ETSI TS 101 563 V1.3.1 (2014-11)

Speech and multimedia Transmission Quality (STQ);
IMS/PES/VoLTE exchange performance requirements

Reference
RTS/STQ-212

Keywords
IMS, performance

ETSI

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

As a general principle, ITU-T SG12 Q11/12 has the opinion that PSTN/ISDN emulation based on IMS architecture (or any other for that matter) should strive to be transparent to the end-user. Following this principle, the definitions of IMS/PES/VoLTE design objectives should be based on "best practice" performance of legacy PSTN/ISDN signalling. The values contained in the present document are "best practice" performance values measured on IMS and NGN implementations.

1 Scope

The present document contains design requirements applicable to IMS/PES/VoLTE exchange implementations based on Recommendation ITU-T Q.543 [1]. The definitions of IMS/PES/VoLTE 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 IMS and NGN implementations. The ISDN VGW values are based on carrier grade implementations.

The handling of preconditions is out of the scope of the present document.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] Recommendation ITU-T Q.543: "Digital exchange performance design objectives".

[2] ETSI TS 183 036: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); ISDN/SIP interworking; Protocol specification".

[3] ETSI TS 124 229: "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)".

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

[5] Recommendation ITU-T Q.541 (1993): "Digital exchange design objectives - General".

[6] Recommendation ITU-T G.812 (2004): "Timing requirements of slave clocks suitable for use as node clocks in synchronization networks".

[7] Recommendation ITU-T G.823: "The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy".

[8] Recommendation ITU-T G.826 (12/2002): "End-to-end error performance parameters and objectives for international, constant bit-rate digital paths and connections".

[9] ETSI TS 102 928: "Speech and multimedia Transmission Quality (STQ); End-to-End Transmission Planning Requirements for Real Time Services in an NGN context".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACK	Acknowledgment
AGCF	Access Gateway Control Function
CSCF	Call Session Control Function
ECM	EPS Connection Management
EPS	Evolved Packet System
IAD	Integrated Access Device
IMS	IP Multimedia Subsystem
ISDN	Integrated Service Digital Network
ITU-T	ITU Telecommunication Standardization Sector
MGW	Media Gateway
MME	Mobility Management Entity
MSAN	Multi Service Access Node
NGN	New 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
S-GW	Signaling Gateway
SIP	Session Initiation Protocol
TIE	Time Interval Error
UE	User Equipment
VGW	Voice Gateway
VoLTE	Voice over LTE

4 Reference loads and parameter requirements

4.1 ISDN/PSTN reference loads definitions

The ISDN/PSTN reference loads definitions and values described in table 1 to table 9 are the reference loads definitions described in Recommendation ITU-T Q.543 [1]. The derived ISDN procedures are based on the ISDN/SIP interworking [2] procedures, the derived PES procedures are based on the IMS/PES Emulation specification [4] and the derived SIP procedures are based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP) [3].

4.2 IMS and LTE reference loads definitions

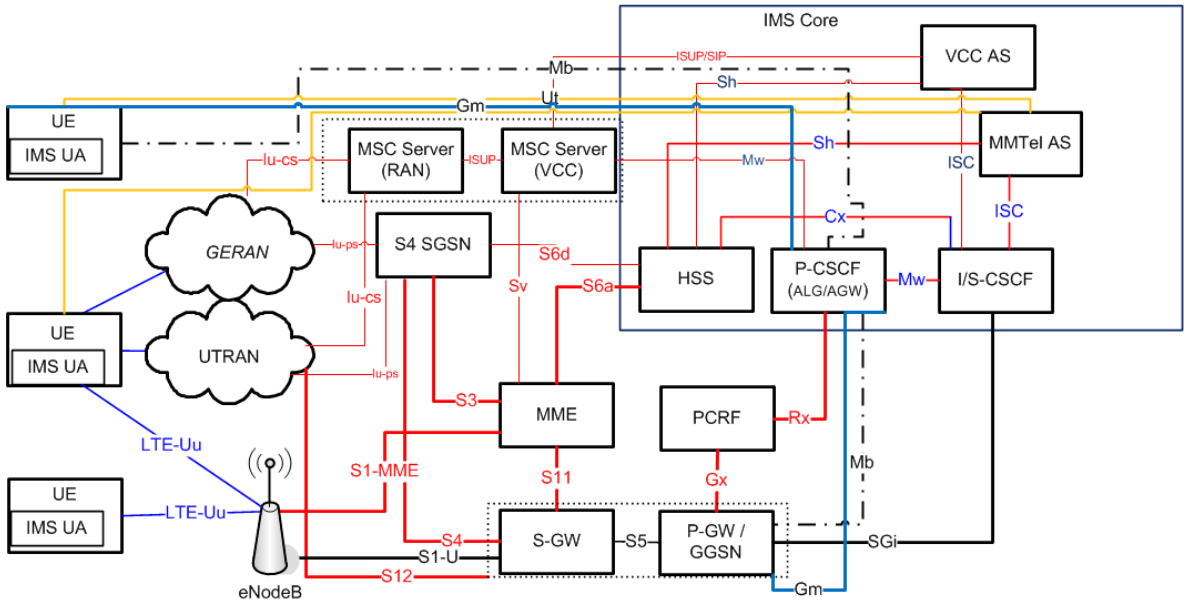

Figure 1: IMS/LTE Basic Configuration

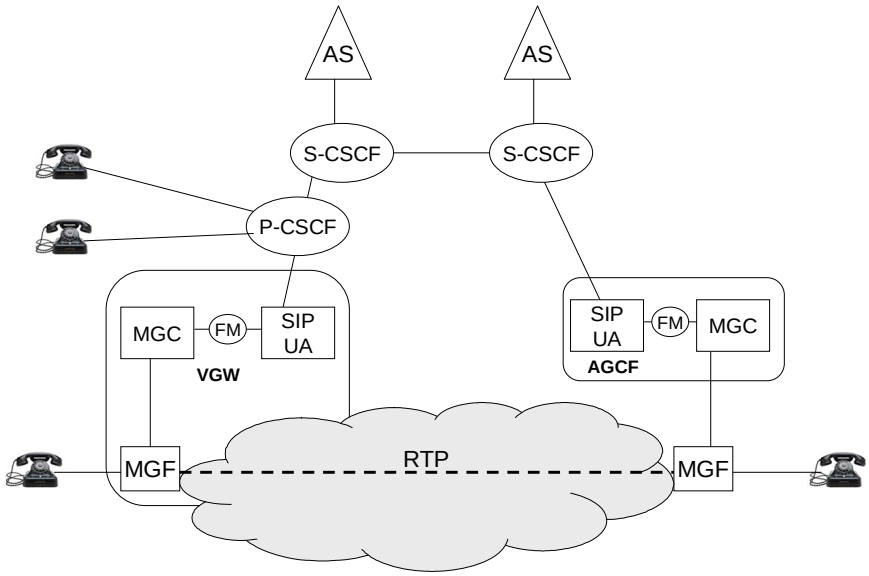

Figure 2: AGCF/VGW session processing models

4.3 Parameter requirements

IMS systems shall comply with the requirements given in the following tables.

Table 1

Meaning of timers	Parameter Q.543 [1]	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		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 [1] 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 [4] 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 [4] 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

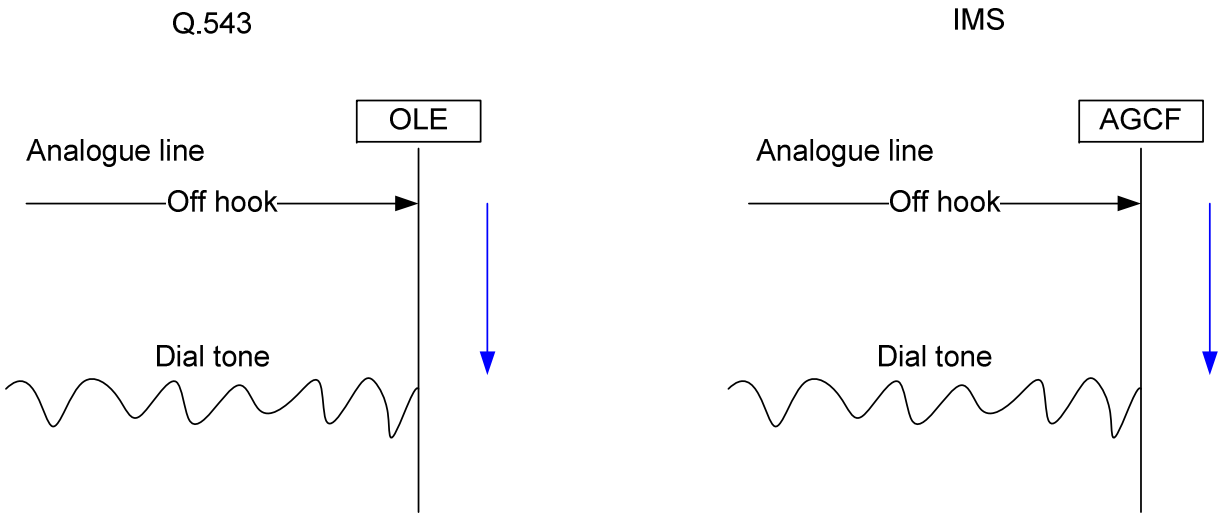

Figure 3: Local exchange analogue subscriber call request delay: overlap sending

Table 2

Meaning of timers	Parameter Q.543 [1]	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		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 [1] 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 [2] 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 [3] 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

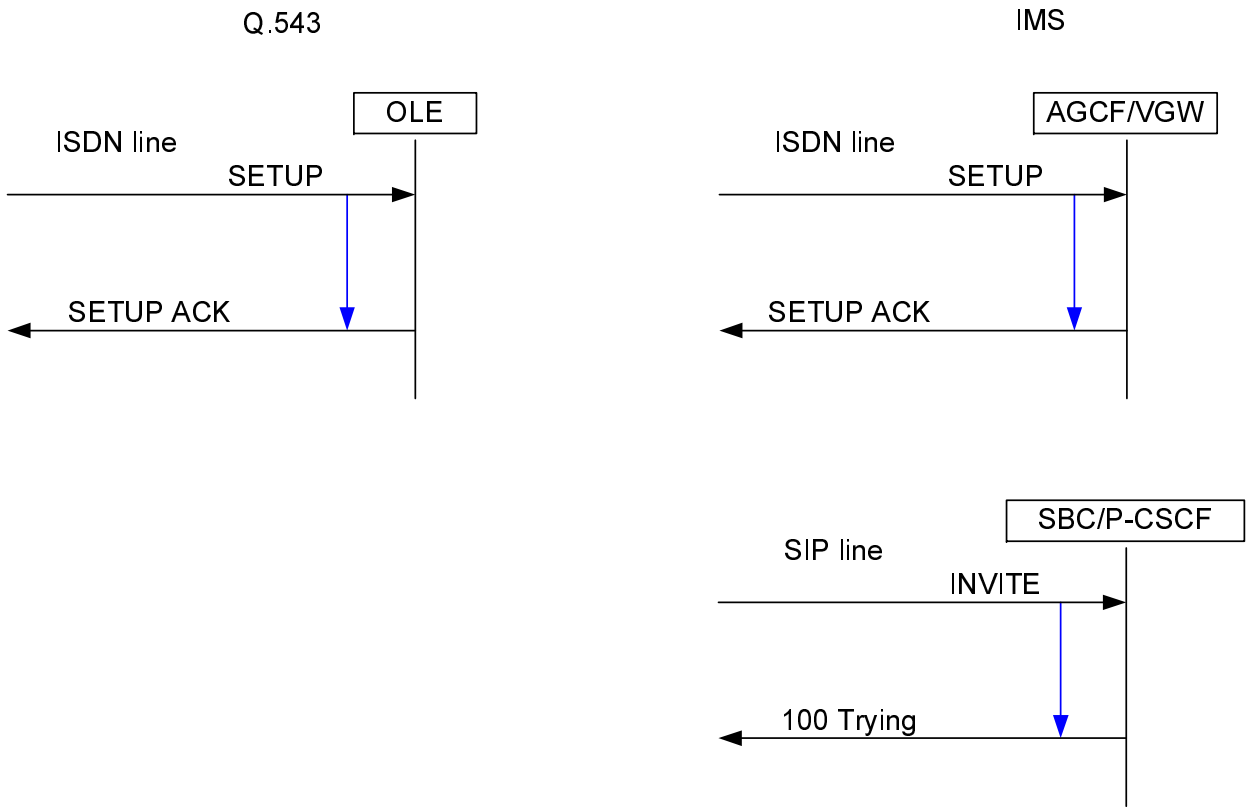

Figure 4: Local exchange ISDN subscriber call request delay: overlap sending

Table 3

Meaning of timers	Parameter Q.543	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		Mean Value	95 % probability of not exceeding	Mean Value	95 % probability of not exceeding
Local exchange ISDN subscriber call request delay: en Block sending						
ISDN SUBSCRIBER LINES Local exchange call request delay en - block sending.	clause 2.3.2.3 [1] 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 [2] 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 PROCCEDING message is passed back to the subscriber signalling system.	≤ 300 ms	≤ 400 ms	≤ 500 ms	≤ 600 ms

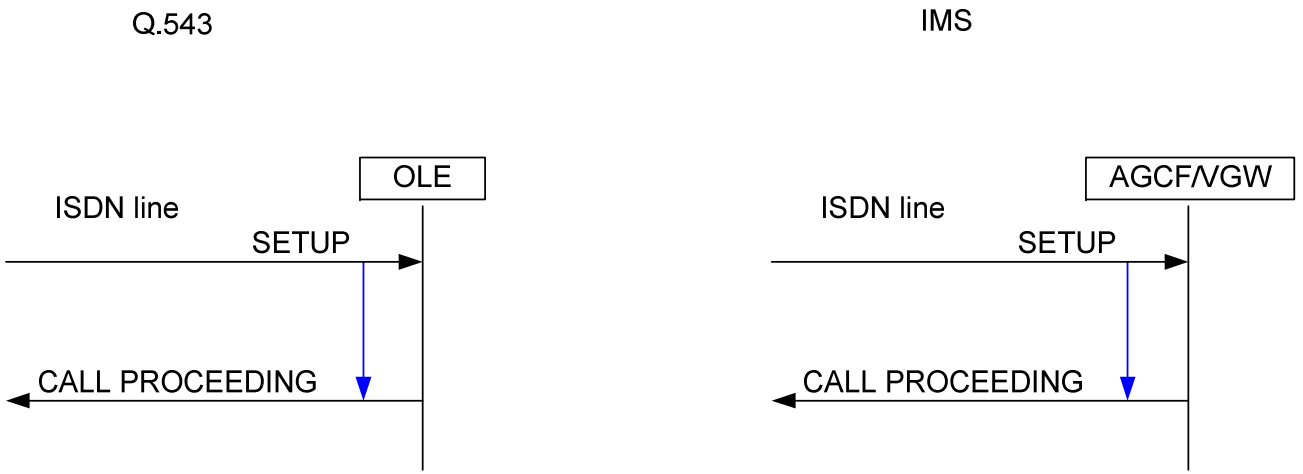

Figure 5: Local exchange ISDN subscriber call request delay: en Block sending

Table 4

Meaning of timers	Parameter Q.543 [1]	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		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 [1] 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 [4] 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 [1] 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 [2] 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

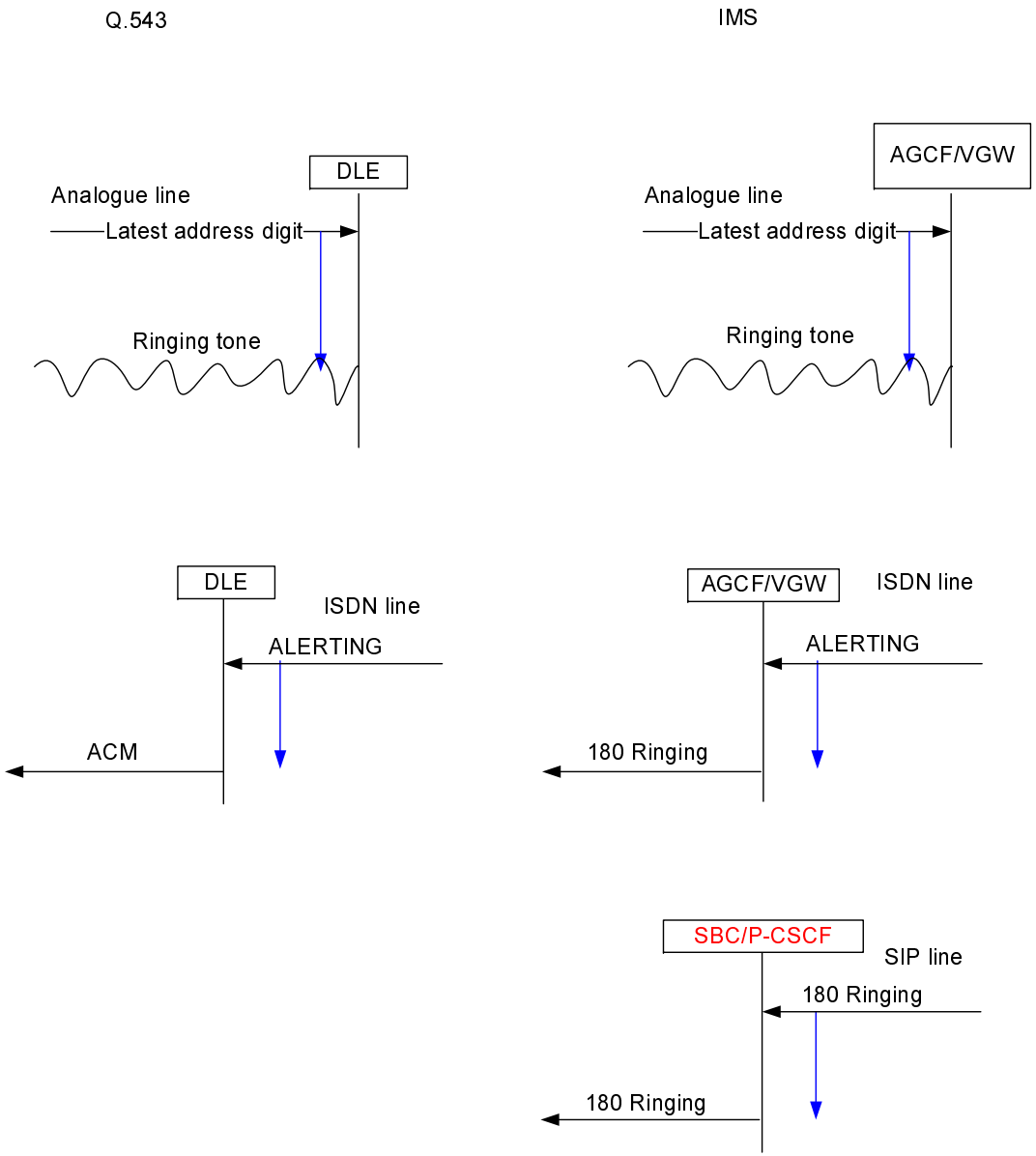

Figure 6: Local exchange Alerting sending delay for terminating traffic (in different locations)

Table 5

Meaning of timers	Parameter Q.543 [1]	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		Mean Value	95 % probability of not exceeding	Mean Value	95 % probability of not exceeding
Alerting sending delay for internal traffic (the user are in same locations, controlled by same AGCF/VGW or P-CSCF)						
ANALOGUE SUBSCRIBER LINES Alerting sending Delay for internal traffic.	clause 2.3.6.2.1 [1] 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 [4] 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 [4] 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	≤ 1 100 ms
ISDN SUBSCRIBER LINES Alerting sending Delay for Internal traffic.	clause 2.3.6.2.2 [1] 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 [2] 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 For calls terminating 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
VoLTE SUBSCRIBER LINES 180 sending Delay for Internal traffic.		VoLTE For calls terminating sending delay is defined as the interval from the instant that a 180 message at the VoLTE - UE interface has received and 180 is sent on the VoLTE - UE towards the calling subscriber.	≤ 150 ms	≤ 200 ms	≤ 250 ms	≤ 300 ms

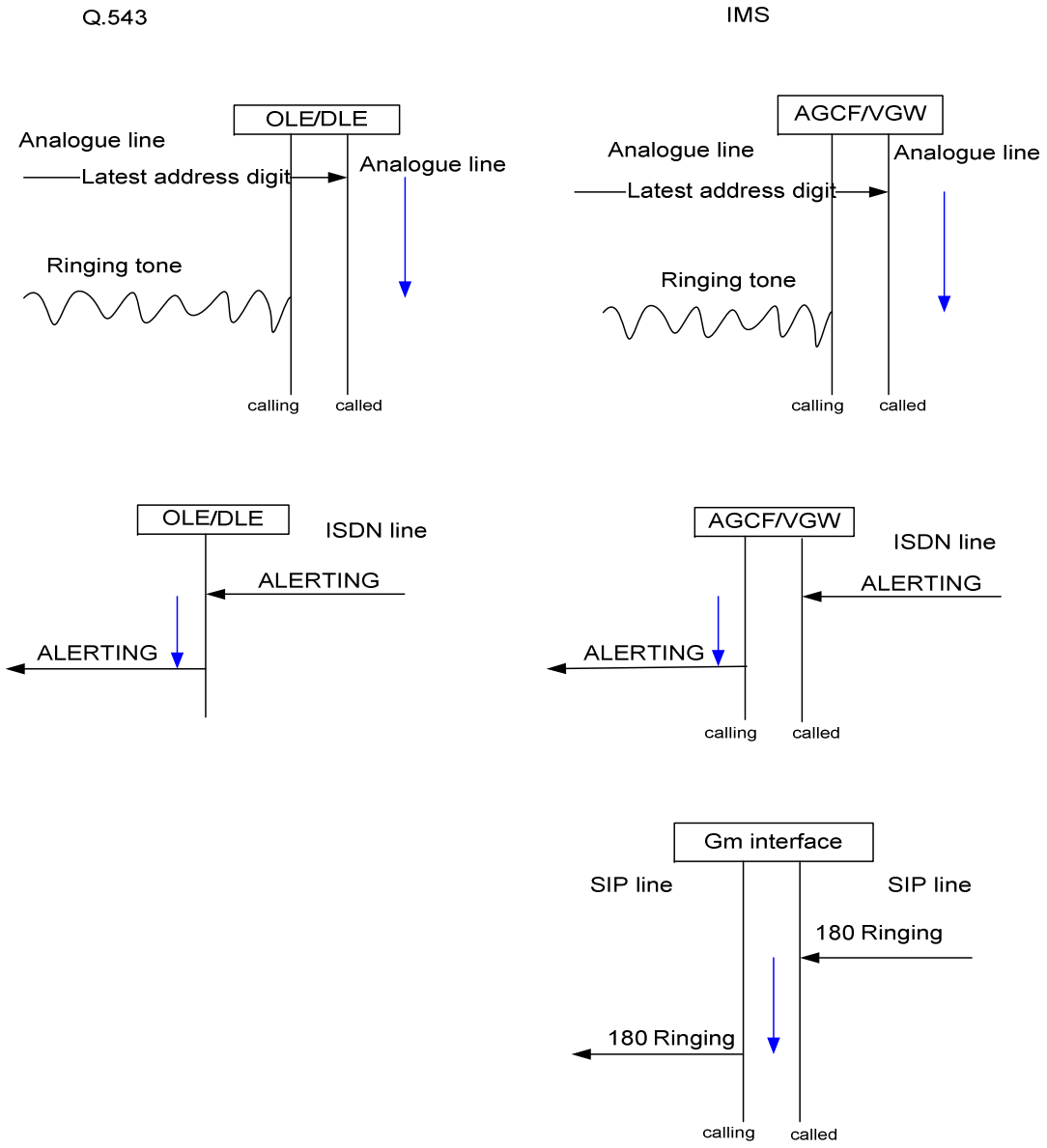

Figure 7: Alerting sending delay for internal traffic
(the user are in same locations, controlled by same AGCF/VGW or P-CSCF)

Table 6

Meaning of timers	Parameter Q.543 [1]	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		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 [1] 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 setup 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 [2] 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 [2] 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
		IMS [3] 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

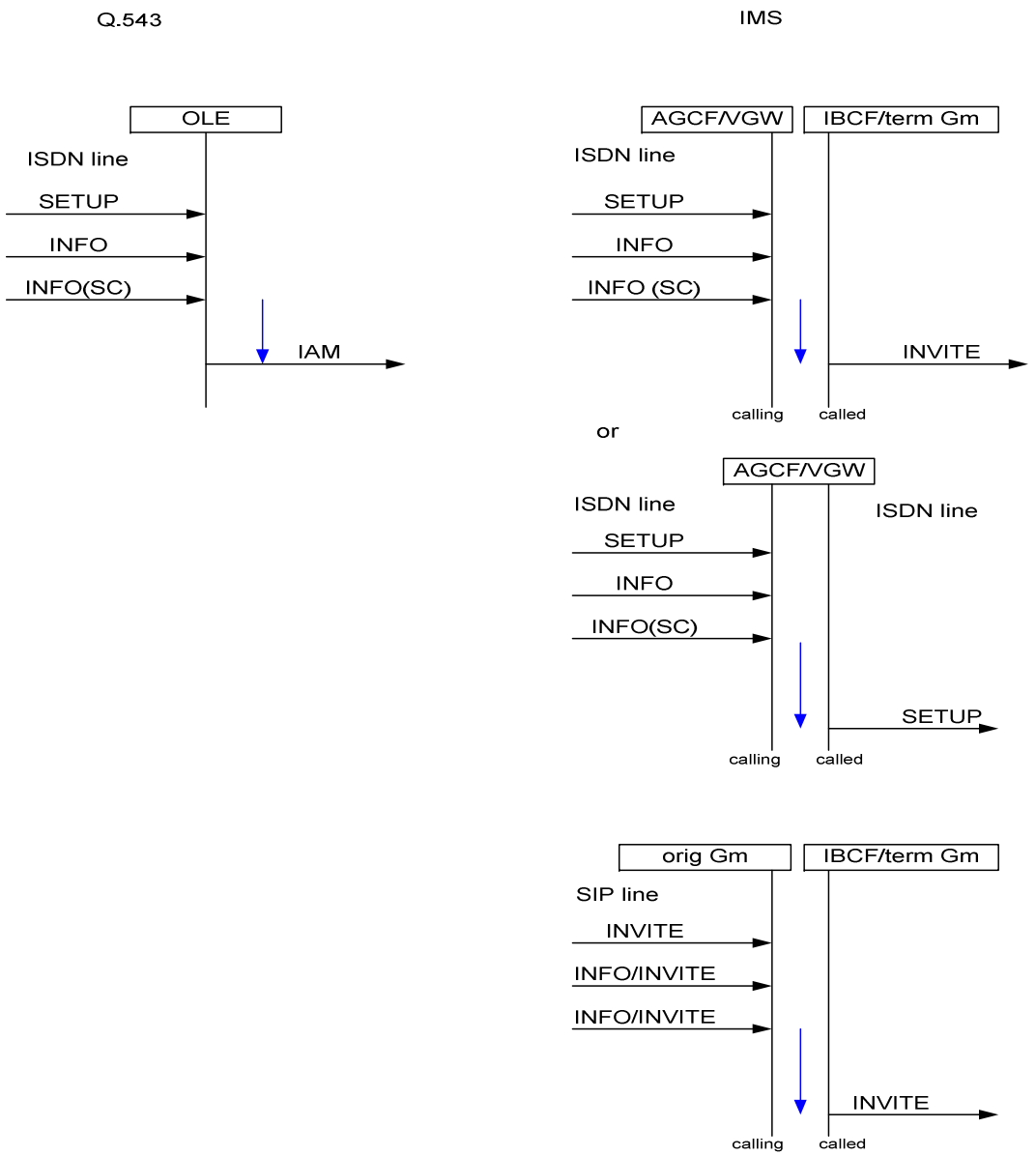

Figure 8: Call set up delay: Overlap sending is used

Table 7

Meaning of timers	Parameter Q.543 [1]	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		Mean Value	95 % probability of not exceeding	Mean Value	95 % probability of not exceeding
Call set up delay: en Block sending is used						
ISDN SUBSCRIBER LINES Call set up delay using en-block signalling.	clause 2.4.3.1 [1] Exchange call setup delay for originating outgoing traffic connections. 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. 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 setup is sent on the outgoing signalling system.	ISDN [2] 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.	≤ 350 ms	≤ 450 ms	≤ 550 ms	≤ 650 ms
		ISDN [2] 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.	≤ 350 ms	≤ 450 ms	≤ 550 ms	≤ 650 ms
		ISDN [2] 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 1).	≤ 450 ms	≤ 550 ms	≤ 650 ms	≤ 750 ms
IMS SUBSCRIBER Call set up delay using for Internal traffic.		IMS [3] 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

Meaning of timers	Parameter Q.543 [1]	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		Mean Value	95 % probability of not exceeding	Mean Value	95 % probability of not exceeding
Call set up delay: en Block sending is used						
		VoLTE 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 VoLTE - UE (**ECM idle**) interface until the instant when the corresponding INVITE signalling information is passed on the terminating VoLTE - UE (**ECM Idle)** interface to the called user with QCI 1 (see note 2).	≤ 2 150 ms	≤ 2 250 ms	≤ 2 400 ms	≤ 2 500 ms
		VoLTE 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 VoLTE - UE (**ECM Connected**) interface until the instant when the corresponding INVITE signalling information is passed on the terminating VoLTE - UE (**ECM Connected**) interface to the called user (see note 3).	≤ 250 ms	≤ 350 ms	≤ 500 ms	≤ 600 ms
NOTE 1: If SC (#) is not included the setup delay may increase up to the digit collection timer (15 s). NOTE 2: Paging Cycle 1,28 s. NOTE 3: S1-Control plane delay: 2 ms - 15 ms (S1 is the interface between eNode Bs and MME and S-GW).						

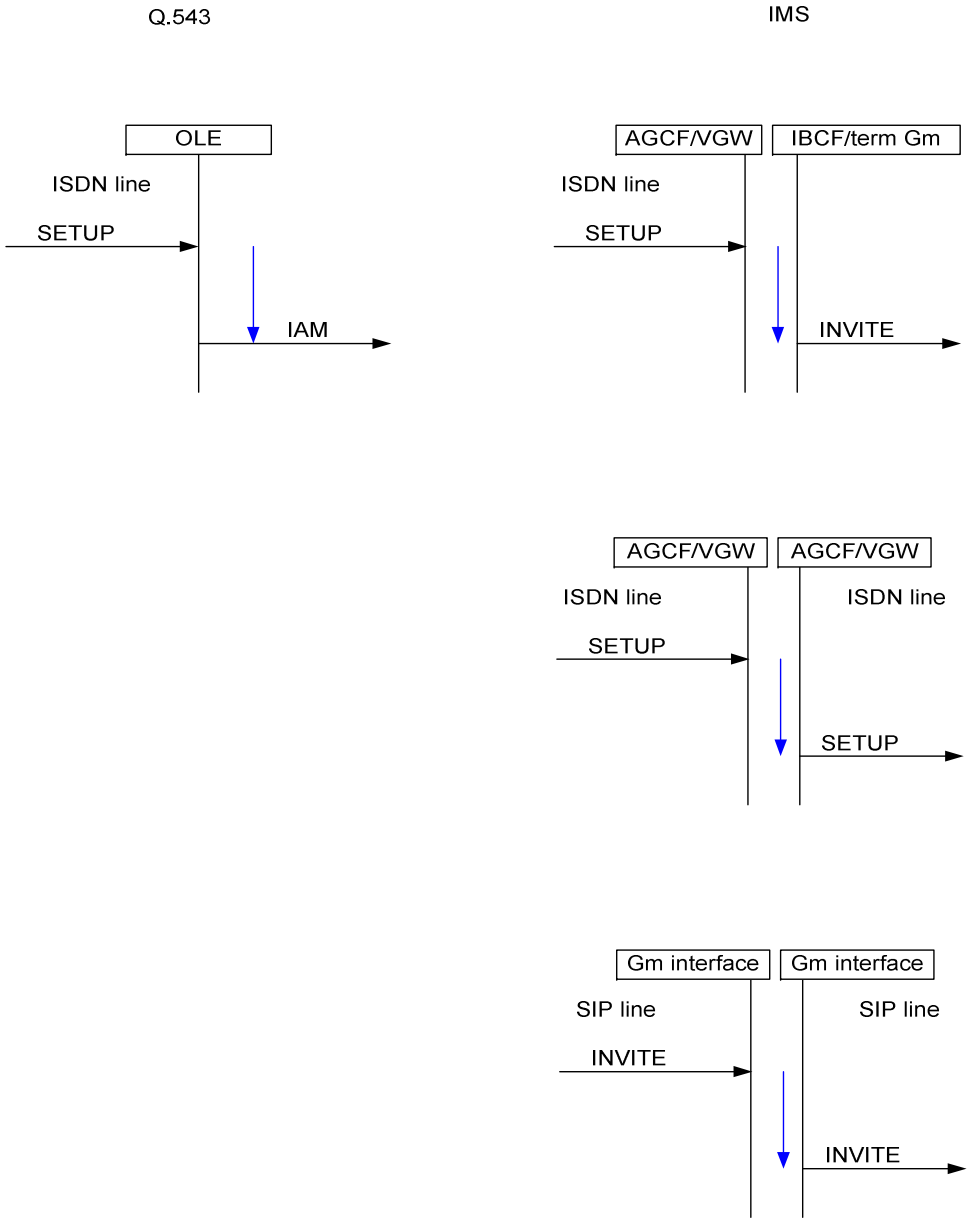

Figure 9: Call set up delay: en Block sending is used

Table 8

Meaning of timers	Parameter Q.543 [1]	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		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 [1] 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 [2] 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 [3] 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
VoLTE		VoLTE 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 VoLTE - UE 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 VoLTE - UE interface.	≤ 150 ms	≤ 200 ms	≤ 250 ms	≤ 300 ms
NOTE: The through connection of RTP is not considered.						

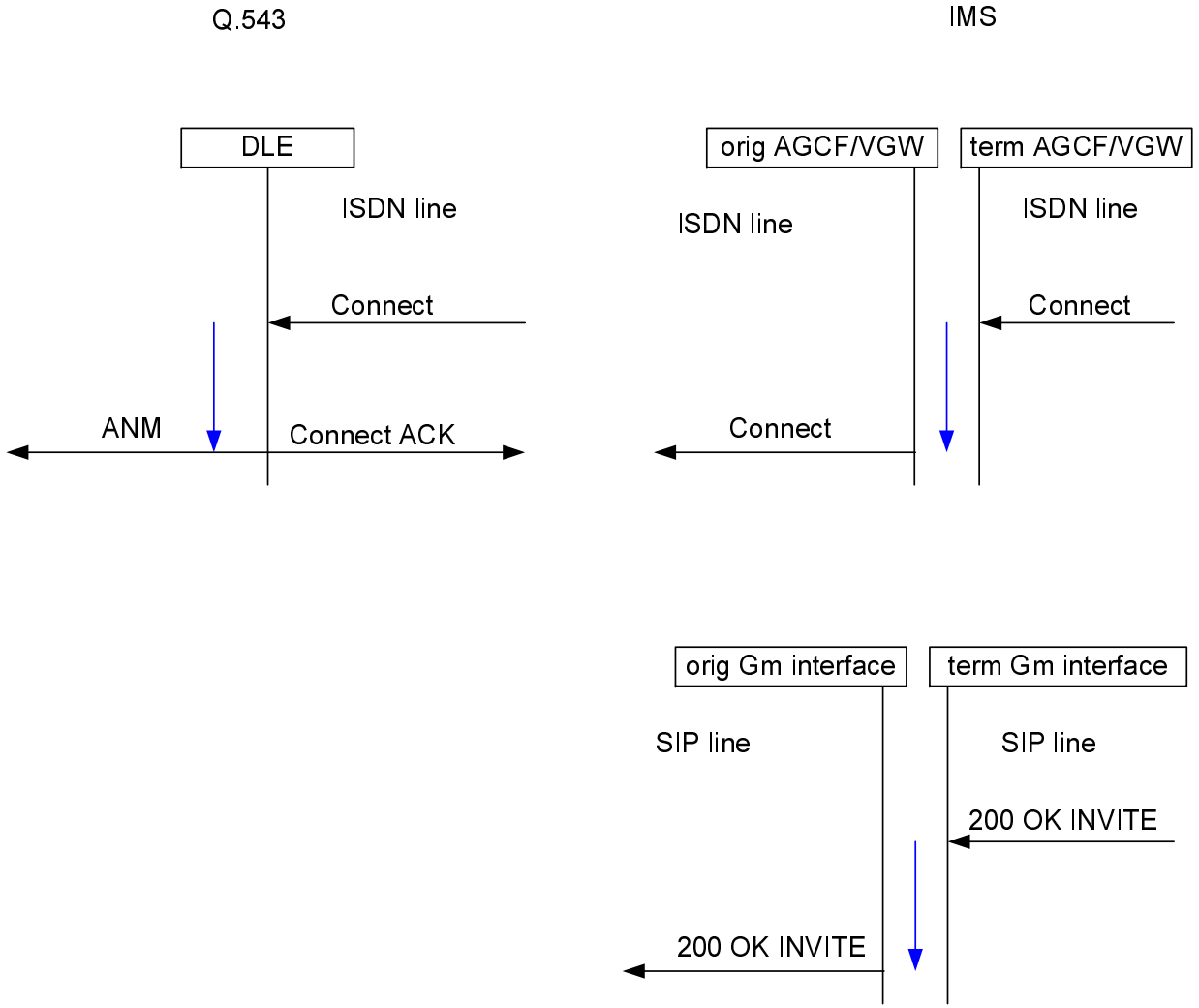

Figure 10: Through-connection delay

Table 9

Meaning of timers	Parameter Q.543 [1]	IMS, PES equivalent	Reference Load A		Reference Load B	
	Detailed description		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 [1] 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 [2] 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 [3] 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
VoLTE - IMS SUBSCRIBER Connection call release delay Delay for Internal traffic.		VoLTE Connection release delay is defined as the interval from the instant when a BYE message is received at the originating or terminating VoLTE - UE interface until the instant when 200OK is sent and a corresponding BYE message is sent at the terminating or originating VoLTE - UE interface respectively.	≤ 150 ms	≤ 200 ms	≤ 250 ms	≤ 300 ms

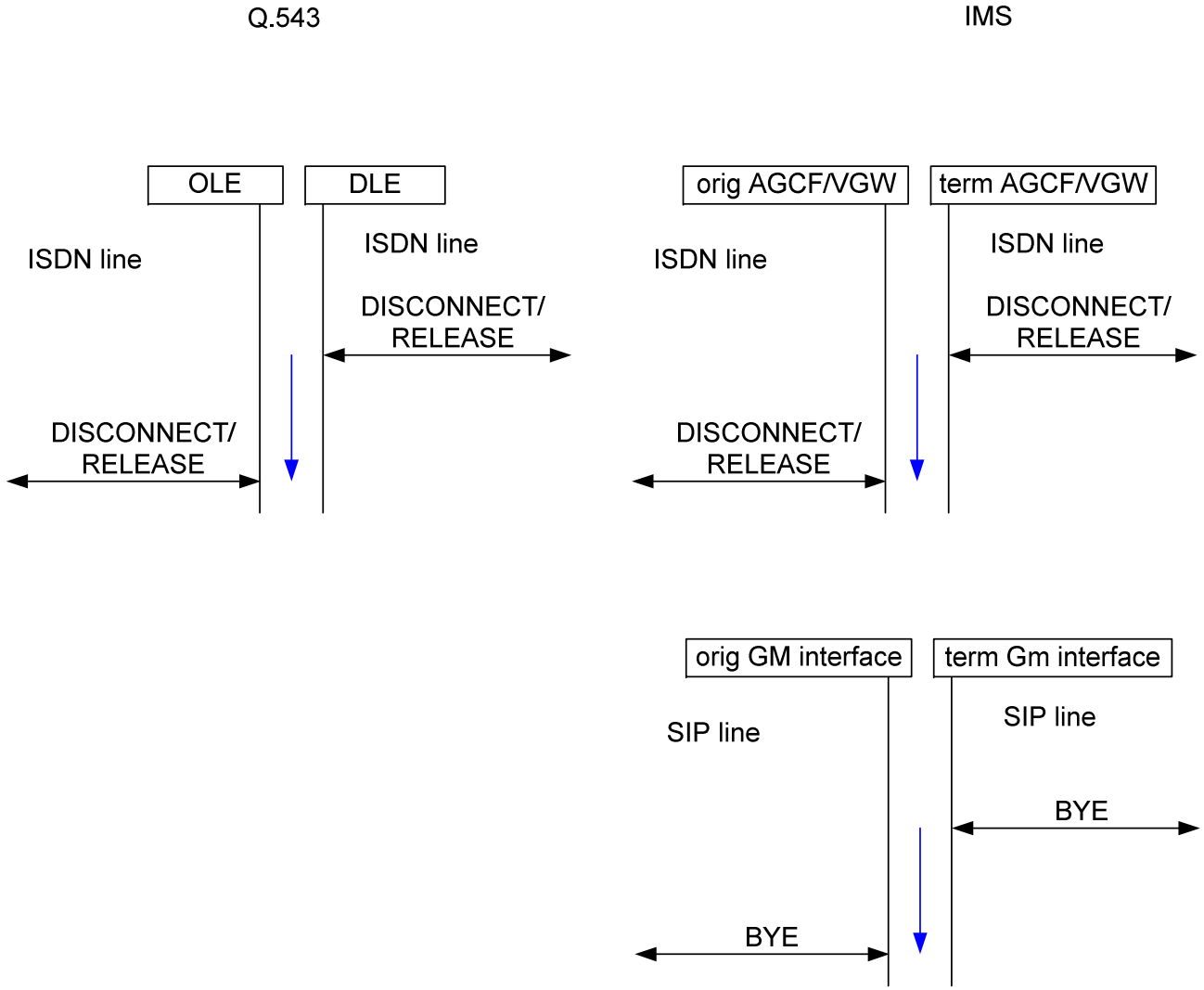

Figure 11: Connection call release delay

4.4 Call processing performance objectives

4.4.1 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:

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

4.4.2 Release failure

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

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

4.4.3 Incorrect charging or accounting

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

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

4.4.4 Misrouting

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

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

4.4.5 No tone

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

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

4.4.6 Other failures

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

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

4.5 Transmission performance

4.5.1 64 kbit/s switched connections

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

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

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

NOTE: In Recommendation ITU-T G.826 [8], budgets of 18,5 % of $1,5 \times 10^{-6}$ were allocated to each national network, so the packet loss for a national connection should be no more than $2,75 \times 10^{-7}$ [9].

4.6 Slip rate

4.6.1 Normal conditions

The slip rate under normal conditions is covered in Recommendation ITU-T Q.541 [5].

4.6.2 Temporary loss of timing control

The case of temporary loss of timing control corresponds to the "holdover operation" defined and recommended in Recommendation ITU-T G.812 [6]. The allowable slip rate will correspond to the maximum relative TIE also recommended therein.

4.6.3 Abnormal conditions at the exchange input

The slip rate in case of abnormal conditions (wide phase deviations, etc.) at the exchange input is the subject of further study taking into account the requirements of Recommendation ITU-T G.823 [7].

Annex A (informative): Bibliography

- ETSI ES 282 002: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); PSTN/ISDN Emulation Sub-system (PES); Functional architecture".

History

Document history		
V1.1.1	August 2011	Publication
V1.2.1	August 2012	Publication
V1.3.1	November 2014	Publication