectedPayloadType  INTEGER(0..127),
                   ...
                 },
                 ...
              },
              ...
            },
            ...
        }
}

FECData ::= CHOICE
{
        rfc2733                           SEQUENCE
        {
            protectedPayloadType          INTEGER(0..127),
            fecScheme                     OBJECT IDENTIFIER OPTIONAL,
            pktMode                       CHOICE
            {
              rfc2198coding            NULL,
              rfc2733sameport           SEQUENCE
              {
                 ...
              },
              rfc2733diffport           SEQUENCE
              {
                 protectedChannel      LogicalChannelNumber,
                 ...
              },
              ...
            },
            ...
        },
        ...
}

TransportAddress ::= CHOICE
{
        unicastAddress                    UnicastAddress,
        multicastAddress                  MulticastAddress,
        ...
}

UnicastAddress ::= CHOICE
{
        iPAddress                         SEQUENCE
        {
            network                       OCTET STRING (SIZE(4)),
            tsapIdentifier                INTEGER(0..65535),
            ...
        },
        iPXAddress                        SEQUENCE
        {
            node                          OCTET STRING (SIZE(6)),
            netnum                        OCTET STRING (SIZE(4)),
            tsapIdentifier                OCTET STRING (SIZE(2)),
            ...
        },
      iP6Address                          SEQUENCE
      {
           network                        OCTET STRING (SIZE(16)),
           tsapIdentifier                 INTEGER(0..65535),
           ...
      },
      netBios                             OCTET STRING (SIZE(16)),
      iPSourceRouteAddress                SEQUENCE
      {
           routing                        CHOICE
           {
                strict                    NULL,
                loose                     NULL
           },
           network                        OCTET STRING (SIZE(4)),
           tsapIdentifier                 INTEGER(0..65535),
           route                          SEQUENCE OF OCTET STRING (SIZE(4)),
           ...
      },
      ...,
      nsap                                OCTET STRING (SIZE(1..20)),
      nonStandardAddress                  NonStandardParameter
}

MulticastAddress ::= CHOICE
{
      iPAddress                           SEQUENCE
      {
           network                        OCTET STRING (SIZE(4)),
           tsapIdentifier                 INTEGER(0..65535),
           ...
      },
      iP6Address                          SEQUENCE
      {
           network                        OCTET STRING (SIZE(16)),
           tsapIdentifier                 INTEGER(0..65535),
           ...
      },
      ...,
      nsap                                OCTET STRING (SIZE(1..20)),
      nonStandardAddress                  NonStandardParameter
}

EncryptionSync ::= SEQUENCE
                                          -- used to supply new key and synchronization point
{
      nonStandard                         NonStandardParameter OPTIONAL,
      synchFlag                           INTEGER(0..255) , -- may need to be larger
                                                            -- for H.324, etc.
                                                            -- shall be the Dynamic
                                                            -- Payload# for H.323
      h235Key                             OCTET STRING (SIZE(1..65535)), -- H.235.0
                                                                -- encoded value
      escrowentry                         SEQUENCE SIZE(1..256) OF EscrowData OPTIONAL,
      ...,
      genericParameter                    GenericParameter OPTIONAL
}

EscrowData ::= SEQUENCE
{
      escrowID                            OBJECT IDENTIFIER,
      escrowValue                         BIT STRING (SIZE(1..65535)),
      ...
}
```

```
OpenLogicalChannelAck ::= SEQUENCE
{
    forwardLogicalChannelNumber      LogicalChannelNumber,

    reverseLogicalChannelParameters  SEQUENCE
    {
        reverseLogicalChannelNumber LogicalChannelNumber,
        portNumber                  INTEGER (0..65535) OPTIONAL,
        multiplexParameters         CHOICE
        {
            h222LogicalChannelParameters  H222LogicalChannelParameters,
            -- H.223 parameters are never present in reverse direction
            ...,
            h2250LogicalChannelParameters H2250LogicalChannelParameters

        } OPTIONAL,                 -- not present for H.223
        ...,
        replacementFor              LogicalChannelNumber OPTIONAL

    } OPTIONAL,                     -- not present for unidirectional channel
                                    -- request
    ...,
    separateStack                   NetworkAccessParameters OPTIONAL,
                                    -- for Open requester to establish
                                    -- the stack
    forwardMultiplexAckParameters   CHOICE
    {
        -- H.222 parameters are never present in the Ack
        -- H.223 parameters are never present in the Ack
        -- V.76 parameters are never present in the Ack
        h2250LogicalChannelAckParameters H2250LogicalChannelAckParameters,
        ...
    } OPTIONAL,
    encryptionSyncEncryptionSync OPTIONAL, -- used only by Master
    genericInformation          SEQUENCE OF GenericInformation OPTIONAL
                                        -- generic information associated
                                        -- with the message
}

OpenLogicalChannelReject ::= SEQUENCE
{
    forwardLogicalChannelNumber      LogicalChannelNumber,
    cause                            CHOICE
    {
        unspecified                 NULL,
        unsuitableReverseParameters NULL,
        dataTypeNotSupported        NULL,
        dataTypeNotAvailable        NULL,
        unknownDataType             NULL,
        dataTypeALCombinationNotSupported  NULL,
        ...,
        multicastChannelNotAllowed  NULL,
        insufficientBandwidth       NULL,
        separateStackEstablishmentFailed   NULL,
        invalidSessionID            NULL,
        masterSlaveConflict         NULL,
        waitForCommunicationMode    NULL,
        invalidDependentChannel     NULL,
        replacementForRejected      NULL,
        securityDeniedNULL,
        qoSControlNotSupported      NULL  --  added for callee to indicate
                                    -- that requested QoS support cannot be
                                    -- supported.
```

```
     },
     ...,
          genericInformation          SEQUENCE OF GenericInformation OPTIONAL
                                      -- generic information associated
                                      -- with the message
}

OpenLogicalChannelConfirm ::= SEQUENCE
{
     forwardLogicalChannelNumber      LogicalChannelNumber,
     ...,
          genericInformation          SEQUENCE OF GenericInformation OPTIONAL
                                      -- generic information associated
                                      -- with the message
}

H2250LogicalChannelAckParameters ::= SEQUENCE
{
     nonStandard                      SEQUENCE OF NonStandardParameter OPTIONAL,
     sessionID                        INTEGER(1..255) OPTIONAL,
     mediaChannel                     TransportAddress OPTIONAL,
     mediaControlChannel              TransportAddress OPTIONAL,-- forward RTCP
                                                                -- channel
     dynamicRTPPayloadType            INTEGER(96..127) OPTIONAL,-- used only by
                                                                -- the master or
                                                                -- MC
     ...,
     flowControlToZero                BOOLEAN,
     portNumber                       INTEGER (0..65535) OPTIONAL
}


CloseLogicalChannel ::= SEQUENCE
{
     forwardLogicalChannelNumber      LogicalChannelNumber,
     source                           CHOICE
     {
          user                        NULL,
          lcse                        NULL
     },
     ...,
     reason                           CHOICE
     {
          unknown                     NULL,
          reopen                      NULL,
          reservationFailure          NULL,
          ...,
          networkErrorCode            INTEGER(0..255) -- Indicates the error
                                      -- code received from network
     }
}

CloseLogicalChannelAck ::= SEQUENCE
{
     forwardLogicalChannelNumber      LogicalChannelNumber,
     ...
}

RequestChannelClose ::= SEQUENCE
{
     forwardLogicalChannelNumber      LogicalChannelNumber,
     ...,
     qosCapability                    QOSCapability OPTIONAL,
     reason                           CHOICE
```

```
    {
        unknown                     NULL,
        normal                      NULL,
        reopen                      NULL,
        reservationFailure          NULL,
        ...,
            networkErrorCode        INTEGER(0..255) -- Indicates the error
                                    -- code received from network
    }
}

RequestChannelCloseAck ::= SEQUENCE
{
    forwardLogicalChannelNumber     LogicalChannelNumber,
    ...
}

RequestChannelCloseReject ::= SEQUENCE
{
    forwardLogicalChannelNumber     LogicalChannelNumber,
    cause                           CHOICE
    {
        unspecified                 NULL,
        ...
    },
    ...
}

RequestChannelCloseRelease ::= SEQUENCE
{
    forwardLogicalChannelNumber     LogicalChannelNumber,
    ...
}

-- =============================================================================
-- H.223 multiplex table definitions
-- =============================================================================

MultiplexEntrySend ::= SEQUENCE
{
    sequenceNumber SequenceNumber,
    multiplexEntryDescriptors       SET SIZE (1..15) OF MultiplexEntryDescriptor,
    ...
}

MultiplexEntryDescriptor ::= SEQUENCE
{
    multiplexTableEntryNumber       MultiplexTableEntryNumber,
    elementList                     SEQUENCE SIZE (1..256) OF MultiplexElement OPTIONAL
}

MultiplexElement ::= SEQUENCE
{
    type                            CHOICE
    {
        logicalChannelNumber        INTEGER(0..65535),
        subElementList              SEQUENCE SIZE (2..255) OF MultiplexElement
    },
    repeatCount                     CHOICE
    {
        finite                      INTEGER (1..65535),    -- repeats of type
        untilClosingFlag            NULL                   -- used for last element
    }
}
```

```
MultiplexTableEntryNumber ::= INTEGER (1..15)

MultiplexEntrySendAck ::= SEQUENCE
{
    sequenceNumber                  SequenceNumber,
    multiplexTableEntryNumber       SET SIZE (1..15) OF
                                    MultiplexTableEntryNumber,
    ...
}

MultiplexEntrySendReject ::= SEQUENCE
{
    sequenceNumber                  SequenceNumber,
    rejectionDescriptions           SET SIZE (1..15) OF
                                    MultiplexEntryRejectionDescriptions,
    ...
}

MultiplexEntryRejectionDescriptions ::= SEQUENCE
{
    multiplexTableEntryNumber       MultiplexTableEntryNumber,
    cause                           CHOICE
    {
        unspecifiedCause            NULL,
        descriptorTooComplex        NULL,
        ...
    },
    ...
}

MultiplexEntrySendRelease ::= SEQUENCE
{
    multiplexTableEntryNumber       SET SIZE (1..15) OF
                                    MultiplexTableEntryNumber,
    ...
}

RequestMultiplexEntry ::= SEQUENCE
{
    entryNumbers                    SET SIZE (1..15) OF
                                    MultiplexTableEntryNumber,
    ...
}

RequestMultiplexEntryAck ::= SEQUENCE
{
    entryNumbers                    SET SIZE (1..15) OF
                                    MultiplexTableEntryNumber,
    ...
}

RequestMultiplexEntryReject ::= SEQUENCE
{
    entryNumbers                    SET SIZE (1..15) OF
                                    MultiplexTableEntryNumber,
    rejectionDescriptions           SET SIZE (1..15) OF
                                    RequestMultiplexEntryRejectionDescriptions,
    ...
}

RequestMultiplexEntryRejectionDescriptions ::= SEQUENCE
{
    multiplexTableEntryNumber       MultiplexTableEntryNumber,
    cause                              CHOICE
    {
        unspecifiedCause               NULL,
        ...
    },
    ...
}

RequestMultiplexEntryRelease ::= SEQUENCE
{
    entryNumbers                       SET SIZE (1..15) OF
                                       MultiplexTableEntryNumber,
    ...
}

-- =============================================================================
-- Request mode definitions
-- =============================================================================

-- RequestMode is a list, in order or preference, of modes that a terminal would
-- like to have transmitted to it.

RequestMode ::= SEQUENCE
{
    sequenceNumber                     SequenceNumber,
    requestedModes                     SEQUENCE SIZE (1..256) OF ModeDescription,
    ...
}

RequestModeAck ::= SEQUENCE
{
    sequenceNumber                     SequenceNumber,
    response                           CHOICE
    {
        willTransmitMostPreferredMode  NULL,
        willTransmitLessPreferredMode  NULL,
        ...
    },
    ...
}

RequestModeReject ::= SEQUENCE
{
    sequenceNumber                     SequenceNumber,
    cause                              CHOICE
    {
        modeUnavailable                NULL,
        multipointConstraint           NULL,
        requestDenied                  NULL,
        ...
    },
    ...
}

RequestModeRelease ::= SEQUENCE
{
    ...
}

-- =============================================================================
-- Request mode definitions: Mode description
-- =============================================================================

ModeDescription ::= SET SIZE (1..256) OF ModeElement
```

```
ModeElementType ::= CHOICE
{
    nonStandard                     NonStandardParameter,
    videoMode                       VideoMode,
    audioMode                       AudioMode,
    dataMode                        DataMode,
    encryptionMode                  EncryptionMode,
    ...,
    h235Mode                        H235Mode,
    multiplexedStreamMode           MultiplexedStreamParameter,
    redundancyEncodingDTMode        RedundancyEncodingDTMode,
    multiplePayloadStreamMode       MultiplePayloadStreamMode,
    depFecMode                      DepFECMode, -- deprecated, do not use
    fecMode                         FECMode
}

ModeElement ::= SEQUENCE
{
    type                            ModeElementType,

    h223ModeParameters              H223ModeParameters OPTIONAL,
    ...,
    v76ModeParameters               V76ModeParameters OPTIONAL,
    h2250ModeParameters             H2250ModeParameters OPTIONAL,
    genericModeParameters           GenericCapability OPTIONAL,
    multiplexedStreamModeParameters MultiplexedStreamModeParameters OPTIONAL,
    logicalChannelNumber            LogicalChannelNumber OPTIONAL

}

H235Mode ::= SEQUENCE
{
    encryptionAuthenticationAndIntegrity    EncryptionAuthenticationAndIntegrity,

    mediaMode                       CHOICE
    {
        nonStandard                 NonStandardParameter,
        videoMode                   VideoMode,
        audioMode                   AudioMode,
        dataMode                    DataMode,
        ...
    },
    ...
}

MultiplexedStreamModeParameters ::= SEQUENCE
{
    logicalChannelNumber            LogicalChannelNumber,
    ...
}

RedundancyEncodingDTMode ::= SEQUENCE
{
    redundancyEncodingMethod        RedundancyEncodingMethod,
    primary                         RedundancyEncodingDTModeElement,
    secondary                       SEQUENCE OF RedundancyEncodingDTModeElement,
    ...
}

RedundancyEncodingDTModeElement ::= SEQUENCE
{
    type                            CHOICE
    {
          nonStandard                  NonStandardParameter,
          videoMode                    VideoMode,
          audioMode                    AudioMode,
          dataMode                     DataMode,
          encryptionMode               EncryptionMode,
          h235Mode                     H235Mode,
          ...,
          fecMode                      FECMode
     },
     ...
}

MultiplePayloadStreamMode ::= SEQUENCE
{
     elements                          SEQUENCE OF MultiplePayloadStreamElementMode,
     ...
}

MultiplePayloadStreamElementMode ::= SEQUENCE
{
     type                              ModeElementType,
     ...
}

DepFECMode ::= CHOICE -- deprecated, do not use
{
     rfc2733Mode                       SEQUENCE
     {
          mode                         CHOICE
          {
               redundancyEncoding      NULL,
               separateStreamCHOICE
          {
               differentPort           SEQUENCE
               {
               protectedSessionID      INTEGER(1..255),
               protectedPayloadType    INTEGER(0..127) OPTIONAL,
               ...
               },
               samePort                SEQUENCE
               {
                    protectedType      ModeElementType,
                  ...
               },
               ...
          },
          ...
      },
      ...
     },
     ...
}

FECMode ::= SEQUENCE
{
     protectedElement                  ModeElementType,
     fecScheme                         OBJECT IDENTIFIER OPTIONAL,
                                        -- identifies encoding scheme
     rfc2733Format                     CHOICE
     {
          rfc2733rfc2198               MaxRedundancy, -- RFC 2198 redundancy
               rfc2733sameport         MaxRedundancy,
                                        -- separate packet, same port
          rfc2733diffport               MaxRedundancy
                                         -- separate packet and port
     } OPTIONAL,
     ...
}

H223ModeParameters ::= SEQUENCE
{
     adaptationLayerType                CHOICE
     {
          nonStandard                   NonStandardParameter,
          al1Framed                     NULL,
          al1NotFramed                  NULL,
          al2WithoutSequenceNumbers     NULL,
          al2WithSequenceNumbers        NULL,
          al3                           SEQUENCE
          {
               controlFieldOctets       INTEGER(0..2),
               sendBufferSize           INTEGER(0..16777215)  -- units octets
          },
          ...,
          al1M                          H223AL1MParameters,
          al2M                          H223AL2MParameters,
          al3M                          H223AL3MParameters

     },

     segmentableFlag                    BOOLEAN,
     ...
}

V76ModeParameters ::= CHOICE
{
     suspendResumewAddress              NULL,
     suspendResumewoAddress             NULL,
     ...
}

H2250ModeParameters ::= SEQUENCE
{
     redundancyEncodingMode             RedundancyEncodingMode OPTIONAL,
     ...
}

RedundancyEncodingMode ::= SEQUENCE
{
     redundancyEncodingMethod           RedundancyEncodingMethod,
     secondaryEncoding                  CHOICE
     {
          nonStandard                   NonStandardParameter,
          audioData                     AudioMode,
          ...
     } OPTIONAL,
     ...
}

-- =============================================================================
-- Request mode definitions: Video modes
-- =============================================================================

VideoMode ::= CHOICE
{
     nonStandard                        NonStandardParameter,
     h261VideoMode                      H261VideoMode,
     h262VideoMode                     H262VideoMode,
     h263VideoMode                     H263VideoMode,
     is11172VideoMode                  IS11172VideoMode,
     ...,
     genericVideoMode                  GenericCapability
}

H261VideoMode ::= SEQUENCE
{
     resolution                        CHOICE
     {
          qcif                          NULL,
          cif                           NULL
     },
     bitRate                           INTEGER (1..19200),   -- units 100 bit/s
     stillImageTransmission            BOOLEAN,
     ...
}

H262VideoMode ::= SEQUENCE
{
     profileAndLevel                   CHOICE
     {
          profileAndLevel-SPatML        NULL,
          profileAndLevel-MPatLL        NULL,
          profileAndLevel-MPatML        NULL,
          profileAndLevel-MPatH-14      NULL,
          profileAndLevel-MPatHL        NULL,
          profileAndLevel-SNRatLL       NULL,
          profileAndLevel-SNRatML       NULL,
          profileAndLevel-SpatialatH-14 NULL,
          profileAndLevel-HPatML        NULL,
          profileAndLevel-HPatH-14      NULL,
          profileAndLevel-HPatHL        NULL,
          ...
     },
     videoBitRate                      INTEGER(0..1073741823) OPTIONAL, -- units 400 bit/s
     vbvBufferSize                     INTEGER(0..262143) OPTIONAL, -- units 16 384 bits
     samplesPerLine                    INTEGER(0..16383) OPTIONAL, -- units samples/line
     linesPerFrame                     INTEGER(0..16383) OPTIONAL, -- units lines/frame
     framesPerSecond                   INTEGER(0..15) OPTIONAL, -- frame_rate_code
     luminanceSampleRate               INTEGER(0..4294967295) OPTIONAL, -- units samples/s
     ...
}

H263VideoMode ::= SEQUENCE
{
     resolution                        CHOICE
     {
          sqcif                         NULL,
          qcif                          NULL,
          cif                           NULL,
          cif4                          NULL,
          cif16                         NULL,
          ...,
          custom                        NULL
     },
     bitRate                           INTEGER (1..19200),   -- units 100 bit/s
     unrestrictedVector                BOOLEAN,
     arithmeticCoding                  BOOLEAN,
     advancedPrediction                BOOLEAN,
     pbFrames                          BOOLEAN,
     ...,
     errorCompensation                BOOLEAN,
     enhancementLayerInfo             EnhancementLayerInfo OPTIONAL,
     h263Options                      H263Options OPTIONAL
}

IS11172VideoMode ::= SEQUENCE
{
     constrainedBitstream             BOOLEAN,
     videoBitRate                     INTEGER(0..1073741823) OPTIONAL, -- units
                                        -- 400 bit/s
     vbvBufferSize                    INTEGER(0..262143) OPTIONAL,     -- units
                                       -- 16 384 bits
     samplesPerLine                   INTEGER(0..16383) OPTIONAL,     -- units
                                      -- samples/line
     linesPerFrame                    INTEGER(0..16383) OPTIONAL,     -- units
                                      -- lines/frame
     pictureRate                      INTEGER(0..15) OPTIONAL,
     luminanceSampleRate              INTEGER(0..4294967295) OPTIONAL, -- units
                                       -- samples/s
     ...
}

-- =============================================================================
-- Request mode definitions: Audio modes
-- =============================================================================

AudioMode ::= CHOICE
{
     nonStandard                      NonStandardParameter,
     g711Alaw64k                      NULL,
     g711Alaw56k                      NULL,
     g711Ulaw64k                      NULL,
     g711Ulaw56k                      NULL,

     g722-64k                         NULL,
     g722-56k                         NULL,
     g722-48k                         NULL,

     g728                             NULL,
     g729                             NULL,
     g729AnnexA                       NULL,

     g7231                            CHOICE
     {
          noSilenceSuppressionLowRate  NULL,
          noSilenceSuppressionHighRate NULL,
          silenceSuppressionLowRate    NULL,
          silenceSuppressionHighRate   NULL
     },

     is11172AudioMode                 IS11172AudioMode,
     is13818AudioMode                 IS13818AudioMode,

     ...,
     g729wAnnexB                      INTEGER(1..256),
     g729AnnexAwAnnexB                INTEGER(1..256),
     g7231AnnexCMode                  G7231AnnexCMode,
     gsmFullRate                      GSMAudioCapability,
     gsmHalfRate                      GSMAudioCapability,
     gsmEnhancedFullRate              GSMAudioCapability,
     genericAudioMode                 GenericCapability,
     g729Extensions                   G729Extensions,
     vbd                              VBDMode
}
```

```
IS11172AudioMode ::= SEQUENCE
{
    audioLayer                   CHOICE
    {
        audioLayer1              NULL,
        audioLayer2              NULL,
        audioLayer3              NULL
    },

    audioSampling                CHOICE
    {
        audioSampling32k         NULL,
        audioSampling44k1        NULL,
        audioSampling48k         NULL
    },

    multichannelType             CHOICE
    {
        singleChannel            NULL,
        twoChannelStereo         NULL,
        twoChannelDual           NULL
    },

    bitRate                      INTEGER (1..448),      -- units kbit/s
    ...
}

IS13818AudioMode ::= SEQUENCE
{
    audioLayer                   CHOICE
    {
        audioLayer1              NULL,
        audioLayer2              NULL,
        audioLayer3              NULL
    },

    audioSampling                CHOICE
    {
        audioSampling16k         NULL,
        audioSampling22k05       NULL,
        audioSampling24k         NULL,
        audioSampling32k         NULL,
        audioSampling44k1        NULL,
        audioSampling48k         NULL
    },

    multichannelType             CHOICE
    {
        singleChannel            NULL,
        twoChannelStereo         NULL,
        twoChannelDual           NULL,
        threeChannels2-1         NULL,
        threeChannels3-0         NULL,
        fourChannels2-0-2-0      NULL,
        fourChannels2-2          NULL,
        fourChannels3-1          NULL,
        fiveChannels3-0-2-0      NULL,
        fiveChannels3-2          NULL
    },

    lowFrequencyEnhancement      BOOLEAN,

    multilingual                 BOOLEAN,
     bitRate                          INTEGER (1..1130),    -- units kbit/s
     ...
}

G7231AnnexCMode ::= SEQUENCE
{
     maxAl-sduAudioFrames             INTEGER (1..256),
     silenceSuppression               BOOLEAN,
     g723AnnexCAudioMode              SEQUENCE
     {
          highRateMode0               INTEGER (27..78),     -- units octets
          highRateMode1               INTEGER (27..78),     -- units octets
          lowRateMode0                INTEGER (23..66),     -- units octets
          lowRateMode1                INTEGER (23..66),     -- units octets
          sidMode0                    INTEGER (6..17),-- units octets
          sidMode1                    INTEGER (6..17),-- units octets
          ...
     },
     ...
}

VBDMode ::= SEQUENCE
{
     type                             AudioMode,-- shall not be "vbd"
     ...
}

-- =============================================================================
-- Request mode definitions: Data modes
-- =============================================================================

DataMode ::= SEQUENCE
{
     application                      CHOICE
     {
          nonStandard                 NonStandardParameter,
          t120                        DataProtocolCapability,
          dsm-cc                      DataProtocolCapability,
          userData                    DataProtocolCapability,
          t84                         DataProtocolCapability,
          t434                        DataProtocolCapability,
          h224                        DataProtocolCapability,
          nlpid                       SEQUENCE
          {
               nlpidProtocol          DataProtocolCapability,
               nlpidData              OCTET STRING
          },
          dsvdControl                 NULL,
          h222DataPartitioning        DataProtocolCapability,
          ...,
          t30fax                      DataProtocolCapability,
          t140                        DataProtocolCapability,
          t38fax                      SEQUENCE
          {
               t38FaxProtocol         DataProtocolCapability,
               t38FaxProfile          T38FaxProfile
          },
          genericDataMode             GenericCapability

     },
     bitRate                          INTEGER (0..4294967295), -- units 100 bit/s
     ...
}
```

```
-- =============================================================================
-- Request mode definitions: Encryption modes
-- =============================================================================

EncryptionMode ::= CHOICE
{
    nonStandard                         NonStandardParameter,
    h233Encryption                      NULL,
    ...
}

-- =============================================================================
-- Round Trip Delay definitions
-- =============================================================================

RoundTripDelayRequest ::= SEQUENCE
{
    sequenceNumber                      SequenceNumber,
    ...
}

RoundTripDelayResponse ::= SEQUENCE
{
    sequenceNumber                      SequenceNumber,
    ...
}

-- =============================================================================
-- Maintenance Loop definitions
-- =============================================================================

MaintenanceLoopRequest ::= SEQUENCE
{
    type                                CHOICE
    {
        systemLoop                      NULL,
        mediaLoop                       LogicalChannelNumber,
        logicalChannelLoop              LogicalChannelNumber,
        ...
    },
    ...
}

MaintenanceLoopAck ::= SEQUENCE
{
    type                                CHOICE
    {
        systemLoop                      NULL,
        mediaLoop                       LogicalChannelNumber,
        logicalChannelLoop              LogicalChannelNumber,
        ...
    },
    ...
}

MaintenanceLoopReject ::= SEQUENCE
{
    type                                CHOICE
    {
        systemLoop                      NULL,
        mediaLoop                       LogicalChannelNumber,
        logicalChannelLoop              LogicalChannelNumber,
        ...
    },
    cause                               CHOICE
    {
        canNotPerformLoop               NULL,
        ...
    },
    ...
}

MaintenanceLoopOffCommand ::= SEQUENCE
{
    ...
}

-- =============================================================================
-- Communication Mode definitions
-- =============================================================================

CommunicationModeCommand ::= SEQUENCE
{
    communicationModeTable              SET SIZE(1..256) OF CommunicationModeTableEntry,
    ...
}

CommunicationModeRequest ::= SEQUENCE
{
    ...
}

CommunicationModeResponse ::= CHOICE
{
    communicationModeTable              SET SIZE(1..256) OF CommunicationModeTableEntry,
    ...
}
CommunicationModeTableEntry ::= SEQUENCE
{
    nonStandard                         SEQUENCE OF NonStandardParameter OPTIONAL,
    sessionID                           INTEGER(1..255),
    associatedSessionID                 INTEGER(1..255) OPTIONAL,

    terminalLabel                       TerminalLabel OPTIONAL, -- if not present,
                                          -- it refers to
                                          -- all
                                          -- participants in
                                          -- the conference
    sessionDescription                  BMPString (SIZE(1..128)) ,
                                        -- Basic ISO/IEC 10646 (Unicode)
    dataType                            CHOICE
    {
        videoData                       VideoCapability,
        audioData                       AudioCapability,
        data                            DataApplicationCapability,
        ...
    },
    mediaChannel                        TransportAddress OPTIONAL,
    mediaGuaranteedDelivery             BOOLEAN OPTIONAL,
    mediaControlChannel                 TransportAddress OPTIONAL,
                                        -- reverse RTCP channel
    mediaControlGuaranteedDelivery      BOOLEAN OPTIONAL,
    ...,
    redundancyEncoding                  RedundancyEncoding OPTIONAL,
    sessionDependency                   INTEGER (1..255) OPTIONAL,
    destination                         TerminalLabel OPTIONAL
}
```

```
-- =============================================================================
-- Conference Request definitions
-- =============================================================================

ConferenceRequest ::= CHOICE
{

     terminalListRequest              NULL,          -- same as H.230 TCU (term->MC)

     makeMeChair                      NULL,           -- same as H.230 CCA (term->MC)
     cancelMakeMeChair                NULL,           -- same as H.230 CIS (term->MC)

     dropTerminal                     TerminalLabel, -- same as H.230 CCD(term->MC)

     requestTerminalID                TerminalLabel, -- same as TCP (term->MC)

     enterH243Password                NULL,           -- same as H.230 TCS1(MC->term)
     enterH243TerminalID              NULL,           -- same as H.230 TCS2/TCI
                                                      --   (MC->term)
     enterH243ConferenceID            NULL,           -- same as H.230 TCS3 (MC->term)
     ...,
     enterExtensionAddress            NULL,           -- same as H.230 TCS4 (GW->term)
     requestChairTokenOwner           NULL,          -- same as H.230 TCA (term->MC)
     requestTerminalCertificate       SEQUENCE
     {
          terminalLabel               TerminalLabel OPTIONAL,
          certSelectionCriteria       CertSelectionCriteria OPTIONAL,
          sRandom                     INTEGER (1..4294967295) OPTIONAL,
                                      -- this is the requester's challenge
          ...
     },
     broadcastMyLogicalChannel        LogicalChannelNumber, -- similar to H.230 MCV
     makeTerminalBroadcaster          TerminalLabel,         -- similar to H.230 VCB
     sendThisSource                   TerminalLabel,         -- similar to H.230 VCS
     requestAllTerminalIDs            NULL,
     remoteMCRequest                  RemoteMCRequest
}

CertSelectionCriteria ::= SEQUENCE SIZE (1..16) OF Criteria

Criteria ::= SEQUENCE
{
     field                            OBJECT IDENTIFIER, -- may include
                                                         -- certificate type
     value                            OCTET STRING (SIZE(1..65535)),
     ...
}

TerminalLabel ::= SEQUENCE
{
          mcuNumber                   McuNumber,
          terminalNumber              TerminalNumber,
          ...
}

McuNumber ::= INTEGER(0..192)
TerminalNumber ::= INTEGER(0..192)

-- =============================================================================
-- Conference Response definitions
-- =============================================================================

ConferenceResponse ::= CHOICE
{
```

```
mCTerminalIDResponse              SEQUENCE        -- response to TCP
                                                  -- (same as TIP)
{                                                 -- sent by MC only
     terminalLabel                TerminalLabel,
     terminalID                   TerminalID,
     ...
},

terminalIDResponse                SEQUENCE       -- response to TCS2 or TCI
{                                                -- same as IIS
     terminalLabel                TerminalLabel, -- (term->MC)
     terminalID                   TerminalID,
     ...
},

conferenceIDResponse              SEQUENCE        -- response to TCS3
{                                                 -- same as IIS
     terminalLabel                TerminalLabel, -- (term->MC)
     conferenceID                 ConferenceID,
     ...
},

passwordResponse                  SEQUENCE        -- response to TCS1
{                                                 -- same as IIS
     terminalLabel                TerminalLabel,  -- (term->MC)
     password                     Password,
     ...
},

terminalListResponse              SET SIZE (1..256) OF TerminalLabel,

videoCommandReject                NULL,      -- same as H.230 VCR
terminalDropReject                NULL,      -- same as H.230 CIR

makeMeChairResponse               CHOICE    -- same as H.230 CCR
{
     grantedChairToken            NULL,     -- same as H.230 CIT
     deniedChairToken             NULL,     -- same as H.230 CCR
     ...
},
...,
extensionAddressResponse          SEQUENCE  -- response to TCS4
{
     extensionAddress             TerminalID, -- same as IIS (term->GW)
     ...
},
chairTokenOwnerResponse           SEQUENCE  -- response to TCA (same as TIR)
                                            -- sent by MC only
{
     terminalLabel                TerminalLabel,
     terminalID                   TerminalID,
     ...
},
terminalCertificateResponse       SEQUENCE
{
          terminalLabel           TerminalLabel OPTIONAL,
          certificateResponse     OCTET STRING (SIZE(1..65535)) OPTIONAL,
     ...
},
broadcastMyLogicalChannelResponse CHOICE
{
     grantedBroadcastMyLogicalChannel  NULL,     -- similar to H.230 MVA
     deniedBroadcastMyLogicalChannel   NULL,     -- similar to H.230 MVR
     ...
     },
     makeTerminalBroadcasterResponse  CHOICE
     {
          grantedMakeTerminalBroadcaster NULL,
          deniedMakeTerminalBroadcaster  NULL,
          ...
     },
     sendThisSourceResponse          CHOICE
     {
          grantedSendThisSource        NULL,
          deniedSendThisSource         NULL,
          ...
     },
     requestAllTerminalIDsResponse    RequestAllTerminalIDsResponse,
     remoteMCResponse                 RemoteMCResponse
}

TerminalID ::= OCTET STRING (SIZE(1..128)) -- as per H.230
ConferenceID ::= OCTET STRING (SIZE(1..32))
Password ::= OCTET STRING (SIZE(1..32))

RequestAllTerminalIDsResponse ::= SEQUENCE
{
     terminalInformation              SEQUENCE OF TerminalInformation,
     ...
}

TerminalInformation ::= SEQUENCE
{
     terminalLabel                    TerminalLabel,
     terminalID                       TerminalID,
     ...
}
-- ===========================================================================
-- Remote MC Request definitions
-- ===========================================================================

     RemoteMCRequest ::= CHOICE
     {
          masterActivate               NULL,
          slaveActivate                NULL,
          deActivate                   NULL,
          ...
     }

     RemoteMCResponse ::= CHOICE
     {
          accept                       NULL,
          reject                       CHOICE
          {
               unspecified             NULL,
               functionNotSupported    NULL,
               ...
          },
          ...
     }

-- ===========================================================================
-- Multilink definitions
-- ===========================================================================

MultilinkRequest ::= CHOICE
{
     nonStandard                      NonStandardMessage,
    callInformation                 SEQUENCE
    {
        maxNumberOfAdditionalConnections   INTEGER (1..65535),
        ...
    },

    addConnection                   SEQUENCE
    {
        sequenceNumber              SequenceNumber,  -- Unique ID of request
        dialingInformation          DialingInformation,
        ...
    },

    removeConnection                SEQUENCE
    {
        connectionIdentifier        ConnectionIdentifier,
        ...
    },

    maximumHeaderInterval           SEQUENCE
    {
        requestType                 CHOICE
        {
            currentIntervalInformationNULL,
            requestedInterval       INTEGER (0..65535), -- Max Header
                                                        -- Interval,
                                                        -- milliseconds
            ...
        },
        ...
    },
    ...
}

MultilinkResponse ::= CHOICE
{
    nonStandard                     NonStandardMessage,

    callInformation                 SEQUENCE
    {
        dialingInformation          DialingInformation,
        callAssociationNumber       INTEGER (0..4294967295),
        ...
    },

    addConnection                   SEQUENCE
    {
        sequenceNumber              SequenceNumber, -- Equal to value in request
        responseCode                CHOICE
        {
            accepted                NULL,
            rejected                CHOICE
            {
              connectionsNotAvailable NULL, -- due to any technical reason
              userRejected          NULL,
              ...
            },
            ...
        },
        ...
    },
    removeConnection                SEQUENCE
    {
        connectionIdentifier        ConnectionIdentifier,
        ...
    },

    maximumHeaderInterval           SEQUENCE
    {
        currentInterval             INTEGER (0..65535), -- Max Header
                                                        -- Interval,
                                                        -- milliseconds

        ...
    },
    ...
}

MultilinkIndication ::= CHOICE
{
    nonStandard                     NonStandardMessage,

    crcDesired                      SEQUENCE
    {
        ...
    },

    excessiveError                  SEQUENCE
    {
        connectionIdentifier        ConnectionIdentifier,
        ...
    },
    ...
}

DialingInformation ::= CHOICE
{
    nonStandard                     NonStandardMessage,

    differential                    SET SIZE (1..65535) OF DialingInformationNumber,
                                    -- list of numbers for all additional
                                    -- channels; only least significant digits
                                    -- different from initial channel's number

    infoNotAvailable                INTEGER (1..65535), -- maximum No. of
                                                        -- additional channels

    ...
}

DialingInformationNumber ::= SEQUENCE
{
    networkAddress                  NumericString (SIZE (0..40)),
    subAddress                      IA5String (SIZE (1..40)) OPTIONAL,
    networkType                     SET SIZE (1..255) OF DialingInformationNetworkType,
    ...
}

DialingInformationNetworkType ::= CHOICE
{
    nonStandard                     NonStandardMessage,
    n-isdn                          NULL,
    gstn                            NULL,
    ...,
    mobile                          NULL
}
```

```
ConnectionIdentifier ::= SEQUENCE
{
    channelTag                      INTEGER (0..4294967295), -- from H.226
    sequenceNumber                  INTEGER (0..4294967295), -- from H.226
    ...
}

-- =============================================================================
-- Logical channel bit-rate change definitions
-- =============================================================================

MaximumBitRate ::= INTEGER (0.. 4294967295) -- units of 100 bit/s

LogicalChannelRateRequest ::= SEQUENCE
{
    sequenceNumber                  SequenceNumber,
    logicalChannelNumber            LogicalChannelNumber,
    maximumBitRate                  MaximumBitRate,
    ...
}

LogicalChannelRateAcknowledge ::= SEQUENCE
{
    sequenceNumber                  SequenceNumber,
    logicalChannelNumber            LogicalChannelNumber,
    maximumBitRate                  MaximumBitRate,
    ...
}

LogicalChannelRateReject ::= SEQUENCE
{
    sequenceNumber                  SequenceNumber,
    logicalChannelNumber            LogicalChannelNumber,
    rejectReason                    LogicalChannelRateRejectReason,
    currentMaximumBitRate           MaximumBitRate OPTIONAL,
    ...
}

LogicalChannelRateRejectReason ::= CHOICE
{
    undefinedReason                 NULL,
    insufficientResources           NULL,
    ...
}

LogicalChannelRateRelease ::= SEQUENCE
{
    ...
}


-- =============================================================================
-- Command Message definitions
-- =============================================================================

-- =============================================================================
-- Command Message: Send Terminal Capability Set
-- =============================================================================

SendTerminalCapabilitySet ::= CHOICE
{
    specificRequest                 SEQUENCE
    {
        multiplexCapability         BOOLEAN,
          capabilityTableEntryNumbers  SET SIZE (1..65535) OF
                                       CapabilityTableEntryNumber OPTIONAL,

          capabilityDescriptorNumbers  SET SIZE (1..256) OF
                                       CapabilityDescriptorNumber OPTIONAL,
          ...
     },
     genericRequestNULL,
     ...
}

-- ===============================================================================
-- Command Message: Encryption
-- ===============================================================================

EncryptionCommand ::= CHOICE
{
     encryptionSE                      OCTET STRING,    -- per H.233, but no
                                                        -- error protection
     encryptionIVRequest               NULL,            -- requests new IV
     encryptionAlgorithmID             SEQUENCE
     {
          h233AlgorithmIdentifier      SequenceNumber,
          associatedAlgorithm          NonStandardParameter
     },
     ...
}

-- ===============================================================================
-- Command Message: Flow Control
-- ===============================================================================

FlowControlCommand ::= SEQUENCE
{
     scope                             CHOICE
     {
          logicalChannelNumber         LogicalChannelNumber,
          resourceID                   INTEGER (0..65535),
          wholeMultiplex               NULL
     },
     restriction                       CHOICE
     {
          maximumBitRate               INTEGER (0..16777215), -- units 100 bit/s
          noRestriction                NULL
     },
     ...
}

-- ===============================================================================
-- Command Message: Change or End Session
-- ===============================================================================

EndSessionCommand ::= CHOICE
{
     nonStandard                       NonStandardParameter,

     disconnect                        NULL,

     gstnOptions                       CHOICE
     {
          telephonyMode                NULL,
          v8bis                        NULL,
          v34DSVD                      NULL,
          v34DuplexFAX                 NULL,
          v34H324                      NULL,
          ...
     },

     ...,
     isdnOptions                       CHOICE
     {
          telephonyMode                NULL,
          v140                         NULL,
          terminalOnHold               NULL,
          ...
     },
          genericInformation           SEQUENCE OF GenericInformation
                                       -- generic information associated
                                       -- with the message
}

-- =============================================================================
-- Command Message: Conference Commands
-- =============================================================================

ConferenceCommand ::= CHOICE
{
     broadcastMyLogicalChannel         LogicalChannelNumber, -- similar to H.230 MCV
     cancelBroadcastMyLogicalChannel   LogicalChannelNumber, -- similar to
                                                             -- H.230 Cancel-MCV

     makeTerminalBroadcaster           TerminalLabel,    -- same as H.230 VCB
     cancelMakeTerminalBroadcaster     NULL,             -- same as H.230
                                                         -- Cancel-VCB

     sendThisSourceTerminalLabel,                        -- same as H.230 VCS
     cancelSendThisSource              NULL,             -- same as H.230
                                                         -- cancel VCS

     dropConferenceNULL,                                 -- same as H.230 CCK
     ...,
     substituteConferenceIDCommand     SubstituteConferenceIDCommand
}

SubstituteConferenceIDCommand ::= SEQUENCE
{
     conferenceIdentifier              OCTET STRING (SIZE(16)),
     ...
}

-- =============================================================================
-- Command Message: Miscellaneous H.230-like commands
-- =============================================================================

EncryptionUpdateDirection ::= CHOICE
{
     masterToSlave                     NULL,
     slaveToMaster                     NULL,
     ...
}

MiscellaneousCommand ::= SEQUENCE
{
     logicalChannelNumber              LogicalChannelNumber,
     type                              CHOICE
     {
```

```
equaliseDelay NULL,           -- same as H.230 ACE
zeroDelay NULL,               -- same as H.230 ACZ
multipointModeCommand         NULL,
cancelMultipointModeCommand   NULL,
videoFreezePicture            NULL,
videoFastUpdatePicture        NULL,

videoFastUpdateGOB            SEQUENCE
{
     firstGOB                 INTEGER (0..17),
     numberOfGOBs             INTEGER (1..18)
},

videoTemporalSpatialTradeOff  INTEGER (0..31), -- commands a trade-off value

videoSendSyncEveryGOB         NULL,
videoSendSyncEveryGOBCancel   NULL,

...,
videoFastUpdateMB             SEQUENCE
{
     firstGOB                 INTEGER (0..255) OPTIONAL,
     firstMB                  INTEGER (1..8192) OPTIONAL,
     numberOfMBs              INTEGER (1..8192),
     ...
},
maxH223MUXPDUsize             INTEGER(1..65535),    -- units octets
encryptionUpdate              EncryptionSync,
encryptionUpdateRequest       EncryptionUpdateRequest,
switchReceiveMediaOff         NULL,
switchReceiveMediaOn          NULL,

progressiveRefinementStart    SEQUENCE
{
     repeatCount              CHOICE
     {
          doOneProgression                          NULL,
          doContinuousProgressions                  NULL,
          doOneIndependentProgression               NULL,
          doContinuousIndependentProgressions       NULL,
          ...
     },
     ...
},
progressiveRefinementAbortOne                       NULL,
progressiveRefinementAbortContinuous                NULL,

videoBadMBs                   SEQUENCE
{
     firstMB                  INTEGER (1..9216),
     numberOfMBs              INTEGER (1..9216),
     temporalReference        INTEGER (0..1023),
     ...
},
lostPicture                   SEQUENCE OF PictureReference,
lostPartialPicture            SEQUENCE
{
     pictureReference         PictureReference,
     firstMB                  INTEGER (1..9216),
     numberOfMBs              INTEGER (1..9216),
     ...
},
recoveryReferencePicture      SEQUENCE OF PictureReference,
encryptionUpdateCommand       SEQUENCE   -- for ack'ed key update in H.235V3
```

```
          {
               encryptionSync          EncryptionSync,
               multiplePayloadStream   MultiplePayloadStream OPTIONAL,
               ...
          },
          encryptionUpdateAck          SEQUENCE
          {
               synchFlag               INTEGER (0..255),
               ...
          }
     },

     ...,
     direction                         EncryptionUpdateDirection OPTIONAL
}

KeyProtectionMethod ::= SEQUENCE -- specify how the new
                                                     -- key is to be protected
{
     secureChannel                     BOOLEAN,
     sharedSecret                      BOOLEAN,
     certProtectedKey                  BOOLEAN,
     ...
}

EncryptionUpdateRequest ::= SEQUENCE
{
     keyProtectionMethod               KeyProtectionMethod OPTIONAL,
     ...,
     synchFlag                         INTEGER (0..255) OPTIONAL
}

PictureReference ::= CHOICE
{
     pictureNumber                     INTEGER (0..1023),
     longTermPictureIndex              INTEGER (0..255),
     ...
}
-- =============================================================================
-- Command Message: H.223 Multiplex Reconfiguration
-- =============================================================================

H223MultiplexReconfiguration ::= CHOICE
{
     h223ModeChange                    CHOICE
     {
          toLevel0                     NULL,
          toLevel1                     NULL,
          toLevel2                     NULL,
          toLevel2withOptionalHeader   NULL,
          ...
     },

     h223AnnexADoubleFlag              CHOICE
     {
          start                        NULL,
          stop                         NULL,
          ...
     },

     ...
}
```

```
-- =============================================================================
-- Command Message: New ATM virtual channel command
-- =============================================================================

NewATMVCCommand ::= SEQUENCE
{
    resourceID                      INTEGER(0..65535),
    bitRate                         INTEGER(1..65535),      -- units 64 kbit/s
    bitRateLockedToPCRClock         BOOLEAN,
    bitRateLockedToNetworkClock     BOOLEAN,
    aal                             CHOICE
    {
        aal1                        SEQUENCE
        {
          clockRecovery             CHOICE
          {
            nullClockRecovery       NULL,
            srtsClockRecovery       NULL,
            adaptiveClockRecovery   NULL,
            ...
          },
          errorCorrection  CHOICE
          {
            nullErrorCorrection     NULL,
            longInterleaver         NULL,
            shortInterleaver        NULL,
            errorCorrectionOnly     NULL,
            ...
            },
            structuredDataTransfer  BOOLEAN,
            partiallyFilledCells    BOOLEAN,
            ...
        },
        aal5                        SEQUENCE
        {
            forwardMaximumSDUSize   INTEGER (0..65535),     -- units octets
            backwardMaximumSDUSize  INTEGER (0..65535),     -- units octets
            ...
        },
        ...
    },
    multiplex                       CHOICE
    {
        noMultiplex                 NULL,
        transportStream             NULL,
        programStream               NULL,
        ...
    },
    reverseParameters               SEQUENCE
    {
        bitRate                     INTEGER(1..65535),      -- units 64 kbit/s
        bitRateLockedToPCRClock     BOOLEAN,
        bitRateLockedToNetworkClock BOOLEAN,
        multiplex                   CHOICE
        {
            noMultiplex             NULL,
            transportStream         NULL,
            programStream           NULL,
            ...
        },
        ...
    },
    ...
}
```

```
-- ===========================================================================
-- Command Message: Mobile Multilink Reconfiguration command
-- ===========================================================================

MobileMultilinkReconfigurationCommand ::= SEQUENCE
{
    sampleSize                          INTEGER (1..255),
    samplesPerFrame                     INTEGER (1..255),
    status                              CHOICE
    {
        synchronized                    NULL,
        reconfiguration                 NULL,
        ...
    },
    ...
}
-- ===========================================================================
-- Indication Message definitions
-- ===========================================================================

-- ===========================================================================
-- Indication Message: Function not understood
-- ===========================================================================

-- This is used to return a request, response or command that is not understood

FunctionNotUnderstood ::= CHOICE
{
    request                             RequestMessage,
    response                            ResponseMessage,
    command                             CommandMessage
}

-- ===========================================================================
-- Indication Message: Function not Supported
-- ===========================================================================

-- This is used to return a complete request, response or command that is not
-- recognized

FunctionNotSupported ::= SEQUENCE
{
    cause                               CHOICE
    {
        syntaxError                     NULL,
        semanticError                   NULL,
        unknownFunction                 NULL,
        ...
    },
    returnedFunction                    OCTET STRING OPTIONAL,
    ...
}

-- ===========================================================================
-- Indication Message: Conference
-- ===========================================================================

ConferenceIndication ::= CHOICE
{
    sbeNumber                           INTEGER (0..9),-- same as H.230 SBE Number

    terminalNumberAssign                TerminalLabel,  -- same as H.230 TIA
    terminalJoinedConference          TerminalLabel,  -- same as H.230 TIN

    terminalLeftConference            TerminalLabel,  -- same as H.230 TID

    seenByAtLeastOneOther             NULL,      -- same as H.230 MIV
    cancelSeenByAtLeastOneOther       NULL,      -- same as H.230 cancel MIV

    seenByAll                         NULL,      -- like H.230 MIV
    cancelSeenByAll                   NULL,      -- like H.230 MIV

    terminalYouAreSeeing              TerminalLabel,  -- same as H.230 VIN

    requestForFloor                   NULL,      -- same as H.230 TIF

    ...,
    withdrawChairToken                NULL,      -- same as H.230 CCR MC-> chair
    floorRequested                    TerminalLabel,  -- same as H.230 TIF MC-> chair
    terminalYouAreSeeingInSubPictureNumber   TerminalYouAreSeeingInSubPictureNumber,
    videoIndicateCompose              VideoIndicateCompose,
    masterMCU NULL,                   -- same as H.230 MIM
    cancelMasterMCU                   NULL -- same as H.230 cancel MIM
}

TerminalYouAreSeeingInSubPictureNumber ::= SEQUENCE
{
    terminalNumber                    TerminalNumber,
    subPictureNumber                  INTEGER (0..255),
    ...,
    mcuNumber                         McuNumber
}

VideoIndicateCompose ::= SEQUENCE
{
    compositionNumber                 INTEGER (0..255),
    ...
}

-- =============================================================================
-- Indication Message: Miscellaneous H.230-like indication
-- =============================================================================

MiscellaneousIndication ::= SEQUENCE
{
    logicalChannelNumber              LogicalChannelNumber,
    type                              CHOICE
    {
        logicalChannelActive          NULL,      -- same as H.230 AIA and VIA
        logicalChannelInactive        NULL,      -- same as H.230 AIM and VIS

        multipointConference          NULL,
        cancelMultipointConference    NULL,

        multipointZeroComm            NULL,      -- same as H.230 MIZ
        cancelMultipointZeroComm      NULL,      -- same as H.230 cancel MIZ

        multipointSecondaryStatus     NULL,      -- same as H.230 MIS
        cancelMultipointSecondaryStatus NULL,    -- same as H.230 cancel MIS

        videoIndicateReadyToActivate NULL,      -- same as H.230 VIR

        videoTemporalSpatialTradeOff  INTEGER (0..31), -- indicates current
                                                       -- trade-off

        ...,
          videoNotDecodedMBs          SEQUENCE
          {
               firstMB                INTEGER (1..8192),
               numberOfMBs            INTEGER (1..8192),
               temporalReference      INTEGER (0..255),
               ...
          },
          transportCapability         TransportCapability
     },
     ...
}

-- =============================================================================
-- Indication Message: Jitter Indication
-- =============================================================================

JitterIndication ::= SEQUENCE
{
     scope                            CHOICE
     {
          logicalChannelNumber        LogicalChannelNumber,
          resourceID                  INTEGER (0..65535),
          wholeMultiplex              NULL
     },
     estimatedReceivedJitterMantissa  INTEGER (0..3),
     estimatedReceivedJitterExponent  INTEGER (0..7),
     skippedFrameCount                INTEGER (0..15) OPTIONAL,
     additionalDecoderBuffer          INTEGER (0..262143) OPTIONAL,
                                      -- 262143 is 2^18 - 1
     ...
}

-- =============================================================================
-- Indication Message: H.223 logical channel skew
-- =============================================================================

H223SkewIndication ::= SEQUENCE
{
     logicalChannelNumber1            LogicalChannelNumber,
     logicalChannelNumber2            LogicalChannelNumber,
     skew      INTEGER (0..4095),     -- units milliseconds
     ...
}

-- =============================================================================
-- Indication Message: H.225.0 maximum logical channel skew
-- =============================================================================

H2250MaximumSkewIndication ::= SEQUENCE
{
     logicalChannelNumber1            LogicalChannelNumber,
     logicalChannelNumber2            LogicalChannelNumber,
     maximumSkew                      INTEGER (0..4095), -- units milliseconds
     ...
}

-- =============================================================================
-- Indication Message: MC Location Indication
-- =============================================================================

MCLocationIndication ::= SEQUENCE
{
     signalAddress                    TransportAddress, -- this is the
                                                        -- H.323 Call Signalling
                                                        -- address of the entity
                                                        -- which contains the MC
     ...
}

-- ======================================================================
-- Indication Message: Vendor Identification
-- ======================================================================

     VendorIdentification ::= SEQUENCE
     {
          vendor                      NonStandardIdentifier,
          productNumber               OCTET STRING (SIZE(1..256)) OPTIONAL,
                                      -- per  vendor
          versionNumber               OCTET STRING (SIZE(1..256)) OPTIONAL,
                                      -- per productNumber
          ...
     }


-- ======================================================================
-- Indication Message: New ATM virtual channel indication
-- ======================================================================

NewATMVCIndication ::= SEQUENCE
{
     resourceID                       INTEGER(0..65535),
     bitRate                          INTEGER(1..65535),    -- units 64 kbit/s
     bitRateLockedToPCRClock          BOOLEAN,
     bitRateLockedToNetworkClock      BOOLEAN,
     aal                              CHOICE
     {
          aal1                        SEQUENCE
          {
            clockRecovery             CHOICE
            {
                nullClockRecovery     NULL,
                srtsClockRecovery     NULL,
                adaptiveClockRecovery NULL,
              ...
              },
              errorCorrection         CHOICE
              {
                nullErrorCorrection   NULL,
                longInterleaver       NULL,
                shortInterleaver      NULL,
                errorCorrectionOnly   NULL,
                    ...
              },
              structuredDataTransfer  BOOLEAN,
              partiallyFilledCells    BOOLEAN,
              ...
          },
          aal5                        SEQUENCE
          {
              forwardMaximumSDUSize   INTEGER (0..65535),   -- units octets
              backwardMaximumSDUSize  INTEGER (0..65535),   -- units octets
              ...
          },
          ...
     },
    multiplex CHOICE
    {
        noMultiplex                 NULL,
        transportStream             NULL,
        programStream               NULL,
        ...
    },
    ...,
    reverseParameters               SEQUENCE
    {
        bitRate                     INTEGER(1..65535),    -- units 64 kbit/s
        bitRateLockedToPCRClock     BOOLEAN,
        bitRateLockedToNetworkClock BOOLEAN,
        multiplex                   CHOICE
        {
            noMultiplex             NULL,
            transportStream         NULL,
            programStream           NULL,
            ...
        },
        ...
    }
}

-- ===============================================================================
-- Indication Message: User input
-- ===============================================================================

IV8 ::= OCTET STRING (SIZE(8))
                                    -- initial value for
                                    -- 64-bit block ciphers
IV16 ::= OCTET STRING (SIZE(16))
                                    -- initial value for
                                    -- 128-bit block ciphers

Params ::= SEQUENCE
{
    iv8                             IV8 OPTIONAL, -- 8-octet initialization vector
    iv16                            IV16 OPTIONAL, -- 16-octet initialization vector
    iv                              OCTET STRING OPTIONAL,-- arbitrary length
                                                  -- initialization vector
    ...
}

UserInputIndication ::= CHOICE
{
    nonStandard                     NonStandardParameter,
    alphanumeric                    GeneralString,
    ...,
    userInputSupportIndication      CHOICE
    {
        nonStandard                 NonStandardParameter,
        basicString                 NULL, -- indicates unsecured basic string
        iA5String                   NULL, -- indicates unsecured IA5 string
        generalString               NULL, -- indicates unsecured general string
        ...,
        encryptedBasicString        NULL, -- indicates encrypted Basic string
        encryptedIA5String          NULL, -- indicates encrypted IA5 string
        encryptedGeneralString      NULL -- indicates encrypted general string
    },
    signal                          SEQUENCE
    {
        signalType                  IA5String (SIZE (1) ^ FROM ("0123456789#*ABCD!")),
                                    -- holds dummy "!" if encryptedSignalType
                                    -- is being used
        duration                    INTEGER (1..65535) OPTIONAL,
                                    -- milliseconds
        rtp                         SEQUENCE
        {
          timestamp                 INTEGER (0..4294967295) OPTIONAL,
          expirationTime            INTEGER (0..4294967295) OPTIONAL,
          logicalChannelNumber      LogicalChannelNumber,
            ...
        } OPTIONAL,
        ...,
        rtpPayloadIndication        NULL OPTIONAL,
        paramS                      Params OPTIONAL, -- any "runtime" parameters
        encryptedSignalType         OCTET STRING (SIZE(1)) OPTIONAL,
                                    -- encrypted signalType
        algorithmOID                OBJECT IDENTIFIER OPTIONAL
    },
    signalUpdate                    SEQUENCE
    {
        duration                    INTEGER (1..65535), -- milliseconds
        rtp                         SEQUENCE
        {
            logicalChannelNumber    LogicalChannelNumber,
            ...
        } OPTIONAL,
        ...
    },
    extendedAlphanumeric            SEQUENCE
    {
        alphanumeric                GeneralString, -- holds empty string if
                                                   -- encryptedAlphanumeric is
                                                   -- being used
        rtpPayloadIndication        NULL OPTIONAL,
        ...,
        encryptedAlphanumeric       SEQUENCE
        {
            algorithmOID            OBJECT IDENTIFIER,
            paramS                  Params OPTIONAL, -- any "runtime" parameters
            encrypted               OCTET STRING, -- general string encrypted
        ...
        } OPTIONAL
    },
    encryptedAlphanumeric           SEQUENCE
    {
        algorithmOID                OBJECT IDENTIFIER,
        paramS                      Params OPTIONAL,-- any "runtime" parameters
        encrypted                   OCTET STRING,   -- basic string encrypted
        ...
    },      genericInformation      SEQUENCE OF GenericInformation
                                    -- generic information associated
                                    -- with the message
}

-- =============================================================================
-- Indication Message: Flow Control
-- =============================================================================

FlowControlIndication ::= SEQUENCE
{
    scope                           CHOICE
    {
          logicalChannelNumber         LogicalChannelNumber,
          resourceID                   INTEGER (0..65535),
          wholeMultiplex               NULL
     },
     restriction                       CHOICE
     {
          maximumBitRate               INTEGER (0..16777215), -- units 100 bit/s
          noRestriction                NULL
     },
     ...
}

-- =============================================================================
-- Indication Message: Mobile Multilink Reconfiguration indication
-- =============================================================================

MobileMultilinkReconfigurationIndication ::= SEQUENCE
{
     sampleSize                        INTEGER (1..255),
     samplesPerFrame                   INTEGER (1..255),
     ...
}

END
```

Annex B

Messages: Semantic definitions

(This annex forms an integral part of this Recommendation)

B.0 This annex provides semantic definitions and constraints on the syntax elements defined in the previous clause.

B.0.1 MultimediaSystemControlMessage: a choice of message types. Messages defined in this Recommendation are classified as request, response, command and indication messages.

B.0.2 RequestMessage: a request message results in an action by the remote terminal and requires an immediate response from it. The nonStandard message may be used to send non-standard requests.

B.0.3 ResponseMessage: a response message is the response to a request message. The nonStandard message may be used to send non-standard responses.

B.0.4 CommandMessage: a command message requires action but no explicit response. The nonStandard message may be used to send non-standard commands.

B.0.5 IndicationMessage: an indication contains information that does not require action or response. The nonStandard message may be used to send non-standard indications.

B.0.6 NonStandardParameter: this may be used to indicate a non-standard parameter. It consists of an identity and the actual parameters, which are coded as an octet string.

B.0.7 NonStandardIdentifier: used to identify the type of non-standard parameter. It is either an object identifier, or an H.221 type of identifier that is an octet string consisting of exactly four octets as follows. Country code consists of two octets, the first being according to Annex A/T.35. The second octet is assigned nationally, unless the first octet is 1111 1111, in which case the second octet shall contain the country code according to Annex B/T.35. The terminal manufacturer code consists of two octets assigned nationally. The manufacturer codes are the same as those assigned for use in ITU-T Rec. H.320 [22]. H.245 non-standard identifiers may be either "object" type or "h221NonStandard" type at the discretion of the manufacturer defining the non-standard message, as OBJECT IDENTIFIERs and h221NonStandard messages come from non-overlapping spaces and cannot be confused. However, since h221NonStandard messages are also used by ITU-T Rec. H.320, such messages come from the same space as H.320 messages, and shall have the same meaning.

B.1 Master-Slave Determination messages

This set of messages is used by a protocol to determine which terminal is the master terminal and which is the slave terminal.

B.1.1 Master-Slave Determination

This is sent from a MSDSE to a peer MSDSE.

terminalType is a number that identifies different types of terminal, such as, terminals, MCUs and gateways. The allocation of values to terminal types is outside the scope of this Recommendation.

statusDeterminationNumber is a random number in the range 0 ... $2^{24} - 1$.

B.1.2 Master-Slave Determination Acknowledge

This is used to confirm whether the terminal is the master terminal or the slave terminal, as indicated by decision. When decision is of type master, the terminal receiving this message is the master terminal and when decision is of type slave, it is the slave terminal.

B.1.3 Master-Slave Determination Reject

This is used to reject the MasterSlaveDetermination message. When the cause is of type identicalNumbers, the rejection was due to the random numbers being equivalent and the terminal types being the same.

B.1.4 Master-Slave Determination Release

This is sent in the case of a timeout.

B.2 Terminal capability messages

This set of messages is for the secure exchange of capabilities between the two terminals.

B.2.1 Overview

The transmitting terminal assigns each individual mode the terminal is capable of operating in a number in a capabilityTable. For example, G.723.1 audio, G.728 audio, and CIF H.263 video would each be assigned separate numbers.

These capability numbers are grouped into AlternativeCapabilitySet structures. Each AlternativeCapabilitySet indicates that the terminal is capable of operating in exactly one mode listed in the set. For example, an AlternativeCapabilitySet listing {G.711, G.723.1, G.728} means that the terminal can operate in any one of those audio modes, but not more than one.

These AlternativeCapabilitySet structures are grouped into simultaneousCapabilities structures. Each simultaneousCapabilities structure indicates a set of modes the terminal is capable of using simultaneously. For example, a simultaneousCapabilities structure containing the two AlternativeCapabilitySet structures {H.261, H.263} and {G.711, G.723.1, G.728} means that the terminal can operate either of the video codecs simultaneously with any one of the audio codecs. The simultaneousCapabilities set {{H.261}, {H.261, H.263}, {G.711, G.723.1, G.728} } means the terminal can operate two video channels and one audio channel simultaneously: one video channel per H.261, another video channel per either H.261 or H.263, and one audio channel per either G.711, G.723.1 or G.728.

NOTE – The actual capabilities stored in the capabilityTable are often more complex than presented here. For example, each H.263 capability indicates details including ability to support various picture formats at given minimum picture intervals, and ability to use optional coding modes.

The terminal's total capabilities are described by a set of CapabilityDescriptor structures, each of which is a single simultaneousCapabilities structure and a capabilityDescriptorNumber. By sending more than one CapabilityDescriptor, the terminal may signal dependencies between operating modes by describing different sets of modes which it can simultaneously use. For example, a terminal issuing two CapabilityDescriptor structures, one {{H.261, H.263}, {G.711, G.723.1, G.728}} as in the previous example, and the other {{H.262}, {G.711}}, means the terminal can also operate the H.262 video codec, but only with the low-complexity G.711 audio codec.

Terminals may dynamically add capabilities during a communication session by issuing additional CapabilityDescriptor structures, or remove capabilities by sending revised CapabilityDescriptor structures. All terminals shall transmit at least one CapabilityDescriptor structure.

B.2.2 Terminal Capability Set

This message contains information about the terminal's capability to transmit and receive. It also indicates the version of this Recommendation that is in use. It is sent from an outgoing CESE to a peer incoming CESE.

sequenceNumber is used to label instances of TerminalCapabilitySet so that the corresponding response can be identified.

protocolIdentifier is used to indicate the version of this Recommendation that is in use. Annex D lists the object identifiers defined for use by this Recommendation.

multiplexCapability indicates capabilities relating to multiplexing and network adaptation. A terminal shall include multiplexCapability in the first TerminalCapabilitySet sent.

V75Capability indicates the capabilities of the V.75 control entity. The audioHeader indicates the capability of the V.75 audio header.

B.2.2.1 Capability Table

A capability table is a numbered list of capabilities. A terminal shall be capable of everything that it lists in its capability table, but shall not necessarily be capable of simultaneously performing more than one of them.

A TerminalCapabilitySet may contain zero or more CapabilityTableEntrys. At the start, no table entries are defined. When a CapabilityTableEntry is received, it replaces the previously received CapabilityTableEntry with the same CapabilityTableEntryNumber. A CapabilityTableEntry without a Capability may be used to remove the previously received CapabilityTableEntry with the same CapabilityTableEntryNumber.

B.2.2.2 Capability Descriptors

CapabilityDescriptors are used to indicate a terminal's capability to transmit and receive. Each CapabilityDescriptor provides an independent statement about the terminal's capabilities.

capabilityDescriptorNumber is used to number CapabilityDescriptors. If a terminal has a preference for the mode it would like to transmit or receive, and wishes to express this when transmitting its capabilities, it may do so by giving CapabilityDescriptors that relate to its preferred mode or modes small values of capabilityDescriptorNumber.

simultaneousCapabilities is a set of AlternativeCapabilitySet. It is used to list the simultaneous capabilities of the terminal.

An AlternativeCapabilitySet is a sequence of CapabilityTableEntryNumbers. Only those CapabilityTableEntrys that have been defined shall be present in an AlternativeCapabilitySet, although it is possible to define CapabilityTableEntrys and refer to them in the same TerminalCapabilitySet. If a terminal has a preference for the mode it would like to transmit or receive, and wishes to express this when transmitting its capabilities, it may do so by listing elements in AlternativeCapabilitySets in order of decreasing preference.

A terminal shall be capable of simultaneously performing any one capability from each AlternativeCapabilitySet listed in simultaneousCapabilities.

At least one capability descriptor shall have the following structure: there shall be at least one AlternativeCapabilitySet containing only capabilities of a single medium type for each medium type that the terminal can support. This is to ensure that the remote terminal can select a mode of transmission that includes at least one instance of each medium type that the receiver can support.

NOTE 1 – A repetition of a capability in an AlternativeCapabilitySet is redundant and conveys no further information, while the repetition of a capability in different AlternativeCapabilitySets in the same CapabilityDescriptor indicates the possibility of an additional, simultaneous, instance of the particular capability.

NOTE 2 – Terminals that cannot vary the allocation of resources can indicate their capability completely by use of a single CapabilityDescriptor.

B.2.2.3 Capability

The choices receiveVideoCapability, receiveAudioCapability, receiveDataApplicationCapability, receiveUserInputCapability and receiveMultiplexedStreamCapability indicate the capability to receive according to the respective VideoCapability, AudioCapability, DataApplicationCapability, UserInputCapability and MultiplexedStreamCapability.

The choices transmitVideoCapability, transmitAudioCapability, transmitDataApplicationCapability, transmitUserInputCapability and transmitMultiplexedStreamCapability indicate the capability to transmit according to the respective VideoCapability, AudioCapability, DataApplicationCapability UserInputCapability and MultiplexedStreamCapability.

The choices receiveAndTransmitVideoCapability, receiveAndTransmitAudioCapability, receiveAndTransmitDataApplicationCapability, receiveAndTransmitUserInputCapability and receiveAndTransmitMultiplexedStreamCapability indicate the capability to receive and transmit symmetrically according to the respective VideoCapability, AudioCapability, DataApplicationCapability and UserInputCapability and MultiplexedStreamCapability. These code points may be useful for indicating that the receive and transmit capabilities are not independent.

For clarification by example, a terminal that declares {{Rx-G.723.1, Rx-G.729}, {Tx-G.723.1, Tx-G.729}} does not indicate a symmetric limitation and so is capable of receiving G.723.1 while transmitting G.729, while a terminal that declares {{RxAndTx-G.723.1, RxAndTx-G.729}} does indicate a symmetric limitation and so is not capable of receiving G.723.1 while transmitting G.729.

The boolean h233EncryptionTransmitCapability, when true, indicates that the terminal supports encryption according to ITU-T Recs H.233 [14] and H.234 [15].

h233IVResponseTime is measured in units of milliseconds, and indicates the minimum time the receiver requires the transmitter to wait after the completion of transmission of an IV message before starting to use the new IV. The means of transmitting the IV is not defined in this Recommendation.

ConferenceCapability indicates various conference capabilities.

multipointVisualizationCapability (similar to H.230 MVC) is included in the cap-set of an MCU or terminal to indicate that it shall properly generate or process conferenceResponse.broadcastMyLogicalChannel.grantedBroadcastMyLogicalChannel (similar to H.230 MVA) and conferenceResponse.broadcastMyLogicalChannel.deniedBroadcastMyLogicalChannel (similar to H.230 MVR) in response to conferenceRequest. BroadcastMyLogicalChannel (similar to H.230 MCV).

h235SecurityCapability indicates the capabilities that the terminal supports according to ITU-T Rec. H.235.0 [16]. The mediaCapability field shall refer to Capability Table Entries that do contain a transmit, receive, or receiveAndTransmit AudioCapability, VideoCapability, DataApplicationCapability, or similar capability indicated by a NonStandardParameter only. The genericH235SecurityCapability indicates the security capability within H.235.7 that the endpoint supports the indicated MIKEY protocol [79]. When MIKEY is executed at media level, then the genericParameters within genericH235securityCapability hold also the MIKEY messages.

EncryptionAuthenticationAndIntegrity indicates which encryption, authentication, and integrity capabilities are supported for the signalled mediaCapability. mediaCapability defines the supported audio, video, or data algorithms as well as the supported distribution methods (e.g., receive, transmit, or receive and transmit). The maxPendingReplacementFor parameter indicates the maximum number of open logical channel operations which are allowed to be in the REPLACEMENT PENDING state simultaneously. The REPLACEMENT PENDING state occurs when a logical channel has been established using the replacementFor parameter, but the replaced logical channel has not yet been closed.

genericControlCapability indicates generic control capabilities.

B.2.2.3.1 Example (Informative)

Suppose that an endpoint is able to support various audio codecs, alternative encodings of an audio channel such as DTMF and Voice Band Data (VBD), one or more encryption schemes, and RFC 2198 redundancy, but does not wish to support all possible combinations of these capabilities. In particular, it may well wish to support a multiple payload channel with any one of its supported audio codecs, DTMF, or VBD. It is able to encrypt any of the payloads under some algorithm (or set of algorithms), and it is able to transmit VBD with RFC 2198 redundancy.

It might then announce its capabilities in the following way.

First, the basic audio capabilities:

Capability 1 = g711Ulaw64k

Capability 2 = g729wAnnexB

Capability 3 = vbd

Capability 4 = audioTone

Here is an alternative capability for either G.711 or G.729B (but not both)

Capability 5 = oneOfCapabilities (1, 2)

Next, redundant-encoded VBD and 'reliable' DTMF transport:

Capability 6 = RedundancyEncodingCapability (primary = 3, secondary = 3)

Capability 7 = RedundancyEncodingCapability (primary = 4, secondary = 4, 4)

Then the multiple-payload stream, with redundancy for VBD:

Capability 8 = MultiplePayloadStreamCapability (5, 6, 7)

And, finally, the MPS with all payloads encrypted:

Capability 9 = H235SecurityCapability (8) [Encrypted MPS]

Now, an alternativeCapabilitySet might consist of caps (9, 8, 7, 2, 1), to be combined with alternative video caps and/or alternative data caps to form a multimedia CapabilityDescriptor.

B.2.2.4 Multiplex Capabilities

MultiplexCapability indicates capabilities relating to multiplexing and network adaptation. A terminal shall send MultiplexCapability in the first TerminalCapabilitySet sent. Unless stated otherwise, these are capabilities to receive.

H222Capability: indicates multiplexing and network adaptation capabilities that are specific to the multiplex defined in ITU-T Rec. H.222.1 [9].

numberOfVCs indicates how many simultaneous ATM Virtual Channels (VCs) can be supported by the terminal. This includes any VCs that transport H.245, T.120, DSM-CC or any other data, and all VCs that carry audiovisual information. It does not include the VC used for Q.2931 signalling [26].

vcCapability is a set, of size equal to the value of numberOfVCs, that indicates the capabilities present for each available VC.

The sequence aal1, when present, indicates the capability for ATM adaptation layer 1, and which of its options, as specified in ITU-T Rec. I.363 [25], are supported. The codepoints are defined in Table B.1.

Table B.1/H.245 – ATM Adaptation Layer 1 codepoints

ASN.1 codepoint	Semantic meaning of codepoint
nullClockRecovery	Null source clock frequency recovery method: synchronous circuit transport.
srtsClockRecovery	Synchronous residual timestamp source clock frequency recovery method.
adaptiveClockRecovery	Adaptive clock source clock frequency recovery method.
nullErrorCorrection	No error correction is supported.
longInterleaver	The forward error correction method for loss sensitive signal transport is supported.
shortInterleaver	The forward error correction method for delay sensitive signal transport is supported.
errorCorrectionOnly	The forward error correction method without cell interleaving is supported.
structuredDataTransfer	Structured data transfer is supported.
partiallyFilledCells	Partially filled cells is supported.

The sequence aal5, when present, indicates the capability for ATM adaptation layer 5, and which of its options, as specified in ITU-T Rec. I.363 [25], are supported. forwardMaximumSDUSize and backwardMaximumSDUSize indicate the maximum CPCS-SDU size in the forward and reverse directions, measured in octets. Either aal1 or aal5 or both shall be present.

The booleans transportStream and programStream, when equal to true, indicate the capability to support the Transport Stream and Program Stream multiplexes, respectively [8].

availableBitRates indicates the bit-rate capabilities for the VC. It is a sequence of different bit rates that can be supported, measured in units of 64 kbit/s. Bit rates are listed in decreasing order, that is, the highest bit rate supported is listed first. Supported bit rates can be listed as individual values using the field singleBitRate, or as a rangeOfBitRates between lowerBitRate and higherBitRate, indicating that all values between this lower limit and higher limit, including these limits, are supported. The bit rates indicated are measured at the AAL-SAP.

The sequence aal1ViaGateway, when present, indicates the capability of ATM adaptation layer 1 supported by AAL1/5 conversion gateways. The codepoints are the same as those of sequence aal1. The sequence Q2931Address indicates one or more sets of Q.2931 party number and party subaddress.

H223Capability: indicates capabilities specific to the H.223 multiplex [10].

The boolean transportWithI-frames, when true, indicates that the terminal is capable of sending and receiving control channel messages using LAPM I-frames as defined in ITU-T Rec. V.42 [38].

The booleans videoWithAL1, videoWithAL2, videoWithAL3, audioWithAL1, audioWithAL2, audioWithAL3, dataWithAL1, dataWithAL2 and dataWithAL3, when true, indicate the capability to receive the stated medium type (video, audio, or data) using the stated adaptation layer (AL1, AL2, or AL3).

The integers maximumAl2SDUSize and maximumAl3SDUSize indicate the maximum number of octets in each SDU that the terminal can receive when using adaptation layer types 2 and 3, respectively.

maximumDelayJitter indicates the maximum peak-to-peak multiplexing jitter that the transmitter shall cause. It is measured in milliseconds. Multiplexing jitter is defined as the difference in time of delivery of the first octet of an audio frame when delivered in the multiplexed stream and when it would be delivered at constant bit rate without a multiplex.

h223MultiplexTableCapability: indicates the terminals ability to receive and process multiplex table entries.

basic indicates that the multiplex can only receive basic MultiplexEntryDescriptors as defined in ITU-T Rec. H.223 [10].

enhanced indicates that the multiplex can receive enhanced MultiplexEntryDescriptors with the additional parameters defined below.

maximumNestingDepth depth indicates the maximum nesting depth of recursively invoked subElementList fields. MultiplexEntryDescriptors which do not use the subElementList field shall be considered to have a nesting depth of zero.

maximumElementListSize indicates the maximum number of fields in the ASN.1 SEQUENCE.

maximumSubElementListSize indicates the maximum number of subelements in the subElementList.

The boolean maxMUXPDUSizeCapability, when true, indicates that the transmitter is able to restrict the size of the H.223 MUX-PDUs that it transmits. It has no meaning when part of a receive capability.

The boolean nsrpSupport, when true, indicates support of the Annex A/H.324 NSRP mode.

MobileOperationTransmitCapability: indicates the capability to transmit the multiplex layers described in Annex A/H.223 and Annex B/H.223.

The boolean h223AnnexA, if true, indicates the terminal can transmit the MUX-PDUs as defined in Annex A/H.223.

The boolean h223AnnexADoubleFlag, if true, indicates the terminal can transmit the MUX-PDUs as defined in Annex A/H.223 with its optional double-flag mode.

The boolean h223AnnexB, if true, indicates the terminal can transmit the MUX-PDUs as defined in Annex B/H.223.

The boolean h223AnnexBwithOptionalHeaderField, if true, indicates the terminal can transmit the MUX-PDU as defined in Annex B/H.223 with its optional header field.

h223AnnexCCapability: indicates the capability to receive and process AL-PDUs as described in Annex C/H.223, with the following condition.

The booleans videoWithAL1M, videoWithAL2M, videoWithAL3M, audioWithAL1M, audioWithAL2M, audioWithAL3M, dataWithAL1M, dataWithAL2M and dataWithAL3M, when true, indicate the capability to receive the stated medium type (video, audio, or data) using the stated adaptation layer (AL1M, AL2M, or AL3M).

alpduInterleaving, if true, indicates the capability to receive and process AL-PDUs for which interleaving is applied.

The integer maximumAl1MPDUSize indicates the maximum number of octets in each PDU that the terminal can receive when using adaptation layer AL1M.

The integers maximumAl2MSDUSize and maximumAL3MSDUSize indicate the maximum number of octets in each SDU that the terminal can receive when using adaptation layer AL2M and AL3M, respectively.

rsCodeCapability, if true, indicates the capability to receive the AL-PDUs for which Reed-Solomon coding is indicated.

bitRate, if present, indicates the bit rate to transmit the bitstream output from the H.223 multiplexer.

mobileMultilinkFrameCapability, if present, indicates the capability to receive and process mobile multilink frames with the specified maximumSampleSize and maximumPayloadLength. maximumSampleSize indicates the maximum number of octets in each sample that the terminal can process. maximumPayloadLength indicates the maximum length of frames in octets that the terminal can process.

V76Capability: indicates capabilities specific to the V.76 multiplex.

The suspendResumeCapabilitywAddress indicates the capability of supporting V.76 suspend/resume with an address field. The suspendResumeCapabilitywoAddress indicates the capability of supporting V.76 suspend/resume without an address field.

rejCapability indicates the capability of the V.76 multiplex error control function to perform reject.

sREJCapability indicates the capability of the multiplex error control function to perform selective reject.

mREJCapability indicates the capability of the multiplex error control function to perform multiple selective reject.

crc8bitCapability is the capability of the multiplex to use 8-bit CRC.

crc16bitCapability is the capability of the multiplex to use 16-bit CRC.

crc32bitCapability is the capability of the multiplex to use 32-bit CRC.

uihCapability indicates support of V.76 UIH frames.

numOfDLCS indicates the number of DLCs which the V.76 multiplex can support.

twoOctetAddressFieldCapability indicates the ability of the V.76 multiplex to support an address field of two octets.

loopBackTestCapability indicates the support of loop back per ITU-T Rec. V.76. n401Capability indicates the maximum value of N401 described in ITU-T Rec. V.76. maxWindowSizeCapability indicates the maximum window size the V.76 multiplex can support.

H2250Capability: indicates capabilities specific to the H.225.0 media packetization layer.

maximumAudioDelayJitter indicates the maximum peak-to-peak delivery of audio packets to the transport layer that the transmitter shall cause. It is measured in milliseconds.

receiveMultipointCapability indicates the receive capabilities of a terminal in a multipoint conference.

transmitMultipointCapability indicates the transmit capabilities of a terminal in a multipoint conference.

receiveAndTransmitMultipointCapability indicates the receive and transmit capabilities of a terminal in a multipoint conference.

mcCapability indicates the ability of a terminal to act as an MC in a centralized or distributed conference.

rtcpVideoControlCapability indicates a terminal's ability to process both RTCP Full Intra Request (FIR) and Negative Acknowledgement (NACK) messages.

MediaPacketizationCapability indicates which optional media packetization scheme are supported by the endpoint.

h261aVideoPacketization indicates that the H.261 alternative RTP payload format described in ITU-T Rec. H.225.0 is in use.

rtpPayloadType indicates the RTP payload packetization schemes supported by the endpoint as follows.

payloadDescriptor identifies the semantics associated with the payloadType: if the rfc-number is chosen, it indicates the official document of the IETF in which the payload format is defined; obsolete RFCs should not be referenced here. If the oid component is chosen, this identifies a payload format specified as part of a Recommendation defined by the ITU or an International Standard defined by the ISO and registered in the respective document under this Object Identifier. This applies equally well to both capability exchange and opening logical channels. The payloadDescriptor shall be filled out as follows:

1) If ITU-T Rec. H.225.0 specifies an OID or RFC to be used for the codec, ITU-T H.225.0 shall be followed.
2) Otherwise, if an OID for the codec is described in the ITU-T codec Recommendation, that OID shall be used.
3) Otherwise, if the codec is defined by an ITU-T Recommendation (without an explicit OID), the oid component shall be used, and shall be that of the ITU-T Recommendation number as follows: `{itu-t(0) recommendation(0)` `<`*`letter`*`>(<`*`number`*`>) <`*`number`*`>}`. For example, ITU-T Rec. G.711 would use the OID {itu-t(0) recommendation(0) g(7) 711}.
4) Otherwise, if an RFC defining the codec packetization exists, the rfc-number component shall be used.
5) Otherwise, the nonStandardIdentifier component shall be used.

Further identification of the payload type (optional modes, versions, bit rates, etc., if any) shall be found in the DataType structures of OpenLogicalChannel. H.245 decoders shall recognize the above given OID(s) in addition to any defined rfc-number for the codec.

payloadType may be included to indicate which payload type is associated with this format. If used in capability exchange, the payloadType shall be set to a statically assigned payload type if and only if one exists for this payload format. Otherwise, the payloadType shall be omitted. If used in conjunction with OpenLogicalChannel, the payloadType shall indicate the RTP payload type value to be used (either static or dynamic), regardless of any statically assigned payload type. Note that if the payload type value is in the range 96..127, the identical value shall also be placed in h2250LogicalChannelParameters.dynamicRTPPayloadType.

TransportCapability indicates optional transport capabilities such as quality of service and median channel type capabilities.

redundancyEncodingCapability indicates which redundancy encoding modes are supported (if any). For each capability entry, the redundancyEncodingMethod specifies the type of encoding to be used: the primary encoding, and which secondary encodings are supported for this primary encoding. The choice of encoding schemes depends on the mode selected. rtpAudioRedundancyEncoding refers to the audio redundancy encoding; if this mode is the selected redundancyEncodingMethod, only CapabilityEntryNumbers referring to audio encodings are valid. rtpH263VideoRedundancyEncoding indicates that video redundancy coding according to H.263 + Annex N is possible or that a logical channel shall be opened using video redundancy coding. Additional parameters are provided as follows:

numberOfThreads indicates the maximum number of the threads the sender/receiver is able to support when used during capability exchange; it contains the actual number of threads for a specific stream when opening a logical channel.

framesBetweenSyncPoints defines the maximum number of video frames that may be transmitted (summed across all threads) between two synchronization points of all threads during capability exchange; defines the actual number of frames for a specific stream for OpenLogicalChannel.

frameToThreadMapping defines which modes are supported by a sender/receiver during capability exchange and which mode is to be used when opening a logical channel: "round-robin" indicates that frames are assigned in a round-robin fashion to the threads, with the first frame after a synchronization point being assigned to thread 0, the second to thread 1, and so forth. The "custom" format allows to specify arbitrary mappings of frames to threads; during caps exchange, support for custom format is indicated by choosing this component and encoding an arbitrary (possibly empty) SEQUENCE. Support for custom formats implies support for round-robin mappings.

containedThreads applies only to commands that open logical channels: this parameter then indicates which of the threads are transmitted in logical channel to be opened. A logical channel may contain any number of 1 through 15 threads; however, two logical channels shall not specify to contain the same thread.

In case of rtpH263VideoRedundancyEncoding, the secondaryEncoding parameter shall not be present; this also applies to the H2250ModeParameters and the RedundancyEncoding ASN.1 structures of ITU-T Rec. H.245.

When a logical channel for video redundancy coding is opened, the logical channel containing thread 0 shall be opened first, and this logical channel shall be referenced by all other logical channels by means of the forwardLogicalChannelDependency parameter in the OpenLogicalChannel command.

LogicalChannelSwitchingCapability indicates the ability of a receiver to switch which stream (e.g., which logical channel) is being rendered based on the switchReceiveMedia on and off commands.

t120DynamicPortCapability indicates that the endpoint can place a T.120 [32] call to a dynamic transport address instead of the standard well known port address as defined in ITU-T Rec. T.123 [33].

MultipointCapability: indicates a terminal's capabilities specific to multipoint.

multicastCapability indicates the ability of a terminal to multicast audio or video traffic.

multiUniCastConference indicates the ability of a terminal to participate in a multiUniCast conference.

MediaDistributionCapability: indicates a terminal's capabilities for transmission and reception of media in a multipoint conference. Centralized Control and Audio shall be TRUE for H.323 terminals. If Video is supported, the Centralized Video shall be set TRUE. If T.120 is supported, the Centralized Data T.120 Data Application Capability shall be present.

Centralized and distributed control, audio, and video, indicate the ability of a terminal to participate in a conference with those media distribution types. Centralized and distributed data indicate the ability of a terminal to participate in conference with those media distribution types for the specific Data Application Protocol. MediaDistributionCapability is a sequence to allow for the definition of simultaneous capabilities (e.g., centralized audio with distributed video or centralized video with distributed audio, or specific data capabilities per a Data Application Protocol).

QOSCapabilities indicates quality of service capabilities such as RSVPParameters and ATMParameters parameters.

mediaChannelCapabilities indicate what transports the media channel may be carried on. IP-UDP indicates that the endpoint supports transporting the media channel over an IP network layer and a UDP transport layer. IP-TCP indicates that the endpoint supports transporting the media channel over an IP network layer and a TCP transport layer. atm-AAL5-UNIDIR indicates that the endpoint support transporting the media channel over an ATM AAL5 unidirectional virtual circuit. atm-AAL5-BIDIR indicates that the endpoint support transporting the media channel over an ATM AAL5 bidirectional virtual circuit.

RSVPParameters indicate specific parameter information about the RSVP protocol.

ATMParameters indicate specific parameter information about an ATM virtual circuit.

QosMode indicates whether the mode is a guaranteed quality of service or controlled load mode where no upper bound on end-to-end delay is enforced.

ServicePriority describes the service priority that is to be provided to the stream. It may be signalled or configured. If signalled, then the servicePriorityValue contains the requested priority. This parameter is further defined in 6.1/H.361 (Service priority).

AuthorizationParameters describes the parameters that can be used to authorize the QoS request. This parameter is further defined in 6.4/H.361 (Authorization parameters).

QOSDescriptor describes the QoS required for the stream. It consists of 2 parts. The QoSType describes the strength of the request. The strength can be either desired or mandatory. The QoS Class indicates the delay, loss and jitter that are required. It is described as a class defined in ITU-T Rec. Y.1541.

GenericTransportParameters describes the traffic characteristics for the purpose of QoS.

genericMultiplexCapability: indicates generic multiplex capabilities.

B.2.2.5 Video capabilities

This indicates video capabilities. The indication of more than a single capability within a single VideoCapability does not indicate simultaneous processing capability. Simultaneous processing capability can be indicated by instances of VideoCapability in different AlternativeCapabilitySets in a single CapabilityDescriptor.

ExtendedVideoCapability: indicates video capabilities with a sequence of associated GenericCapability structures.

videoCapability indicates a sequence of alternative video capabilities; any one of the VideoCapability capabilities may be used with the indicated videoCapabilityExtension.

videoCapabilityExtension, if present, indicates a sequence of GenericCapability structures associated with the videoCapability.

The sequence of VideoCapability structures shall not contain an ExtendedVideoCapability.

When used in an OpenLogicalChannel message, ExtendedVideoCapability.videoCapability shall contain exactly one VideoCapability.

H261VideoCapability: indicates H.261 [18] capabilities.

If present, qcifMPI indicates the minimum picture interval in units of 1/29.97 for the encoding and/or decoding of QCIF pictures, and if not present, no capability for QCIF pictures is indicated.

If present, cifMPI indicates the minimum picture interval in units of 1/29.97 for the encoding and/or decoding of CIF pictures, and if not present, no capability for CIF pictures is indicated.

The boolean temporalSpatialTradeOffCapability, when true, indicates that the encoder is able to vary its trade-off between temporal and spatial resolution as commanded by the remote terminal. It has no meaning when part of a receive capability.

maxBitRate indicates the maximum bit rate in units of 100 bit/s at which a transmitter can transmit video or a receiver can receive video.

stillImageTransmission indicates the capability for still images as specified in Annex D/H.261.

videoBadMBsCap, when true, indicates the capability of an encoder to receive or a decoder to transmit the videoBadMBs command. When part of a transmit capability, it indicates the ability of the encoder to process videoBadMBs commands and to take appropriate corrective action toward recovery of video quality. When part of a receive capability, it indicates the ability of the decoder to send appropriate videoBadMBs indications.

H262VideoCapability: indicates H.262 [19] capabilities.

The list of booleans indicate the capability of processing the particular profiles and levels: a value of true indicates that such operation is possible, while a value of false indicates that such operation is not possible. An encoder shall produce bit streams compliant to the specifications of a profile and level for which it has indicated capability, but also within the limitations imposed by the optional fields (see below). A decoder shall be able to accept all bit streams conforming to a profile and level for which it has indicated capability, provided it is within the limitations indicated by the optional fields. The optional fields are integers with units defined in Table B.2.

videoBadMBsCap is used in H262VideoCapability in the same manner as it is used in H261VideoCapability.

Table B.2/H.245 – Units for H.262 codepoints

ASN.1 codepoint	Units for referenced parameter
videoBitRate	400 bit/s
vbvBufferSize	16 384 bits
samplesPerLine	samples per line
linesPerFrame	lines per frame
framesPerSecond	The index, frame_rate_code, into Table 6-4/H.262
luminanceSampleRate	samples per second

H263VideoCapability: indicates H.263 [20] capabilities.

If present, sqcifMPI indicates the minimum picture interval in units of 1/29.97 for the encoding and/or decoding of SQCIF pictures, and if not present, no capability for SQCIF pictures is indicated.

If present, qcifMPI indicates the minimum picture interval in units of 1/29.97 for the encoding and/or decoding of QCIF pictures, and if not present, no capability for QCIF pictures is indicated.

If present, cifMPI indicates the minimum picture interval in units of 1/29.97 for the encoding and/or decoding of CIF pictures, and if not present, no capability for CIF pictures is indicated.

If present, cif4MPI indicates the minimum picture interval in units of 1/29.97 for the encoding and/or decoding of 4CIF pictures, and if not present, no capability for 4CIF pictures is indicated.

If present, cif16MPI indicates the minimum picture interval in units of 1/29.97 for the encoding and/or decoding of 16CIF pictures, and if not present, no capability for 16CIF pictures is indicated.

maxBitRate indicates the maximum bit rate in units of 100 bit/s at which a transmitter can transmit video or a receiver can receive video.

The booleans unrestrictedVector (Annex D/H.263), arithmeticCoding (Annex E/H.263), advancedPrediction (Annex F/H.263), and pbFrames (Annex G/H.263), when true, indicate the capability to transmit and/or receive these optional modes defined in the annexes of ITU-T Rec. H.263.

The boolean temporalSpatialTradeOffCapability, when true, indicates that the encoder is able to vary its trade-off between temporal and spatial resolution as commanded by the remote terminal. It has no meaning when part of a receive capability.

The integer hrd-B, when present, indicates the HRD parameter B in Annex B/H.263, and is measured in units of 128 bits. When not present, the default value defined in Annex B/H.263 applies. It is a receiver capability and has no meaning in transmission capability sets.

The integer bppMaxKb, when present, indicates the maximum number of bits for one coded picture that the receiver can receive and decode correctly, and is measured in units of 1024 bits. When not present, the default value defined in H.263 applies. It is a receiver capability and has no meaning in transmission capability sets.

The following capabilities are intended for use in certain very low frame rate applications such as surveillance applications:

If present, slowSqcifMPI indicates the minimum picture interval in units of seconds per frame for the encoding and/or decoding of SQCIF pictures. If not present and sqcifMPI is not present, no capability for SQCIF pictures is indicated. If sqcifMPI is present, slowSqcifMPI shall not be present.

If present, slowQcifMPI indicates the minimum picture interval in units of seconds per frame for the encoding and/or decoding of QCIF pictures. If not present and qcifMPI is not present, no capability for QCIF pictures is indicated. If qcifMPI is present, slowQcifMPI shall not be present.

If present, slowCifMPI indicates the minimum picture interval in units of seconds per frame for the encoding and/or decoding of CIF pictures. If not present and cifMPI is not present, no capability for CIF pictures is indicated. If cifMPI is present, slowCifMPI shall not be present.

If present, slowCif4MPI indicates the minimum picture interval in units of seconds per frame for the encoding and/or decoding of 4CIF pictures. If not present and cif4MPI is not present, no capability for 4CIF pictures is indicated. If cif4MPI is present, slowCif4MPI shall not be present.

If present, slowCif16MPI indicates the minimum picture interval in units of seconds per frame for the encoding and/or decoding of 16CIF pictures. If not present and cif16MPI is not present, no capability for 16CIF pictures is indicated. If cif16MPI is present, slowCif16MPI shall not be present.

The values of MPI are applicable when all of the optional modes, for which capability is indicated, are being used, as well as when any combination of them is used. A terminal may signal the capability for a smaller MPI when some options are not used by transmitting another VideoCapability including this smaller MPI and indicating the reduced set of options.

The boolean errorCompensation, when true, indicates the capability to transmit and/or receive feedback information for error compensation as illustrated in Appendix I/H.263. When part of a transmit capability, it indicates the ability of the encoder to process videoNotDecodedMBs indications and compensate errors. When part of a receive capability, it indicates the ability of the decoder to identify erroneous MBs, treat them as not coded, and send appropriate videoNotDecodedMBs indications.

If present, enhancementLayerInfo indicates the capability of the encoder to transmit, or the decoder to receive, bitstreams with the optional scalability mode (Annex O/H.263). enhancementLayerInfo is a sequence which indicates the configuration parameters of the scalability mode.

If present, H263Options indicates the capability for optional modes of ITU-T Rec. H.263.

EnhancementLayerInfo: indicates capability for the Scalability Mode of ITU-T Rec. H.263.

baseBitRateConstrained indicates whether the base layer is constrained not to exceed the maximum bit rate in the video capability minus the sum of the maximum bit rate in each of the enhancement options.

When present, snrEnhancement indicates the presence of an snr enhancement layer capability. The set size indicates the number of snrEnhancement layers the terminal is capable of supporting within a single logical channel.

When present, spatialEnhancement indicates the presence of a spatial enhancement layer capability. An enhancement layer bit stream contains a picture size which is either twice the width, or twice the height, or both, of the picture size in the layer which it references. For a terminal to be capable of spatial enhancement in one-dimension (width or height), a terminal must also indicate the capability to support the associated custom picture format required in the enhancement layer. The set size indicates the number of spatialEnhancement layers the terminal is capable of supporting within a single logical channel.

When present, bPictureEnhancement indicates the presence of a B pictures enhancement layer capability. The set size indicates the number of bPictureEnhancement layers the terminal is capable of supporting within a single logical channel.

EnhancementOptions inside the bPictureEnhancement sequence indicates which additional options an encoder may transmit or a decoder can receive in the B pictures.

numberOfBPictures indicates the maximum number of B pictures the terminal is capable of supporting between successive pairs of anchor reference pictures used in the prediction of the B pictures. For example, if equal to 2, then two B pictures can be sent between each pair of P pictures or other anchor pictures.

EnhancementOptions: indicates scalability enhancement layer capabilities.

The parameters in EnhancementOptions have the same semantic definitions as the parameters of the same name in H263VideoCapability.

H263Options: indicates capability of additional optional modes of ITU-T Rec. H.263.

advancedIntraCodingMode, when true, indicates the capability to transmit or receive the Advanced INTRA Coding Mode of Annex I/H.263.

deblockingFilterMode, when true, indicates the capability to transmit or receive the Deblocking Filter Mode of Annex J/H.263.

improvedPBFramesMode, when true, indicates the capability to transmit or receive the Improved PB frames Mode of Annex M/H.263.

unlimitedMotionVectors, when true, indicates the capability of the encoder or decoder to support unlimited motion vector range when Unrestricted Motion Vector Mode (Annex D/H.263) is also indicated. unlimitedMotionVectors shall be FALSE if unrestrictedVector is FALSE in the same H263VideoCapability or H263VideoMode.

fullPictureFreeze, when true, indicates the capability of the encoder to send or the decoder to receive Full Picture Freeze commands as described in Annex L/H.263.

partialPictureFreezeAndRelease, when true, indicates the capability of the encoder to send or the decoder to receive Full Picture Freeze and Release commands as described in Annex L/H.263.

resizingPartPicFreezeAndRelease, when true, indicates the capability of the encoder to send or the decoder to receive the Resizing Partial Picture Freeze and Release commands as described in Annex L/H.263.

fullPictureSnapshot, when true, indicates the capability of the encoder to send or the decoder to receive Full Picture snapshots of the video content as described in Annex L/H.263.

partialPictureSnapshot, when true, indicates the capability of the encoder to send or the decoder to receive Partial Picture Snapshots of the video content as described in Annex L/H.263.

videoSegmentTagging, when true, indicates the capability of the encoder to send or the decoder to receive Video Segment tagging for the video content as described in Annex L/H.263.

progressiveRefinement, when true, indicates the capability of the encoder to send or the decoder to receive Progressive Refinement tagging as described in Annex L/H.263. In addition, when true, the encoder shall respond to the progressive refinement miscellaneous commands doOneProgression, doContinuousProgressions, doOneIndependentProgression, doContinuousIndependentProgressions, progressiveRefinementAbortOne, and progressiveRefinementAbortContinuous. In addition, the encoder shall insert the Progressive Refinement Segment Start Tags and the Progressive Refinement Segment End Tags as defined in the Supplemental Enhancement Information Specification of Annex L/H.263.

NOTE – Progressive Refinement tagging can be sent by an encoder and received by a decoder even when not commanded in a miscellaneous command.

dynamicPictureResizingByFour, when true, indicates the capability of an encoder or decoder to support the picture resizing-by-four (with clipping) submode of the implicit Reference Picture Resampling Mode of Annex P/H.263.

dynamicPictureResizingSixteenthPel, when true, indicates the capability of an encoder or decoder to support resizing a reference picture to any width and height using the implicit Reference Picture Resampling mode of Annex P/H.263 (with clipping).

dynamicWarpingHalfPel, when true, indicates the capability of an encoder or decoder to support the arbitrary picture warping operation within the Reference Picture Resampling mode of Annex P/H.263 (with any fill mode) using half-pixel accuracy warping.

dynamicWarpingSixteenthPel, when true, indicates the capability of an encoder or decoder to support the arbitrary picture warping operation within the Reference Picture Resampling mode of Annex P/H.263 (with any fill mode) using either half-pixel or sixteenth pixel accuracy warping.

If DynamicPictureResizingSixteenthPel is true then DynamicPictureResizingByFour shall be true. If DynamicWarpingSixteenthPel is true, then DynamicWarpingHalfPel, DynamicPictureResizingByFour, and DynamicPictureResizingSixteenthPel shall be true.

The declaration of the capability dynamicPictureResizingByFour with a given picture size, referred to here as the native picture size, implies the support for up to two other picture sizes, referred to here as derived picture sizes. Defining the native picture size as having picture width W, and picture height H, the supported derived picture sizes shall have picture width W/2 and picture height H/2, and picture width W/4 and picture height H/4, subject to the following constraint: each derived picture size shall be supported provided its picture width is not less than 128 and its picture height is not less than 96 (128 and 96 being the picture width and height of the SQCIF format). The derived picture sizes shall be supported with the same optional modes, MPI (Minimum Picture Interval) and clock frequency as supported with the native picture size.

independentSegmentDecoding, when true, indicates the capability of an encoder or decoder to support the Independent Segment Decoding Mode of Annex R/H.263.

slicesInOrder-NonRect, when true, indicates the capability of an encoder or decoder to support the submode of Slice Structured Mode (Annex K/H.263) where slices are transmitted in order and contain macroblocks in scanning order of the picture.

slicesInOrder-Rect, when true, indicates the capability of an encoder or decoder to support the submode of Slice Structured Mode (Annex K/H.263) where slices are transmitted in order and the slice occupies a rectangular region of the picture.

slicesNoOrder-NonRect, when true, indicates the capability of an encoder or decoder to support the submode of Slice Structured Mode (Annex K/H.263) where slices contain macroblocks in scanning order of the picture and need not be transmitted in order.

slicesNoOrder-Rect, when true, indicates the capability of an encoder or decoder to support the submode of Slice Structured Mode (Annex K/H.263) where slices occupy a rectangular region of the picture and need not be transmitted in order.

alternateInterVLCMode, when true, indicates the capability of an encoder or decoder to support Alternate Inter VLC Mode of Annex S/H.263.

modifiedQuantizationMode, when true, indicates the capability of an encoder or decoder to support the Modified Quantization Mode of Annex T/H.263.

reducedResolutionUpdate, when true, indicates the capability of an encoder or decoder to support the Reduced Resolution Update mode defined in Annex Q/H.263.

videoBadMBsCap is used in H263VideoCapability in the same manner as it is used in H261VideoCapability.

dataPartitionedSlices, when true, indicates the capability of an encoder or decoder to support the Data Partitioned Slice mode defined in Annex V/H.263. dataPartitionedSlices shall be false if slicesInOrder-NonRect and slicesInOrder-Rect and slicesNoOrder-NonRect and slicesNoOrder-Rect are all false in the same H263Options message.

fixedPointIDCT0, when true, indicates the capability of an encoder or decoder to support Reference IDCT 0 defined in Annex W/H.263.

interlacedFields, when true, indicates the capability of an encoder or decoder to support interlaced field coding as defined in Annex W/H.263.

currentPictureHeaderRepetition, when true, indicates the capability of an encoder or decoder to support repetition of the current picture header as defined in Annex W/H.263.

previousPictureHeaderRepetition, when true, indicates the capability of an encoder or decoder to support repetition of the previous picture header as defined in Annex W/H.263.

nextPictureHeaderRepetition, when true, indicates the capability of an encoder or decoder to support repetition of the next picture header (with or without a reliable temporal reference indication) as defined in Annex W/H.263.

currentPictureHeaderRepetition, previousPictureHeaderRepetition, and nextPictureHeaderRepetition, when true and when part of receiver capabilities, indicate that a decoder can recover from a picture header corruption or loss by replacing the corrupted or lost picture header with a picture header transmitted according to Annex W/H.263.

pictureNumber, when true, indicates the capability of an encoder to transmit picture numbers according to Annex W/H.263 or the capability of a decoder to detect reference picture losses from transmitted picture numbers.

spareReferencePictures, when true, indicates the capability of an encoder to support generation of spare reference picture indications as defined in Annex W/H.263 or the capability of a decoder to use a spare reference picture if it lacks the actual reference picture.

TransparencyParameters: indicate parameters specifying a transparent video layer.

presentationOrder indicates the layering of transparent video layers. During capability exchange, the value of presentationOrder shall take one of the values 0, 1 and 2: if 0, it indicates that the Reference Picture Background (RPB) type of transparency support as defined in Annex L/H.263 is supported; if 1, it indicates that an externally controlled background picture can be used; and if 2, it indicates that the bitstream can specify use of either the Reference Picture Background transparency or an externally-controlled background picture type of transparency. During logical open channel, the INTEGER value specifies the presentation order. A layer with a higher presentation order shall be layered on top of a layer with a lower presentation order. The presentationOrder can be viewed as an axis perpendicular to the screen with direction of increasing parameter towards the viewer.

offset-x and offset-y indicate the pixel offset, in 1/8 pixels, of the signalled transparent layer to base layer, in units relative to the base layer. When used in a capability, these denote the capability to offset the location of the transparent video layer, and shall have values restricted to 1, 2, 4, or 8, in 1/8 pel units: for example, if the value is 4, the capability to offset the transparent layer in 1/2 pixel increments is indicated.

scale-x and scale-y indicate a scaling factor to be applied in the corresponding x and y coordinates to the signalled transparent layer before video layering, in units relative to the base layer. In a capability message, they indicate the maximum scale factor that can be applied: 1 indicates rescaling is not supported, 2 indicates it can double the size of the layer or keep it unscaled, 3 indicates it can double it, triple it or keep it unscaled, etc.

The boolean **separateVideoBackChannel** indicates, when true, that the terminal can support the Separate Logical Channel mode: no other video capability shall be indicated in the same H263VideoCapability: no MPI values shall be present, and all other mode flags and contents have no meaning and shall be false or absent. When sent in a mode request message, separateVideoBackChannel = true, shall be sent as the only video capability in that H263VideoMode, and indicates that the receiver wants to receive a channel containing only H.263 back-channel data. If present in the OpenLogicalChannel message, it indicates that the logical channel is for video back channel messages only and no other H.263 video bitstream shall be delivered by that logical channel.

refPictureSelection: indicates the capability of Reference Picture Selection mode (Annex N/H.263) and optionally the capability of the Enhanced Reference Picture Selection mode (Annex U/H.263).

If present, additionalPictureMemory indicates the presence of the extra amount of memory, in addition to the amount which can be used by the normal decoder which does not support reference picture selection mode. If not present, it indicates that no information regarding the additional amount of memory which the decoder can use is available for an encoder at the other terminal. If it is indicated in H263VideoMode, it indicates the presence of the additional amount of picture memory used for decoding.

sqcifAdditionalPictureMemory indicates that the encoder can send or the decoder can receive an H.263 bitstream which requires the decoder to have the additional memory to store the indicated number of pictures of size SQCIF, or of a smaller size in both horizontal and vertical dimension if custom picture format support for such pictures is indicated in customPictureFormat.

qcifAdditionalPictureMemory indicates that the encoder can send or the decoder can receive an H.263 bitstream which requires the decoder to have the additional memory to store the indicated number of pictures of size QCIF, or of a smaller size in both horizontal and vertical dimension if custom picture format support for such pictures is indicated in customPictureFormat. The number of picture memories indicated in qcifAdditionalPictureMemory shall not be larger than the number of pictures indicated in sqcifAdditionalPictureMemory (if present).

cifAdditionalPictureMemory indicates that the encoder can send or the decoder can receive an H.263 bitstream which requires the decoder to have the additional memory to store the indicated number of pictures of size CIF, or of a smaller size in both horizontal and vertical dimension if custom picture format support for such pictures is indicated in customPictureFormat. The number of picture memories indicated in cifAdditionalPictureMemory shall not be larger than the number of pictures indicated in sqcifAdditionalPictureMemory, or qcifAdditionalPictureMemory (if present).

cif4AdditionalPictureMemory indicates that the encoder can send or the decoder can receive an H.263 bitstream which requires the decoder to have the additional memory to store the indicated number of pictures of size 4CIF, or of a smaller size in both horizontal and vertical dimension if custom picture format support for such pictures is indicated in customPictureFormat. The number of picture memories indicated in cif4AdditionalPictureMemory shall not be larger than the number of pictures indicated in sqcifAdditionalPictureMemory, qcifAdditionalPictureMemory, or cifAdditionalPictureMemory (if present).

cif16AdditionalPictureMemory indicates that the encoder can send or the decoder can receive an H.263 bitstream which requires the decoder to have the additional memory to store the indicated number of pictures of size 16CIF, or of a smaller size in both horizontal and vertical dimension if custom picture format support for such pictures is indicated in customPictureFormat. The number of picture memories indicated in cif16AdditionalPictureMemory shall not be larger than the number of pictures indicated in sqcifAdditionalPictureMemory, qcifAdditionalPictureMemory, cifAdditionalPictureMemory, or cif4AdditionalPictureMemory (if present).

bigCpfAdditionalPictureMemory indicates that the encoder can send or the decoder can receive an H.263 bitstream which requires the decoder to have the additional memory to store the indicated number of pictures having a custom picture format of a size indicated in customPictureFormat which are larger than 16CIF in the horizontal or vertical dimension. The number of picture memories indicated in bigCpfAdditionalPictureMemory shall not be larger than the number of pictures indicated in sqcifAdditionalPictureMemory, qcifAdditionalPictureMemory, cifAdditionalPictureMemory, cif4AdditionalPictureMemory, or cif16AdditionalPictureMemory (if present).

videoMux indicates, during the capability exchange procedure, that the terminal can support the VideoMux mode illustrated in Annex N/H.263. When true, the encoder or decoder can use a video bitstream containing video back channel message. If it is indicated in H263VideoMode, it indicates that receiving video back channel messages in VideoMux mode is preferable. When used in H263VideoMode, videoMux and separateVideoBackChannel shall not both be true.

videoBackChannelSend indicates which type of video back channel message is supported by the terminal. If it is indicated in H263VideoMode, it indicates the preferred type of back channel message.

none indicates that the encoder is not capable of sending or the decoder is not capable of receiving an H.263 bitstream which contains requests for any back-channel messages to be returned.

ackMessageOnly indicates that the encoder is capable of sending or the decoder is capable of receiving an H.263 bitstream which contains requests for only acknowledgement back channel messages to be returned.

nackMessageOnly indicates that the encoder is capable of sending or the decoder is capable of receiving an H.263 bitstream which contains requests for only non-acknowledgement back channel messages to be returned.

ackOrNackMessageOnly indicates that the encoder is capable of sending or the decoder is capable of receiving an H.263 bitstream which contains requests for either acknowledgement or non-acknowledgement back channel messages to be returned, but only one for a particular video bitstream.

ackAndNackMessage indicates that the encoder is capable of sending or the decoder is capable of receiving an H.263 bitstream which contains requests for acknowledgement and non-acknowledgement back channel messages to be returned.

enhancedReferencePicSelect, when present, indicates the capability of the encoder or decoder to use the Enhanced Reference Picture Selection mode of Annex U/H.263. If the encoder is capable of using the Enhanced Reference Picture Selection mode of Annex U/H.263, it shall also be capable of receiving the following three miscellaneous command messages, lostPicture, lostPartialPicture, and recoveryReferencePicture, and taking necessary actions to recover the quality of the far-end decoded pictures.

subPictureRemovalParameters, if present, indicates the capability for reference picture sub-picture removal using Annex U/H.263.

mpuHorizMBs indicates the horizontal size in macroblocks of the minimum picture unit for reference picture sub-picture removal using Annex U/H.263.

mpuVertMBs indicates the vertical size in macroblocks of the minimum picture unit for reference picture sub-picture removal using Annex U/H.263.

mpuTotalNumber indicates the total multi-picture buffer memory capacity when operating with sub-picture removal using Annex U/H.263 in units of minimum picture units.

CustomPictureClockFrequency: indicates the capability to support custom picture clock frequency when present as a capability, and parameters for custom picture clock frequency when present in OpenLogicalChannel and RequestMode.

When used in OpenLogicalChannel, if customPictureClockFrequency has more than one member in its set, then the video bitstream is allowed to switch between the various Picture Clock Frequencies (PCFs) within that set within the same video bitstream. Even if there is only one PCF in the set, if any MPI values are sent for the standard PCF at higher levels in the same message (e.g., in the same H263VideoCapability), then within the same bitstream there can be switching between the standard PCF and the custom one. If one wishes to indicate that the PCF should not change within the bitstream, then data relevant to only one PCF should be sent (either only MPI values for the standard PCF or just the customPictureClockFrequency).

clockConversionCode indicates the clock conversion code when custom picture clock frequency is used in ITU-T Rec. H.263.

clockDivisor indicates the natural binary representation of the value of the clock divisor. The custom picture clock frequency is given by 1 800 000/(clock divisor * clock conversion factor) Hz.

If present, sqcifMPI indicates the minimum picture interval in units of 1/(custom picture clock frequency) for the encoding and/or decoding of SQCIF pictures, and if not present, no capability for SQCIF pictures is indicated.

If present, qcifMPI indicates the minimum picture interval in units of 1/(custom picture clock frequency) for the encoding and/or decoding of QCIF pictures, and if not present, no capability for QCIF pictures is indicated.

If present, cifMPI indicates the minimum picture interval in units of 1/(custom picture clock frequency) for the encoding and/or decoding of CIF pictures, and if not present, no capability for CIF pictures is indicated.

If present, cif4MPI indicates the minimum picture interval in units of 1/(custom picture clock frequency) for the encoding and/or decoding of 4CIF pictures, and if not present, no capability for 4CIF pictures is indicated.

If present, cif16MPI indicates the minimum picture interval in units of 1/(custom picture clock frequency) for the encoding and/or decoding of 16CIF pictures, and if not present, no capability for 16CIF pictures is indicated.

CustomPictureFormat: indicates the capability to support a custom picture format when present as a capability, and parameters for custom picture format when present in OpenLogicalChannel and RequestMode.

The parameters maxCustomPictureWidth, maxCustomPictureHeight, minCustomPictureWidth, minCustomPictureHeight indicate the range of picture sizes in units of 4 pixels that an encoder or decoder can support; and the requested picture size in the case of use with RequestMode.

standardMPI indicates the minimum picture interval in units of 1/29.97 when no custom picture clock frequency is used.

customPCF indicates the parameters for custom picture clock frequency when used in conjunction with custom picture format.

clockConversionCode indicates a clock conversion code when custom picture clock frequency is used in ITU-T Rec. H.263.

clockDivisor indicates the natural binary representation of the value of the clock divisor. The custom picture clock frequency is given by 1 800 000/(clock divisor * clock conversion factor) Hz.

customMPI indicates the minimum picture interval in units of 1/(custom picture clock frequency) for the encoding and/or decoding of pictures in the custom picture format size.

pixelAspectInformation indicates the capability of an encoder or decoder to support various pixel aspect ratios; and the requested pixel aspect ratio in the case of use with RequestMode.

pixelAspectCode indicates the capability to support the pixel aspect ratio as indicated by the PAR code of ITU-T Rec. H.263.

extendedPAR: width, height indicate the capability to support the pixel aspect ratio as indicated by the extended pixel aspect ratio (EPAR) code of ITU-T Rec. H.263.

H263VideoModeCombos

When present, h263VideoModeCombos is used to indicate dependencies among optional modes of ITU-T Rec. H.263. The mode combinations for which capabilities are indicated in h263VideoModeCombos are not implied to be allowed for use with other optional modes signalled at higher levels within the same H263Options or H263VideoCapability or H263VideoMode message except as noted in the fourth paragraph of this clause and in the third paragraph of the following clause. In other words, if support for some mode booleans for the same modes that contain booleans in H263VideoModeCombos are indicated at higher levels of the syntax in h263Mode or H263Capability, these modes are not assumed to also apply in uncoupled combinations with the modes declared in H263VideoModeCombos.

h263VideoUncoupledModes indicates which optional modes of H.263 operation can be switched on or off independently to each other in any syntactically correct way for a picture and which can be switched on or off independently to the modes indicated within the h263VideoCoupledModes sent in the same H263VideoModeCombos sequence.

h263VideoCoupledModes indicates one or more sets of the optional modes of H.263 operation which can be switched on or off together for a picture within an H.263 bitstream, but for which the ability to independently switch on or off any subset of these modes is not implied. Any set of modes which are indicated as coupled in an h263VideoCoupledModes message can be used along with the full set or any subset of the modes that are indicated as uncoupled in the accompanying h263VideoUncoupledModes message within the same H263VideoModeCombos message. Within the contents of each H263ModeComboFlags message of an h263VideoCoupledModes message there shall be at least two boolean flags set to true, and there shall not be a set of mode flags set to true which indicates a coupled combination of modes which is not syntactically allowed within the same picture of an H.263 bitstream.

Some optional features of ITU-T Rec. H.263 are not included in H263ModeComboFlags since they are thought unlikely to require coupling in implementation. Specifically, these include the features specified in Annex L/H.263 (for example, fullPictureFreeze, partialPictureFreezeAndRelease, and resizingPartPicFreezeAndRelease) and the optional picture formats and optional picture clock frequencies. If support of any of these such features is signalled at a higher level within the same H263Options or H263VideoCapability or H263VideoMode message, these features shall operate in an uncoupled manner with the mode combinations signalled in H263VideoModeCombos. A fairly complex example of the use of H263VideoModeCombos follows.

The example consists of a case in which H263VideoCapability indicates that advancedPrediction and unrestrictedVector are supported, and (in the same H263VideoCapability message) inside an H263Options message it is indicated that dynamicPictureResizingByFour is supported and (in the same H263VideoCapability message) inside a H263VideoModeCombos message is an h263VideoUncoupledModes message which indicates that advancedIntraCodingMode is supported in an uncoupled manner along with an h263VideoCoupledModes message which indicates that modifiedQuantizationMode and slicesInOrder-NonRect are supported in a coupled manner. This then means that the video bitstream can contain (only) pictures with the following mode combinations: None, advancedPrediction, unrestrictedVector, dynamicPictureResizingByFour, advancedPrediction with unrestrictedVector, advancedPrediction with dynamicPictureResizingByFour, unrestrictedVector with dynamicPictureResizingByFour, advancedPrediction with unrestrictedVector with dynamicPictureResizingByFour, advancedIntraCodingMode, modifiedQuantizationMode with slicesInOrder-NonRect, and advancedIntraCodingMode with modifiedQuantizationMode with slicesInOrder-NonRect.

H263ModeComboFlags

The individual parameters of H263ModeComboFlags have the same meaning as the parameters with the same name in H263VideoCapability and H263Options.

unlimitedMotionVectors shall be FALSE if unrestrictedVector is FALSE in the same H263VideoUncoupledModes message. unlimitedMotionVectors shall be FALSE if unrestrictedVector is FALSE in the same H263VideoCoupledModes message and in the H263VideoUncoupledModes message in the same H263VideoModeCombos message.

referencePicSelect, when true, indicates the ability of the encoder or decoder to use the Reference Picture Selection mode of ITU-T Rec. H.263. When true, the specific parameters specifying how the Reference Picture Selection mode can be used shall be as sent in the refPictureSelection field of the same H263Options message. referencePicSelect shall not be true unless refPicturesSelection is present in the same H263Options message.

enhancedReferencePicSelect shall be FALSE if referencePicSelect is FALSE in the same H263VideoUncoupledModes message. enhancedReferencePicSelect shall be FALSE if referencePicSelect is FALSE in the same H263VideoCoupledModes message and in the H263VideoUncoupledModes message in the same H263VideoModeCombos message.

dataPartitionedSlices shall be FALSE if slicesInOrder-NonRect and slicesInOrder-Rect and slicesNoOrder-NonRect and slicesNoOrder-Rect are all FALSE in the same H263VideoUncoupledModes message. dataPartitionedSlices shall be FALSE if slicesInOrder-NonRect and slicesInOrder-Rect and slicesNoOrder-NonRect and slicesNoOrder-Rect are all FALSE in the same H263VideoCoupledModes message and in the H263VideoUncoupledModes message in the same H263VideoModeCombos message.

IS11172 VideoCapability: indicates IS11172 [44] capabilities.

constrainedBitstream indicates the capability for bitstreams in which constrained_parameters flag is set to "1": a value of true indicates that such operation is possible, while a value of false indicates that such operation is not possible. An encoder shall produce bitstreams within the limitations imposed by the optional fields (see below). A decoder shall be able to accept all bit streams within the limitations indicated by the optional fields. The optional fields are integers with units defined in Table B.3.

videoBadMBsCap is used in IS11172VideoCapability in the same manner as it is used in H261VideoCapability.

Table B.3/H.245 – Units for IS11172-2 codepoints

ASN.1 codepoint	Units for referenced parameter
videoBitRate	400 bit/s
vbvBufferSize	16 384 bits
samplesPerLine	samples per line
linesPerFrame	lines per frame
pictureRate	refer to Section 2.4.3.2 of IS11172-2
luminanceSampleRate	samples per second

genericVideoCapability: indicates generic video capabilities.

B.2.2.6 Audio capabilities

This indicates audio capabilities. The indication of more than a single capability within a single AudioCapability does not indicate simultaneous processing capability. Simultaneous processing capability can be indicated by instances of AudioCapability in different AlternativeCapabilitySets in a single CapabilityDescriptor.

The capability to transmit and/or receive G-series audio is indicated by a choice of integers. When an H.222.1 multiplex is used, these numbers refer to the available STD buffer size in units of 256 octets. When an H.223 multiplex is used, these numbers refer to the maximum number of audio frames per AL-SDU. When an H.225.0 multiplex is used, these numbers indicate the maximum number of audio frames per packet: an endpoint shall support the reception of any number of frames per packet up to and including the maximum number indicated in the AudioCapability; in addition, the endpoint shall not transmit more frames per packet than it indicates in its transmission AudioCapability. The exact meaning of the codepoints is given in Table B.4.

Table B.4/H.245 – G-series audio codepoints

ASN.1 codepoint	Semantic meaning of codepoint
g711Alaw64k	G.711 audio at 64 kbit/s, A-law
g711Alaw56k	G.711 audio at 56 kbit/s, A-law, truncated to 7 bits
g711Ulaw64k	G.711 audio at 64 kbit/s, μ-law
g711Ulaw56k	G.711 audio at 56 kbit/s, μ-law, truncated to 7 bits
g722-64k	G.722 7 kHz audio at 64 kbit/s
g722-56k	G.722 7 kHz audio at 56 kbit/s
g722-48k	G.722 7 kHz audio at 48 kbit/s
g7231	G.723.1 at either 5.3 or 6.3 kbit/s
g728	G.728 audio at 16 kbit/s
g729	G.729 audio at 8 kbit/s
g729AnnexA	Annex A/G.729 audio at 8 kbit/s
g729wAnnexB	G.729 audio at 8 kbit/s with silence suppression as in Annex B
g729AnnexAwAnnexB	Annex A/G.729 audio at 8 kbit/s with silence suppression as in Annex B
g7231AnnexCCapability	G.723.1 with Annex C/G.723.1
gsmFullRate	Full-rate speech transcoding (GSM 06.10)

Table B.4/H.245 – G-series audio codepoints

ASN.1 codepoint	Semantic meaning of codepoint
gsmHalfRate	Half-rate speech transcoding (GSM 06.20)
gsmEnhancedFullRate	Enhanced Full Rate (EFR) speech transcoding (GSM 06.60)
g729Extensions	G.729 Extensions

G7231: indicates the ability to process audio codec G.723.1. maxAl-sduAudioFrames indicates the maximum number of audio frames per AL-SDU. The boolean silenceSupression, when true, indicates the capability to use silence compression defined in Annex A/G.723.1.

G7231AnnexCCapability: indicates the ability to process audio codec G.723.1 with its Annex C. maxAl-sduAudioFrames indicates the maximum number of audio frames per AL-SDU. The boolean silenceSupression, when true, indicates the capability to use silence compression defined in Annex A/G.723.1. g723AnnexCAudioMode shall not be present when G7231AnnexCCapability is included in a TerminalCapabilitySet message, but shall be present when G7231AnnexCCapability is included in an OpenLogicalChannel message. The fields highRateMode0, highRateMode1, lowRateMode0, lowRateMode1, sidMode0, and sidMode1 indicate the number of octets per frame for each of the audio and error protection modes of G.723.1 and Annex C/G.723.1 that will be used on the logical channel.

IS11172AudioCapability: indicates the ability to process audio coded according to ISO/IEC 11172-3 [45].

Booleans that have the value of true indicate that the particular mode of operation is possible, while a value of false indicates that it is not. The booleans audioLayer1, audioLayer2 and audioLayer3 indicate which audio coding layers can be processed. The booleans audioSampling32k, audioSampling44k1 and audioSampling48k indicate which of the audio sample rates, 32 kHz, 44.1 kHz and 48 kHz, respectively, can be processed. The booleans singleChannel and twoChannels indicate capability for single channel and stereo/dual channel operation, respectively. The integer bitRate indicates the maximum audio bit-rate capability, and is measured in units of kbit/s.

IS13818AudioCapability: indicates the ability to process audio coded according to ISO/IEC 13818-3 [46].

Booleans that have the value of true indicate that the particular mode of operation is possible, while a value of false indicates that it is not. The booleans audioLayer1, audioLayer2 and audioLayer3 indicate which audio coding layers can be processed. The booleans audioSampling16k, audioSampling22k05, audioSampling24k, audioSampling32k, audioSampling44k1 and audioSampling48k indicate which of the audio sample rates, 16 kHz, 22.05 kHz, 24 kHz, 32 kHz, 44.1 kHz and 48 kHz, respectively, can be processed.

The booleans concerned with multichannel operation indicate capability to operate in the particular modes, as specified in Table B.5.

Table B.5/H.245 – ISO/IEC 13818-3 multichannel codepoints

ASN.1 codepoint	Semantic meaning of codepoint
singleChannel	One channel, using the 1/0 configuration. Single channel mode (as in ISO/IEC 11172-3)
twoChannels	Two channels, using the 2/0 configuration. Stereo or dual channel mode (as in ISO/IEC 11172-3)
threeChannels2-1	Three channels, using the 2/1 configuration. Left, Right and single surround channel
threeChannels3-0	Three channels, using the 3/0 configuration. Left, Centre and Right, without surround channel
fourChannels2-0-2-0	Four channels, using the 2/0 + 2/0 configuration. Left and Right of the first programme and Left and Right of the second programme
fourChannels2-2	Four channels, using the 2/2 configuration. Left, Right, Left surround and Right surround
fourChannels3-1	Four channels, using the 3/1 configuration. Left, Centre, Right, and a single surround channel
fiveChannels3-0-2-0	Five channels, using the 3/0 + 2/0 configuration. Left, Centre and Right of the first programme and Left and Right of the second programme
fiveChannels3-2	Five channels, using the 3/2 configuration. Left, Centre, Right, Left surround and Right surround

The boolean lowFrequencyEnhancement indicates the capability for a low frequency enhancement channel.

The boolean multilingual, when true, indicates the capability to support up to seven multilingual channels, and when false that no multilingual channel is supported.

The integer bitRate indicates the maximum audio bit-rate capability, and is measured in units of kbit/s.

GSMAudioCapability: indicates capabilities for the GSM full rate, half rate and enhanced full rate speech transcoding audio codecs. audioUnitSize indicates the maximum number of bytes to be sent in each packet, comfortNoise, when true, indicates the capability to support the comfort noise processing for the full, half or enhanced full rate speech traffic channel (GSM 06.12, GSM 06.22, GSM 06.62), and scrambled, when true, indicates the capability to support bit scrambling for the full, half, or enhanced full rate speech traffic channels (GSM 06.10, GSM 06.20, GSM 06.60).

genericAudioCapability: indicates generic audio capabilities.

g729Extensions: indicates capability of additional optional modes of G.729. This codepoint shall not be used to indicate g729AnnexA, g729wAnnexB and g729AnnexAwAnnexB, for which **g729AnnexA**, **g729AnnexB** and **g729AnnexAwAnnexB** shall be used.

audioUnit:

– for an H.222 multiplex, indicates the size of the STD buffer in units of 256 octets;

– for an H.223 multiplex, indicates the maximum number of audio frames per AL-SDU; and

– for an H.225.0 multiplex, indicates the maximum number of audio frames per packet.

audioUnit shall be present for Capability Exchange. It may be present for Mode Request.

annexA, when true, indicates the capability to transmit or receive the Annex A/G.729 audio at 8 kbit/s, instead of G.729 main body.

annexB, when true, indicates the capability of silence suppression as in Annex B/G.729.

annexD, when true, indicates the capability to transmit or receive the Annex D/G.729 audio at 6.4 kbit/s.

annexE, when true, indicates the capability to transmit or receive the Annex E/G.729 audio at 11.8 kbit/s.

annexF, when true, indicates the capability of silence suppression as in Annex F/G.729.

annexG, when true, indicates the capability of silence suppression as in Annex G/G.729.

annexH, when true, indicates the capability of switching operation between 6.4 kbit/s (Annex D/G.729) and 11.8 kbit/s (Annex E/G.729).

audioTelephonyEvent may be included to indicate support for in-band audio telephone events as per RFC 4733. The events supported shall be described in the audioTelephoneEvent as described in the <list of value> in RFC 4733. Events 0-15 (corresponding to DTMF digits 0-9, *, #, A, B, C, D) are the only mandatory events.

audioTone may be included to indicate support for in-band audio tones as per RFC 4733.

B.2.2.7 Data application capabilities

This indicates data capabilities. The indication of more than a single capability within a single DataApplicationCapability does not indicate simultaneous processing capability. Simultaneous processing capability can be indicated by instances of DataApplicationCapability in different AlternativeCapabilitySets in a single CapabilityDescriptor.

Recommendations that use this Recommendation may place restrictions on which of these modes may be signalled.

Some of the data capabilities require bidirectional logical channels, for example, to run a retransmission protocol. This requirement is implicitly included in the appropriate capability codepoints.

DataApplicationCapability: a list of data applications and bit rates. Each data application indicated shall be supported by one or more DataProtocolCapabilitys.

maxBitRate indicates the maximum bit rate in units of 100 bit/s at which a transmitter can transmit video or a receiver can receive the given data application.

t120 indicates the capability to support the T.120 [32] protocol.

dsm-cc indicates the capability to support the DSM-CC [47] protocol.

userData indicates the capability to support unspecified user data from external data ports.

t84 indicates the capability to support the transfer of T.84 [31] type images (JPEG, JBIG, Facsimile Gr.3/4).

t434 indicates the capability to support the transfer of T.434 [35] telematic binary files.

h224 indicates the capability to support the real-time simplex device control protocol H.224 [11].

nlpid indicates the capability to support the network layer protocol as specified by nlpidData as defined in ISO/IEC TR 9577 [52]. These protocols include Internet protocol (IP) and IETF Point-to-Point Protocol (PPP), among others.

NOTE – The use of the NLPID is extensively described in RFC 1490, "Multiprotocol Interconnect over Frame Relay".

dsvdControl indicates the capability of the DSVD terminal to support an out-of-band control channel.

h222DataPartitioning indicates the capability to support the modified and restricted usage of data partitioning of H.262, as specified in ITU-T Rec. H.222.1, in which the enhancement data is transmitted as a data channel supported by the listed DataProtocolCapability.

t30fax: This codepoint indicates the capability to use Annex C/T.30 analog mode (G3V), as specified in ITU-T Rec. T.39 for the DSVF/MSVF modes.

t140: This codepoint indicates the capability to use the T.140 text conversation protocol, as specified in ITU-T Rec. T.140.

t38fax: This codepoint indicates a data protocol conforming to ITU-T Rec. T.38 [29].

The fields **version**, **t38FaxRateManagement**, **t38FaxUdpOptions** and **t38FaxTcpOptions** are defined in ITU-T Rec. T.38.

fillBitRemoval, when true, indicates that the gateway/terminal has the ability to remove and insert fill bits.

transcodingJBIG, when true, indicates that the gateway has the ability to transcode in real time between the line compression and JBIG for transfer over the IP network.

transcodingMMG, when true, indicates that the gateway has the ability to transcode in real time between the line compression and MMG for transfer over the IP network.

genericDataCapability indicates generic data capabilities. When maxBitRate is included in the genericDataCapability, its value shall be the same as the value of maxBitRate in the DataApplicationCapability.

DataProtocolCapability: contains a list of data protocols.

v14buffered indicates the capability to support a specified data application using buffered V.14 [36].

v42lapm indicates the capability to support a specified data application using the LAPM protocol defined in ITU-T Rec. V.42 [38].

hdlcFrameTunnelling indicates the capability to support a specified data application using HDLC Frame Tunnelling. Refer to section 4.5.2 of ISO/IEC 13239 [43].

h310SeparateVCStack indicates the capability to support a specified data application using the protocol stack defined in ITU-T Rec. H.310 for the transport of H.245 messages over a separate ATM VC to that used for audiovisual communication.

h310SingleVCStack indicates the capability to support a specified data application using the protocol stack defined in ITU-T Rec. H.310 for the transport of H.245 messages in the same ATM VC as that used for audiovisual communication.

transparent indicates the capability to support a specified data application using transparent data transfer.

v120: use of v120 is for further study in ITU-T Rec. H.323.

separateLANStack indicates that a separate transport stack will be used to transport the data. The intent of a separate network connection for data is indicated by dataType in OpenLogicalChannel resolving to values h310SeparateVCStack or separateLANStack of DataProtocolCapability. When the selected DataApplicationCapability is t120, these choices imply use of the T.123 basic profile for B-ISDN and LAN, respectively. Alternative LAN profiles may be selected by a nonStandard DataProtocolCapability.

If separateLANStack is selected and separateStack is present in the OpenLogicalChannel request, the receiver should attempt to establish the stack indicated. It will respond OpenLogicalChannelAck if successful, otherwise OpenLogicalChannelReject with a suitable cause.

If separateLANStack is selected and separateStack is absent in the OpenLogicalChannel request, the receiver should supply an appropriate separateStack in its OpenLogicalChannelAck response. The receiver of this (the original requester) should then attempt to establish the stack indicated. It will issue CloseLogicalChannel if unsuccessful.

If separateLANStack is selected and separateStack is present in the OpenLogicalChannel request, it can be overridden by separateStack in the OpenLogicalChannelAck response. If the original requester does not tolerate an override, it will issue CloseLogicalChannel.

If separateLANStack is selected and separateStack is absent in the OpenLogicalChannel request and also absent in the OpenLogicalChannelAck response, the original requester can infer that the responder does not understand these ASN.1 extensions and should issue CloseLogicalChannel to clean up.

v76wCompression indicates the capability to support data compression on a V.76 data channel.

tcp indicates the capability to support TCP/IP for this application.

udp indicates the capability to support UDP for this application.

T84Profile: indicates the types of still image profile that the terminal is able to support.

t84Unrestricted provides no indication of the type of T.84 still image that the terminal is able to support: information in the T.84 layer should be used to determine whether a particular image can be received.

t84Restricted indicates the type of T.84 still image that the terminal is able to support.

qcif indicates the support of a sequential colour YCrCb type image with QCIF resolution.

cif indicates the support of a sequential colour YCrCb type image with CIF resolution.

ccir601Seq indicates the support of a sequential colour YCrCb type image with CCIR601 resolution.

ccir601Prog indicates the support of a progressive colour YCrCb type image with CCIR601 resolution.

hdtvSeq indicates the support of a sequential colour YCrCb type image with HDTV resolution.

hdtvProg indicates the support of a progressive colour YCrCb type image with HDTV resolution.

g3FacsMH200x100 indicates the support of a sequential Facsimile Gr. 3 MH (Modified Huffman) coded bi-level image at the normal (200 × 100 ppi) resolution.

g3FacsMH200x200 indicates the support of a sequential Facsimile Gr. 3 MH (Modified Huffman) coded bi-level image at the high (200 × 200 ppi) resolution.

g4FacsMMR200x100 indicates the support of a sequential Facsimile Gr. 4 MMR (Modified Modified Reed) coded bi-level image at the normal (200 × 100 ppi) resolution.

g4FacsMMR200x200 indicates the support of a sequential Facsimile Gr. 4 MMR (Modified Modified Reed) coded bi-level image at the high (200 × 200 ppi) resolution.

jbig200x200Seq indicates the support of a sequential bi-level JBIG coded bi-level image at the 200 × 200 ppi resolution.

jbig200x200Prog indicates the support of a progressive bi-level JBIG coded bi-level image at the 200 × 200 ppi resolution.

jbig300x300Seq indicates the support of a sequential bi-level JBIG coded bi-level image at the 300 × 300 ppi resolution.

jbig300x300Prog indicates the support of a progressive bi-level JBIG coded bi-level image at the 300 × 300 ppi resolution.

digPhotoLow indicates the support of a sequential JPEG coded colour image of up to 720 × 576 image size.

digPhotoMedSeq indicates the support of a sequential JPEG coded colour image of up to 1440 × 1152 image size.

digPhotoMedProg indicates the support of a progressive JPEG coded colour image of up to 1440 × 1152 image size.

digPhotoHighSeq indicates the support of a sequential JPEG coded colour image of up to 2880 × 2304 image size.

digPhotoHighProg indicates the support of a progressive JPEG coded colour image of up to 2880 × 2304 image size.

B.2.2.8 Encryption, authentication and integrity capabilities

EncryptionCapability, if present, indicates the encryption capabilities of a terminal for each media type where the capabilities are present. The scope of encryption indicates whether the encryption is applied to the entire bit stream, a portion of the bit stream in a standard way, or a portion of the stream in a non-standard way. The algorithm selects the encryption algorithm.

AuthenticationCapability if present, indicates that the authentication components of ITU-T Rec. H.235.0 [16] are supported by the terminal. antiSpamAlgorithm indicates the method and algorithm that is used to provide countermeasures against flooding and denial-of-service attacks.

IntegrityCapability if present, indicates that the integrity components of ITU-T Rec. H.235.0 [16] are supported by the terminal.

B.2.2.9 Conference capabilities

ConferenceCapability indicates conference capabilities such as the ability to support Chair Control as described in ITU-T Rec. H.243.

videoIndicateMixingCapability shall be defined as H.230 VIM.

B.2.2.10 User input capabilities

UserInputCapabilities indicates which parameters in the UserInputIndication message are supported by the terminal. BasicString indicates that the terminal supports the basicString option of userInputSupportIndication, iA5String indicates that the terminal supports the iA5String option of userInputSupportIndication, and generalString indicates that the terminal supports the generalString option of userInputSupportIndication. Dtmf indicates that the terminal supports dtmf using the signal and signal update components of the userInputIndication message. Hookflash indicates that the terminal supports hookflash using the signal and signal update components of the userInputIndication message.

For secure DTMF UserInputCapabilities indicate which parameters in the UserInputIndication message are encrypted.

encryptedBasicString indicates that the terminal supports the encryptedalphanumeric option of UserInputIndication.

encryptedIA5String indicates that the terminal supports the encryptedSignalType option of UserInputIndication.

encryptedGeneralString indicates that the terminal supports the encryptedalphanumeric option of extendedAlphanumeric of UserInputIndication.

secureDTMF indicates that the terminal supports the encryptedSignalType within signal for secure DTMF.

The genericUserInputCapability field represents a means of transporting new kinds of user input capabilities, which may be defined in the future or may be non-standard. It is not a replacement or alternative to the existing means of signalling DTMF capability.

B.2.2.11 Generic capabilities

The **GenericCapability** type allows new capabilities to be specified in such a way that a new version of H.245 syntax does not need to be issued. This generic means of specifying capabilities allows network based devices, such as MCs, to determine a highest common operating mode without having a detailed knowledge of the capability being used. It allows for both ITU-T and other standards based capability descriptions (including proprietary capability descriptions) to be defined. ITU-T standards based capability descriptions should be included as annexes to this Recommendation. Non-ITU-T standards capability descriptions may be published in any suitable form.

The field **capabilityIdentifier** indicates which type of capability is being defined. ITU-T based capability descriptions shall use the **standard** OBJECT IDENTIFIER, while other standards based and proprietary capability descriptions shall use one of **standard**, **h221NonStandard**, **uuid** and **domainBased** as appropriate.

The field **subIdentifier** indicates a type or set of parameters associated with the **capabilityIdentifier**.

maxBitRate indicates the maximum rate at which the capability can operate when capabilities are exchanged, and the actual bit rate to be used when open logical channel signalling takes place. It shall be present whenever a meaningful value can be indicated, and when mandated by the specification of the particular capability description. It is defined separately so that intermediaries on the signalling path can have visibility of the bandwidth being used without having detailed knowledge of each capability.

The parameters of the capability can be described as any combination of **collapsing, nonCollapsing,** and **nonCollapsingRaw**, together with **transport**, as specified in the capability description.

The **collapsing** field indicates capabilities that are described in such a way that an MC can combine the capabilities from a number of endpoints and build a common capability set using a simple set of rules without having detailed knowledge of the individual codec.

The **nonCollapsing** field indicates capabilities using the same syntax as **collapsing** but which cannot be processed by an MC. In this case, the semantics of **ParameterValue** change to indicate only values and not collapsing rules. For example, **unsignedMin** and **unsignedMax** have the same semantics, and simply indicate a 16-bit integer parameter.

The **nonCollapsingRaw** field indicates capabilities using an OCTET STRING. Typically this may consist of a ASN.1 PER encoded data structure. Note that an MC must have specific knowledge of capabilities described in this way to make use of them.

The **transport** field indicates transport parameters specific to the capability being described.

It is recommended when specifying capability descriptions to define as many parameters as possible as **collapsing**, as it is only parameters defined in this way that are ensured to be processed rather than simply forwarded by network elements.

GenericCapabilities that include both collapsing and nonCollapsing sequences should not include GenericParameter structures of different types (collapsing, nonCollapsing) that use the same parameterIdentifier.

NOTE 1 – Such reuse of the same parameterIdentifier could cause a parameterIdentifier value collision if the parameter were translated automatically to a system, for example an H.320 system, that does not have the distinction between collapsing and nonCollapsing parameters.

The standard parameterIdentifier field of a GenericParameter should not be assigned the value 0.

NOTE 2 – Such assignment to the value 0 would interfere with automatic translation to H.320 signalling, for example as is done in Annex A/H.239 and in ITU-T Rec. H.241.

GenericParameter indicates one capability parameter or one group of capability parameters.

The **parameterIdentifier** allows the values of standard (i.e., defined in the capability description) and proprietry parameters to be indicated. The parameters defined in the capability description use the **standard** form which identifies the parameter with an integer. Parameters that are propriety extensions use the **h221NonStandard, uuid**, or **domainBased** forms.

The **parameterValue** field indicates the parameter's value. The presence of a **logical** parameter indicates that the endpoint supports the option that the parameter represents. The **booleanArray** field contains up to eight independent boolean variables. The **unsignedMin** and **unsignedMax** fields indicate a parameter using an unsigned 16-bit integer. The **unsigned32Min** and **unsigned32Max** fields indicate a parameter using an unsigned 32-bit integer. The **octetString** field indicates a parameter as an OCTET STRING. The **genericParameter** field indicates a sequence of parameters that have been grouped together at this layer of the capability hierarchy.

To combine capability descriptions from multiple endpoints into a common capability description for a capability which an MC has no in-built knowledge, an MC should first ignore any parameters which are not supported by all endpoints that the MC has decided are candidates for using a particular capability. Then, for each of the candidate endpoints' parameters with the same **parameterIdentifier**, the MC should:

– perform a logical AND in the case of **booleanArray** or **logical**;

– choose the minimum value in the case of **unsignedMin** or **unsigned32Min**; and

– choose the maximum value in the case of **unsignedMax** or **unsigned32Max**.

The **supersedes** field allows a capability description to contain a group of parameters from which only one should be selected when a common capability description is determined. This might be the case for a video codec that supports SQCIF, QCIF and CIF resolutions with different minimum picture intervals. The value in the parameterIdentifier refers to a parameter at the same level of nesting. Multiple **supersedes** fields are included with a parameter so that a tree of parameter dependencies can be expressed as is found in the H.262 capability description. Each of the parameters identified in the **supersedes** field should be discarded from the common capability description. The parameters that the discarded parameters supersede shall in turn also be discarded and this process shall be repeated until all superseded parameters are discarded.

The result of this operation is the common capability description.

NOTE 3 – An MC that has in-built knowledge of a particular capability description may use its own set of rules to produce a common capability description.

B.2.2.12 Multiplexed stream capabilities

multiplexedStreamCapability indicates the capability of supporting a multiplexed stream on a single logical channel.

multiplexFormat indicates the multiplex protocol that is supported.

controlOnMuxStream, if true, indicates that the logical channel signalling for the multiplexed stream is supported using the control channel transported over the multiplexed stream. If false, the logical channel signalling for the multiplexed stream is supported using this H.245 control channel. When controlOnMuxStream is false and multiplexFormat is H223Capability, at most one logical channel for H.223 multiplexed stream shall be opened. controlOnMuxStream shall be false if the MultiplexFormat is set to h222Capability.

capabilityOnMuxStream, if present, indicates the set of capabilities for the multiplexed stream. These capabilities are indicated with a set of AlternativeCapabilitySet. This AlternativeCapabilitySet shall not include the multiplexedStreamTransmission capability. If absent, the set of capabilities for the multiplexed stream shall be exchanged using the control channel that is transported over the multiplexed stream, after the multiplexed stream logical channel is opened.

B.2.2.13 RTP payload for Audio Telephony Event and Audio Tone Capability

receiveRTPAudioTelephonyEventCapability may be included to indicate support for in-band audio telephone events as per RFC 4733. The dynamicRTPPayloadType indicates which dynamic RTP payload type shall be used for transporting these events. The events supported shall be described in the audioTelephoneEvent as described in the <list of value> in RFC 4733. Events 0-15 (corresponding to DTMF digits 0-9, *, #, A, B, C, D) are the only mandatory events.

receiveRTPAudioToneCapability may be included to indicate support for in-band audio tones as per RFC 4733. The dynamicRTPPayloadType indicates which dynamic RTP payload type shall be used for transporting these tones.

B.2.2.14 Multiple Payload Stream

A multiple payload stream (MPS) contains packets representing a single logical media stream, that is, the packets all represent encodings of that same stream for specified time intervals. To allow identification and correlation of the various encodings used, all packets in a single MPS SHALL carry payload type identifiers in the same location in the packet and SHOULD use timestamps in the same format and derived from a single clock source (e.g., RTP payloads should use the same SSRC). In most cases these packets will represent sequential, non-overlapping time intervals and simply choose distinct encodings for distinct intervals, but there are cases where alternate encodings represent overlapping intervals, such as, when an event occurs in the middle of an encoding interval that must be encoded distinctly in the alternate encoding. This may occur, for example, when a DTMF tone is detected in the middle of a voice-encoding interval and should be sent using RFC 4733 telephone-event. In this case the timestamp in the telephone-event packet will correspond to a time in the middle of the voice-encoding interval. Packets with zero duration may be used where the stream event represented has no measurable duration. It is also permissible to use RFC 2198 to send a packet multiple times, packed into a packet with other payload types and time intervals.

When opening a logical channel containing a MPS, each stream within the MPS has its own bit rate, which is independent of the other bit-rate values for other streams. Given that media within a MPS is effectively interleaved (i.e., only one stream within a MPS channel would be transmitting at any point in time), the total bit rate for the MPS channel is the maximum of the bit-rate values of all MPS streams.

The bit rate for a MPS channel may be controlled through various H.245 commands, as with non-MPS channels. In the case that the bit-rate for the channel is adjusted to be lower than the bit rate of a particular stream, then that particular stream cannot be used to transmit media. For example, if a MPS channel is opened with G.729 and G.711 streams and the Flow Control Command is used to adjust the bit rate for the channel to 32 kbit/s, then the endpoint may only transmit using G.729.

The bit rate for particular stream of a MPS channel may also be controlled through various H.245 commands. In that case, the bit rate would impact only the particular stream. Again, the bit rate for the channel would be the maximum of the bit-rate values of all MPS streams, except in the case that the bit rate for the entire channel has been decreased.

Thus, when using a multiple payload stream, there are two bit-rate values to consider. The first is the implicit bit rate for the channel, which is the maximum of the bit-rate values of all MPS streams. The second is the maximum bit rate for the entire channel, as signalled through various H.245 commands (e.g., Flow Control Command). When a Flow Control Command or other such H.245

command is used to remove bit-rate restrictions from the channel, then the bit rate for the channel is, once again, considered to be the maximum of the bit-rate values of all MPS streams.

NOTE – Since all packets must represent encodings of a single source (destination) stream it is not appropriate to include distinct media types, such as audio and video, although data-type packets representing data derived from the media stream (such as DTMF digits detected in an audio stream) may be an alternate representation or encoding and are appropriate.

B.2.2.15 Forward Error Correction

An endpoint may advertise the ability to perform Forward Error Correction. When advertising RFC 2733, the endpoint has the ability to signal that FEC data may be sent on a separate stream or the same stream (using redundant encoding), as per RFC 2198. This capability allows the endpoint to indicate (by capability table entry number) which codecs may be used in an FEC stream.

If the endpoint sending **OpenLogicalChannel** wishes to use RFC 2198 (and that capability is supported by the recipient) for carrying the FEC data, it shall use the **DataType redundancyEncoding**, including the VBD encoding, for example, as the **primary** encoding and the **DataType fec** as a **secondary** encoding. The payload type for the RFC 2198 packets shall be specified in the **dynamicPayloadType** field of the **OpenLogicalChannel**. The payload type for the **primary** encoding and the FEC data may be signalled in the **payloadType** field of the **primary** and **secondary RedundancyEncodingElement** fields.

If an endpoint wishes to transmit FEC data on a separate stream, it has two choices: to transmit to the same port as the FEC protected data or to a different port. When transmitting on a different port, it shall use a separate **OpenLogicalChannel** explicitly for the FEC stream. The **dataType** selected shall be **fec** and shall not be contained within a **redundancyEncoding** field. It shall select **mode.separateStream.differentPort** and include the session ID of the protected stream and, optionally, the payload type of the protected media, in the case that the subject channel carries multiple payload types, such as an MPS stream. When transmitting on a separate stream, but to the same port as the protected media, the FEC data shall be signalled as part of an MPS stream. In that case, one element of the MPS stream would be the protected audio and one element would be **fec**. In this case, it would select **mode.separateStream.samePort** and would advertise the payload type of the protected stream.

B.2.3 Terminal Capability Set Acknowledge

This is used to confirm receipt of a TerminalCapabilitySet from the peer CESE.

The sequenceNumber shall be the same as the sequenceNumber in the TerminalCapabilitySet for which this is the confirmation.

B.2.4 Terminal Capability Set Reject

This is used to reject a TerminalCapabilitySet from the peer CESE.

The sequenceNumber shall be the same as the sequenceNumber in the TerminalCapabilitySet for which this is the negative acknowledgement.

The reasons for sending this message are given in Table B.6.

Table B.6/H.245 – Reasons for rejecting a TerminalCapabilitySet

ASN.1 codepoint	Cause
unspecified	No cause for rejection specified.
undefinedTableEntryUsed	A capability descriptor made reference to a capabilityTable entry that is not defined.
descriptorCapacityExceeded	The terminal was incapable of storing all of the information in the TerminalCapabilitySet.
tableEntryCapacityExceeded	The terminal was incapable of storing more entries than that indicated in highestEntryNumberProcessed or else could not store any.

B.2.5 Terminal Capability Set Release

This is sent in the case of a timeout.

B.3 Logical channel signalling messages

This set of messages is for logical channel signalling. The same set of messages is used for unidirectional and bidirectional logical channel signalling; however, some parameters are only present in the case of bidirectional logical channel signalling.

"Forward" is used to refer to transmission in the direction from the terminal making the original request for a logical channel to the other terminal, and "reverse" is used to refer to the opposite direction of transmission, in the case of a bidirectional channel request.

B.3.1 Open Logical Channel

This is used to attempt to open a unidirectional logical channel connection between an outgoing LCSE and a peer incoming LCSE and to open a bidirectional logical channel connection between an outgoing B-LCSE and a peer incoming B-LCSE.

forwardLogicalChannelNumber: indicates the logical channel number of the forward logical channel that is to be opened.

forwardLogicalChannelParameters: include parameters associated with the logical channel in the case of attempting to open a unidirectional channel and parameters associated with the forward logical channel in the case of attempting to open a bidirectional channel.

reverseLogicalChannelParameters: include parameters associated with the reverse logical channel in the case of attempting to open a bidirectional channel. Its presence indicates that the request is for a bidirectional logical channel with the stated parameters, and its absence indicates that the request is for a unidirectional logical channel.

NOTE – H.222 parameters are not included in reverseLogicalChannelParameters as their values are not known to the terminal initiating the request.

portNumber is a user-to-user parameter that may be used by a user for such purposes as associating an input or output port, or higher layer channel number, with the logical channel.

dataType indicates the data that is to be carried on the logical channel.

If it is nullData, the logical channel will not be used for the transport of elementary stream data, but only for adaptation layer information – if video is to be transmitted in one direction only, but a retransmission protocol is to be used, such as AL3 defined in H.223, a return channel is needed to transport the retransmission requests – it may also be used to describe a logical channel that only contains PCR values in the case of H.222.1 Transport Streams [9].

A dataType of h235Media is used to specify encryption of the logical channel; the actual data type is indicated within H235Media, along with the encryption specification.

Terminals capable only of unidirectional (transmit or receive) operation on media types which make use of bidirectional channels shall send capabilities only for the supported direction of operation. The reverse direction shall use the nullData type, for which no capability is necessary. Transmit-only terminals should send transmit capabilities, but terminals should not assume that the absence of transmit capabilities implies that transmit-only operation is not possible.

separateStack indicates that a separate transport stack will be used to transport the data and provides an address to use to establish the stack which is either a Q.2931, E.164, or local area network transport address.

networkAccessParameters define the distribution, network address, and creation and association information to be used for the separateStack.

distribution shall be present when networkAddress is set to localAreaNetwork and shall indicate whether the networkAddress is a uni or multicast transport address.

networkAddress indicates the address of the actual stack in use: Q.2931, E.164, or local area network transport address.

associateConference indicates whether or not the data conference is new (associateConference=FALSE) or is an existing data conference which should be associated with the audio/video call (associateConference=TRUE).

externalReference indicates information which may be used to further provide association or information concerning the separateStack.

If it is of type VideoCapability, AudioCapability, the logical channel may be used for any of the variations indicated by each individual capability; and it shall be possible to switch between these variations using only signalling that is in-band to the logical channel – for example, in the case of H.261 video, if both QCIF and CIF are indicated, it shall be possible to switch between these on a picture-by-picture basis. In the case of DataApplicationCapability, only one instance of a capability can be indicated since there is no in-band signalling allowing a switch between variations.

If it is encryptionData, the logical channel will be used for the transport of encryption information as specified.

If it is multiplexedStream, the logical channel will be used for the transport of audio/video/data as a multiplexed stream as specified. The fields of MultiplexedStreamParameter have the same meaning as the fields of the same name in MultiplexedStreamCapability.

forwardLogicalChannelDependency indicates which logical channel number the forward channel to be opened is dependent on.

reverseLogicalChannelDependency indicates which logical channel number the reverse channel to be opened is dependent on.

The replacementFor parameter indicates that the logical channel to be opened will be a *replacement for* the specified existing, already-open logical channel. This parameter shall be used only to refer to logical channels already in the ESTABLISHED state. Logical channels opened using this parameter shall not carry any data traffic until after all traffic on the referenced established logical channel ceases. Media decoders will in this case never be required to decode data traffic from both logical channels simultaneously. Once traffic on the newly established logical channel has begun, the old logical channel shall immediately be closed. Receivers may acknowledge logical channels opened using the replacementFor mechanism with the understanding that the old and new logical channels shall not be used simultaneously, and therefore will not exceed the receiver's capability to decode.

The encryptionSync field shall be used by the master to provide the encryption key value and the synchronization point at which the key should be used. It may also be used by the slave to provide the encryption key and the synchronization point for a media channel sourced by the slave. For H.323, the syncFlag shall be set to the RTP dynamic payload number which matches the key.

H222LogicalChannelParameters: used to indicate parameters specific to using ITU-T Rec. H.222.1 [9]. It shall be present in forwardLogicalChannelParameters and shall not be present in reverseLogicalChannelParameters.

resourceID indicates in which ATM Virtual Channel the logical channel is to be transported. The means by which this parameter is associated with an ATM Virtual Channel is not specified in this Recommendation. When ITU-T Rec. H.222.0 is used in ITU-T Rec. H.323 as the multiplexed stream format, this parameter contains the logical channel number of the multiplexed stream in which this logical channel is to be multiplexed.

subChannelID indicates which H.222.1 sub-channel is used for the logical channel. It shall be equal to the PID in a Transport Stream and the stream_id in a Program Stream.

pcr-pid indicates the PID used for the transport of Program Clock References when the Transport Stream is used. It shall be present when the ATM virtual channel carries a Transport Stream and shall not be present when the ATM virtual channel carries a Program Stream.

programDescriptors is an optional octet string, which, if present, contains one or more descriptors, as specified in ITU-T Recs H.222.0 and H.222.1, that describe the program that the information to be carried in the logical channel is a part of.

streamDescriptors is an optional octet string, which, if present, contains one or more descriptors, as specified in ITU-T Recs H.222.0 and H.222.1, that describe the information that is to be carried in the logical channel.

H223LogicalChannelParameters: used to indicate parameters specific to using ITU-T Rec. H.223 [10]. It shall be present in forwardLogicalChannelParameters and reverseLogicalChannelParameters.

adaptationLayerType indicates which adaptation layer and options will be used on the logical channel. The codepoints are as follows: nonStandard, al1Framed (AL1 framed mode), al1NotFramed (AL1 unframed mode), al2WithoutSequenceNumbers (AL2 with no sequence numbers present), al2WithSequenceNumbers (AL2 with sequence numbers present), and al3 (AL3, indicating the number of control field octets that will be present and the size of the send buffer, B_S, that will be used, the size being measured in octets), al1M (AL1M defined in Annex C/H.223 with the specified parameters), al2M (AL2M defined in Annex C/H.223 with the specified parameters) or al3M (AL3M defined in Annex C/H.223 with the specified parameters).

segmentableFlag, when equal to true indicates that the channel is designated to be segmentable, and when equal to false indicates that the channel is designated to be non-segmentable.

H223AL1MParameters: used to indicate parameters specific to using adaptation Layer AL1M.

transferMode indicates whether framed mode or unframed mode is used.

headerFEC indicates whether FEC is SEBCH(16,7) or Golay(24,12).

The length of CRC bits for the payload is indicted by crcLength as 4, 8, 12, 16, 20, 28 or 32 bits or by crcNotUsed.

rcpcCodeRate indicates the RCPC code rate as 8/8, 8/9, ..., 8/32.

arqType indicates the ARQ mode of operation: noARQ indicates no retransmission, typeIArq indicates ARQ type I, and typeIIArq indicates ARQ type II.

alpduInterleaving, if true, indicates the use of AL-PDU interleaving.

alsduSplitting, if true, indicates the use of AL-SDU splitting mode.

rsCodeCorrection indicates the RS code correction ability as 0, 1, …, 127 octets. A fixed number of the RS code parity symbols (octets) corresponding to rsCodeCorrection is added to each variable length AL-SDU and CRC field. When the RS coding is used, typeIIArq and alpduInterleaving are not supported.

H223AL2MParameters: used to indicate parameters specific to using adaptation Layer AL2M.

headerFEC indicates whether FEC is SEBCH(16,5) or Golay(24,12).

alpduInterleaving, if true, indicates the use of AL-PDU interleaving.

H223AL3MParameters: used to indicate parameters specific to using adaptation Layer AL3M.

This has the same parameters as AL1MParameters, except transferMode and alsduSplitting are not present.

H223AnnexCArqParameters

numberOfRetransmissions indicates the maximum number of retransmissions that may be used: finite indicates a finite limit on the number of retransmissions that may be used in the range 0 to 16; and infinite indicates that there is no limit on the number of retransmissions that may be used. numberOfRetransmissions equal to the finite value of 0 indicates that the control field is used for the splitting mode but retransmissions are not used.

sendBufferSize indicates the size of the send buffer that will be used, the size being measured in octets.

V76LogicalChannelParameters: used to indicate parameters specific to using ITU-T Rec. V.76.

audioHeader is used to indicate the use of an audio header on the logical channel. This is a valid parameter for channels of the DataType audio.

suspendResume is used to indicate that the channel may use the suspend/resume procedures to suspend other logical channels. Three channel options may be selected; no suspend resume on the channel, suspend resume using an address or suspend resume without an address as defined in ITU-T Rec. V.76. suspendResumewAddress indicates that the suspend/resume channel shall use the address field as defined in ITU-T Rec. V.76. suspendResumewoAddress indicates that the suspend/resume channel shall not use the address field.

eRM indicates that the logical channel shall perform error recovery procedures as defined in ITU-T Rec. V.76.

uNERM indicates that the logical channel shall operate in non-error recovery mode as defined in ITU-T Rec. V.76.

For description of n401, windowSize and loopbackTestProcedure see 12.2.1/V.42, and its clauses. For the purposes of ITU-T Rec. V.70, n401 shall be encoded in octets.

crcLength is an optional parameter that indicates the CRC length used in error recovery mode. If this parameter is not present, the default CRC length shall be used. crc8bit indicates to use an 8-bit CRC, crc16bit indicates to use a 16-bit CRC and crc32bit indicates to use a 32-bit CRC as defined in ITU-T Rec. V.76.

recovery is an optional parameter that indicates the error recover procedures defined in ITU-T Rec. V.76. If this parameter is not present, the default error recovery procedure shall be used. sREJ indicates to use the selective frame reject procedure and mSREJ indicates to use the multiple selective reject procedure as defined in ITU-T Rec. V.76.

uIH indicates the use of V.76 UIH frames.

rej indicates the use of the reject procedure in ITU-T Rec. V.76.

V75Parameters is used to indicate parameter specific to using ITU-T Rec. V.75. audioHeaderPresent indicates the presence of the V.75 audio header.

H2250LogicalChannelParameters: used to indicate parameters specific to using ITU-T Rec. H.225.0. It shall be present in forwardLogicalChannelParameters and reverseLogicalChannelParameters.

The sessionID is a unique RTP or T.120 Session Identifier in the conference. It is used by the transmitter to refer to the session to which the logical channel applies. Only the master can create the session identification. By convention, there are three primary sessions. The first primary session with a session identification of 1 is the audio session, the second primary session with a session identification of 2 is the video session, and the third primary session with a session identification of 3 is the data session. A slave entity can open an additional session by providing a session identification of 0 in the openLogicalChannel message. The master will create a unique session identification and provide it in the openLogicalChannelAck message.

The associatedSessionID is used to associate one session with another. Typical use will be to associate an audio session with a video session to indicate which sessions to process for lip synchronization.

The mediaChannel indicates a transportAddress to be used for the logical channel. When the transport is unicast, mediaChannel is not present in the OpenLogicalChannel forwardLogicalChannelParameters, but may be present in the reverseLogicChannelParameters. If the transportAddress is multicast and when not employing the **SingleTransmitterMulticast** capability, the master is responsible for creating the multicast transport address and shall include the address in the OpenLogicalChannel message. A slave entity that wishes to open a new multicast channel will provide zeroes in the multicast transportAddress field. The master will create and provide the multicast transportAddress in the OpenLogicalChannelAck message for the slave entity. Note that the MC will use the communicationModeCommand to specify the details about all the RTP Sessions in the conference. Either endpoint in a point-to-point call MAY assign a multicast address to present in the OpenLogicalChannel if both endpoints negotiate and use the SingleTransmitterMulticast capability procedures described in clause 8.3.3 of ITU-T Rec. H.323.

The mediaChannel is used to describe the transport address for the logical channel. IPv4 and IPv6 addresses shall be encoded with the most significant octet of the address being the first octet in the respective OCTET STRING, e.g., the class B IPv4 address 130.1.2.97 shall have the "130" being encoded in the first octet of the OCTET STRING, followed by the "1" and so forth. The IPv6 address a148:2:3:4:a:b:c:d shall have the "a1" encoded in the first octet, "48" in the second, "00" in the third, "02" in the fourth and so forth. IPX addresses, node, netnum, and port shall be encoded with the most significant octet of each field being the first octet in the respective OCTET STRING.

mediaGuaranteedDelivery indicates whether or not the underlying media transport should be selected to provide or not provide guaranteed delivery of data.

mediaControlChannel indicates the media control channel in which the sender of the open logical channel will be listening for media control messages for this session. This field is present only when a media control channel is required.

mediaControlGuaranteedDelivery indicates whether or not the underlying media control transport should be selected to provide or not provide guaranteed delivery of data. This field is present only when a media control channel is required.

The silenceSuppression is used to indicate whether the transmitter stops sending packets during times of silence. It shall be included in the openLogicalChannel message for an audio channel and omitted for any other type of channel.

destination indicates the terminalLabel of the destination if one has been assigned.

dynamicRTPPayloadType indicates a dynamic payload value. When this field is used, RTPPayloadType.payloadType and the value of this field shall match.

mediaPacketization indicates which optional media packetization scheme is in use.

redundancyEncoding indicates that the redundant encoding method indicated in this parameter is to be used for the logical channel to be opened. The primary encoding is defined by the *dataType* of the *forwardLogicalChannelParameters* or the *reverseLogicalChannelParameters*, respectively. The type of redundancy encoding to be applied for this logical channel is identified by the *redundancyEncodingMethod* parameter, the secondary encoding is specified in the *secondaryEncoding* parameter. The *DataType* (audio, video, etc.) selected for both primary and secondary encoding shall match and shall be in accordance with the *redundancyEncodingMethod* selected. The source parameter is used to identify the terminal number of the sender of the OpenLogicalChannel message.

The opening of a channel protected by redundancy, as specified in RFC 2198, is achieved using **dataType.redundancyEncoding**. This field allows signalling a primary data type and a number of **secondary** data types. It also makes it possible to use RFC 2198 with "multiple payload stream" and with Forward Error Correction.

When opening a logical channel, the RTP payload type for the RFC 2198 packet is specified by the **dynamicPayloadType** field in the **OpenLogicalChannel** or by the **payloadType** field inside the **multiplePayloadStreamElement** structure. The payload types for the primary and secondary payload types are specified in the **RedundancyEncodingElement** structure, along with the **DataType** of the primary or secondary data.

When RFC 2198 redundancy encoding is used, the **redundancyEncodingMethod** shall be set to **rtpRedundancyEncoding**. Also, when using RFC 2198 and populating the **RedundancyEncoding** SEQUENCE, only the **rtpRedundancyEncoding** SEQUENCE shall be used. The fields **RedundancyEncoding.secondaryEncoding** and **RedundancyEncoding.rtpRedundancyEncoding** shall not be used at the same time.

When encryption is specified for a channel carrying multiple payloads, redundancy encoding using RFC 2198 is used to preserve the actual payload types transmitted. The Encapsulating payload type is set to the value specified in the syncFlag field of the encryptionSync element.

h235 Key: used to include, and specify the method by which media specific session keys are protected as they are passed between two endpoints. The encoding of this field is a nested ASN.1 value as described in ITU-T Rec. H.235.0.

EscrowData is used to specify the type and contents of any key escrow mechanism in use. Specific types and contents may be required by implementations when media encryption is enabled.

T120SetupProcedure indicates how the T.120 conference is to be set up. For originateCall and waitForCall, the caller should derive the T.120 numeric conference name from the H.323 CID (as described in ITU-T Rec. H.323), and issue the appropriate PDU (if the endpoint is master, it should issue an invite request, while a slave should issue a join request). For issueQuery, the caller should first issue a query request, and then set up the T.120 conference in accordance with the contents of the query response (as described in ITU-T Rec. T.124).

B.3.2 Open Logical Channel Acknowledge

This is used to confirm acceptance of the logical channel connection request from the peer LCSE or B-LCSE. In the case of a request for a unidirectional logical channel, it indicates acceptance of that unidirectional logical channel. In the case of a request for a bidirectional logical channel, it indicates acceptance of that bidirectional logical channel, and indicates the appropriate parameters of the reverse channel.

forwardLogicalChannelNumber indicates the logical channel number of the forward channel that is being opened.

reverseLogicalChannelParameters is present if and only if responding to a bidirectional channel request.

reverseLogicalChannelNumber indicates the logical channel number of the reverse channel.

portNumber is a user-to-user parameter that may be used by a user for such purposes as associating an input or output port, or higher layer channel number, with the reverse logical channel.

multiplexParameters indicate parameters specific to the multiplex, H.222, H.223, or H.225.0, that is used to transport the reverse logical channel.

FlowControlToZero indicates whether the transmitter is allowed to start transmitting on the logical channel. If set to true, it indicates that the transmitter should not transmit on the logical channel until receiving a subsequent FlowControl message, applying to the logical channel, allowing it to do so. If set to false, or absent, the transmitter is allowed to begin transmitting immediately the channel is established.

The replacementFor parameter indicates that the logical channel to be opened will be a *replacement for* the specified existing, already-open logical channel. This parameter shall be used only to refer to logical channels already in the ESTABLISHED state. Logical channels opened using this parameter shall not carry any data traffic until after all traffic on the referenced established logical channel ceases. Media decoders will in this case never be required to decode data traffic from both logical channels simultaneously. Once traffic on the newly established logical channel has begun, the old logical channel shall immediately be closed. Receivers may acknowledge logical channels opened using the replacementFor mechanism with the understanding that the old and new logical channels shall not be used simultaneously, and therefore will not exceed the receiver's capability to decode.

separateStack indicates that a separate transport stack will be used to transport the data and provides an address, to use to establish the stack, which is either a Q.2931, E.164, or local area network transport address.

forwardMultiplexAckParameters indicate parameters specific to the multiplex, H.222, H.223, or H.225.0 that is used to transport the forward logical channel.

The encryptionSync field shall be used by the master to provide the encryption key value and the synchronization point at which the key should be used. For ITU-T Rec. H.323, the syncFlag shall be set to the RTP dynamic payload number which matches the key.

H2250LogicalChannelAckParameters are used to indicate parameters specific to using ITU-T Rec. H.225.0.

sessionID is a unique RTP Session Identifier in the conference that can only be created by the master. It is created and provided by the master if the slave wishes to create a new session by specifying an invalid session identification of 0 in the openLogicalChannelAck message.

The mediaChannel indicates a transportAddress to be used for the logical channel. It shall be present in the OpenLogicalChannelAck message when the transport is unicast except where the OpenLogicalChannel request specified a reverse unicast mediaChannel. If the transportAddress is multicast, the master is responsible for creating the multicast transport address and shall include the address in the OpenLogicalChannel message. A slave entity that wishes to open a new multicast channel will provide zeroes in the multicast transportAddress field. The master will create and provide the multicast transportAddress in the OpenLogicalChannelAck message for the slave entity. Note that the MC will use the communicationModeCommand to specify the details about all the RTP Sessions in the conference.

The mediaChannel is used to describe the transport address for the logical channel. IPv4 and IPv6 addresses shall be encoded with the most significant octet of the address being the first octet in the respective OCTET STRING, e.g., the class B IPv4 address 130.1.2.97 shall have the "130" being encoded in the first octet of the OCTET STRING, followed by the "1" and so forth. The IPv6 address a148:2:3:4:a:b:c:d shall have the "a1" encoded in the first octet, "48" in the second, "00" in the third, "02" in the fourth and so forth. IPX addresses, node, netnum, and port shall be encoded with the most significant octet of each field being the first octet in the respective OCTET STRING.

mediaControlChannel indicates the media control channel in which the sender of the openLogicalChannelAck will be listening for media control messages for this session. This field is present only when a media control channel is required.

dynamicRTPPayloadType indicates a dynamic payload value which is used in H.323 for the H.225.0 alternative H.261 video packetization scheme. This field is present only when a dynamic RTP payload is in use.

The portNumber field is used in Annex C/H.323 when the receiving endpoint finds that the B-HLI given by the portNumber field in the OpenLogicalChannel message is inappropriate, and indicates the alternative value that is to be used.

NOTE – H.223 parameters are not included in reverseLogicalChannelParameters as their values were specified in the OpenLogicalChannel request message.

B.3.3 Open Logical Channel Reject

This is used to reject the logical channel connection request from the peer LCSE or B-LCSE.

NOTE – In the case of a bidirectional channel request, rejection applies to both forward and reverse channels. It is not possible to accept one and reject the other.

forwardLogicalChannelNumber indicates the logical channel number of the forward channel specified in the request that is being rejected.

The cause field indicates the reason for rejection of the logical channel establishment. The cause values are given in Table B.7.

Table B.7/H.245 – Reasons for rejecting a OpenLogicalChannel

ASN.1 codepoint	Cause
unspecified	No cause for rejection specified.
unsuitableReverseParameters	This shall only be used to reject a bidirectional logical channel request when the only reason for rejection is that the requested reverseLogicalChannelParameters are inappropriate. Such a rejection shall immediately be followed by initiating procedures to open a similar but acceptable bidirectional logical channel.
dataTypeNotSupported	The terminal was not capable of supporting the dataType indicated in OpenLogicalChannel.
dataTypeNotAvailable	The terminal was not capable of supporting the dataType indicated in OpenLogicalChannel simultaneously with the dataTypes of logical channels that are already open.
unknownDataType	The terminal did not understand the dataType indicated in OpenLogicalChannel.
dataTypeALCombinationNotSupported	The terminal was not capable of supporting the dataType indicated in OpenLogicalChannel simultaneously with the Adaptation Layer type indicated in H223LogicalChannelParameters.
multicastChannelNotAllowed	Multicast Channel could not be opened.
insufficientBandwidth	The channel could not be opened because permission to use the requested bandwidth for the logical channel was denied.

Table B.7/H.245 – Reasons for rejecting a OpenLogicalChannel

ASN.1 codepoint	Cause
separateStackEstablishmentFailed	A request to run the data portion of a call on a separate stack failed.
invalidSessionID	Attempt by slave to set SessionID when opening a logical channel to the master.
masterSlaveConflict	Attempt by slave to open logical channel in which the master has determined a conflict may occur (see C.4.1.3 and C.5.1.3).
waitForCommunicationMode	Attempt to open logical channel before MC has transmitted the CommunicationModeCommand.
invalidDependentChannel	Attempt to open logical channel with a dependent channel specified which is not present.
replacementForRejected	A logical channel of the type attempted cannot be opened using the replacementFor parameter. The transmitter may wish to re-try by firstly closing the logical channel which was to be replaced, and then opening the replacement.

B.3.4 Open Logical Channel Confirm

This is used in bidirectional signalling to indicate to the incoming B-LCSE that the reverse channel is open and can be used for transmission.

forwardLogicalChannelNumber indicates the logical channel number of the forward channel which was opened.

B.3.5 Close Logical Channel

This is used by the outgoing LCSE or B-LCSE to close a logical channel connection between two peer LCSEs or B-LCSEs.

NOTE – In the case of a bidirectional logical channel, this closes both forward and reverse channels. It is not possible to close one and not the other.

forwardLogicalChannelNumber indicates the logical channel number of the forward channel of the logical channel that is to be closed.

The source of the logical channel release is given in Table B.8.

Table B.8/H.245 – Sources of logical channel release

ASN.1 codepoint	Cause
user	The LCSE or B-LCSE user is the source of the release.
lcse	The LCSE or B-LCSE is the source of the release. This may occur as a result of a protocol error.

reason indicates why the channel is being closed. reservationFailure indicates that a QoS reservation was not able to be placed for the channel and it is therefore being closed. reopen indicates that the endpoint should close the channel and then re-open a channel using the OpenLogicalChannel procedures. As an example, this may occur if a multipoint call is reduced to a point-to-point call due to endpoints dropping from a conference.

B.3.6 Close Logical Channel Acknowledge

This is used to confirm the closing of a logical channel connection.

forwardLogicalChannelNumber indicates the logical channel number of the forward channel of the logical channel that is being closed.

B.3.7 Request Channel Close

This is used by the outgoing CLCSE to request the closing of a logical channel connection between two peer LCSEs.

forwardLogicalChannelNumber indicates the logical channel number of the forward channel of the logical channel that is requested to close.

qosCapability is used to indicate the QoS parameters which were in use on the channel.

reason indicates why the request to close the channel is occurring. reservationFailure indicates that a QoS reservation was not able to be placed for the channel and it is therefore being closed. reopen indicates that the endpoint should close the channel and then re-open a channel using the OpenLogicalChannel procedures. As an example, this may occur if a multipoint call is reduced to a point-to-point call due to endpoints dropping from a conference.

B.3.8 Request Channel Close Acknowledge

This is used by the incoming CLCSE to indicate that the logical channel connection will be closed.

forwardLogicalChannelNumber indicates the logical channel number of the forward channel of the logical channel that it has been requested to close.

B.3.9 Request Channel Close Reject

This is used by the incoming CLCSE to indicate that the logical channel connection will not be closed.

forwardLogicalChannelNumber indicates the logical channel number of the forward channel of the logical channel that it has been requested to close.

The cause field indicates the reason for rejection of the request to close the logical channel. The only valid cause value is unspecified.

B.3.10 Request Channel Close Release

This is sent by the outgoing CLCSE in the case of a timeout.

forwardLogicalChannelNumber indicates the logical channel number of the forward channel of the logical channel that it has requested to close.

B.4 Multiplex Table signalling messages

This set of messages is for the secure transmission of H.223 multiplex table entries from the transmitter to the receiver.

B.4.1 Multiplex Entry Send

This is used to send H.223 multiplex table entries from the transmitter to the receiver. It is sent from an outgoing MTSE and a peer incoming MTSE.

sequenceNumber is used to label instances of MultiplexEntrySend so that the corresponding response can be identified.

MultiplexEntryDescriptors is a set of 1 to 15 MultiplexEntryDescriptors.

MultiplexEntryDescriptor: describes a single multiplex table entry. It includes the MultiplexTableEntryNumber and a list of MultiplexElements. A missing element list indicates that the entry is deactivated.

MultiplexElement: a recursive structure that describes a single element and a repeat count. If of type logicalChannelNumber, the element indicates a single slot from the given logical channel, and the repeat count indicates the length of the slot in octets. If of type subElementList, the element indicates a sequence of nested MultiplexElements, and the repeat count indicates the number of times to repeat the sequence. In either case, if the repeatCount field is untilClosingFlag, this means to repeat the element indefinitely until the closing flag of the MUX-PDU.

In each MultiplexEntryDescriptor, the repeatCount of the final MultiplexElement in the elementList shall be set to "untilClosingFlag", and the repeatCount of all other MultiplexElements in the elementList shall be set to "finite". This ensures that all multiplex table entries define a multiplex sequence pattern of indefinite length, repeating until the closing flag of the MUX-PDU. A MultiplexEntryDescriptor with a missing elementList field shall indicate a deactivated entry.

Each MultiplexEntrySend request may contain up to 15 MultiplexEntryDescriptors, each describing a single multiplex table entry. Multiplex entries may be sent in any order.

B.4.2 Multiplex Entry Send Acknowledge

This is used to confirm receipt of one or more multiplexEntryDescriptors from a MultiplexEntrySend from the peer MTSE.

The sequenceNumber shall be the same as the sequenceNumber in the MultiplexEntrySend for which this is the confirmation.

multiplexTableEntryNumber indicates which multiplex table entries are being confirmed.

B.4.3 Multiplex Entry Send Reject

This is used to reject one or more multiplexEntryDescriptors from a MultiplexEntrySend from the peer MTSE.

The sequenceNumber shall be the same as the sequenceNumber in the MultiplexEntrySend for which this is the rejection.

MultiplexEntryRejectionDescriptions specifies which table entries are being rejected, and why. The causes of rejection are given in Table B.9.

Table B.9/H.245 – Reasons for rejecting a MultiplexEntrySend

ASN.1 codepoint	Cause
unspecified	No cause for rejection specified.
descriptorTooComplex	The MultiplexEntryDescriptor exceeded the capability of the receive terminal.

B.4.4 Multiplex Entry Send Release

This is sent by the outgoing MTSE in the case of a timeout.

multiplexTableEntryNumber indicates which multiplex table entries have timed out.

B.5 Request Multiplex Table signalling messages

This set of messages is for the secure request of retransmission of one or more MultiplexEntryDescriptors from the transmitter to the receiver.

B.5.1 Request Multiplex Entry

This is used to request the retransmission of one or more MultiplexEntryDescriptors.

entryNumbers is a list of the MultiplexTableEntryNumbers of the MultiplexEntryDescriptors for which retransmission is requested.

B.5.2 Request Multiplex Entry Acknowledge

This is used by the incoming RMESE to indicate that the multiplex entry will be transmitted.

entryNumbers is a list of the MultiplexTableEntryNumbers of the MultiplexEntryDescriptors that will be transmitted.

B.5.3 Request Multiplex Entry Reject

This is used by the incoming RMESE to indicate that the multiplex entry will not be transmitted.

entryNumbers is a list of the MultiplexTableEntryNumbers of the MultiplexEntryDescriptors that will not be transmitted. The values of MultiplexTableEntryNumber in entryNumbers should match the values of MultiplexTableEntryNumber in rejectionDescriptions otherwise errors may occur during operation.

RequestMultiplexEntryRejectionDescriptions specifies which table entries are being rejected, and why. The causes of rejection are given in Table B.10.

Table B.10/H.245 – Reasons for rejecting a MultiplexEntrySend

ASN.1 codepoint	Cause
unspecified	No cause for rejection specified.

B.5.4 Request Multiplex Entry Release

This is sent by the outgoing RMESE in the case of a timeout.

entryNumbers is a list of the MultiplexTableEntryNumbers of the MultiplexEntryDescriptors for which timeout has occurred.

B.6 Request Mode messages

This set of messages is used by a receive terminal to request particular modes of transmission from the transmit terminal.

B.6.1 Request Mode

This is used to request particular modes of transmission from the transmit terminal. It is a list, in order or preference (most preferable first), of modes that the terminal would like to receive. Each mode is described using a ModeDescription.

sequenceNumber is used to label instances of RequestMode so that the corresponding response can be identified.

ModeDescription: a set of one or more ModeElements.

ModeElement: used to describe a mode element, that is, one of the constituent parts of a complete mode description. It indicates the type of elementary stream that is requested and optionally how it is requested to be multiplexed.

type is used to indicate the type of elementary stream that is requested. It is a choice of VideoMode, AudioMode, DataMode, EncryptionMode, and H235Mode. H235Mode indicates that encrypted media is requested.

multiplexedStreamMode indicates the requested multiplexed stream transmission mode. The fields of MultiplexedStream have the same meaning as the fields of the same name in MultiplexedStreamCapability.

h223ModeParameters: used to indicate parameters specific to using ITU-T Rec. H.223 [10].

adaptationLayerType indicates which adaptation layer and options are requested for the requested type. The codepoints are as follows: nonStandard, al1Framed (AL1 framed mode), al1NotFramed (AL1 unframed mode), al2WithoutSequenceNumbers (AL2 with no sequence numbers present), al2WithSequenceNumbers (AL2 with sequence numbers present), and al3 (AL3, indicating the number of control field octets that will be present and the size of the send buffer, B_S, that will be used, the size being measured in octets), al1M (Al1M defined in Annex C/H.223 with specified parameters), al2M (Al2M defined in Annex C/H.223 with specified parameters), and al3M (Al3M defined in Annex C/H.223 with specified parameters).

segmentableFlag, when equal to true indicates that segmentable multiplexing is requested, and when equal to false indicates that non-segmentable multiplexing is requested.

h2250ModeParameters contains information specific for use along with ITU-T Recs H.225.0 and H.323.

redundancyEncodingMode (if present) specifies which *redundancyEncodingMethod* shall be used and which *secondaryEncoding* shall be used as redundancy encoding. The primary encoding is specified by the *type* element contained in the *ModeElement*.

genericModeParameters indicates generic mode parameters.

multiplexedStreamModeParameters indicates the multiplexed stream logical channel to which this mode request applies: the logical channel is identified by the logicalChannelNumber field.

logicalChannelNumber: if present, indicates the logical channel for which the specified mode is requested. logicalChannelNumber should only be used to specify an open logical channel.

B.6.1.1 Video Mode

This is a choice of VideoModes.

H261VideoMode: indicates the requested picture resolution (either QCIF or CIF), bit rate, in units of 100 bit/s, and still picture transmission.

H262VideoMode: indicates the requested profile and level, and the optional fields, if present, indicate the requested values of the parameters given. The optional fields are integers with units defined in Table B.2.

H263VideoMode: indicates the requested picture resolution (SQCIF, QCIF, CIF, 4CIF and 16CIF or some custom picture format) and bit rate, in units of 100 bit/s. When communicating with an endpoint supporting ITU-T Rec. H.245 version 8 or earlier, it is not possible to request only a custom picture format. Therefore, when receiving RequestMode from an endpoint supporting ITU-T Rec. H.245 version 8 or earlier, if the RequestMode contains a custom picture format, this should be considered the requested resolution rather than the resolution indicated in the resolution field of H263VideoMode.

The booleans unrestrictedVector, arithmeticCoding, advancedPrediction, and pbFrames, when true, indicate that is it requested to use these optional modes that are defined in the annexes of ITU-T Rec. H.263.

The boolean errorCompensation, when true, indicates that the encoder is capable of processing videoNotDecodedMBs indications and compensating errors as illustrated in Appendix I/H.263. The encoder is not required to respond to videoNotDecoded indications. In a multipoint control unit (MCU), it may not be practical for the MCU to respond to all indications.

EnhancementOptions: indicates the requested scalability enhancement layer parameters.

H263Options: indicates the requested optional modes of ITU-T Rec. H.263.

IS11172VideoMode: indicates request for constrainedBitstream and the optional fields, if present, indicate the requested values of the parameters given. The optional fields are integers with units defined in Table B.3.

genericVideoMode indicates generic video mode parameters.

B.6.1.2 Audio Mode

This is a choice of AudioModes.

The exact meaning of the G-series audio codepoints is given in Table B.4. There are four options for G.723.1 audio, to allow either of the bit rates (the low bit rate of 5.3 kbit/s or the high bit rate of 6.3 kbit/s) to be requested with or without the use of silence suppression.

G7231AnnexCMode: used to request audio coded according to Annex C/G.723.1. maxAl-sduAudioFrames indicates the requested maximum number of audio frames per AL-SDU. The boolean silenceSupression, when true, requests the use of silence compression defined in Annex A/G.723.1. The fields of g723AnnexCAudioMode, highRateMode0, highRateMode1, lowRateMode0, lowRateMode1, sidMode0, and sidMode1 indicate the requested number of octets per frame for each of the audio and error protection modes of ITU-T Rec. G.723.1 and Annex C/G.723.1.

IS11172AudioMode: used to request audio coded according to ISO/IEC 11172-3 [45].

audioLayer indicates which coding layer is requested: either audioLayer1, audioLayer2 or audioLayer3.

audioSampling indicates which sample rate is requested: audioSampling32k, audioSampling44k1 and audioSampling48k indicate the audio sample rates 32 kHz, 44.1 kHz and 48 kHz, respectively.

multichannelType indicates which multichannel mode is requested: singleChannel, twoChannelStereo and twoChannelDual request single channel, stereo and dual channel operation respectively.

bitRate indicates the requested audio bit rate, and is measured in units of kbit/s.

IS13818AudioMode: used to request audio coded according to ISO/IEC 13818-3 [46].

audioLayer indicates which coding layer is requested: either audioLayer1, audioLayer2 or audioLayer3.

audioSampling indicates which sample rate is requested: audioSampling16k, audioSampling22k05, audioSampling24k, audioSampling32k, audioSampling44k1 and audioSampling48k indicate the audio sample rates 16 kHz, 22.05 kHz, 24 kHz, 32 kHz, 44.1 kHz and 48 kHz respectively.

multichannelType indicates which multichannel mode is requested as specified in Table B.11.

Table B.11/H.245 – ISO/IEC 13818-3 multichannel codepoints

ASN.1 codepoint	Semantic meaning of codepoint
singleChannel	One channel, using the 1/0 configuration. Single channel mode (as in ISO/IEC 11172-3)
twoChannelStereo	Two channels, using the 2/0 configuration, stereo channel mode (as in ISO/IEC 11172-3)
twoChannelDual	Two channels, using the 2/0 configuration, dual channel mode (as in ISO/IEC 11172-3)
threeChannels2-1	Three channels, using the 2/1 configuration. Left, Right and single surround channel

Table B.11/H.245 – ISO/IEC 13818-3 multichannel codepoints

ASN.1 codepoint	Semantic meaning of codepoint
threeChannels3-0	Three channels, using the 3/0 configuration. Left, Centre and Right, without surround channel
fourChannels2-0-2-0	Four channels, using the 2/0 + 2/0 configuration. Left and Right of the first programme and Left and Right of the second programme
fourChannels2-2	Four channels, using the 2/2 configuration. Left, Right, Left surround and Right surround
fourChannels3-1	Four channels, using the 3/1 configuration. Left, Centre, Right, and a single surround channel
fiveChannels3-0-2-0	Five channels, using the 3/0 + 2/0 configuration. Left, Centre and Right of the first programme and Left and Right of the second programme
fiveChannels3-2	Five channels, using the 3/2 configuration. Left, Centre, Right, Left surround and Right surround

The boolean lowFrequencyEnhancement, when true, requests a low frequency enhancement channel.

The boolean multilingual, when true, requests up to seven multilingual channels.

bitRate indicates the requested audio bit rate, and is measured in units of kbit/s.

genericAudioMode indicates generic audio mode parameters.

B.6.1.3 Data Mode

This is a choice of data applications and bit rates.

bitRate indicates the requested bit rate in units of 100 bit/s.

t120 requests the use of the T.120 [32] protocol.

dsm-cc requests the use of the DSM-CC [47] protocol.

userData requests the use of unspecified user data from external data ports.

t84 requests the use of ITU-T Rec. T.84 [31] for the transfer of such images (JPEG, JBIG, Facsimile Gr.3/4).

t434 requests the use of ITU-T Rec. T.434 [35] for the transfer of telematic binary files.

h224 requests the use of the real-time simplex device control protocol H.224 [11].

nlpid requests the use of the specified network link layer data application.

dsvdControl requests the use of the DSVD terminal to support an out-of-band control channel.

h222DataPartitioning requests the use of the modified and restricted usage of data partitioning of H.262, as specified in ITU-T Rec. H.222.1, in which the enhancement data is transmitted as a data channel supported by the listed DataProtocolCapability.

t30fax requests the use of Annex C/T.30 analog mode (G3V), as specified in ITU-T Rec. T.39 for the DSVF/MSVF modes.

t140 requests the use of the T.140 text conversation protocol, as specified in ITU-T Rec. T.140.

t38fax requests the use of ITU-T Rec. T.38 [29].

genericDataMode: indicates generic data mode parameters. When maxBitRate is included in the genericDataMode, its value shall be the same as the value of maxBitRate in the DataMode.

B.6.1.4 Encryption Mode

This is a choice of encryption modes.

h233Encryption requests the use of encryption according to ITU-T Recs H.233 [14] and H.234 [15].

B.6.2 Request Mode Acknowledge

This is sent to confirm that the transmit terminal intends to transmit in one of the modes requested by the receive terminal.

The sequenceNumber shall be the same as the sequenceNumber in the RequestMode for which this is the confirmation.

The response field indicates the action from the remote terminal. The possible values of response are given in Table B.12.

Table B.12/H.245 – Confirmation responses to Request Mode

ASN.1 codepoint	Response
willTransmitMostPreferredMode	The transmit terminal will change to the receiver's most preferred mode.
willTransmitLessPreferredMode	The transmit terminal will change to one of the receiver's preferred mode, but not the most preferred mode.

B.6.3 Request Mode Reject

This is sent to reject the request by the receive terminal.

The sequenceNumber shall be the same as the sequenceNumber in the RequestMode for which this is the response.

The cause field indicates the reason for rejection of the requested mode. The cause values are given in Table B.13.

Table B.13/H.245 – Rejection responses to Request Mode

ASN.1 codepoint	Response
modeUnavailable	The transmit terminal will not change its mode of transmission as the requested modes are not available.
multipointConstraint	The transmit terminal will not change its mode of transmission due to a multipoint constraint.
requestDenied	The transmit terminal will not change its mode of transmission.

B.6.4 Request Mode Release

This is used by the outgoing MRSE in the case of a timeout.

B.7 Round-trip Delay messages

This set of messages is used by a terminal to determine the round-trip delay between two communicating terminals. It also enables a H.245 user to determine whether the peer H.245 protocol entity is alive.

B.7.1 Round-trip Delay Request

This is sent from the outgoing RTDSE to the incoming RTDSE.

sequenceNumber is used to label instances of RoundTripDelayRequest so that the corresponding response can be identified.

B.7.2 Round-trip Delay Response

This is sent from the incoming RTDSE to the outgoing RTDSE.

The sequenceNumber shall be the same as the sequenceNumber in the RoundTripDelayRequest for which this is the response.

B.8 Maintenance Loop messages

This set of messages is used by a terminal to perform maintenance loop functions.

B.8.1 Maintenance Loop Request

This is sent to request a particular type of loop back. The types mediaLoop and logicalChannelLoop request the loopback of only one logical channel as indicated by LogicalChannelNumber, while the type systemLoop refers to all logical channels. The exact definition of these types is system specific and outside the scope of this Recommendation.

B.8.2 Maintenance Loop Acknowledge

This is used to confirm that the terminal will perform the loop as requested.

B.8.3 Maintenance Loop Reject

This is used to indicate that the terminal will not perform the loop as requested.

A terminal may use the cause canNotPerformLoop to indicate that it does not have the capability to perform the requested loop.

B.8.4 Maintenance Loop Command Off

On receipt of this command, the terminal shall disconnect all loops and restore audio, video and data paths to their normal condition.

B.9 Communication Mode Messages

This set of messages is used by an H.323 MC to convey the communication mode of an H.323 conference.

B.9.1 Communication Mode Command

The **CommunicationModeCommand** is sent by an H.323 MC to specify the communication mode for each media type: unicast or multicast. This command may cause a switch between a centralized and decentralized conference and therefore may involve closing all existing logical channels and opening new ones.

The **CommunicationModeCommand** specifies all the sessions in the conference. For each session, the following data is specified: the RTP session identifier, the associated RTP session ID if applicable, a terminal label if applicable, a description of the session, the datatype of the sessions (e.g., G.711), and a unicast or multicast address for the media and media control channels as appropriate for the conference configuration and type. In case a redundancy encoding shall be used, the communicationModeTableEntry also specifies the redundancyEncodingMethod as well as the secondary encoding format.

The **CommunicationModeCommand** conveys the transmit modes which conference endpoints are to use in a conference. The command does not convey receive modes, as they are specified by **OpenLogicalChannel** commands which are sent from the MC to the endpoints.

It is presumed that the **CommunicationModeCommand** is defining the modes of a conference and is therefore sent after the **multipointConference** indication which notifies an endpoint that it must comply with the commands of the MC. Endpoints should wait for a **CommunicationModeCommand** before opening logical channels when they have received a **multipointConference** indication.

Endpoints receiving a **CommunicationModeCommand** use the **terminalLabel** field of each table entry to determine if the entry is applicable for its own processing. Entries which do not contain a **terminalLabel** apply to all endpoints in the conference. Entries which contain **terminalLabels** are commands to specific endpoints and which match the **terminalLabel** in the entry. For example, when audio streams from all endpoints are placed on one multicast address (one session), the table entry for the audio mode, media address, and media control address will not contain a **terminalLabel**. When the table entry commands an endpoint to send its video to a multicast address, the MC will include that endpoint's **terminalLabel**.

SessionDependency is set by the MC to indicate when a session is dependent on another session for meaningful decoding of the data.

The **destination** field in the CommunicationModeTableEntry indicates the endpoint to which the transmitting endpoint should open a logical channel. If the **destination** field exists in the CommunicationModeTableEntry, the endpoint shall use the destination as the **destination** field in H2250LogicalChannelParameters of the OpenLogicalChannel message.

The CommunicationModeCommand can be used to instruct endpoints in a conference (or a point-to-point call) to change modes (by indicating a new mode with the mediaChannel already used) or to transmit to a new address (by indicating the mode currently in use, but with new mediaChannel). Similarly, an endpoint that receives a CommunicationModeCommand indicating the mode currently in use and no mediaChannel should close the appropriate channel and the attempt to reopen using the OpenLogicalChannel procedures, where the OpenLogicalChannelAck contains the address to which the endpoint will send the medium.

B.9.2 Communication Mode Request

This is sent to the MC to request the communication mode of the current conference.

B.9.3 Communication Mode Response

This is sent by the MC, in response to a CommunicationModeRequest to specify the communication mode of a conference.

B.10 Conference Request and Response Messages

TerminalID, which is used in the Conference Request and Response Messages, has a length of 128 octets. When communicating between an H.323 terminal and an H.320 terminal via an H.323 Gateway, this field will be truncated to 32 octets.

B.10.1 Terminal List Request

This request equates to H.230 TCU as described in ITU-T Rec. H.243.

B.10.2 Terminal List Response

This request equates to a sequence of terminalNumbers as described in ITU-T Rec. H.230.

B.10.3 Make Me Chair

This request equates to CCA as described in ITU-T Rec. H.230.

B.10.4 Cancel Make Me Chair

This request equates to CIS as described in ITU-T Rec. H.230.

B.10.5 Make Me Chair Response

This request equates to either H.230 CIT if the chair control token is granted or H.230 CCR if the chair control token is denied.

B.10.6 Drop Terminal

This request equates to CCD as described in ITU-T Rec. H.230.

B.10.7 Terminal Drop Reject

This response equates to CIR as described in ITU-T Rec. H.230.

B.10.8 RequestTerminal ID

This request equates to TCP as described in ITU-T Rec. H.230.

B.10.9 MC Terminal ID Response

This response equates to TIP as described in ITU-T Rec. H.230.

B.10.10 Enter H.243 Password Request

This request equates to TCS1 as described in ITU-T Rec. H.230.

B.10.11 Password Response

This response equates to IIS as described in ITU-T Rec. H.230.

B.10.12 Enter H.243 Terminal ID Request

This request equates to TCS2/TCI as described in ITU-T Rec. H.230.

B.10.13 Terminal ID Response

This response equates to IIS as described in ITU-T Rec. H.230.

B.10.14 Enter H.243 Conference ID Request

This request equates to TCS3 as described in ITU-T Rec. H.230.

B.10.15 Conference ID Response

This response equates to IIS as described in ITU-T Rec. H.230.

B.10.16 Video Command Reject

This request equates to H.230 VCR.

B.10.17 Enter Extension Address Request

This request equates to TCS4 as described in ITU-T Rec. H.230.

B.10.18 Extension Address Response

This response equates to IIS as described in ITU-T Rec. H.230.

B.10.19 Request Chair Control Token Owner

This request equates to TCA as described in ITU-T Rec. H.230 for the Chair Control Token.

B.10.20 Chair Token Owner Response

This response equates to TIR as described in ITU-T Rec. H.230 for the Chair Control Token.

B.10.21 Request Terminal Certificate

This request is issued by any endpoint in a conference to its MC. It allows an endpoint to obtain the digital certificate for the user at a particular terminal. The requesting terminal may optionally include its own terminalCertificate and a challengeString which is encrypted with the private key.

The CertSelectionCriteria defines a set certificates that are acceptable to the requester. The responder (the MC) should attempt to satisfy these criteria. CertSelectionCriteria may be present along with terminalLabel. In this case, the MC may use the criteria either to select an appropriate certificate from those presented by the specified terminal, or may request from the specified terminal for a certificate matching the criteria, which it then returns to the original, requesting terminal.

This response may return the digital certificate and optionally a signature associated with the certificate as per the following:

- If the source of the terminalCertificateResponse does not have a suitable certificate, this message may be returned with no certificate (and therefore, no certificateResponse structure).
- If an endpoint is requesting the certificate of another endpoint in a multipoint conference (indicated by the terminalLabel), the responding MC shall return a certificate associated with the requested endpoint (contained within the certificateResponse structure).
- The certificateResponse structure should be present. In the event that the MC is presenting the certificate to the requester on behalf of another endpoint, there shall be a cryptographic link between the signatures and that of the MC. This shall be provided in one of two ways.
  - The private key used to protect session key material distributed in the most recent exchange shall be used.
  - If there has been no key material exchanged, or that key is not suitable for signing, the certificate that was used during the most recent endpoint-MC authentication shall be the source of the private key.

B.10.22 Terminal Certificate Response

This response returns the digital certificate and a responseString which is encrypted with the private key for a specific terminal.

B.10.23 Broadcast My Logical Channel

This request is similar to H.230 MCV used according to the procedure in 6.3.2.2/H.243, but only refers to a single logical channel and has a response message broadcastMyLogicalChannelResponse which acknowledges the request. Note that when the MCV procedure in 6.3.2.1/H.243 applies (that is, when either end of a terminal-MCU or inter-MCU link lacks multipointVisualizationCapability), the conferenceCommand form of BroadcastMyLogicalChannel is used instead.

B.10.24 Broadcast My Logical Channel Response

Provides a granted or denied response to the BroadcastMyLogicalChannel Request.

B.10.25 Make Terminal Broadcaster

This request is similar to H.230 VCB and has a response message makeTerminalBroadcasterResponse which acknowledges the request.

B.10.26 Make Terminal Broadcaster Response

Provides a granted or denied response to the MakeTerminalBroadcaster Request.

B.10.27 Send This Source

This request is similar to H.230 VCS and has a response message SendThisSourceResponse which acknowledges the request.

B.10.28 SendThisSource Response

Provides a granted or denied response to SendThisSource Request.

B.10.29 Request All Terminals IDs

Sent by an endpoint to the MC of a conference to obtain all of the terminal labels and terminal IDs of the conference participants.

B.10.30 Request All Terminal IDs Response

Response to RequestAllTerminalIDs containing a list of all endpoints in conference by terminalLabel and terminalID.

B.10.31 RemoteMC Request

This request is sent by an active MC to another MC to activate/de-activate it. A RemoteMC Request with a choice of masterActivate or slaveActivate may be sent by an active MC to an inactive MC to activate it as Master or Slave, respectively, of a cascaded connection. A RemoteMC Request with a choice of deActivate may be sent by a Master MC to an already active Slave MC to de-activate it.

B.10.32 RemoteMC Response

The RemoteMC Response is sent to indicate acceptance or rejection of the RemoteMC Request. Acceptance of this request is determined by the following criteria:

Choice = activateSlave

The receiver is inactive and the sender of the request initiated this call with a conferenceGoal of INVITE in the H.225 Setup message or the receiver of the request initiated this call with a conferenceGoal of JOIN in the H.225 Setup message.

Choice = activateMaster

The receiver is inactive and the sender of the request initiated this call with a conferenceGoal of CREATE in the H.225 Setup message.

Choice = deActivate

The receiver is an active MC.

If the conditions stated above are not met, the request should be rejected with a choice of invalidConfiguration.

A reject choice of functionNotSupported is used by endpoints not supporting cascading.

B.11 Multilink Messages

multilinkRequest, multilinkResponse, and multilinkIndication messages are used to support the use of channel aggregation according to ITU-T Rec. H.226, as specified in Annex F/H.324. These messages provide for the addition and removal of physical connections, automatic exchange of network addresses (telephone numbers), and control of H.226 operation.

B.11.1 callInformation Request and Response

MultilinkRequest.callInformation is used by the initiator, as defined in Annex F/H.324, to request the information needed to establish and associate additional physical connections. The maximum number of additional connections that the sender is capable of establishing is sent in the maxNumberOfAdditionalConnections parameter.

The MultilinkResponse.callInformation message includes the DialingInformation parameter, with contents as described below, as well as a callAssociationNumber. The callAssociationNumber shall contain a 32-bit uniformly distributed random number. Any subsequent callInformation exchanges within the same session shall use the identical callAssociationNumber.

B.11.2 addConnection Request and Response

The MultilinkRequest.addConnection message may be used by the responder, as defined in Annex F/H.324, to ask the initiator to add physical connections. The DialingInformation structure shall indicate the connections to be added. The sequenceNumber parameter shall be incremented by 1, modulo 256, for each new MultilinkRequest.addConnection message sent.

On receiving this message, the initiator shall respond with an MultilinkResponse.addConnection message indicating that it either intends to add the connections as requested, or that it does not intend to do so, along with the appropriate reason code. The sequenceNumber parameter shall be equal to the sequenceNumber parameter of the corresponding MultilinkRequest.addConnection message.

B.11.3 removeConnection Request and Response

The MultilinkRequest.removeConnection message may be used by either the initiator or responder, as defined in Annex F/H.324, to request that the far-end remove a channel from the H.226 channel set. This is used as part of the procedure in Annex F/H.324 for removing physical connections. The connectionIdentifier parameter shall identify the channel to be removed, using the channel numbering received via H.226 from the terminal receiving the MultilinkRequest.removeConnection message.

The MultilinkResponse.removeConnection message shall be sent in response, after the channel has been removed from the H.226 channel set, indicating that this channel is no longer (or was never) in use. The connectionIdentifier parameter shall be identical to the value in the corresponding MultilinkRequest.removeConnection message.

B.11.4 maximumHeaderInterval Request and Response

The MultilinkRequest.maximumHeaderInterval message may be used to request the actual H.226 Maximum Header Interval being used by the remote transmitter without altering it (the currentIntervalInformation choice), or to request a particular value to be used instead (the requestedInterval choice, with units in milliseconds).

The MultilinkResponse.maximumHeaderInterval message shall be sent in response. If the corresponding request was a request for information about the current minimum rate, the terminal shall provide the value that its transmitter is currently using as the Maximum Header Interval in the response. If the corresponding request specified a particular minimum rate to use, the terminal should attempt to comply with this request by modifying the Maximum Header Interval used by its transmitter. Whether or not it makes a change to the Maximum Header Interval, the response shall indicate the new value that is in use (which may be different from the requested value).

B.11.5 Multilink Indications

The MultilinkIndication.crcDesired message may be sent by a terminal to indicate its desire that the remote terminal send the optional H.226 data CRC in all subsequent data sets. The receiving terminal may optionally comply: no explicit acknowledgment or response is required.

The MultilinkIndication.excessiveError message may be sent to indicate to the remote terminal that excessive errors are being received on a particular connection. The means for the terminal to determine the error rate or the criterion for determining what is excessive is defined locally at that terminal. The connection is indicated using the connectionIdentifier parameter. On receipt of this message, a terminal may choose to take corrective action. The particular corrective action that it should take is not specified.

B.11.6 DialingInformation

The DialingInformation type is used to provide explicit dialling information (telephone numbers) to allow the automatic establishment of physical connections. The differential choice provides a list of DialingInformationNumber parameters, one for each potential additional connection. The length of this list indicates the maximum number of additional connections available. If such information is not available, the infoNotAvailable choice is used, indicating only the number of additional connections that are available.

B.11.7 DialingInformationNumber

The DialingInformationNumber type includes up to three sub-parameters that indicate the dialling information for a physical connection differentially relative to the corresponding information for an already established initial connection.

The networkAddress parameter shall include the least significant (right-most) portion of the telephone number for the connection, up to and including the most significant digit that is different from the number for an initially established connection, and shall include no digits that are more significant than this. If the number for the connection is identical to that of the initial connection, the networkAddress parameter shall consist of a zero-length string (since there are no differing digits in the telephone number).

NOTE – The differential digit method is used instead of the full E.164 digit string because the first few digits of the number to be dialled can vary based on the geographic location of the two terminals; for example whether or not they are located in the same city.

If there is a sub-address used for dialling, and the sub-address of a given connection is different from that of the initial connection, the responder shall include the sub-address, in full, in the optional subAddress parameter.

The network types supported for the connection (GSTN, ISDN, or both) shall be indicated using the networkType parameter.

B.11.8 DialingInformationNetworkType

The DialingInformationNetworkType type indicates a circuit-switched network type, n-isdn (N-ISDN), gstn (GSTN) or mobile (Mobile).

B.11.9 ConnectionIdentifier

The ConnectionIdentifier type is used to identify uniquely a single physical connection in H.226, using a combination of channelTag and sequenceNumber from an H.226 Header. If a Channel Tag was not specified at all in the Header, a value of zero shall be used for the channelTag parameter.

B.12 Logical Channel Bit rate Change Messages

LogicalChannelRateRequest, LogicalChannelRateAcknowledge, LogicalChannelRateReject and LogicalChannelRateRelease are used to change the bit rate of a logical channel. The procedure for using these messages is that a terminal can request a target bit rate for a specific logical channel, and the remote terminal can acknowledge or reject the request.

These messages provide an enhanced level of interaction, by allowing for a target bit-rate request as opposed to maximum bit-rate enforcement dictated by FlowControlCommand, and by providing feedback on whether the request is fulfilled or denied.

B.12.1 Logical Channel Rate Request

This is used by a terminal to request a change in the bit rate of the given logical channel being transmitted to it.

sequenceNumber is used to label instances of LogicalChannelRateRequest so that the corresponding response can be identified.

logicalChannelNumber indicates the logical channel that the bit-rate change request applies to.

maximumBitRate indicates, in units of 100 bit/s, the requested maximum bit rate for the logical channel.

B.12.2 Logical Channel Rate Acknowledge

This message is sent to acknowledge a request for a change in bit rate of a logical channel.

The sequenceNumber shall be the same as the sequenceNumber in the LogicalChannelRateRequest for which this is the response.

logicalChannelNumber indicates the logical channel that the bit-rate change request applies to.

maximumBitRate indicates, in units of 100 bit/s, the maximum bit rate for the logical channel that the terminal is acknowledging.

B.12.3 Logical Channel Rate Reject

This message is sent to reject a request for a change in bit rate of a logical channel.

The sequenceNumber shall be the same as the sequenceNumber in the LogicalChannelRateRequest for which this is the response.

logicalChannelNumber indicates the logical channel that the bit-rate change request applies to.

rejectReason indicates the reason why the request has been denied. Current defined reasons are undefined reason and insufficient resources.

currentMaximumBitRate indicates, in units of 100 bit/s, the maximum bit rate at which the terminal is going to transmit on the logical channel.

B.12.4 Logical Channel Rate Release

This is sent in the case of a timeout.

B.13 Commands

A command message requires action but no explicit response.

B.13.1 Send Terminal Capability Set

specificRequest commands the far-end terminal to indicate its transmit and receive capabilities by sending one or more TerminalCapabilitySets that contain the information requested, as specified below. This command may be sent at any time to elicit the capabilities of the remote terminal, for example, following an interruption or other cause for uncertainty; however, such messages should not be sent repetitively without strong cause.

A terminal shall only request the transmission of capabilityTableEntryNumbers and capabilityDescriptorNumbers that it has previously received. A terminal shall ignore any requests to transmit capabilityTableEntryNumbers and capabilityDescriptorNumbers that it has not previously transmitted and no fault shall be considered to have occurred.

The boolean multiplexCapability, when true, requests the transmission of the MultiplexCapability.

capabilityTableEntryNumbers is a set of the CapabilityTableEntryNumbers that indicate the CapabilityTableEntrys that the terminal requests to be transmitted.

capabilityDescriptorNumbers is a set of the capabilityDescriptorNumbers that indicate the CapabilityDescriptors that the terminal requests to be transmitted.

genericRequest commands the far-end terminal to send its entire terminal capability set.

B.13.2 Encryption

This command is used to exchange encryption capabilities and to command the transmission of an initialization vector (IV), refer to ITU-T Recs H.233 [14] and H.234 [15].

encryptionSE is an H.233 Session Exchange (SE) message, except that the error protection bits described in ITU-T Rec. H.233 shall not be applied.

encryptionIVRequest commands the far-end encryptor to transmit a new IV in a logical channel opened for encryptionData.

encryptionAlgorithmID indicates to the receiver that the sending terminal will associate the given h233AlgorithmIdentifier value with the non-standard encryption algorithm associatedAlgorithm.

B.13.3 Flow Control

This command is used to specify the upper limit of bit rate of either a single logical channel or the whole multiplex. A terminal may send this command to restrict the bit rate that the far-end terminal sends. A terminal that receives this command shall comply with it.

When scope is of type logicalChannelNumber the limit applies to the given logical channel, when scope is of type resourceID the limit applies to the given ATM virtual channel, and when scope is of type wholeMultiplex the limit applies to the whole multiplex.

maximumBitRate is measured in units of 100 bit/s averaged over non-overlapping consecutive periods of one second. When this is present, the specified limit supersedes any previous limit, whether higher or lower. When it is not present any previous restriction on the bit rate for the channel is no longer applicable.

The point at which the bit-rate limit is applied, and the specification of which bits are included in the calculation of bit rate is not specified in this Recommendation, but should be specified by recommendations that use this Recommendation.

Each transmission of this command affects a specific logical channel or the entire multiplex. More than one such command may be in effect at the same time, up to the number of open logical channels plus one, for the overall multiplex limitation.

NOTE – When the bit rate that can be transmitted on a logical channel is constrained to particular values, for example G.723.1 audio, and the request is to transmit at a rate lower than the lowest rate at which it would normally operate, it shall respond by stopping transmission on the logical channel.

B.13.4 End session

This command indicates the end of the H.245 session. After transmitting EndSessionCommand, the terminal shall not send any more of the messages defined in this Recommendation.

disconnect indicates that the connection will be dropped.

gstnOptions: a choice of alternatives that will occur after ending the H.245 session when a V-series modem is used over the GSTN.

The possible options are given in Table B.14.

Table B.14/H.245 – Options after EndSessionCommand when using an V-series modem over the GSTN

ASN.1 codepoint	Option
telephonyMode	The terminal shall initiate the cleardown procedures defined in the V-series modem Recommendation, except that it shall not physically disconnect the GSTN connection.
v8bis	The terminal shall initiate the cleardown procedures defined in the V-series modem Recommendation and enter a V.8 *bis* session.
v34DSVD	The terminal shall preserve the V.34 modem connection, but use it to support V.70.
v34DuplexFAX	The terminal shall preserve the V.34 modem connection, but use it to support T.30 FAX [27].
v34H324	The terminal shall preserve the V.34 modem connection, but use it to support ITU-T Rec. H.324 [24].

isdnOptions: a choice of alternatives that will occur after ending the H.245 session when a digital communications terminal is used over a digital network.

The possible options are given in Table B.15.

Table B.15/H.245 – Options after EndSessionCommand when using a digital communications terminal over a digital network

ASN.1 codepoint	Option
telephonyMode	The terminal shall initiate the cleardown procedures defined in the Recommendation governing communication on the particular digital channel to which the terminal is connected, except that it shall not physically disconnect the digital connection.
v140	The terminal shall initiate the cleardown procedures defined in the Recommendation governing communication on the particular digital channel to which the terminal is connected and enter a V.140 session [39].
terminalOnHold	The terminal shall initiate the 'terminal on hold' procedures defined in the Recommendation governing communication on the particular digital channel to which the terminal is connected.

B.13.5 Miscellaneous Command

This is used for a variety of commands, some of which are present in ITU-T Recs H.221 [7] and H.230 [13].

logicalChannelNumber indicates the logical channel number to which the command applies. It shall indicate a logical channel opened for video data when the type is one of videoFreezePicture, videoFastUpdatePicture, videoFastUpdateGOB, videoTemporalSpatialTradeOff, videoSendSyncEveryGOB, videoFastUpdateMB, videoSendSyncEveryGOBCancel, lostPicture, lostPartialPicture, and recoveryReferencePicture. When the type is one of equaliseDelay, zeroDelay, multipointModeCommand or cancelMultipointModeCommand where multiple logical channels are involved, the logicalChannelNumber shall be arbitrary, but shall be a valid LogicalChannelNumber (i.e., in the range 1-65535) and the receiver shall ignore the value.

equaliseDelay and zeroDelay shall have the same meaning as the commands ACE and ACZ defined in ITU-T Rec. H.230 [13].

multipointModeCommand commands that a terminal in receipt shall comply with all requestMode requests issued by the MCU. An example of a mode change is an audio coding change from G.711 to G.728.

cancelMultipointModeCommand cancels a previously sent multipointModeCommand command.

videoFreezePicture commands the video decoder to complete updating the current video frame and subsequently display the frozen picture until receipt of the appropriate freeze-picture release control signal.

videoFastUpdatePicture commands the video encoder to enter the fast-update mode at its earliest opportunity.

videoFastUpdateGOB commands the far-end video encoder to perform a fast update of one or more GOBs. firstGOB indicates the number of the first GOB to be updated, and numberOfGOBs indicates the number of GOBs to be updated. It shall only be used with video compression algorithms that define GOBs, for example, H.261 and H.263. GOB numbering is done as in H.263, even if H.261 is in use. The first GOB of the picture is GOB number 0, the second GOB is GOB number 1, etc. The scanning of GOBs for interpretation of the numberOfGOBs parameter shall be according to the relevant video coding standard, so the second GOB in an H.261 CIF picture is to the right of the first, while it is below the first GOB in H.261 QCIF and in H.263 pictures.

videoTemporalSpatialTradeOff commands the far-end video encoder to change its trade-off between temporal and spatial resolution. A value of 0 commands a high spatial resolution and a value of 31 commands a high frame rate. The values from 0 to 31 indicate monotonically a desire for higher frame rate. Actual values do not correspond to precise values of spatial resolution or frame rate.

videoSendSyncEveryGOB commands the far-end video encoder to use sync for every GOB as defined in ITU-T Rec. H.263 [20], until the command videoSendSyncEveryGOBCancel is received, from which time the far-end video encoder may decide the frequency of GOB syncs. These commands shall only be used with video encoded according to ITU-T Rec. H.263.

videoFastUpdateMB commands the far-end video encoder to perform a fast update of one or more MBs. firstGOB indicates the number of the first GOB to be updated, firstMB indicates the number of the first MB to be updated and numberOfMBs indicates the number of MBs to be updated. It shall only be used with video compression algorithms that define MBs, for example, H.261 and H.263. Terminals may respond to this command with a GOB update which includes the MBs requested. GOB numbering is done as in H.263, even if H.261 is in use. The first GOB of the picture is GOB number 0, the second GOB is GOB number 1, etc. Either firstGOB or firstMB or both shall be present. When firstGOB is present and firstMB is absent, the first macroblock to be updated is the first macroblock of the indicated GOB. When firstGOB and firstMB are both present, firstMB is indicated relative to the start of the indicated firstGOB, such that the first macroblock of the indicated GOB is considered macroblock number 1. When firstGOB is absent and firstMB is present, firstMB is relative to the top left of the picture, with the top left macroblock considered as macroblock number 1. The scan order of macroblocks in the remainder of the GOB and subsequent to that point is defined as the scan order of the relevant video coding standard, thus the scanning order starting at the third GOB in an H.261 CIF picture starts from macroblock number 1 being the macroblock in the left column of the fourth row of the picture and scans down through the three rows of the GOB to reach macroblock number 33 in the eleventh column of the sixth row, and then jumps up vertically to begin scanning the next GOB starting in the twelfth column of the fourth row.

maxH223MUXPDUsize commands the transmitter to restrict the size of the H223 MUX-PDUs that it transmits to a maximum of the specified number of octets.

encryptionUpdate and EncryptionUpdateRequest are used to initiate and distribute new keying material to be used in the encryption of the indicated media channels.

Switch receive media on and off can be used by an MC to command an endpoint to switch between a unicast and multicast channel when the MC+MP is mixing audio. In this case, when the MC stream includes the terminal audio, the MC+MP can switch the endpoint to a unicast stream which would contain a special mix for the terminal with its audio removed.

switchReceiveMediaOff is used by an MC to indicate to an endpoint that a particular logical channel should not be used for receive media.

switchReceiveMediaOn is used by an MC to indicate to an endpoint that a particular logical channel should be used for receive media.

doOneProgression commands the video encoder to begin producing a progressive refinement sequence. In this mode, the encoder produces video data consisting of one picture followed by a sequence of zero or more frames of refinement of the quality of the same picture. The encoder stays in this mode until either the encoder decides an acceptable fidelity level has been reached or the progressiveRefinementAbortOne command is received. In addition, the encoder shall insert the Progressive Refinement Segment Start Tag and the Progressive Refinement Segment End Tag to mark the beginning and end of the progressive refinement as defined in the Supplemental Enhancement Information Specification (Annex L/H.263).

doContinuousProgressions commands the video encoder to begin producing progressive refinement sequences. In this mode, the encoder produces video data consisting of one picture followed by a sequence of zero or more frames of refinement of the quality of the same picture. When the encoder decides an acceptable fidelity level has been reached or the progressiveRefinementAbortOne command is received, the encoder stops refining the current progression and begins another progressive refinement for a different picture. The sequence of progressive refinements continues until the progressiveRefinementAbortContinuous command is received. In addition, the encoder shall insert Progressive Refinement Segment Start Tags and Progressive Refinement Segment End Tags to mark the start and end of each progressive refinement as defined in the Supplemental Enhancement Information Specification (Annex L/H.263).

doOneIndependentProgression commands the video encoder to begin an independent progressive refinement sequence. In this mode, the encoder produces video data consisting of one Intra picture followed by a sequence of zero or more frames of refinement of the quality of the same picture. The encoder stays in this mode until either the encoder decides an acceptable fidelity level has been reached or the progressiveRefinementAbortOne command is received. In addition, the encoder shall insert the Progressive Refinement Segment Start Tag and the Progressive Refinement Segment End Tag to mark the beginning and end of the progressive refinement as defined in the Supplemental Enhancement Information Specification (Annex L/H.263).

doContinuousIndependentProgressions commands the video encoder to begin producing independent progressive refinement sequences. In this mode, the encoder produces video data consisting of one Intra picture followed by a sequence of zero or more frames of refinement of the quality of the same picture. When the encoder decides an acceptable fidelity level has been reached or the progressiveRefinementAbortOne command is received, the encoder stops refining the current progression and begins another independent progressive refinement for a different picture. The sequence of independent progressive refinements continues until the progressiveRefinementAbortContinuous command is received. In addition, the terminal shall insert Progressive Refinement Segment Start Tags and Progressive Refinement Segment End Tags to mark the start and end of each independent progressive refinement as defined in the Supplemental Enhancement Information Specification (Annex L/H.263).

progressiveRefinementAbortOne commands the video encoder to terminate doOneProgression, doOneIndependentProgression, or the current progressive refinement in the sequence of progressive refinements in either doContinuousProgressions or doContinuousIndependentProgressions.

progressiveRefinementAbortContinuous commands the video encoder to terminate either doContinuousProgressions or doContinuousIndependentProgressions.

videoBadMBs commands the far-end video encoder to take corrective action when a set of MBs has not been properly received. The encoder shall use this information to take action toward recovery of video quality. Unlike videoNotDecodedMBs, the videoBadMBs command lacks any specific definition of how the decoder has treated the specified set of MBs. The encoder should respond to this command by ensuring that the specified set of macroblocks is not used for the prediction of video pictures subsequent to the encoder's receipt of the command. The specific action to be taken by the encoder is not defined, but may include any appropriate remedial action, such as sending an INTRA frame. This command shall not be transmitted by a video decoder if the corresponding far-end encoder has not indicated the videoBadMBsCap capability. This command shall only be used with video coding algorithms that define MBs, for example, H.261, H.262, IS11172 and H.263. The MB numbering is done according to raster-scan order within the picture, with the upper left MB of the picture defined as macroblock number 1, and the MB number increasing first from left to right and then from top to bottom.

lostPicture commands the far-end video encoder to take corrective action due to the loss or corruption of the indicated pictures. These are indicated by either pictureNumber, a short-term picture number, or longTermPictureIndex, a long-term picture index. An encoder capable of Annex U/H.263 (Enhanced Reference Picture Selection, with or without sub-picture removal) and/or W.6.3.12/H.263 (Picture Number) shall be capable of understanding this message and taking corrective action.

lostPartialPicture commands the far-end video encoder to take corrective action when a set of MBs has not been properly received. It is the same as videoBadMBs except that the picture is indicated by either pictureNumber, a short-term picture number, or longTermPictureIndex, a long-term picture index. An encoder capable of Annex U/H.263 (Enhanced Reference Picture Selection, with or without sub-picture removal) and/or W.6.3.12/H.263 (Picture Number) shall be capable of understanding this message and taking corrective action.

recoveryReferencePicture commands the far-end encoder to use only the indicated pictures for prediction. These are indicated by either pictureNumber, a short-term picture number, or longTermPictureIndex, a long-term picture index. An encoder capable of Annex U/H.263 (Enhanced Reference Picture Selection, with or without sub-picture removal) and/or W.6.3.12/H.263 (Picture Number) shall be capable of understanding this message and taking corrective action. It may be sent from a decoder that considers the indicated pictures to have been received and decoded correctly, and considers other (unspecified) pictures to have been corrupted by transmission.

encryptionUpdateCommand shall be used in ITU-T Rec. H.235.0 for the improved key update procedure to distribute new session key material (see 8.6.2/H.235.6). multiplePayloadStream is only used when a multiple payload stream is to be re-keyed in which case the dynamic payload type within EncryptionSync shall be ignored.

encryptionUpdateAck shall be used in ITU-T Rec. H.235.0 for the improved key update procedure to let the slave acknowledge reception of new session key material on a logical channel owned by the master (see 8.6.2/H.235.6).

direction shall indicate the direction (masterToSlave or slaveToMaster) of the logical channel upon which the key material is being distributed (see 8.6.2/H.235.6).

B.13.6 Conference Command

BroadcastMyLogicalChannel shall be similar to H.230 MCV used according to the procedure in 6.3.2.1/H.243, but shall only refer to a single logical channel. Note that when the preferred MCV procedure in 6.3.2.2/H.243 is used (that is, when both ends of a terminal-MCU or inter-MCU link possess multipointVisualizationCapability), the conferenceRequest form of BroadcastMyLogicalChannel is used instead.

CancelBroadcastMyLogicalChannel shall be similar to H.230 Cancel-MCV but shall only refer to a single logical channel.

MakeTerminalBroadcaster shall be defined as H.230 VCB.

CancelMakeTerminalBroadcaster shall be defined as Cancel-VCB.

SendThisSource shall be defined as H.230 VCS.

CancelSendThisSource shall be defined as H.230 Cancel-VCS.

DropConference shall be defined as H.230 CCK.

Substitute CID Command allows an active MC to change the Conference Identifier (CID), effectively moving the recipient of this command into another conference. The recipient of this command shall use the newly assigned CID in all future call signalling messages.

B.13.7 H.223 Multiplex Reconfiguration

h223ModeChange commands the transmitter to change the level of multiplex mode as described in Annex C/H.324, to level 0, level 1, level 2, or level 2 with Annex B/H.223 optional header.

h223AnnexADoubleFlag commands the transmitter to start or stop the use of double-flag mode of Annex A/H.223.

B.13.8 New ATM Virtual Channel Command

This is used to command the remote terminal to open an ATM virtual channel with the given parameters.

resourceID is used to identify the ATM virtual channel. The means by which this parameter is associated with an ATM virtual channel is not specified in this Recommendation.

bitRate indicates the bit rate, measured at the AAL-SAP, of the virtual channel, and is measured in units of 64 kbit/s.

bitRateLockedToPCRClock indicates that the bit rate of the virtual channel is clocked to the clock used to produce H.222.0 clock reference values (Program clock reference or System clock reference).

bitRateLockedToNetworkClock indicates that the bit rate of the virtual channel is clocked to the local network clock. This does not guarantee that the bit-rate clock will be locked to the local network at the receiver, as common network clocks may not be available.

aal indicates which ATM Adaptation Layer will be used, and its parameters.

The sequence aal1 indicates which of the options for ATM adaptation layer 1, as specified in I.363 [25], are supported. The codepoints are defined in Table B.1.

The sequence aal5 indicates which of the options for ATM adaptation layer 5, as specified in I.363 [25], are supported. forwardMaximumSDUSize and backwardMaximumSDUSize indicate the maximum CPCS-SDU size in the forward and reverse directions, measured in octets.

multiplex indicates the type of multiplex that will be used on the ATM virtual channel. The options are noMultiplex (No H.222.0 multiplex), H.222.0 Transport Stream and H.222.0 Program Stream.

B.13.9 Mobile Multilink Reconfiguration Command

This is used to command the transmitter to change the multilink frame configuration as described in Annex H/H.324.

sampleSize indicates the size of a sample in octets. A sample is the number of octets that will be distributed on the available physical channels.

samplesPerFrame indicates the multilink payload length in samples.

status indicates the status of the receiver when it sends this command message. If synchronized, this indicates that the receiver has established the frame synchronization and commands the transmitter to start sending the compressed header frame. If reconfiguration, this commands the transmitter to change the sample size and/or the frame length and to start sending the full header frame.

B.14 Indications

An indication contains information that does not require action or response.

B.14.1 Function Not Understood

This is used to return requests, responses and commands that are not understood to the transmitter.

If a terminal receives a request, response or command that it does not understand, either because it is non-standard or has been defined in a subsequent revision of this Recommendation, it should respond by sending FunctionNotSupported or FunctionNotUnderstood.

NOTE – FunctionNotUnderstood was named FunctionNotSupported in version 1 of this Recommendation. The name of this function was changed to allow for the addition of a more powerful FunctionNotSupported command without breaking backward compatibility with version 1 syntax.

B.14.2 Miscellaneous Indication

This is used for a variety of indications, some of which are present in ITU-T Recs H.221 [7] and H.230 [13].

logicalChannelNumber indicates the logical channel number to which the indication applies. It shall indicate a logical channel opened for video data when the type is videoIndicateReadyToActivate, and videoTemporalSpatialTradeOff. When the type is one of multipointConference, cancelMultipointConference, multipointZeroComm, cancelMultipointZeroComm, multipointSecondaryStatus, or cancelMultipointSecondaryStatus where multiple logical channels are involved, the logicalChannelNumber shall be arbitrary, but shall be a valid LogicalChannelNumber (i.e., in the range 1-65535) and the receiver shall ignore the value.

logicalChannelInactive is used to indicate that the content of the logical channel does not represent a normal signal. It is analogous to AIM and VIS defined in ITU-T Rec. H.230.

logicalChannelActive is complementary to logicalChannelInactive. It is analogous to AIA and VIA defined in ITU-T Rec. H.230. MultipointZeroComm, cancelMultipointZeroComm, multipointSecondaryStatus, and cancelMultipointSecondaryStatus shall have the same meaning as MIZ, cancelMIZ, MIS and cancelMIS respectively, as defined in ITU-T Rec. H.230.

multipointConference indicates that the terminal is joined to an H.243 multipoint conference, and the terminal is expected to obey bit-rate symmeterization. However, bit-rate symmeterization will be enforced via FlowControlCommand messages. Note that multipointConference has exactly the same meaning as MCC in ITU-T Rec. H.230. Note that multipointConference, like MCC, does not require mode symmetry.

videoIndicateReadyToActivate shall have the same meaning as VIR defined in ITU-T Rec. H.230, that is, it is transmitted by a terminal whose user has decided not to send video unless he will also receive video from the other end.

videoTemporalSpatialTradeOff indicates to the far-end video decoder its current trade-off between temporal and spatial resolution. A value of 0 indicates a high spatial resolution and a value of 31 indicates a high frame rate. The values from 0 to 31 indicate monotonically a higher frame rate. Actual values do not correspond to precise values of spatial resolution or frame rate. A terminal that has indicated temporalSpatialTradeOffCapability shall transmit this indication whenever it changes its trade-off and when a video logical channel is initially opened.

videoNotDecodedMBs indicates to the far-end video encoder that a set of MBs has been received erroneously and that any MB in the specified set has been treated as not coded. The encoder may use this information to compensate transmission errors, as illustrated in Appendix I/H.263. firstMB indicates the number of the first MB treated as not coded, and numberOfMBs indicates the number of MBs treated as not coded. The MB numbering is done such that the macroblock in the upper left corner of the picture is considered macroblock number 1 and the number for each macroblock increases from left to right and then from top to bottom in raster-scan order (such that if there is a total of N macroblocks in a picture, the bottom right macroblock is considered macroblock number N). The temporal reference of the picture containing not decoded MBs is indicated in temporalReference. This indication shall only be used with the H.263 video compression algorithm.

B.14.3 Jitter Indication

This is used to indicate the amount of jitter, as estimated by the receive terminal, of a logical channel. It may be useful for choice of bit rate and buffer control in video channels, or to determine an appropriate rate of transmission of timing information, etc. The video encoder will then have the option of using this information to restrict the video bit rate or the video decoder buffer fluctuations to help prevent decoder buffer underflow or overflow, given the occurring jitter. If the encoder takes this option, it will enable correct operation for existing designs of video decoder buffers, regardless of the amplitude of received jitter, as well as allow correct operation with minimum delay.

When scope is of type logicalChannelNumber the information applies to the given logical channel, when scope is of type resourceID the information applies to the given ATM virtual channel, and when scope is of type wholeMultiplex the information applies to the whole multiplex.

estimatedReceivedJitterMantissa and estimatedReceivedJitterExponent provide an estimate of the jitter that has been received by the terminal that has sent the message.

estimatedReceivedJitterMantissa indicates the mantissa of the jitter estimate as given in Table B.16.

Table B.16/H.245 – Mantissa of estimatedReceivedJitterMantissa in JitterIndication

estimatedReceivedJitterMantissa	Mantissa
0	1
1	2.5
2	5
3	7.5

estimatedReceivedJitterExponent indicates the exponent of the jitter estimate as given in Table B.17.

Table B.17/H.245 – Exponent of estimatedReceivedJitterExponent in JitterIndication

estimatedReceivedJitterExponent	Exponent
0	Out of range
1	1 µs
2	10 µs
3	100 µs
4	1 ms
5	10 ms
6	100 ms
7	1 s

The jitter estimate is obtained by multiplying the mantissa by the exponent, unless estimatedReceivedJitterExponent is equal to zero, in which case the estimate is just known to be more than 7.5 seconds.

skippedFrameCount indicates how many frames have been skipped by the decoder since the last JitterIndication message was received. Since the maximum value that can be encoded is 15, if this option is implemented, this information must be transmitted before more than 15 frames have been skipped.

NOTE – Since frames are skipped when the decoder buffer underflows, additional jitter may cause the decoder buffer to underflow more or less often than the encoder expects frame skips to happen.

additionalDecoderBuffer indicates the additional size of the video decoder buffer over and above that required by the indicated profile and level. This is defined in the same way as vbv_buffer_size ITU-T Rec. H.262 [19].

B.14.4 H.223 Skew Indication

This is used to indicate to the far-end terminal the average amount of time skew between two logical channels.

logicalChannelNumber1 and logicalChannelNumber2 are logical channel numbers of opened logical channels.

skew is measured in milliseconds, and indicates the delay that must be applied to data belonging to logicalChannelNumber2 as measured at the output of the multiplex, to achieve synchronization with logicalChannelNumber1 as measured at the output of the multiplex. The skew includes differences in: sample time, encoder delay, and transmitter buffer delay, and is measured relative to the transmission time of the first bit of data representing a given sample point. The actual delay necessary for synchronization is dependent on decoder implementation, and is a local matter for the receiver.

B.14.5 New ATM Virtual Channel Indication

This is used to indicate the parameters of an ATM virtual channel that the terminal intends to open.

resourceID is used to identify the ATM virtual channel. The means by which this parameter is associated with an ATM virtual channel is not specified in this Recommendation.

bitRate indicates the bit rate, measured at the AAL-SAP, of the virtual channel, and is measured in units of 64 kbit/s.

bitRateLockedToPCRClock indicates that the bit rate of the virtual channel is clocked to the clock used to produce H.222.0 clock reference values (Program clock reference or System clock reference).

bitRateLockedToNetworkClock indicates that the bit rate of the virtual channel is clocked to the local network clock. This does not guarantee that the bit-rate clock will be locked to the local network at the receiver, as common network clocks may not be available.

aal indicates which ATM Adaptation Layer will be used, and its parameters.

The sequence aal1 indicates which of the options for ATM adaptation layer 1, as specified in ITU-T Rec. I.363 [25], are supported. The codepoints are defined in Table B.1.

The sequence aal5 indicates which of the options for ATM adaptation layer 5, as specified in ITU-T Rec. I.363 [25], are supported. forwardMaximumSDUSize and backwardMaximumSDUSize indicate the maximum CPCS-SDU size in the forward and reverse directions, measured in octets.

multiplex indicates the type of multiplex that will be used on the ATM virtual channel. The options are noMultiplex (No H.222.0 multiplex), H.222.0 Transport Stream and H.222.0 Program Stream.

B.14.6 User Input

This is used for User Input messages.

alphanumeric is a string of characters coded according to ITU-T Rec. T.51 [30]. This could be used for key-pad input, an equivalent to DTMF.

userInputSupportIndication: indicates to the remote terminal which GENERALSTRING types the terminal supports.

NOTE 1 – It is expected that most implementations of PER decoders will not be capable of decoding other strings than IA5. This indication should be used to "warn" the remote terminal not to attempt fancy variable length coding schemes.

If the DTMF is sent via RTP and in UserInputIndication in alphanumeric form, it shall be encoded in the extendedAlphanumeric sequence and the rtpPayloadIndication flag shall be included.

nonStandard is a NonStandardParameter indicating a non-standard use of the UserInput indication message.

The boolean basicString, when true, indicates that the characters 0-9, * and # are supported.

The boolean iA5String, when true, indicates that the complete IA5String character set is supported.

The boolean generalString, when true, indicates that the complete GeneralString character set is supported.

The boolean encryptedBasicString, when true, indicates an encrypted basic string.

The boolean encryptedIA5String, when true, indicates an encrypted IA5 string.

The boolean encryptedGeneralString, when true, indicates an encrypted general string.

Clause 7.7/H.235.6 describes the procedures for encrypted H.245 DTMF and how to deploy the fields encryptedAlphanumeric within UserInputIndication (= encrypted basic string), encryptedSignalType within signal (= encrypted IA5 string) and encryptedAlphanumeric within extendedAlphanumeric (= encrypted general string).

The **signal** and **signalUpdate** indications may be used when precise control is desired over the alignment of DTMF or hookflash with audio in the associated logical channel and when control or indication of the duration of DTMF is needed.

signal indicates the signalling element to be produced when sent to a PSTN gateway, that was detected in the audio stream when sent from a PSTN gateway, or to be signalled between other endpoint combinations. When received by a gateway to the PSTN, **signal** causes the gateway to inject the specified signalling element into the PSTN channel; when received by a gateway to another H-series terminal, **signal** will be translated to the appropriate message in the protocol of the connected terminal. Gateways produce **signal** (and **signalUpdate**) messages to indicate detection of signalling elements in the audio received from a PSTN endpoint, or by translation of corresponding messages from other protocols.

signalType is set to "!" (exclamation point) to indicate a hookflash, or to one of "0123456789*#ABCD" to indicate a DTMF tone.

NOTE 2 – Hookflash is a momentary on-hook condition (typically one-half second in duration), commonly used to control features in the attached switching equipment. It may not be possible for a gateway to produce or detect a hookflash due to characteristics of the PSTN channel or due to local configuration (to prevent undesired activation of features in attached equipment). Therefore, the ability to transmit or receive hookflash indications is separately declared in **UserInputCapability**.

duration indicates the total duration of the tone if known, or an initial estimate of the tone duration if the tone continues to be in progress at the time **signal** is transmitted. If **duration** is omitted, the receiver shall use an appropriate default based on local configuration and network requirements. **duration** shall be ignored in the case of a hookflash ("!") indication.

signalUpdate revises the estimate of the total duration or declares the actual measured duration of the tone detected or to be generated. It should be transmitted so as to arrive well before the estimate that was previously sent in **signal** or **signalUpdate** expires; otherwise the revised duration will be ignored as the tone will have already been terminated by the receiver. Note that it is not necessary to send **signalUpdate** if the total duration was indicated in **signal**.

rtp contains parameters needed to align the tone or hookflash with an RTP/UDP stream (H.323). In signalUpdate, this element needs to be included only if multiple signal messages have been issued specifying different LogicalChannelNumbers and it is necessary to indicate which signal is to be updated.

timestamp specifies, in terms of the RTP timestamp of the primary encoder on the associated audio channel, the time at which the tone or hookflash should be generated (delivered or injected into the audio stream). The tone or hookflash shall not be generated before audio with the same timestamp is played; it should be generated as soon as possible after this time, but not later than the **expirationTime** timestamp. The sender of an indication shall not set **timestamp** to a time that is "in the future"; **timestamp** is normally set equal to the timestamp of audio currently being sent or most recently sent on the associated audio channel. If **timestamp** is not specified, the signal shall be delivered or injected upon receipt.

expirationTime specifies, in terms of the RTP timestamp of the primary encoder on the associated audio channel, the time after which the tone or hookflash shall be considered "stale" and discarded by the receiver. Endpoints that receive **signal** and are unable to act on it before the **expirationTime** timestamp on the associated channel shall discard the message. If an **expirationTime** time is not specified by the sender, the message may nevertheless be discarded as a result of local configuration of the recipient.

logicalChannelNumber shall specify the LogicalChannelNumber of the associated audio channel, the context in which **timestamp** and **expirationTime** are meaningful.

An MC shall convert the timestamps and logical channel number from the received indication into the correct logical channel number and timestamps for each output channel when it forwards the indication to each receiving endpoint (the timestamps might change if the audio is being transcoded or mixed in an MP). An MC receiving an indication after the **expirationTime** time may discard the message immediately without forwarding it; otherwise, the MC shall forward all requests immediately without waiting for **timestamp** time to occur.

Endpoints shall use the **alphanumeric** indication to convey DTMF user input if the other endpoint has not indicated the ability to receive DTMF using **UserInputCapability**.

An endpoint which has the capability to receive DTMF indications using **signal** shall also be able to accept **alphanumeric** indications for compatibility with older terminals. An **alphanumeric** indication may be treated as a sequence of one or more **signal** indications with **duration**, **timestamp**, and **expirationTime** elements omitted, and characters not valid in **signalType** being discarded.

If the DTMF is sent via RTP as per 10.5/H.323 and in UserInputIndication in signal form, the rtpPayloadIndication flag shall be included.

In typical usage, a gateway detecting DTMF in the audio stream from a PSTN channel will send **signal** immediately upon detection of a tone, using a relatively high estimate of **duration**, and begin measuring the tone duration. When the tone ends, **signalUpdate** is sent to indicate the total measured duration. If the tone has not ended but the measured duration is approaching the previous estimate (such that the estimate might be exceeded by the measured duration before a **signalUpdate** could be received), a **signalUpdate** is sent increasing the estimate. The frequency of sending **signalUpdate**, the initial duration estimate sent in **signal**, and the amount by which subsequent estimates are increased, are left to the implementer, but caution should be exercised so as to not burden the network with large numbers of **signalUpdate** messages and to avoid premature expiration of previous estimates.

In typical usage from a non-gateway endpoint, the **signal** element will contain the total duration of the tone to be produced by the gateway. In some applications, however, it may be desirable to provide real-time interactive control of tone duration to the user. In this case, **signal** and **signalUpdate** would be used in a manner similar to that described for gateways in the preceding paragraph, with **signal** being sent upon the activation of the user input (e.g., depression of a key or on-screen control) using an estimated tone duration, and **signalUpdate** used to send updated estimates so long as the input continues to be activated and to indicate the total duration when the input is deactivated.

B.14.7 Conference Indications

sbeNumber shall be defined as H.230 SBE Number.

terminalNumberAssign shall be defined as H.230 TIA.

terminalJoinedConference shall be defined as H.230 TIN.

terminalLeftConference shall be defined as H.230 TID.

seenByAtLeastOneOther shall be defined as H.230 MIV.

cancelSeenByAtLeastOneOther shall be defined as H.230 cancel-MIV.

seenByAll shall be defined as H.230 MIV.

cancelSeenByAll shall be defined as H.230 MIV.

terminalYouAreSeeing shall be defined as H.230 VIN.

requestForFloor shall be defined as H.230 TIF and be sent from a terminal to the MC.

WithdrawChairToken shall be defined as H.230 CCR and is sent from the MC to the Chair Token holder.

FloorRequested shall be defined as H.230 TIF when sent from the MC to the Chair Token holder. This request included the TerminalLabel of the requesting terminal.

terminalYouAreSeeingInSubPictureNumber shall be defined as H.230 VIN2. subPictureNumber is defined as N as indicated in Figures 2-4/H.243.

videoIndicateCompose shall be defined as H.230 VIC. compositionNumber is defined as M in Table 4/H.243.

B.14.8 H2250 Maximum Logical Channel Skew

H2250MaximumSkewIndication indicates the maximum skew between logical channels.

skew is measured in milliseconds, and indicates the maximum number of milliseconds that the data on logicalChannelNumber2 is delayed from the data on logicalChannelNumber1 as delivered to the network transport. The skew is measured relative to the time of delivery to the network transport of the first bit of data representing a given sample point. Lip synchronization, if desired, is a local matter for the receiver and shall be achieved via use of timestamps.

B.14.9 MC Location Indication

This indication is sent by the MC to indicate to other terminals the signalling address that should be used to reach the MC.

B.14.10 Vendor Identification Indication

vendorIdentification indication should be sent at the start of each call to identify the manufacturer, product, and product version number.

B.14.11 Function Not Supported

This is used to return requests, responses and commands that are not understood back to the transmitter.

The whole of the RequestMessage, ResponseMessage or CommandMessage is returned.

If a terminal receives a request, response or command that it does not understand, either because it is non-standard or has been defined in a subsequent revision of this Recommendation, it shall respond by sending FunctionNotSupported.

If a terminal receives a request, response or command that has incorrect encoding, it shall set cause to the value syntaxError. If it has correct encoding, but the encoded values are semantically incorrect, it shall set cause to the value semanticError. If the message is an unrecognized extension to MultimediaSystemControlMessage, RequestMessage, ResponseMessage or CommandMessage, it shall set cause to the value unknownFunction.

In each case, the whole MultimediaSystemControlMessage should be returned as an octet string in returnedFunction.

FunctionNotSupported shall not be used at any other time. In particular, when an unrecognized extension is present at other points in the syntax, FunctionNotSupported shall not be used: the terminal shall respond to the message in the normal way, as if no extension were present. FunctionNotSupported shall never be sent in response to a received indication.

B.14.12 Flow Control Indication

This is used to signal to the remote terminal that the terminal has adjusted its outgoing maximum bit rate either in response to an incoming FlowControlCommand or because the terminal wishes to adjust its outgoing rate. This allows a terminal to signal any change in the outgoing maximum bit rate within the constraint of the upper limits set by the open logical channel and the terminal capabilities.

Any terminal receiving a FlowControlCommand should respond with a FlowControlIndication to indicate the new maximum bit rate to which it has been set.

The fields of FlowControlIndication have the same meaning as the fields of the same name in FlowControlCommand.

B.14.13 Mobile Multilink Reconfiguration Indication

This is used to signal to the receiver that the transmitter will change the value of sample size and/or the value of samples per frame in the information frame header as described in Annex H/H.324. This indication may be sent while in the full header mode, and shall not be sent while in the compressed header mode.

sampleSize indicates the size of a sample in octets. A sample is the number of octets that will be distributed on the available physical channels.

samplesPerFrame indicates the multilink payload length in samples.

B.15 Generic messages

The **GenericMessage** type permits new RequestMessage, CommandMessage, ResponseMessage, and IndicationMessage items to be specified in such a way that a new version of H.245 syntax does not need to be issued. This method permits both standard and non-standard messages to be defined.

NOTE 1 – GenericMessage structures defined in this Recommendation should be listed in annexes to this Recommendation. GenericMessage structures defined in other ITU-T Recommendations should be referred to in an appendix to this Recommendation. GenericMessage structures defined outside ITU-T may be published in any suitable form.

The **messageIdentifier** field indicates the unique message type. ITU-T based message identifiers shall use the standard OBJECT IDENTIFIER, while other standards based and proprietary message identifiers shall use one of standard, h221NonStandard, uuid and domainBased as appropriate.

The optional **subMessageIdentifier** field indicates a sub-message associated with the messageIdentifier.

The **messageContents** field indicates parameters of the message.

To avoid ambiguity and interoperability problems, a **standard ParameterIdentifier** with the value 0 should not be defined for use in the messageContents field.

NOTE 2 – Some Recommendations define automatic procedures for the translation of GenericParameters from the H.245 signalling system to the BAS codec signalling system used in ITU-T Rec. H.320. These procedures use the value 0 in the place of a standard ParameterIdentifier as a special signal demarcating the end of a list of GenericParameter items.

The genericRequest field is a GenericMessage used to send a generic RequestMessage.

The genericResponse field is a GenericMessage used to send a generic ResponseMessage.

The genericCommand field is a GenericMessage used to send a generic CommandMessage.

The genericIndication field is a GenericMessage used to send a generic IndicationMessage.

Annex C

Procedures

(This annex forms an integral part of this Recommendation)

C.1 Introduction

This annex defines generic multimedia system control procedures that use the messages defined in this Recommendation. Recommendations using this Recommendation shall indicate which of these procedures are applicable, as well as defining any specific requirements.

Procedures to perform the following functions are described in this clause:

- master-slave determination;
- terminal capability exchange;
- unidirectional logical channel signalling;
- bidirectional logical channel signalling;
- receive terminal close logical channel request;
- H.223 multiplex table entry modification;
- request multiplex entry;
- receiver to transmitter transmit mode request;
- round-trip delay determination;
- maintenance loop.

C.1.1 Method of specification

Procedures are generally specified in this clause using SDLs. The SDL provides a graphical specification of the procedures, and includes specification of actions in the event of exception conditions.

C.1.2 Communication between protocol entity and protocol user

The interaction with the user of a particular function is specified in terms of primitives transferred at the interface between the protocol entity and the protocol user. Primitives are for the purpose of defining protocol procedures and are not intended to specify or constrain implementation. There may be a number of parameters associated with each primitive.

To assist in the specification, protocol states are defined. These states are conceptual and reflect general conditions of the protocol entity in the sequences of primitives exchanged between the protocol entity and the user, and the exchange of messages between the protocol entity and its peer.

For each protocol entity the allowed sequence of primitives between the user and the protocol entity is defined using a state transition diagram. The allowed sequence constrains the actions of the user, and defines the possible responses from the protocol entity.

A primitive parameter described as being null is equivalent to the parameter not being present.

C.1.3 Peer-to-peer communication

Protocol information is transferred to the peer protocol entity via the relevant messages defined in Annex A. Some protocol entities described have state variables associated with them. A number of protocol entities described also have timers associated with them.

A timer is identified by the notation Tn, where n is a number. In the SDL diagrams setting a timer means that a timer is loaded with a specified value and the timer is started. Resetting a timer means that a timer is stopped with its value at the time of reset being retained. Timer expiry means that a timer has run for its specified time and has reached the value of zero.

A protocol entity may also have associated parameters. A parameter is identified by the notation Nn, where n is a number.

These timers and counters are listed in Appendix III.

Some protocol entities define an error primitive to report protocol error conditions to a management entity.

C.1.4 SDL diagrams

The SDL diagrams show actions to the allowed interactions with the protocol user, and to reception of messages from the peer protocol entity. Primitives which are not allowed for a given state, as specified by the state transition diagrams, are not shown in the SDL diagrams. However, the responses to the reception of inappropriate messages are described in the SDL diagrams.

C.1.5 SDL key

The SDL key is shown in Figure C.1.

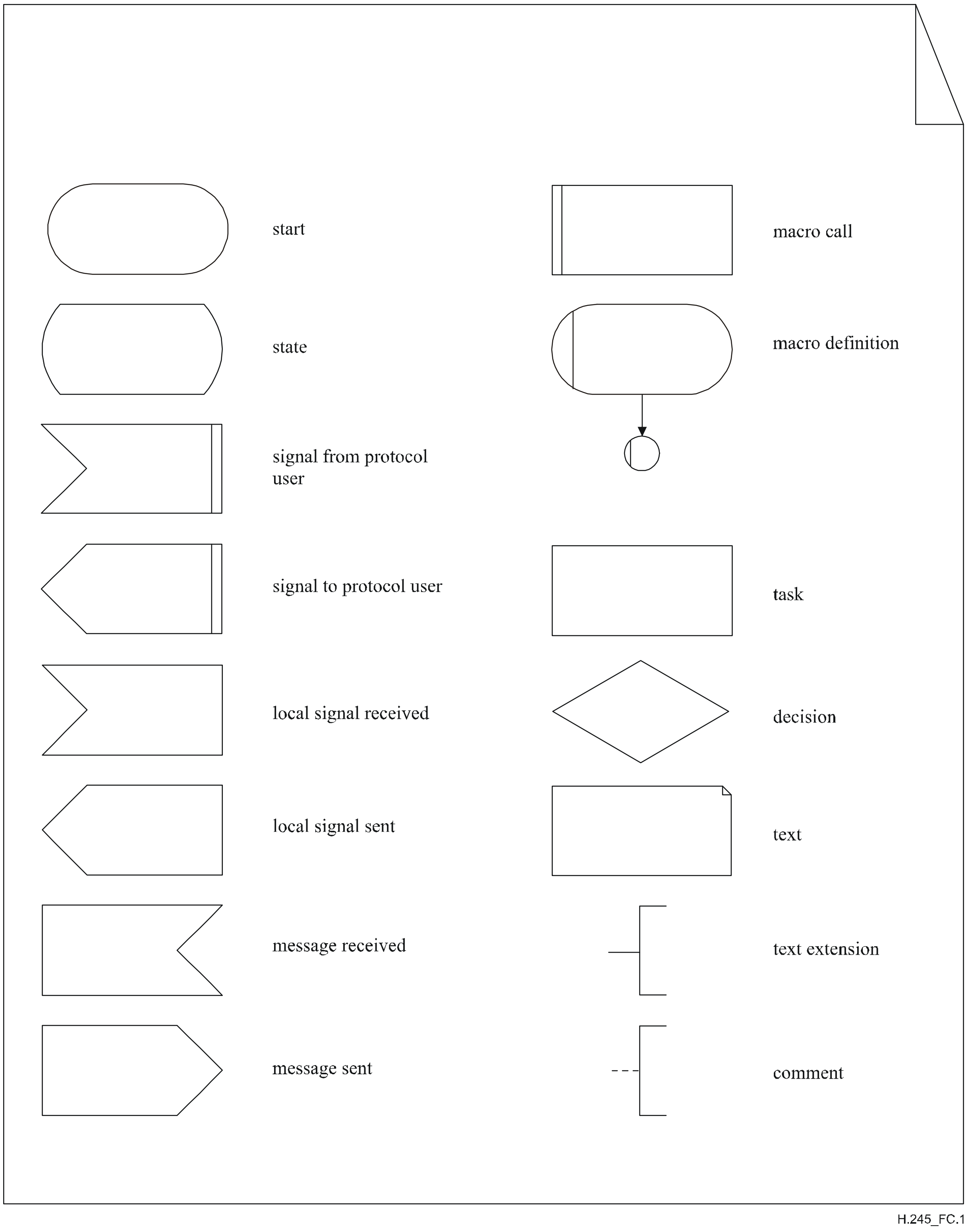


Figure C.1/H.245 – SDL key

C.2 Master-slave determination procedures

C.2.1 Introduction

Conflicts may arise when two or more terminals involved in a call initiate similar events simultaneously, for which resources are available for only one occurrence of the event e.g., opening of logical channels. To resolve such conflicts, one terminal may act as a master and the other terminals(s) may act as slave terminal(s). The procedures described here allow terminals in the call to determine which is the master terminal and which is the slave terminal(s).

The protocol described here is referred to as the Master-Slave Determination Signalling Entity (MSDSE). There is one instance of the MSDSE in each terminal involved in a call.

Either terminal may initiate the master-slave determination process by issuing the DETERMINE.request primitive to its MSDSE. The result of the procedure is returned by the DETERMINE.indication and DETERMINE.confirm primitives. While the DETERMINE.indication primitive indicates the result, it does not indicate that the result is known at the remote terminal. The DETERMINE.confirm primitive indicates the result and confirms that it is also known at the remote terminal. A terminal may only initiate the master-slave determination process if no procedure which depends upon its result is locally active.

A terminal shall respond to procedures that rely on knowledge of the result and are initiated by the remote terminal any time after the status determination result is known at the local terminal. This may be before the local terminal has received confirmation that the remote terminal also has knowledge of the result. A terminal shall not initiate procedures that rely on knowledge of the result until it has received confirmation that the remote terminal also has knowledge of the result of the current instance of the determination procedure.

The following text provides an overview of the operation of the protocol. In the case of any discrepancy with the formal specification of the protocol that follows, the formal specification will supersede.

C.2.1.1 Protocol overview – Initiation by local user

A master-slave determination procedure is initiated when the DETERMINE.request primitive is issued by the MSDSE user. A MasterSlaveDetermination message is sent to the peer MSDSE, and timer T106 is started. If a MasterSlaveDeterminationAck message is received in response to the MasterSlaveDetermination message then timer T106 is stopped and the user is informed with the DETERMINE.confirm primitive that the master-slave determination procedure was successful and a MasterSlaveDeterminationAck message is sent to the peer MSDSE. If however a MasterSlaveDeterminationReject message is received in response to the MasterSlaveDetermination message, then a new status determination number is generated, timer T106 is restarted, and another MasterSlaveDetermination message is sent. If after sending a MasterSlaveDetermination message N100 times, a MasterSlaveDeterminationAck still has not been received, then timer T106 is stopped and the user is informed with the REJECT.indication primitive that the master-slave determination procedure has failed to produce a result.

If timer T106 expires then the MSDSE user is informed with the REJECT.indication primitive and a MasterSlaveDeterminationRelease message is sent to the peer MSDSE.

C.2.1.2 Protocol overview – Initiation by remote user

When a MasterSlaveDetermination message is received at the MSDSE, a status determination procedure is initiated. If the status determination procedure returns a determinate result, then the user is informed of the master-slave determination result with the DETERMINE.indication primitive, a MasterSlaveDeterminationAck message is sent to the peer MSDSE, and timer T106 is started. If a MasterSlaveDeterminationAck message is received in response to the

MasterSlaveDeterminationAck message, then timer T106 is stopped and the user is informed with the DETERMINE.confirm primitive that the master-slave determination procedure was successful.

If timer T106 expires then the MSDSE user is informed with the REJECT.indication primitive.

If however the status determination procedure returns an indeterminate result, then the MasterSlaveDeterminationReject message is sent to the peer MSDSE.

C.2.1.3 Protocol overview – Simultaneous initiation

When a MasterSlaveDetermination message is received at the MSDSE that itself has already initiated a status determination procedure, and is awaiting a MasterSlaveDeterminationAck or MasterSlaveDeterminationReject message, then a status determination procedure is initiated. If the status determination procedure returns a determinate result, the MSDSE responds as if the procedure was initiated by the remote user, and the procedures described above for this condition apply.

If however the status determination procedure returns an indeterminate result, then a new status determination number is generated, and the MSDSE responds as if the procedure was again initiated by the local MSDSE user as described above.

C.2.1.4 Status determination procedure

The following procedure is used to determine which terminal is the master from the terminalType and statusDeterminationNumber values. Firstly, the terminalType values are compared and the terminal with the larger terminal type number is determined as the master. If the terminal type numbers are the same, the statusDeterminationNumbers are compared using modulo arithmetic to determine which is master.

If both terminals have equal terminalType field values and the difference between statusDeterminationNumber field values modulo 2^{24} is 0 or 2^{23}, an indeterminate result is obtained.

C.2.2 Communication between the MSDSE and the MSDSE user

C.2.2.1 Primitives between the MSDSE and the MSDSE user

Communication between the MSDSE, and MSDSE user, is performed using the primitives shown in Table C.1.

Table C.1/H.245 – Primitives and parameters

Generic name	type			
	request	**indication**	**response**	**confirm**
DETERMINE	– (Note 1)	TYPE	not defined (Note 2)	TYPE
REJECT	not defined	–	not defined	not defined
ERROR	not defined	ERRCODE	not defined	not defined
NOTE 1 – "–" means no parameters. NOTE 2 – "not defined" means that this primitive is not defined.				

C.2.2.2 Primitive definition

The definition of these primitives is as follows:

a) The DETERMINE primitive is used to initiate, and to return the result from, the master-slave determination procedure.

   The DETERMINE.request primitive is used to initiate the master-slave determination procedure.

The DETERMINE.indication primitive is used to indicate the result of the master-slave determination procedure. As the result of the procedure may not be known at the remote terminal, the terminal shall not initiate any procedures that rely on knowledge of the result, although it shall respond to any procedures that rely on knowledge of the result.

The DETERMINE.confirm primitive is used to indicate the result of the master-slave determination procedure and that the result of the procedure is known at both terminals. The terminal may initiate, and shall respond to, any procedures that rely on knowledge of the result.

b) The REJECT primitive indicates that the master-slave determination procedure was unsuccessful.

c) The ERROR primitive reports MSDSE errors to a management entity.

C.2.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.1 is as follows:

a) The TYPE parameter indicates the terminal status. It has the value of "MASTER" or "SLAVE".

b) The ERRCODE value indicates the type of MSDSE error. Table C.5 indicates the values that the ERRCODE parameter may take.

C.2.2.4 MSDSE states

The following states are used to specify the allowed sequence of primitives between the MSDSE and the MSDSE user.

State 0: IDLE

No master-slave determination procedure has been initiated.

State 1: OUTGOING AWAITING RESPONSE

The local MSDSE user has requested a master-slave determination procedure. A response from the remote MSDSE is awaited.

State 2: INCOMING AWAITING RESPONSE

The remote MSDSE has initiated a master-slave determination procedure in the local MSDSE. An acknowledgement was sent to the remote MSDSE and a response from the remote MSDSE is awaited.

C.2.2.5 State transition diagram

The allowed sequence of primitives between the MSDSE and the MSDSE user is defined here. The allowed sequences are shown in Figure C.2.

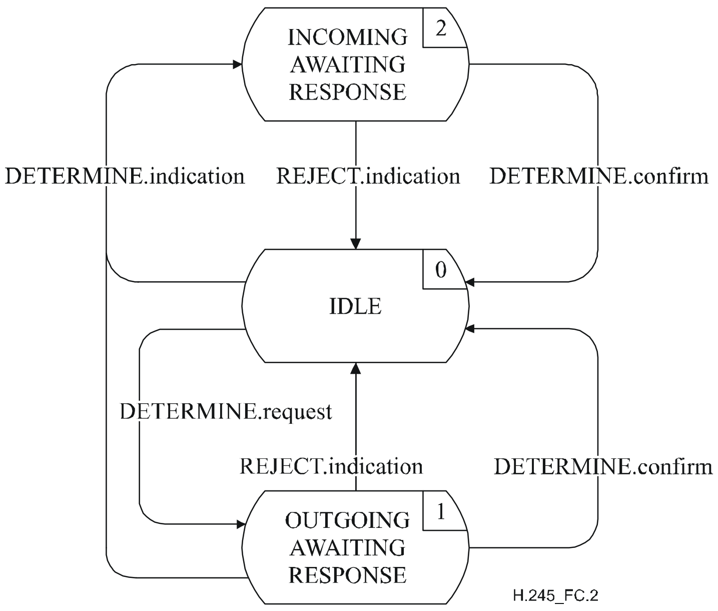


Figure C.2/H.245 – State transition diagram for sequence of primitives at MSDSE

C.2.3 Peer-to-peer MSDSE communication

C.2.3.1 MSDSE messages

Table C.2 shows the MSDSE messages and fields, defined in Annex A, which are relevant to the MSDSE protocol.

Table C.2/H.245 – MSDSE message names and fields

Function	Message	Field
determination	MasterSlaveDetermination	terminalType statusDeterminationNumber
	MasterSlaveDeterminationAck	decision
	MasterSlaveDeterminationReject	cause
error recovery	MasterSlaveDeterminationRelease	–

C.2.3.2 MSDSE state variables

The following MSDSE state variables are defined:

sv_TT

This state variable holds the terminal type number for this terminal.

sv_SDNUM

This state variable holds the status determination number for this terminal.

sv_STATUS

This state variable is used to store the result of the latest master-slave determination procedure. It has values of "master", "slave", and "indeterminate".

sv_NCOUNT

This state variable is used to count the number of MasterSlaveDetermination messages that have been sent during the OUTGOING AWAITING RESPONSE state.

C.2.3.3 MSDSE timers

The following timer is specified for the outgoing MSDSE:

T106

This timer is used during the OUTGOING AWAITING RESPONSE state and during the INCOMING AWAITING RESPONSE state. It specifies the maximum allowed time during which no acknowledgement message may be received.

C.2.3.4 MSDSE counters

The following parameter is specified for the MSDSE:

N100

This parameter specifies the maximum value of sv_NCOUNT.

C.2.4 MSDSE procedures

C.2.4.1 Introduction

Figure C.3 summarizes the MSDSE primitives and their parameters, and messages.

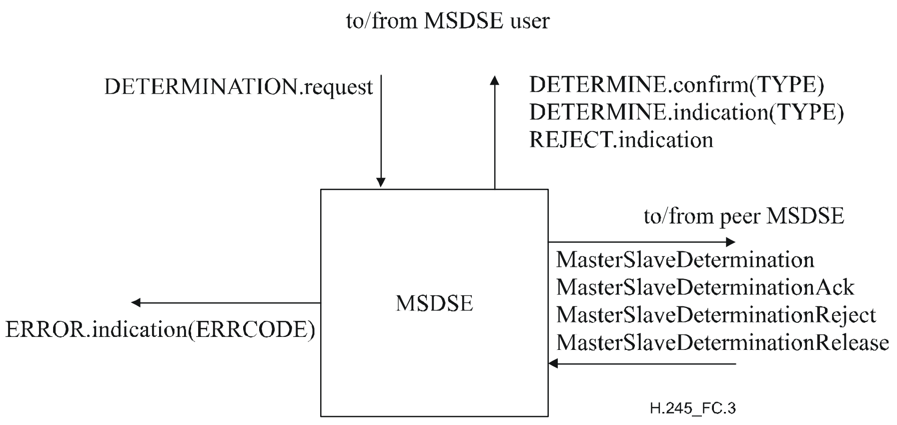

to/from MSDSE user
DETERMINATION.request
DETERMINE.confirm(TYPE)
DETERMINE.indication(TYPE)
REJECT.indication
to/from peer MSDSE
MasterSlaveDetermination
MasterSlaveDeterminationAck
MasterSlaveDeterminationReject
MasterSlaveDeterminationRelease
MSDSE
ERROR.indication(ERRCODE)
H.245_FC.3

Figure C.3/H.245 – Primitives and messages in the MSDSE

C.2.4.2 Primitive parameter default values

Where not explicitly stated in the SDL diagrams the parameters of the indication and confirm primitives assume values as shown in Table C.3.

Table C.3/H.245 – Default primitive parameter values

Primitive	Parameter	Default value
DETERMINE.confirm	TYPE	MasterSlaveDeterminationAck.decision
DETERMINE.indication	TYPE	sv_STATUS

C.2.4.3 Message field default values

Where not explicitly stated in the SDL diagrams the message fields assume values as shown in Table C.4.

Table C.4/H.245 – Default message field values

Message	Field	Default value
MasterSlaveDetermination	terminalType statusDeterminationNumber	sv_TT sv_SDNUM

MasterSlaveDeterminationAck	decision	Opposite of sv_STATUS i.e.,
		if(sv_STATUS == master) decision = slave
		if(sv_STATUS == slave) decision = master

MasterSlaveDeterminationReject	cause	identicalNumbers

C.2.4.4 ERRCODE parameter values

Table C.5 shows the values that the ERRCODE parameter of the ERROR.indication primitive may take for the MSDSE.

Table C.5/H.245 – ERRCODE parameter values at MSDSE

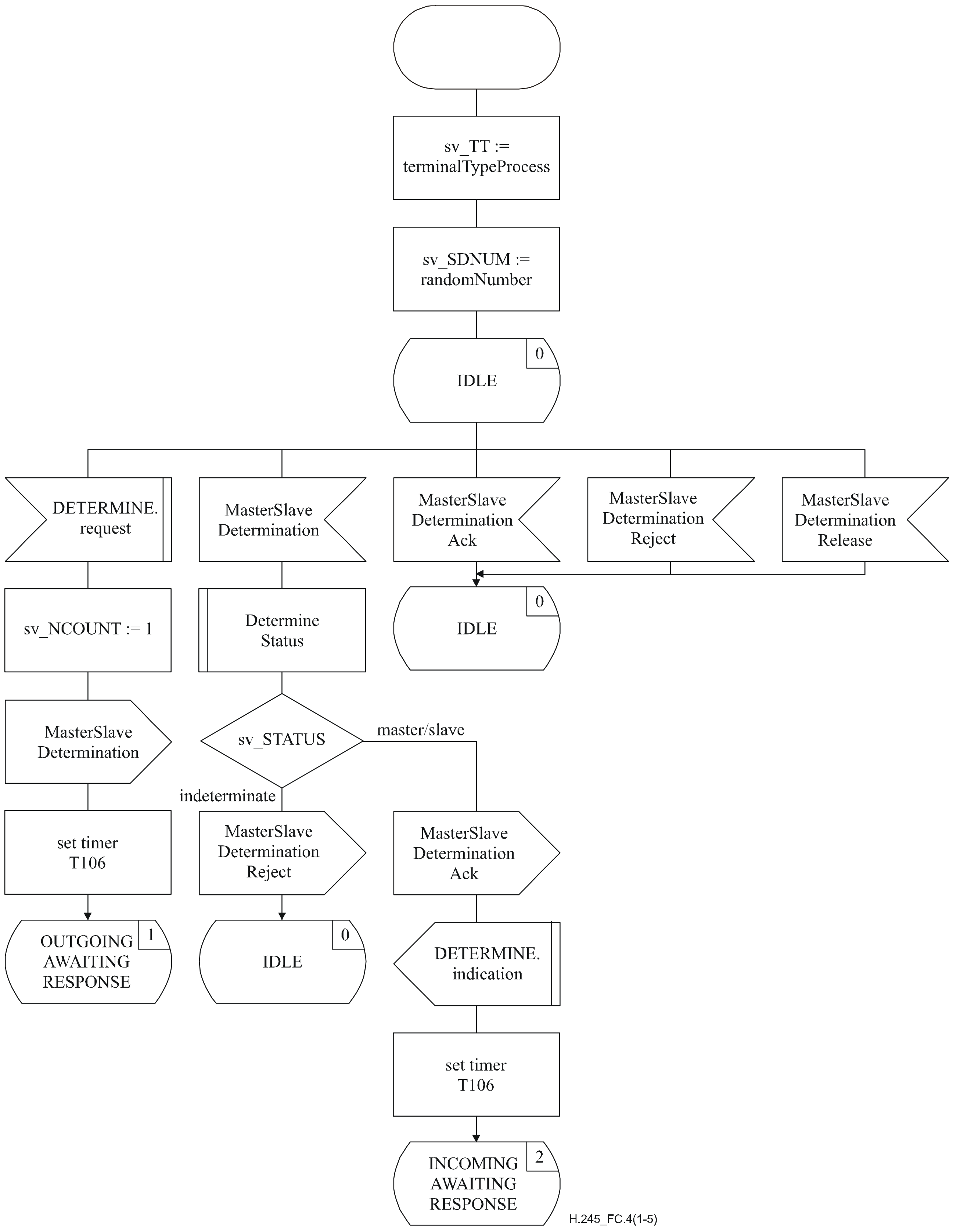
Error type	Error code	Error condition	State
no response from remote MSDSE	A	local timer T106 expiry	OUTGOING AWAITING RESPONSE INCOMING AWAITING RESPONSE
remote sees no response from local MSDSE	B	remote timer T106 expiry	OUTGOING AWAITING RESPONSE INCOMING AWAITING RESPONSE
inappropriate message	C	MasterSlaveDetermination	INCOMING AWAITING RESPONSE
	D	MasterSlaveDeterminationReject	INCOMING AWAITING RESPONSE
inconsistent field value	E	MasterSlaveDeterminationAck.decision != sv_STATUS	INCOMING AWAITING RESPONSE
maximum number of retries	F	sv_NCOUNT == N100	OUTGOING AWAITING RESPONSE

C.2.4.5 SDLs

The MSDSE procedures are expressed in SDL form in Figure C.4.

terminalTypeProcess is process that returns a number that identifies different types of terminal, such as, terminals, MCUs and gateways.

randomNumber is process that returns a random number in the range 0 ... $2^{24} – 1$.



sv_TT := terminalTypeProcess
sv_SDNUM := randomNumber
IDLE
0
DETERMINE. request
MasterSlave Determination
MasterSlave Determination Ack
MasterSlave Determination Reject
MasterSlave Determination Release
sv_NCOUNT := 1
Determine Status
IDLE
0
MasterSlave Determination
sv_STATUS
master/slave
indeterminate
set timer T106
MasterSlave Determination Reject
MasterSlave Determination Ack
OUTGOING AWAITING RESPONSE
1
IDLE
0
DETERMINE. indication
set timer T106
INCOMING AWAITING RESPONSE
2
H.245_FC.4(1-5)

Figure C.4/H.245 – MSDSE SDL *(sheet 1 of 5)*

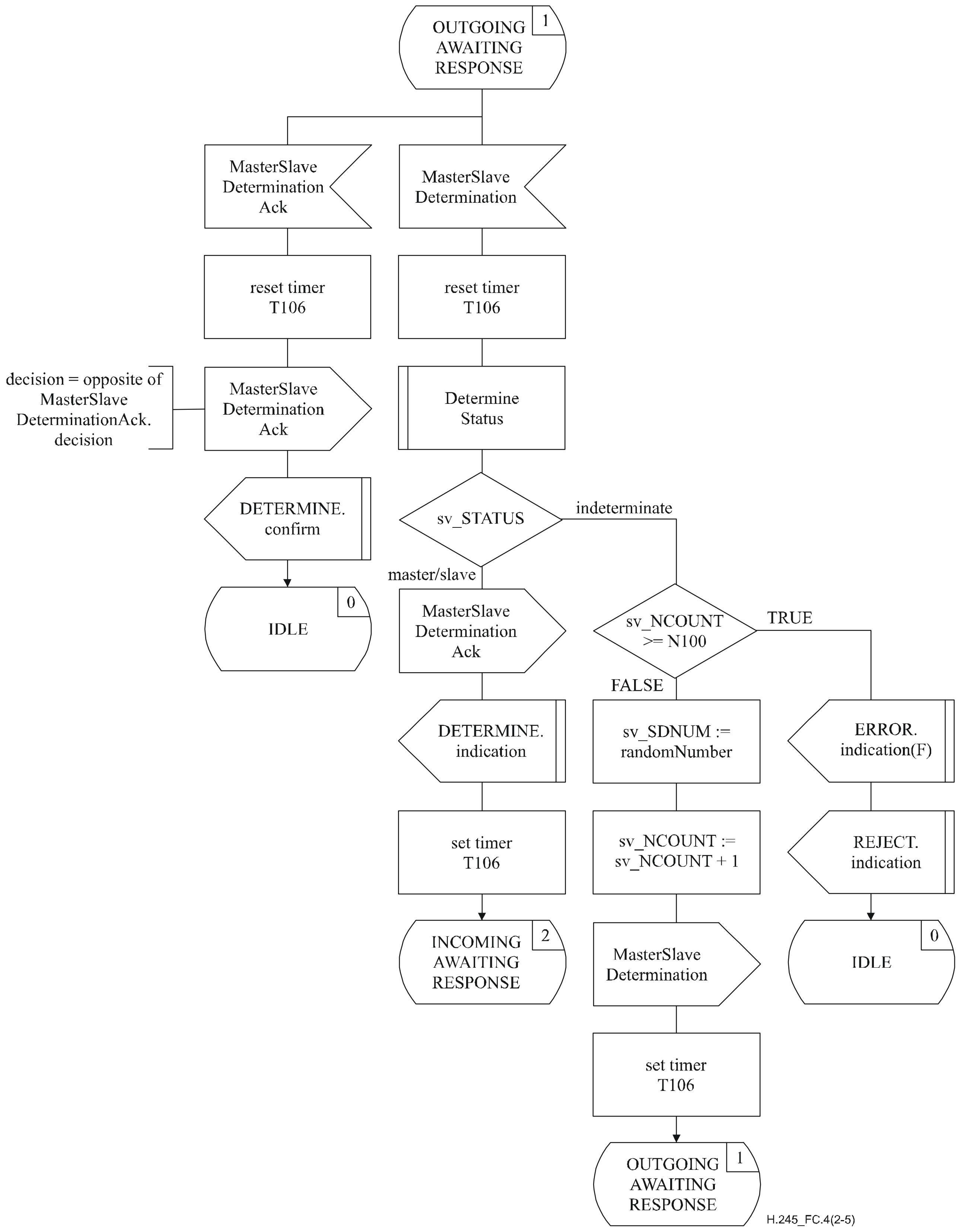

OUTGOING AWAITING RESPONSE
1
MasterSlave Determination Ack
MasterSlave Determination
reset timer T106
reset timer T106
decision = opposite of MasterSlave DeterminationAck. decision
MasterSlave Determination Ack
Determine Status
DETERMINE. confirm
sv_STATUS
indeterminate
master/slave
IDLE
0
MasterSlave Determination Ack
sv_NCOUNT >= N100
TRUE
FALSE
DETERMINE. indication
sv_SDNUM := randomNumber
ERROR. indication(F)
set timer T106
sv_NCOUNT := sv_NCOUNT + 1
REJECT. indication
INCOMING AWAITING RESPONSE
2
MasterSlave Determination
IDLE
0
set timer T106
OUTGOING AWAITING RESPONSE
1
H.245_FC.4(2-5)

Figure C.4/H.245 – MSDSE SDL ***(sheet 2 of 5)***

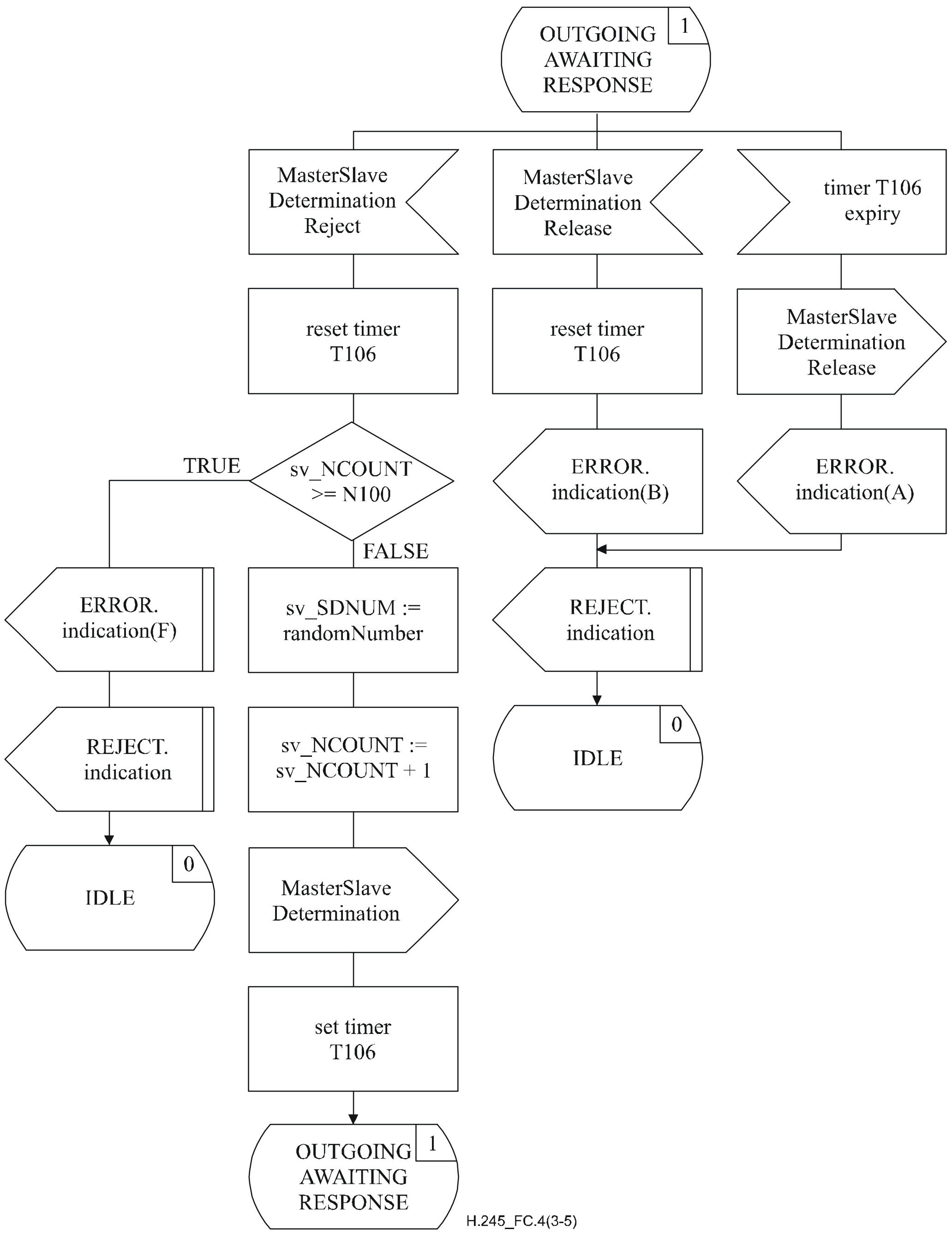


Figure C.4/H.245 – MSDSE SDL *(sheet 3 of 5)*

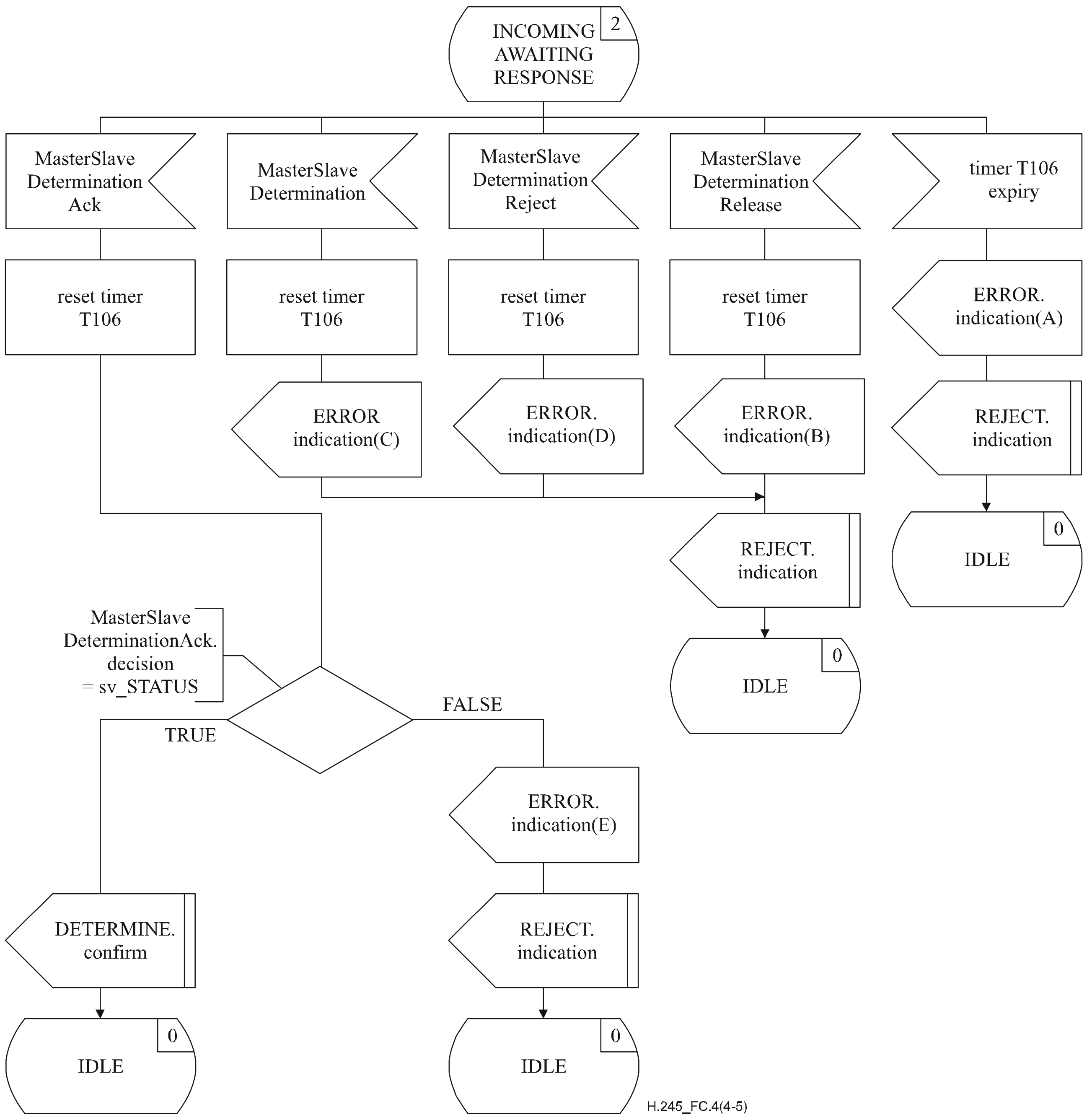
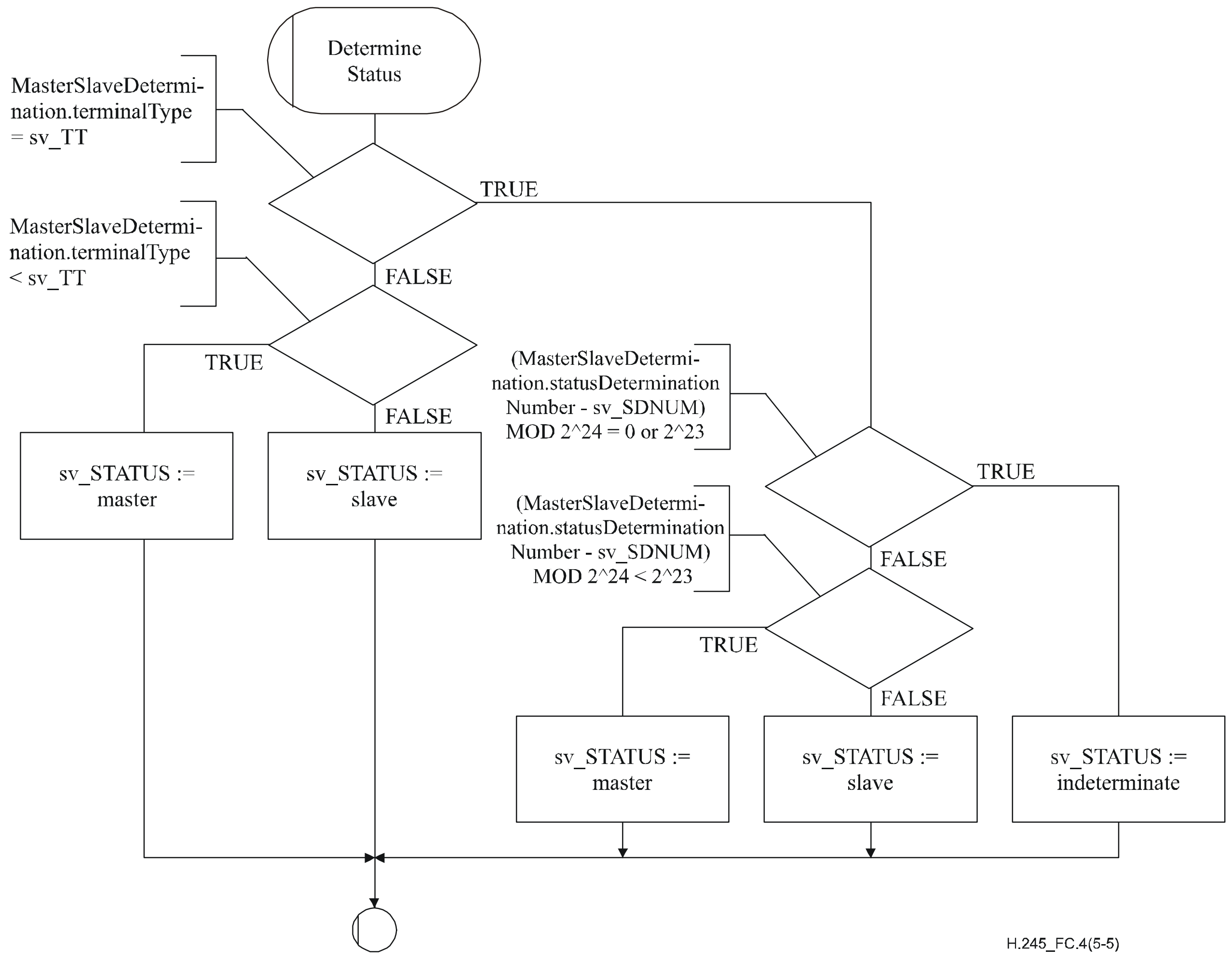


Figure C.4/H.245 – MSDSE SDL *(sheet 4 of 5)*



Determine Status
MasterSlaveDetermination.terminalType = sv_TT
TRUE
MasterSlaveDetermination.terminalType < sv_TT
FALSE
TRUE
FALSE
(MasterSlaveDetermination.statusDetermination Number - sv_SDNUM) MOD 2^24 = 0 or 2^23
sv_STATUS := master
sv_STATUS := slave
TRUE
(MasterSlaveDetermination.statusDetermination Number - sv_SDNUM) MOD 2^24 < 2^23
FALSE
TRUE
FALSE
sv_STATUS := master
sv_STATUS := slave
sv_STATUS := indeterminate
H.245_FC.4(5-5)

Figure C.4/H.245 – MSDSE SDL *(sheet 5 of 5)*

C.3 Capability exchange procedures

C.3.1 Introduction

These procedures are used by terminals to communicate their capabilities, and are referred to as the Capability Exchange Signalling Entity (CESE). Procedures are specified in terms of primitives and states at the interface between the CESE and the CESE user. Protocol information is transferred to the peer CESE via relevant messages defined in Annex A. There is an outgoing CESE and an incoming CESE. At each of the outgoing and incoming ends there is one instance of the CESE for each call.

All terminals intended for use in point-to-point applications or those connected to an MCU shall be able to identify a TerminalCapabilitySet and its structure, and such capability values therein that are mandatory for those applications; any unrecognized capability values shall be ignored, and no fault shall be implied.

The capability exchange may be performed at any time. The capability exchange may signal both changed and unchanged capabilities. Unchanged capabilities should not be sent repetitively without strong cause.

The following text provides an overview of the operation of the protocol. In the case of any discrepancy with the formal specification of the protocol that follows, the formal specification will supersede.

C.3.1.1 Protocol overview – Outgoing CESE

A capability exchange is initiated when the TRANSFER.request primitive is issued by the user at the outgoing CESE. A TerminalCapabilitySet message is sent to the peer incoming CESE, and timer T101 is started. If a TerminalCapabilitySetAck message is received in response to the TerminalCapabilitySet message then timer T101 is stopped and the user is informed with the TRANSFER.confirm primitive that the capability exchange was successful. If, however, a TerminalCapabilitySetReject message is received in response to the TerminalCapabilitySet message then timer T101 is stopped and the user is informed with the REJECT.indication primitive that the peer CESE user has refused the capability exchange.

If timer T101 expires then the outgoing CESE user is informed with the REJECT.indication primitive and a TerminalCapabilitySetRelease message is sent.

C.3.1.2 Protocol overview – Incoming CESE

When a TerminalCapabilitySet message is received at the incoming CESE, the user is informed of the capability exchange request with the TRANSFER.indication primitive. The incoming CESE user signals acceptance of the capability exchange request by issuing the TRANSFER.response primitive, and a TerminalCapabilitySetAck message is sent to the peer outgoing CESE. The incoming CESE user signals rejection of the capability exchange request by issuing the REJECT.request primitive, and a TerminalCapabilitySetReject message is sent to the peer outgoing CESE.

C.3.2 Communication between CESE and CESE user

C.3.2.1 Primitives between CESE and CESE user

Communication between the CESE and CESE user, is performed using the primitives shown in Table C.6.

Table C.6/H.245 – Primitives and parameters

Generic name	**Type**			
	request	**indication**	**response**	**confirm**
TRANSFER	PROTOID MUXCAP CAPTABLE CAPDESCRIPTORS	PROTOID MUXCAP CAPTABLE CAPDESCRIPTORS	– (Note 1)	–
REJECT	CAUSE	SOURCE CAUSE	not defined (Note 2)	not defined
NOTE 1 – "–" means no parameters. NOTE 2 – "not defined" means that this primitive is not defined.				

C.3.2.2 Primitive definition

The definition of these primitives is as follows:

a) The TRANSFER primitives are used for transfer of the capability exchange.

b) The REJECT primitives are used to reject a capability descriptor entry, and to terminate a current capability transfer.

C.3.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.6 is as follows:

a) The PROTOID parameter is the protocol identifier parameter. This parameter is mapped to the protocolIdentifier field of the TerminalCapabilitySet message and carried transparently to the peer CESE user. This parameter is mandatory.

b) The MUXCAP parameter is the multiplex capability parameter. This parameter is mapped to the multiplexCapability field of the TerminalCapabilitySet message and carried transparently to the peer CESE user. This parameter is optional.

c) The CAPTABLE parameter is the capability table parameter. There may be one or more capability table entries described within this parameter. This parameter is mapped to the capabilityTable field of the TerminalCapabilitySet message and carried transparently to the peer CESE user. This parameter is optional.

d) The CAPDESCRIPTORS parameter is the capability descriptors parameter. There may be one or more capability descriptors described within in this parameter. This parameter is mapped to the capabilityDescriptors field of the TerminalCapabilitySet message and carried transparently to the peer CESE user. This parameter is optional.

e) The SOURCE parameter indicates the source of the REJECT.indication primitive. The SOURCE parameter has the value of "USER" or "PROTOCOL". The latter case may occur as the result of a timer expiry.

f) The CAUSE parameter indicates the reason for rejection of a CAPTABLE or CAPDESCRIPTORS parameter. The CAUSE parameter is not present when the SOURCE parameter indicates "PROTOCOL".

C.3.2.4 CESE states

The following states are used to specify the allowed sequence of primitives between the CESE and the CESE user.

The states for an outgoing CESE are:

State 0: IDLE

The CESE is idle.

State 1: AWAITING RESPONSE

The CESE is waiting for a response from the remote CESE.

The states for an incoming CESE are:

State 0: IDLE

The CESE is idle.

State 1: AWAITING RESPONSE

The CESE is waiting for a response from the CESE user.

C.3.2.5 State transition diagram

The allowed sequence of primitives between the CESE and the CESE user is defined here. The allowed sequence of primitives relates to states of the CESE as viewed from the CESE user. The allowed sequences are specified separately for each of an outgoing CESE and an incoming CESE, as shown in Figures C.5 and C.6 respectively.

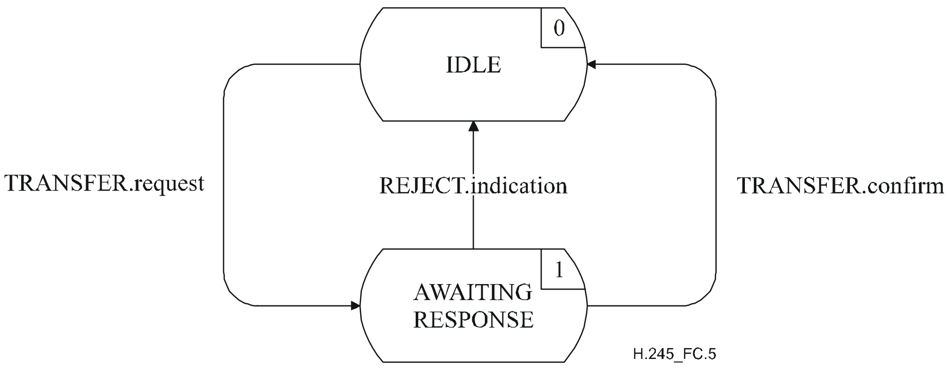


Figure C.5/H.245 – State transition diagram for sequence of primitives at outgoing CESE

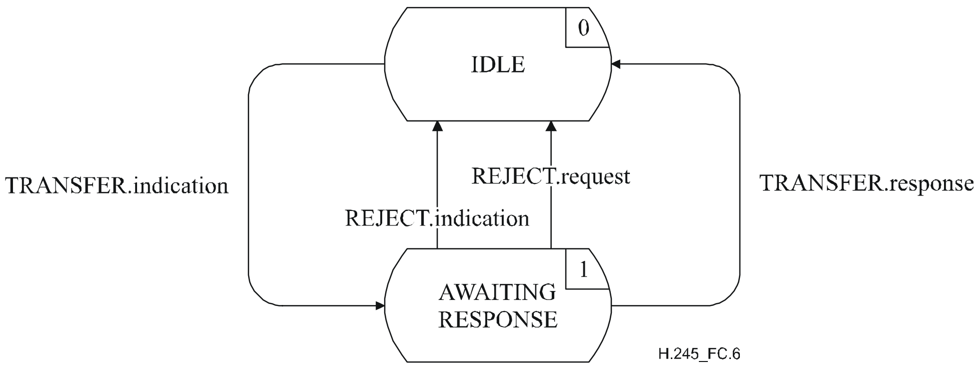


Figure C.6/H.245 – State transition diagram for sequence of primitives at incoming CESE

C.3.3 Peer-to-peer CESE communication

C.3.3.1 Messages

Table C.7 shows the CESE messages and fields, defined in Annex A, which are relevant to the CESE protocol.

Table C.7/H.245 – CESE message names and fields

Function	Message	Direction	Field
transfer	TerminalCapabilitySet	O → I (Note)	sequenceNumber protocolIdentifier multiplexCapability capabilityTable capabilityDescriptors
	TerminalCapabilitySetAck	O ← I	sequenceNumber
reject	TerminalCapabilitySetReject	O ← I	sequenceNumber cause
reset	TerminalCapabilitySetRelease	O → I	–
NOTE – Direction: O – Outgoing, I – Incoming.			

C.3.3.2 CESE state variables

The following state variable is defined at the outgoing CESE:

out_SQ

This state variable is used to indicate the most recent TerminalCapabilitySet message. It is incremented by one and mapped to the TerminalCapabilitySet message sequenceNumber field before transmission of the TerminalCapabilitySet message. Arithmetic performed on out_SQ is modulo 256.

The following state variable is defined at the incoming CESE:

in_SQ

This state variable is used to store the value of the sequenceNumber field of the most recently received TerminalCapabilitySet message. The TerminalCapabilitySetAck and TerminalCapabilitySetReject messages have their sequenceNumber fields set to the value of in_SQ, before being sent to the peer CESE.

C.3.3.3 CESE timers

The following timer is specified for the outgoing CESE:

T101

This timer is used during the AWAITING RESPONSE state. It specifies the maximum time during which no TerminalCapabilitySetAck or TerminalCapabilitySetReject message may be received.

C.3.4 CESE procedures

Figure C.7 summarizes the CESE primitives and their parameters, and messages, for each of the outgoing and incoming CESE.

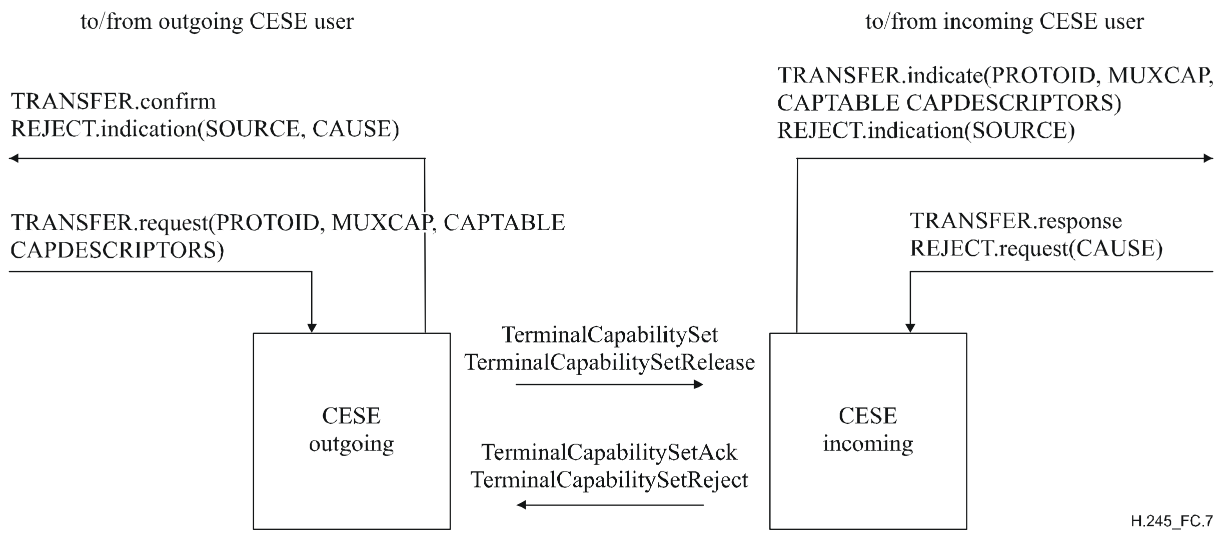

to/from outgoing CESE user
to/from incoming CESE user
TRANSFER.confirm
REJECT.indication(SOURCE, CAUSE)
TRANSFER.indicate(PROTOID, MUXCAP, CAPTABLE CAPDESCRIPTORS)
REJECT.indication(SOURCE)
TRANSFER.request(PROTOID, MUXCAP, CAPTABLE CAPDESCRIPTORS)
TRANSFER.response
REJECT.request(CAUSE)
TerminalCapabilitySet
TerminalCapabilitySetRelease
TerminalCapabilitySetAck
TerminalCapabilitySetReject
CESE outgoing
CESE incoming
H.245_FC.7

Figure C.7/H.245 – Primitives and messages in the Capability Exchange Signalling Entity

C.3.4.1 Primitive parameter default values

Where not explicitly stated in the SDL diagrams, the parameters of the indication and confirm primitives assume values as shown in Table C.8.

Table C.8/H.245 – Default primitive parameter values

Primitive	Parameter	Default value
TRANSFER.indication	PROTOID	TerminalCapabilitySet.protocolIdentifier
	MUXCAP	TerminalCapabilitySet.multiplexCapability
	CAPTABLE CAPDESCRIPTORS	TerminalCapabilitySet.capabilityTable TerminalCapabilitySet.capabilityDescriptors
REJECT.indication	SOURCE CAUSE	USER null

C.3.4.2 Message field default values

Where not explicitly stated in the SDL diagrams, the message fields assume values as shown in Table C.9.

Table C.9/H.245 – Default message field values

Message	Field	Default value (Note)

TerminalCapabilitySet	sequenceNumber
	protocolIdentifier
	multiplexCapability
	capabilityTable
	capabilityDescriptors
		out_SQ
		TRANSFER.request(PROTOID)
		TRANSFER.request(MUXCAP)
		TRANSFER.request(CAPTABLE)
		TRANSFER.request(CAPDESCRIPTORS)

TerminalCapabilitySetAck	sequenceNumber	in_SQ
TerminalCapabilitySetReject	sequenceNumber cause	in_SQ REJECT.request(CAUSE)
TerminalCapabilitySetRelease	–	–
NOTE – A message field shall not be coded if the corresponding primitive parameter is null, i.e., not present.		

C.3.4.3 SDLs

The outgoing CESE and the incoming CESE procedures are expressed in SDL form in Figures C.8 and C.9, respectively.

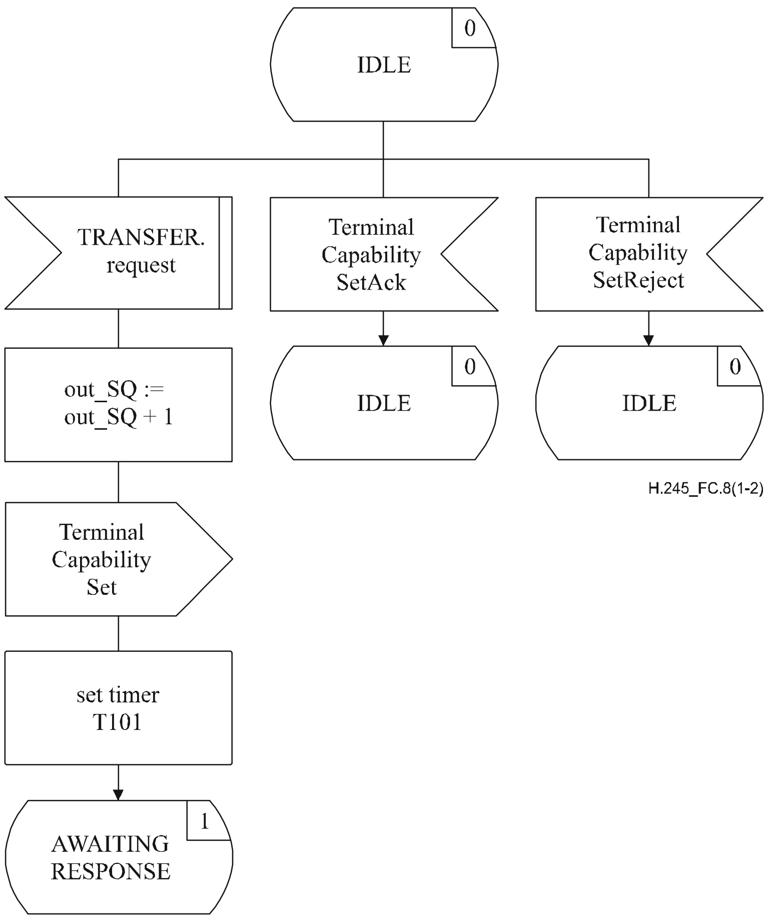
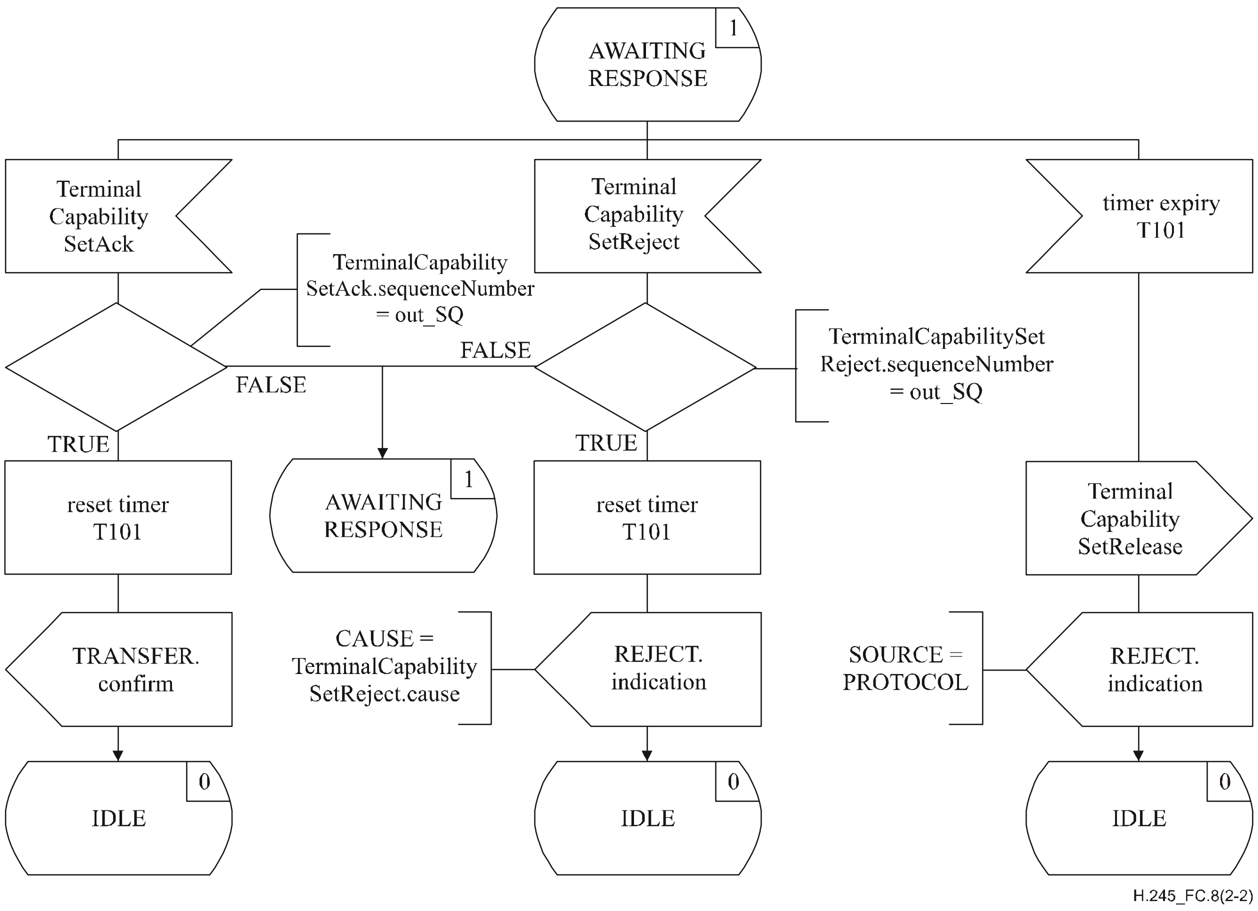


Figure C.8/H.245 – Outgoing CESE SDL *(sheet 1 of 2)*



AWAITING RESPONSE
1
Terminal Capability SetAck
Terminal Capability SetReject
timer expiry T101
TerminalCapability SetAck.sequenceNumber = out_SQ
FALSE
FALSE
TerminalCapabilitySet Reject.sequenceNumber = out_SQ
TRUE
TRUE
reset timer T101
AWAITING RESPONSE
1
reset timer T101
Terminal Capability SetRelease
TRANSFER. confirm
CAUSE = TerminalCapability SetReject.cause
REJECT. indication
SOURCE = PROTOCOL
REJECT. indication
IDLE
0
IDLE
0
IDLE
0
H.245_FC.8(2-2)

Figure C.8/H.245 – Outgoing CESE SDL ***(sheet 2 of 2)***

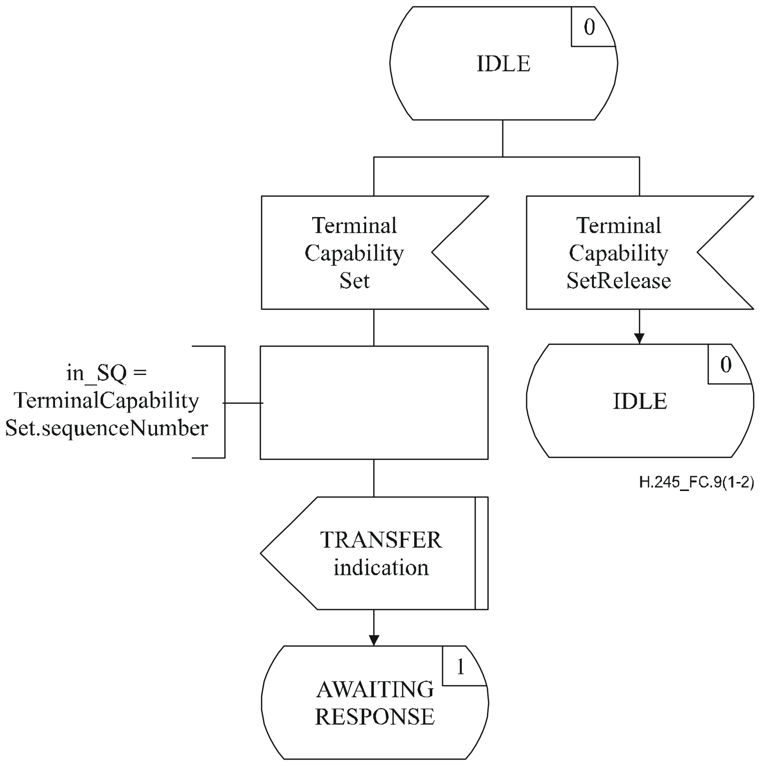


Figure C.9/H.245 – Incoming CESE SDL ***(sheet 1 of 2)***

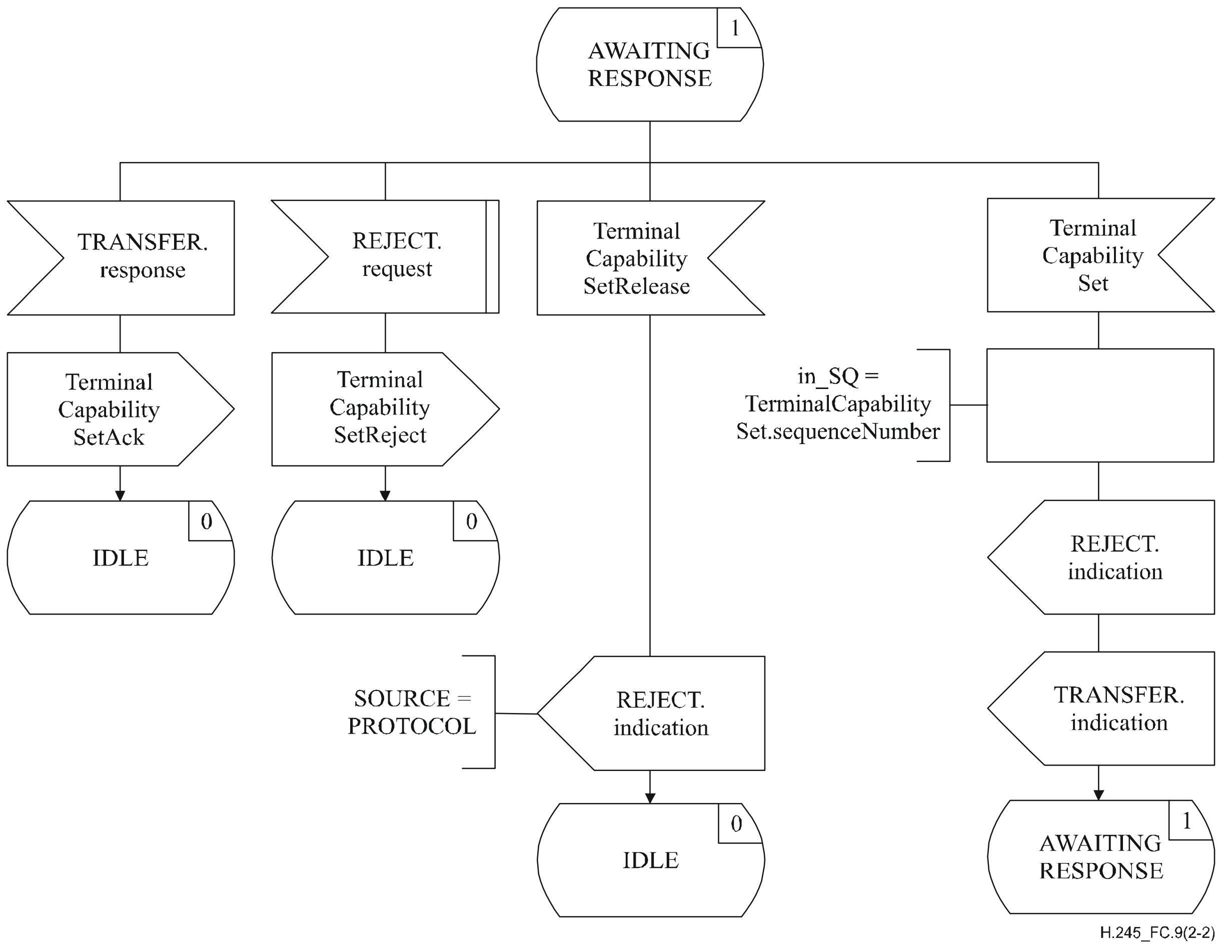


Figure C.9/H.245 – Incoming CESE SDL *(sheet 2 of 2)*

C.4 Unidirectional Logical Channel signalling procedures

C.4.1 Introduction

The protocol specified here provides reliable opening and closing of unidirectional logical channels using acknowledged procedures.

The protocol specified here is referred to as the Logical Channel Signalling Entity (LCSE). Procedures are specified in terms of primitives at the interface between the LCSE and the LCSE user, and LCSE states. Protocol information is transferred to the peer LCSE via relevant messages defined in Annex A.

There is an outgoing LCSE and an incoming LCSE. At each of the outgoing and incoming sides there is one instance of the LCSE for each unidirectional logical channel. There is no connection between an incoming LCSE and an outgoing LCSE at one side, other than via primitives to and from the LCSE user. LCSE error conditions are reported.

Data shall only be sent on a logical channel in the ESTABLISHED state. If data is received on a logical channel that is not in the ESTABLISHED state the data shall be discarded and no fault shall be considered to have occurred.

Mode switching should be performed by closing and opening existing logical channels, or by opening new logical channels.

NOTE – Some Recommendations that use this Recommendation may define some default logical channels. These shall be considered ESTABLISHED from the start of communication and shall not be opened using these procedures. They may, however, be closed by these procedures, and subsequently be re-opened for the same or a different purpose.

A terminal that is no longer capable of processing the signals on a logical channel should take appropriate action: this should include closing the logical channel and transmitting the relevant (changed) capability information to the remote terminal.

The following text provides an overview of the operation of the LCSE protocol. In the case of discrepancy between this and the formal specification, the formal specification will supersede.

C.4.1.1 Protocol overview

The opening of a logical channel is initiated when the ESTABLISH.request primitive is issued by the user at the outgoing LCSE. An OpenLogicalChannel message, containing forward logical channel parameters but not including reverse logical channel parameters, is sent to the peer incoming LCSE, and timer T103 is started. If an OpenLogicalChannelAck message is received in response to the OpenLogicalChannel message then timer T103 is stopped and the user is informed with the ESTABLISH.confirm primitive that the logical channel has been successfully opened. The logical channel may now be used to transmit user information. If however an OpenLogicalChannelReject message is received in response to the OpenLogicalChannel message then timer T103 is stopped and the user is informed with the RELEASE.indication primitive that the peer LCSE user has refused establishment of the logical channel.

If timer T103 expires in this period then the user is informed with the RELEASE.indication primitive, and a CloseLogicalChannel message is sent to the peer incoming LCSE.

A logical channel which has been successfully established may be closed when the RELEASE.request primitive is issued by the user at the outgoing LCSE. A CloseLogicalChannel message is sent to the peer incoming LCSE, and the timer T103 is started. When a CloseLogicalChannelAck message is received, timer T103 is stopped and the user is informed that the logical channel has been successfully closed with the RELEASE.confirm primitive.

If timer T103 expires in this period then the user is informed with the RELEASE.indication primitive.

Before either of the OpenLogicalChannelAck or OpenLogicalChannelReject messages have been received in response to a previously sent OpenLogicalChannel message, the user at the outgoing LCSE may close the logical channel using the RELEASE.request primitive.

Before the CloseLogicalChannelAck message is received in response to a previously sent CloseLogicalChannel message, the user at the outgoing LCSE may establish a new logical channel by issuing the ESTABLISH.request primitive.

C.4.1.2 Protocol overview – Incoming LCSE

When an OpenLogicalChannel message is received at the incoming LCSE, the user is informed of the request to open a new logical channel with the ESTABLISH.indication primitive. The incoming LCSE user signals acceptance of the request to establish the logical channel by issuing the ESTABLISH.response primitive, and an OpenLogicalChannelAck message is sent to the peer outgoing LCSE. The logical channel may now be used to receive user information. The incoming LCSE user signals rejection of the request to establish the logical channel by issuing the RELEASE.request primitive, and an OpenLogicalChannelReject message is sent to the peer outgoing LCSE.

A logical channel which has been successfully established may be closed when the CloseLogicalChannel message is received at the incoming LCSE. The incoming LCSE user is informed with the RELEASE.indication primitive, and the CloseLogicalChannelAck message is sent to the peer outgoing LCSE.

C.4.1.3 Conflict resolution

Conflicts may arise when requests to open logical channels are initiated at the same time. It may be possible to determine that there is a conflict from knowledge of exchanged capabilities.

Terminals shall be capable of detecting when conflict has arisen, or might arise, and shall act as follows.

Before logical channels can be opened, one terminal must be determined as the master terminal, and the other as the slave. The protocol defined in C.2 provides one means to make this decision. The master terminal shall reject immediately any request from the slave that it identifies as a conflicting request. The slave terminal may identify such conflicts, but shall respond to the request from the master terminal, with the knowledge that its earlier request will be rejected.

NOTE – Such conflicts might be caused by limited terminal resources, for example, when receive and transmission capabilities are dependent, as in the case of a terminal that can support a number of audio algorithms, but can only decode the same algorithm as it is encoding.

The following behaviour is recommended to minimize the chance of endpoints attempting to open conflicting logical channels when the slave endpoint has symmetric capability limitations. When the master and the slave have indicated choices of receive capabilities for a particular media type, the slave should attempt to open a logical channel for the master's most preferred capability for which it has capability, as given by the order the master has expressed its capabilities; and the master should attempt to open a logical channel for its most preferred capability for which the slave has capability, as given by the order it has expressed its capabilities.

For example, if the master has declared capability for G.723.1, G.729, and G.711 and the slave has indicated capability for G.711 and G.729, with the most preferable being listed first in both cases, then both master and slave should attempt to open logical channels for G.729.

After the request to open a logical channel has been rejected by the master, with cause equal to masterSlaveConflict, the slave is responsible for opening a non-conflicting channel.

When the slave detects a conflict and the master does not reject a conflicting open logical channel, the slave should close the conflicting channel. In the case of conflicting logical channels due to symmetric capability limitations, the slave should open an appropriate logical channel using the replacement for procedure, and in due course close the conflicting logical channel.

C.4.1.4 Conflict resolution of unidirectional and bidirectional channels

Another type of conflict that might occur is when both endpoints try to open a channel of the same type, but one of them tries to open the channel as a unidirectional channel and the other terminal tries to open it as a bidirectional channel.

In such a case, the master shall reject the channel with cause equal to masterSlaveConflict, and the slave should determine if it needs to try and open a non-conflicting channel or do nothing more.

When the slave detects a conflict and the master does not reject a conflicting open logical channel, the slave should close the conflicting channel.

Appendix X holds scenarios to help clarify how to resolve such conflicts.

C.4.2 Communication between the LCSE and the LCSE user

C.4.2.1 Primitives between the LCSE and the LCSE user

Communication between the LCSE and the LCSE user is performed using the primitives shown in Table C.10.

Table C.10/H.245 – Primitives and parameters

Generic name	Type			
	request	indication	response	confirm
ESTABLISH	FORWARD_PARAM	FORWARD_PARAM	– (Note 1)	–
RELEASE	CAUSE	SOURCE CAUSE	not defined (Note 2)	–
ERROR	not defined	ERRCODE	not defined	not defined
NOTE 1 – "–" means no parameters. NOTE 2 – "not defined" means that this primitive does not exist.				

C.4.2.2 Primitive definition

The definition of these primitives is as follows:

a) The ESTABLISH primitives are used to establish a logical channel for audiovisual and data communication.

b) The RELEASE primitives are used to release a logical channel.

c) The ERROR primitive reports LCSE errors to a management entity.

C.4.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.10 is as follows:

a) The FORWARD_PARAM parameter specifies the parameters associated with the logical channel. This parameter is mapped to the forwardLogicalChannelParameters field of the OpenLogicalChannel message and is carried transparently to the peer LCSE user.

b) The SOURCE parameter indicates to the LCSE user the source of the logical channel release. The SOURCE parameter has the value of "USER" or "LCSE", indicating either the LCSE user, or the LCSE. The latter may occur as the result of a protocol error.

c) The CAUSE parameter indicates the reason as to why the peer LCSE user rejected a request to establish a logical channel. The CAUSE parameter is not present when the SOURCE parameter indicates "LCSE".

d) The ERRCODE parameter indicates the type of LCSE error. Table C.14 shows the allowed values of the ERRCODE parameter.

C.4.2.4 LCSE states

The following states are used to specify the allowed sequence of primitives between the LCSE and the LCSE user, and the exchange of messages between peer LCSEs. The states are specified separately for each of an outgoing LCSE and an incoming LCSE. The states for an outgoing LCSE are:

State 0: RELEASED

The logical channel is released. The logical channel shall not be used to send outgoing data.

State 1: AWAITING ESTABLISHMENT

The outgoing LCSE is waiting to establish a logical channel with a peer incoming LCSE. The logical channel shall not be used to send outgoing data.

State 2: ESTABLISHED

The LCSE peer-to-peer logical channel connection has been established. The logical channel may be used to send outgoing data.

State 3: AWAITING RELEASE

The outgoing LCSE is waiting to release a logical channel with the peer incoming LCSE. The logical channel shall not be used to send outgoing data.

The states for an incoming LCSE are:

State 0: RELEASED

The logical channel is released. The logical channel shall not be used to receive incoming data.

State 1: AWAITING ESTABLISHMENT

The incoming LCSE is waiting to establish a logical channel with a peer outgoing LCSE. The logical channel shall not be used to receive incoming data.

State 2: ESTABLISHED

An LCSE peer-to-peer logical channel connection has been established. The logical channel may be used to receive incoming data.

C.4.2.5 State transition diagram

The allowed sequence of primitives between the LCSE and the LCSE user is defined here. The allowed sequence of primitives relates to states of the LCSE as viewed from the LCSE user. The allowed sequences are specified separately for each of an outgoing LCSE and an incoming LCSE, as shown in Figures C.10 and C.11, respectively.

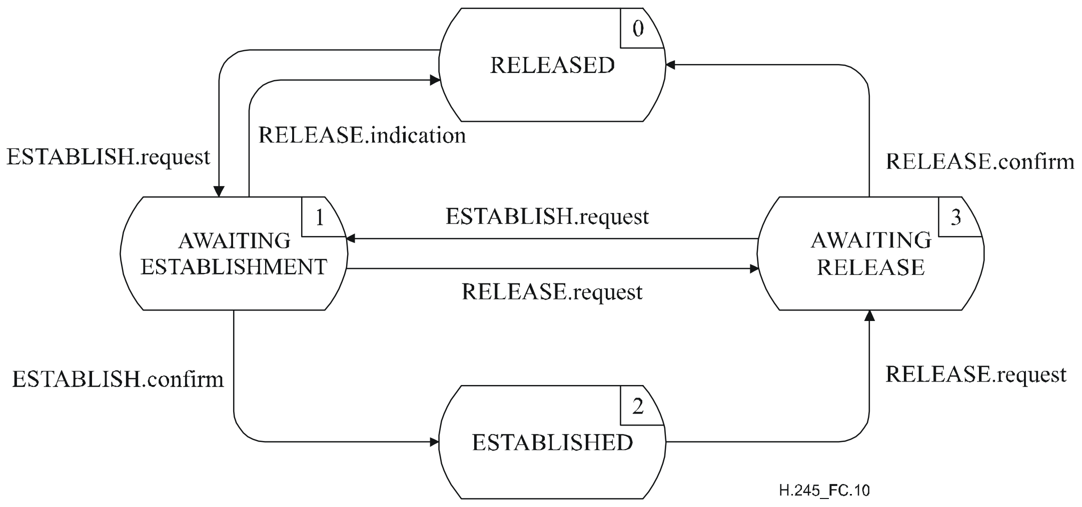


Figure C.10/H.245 – State transition diagram for sequence of primitives at outgoing LCSE

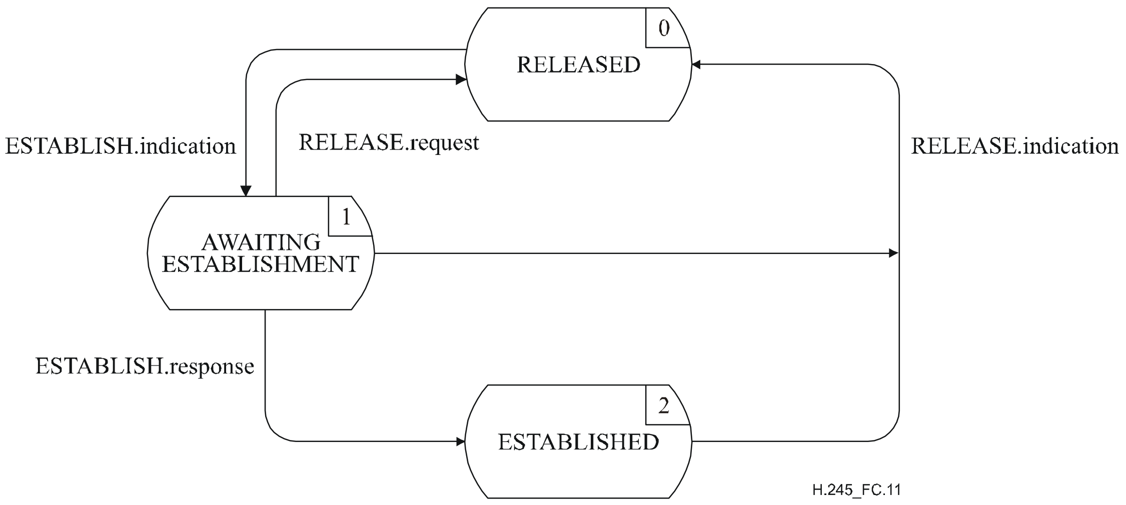


Figure C.11/H.245 – State transition diagram for sequence of primitives at incoming LCSE

C.4.3 Peer-to-peer LCSE communication

C.4.3.1 LCSE messages

Table C.11 shows the LCSE messages and fields, defined in Annex A, which are relevant to the LCSE protocol.

Table C.11/H.245 – LCSE message names and fields

Function	Message	Direction	Field
establishment	OpenLogicalChannel	O → I (Note)	forwardLogicalChannelNumber forwardLogicalChannelParameters
	OpenLogicalChannelAck	O ← I	forwardLogicalChannelNumber
	OpenLogicalChannelReject	O ← I	forwardLogicalChannelNumber cause
release	CloseLogicalChannel	O → I	forwardLogicalChannelNumber source
	CloseLogicalChannelAck	O ← I	forwardLogicalChannelNumber
NOTE – Direction: O – Outgoing, I – Incoming.			

C.4.3.2 LCSE state variables

The following state variable is defined at the outgoing LCSE:

out_LCN

This state variable distinguishes between outgoing LCSEs. It is initialized at outgoing LCSE initialization. The value of out_LCN is used to set the forwardLogicalChannelNumber field of LCSE messages sent from an outgoing LCSE. For LCSE messages received at an outgoing LCSE, the message forwardLogicalChannelNumber field value is identical to the value of out_LCN.

The following state variable is defined at the incoming LCSE:

in_LCN

This state variable distinguishes between incoming LCSEs. It is initialized at incoming LCSE initialization. The value of in_LCN is used to set the forwardLogicalChannelNumber field of LCSE messages sent from an incoming LCSE. For LCSE messages received at an incoming LCSE, the message forwardLogicalChannelNumber field value is identical to the value of in_LCN.

C.4.3.3 LCSE timers

The following timer is specified for the outgoing LCSE:

T103

This timer is used during the AWAITING ESTABLISHMENT and AWAITING RELEASE states. It specifies the maximum allowed time during which no OpenLogicalChannelAck, OpenLogicalChannelReject or CloseLogicalChannelAck message may be received.

C.4.4 LCSE procedures

C.4.4.1 Introduction

Figure C.12 summarizes the primitives and their parameters, and the messages, for each of the outgoing and incoming LCSE.

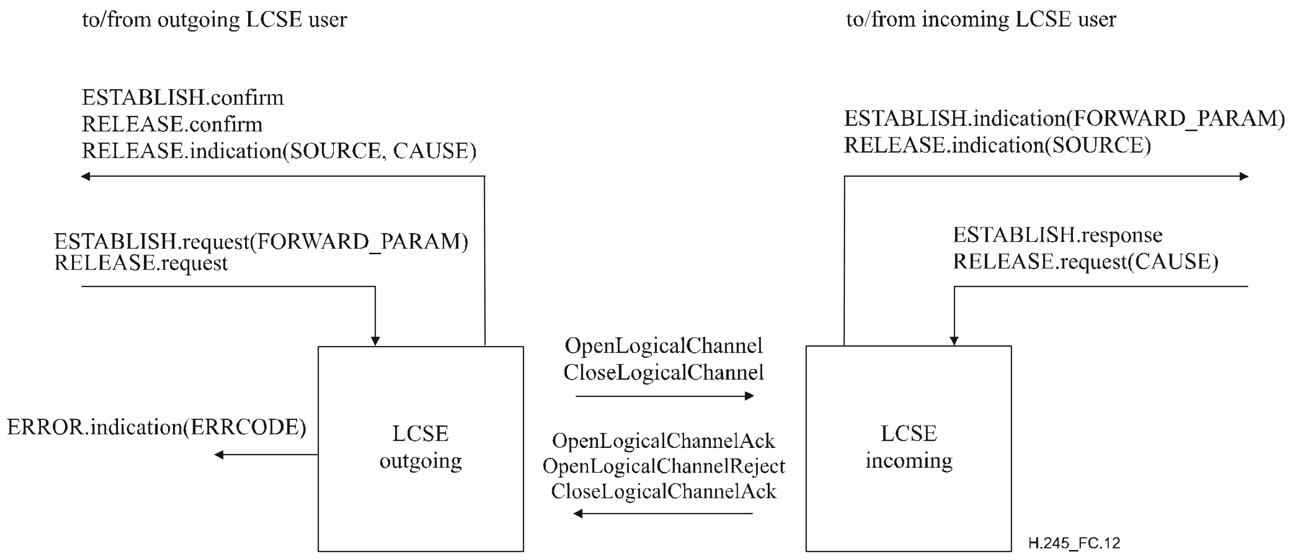


Figure C.12/H.245 – Primitives and messages in the Logical Channel Signalling Entity

C.4.4.2 Primitive parameter default values

Where not explicitly stated in the SDL diagrams the parameters of the indication and confirm primitives assume values as shown in Table C.12.

Table C.12/H.245 – Default primitive parameter values

Primitive	Parameter	Default value (Note)
ESTABLISH.indication	FORWARD_PARAM	OpenLogicalChannel.forwardLogicalChannelParameters
RELEASE.indication	SOURCE CAUSE	CloseLogicalChannel.source null
NOTE – A primitive parameter shall be coded as null, if an indicated message field is not present in the message.		

C.4.4.3 Message field default values

Where not explicitly stated in the SDL diagrams, the message fields assume values as shown in Table C.13.

Table C.13/H.245 – Default message field values

Message	Field	Default value (Note 1)
OpenLogicalChannel (Note 2)	forwardLogicalChannelNumber forwardLogicalChannelParameters	out_LCN ESTABLISH.request (FORWARD_PARAM)
OpenLogicalChannelAck	forwardLogicalChannelNumber	in_LCN
OpenLogicalChannelReject	forwardLogicalChannelNumber cause	in_LCN RELEASE.request (CAUSE)
CloseLogicalChannel	forwardLogicalChannelNumber source	out_LCN user
CloseLogicalChannelAck	forwardLogicalChannelNumber	in_LCN
NOTE 1 – A message field shall not be coded, if the corresponding primitive parameter is null, i.e., not present. NOTE 2 – reverseLogicalChannelParameters are not coded in unidirectional logical channel signalling procedures.		

C.4.4.4 ERRCODE parameter values

The ERRCODE parameter of the ERROR.indication primitive indicates a particular error condition. Table C.14 shows the values that the ERRCODE parameter may take at the outgoing LCSE. There is no ERROR.indication primitive associated with the incoming LCSE.

Table C.14/H.245 – ERRCODE parameter values at outgoing LCSE

Error type	Error code	Error condition	State
inappropriate message	A	OpenLogicalChannelAck	RELEASED
	B	OpenLogicalChannelReject	RELEASED ESTABLISHED
	C	CloseLogicalChannelAck	ESTABLISHED
no response from peer LCSE	D	timer T103 expiry	AWAITING ESTABLISHMENT AWAITING RELEASE

C.4.4.5 SDLs

The outgoing LCSE and the incoming LCSE procedures are expressed in SDL form in Figures C.13 and C.14, respectively.

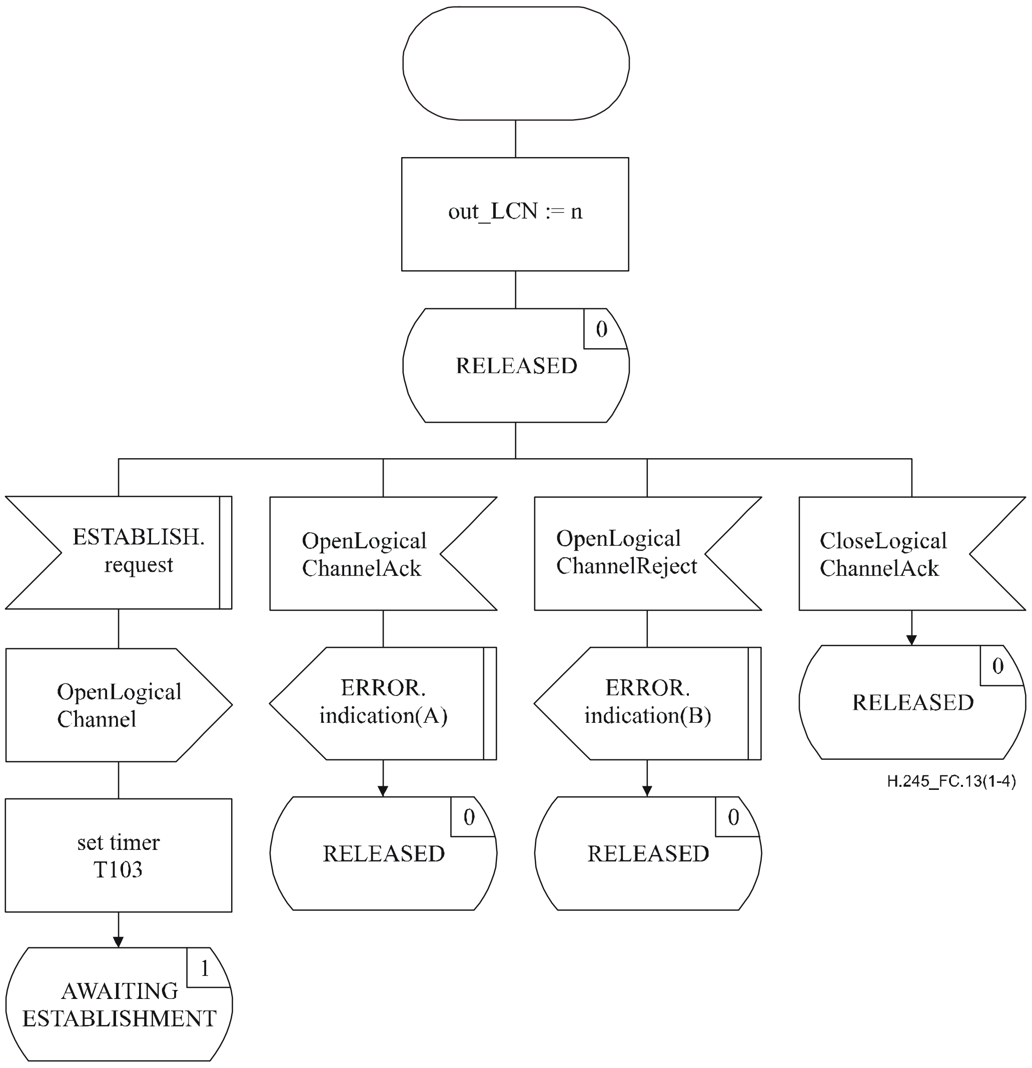


Figure C.13/H.245 – Outgoing LCSE SDL *(sheet 1 of 4)*

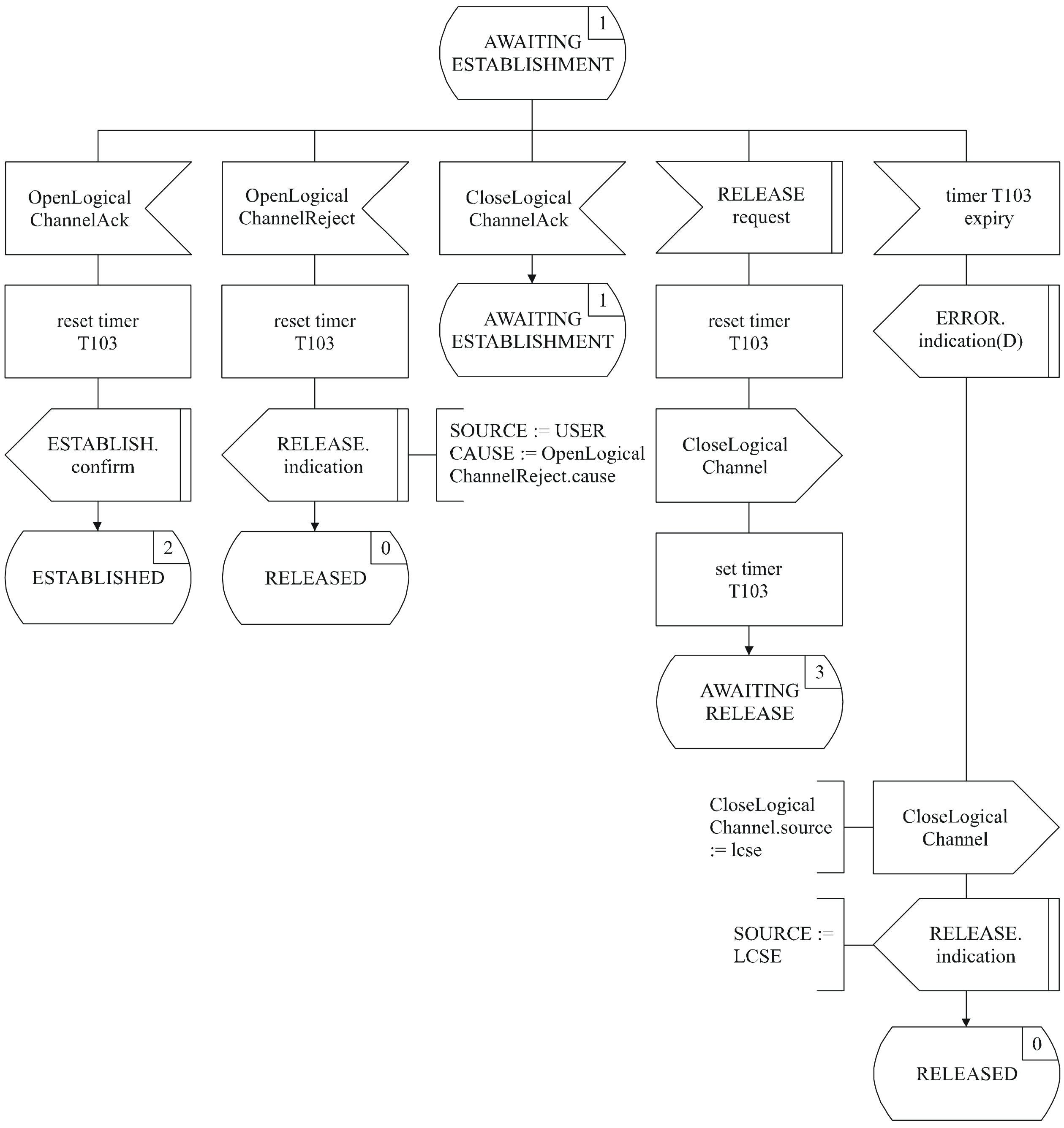


Figure C.13/H.245 – Outgoing LCSE SDL ***(sheet 2 of 4)***

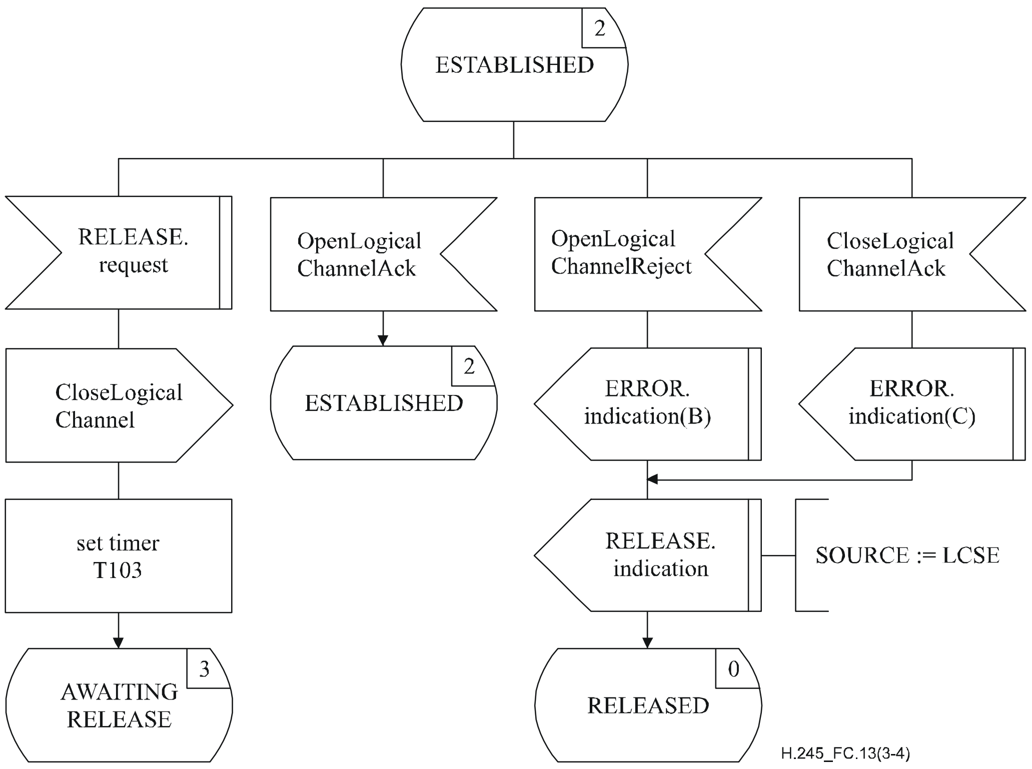


Figure C.13/H.245 – Outgoing LCSE SDL *(sheet 3 of 4)*

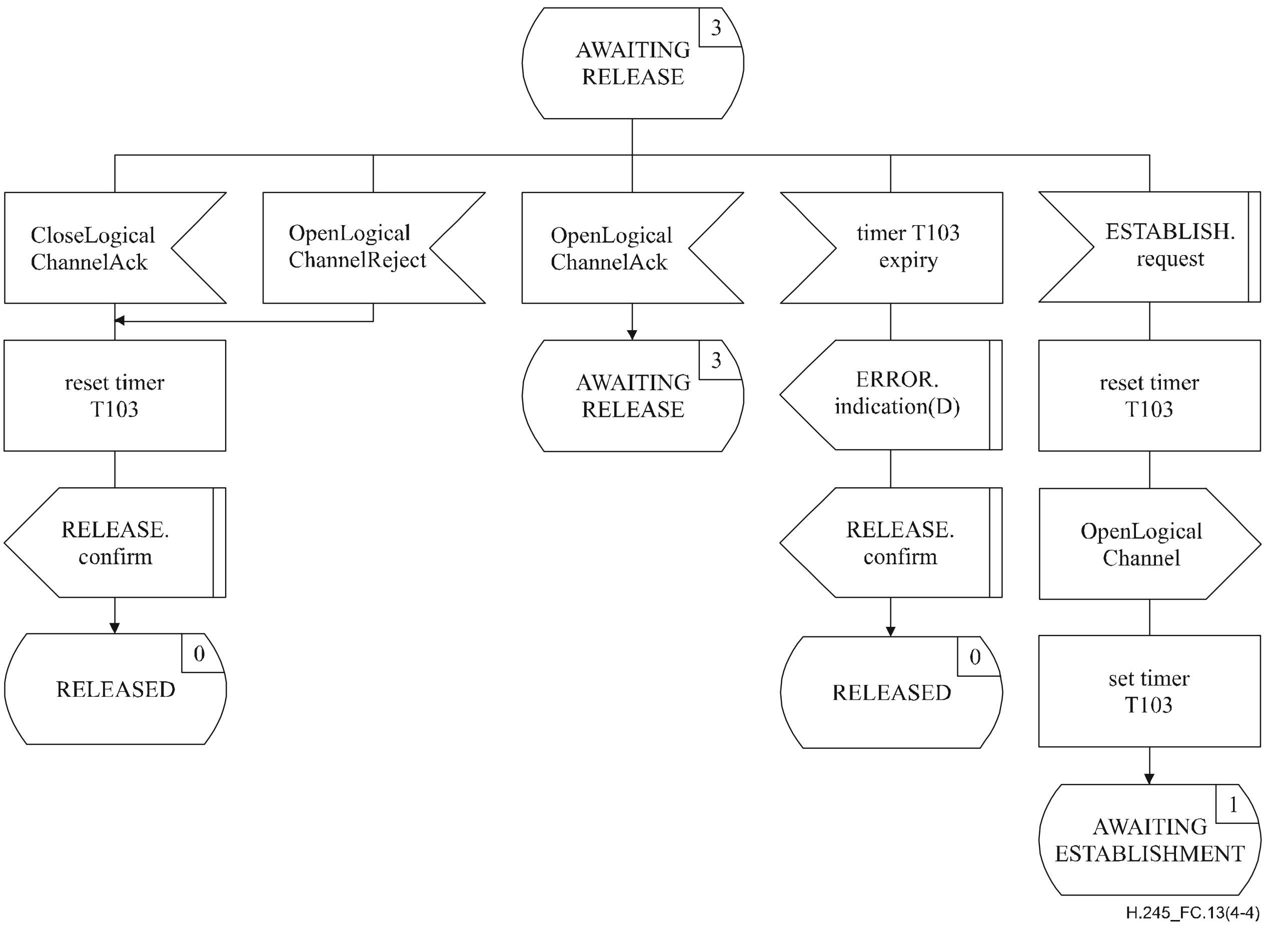


Figure C.13/H.245 – Outgoing LCSE SDL ***(sheet 4 of 4)***

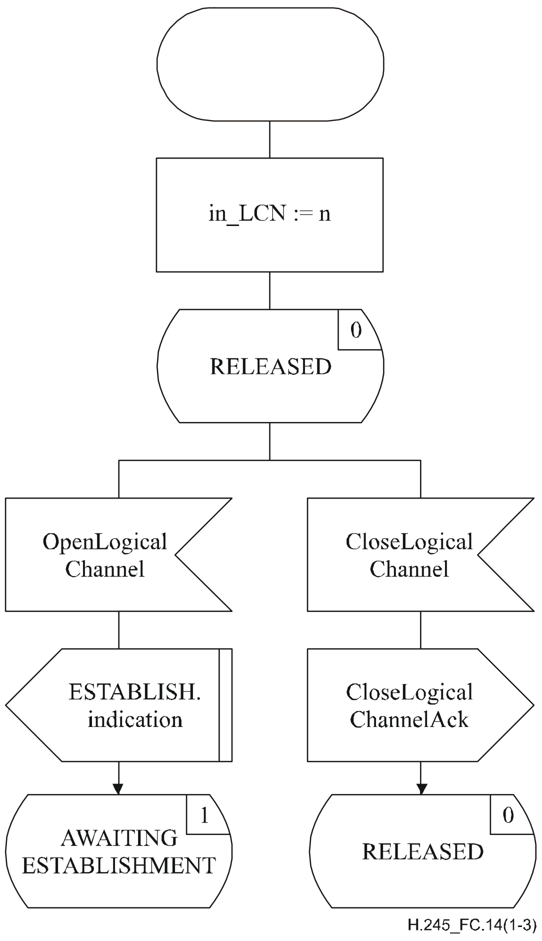


Figure C.14/H.245 – Incoming LCSE SDL *(sheet 1 of 3)*

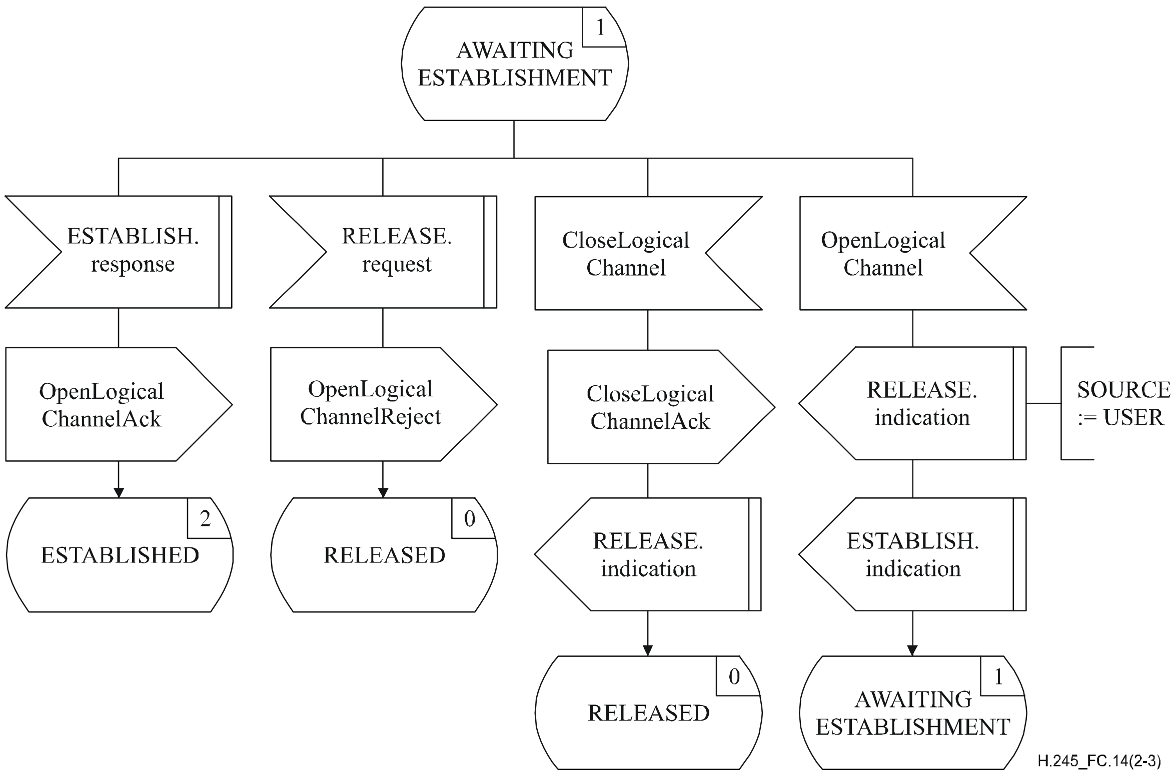


Figure C.14/H.245 – Incoming LCSE SDL *(sheet 2 of 3)*

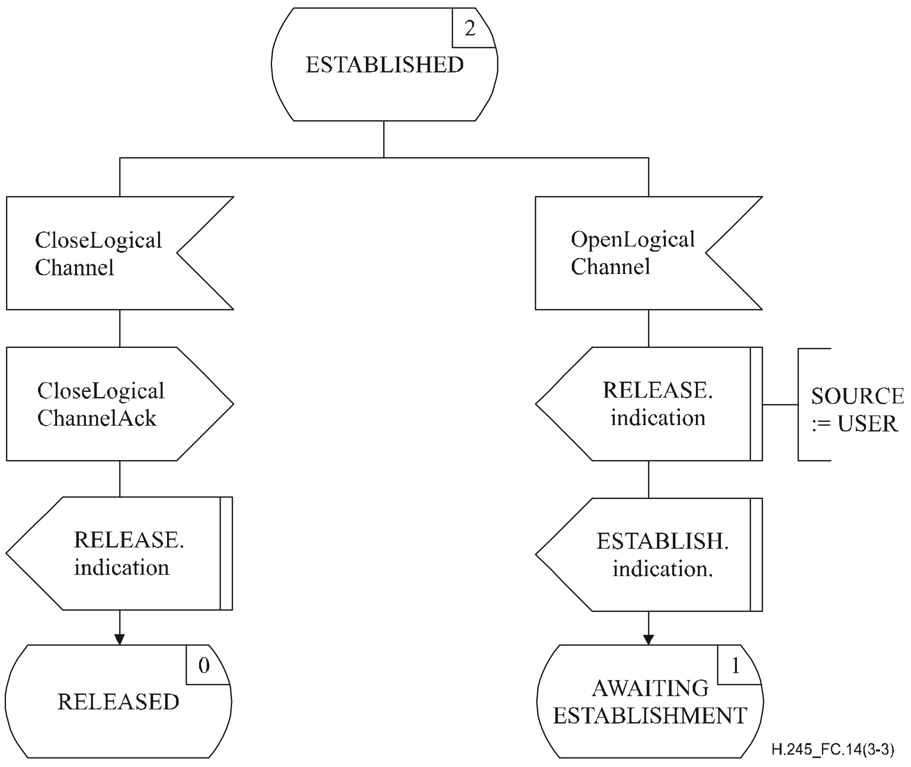


Figure C.14/H.245 – Incoming LCSE SDL *(sheet 3 of 3)*

C.5 Bidirectional Logical Channel signalling procedures

C.5.1 Introduction

The protocol specified here provides reliable opening and closing of bidirectional logical channels using acknowledged procedures.

The protocol specified here is referred to as the Bidirectional Logical Channel Signalling Entity (B-LCSE). Procedures are specified in terms of primitives at the interface between the B-LCSE and the B-LCSE user, and B-LCSE states. Protocol information is transferred to the peer B-LCSE via relevant messages defined in Annex A.

There is an outgoing B-LCSE and an incoming B-LCSE. At each of the outgoing and incoming sides there is one instance of the B-LCSE for each bidirectional logical channel. There is no connection between an incoming B-LCSE and an outgoing B-LCSE at one side, other than via primitives to and from the B-LCSE user. B-LCSE error conditions are reported.

A bidirectional logical channel consists of a pair of associated unidirectional channels. "Forward" (Outgoing side) is used to refer to transmission in the direction from the terminal making the request for a bidirectional logical channel to the other terminal, and "reverse" (Incoming side) is used to refer to the opposite direction of transmission.

Data shall only be sent on a bidirectional logical channel in the ESTABLISHED state. However, data may be received on the forward channel when the incoming B-LCSE is in the AWAITING CONFIRMATION state. Data that is received while in other states than the ESTABLISHED state and the AWAITING CONFIRMATION state shall be discarded and no fault shall be considered to have occurred.

A terminal may reject a request to open a bidirectional logical channel solely because it cannot support the requested reverse channel parameters. In this case it shall reject the request with cause equal to unsuitableReverseParameters, and shall immediately initiate procedures to establish a bidirectional logical channel as requested by the remote terminal, in which the reverse parameters are identical to the forward parameters of the remote terminal's failed request, and with forward parameters that the terminal can support and which the remote terminal is known to be able to support.

Mode switching should be performed by closing and opening existing logical channels, or by opening new logical channels.

NOTE – Some Recommendations that use this Recommendation may define some default logical channels. These shall be considered ESTABLISHED from the start of communication and shall not be opened using these procedures. They may, however, be closed by these procedures, and subsequently be re-opened for the same or a different purpose.

A terminal that is no longer capable of processing the signals on a logical channel should take appropriate action: this should include closing the logical channel and transmitting the relevant (changed) capability information to the remote terminal.

The following text provides an overview of the operation of the B-LCSE protocol. In the case of discrepancy between this and the formal specification, the formal specification will supersede.

C.5.1.1 Protocol overview

The opening of a logical channel is initiated when the ESTABLISH.request primitive is issued by the user at the outgoing B-LCSE. An OpenLogicalChannel message, containing both forward and reverse logical channel parameters, is sent to the peer incoming B-LCSE, and timer T103 is started. If an OpenLogicalChannelAck message is received in response to the OpenLogicalChannel message then timer T103 is stopped, an OpenLogicalChannelConfirm message is sent to the peer incoming B-LCSE, and the user is informed with the ESTABLISH.confirm primitive that the logical channel has been successfully opened. The logical channel may now be used to transmit and receive user information. If however an OpenLogicalChannelReject message is received in response to the OpenLogicalChannel message then timer T103 is stopped and the user is informed with the RELEASE.indication primitive that the peer B-LCSE user has refused establishment of the logical channel.

If timer T103 expires in this period then the user is informed with the RELEASE.indication primitive, and a CloseLogicalChannel message is sent to the peer incoming B-LCSE.

A logical channel which has been successfully established may be closed when the RELEASE.request primitive is issued by the user at the outgoing B-LCSE. A CloseLogicalChannel message is sent to the peer incoming B-LCSE, and the timer T103 is started. When a CloseLogicalChannelAck message is received, timer T103 is stopped and the user is informed that the logical channel has been successfully closed with the RELEASE.confirm primitive.

If timer T103 expires in this period then the user is informed with the RELEASE.indication primitive.

Before either of the OpenLogicalChannelAck or OpenLogicalChannelReject messages have been received in response to a previously sent OpenLogicalChannel message, the user at the outgoing B-LCSE may close the logical channel using the RELEASE.request primitive.

Before the CloseLogicalChannelAck message is received in response to a previously sent CloseLogicalChannel message, the user at the outgoing B-LCSE may establish a new logical channel by issuing the ESTABLISH.request primitive.

C.5.1.2 Protocol overview – Incoming B-LCSE

When an OpenLogicalChannel message is received at the incoming B-LCSE, the user is informed of the request to open a new logical channel with the ESTABLISH.indication primitive. The incoming B-LCSE user signals acceptance of the request to establish the logical channel by issuing the ESTABLISH.response primitive, and an OpenLogicalChannelAck message is sent to the peer outgoing B-LCSE. The forward channel of the bidirectional logical channel may now be used to receive user information. The incoming B-LCSE user signals rejection of the request to establish the logical channel by issuing the RELEASE.request primitive, and an OpenLogicalChannelReject message is sent to the peer outgoing B-LCSE.

When an OpenLogicalChannelConfirm message is received at the incoming B-LCSE, the user is informed that the bidirectional logical channel is established with the ESTABLISH.confirm primitive. The reverse channel of the bidirectional logical channel may now be used to transmit user information.

A logical channel which has been successfully established may be closed when the CloseLogicalChannel message is received at the incoming B-LCSE. The incoming B-LCSE user is informed with the RELEASE.indication primitive, and the CloseLogicalChannelAck message is sent to the peer outgoing B-LCSE.

C.5.1.3 Conflict resolution

Conflicts may arise when requests to open logical channels are initiated at the same time. It may be possible to determine that there is conflict from knowledge of exchanged capabilities. On other occasions, both terminals may initiate the opening of a bidirectional logical channel for the same purpose, even though the exact parameters requested may be different, and both terminals have sufficient capability for both requests. Terminals shall be capable of detecting when both of these situations have arisen, any shall act as follows.

Before logical channels can be opened, one terminal must be determined as the master terminal, and the other as the slave. The protocol defined in C.2 provides one means to make this decision. The master terminal shall reject immediately any request from the slave that it identifies as a conflicting request. The slave terminal may identify such conflicts, but shall respond to the request from the master terminal, with the knowledge that its earlier request will be rejected.

In the second type of conflict defined above, it is impossible to distinguish when two bidirectional channels are actually wanted from the case when only one is wanted. Terminals shall respond assuming that only one is wanted, but a terminal may subsequently repeat its request if the assumption was incorrect.

The following behaviour is recommended to minimize the chance of endpoints attempting to open conflicting logical channels when the slave endpoint has symmetric capability limitations. When the master and the slave have indicated choices of receive capabilities for a particular media type, the slave should attempt to open a logical channel for the master's most preferred capability for which it has capability, as given by the order the master has expressed its capabilities; and the master should attempt to open a logical channel for its most preferred capability for which the slave has capability, as given by the order it has expressed its capabilities.

For example, if the master has declared capability for G.723.1, G.729 and G.711 and the slave has indicated capability for G.711 and G.729, with the most preferable being listed first in both cases, then both master and slave should attempt to open logical channels for G.729.

After the request to open a logical channel has been rejected by the master, with cause equal to masterSlaveConflict, the slave is responsible for opening a non-conflicting channel.

When the slaves detects a conflict and the master does not reject a conflicting open logical channel, the slave should close the conflicting channel. In the case of conflicting logical channels due to symmetric capability limitations, the slave should open an appropriate logical channel using the replacement for procedure, and in due course close the conflicting logical channel.

C.5.2 Communication between the B-LCSE and the B-LCSE user

C.5.2.1 Primitives between the B-LCSE and the B-LCSE user

Communication between the B-LCSE and the B-LCSE user is performed using the primitives shown in Table C.15.

Table C.15/H.245 – Primitives and parameters

Generic name	Type			
	request	indication	response	confirm
ESTABLISH	FORWARD_ PARAM REVERSE_ PARAM	FORWARD_ PARAM REVERSE_ PARAM	REVERSE_DATA	REVERSE_DATA
RELEASE	CAUSE	SOURCE CAUSE	not defined (Note 2)	– (Note 1)
ERROR	not defined	ERRCODE	not defined	not defined
NOTE 1 – "–" means no parameters. NOTE 2 – "not defined" means that this primitive does not exist.				

C.5.2.2 Primitive definition

The definition of these primitives is as follows:

a) The ESTABLISH primitives are used to establish a logical channel for audiovisual and data communication.

b) The RELEASE primitives are used to release a logical channel.

c) The ERROR primitive reports B-LCSE errors to a management entity.

C.5.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.15 is as follows:

a) The FORWARD_PARAM parameter specifies the parameters associated with the forward channel, that is, from the terminal containing the outgoing B-LCSE to the terminal containing the incoming B-LCSE. This parameter is mapped to the forwardLogicalChannelParameters field of the OpenLogicalChannel message and is carried transparently to the peer LCSE user.

b) The REVERSE_PARAM parameter specifies the parameters associated with the reverse channel, that is, from the terminal containing the incoming B-LCSE to the terminal containing the outgoing B-LCSE. This parameter is mapped to the reverseLogicalChannelParameters field of the OpenLogicalChannel message and is carried transparently to the peer LCSE user.

c) The REVERSE_DATA parameter specifies some parameters associated with the reverse channel, that is, from the terminal containing the incoming B-LCSE to the terminal containing the outgoing B-LCSE. This parameter is mapped to the reverseLogicalChannelParameters field of the OpenLogicalChannelAck message and is carried transparently to the peer B-LCSE user.

d) The SOURCE parameter indicates to the B-LCSE user the source of the logical channel release. The SOURCE parameter has the value of "USER" or "B-LCSE", indicating either the B-LCSE user, or the B-LCSE. The latter may occur as the result of a protocol error.

e) The CAUSE parameter indicates the reason as to why the peer B-LCSE user rejected a request to establish a logical channel. The CAUSE parameter is not present when the SOURCE parameter indicates "B-LCSE".

f) The ERRCODE parameter indicates the type of B-LCSE error. Table C.19 shows the allowed values of the ERRCODE parameter.

C.5.2.4 B-LCSE states

The following states are used to specify the allowed sequence of primitives between the B-LCSE and the B-LCSE user, and the exchange of messages between peer B-LCSEs. The states are specified separately for each of an outgoing B-LCSE and an incoming B-LCSE. The states for an outgoing B-LCSE are:

State 0: RELEASED

The logical channel is released. The logical channel shall not be used to send or receive data.

State 1: AWAITING ESTABLISHMENT

The outgoing B-LCSE is waiting to establish a logical channel with a peer incoming B-LCSE. The logical channel shall not be used to send or receive data.

State 2: ESTABLISHED

The B-LCSE peer-to-peer logical channel connection has been established. The logical channel may be used to send and receive data.

State 3: AWAITING RELEASE

The outgoing B-LCSE is waiting to release a logical channel with the peer incoming B-LCSE. The logical channel shall not be used to send data, but data may continue to be received.

The states for an incoming B-LCSE are:

State 0: RELEASED

The logical channel is released. The logical channel shall not be used to receive or send data.

State 1: AWAITING ESTABLISHMENT

The incoming B-LCSE is waiting to establish a logical channel with a peer outgoing B-LCSE. The logical channel shall not be used to receive or send data.

State 2: AWAITING CONFIRMATION

The incoming B-LCSE is awaiting confirmation that the logical channel is established with a peer outgoing B-LCSE. The logical channel shall not be used to send data, but data may be received.

State 3: ESTABLISHED

A B-LCSE peer-to-peer logical channel connection has been established. The logical channel may be used to receive and send data.

C.5.2.5 State transition diagram

The allowed sequence of primitives between the B-LCSE and the B-LCSE user is defined here. The allowed sequence of primitives relates to states of the B-LCSE as viewed from the B-LCSE user. The allowed sequences are specified separately for each of an outgoing B-LCSE and an incoming B-LCSE, as shown in Figures C.15 and C.16, respectively.

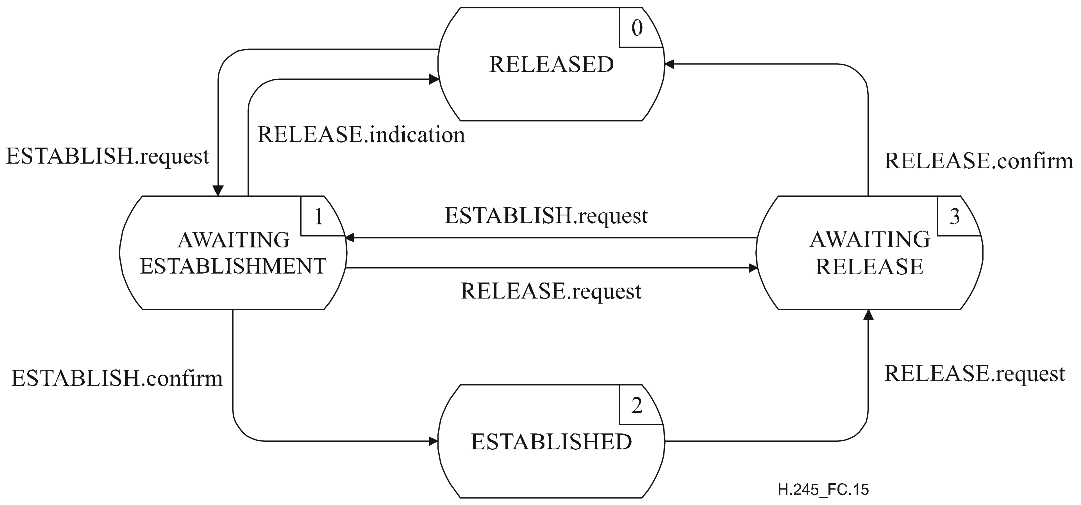


Figure C.15/H.245 – State transition diagram for sequence of primitives at outgoing B-LCSE

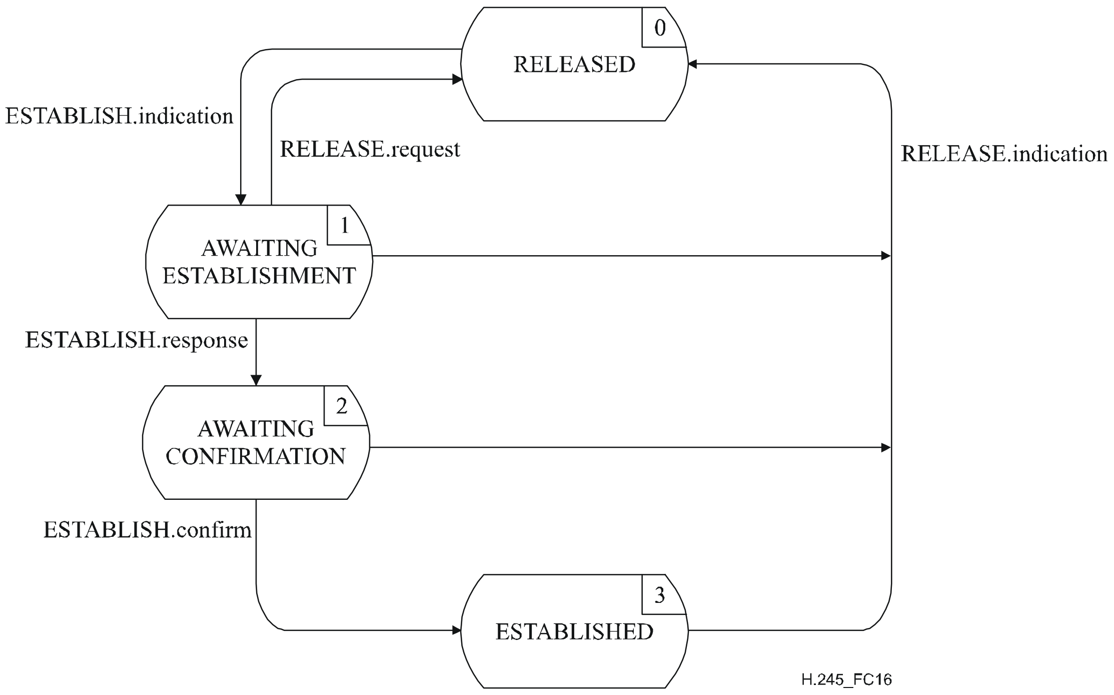


Figure C.16/H.245 – State transition diagram for sequence of primitives at incoming B-LCSE

C.5.3 Peer-to-peer B-LCSE communication

C.5.3.1 B-LCSE messages

Table C.16 shows the B-LCSE messages and fields, defined in Annex A, which are relevant to the B-LCSE protocol.

Table C.16/H.245 – B-LCSE message names and fields

Function	Message	Direction	Field
establishment	OpenLogicalChannel OpenLogicalChannelAck	O → I (Note) O ← I	forwardLogicalChannelNumber forwardLogicalChannelParameters reverseLogicalChannelParameters forwardLogicalChannelNumber reverseLogicalChannelParameters
	OpenLogicalChannelReject	O ← I	forwardLogicalChannelNumber cause
	OpenLogicalChannelConfirm	O → I	forwardLogicalChannelNumber
release	CloseLogicalChannel	O → I	forwardLogicalChannelNumber source
	CloseLogicalChannelAck	O ← I	forwardLogicalChannelNumber
NOTE – Direction: O – Outgoing, I – Incoming.			

C.5.3.2 B-LCSE state variables

The following state variable is defined at the outgoing B-LCSE:

out_LCN

This state variable distinguishes between outgoing B-LCSEs. It is initialized at outgoing B-LCSE initialization. The value of out_LCN is used to set the forwardLogicalChannelNumber field of B-LCSE messages sent from an outgoing B-LCSE. For B-LCSE messages received at an outgoing B-LCSE, the message forwardLogicalChannelNumber field value is identical to the value of out_LCN.

The following state variable is defined at the incoming B-LCSE:

in_LCN

This state variable distinguishes between incoming B-LCSEs. It is initialized at incoming B-LCSE initialization. The value of in_LCN is used to set the forwardLogicalChannelNumber field of B-LCSE messages sent from an incoming B-LCSE. For B-LCSE messages received at an incoming B-LCSE, the message forwardLogicalChannelNumber field value is identical to the value of in_LCN.

C.5.3.3 B-LCSE timers

The following timer is specified for the outgoing and incoming B-LCSE:

T103

At the outgoing B-LCSE this timer is used during the AWAITING ESTABLISHMENT and AWAITING RELEASE states. It specifies the maximum time during which no OpenLogicalChannelAck, OpenLogicalChannelReject or CloseLogicalChannelAck message may be received.

At the incoming B-LCSE, this timer is used during the AWAITING CONFIRMATION state. It specifies the maximum time during which no OpenLogicalChannelConfirm message may be received.

C.5.4 B-LCSE procedures

C.5.4.1 Introduction

Figure C.17 summarizes the primitives and their parameters, and the messages, for each of the outgoing and incoming B-LCSE.

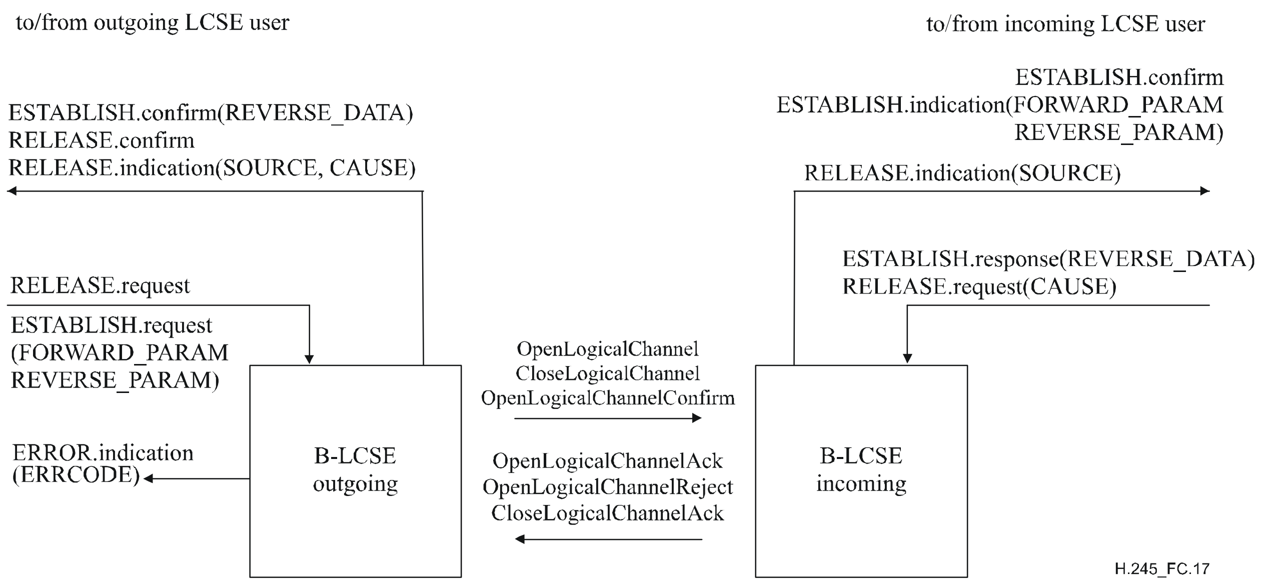


Figure C.17/H.245 – Primitives and messages in the bidirectional Logical Channel Signalling Entity

C.5.4.2 Primitive parameter default values

Where not explicitly stated in the SDL diagrams, the parameters of the indication and confirm primitives assume values as shown in Table C.17.

Table C.17/H.245 – Default primitive parameter values

Primitive	Parameter	Default value (Note)
ESTABLISH.indication	FORWARD_PARAM	OpenLogicalChannel.forwardLogicalChannelParameters
	REVERSE_PARAM	OpenLogicalChannel.reverseLogicalChannelParameters
ESTABLISH.confirm	REVERSE_DATA	OpenLogicalChannelAck.reverseLogicalChannel Parameters
RELEASE.indication	SOURCE	CloseLogicalChannel.source
	CAUSE	null
NOTE – A primitive parameter shall be coded as null, if an indicated message field is not present in the message.		

C.5.4.3 Message field default values

Where not explicitly stated in the SDL diagrams, the message fields assume values as shown in Table C.18.

Table C.18/H.245 – Default message field values

Message	Field	Default value (Note)
OpenLogicalChannel	forwardLogicalChannelNumber forwardLogicalChannelParameters reverseLogicalChannelParameters	out_LCN ESTABLISH.request (FORWARD_PARAM) ESTABLISH.request (REVERSE_PARAM)
OpenLogicalChannelAck	forwardLogicalChannelNumber reverseLogicalChannelParameters	in_LCN ESTABLISH.response (REVERSE_DATA)
OpenLogicalChannelReject	forwardLogicalChannelNumber cause	in_LCN RELEASE.request(CAUSE)
OpenLogicalChannelConfirm	forwardLogicalChannelNumber	out_LCN
CloseLogicalChannel	forwardLogicalChannelNumber source	out_LCN user
CloseLogicalChannelAck	forwardLogicalChannelNumber	in_LCN
NOTE – A message field shall not be coded if the corresponding primitive parameter is null, i.e., not present.		

C.5.4.4 ERRCODE parameter values

The ERRCODE parameter of the ERROR.indication primitive indicates a particular error condition. Table C.19 shows the values that the ERRCODE parameter may take at the outgoing B-LCSE and Table C.20 shows the values that the ERRCODE parameter may take at the incoming B-LCSE.

Table C.19/H.245 – ERRCODE parameter values at outgoing B-LCSE

Error type	Error code	Error condition	State
inappropriate message	A	OpenLogicalChannelAck	RELEASED
	B	OpenLogicalChannelReject	RELEASED ESTABLISHED
	C	CloseLogicalChannelAck	ESTABLISHED
no response from peer B-LCSE	D	timer T103 expiry	AWAITING ESTABLISHMENT AWAITING RELEASE

Table C.20/H.245 – ERRCODE parameter values at incoming B-LCSE

Error type	Error code	Error condition	State
inappropriate message	E	OpenLogicalChannelConfirm	AWAITING ESTABLISHMENT
no response from peer B-LCSE	F	timer T103 expiry	AWAITING CONFIRMATION

C.5.4.5 SDLs

The outgoing B-LCSE and the incoming B-LCSE procedures are expressed in SDL form in Figures C.18 and C.19, respectively.

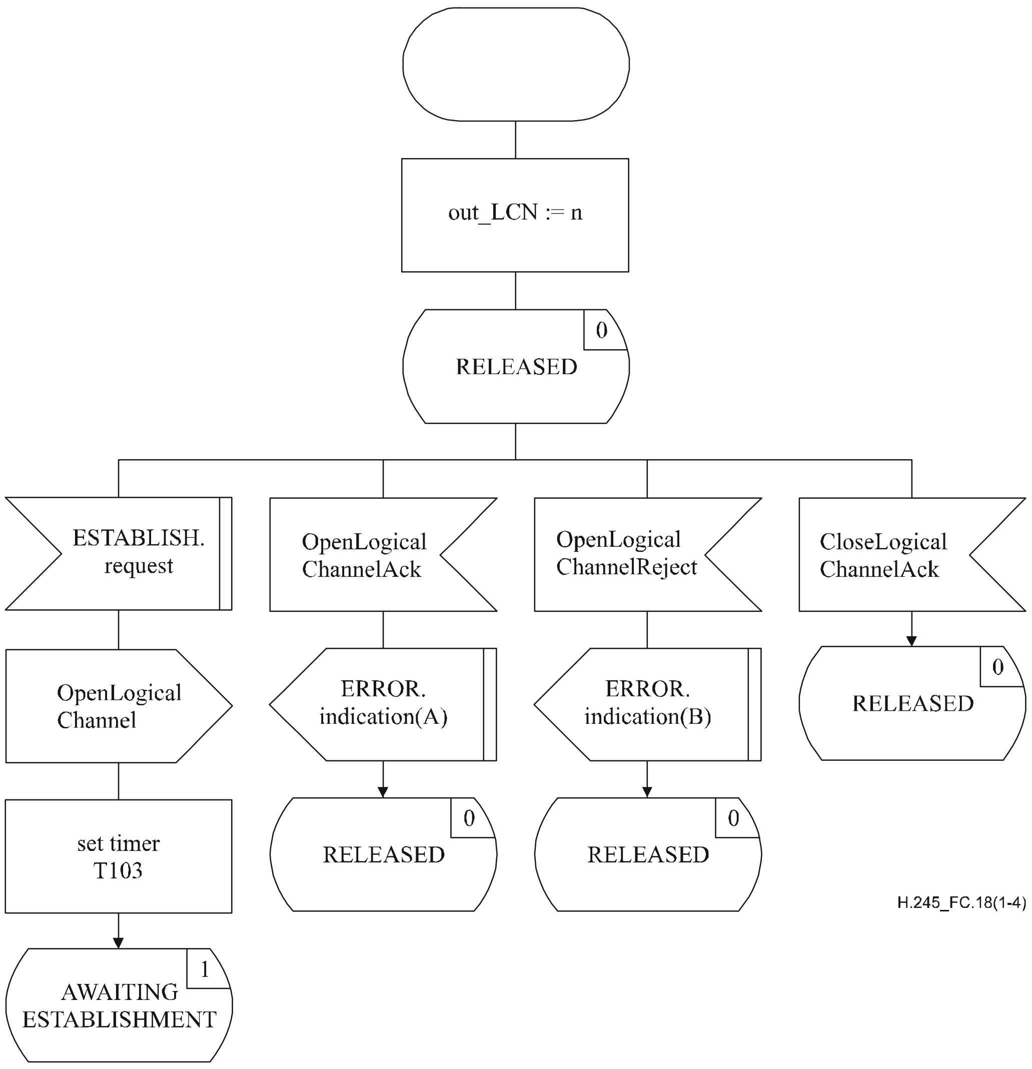


Figure C.18/H.245 – Outgoing B-LCSE SDL *(sheet 1 of 4)*

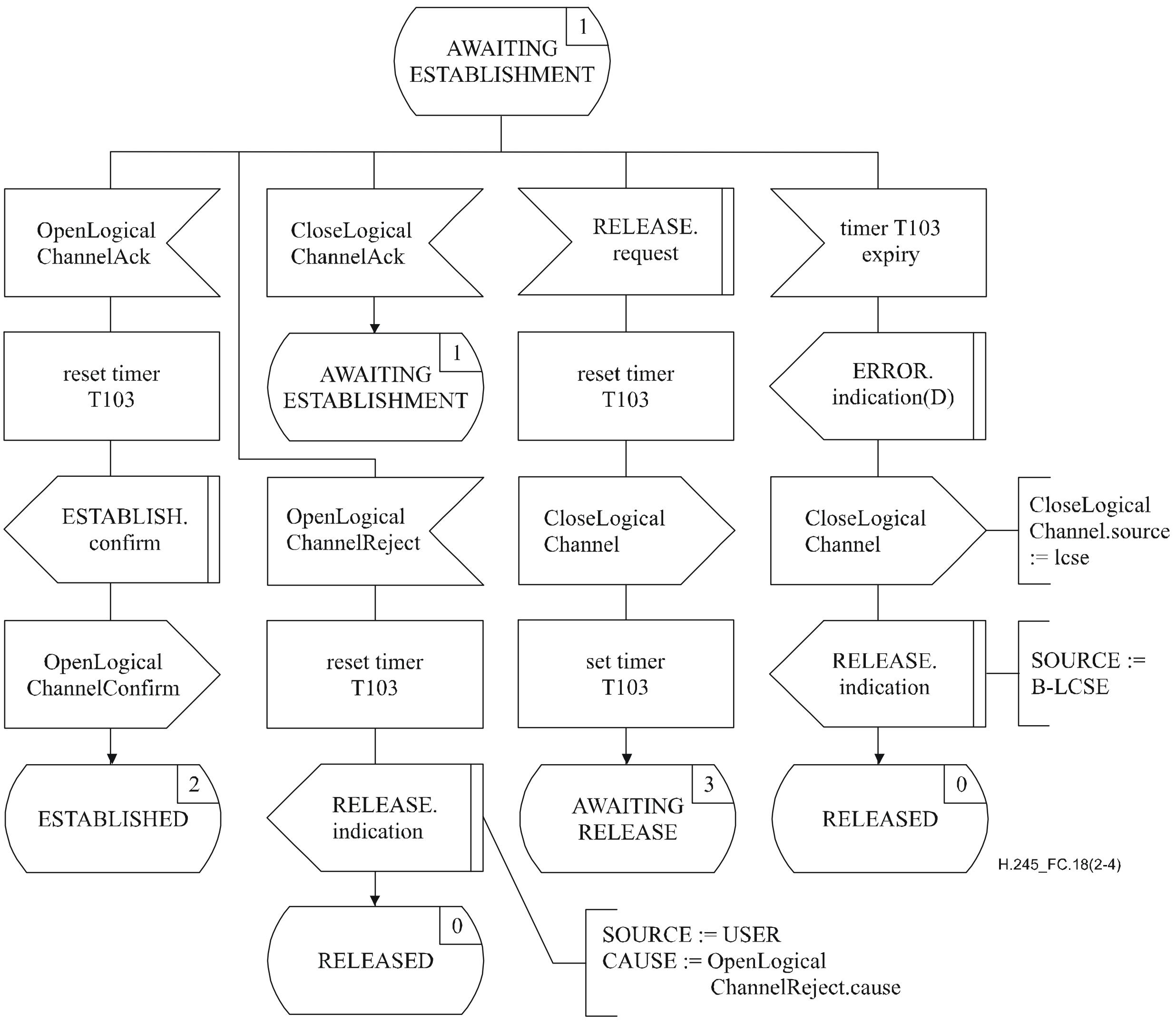


Figure C.18/H.245 – Outgoing B-LCSE SDL *(sheet 2 of 4)*

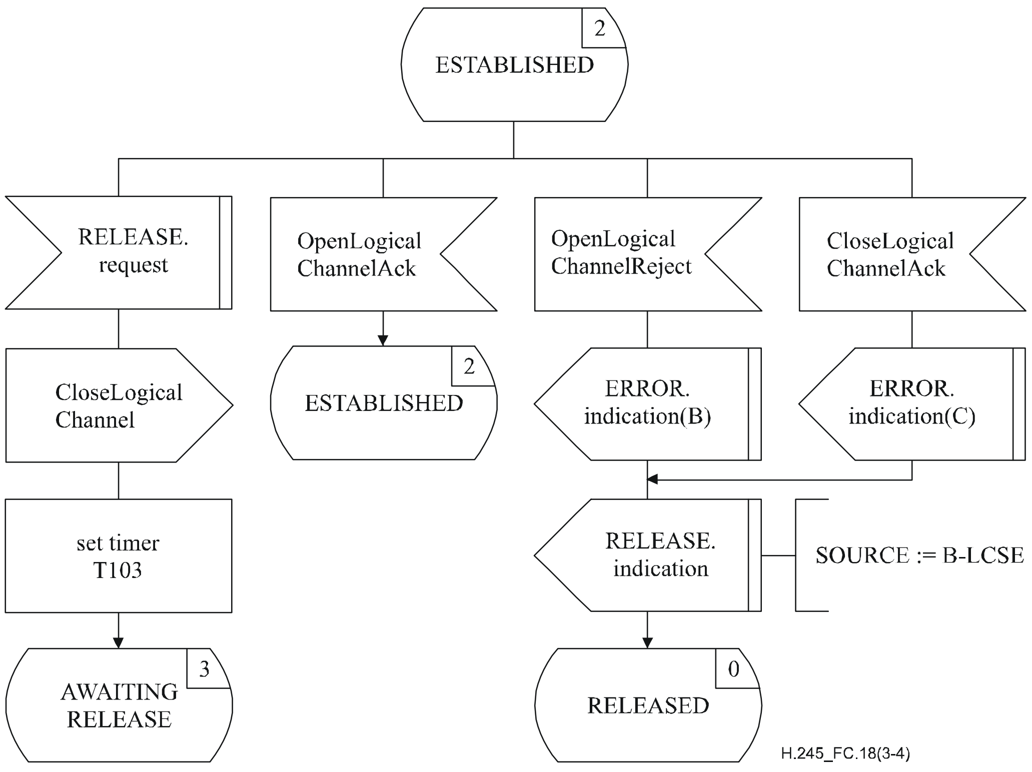


Figure C.18/H.245 – Outgoing B-LCSE SDL *(sheet 3 of 4)*

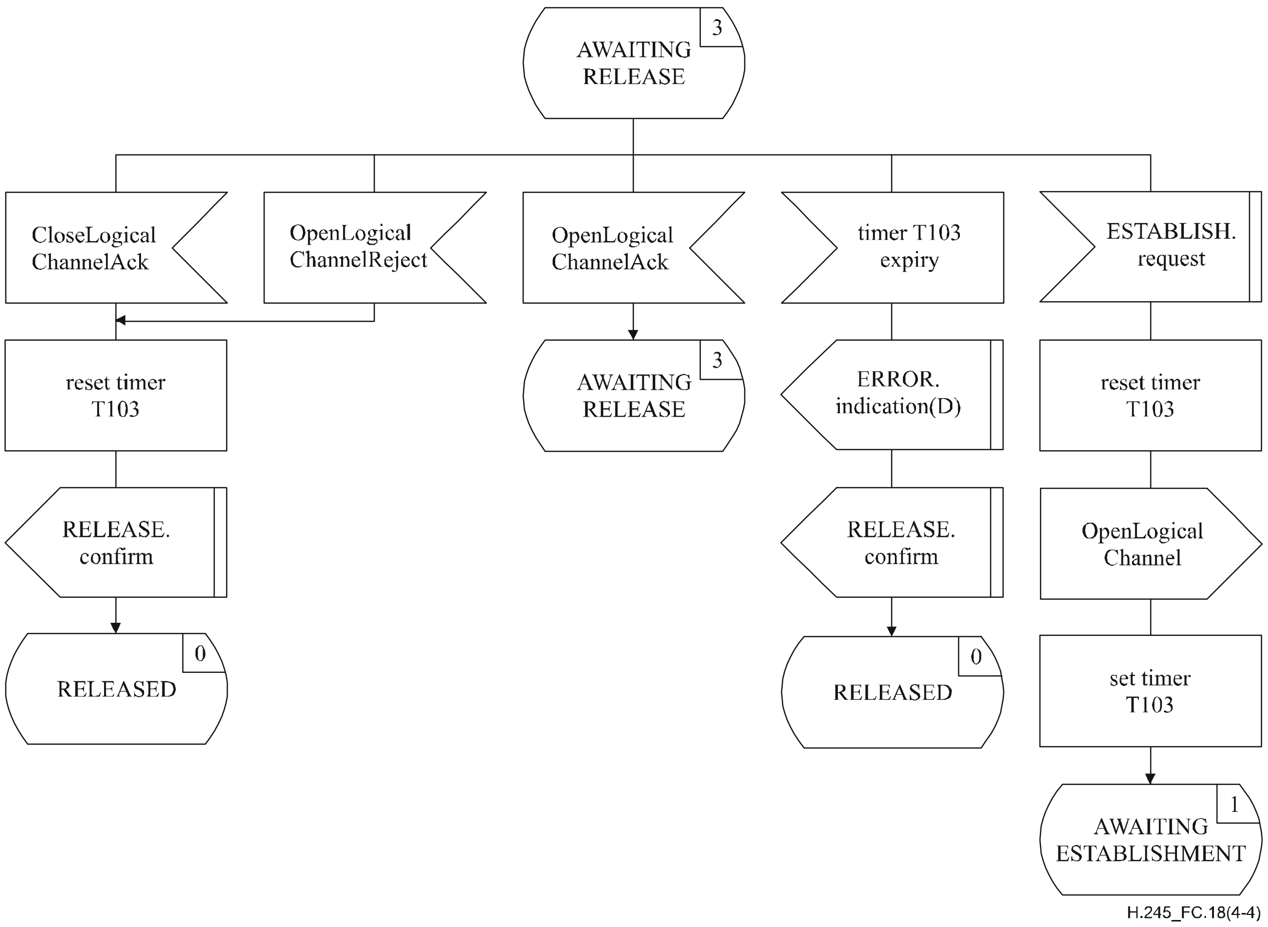


Figure C.18/H.245 – Outgoing B-LCSE SDL *(sheet 4 of 4)*

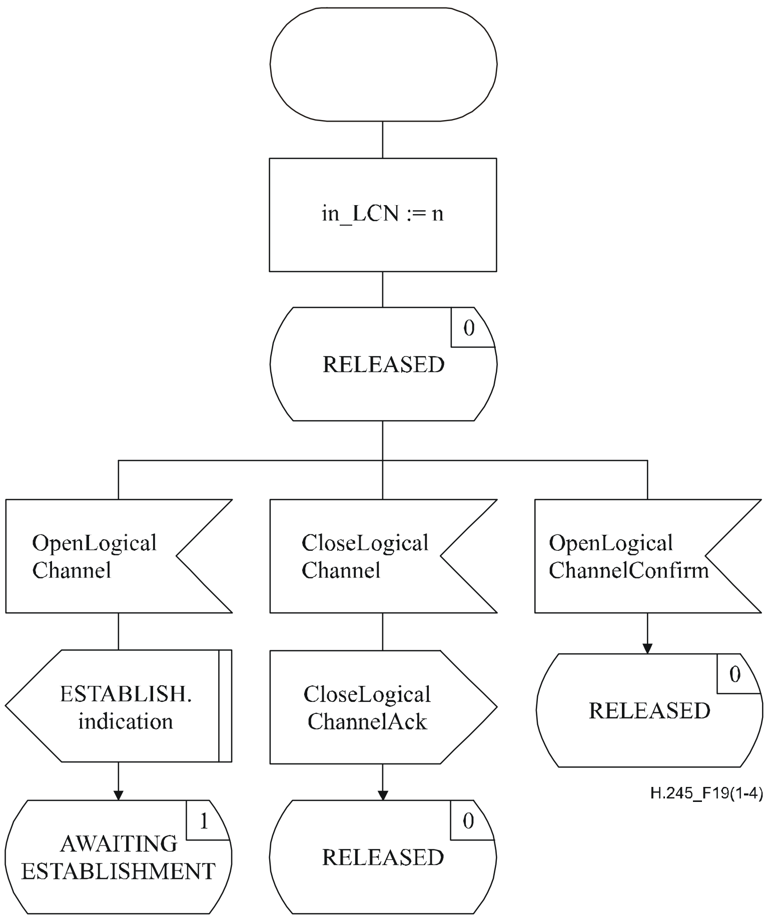


Figure C.19/H.245 – Incoming B-LCSE SDL *(sheet 1 of 4)*

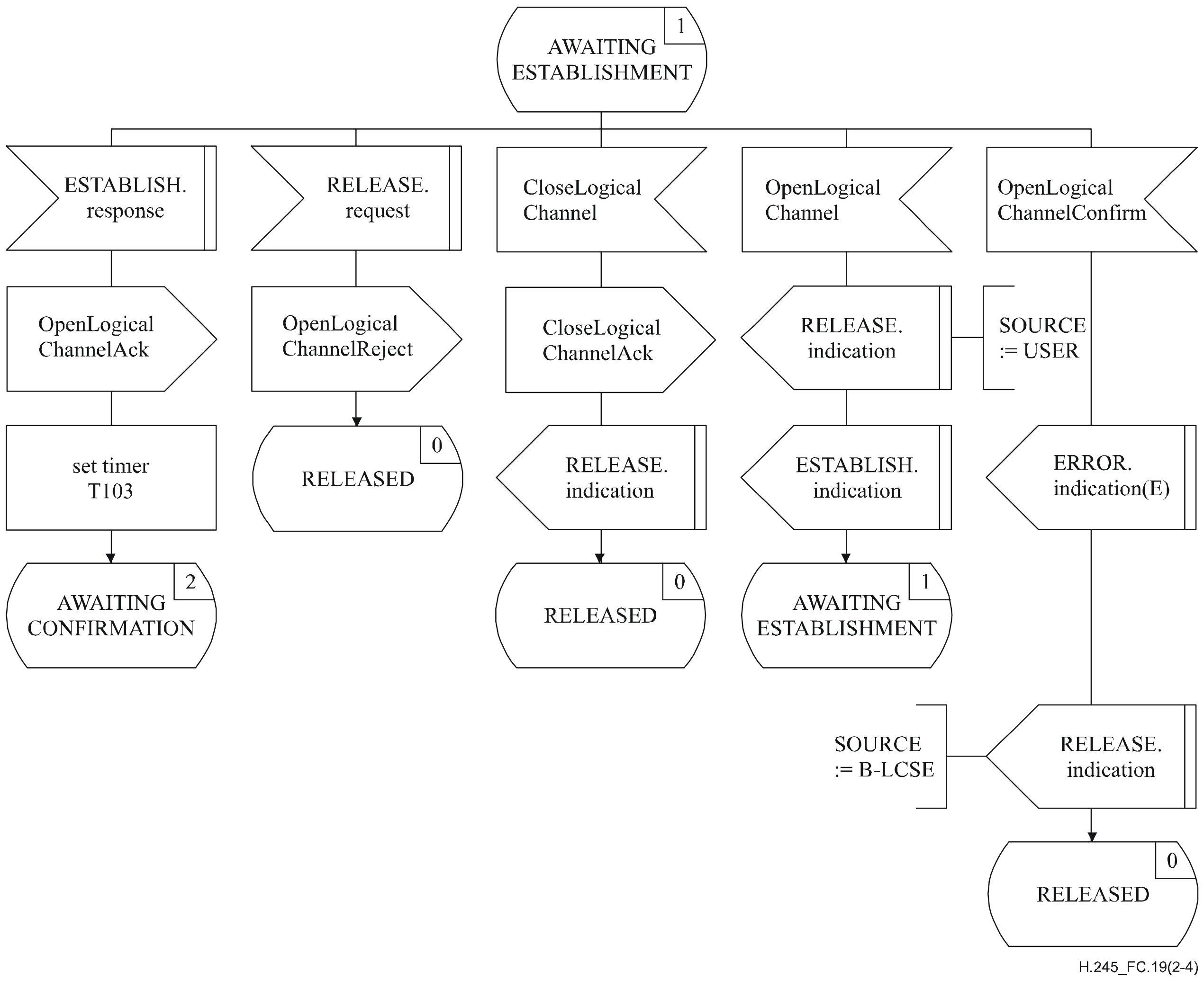


Figure C.19/H.245 – Incoming B-LCSE SDL *(sheet 2 of 4)*

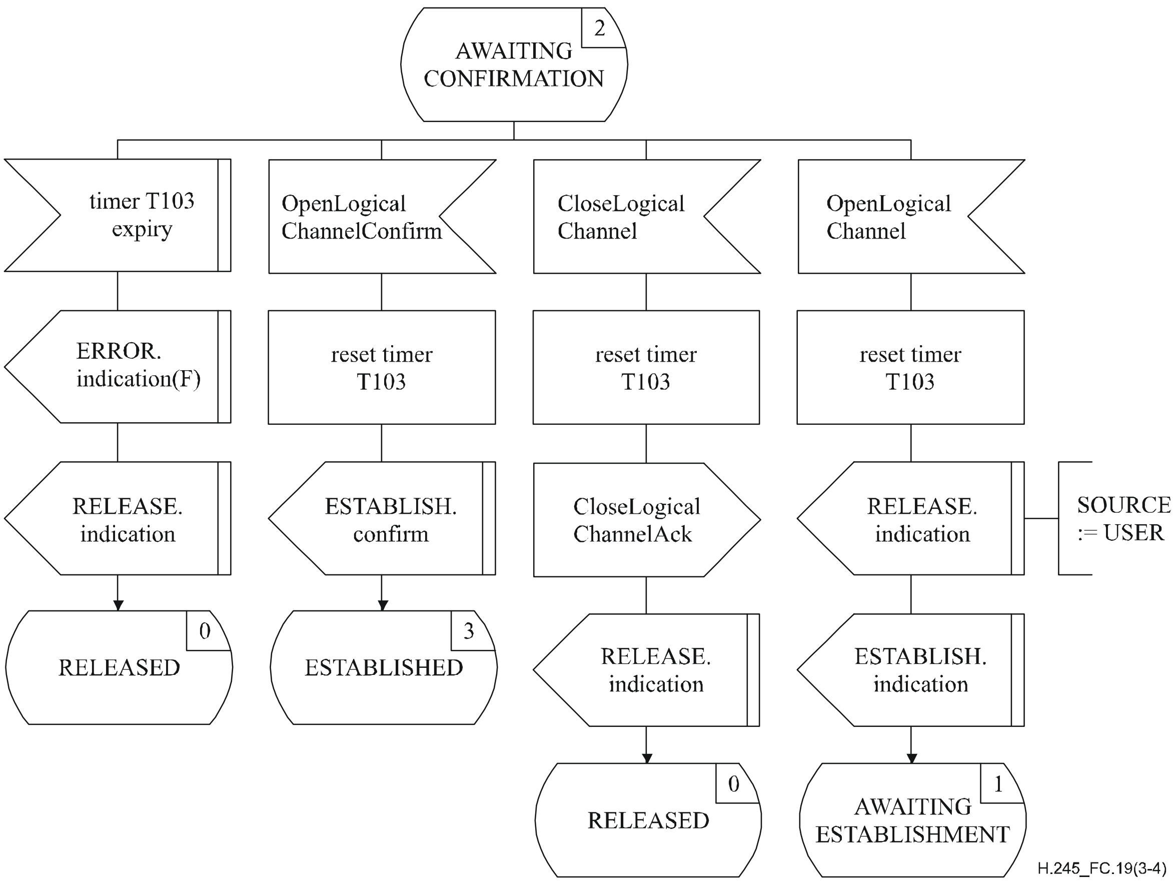


Figure C.19/H.245 – Incoming B-LCSE SDL ***(sheet 3 of 4)***

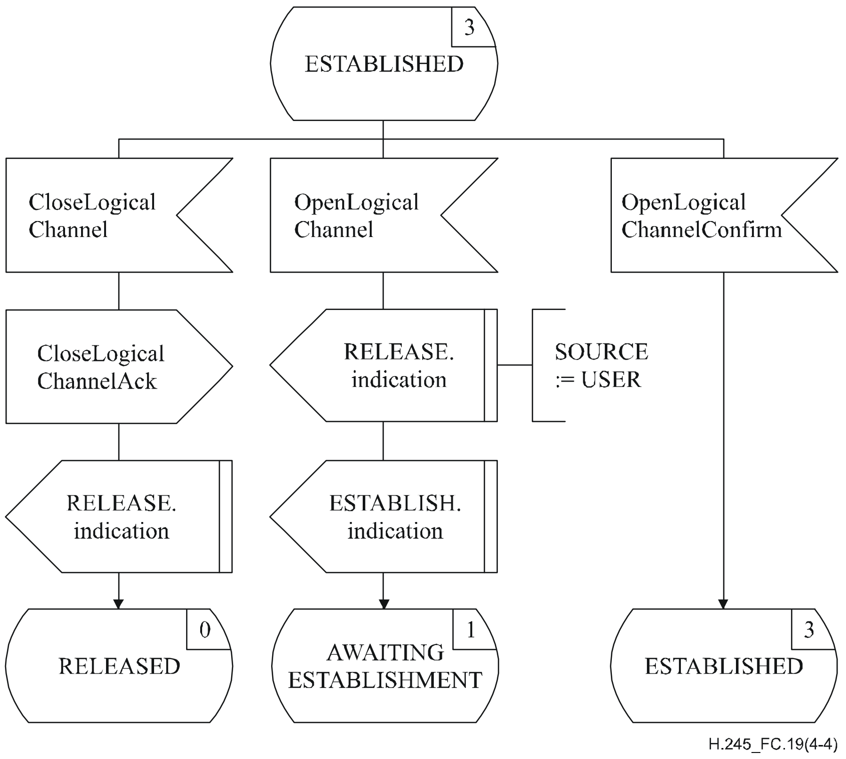


Figure C.19/H.245 – Incoming B-LCSE SDL ***(sheet 4 of 4)***

C.6 Close Logical Channel procedures

C.6.1 Introduction

These procedures are used by a terminal to request the remote terminal to close a logical channel. Note that these are only close request procedures; the actual logical channel close occurs using the LCSE and B-LCSE procedures. The procedures are referred to here as the Close Logical Channel Signalling Entity (CLCSE). Procedures are specified in terms of primitives and states at the interface between the CLCSE and the CLCSE user. Protocol information is transferred to the peer CLCSE via relevant messages defined in Annex A. There is an outgoing CLCSE and an incoming CLCSE. At each of the outgoing and incoming ends there is one instance of the CLCSE for each logical channel.

If a terminal is incapable of processing the incoming signals, it may use these procedures to request the closing of the relevant logical channels.

A terminal that answers such a response positively, that is, by issuing the CLOSE.response primitive, shall initiate the closing of the logical channel by sending the RELEASE.request primitive to the appropriate LCSE or B-LCSE as soon as possible.

The following text provides an overview of the operation of the protocol. In the case of any discrepancy with the formal specification of the protocol that follows, the formal specification will supersede.

C.6.1.1 Protocol overview – Outgoing CLCSE

A close logical channel request procedure is initiated when the CLOSE.request primitive is issued by the user at the outgoing CLCSE. A RequestChannelClose message is sent to the peer incoming CLCSE, and timer T108 is started. If a RequestChannelCloseAck message is received in response to the RequestChannelClose message then timer T108 is stopped and the user is informed with the CLOSE.confirm primitive that the close logical channel request procedure was successful. If however a RequestChannelCloseReject message is received in response to the RequestChannelClose message then timer T108 is stopped and the user is informed with the REJECT.indication primitive that the peer CLCSE user has refused to close the logical channel.

If timer T108 expires then the outgoing CLCSE user is informed with the REJECT.indication primitive and a RequestChannelCloseRelease message is sent.

C.6.1.2 Protocol overview – Incoming CLCSE

When a RequestChannelClose message is received at the incoming CLCSE, the user is informed of the close logical channel request with the CLOSE.indication primitive. The incoming CLCSE user signals acceptance of the close logical channel request by issuing the CLOSE.response primitive, and a RequestChannelCloseAck message is sent to the peer outgoing CLCSE. The incoming CLCSE user signals rejection of the close logical channel request by issuing the REJECT.request primitive, and a RequestChannelCloseReject message is sent to the peer outgoing CLCSE.

C.6.2 Communication between CLCSE and CLCSE user

C.6.2.1 Primitives between CLCSE and CLCSE user

Communication between the CLCSE and CLCSE user, is performed using the primitives shown in Table C.21.

Table C.21/H.245 – Primitives and parameters

Generic name	Type			
	request	indication	response	confirm
CLOSE	– (Note 1)	–	–	–
REJECT	CAUSE	SOURCE CAUSE	not defined (Note 2)	not defined
NOTE 1 – "–" means no parameters. NOTE 2 – "not defined" means that this primitive is not defined.				

C.6.2.2 Primitive definition

The definition of these primitives is as follows:

a) The CLOSE primitives are used to request closure of a logical channel.

b) The REJECT primitives are used to reject the closing of a logical channel.

C.6.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.21 is as follows:

a) The SOURCE parameter indicates the source of the REJECT.indication primitive. The SOURCE parameter has the value of "USER" or "PROTOCOL". The latter case may occur as the result of a timer expiry.

b) The CAUSE parameter indicates the reason for refusal to close a logical channel. The CAUSE parameter is not present when the SOURCE parameter indicates "PROTOCOL".

C.6.2.4 CLCSE states

The following states are used to specify the allowed sequence of primitives between the CLCSE and the CLCSE user.

The states for an outgoing CLCSE are:

State 0: IDLE

The CLCSE is idle.

State 1: AWAITING RESPONSE

The CLCSE is waiting for a response from the remote CLCSE.

The states for an incoming CLCSE are:

State 0: IDLE

The CLCSE is idle.

State 1: AWAITING RESPONSE

The CLCSE is waiting for a response from the CLCSE user.

C.6.2.5 State transition diagram

The allowed sequence of primitives between the CLCSE and the CLCSE user is defined here. The allowed sequences are specified separately for each of an outgoing CLCSE and an incoming CLCSE, as shown in Figures C.20 and C.21, respectively.

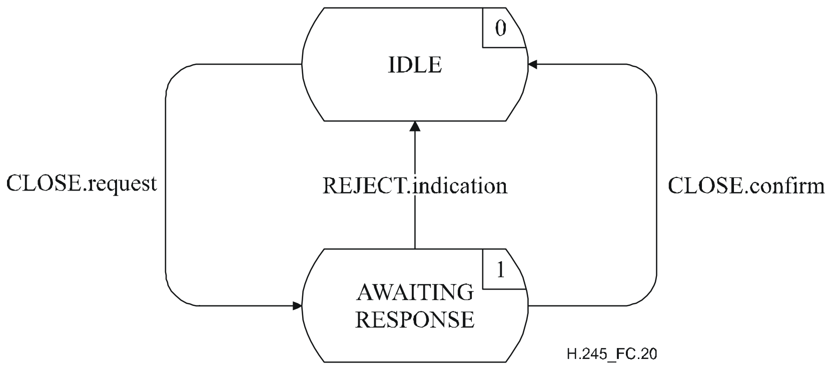


Figure C.20/H.245 – State transition diagram for sequence of primitives at outgoing CLCSE

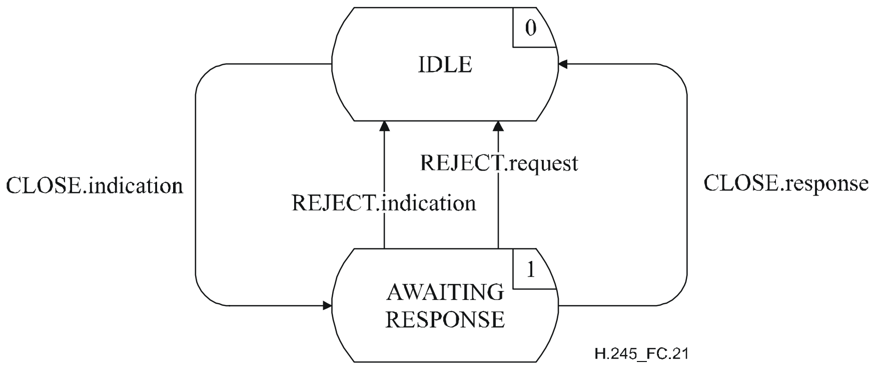


Figure C.21/H.245 – State transition diagram for sequence of primitives at incoming CLCSE

C.6.3 Peer-to-peer CLCSE communication

C.6.3.1 Messages

Table C.22 shows the CLCSE messages and fields, defined in Annex A, which are relevant to the CLCSE protocol.

Table C.22/H.245 – CLCSE message names and fields

Function	Message	Direction	Field
transfer	RequestChannelClose	O → I (Note)	forwardLogicalChannelNumber
	RequestChannelCloseAck	O ← I	forwardLogicalChannelNumber
	RequestChannelCloseReject	O ← I	forwardLogicalChannelNumber
reset	RequestChannelCloseRelease	O → I	forwardLogicalChannelNumber
NOTE – Direction: O – Outgoing, I – Incoming.			

C.6.3.2 CLCSE state variables

The following state variable is defined at the outgoing CLCSE:

out_LCN

This state variable distinguishes between outgoing CLCSEs. It is initialized at outgoing CLCSE initialization. The value of out_LCN is used to set the forwardLogicalChannelNumber field of CLCSE messages sent from an outgoing CLCSE. For CLCSE messages received at an outgoing CLCSE, the message forwardLogicalChannelNumber field value is identical to the value of out_LCN.

The following state variable is defined at the incoming CLCSE:

in_LCN

This state variable distinguishes between incoming CLCSEs. It is initialized at incoming CLCSE initialization. The value of in_LCN is used to set the forwardLogicalChannelNumber field of CLCSE messages sent from an incoming CLCSE. For CLCSE messages received at an incoming CLCSE, the message forwardLogicalChannelNumber field value is identical to the value of in_LCN.

C.6.3.3 CLCSE timers

The following timer is specified for the outgoing CLCSE:

T108

This timer is used during the AWAITING RESPONSE state. It specifies the maximum time during which no RequestChannelCloseAck or RequestChannelCloseReject message may be received.

C.6.4 CLCSE procedures

Figure C.22 summarizes the CLCSE primitives and their parameters, and messages, for each of the outgoing and incoming CLCSE.

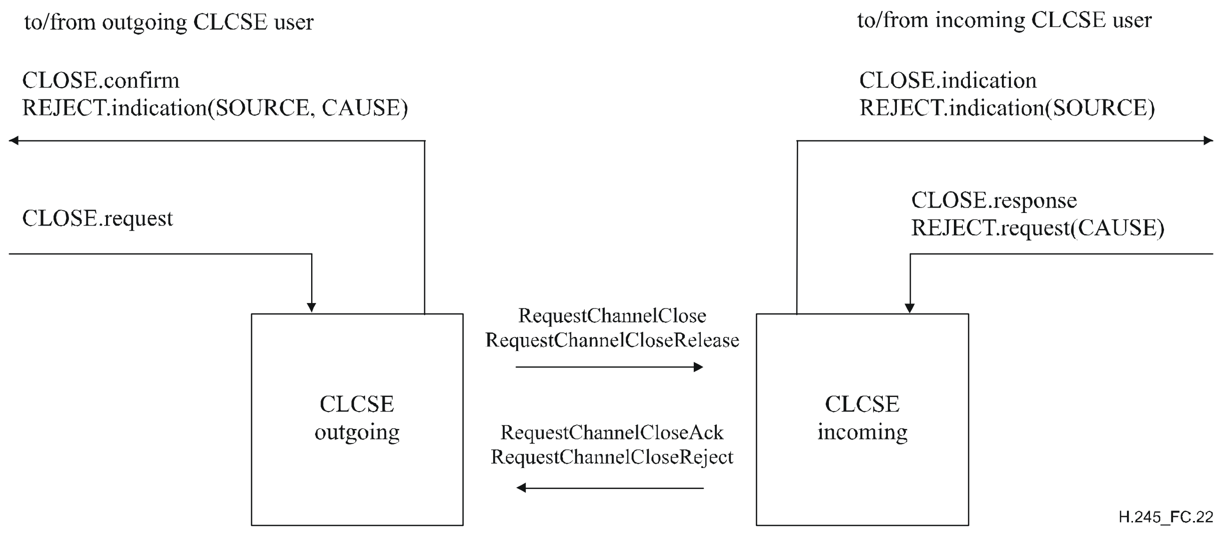

to/from outgoing CLCSE user
CLOSE.confirm
REJECT.indication(SOURCE, CAUSE)
CLOSE.request
to/from incoming CLCSE user
CLOSE.indication
REJECT.indication(SOURCE)
CLOSE.response
REJECT.request(CAUSE)
RequestChannelClose
RequestChannelCloseRelease
RequestChannelCloseAck
RequestChannelCloseReject
CLCSE outgoing
CLCSE incoming
H.245_FC.22

Figure C.22/H.245 – Primitives and messages in the Close Logical Channel Signalling Entity

C.6.4.1 Primitive parameter default values

Where not explicitly stated in the SDL diagrams, the parameters of the indication and confirm primitives assume values as shown in Table C.23.

Table C.23/H.245 – Default primitive parameter values

Primitive	Parameter	Default value
REJECT.indication	SOURCE	USER
	CAUSE	null

C.6.4.2 Message field default values

Where not explicitly stated in the SDL diagrams, the message fields assume values as shown in Table C.24.

Table C.24/H.245 – Default message field values

Message	Field	Default value
RequestChannelClose	forwardLogicalChannelNumber	out_LCN
RequestChannelCloseAck	forwardLogicalChannelNumber	in_LCN
RequestChannelCloseReject	forwardLogicalChannelNumber cause	in_LCN REJECT.request(CAUSE)
RequestChannelCloseRelease	forwardLogicalChannelNumber	out_LCN

C.6.4.3 SDLs

The outgoing CLCSE and the incoming CLCSE procedures are expressed in SDL form in Figures C.23 and C.24, respectively.

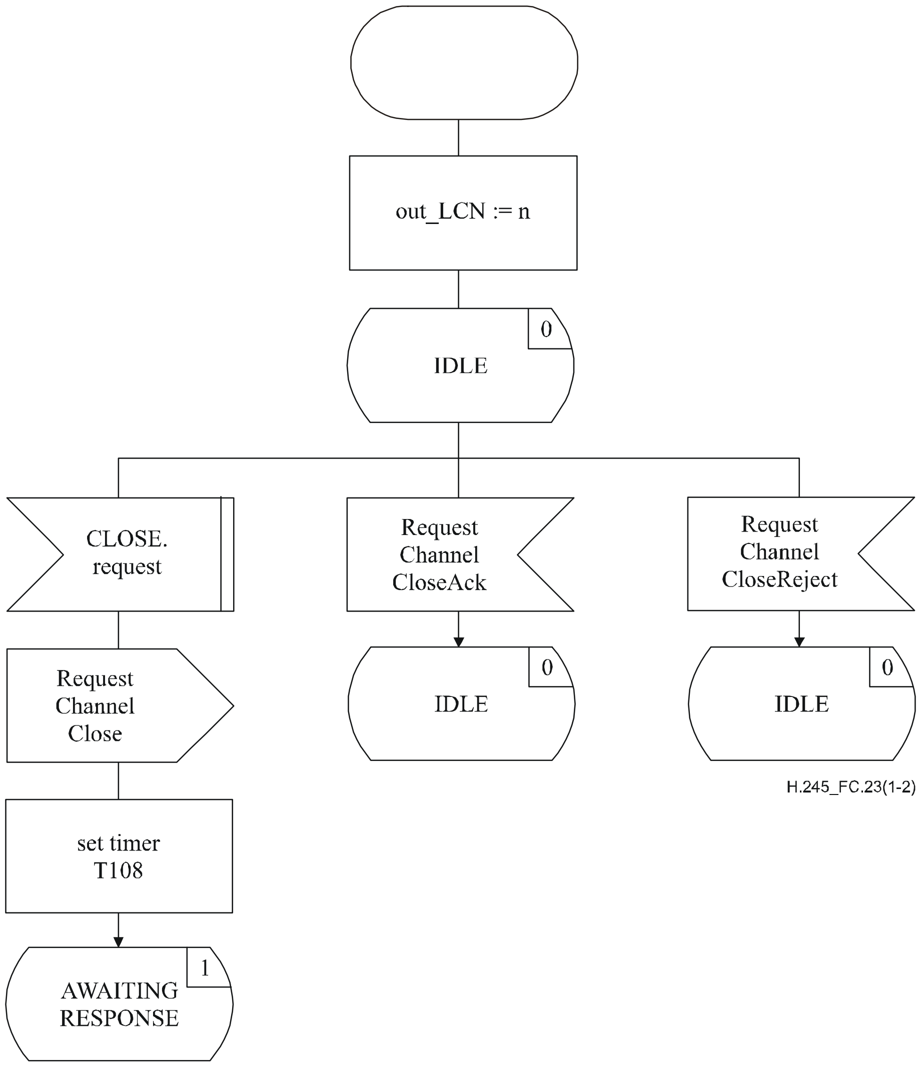


Figure C.23/H.245 – Outgoing CLCSE SDL ***(sheet 1 of 2)***

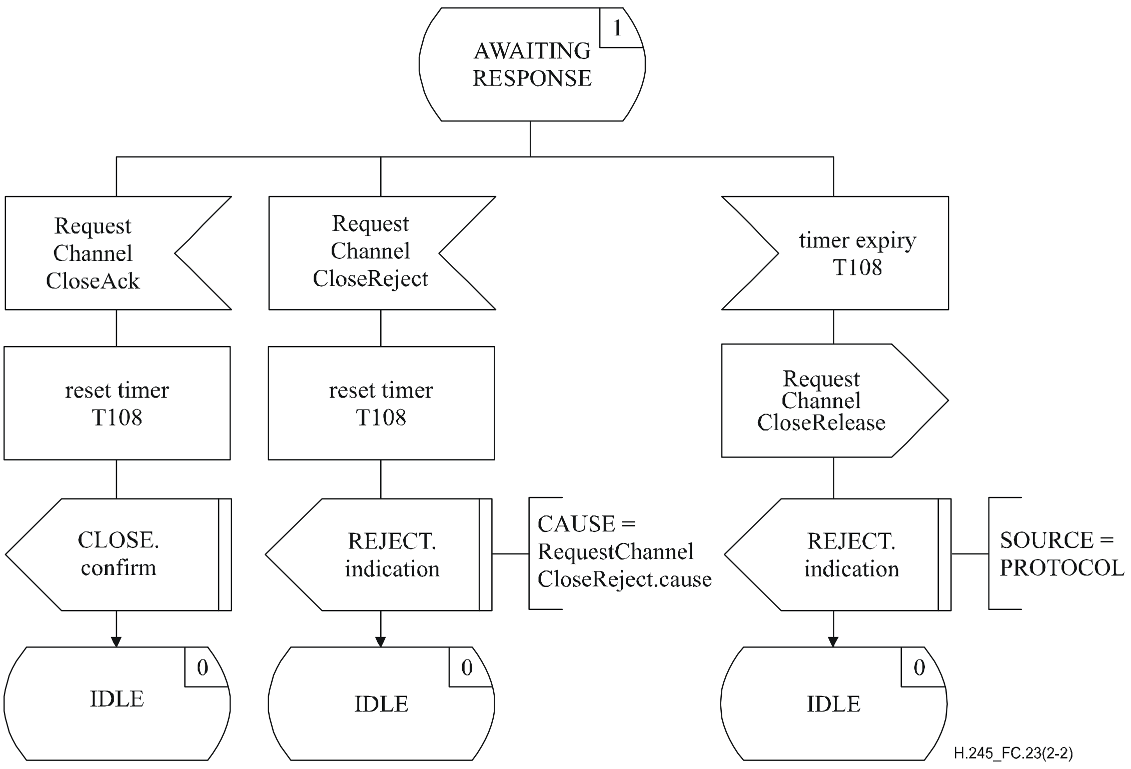


Figure C.23/H.245 – Outgoing CLCSE SDL ***(sheet 2 of 2)***

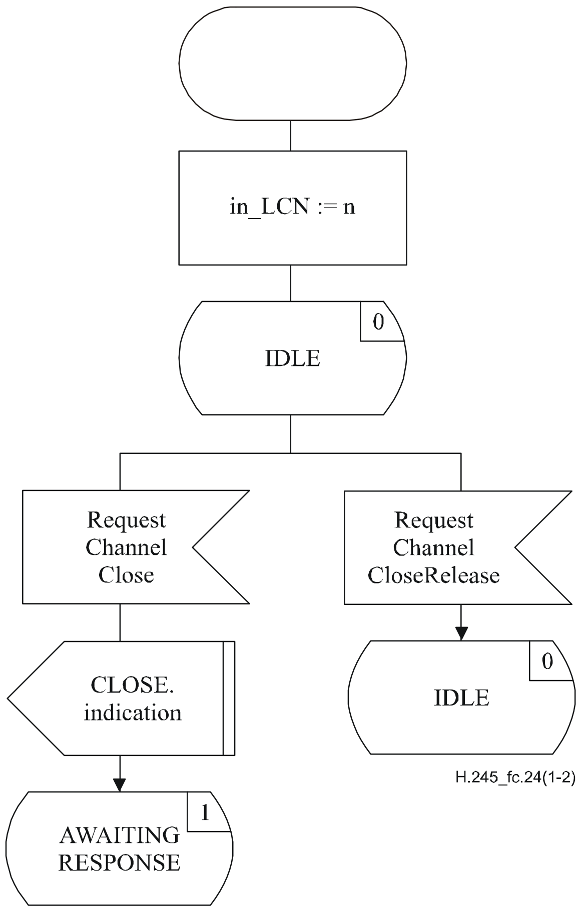


Figure C.24/H.245 – Incoming CLCSE SDL ***(sheet 1 of 2)***

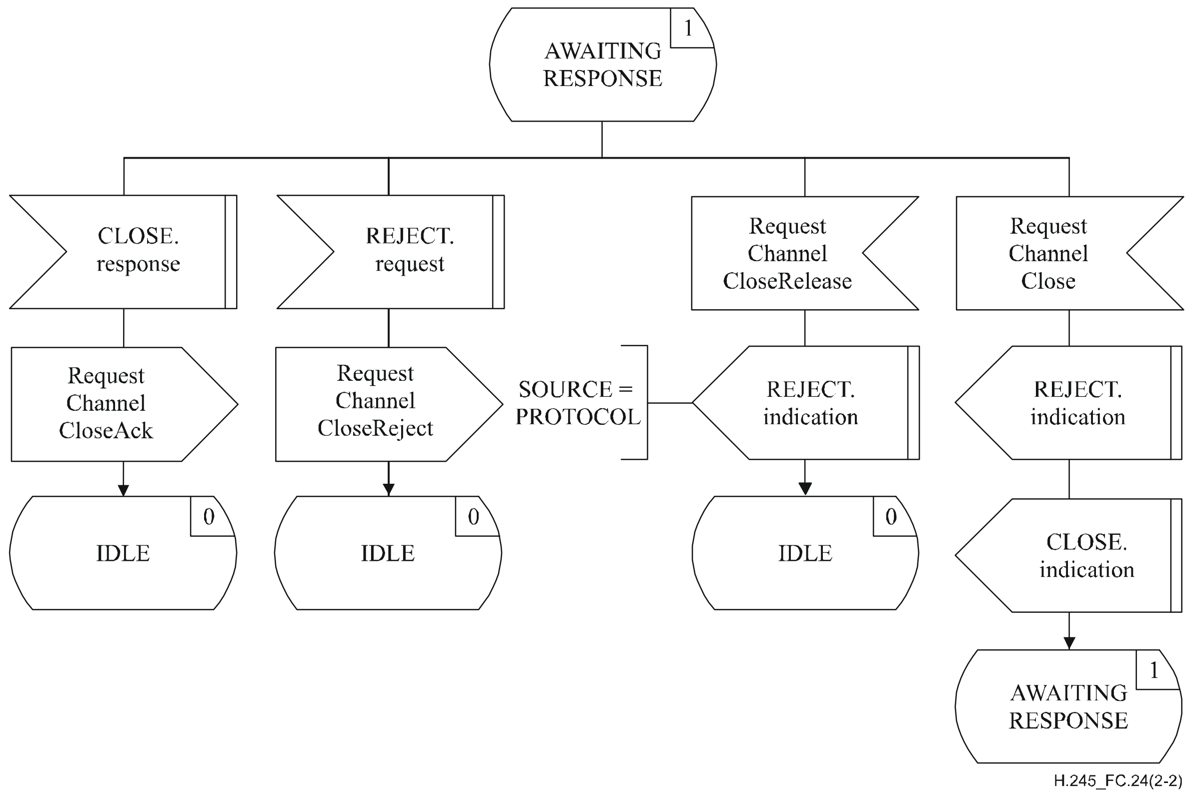


Figure C.24/H.245 – Incoming CLCSE SDL *(sheet 2 of 2)*

C.7 H.223 Multiplex Table Procedures

C.7.1 Introduction

The multiplex table serves to associate each octet within a H.223 MUX-PDU [10] with a particular logical channel number. The H.223 multiplex table may have up to 16 entries, numbered from 0 to 15. Table entries 1 to 15 shall be sent from transmitters to receivers as specified in the following procedures.

The procedures described here are referred to as the Multiplex Table Signalling Entity (MTSE). Procedures are specified in terms of primitives and states at the interface between the MTSE and the MTSE user. Protocol information is transferred to the peer MTSE via relevant messages defined in Annex A.

There is an outgoing MTSE and an incoming MTSE. There is one instance of the MTSE for each multiplex table entry.

A transmit terminal uses this protocol to signal to a remote terminal one or more new multiplex table entries. The remote terminal may accept or reject the new multiplex table entries. If the remote terminal accepts a multiplex table entry, the previous entry at the given entry number is replaced with the new entry.

The transmitter may deactivate a multiplex table entry by sending a MultiplexEntryDescriptor with no elementList. The transmitter shall at no time use a multiplex table entry that is deactivated. Before transmitting a MultiplexEntrySend, the transmitter shall stop using the entries that are described by it. It shall not restart using those entries until it has received a MultiplexEntrySendAck. This procedure is used because if the use of these multiplex table entries is not stopped before sending the MultiplexEntrySend, errors may cause an ambiguity in the receiver.

The transmitter shall stop using deactivated entries before sending the MultiplexEntrySend indicating that they have been deactivated. Deactivated entries may be used again at any time by transmitting a MultiplexEntrySend message for activating that entry. Deactivating entries that are no longer required by the transmitter may increase the probability of detecting errors in the H.223 Multiplex Code field.

NOTE – While some multiplex table entries are being updated, other (active) entries may continue to be used. Also, a multiplex table entry may be deleted in the same MultiplexEntrySend that is used to modify other multiplex table entries.

At the start of communication, unless specified otherwise in an appropriate Recommendation, only table entry 0 is available for transmission, and table entries 1 to 15 are deactivated.

A Request Multiplex Entry procedure may be used at any time to elicit retransmission of specified multiplex table entries from the remote terminal, for example, following an interruption or other cause for uncertainty.

The following text provides an overview of the operation of the protocol. In the case of any discrepancy with the formal specification of the protocol that follows, the formal specification will supersede.

C.7.1.1 Protocol overview – Outgoing MTSE

A multiplex table entry send request procedure is initiated when the TRANSFER.request primitive is issued by the user at the outgoing MTSE. A MultiplexEntrySend message is sent to the peer incoming MTSE, and timer T104 is started. If a MultiplexEntrySendAck message is received in response to the MultiplexEntrySend message then timer T104 is stopped and the user is informed with the TRANSFER.confirm primitive that the multiplex table entry send request was successful. If however a MultiplexEntrySendReject message is received in response to the MultiplexEntrySend message then timer T104 is stopped and the user is informed with the REJECT.indication primitive that the peer MTSE user has refused to accept the multiplex table entry.

If timer T104 expires then the outgoing MTSE user is informed with the REJECT.indication primitive and a MultiplexEntrySendRelease message is sent.

Only MultiplexEntrySendAck and MultiplexEntrySendReject messages which are in response to the most recent MultiplexEntrySend message are accepted. Responses to earlier MultiplexEntrySend messages are ignored.

A new multiplex table entry send request procedure may be initiated with the TRANSFER.request primitive by the user at the outgoing MTSE before a MultiplexEntrySendAck or a MultiplexEntrySendReject message has been received.

C.7.1.2 Protocol overview – Incoming MTSE

When a MultiplexEntrySend message is received at the incoming MTSE, the user is informed of the multiplex table entry send request with the TRANSFER.indication primitive. The incoming MTSE user signals acceptance of the multiplex table entry by issuing the TRANSFER.response primitive, and a MultiplexEntrySendAck message is sent to the peer outgoing MTSE. The incoming MTSE user signals rejection of the multiplex table entry by issuing the REJECT.request primitive, and a MultiplexEntrySendReject message is sent to the peer outgoing MTSE.

A new MultiplexEntrySend message may be received before the incoming MTSE user has responded to an earlier MultiplexEntrySend message. The incoming MTSE user is informed with the REJECT.indication primitive, followed by the TRANSFER.indication primitive, and the incoming MTSE user responds to the new multiplex table entry.

If a MultiplexEntrySendRelease message is received before the incoming MTSE user has responded to an earlier MultiplexEntrySend message, then the incoming MTSE user is informed with the REJECT.indication, and the earlier multiplex table entry is discarded.

C.7.2 Communication between the MTSE and MTSE user

C.7.2.1 Primitives between MTSE and MTSE user

Communication between the MTSE and MTSE user is performed using the primitives shown in Table C.25.

Table C.25/H.245 – Primitives and parameters

Generic name	Type			
	request	**indication**	**response**	**confirm**
TRANSFER	MUX-DESCRIPTOR	MUX-DESCRIPTOR	– (Note 1)	–
REJECT	CAUSE	SOURCE CAUSE	not defined (Note 2)	not defined
NOTE 1 – "–" means no parameters. NOTE 2 – "not defined" means that this primitive is not defined.				

C.7.2.2 Primitive definition

The definition of these primitives is as follows:

a) The TRANSFER primitives are used to transfer multiplex table entries.

b) The REJECT primitives are used to reject a multiplex table entry, and to terminate a multiplex table entry transfer.

C.7.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.25 is as follows:

a) The MUX-DESCRIPTOR parameter is a multiplex table entry. This parameter is mapped to the MultiplexEntryDescriptor field of the multiplexEntrySend message and carried transparently from the MTSE user at the outgoing MTSE to the MTSE user at the incoming MTSE. There may be multiple MUX-DESCRIPTORs associated with the TRANSFER primitive.

b) The SOURCE parameter indicates the source of the REJECT.indication primitive. The SOURCE parameter has the value of "USER" or "PROTOCOL". The latter case may occur as the result of a timer expiry.

c) The CAUSE parameter indicates the reason for rejection of a multiplex table entry. The CAUSE parameter is not present when the SOURCE parameter indicates "PROTOCOL".

C.7.2.4 MTSE states

The following states are used to specify the allowed sequence of primitives between the MTSE and the MTSE user. The states are specified separately for each of an outgoing MTSE and an incoming MTSE. The states for an outgoing MTSE are:

State 0: IDLE

There is no MTSE transfer is in progress. The multiplex table entry may be used by the transmitter.

State 1: AWAITING RESPONSE

The MTSE user has requested the transfer of a multiplex table entry, and a response from the peer MTSE is awaited. The multiplex table entry shall not be used by the transmitter.

The states for an incoming MTSE are:

State 0: IDLE

There is no MTSE transfer in progress. The multiplex table entry may be in use by the transmitter.

State 1: AWAITING RESPONSE

The peer MTSE has transferred a multiplex table entry, and a response from the MTSE user is awaited. The multiplex table entry may not be in use by the transmitter.

C.7.2.5 State transition diagram

The allowed sequence of primitives between the MTSE and the MTSE user is defined here. The allowed sequences are specified separately for each of an outgoing MTSE and an incoming MTSE, as shown in Figures C.25 and C.26, respectively.

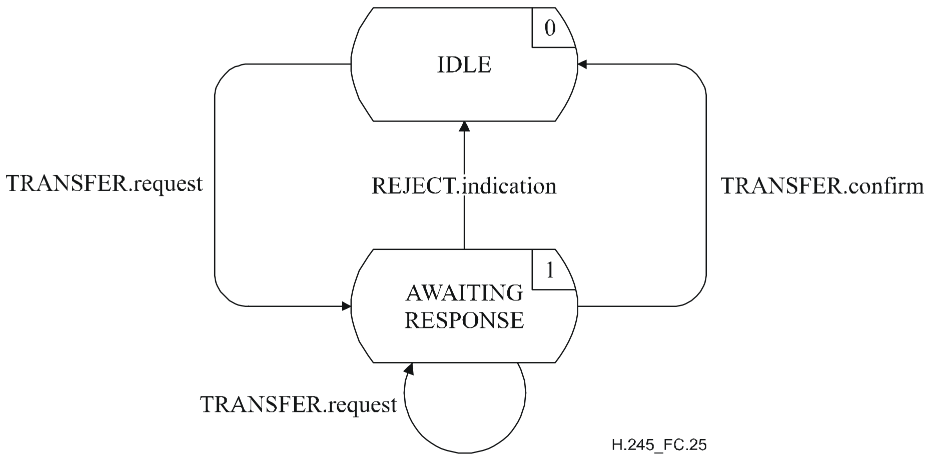


Figure C.25/H.245 – State transition diagram for sequence of primitives at outgoing MTSE

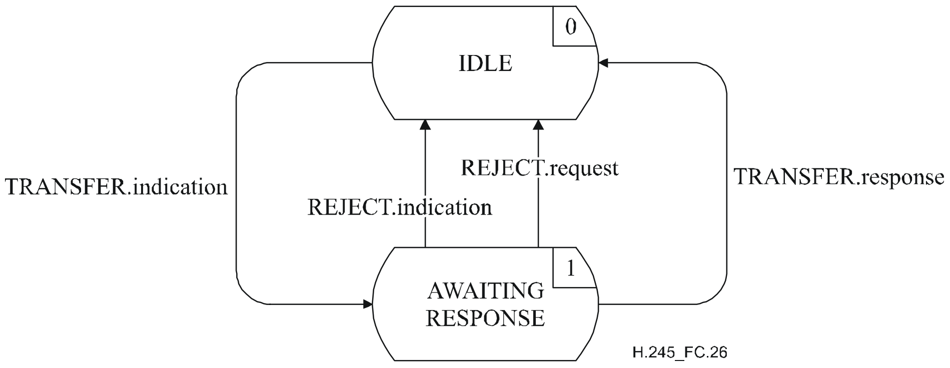


Figure C.26/H.245 – State transition diagram for sequence of primitives at incoming MTSE

C.7.3 Peer-to-peer MTSE communication

C.7.3.1 Messages

Table C.26 shows the MTSE messages and fields, defined in Annex A, which are relevant to the MTSE protocol.

Table C.26/H.245 – MTSE message names and fields

Function	Message	Direction	Field
transfer	MultiplexEntrySend	O → I (Note)	sequenceNumber multiplexEntryDescriptors.multiplexTableEntryNumber multiplexEntryDescriptors.elementList
	MultiplexEntrySendAck	O ← I	sequenceNumber multiplexTableEntryNumber
reject	MultiplexEntrySendReject	O ← I	sequenceNumber multiplexTableEntryNumber rejectionDescriptions.cause
reset	MultiplexEntrySendRelease	O → I	multiplexTableEntryNumber
NOTE 1 – Direction: O – Outgoing, I – Incoming.			

C.7.3.2 MTSE state variables

The following state variables are defined at the outgoing MTSE:

out_ENUM

This state variable distinguishes between outgoing MTSEs. It is initialized at outgoing MTSE initialization. The value of out_ENUM is used to set the multiplexTableEntryNumber field of MTSE messages sent from an outgoing MTSE. For MTSE messages received at an outgoing MTSE, the message multiplexTableEntryNumber field value is identical to the value of out_ENUM.

out_SQ

This state variable is used to indicate the most recently sent MultiplexEntrySend message. It is incremented by one and mapped to the MultiplexEntrySend message sequenceNumber field before transmission of a MultiplexEntrySend message. Arithmetic performed on out_SQ is modulo 256.

The following state variables are defined at the incoming MTSE:

in_ENUM

This state variable distinguishes between incoming MTSEs. It is initialized at incoming MTSE initialization. The value of in_ENUM is used to set the multiplexTableEntryNumber field of MTSE messages sent from an incoming MTSE. For MTSE messages received at an incoming MTSE, the message multiplexTableEntryNumber field value is identical to the value of in_ENUM.

in_SQ

This state variable is used to store the value of the sequenceNumber field of the most recently received MultiplexEntrySend message. The MultiplexEntrySendAck and MultiplexEntrySendReject messages have their sequenceNumber fields set to the value of in_SQ, before being sent to the peer MTSE.

C.7.3.3 MTSE timers

The following timer is specified for the outgoing MTSE:

T104

This timer is used during the AWAITING RESPONSE state. It specifies the maximum time during which no MultiplexEntrySendAck or MultiplexEntrySendReject message may be received.

C.7.4 MTSE procedures

C.7.4.1 Introduction

Figure C.27 summarizes the primitives and their parameters, and the messages and relevant fields, for each of the outgoing and incoming MTSE.

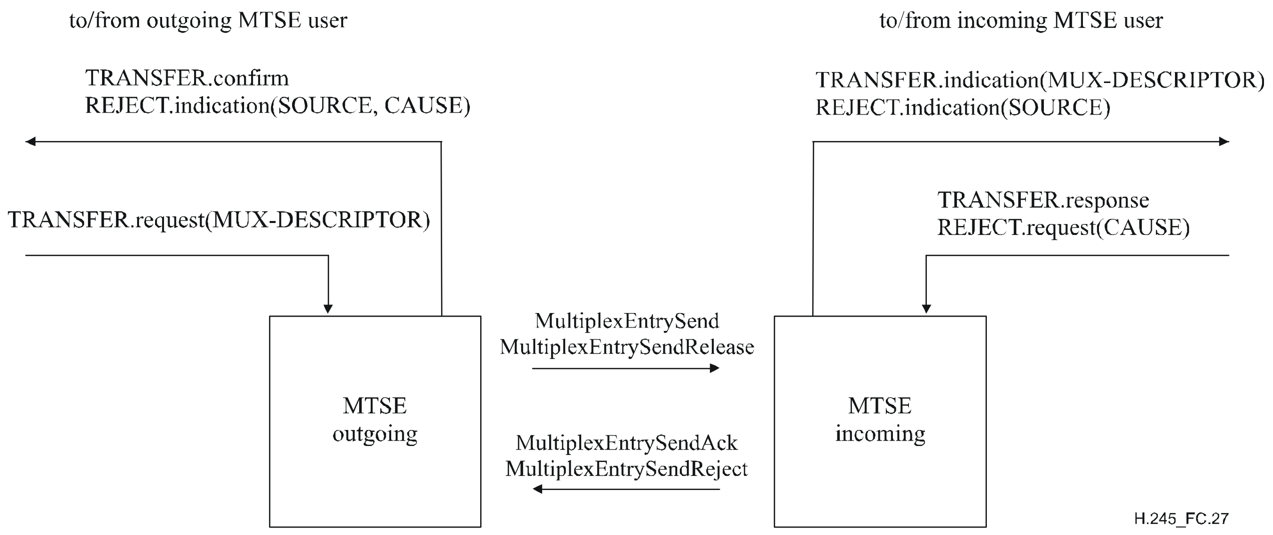

to/from outgoing MTSE user
to/from incoming MTSE user
TRANSFER.confirm
REJECT.indication(SOURCE, CAUSE)
TRANSFER.indication(MUX-DESCRIPTOR)
REJECT.indication(SOURCE)
TRANSFER.request(MUX-DESCRIPTOR)
TRANSFER.response
REJECT.request(CAUSE)
MTSE outgoing
MultiplexEntrySend
MultiplexEntrySendRelease
MultiplexEntrySendAck
MultiplexEntrySendReject
MTSE incoming
H.245_FC.27

Figure C.27/H.245 – Primitives and messages in the Multiplex Table Signalling Entity

C.7.4.2 Primitive parameter default values

Where not explicitly stated in the SDL diagrams, the parameters of the indication and confirm primitives assume values as shown in Table C.27.

Table C.27/H.245 – Default primitive parameter values

Primitive	Parameter	Default value
TRANSFER.indication	MUX-DESCRIPTOR	MultiplexEntrySend.multiplexEntryDescriptors.elementList
REJECT.indication	SOURCE CAUSE	USER null

C.7.4.3 Message field default values

Where not explicitly stated in the SDL diagrams, the message fields assume values as shown in Table C.28.

Table C.28/H.245 – Default message field values

Message	Field	Default value (Note)
MultiplexEntrySend	sequenceNumber	out_SQ
	multiplexEntryDescriptors.multiplex TableEntryNumber	out_ENUM
	multiplexEntryDescriptors.elementList	TRANSFER.request(MUX-DESCRIPTOR)
MultiplexEntrySendAck	sequenceNumber	in_SQ
	multiplexTableEntryNumber	in_ENUM
MultiplexEntrySendReject	sequenceNumber	in_SQ
	rejectionDescriptions.multiplex TableEntryNumber	in_ENUM
	rejectionDescriptions.cause	REJECT.request(CAUSE)
MultiplexEntrySendRelease	multiplexTableEntryNumber	out_ENUM
NOTE – A message field shall not be coded if the corresponding primitive parameter is null, i.e., not present.		

C.7.4.4 SDLs

The outgoing MTSE and the incoming MTSE procedures are expressed in SDL form in Figures C.28 and C.29, respectively.

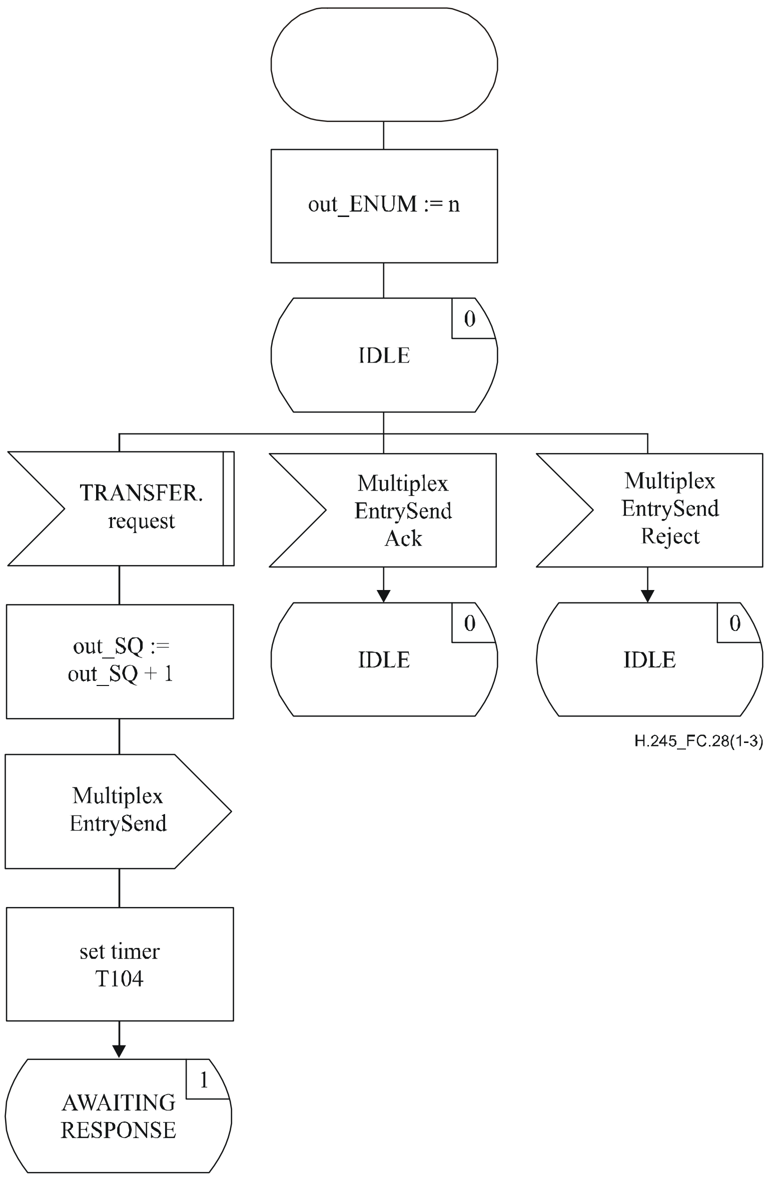


Figure C.28/H.245 – Outgoing MTSE SDL *(sheet 1 of 3)*

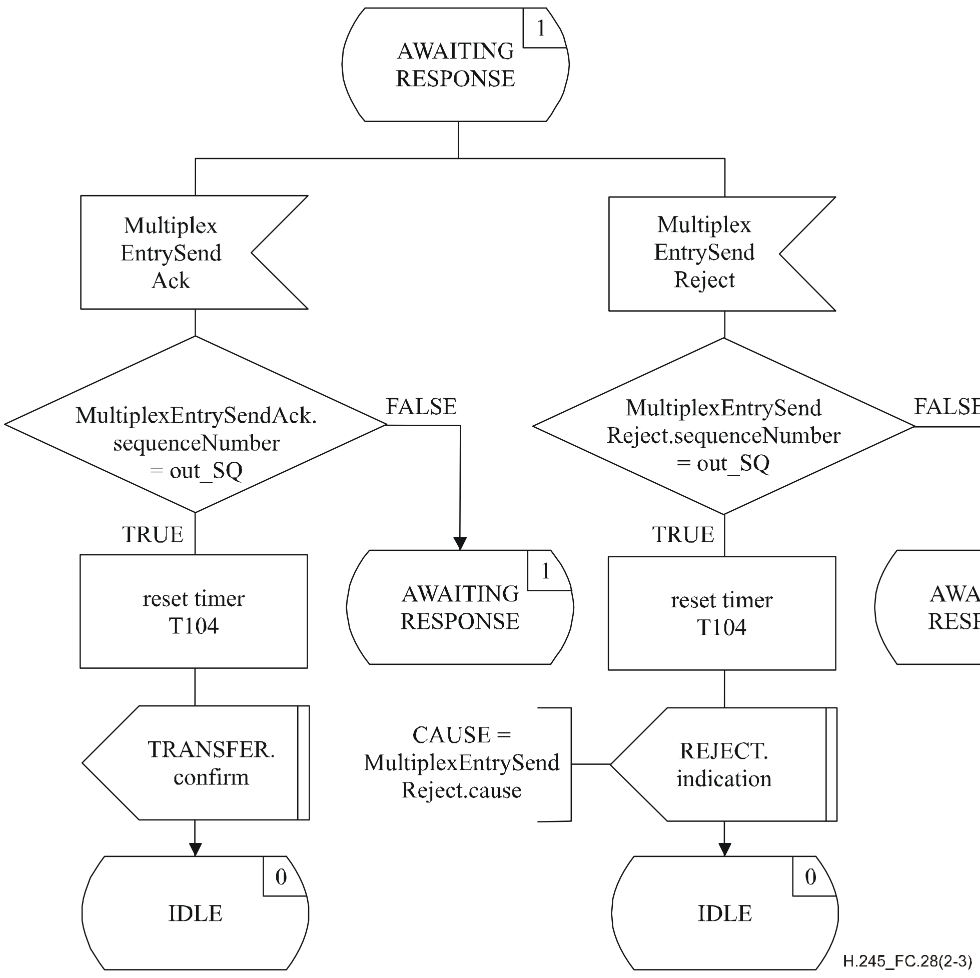


Figure C.28/H.245 – Outgoing MTSE SDL *(sheet 2 of 3)*

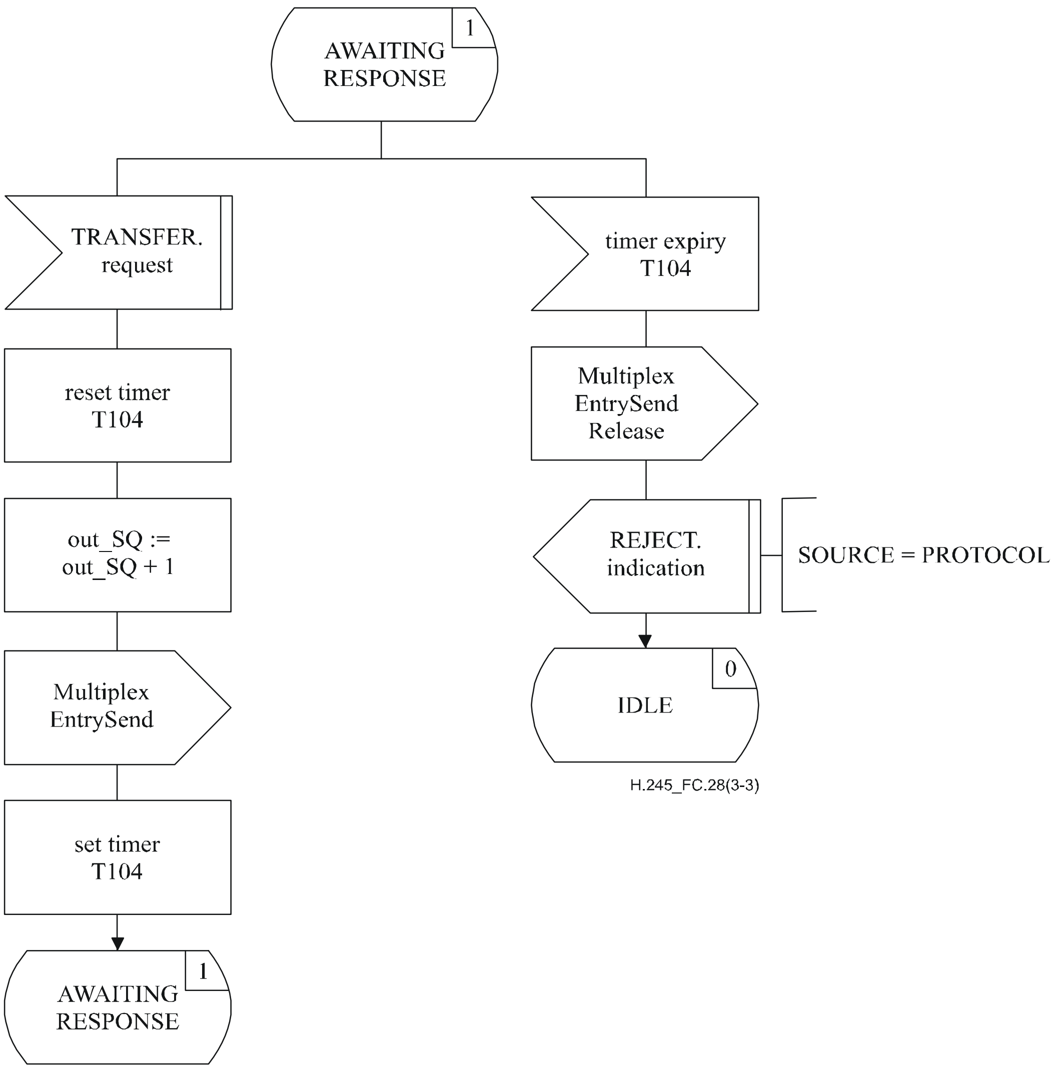


Figure C.28/H.245 – Outgoing MTSE SDL *(sheet 3 of 3)*

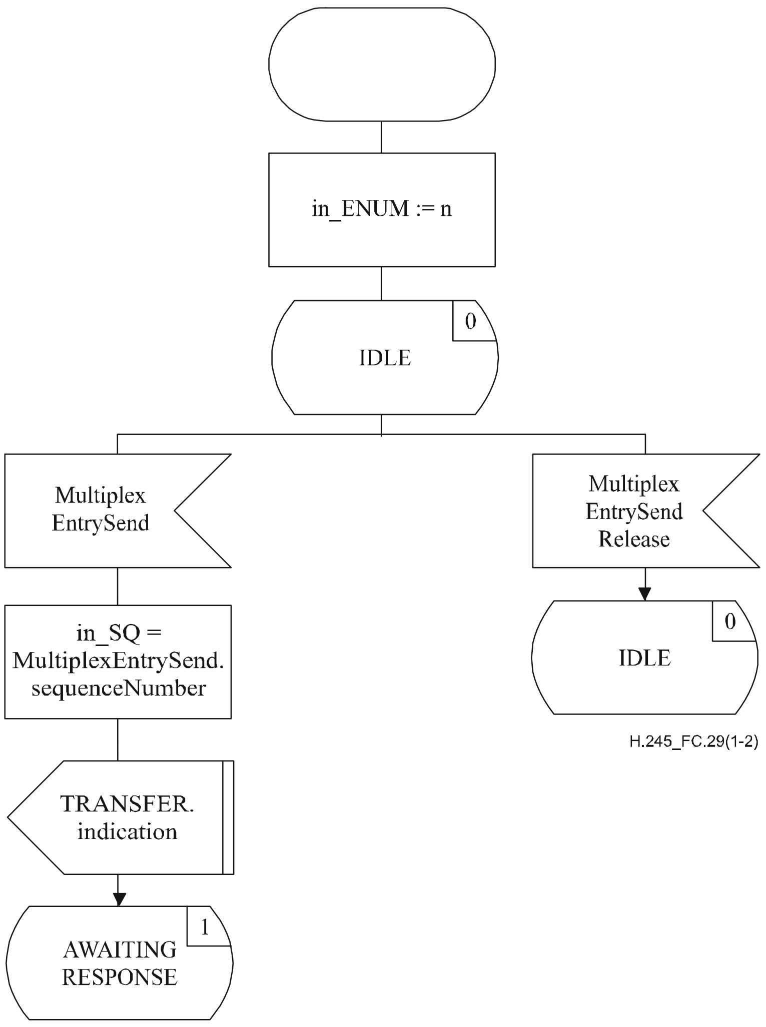


Figure C.29/H.245 – Incoming MTSE SDL *(sheet 1 of 2)*

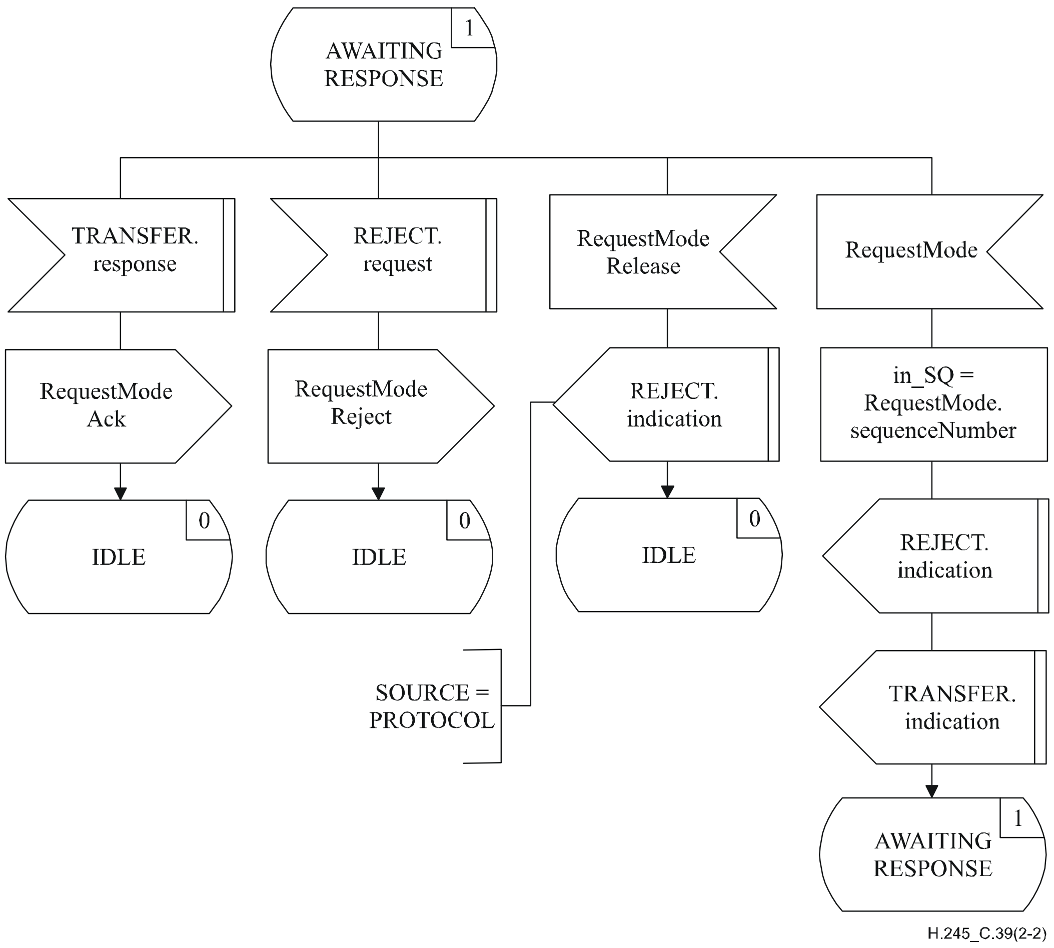


Figure C.29/H.245 – Incoming MTSE SDL *(sheet 2 of 2)*

C.8 Request Multiplex Entry procedures

C.8.1 Introduction

These procedures are used by a terminal to request the retransmission of one or more MultiplexEntryDescriptors. The procedures are referred to here as the Request Multiplex Entry Signalling Entity (RMESE). Procedures are specified in terms of primitives and states at the interface between the RMESE and the RMESE user. Protocol information is transferred to the peer RMESE via relevant messages defined in Annex A. There is an outgoing RMESE and an incoming RMESE. There is one instance of the RMESE for each multiplex table entry.

A terminal that answers such a response positively, that is, by issuing the SEND.response primitive, shall initiate the Multiplex Table procedures to send the multiplex table entry as soon as possible.

The following text provides an overview of the operation of the protocol. In the case of any discrepancy with the formal specification of the protocol that follows, the formal specification will supersede.

NOTE – This protocol has been defined so that there is an independent RMESE for each multiplex table entry, and the syntax has been defined to allow a single message to carry information relating to one or more multiplex table entries. The way that messages are constructed is an implementation decision: for example, a terminal may respond to a RequestMultiplexEntry message requesting three entries to be sent with one, two or three response messages.

C.8.1.1 Protocol overview – Outgoing RMESE

A request multiplex entry procedure is initiated when the SEND.request primitive is issued by the user at the outgoing RMESE. A RequestMultiplexEntry message is sent to the peer incoming

RMESE, and timer T107 is started. If a RequestMultiplexEntryAck message is received in response to the RequestMultiplexEntry message then timer T107 is stopped and the user is informed with the SEND.confirm primitive that the request multiplex entry procedure was successful. If, however, a RequestMultiplexEntryReject message is received in response to the RequestMultiplexEntry message then timer T107 is stopped and the user is informed with the REJECT.indication primitive that the peer RMESE user has refused to send the multiplex entry.

If timer T107 expires, then the outgoing RMESE user is informed with the REJECT.indication primitive and a RequestMultiplexEntryRelease message is sent.

C.8.1.2 Protocol overview – Incoming RMESE

When a RequestMultiplexEntry message is received at the incoming RMESE, the user is informed of the multiplex entry request with the SEND.indication primitive. The incoming RMESE user signals acceptance of the multiplex entry request by issuing the SEND.response primitive, and a RequestMultiplexEntryAck message is sent to the peer outgoing RMESE. The incoming RMESE user signals rejection of the multiplex entry request by issuing the REJECT.request primitive, and a RequestMultiplexEntryReject message is sent to the peer outgoing RMESE.

C.8.2 Communication between RMESE and RMESE user

C.8.2.1 Primitives between RMESE and RMESE user

Communication between the RMESE and RMESE user is performed using the primitives shown in Table C.29.

Table C.29/H.245 – Primitives and parameters

Generic name	**Type**			
	request	**indication**	**response**	**confirm**
SEND	– (Note 1)	–	–	–
REJECT	CAUSE	SOURCE CAUSE	not defined (Note 2)	not defined
NOTE 1 – "–" means no parameters. NOTE 2 – "not defined" means that this primitive is not defined.				

C.8.2.2 Primitive definition

The definition of these primitives is as follows:

a) The SEND primitives are used to request the transmission of a multiplex entry.

b) The REJECT primitives are used to reject the request for transmission of a multiplex entry.

C.8.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.29 is as follows:

a) The SOURCE parameter indicates the source of the REJECT.indication primitive. The SOURCE parameter has the value of "USER" or "PROTOCOL". The latter case may occur as the result of a timer expiry.

b) The CAUSE parameter indicates the reason for refusal to send a multiplex table entry. The CAUSE parameter is not present when the SOURCE parameter indicates "PROTOCOL".

C.8.2.4 RMESE states

The following states are used to specify the allowed sequence of primitives between the RMESE and the RMESE user.

The states for an outgoing RMESE are:

State 0: IDLE

The RMESE is idle.

State 1: AWAITING RESPONSE

The RMESE is waiting for a response from the remote RMESE.

The states for an incoming RMESE are:

State 0: IDLE

The RMESE is idle.

State 1: AWAITING RESPONSE

The RMESE is waiting for a response from the RMESE user.

C.8.2.5 State transition diagram

The allowed sequence of primitives between the RMESE and the RMESE user is defined here. The allowed sequences are specified separately for each of an outgoing RMESE and an incoming RMESE, as shown in Figures C.30 and C.31, respectively.

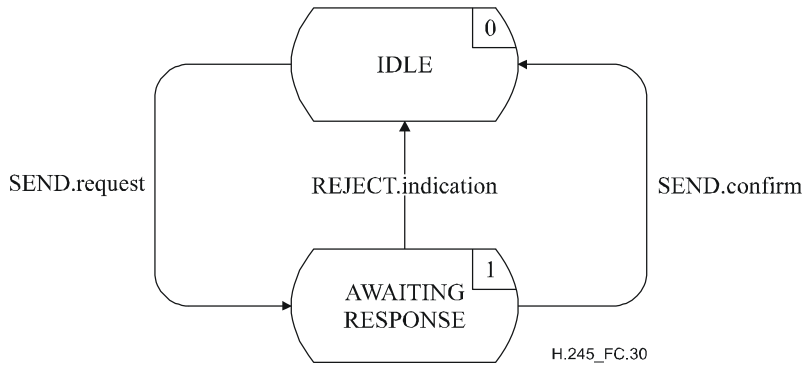


Figure C.30/H.245 – State transition diagram for sequence of primitives at outgoing RMESE

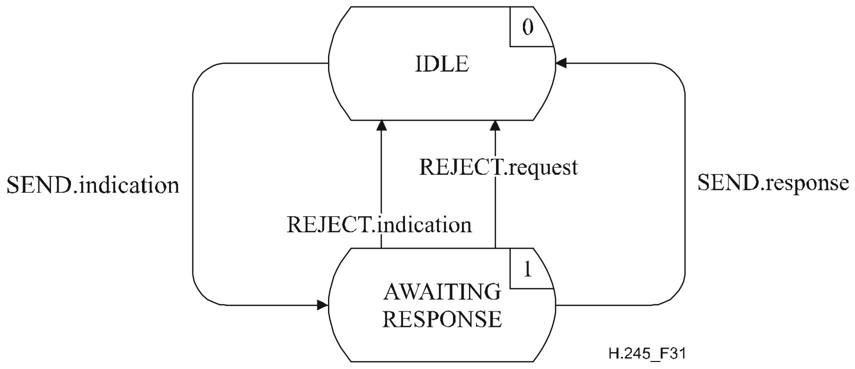


Figure C.31/H.245 – State transition diagram for sequence of primitives at incoming RMESE

C.8.3 Peer-to-peer RMESE communication

C.8.3.1 Messages

Table C.30 shows the RMESE messages and fields, defined in Annex A, which are relevant to the RMESE protocol.

Table C.30/H.245 – RMESE message names and fields

Function	Message	Direction	Field
transfer	RequestMultiplexEntry	O → I (Note)	multiplexTableEntryNumber
	RequestMultiplexEntryAck	O ← I	multiplexTableEntryNumber
	RequestMultiplexEntryReject	O ← I	multiplexTableEntryNumber rejectionDescriptions.cause
reset	RequestMultiplexEntryRelease	O → I	
NOTE – Direction: O – Outgoing, I – Incoming.			

C.8.3.2 RMESE state variables

The following state variable is defined at the outgoing RMESE:

out_ENUM

This state variable distinguishes between outgoing RMESEs. It is initialized at outgoing RMESE initialization. The value of out_ENUM is used to set the multiplexTableEntryNumber field of RMESE messages sent from an outgoing RMESE. For RMESE messages received at an outgoing RMESE, the message multiplexTableEntryNumber field value is identical to the value of out_ENUM.

The following state variable is defined at the incoming RMESE:

in_ENUM

This state variable distinguishes between incoming RMESEs. It is initialized at incoming RMESE initialization. The value of in_ENUM is used to set the multiplexTableEntryNumber field of RMESE messages sent from an incoming RMESE. For RMESE messages received at an incoming RMESE, the message multiplexTableEntryNumber field value is identical to the value of in_ENUM.

C.8.3.3 RMESE timers

The following timer is specified for the outgoing RMESE:

T107

This timer is used during the AWAITING RESPONSE state. It specifies the maximum time during which no RequestMultiplexEntryAck or RequestMultiplexEntryReject message may be received.

C.8.4 RMESE procedures

Figure C.32 summarizes the RMESE primitives and their parameters, and messages, for each of the outgoing and incoming RMESE.

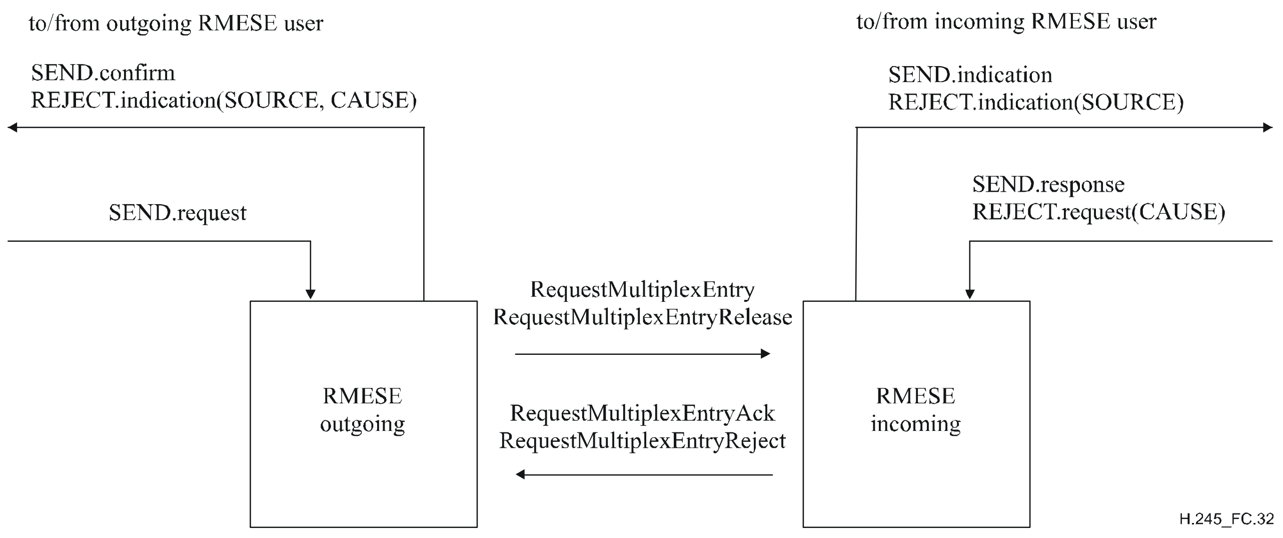

to/from outgoing RMESE user
SEND.confirm
REJECT.indication(SOURCE, CAUSE)
SEND.request
to/from incoming RMESE user
SEND.indication
REJECT.indication(SOURCE)
SEND.response
REJECT.request(CAUSE)
RequestMultiplexEntry
RequestMultiplexEntryRelease
RequestMultiplexEntryAck
RequestMultiplexEntryReject
RMESE outgoing
RMESE incoming
H.245_FC.32

Figure C.32/H.245 – Primitives and messages in the Request Multiplex Entry Signalling Entity

C.8.4.1 Primitive parameter default values

Where not explicitly stated in the SDL diagrams, the parameters of the indication and confirm primitives assume values as shown in Table C.31.

Table C.31/H.245 – Default primitive parameter values

Primitive	Parameter	Default value
REJECT.indication	SOURCE	USER
	CAUSE	null

C.8.4.2 Message field default values

Where not explicitly stated in the SDL diagrams, the message fields assume values as shown in Table C.32.

Table C.32/H.245 – Default message field values

Message	Field	Default value
RequestMultiplexEntry	multiplexTableEntryNumber	out_ENUM
RequestMultiplexEntryAck	multiplexTableEntryNumber	in_ENUM
RequestMultiplexEntryReject	multiplexTableEntryNumber	in_ENUM
	cause	REJECT.request(CAUSE)
RequestMultiplexEntryRelease	multiplexTableEntryNumber	out_ENUM

C.8.4.3 SDLs

The outgoing RMESE and the incoming RMESE procedures are expressed in SDL form in Figures C.33 and C.34, respectively.

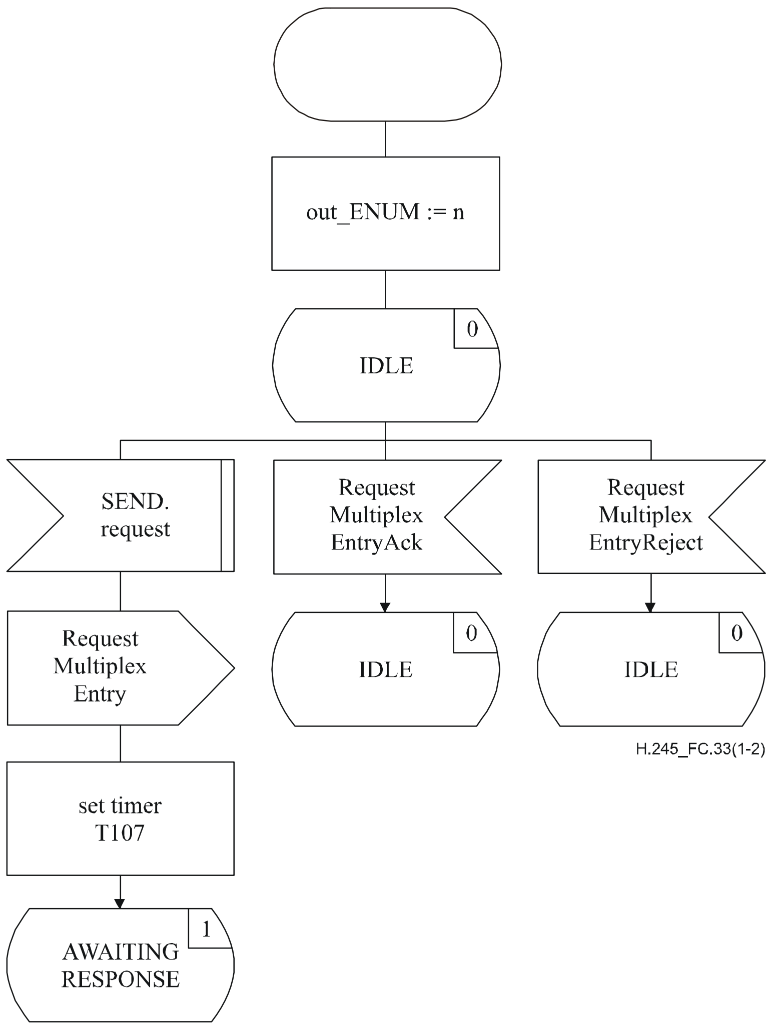


Figure C.33/H.245 – Outgoing RMESE SDL ***(sheet 1 of 2)***

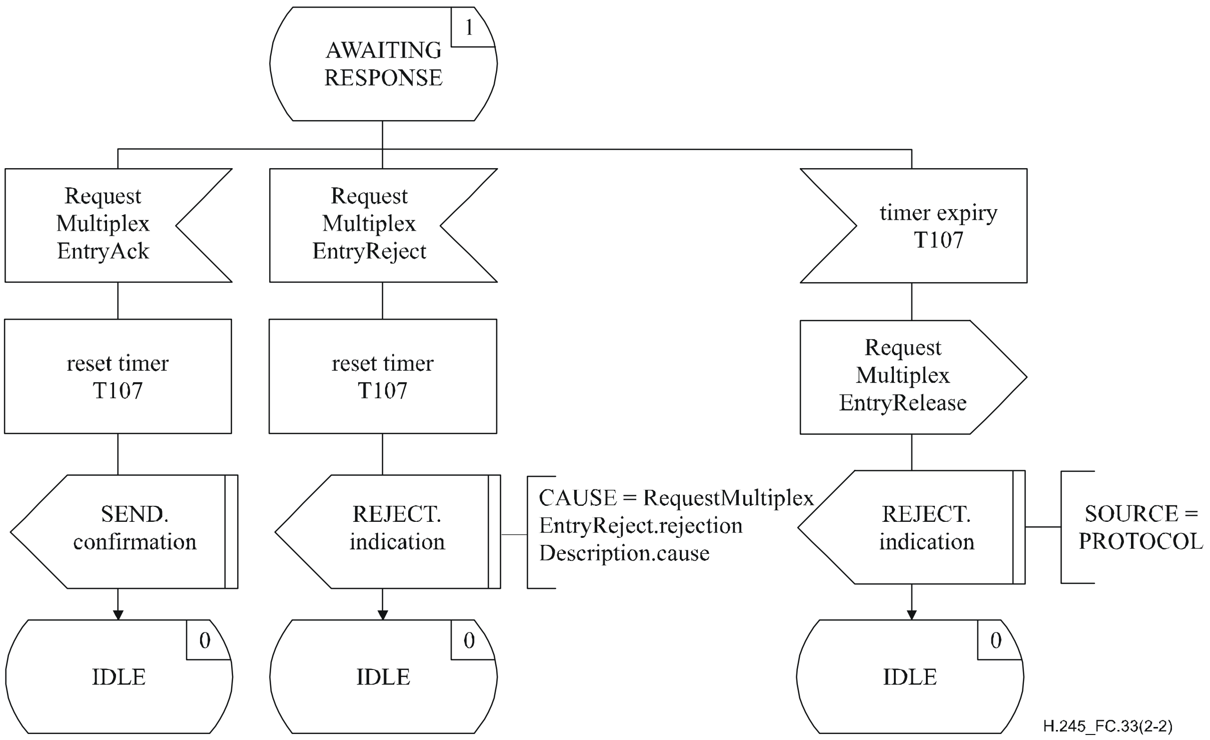


Figure C.33/H.245 – Outgoing RMESE SDL ***(sheet 2 of 2)***

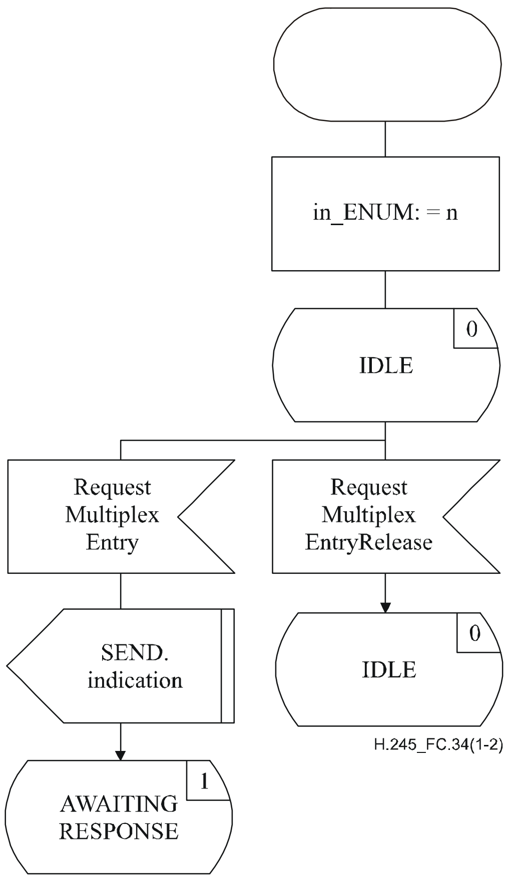


Figure C.34/H.245 – Incoming RMESE SDL ***(sheet 1 of 2)***

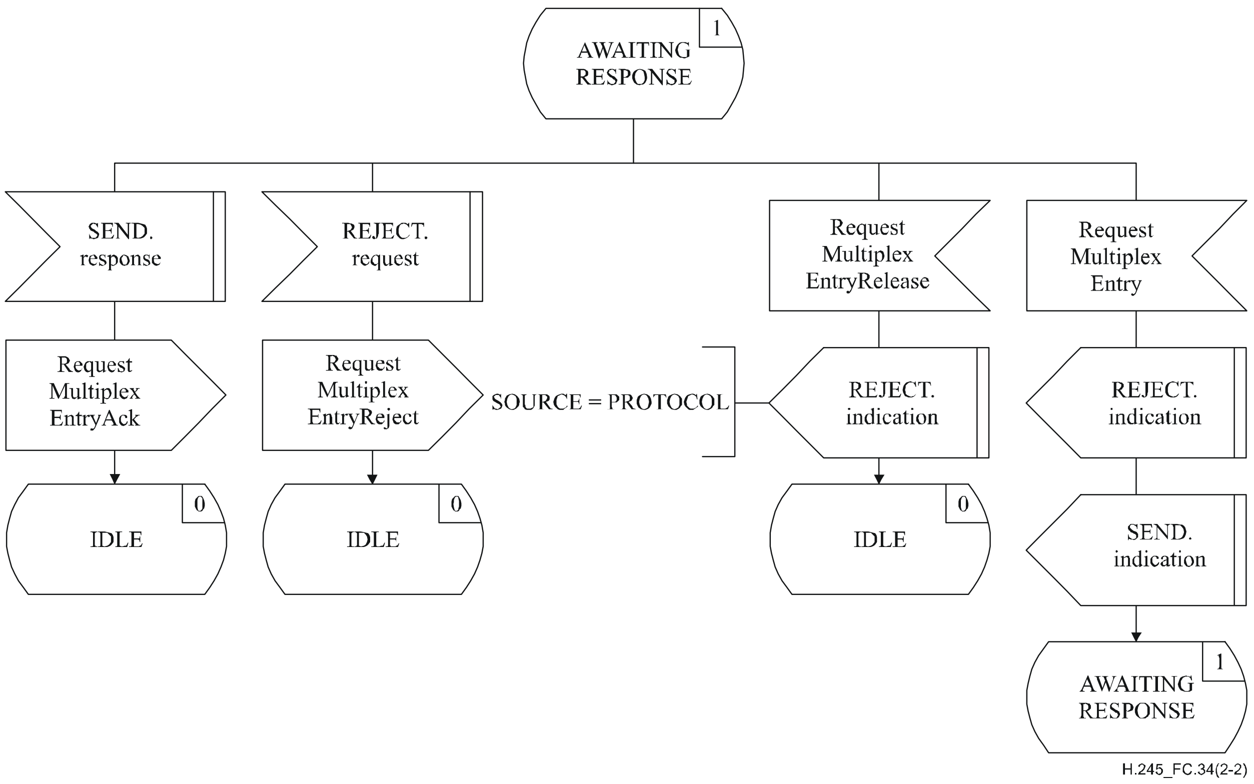


Figure C.34/H.245 – Incoming RMESE SDL ***(sheet 2 of 2)***

C.9 Mode Request procedures

C.9.1 Introduction

The procedures described here allow a terminal to request a remote terminal to use a particular mode of operation in its transmit direction. The procedures are referred to here as the Mode Request Signalling Entity (MRSE). Procedures are specified in terms of primitives and states at the interface between the MRSE and the MRSE user. Protocol information is transferred to the peer MRSE via relevant messages defined in Annex A. There is an outgoing MRSE and an incoming MRSE. At each of the outgoing and incoming ends there is one instance of the MRSE per call.

A terminal that answers such a response positively, that is, by issuing the TRANSFER.response primitive, shall initiate the logical channel signalling procedures to establish the appropriate mode of transmission as soon as possible.

If the currently valid capabilities received from the remote terminal contain one or more transmission capabilities, a terminal may select a mode that it prefers to have transmitted to it by performing the Mode Request procedures. A terminal whose currently valid capabilities contain one or more transmission capabilities and which is in receipt of such a request, should comply with the request.

A mode request shall not be sent to a terminal whose currently valid capabilities contain no transmission capabilities, that is, the terminal does not wish to, and shall not, be remotely controlled. If such a terminal does however receive a mode request, it may comply.

A terminal that receives multipointModeCommand shall comply with all received mode requests, until the command is cancelled by receipt of cancelMultipointModeCommand. A mode request may be sent to a terminal whose currently valid capabilities contain no transmission capabilities when multipointModeCommand has previously been sent.

The requested mode may include channels which are already open. For example, if a channel for G.723.1 was currently open and a terminal wished to receive an additional G.728 channel, it would send a mode request containing both the G.723.1 and the G.728 channel. If the G.723.1 channel request were absent, this would indicate that G.723.1 was no longer desired.

When the logicalChannelNumber parameter is present, the request refers only to the indicated logical channel, which shall be in the open state, and requests that the mode of the indicated logical channel be changed to the specified mode.

NOTE – Unless the logicalChannelNumber parameter is present, the request mode description specifies a complete mode. If, for example, video is currently being transmitted and a mode request is received that does not include any specification for video, then this requests video transmission to stop.

Where one source is feeding several receivers it may be unable to respond to any received signals such as requests to transmit in a particular mode.

The following text provides an overview of the operation of the MRSE protocol. In the case of any discrepancy between this and the formal specification, the formal specification will supersede.

C.9.1.1 Protocol overview – Outgoing MRSE

A mode request procedure is initiated when the TRANSFER.request primitive is issued by the user at the outgoing MRSE. A RequestMode message is sent to the peer incoming MRSE, and timer T109 is started. If a RequestModeAck message is received in response to the RequestMode message then timer T109 is stopped and the user is informed with the TRANSFER.confirm primitive that the mode request was successful. If however a RequestModeReject message is received in response to the RequestMode message then timer T109 is stopped and the user is informed with the REJECT.indication primitive that the peer MRSE user has refused to accept the mode request.

If timer T109 expires, then the outgoing MRSE user is informed with the REJECT.indication primitive and a RequestModeRelease message is sent.

Only RequestModeAck and RequestModeReject messages which are in response to the most recent RequestMode message are accepted. Messages in response to earlier RequestMode messages are ignored.

A new mode request procedure may be initiated with the TRANSFER.request primitive by the user at the outgoing MRSE before a RequestModeAck or a RequestModeReject message has been received.

C.9.1.2 Protocol overview – Incoming MRSE

When a RequestMode message is received at the incoming MRSE, the user is informed of the mode request with the TRANSFER.indication primitive. The incoming MRSE user signals acceptance of the mode request by issuing the TRANSFER.response primitive, and a RequestModeAck message is sent to the peer outgoing MRSE. The incoming MRSE user signals rejection of the mode request by issuing the REJECT.request primitive, and a RequestModeReject message is sent to the peer outgoing MRSE.

A new RequestMode message may be received before the incoming MRSE user has responded to an earlier RequestMode message. The incoming MRSE user is informed with the REJECT.indication primitive, followed by the TRANSFER.indication primitive, and the incoming MRSE user responds to the new multiplex table entry.

If a RequestModeRelease message is received before the incoming MRSE user has responded to an earlier RequestMode message, then the incoming MRSE user is informed with the REJECT.indication, and the earlier mode request is discarded.

C.9.2 Communication between MRSE and MRSE user

C.9.2.1 Primitives between MRSE and MRSE user

Communication between the MRSE and MRSE user is performed using the primitives shown in Table C.33.

Table C.33/H.245 – Primitives and parameters

Generic name	Type			
	request	indication	response	confirm
TRANSFER	MODE-ELEMENT	MODE-ELEMENT	MODE-PREF	MODE-PREF
REJECT	CAUSE	SOURCE CAUSE	not defined (Note)	not defined
NOTE – "not defined" means that this primitive is not defined.				

C.9.2.2 Primitive definition

The definition of these primitives is as follows:

a) The TRANSFER primitives are used for the transfer of the mode request.

b) The REJECT primitives are used to reject a mode request.

C.9.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.33 is as follows:

a) The MODE-ELEMENT parameter specifies a mode element. This parameter is mapped to the requestedModes field of the RequestMode message and is carried transparently from the outgoing MRSE user to the incoming MRSE user. This parameter is mandatory. There may be multiple MODE-ELEMENTS associated with the TRANSFER primitives.

b) The MODE-PREF parameter informs the user as to whether the most preferred mode requested will be used or not. This parameter is mapped to the response field of the RequestModeAck message and carried transparently from the incoming RMSE user to the outgoing RMSE user. It has two values: "MOST-PREFERRED" and "LESS-PREFERRED".

c) The SOURCE parameter indicates the source of the REJECT.indication primitive. The SOURCE parameter has the value of "USER" or "PROTOCOL". The latter case may occur as the result of a timer expiry.

d) The CAUSE parameter indicates the reason for refusal to reject a mode request. The CAUSE parameter is not present when the SOURCE parameter indicates "PROTOCOL".

C.9.2.4 MRSE states

The following states are used to specify the allowed sequence of primitives between the MRSE and the MRSE user. The states for an outgoing MRSE are:

State 0: IDLE

The MRSE is idle.

State 1: AWAITING RESPONSE

The MRSE is waiting for a response from the remote MRSE.

The states for an incoming MRSE are:

State 0: IDLE

The MRSE is idle.

State 1: AWAITING RESPONSE

The MRSE is waiting for a response from the MRSE user.

C.9.2.5 State transition diagram

The allowed sequence of primitives between the MRSE and the MRSE user is defined here. The allowed sequences are specified separately for each of an outgoing MRSE and an incoming MRSE, as shown in Figures C.35 and C.36, respectively.

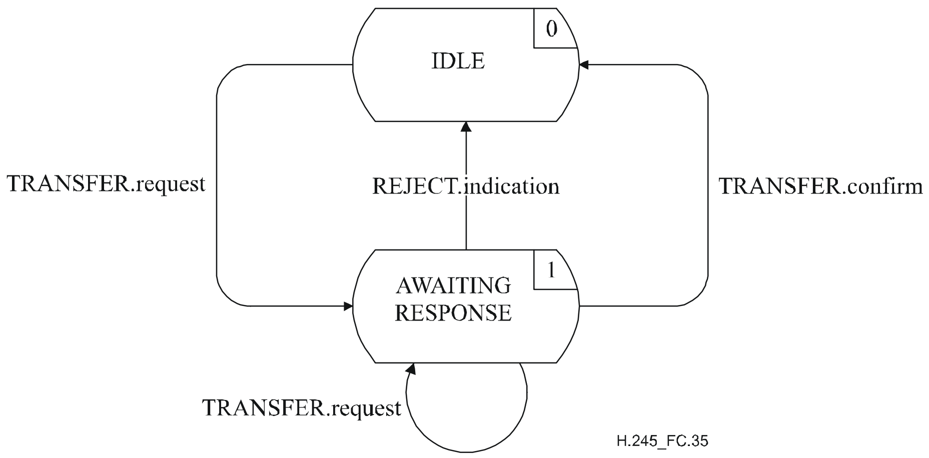


Figure C.35/H.245 – State transition diagram for sequence of primitives at outgoing MRSE

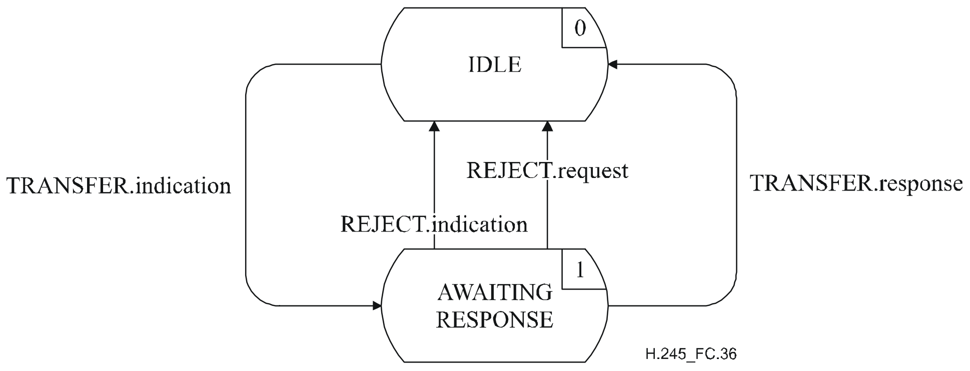


Figure C.36/H.245 – State transition diagram for sequence of primitives at incoming MRSE

C.9.3 Peer-to-peer MRSE communication

C.9.3.1 Messages

Table C.34 shows the MRSE messages and fields, defined in Annex A, which are relevant to the MRSE protocol.

Table C.34/H.245 – MRSE message names and fields

Function	Message	Direction	Field
mode request	RequestMode	O → I (Note)	sequenceNumber requestedModes
	RequestModeAck	O ← I	sequenceNumber response
	RequestModeReject	O ← I	sequenceNumber cause
reset	RequestModeRelease	O → I	–
NOTE – Direction: O – Outgoing, I – Incoming.			

C.9.3.2 MRSE state variables

The following state variable is defined at the outgoing MRSE:

out_SQ

This state variable is used to indicate the most recent RequestMode message. It is incremented by one and mapped to the RequestMode message sequenceNumber field before transmission of the RequestMode message. Arithmetic performed on out_SQ is modulo 256.

The following state variable is defined at the incoming MRSE:

in_SQ

This state variable is used to store the value of the sequenceNumber field of the most recently received RequestMode message. The RequestModeAck and RequestModeReject messages have their sequenceNumber fields set to the value of in_SQ, before being sent to the peer MRSE.

C.9.3.3 MRSE timers

The following timer is specified for the outgoing MRSE:

T109

This timer is used during the AWAITING RESPONSE state. It specifies the maximum time during which no RequestModeAck or RequestModeReject message may be received.

C.9.4 MRSE procedures

Figure C.37 summarizes the MRSE primitives and their parameters, and messages, for each of the outgoing and incoming MRSE.

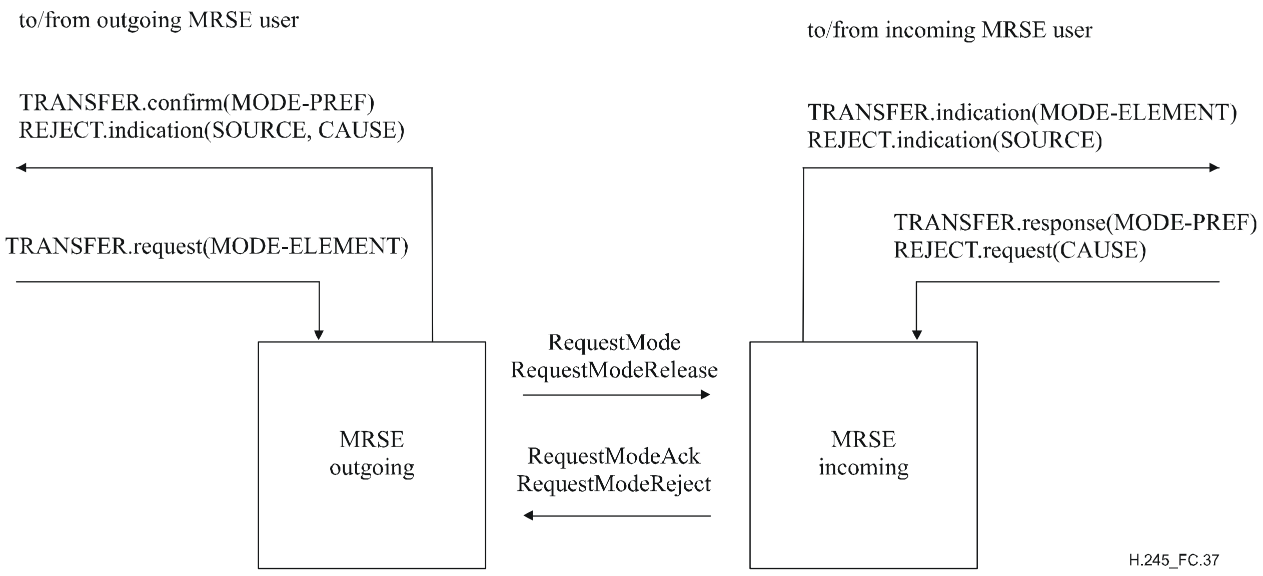

to/from outgoing MRSE user
TRANSFER.confirm(MODE-PREF)
REJECT.indication(SOURCE, CAUSE)
TRANSFER.request(MODE-ELEMENT)
MRSE outgoing
RequestMode
RequestModeRelease
RequestModeAck
RequestModeReject
to/from incoming MRSE user
TRANSFER.indication(MODE-ELEMENT)
REJECT.indication(SOURCE)
TRANSFER.response(MODE-PREF)
REJECT.request(CAUSE)
MRSE incoming
H.245_FC.37

Figure C.37/H.245 – Primitives and messages in the Mode Request Signalling Entity

C.9.4.1 Primitive parameter default values

Where not explicitly stated in the SDL diagrams, the parameters of the indication and confirm primitives assume values as shown in Table C.35.

Table C.35/H.245 – Default primitive parameter values

Primitive	Parameter	Default value
TRANSFER.indication	MODE-ELEMENT	RequestMode.requestedModes
TRANSFER.confirm	MODE-PREF	RequestModeAck.response
REJECT.indication	SOURCE CAUSE	USER null

C.9.4.2 Message field default values

Where not explicitly stated in the SDL diagrams, the message fields assume values as shown in Table C.36.

Table C.36/H.245 – Default message field values

Message	Field	Default value
RequestMode	sequenceNumber requestedModes	out_SQ TRANSFER.request(MODE-ELEMENT)
RequestModeAck	sequenceNumber	in_SQ
	response	TRANSFER.response(MODE-PREF)
RequestModeReject	sequenceNumber cause	in_SQ REJECT.request(CAUSE)
RequestModeRelease	–	–

C.9.4.3 SDLs

The outgoing MRSE and the incoming MRSE procedures are expressed in SDL form in Figures C.38 and C.39, respectively.

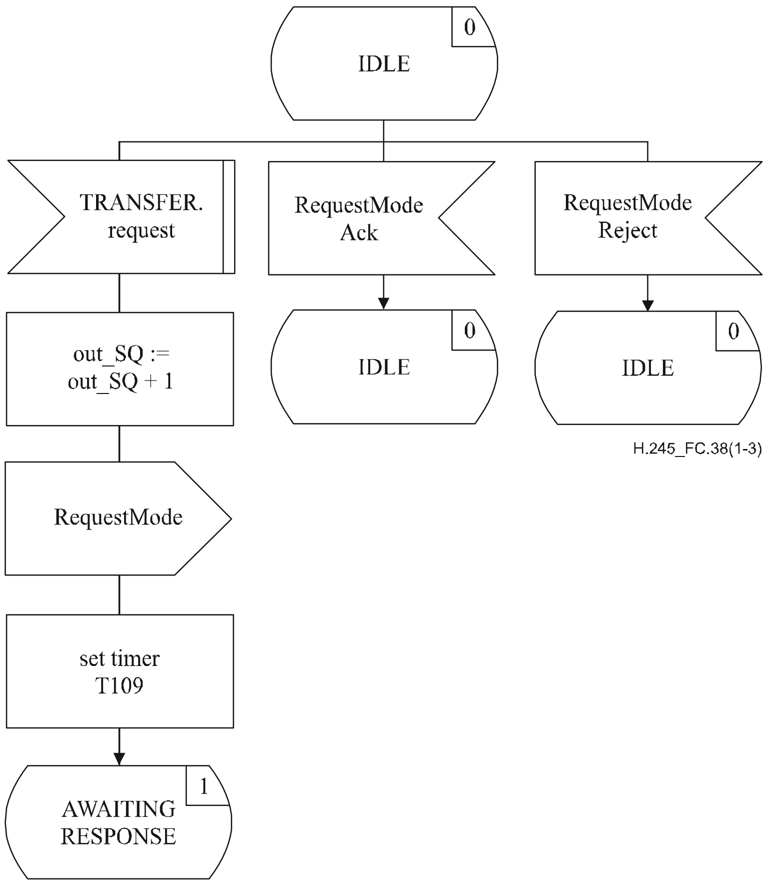


Figure C.38/H.245 – Outgoing MRSE SDL *(sheet 1 of 3)*

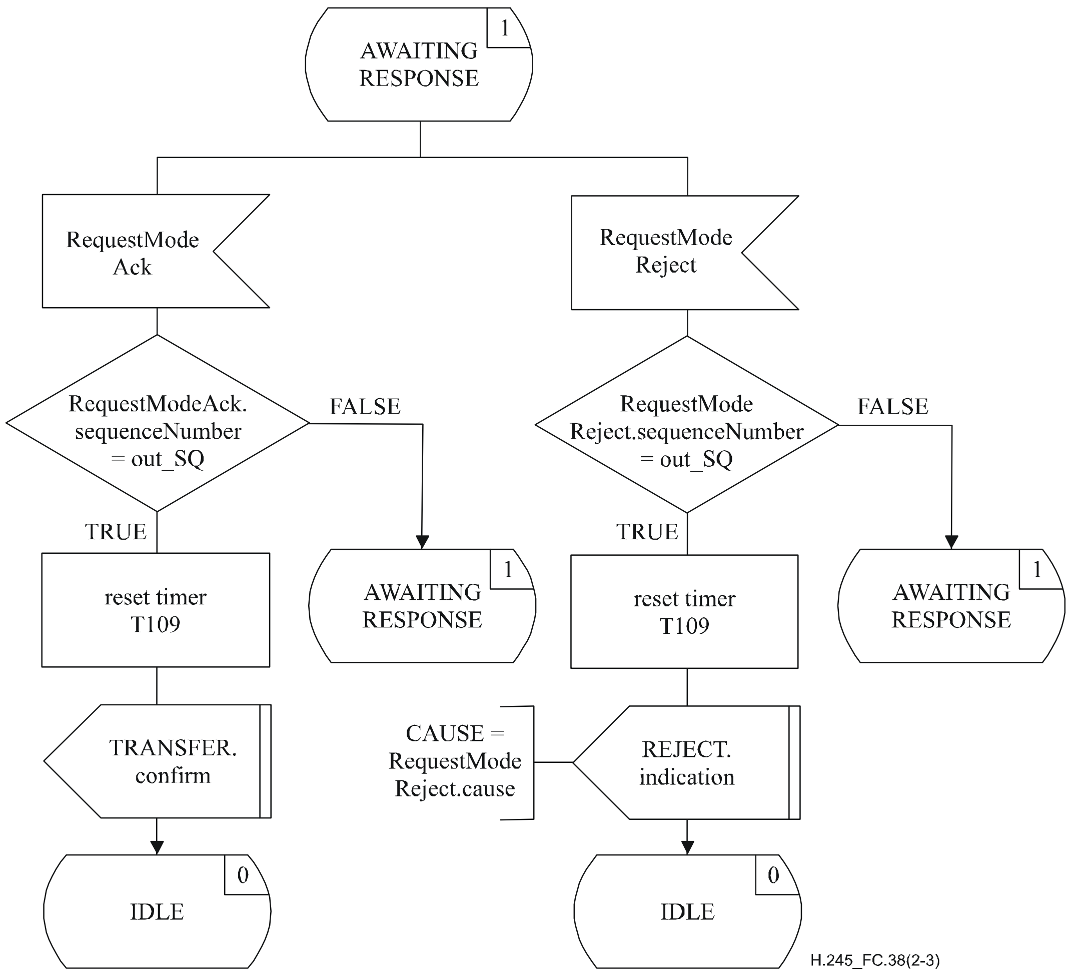


Figure C.38/H.245 – Outgoing MRSE SDL ***(sheet 2 of 3)***

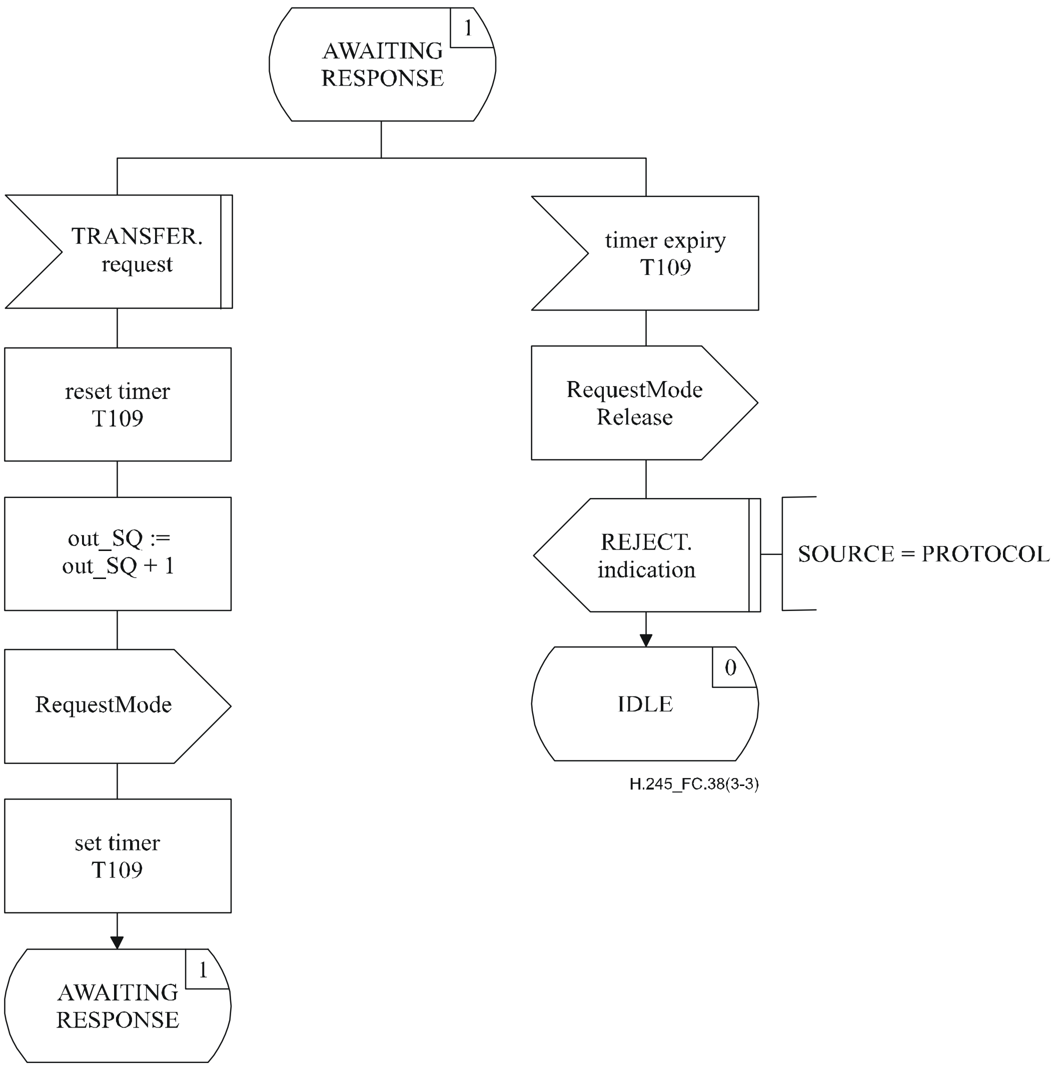


Figure C.38/H.245 – Outgoing MRSE SDL *(sheet 3 of 3)*

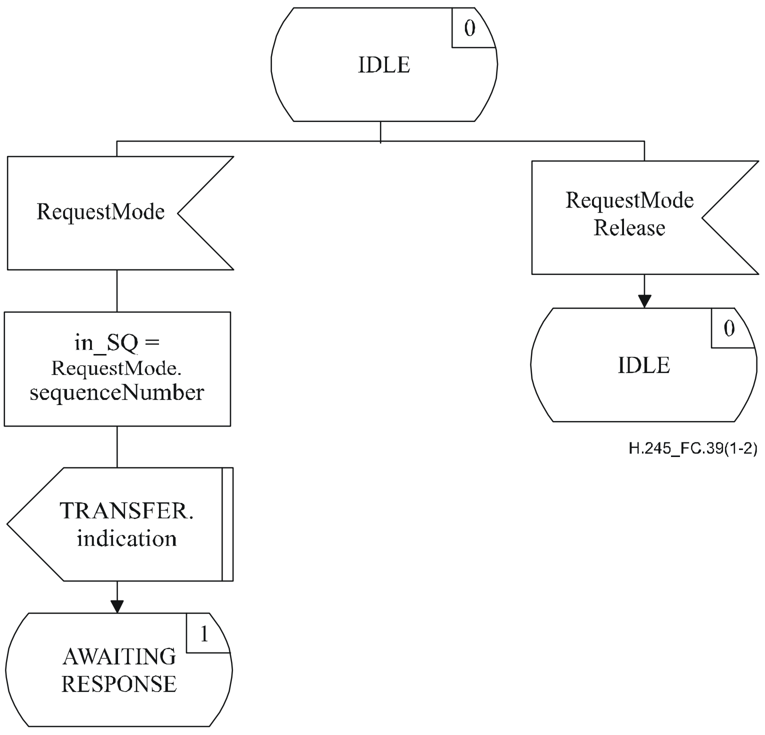


Figure C.39/H.245 – Incoming MRSE SDL ***(sheet 1 of 2)***

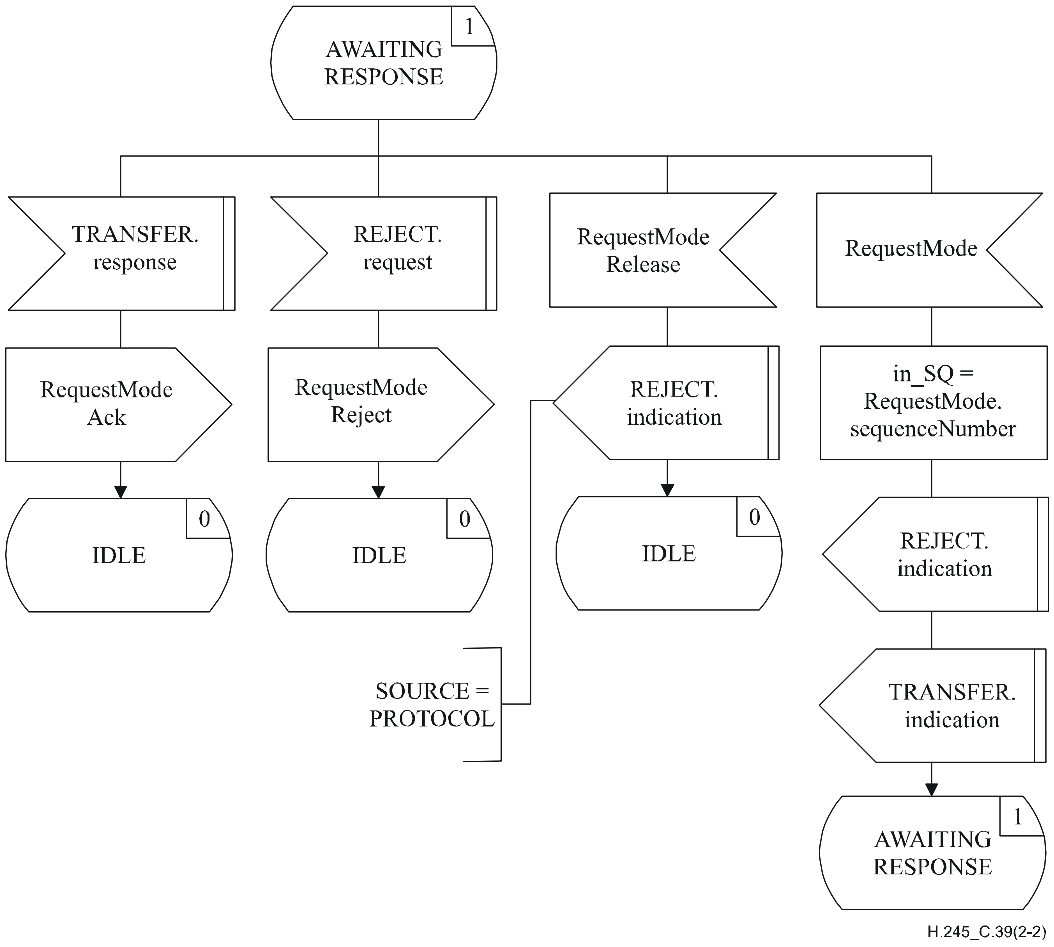


Figure C.39/H.245 – Incoming MRSE SDL ***(sheet 2 of 2)***

C.10 Round-trip delay procedures

C.10.1 Introduction

Procedures are described here that allow the determination of the round-trip delay between two communicating terminals. This function also enables a H.245 user to determine if the peer H.245 protocol entity is still alive.

The function described here is referred to as the Round-Trip Delay Signalling Entity (RTDSE). Procedures are specified in terms of primitives and states at the interface between the RTDSE and the RTDSE user. There is one instance of the RTDSE in each terminal. Any terminal may perform the round-trip delay determination.

The following text provides an overview of the operation of the RTDSE protocol. In the case of any discrepancy between this and the formal specification, the formal specification will supersede.

C.10.1.1 Protocol overview – RTDSE

A round-trip delay determination procedure is initiated when the TRANSFER.request primitive is issued by the RTDSE user. A RoundTripDelayRequest message is sent to the peer RTDSE, and timer T105 is started. If a RoundTripDelayResponse message is received in response to the RoundTripDelayRequest message then timer T105 is stopped and the user is informed with the TRANSFER.confirm primitive of the round-trip delay, which is the value of timer T105.

If a RoundTripDelayRequest message is at any time received from the peer RTDSE, a RoundTripDelayResponse message is immediately sent to the peer RTDSE.

If timer T105 expires, then the RTDSE user is informed with the EXPIRY.indication primitive.

Only the RoundTripDelayResponse message which is in response to the most recent RoundTripDelayRequest message is accepted. Messages in response to earlier RoundTripDelayRequest messages are ignored.

A new round-trip delay determination procedure may be initiated with the TRANSFER.request primitive by the RTDSE user before a RoundTripDelayResponse message has been received.

C.10.2 Communication between the RTDSE and the RTDSE user

C.10.2.1 Primitives between the RTDSE and the RTDSE user

Communication between the RTDSE and RTDSE user is performed using the primitives shown in Table C.37. These primitives are for the purpose of defining RTDSE procedures and are not meant to specify or constrain implementation.

Table C.37/H.245 – Primitives and parameters

Generic name	Type			
	request	**indication**	**response**	**confirm**
TRANSFER	– (Note 1)	not defined (Note 2)	not defined	DELAY
EXPIRY	not defined	–	not defined	not defined
NOTE 1 – "–" means no parameters. NOTE 2 – "not defined" means that this primitive is not defined.				

C.10.2.2 Primitive definition

The definition of these primitives is as follows:

a) The TRANSFER primitive is used to request, and report upon, the round-trip delay determination.

b) The EXPIRY primitive indicates that no response has been received from the peer terminal.

C.10.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.37 is as follows:

a) The DELAY parameter returns the measured round-trip delay.

C.10.2.4 RTDSE states

The following states are used to specify the allowed sequence of primitives between the RTDSE and the RTDSE user.

State 0: IDLE

There is no RTDSE transfer in progress.

State 1: AWAITING RESPONSE

The RTDSE user has requested the measurement of the round-trip delay. A response from the peer RTDSE is awaited.

C.10.2.5 State transition diagram

The allowed sequence of primitives between the RTDSE and the RTDSE user is defined here. The allowed sequences are shown in Figure C.40.

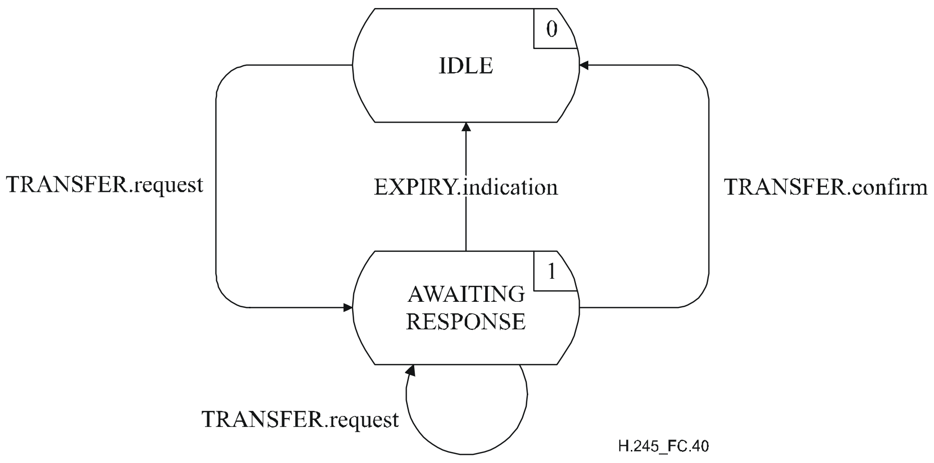


Figure C.40/H.245 – State transition diagram for sequence of primitives at RTDSE

C.10.3 Peer-to-peer RTDSE communication

C.10.3.1 Messages

Table C.38 shows the RTDSE messages and fields, defined in Annex A, which are relevant to the RTDSE protocol.

Table C.38/H.245 – RTDSE message names and fields

Function	Message	Field
transfer	RoundTripDelayRequest	sequenceNumber
	RoundTripDelayResponse	sequenceNumber

C.10.3.2 RTDSE state variables

The following RTDSE state variable is defined:

out_SQ

This state variable is used to indicate the most recent RoundTripDelayRequest message. It is incremented by one and mapped to the RoundTripDelayRequest message sequenceNumber field before transmission of an RoundTripDelayRequest message. Arithmetic performed on out_SQ is modulo 256.

C.10.3.3 RTDSE timers

The following timer is specified for the RTDSE:

T105

This timer is used during the AWAITING RESPONSE state. It specifies the maximum time during which no RoundTripDelayResponse message may be received.

C.10.4 RTDSE procedures

C.10.4.1 Introduction

Figure C.41 summarizes the RTDSE primitives and their parameters, and messages.

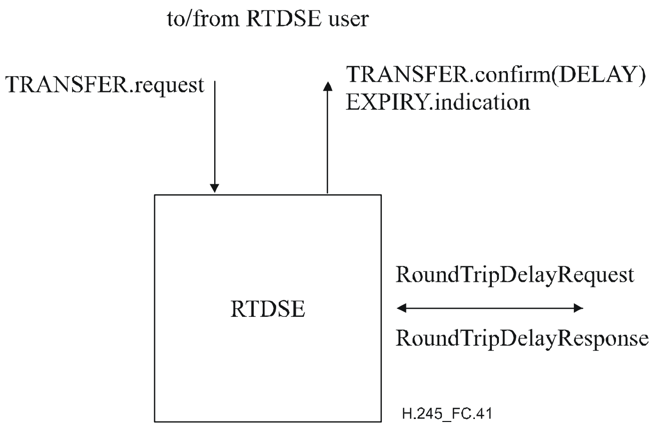


Figure C.41/H.245 – Primitives and messages in the RTDSE

C.10.4.2 Primitive parameter default values

Where not explicitly stated in the SDL diagrams, the parameters of the indication and confirm primitives assume values as shown in Table C.39.

Table C.39/H.245 – Default primitive parameter values

Primitive	Parameter	Default value
TRANSFER.confirm	DELAY	initial value of timer T105 minus value of timer T105
EXPIRY.indication	–	–
NOTE – Timers are defined to count down to zero. The DELAY parameter indicates the time that the timer has been running, and so has the value of the difference between the initial setting and the retained value of the timer.		

C.10.4.3 Message field default values

Where not explicitly stated in the SDL diagrams, the message fields assume values as shown in Table C.40.

Table C.40/H.245 – Default message field values

Message	Field	Default value
RoundTripDelayRequest	sequenceNumber	out_SQ
RoundTripDelayResponse	sequenceNumber	RoundTripDelayRequest.sequenceNumber

C.10.4.4 SDLs

The RTDSE procedures are expressed in SDL form in Figure C.42.

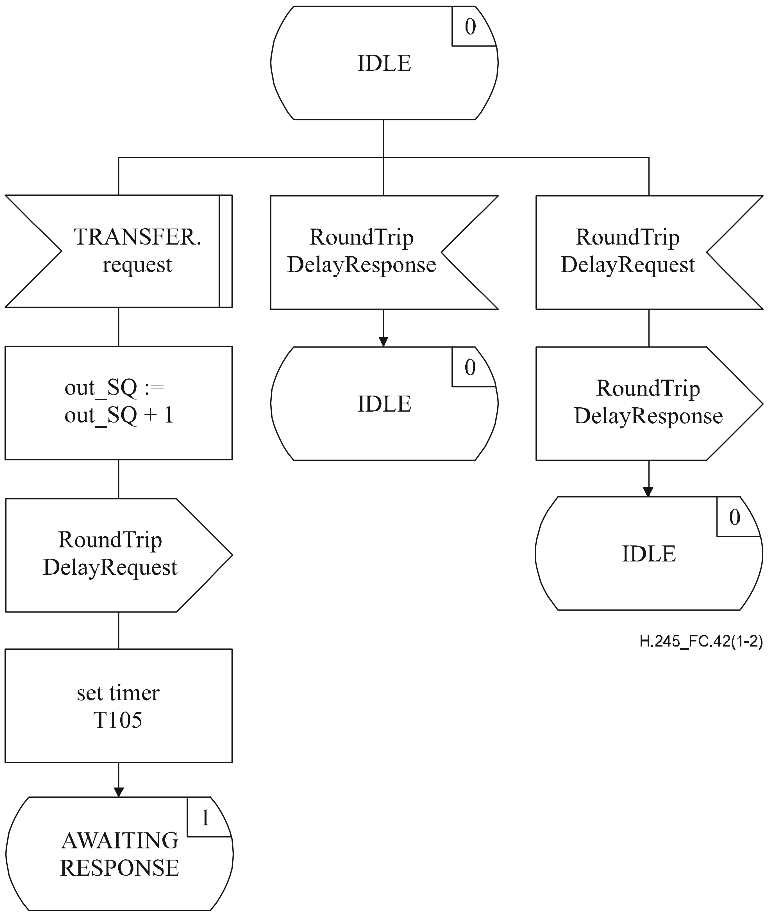


Figure C.42/H.245 – RTDSE SDL *(sheet 1 of 2)*

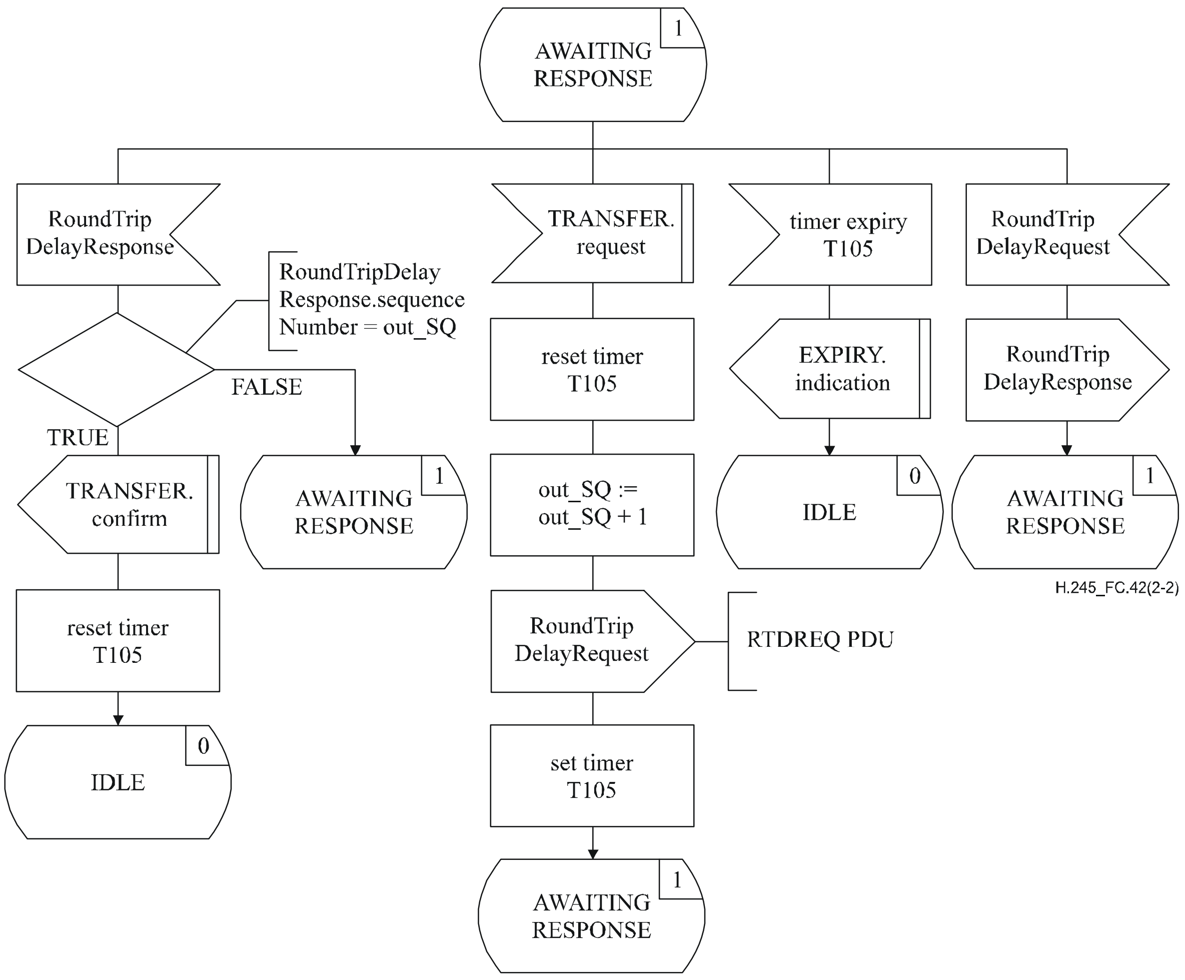


Figure C.42/H.245 – RTDSE SDL *(sheet 2 of 2)*

C.11 Maintenance Loop procedures

C.11.1 Introduction

The protocol specified here provides reliable operation of maintenance loops using acknowledged procedures.

The protocol specified here is referred to as the Maintenance Loop Signalling Entity (MLSE). Procedures are specified in terms of primitives at the interface between the MLSE and the MLSE user, and MLSE states. Protocol information is transferred to the peer MLSE via relevant messages defined in Annex A.

There is an outgoing MLSE and an incoming MLSE. At each of the outgoing and incoming sides there is one instance of the MLSE for each bidirectional logical channel, and one for the system loop. There is no connection between an incoming MLSE and an outgoing MLSE at one side, other than via primitives to and from the MLSE user. MLSE error conditions are reported.

The terminal that contains the incoming MLSE shall loop the appropriate data while it is in the LOOPED state, and not at any other time. The terminal that contains the outgoing MLSE shall be capable of receiving looped data while in any state, but while in the LOOPED state, should receive looped data only.

NOTE – The MaintenanceLoopOffCommand message applies to all MLSEs. It is always used to stop all maintenance loops.

The following text provides an overview of the operation of the MLSE protocol. In the case of discrepancy between this and the formal specification, the formal specification will supersede.

C.11.1.1 Protocol overview – Outgoing

The establishment of a maintenance loop is initiated when the LOOP.request primitive is issued by the user at the outgoing MLSE. An MaintenanceLoopRequest message is sent to the peer incoming MLSE, and timer T102 is started. If an MaintenanceLoopAck message is received in response to the MaintenanceLoopRequest message then timer T102 is stopped and the user is informed with the LOOP.confirm primitive that the maintenance loop has been successfully established. If however a MaintenanceLoopReject message is received in response to the MaintenanceLoopRequest message, then timer T102 is stopped and the user is informed with the RELEASE.indication primitive that the peer MLSE user has refused establishment of the maintenance loop.

If timer T102 expires in this period then the user is informed with the RELEASE.indication primitive, and a MaintenanceLoopOffCommand message is sent to the peer incoming MLSE. This will cancel all maintenance loops, and not just the one concerned with the particular MLSE.

A maintenance loop that has been successfully established may be cancelled when the RELEASE.request primitive is issued by the user at the outgoing MLSE. A MaintenanceLoopOffCommand message is sent to the peer incoming MLSE.

Before either of the MaintenanceLoopAck or MaintenanceLoopReject messages have been received in response to a previously sent MaintenanceLoopRequest message, the user at the outgoing MLSE may cancel the maintenance loop using the RELEASE.request primitive.

C.11.1.2 Protocol overview – Incoming

When a MaintenanceLoopRequest message is received at the incoming MLSE, the user is informed of the request to establish a maintenance loop with the LOOP.indication primitive. The incoming MLSE user signals acceptance of the request to establish the maintenance loop by issuing the LOOP.response primitive, and a MaintenanceLoopAck message is sent to the peer outgoing MLSE. The maintenance loop shall now be performed. The incoming MLSE user signals rejection of the request to establish the maintenance loop by issuing the RELEASE.request primitive, and a MaintenanceLoopReject message is sent to the peer outgoing MLSE.

A maintenance loop that has been successfully established may be cancelled when the MaintenanceLoopOffCommand message is received at the incoming MLSE. The incoming MLSE user is informed with the RELEASE.indication primitive.

C.11.2 Communication between the MLSE and the MLSE user

C.11.2.1 Primitives between the MLSE and the MLSE user

Communication between the MLSE and the MLSE user is performed using the primitives shown in Table C.41.

Table C.41/H.245 – Primitives and parameters

Generic name	Type			
	request	indication	response	confirm
LOOP	LOOP_TYPE	LOOP_TYPE	– (Note 1)	–
RELEASE	CAUSE	SOURCE CAUSE	not defined (Note 2)	not defined
ERROR	not defined	ERRCODE	not defined	not defined
NOTE 1 – "–" means no parameters. NOTE 2 – "not defined" means that this primitive does not exist.				

C.11.2.2 Primitive definition

The definition of these primitives is as follows:

a) The LOOP primitives are used to establish a maintenance loop.

b) The RELEASE primitives are used to cancel a maintenance loop.

c) The ERROR primitive reports MLSE errors to a management entity.

C.11.2.3 Parameter definition

The definition of the primitive parameters shown in Table C.41 is as follows:

a) The LOOP_TYPE parameter specifies the parameters associated with the maintenance loop. It has values of "SYSTEM", "MEDIA", and "LOGICAL_CHANNEL". This parameter, and the logical channel number, determine the value of the type field of the MaintenanceLoopRequest message which is then carried transparently to the peer MLSE user.

b) The SOURCE parameter indicates to the MLSE user the source of the maintenance loop release. The SOURCE parameter has the value of "USER" or "MLSE", indicating either the MLSE user, or the MLSE. The latter may occur as the result of a protocol error.

c) The CAUSE parameter indicates the reason as to why the peer MLSE user rejected a request to establish a maintenance loop. The CAUSE parameter is not present when the SOURCE parameter indicates "MLSE".

d) The ERRCODE parameter indicates the type of MLSE error. Table C.45 shows the allowed values of the ERRCODE parameter.

C.11.2.4 MLSE states

The following states are used to specify the allowed sequence of primitives between the MLSE and the MLSE user, and the exchange of messages between peer MLSEs. The states are specified separately for each of an outgoing MLSE and an incoming MLSE. The states for an outgoing MLSE are:

State 0: NOT LOOPED

There is no maintenance loop.

State 1: AWAITING RESPONSE

The outgoing MLSE is waiting to establish a maintenance loop with a peer incoming MLSE.

State 2: LOOPED

The MLSE peer-to-peer maintenance loop has been established. All data received on the appropriate channel should be looped data.

The states for an incoming MLSE are:

State 0: NOT LOOPED

There is no maintenance loop.

State 1: AWAITING RESPONSE

The incoming MLSE is waiting to establish a maintenance loop with a peer outgoing MLSE. The appropriate data shall not be looped.

State 2: LOOPED

An MLSE peer-to-peer maintenance loop has been established. All data received on the appropriate channel shall be looped.

C.11.2.5 State transition diagram

The allowed sequence of primitives between the MLSE and the MLSE user is defined here. The allowed sequence of primitives relates to states of the MLSE as viewed from the MLSE user. The allowed sequences are specified separately for each of an outgoing MLSE and an incoming MLSE, as shown in Figures C.43 and C.44, respectively.

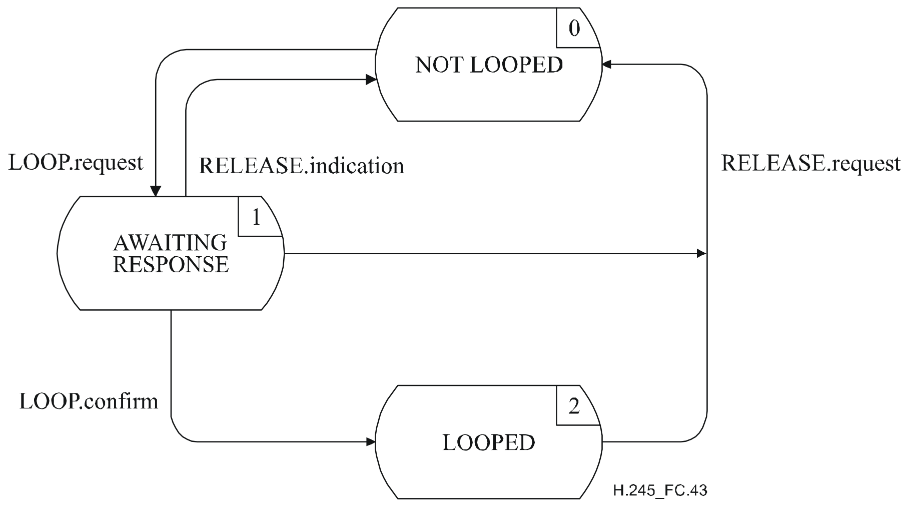


Figure C.43/H.245 – State transition diagram for sequence of primitives at outgoing MLSE

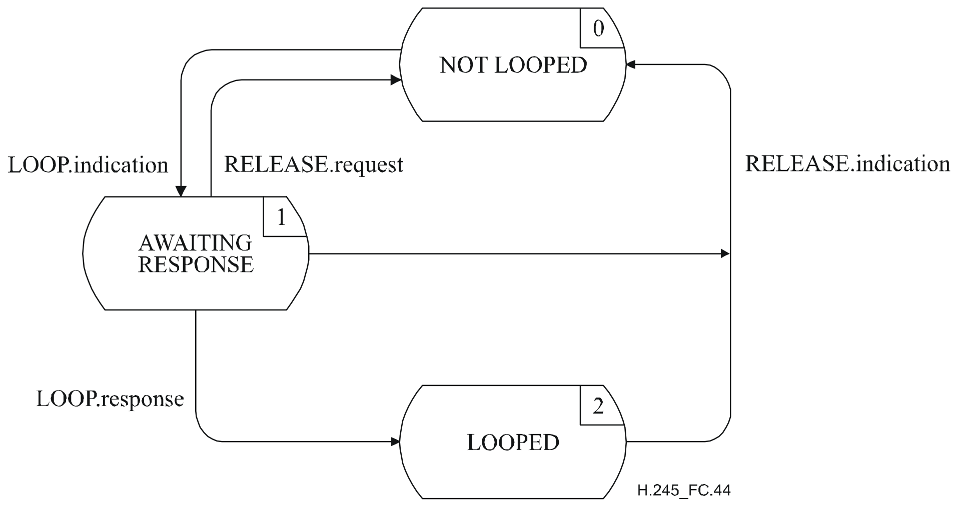


Figure C.44/H.245 – State transition diagram for sequence of primitives at incoming MLSE

C.11.3 Peer-to-peer MLSE communication

C.11.3.1 MLSE messages

Table C.42 shows the MLSE messages and fields, defined in Annex A, which are relevant to the MLSE protocol.

Table C.42/H.245 – MLSE message names and fields

Function	Message	Direction	Field
establish	MaintenanceLoopRequest	O → I (Note)	type
	MaintenanceLoopAck	O ← I	type
	MaintenanceLoopReject	O ← I	type cause
release	MaintenanceLoopOffCommand	O → I	–
NOTE – Direction: O – Outgoing, I – Incoming.			

C.11.3.2 MLSE state variables

The following state variable is defined at the outgoing MLSE:

out_MLN

This state variable distinguishes between outgoing MLSEs. It is initialized at outgoing MLSE initialization. The value of out_MLN is used to set the type field of MaintenanceLoopRequest messages sent from an outgoing MLSE.

The following state variables are defined at the incoming MLSE:

in_MLN

This state variable distinguishes between incoming MLSEs. It is initialized at incoming MLSE initialization. For MaintenanceLoopRequest messages received at an incoming MLSE, the message type field value is consistent with the value of in_MLN.

in_TYPE

This state variable stores the value of LOOP_TYPE when the MaintenanceLoopRequest is received. This state variable assists in setting the value of the type field in the MaintenanceLoopAck message.

C.11.3.3 MLSE timers

The following timer is specified for the outgoing MLSE:

T102

This timer is used during the AWAITING RESPONSE state. It specifies the maximum allowed time during which no MaintenanceLoopAck or MaintenanceLoopReject message may be received.

C.11.4 MLSE procedures

C.11.4.1 Introduction

Figure C.45 summarizes the primitives and their parameters, and the messages, for each of the outgoing and incoming MLSE.

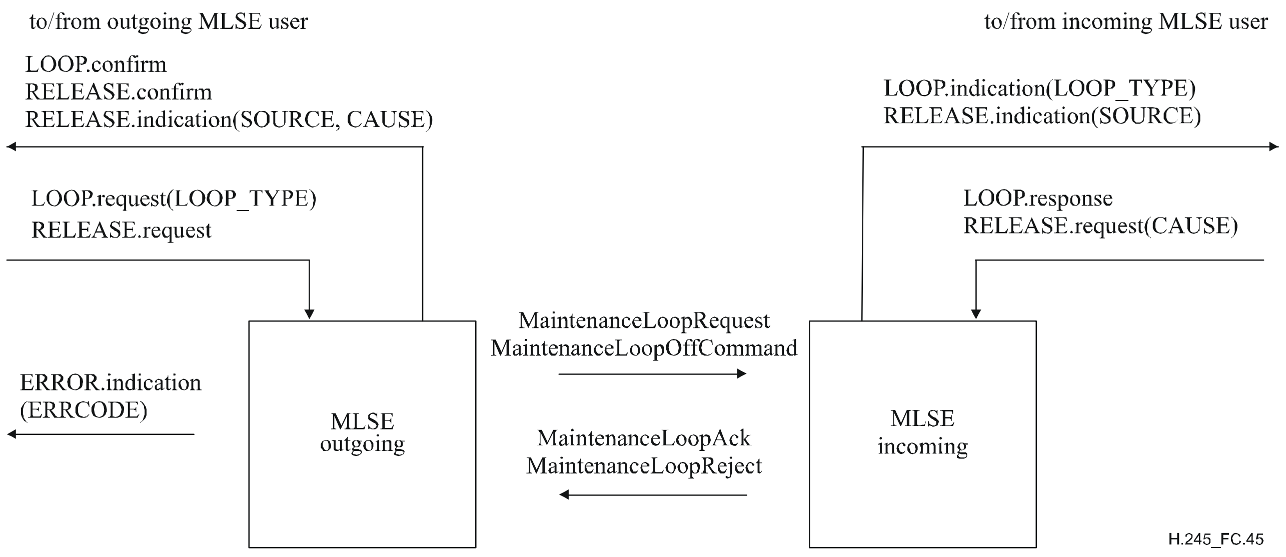


Figure C.45/H.245 – Primitives and messages in the Maintenance Loop Signalling Entity

C.11.4.2 Primitive parameter default values

Where not explicitly stated in the SDL diagrams, the parameters of the indication and confirm primitives assume values as shown in Table C.43.

Table C.43/H.245 – Default primitive parameter values

Primitive	Parameter	Default value (Note)
LOOP.indication	LOOP_TYPE	MaintenanceLoopRequest.type
RELEASE.indication	SOURCE CAUSE	USER MaintenanceLoopReject.cause
NOTE – A primitive parameter shall be coded as null, if an indicated message field is not present in the message.		

C.11.4.3 Message field default values

Where not explicitly stated in the SDL diagrams, the message fields assume values as shown in Table C.44.

Table C.44/H.245 – Default message field values

Message	Field	Default value (Note 1)
MaintenanceLoopRequest	type	LOOP.request(LOOP_TYPE) and out_MLN (Note 2)
MaintenanceLoopAck	type	in_LOOP and in_MLN (Note 3)
MaintenanceLoopReject	type cause	in_LOOP and in_MLN (Note 3) RELEASE.request(CAUSE)
MaintenanceLoopOffCommand	–	–
NOTE 1 – A message field shall not be coded, if the corresponding primitive parameter is null, i.e., not present. NOTE 2 – The value of the type field is derived from the LOOP_TYPE parameter and the logical channel number. NOTE 3 – The value of the type field is derived from the in_LOOP and in_MLN state variables.		

C.11.4.4 ERRCODE parameter values

The ERRCODE parameter of the ERROR.indication primitive indicates a particular error condition. Table C.45 shows the values that the ERRCODE parameter may take at the outgoing MLSE. There is no ERROR.indication primitive associated with the incoming MLSE.

Table C.45/H.245 – ERRCODE parameter values at outgoing MLSE

Error type	Error code	Error condition	State
inappropriate message	A	MaintenanceLoopAck	LOOPED
no response from peer MLSE	B	timer T102 expiry	AWAITING RESPONSE

C.11.4.5 SDLs

The outgoing MLSE and the incoming MLSE procedures are expressed in SDL form in Figures C.46 and C.47, respectively.

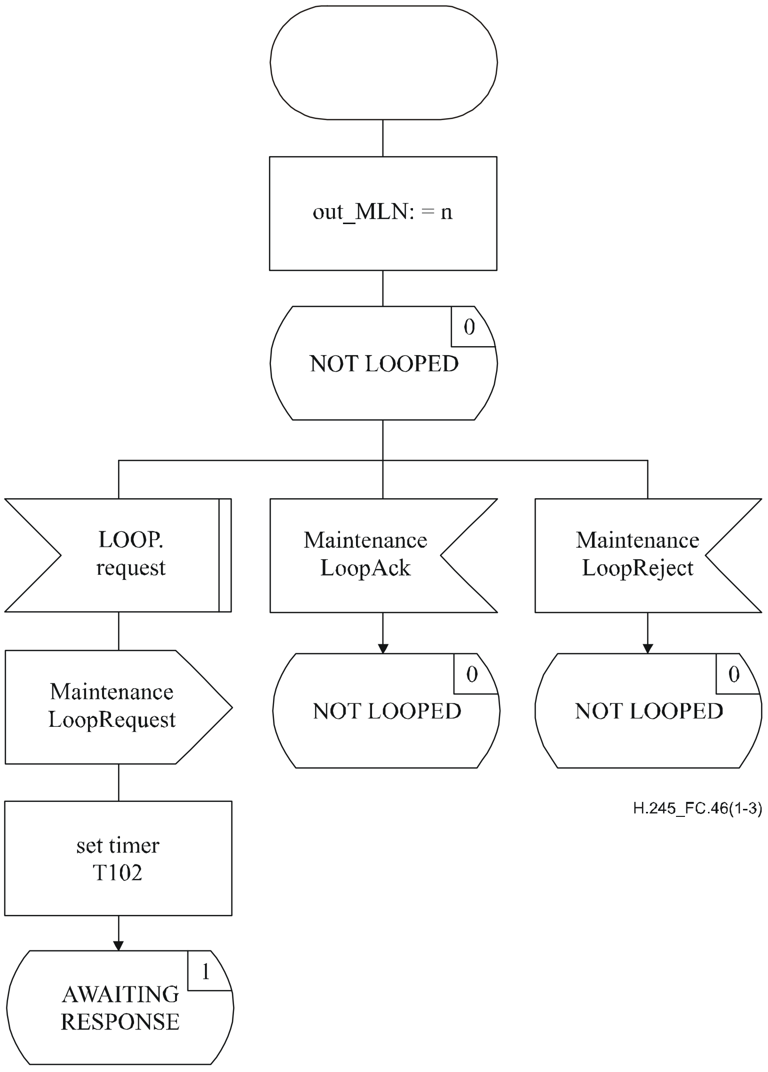


Figure C.46/H.245 – Outgoing MLSE SDL *(sheet 1 of 3)*

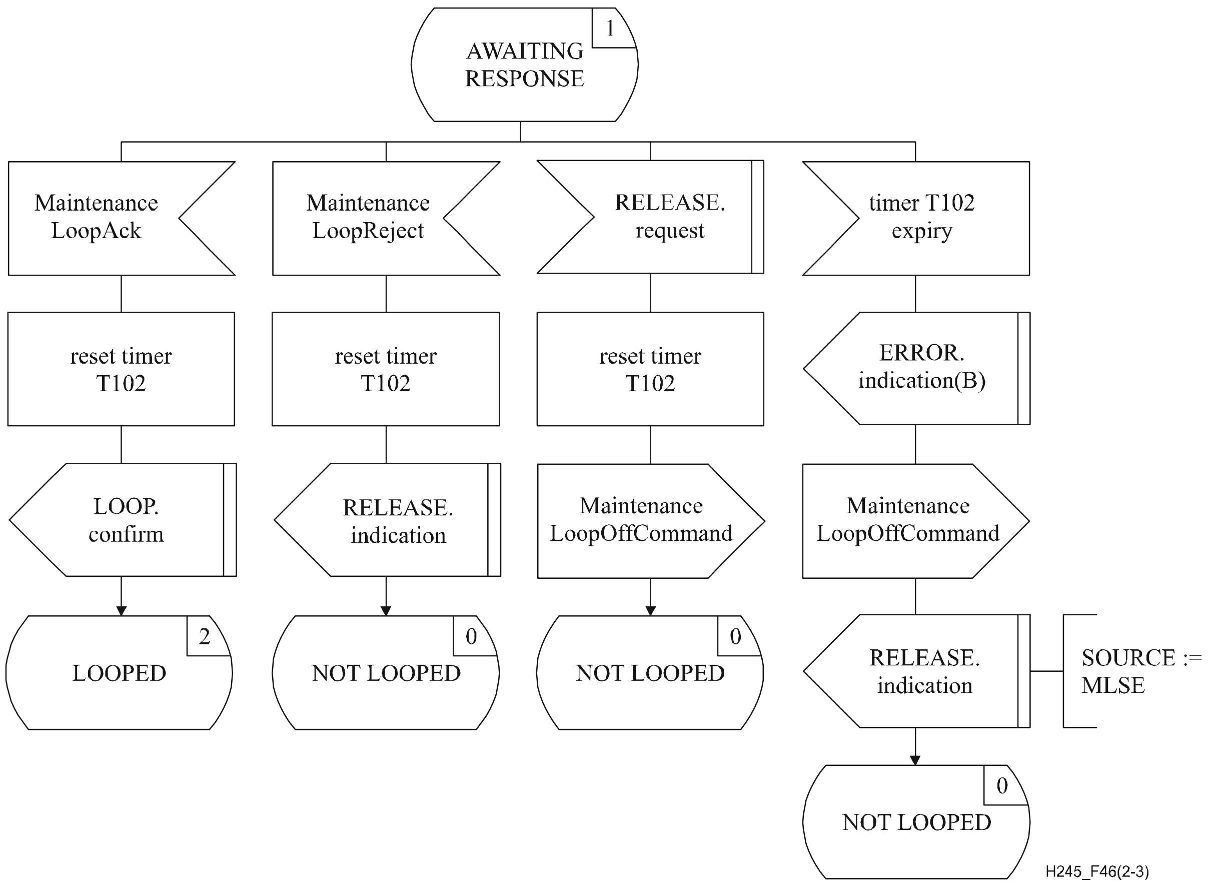


Figure C.46/H.245 – Outgoing MLSE SDL *(sheet 2 of 3)*

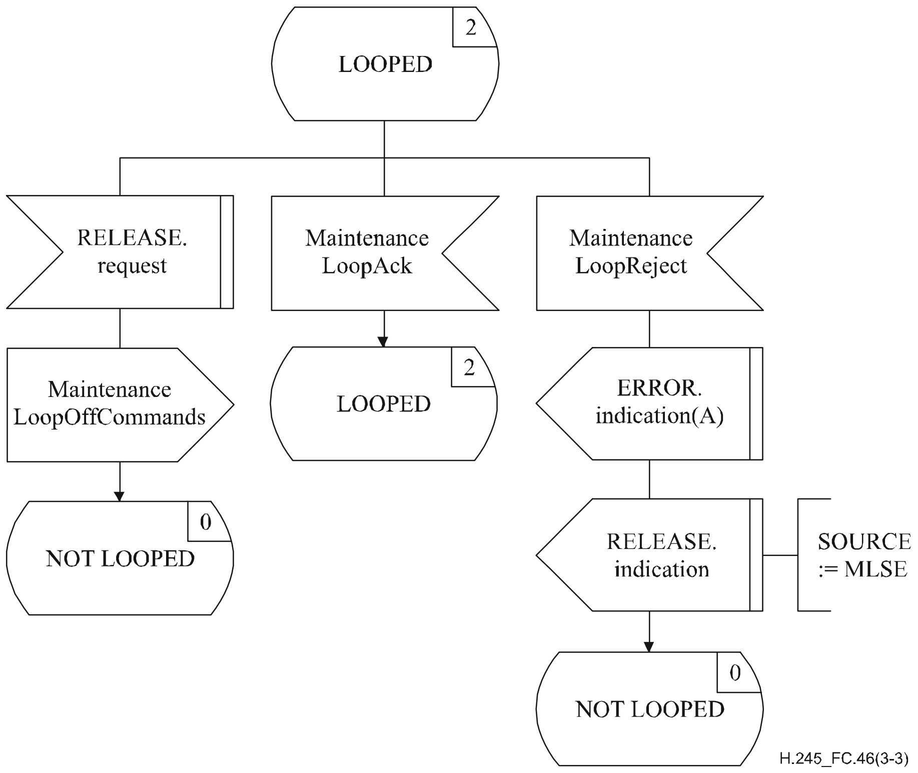


Figure C.46/H.245 – Outgoing MLSE SDL *(sheet 3 of 3)*

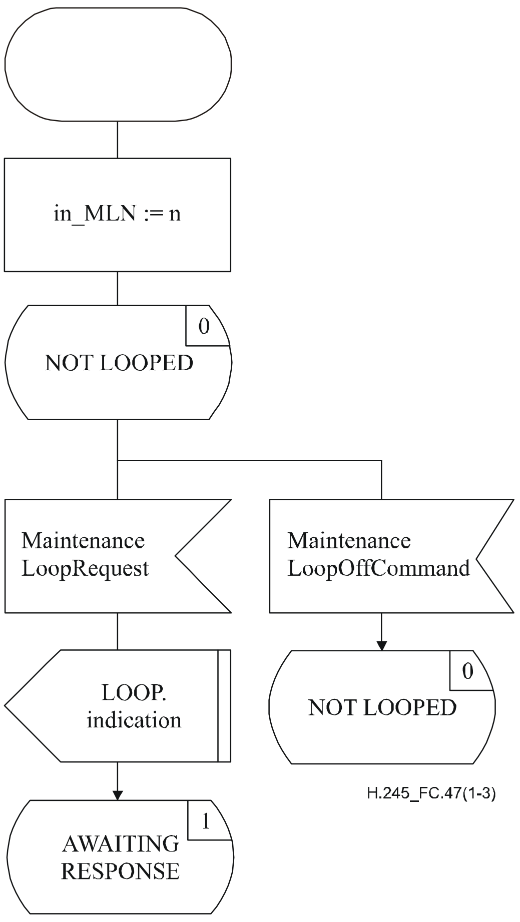


Figure C.47/H.245 – Incoming MLSE SDL *(sheet 1 of 3)*

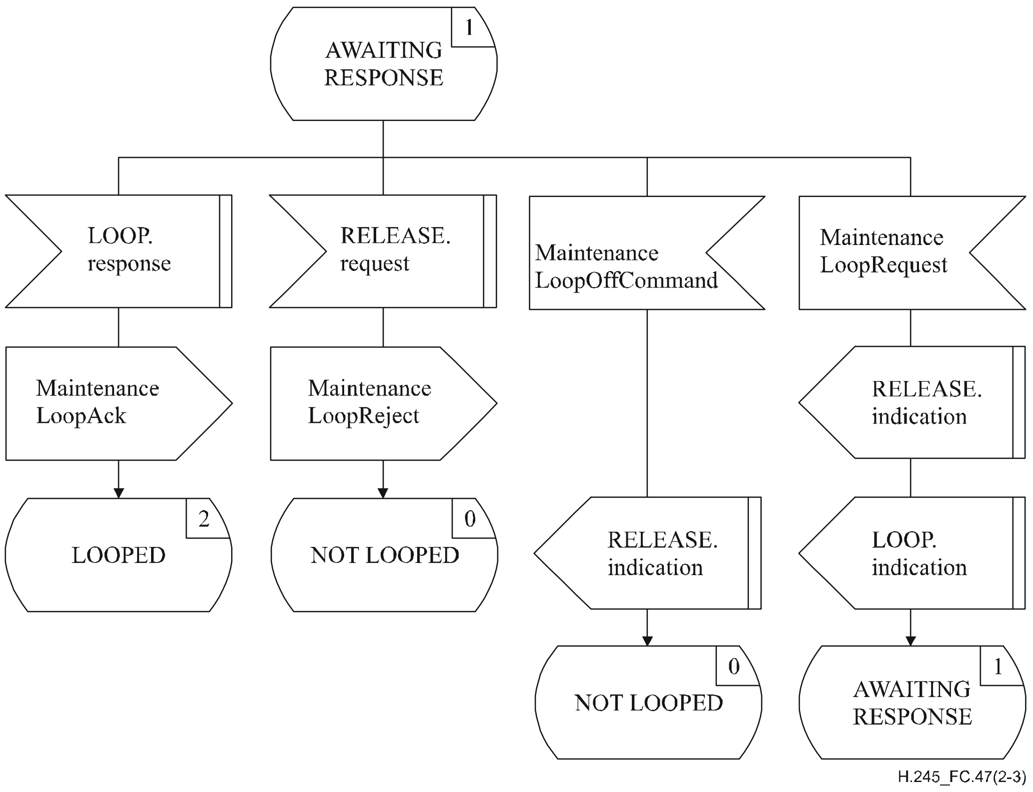


Figure C.47/H.245 – Incoming MLSE SDL *(sheet 2 of 3)*

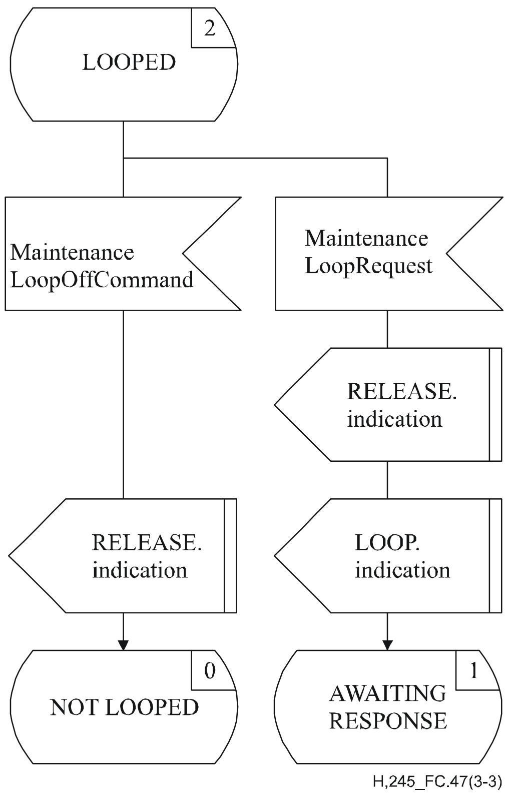


Figure C.47/H.245 – Incoming MLSE SDL *(sheet 3 of 3)*

Annex D

Object identifier assignments

(This annex forms an integral part of this Recommendation)

Table D.1 lists the assignment of OIDs defined for use by this Recommendation.

Table D.1/H.245

Object Identifier Value	Description
`{itu-t(0) recommendation(0) h(8) 245 version(0) 1}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. This indicates the first version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 2}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the second version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 3}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the third version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 4}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the fourth version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 5}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the fifth version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 6}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the sixth version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 7}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the seventh version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 8}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the eighth version of this Recommendation.

Table D.1/H.245

Object Identifier Value	Description
`{itu-t(0) recommendation(0) h(8) 245 version(0) 9}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the ninth version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 10}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the tenth version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 11}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the eleventh version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 12}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the twelfth version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 13}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the thirteenth version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 14}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the fourteenth version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 version(0) 15}`	This OID is used to indicate the version of this Recommendation in use as a multimedia system control protocol. At this time there are fifteen standardized versions defined. This indicates the fifteenth version of this Recommendation.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) video(0) iso-iec-14496-2(0)}`	This OID is used to indicate the generic capability for ISO/IEC 14496-2. This capability is defined in Annex E.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) iso-iec-14496-3(0)}`	This OID is used to indicate the generic capability for ISO/IEC 14496-3. This capability is defined in Annex H.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) amr(1)}`	This OID is used to indicate the generic capability for the GSM Adaptive Multi rate speech codec. This capability is defined in Annex I.

Table D.1/H.245

Object Identifier Value	Description
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) acelp(2)}`	This OID is used to indicate the generic capability for the TIA/EIA/ANSI IS-136 ACELP voice codec. This capability is defined in Annex J.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) us1(3)}`	This OID is used to indicate the generic capability for the TIA/EIA/ANSI IS-136 US1 voice codec. This capability is defined in Annex K.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) is127evrc(4)}`	This OID is used to indicate the generic capability for the TIA/EIA IS-127 Enhanced Variable Rate Codec. This capability is defined in Annex L.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) iso-iec-13818-7(5)}`	This OID is used to indicate the generic capability for ISO/IEC 13818-7. This capability is defined in Annex M.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) rfc3389(6)}`	Deprecated. There was a conflict between this OID and the next in the table. Both of these values of OID are deprecated, and both of these capabilities appear lower in this table with new values of OID.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) itu-rbs.1196(6)}`	Deprecated.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) l-16(7)}`	This OID is used to indicate the generic capability for L-16 sample base variable rate linear 16-bit codec as defined in IETF RFC 1890. This capability is defined in Annex O.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) bounded-audio-stream(8)}`	This OID is used to indicate bounded audio stream capability as a generic capability. This capability is defined in Annex P.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) amr-nb(9)}`	This OID is used to indicate the generic capability for the GSM Adaptive Multi Rate Narrow Band (AMR-NB) codec. This capability is defined in Annex R.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) amr-wb(10)}`	This OID is used to indicate the generic capability for the GSM Adaptive Multi Rate Wide Band (AMR-WB) codec. This capability is defined in Annex R.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) ilbc(11)}`	This OID is used to indicate the generic capability for the Internet Low Bit Rate Codec (iLBC). This capability is defined in Annex S.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) itu-rbs.1196(12)}`	This OID is used to indicate the generic capability for ITU-R BS.1196. This capability is defined in Annex M.

Table D.1/H.245

Object Identifier Value	Description
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) rfc3389(13)}`	This OID is used to indicate the generic capability for signalling comfort noise as specified in RFC 3389. This capability is defined in Annex N.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) data(2) iso-iec-14496-1(0)}`	This OID is used to indicate the generic capability for ISO/IEC 14496-1. This capability is defined in Annex G.
`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) data(2) nx64(1)}`	This OID is used to indicate the generic capability for Nx64 clear channel data transmission, as documented in Annex Q.
`{itu-t(0) recommendaton(0) h(8) 245 generic-capabilities(1) control(3) logical-channel-bit-rate-management(0)}`	This OID is used to indicate the generic capability for logical channel bit rate management. This capability is defined in Annex F.

Annex E

ISO/IEC 14496-2 Capability Definitions

(This annex forms an integral part of this Recommendation)

Table E.1 defines the capability identifier for ISO/IEC 14496-2 Capabilities [49]. These parameters shall only be included as **genericVideoCapability** within the **VideoCapability** structure and as **genericVideoMode** within the **VideoMode** structure. Tables E.2 to E.6 define the associated capability parameters.

A single **profileAndLevel** instantiation of ISO/IEC 14496-2 may support multiple visual objects. Each such visual object is carried as an elementary stream in its own separate logical channel. Since it is possible for multiple ISO/IEC 14496-2 visual environments to be actively transmitted at the same time, and since each of these may be constructed from multiple object streams, it is necessary to have a mechanism for indicating which object streams are associated together in a single ISO/IEC 14496-2 visual environment. This association shall be performed by use of the **forwardLogicalChannelDependency** mechanism in **OpenLogicalChannel** whenever multiple visual objects are in use for the same ISO/IEC 14496-2 visual environment. All visual objects associated together to an ISO/IEC 14496-2 visual environment shall have the same profile and level by indicating the same **profileAndLevel** value when opening logical channels. If a logical channel was opened with an indication of a dependency on some other logical channel in this fashion, and the logical channel on which its dependency was indicated is closed, the remaining open logical channels which had previously been grouped together by some chain of **forwardLogicalChannelDependency** links shall remain logically grouped as a single ISO/IEC 14496-2 visual environment.

Table E.1/H.245 – Capability Identifier for ISO/IEC 14496-2 Capability

Capability name	ISO/IEC 14496-2
Capability class	Video codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) video(0) iso-iec-14496-2(0)}`
maxBitRate	The maxBitRate field shall always be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Table E.2/H.245 – Profile and Level for ISO/IEC 14496-2 Capability

Parameter name	profileAndLevel
Parameter description	This is a nonCollapsing GenericParameter. profileAndLevel indicates the capability of processing the particular profiles in combination with the level as given in Table G.1 'FLC table for profile_and_level_indication' of ISO/IEC 14496-2.
Parameter identifier value	0
Parameter status	Mandatory
Parameter type	unsignedMax. Shall be in the range 0..255.
Supersedes	–

Table E.3/H.245 – Object Parameter for ISO/IEC 14496-2 Capability

Parameter name	object
Parameter description	This is a nonCollapsing GenericParameter. object indicates the set of tools to be used by the decoder of the bitstream contained in the logical channel as given in Table 6-10 'FLC table for video_object_type indication' of ISO/IEC 14496-2.
Parameter identifier value	1
Parameter status	Optional. Shall not be present for Capability Exchange. Shall be present for Logical Channel Signalling. May be present for Mode Request
Parameter type	unsignedMax. Shall be in the range 0..255.
Supersedes	–

Table E.4/H.245 – Decoder Configuration Information for ISO/IEC 14496-2 Capability

Parameter name	decoderConfigurationInformation
Parameter description	This is a nonCollapsing GenericParameter. decoderConfigurationInformation indicates how to configure the decoder for a particular object (bitstream) (refer to subclause 6.2.1 'Start Codes' and subclauses K.3.1 'VideoObject' to K.3.4 'FaceObject' of ISO/IEC 14496-2).
Parameter identifier value	2
Parameter status	Optional. Shall not be present for Capability Exchange and Mode Request. May be present for Logical Channel Signalling.
Parameter type	octetString
Supersedes	–

Table E.5/H.245 – Drawing Order for ISO/IEC 14496-2 Capability

Parameter name	drawingOrder
Parameter description	This is a nonCollapsing GenericParameter. drawingOrder indicates the drawing order of a visual object within a composition of (possibly overlaid) visual objects. The visual object having the lowest drawingOrder shall be drawn first. If visual objects have the same drawingOrder, the object corresponding to the logical channel with the lowest logical channel number shall be drawn first. If drawingOrder is not present during logical channel signalling, it is assumed to have the value 32768.
Parameter identifier value	3
Parameter status	Optional. Shall not be present for Capability Exchange and Mode Request. May be present for Logical Channel Signalling.
Parameter type	unsignedMax. Shall be in the range 0..65535.
Supersedes	–

Table E.6/H.245 – Visual Back Channel Handle for ISO/IEC 14496-2 Capability

Parameter name	visualBackChannelHandle
Parameter description	This is a Collapsing GenericParameter. The presence of this parameter indicates the transmitter receives backward channel messages or the receiver sends backward channel messages that are provided in ISO/IEC 14496-2.
Parameter identifier value	4
Parameter status	May be present for Capability Exchange, Logical Channel Signalling, and Mode Request.
Parameter type	logical
Supersedes	–

Annex F

Logical Channel Bit-Rate Management Capability Definitions

(This annex forms an integral part of this Recommendation)

Table F.1 defines the capability identifier for Bit-Rate Management. These parameters, which provide information about which bit-rate management messages the terminal supports, shall only be included as **genericControlCapability** within the **Capability** structure. Tables F.2 to F.4 define the associated capability parameters.

Table F.1/H.245 – Capability Identifier for Logical Channel Bit-Rate Management

Capability name	H.245 Logical Channel Bit-Rate Management
Capability class	Control.
Capability identifier type	Standard.
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) control(3) logical-channel-bitrate-management(0)}`
maxBitRate	The maxBitRate field shall not be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Table F.2/H.245 – Flow Control Capability Parameter for Bit-Rate Management

Parameter name	Flow Control Capability
Parameter description	This is a collapsing GenericParameter. The presence of this parameter indicates the capability to support the FlowControlIndication message.
Parameter identifier value	0
Parameter status	Optional
Parameter type	logical
Supersedes	–

Table F.3/H.245 – Logical Channel Bit-Rate Change Capability Parameter for Bit-Rate Management

Parameter name	Logical Channel Bit-Rate Change Capability
Parameter description	This is a collapsing GenericParameter. The presence of this parameter indicates the capability to support the Logical Channel Rate Change Procedure, which uses the messages LogicalChannelRateRequest, LogicalChannelRateAcknowledge, LogicalChannelRateReject and LogicalChannelRateRelease.
Parameter identifier value	1
Parameter status	Optional
Parameter type	logical
Supersedes	–

Table F.4/H.245 – RTCP Frequency Parameter for Bit-Rate Management

Parameter name	RTCP Frequency Capability
Parameter description	This is a collapsing GenericParameter. This indicates the frequency at which the terminal can send RTCP reports.
Parameter identifier value	2
Parameter status	Optional
Parameter type	unsigned32Min
Supersedes	–

Annex G

ISO/IEC 14496-1 Capability Definitions

(This annex forms an integral part of this Recommendation)

Table G.1 defines the capability identifier for ISO/IEC 14496-1 [48] capabilities. Tables G.2 to G.6 define the associated capability parameters for ISO/IEC 14496-1. These parameters shall only be included as **genericDataCapability** within the **DataCapability** structure and as **genericDataMode** within the **DataMode** structure. For capability exchange, streamType and profileAndLevel shall be specified, and objectType may be specified. When opening a logical channel (forward or reverse) either ES_ID or objectDescriptor shall be specified.

Further information about the usage of the ISO/IEC 14496-1 Generic Capability is included in Annex F/H.324.

G.1 Capability Identifier

Table G.1/H.245 – Capability Identifier for ISO/IEC 14496-1

Capability name	ISO/IEC 14496-1
Capability class	Data application
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) data(2) iso-iec-14496-1(0)}`
maxBitRate	This field shall be included to indicate the maximum bit rate of one single ISO/IEC 14496 data stream.
nonCollapsingRaw	This field shall not be included.
transport	This field shall be included to indicate the error protection protocol for a specific ISO/IEC 14496 data stream carried in one logical channel.

G.2 Capability parameters used for capability negotiations and logical channel signalling

Table G.2/H.245 – Capability Parameter streamType

Parameter name	streamType
Parameter description	This is a nonCollapsing GenericParameter. **StreamType** indicates the type of the ISO/IEC 14496 stream that is referred to by a specific instance of ISO/IEC 14496-1 Generic Capability as given in Table 9 ("streamType Values") of ISO/IEC 14496-1.
Parameter identifier value	0
Parameter status	Optional. Shall be present for Capability Exchange. Shall not be present for Logical Channel Signalling and Mode Request.
Parameter type	unsignedMax. Shall be in the range 0..255.
Supersedes	–

Table G.3/H.245 – Capability Parameter profileAndLevel

Parameter name	profileAndLevel
Parameter description	This is a nonCollapsing GenericParameter. profileAndLevel indicates the capability of processing the particular profiles in combination with the level as given in • Table 3 of ISO/IEC 14496-1 ("ODProfileLevelIndication Values") for streamType = 0x01 • Table 4 of ISO/IEC 14496-1 ("sceneProfileLevelIndication Values") for streamType = 0x03 • Table 5 of ISO/IEC 14496-1 ("audioProfileLevelIndication Values") for streamType = 0x05 • Table 6 of ISO/IEC 14496-1 ("visualProfileLevelIndication Values") for streamType = 0x04
Parameter identifier value	1
Parameter status	Optional. Shall be present for Capability Exchange. Shall not be present for Logical Channel Signalling and Mode Request.
Parameter type	unsignedMax. Shall be in the range 0..255.
Supersedes	–

Table G.4/H.245 – Capability Parameter objectType

Parameter name	objectType
Parameter description	This is a nonCollapsing GenericParameter. objectType indicates the set of tools to be used by the decoder of the bitstream contained in one logical channel as given in • Table 8 of ISO/IEC 14496-1 ("objectTypeIndication Values") for streamType = 0x04 or 0x05 • Table 7 of ISO/IEC 14496-1 ("graphicsProfileLevelIndication Values") for streamType = 0x03 For all other values of streamType, objectType is not defined and shall therefore not be used.
Parameter identifier value	2
Parameter status	Optional. For streamType = 0x04 or 0x05, shall not be present for Capability Exchange, shall be present for Logical Channel Signalling. May be present for Mode Request. For streamType = 0x03, shall be present for Capability Exchange, shall be present for Logical Channel Signalling. May be present for ModeRequest. For other streamType values, shall not be present.
Parameter type	unsignedMax. Shall be in the range 0..255.
Supersedes	–

G.3 Capability parameters used for logical channel signalling only

Table G.5/H.245 – Capability Parameter objectDescriptor

Parameter name	objectDescriptor
Parameter description	This is a nonCollapsing GenericParameter. **objectDescriptor** contains an octet string which provides all the necessary information to configure the decoder for a particular bitstream in one logical channel (refer to ISO/IEC 14496-1). It shall contain information for only one Elementary Stream.
Parameter identifier value	3
Parameter status	Optional. Shall not be present for Capability Exchange and Mode Request. May be present for Logical Channel Signalling.
Parameter type	octetString
Supersedes	–

Table G.6/H.245 – Capability Parameter ES_ID

Parameter name	ES_ID
Parameter description	This is a nonCollapsing GenericParameter. **ES_ID** indicates the ID of the elementary stream that is contained in one specific logical channel and by which it may be referred by other ISO/IEC 14496 data streams. For the InitialObjectDescriptor, ES_ID shall be set to '0' (zero).
Parameter identifier value	4
Parameter status	Optional. Shall not be present for Capability Exchange. May be present for Logical Channel Signalling. Shall be present for Mode Request.
Parameter type	unsignedMax. Shall be in the range 0..65535.
Supersedes	–

Annex H

ISO/IEC 14496-3 Capability Definitions

(This annex forms an integral part of this Recommendation)

Table H.1 defines the capability identifier for ISO/IEC 14496-3 [50] and ISO/IEC 14496-3/Amd.1 [51] Capabilities. Tables H.2 to H.11 define the associated capability parameters for ISO/IEC 14496-3. These parameters shall only be included as genericAudioCapability within the AudioCapability structure and as genericAudioMode within the AudioMode structure. For capability exchange, profileAndLevel, formatType and maxAl-sduAudioFrames shall be present, audioObjectType and maxAudioObjects may be present, and all other parameters shall be absent. If formatType indicates ISO/IEC 14496-3 Transport Stream format, maxAudioObjects shall be present for capability exchange. When opening a logical channel (forward or reverse), profileAndLevel, formatType and audioObjectType shall be present and all other parameters may be specified. For mode request, profileAndLevel and formatType shall be present and audioObjectType may be specified.

profileAndLevel of ISO/IEC 14496-3 and ISO/IEC 14496-3/Amd.1 may support several types of audio objects. The audio object shall be carried as one of two bitstream formats which are the raw data format and the ISO/IEC 14496-3 Transport Stream format. formatType indicate the choice of the bitstream format type. In applications using multi-rate or scalable transmission, it is useful to allow changes in the structure of the audio objects in one logical channel. This can be realized with the MPEG-4/Audio format which allows changing the configuration of the stream frame by frame. For low bit-rate transmission, the raw data format may be used to reduce redundancy of transmitting the configuration of the stream every frame.

Table H.1/H.245 – Capability Identifier for ISO/IEC 14496-3 Capability

Capability name	ISO/IEC 14496-3
Capability class	Audio Codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) iso-iec-14496-3(0)}`
maxBitRate	This field shall always be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Table H.2/H.245 – Profile and Level for ISO/IEC 14496-3 Capability

Parameter name	profileAndLevel
Parameter description	This is a nonCollapsing GenericParameter. profileAndLevel indicates the capability of processing the particular profiles in combination with the level as given in ISO/IEC 14496-1 and ISO/IEC 14496-1/Amd.1.
Parameter identifier value	0
Parameter status	Mandatory
Parameter type	unsignedMax. Shall be in the range 0..255.
Supersedes	–

Table H.3/H.245 – formatType for ISO/IEC 14496-3 Capability

Parameter name	formatType
Parameter description	This is a nonCollapsing GenericParameter. formatType indicates the choice of the bitstream format type of an audio object between the raw data format and the audio format as follows: • 0: the raw data format (ISO/IEC 14496-3 and ISO/IEC 14496-3/Amd.1) • 1: the format defined as Low-overhead MPEG-4 Audio Transport Multiplex (LATM) in ISO/IEC 14496-3/Amd.1.
Parameter identifier value	1
Parameter status	Mandatory
Parameter type	logical
Supersedes	–

Table H.4/H.245 – maxAl-sduAudioFrames for ISO/IEC 14496-3 Capability

Parameter name	maxAl-sduAudioFrames
Parameter description	This is a collapsing GenericParameter. It specifies what is the maximum number of audio frames per AL-SDU
Parameter identifier value	2
Parameter status	Shall be present for capability exchange and logical channel signalling. Shall not be present for mode request.
Parameter type	unsignedMin. Shall be in the range 1..256.
Supersedes	–

Table H.5/H.245 – audioObjectType for ISO/IEC 14496-3 Capability

Parameter name	audioObjectType
Parameter description	This is a nonCollapsing GenericParameter. audioObjectType indicates the set of tools to be used by the decoder of the bitstream contained in the logical channel as given in ISO/IEC 14496-3/Amd.1. It can be used to limit the capability within the specified profileAndLevel in capability exchange.
Parameter identifier value	3
Parameter status	Optional. May be present for Capability Exchange. Shall be present for Logical Channel Signalling. May be present for Mode Request.
Parameter type	unsignedMax. Shall be in the range 0..31.
Supersedes	–

Table H.6/H.245 – audioSpecificConfig for ISO/IEC 14496-3 Capability

Parameter name	audioSpecificConfig
Parameter description	This is a nonCollapsing GenericParameter. audioSpecificConfig indicates how to configure the decoder for a particular object (refer to ISO/IEC 14496-3/Amd.1).
Parameter identifier value	4
Parameter status	Optional. Shall not be present for Capability Exchange and Mode Request. Shall be present for Logical Channel Signalling if formatType equals 0 (raw data format). If not, shall not be present for Logical Channel Signalling.
Parameter type	octetString
Supersedes	–

Table H.7/H.245 – maxAudioObjects for ISO/IEC 14496-3 Capability

Parameter name	maxAudioObjects
Parameter description	This is a Collapsing GenericParameter. It specifies what is the maximum number of multiplexed audio objects in the audio payload.
Parameter identifier value	5
Parameter status	Optional. If formatType equals 0 (raw data format), shall not be present for Capability Exchange and Logical Channel Signalling. If not, shall be present for Capability Exchange and Logical Channel Signalling. Shall not be present for Mode Request.
Parameter type	unsignedMin. Shall be in the range 1..16.
Supersedes	–

Table H.8/H.245 – muxConfigPresent for ISO/IEC 14496-3 Capability

Parameter name	muxConfigPresent
Parameter description	This is a nonCollapsing GenericParameter. muxConfigPresent indicates whether audio payload configuration is multiplexed into the audio payload itself as given in ISO/IEC 14496-3/Amd.1: 0: audio payload configuration (streamMuxConfig) is not multiplexed into the audio payload. 1: streamMuxConfig is multiplexed into the audio payload.
Parameter identifier value	6
Parameter status	Optional. Shall not be present for Capability Exchange and Mode Request. Shall be present for Logical Channel Signalling if formatType equals 1 (LATM format). If not, shall not be present for Logical Channel Signalling.
Parameter type	logical
Supersedes	–

Table H.9/H.245 – EP_DataPresent for ISO/IEC 14496-3 Capability

Parameter name	EP_DataPresent
Parameter description	This is a nonCollapsing GenericParameter. EP_DataPresent indicates whether the audio payload has error resiliency for bit error (not packet loss) as given in ISO/IEC 14496-3/Amd.1: 0: The audio payload has not error resiliency. 1: The audio payload has error resiliency. The configuration for the ISO/IEC 14496-3/Amd.1 EP tool (errorProtection_SpecificConfig) may be present for Logical Channel Signalling.
Parameter identifier value	7
Parameter status	Optional. Shall not be present for Capability Exchange and Mode Request. Shall be present for Logical Channel Signalling if formatType equals 1 (LATM format). If not, shall not be present for Logical Channel Signalling.
Parameter type	logical
Supersedes	–

Table H.10/H.245 – streamMuxConfig for ISO/IEC 14496-3 Capability

Parameter name	streamMuxConfig
Parameter description	This is a nonCollapsing GenericParameter. streamMuxConfig indicates configuration of the audio payload as given in ISO/IEC 14496-3/Amd.1.
Parameter identifier value	8
Parameter status	Optional. Shall not be present for Capability Exchange and Mode Request. Shall be present for Logical Channel Signalling if formatType equals 1 (LATM format). If not, shall not be present for Logical Channel Signalling.
Parameter type	octetString
Supersedes	–

Table H.11/H.245 – errorProtection_SpecificConfig for ISO/IEC 14496-3 Capability

Parameter name	errorProtection_SpecificConfig
Parameter description	This is a nonCollapsing GenericParameter. errorProtection_SpecificConfig indicates how to configure the ISO/IEC 14496-3/Amd.1 EP tool as given in the LATM EP_MuxElement() description in ISO/IEC 14496-3/Amd.1.
Parameter identifier value	9
Parameter status	Optional. Shall not be present for Capability Exchange and Mode Request. Shall be present for Logical Channel Signalling if formatType equals 1 (LATM format). If not, shall not be present for Logical Channel Signalling.
Parameter type	octetString
Supersedes	–

Annex I

GSM Adaptive Multi-Rate Capability Definitions

(This annex forms an integral part of this Recommendation)

Table I.1 defines the capability identifier for GSM Adaptive Multi-Rate (AMR) Capabilities. Tables I.2 to I.7 define the associated capability parameters. The relevant specifications are [58], [69], [70], [71], [72], [73], [74] and [75].

Clause I.1 defines the mode signalling and the packetization of speech frames to the octet structure.

Table I.1/H.245 – GSM AMR Capability Identifier

Capability name	AMR
Capability class	Audio codec.
Capability identifier type	Standard.
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) amr(1)}`
maxBitRate	Shall be 122
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Table I.2/H.245 – GSM AMR Capability Parameter – maxAl-sduAudioFrames

Parameter name	maxAl-sduAudioFrames
Parameter description	This is a collapsing GenericParameter. It specifies what is the maximum number of audio frames per AL-SDU.
Parameter identifier value	0
Parameter status	Shall be present for capability exchange and logical channel signalling. Shall not be present for mode request.
Parameter type	unsignedMin
Supersedes	–

Table I.3/H.245 – GSM AMR Capability Parameter – bitRate

Parameter name	bitRate
Parameter description	This is a nonCollapsing GenericParameter. It specifies the AMR bitrate. This parameter shall be used only in mode requests. 0 = 4.75, 1 = 5.15, 2 = 5.90, 3 = 6.70, 4 = 7.40, 5 = 7.95, 6 = 10.2, 7 = 12.2.
Parameter identifier value	1
Parameter status	Optional
Parameter type	unsignedMin
Supersedes	–

Table I.4/H.245 – GSM AMR Capability Parameter – GSM AMR Comfort Noise

Parameter name	gsmAmrComfortNoise
Parameter description	This is a collapsing GenericParameter. It specifies that GSM AMR comfort noise is to be used in mode request. This parameter shall be used only in mode requests but not in capabilities because this capability is mandatory.
Parameter identifier value	2
Parameter status	Optional
Parameter type	logical
Supersedes	–

Table I.5/H.245 – GSM AMR Capability Parameter – GSM EFR comfort noise

Parameter name	gsmEfrComfortNoise
Parameter description	This is a collapsing GenericParameter. In a capability, the parameter specifies whether there is a GSM EFR comfort noise capability or not. In a mode request, the parameter specifies that GSM EFR comfort noise is requested.
Parameter identifier value	3
Parameter status	Optional
Parameter type	logical
Supersedes	–

Table I.6/H.245 – GSM AMR Capability Parameter – IS-641 comfort noise

Parameter name	is-641ComfortNoise
Parameter description	This is a collapsing GenericParameter. In a capability, the parameter specifies whether there is a IS-641 comfort noise capability or not. In a mode request, the parameter specifies that IS-641 comfort noise is requested.
Parameter identifier value	4
Parameter status	Optional
Parameter type	logical
Supersedes	–

Table I.7/H.245 – GSM AMR Capability Parameter – PDC EFR comfort noise

Parameter name	pdcEFRComfortNoise
Parameter description	This is a collapsing GenericParameter. In a capability, the parameter specifies whether there is a PDC EFR comfort noise capability or not. PDC EFR is a 6.7 kbit/s ACELP codec specified in section 5.4 of [74]. In a mode request, the parameter specifies that PDC EFR comfort noise is requested.
Parameter identifier value	5
Parameter status	Optional
Parameter type	logical
Supersedes	–

I.1 Definition of mode signalling and bit stuffing to achieve octet alignment

The AMR mode signalling in mobile systems is partly based on external signalling not defined within the AMR speech codec specification. For compatibility with mobile systems this clause defines the mode signalling needed for AMR use in the ITU-T H-series Recommendations. The size of the speech frames of the AMR codec in the different modes is not a multiple of eight. For that reason bit stuffing is needed to achieve an octet structure.

Note that in future, the content of this clause may be changed to refer to ETSI documentation or other appropriate standardization documentation.

Table I.10 maps all the AMR modes into specific mode indices mi(k). Mode indices are also reserved for silence suppression frames used in different systems. Tables I.11 to I.14 specify the formats for these. Table I.15 specifies a no transmission frame.

The bits delivered by the AMR speech encoder, $\{s(1),s(2),...,s(K_s)\}$, shall be rearranged according to subjective importance before they are octet aligned. Tables I.16 to I.23 define the correct rearrangement for the speech codec modes 12.2 kbit/s, 10.2 kbit/s, 7.95 kbit/s, 7.40 kbit/s, 6.70 kbit/s, 5.90 kbit/s, 5.15 kbit/s and 4.75 kbit/s, respectively. In the tables speech codec parameters are numbered in the order they are delivered by the corresponding speech encoder according to GSM 06.90 and the rearranged bits are labelled $\{d(0),d(1),...,d(K_d - 1)\}$, defined in the order of decreasing importance. Index K_d refers to the number of bits delivered by the speech encoder: see Table I.8.

Table I.8/H.245 – Number of speech bits in different AMR modes

Codec mode	Number of speech bits delivered per block (K_d)
AMR12.2	244
AMR10.2	204
AMR7.95	159
AMR7.4	148
AMR6.7	134
AMR5.9	118
AMR5.15	103
AMR4.75	95

The ordering algorithm is in pseudo code as:

```
for $j = 0$ to $K_d - 1$
$d(j) = s(table(j) + 1)$
```

where table(j) is read line by line left to right.

Hence, the octet structure $b_n(k)$ for each AMR codec mode is defined as follows:

Number of stuffing bits:	$K_s = 8 * N - K_d - K_i$,	where K_i is the number of mode index bits
Octet[0]:	$b_0(k) = mi(k)$,	for $k = 0, 1, 2, 3$ (mode index)
	$b_0(k) = d(k - 4)$,	for $k = 4, 5, 6, 7$
Octet[m]:	$b_m(k) = d(8 * m - 4 + k)$,	for $k = 0, \ldots 7$ and $0 < m < N - 1$
Octet[N – 1]:	$b_{N-1}(k) = d(8 * (N - 1) - 4 + k)$,	for $k = 0, \ldots, 7 - K_s$
	If $K_s > 0$	
	$b_{N-1}(k) = UB$,	for $k = 8 - K_s, \ldots, 7$

Table I.9/H.245 – Example, mapping of the AMR speech coding mode 6.7 kbit/s

Octet	MSB			Octet structure				LSB
b_0	d(3)	d(2)	d(1)	d(0)	0	0	1	1
b_1	d(11)	d(10)	d(9)	d(8)	d(7)	d(6)	d(5)	d(4)
b_2	...	...	...	...	...	...	...	d(12)
b_{17}	UB	UB	UB	UB	UB	UB	d(133)	d(132)

Table I.10/H.245 – Mapping of the AMR speech coding modes defined in GSM 06.90 to mode index bits in transmitted octets

Mode_index (4 bits)	Naming in GSM 06.90 and GSM 06.92
0 (Amr4-75k)	4.75 kbit/s mode
1 (Amr5-15k)	5.15 kbit/s mode
2 (Amr5-90k)	5.90 kbit/s mode
3 (Amr6-70k)	6.70 kbit/s mode (PDC-EFR)
4 (Amr7-40k)	7.40 kbit/s mode (IS-641)
5 (Amr7-95k)	7.95 kbit/s mode
6 (Amr10-2k)	10.2 kbit/s mode
7 (Amr12-2k)	12.2 kbit/s mode (GSM EFR)
8	GSM AMR Comfort Noise Frame (mandatory)
9	GSM EFR Comfort Noise Frame (optional)
10	IS-641 Comfort Noise frame (optional)
11	PDC EFR Comfort Noise Frame (optional)
12-14	For future use
15	No transmission

Table I.11/H.245 – Mapping of Comfort Noise descriptor bits from GSM 06.92 to octets for the mode index 8
(Bits from s1 to s35 refer to GSM 06.92)

Transmitted octets	MSB			Mapping of bits				LSB
1	Index of 1st LSF subvector	Index of LSF reference vector			Mode_Index			
	s4	s3	s2	s1	mi(3)	mi(2)	mi(1)	mi(0)
2	Index of 2nd LSF subvector	Index of 1st LSF subvector						
	s12	s11	s10	s9	s8	s7	s6	s5
3	Index of 2nd LSF subvector							
	s20	s19	s18	s17	s16	s15	s14	s13

Table I.11/H.245 – Mapping of Comfort Noise descriptor bits from GSM 06.92 to octets for the mode index 8
(Bits from s1 to s35 refer to GSM 06.92)

Transmitted octets	MSB			Mapping of bits				LSB
4	Index of 3rd LSF subvector							
	s28	s27	s26	s25	s24	s23	s22	s21
5	SID-type bit	Frame energy						Index of 3rd LSF subvector
	t1	s35	s34	s33	s32	s31	s30	s29
6	Stuffing bits					Speech_Mode_Indication		
	UB	UB	UB	UB	UB	smi(2)	smi(1)	smi(0)

Definitions of additional descriptor bits needed for the silence descriptor in Table I.11:

SID-type (t1) is {0=SID_FIRST, 1=SID_UPDATE}

Speech Mode Indication (smi(0)-smi(2)) is the Speech Mode according to the first eight entries in the Mode_Index table.

Table I.12/H.245 – Mapping of silence insertion descriptor bits from GSM 06.60 (parameters also described in GSM 06.62) to octets for the Mode Index 9
(Bits from s1 to s91 refer to GSM 06.60)

Transmitted octets	MSB			Mapping of bits				LSB
1	Index of 1st LSF submatrix				Mode_Index			
	s4	s3	s2	s1	mi(3)	mi(2)	mi(1)	mi(0)
2	Index of 2nd LSF submatrix					Index of 1st LSF submatrix		
	s12	s11	s10	s9	s8	s7	s6	s5
3	Index of 3rd LSF submatrix					Index of 2nd LSF submatrix		
	s20	s19	s18	s17	s16	s15	s14	s13
4	Index of 4th LSF submatrix				Sign of 3rd LSF submatrix	Index of 3rd LSF submatrix		
	s28	s27	s26	s25	s24	s23	s22	s21
5	Index of 5th LSF submatrix				Index of 4th LSF submatrix			
	s36	s35	s34	s33	s32	s31	s30	s29
6	Stuffing bits	Fixed codebook gain					Index of 5th LSF submatrix	
	UB	s91	s90	s89	s88	s87	s38	s37

Table I.13/H.245 – Mapping of silence insertion descriptor bits from TIA IS-641-A to octets, for the mode index 10
(Bits from cn0 to cn37 refer to TIA IS-641-A)

Transmitted octets	MSB			Mapping of bits				LSB
1	Index of 1st LSF subvector				Mode_Index			
	cn3	cn2	cn1	cn0	mi(3)	mi(2)	mi(1)	mi(0)
2	Index of 2nd LSF subvector				Index of 1st LSF subvector			
	cn11	cn10	cn9	cn8	cn7	cn6	cn5	cn4
3	Index of 3rd LSF subvector			Index of 2nd LSF subvector				
	cn19	cn18	cn17	cn16	cn15	cn14	cn13	cn12
4	Random Excitation Gain		Index of 3rd LSF subvector					
	cn27	cn26	cn25	cn24	cn23	cn22	cn21	cn20
5	Index of 1st RESC parameter		Random Excitation Gain					
	cn35	cn34	cn33	cn32	cn31	cn30	cn29	cn28
6	Stuffing bits						Index of 2nd RESC parameter	
	UB	UB	UB	UB	UB	UB	cn37	cn36

Table I.14/H.245 – Mapping of silence insertion descriptor bits from RCR STD-27H to octets for the mode index 11
(Bits from s1 to s35 refer to RCR STD-27H)

Transmitted octets	MSB			Mapping of bits				LSB
1	Index of 1st LSF subvector	Index of LSF reference vector			Mode_Index			
	s4	s3	s2	s1	mi(3)	mi(2)	mi(1)	mi(0)
2	Index of 2nd LSF subvector	Index of 1st LSF subvector						
	s12	s11	s10	s9	s8	s7	s6	s5
3	Index of 2nd LSF subvector							
	s20	s19	s18	s17	s16	s15	s14	s13
4	Index of 3rd LSF subvector							
	s28	s27	s26	s25	s24	s23	s22	s21
5	SID-type	Frame energy						Index of 3rd LSF subvector
	t1	s35	s34	s33	s32	s31	s30	s29
6	Stuffing bits							SID-type
	UB	UB	UB	UB	UB	UB	UB	t2

Definition of additional descriptor bits needed for PDC-EFR in Table I.14:

SID-type is {0=POST0, 1=POST1(SID_UPDATE), 2=PRE, 3=POST1_BAD}, where LSB of SID-type is t1, and MSB of SID-type is t2.

Table I.15/H.245 – The definition of the no transmission frame for the mode index 15

Transmitted octets	**MSB**			**Frame content**				**LSB**
1	Stuffing bits				Mode_Index			
	UB	UB	UB	UB	mi(3)	mi(2)	mi(1)	mi(0)

Table I.16/H.245 – Subjective importance of the speech-encoded bits for AMR12.2

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	23	15	16	17	18
19	20	21	22	24	25	26	27	28	38
141	39	142	40	143	41	144	42	145	43
146	44	147	45	148	46	149	47	97	150
200	48	98	151	201	49	99	152	202	86
136	189	239	87	137	190	240	88	138	191
241	91	194	92	195	93	196	94	197	95
198	29	30	31	32	33	34	35	50	100
153	203	89	139	192	242	51	101	154	204
55	105	158	208	90	140	193	243	59	109
162	212	63	113	166	216	67	117	170	220
36	37	54	53	52	58	57	56	62	61
60	66	65	64	70	69	68	104	103	102
108	107	106	112	111	110	116	115	114	120
119	118	157	156	155	161	160	159	165	164
163	169	168	167	173	172	171	207	206	205
211	210	209	215	214	213	219	218	217	223
222	221	73	72	71	76	75	74	79	78
77	82	81	80	85	84	83	123	122	121
126	125	124	129	128	127	132	131	130	135
134	133	176	175	174	179	178	177	182	181
180	185	184	183	188	187	186	226	225	224
229	228	227	232	231	230	235	234	233	238
237	236	96	199						

Table I.17/H.245 – Subjective importance of the speech-encoded bits for AMR10.2

7	6	5	4	3	2	1	0	16	15
14	13	12	11	10	9	8	26	27	28
29	30	31	115	116	117	118	119	120	72
73	161	162	65	68	69	108	111	112	154
157	158	197	200	201	32	33	121	122	74
75	163	164	66	109	155	198	19	23	21
22	18	17	20	24	25	37	36	35	34
80	79	78	77	126	125	124	123	169	168
167	166	70	67	71	113	110	114	159	156
160	202	199	203	76	165	81	82	92	91
93	83	95	85	84	94	101	102	96	104
86	103	87	97	127	128	138	137	139	129
141	131	130	140	147	148	142	150	132	149
133	143	170	171	181	180	182	172	184	174
173	183	190	191	185	193	175	192	176	186
38	39	49	48	50	40	52	42	41	51
58	59	53	61	43	60	44	54	194	179
189	196	177	195	178	187	188	151	136	146
153	134	152	135	144	145	105	90	100	107
88	106	89	98	99	62	47	57	64	45
63	46	55	56						

Table I.18/H.245 – Subjective importance of the speech-encoded bits for AMR7.95

8	7	6	5	4	3	2	14	16	9
10	12	13	15	11	17	20	22	24	23
19	18	21	56	88	122	154	57	89	123
155	58	90	124	156	52	84	118	150	53
85	119	151	27	93	28	94	29	95	30
96	31	97	61	127	62	128	63	129	59
91	125	157	32	98	64	130	1	0	25
26	33	99	34	100	65	131	66	132	54
86	120	152	60	92	126	158	55	87	121
153	117	116	115	46	78	112	144	43	75
109	141	40	72	106	138	36	68	102	134
114	149	148	147	146	83	82	81	80	51
50	49	48	47	45	44	42	39	35	79
77	76	74	71	67	113	111	110	108	105
101	145	143	142	140	137	133	41	73	107
139	37	69	103	135	38	70	104	136	

Table I.19/H.245 – Subjective importance of the speech-encoded bits for AMR7.4

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	26	87	27
88	28	89	29	90	30	91	51	80	112
141	52	81	113	142	54	83	115	144	55
84	116	145	58	119	59	120	21	22	23
17	18	19	31	60	92	121	56	85	117
146	20	24	25	50	79	111	140	57	86
118	147	49	78	110	139	48	77	53	82
114	143	109	138	47	76	108	137	32	33
61	62	93	94	122	123	41	42	43	44
45	46	70	71	72	73	74	75	102	103
104	105	106	107	131	132	133	134	135	136
34	63	95	124	35	64	96	125	36	65
97	126	37	66	98	127	38	67	99	128
39	68	100	129	40	69	101	130		

Table I.20/H.245 – Subjective importance of the speech-encoded bits for AMR6.7

0	1	4	3	5	6	13	7	2	8
9	11	15	12	14	10	28	82	29	83
27	81	26	80	30	84	16	55	109	56
110	31	85	57	111	48	73	102	127	32
86	51	76	105	130	52	77	106	131	58
112	33	87	19	23	53	78	107	132	21
22	18	17	20	24	25	50	75	104	129
47	72	101	126	54	79	108	133	46	71
100	125	128	103	74	49	45	70	99	124
42	67	96	121	39	64	93	118	38	63
92	117	35	60	89	114	34	59	88	113
44	69	98	123	43	68	97	122	41	66
95	120	40	65	94	119	37	62	91	116
36	61	90	115						

Table I.21/H.245 – Subjective importance of the speech-encoded bits for AMR5.9

0	1	4	5	3	6	7	2	13	15
8	9	11	12	14	10	16	28	74	29
75	27	73	26	72	30	76	51	97	50
71	96	117	31	77	52	98	49	70	95
116	53	99	32	78	33	79	48	69	94
115	47	68	93	114	46	67	92	113	19
21	23	22	18	17	20	24	111	43	89
110	64	65	44	90	25	45	66	91	112
54	100	40	61	86	107	39	60	85	106
36	57	82	103	35	56	81	102	34	55
80	101	42	63	88	109	41	62	87	108
38	59	84	105	37	58	83	104		

Table I.22/H.245 – Subjective importance of the speech-encoded bits for AMR5.15

7	6	5	4	3	2	1	0	15	14
13	12	11	10	9	8	23	24	25	26
27	46	65	84	45	44	43	64	63	62
83	82	81	102	101	100	42	61	80	99
28	47	66	85	18	41	60	79	98	29
48	67	17	20	22	40	59	78	97	21
30	49	68	86	19	16	87	39	38	58
57	77	35	54	73	92	76	96	95	36
55	74	93	32	51	33	52	70	71	89
90	31	50	69	88	37	56	75	94	34
53	72	91							

Table I.23/H.245 – Subjective importance of the speech-encoded bits for AMR4.75

0	1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	23	24	25	26
27	28	48	49	61	62	82	83	47	46
45	44	81	80	79	78	17	18	20	22
77	76	75	74	29	30	43	42	41	40
38	39	16	19	21	50	51	59	60	63
64	72	73	84	85	93	94	32	33	35
36	53	54	56	57	66	67	69	70	87
88	90	91	34	55	68	89	37	58	71
92	31	52	65	86					

Annex J

TDMA ACELP Voice Codec Definitions

(This annex forms an integral part of this Recommendation)

Table J.1 defines the capability identifier for TIA/EIA 136 ACELP voice codec Capabilities [75]. Tables J.2 to J.4 define the associated capability parameters. This codec is used in TDMA Cellular and PCS base stations and mobile phones. The technical specifications of this codec are provided in TIA/EIA standard 136 Part 410. This standard is published by the TIA (North American) Telecommunications Industry Association and endorsed by ANSI, the American National Standards Institute.

Table J.1/H.245 – TIA/EIA 136 ACELP Capability Identifier

Capability name	TIA/EIA 136 ACELP Vocoder
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) acelp(2)}`
maxBitRate	This field shall be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Table J.2/H.245 – TIA/EIA 136 ACELP Capability Parameter – maxAl-sduAudioFrames

Parameter name	maxAl-sduAudioFrames
Parameter description	This is a collapsing GenericParameter. Specifies the maximum number of audio frames per AL-SDU.
Parameter identifier value	0
Parameter status	Shall be present for capability exchange and logical channel signalling. Shall not be present for mode request.
Parameter type	unsignedMin
Supersedes	–

Table J.3/H.245 – TIA/EIA 136 ACELP Capability Parameter – Comfort Noise

Parameter name	comfortNoise
Parameter description	This is a collapsing GenericParameter. Specifies that TIA/EIA 136 (IS-641) comfort noise is to be used in mode request. This parameter shall be used only in mode requests but not in capabilities because this capability is mandatory.
Parameter identifier value	1
Parameter status	Optional
Parameter type	logical
Supersedes	–

Table J.4/H.245 – TIA/EIA 136 ACELP Capability Parameter – Scrambled

Parameter name	scrambled
Parameter description	This is a collapsing GenericParameter. Specifies that scrambling is to be used in mode request. This parameter shall be used only in mode requests but not in capabilities because this capability is mandatory.
Parameter identifier value	2
Parameter status	Optional
Parameter type	logical
Supersedes	–

Annex K

TDMA US1 Voice Codec Definitions

(This annex forms an integral part of this Recommendation)

Table K.1 defines the capability identifier for TIA/EIA 136 US1 voice codec Capabilities [76]. Tables K.2 to K.4 define the associated capability parameters. This codec is used in TDMA Cellular and PCS base stations and mobile phones. The technical specifications of this codec are provided in TIA/EIA standard 136 Part 430. This standard is published by TIA – the (North American) Telecommunications Industry Association and endorsed by ANSI, The American National Standards Institute.

Table K.1/H.245 – TIA/EIA 136 US1 Capability Identifier

Capability name	TIA/EIA 136 US1 Vocoder
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) us1(3)}`
maxBitRate	This field shall be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Table K.2/H.245 – TIA/EIA 136 US1 Capability Parameter – maxAl-sduAudioFrames

Parameter name	maxAl-sduAudioFrames
Parameter description	This is a collapsing GenericParameter. Specifies the maximum number of audio frames per AL-SDU.
Parameter identifier value	0
Parameter status	Shall be present for capability exchange and logical channel signalling. Shall not be present for mode request.
Parameter type	unsignedMin
Supersedes	–

Table K.3/H.245 – TIA/EIA 136 US1 Capability Parameter – Comfort Noise

Parameter name	comfortNoise
Parameter description	This is a collapsing GenericParameter. Specifies that comfort noise is to be used in mode request. This parameter shall be used only in mode requests but not in capabilities because this capability is mandatory.
Parameter identifier value	1
Parameter status	Optional
Parameter type	logical
Supersedes	–

Table K.4/H.245 – TIA/EIA 136 US1 Capability Parameter – Scrambled

Parameter name	scrambled
Parameter description	This is a collapsing GenericParameter. Specifies that scrambling is to be used in mode request. This parameter shall be used only in mode requests but not in capabilities because this capability is mandatory.
Parameter identifier value	2
Parameter status	Optional
Parameter type	logical
Supersedes	–

Annex L

CDMA EVRC Voice Codec Definitions

(This annex forms an integral part of this Recommendation)

Table L.1 defines the capability identifier for TIA/EIA IS-127 Enhanced Variable Rate Codec (EVRC) which is used in TIA/EIA IS-95 CDMA Cellular and PCS base stations and mobile phones. The full technical description and detailed specifications of this codec are provided in TIA/EIA IS-127 standard which is published by the North American Telecommunications Industry Association (TIA). Tables L.2 to L.4 define the associated capability parameters.

Table L.1/H.245 – CDMA EVRC Capability Identifier

Capability name	TIA/EIA IS-127 CDMA EVRC
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) is127evrc(4)}`
maxBitRate	This field shall be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Table L.2/H.245 – TIA/EIA IS-127 CDMA EVRC Capability Parameter – maxAl-sduAudioFrames

Parameter name	maxAl-sduAudioFrames
Parameter description	This is a collapsing GenericParameter. Specifies the maximum number of audio frames per AL-SDU.
Parameter identifier value	0
Parameter status	Shall be present for capability exchange and logical channel signalling. Shall not be present for mode request.
Parameter type	unsignedMin
Supersedes	–

Table L.3/H.245 – CDMA EVRC Capability Parameter – EVRC Bit-Rate

Parameter name	EVRCRate
Parameter description	This is a nonCollapsing GenericParameter. It specifies the vocoder output bit-rate mode. This parameter shall be used in mode requests: 1 = full-rate; 2 = half-rate; 3 = eighth-rate; 4 = blanked mode.
Parameter identifier value	1
Parameter status	Optional
Parameter type	unsignedMin
Supersedes	–

Table L.4/H.245 – CDMA EVRC Capability Parameter – Scrambled

Parameter name	scrambled
Parameter description	This is a collapsing GenericParameter. Specifies that scrambling is to be used in mode request.
Parameter identifier value	2
Parameter status	Optional
Parameter type	logical
Supersedes	–

Annex M

ISO/IEC 13818-7 and ITU-R BS.1196 Definitions

(This annex forms an integral part of this Recommendation)

Table M.1 defines the capability identifier for ISO/IEC 13818-7. Table M.2 defines the associated capability parameters.

Table M.3 defines the capability identifier for ITU-R BS.1196. There are no associated capability parameters.

Table M.1/H.245 – ISO/IEC 13818-7 Capability Identifier

Capability name	ISO/IEC 13818-7
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) iso-iec-13818-7(5)}`
maxBitRate	This field shall be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included

Table M.2/H.245 – Profile and Level for ISO/IEC 13818-7 Capability

Parameter name	profileAndLevel
Parameter description	This is a nonCollapsing GenericParameter. profileAndLevel indicates the capability of processing the particular profiles in combination with the level as given in ISO/IEC 13818-7.
Parameter identifier value	0
Parameter status	Mandatory
Parameter type	unsignedMax. Shall be in the range 0..255.
Supersedes	–

Table M.3/H.245 – ITU-R BS.1196 Capability Identifier

Capability name	ITU-R BS.1196
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) itu-r-bs-1196(12)}`
maxBitRate	This field shall be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Annex N

RFC 3389 – RTP Payload for Comfort Noise

(This annex forms an integral part of this Recommendation)

Table N.1 defines the capability identifier for RFC 3389. There are no associated capability parameters.

IETF RFC 3389 specifies a means of signalling comfort noise intermixed with regular audio packets and is based on Appendix II/G.711. The primary purpose of that RFC is to provide for comfort noise signalling for codecs that do not define their own and is generally accepted as the means of signalling comfort noise within RTP-based systems.

Comfort noise capability may be signalled as any other capability and media of that type may be opened in conjunction with G.711, G.726, etc., by specifying this capability as part of a multiple payload stream (MPS) channel.

Table N.1/H.245 – RFC 3389 Comfort Noise

Capability name	RFC 3389 Comfort Noise
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) rfc3389(13)}`
maxBitRate	This field shall be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included

Annex O

L16 Capability Identifier

(This annex forms an integral part of this Recommendation)

Table O.1 defines the capability identifier for L16. The L16 codec is an uncompressed audio data codec, using 16-bit signed representation with 65535 equally divided steps between minimum and maximum signal level, ranging from –32768 to 32767. The value is represented in two's complement notation and network byte order. This codec is used for Acoustic Performance verification and possibly for low cost wideband LAN applications. It is defined in section 4.4.8 of IETF RFC 1890.

Table O.2 defines the associated capability parameter.

Table O.1/H.245 – L16 Capability Identifier

Capability name	L16 audio codec
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) l-16(7)}`
maxBitRate	This field shall be included. The rate defines the number of samples per second; this is also the RTP time stamp clock rate. The recommended values for rate are 8000, 11025, 16000, 22050, 24000, 32000, 44100, and 48000 samples per second. Other values are permissible.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included

Table O.2/H.245 – L16 Capability Parameter – channels

Parameter name	channels
Parameter description	This is a collapsing Generic Parameter. It specifies the number of interleaved audio streams. The default is 1, stereo is 2. Interleaving takes place between individual two byte samples.
Parameter identifier value	0
Parameter status	Shall be present for capability exchange and logical channel signalling. Shall not be present for mode request.
Parameter type	unsignedMin
Supersedes	–

Annex P

Bounded audio stream capability

(This annex forms an integral part of this Recommendation)

This generic capability can be used as genericAudioCapability choice of AudioCapability in TerminalCapabilitySet, OpenLogicalChannel and CommunicationModeCommand messages, and as genericAudioMode within a RequestMode message.

Two parameters are defined for the bounded audio stream capability:

- The minimum packet size (frames per packet) as a collapsing parameter;
- The H.245-defined audioCapability for which a minimum packet size is required. This value defines the codec as well as the maximum packet size for the desired audio stream.

Table P.1/H.245 – Capability Identifier for bounded audio stream

Capability name	Bounded audio stream
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) bounded-audio-stream(8)}`
maxBitRate	The maxBitRate field shall always be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included

Table P.2/H.245 – Minimum packet size parameter

Parameter name	minimumPacketSize
Parameter description	This is a collapsing Generic Parameter. It specifies the minimum number of frames per packet.
Parameter identifier value	0
Parameter status	Mandatory
Parameter type	unsignedMax. Shall be in the range 1..256.
Supersedes	–

Table P.3/H.245 – Audio capability

Parameter name	audioCapability
Parameter description	This is a nonCollapsing GenericParameter. It contains a valid audioCapability PER encoding according to Annex B.
Parameter identifier value	1
Parameter status	Mandatory
Parameter type	octetString
Supersedes	–

Annex Q

Generic Capability for Nx64K Circuit Relay over IP

(This annex forms an integral part of this Recommendation)

Q.1 Introduction

This annex describes the use of a Generic Capability for structure-locked Nx64 Circuit Relay across an IP network. No assumptions are made with regard to the content or structure of the information to be relayed. Several parameters are defined to simplify negotiation of a satisfactory channel.

This capability is intended to satisfy the following requirements:

1) The transport must be able to carry unrestricted or restricted digital information, at 64 kbit/s or 56 kbit/s, as indicated via ITU-T Rec. Q.931. Note that only the bearer information is being transported here, exclusive of network framing signals or control channels.
2) The transmission must be byte transparent (so-called "structure-locked transport").
3) No signal processing of any kind (padding, echo cancellation, tone detection, silence suppression, or encoding, etc.) should be performed at the TDM/IP interface.
4) Transport via RTP (or SRTP) must be supported.
5) Packet size must be negotiable.
6) Packet loss/corruption recovery mechanisms, and order, must be negotiable.
   a) Forward error correction as per RFC 2733, in which each FEC "parity" packet involves R successive packets – this doubles the bandwidth of the channel.
   b) Redundant transmission as per RFC 2198 in which extra copies of each media block are transmitted.
7) Specification of bandwidth should be expressed as a product of number of channels and channel capacity (Nx64 kbit/s).
8) The number of circuit channels will not change during the life of a media session.

This capability makes use of a packet format defined in ITU-T Rec. Y.1413 [81]. Some consideration was given to work in the IETF pwe3 working group, but that effort seems more interested in efficient transport of bundled audio circuits rather than digital data (see, e.g., [86]).

Q.2 Description

Q.2.1 Terminology

Frame is the aggregation of one 8-bit sample per channel in channel order from 1 to N. For 64 kbit/s channels sampled at 8 kHz, the frame is comprised of N octets. The one-sample-per-channel frame size was chosen in order to permit flexibility in total packet size for a range of N from 1 to 31 or more and samples-per-channel from 1 to 2047, say.

M is the number of frames per packet payload.

N is the number of 64 kbit/s TDM channels per frame.

Q.2.2 Capability Identifier

The proposed Generic Capability feature for Nx64K clear channel data transmission shall be identified via **GenericCapability.capabilityIdentifier.standard** set to:

{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) data(2) nx64(1)}

For use in the Generic Capability,

Table Q.1/H.245 – Nx64 Capability Identifier

Capability name	Nx64 Circuit Relay
Capability class	Data codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) data(2) nx64(1)}`
maxBitRate	The maxBitRate field shall always be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Q.2.3 Parameters for Capability Exchange

The defined parameters for the Nx64 capability shall be as described in Tables Q.2 and Q.3:

Table Q.2/H.245 – Nx64 Number-of-Channels Parameter

Parameter name	Number of Channels
Parameter description	This is a Collapsing GenericParameter. Number of Channels specifies the number of 64 kbit/s bearer channels to be carried in the stream.
Parameter identifier value	1
Parameter status	Optional, default is 1
Parameter type	unsignedMax. Shall be in the range 1..255. unsignedMin (in capability exchange only).
Supersedes	–

Table Q.3/H.245 – Nx64 Payload Size Parameter

Parameter name	Payload Size
Parameter description	This is a Collapsing GenericParameter. Payload Size specifies the number of frames to be carried in one packet of the stream.
Parameter identifier value	2
Parameter status	unsignedMax is Mandatory unsignedMin is Optional
Parameter type	unsignedMax. Shall be in the range 1..2047. unsignedMin (in capability exchange only).
Supersedes	–

The maximum block size in frames is the only parameter that must be specified, and in any case, the minimum value will default to the maximum value if no minimum is specified. This permits the specification of a wide range of combinations with a single capability. **GenericCapability.maxBitRate** may be set to the value of the maximum number of channels times 640.

Q.2.4 Parameters for capabilities in channel establishment

Q.2.4.1 In H.245

When used as the DataType in an H.245 **OpenLogicalChannel** or **OpenLogicalChannelAck**, or as a **mode** in a **RequestMode**, the Nx64 Generic Capability should not contain any minimum values; that is, all specified parameters should contain the desired values for the specified data channel. These values must, of course, be compatible with the capabilities already exchanged.

Q.2.4.2 In Fast Connect or Extended Fast Connect

When used as the media DataType in an H.245 OpenLogicalChannel proposal contained within an H.225.0 **fastStart** element [12], the Nx64 Generic Capability must contain only maximum values of the parameters in order to indicate the actual values requested. Any omitted parameter is implicitly offered with the default value only.

Q.2.5 Packet format

The packet format shall be RTP [84], with the payload comprised of one or more frames in network byte order, along with the negotiated redundancy elements, if any. A frame is defined as the aggregation of one 8-bit sample from each of the N TDM channels in some fixed order (the order is determined by the circuit-switched network). This frame format is identical to the structure-locked encapsulation format (without signalling) specified in 9.2.1/Y.1413, reproduced in Figure Q.1. This framing avoids knowledge of any internal structure of the data, yet it retains synchronization of the packet stream with the source circuit. The frame size (M) shall remain constant throughout the life of the connection.

8 7 6 5 4 3 2 1	Frame
Bits belonging to timeslot 1	1
Bits belonging to timeslot 2	
...	
Bits belonging to timeslot N	
Bits belonging to timeslot 1	2
Bits belonging to timeslot 2	
...	
Bits belonging to timeslot N	
...	...
Bits belonging to timeslot 1	M
Bits belonging to timeslot 2	
...	
Bits belonging to timeslot N	

NOTE 1 – Bit 8 is the most significant bit.
NOTE 2 – The packet contains M TDM frames with N timeslots per frame.

Figure Q.1/H.245 – Payload format for structure-locked encapsulation without CAS (from ITU-T Rec. Y.1413)

Q.2.6 RTP header restrictions

The following constraints are adapted from 8.4/Y.1413 and must be observed in formatting packets under this capability.

1) Padding, header extensions, multiple synchronization sources, and markers are not used.

2) Payload type(s) shall be selected from the dynamic range.

3) Sequence numbers shall be consecutive for consecutive packets; in conjunction with the fixed payload size, this permits a receiver to calculate the exact number of frames lost by a missing packet.

4) The RTP timestamp, in conjunction with the packet size and packet rate, may be used for carrying timing information over the IP network; the clock frequency used for generating timestamps should be an integer multiple of 8 kHz. Guidance for the proper selection of this clock frequency is given in Appendix V/Y.1413.

5) The Synchronization Source field in the RTP header may be used for detection of misconnections.

Q.2.7 Redundancy formatting

This capability permits several optional methods of error correction through redundancy or forward error correction. As part of capability exchange, one or more methods may be specified using standard H.245 capabilities.

Q.2.8 Timing considerations

The transport of synchronous information across the IP network is subject to several types of problems. IP transport suffers from jitter in the packet propagation times, which may be compensated for by introducing additional delay (buffering at the receiver). Error correction mechanisms can provide redundancy.

Clocking at the TDM source and destination also affect the end-to-end performance of the connection. If the source and destination TDM systems run on different clocks that drift relative to each other, data underruns or overruns are inevitable. The occurrence of such events can be limited somewhat by buffering, but will result, sooner or later, in the loss of some information, or the insertion of meaningless data. Several different clock situations may be considered.

Q.2.9 Common clock

Both the source and the destination are tied to a common network clock. Under these circumstances overruns or underruns should not occur, so long as the packet transport performs satisfactorily.

Q.2.9.1 Independent clocks

In this case, the sender and receiver run at different rates, but the drift of one clock relative to the other may be compensated for a time by buffering. The use of precise, calibrated clocks may reduce the occurrence of slips to a satisfactory level, depending on the application using the transport.

Q.2.9.2 Bearer capability

This format may be used to carry restricted or unrestricted 64 kbit/s or 56 kbit/s data embedded in a 64 kbit/s channel, as indicated by the Q.931 Bearer Capability. See 7.2.2.1/H.225.0 for coding of the BearerCapability in the Setup message.

Annex R

Adaptive Multi-Rate Capability Definitions

(This annex forms an integral part of this Recommendation)

R.1 Introduction

Tables R.1 and R.2 define the capability identifier for GSM Adaptive Multi-Rate Narrow Band (AMR-NB) and Adaptive Multi-Rate Wide Band (AMR-WB) capabilities respectively. Tables R.3 to R.10 define the associated capability parameters.

The mode signalling and packetization of speech frames to the octet structure are specified in [RFC 3267]. In-band mode request mechanism (CMR) shall be used as per RFC 3267 for bit rate changes.

R.2 Description

Table R.1/H.245 – Capability Identifier for GSM AMR-NB Capability

Capability name	AMR-NB
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) amr-nb(9)}`
maxBitRate	The value shall be in units of 100 bit/s and should also account for redundant frames if any.
nonCollapsingRaw	This field shall not be included
transport	This field shall not be included

Table R.2/H.245 – Capability Identifier for GSM AMR-WB Capability

Capability name	AMR-WB
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) amr-wb(10)}`
maxBitRate	The value shall be in units of 100 bit/s and should also account for redundant frames if any.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Table R.3/H.245 – GSM AMR Capability Parameter – octetAlign

Parameter name	octetAlign
Parameter description	This is a collapsing booleanArray GenericParameter. The presence of this parameter denotes that octet-aligned mode of operation is used. If absent, bandwidth efficient mode is used. Since, CRC and robust sorting can only be applied with octet-aligned frame format; Following bits represent CRC and robust sorting when this parameter is present. Bit 8 (value 1) – If set, CRC will be computed. Bit 7 (value 2) – If set, robust sorting will be performed.
Parameter identifier value	0
Parameter status	Optional. May be present for capability exchange, logical channel signalling and RequestMode messages.
Parameter type	booleanArray
Supersedes	–

Table R.4/H.245 – GSM AMR Capability Parameter – modeSet

Parameter name	modeSet
Parameter description	This is a collapsing booleanArray GenericParameter. If present, specifies the subset of modes available. If absent, no modes are supported. Each bit represents a mode and Bits 1 – 8 will be set depending on the modes supported. For AMR-NB codec, Bit 8 (value 1) – If set, indicates 4.75 kbit/s Bit 7 (value 2) – If set, indicates 5.15 kbit/s Bit 6 (value 4) – It set, indicates 5.9 kbit/s Bit 5 (value 8) – If set, indicates 6.7 kbit/s Bit 4 (value 16) – If set, indicates 7.4 kbit/s Bit 3 (value 32) – If set, indicates 7.95 kbit/s Bit 2 (value 64) – If set, indicates 10.2 kbit/s Bit 1 (value 128) – If set, indicates 12.2 kbit/s For AMR-WB codec, Bit 8 (value 1) – If set, indicates 6.6 kbit/s Bit 7 (value 2) – If set, indicates 8.85 kbit/s Bit 6 (value 4) – It set, indicates 12.65 kbit/s Bit 5 (value 8) – If set, indicates 14.25 kbit/s Bit 4 (value 16) – If set, indicates 15.85 kbit/s Bit 3 (value 32) – If set, indicates 18.25 kbit/s Bit 2 (value 64) – If set, indicates 19.85 kbit/s Bit 1 (value 128) – If set, indicates 23.05 kbit/s In capability exchange, this parameter indicates supported modes and in logical channel signaling, indicates modes to be used for the current session.

Table R.4/H.245 – GSM AMR Capability Parameter – modeSet

Parameter identifier value	1
Parameter status	Shall be Mandatory for AMR-NB codec and Optional for AMR-WB codec. May be present for capability exchange, logical channel signalling and RequestMode messages.
Parameter type	booleanArray
Supersedes	–

Table R.5/H.245 – GSM AMR Capability Parameter – modeSetExtended

Parameter name	modeSetExtended
Parameter description	This is a collapsing booleanArray GenericParameter. If present, the Least Significant Bit must be set to denote that 9th mode (23.85 kbit/s) of AMR-WB is available. This parameter shall be absent if 9th mode is not supported. This parameter is not used for AMR-NB and shall be ignored if received. For AMR-WB codec, Bit 8 (value 1) – If set, indicates 23.85 kbit/s. All other bits are reserved, shall be set to 0, and shall be ignored by receivers. In capability exchange, this parameter indicates supported modes and in logical channel signalling, indicates modes to be used for the current session.
Parameter identifier value	2
Parameter status	Optional. May be present for capability exchange, logical channel signalling and RequestMode messages.
Parameter type	booleanArray
Supersedes	–

Table R.6/H.245 – GSM AMR Capability Parameter – modeChangePeriod

Parameter name	modeChangePeriod
Parameter description	This is a collapsing GenericParameter. It specifies the interval N (as number of frame-blocks) at which the mode changes are allowed. The initial phase is arbitrary, but the mode changes must be separated by multiple of N frame-blocks.
Parameter identifier value	3
Parameter status	Shall be present for capability exchange, logical channel signalling and may be present for RequestMode messages.
Parameter type	unsignedMax
Supersedes	–

Table R.7/H.245 – GSM AMR Capability Parameter – modeChangeAny

Parameter name	modeChangeAny
Parameter description	This is a collapsing GenericParameter. If present, it specifies that mode changes are allowed to any mode specified in modeSet parameter. If absent, mode changes are allowed only to the neighboring modes within the specified modeSet.
Parameter identifier value	4
Parameter status	Optional. May be present for capability exchange, logical channel signalling and RequestMode messages.
Parameter type	logical
Supersedes	–

Table R.8/H.245 – GSM AMR Capability Parameter – AlSduAudioFrames

Parameter name	AlSduAudioFrames
Parameter description	This is a collapsing GenericParameter. If present, this parameter specifies the maximum number of audio frames per AL-SDU. If not present, the number of frames will be 1.
Parameter identifier value	5
Parameter status	Optional. May be present for capability exchange, logical channel signalling and RequestMode messages. When used in Capability exchange message, specifies the maximum number of frames supported in a RTP packet. Otherwise, represents the number of frames to be used in the current session. In the capability exchange, this parameter represents maxptime and in logical channel signalling it represents ptime as defined in RFC 3267.
Parameter type	unsignedMin
Supersedes	–

Table R.9/H.245 – GSM AMR Capability Parameter – Interleaving

Parameter name	Interleaving
Parameter description	This is a collapsing GenericParameter. If present, it specifies that frame level interleaving shall be applied for the payloads of this session, and the value specifies the maximum number of frames in an interleaving group. If not present, frames in the payload are not interleaved. Interleaving is supported only with octet-aligned mode of operation. This parameter shall be absent if octetAlign parameter is absent.
Parameter identifier value	6
Parameter status	Optional. May be present for capability exchange, logical channel signalling and RequestMode messages.
Parameter type	unsignedMin
Supersedes	–

Table R.10/H.245 – GSM AMR Capability Parameter – numChannels

Parameter name	numChannels
Parameter description	This is a collapsing GenericParameter. If present, specifies the number of audio channels. If not specified, it has the default value of 1.
Parameter identifier value	7
Parameter status	Optional. May be present for capability exchange, logical channel signalling and RequestMode messages. When used in Capability exchange message, specifies the maximum number of channels supported. Otherwise, represents the number of channels to be used in the current session. If this parameter is not present, then the numChannels is 1.
Parameter type	unsignedMin
Supersedes	–

Annex S

Internet Low Bit Rate Codec (iLBC) Capability Definitions

(This annex forms an integral part of this Recommendation)

S.1 Introduction

The IETF has completed the work on iLBC and it has been published as an experimental RFC. Even though its status is marked as "experimental", the codec has gained acceptance by a number of VoIP equipment and software manufacturers who are looking for a royalty-free codec with acceptable audio quality for use with VoIP systems. While royalty-free codecs exist from the ITU, iLBC is favoured by some due to the fact that it has built-in error correction functionality that helps it perform better in networks with higher packet loss.

The capability identifier defined in Table S.1 is allocated to provide support for the Internet Low Bit Rate codec as defined in RFC 3951. Tables S.2 and S.3 define the associated capability parameters. The RTP media packetization is defined in RFC 3952.

S.2 Description

Table S.1/H.245 – Capability Identifier for iLBC Capability

Capability name	iLBC
Capability class	Audio codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) audio(1) ilbc(11)}`
maxBitRate	This parameter is optional.
collapsing	This field may be present and consisting of the parameters defined below.
nonCollapsing	This field shall not be included and shall be ignored if received.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

Table S.2/H.245 – iLBC Capability Parameter – MaxFramesPerPacket

Parameter name	MaxFramesPerPacket
Parameter description	This is a collapsing capability. This parameter specifies the maximum number of frames per packet.
Parameter identifier value	0
Parameter status	Optional. If absent, it is assumed that the maximum number of frames per packet is 1.
Parameter type	unsignedMin
Supersedes	–

Table S.3/H.245 – iLBC Capability Parameter – Mode

Parameter name	Mode
Parameter description	This is a collapsing capability. This parameter indicates whether the frame size is 20 ms or 30 ms. The value of this field shall be 20 or 30, with 20 indicating that both 20 and 30 ms framings are supported.
Parameter identifier value	1
Parameter status	Optional. If absent, the frame size shall be 30 ms.
Parameter type	unsignedMax
Supersedes	–

Section 5 of RFC 3952 specifies that devices shall operate in a symmetric fashion with respect to frame size. Further, if either side has a preference to transmit at a lower bit rate, then both sides shall transmit at the lower bit rate. The lowest bit rate is the 30 ms mode.

For H.323, this means that for a single RTP session (identified by H.245's **sessionID** parameter), both devices need to utilize the same mode, regardless of what is indicated within the Open Logical Channel request. If one endpoint transmits an Open Logical Channel with a mode of 20 ms specified and the other endpoint simultaneously transmits and Open Logical Channel with a mode of 30 ms specified, then the two endpoints shall operate using a mode of 30 ms.

A device that wishes to operate with a mode of 30 ms and having received an OLC proposing a mode of 20 ms shall transmit its OLC before returning an OLCAck for an incoming request proposing a mode of 20 ms for the same session. In this way, devices can avoid awkward transitions from 20 ms to 30 ms framing.

In the event that a channel has already been opened and an endpoint wishes to transition the media stream to use a different framing mode, an endpoint shall use the **RequestMode** message to request a transition. Since an iLBC implementation can determine the current mode by inspecting the media stream, there is no need for signalling to close and re-open the media channel. The recipient of the **RequestMode** may accept or reject the new requested mode. Upon receipt of the requested mode change, the recipient shall transmit a **RequestModeAck** indicating a response of **willTransmitMostPreferredMode** if it accepts the request. When the requester detects the new mode in the media flow or when it receives the **RequestModeAck** message, it shall also transmit media packets using the new mode. If the requested mode is not accepted, the recipient of the **RequestMode** shall transmit a **RequestModeReject** with a reason of **requestDenied**.

A device shall not indicate other reasons other than **requestDenied** in the **RequestModeReject**.

Appendix I

Overview of ASN.1 syntax

(This appendix does not form an integral part of this Recommendation)

I.1 Introduction to ASN.1

Abstract Syntax Notation One (ASN.1) is a data specification language. It was originally standardized as part of the ITU-T X.400 electronic mail series as ITU-T X.409. This evolved to ITU-T X.208 and most recently ITU-T X.680. ASN.1 allows unambiguous specification of complex data structures including those with variable-length fields, optional fields and recursion.

The above Recommendations deal only with the syntax and semantics of ASN.1 specifications. The binary encoding of data structures is covered in other Recommendations, notably ITU-T X.690 (basic encoding rules or BER) and ITU-T X.691 (packed encoding rules or PER). BER allows data to be deciphered by systems that have general knowledge of ASN.1 but do not know the details of the specification used to form the data. In other words, the data types are encoded along with the data values. PER is much more efficient since only data values are encoded and the coding is designed with very little redundancy. This method can be used when both the transmitter and the receiver expect data to adhere to a known structure.

This Recommendation is implemented using the packed encoding rules. Since both sides of a call know that messages will conform to the ITU-T H.245 specification, it is not necessary to encode that specification into the messages. For decoding simplicity, the aligned variant of PER is used. This forces fields that require eight or more bits to be aligned on octet boundaries and to consume an integral number of octets. Alignment is done by padding the data with zeros before large fields.

I.2 Basic ASN.1 data types

The simplest data type is BOOLEAN, which represents the values `FALSE` and `TRUE`. These are encoded in a single bit as 0 and 1, respectively. For example, `segmentableFlag BOOLEAN` is coded:

Value	Encoding
`FALSE`	0
`TRUE`	1

The most fundamental data type is INTEGER, which represents whole number values. Integers can be unconstrained as in:

```
bitRate                           INTEGER
```

or they can be constrained to a range of values, for example:

```
maximumAl2SDUSize                 INTEGER (0..65535)
```

Constrained integers are encoded differently depending on the size of the range. Suppose N is the number of integers in the range, i.e., the upper limit minus the lower limit plus one. Depending on N, the constrained integer will be encoded in one of five ways:

N	Encoding
1	no bits needed
2-255	an unaligned field of 1 to 8 bits
256	an aligned 8-bit field
257-65536	an aligned 16-bit field
larger	as the minimum number of aligned octets preceded by the above encoding of the number of octets

In all cases, the number that is actually used is the value to be encoded minus the lower limit of the range. In these examples "pad" represents zero to seven 0 bits that are added to the encoding so that the following field will start on a 8-bit boundary.

```
firstGOB            INTEGER (0..17)
```

Value	Encoding
0	00000
3	00011

```
h233IVResponseTime      INTEGER (0..255)
```

Value	Encoding
3	pad 00000011
254	pad 11111110

```
skew                INTEGER (0..4095)
```

Value	Encoding
3	pad 00000000 00000011
4095	pad 00001111 11111111

Unconstrained (2's complement) integer values that can be represented in 127 octets or less are encoded in the minimum number of octets needed. The number of octets (the length) is encoded as an aligned octet that precedes the number itself. For example:

–1	pad 00000001 11111111
0	pad 00000001 00000000
128	pad 00000010 00000000 10000000
1000000	pad 00000011 00001111 01000010 01000000

ASN.1 supports a variety of string data types. These are variable-length lists of bits, octets or other short data types. They are typically encoded as a length followed by the data. The length can be encoded as an unconstrained integer or as a constrained integer if the SIZE of the string is specified. For example:

```
data                    OCTET STRING
```

Since the length of the octet string is not bounded, it will have to be encoded as a *semi-constrained whole number* (has a lower bound, but no upper bound). First, the data is padded so that the encoding will be aligned. The rest of the code is as follows:

Length	Encoding
0 to 127	8-bit length followed by the data
128 to 16K – 1	16-bit length with the MSB set, then the data
16K to 32K – 1	11000001, 16K octets of data, then code the rest
32K to 48K – 1	11000010, 32K octets of data, then code the rest
48K to 64K – 1	11000011, 48K octets of data, then code the rest
64K or more	11000100, 64K octets of data, then code the rest

This method is called "fragmentation". Note that if the length is a multiple of 16K, then the representation will end with an octet of zero indicating a zero-length string.

I.3 Aggregate data types

ASN.1 includes several aggregate or container data types that are similar in concept to C's union, struct and array types. These are, respectively, **CHOICE**, **SEQUENCE** and **SEQUENCE OF**. In all cases they are encoded with some bits specific to the container followed by the normal encodings of the contents.

CHOICE is used to select exactly one of a group of data types. For example:

```
VideoCapability ::= CHOICE
{
    nonStandard                 NonStandardParameter,
    h261VideoCapability         H261VideoCapability,
    h262VideoCapability         H262VideoCapability,
    h263VideoCapability         H263VideoCapability,
    is11172VideoCapability      IS11172VideoCapability,
    ...
}
```

An index number is assigned to each choice, starting with zero. The index of the actual choice is encoded as a constrained integer. The index is followed by the encoding of the actual selection or nothing if the selection is **NULL**. If the extension marker is present (as above), the index is preceded by a bit that is zero if the actual choice is from the original list.

SEQUENCE is simply a grouping of dissimilar data types. Individual elements of the sequence may be **OPTIONAL**. The encoding is very simple. If there is an extension marker the first bit indicates the presence of additional elements. This is followed by a series of bits, one for each optional element that indicates if that data is present. This is followed by the encodings of the components of the sequence. For example:

```
H261VideoCapability ::= SEQUENCE
{
qcifMPI                          INTEGER (1..4) OPTIONAL, -- units 1/29.97 Hz
cifMPI                           INTEGER (1..4) OPTIONAL, -- units 1/29.97 Hz
temporalSpatialTradeOffCapability  BOOLEAN,
    ...
}
```

The encoding has one bit for the extension marker, two bits for the optional fields, two bits each for any optional field that is present, one bit for the boolean and then any extension data. Note that in this sequence has no padding for octet alignment.

The **SEQUENCE OF** and **SET OF** types describe a collection of similar components (an array). **SEQUENCE OF** implies that the order of the elements is significant, with **SET OF** the element order is arbitrary. The PER encoding is the same for both types.

These types can have a **SIZE** constraint or an unconstrained number of elements. If the number is known *a priori* and is less than 64K, it is not encoded. Otherwise the actual number of components is encoded as a constrained or semi-constrained length. This is followed by the encoding of the data. If the length is at least 16K and is encoded then the list of data will be broken into fragments like the octet string. In this case the fragments are broken after some number of component fields (16K, 32K, etc.), not after some number of octets.

I.4 Object identifier type

Normally the type of a value is given in the ASN.1 specification so that the only information that needs to be coded and transmitted is the data itself. Occasionally, however, it is desirable to encode the data type as well as the data value. For example, **protocolIdentifier** contains

```
protocolIdentifier      OBJECT IDENTIFIER,
                        -- shall be set to the value
                        -- {itu-t (0) recommendation (0) h (8) 245 version (0) 1}
```

All integers appearing within the braces **{}** are encoded, both those within and without parenthesis **()**. In this example the integers 0, 0, 8, 245, 0, 1 are to be encoded.

This is encoded as the data encoded with the BER (ITU-T X.690) preceded by the length of that encoding in octets. The length is encoded as a semi-constrained whole number (see the **OCTET STRING** example above). The following illustrates how this is encoded.

The first octet indicates the length of the encoding that follows.

The first two components of the object identifier are combined together as 40*first one + second one, in this case 40 * 0 + 0 = 0. The others are encoded as they are. Each is encoded into a series of octets, the first bit of which indicates whether there is any more. So:

0 → 0000 0000

8 → 0000 1000

while 245, being more than 127 becomes 1000 0001 0111 0101.

So the entire encoding in hexadecimal consists of the seven octets 06000881 750001.

Appendix II

Examples of H.245 procedures

(This appendix does not form an integral part of this Recommendation)

II.1 Introduction

This appendix illustrates examples of the procedures defined in Annex C. Figure II.1-1 shows the key to diagrams used in this appendix.

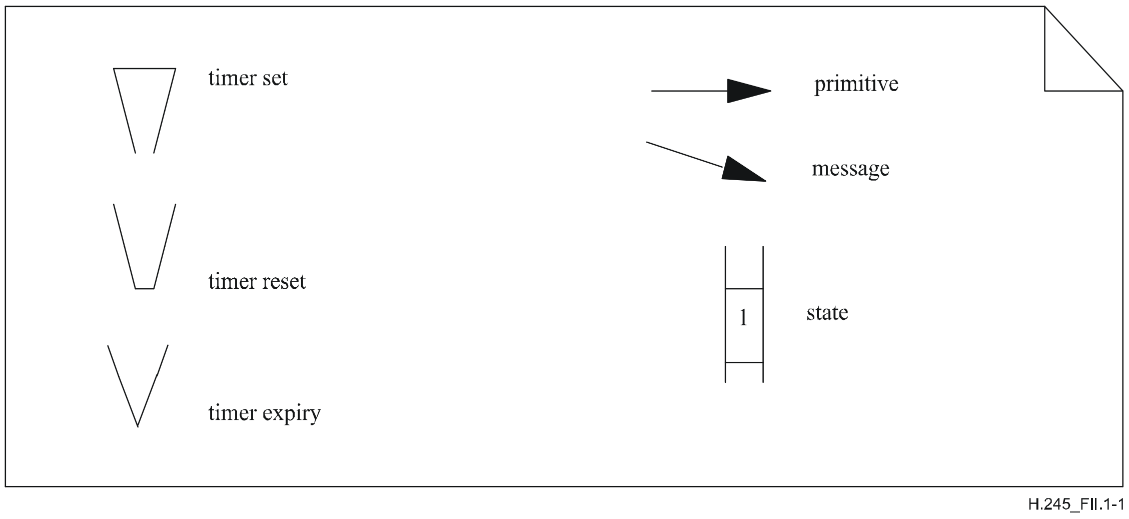


Figure II.1-1/H.245 – Key to figures

II.2 Master-slave Determination Signalling Entity

In Figures II.2-1 to II.2-10 messages are represented by the shortened names given in Table II.2-1.

Table II.2-1/H.245 – Master-slave determination shortened names

Message	Name in examples
MasterSlaveDetermination	MSD
MasterSlaveDeterminationAck	MSDAck
MasterSlaveDeterminationReject	MSDReject
MasterSlaveDeterminationRelease	MSDRelease

In Figures II.2-1 to II.2-10, IDLE, OUTGOING AWAITING RESPONSE, and INCOMING AWAITING RESPONSE states are labelled as "0", "1", and "2", respectively.

In the following figures, the parameter value associated with the DETERMINE.indication and DETERMINE.confirm primitives is that of the TYPE parameter. The field value associated with the MasterSlaveDeterminationAck message is that of the decision field.

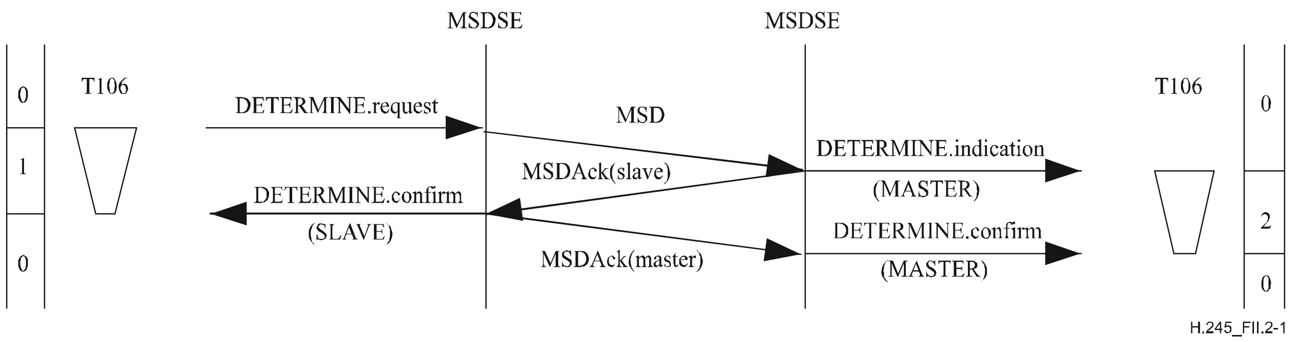


Figure II.2-1/H.245 – Master-slave determination – Master at remote MSDSE

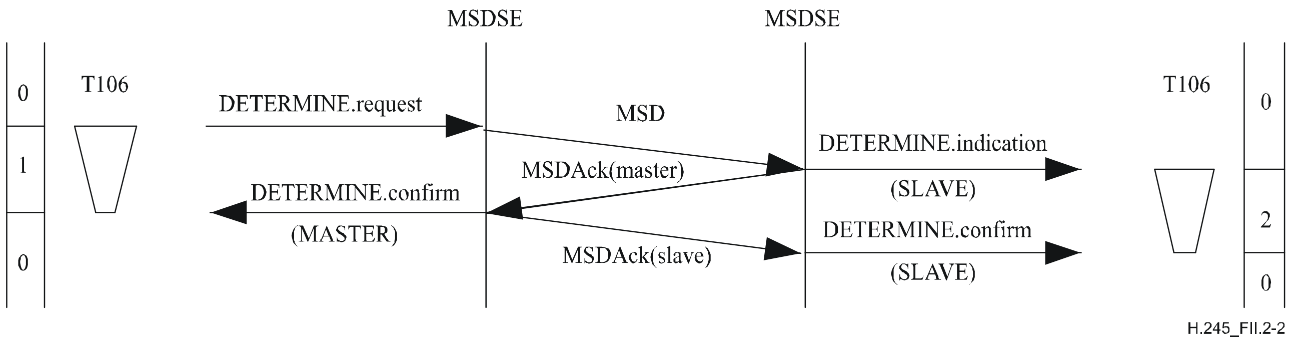


Figure II.2-2/H.245 – Master-slave determination – Slave at remote MSDSE

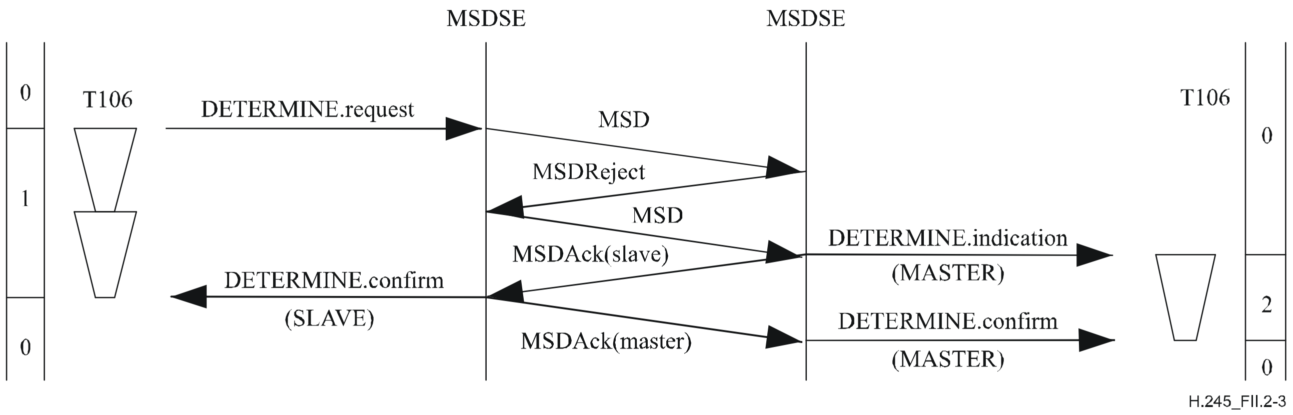


Figure II.2-3/H.245 – Master-slave determination – First attempt produced an indeterminate result. The second attempt was successful

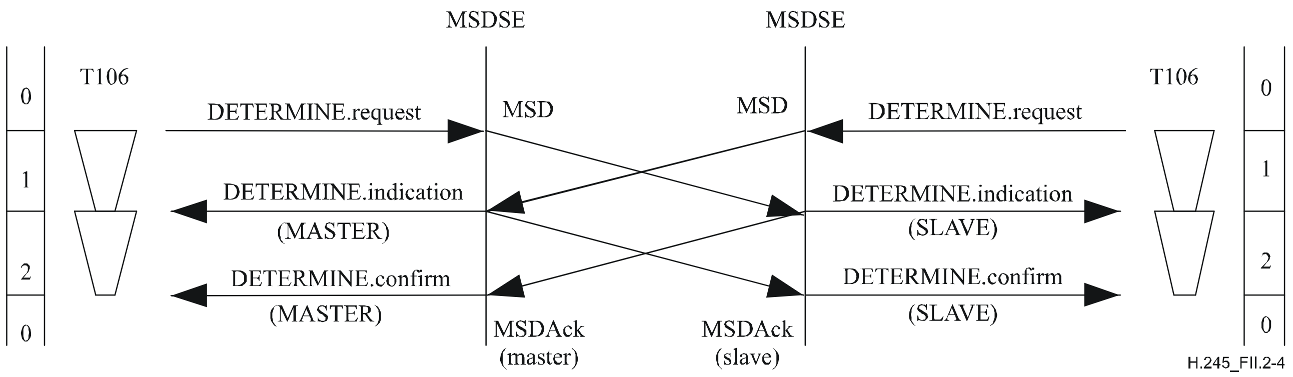


Figure II.2-4/H.245 – Master-slave determination – Simultaneous determination

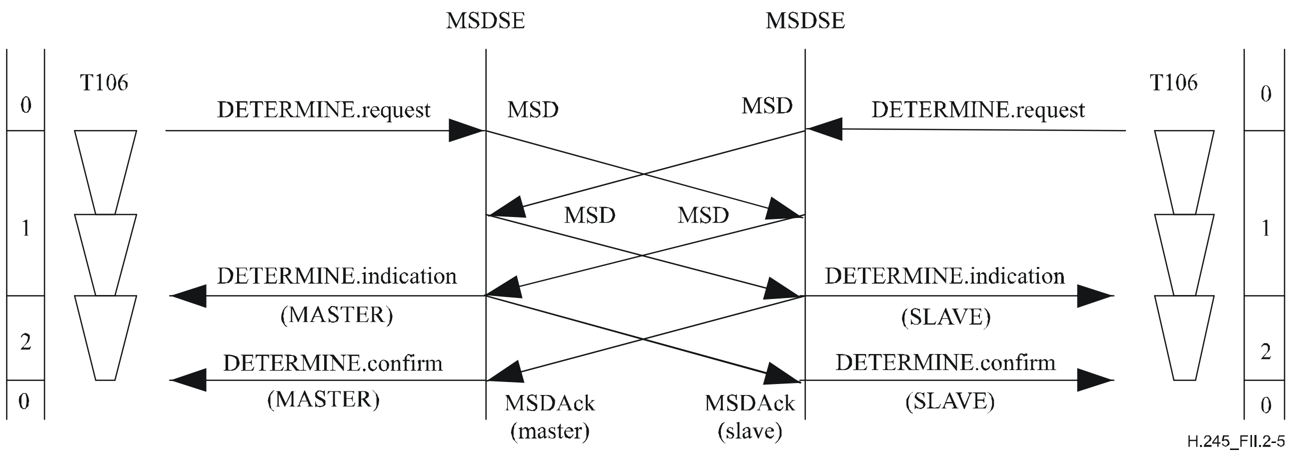


Figure II.2-5/H.245 – Master-slave determination – Simultaneous determination but with the first attempt returning an indeterminate result

In Figure II.2-6, local timer T106 has expired. Only the terminal on the right knows its status. The terminal on the right is able to receive new commands but may not request anything of the other terminal that relies on knowledge of the status determination result. The terminal on the left can neither accept nor initiate new procedures. A second status determination procedure should be initiated.

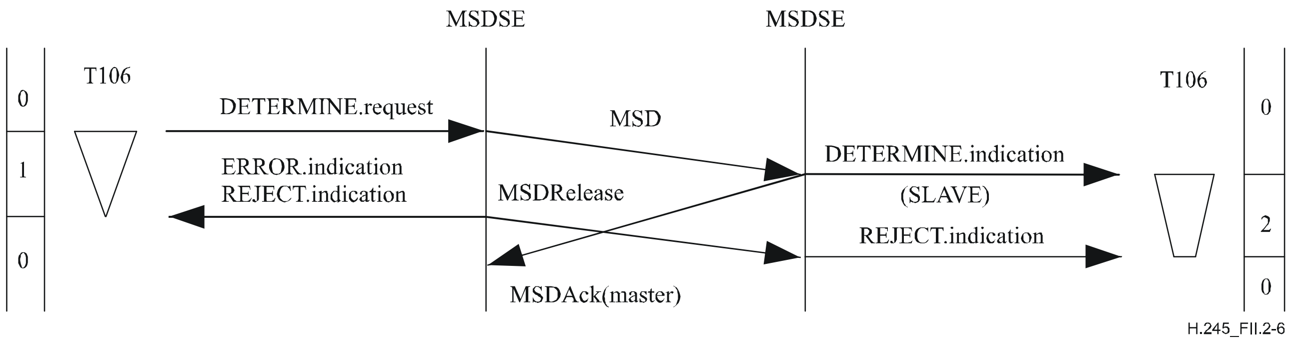


Figure II.2-6/H.245 – Master-slave determination – Local timer T106 expiry with slave at remote end

In Figure II.2-7, remote timer T106 has expired during the INCOMING AWAITING ACKNOWLEDGEMENT state. Both terminals know their status. The terminal on the left may receive and issue commands. However, the remote terminal does not know if the local terminal is ready to receive, and cannot issue commands that rely on knowledge of the status determination result. A second status determination procedure should be initiated.

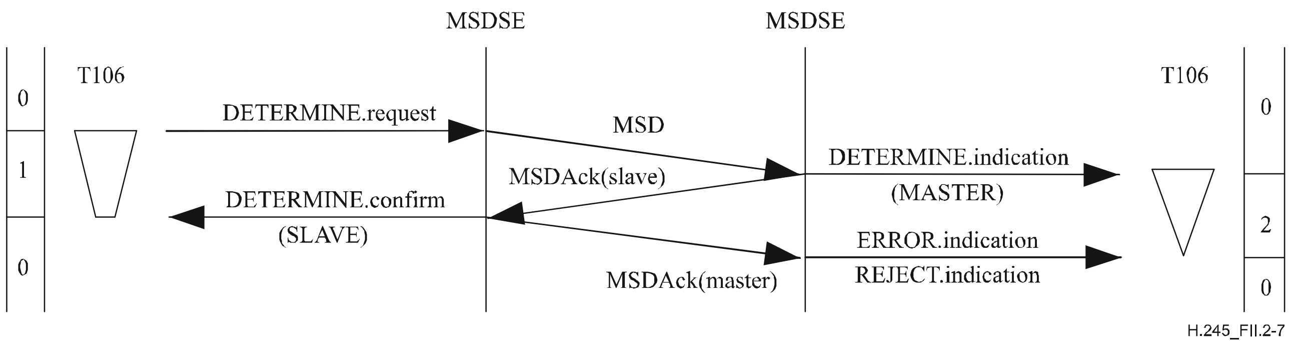


Figure II.2-7/H.245 – Master-slave determination – Remote timer T106 expiry with master at remote end

In Figure II.2-8, remote timer T106 has expired during the OUTGOING AWAITING ACKNOWLEDGEMENT state during a simultaneous determination procedure. Both terminals know their status. The terminal on the right can receive and issue commands. However, the terminal on the left does not know if the other terminal is ready to receive, and cannot issue commands that rely on knowledge of the status determination result. It may receive such commands. A second status determination procedure should be initiated.

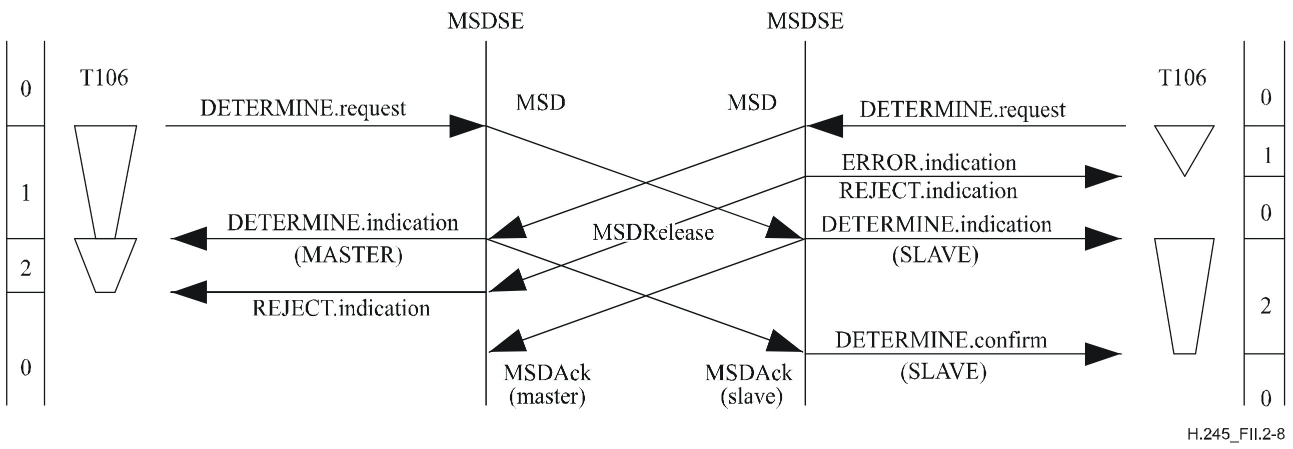


Figure II.2-8/H.245 – Master-slave determination – Simultaneous determination procedures with timer T106 expiry at slave

In Figure II.2-9, remote timer T106 has expired during the INCOMING AWAITING ACKNOWLEDGEMENT state, during a simultaneous determination procedure. Both terminals know their status. The terminal on the left can receive and issue commands. However, the terminal on the right does not know if the other terminal is ready to receive, and cannot issue commands that rely on knowledge of the status determination result. It may receive such commands. A second status determination procedure should be initiated.

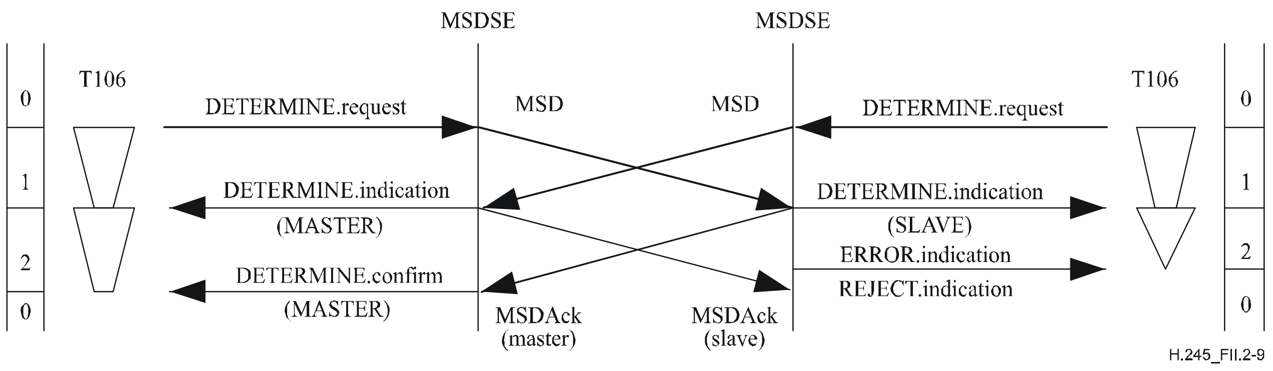


Figure II.2-9/H.245 – Master-slave determination – Simultaneous determination procedures with timer T106 expiry during INCOMING AWAITING ACKNOWLEDGEMENT

In Figure II.2-10, an indeterminate result was obtained N100 times. In this case, N100 = 3.

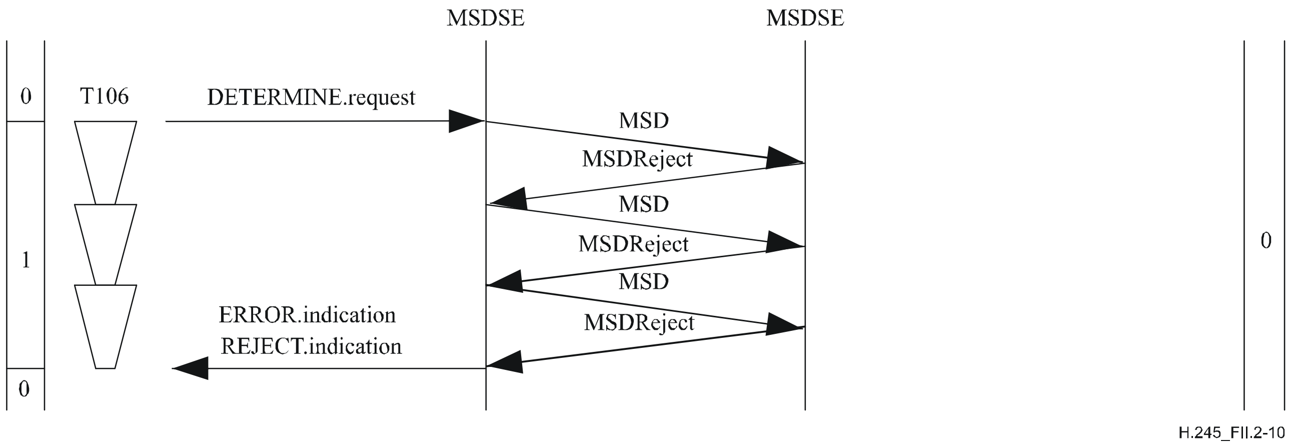


Figure II.2-10/H.245 – Master-slave determination – Indeterminate result with N100 = 3

II.3 Capability Exchange Signalling Entity

Figures II.3-1 to II.3-4 illustrate CESE procedures. The IDLE and AWAITING RESPONSE states are labelled as "0" and "1", respectively.

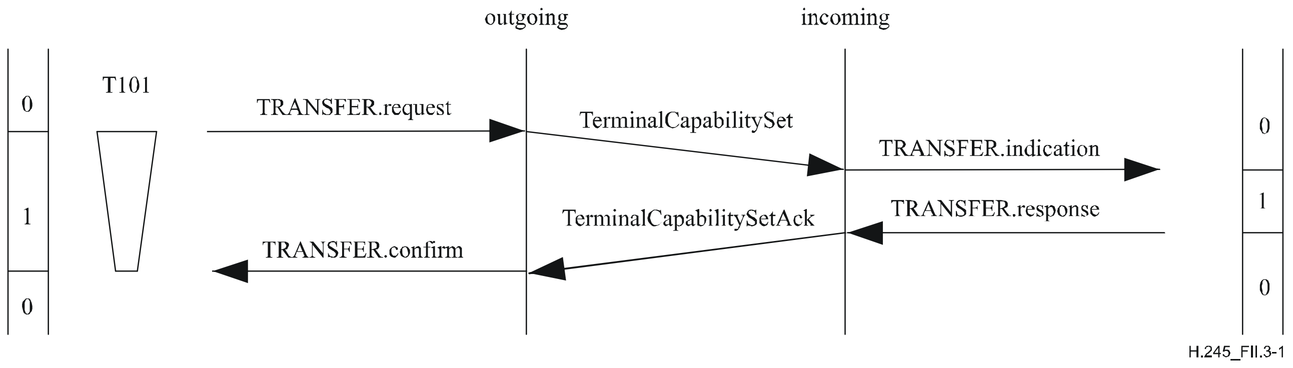


Figure II.3-1/H.245 – Capability exchange with acceptance from the peer incoming CESE user

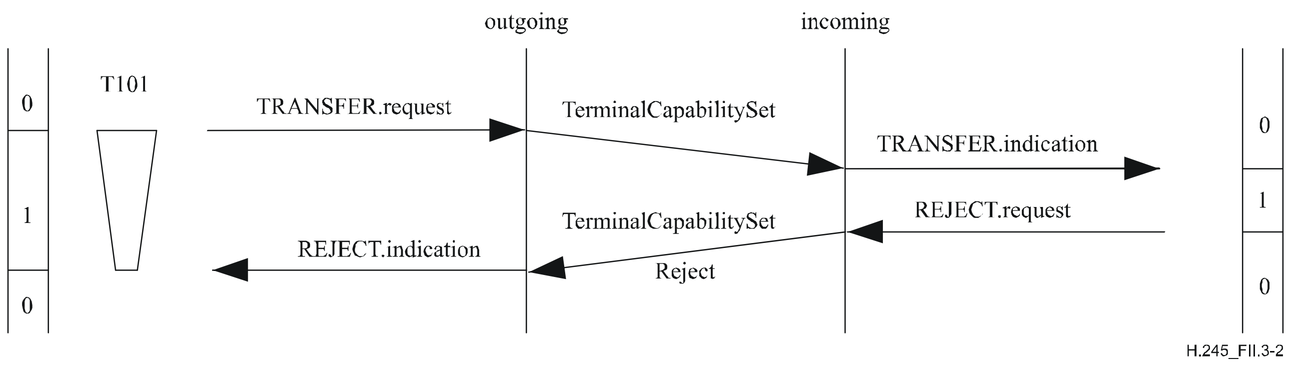
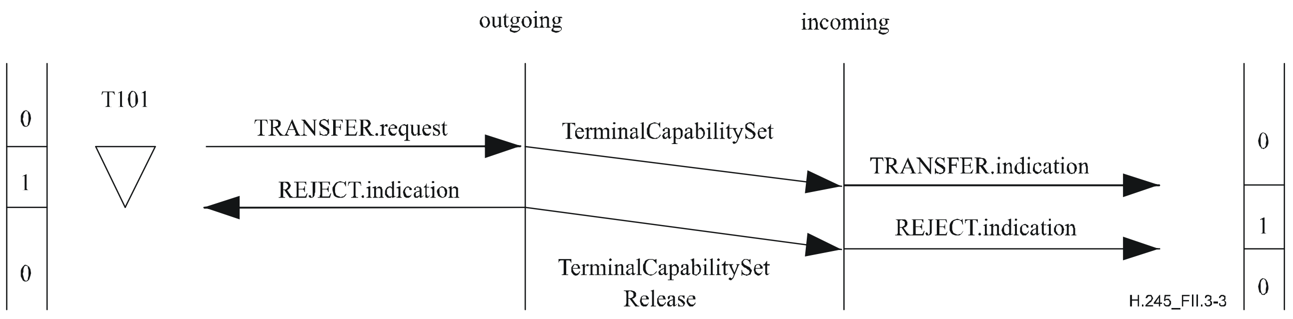
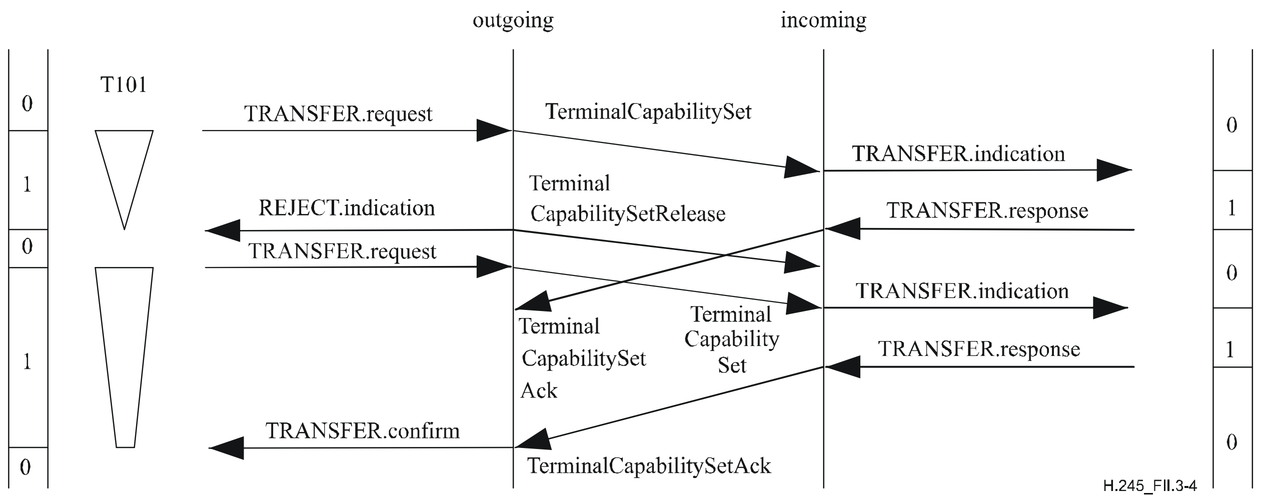


Figure II.3-2/H.245 – Capability exchange with rejection from peer incoming CESE user



NOTE – The TerminalCapabilitySetRelease message arrives at the incoming CESE before response from the incoming CESE user.

Figure II.3-3/H.245 – Capability exchange with timer T101 expiry



NOTE – The TerminalCapabilitySetRelease message arrives at the incoming CESE after response from the incoming CESE user. At the outgoing CESE the TerminalCapabilitySetAck message in response to the first TerminalCapabilitySet message is ignored. Only the second capability exchange is successful.

Figure II.3-4/H.245 – Capability exchange with timer T101 expiry followed by a second capability exchange

II.4 Logical Channel Signalling Entity

Figures II.4-1 to II.4-7 illustrate LCSE procedures. The outgoing LCSE states of RELEASED, AWAITING ESTABLISHMENT, ESTABLISHED, and AWAITING RELEASE are labelled as "0", "1", "2", and "3", respectively. The incoming LCSE states of RELEASED, AWAITING ESTABLISHMENT, and ESTABLISHED, are labelled as "0", "1", and "2", respectively.

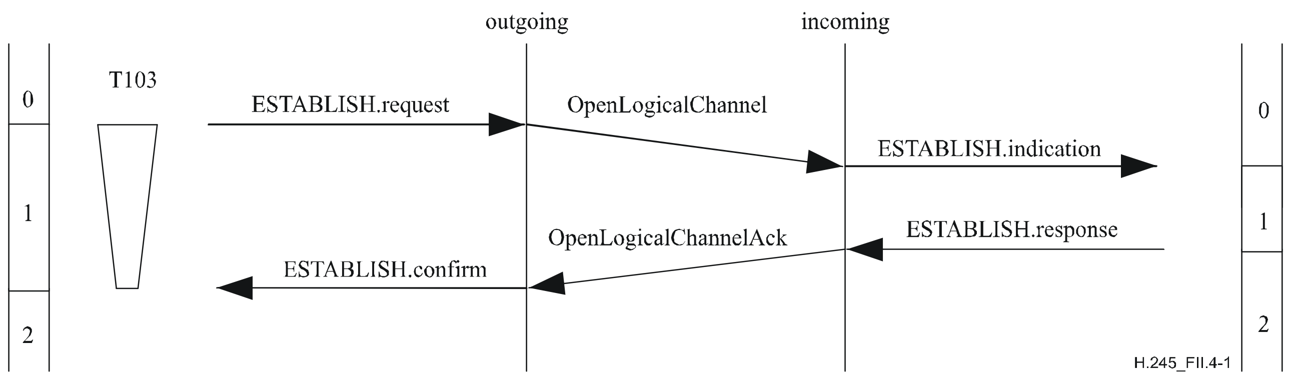


Figure II.4-1/H.245 – Logical channel establishment

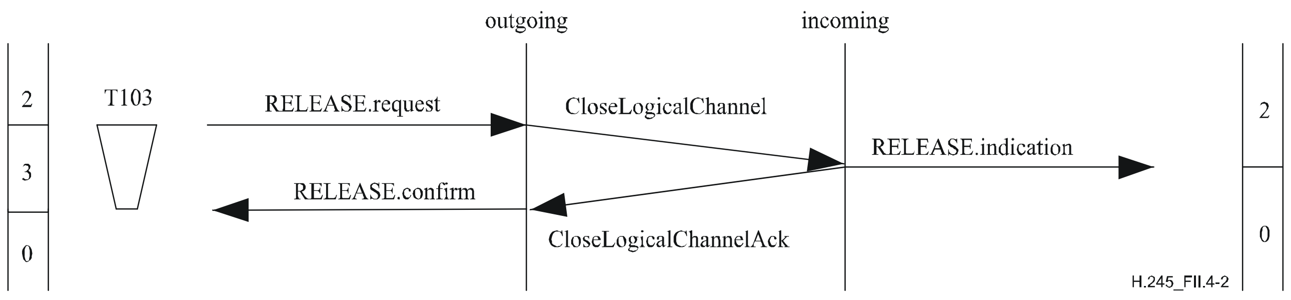


Figure II.4-2/H.245 – Logical channel release

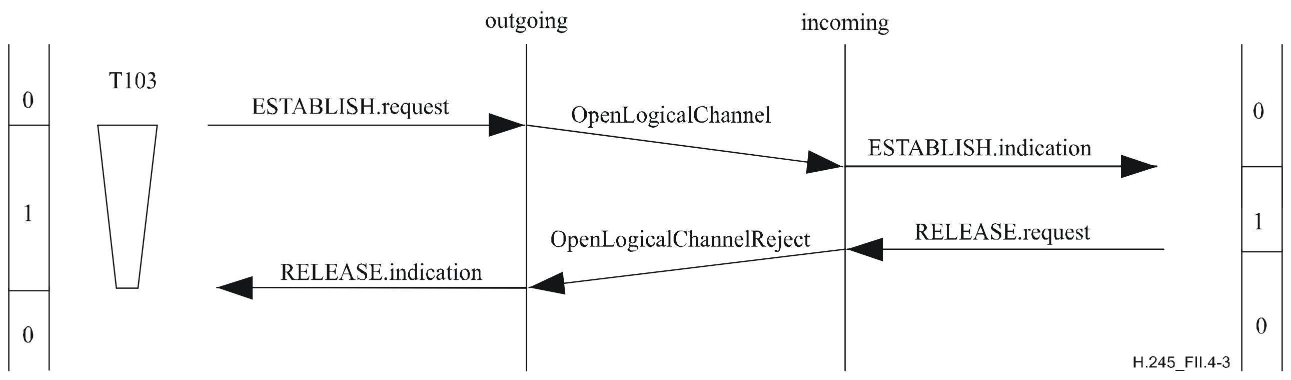


Figure II.4-3/H.245 – Logical channel establishment rejection by peer LCSE user

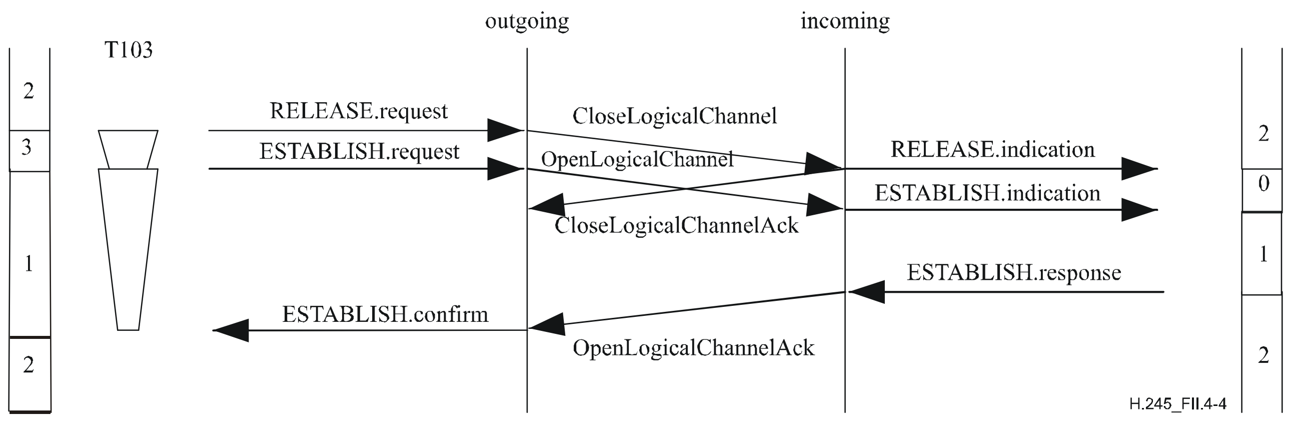


Figure II.4-4/H.245 – Logical channel release followed by immediate re-establishment

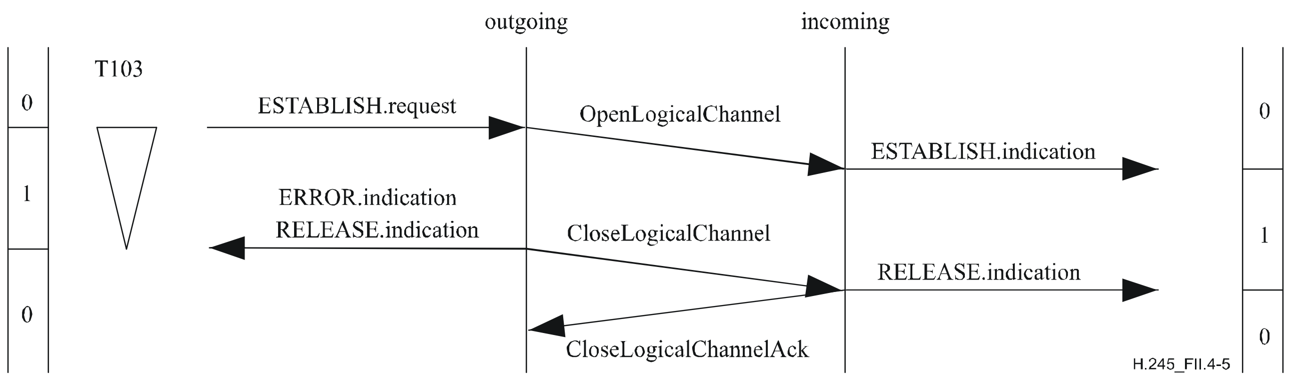
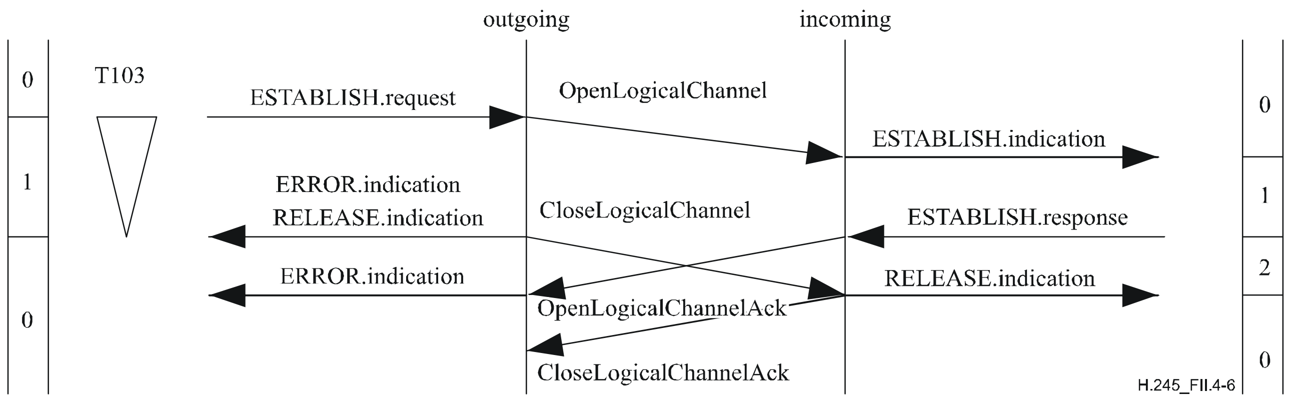


Figure II.4-5/H.245 – Logical channel establishment request with expiry of timer T103 due to slow response from peer incoming LCSE user



NOTE – Timer T103 has expired after transmission of the OpenLogicalChannelAck message at the incoming LCSE, but before reception of the OpenLogicalChannelAck message at the outgoing LCSE.

Figure II.4-6/H.245 – Logical channel establishment request with expiry of timer T103

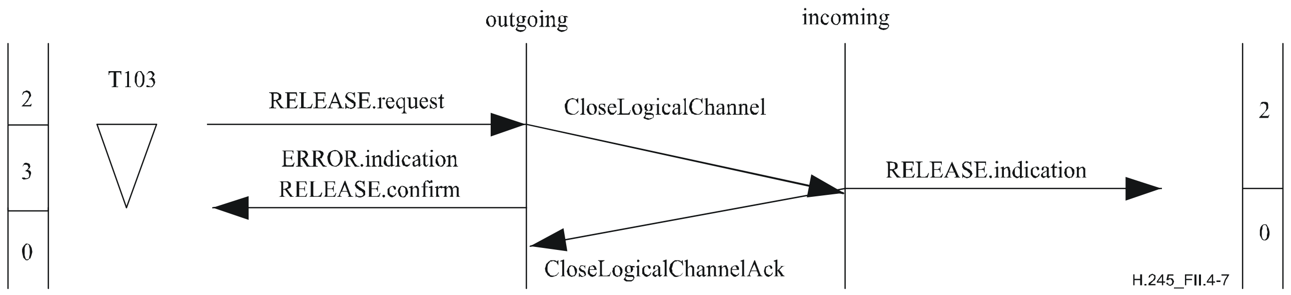


Figure II.4-7/H.245 – Logical channel release request with expiry of timer T103

II.5 Close Logical Channel Signalling Entity

Figures II.5-1 to II.5-4 illustrate CLCSE procedures. The IDLE and AWAITING RESPONSE states are labelled as "0" and "1", respectively.

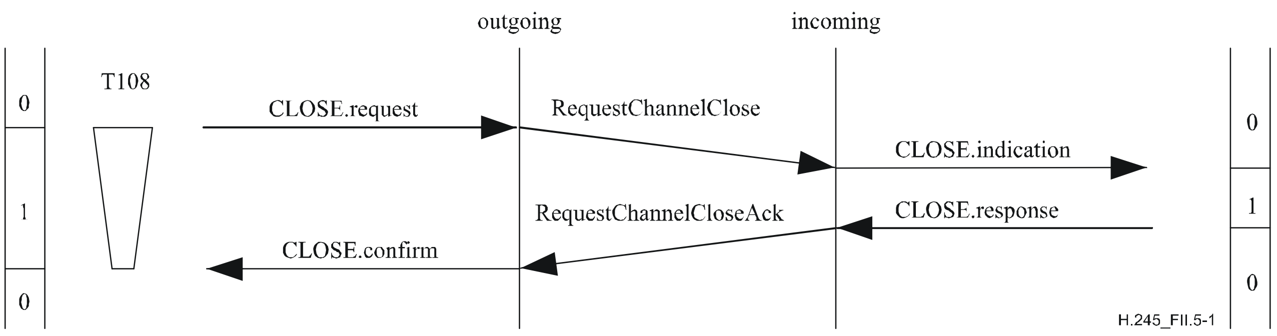


Figure II.5-1/H.245 – Close logical channel request

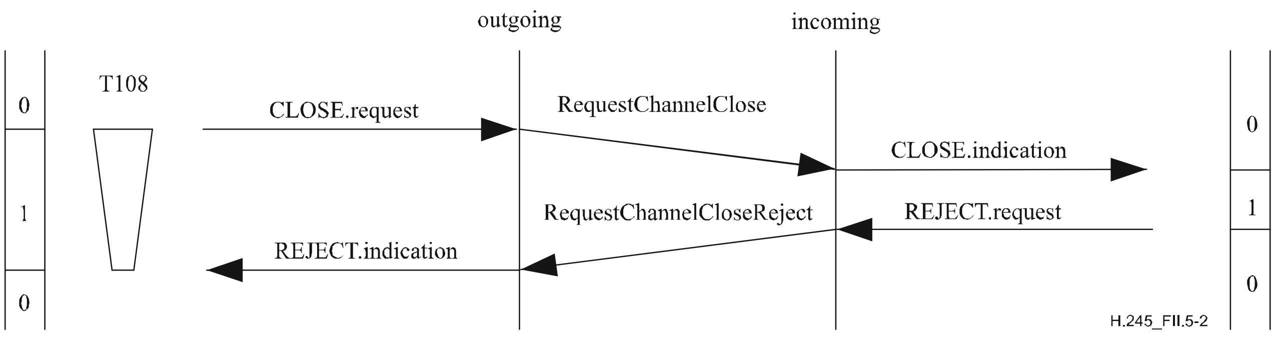
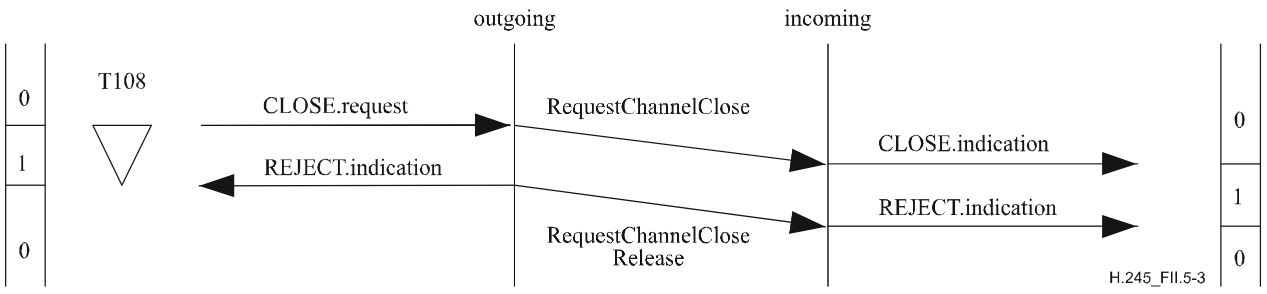
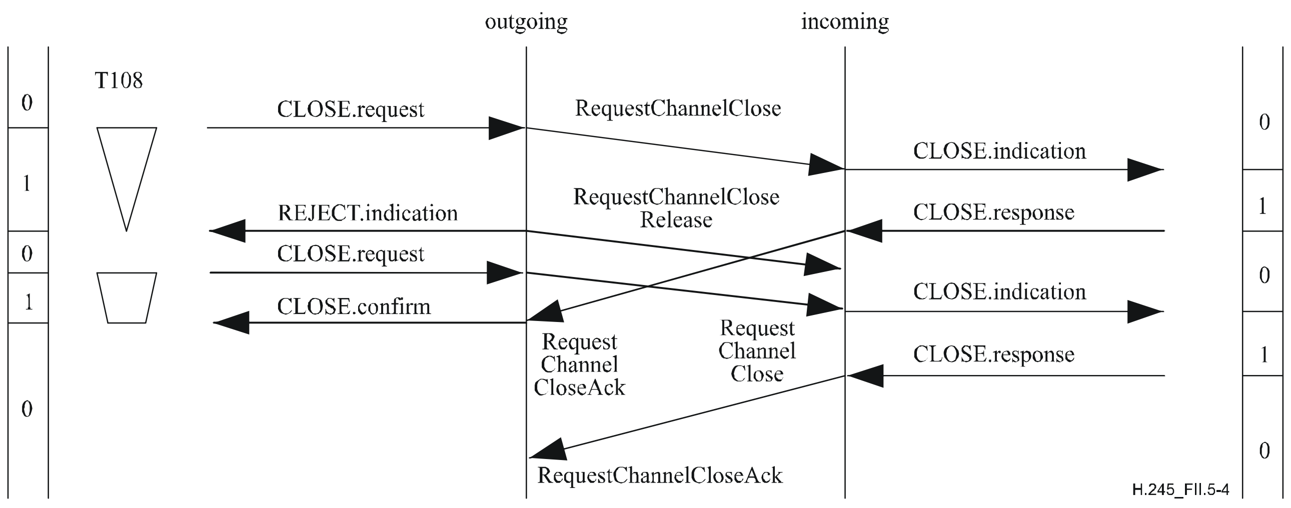


Figure II.5-2/H.245 – Close logical channel request with rejection from peer incoming CLCSE user



NOTE – The RequestChannelCloseRelease message arrives at the incoming CLCSE before response from the incoming CLCSE user.

Figure II.5-3/H.245 – Close logical channel request with timer T108 expiry



NOTE – The close channel request is confirmed on reception of the first RequestChannelClose message.

Figure II.5-4/H.245 – Close logical channel request with timer T108 expiry followed by a second close logical channel request

II.6 Multiplex Table Signalling Entity

Figures II.6-1 to II.6-5 illustrate MTSE procedures. The IDLE and AWAITING RESPONSE states are labelled as "0" and "1", respectively.

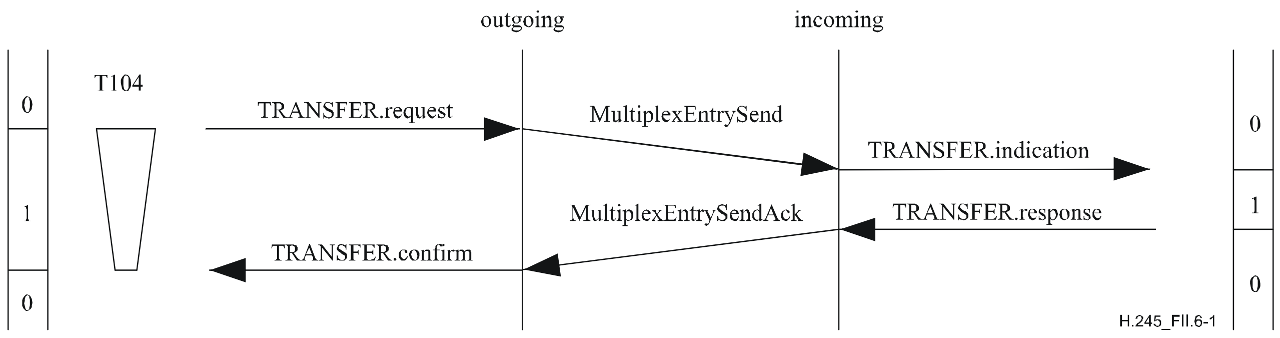


Figure II.6-1/H.245 – Successful multiplex table send request

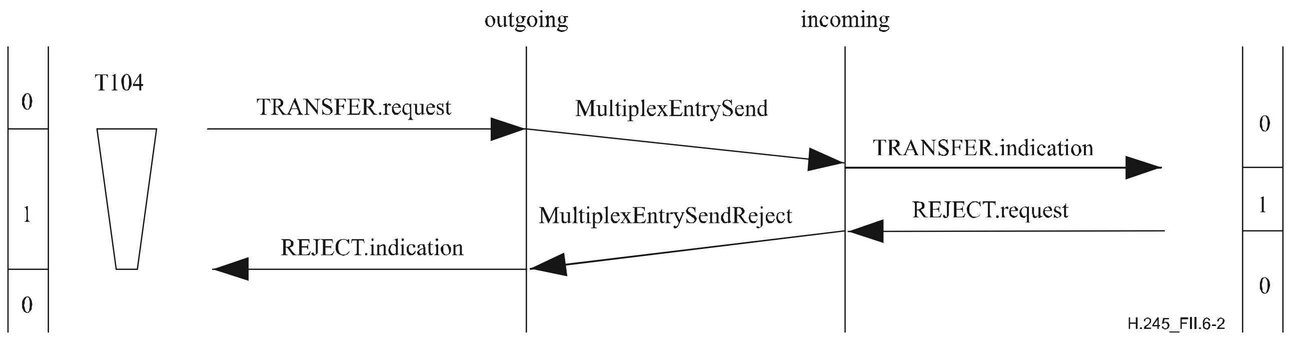
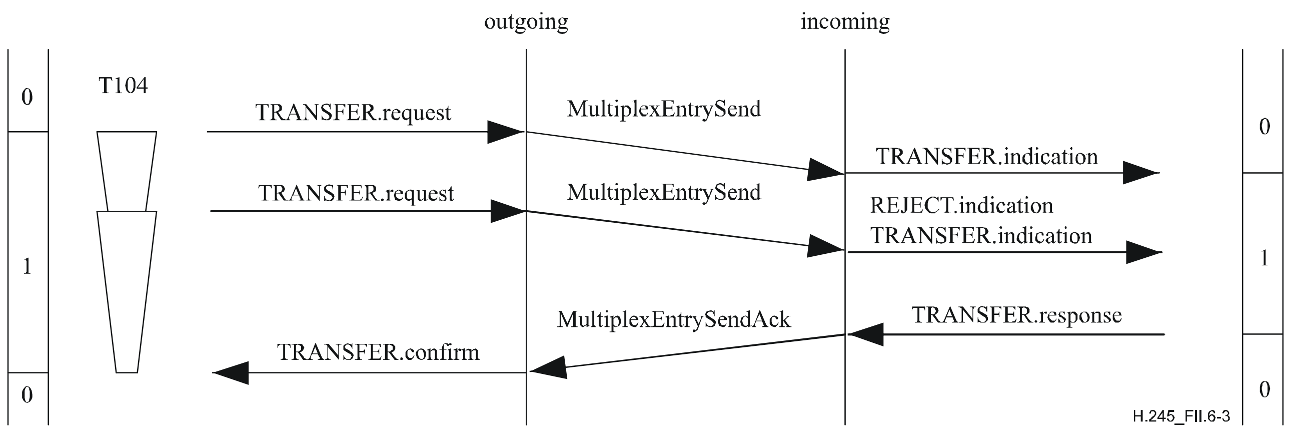


Figure II.6-2/H.245 – Multiplex table send request with rejection from the peer MTSE user



NOTE – The first request was unsuccessful.

Figure II.6-3/H.245 – Multiplex table send request with a second multiplex table send request before acknowledgement of the first request

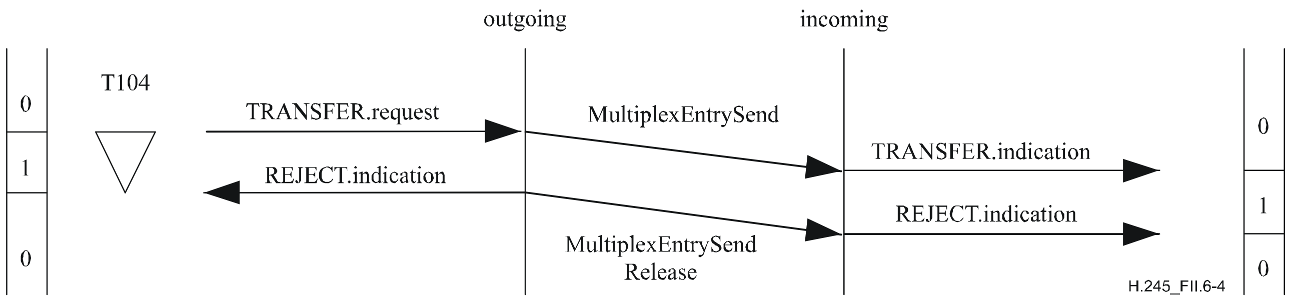
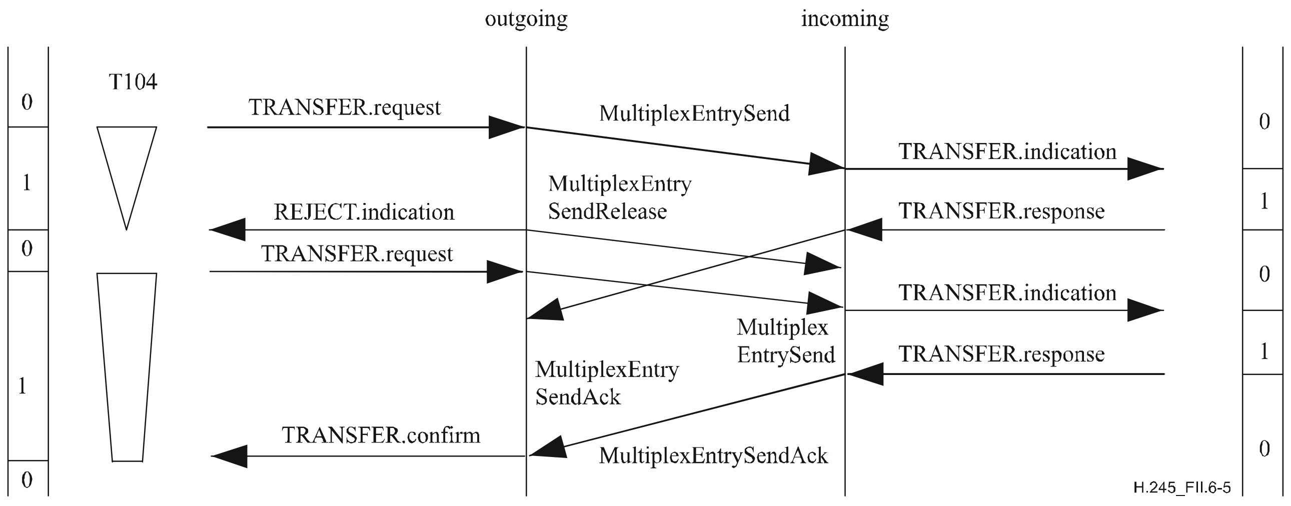


Figure II.6-4/H.245 – Multiplex table send request with timer T104 expiry



NOTE – The first MultiplexEntrySendAck message is ignored at the outgoing MTSE. Only the second request was successful.

Figure II.6-5/H.245 – Multiplex table send request with timer T104 expiry followed by a second multiplex table send request

II.7 Mode Request Signalling Entity

Figures II.7-1 to II.7-5 illustrate MRSE exchanges. The IDLE and AWAITING RESPONSE states are labelled as "0" and "1", respectively.

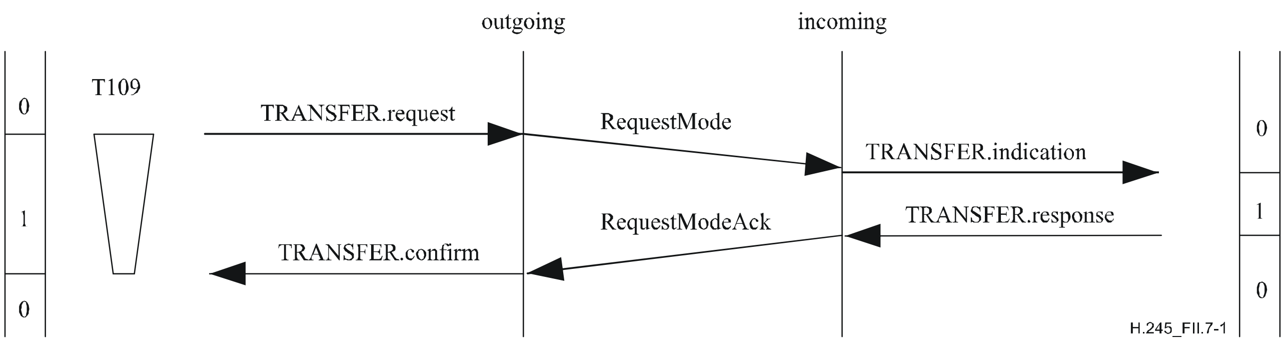


Figure II.7-1/H.245 – Successful mode request

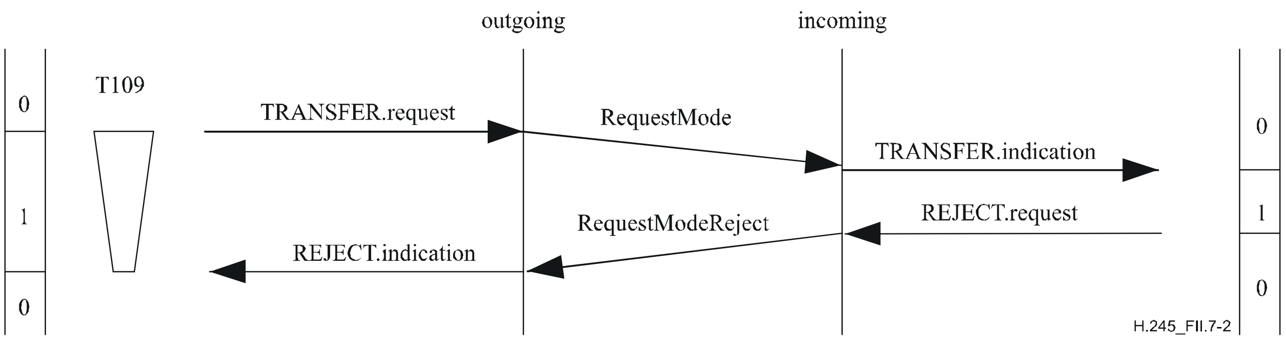
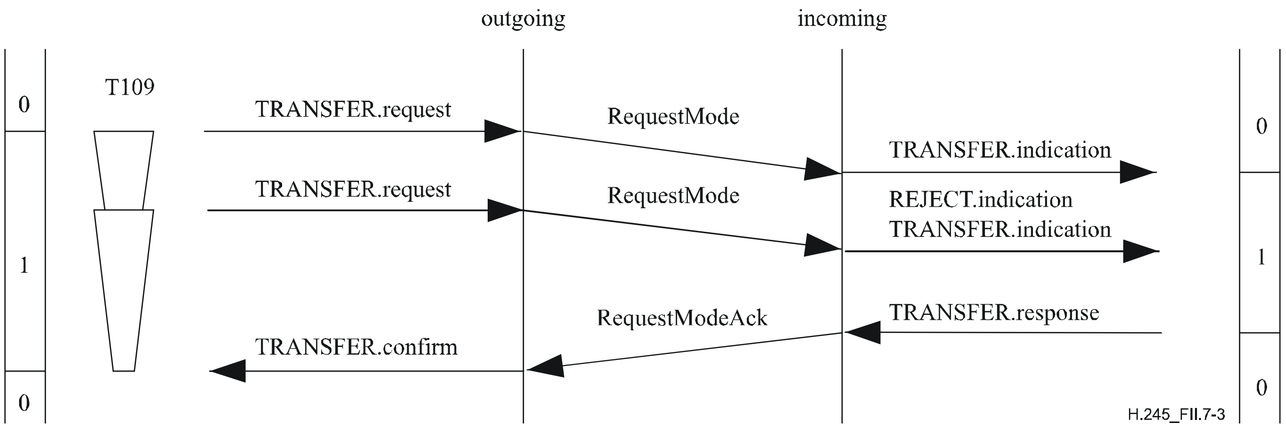
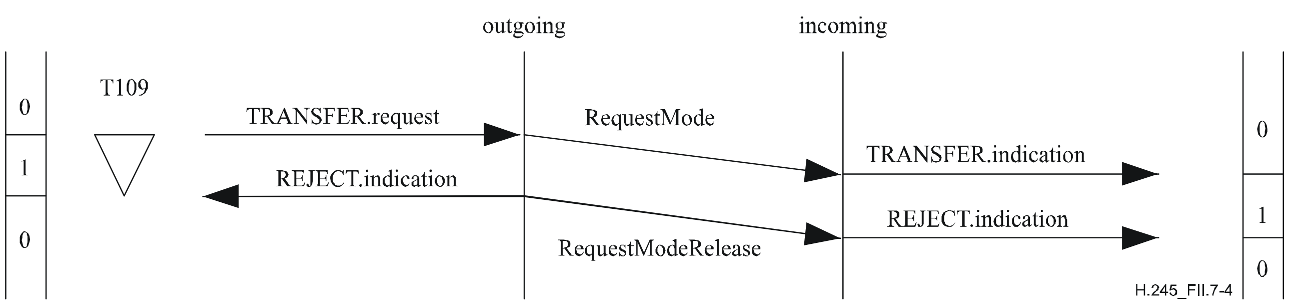


Figure II.7-2/H.245 – Mode request with rejection from the peer MRSE user



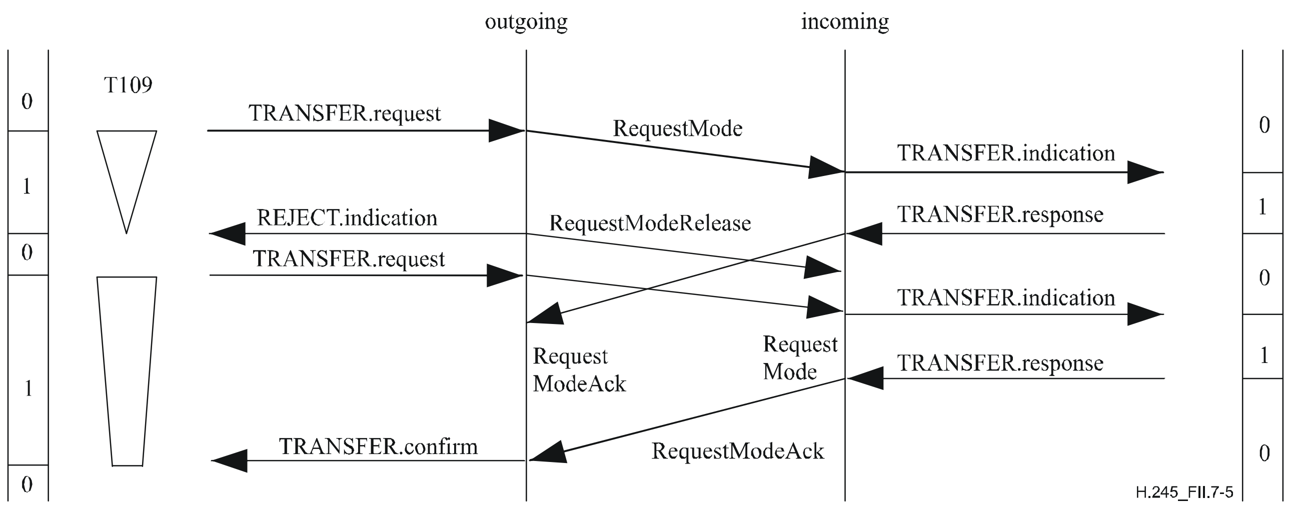
NOTE – The first request was unsuccessful.

Figure II.7-3/H.245 – Mode request with a second mode request before acknowledgement of the first request



NOTE – The mode request was unsuccessful.

Figure II.7-4/H.245 – Mode request with timer T109 expiry



NOTE – The first RequestModeAck message is ignored at the outgoing MRSE. Only the second request was successful.

Figure II.7-5/H.245 – Mode request with timer T109 expiry followed by a second mode request

II.8 Round-trip Delay Signalling Entity

Figures II.8-1 to II.8-4 illustrate RTDSE procedures. The RTDSE states of IDLE and AWAITING RESPONSE are labelled as "0" and "1", respectively.

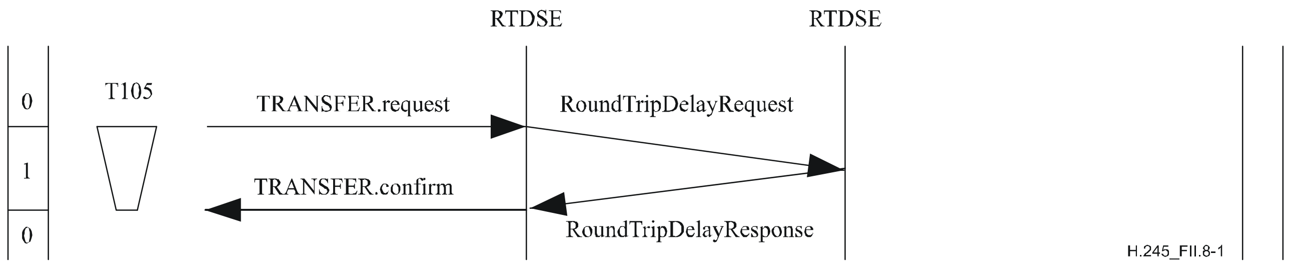


Figure II.8-1/H.245 – Round-trip delay determination procedure

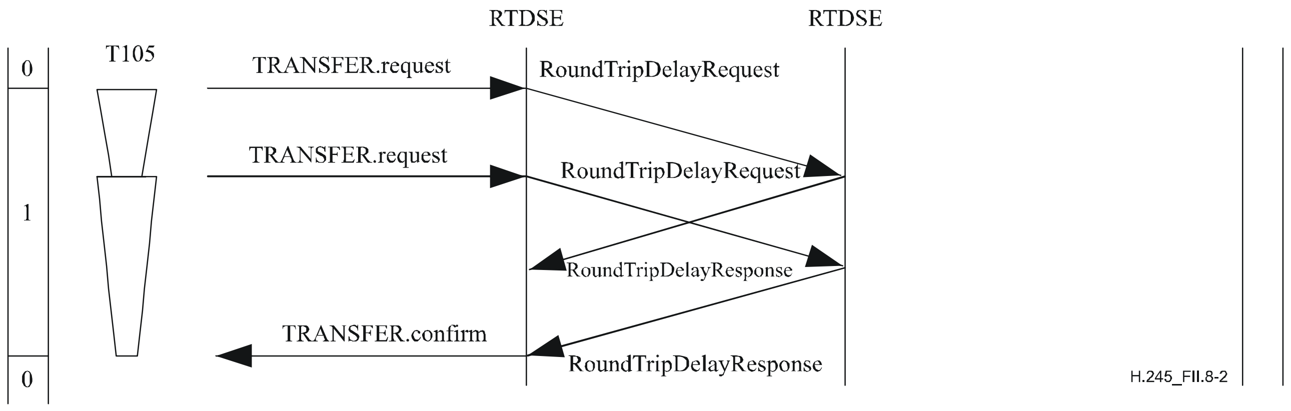


Figure II.8-2/H.245 – Round-trip delay determination procedure with an earlier unacknowledged round-trip delay procedure outstanding

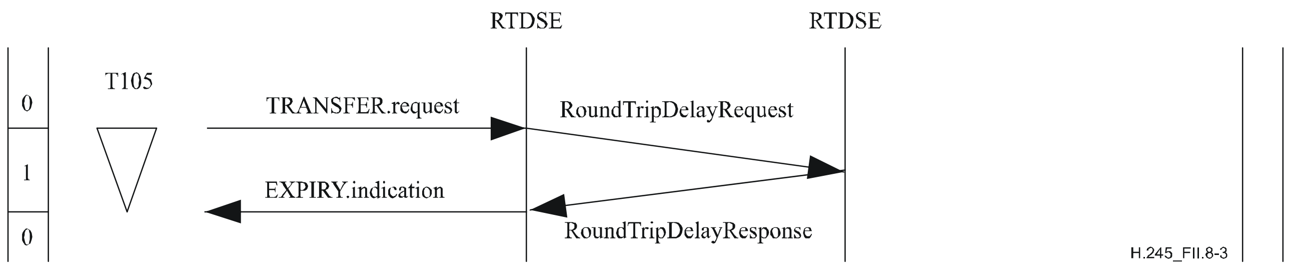
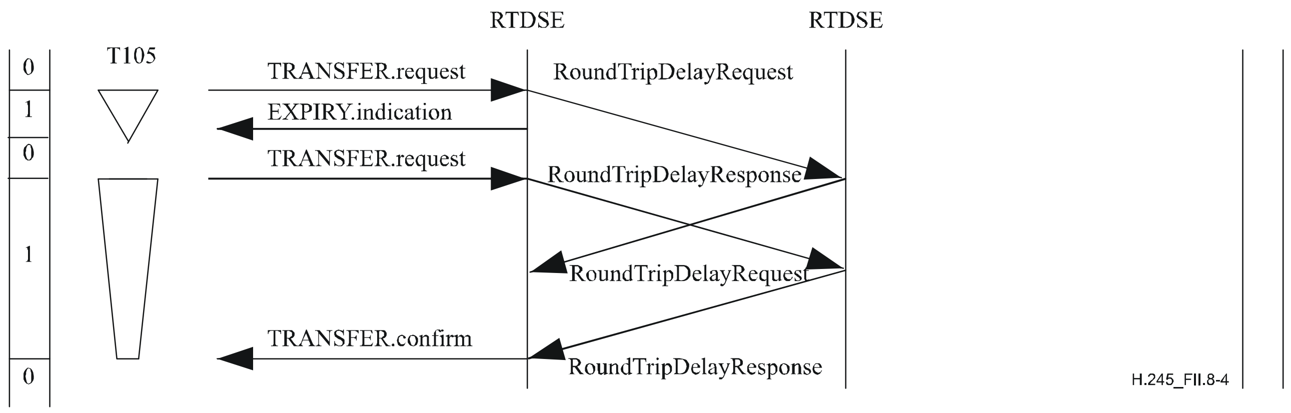


Figure II.8-3/H.245 – Round-trip delay determination procedure with timer T105 expiry



NOTE – The RoundTripDelayResponse message from the first procedure arrives during the second procedure and is ignored.

Figure II.8-4/H.245 – Round-trip delay determination procedure with timer T105 expiry, followed by a second round-trip delay determination procedure

II.9 Bidirectional Logical Channel Signalling Entity

Figures II.9-1 to II.9-7 illustrate B-LCSE procedures. The outgoing B-LCSE states of RELEASED, AWAITING ESTABLISHMENT, ESTABLISHED, and AWAITING RELEASE are labelled as "0", "1", "2", and "3", respectively. The incoming B-LCSE states of RELEASED, AWAITING ESTABLISHMENT, AWAITING CONFIRMATION, and ESTABLISHED, are labelled as "0", "1", "2", and "3", respectively.

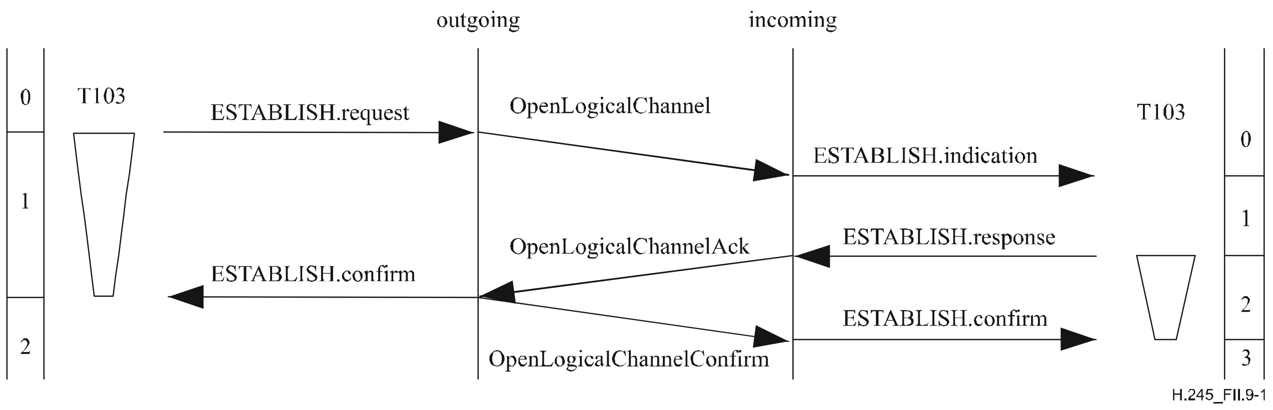


Figure II.9-1/H.245 – Bidirectional logical channel establishment

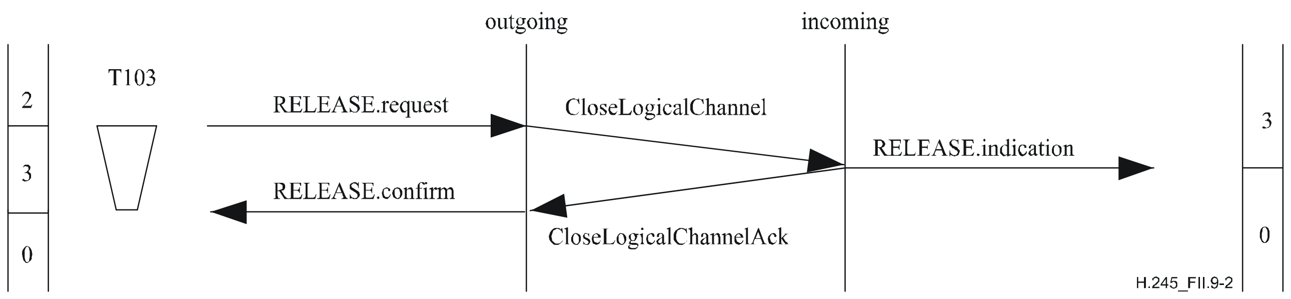


Figure II.9-2/H.245 – Bidirectional logical channel release

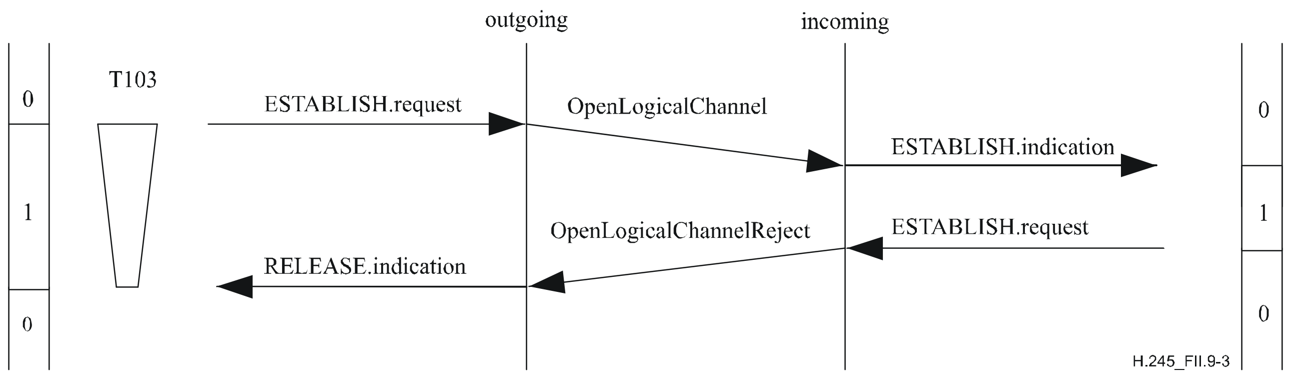


Figure II.9-3/H.245 – Bidirectional logical channel establishment rejection by peer B-LCSE user

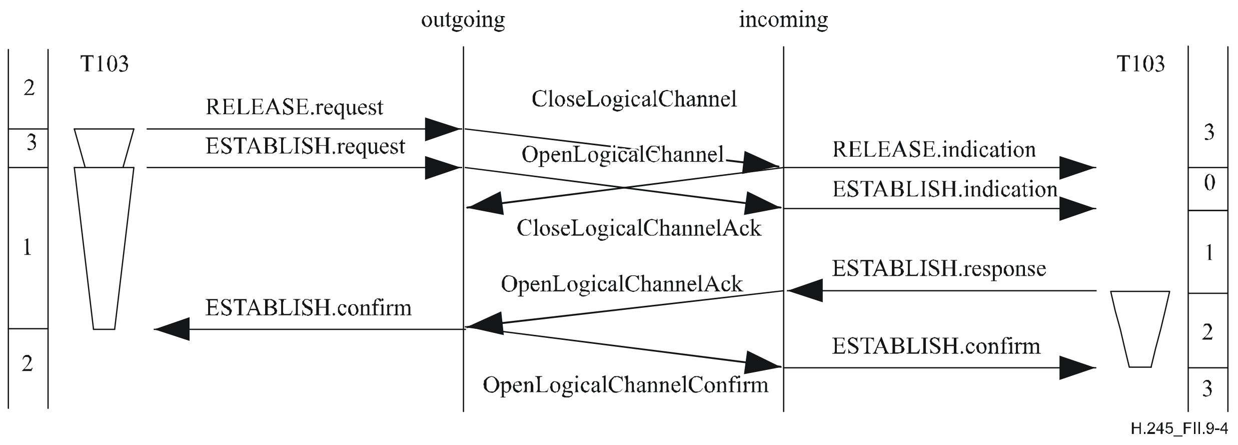


Figure II.9-4/H.245 – Bidirectional logical channel release followed by immediate re-establishment

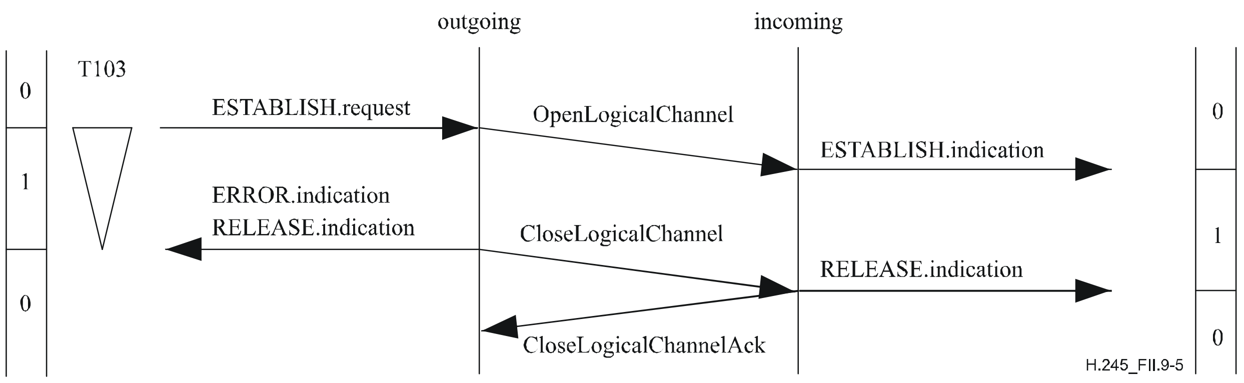
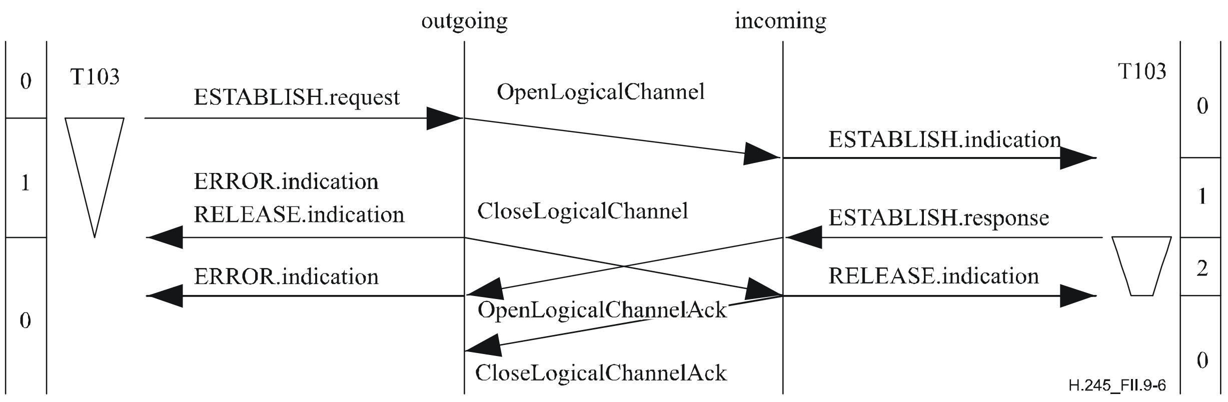


Figure II.9-5/H.245 – Bidirectional logical channel establishment request with expiry of timer T103 at the outgoing side due to slow response from peer incoming B-LCSE user



NOTE – Timer T103 at the outgoing side has expired after transmission of the OpenLogicalChannelAck message at the incoming B-LCSE, but before reception of the OpenLogicalChannelAck message at the outgoing B-LCSE.

Figure II.9-6/H.245 – Bidirectional logical channel establishment request with expiry of timer T103 at the outgoing side

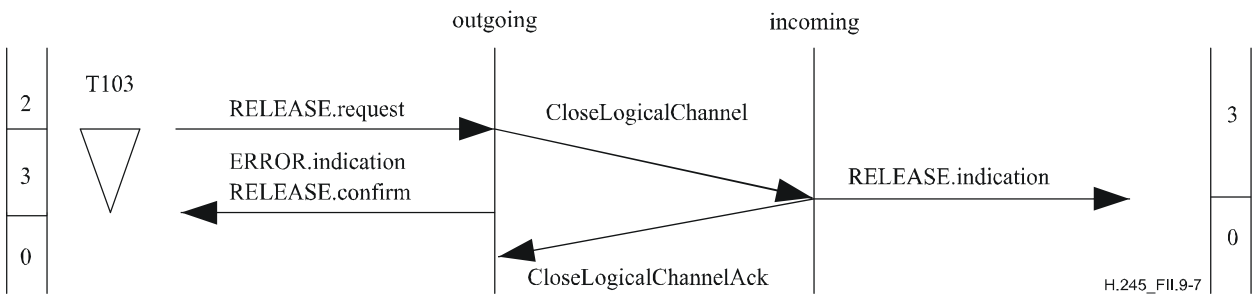


Figure II.9-7/H.245 – Bidirectional logical channel release request with expiry of timer T103 at the outgoing side

Appendix III

Summary of procedure timers and counters

(This appendix does not form an integral part of this Recommendation)

This appendix provides a list of the timers and counters specified in Annex C.

This Recommendation does not define the values loaded into these timers. The values may be defined in other Recommendations such as ITU-T Recs H.310, H.323 and H.324.

III.1 Timers

Table III.1 shows the timers specified in this Recommendation.

Table III.1/H.245 – Procedure timers

Timer	Procedure	Definition
T106	Master-slave Determination	This timer is used in the OUTGOING AWAITING RESPONSE state and during the INCOMING AWAITING RESPONSE state. It specifies the maximum time during which no acknowledgement message may be received.
T101	Capability Exchange	This timer is used in the AWAITING RESPONSE state. It specifies the maximum time during which no TerminalCapabilitySetAck or TerminalCapabilitySetReject message may be received.
T103	Unidirectional and Bidirectional Logical Channel Signalling	This timer is used in the AWAITING ESTABLISHMENT and AWAITING RELEASE states. It specifies the maximum time during which no OpenLogicalChannelAck or OpenLogicalChannelReject or CloseLogicalChannelAck message may be received.
T108	Close Logical Channel	This timer is used in the AWAITING RESPONSE state. It specifies the maximum time during which no RequestChannelCloseAck or RequestChannelCloseReject message may be received.
T104	H.223 Multiplex Table	This timer is used in the AWAITING RESPONSE state. It specifies the maximum time during which no MultiplexEntrySendAck or MultiplexEntrySendReject message may be received.
T109	Mode Request	This timer is used in the AWAITING RESPONSE state. It specifies the maximum time during which no RequestModeAck or RequestModeReject message may be received.
T105	Round-trip Delay	This timer is used in the AWAITING RESPONSE state. It specifies the maximum time during which no RoundTripDelayResponse message may be received.
T107	Request Multiplex Entry	This timer is used during the AWAITING RESPONSE state. It specifies the maximum time during which no RequestMultiplexEntryAck or RequestMultiplexEntryReject message may be received.
T102	Maintenance Loop	This timer is used during the AWAITING RESPONSE state. It specifies the maximum allowed time during which no MaintenanceLoopAck or MaintenanceLoopReject message may be received.

III.2 Counters

Table III.2 shows the counters specified in this Recommendation

Table III.2/H.245 – Procedure counters

Timer	Procedure	Definition
N100	Master-slave Determination	This counter specifies the maximum number of times that MasterSlaveDetermination messages will be sent during the OUTGOING AWAITING RESPONSE state.

Appendix IV

H.245 extension procedure

(This appendix does not form an integral part of this Recommendation)

This Recommendation is a "living document" used by a number of systems Recommendations including H.310, H.323, H.324, and V.70, which is expected to be extended, in a backward-compatible way, likely at each meeting of ITU-T Study Group 16. This appendix explains the procedure that should be used to add extensions to this Recommendation.

At a given point in time there is only one H.245 syntax in force. No other ITU-T Recommendation should include other variants of H.245 syntax in their Recommendations in a normative manner.

Requests for extensions to this Recommendation should be submitted as a White Contribution or formal liaison to Study Group 16, with a copy sent as early as possible to the H.245 Rapporteur and editor. Such requests should include:

1) functional requirements for syntax to be drafted by the H.245 editor or proposed syntax based on the current approved version of this Recommendation; and
2) proposed semantics for Annex B; and
3) proposed procedures for Annex C if new procedures are requested.

All extensions to this Recommendation must be backwards compatible with all previous versions of this Recommendation. Pre-existing syntax, semantics, and procedures cannot be changed. The meaning of pre-existing syntax cannot be changed. Specifically, when an H.245 capability is extended, the extension shall not change the meaning of the original capability in such a way that a terminal which does not understand the extension would need to modify its operation to use the capability without the extension. All ASN.1 extension components should be constrained.

Requests should be submitted as early as possible to allow time for review of extensions by H.245 experts in Study Group 16. It must be understood that the exact requested syntax may be modified because of:

1) verification of correct ASN.1 syntax;
2) harmonization with other, conflicting, requests for H.245 extensions;
3) backward compatibility with pre-existing versions of H.245;
4) expert review of placement of new functions relative to the existing H.245 structure;
5) naming that is inconsistent with pre-existing syntax;
6) unconstrained or ambiguous ASN.1 components.

Abbreviations and acronyms should be avoided, especially if a word or phrase is not abbreviated or expressed as an acronym in pre-existing syntax. For example, the word "Parameters", should not be abbreviated as "Params". If a word has been used in pre-existing syntax, do not use another word with the same meaning. For example, call components of an aggregate type, Entry, instead of Item, because Entry has consistently been used to describe this. Be consistent.

Although all ASN.1 components should be constrained, how to constrain the most common types is described below.

Constrain SET OF and SEQUENCE OF ASN.1 components by providing either a minimum and maximum or a fixed size. If there is no inherent maximum based upon a component's semantics, choose a reasonable, although arbitrary, maximum such as 256. If a SET OF or SEQUENCE OF component is OPTIONAL, specify a non-zero minimum unless there is a semantic difference between the cases, present-but-empty and not present, in which case the semantic difference should be described. If a request for extensions contains SET OF or SEQUENCE OF components that are not constrained, the editor may use SIZE (1..256) as a default constraint.

Constrain ASN.1 character string components by providing a size, either a minimum and maximum or a fixed size. If a request for extensions contains character string components that are not constrained, the editor may use SIZE (0..255) as a default constraint.

Constrain INTEGER components by providing a range of values. If there is no inherent range based upon a component's semantics, choose a reasonable, although arbitrary, range whose maximum value is chosen from the following:

255	($2^8 – 1$)
65535	($2^{16} – 1$)
16777215	($2^{24} – 1$)
4294967295	($2^{32} – 1$)

If a request for extensions contains INTEGER components that are not constrained, the editor may use INTEGER (0..4294967295) as a default.

The H.245 editor will review all extension requests and propose the final text for extended versions of H.245 for Study Group 16 approval. Upon Study Group approval of each new version of this Recommendation, the H.245 version number in **protocolIdentifier** will be incremented to identify the new version.

Please note that it is the intention of Study Group 16 to accept only harmonized H.245 extensions originating from the H.245 editor.

Appendix V

The replacementFor procedure

(This appendix does not form an integral part of this Recommendation)

The H.245 `replacementFor` procedure allows seamless changing of modes from one codec to another without the need for two media decoders. This procedure may be used only if the receiving terminal has indicated the `maxPendingReplacementFor` capability.

Since opening and closing of H.245 logical channels is not synchronized with media content, media dropout can occur between the time of closing a logical channel and the opening of its replacement. The `replacementFor` parameter allows the avoidance of such media dropout.

Example

Suppose logical channel 723 is open, carrying G.723.1 audio, and it is desired to switch to G.711 (on logical channel 711), but the receiver has a capability for only one audio channel. The `replacementFor` procedure may be used by the transmitter to effect a seamless mode change as follows:

1) *Only for the case of H.323 using RSVP,* since the new channel will require more bandwidth (64 kbit/s) than the existing channel (6.4 kbit/s), the transmitter and receiver establish a larger RSVP bandwidth reservation.

2) The transmitter sends `OpenLogicalChannel` for the new logical channel 711, including the `replacementFor` parameter, referring to the existing logical channel 723.

   This tells the receiver that logical channel 711 is a *replacement for* logical channel 723, and that logical channel 711 will never carry traffic simultaneously with logical channel 723.

3) While continuing to decode G.723.1 from logical channel 723, the receiver prepares for a seamless switch to decoding G.711.

   Such preparation might include loading appropriate decoder software.

   When the receiver has completed preparations to accept the G.711 audio stream, it responds with `OpenLogicalChannelAck` for logical channel 711. For H.323, the media and media control transport addresses returned are the same as those already used for logical channel 723.

4) The transmitter stops sending G.723 audio on logical channel 723 and seamlessly begins sending G.711 audio on logical channel 711.

5) The transmitter immediately sends `CloseLogicalChannel` for logical channel 723, as this logical channel is no longer carrying any traffic, and is no longer needed.

6) *Only for the case of H.323 using RSVP,* if the new channel requires less bandwidth than the original channel, the transmitter and receiver establish a smaller RSVP bandwidth reservation (does not apply in this example).

In all cases, LCSE and B-LCSE operations conform to normal procedures. The `replacementFor` parameter merely informs the receiver of the pending mode change and that the two logical channels will not be used simultaneously, and therefore that the second logical channel can (in some implementations) be accepted in cases where it would otherwise be rejected (for lack of the capability to receive another independent logical channel).

Note that in some cases the receiver may reject the attempt to open the logical channel using the `replacementFor` mechanism (for example, if a receiver can accept the `replacementFor` mechanism for audio channels, but not for video channels). In that case transmitters should re-try the mode change without `replacementFor`, for example by closing the channel, then opening a new one, accepting any temporary media dropout.

Note also that in H.323 systems, receivers are required to reuse the existing media and media control transport addresses. The switch over point to the new logical channel is marked by the RTP header.

Appendix VI

Examples of H.263 Capability Structure Settings

(This appendix does not form an integral part of this Recommendation)

To clarify the usage of the H.263 Capability Structure, a number of examples are given in this appendix.

VI.1 Examples of Enhancement Layer H.245 parameter setting

Table VI.1 shows the following example settings of parameters of enhancement layer parameters.

Example # 1: This signals a simple H.263 base video capability at 10 frames/s, maximum bit rate of 20 kbit/s with no options.

Example # 2: These parameters settings signal the capability of a logical channel stream with a spatial enhancement layer at QCIF resolution, 10 frames/s at a maximum bit rate of 5 kbit/s and no other options set.

Example # 3: These parameters settings signal the capability of a logical channel stream with a SNR enhancement layer at SQCIF resolution, 10 frames/s at a maximum bit rate of 5 kbit/s and no other options set.

Example # 4: These parameters settings signal the capability of a logical channel stream with a three enhancment layers. Two SNR enhancement layers, one at SQCIF the other a QCIF, at 10 frames/s and no other options set and the other a spatial enhancement layer at CIF resolution, 10 frames/s and no other options set; all three combined at a maximum bit rate of 15 kbit/s.

Example # 5: These parameters settings signal the capability of a logical channel stream with a three enhancement layers and a base layer at a maximum bit rate of 25 kbit/s. The base layer in QCIF with no options. In addition the terminal is capable of one SNR enhancement layer at QCIF, 10 frames/s and no other options set, one SNR enhancement layer at CIF resolution, 10 frames/s with no other options set and a spatial enhancement layer at CIF resolution, 10 frames/s and no other options set.

Table VI.1/H.245 – Enhancement Layer H.245 parameter setting examples

		Examples								
H263Capability parameter		1	2	3	4			5		
sqcifMPI		3	NP	NP	NP			NP		
qcifMPI		NP	NP	NP	NP			3		
cifMPI		NP	NP	NP	NP			NP		
cif4MPI		NP	NP	NP	NP			NP		
cif16MPI		NP	NP	NP	NP			NP		
maxBitRate		200	50	50	150			250		
unrestrictedVector		F	F	F	F			F		
arithmeticCoding		F	F	F	F			F		
advancedPrediction		F	F	F	F			F		
pbFrames		F	F	F	F			F		

Table VI.1/H.245 – Enhancement Layer H.245 parameter setting examples

		Examples								
temporalSpatialTradeOffCap		F	F	F	F			F		
hrd-B		NP	NP	NP	NP			NP		
bppMaxKb		NP	NP	NP	NP			NP		
slowSqcifMPI		NP	NP	NP	NP			NP		
slowQcifMPI		NP	NP	NP	NP			NP		
slowCifMPI		NP	NP	NP	NP			NP		
slowCif4MPI		NP	NP	NP	NP			NP		
slowCif16MPI		NP	NP	NP	NP			NP		
errorCompensation		NP	NP	NP	NP			NP		
SET OF (EnhancementOptions[a]) =		NP	NP	1	1	2		1	2	
snrEnhancement	sqcifMPI			3	3	NP		NP	NP	
	qcifMPI			NP	NP	3		3	NP	
	cifMPI			NP	NP	NP		NP	3	
	cif4MPI			NP	NP	NP		NP	NP	
	cif16MPI			NP	NP	NP		NP	NP	
	maxbitrate			50	50	50		50	50	
SET OF (EnhancementOptions[a]) =		NP	1	NP	NP	NP	1	NP	NP	1
spatialEnhancement	sqcifMPI		NP				NP			NP
	qcifMPI		3				NP			NP
	cifMPI		NP				3			3
	cif4MPI		NP				NP			NP
	cif16MPI		NP				NP			NP
	maxbitrate		50				50			50
SET OF (EnhancementOptions[a]) =		NP	NP	NP	NP	NP	NP			
bframeEnhancement	sqcifMPI									
	qcifMPI									
	cifMPI									
	cif4MPI									
	cif16MPI									
	maxbitrate									

NPNot Present
T True
F False
[a] Other options below "maxbitrate" in the EnhancementOptions structure not shown

VI.2 Examples of Video Back Channel H.245 parameter setting

This clause provides examples of H263Capability and H263Options settings for video back channel operation.

Example 1: Separate Logical Channel mode

In this mode, an extra bidirectional logical channel is opened for video back channel messages. The dependency between a forward video channel and the video back channel is described by **forwardLogicalChannelDependency** and **reverseLogicalChannelDependency** in the OpenLogicalChannel message.

The logical channel for video back channel messages shall only be established after the forward video channel is established. If an OpenLogicalChannel message is received with a dependency reference to a non-existing channel, the terminal shall respond with an OpenLogicalChannelReject with the reason code invalidDependentChannel. An example follows:

1) A bidirectional logical channel for video data is opened between terminal A and terminal B as shown in Figure VI.1. The OpenLogicalChannel message for the bidirectional logical channel includes RefPictureSelectionCapability in H263VideoCapability.

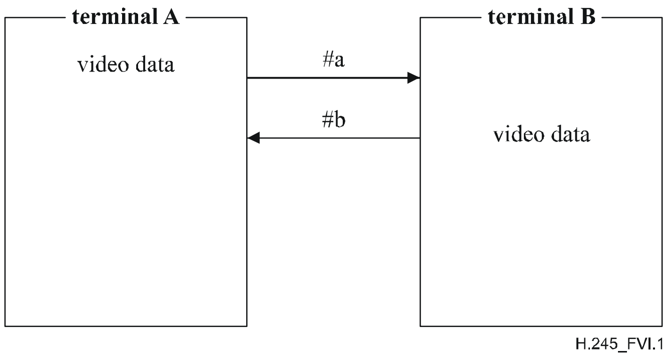


Figure VI.1/H.245 – Logical Channels for Video Data

2) Next, a bidirectional logical channel for video back channel messages is opened, as shown in Figure VI.2. In this example, we assume that terminal A requests to open the bidirectional logical channel. (If the terminal B requests to open the channel, forwardLogicalChannelDependency is replaced by reverseLogicalChannelDependency and vice versa.) The OpenLogicalChannel message of this logical channel includes forwardLogicalChannelDependency in forwardLogicalChannelParameters indicating LCN of LC #a in Figure VI.2 and reverseLogicalChannelDependency in reverseLogicalChannelParameters indicating LCN of LC #b, as well as separateVideoBackChannel.

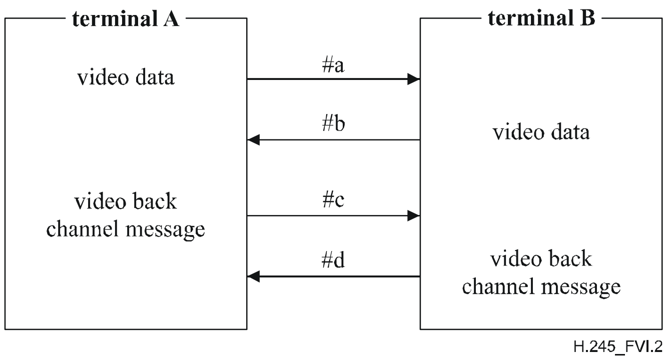


Figure VI.2/H.245 – Logical Channels for Separate Logical Channel Mode

3) After the logical channel for video back channel messages is established, terminal A sends the video data to LC #a and receives from LC #d, the video back channel messages that correspond to the video data sent to LC #a. In the same manner, terminal A receives the video data from LC #b and sends to LC #c, the video back channel messages that correspond to the video data from terminal B.

An example of setting H263Capability parameters in each OpenLogicalChannel messages is summarized in Table VI.2. Only a part of capabilities of H263Capability is shown for simplicity.

Table VI.2/H.245 – H263Capability setting examples for OpenLogicalChannel messages

H263Capability Parameter		**H263Capability in OpenLogicalChannel messages**		
		#a, #b	**#c, #d**	**#e, #f**
sqcifMPI		NP	NP	NP
qcifMPI		3	NP	3
cifMPI		NP	NP	NP
cif4MPI		NP	NP	NP
cif16MPI		NP	NP	NP
maxBitRate		240	10	240
refPictureSelection			NP	
	additionalPictureMemory	Unspecified	–	Unspecified
	videoMuxCapability	False	–	(shall be) True
	videoBackChannelSendCapability	ackAndNackMessage	–	AckAndNackMessage
separateVideoBackChannel		False	True	False
NP Not Present				

Example 2: VideoMux mode

When a terminal indicates the videoMuxCapability in RefPictureSelectionCapability during capability exchange, another terminal may use this mode to send video back channel messages. Because video back channel messages are multiplexed into the coded video bitstream, the terminals do not need to establish an extra logical channel for video back channel messages. An example follows:

1) A bidirectional logical channel for video is opened by the OpenLogicalChannel message including refPictureSelectionCapability with the true values VideoMux mode in their H263VideoCapability (see Figure VI.3).

2) After the logical channel for video is established, terminal A sends the video data to LC #e and receives from LC #f, the video back channel messages that correspond to the video data sent to LC #e are multiplexed into the video data from terminal B.

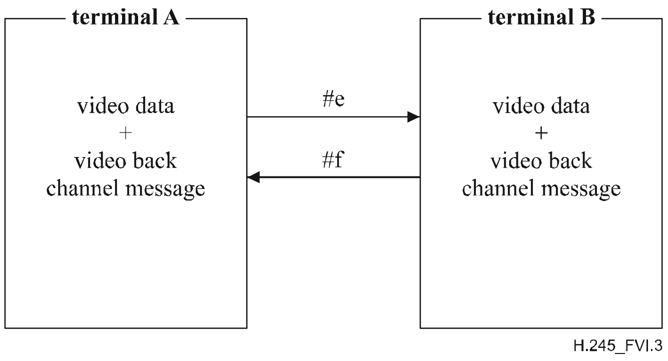


Figure VI.3/H.245 – Logical Channels for VideoMux Mode

A example of setting H263Capability parameters in each OpenLogicalChannel messages is summarized in Table VI.2.

Example 3: Separate Logical Channel mode in unidirectional video communication

This example shows the case when only terminal A sends video data and terminal B sends only video back channel messages (see Figure VI.4). The parameter settings of logical channel #g and #h are shown in Table VI.3.

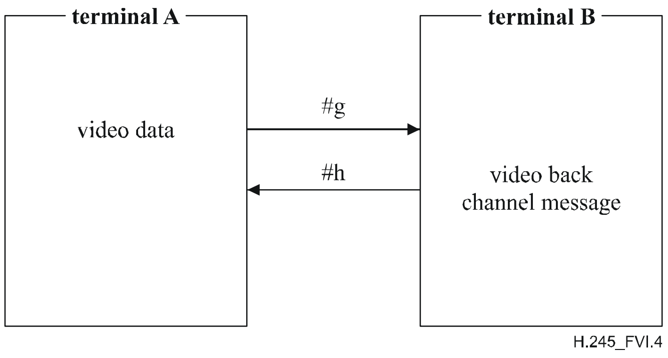


Figure VI.4/H.245 – Separate Logical Channel mode in unidirectional video communication

Example 4: Coexistence of Separate Logical Channel mode with VideoMux mode

The example illustrated in Figure VI.5 shows the case when only terminal A uses the Separate Logical Channel mode to receive video back channel messages from terminal B via LC #l and terminal B uses the VideoMux mode to receive video back channel message via LC #i. This example may not be realistic but is a possible configuration. The parameter settings of each logical channels are shown in Table VI.3.

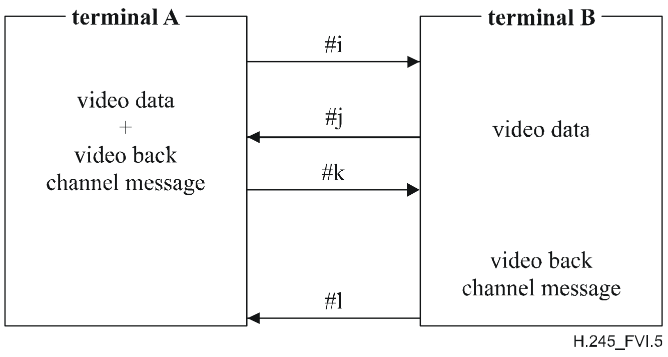


Figure VI.5/H.245 – Coexistence of Separate Logical Channel mode with VideoMux mode

Table VI.3/H.245 – H263Capability setting examples for OpenLogicalChannel messages

H263Capability in OpenLogicalChannel message							
H263Capability parameter		**#g**	**#h**	**#i**	**#j**	**#k**	**#l**
sqcifMPI		NP	NP	NP	NP	NP	NP
qcifMPI		3	NP	3	3	NP	NP
cifMPI		NP	NP	NP	NP	NP	NP
cif4MPI		NP	NP	NP	NP	NP	NP
cif16MPI		NP	NP	NP	NP	NP	NP
maxBitRate		240	10	240	240	10	10
refPictureSelection			NP			NP	NP
	additionalPictureMemory	unspecified	–	unspecified	unspecified	–	–
	videoMuxCapability	F	–	F	(shall be) T	–	–
	videoBackChannelSendCapability	ackAndNack Message	–	AckAndNack Message	ackAndNack Message	–	–
separateVideoBackChannel		F	T	F	F	F	T
NP Not Present T True F False							

Appendix VII

Procedure and template for defining new capabilities with H.245 generic capabilities

(This appendix does not form an integral part of this Recommendation)

This appendix defines the procedure and a template for defining new capabilities that are expressed in the form of H.245 generic capabilities. It also provides an example of how this template could have been used to describe the H.261 codec, instead of the ASN.1 syntax that has been used in this Recommendation. This new mechanism for defining capabilities in this Recommendation is intended to be used for all new capabilities that are added to this Recommendation; it is not intended to be used to redefine existing capabilities.

Capability descriptions relating to ITU-T Recommendations shall be defined in Annexes to either this Recommendation or the Recommendation itself (e.g., ITU-T Rec. H.283).

Other capability descriptions may be defined in annexes to this Recommendation, or elsewhere.

GenericCapabilities that include both collapsing and nonCollapsing sequences should not include GenericParameter structures of different types (collapsing, nonCollapsing) that use the same parameterIdentifier.

NOTE 1 – Such reuse of the same parameterIdentifier could cause a parameterIdentifier value collision if the parameter were translated automatically to a system, for example an H.320 system, that does not have the distinction between collapsing and nonCollapsing parameters.

The standard parameterIdentifier field of a GenericParameter should not be assigned the value 0.

NOTE 2 – Such assignment to the value 0 would interfere with automatic translation to H.320 signalling, for example as is done in Annex A/H.239 and in ITU-T Rec. H.241.

VII.1 Procedure

VII.1.1 Definition of generic capabilities in this Recommendation

In case the definition is to be included in annexes to this Recommendation, the following procedure should be performed:

1) Define an OBJECT IDENTIFIER for this capability, and list it in Annex D.
2) Define the capability with Generic Capability in a new annex to this Recommendation.

OBJECT IDENTIFIER has the form: {itu-t(0) recommendation(0) h(8) 245 generic-capabilities(1) *capability-class capability-name*}.

capability-class is one of video(0), audio(1), data(2), control(3), multiplex(4), or user-input(5). The value for *capability-name* is assigned in numerical order for each *capability-class*.

VII.1.2 Definition of generic capabilities in other ITU Recommendations

In case the definition is to be included in other ITU Recommendations, the following procedure should be performed:

1) Define an OBJECT IDENTIFIER for this capability in the Recommendation itself, and list it in Appendix VIII.
2) Define the capability with Generic Capability in a new annex to the appropriate Recommendation.

VII.1.3 Definition of generic capabilities in non-ITU standards

In case the definition is to be included in non-ITU standards, the following procedure should be performed:

1) Define an OBJECT IDENTIFIER for this capability in appropriate standard, and list it in Appendix VIII.
2) Define the capability with Generic Capability in the appropriate standard.

VII.2 Template

VII.2.1 Capability Identifier

A single instance of Table VII.1 shall be defined for each GenericCapability description.

Table VII.1/H.245 – Capability Identifier Template

Capability name	The name of the codec, e.g., H.261
Capability class	The class of the capability, e.g., video, audio, etc.
Capability identifier type	The type of the identifier that defines the codec: standard, h221NonStandard, or uuid.
Capability identifier value	The value of the codec tag, e.g., `{itu-t(0) recommendation(0) h(8) 261 generic-capabilities(1) 0}`. The value of generic-capabilities identifies a type or set of parameters associated with the capability. Note that the actual format of this object identifier is the responsibility of those defining the capabilities, but should be defined considering possible extensions.
maxBitRate	Whether the maxBitRate field shall be included, shall not be included, or is optional.
nonCollapsingRaw	The specification of the format of the OCTET STRING, and whether it shall or shall not be included.
transport	Whether the transport field shall be included, shall not be included, or is optional.

VII.2.2 Capability parameters

This clause is applicable to collapsing and nonCollapsing GenericParameters. An instance of Table VII.2 shall be defined for each GenericParameter. The template should be divided into sections to distinguish between which parameters are for capability negotiation and which are specific to logical channel signalling.

Table VII.2/H.245 – Capability Patrameter Template

Parameter name	The name of the parameter, e.g., cifMPI
Parameter description	A descriptive name of the parameter, e.g., specifies the minimum picture interval at CIF resolution
Parameter identifier value	An integer that identifies this "standard" parameter
Parameter status	Whether the parameter is mandatory, conditionally mandatory (e.g., dependent on another parameter) or optional.
Parameter type	The type of the parameter: logical, booleanArray, unsignedMin, unsignedMax, unsigned32Min, unsigned32Max, octetString [or genericParameter].

Table VII.2/H.245 – Capability Patrameter Template

Supersedes	The parameters that this parameter supersedes. This table element shall specify zero, 1 or more parameters that this parameter supersedes. The format shall be: parameter-name "(" parameter-identifier-value ")", e.g., qcifMPI (0)
NOTE – This table does not allow the ParameterTag type (standard, h221NonStandard, or uuid) to be specified as it is only to be used for standard capability descriptions.	

VII.3 Example Template – H.261

VII.3.1 H.261 Capability Identifier

Table VII.3/H.245 – Example H.261 Capability Identifier

Capability name	ITU-T Rec. H.261
Capability class	Video codec
Capability identifier type	Standard
Capability identifier value	`{itu-t(0) recommendation(0) h(8) 261 generic-capabilities(1) 0}`. This is the first (and only) set of parameters defined for ITU-T Rec. H.261.
maxBitRate	The maxBitRate field shall always be included.
nonCollapsingRaw	This field shall not be included.
transport	This field shall not be included.

VII.3.2 H.261 Capability parameters

Note that there is no table for the maximum bit-rate field that is found in the ASN.1 syntax of ITU-T Rec. H.245 for ITU-T Rec. H.261. This is because the maximum bit rate is given at the top level of the GenericCapability structure. Note also that temporalSpatialTradeOffCapability and stillImageTransmission could have been combined into one GenericParameter of type booleanArray.

Table VII.4/H.245 – Example H.261 Capability Parameter – qcifMPI

Parameter name	qcifMPI
Parameter description	If present, this indicates the minimum picture interval in units of 1/29.97 for the encoding and/or decoding of QCIF pictures, and if not present, no capability for QCIF pictures is indicated.
Parameter identifier value	0
Parameter status	Optional
Parameter type	unsignedMax
Supersedes	–

Table VII.5/H.245 – Example H.261 Capability Parameter – cifMPI

Parameter name	cifMPI
Parameter description	If present, this indicates the minimum picture interval in units of 1/29.97 for the encoding and/or decoding of CIF pictures, and if not present, no capability for CIF pictures is indicated.
Parameter identifier value	1
Parameter status	Optional
Parameter type	unsignedMax
Supersedes	qcifMPI (0)

Table VII.6/H.245 – Example H.261 Capability Parameter – temporalSpatialTradeOffCapability

Parameter name	temporalSpatialTradeOffCapability
Parameter description	The presence of this parameter indicates that the encoder is able to vary its trade-off between temporal and spatial resolution as commanded by the remote terminal. It has no meaning when part of a receive capability.
Parameter identifier value	2
Parameter status	Optional
Parameter type	logical
Supersedes	–

Table VII.7/H.245 – Example H.261 Capability Parameter – stillImageTransmision

Parameter name	stillImageTransmission
Parameter description	The presence of this parameter indicates the capability for still images as specified in Annex D/H.261.
Parameter identifier value	3
Parameter status	Optional
Parameter type	logical
Supersedes	–

Appendix VIII

List of generic capabilities and generic messages defined in Recommendations/Standards other than this Recommendation

(This appendix does not form an integral part of this Recommendation)

Table VIII.1 lists the generic capabilities defined in Recommendations or Standards other than this Recommendation.

Table VIII.1/H.245 – List of generic capabilities defined in Recommendations/Standards other than this Recommendation

Capability name	Capability class	Capability identifier	Name of Recommendation or Standard that defines this capability
H.283	Data protocol	`{itu-t(0) recommendation(0) h(8) 283 generic-capabilities(1) 0}`	ITU-T Rec. H.283
G.722.1	Audio protocol	`{itu-t(0) recommendation(0) g(7) 7221 generic-capabilities(1) 0}`	ITU-T Rec. G.722.1
G.722.1 Extension	Audio protocol	`{itu-t(0) recommendation(0) g(7) 7221 generic-capabilities(1) extension(1) 0}`	ITU-T Rec. G.722.1
H.324	Data protocol	`{itu-t(0) recommendation(0) h(8) 324 generic-capabilities(1) http(0)}`	ITU-T Rec. H.324
H.324 Session Reset	Control protocol	`{itu-t(0) recommendation(0) h(8) 324 generic-capabilities(1) SessionResetCapability(1)}`	ITU-T Rec. H.324
H.324 MONA	Control protocol	`{itu-t(0) recommendation(0) h(8) 324 generic-capabilities(1) mona(2)}`	ITU-T Rec. H.324
H.324 MOS	Control protocol	`{itu-t(0) recommendation(0) h(8) 324 generic-capabilities(1) mona(2) mos(1)}`	ITU-T Rec. H.324
H.324 MOS Ack	Control protocol	`{itu-t(0) recommendation(0) h(8) 324 generic-capabilities(1) mona(2) mosack(2)}`	ITU-T Rec. H.324
H.324 Text Conversation	User Input protocol	`{itu-t(0) recommendation(0) h(8) 324 generic-capabilities(1) textConversationCapability(3)}`	ITU-T Rec. H.324

Table VIII.1/H.245 – List of generic capabilities defined in Recommendations/Standards other than this Recommendation

Capability name	Capability class	Capability identifier	Name of Recommendation or Standard that defines this capability
H.263	Video protocol	`{itu-t(0) recommendation(0) h(8) 263 generic-capabilities(1) 0}`	ITU-T Rec. H.263 NOTE – Use of this capability to signal H.263 "Profiles and Levels" per Annex X/H.263 should always be accompanied in parallel by the signalling of the same modes in H263VideoCapability. This is necessary to ensure that systems which do not recognize the H.263 generic capabilities continue to interwork with newer systems.
H.224	Data protocol	`{itu-t(0) recommendation(0) h(8) 224 generic-capabilities(1) 0}`	ITU-T Rec. H.224
G.722.2	Audio protocol	`{itu-t(0) recommendation(0) g(7) 7222 generic-capabilities(1) 0}`	ITU-T Rec. G.722.2
G.726	Audio protocol	`{itu-t(0) recommendation(0) g(7) 726 generic-capabilities(1) version2003(0)}`	ITU-T Rec. G.726
H.241/H.264	Video protocol	`{itu-t(0) recommendation(0) h(8) 241 specificVideoCodecCapabilities(0) h264(0) generic-capabilities(1)}`	ITU-T Rec. H.241
H.241/H.264	Video protocol	`{itu-t(0) recommendation(0) h(8) 241 specificVideoCodecCapabilities(0) h264(0) iPpacketization(0) RFC3984NonInterleaved(1)}`	ITU-T Rec. H.241
H.241/H.264	Video protocol	`{itu-t(0) recommendation(0) h(8) 241 specificVideoCodecCapabilities(0) h264(0) iPpacketization(0) RFC3984Interleaved(2)}`	ITU-T Rec. H.241
H.241/H.264	Video protocol	`{itu-t(0) recommendation(0) h(8) 241 specificVideoCodecCapabilities(0) h264(0) set-submode(2)}`	ITU-T Rec. H.241
h239Control Capability	Control protocol	`{itu-t(0) recommendation(0) h(8) 239 generic-capabilities(1) h239ControlCapability(1)}`	ITU-T Rec. H.239
h239Extende d Video Capability	Video protocol	`{itu-t(0) recommendation(0) h(8) 239 generic-capabilities(1) h239ExtendedVideoCapability(2)}`	ITU-T Rec. H.239

Table VIII.1/H.245 – List of generic capabilities defined in Recommendations/Standards other than this Recommendation

Capability name	Capability class	Capability identifier	Name of Recommendation or Standard that defines this capability
GenericH235 security Capability	Security protocol	`{itu-t(0) recommendation (0) h(8) 235 version(0) 3 72}`	ITU-T Rec. H.235.7 – For MIKEY-PS – (Notes 1 and 2)
GenericH235 security Capability	Security protocol	`{itu-t(0) recommendation (0) h(8) 235 version(0) 3 73}`	ITU-T Rec. H.235.7 – For MIKEY-DHHMAC – (Notes 1 and 2)
GenericH235 security Capability	Security protocol	`{itu-t(0) recommendation (0) h(8) 235 version(0) 3 74}`	ITU-T Rec. H.235.7 – For MIKEY-PK-SIGN – (Notes 1 and 2)
GenericH235 security Capability	Security protocol	`{itu-t(0) recommendation (0) h(8) 235 version(0) 3 75}`	ITU-T Rec. H.235.7 – For MIKEY-DH-SIGN – (Notes 1 and 2)
H.249 Navigation Key	User Input capability	`{itu-t(0) recommendation(0) h(8) 249 navigation-key(1)}`	ITU-T Rec. H.249
H.249 Soft Key	User Input capability	`{itu-t(0) recommendation(0) h(8) 249 soft-keys(2)}`	ITU-T Rec. H.249
H.249 Pointing Device	User Input capability	`{itu-t(0) recommendation(0) h(8) 249 pointing-device(3)}`	ITU-T Rec. H.249
H.249 Modal Interface	User Input capability	`{itu-t(0) recommendation(0) h(8) 249 modal-interface(4)}`	ITU-T Rec. H.249
G.711.1Alaw	Audio protocol	`{itu-t(0) recommendation(0) g(7) g711(711) dot(1) part1(1) generic-capabilities(1) a-law(1) 0 }`	ITU-T Rec. G.711.1
G.711.1Ulaw	Audio protocol	`{itu-t(0) recommendation(0) g(7) g711(711) dot(1) part1(1) generic-capabilities(1) u-law(0) 0 }`	ITU-T Rec. G.711.1
G.719	Audio protocol	`{itu-t(0) recommendation(0) g(7) 719 generic-capabilities(1) 0 }`	ITU-T Rec. G.719
H.323 Single Transmitter Multicast	Control protocol	`{itu-t(0) recommendation(0) h(8) 323 main(0) generic-capabilities(0) SingleTransmitterMulticast(1)}`	ITU-T Rec. H.323

Table VIII.1/H.245 – List of generic capabilities defined in Recommendations/Standards other than this Recommendation

Capability name	Capability class	Capability identifier	Name of Recommendation or Standard that defines this capability
T140Data	Data Application Capability	`{itu-t(0) recommendation(0) h(8) 323 annex(1) g(7) generic-capabilities(0)}`	ITU-T Rec. H.323 (Note 3)
T140Audio	Audio Capability	`{itu-t(0) recommendation(0) h(8) 323 annex(1) g(7) generic-capabilities(0)}`	ITU-T Rec. H.323 (Note 3)
NOTE 1 – Used within H235SecurityCapability and in H235Mode. NOTE 2 – Used within OLC, OLCAck for the MIKEY protocols. NOTE 3 – The T140Audio and T140Data capabilities use the same capability identifier value and are distinguished by their capability class.			

Table VIII.2 lists the generic messages defined in Recommendations or Standards other than this Recommendation.

Table VIII.2/H.245 – List of generic messages defined in Recommendations/Standards other than this Recommendation

Message name	Message class	Message identifier	Name of Recommendation or Standard that defines this message
H.239	Generic message	`{itu-t(0) recommendation(0) h(8) 239 generic-message(2)}`	ITU-T Rec. H.239
GenericCommand, GenericIndication	Generic message	`{itu-t(0) recommendation(0) h(8) 235 version(0) 3 72}`	ITU-T Rec. H.235.7 (Note)
GenericCommand, GenericIndication	Generic message	`{itu-t(0) recommendation(0) h(8) 235 version(0) 3 73}`	ITU-T Rec. H.235.7 (Note)
GenericCommand, GenericIndication	Generic message	`{itu-t(0) recommendation(0) h(8) 235 version(0) 3 74}`	ITU-T Rec. H.235.7 (Note)
GenericCommand, GenericIndication	Generic message	`{itu-t(0) recommendation(0) h(8) 235 version(0) 3 75}`	ITU-T Rec. H.235.7 (Note)
H.230	Generic message	`{itu-t(0) recommendation(0) h(8) 230 generic-message(2)}`	ITU-T Rec. Annex A/H.230
NOTE – Used for TGK re-keying/updating for the MIKEY protocols.			

Appendix IX

ASN.1 usage in this Recommendation

(This appendix does not form an integral part of this Recommendation)

This appendix lists the ASN.1 concepts that have been used in this Recommendation. It is the intention of Study Group 16 to restrict extensions of this Recommendation to using only these concepts. Additional ASN.1 concepts will only be considered in exceptional circumstances.

IX.1 Tagging

All tags within this Recommendation are AUTOMATIC TAGS.

IX.2 Types

The following types occur in the ASN.1 definitions of this Recommendation:

```
BIT STRING        IA5String          OCTET STRING
BMPString         INTEGER            SEQUENCE
BOOLEAN           NULL               SEQUENCE OF
CHOICE            NumericString      SET
GeneralString     OBJECT IDENTIFIER  SET OF
```

IX.3 Constraints and Ranges

This Recommendation uses size constraints ("SIZE": strings, set-of and sequence-of), value range constraints (integers) and permitted alphabets ("FROM").

IX.4 Extensibility

This Recommendation uses the extension marker (ellipsis "...").

Appendix X

Resolution of unidirectional and bidirectional conflict scenarios

(This appendix does not form an integral part of this Recommendation)

This appendix lists the typical conflict scenarios that involved conflicts that occur due to the use of unidirectional and bidirectional channels, and describes the conflict resolution procedure for each one of them.

X.1 Both terminals use bidirectional OLC

In this scenario, both terminals propose a bidirectional video channel, as shown in Figure X.1.

Since both terminals are only capable of processing a single video stream in each direction, this causes a conflict.

The master terminal in this case sends out a reject message with cause equal to masterSlaveConflict on the slave's channel proposal.

The slave should accept the master's proposal and it should not try to open a non-conflicting channel instead.

The slave might also detect unsuitable reverse parameters in the master's proposal, in which case, it should reject the master's proposal with cause equal to unsuitableReverseParameters, and reissue a proposal with proper forward and reverse parameters, as described in C.5.1.

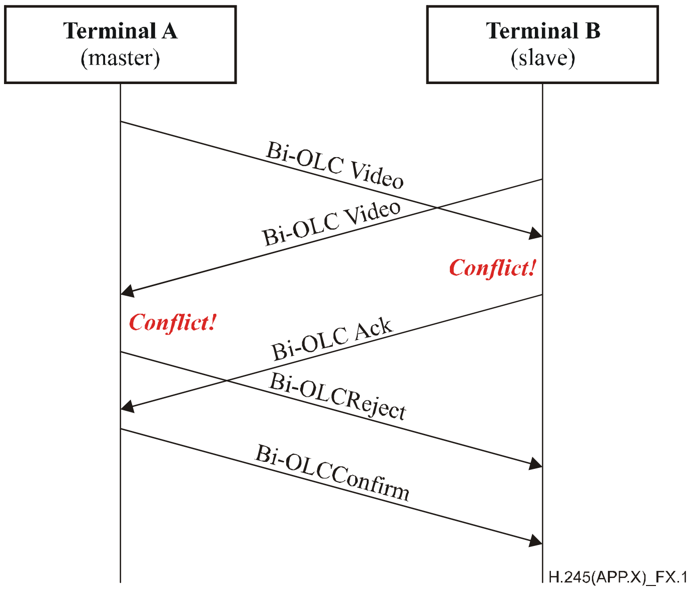


Figure X.1/H.245 – Both terminals use bidirectional OLC

X.2 Master proposes bidirectional OLC and slave proposes unidirectional OLC

In this scenario, the master proposes a bidirectional video channel and the slave proposes a unidirectional video channel, as shown in Figure X.2.

The master terminal in this case sends out a reject message with cause equal to masterSlaveConflict on the slave's channel proposal.

The slave should accept the master's proposal and it should not try to open a non-conflicting channel instead.

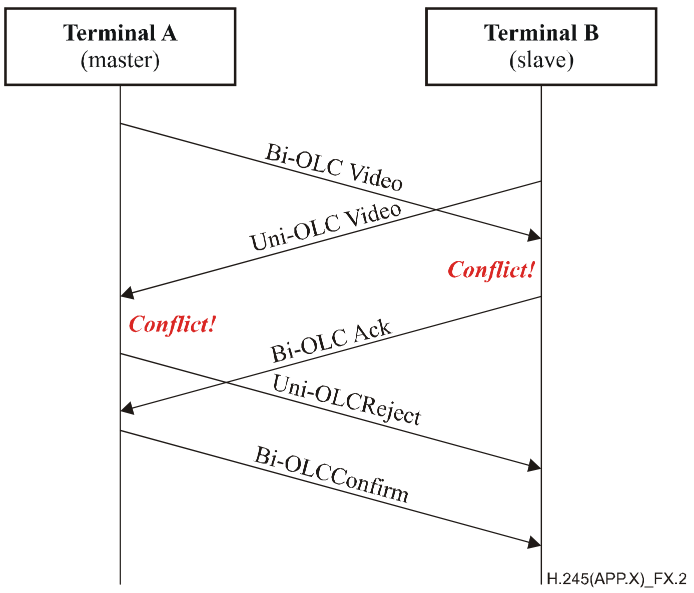


Figure X.2/H.245 – Master proposes bidirectional OLC and slave proposes unidirectional OLC

X.3 Master proposes unidirectional OLC and slave proposes bidirectional OLC

In this scenario, the master proposes a unidirectional video channel and the slave proposes a bidirectional video channel, as shown in Figure X.3.

The master terminal in this case sends out a reject message with cause equal to masterSlaveConflict on the slave's channel proposal.

The slave should accept the master's proposal and it should open a non-conflicting unidirectional video channel instead.

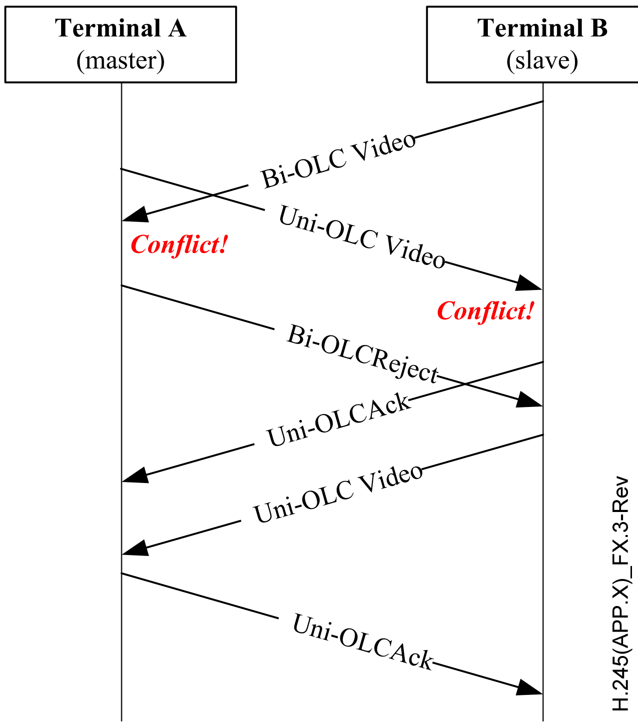


Figure X.3/H.245 – Master proposes unidirectional OLC and slave proposes bidirectional OLC

X.4 Master proposes bidirectional OLC with nullData and slave proposes unidirectional OLC

In this scenario, the master proposes a bidirectional video channel with nullData type in the reverse parameters, and the slave proposes a unidirectional video channel, as shown in Figure X.4.

Since the result of these proposals would be a single video channel in each direction, no conflict should be detected, and each terminal should accept the proposal initiated by the other terminal.

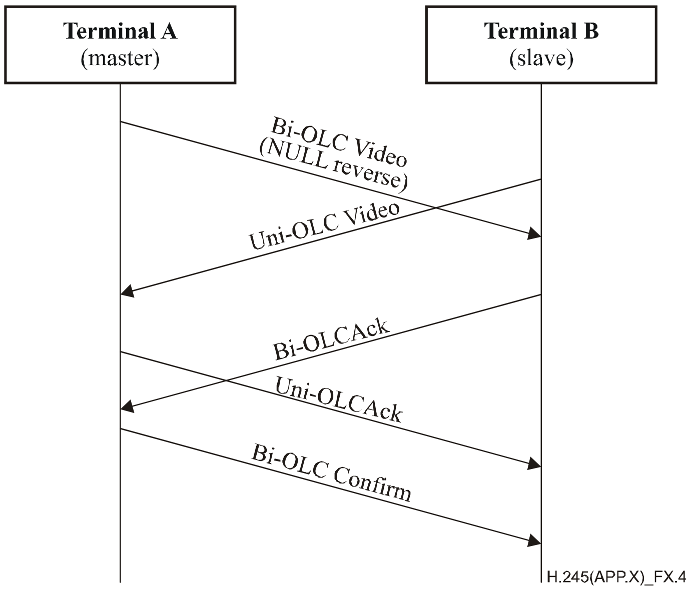


Figure X.4/H.245 – Master proposes bidirectional OLC with nullData and slave proposes unidirectional OLC

X.5 Both terminals propose bidirectional OLC with nullData

In this scenario, both terminals propose a bidirectional video channel with nullData type in the reverse parameters, as shown in Figure X.5.

Since the result of these proposals would be a single video channel in each direction, no conflict should be detected, and each terminal should accept the proposal initiated by the other terminal.

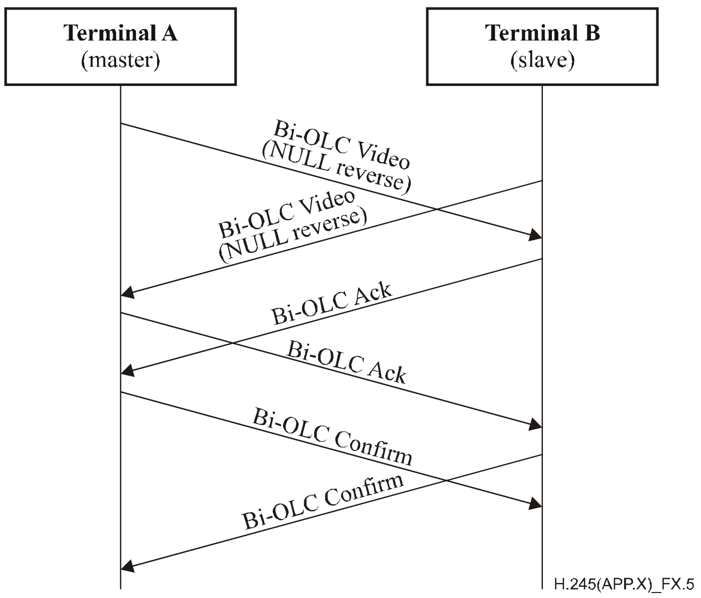


Figure X.5/H.245 – Both terminals propose bidirectional OLC with nullData

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