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SERIES Q: SWITCHING AND SIGNALLING

International automatic and semi-automatic working –
Signalling for circuit multiplication equipment

Signalling between signal processing network equipment (SPNE) and international switching centres (ISC) over an IP network

ITU-T Recommendation Q.56

(Formerly CCITT Recommendation)

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ITU-T Recommendation Q.56

Signalling between signal processing network equipment (SPNE) and international switching centres (ISC) over an IP network

Summary

This Recommendation describes a signalling interface, procedures, and protocol required between an International Switching Centre (ISC) and Signal Processing Network Equipment (SPNE). This IP-based signalling interface provides for the call-by-call control of an SPNE in real time to ensure an appropriate signal enhancement capability such as echo control. The framework of this signalling interface allows for growth for the control of potential future SPNE types.

Source

ITU-T Recommendation Q.56 was prepared by ITU-T Study Group 11 (2001-2004) and approved under the WTSA Resolution 1 procedure on 25 May 2001.

Keywords

μ-Law, A-Law, Automatic Level Control, Echo Canceller, Frequency Equalization, IP Network, Noise Reduction, Signal Processing Equipment, SPNE.

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 not 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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Introduction

There is a need in networks for signal processing equipment, including echo cancellers, automatic level controllers, frequency equalizers, noise reducers, A-Law to μ-Law converters, etc. This equipment needs to be controlled on a call-by-call basis, to ensure the highest possible transmission quality.

This Recommendation describes signalling interface procedures and a protocol required between an International Switching Centre (ISC) and Signal Processing Network Equipment (SPNE). This signalling interface enables an SPNE to be controlled in real time, on a call-by-call basis, to ensure the appropriate signal enhancement capability and parameters are provided for the call. This signalling interface can be used to facilitate the efficient support of existing and future signal processing equipment at the international interface, such as echo cancellers, automatic level controllers, noise reduction devices, frequency equalizers, A-Law to μ-Law converters and other capabilities. It can be used to ensure that the appropriate capabilities are enabled or disabled on a call-by-call basis.

In this Recommendation, a TCP/IP-based protocol is described which has the ability to address 65 536 E1/T1 facilities.

The method whereby a switch determines whether a Signal Processing Function (SPF) should be enabled or disabled is not covered by this Recommendation.

ITU-T Recommendation Q.56

Signalling between signal processing network equipment (SPNE) and international switching centres (ISC) over an IP network

1 Scope

This Recommendation describes a signalling interface between an International Switching Centre (ISC) and Signal Processing Network Equipment, referred to as an SPNE. This Recommendation covers the following SPFs: echo cancellation, noise reduction, automatic level control, A-law/μ-law conversion and frequency equalization. Remaining for further study are additional SPF functions, such as PCM offset conversions, etc. The interface is supported over an IP network.

This Recommendation is specifically concerned with the transfer of signalling information on a per-call basis between the ISC and the SPNE, and for controlling various functions contained in the SPNE.

The signalling interface defined in this Recommendation assumes a fixed relationship between the circuits of the ISC and the SPNE.

While this Recommendation is intended for use on international networks, the information defined here may be used within national networks.

This protocol can support devices that can address channels that occupy less than 8 bits in a PCM slot such as 4, 2 and 1 including 8-bit channels.

2 References

2.1 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.

[1] ITU-T G.165 (1993), *Echo cancellers*.

[2] ITU-T G.168 (2000), *Digital network echo cancellers*.

[3] ITU-T G.169 (1999), *Automatic level control devices*.

[4] ITU-T G.703 (1998), *Physical/electrical characteristics of hierarchical digital interfaces*.

[5] ITU-T G.704 (1998), *Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels*.

[6] ITU-T G.711 (1988), *Pulse code modulation (PCM) of voice frequencies*.

[7] ITU-T Q.50 (2001), *Signalling between circuit multiplication equipments (CME) and international switching centres (ISC)*.

[8] ITU-T Q.115 (1999), *Logic for the control of echo control devices*.

2.2 Bibliography

The documents listed in this clause provide informative background material for the reader and are not normative within this Recommendation.

[9] ITU-T Q.115 (1998), *Implementor's Guide*.

[10] IEEE 802 (1990) IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture.

3 Definitions

This Recommendation defines the following terms:

3.1 A-Law – μ-Law Converter (AMC): An A-Law – μ-Law converter is a device that converts a PCM signal sample from A-Law to μ-Law in one direction, and μ-Law to A-Law in the other.

3.2 Automatic Level Controller (ALC): An automatic level controller is defined as an SPF located in the digital transmission path that automatically adjusts the level of a signal towards a pre-determined value. Devices that modify the frequency response or spectral content of the signal are also covered by this definition. The telecommunications carrier and the ALC manufacturer will typically agree upon features to be included. See ITU-T G.169.

3.3 Signal Processing Network Equipment (SPNE): Type of equipment which contains one or more signal enhancement functions on speech channels passing through it. Examples include echo cancellers, noise reduction devices, automatic level controllers, frequency equalizers, A-law to μ-law converters and PCM offset controllers. An SPNE as referred to in this Recommendation is external to an ISC.

3.4 channel: Used herein to refer to a 64 kbit/s or sub-64 kbit/s digital circuit occupying a specific position in a frame.

3.5 E1 Facility: A transmission link operating at 2048 kbit/s, supporting 30 or 31 64 kbit/s channels.

3.6 Echo Canceller Device (ECD): An echo canceller device is an SPF that is able to remove some or all of the returned echo signal from a voice circuit. It operates by monitoring the speech signal sent to a voice circuit, and by comparing this signal with the signal received from the circuit, is able to determine what components of the returned signal are caused by an echo path in the circuit. It then is able to remove some or all of the returned echo, providing a voice circuit that is free or nearly free from the echo signal. ITU-T G.165 and G.168 describe echo canceller performance.

3.7 Frequency Equalizer (FE): A frequency equalizer is a device capable of amplifying or attenuating certain frequencies of a speech channel. It is a subset of an automatic level controller (see above).

3.8 functional entity: A grouping of service providing functions in a single location and a subset of the total set of functions required to provide the service. An entity that comprises a specific set of functions at a given location (from ITU-T Q.1290).

3.9 group: An assembly, by digital multiplexing, of digital signals occupying a specified number of timeslots to form a composite signal having a bit rate of 2048 kbit/s or 1544 kbit/s.

3.10 Incoming Echo Control Device (IECD): An incoming echo control device cancels the echo returned from the destination network with reference to the direction in which the call is set up. An IECD is normally located at the destination end of the call. However, it may be located at or near the origination end of the network if its echo processing capability is sufficient to handle the round trip delay from origination end to the destination end and back.

3.11 Local Area Network (LAN): A shared, 10, 100, 1000 Mbit/s signalling interface with a transport defined by IEEE and an application component defined in this Recommendation.

3.12 Noise Reduction Device (NRD): A noise reduction device is an SPF that is able to remove some or all of the unwanted noise component from a voice signal. It operates by monitoring the noise and speech signal received from or sent to a voice circuit, and by using a noise reduction algorithm that distinguishes unwanted noise from real speech, is able to remove some or all of the noise signal, providing a voice circuit which is free or nearly free from the noise signal. There is as yet no ITU-T Recommendation that specifies the performance of a noise reduction device. The telecommunications carrier and the NRD manufacturer will typically agree upon noise reduction features to be included.

3.13 Outgoing Echo Control Device (OECD): An outgoing echo control device cancels the echo returned from the origination network with reference to the direction in which the call is set up. An OECD is normally located at the origination end of the call. However, it may be located at the destination end of the network if its echo processing capability is sufficient to handle the round trip delay from destination end to the origination end and back.

3.14 PCM Offset Controller (for future study): A PCM offset controller is an SPF capable of removing PCM offset from a received A-Law or μ-Law voice signal. PCM offset is a constant positive or negative bias contained in the PCM voice signal, such that a zero analogue input voltage results in a constant, non-zero PCM digital output.

3.15 Protocol Entity (PE): The PE is that part of a layer entity which is dedicated to peer-to-peer communications. A layer PE provides services to the next upper layer and uses services of the next lower layer (refer to ITU-T Q.940).

3.16 physical entity: A physical entity contains one or more functional entities.

3.17 Signal Processing Function (SPF): A function such as echo cancellation or noise reduction that is contained within an SPNE. An SPNE contains one or more SPFs.

3.18 sub-channel: A sub-channel is an even fraction of an 8-bit PCM channel such as a 1-bit channel, 2-bit channel, 4-bit channel or an 8-bit channel.

3.19 T1 Facility: A transmission link operating at 1544 kbit/s supporting 24 speech channels.

4 Abbreviations

This Recommendation uses the following abbreviations:

ALC	Automatic Level Controller
AMC	A-Law – μ-Law Converter
ECD	Echo Control Device
FE	Frequency Equalizer
IECD	Incoming Echo Control Device
IP	Internet Protocol
ISC	International Switching Centre
LAN	Local Area Network
NLP	Non-Linear Processor, a component of an echo canceller
NRD	Noise Reduction Device
OECD	Outgoing Echo Control Device
PCC	Per-Call-Control

PDU	Protocol Data Unit
PE	Protocol Entity
SPF	Signal Processing Function
SPNE	Signal Processing Network Equipment
SS7	Signalling System No. 7
TCP	Transmission Control Protocol

5 Architecture

This Recommendation includes both a network-oriented architecture and a protocol-oriented architecture.

5.1 Network Oriented Architecture

The network architecture deals with where SPNE equipment is located in the network. An SPNE can contain one or more of the Signal Processing Functions as illustrated in Figure 1.

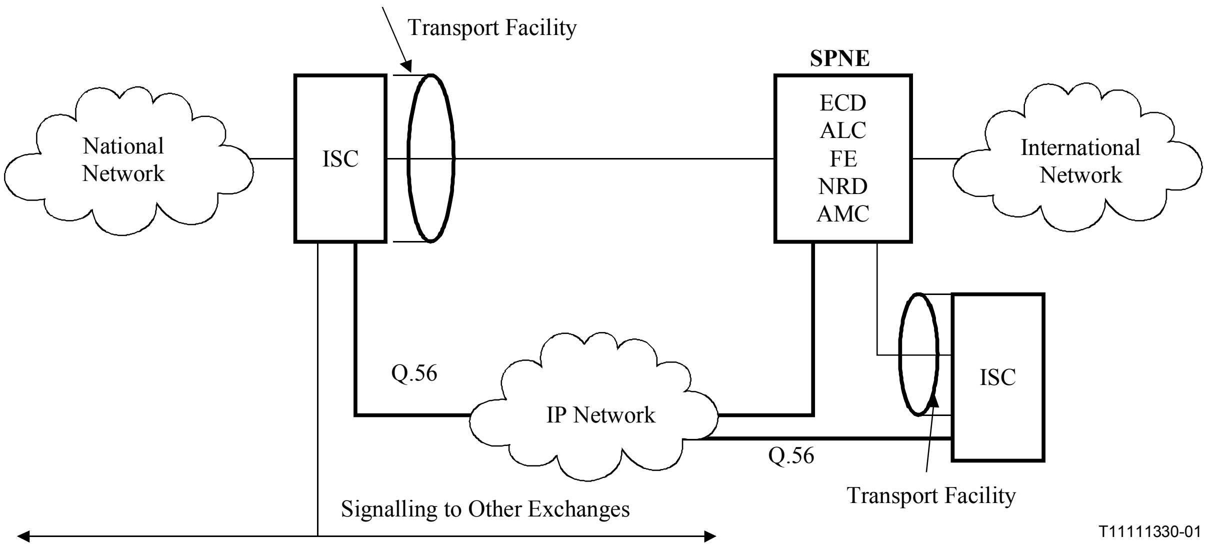


Figure 1/Q.56 – Network Architecture

Figure 2 shows a control architecture where different SPFs within the same SPNE are controlled using the protocol described in this Recommendation.

Definitions of each of these devices can be found in clause 3. Note that not all of these devices are yet covered by ITU Recommendations on equipment or performance.

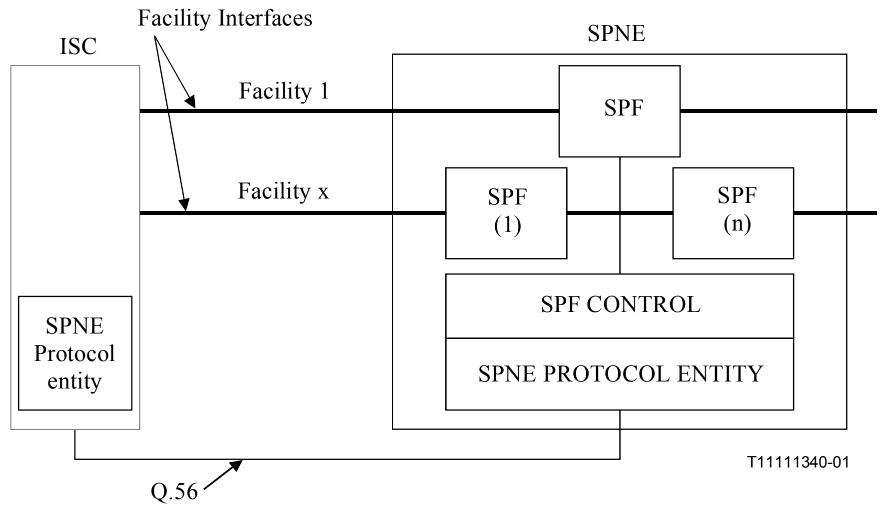
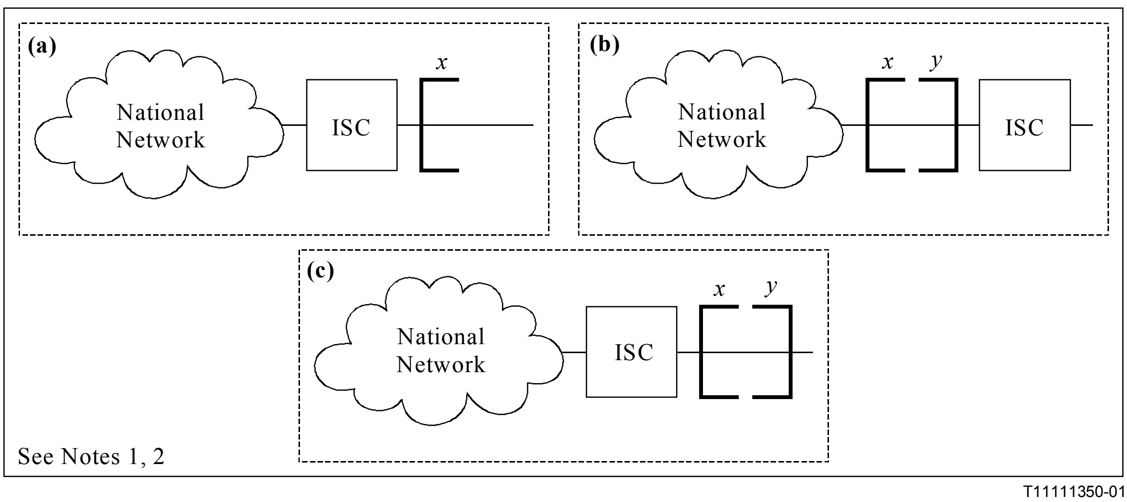


Figure 2/Q.56 – IP Network-Based Interface

NOTE – An SPNE physical entity may contain multiple SPNE functional entities.

Figure 3 illustrates the various locations in which SPNEs can be located within a network. Figure 3 (a) is the traditional arrangement, Figure 3 (b) positions combined associated SPNEs on the national network side of the ISC, and Figure 3 (c) positions combined associated SPNEs on the international network side of the ISC.



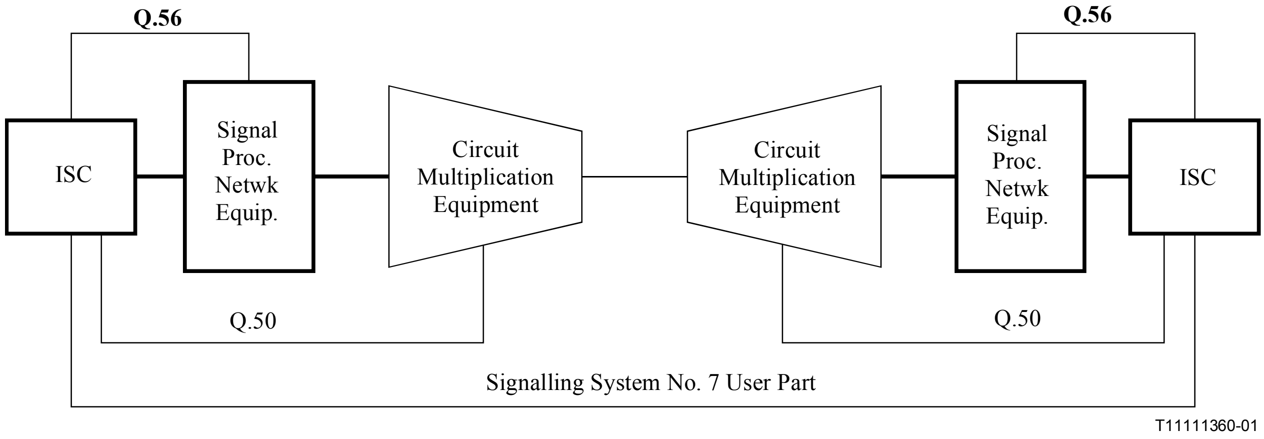
NOTE 1 – *x:* This direction treats speech arriving from the national network side. For an international incoming call, it is an IECD. For an outgoing call, it is an OECD.
y: This direction treats speech arriving from the international network side. For an international incoming call, it is an OECD. For an outgoing call, it is an IECD.

NOTE 2 – SPNEs x and y may be separate devices or they may be combined into a single device. In the case where they are echo cancellers, this configuration is referred to as a "combined associated echo canceller".

Figure 3/Q.56 – Location of SPFs within a Network

Figure 4 illustrates the relationship between the Q.56 PCC signalling interface at the ISC and other relevant signalling protocols. These other signalling protocols include signalling to other exchanges for call and connection control. If a DCME is in the connection there may be a PCC interface to it using Q.50. Services requiring transmission enhancements performed by the SPNE may need to be indicated in ISUP.

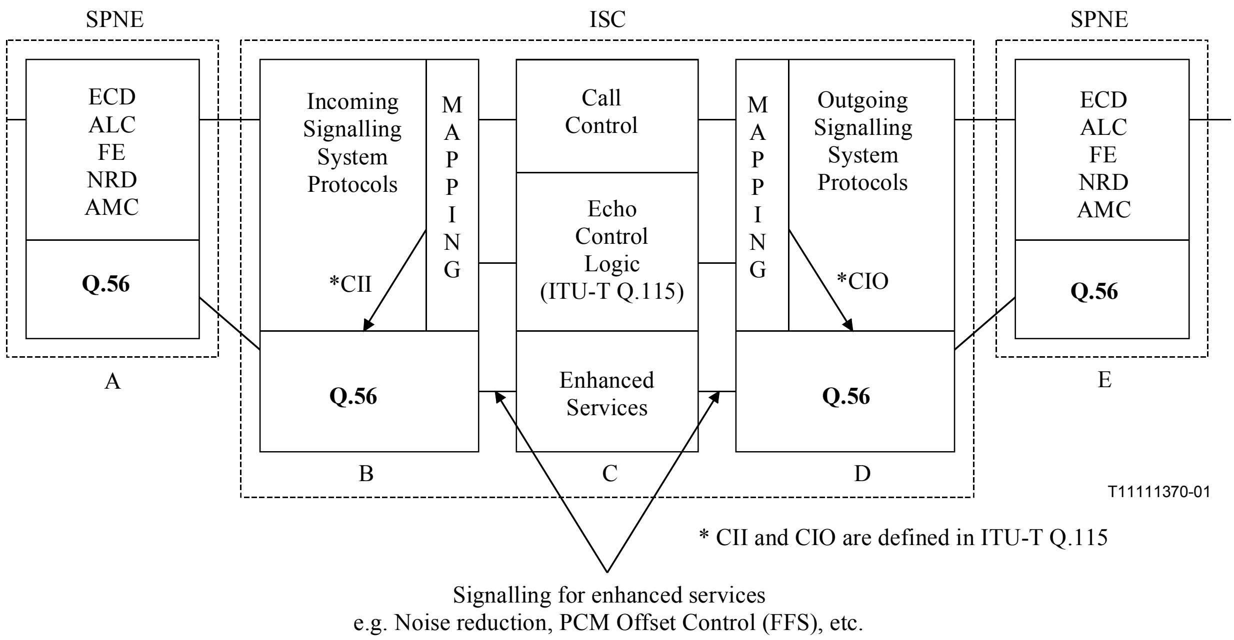
A DCME may be considered a special type of SPNE. Control of a DCME via the SPNE interface is for further study.



NOTE 1 – Circuit Multiplication Devices may or may not be included.
NOTE 2 – R2 or C5 Signalling may also be supported between ISCs.

Figure 4/Q.56 – Relationship of Q.56 to Other Signalling Protocols

Figure 5 illustrates the distribution of functional entities within call control signalling systems. Block A represents the SPNE on the Incoming side of the ISC. Block E represents the SPNE on the Outgoing side of the ISC. Blocks B and D represent the Incoming and Outgoing signalling system protocols, respectively, and Block C represents Call Control for echo control logic and the logic for enhanced services.



NOTE 1 – It is outside the scope of this Recommendation to define how call control determines the requirements for SPNE functions. ITU-T Q.115 should be used for echo control devices.

NOTE 2 – The functional entity associated with incoming and outgoing signalling systems protocols may be located in the same physical entity.

Figure 5/Q.56 – Distribution of Functional Entities

5.2 Network Protocol Oriented Architecture

5.2.1 Application Protocol Architecture

The application protocol receives control information from call control and the signalling system and transfers it to a peer protocol entity in the Signal Processing Network Equipment. If acknowledgements are supported, the peer protocol entity in the Signal Processing Network Equipment sends back acknowledgements to the corresponding application in the ISC.

It is beyond the scope of this Recommendation how ISC call control determines the requirements for SPNE functions. This assumes that other ITU-T Recommendations are defining the call control logic to determine requirements for SPNE functions. ITU-T Q.115 is such a document for echo control.

5.2.2 Lower Layer Protocol Architecture

The lower layer protocol is TCP/IP.

6 Signalling Procedures

This clause describes the procedures at the ISC-SPNE interface, including the control elements incorporated into them for various types of signal processing functions.

The signalling interface defined in this Recommendation is between the ISC and the SPNE. The basic signalling function is to support the real time control of the SPFs contained in an SPNE to ensure that the appropriate signal enhancement function for a given speech channel is correctly configured and enabled, depending on the call type for that channel.

Signal processing functions that are controlled using the protocol described in this Recommendation are described below. (Control of additional SPNE types is for future study.)

6.1 Normal Procedures

6.1.1 ISC Procedures

When an ISC determines that a signal processing function (SPF) needs to be enabled or disabled on a particular channel, it will create a message called an SPF Control Message to be transmitted to the SPNE. The SPF Control Message will contain the facility and channel of the SPNE, its corresponding SPF type (e.g. ECD, ALC, FE, NRD, AMC), and SPF function, whether it is an incoming, outgoing, or combined associated SPNE (see 5.1 for a description of incoming and outgoing devices).

If more than one SPF requires control in an SPNE, the ISC sets the extension bit and appends additional control elements to the message.

The manner in which the ISC determines the specific SPNE to be controlled is implementation dependent. Facility and channel addressing required to communicate with a specific SPNE can be found in the protocol clause of this Recommendation.

The SPNE may be configured to leave signal processing elements enabled or disabled as a default state. The specific default state used in the SPNE will determine the use and sequence of SPF Control Messages required for data and voice calls. The ISC must consider the default method being used. Voice connections refer to voice and voiceband data. Data connections refer to digital data.

Data Connections

Where a data connection is being established and the SPNE is configured to leave any SPFs enabled as a default condition, then an SPF Control Message is sent to disable these SPFs for the channel selected. At the end of a data call, an SPF Control Message is sent to enable these SPFs.

Where an SPF default is set to a disabled state, then no SPF Control Messages are necessary.

Voice Connections

Where a voice connection is being established that requires use of a specific SPF and the SPNE is configured to leave this SPF disabled as a default state, then an SPF Control Message is sent to enable this SPF for the channel selected.

At the end of the voice call, an SPF Control Message is sent to disable the SPF.

Where the SPF default is set to the enabled state, then no SPF Control Messages are necessary.

Where a voice connection is being established that does not require the use of a specific SPF and the SPNE is configured to leave this SPF enabled as a default state, then an SPF Control Message is sent to disable this SPF for the channel selected. At the end of the voice call, an SPF Control Message is sent to enable this SPF.

Where the SPF default is set to disabled state, then no SPF Control Messages are required.

6.1.1.1 Acknowledgment

Acknowledgment messages are optional and for further study.

Where acknowledgment messages are used, the following procedures apply:

The ISC sends an SPF Control Message to order the execution of function(s) on an SPNE and starts a timer T. When the SPNE receives an SPF Control Message and can execute all of the functions ordered by it, the SPNE returns an acknowledgment message that is the same as the SPF Control Message sent to the SPNE. The ISC then stops timer T.

If timer T expires, indicating that an acknowledgment message has not been received, the switch recognizes that the ordered function(s) cannot be executed. Reference may be made to ITU-T Q.115 for available ECD procedures in this case. Procedures for additional SPFs are for further study. The value of timer T is for further study.

6.1.2 SPNE Procedures

When an SPNE receives a Control Message, it determines whether the SPF type matches its own.

If the message is the correct type, the SPNE analyses the message. It reads the incoming SPNE/outgoing SPNE bit, the channel number and the SPNE function or functions, and sends the appropriate commands to its signal processing functions.

The SPNE may be configured to leave SPFs enabled or disabled as a default state. The specific default state used in the SPNE will determine the use and sequence of Control Messages required for data and voice calls. Voice connections refer to voice and voiceband data. Data connections refer to digital data.

6.1.2.1 SPNE Acknowledgment

Acknowledgment messages are optional and for further study.

6.2 Abnormal Procedures

6.2.1 Abnormal ISC Procedures

6.2.1.1 Loss of TCP/IP connectivity (for further study)

When loss of TCP/IP connectivity is detected by the SPNE application in the ISC, Call Processing should be informed.

6.2.1.2 Receipt of Out of Service message from SPNE (for further study)

6.2.1.3 Receipt of unreasonable signalling information messages by the ISC (for further study)

An unreasonable message contains information not recognized by the ISC.

Unreasonable signalling information may be received at an ISC.

The following is considered an unreasonable message:

– The message length is less than or more than the number of octets required.

When an unreasonable message is detected, the message is ignored and flagged for maintenance purposes.

An unreasonable message can only be detected when the message is recognized.

6.2.1.4 Handling of unexpected messages by the ISC (for further study)

An unexpected message is one which contains a message type that is within the set supported at this ISC, but is not expected to be received in the current signalling state.

An example of this would be an acknowledgment message received from an SPNE that is received when none is expected.

Unexpected messages are ignored and flagged for possible maintenance purposes. Additional procedures are for further study.

6.2.2 Abnormal SPNE Procedures

6.2.2.1 Actions by the SPNE as a result of detecting Out of Service (for further study)

6.2.2.2 Receipt of unreasonable signalling information messages at the SPNE

An unreasonable message contains information not recognized by the SPNE.

The following are considered unreasonable messages:

a) The message length is less than or more than the number of octets required.

b) The message coding does not match an acceptable code.

When an unreasonable message is detected, the message is ignored.

An unreasonable message can only be detected when the message is recognized.

6.2.2.3 Handling of unexpected messages at the SPNE

Unexpected messages at the SPNE are ignored.

6.2.2.4 Handling of abnormal termination of TCP/IP connection at the SPNE

In TCP, a connection can get terminated either gracefully or abnormally. Abnormal connection terminations are indicated by RESET (RST) at the TCP layer. When an application terminates a connection gracefully, the TCP layer goes through TCP CLOSE processing. The TCP layer at the ISC sends a TCP RST to its communicating peer endpoint at the BSPNE when it encounters an abnormal condition with the application layer running above in the same host.

When the peer endpoint at the BSPNE receives this TCP RST message, it is an indication for abnormal termination of its TCP connection. The TCP layer that receives the RST notifies its BSPNE application of this abnormal termination indication cleans up resources and removes the endpoint association. The BSPNE application relinquishes any resources associated with that connection where applicable and goes back to listening for a newer connection from the peer application running on the ISC.

Any SPNE control that was performed on the BSPNE by its BSPNE application before abnormal termination occurred shall not be affected after abnormal termination.

The BSPNE application in the ISC may choose to retain the last set of SPNE control information. This is so that when abnormal termination happens right after it sends SPNE control messages to the BSPNE application in the BSPNE, it could check its logic and reapply the call control information to the BSPNE, if applicable, when the TCP connection is re-established.

6.3 Alarm Handling Procedures

This is for further study (ffs).

7 Detailed Protocol Description

A detailed list of SPF control information is provided in Annex C.

7.1 Message Format

An SPF Control Message is sent over the IP interface to control multiple signal processing functions in an SPNE. Routing of the Control messages to a specific SPNE will be performed by the ISC using facility tables.

The SPF Control Message contains five octets as follows:

Message Format

7	6	5	4	3	2	1	0	Octets
Value = 0000 All other values are reserved				Direction		Channel Type		1
Extension	SPF Type			SPF Function				2
Facility Address								3
Facility Address								4
Channel Address								5
. . .								Additional message if Extension = 1

In the above message format, bit 7 is the Most Significant Bit (MSB) that is transmitted first. An extension mechanism (octet 2, bit 7) allows for the simultaneous control of more than one SPF. It indicates that another five octet message follows Octet 5.

The Facility Address represents individual E1 or T1 facilities, and Channel Address represents the address of the channel within the Facility.

Coding

Octet 1

Bits 7 6 5 4	Bits 3 2	**Direction**	Bits 1 0	**Channel Type**
0 0 0 0	0 0	not used	0 0	8-bit channel
all other values are reserved	0 1	outgoing SPF	0 1	4-bit channel
	1 0	incoming SPF	1 0	2-bit channel
	1 1	both incoming and outgoing SPF	1 1	1-bit channel

A value of 0000 (bits 7-4 respectively) implies that the format is for control of SPNEs. All other values are reserved for Standards driven extensions of this message format.

Bits 1 and 0 designate if the channel that is being addressed is an 8-bit channel, a 4-bit channel, a 2-bit channel or a 1-bit channel. This facilitates addressing channels at a sub-DS0 level individually in the case where four 16-k/bits channels, two 32-k/bits channels or eight 8-k/bits channels can be multiplexed into one 64-k/bits DS0 channel.

Octet 2

Bit 7 **Extension Bit**	Bits 6 5 4 **SPF Type**	Bits 3 2 1 0 **SPF Function**
0 last octet 1 another 5 octet message follows octet 5	0 0 0 ECD 0 0 1 ALC 0 1 0 FE 0 1 1 NRD 1 0 0 AMC *all other values reserved for future use*	

If the Extension Bit is 1, then another five octet message of the same format starting with Octet 1, follows Octet 5.

SPF Function coding is as follows:

SPF type = ECD	
Bit 0	0 = disable echo cancellation 1 = enable echo cancellation
Bit 1	0 = disable non-linear processor 1 = enable non-linear processor
Bit 2	0 = disable comfort noise injection 1 = enable comfort noise injection
Bit 3	*Reserved for future use*

SPF type = ALC	
Bits <u>3 2 1 0</u>	
x x x 0	Disable all ALC types
0 0 0 1	ALC type 0
0 0 1 1	ALC type 1
0 1 0 1	ALC type 2
0 1 1 1	ALC type 3
all other values reserved for future use	
NOTE – ALC type is determined and configured by manufacturer and/or carrier and is outside the scope of this Recommendation.	

SPF type = NRD

Bits

3 2 1 0

x x x 0 Disable all NRD types
0 0 0 1 NRD type 0
0 0 1 1 NRD type 1
0 1 0 1 NRD type 2
0 1 1 1 NRD type 3

all other values reserved for future use

NOTE – NRD type is determined and configured by manufacturer and/or carrier and is outside the scope of this Recommendation.

SPF type = FE

Bits

3 2 1 0

x x x 0 Disable all FE types
0 0 0 1 FE type 0
0 0 1 1 FE type 1
0 1 0 1 FE type 2
0 1 1 1 FE type 3

all other values reserved for future use

NOTE – FE type is determined and configured by manufacturer and/or carrier and is outside the scope of this Recommendation.

SPF type = AMC

For this SPF type the direction bit in octet 1 is not relevant. The point of reference for the conversion is assumed to be the ISC. For example, enabling conversion from μ-Law to A-Law converts speech coming from the ISC from μ-Law to A-Law.

Bits

3 2 1 0

x x x 0 Disable all AMC conversion
x x 0 1 Enable conversion from μ-Law to A-Law
x x 1 1 Enable conversion from A-law to μ-Law

Bits

3 2

x x *values reserved for future use*

Octets 3 and 4

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1
			.				
			.				
1	1	1	1	1	1	1	1

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1
				.			
				.			
1	1	1	1	1	1	1	1

Octets 3 and 4 are used to contain the Facility Address of the channel being addressed. This provides the capability to address 2^{16} Facilities. Facility Addresses start from 0.

Octet 5

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1
				.			
				.			
1	1	1	1	1	1	1	1

Octet 5 is used to contain the Channel Address of the channel within the Facility identified using the Facility Address indicated in octets 3 and 4. The Channel Address field can address 256 channels providing the capability to be able to address channels at the sub-DS0 level, where each bit within a DS0 can in itself represent a channel. Channel Addresses start from 0.

An example is provided below to illustrate usage of the above message format:

(MSB) 7	6	5	4	3	2	1	0	Octets
(value for SPNE message type)				*(direction)*		*(channel type)*		1
0	0	0	0	0	1	1	1	
(extnsn)	*(SPF type)*			*(SPF function)*				2
0	0	0	0	1	1	0	0	
(facility address)								3
0	0	0	0	0	0	0	0	
(facility address)								4
0	0	0	0	0	1	0	1	
(channel address)								5
0	0	0	0	1	1	0	1	

The values in the different octets of the above message are as follows:

Octet 1: Bits 7 through 4 define the message type for the SPF Control Message. Bits 3 and 2 define the direction that the SPF control needs to be applied to which in this case is the outgoing SPF. Bits 1 and 0 define the channel type which in this case is a 1-bit channel within a DS0. Value of bits 1 and 0 when other than 0 implies sub-DS0 addressing.

Octet 2: Bit 7 is the extension bit, which in this case is 0. This implies that there is not an adjoining 5 octet message following the current one. Bits 6 through 5 imply that the SPF type is ECD. Bits 3 through 0 indicate enabling Echo Cancellation and the Non-Linear Processor.

Octets 3 and 4: These octets together indicate the address of the facility, which in this case is 5. This facility could be either an E1 or T1 or a span of a larger Facility with a sub-span that is addressable as an E1 or T1.

Octet 5: The value in this octet indicates that the channel being addressed is channel number 13. Since the channel-type field in Octet 1 indicated that this is a 1-bit channel, it is the fifth bit of the second DS0 that is addressed by this message.

ANNEX A

Lower Layer Protocol

The International Switching Centre (ISC) and Signal Processing Network Equipment (SPNE) SPF Control Messages use the services of an IP Network as the lower layer transport. In this arrangement, the SPNE application interfaces with the Transmission Control Protocol (TCP) layer of the IP network for delivery.

SPF Control messages are sent from the ISC via TCP/IP to the SPNE application at the SPNE location. Where acknowledgements are supported messages are sent from the SPNE to the ISC via TCP/IP. Because the ISC controls the SPNE in a master/slave relationship however, the ISC establishes and controls the signalling connection through TCP/IP.

The TCP port number used for receiving and sending messages within the SPNE application at the SPNE location is 1252.

ANNEX B

SDL for SPNE Application

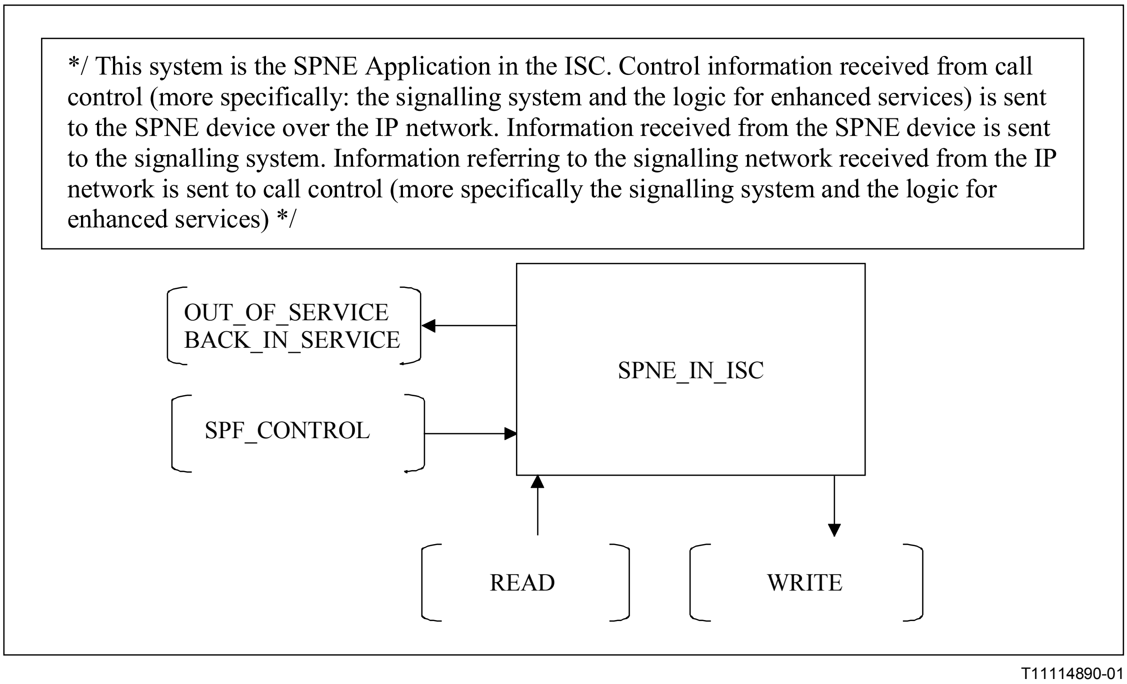


Figure B.1a/Q.56 – Block Diagram of SPNE in ISC

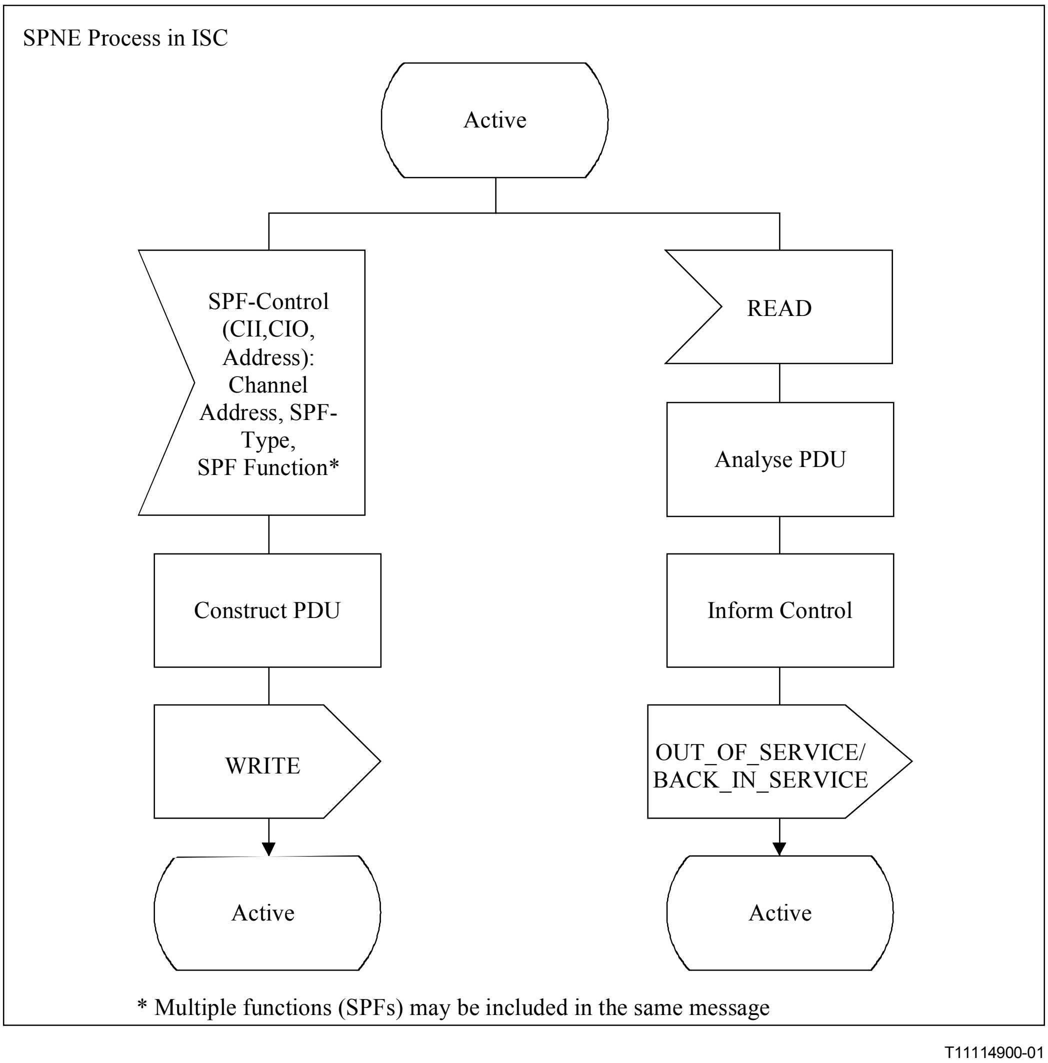


Figure B.1b/Q.56 – SDL for SPNE Application in ISC

Figure B.1b illustrates the SPNE application state transition diagram in the ISC after the TCP/IP connection has been established.

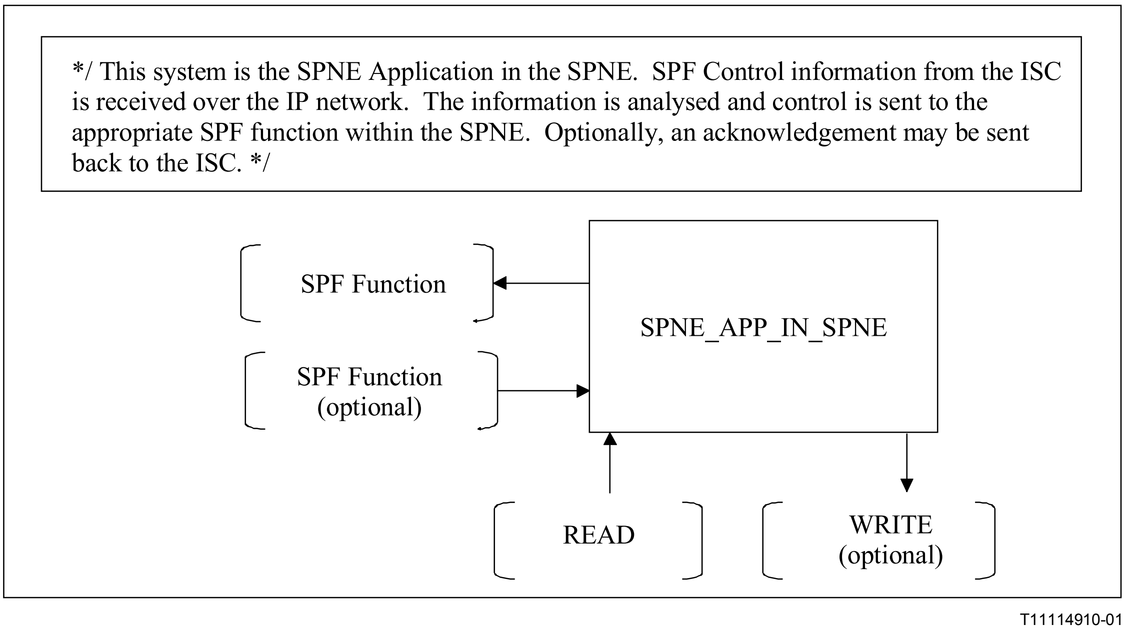


Figure B.1c/Q.56 – Block Diagram for SPNE Application in the SPNE

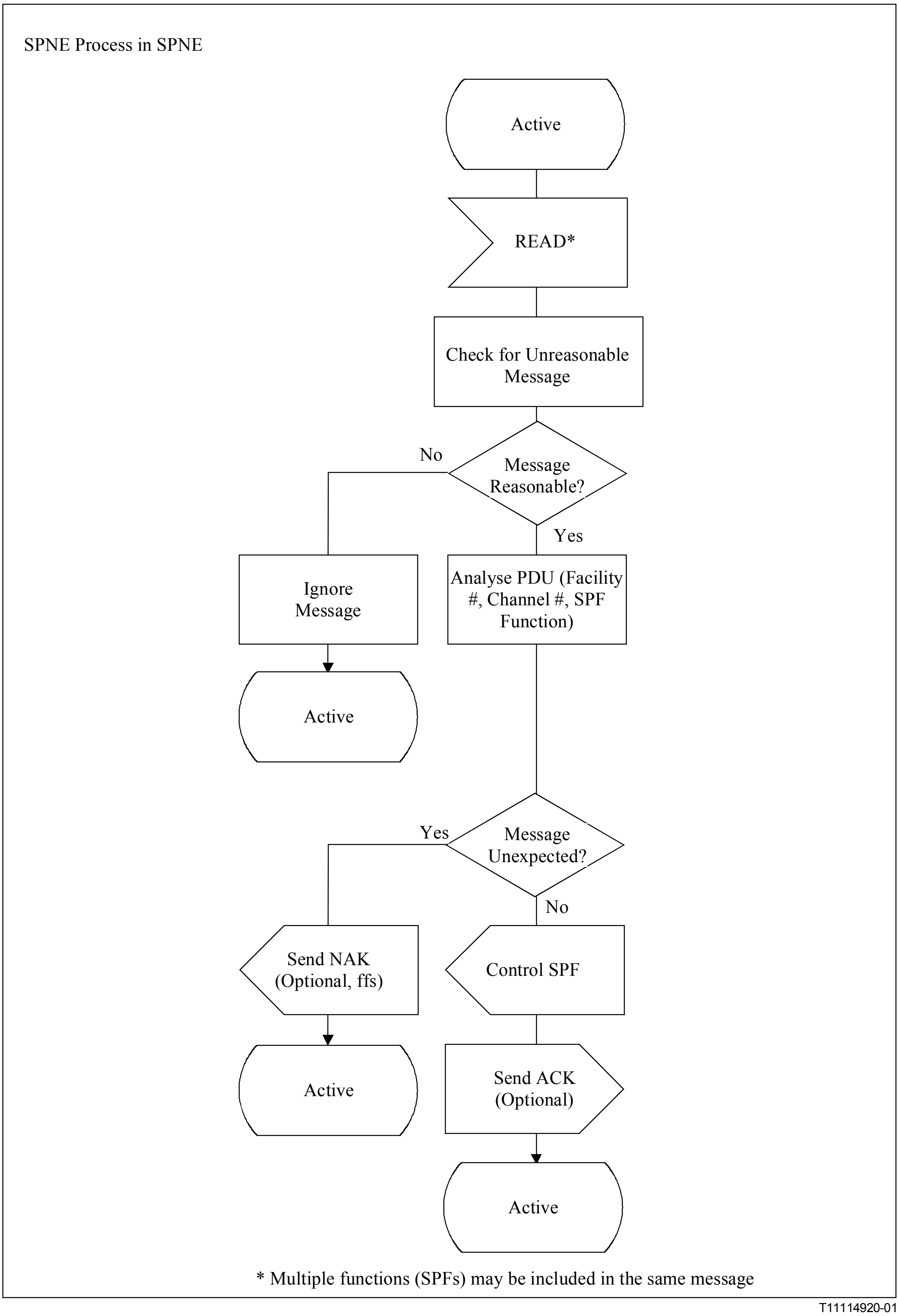


Figure B.1d/Q.56 – SDL for SPNE Application in the SPNE

Figure B.1d illustrates the SPNE application state diagram in the SPNE after the TCP/IP connection has been established.

ANNEX C

SPF Control Information

This annex lists the SPF control information sent from the ISC to the SPNE included in this Recommendation. Messages from the SPNE to the ISC are for further study.

In the following tables, channel n refers to the Facility and Channel Address contained in the SPF Control Message.

Echo Cancellation

The following is a list of control functions required to control network echo cancellers.

Table C.1/Q.56 – ECD Control Functions

Enable echo cancellation on channel n
Disable echo cancellation on channel n
Enable NLP on channel n
Disable NLP on channel n
Enable comfort noise on channel n
Disable comfort noise on channel n

Noise Reduction

The following is a list of control functions required to control noise reduction devices.

Table C.2/Q.56 – NRD Control Functions

Enable noise reduction of type m on channel n
Disable noise reduction on channel n

NOTE – Type of noise reduction algorithm (m) is determined and configured by the manufacturer or carrier and is outside the scope of this Recommendation.

Automatic Level Control (ALC)

The following is a list of control functions required to control automatic level controllers.

Table C.3/Q.56 – ALC Control Functions

Enable ALC of type m on channel n
Disable ALC of type m on channel n

NOTE – Type of ALC algorithm (m) is determined and configured by the manufacturer or carrier and is outside the scope of this Recommendation.

Frequency Equalization (FE)

The following is a list of control functions required to control frequency equalizers.

Table C.4/Q.56 – Frequency equalizer Control Functions

Enable FE of type m on channel n
Disable FE of type m on channel n

NOTE – Type of FE algorithm (m) is determined and configured by the manufacturer or carrier and is outside the scope of this Recommendation.

A-law/μ-Law Conversion

The following is a list of control functions required for A-law/μ-Law conversion equipment.

Table C.5/Q.56 – A-Law/μ-Law Control Functions

Convert from μ-Law to A-Law on channel n
Convert from A-Law to μ-Law on channel n
Disable law conversion

APPENDIX I

Channel Monitor (for future study)

A channel monitor is a device that is able to provide information on the nature or relative quality of a speech or voiceband data signal present on a voice circuit. Examples of such information include:

- echo return loss;
- echo delay;
- echo return loss enhancement;
- speech level;
- background noise level;
- speech activity;
- call type (e.g. Voice, Data, Fax);
- PCM offset.

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