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SERIES Q: SWITCHING AND SIGNALLING

Testing specifications – Testing specifications for next
generation networks

**Performance benchmark for the PSTN/ISDN
emulation subsystem of an IP multimedia
system – Part 4: Reference load network quality
parameters**

Recommendation ITU-T Q.3931.4

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Recommendation ITU-T Q.3931.4

Performance benchmark for the PSTN/ISDN emulation subsystem of an IP multimedia system – Part 4: Reference load network quality parameters

Summary

Recommendation ITU-T Q.3931.4 illustrates the reference load network quality parameters applicable to the PSTN/ISDN emulation subsystem of IP multimedia system exchange implementations.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Q.3931.4	2015-06-13	11	11.1002/1000/12494

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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.

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Recommendation ITU-T Q.3931.4

Performance benchmark for the PSTN/ISDN emulation subsystem of an IP multimedia system – Part 4: Reference load network quality parameters

1 Scope

This Recommendation contains the reference load network quality parameters applicable to the PSTN/ISDN emulation subsystem of IP multimedia system exchange implementations. The definitions of IMS/PES design objectives are based on best practice performance of legacy PSTN/ISDN signalling. The values contained in the present document are best practice performance values measured on IP multimedia subsystem (IMS) and next generation network (NGN) implementations. The ISDN voice gateway (VGW) values are based on carrier grade implementations.

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.

- [ITU-T G.812] Recommendation ITU-T G.812 (2004), *Timing requirements of slave clocks suitable for use as node clocks in synchronization networks.*
- [ITU-T G.823] Recommendation ITU-T G.823 (2000), *The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy.*
- [ITU T G.826] Recommendation ITU-T G.826 (2002), *End-to-end error performance parameters and objectives for international, constant bit-rate digital paths and connections.*
- [ITU-T Q.541] Recommendation ITU-T Q.541 (1993), *Digital exchange design objectives – General.*
- [ITU-T Q.543] Recommendation ITU-T Q.543 (1993), *Digital exchange performance design objectives.*
- [ETSI TS 101 563] ETSI TS 101 563 V.1.3.1 (2014), *Speech and multimedia Transmission Quality (STQ); IMS/PES/VoLTE exchange performance requirements.*
- [ETSI TS 102 928] ETSI TS 102 928 (2014), *Speech and multimedia Transmission Quality (STQ); End-to-End Transmission Planning Requirements for Real Time Services in an NGN context.*
- [ETSI TS 124 229] ETSI TS 124 229 (2013), *Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3 (3GPP TS 24.229).*
- [ETSI TS 183 036] ETSI TS 183 036 (2012), *Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); ISDN/SIP interworking; Protocol specification.*

[ETSI TS 183 043] ETSI TS 183 043 (2011), *Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS-based PSTN/ISDN Emulation; Stage 3 specification.*

3 Definitions

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AGCF	Access Gateway Control Function
CPE	Customer Premises Equipment
CSCF	Call Session Control Function
IAD	Integrated Access Device
IMS	IP Multimedia Subsystem
ISDN	Integrated Service Digital Network
MGW	Media Gateway
MSAN	Multi Service Access Node
NGN	Next Generation Network
P-CSCF	Proxy Call Server Control Function
PES	PSTN/ISDN Emulation Subsystem
QCI	QoS Class Identifier
RTP	Real Time Protocol
SBC	Session Border Control
SDP	Session Description Protocol
SIP	Session Initiation Protocol
UE	User
VGW	Voice Gateway

5 Conventions

None.

6 Reference loads and parameter requirements

6.1 ISDN/PSTN reference loads definitions

The ISDN/PSTN reference loads definitions and values described in Tables 1 to 9 are the reference loads definitions described in [ITU-T Q.543]. The derived ISDN procedures are based on the ISDN/SIP interworking procedures, the derived PSTN/ISDN emulation subsystem (PES) procedures are based on the IMS/PES emulation specification and the derived SIP procedures are based on session initiation protocol (SIP) and session description protocol (SDP).

6.2 Parameter requirements

IMS systems shall comply with the requirements given in the following tables. The values are based on reference loads definitions described in [ETSI TS 101 563].

Table 1

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Local exchange call request delay – originating outgoing and internal traffic connections						
ANALOGUE SUBSCRIBER LINES Local exchange call request delay – originating outgoing and internal traffic connections.	Clause 2.3.2.1 of [ITU-T Q.543] For ANALOGUE SUBSCRIBER LINES, call request delay is defined as the interval from the instant when the off-hook condition is recognizable at the subscriber line interface of the exchange until the exchange begins to apply dial tone to the line. The call request delay interval is assumed to correspond to the period at the beginning of a call attempt during which the exchange is unable to receive any call address information from the subscriber.	PES [ETSI TS 183 043] For ANALOGUE SUBSCRIBER LINES connected to the AGCF/MSAN. Call request delay is defined as the interval from the instant when the off-hook condition is recognizable at the subscriber line interface of the AGCF/MSAN until the AGCF/MSAN begins to apply dial tone to the line.	≤ 400 ms	≤ 600 ms	≤ 800 ms	≤ 1 000 ms
ANALOGUE SUBSCRIBER with IAD (VGW) Local exchange call request delay – originating outgoing and internal traffic connections.		PES [ETSI TS 183 043] For ANALOGUE SUBSCRIBER LINES connected to the VGW. Call request delay is defined as the interval from the instant when the off-hook condition is recognizable at the subscriber line interface of the VGW until the VGW begins to apply dial tone to the line.	≤ 400 ms	≤ 600 ms	≤ 800 ms	≤ 1 000 ms

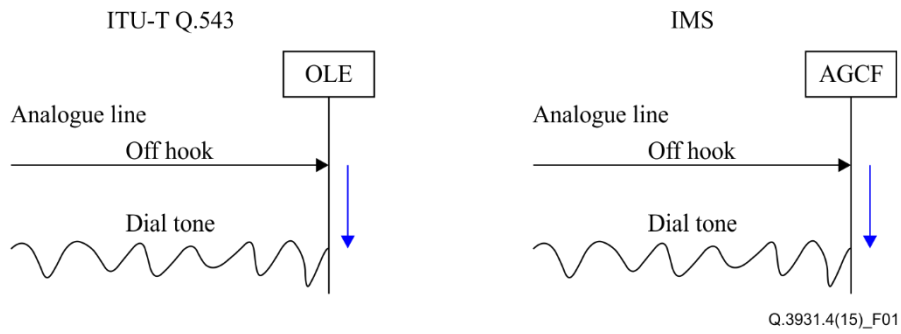


Figure 1 – Local exchange analogue subscriber call request delay: overlap sending

The case of overlap sending for a local exchange analogue subscriber call request delay is shown in Figure 1.

Table 2

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Local exchange ISDN subscriber call request delay: overlap sending						
ISDN SUBSCRIBER LINES Local exchange call request delay – Overlap sending.	Clause 2.3.2.2 of [ITU-T Q.543] Local exchange call request delay. Call request delay is defined as the interval from the instant at which the SETUP message has been received from the subscriber signalling system until the SETUP ACKNOWLEDGE message is passed back to the subscriber signalling system.	ISDN [ETSI TS 183 036] Call request delay is defined as the interval from the instant at which the SETUP message has been received from the subscriber signalling system until the SETUP ACKNOWLEDGE message is passed back to the subscriber signalling system.	≤ 200 ms	≤ 250 ms	≤ 300 ms	≤ 400 ms
IMS SUBSCRIBER Local exchange call request delay.		IMS [ETSI TS 124 229] Call request delay is defined as the interval from the instant at which the INVITE message has been received from the SIP subscriber until the 100 Trying from the SBC/P-CSCF is passed back to the subscriber.	≤ 15 ms	≤ 20 ms	≤ 30 ms	≤ 40 ms

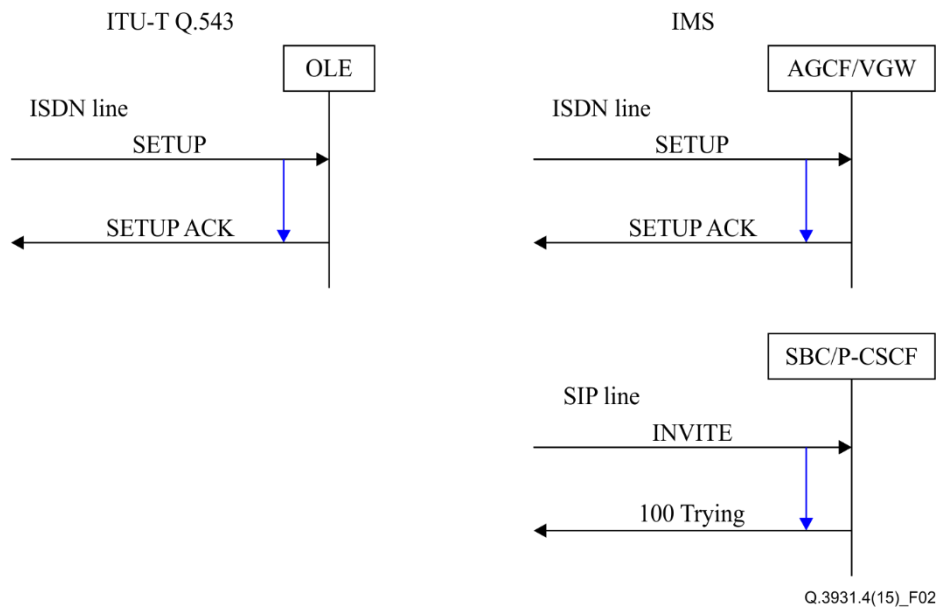


Figure 2 – Local exchange ISDN subscriber call request delay: overlap sending

The case of overlap sending for a local exchange ISDN subscriber call request delay is shown in Figure 2.

Table 3

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Local exchange ISDN subscriber call request delay: en-bloc sending						
ISDN SUBSCRIBER LINES Local exchange call request delay for en-bloc sending.	Clause 2.3.2.3 of [ITU-T Q.543] For DIGITAL SUBSCRIBER LINES using en-bloc sending, call request delay is defined as the interval from the instant at which the SETUP message is received from the subscriber signalling system until the call proceeding message is passed back to the subscriber signalling system.	ISDN [ETSI TS 183 036] For ISDN using en-bloc sending, call request delay is defined as the interval from the instant at which the SETUP message is received from the subscriber signalling system until the CALL PROCEEDING message is passed back to the subscriber signalling system.	≤ 300 ms	≤ 400 ms	≤ 500 ms	≤ 600 ms

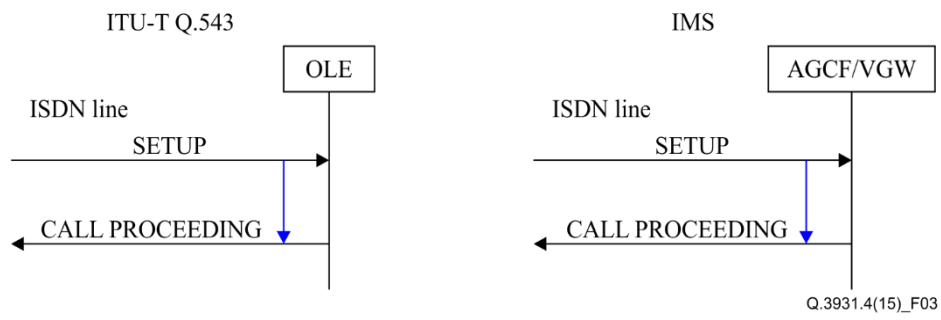


Figure 3 – Local exchange ISDN subscriber call request delay: en-bloc sending

The case of en-bloc sending for a local exchange ISDN subscriber call request delay is shown in Figure 3.

Table 4

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Alerting sending delay for terminating traffic (the users are in different locations, controlled by different S-CSCF/P-CSCF)						
ANALOGUE SUBSCRIBER LINES Alerting sending delay for terminating traffic.	Clause 2.3.6.1.1 of [ITU-T Q.543] For calls terminating on ANALOGUE SUBSCRIBER LINES, alerting sending delay is defined as the interval from the instant when the last digit is available for processing in the exchange until the ringing tone is sent backwards toward the calling user.	PES [ETSI TS 183 043] For calls terminating on ANALOGUE SUBSCRIBER LINES, alerting sending delay is defined as the interval from the instant when the last digit is available for processing in the AGCF/MSAN until the ringing tone is sent toward the calling user.	≤ 300 ms	≤ 450 ms	≤ 600 ms	≤ 750 ms
ISDN SUBSCRIBER LINES Alerting sending delay for terminating traffic.	Clause 2.3.6.1.2 of [ITU-T Q.543] For calls terminating on DIGITAL SUBSCRIBER LINES, the alerting sending delay is defined as the interval from the instant that an ALERTING message is received from the digital subscriber line signalling system to the instant at which an ADDRESS COMPLETE message is passed to the interexchange signalling system or ringing tone is sent backward toward the calling user.	ISDN [ETSI TS 183 036] For calls terminating on ISDN, the alerting sending delay is defined as the interval from the instant that an ALERTING message is received from the digital subscriber line signalling to the instant at which an AGCF/MSAN sends the 180 Ringing backward toward the calling user.	≤ 250 ms	≤ 300 ms	≤ 350 ms	≤ 400 ms

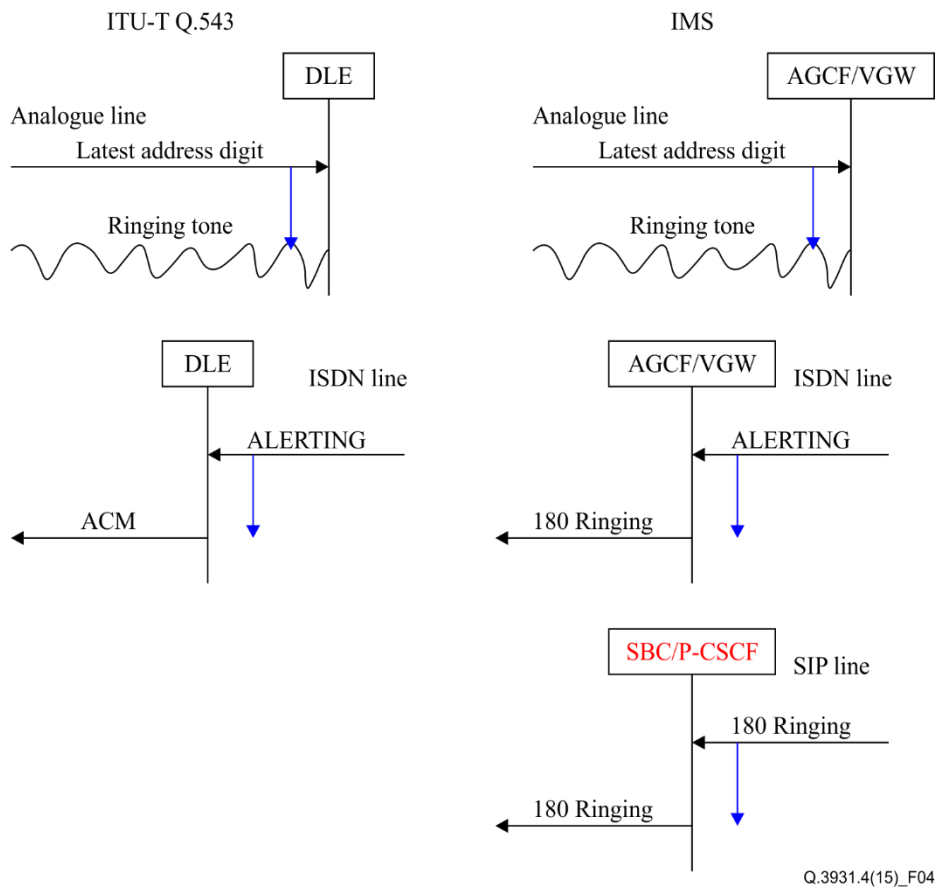


Figure 4 – Local exchange alerting sending delay for terminating traffic (in different locations)

The case of a local exchange alerting sending delay for terminating traffic (in different locations) is shown in Figure 4.

Table 5

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Alerting sending delay for internal traffic (the users are in the same location, controlled by the same AGCF/VGW or P-CSCF)						
ANALOGUE SUBSCRIBER LINES Alerting sending delay for internal traffic.	Clause 2.3.6.2.1 of [ITU-T Q.543] For calls terminating on ANALOGUE SUBSCRIBER LINES, alerting sending delay is defined as the interval from the instant that the signalling information is available for processing in the exchange until ringing tone is applied to an ANALOGUE calling subscriber.	PES [ETSI TS 183 043] For calls terminating on ANALOGUE SUBSCRIBER LINES, alerting sending delay is defined as the interval from the instant that the signalling information is available for processing in the AGCF/MSAN until Ringing tone is sent towards the calling subscriber.	≤ 300 ms	≤ 450 ms	≤ 600 ms	≤ 750 ms
ANALOGUE SUBSCRIBER LINES Alerting sending delay for internal traffic.		PES [ETSI TS 183 043] For calls terminating on ANALOGUE SUBSCRIBER LINES, alerting sending delay is defined as the interval from the instant that the signalling information is available for processing in the MGW / VGW until Ringing tone is sent towards the calling subscriber.	≤ 550 ms	≤ 800 ms	≤ 1 000 ms	≤ 1100 ms

Table 5

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
	Detailed description					
ISDN SUBSCRIBER LINES Alerting sending delay for internal traffic.	Clause 2.3.6.2.2 of [ITU-T Q.543] For internal calls terminating on DIGITAL SUBSCRIBER LINES originating from DIGITAL SUBSCRIBER LINES, alerting sending delay is defined as the interval from the instant that an ALERTING message is received from the signalling system of the called subscriber's line until the ALERTING message is applied to the calling subscriber line.	ISDN [ETSI TS 183 036] For calls terminating on ISDN, alerting sending delay is defined as the interval from the instant that an ALERTING message is received and ALERTING is sent towards the calling subscriber.	≤ 300 ms	≤ 350 ms	≤ 400 ms	≤ 450 ms
IMS SUBSCRIBER LINES 180 Sending delay for internal traffic.		IMS [ETSI TS 124 229] For calls terminating the sending delay is defined as the interval from the instant that a 180 message at the Gm interface has received and 180 is sent on the Gm towards the calling subscriber.	≤ 100 ms	≤ 150 ms	≤ 200 ms	≤ 250 ms

The case of an alerting sending delay for internal traffic is shown in Figure 5.

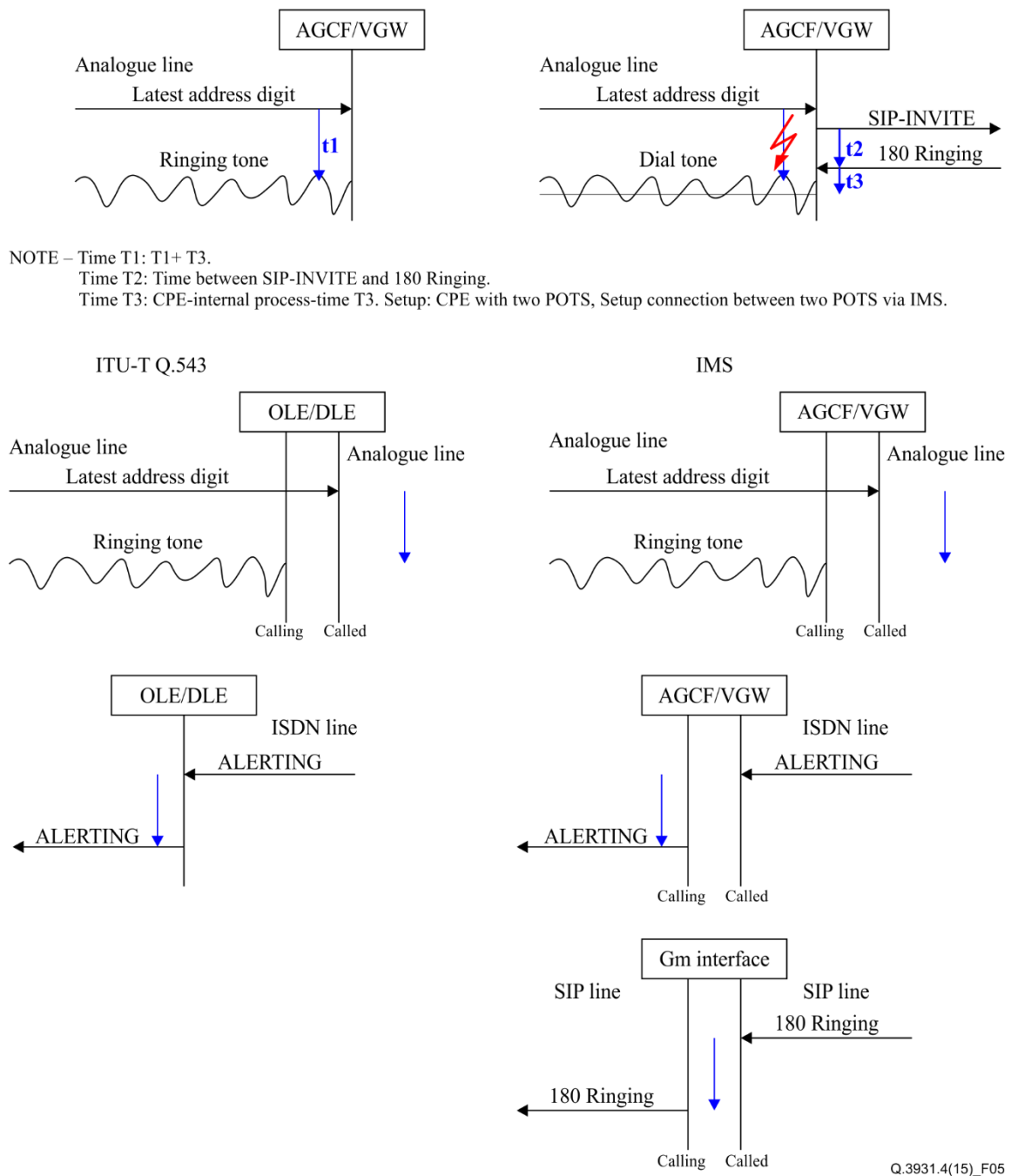


Figure 5 – Alerting sending delay for internal traffic
 (the users are in the same location, controlled by the same AGCF/VGW or P-CSCF)

Table 6

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Call set-up delay						
ISDN SUBSCRIBER LINES Call set-up delay using overlap signalling.	Clause 2.4.3.1 of [ITU-T Q.543] Call set-up delay is defined as the interval from the instant when the signalling information required for routing is received from the incoming signalling system until the instant when the corresponding signalling information is passed to the outgoing signalling system. Exchange call set-up delay for originating outgoing traffic connections, digital subscriber lines. The time interval starts when the INFORMATION message received contains a "sending complete indication" or when the address information necessary for call set-up is complete and ends when the corresponding signalling information is passed to the outgoing signalling system.	ISDN [ETSI TS 183 036] Sending, the time interval starts when the INFORMATION message received contains a "sending complete indication" and ends when the INVITE message on the Ic interface has been sent.	≤ 400 ms	≤ 500 ms	≤ 550 ms	≤ 650 ms
		ISDN [ETSI TS 183 036] Sending, the time interval starts when the INFORMATION message received contains a "sending complete indication" and ends when the INVITE message on terminating Gm interface has been sent.	≤ 450 ms	≤ 450 ms	≤ 550 ms	≤ 650 ms

Table 6

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
	Detailed description					
		IMS [ETSI TS 124 229]Session initiation delay is defined as the interval from the instant when the INVITE signalling information is received from the calling user on the originating Gm interface until the instant when the corresponding INVITE signalling information is passed on the terminating Ic interface to the called user	≤ 250 ms	≤ 350 ms	≤ 450 ms	≤ 550 ms

The case of overlap sending being used for a call set-up delay is shown in Figure 6.

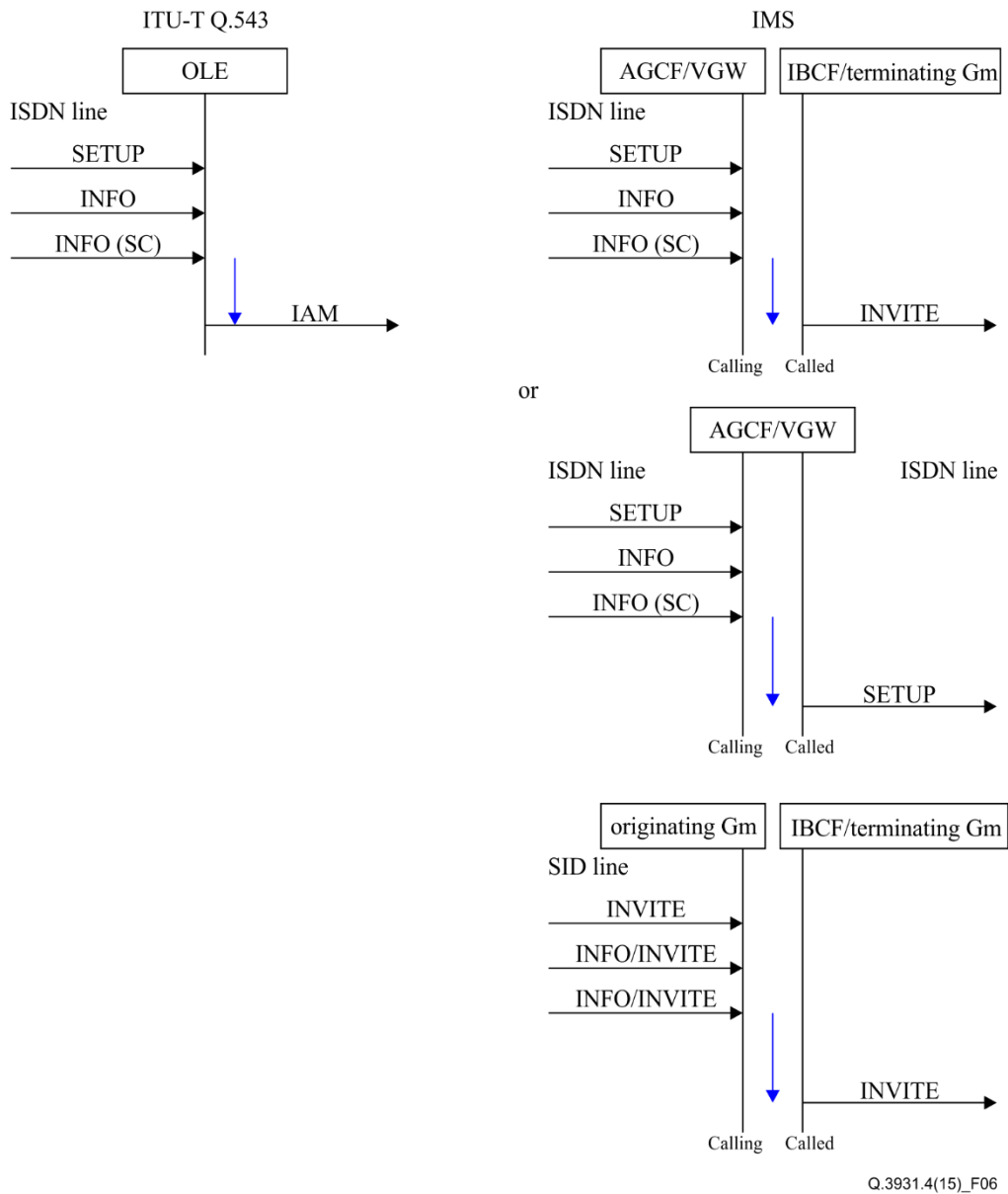


Figure 6 – Call set-up delay: Overlap sending is used

Table 7

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Call set-up delay: en-bloc sending is used						
ISDN SUBSCRIBER LINES Call set-up delay using en-bloc signalling.	<p>Clause 2.4.3.1 of [ITU-T Q.543] Exchange call set-up delay for originating outgoing traffic connections.</p> <p>For call attempts using en-bloc sending Call set-up delay is defined as the interval from the instant when the signalling information required for routing is received from the incoming signalling system until the instant when the corresponding signalling information is passed to the outgoing signalling system.</p> <p>The time interval starts when the SETUP message received contains a "sending complete indication" or when the address information necessary for call set-up is complete and ends when the call set-up is sent on the outgoing signalling system.</p>	<p>ISDN [ETSI TS 183 036] Call set-up delay is defined as the interval from the instant when the signalling information including Sending Complete (#) is received from the incoming signalling system until the instant when the corresponding INVITE signalling information is passed to the Ic interface.</p>	≤ 350 ms	≤ 450 ms	≤ 550 ms	≤ 650 ms
		<p>ISDN [ETSI TS 183 036] Call set-up delay is defined as the interval from the instant when the signalling information including Sending Complete (#) is received from the incoming signalling system until the instant when the corresponding INVITE signalling information is passed to the terminating Gm interface.</p>	≤ 350 ms	≤ 450 ms	≤ 550 ms	≤ 650 ms

Table 7

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Call set-up delay: en-bloc sending is used						
		ISDN [ETSI TS 183 036] Call set-up delay for Internal traffic is defined as the interval from the instant when the SETUP including Sending Complete (#) is received from the incoming signalling system until the instant when the corresponding SETUP signalling information is passed to the called line signalling system (see Note)	≤ 450 ms	≤ 550 ms	≤ 650 ms	≤ 750 ms
IMS SUBSCRIBER Call set-up delay for internal traffic.		IMS [ETSI TS 124 229]Session initiation delay is defined as the interval from the instant when the INVITE signalling information is received from the calling user on the originating Gm interface until the instant when the corresponding INVITE signalling information is passed on the terminating Gm interface to the called user.	≤ 250 ms	≤ 350 ms	≤ 450 ms	≤ 550 ms
NOTE – If SC (#) is not included the set-up delay may increase up to the digit collection timer (15 s).						

The case of en-bloc sending being used for a call set-up delay is shown in Figure 7.

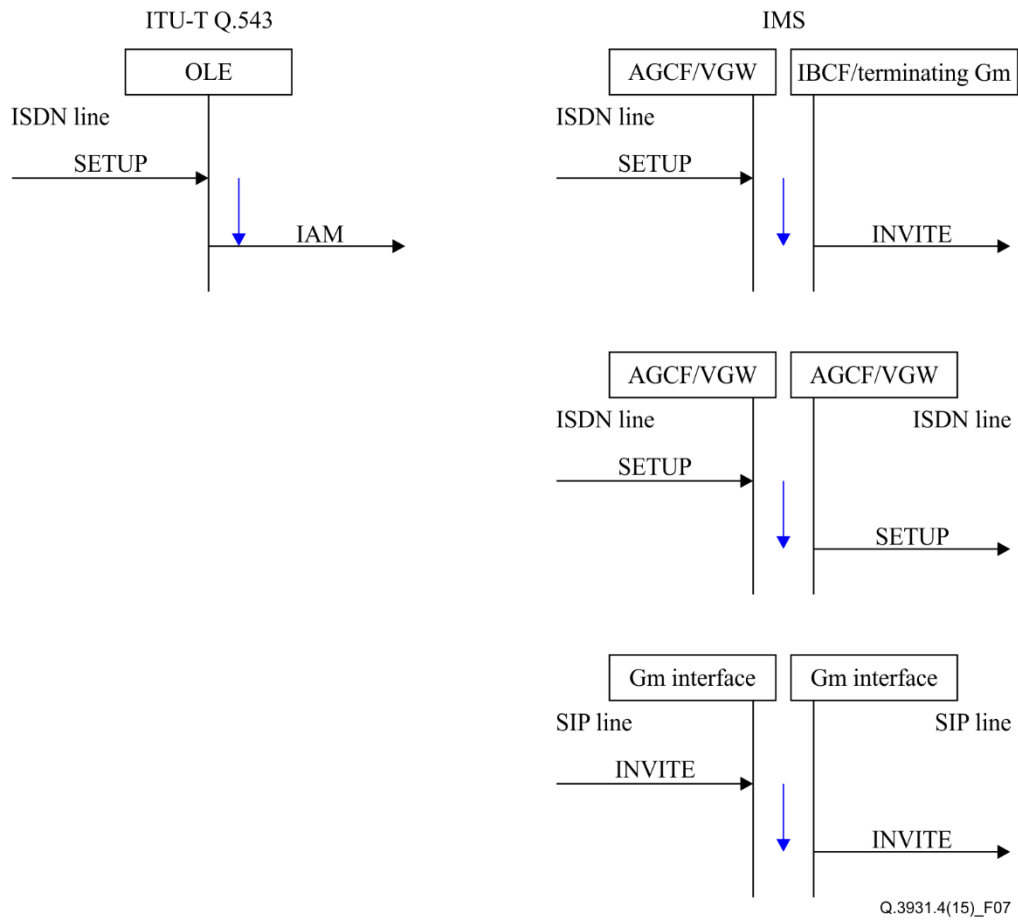


Figure 7 – Call set-up delay: en-bloc sending is used

Table 8

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Through-connection delay						
ISDN SUBSCRIBER LINES Through-connection delay.	Clause 2.4.4.2 of [ITU-T Q.543] Through-connection delay. The through-connection delay is defined as the interval from the instant that the CONNECT message is received from the called line signalling system until the through-connection is established and available for carrying traffic and the ANSWER and CONNECT ACKNOWLEDGEMENT messages have been passed to the appropriate signalling systems.	ISDN [ETSI TS 183 036] The through-connection delay is defined as the interval from the instant that the CONNECT message is received from the called line signalling system until the through-connection is established and available for carrying traffic and the CONNECT message has been sent to the calling user signalling system (see Note).	≤ 300 ms	≤ 350 ms	≤ 400 ms	≤ 450 ms
IMS Through-connection delay Delay for Internal traffic.		IMS [ETSI TS 124 229] The through-connection delay is defined as the interval from the instant that the 200 OK message is received from the called user at the terminating Gm interface until the through-connection is established and available for carrying traffic and the 200 OK message has been sent to the calling user on the originating Gm interface.	≤ 100 ms	≤ 150 ms	≤ 200 ms	≤ 250 ms
NOTE – The through-connection of RTP is not considered.						

The case of a through-connection delay is shown in Figure 8.

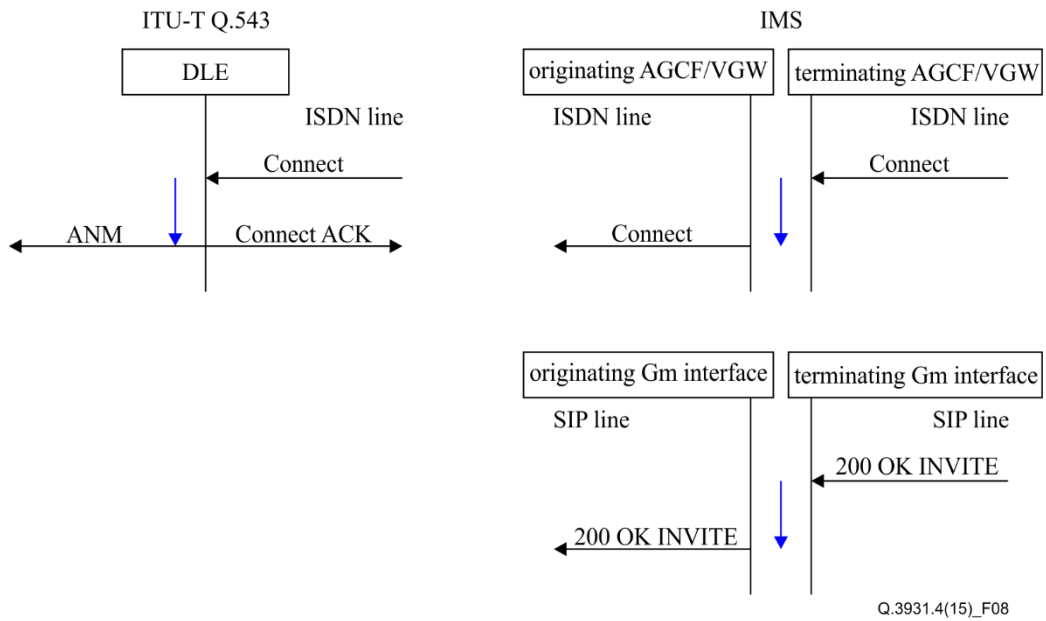


Figure 8 – Through-connection delay

Table 9

Meaning of timers	Parameter ITU-T Q.543	IMS, PES equivalent	Reference load A		Reference load B	
			Mean value	95% probability of not exceeding	Mean value	95% probability of not exceeding
Connection release delay						
ISDN SUBSCRIBER LINES Connection call release delay.	Clause 2.4.6 of [ITU-T Q.543] Connection release delay is defined as the interval from the instant when DISCONNECT or RELEASE message is received from a signalling system until the instant when the connection is no longer available for use on the call (and is available for use on another call) and a corresponding RELEASE or DISCONNECT message is passed to the other signalling system involved in the connection.	ISDN [ETSI TS 183 036] Connection release delay is defined as the interval from the instant when DISCONNECT or RELEASE message is received from a signalling system until the instant when RELEASE COMPLETE is sent and a corresponding RELEASE or DISCONNECT message is sent, or vice versa.	≤ 300 ms	≤ 350 ms	≤ 400 ms	≤ 450 ms
IMS SUBSCRIBER Connection call release delay Delay for Internal traffic.		IMS [ETSI TS 124 229] Connection release delay is defined as the interval from the instant when a BYE message is received at the originating or terminating Gm interface until the instant when 200OK is sent and a corresponding BYE message is sent at the terminating or originating Gm interface respectively.	≤ 100 ms	≤ 150 ms	≤ 200 ms	≤ 250 ms

The case of a connection call release delay is shown in Figure 9.

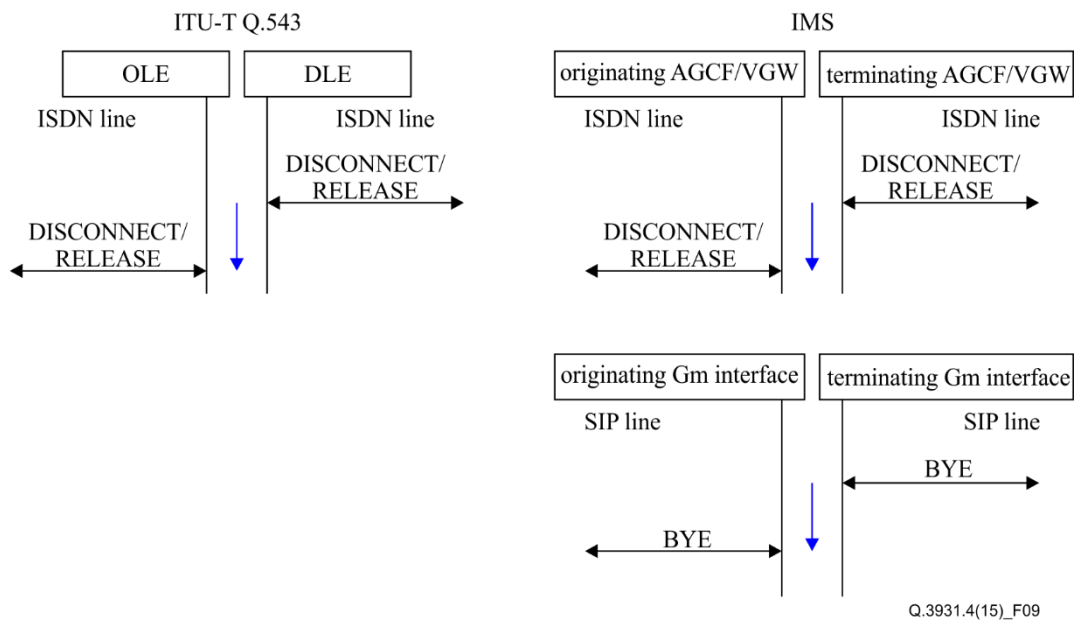


Figure 9 – Connection call release delay

6.3 Call processing performance objectives

6.3.1 Premature release

The probability that an exchange malfunction will result in the premature release of an established connection in any one minute interval shall be:

$$P \leq 2 \times 10^{-5}$$

6.3.2 Release failure

The probability that an exchange malfunction will prevent the required release of a connection shall be:

$$P \leq 2 \times 10^{-5}$$

6.3.3 Incorrect charging or accounting

The probability of a call attempt receiving incorrect charging or accounting treatment due to an exchange malfunction shall be:

$$P \leq 10^{-4}$$

6.3.4 Misrouting

The probability of a call attempt being misrouted following receipt by the exchange of a valid address shall be:

$$P \leq 10^{-4}$$

6.3.5 No tone

The probability of a call attempt encountering no tone following receipt of a valid address by the exchange shall be:

$$P \leq 10^{-4}$$

6.3.6 Other failures

The probability of the exchange causing a call failure for any other reason not identified specifically above shall be:

$$P \leq 10^{-4}$$

6.4 Transmission performance

6.4.1 64 kbit/s switched connections

The probability of a connection being established with an unacceptable transmission quality across the exchange shall be:

$$P \leq 10^{-5}$$

The transmission quality across the exchange is said to be unacceptable when the bit error ratio is above the alarm condition.

NOTE – In [ITU-T G.826], budgets of 18.5% of 1.5×10^{-6} were allocated to each national network, so the packet loss for a national connection should be no more than 2.75×10^{-7} [ETSI TS 102 928].

6.5 Slip rate

6.5.1 Normal conditions

The slip rate under normal conditions is covered in [ITU-T Q.541].

6.5.2 Temporary loss of timing control

The case of temporary loss of timing control corresponds to the "holdover operation" defined and recommended in [ITU-T G.812]. The allowable slip rate will correspond to the maximum relative TIE also recommended therein.

6.5.3 Abnormal conditions at the exchange input

The slip rate in the case of abnormal conditions (wide phase deviations, etc.) at the exchange input is the subject of further study taking into account the requirements of [ITU-T G.823].

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