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Annex H

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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Systems and terminal equipment for audiovisual services

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Terminal for low bit-rate multimedia communication

Annex H: Mobile multilink operation

ITU-T Recommendation H.324 – Annex H

(Formerly CCITT Recommendation)

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ITU-T Recommendation H.324

Terminal for low bit-rate multimedia communication

ANNEX H

Mobile Multilink Operation

Summary

This annex defines the operation of H.324 over up to 8 independent physical connections, aggregated together according to the mobile multilink layer defined in this annex to provide a higher total bit rate. These connections are error prone mobile channels as defined in Annex C/H.324 all having the same transmission rate.

The difference between Annex H and Annex F is that Annex H is primarily intended to be used on error prone connections by not using HDLC framing and with less flexibility in terms of the number, the bit rate, and the delay differences of the channels involved in the aggregation than Annex F in order to work on mobile connections. Annex H is not intended to be a replacement of Annex F on connections with very low bit error rates.

Source

Annex H to ITU-T Recommendation H.324 was prepared by ITU-T Study Group 16 (2001-2004) and approved under the WTSA Resolution 1 procedure on 17 November 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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ITU-T Recommendation H.324

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Mobile Multilink Operation

H.1 Scope

This annex defines the operation of H.324 over up to 8 independent physical connections, aggregated together according to the mobile multilink layer defined in this annex to provide a higher total bit rate. These connections are error prone mobile channels as defined in Annex C/H.324 all having the same transmission rate.

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H.2 Definitions and format conventions

H.2.1 Definition of terms

This Recommendation defines the following terms:

H.2.1.1 header: A collection of parameters whose beginning is marked by one Flag.

H.2.1.2 sample: The smallest unit of data which is always kept contiguous when distributing data among multiple channels. The size of the Sample is an integer number of octets.

H.2.2 Format conventions

See 3.2/H.223.

H.3 Functional requirements

For use on mobile connections, terminals compliant with this annex shall comply with Annex C/H.324. The multilink operation is limited to channels having the same characteristics. In particular the channels to be aggregated shall have the same bit rate. Since the channels as defined in Annex C/H.324 do not utilise V.8 *bis* or V.140, in-band signalling is defined in this annex for the purpose of setting up the mobile multilink, as well as the addition, and the removal of additional connections.

H.4 Overview

In summary, the establishment of a mobile multilink call involves the following steps:

1) Initial channel physical connection is established.
2) The mobile multilink is set up using the in-band joint multilink and multiplex setup procedure.
3) H.324 operation begins on the initial connection.

4) H.245 is used to exchange information about available additional channels, including a 32-bit **callAssociationNumber**, which will be used to identify the call.

5) An additional physical connection is established.

6) In-band control frames are exchanged between the initiator and the responder to set up an additional connection to be associated with the mobile multilink. The initiator supplies the previously received **callAssociationNumber** to identify that the new connection is associated with the existing call.

7) The new connection is added to the mobile multilink layer as part of the H.324 mobile multilink call.

H.5 Mobile Multilink layer specification

H.5.1 Overview

The mobile multilink is a layer between an H.223 multiplex and up to 8 physical channels (Figure 1). Its function is to aggregate the physical channels in order to provide a higher total bit rate for an Annex C/H.324 terminal. The transmission rate of each of the physical channels involved shall have the same value.

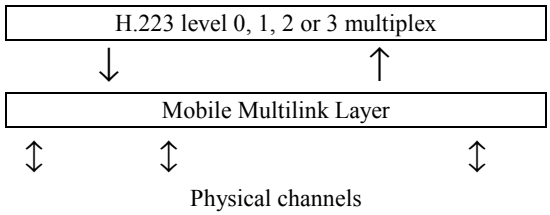

Figure 1/H.324 – Overview of the mobile multilink layer

The input to the mobile multilink layer shall be a bitstream from an H.223 level 0, 1, 2, or 3 multiplex as defined in ITU-T H.223 and in Annexes A, B, C, and D of ITU-T H.223. The output from the multilink layer shall be distributed onto the physical channels.

In order to recover the multiplexed stream at the receiving side from one or more physical channels, a synchronisation mechanism is needed. This is achieved by a framing format where header information is inserted at regular intervals into the physical channels.

H.5.2 Mobile multilink framing

Data to be sent over the physical channels shall be segmented into frames. A frame shall start with a 16-bit flag, followed by a 2 or 5-octet header after which the payload follows as shown in Figure 2. The number of octets in the payload is signalled in the header.

Flag (2 octets)
Header (2 or 5 octets)
Payload (0 to SS*SPF octets)

NOTE – The SS and SPF parameters are defined in H.5.2.2.

Figure 2/H.324 – Mobile multilink layer framing format

H.5.2.1 Flag

A mobile multilink frame shall begin with the 16-bit flag shown in Figure 3 or its one's complement flag if the full header is used or the compressed header is used, respectively. If synchronisation is lost on the receiving side a search for this flag should be performed to reacquire synchronisation. Since this sequence of bits is not unique in the bitstream but can be emulated by data in the payload part of the framing format, a multilink receiver should also check that a valid header can be decoded before synchronisation is accepted.

8	7	6	5	4	3	2	1	Octets
1	0	1	1	0	1	1	0	1
0	0	0	1	1	0	0	0	2

Figure 3/H.324 – 16-bit flag pattern for the mobile multilink

NOTE – The flags defined in Annex A/H.223 are at a Hamming distance of 8 from this flag.

H.5.2.2 Header

Two types of headers are defined: full header and compressed header. The full header contains all information for initial operation, whereas the compressed header contains minimum information which can be used after information frame synchronisation has been acquired. The distinction between these headers is made by the polarity of flag field. The full header is preceded by flag field as shown in Figure 3 and the compressed header is preceded by the one's complemented flag.

H.5.2.2.1 Full Header configuration

The full header is shown in Figure 4.

8	7	6	5	4	3	2	1	Octets
FT	L	SN			CT			1
SS								2
SPF								3
16-bit CRC field								4
								5

Figure 4/H.324 – Full header format

Two types of frames are defined, control frames and information frames, as indicated by the FT (frame type) bit. FT shall be set to "1" for control frames used for in-band signalling to add connections. FT shall be set to "0" for information frames carrying H.223 multiplexed data in the payload part.

The 3-bit sequence number (SN) field shall be incremented by one modulo 8 for each new information frame and shall have the same value for all channels in use.

The 3-bit channel tag (CT) field is a unique identifier for a channel in multilink session.

The L bit shall be set to "1" for the channel that is the highest numbered channel. For all other channels the L bit shall be set to "0".

The 8-bit sample size (SS) field indicates the size of a sample in octets (see H.5.4). The value 0 of SS is reserved for future use.

The 8-bit samples per frame (SPF) field indicates the length in samples of the payload (see H.5.4).

The product of SS and SPF gives the size of the payload in octets.

The last two octets of the header hold a 16-bit CRC field (see 7.4.3.2.3/H.223) as protection for the 3 octets following the flag.

H.5.2.2.2 Compressed Header configuration

The compressed header is shown in Figure 5.

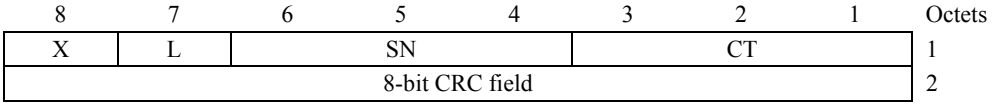

Figure 5/H.324 – Compressed header format

The CT, SN and L fields are identical to those described in H.5.2.2.1.

The X bit is set to "0". The value "1" is reserved for future use.

The 8-bit CRC field (see 7.3.3.2.3/H.223) is used as protection for the octet following the one's complemented flag.

H.5.2.3 Control frames

To support in-band signalling for the handling of initial and additional connections to the multilink layer control frames are used.

Control frames use the full header format with the FT bit set to "1". There are three types of control frames defined as shown in Figure 6.

Control Frame	Mux Level	Control Field						Payload
		L	FT	CT	SN	SS	SPF	
Initial	0	0	1	0	0	1	0	–
	1	0	1	0	1	1	0	–
	2	0	1	0	2	1	0	–
	3	0	1	0	3	1	0	–
Request additional	–	1	1	0	0	1	6	6 octet payload as described in H.6.2.3.1
Accept additional	–	1	1	0	0	1	0	–

Figure 6/H.324 – Header and payload for control frames

Initial control frames are used for setting up a multilink session between two terminals including multiplex level set up. The SN field is set to the level of the multiplex, i.e. 0,1,2, or 3.

request additional control frames are used for requesting to add a physical connection to an already existing multilink session.

accept additional control frames are used for accepting the request to add a physical connection to an already existing multilink session.

The use of these control frames is described in H.6.

H.5.3 Stuffing frames

In the event that the mobile multilink layer has no information to send on a channel, such as when a channel is no longer part of the multilink session but has not been disconnected yet, a flag shown in Figure 3, followed by 5 zero octets shall be sent as the stuffing sequence.

For connections that are part of a multilink session it is the responsibility of the H.223 multiplex to supply the multilink with the correct amount of data, taking into account the overhead for the multilink framing.

H.5.4 Information frames

Information frames use either the full header format with the FT bit set to "0" or the compressed header. For all channels in use the same type of header (full header or compressed header) shall be used.

Information frames are generated for each block of H.223 bit stream. The size of a block is (number of channels * SS * SPF) octets. A block is divided into samples of SS-octets. Then samples are put onto the payload part of information frames. The first sample shall be placed on the frame with the lowest CT value, the next sample on the next lowest numbered frame, and so on. After a sample has been placed on the highest numbered frame the process shall be repeated using the lowest numbered frame until all samples in the block has been sent.

NOTE 1 – On channels having a burst characteristic it may be advantageous to choose a value for a sample larger than one octet. For instance a value that is related to the mean burst length may be a good choice.

NOTE 2 – All the information frames for this block have the same values of SS and SPF.

The L bit shall be set to "1" for the highest numbered channel and to "0" for the remaining channels.

The SN field shall be incremented by one modulo eight for each block of H.223 bit stream.

The CT value indicates the channel onto which the information frame is transmitted.

NOTE 3 – In the case that a header cannot be interpreted due to a CRC error a receiver may assume that the header contained a CT value identical to a previously correct received header.

H.6 Procedures

H.6.1 Establishing Mobile Multilink operation

H.6.1.1 Establishment of initial connection

The procedure described in C.5 and C.6 shall be applied except for C.6.2, which is replaced by the H.6.1.2.

H.6.1.2 Joint multilink and multiplex set-up over the initial connection

After the establishment of the initial physical connection a terminal that intends to use the mobile multilink shall start transmitting control frames for *initial connection* (Figure 6). This sequence of control frames jointly sets up both the mobile multilink layer and the H.223 multiplex level. The terminal shall set the SN field of the header to its highest supported multiplex level, which shall be 0, 1, 2, or 3.

If the terminal detects an Annex C/H.324 stuffing sequence in place of mobile multilink control frames, it shall immediately start the Annex C/H.324 setup procedure according to C.6.2.

If the terminal detects control frames for *initial connection* with a multiplex level lower than its own transmitted level, it shall immediately change its value in the SN field according to the detected lower level.

When the terminal detects control frames with a multiplex level that is identical to its own transmitted level, multilink and multiplex set-up has been completed. The H.223 multiplex shall then start its operation using the multiplex level indicated in the SN field.

H.6.1.3 Initiation of Mobile Multilink operation

If the mobile multilink is set up, all subsequent communication shall apply the mobile multilink mode to all data transmitted over the connection. Specifically, the H.324 bitstream that would otherwise be transmitted in Annex C/H.324 operation is instead used as the input to the mobile multilink. Similarly, received information shall pass through the mobile multilink receiver and the data output stream produced shall be used as input to the ordinary Annex C/H.324 receiver.

It is possible that, upon establishment of the initial connection, the terminals may not yet know if any additional connections will later be established. If no additional connections are established, H.324 mobile multilink operation shall continue to be used, on the initial connection, throughout the H.324 communication session.

The initial connection shall be assigned a CT value of "0" initially until another connection is added to the session.

The H.245 **TerminalCapabilitySet** message shall include the **mobileMultilinkFrameCapability** in **H223Capability**.

H.6.2 Adding physical connections

The procedures for adding associated physical connections require one of the two terminals to be designated as the initiator and the other as the responder. The terminal that originates the first physical connection shall be the initiator, and the terminal that answers the first physical connection shall be the responder.

The procedures for establishing and associating additional connections may be performed on multiple connections at the same time.

When one or more channels are added to a multilink session, the transmitting entity of the multilink shall assign a channel tag from 0 to (N-1) to each of the channels before the next information frames are transmitted, where N is the number of connections in use.

H.6.2.1 Exchanging call information

See F.5.2.1 with multilink replaced with mobile multilink.

H.6.2.1.1 Differential automatic dialling information

See F.5.2.1.1

The responder may use the **networkType** of **mobile**.

H.6.2.1.2 Automatic dialling information not available

See F.5.2.1.2

H.6.2.2 Establishing additional physical connections

See F.5.2.2 with multilink replaced with mobile multilink.

H.6.2.2.1 Responder request to add additional connections

See F.5.2.2.1

H.6.2.3 Associating additional physical connections

Upon establishment of an additional physical connection, the exchange of control frames between the initiator and the responder will determine if the connection can be associated with an existing mobile multilink session or if the connection is an independent connection by using the following procedure.

H.6.2.3.1 Procedure for Initiator

The initiator shall immediately start to send control frames for *request additional*. The payload for *request additional* control frames shall contain the callAssociationNumber that was determined in H.6.2.1 and a 16-bit CRC field, see Figure 7.

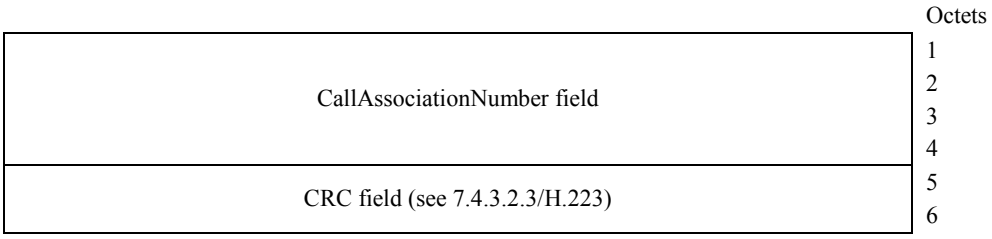

Figure 7/H.324 – Payload for *request additional* control frames

If it detects control frames for *accept additional*, it shall add this connection to the existing session that has the same callAssociationNumber. If it cannot detect a control frame for *accept additional* until the appropriate timer expires, it shall disconnect this additional connection.

H.6.2.3.2 Procedure for Responder

H.6.2.3.2.1 Responder capable of an independent session

If the responder allows another independent session of either mobile multilink or Annex C/H.324, it shall immediately start to send control frames for *initial* connection with its highest supported multiplex level.

If it detects a control frame for *request additional* that has the same callAssociationNumber as that of an existing session, it shall immediately start to send multiple control frames for *accept additional*, and shall add this connection to the session. The number of control frames sent should be sufficient for the receiver to detect taking into account the mobile channel condition.

If it detects a control frame for *initial* connection, it shall start a new session according to the procedure in H.6.1. If it detects a stuffing sequence for Annex C/H.324, it shall start the Annex C/H.324 setup procedure according to C.6.

H.6.2.3.2.2 Responder not capable of an independent session

If the responder is not capable of another independent session, it shall immediately start to send control frames for *accept additional*.

If it detects control frames for *request additional* that has the same callAssociationNumber as that of an existing session, it shall add this connection to the session. If it detects control frames for *initial* connection or stuffing sequence for Annex C/H.324, it shall disconnect this additional connection.

H.6.3 Removing physical connections

H.6.3.1 Removing last remaining connection

Phase F and G in C.5 shall be followed to remove the last remaining physical connection at the end of an H.324 session.

H.6.3.2 Removing additional connections

See F.5.3.2 with references to H.226, H.226 channel set, H.226 Header, and H.226 data set replaced by the mobile multilink, mobile multilink connections, mobile multilink header, and mobile multilink frames, respectively except for the procedure when a connection is removed accidentally. If a connection is removed accidentally, each terminal shall assign a channel tag to each of the remaining channels before the next information frames are transmitted.

When one or more channels are removed from a multilink session, the transmitting entity of the multilink shall assign a channel tag from 0 to (N-1) to each of the channels, where N is the number of connections in use.

H.7 Header modes

Mobile multilink operation has two modes for information frame transmission: full header mode and compressed header mode. This clause defines these modes and the mode transition procedures.

H.7.1 Full header mode

In full header mode, the full header defined in Figure 4 is used for information frames on all channels. In this mode, the transmitter may change the value of SS and SPF in the information frame header, but the transmitter shall send the **MobileMultilinkReconfigurationIndication** message to the receiver before changing the values.

Mobile multilink starts with this mode, and the initial value of SS shall be set to "1", and that of SPF shall be set to "255".

H.7.2 Compressed header mode

In compressed header mode, the compressed header defined in Figure 5 is used for information frames on all channels. In this mode, the transmitter shall use the same SS and SPF values with those used for the last information frames in full header mode.

H.7.3 Mode Transition (from full header to compressed header)

When the receiver has synchronized the frame timing of the information frames in full header mode, the receiver shall send the **MobileMultilinkReconfigurationCommand** with the detected SS and SPF values and the status of **synchronized**. On the receipt of this command, the transmitter shall assess the SS and SPF values in the command message. If these values are the same as the values in use, then the transmitter shall change the mode from full header mode to compressed header mode. Otherwise, the transmitter shall continue the operation in full header mode.

H.7.4 Transition from compressed header mode to full header mode

If the receiver finds that better SS and SPF values for the current channel conditions (e.g. bit error rate or burst error characteristics), the receiver may request to change these values by sending **MobileMultilinkReconfigurationCommand** with the detected SS and SPF values and the status of **reconfiguration**. On the receipt of this command, the transmitter shall move to the full header mode. The receiver should use the values for SS and SPF in the command message, but the actual value used for the information frames is up to the transmitter.

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