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Technical Specification

Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS/PES Performance Benchmark Part 2: Subsystem Configurations and Benchmarks



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Contents

Intellectual Property Rights	5
Foreword.....	5
1 Scope	6
2 References	6
2.1 Normative references	6
2.2 Informative references.....	7
3 Definitions and abbreviations.....	7
3.1 Definitions.....	7
3.2 Abbreviations	8
4 System Under Test (SUT)	8
5 Use cases	10
5.1 ISDN Use cases.....	10
5.1.1 ISDN - ISDN Use case 1	10
5.1.1.1 ISDN - ISDN Scenario 1.1 Basic call with BC= speech - enblock sending.....	10
5.1.1.2 ISDN - ISDN Scenario 1.2 Basic call with BC= speech - enblock sending.....	10
5.1.1.3 ISDN - ISDN Scenario 1.3 Basic call - overlap sending with BC= speech	10
5.1.1.4 ISDN - ISDN Scenario 1.4 Basic call with BC= 3,1 KHz audio - Fax with 33,6 kbit/s	10
5.1.1.5 ISDN - ISDN Scenario 1.5 Basic call with BC= 3,1 KHz audio - Fax with 14,4 kbit/s	11
5.1.1.6 ISDN - ISDN Scenario 1.6 Basic call with BC= 3,1 kHz with PI#3.....	11
5.1.1.7 ISDN - ISDN Scenario 1.7 Basic call with BC= 3,1 kHz with PI#3.....	11
5.1.1.8 ISDN - ISDN Scenario 1.8 Basic call with BC= 3,1 kHz - Modem V.32 bis (4,8 kbit/s, 9,6 kbit/s 14,4 kbit/s)	11
5.1.1.9 ISDN - ISDN Scenario 1.9 Basic call with BC= 3,1 kHz - Modem V.34 (up to 33,6 kbit/s)	11
5.1.1.10 ISDN - ISDN Scenario 1.10 Basic call with BC= UDI - enblock sending	11
5.1.1.11 ISDN - ISDN Scenario 1.11 Basic call with BC= UDI - enblock sending	11
5.1.1.12 ISDN - ISDN Scenario 1.12 - called user is user determined user busy	11
5.1.1.13 ISDN - ISDN Scenario 1.13 - no answer from the called user.....	11
5.1.2 ISDN- PSTN Use case 2.....	11
5.1.2.1 ISDN - PSTN Scenario 2.1 Basic call with BC= speech - enblock sending	11
5.1.2.2 ISDN - PSTN Scenario 2.2 Basic call with BC= speech - enblock sending	12
5.1.2.3 ISDN - PSTN Scenario 2.3 Basic call - overlap sending with BC= speech.....	12
5.1.2.4 ISDN - PSTN Scenario 2.4 Basic call with BC= 3,1 KHz audio - Fax with 33,6 kbit/s.....	12
5.1.2.5 ISDN - PSTN Scenario 2.5 Basic call with BC= 3,1 KHz audio - Fax with 14,4 kbit/s.....	12
5.1.2.6 ISDN - PSTN Scenario 2.6 Basic call with BC= 3,1 kHz - Modem V.32 bis (4,8 kbit/s, 9,6 kbit/s 14,4 kbit/s)	12
5.1.2.7 ISDN - PSTN Scenario 2.7 Basic call with BC= 3,1 kHz - Modem V.34 (up to 33,6 kbit/s).....	12
5.1.2.8 ISDN - PSTN Scenario 2.8 - called user is user determined user busy.....	12
5.1.2.9 ISDN - PSTN Scenario 2.9- no answer from the called user	12
5.1.3 PSTN - ISDN Use Case 3.....	12
5.1.3.1 PSTN - ISDN Scenario 3.1 Basic call. The call is released from the calling user	12
5.1.3.2 PSTN - ISDN Scenario 3.2 Basic call The call is released from the called user.....	12
5.1.3.3 PSTN - ISDN Scenario 3.3 Basic call with BC= 3,1 KHz audio - Fax with 33,6 kbit/s.....	13
5.1.3.4 PSTN - ISDN Scenario 3.4 Basic call with BC= 3,1 KHz audio - Fax with 14,4 kbit/s.....	13
5.1.3.5 PSTN - ISDN Scenario 3.5 Basic call with BC= 3,1 KHz audio - Modem V.90.....	13
5.1.3.6 PSTN - ISDN Scenario 3.6 - called user is user determined user busy.....	13
5.1.3.7 PSTN - ISDN Scenario 3.7 - no answer from the called user	13
5.1.4 PSTN - PSTN Use case 4	13
5.1.4.1 PSTN - PSTN Scenario 4.1 Basic call. The call is released from the calling user	13
5.1.4.2 PSTN - PSTN Scenario 4.2 Basic call The call is released from the called user.	13
5.1.4.3 PSTN - PSTN Scenario 4.3 Basic call with Fax with 33,6 kBit/s (Super G3 Fax)	13
5.1.4.4 PSTN - PSTN Scenario 4.4 Basic call with Fax with 14,4 kBit/s.....	13
5.1.4.5 PSTN - PSTN Scenario 4.5 Basic call with BC= 3,1 KHz audio - Modem V.34 (up to 33,6 kbit/s)	13

5.1.4.6	PSTN - PSTN Scenario 4.6 Basic call with BC= 3,1 KHz audio - Modem V.32 bis (4,8 kbit/s, 9,6 kbit/s 14,4 kbit/s).....	14
5.1.4.7	PSTN - PSTN Scenario 4.7 - called user is user busy.....	14
5.1.4.8	PSTN - ISDN Scenario 4.8 - no answer from the called user	14
5.2	Metrics and design objectives	14
5.2.1	Delay probability - non-ISDN or mixed (ISDN - non-ISDN) environment	14
5.2.2	Speech quality analysis	18
5.3	Call Profiler Traffic Patterns	19
5.3.1	Saw Tooth.....	19
5.3.2	Blast.....	20
5.3.3	Rolling Blast.....	20
5.3.4	Ramp.....	20
5.3.5	Steady Call Rate	20
5.3.6	Poisson Distribution.....	20
5.4	Load Concepts and Definitions	21
5.4.1	Processor Load.....	21
5.4.2	Reference Call and Workload Factors	21
Annex A (informative): Calls flows.....		23
Annex B (informative): Load profiles examples.....		30
Annex C (informative): Load traffic calculation		31
C.1	General	31
C.2	Calculation base on originated/ terminated traffic	31
C.3	ITU-T load definitions.....	32
C.3.1	Reference loads	32
C.3.1.1	Reference load on incoming interexchange circuits	32
C.3.1.2	Reference load on subscriber lines (originating traffic).....	32
C.4	High load reserve	33
C.5	Overload	33
Annex D (informative): Test reports.....		34
D.1	Example of a Call Detail report.....	34
D.2	Example of a call summary report	35
D.3	Example of a voice summary report.....	35
D.4	Example of a voice quality detail report.....	36
Annex E (informative): Bibliography.....		37
History		38

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN).

The present document is part 2 of a multi-part deliverable covering the IMS/NGN Performance Benchmark, as identified below:

- Part 1: "Core Concepts";
- Part 2: "Subsystem Configurations and Benchmarks";**
- Part 3: "Traffic Sets and Traffic Profiles";
- Part 4: "Reference Load network quality parameters".

1 Scope

The present document is for an initial release of a PSTN/ISDN Emulation Sub-system (PES) performance benchmark. The same tests can be used also for legacy PSTN/ISDN networks or for inter-working tests between PSTN/ISDN emulation subsystem and legacy PSTN and ISDN. The metrics measured and reported are for performance of this subsystem under a communications application load.

The present document is the second part of the multi-part deliverable which consists of four parts.

TS 186 025-1 [1] contains the overall benchmark descriptions, architectures, processes, and information models that are common to all specific benchmarking scenarios.

The present document contains the specific benchmarking use-cases and scenarios, along with scenario specific metrics and design objectives. It also defines the SUT configuration parameters. This part also contains any required extensions to the overall descriptions present in the present document, if necessary for the specific scenario.

TS 186 025-3 [i.1] defines an initial benchmark test through the specification of a traffic set, traffic-time profile and benchmark test procedure.

TS 186 025-4 [i.2] defines Reference Load network quality parameters for the use cases defined in 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] ETSI TS 186 025-1: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS/PES Performance Benchmark Part 1: Core Concepts".
- [2] ITU-T Recommendation Q.543: "Digital exchange performance design objective".
- [3] ETSI TS 183 036: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); ISDN/SIP interworking; Protocol specification".
- [4] 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)".
- [5] ETSI TS 183 043: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS-based PSTN/ISDN Emulation; Stage 3 specification".

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.

- [i.1] ETSI TS 186 025-3: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS/PES Performance Benchmark Part 3 : Traffic Sets and Traffic Profiles".
- [i.2] ETSI TS 186 025-4: "Telecommunications and Internet Converged Services and Protocols for Advanced Networking (TISPAN); IMS/PES Performance Benchmark; Part 4: Reference Load network quality parameters".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

background load: workload applied to an SUT during a benchmark test, for the purpose of consuming SUT resources during a benchmark test and changing the traffic intensity at which the capacity of the SUT is reached

benchmark report: document generated at the conclusion of a test procedure containing the metrics measured during the execution of the test and/or computed from the data collected in the benchmark log

benchmark test: procedure by which a test system interacts with a System Under Test to measure its behaviour and produce a benchmark report

configuration: specification of a subset of IMS/PES architectural elements and metrics for which collection of benchmark tests can be defined

design objective: probabilistic model of delay and failure requirements for SUT, associated with a use-case, specified by threshold values and probabilities for delay and scenario failure.

idle load: load that is not dependent on the traffic or other external activities

maximum capacity: maximum processor load that a processor can handle without rejecting new calls

metric: performance measurement of SUT reported in a benchmark report

parameter: attribute of a SUT, test system, system load, or traffic set whose value is set externally and prior to a benchmark test, and whose value affects the behaviour of the benchmark test

processor load: part of time the processor executes work, normally expressed in percent

NOTE: The processor load consists of Idle load, Traffic load and Usage load.

Reference Call (RC): basic ISUP to ISUP call connected through two MGW in the same MGC domain

test parameters: parameters whose values determine the behaviour of a benchmark test

test procedure: specification of the steps to be performed by a benchmark test

test scenario: specific path through a use-case, whose implementation by a test system creates a system load

test system: collection of hardware and software which presents a system load to a system under test and collects data on the system under test's performance, from which metrics can be computed

traffic load: load that results from handling traffic events that are directly related to calls; this load varies with the traffic intensity

traffic-time profile: evolution of the average scenario over a time interval

traffic set: mixture of traffic scenarios

usage load: load that is reserved for the administrations operation and maintenance activities during busy hour

workload: number of reference calls per second (RC/s)

NOTE: It is calculated by multiplying calls per second by its corresponding WLF.

workload factor: traffic load for different types of calls in relation to the traffic load of the reference call (ISUP call)

3.2 Abbreviations

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

APS	Attempts Per Second
BC	Bearer Capability
BHCA	Busy Hour Call Attempts
CLIP	Calling Line Identification Presentation
CW	Communication Waiting
DO	Design Objective
IMS	IP Multimedia Subsystem
ISDN	Integrated Services Digital Network
MCID	Malicious Communication Identification
MGC	Media GateWay Controler
MGW	Media GateWay
MHT	Mean Holding Time
NGN	Next Generation Networks
PES	PSTN/ISDN Emulation Sub-system
PIXIT	Protocol Implementation eXtra Information for Testing
PSTN	Public Switched Telecommunications Network
RC	Reference Call
SAPS	Session Attempts Per Second
SUT	System Under Test
UDI	Unrestricted Digital Information
WLF	WorkLoad Factor.

4 System Under Test (SUT)

The IMS/PES performance benchmark covers benchmark tests for the PSTN/ISDN Emulation Sub-system (PES), The same tests can be used also for legacy PSTN/ISDN networks or for inter-working tests between PSTN/ISDN emulation subsystem and legacy PSTN and ISDN. The following functional entities appear to be necessary from the perspective of specifying information flows and ensuring the interoperability of services.

- Access Gateway Analogue line function
- Access Gateway BRI function
- Access Gateway PRI function
- Residential Gateway Analogue line function
- Residential Gateway BRI function
- Trunk Gateway function
- Access Call Server function
- Transit Call Server function
- Packet Handler Gateway function
- Media Gateway Controller function

- Media Server Control Function
- Customer Location function
- IN Access Subsystem
- SIP Server Access Function
- Trunk Signalling Gateway

The Functional Architecture is shown in figure 1 in such a way that it can be seen that multiple implementation architectures are possible. There are some fundamental points that should not be missed however. The first of these is that we have gateways that convert legacy interfaces such as national analogue PSTN Z reference points and ISDN S or T reference points into NGN interfaces. These are usually thought of as being H.248 interfaces but that is not the only interface that can be used. Depending on the service set MGCP or interfaces carrying suitable information in SIP can be used. The key point is that the information flow can carry the stimulus information traditionally needed in national PSTNs to carry both line and register signalling from customers as well as specialised service signalling.

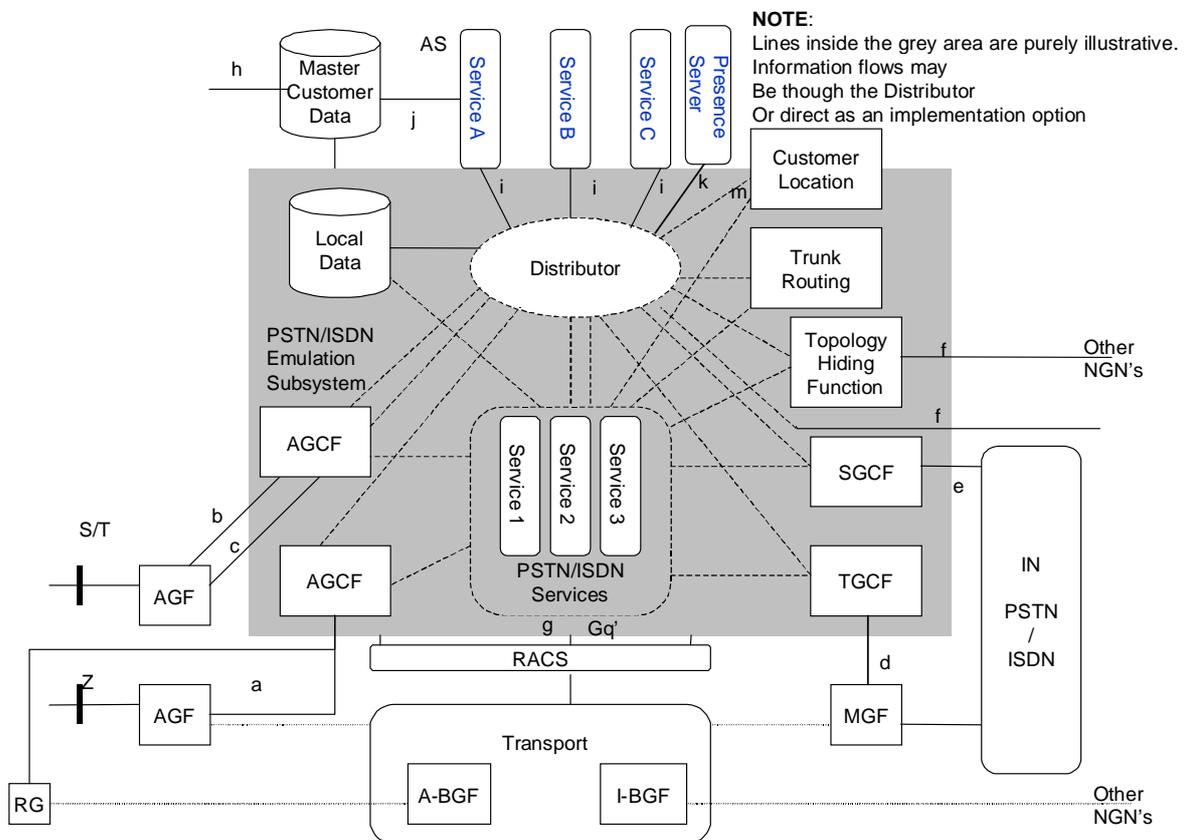


Figure 1: Overview of Functional Entities

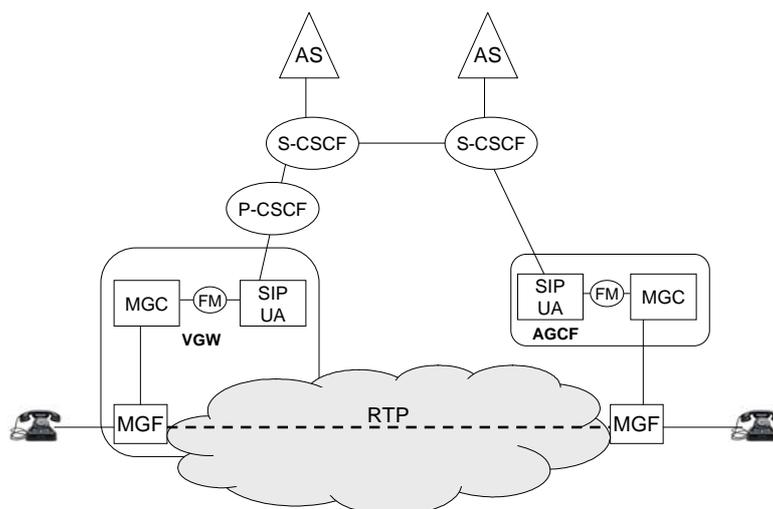


Figure 2: AGCF/VGW session processing model

5 Use cases

This clause defines a set of basic use cases which can be provided simultaneously. Described are ISDN - ISDN, ISDN - PSTN and PSTN-PSTN use cases. They can be handled by the PSTN/ISDN emulation subsystem, by the legacy PSTN/ISDN or as inter-working between PSTN/ISDN emulation subsystem and legacy PSTN and ISDN. Described are user equipment actions.

5.1 ISDN Use cases

5.1.1 ISDN - ISDN Use case 1

5.1.1.1 ISDN - ISDN Scenario 1.1 Basic call with BC= speech - enblock sending

This use case represents the case when the call establishment using en-bloc sending is performed correctly. The call is released from the calling user.

5.1.1.2 ISDN - ISDN Scenario 1.2 Basic call with BC= speech - enblock sending

This scenario represents the case when the call establishment using en-bloc sending is performed correctly. The call is released from the called user.

5.1.1.3 ISDN - ISDN Scenario 1.3 Basic call - overlap sending with BC= speech

This scenario represents the case when the call establishment using overlap sending is performed correctly. The call is released from the calling user.

5.1.1.4 ISDN - ISDN Scenario 1.4 Basic call with BC= 3,1 KHz audio - Fax with 33,6 kbit/s

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are not activated. The call is released from the calling user.

5.1.1.5 ISDN - ISDN Scenario 1.5 Basic call with BC= 3,1 KHz audio - Fax with 14,4 kbit/s

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are not activated. The call is released from the calling user.

5.1.1.6 ISDN - ISDN Scenario 1.6 Basic call with BC= 3,1 kHz with PI#3

This scenario represents the case when in the active call state (N10) the 3,1 kHz transfer is performed correctly. The call is released from the calling user.

5.1.1.7 ISDN - ISDN Scenario 1.7 Basic call with BC= 3,1 kHz with PI#3

This scenario represents the case when in the active call state (N10) the 3,1 kHz transfer is performed correctly The call is released from the called user.

5.1.1.8 ISDN - ISDN Scenario 1.8 Basic call with BC= 3,1 kHz - Modem V.32 bis (4,8 kbit/s, 9,6 kbit/s 14,4 kbit/s)

This scenario represents the case when in the active call state (N10) the 3,1 kHz transfer is performed correctly The call is released from the calling user.

5.1.1.9 ISDN - ISDN Scenario 1.9 Basic call with BC= 3,1 kHz - Modem V.34 (up to 33,6 kbit/s)

This scenario represents the case when in the active call state (N10) the 3,1 kHz transfer is performed correctly The call is released from the calling user.

5.1.1.10 ISDN - ISDN Scenario 1.10 Basic call with BC= UDI - enblock sending

This scenario represents the case when the call establishment using en-bloc sending is performed correctly. The call is released from the calling user.

5.1.1.11 ISDN - ISDN Scenario 1.11 Basic call with BC= UDI - enblock sending

This scenario represents the case when the call establishment using en-bloc sending is performed correctly. The call is released from the called user.

5.1.1.12 ISDN - ISDN Scenario 1.12 - called user is user determined user busy

This scenario represents the case, when the called user is user determined user busy the network initiate call clearing to the calling user with cause value # 17.

5.1.1.13 ISDN - ISDN Scenario 1.13 - no answer from the called user

This scenario represents the case when there is no answer from the called user ("no user responding"), the network initiate call clearing to the calling user with the cause value # 18.

5.1.2 ISDN- PSTN Use case 2

5.1.2.1 ISDN - PSTN Scenario 2.1 Basic call with BC= speech - enblock sending

This scenario represents the case when the call establishment using en-bloc sending is performed correctly. The call is released from the calling user.

5.1.2.2 ISDN - PSTN Scenario 2.2 Basic call with BC= speech - enblock sending

This scenario represents the case when the call establishment using en-bloc sending is performed correctly. The call is released from the called user.

5.1.2.3 ISDN - PSTN Scenario 2.3 Basic call - overlap sending with BC= speech

This scenario represents the case when the call establishment using overlap sending. The call is released from the calling user. The call is released from the calling user.

5.1.2.4 ISDN - PSTN Scenario 2.4 Basic call with BC= 3,1 KHz audio - Fax with 33,6 kbit/s

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are not activated. The call is released from the called user.

5.1.2.5 ISDN - PSTN Scenario 2.5 Basic call with BC= 3,1 KHz audio - Fax with 14,4 kbit/s

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are not activated. The call is released from the called user.

5.1.2.6 ISDN - PSTN Scenario 2.6 Basic call with BC= 3,1 kHz - Modem V.32 bis (4,8 kbit/s, 9,6 kbit/s 14,4 kbit/s)

This scenario represents the case when in the active call state (N10) the 3,1 kHz transfer is performed correctly The call is released from the calling user.

5.1.2.7 ISDN - PSTN Scenario 2.7 Basic call with BC= 3,1 kHz - Modem V.34 (up to 33,6 kbit/s)

This scenario represents the case when in the active call state (N10) the 3,1 kHz transfer is performed correctly The call is released from the calling user.

5.1.2.8 ISDN - PSTN Scenario 2.8 - called user is user determined user busy

This scenario represents the case, when the called user is user determined user busy. the network initiates call clearing to the calling user with cause value # 17.

5.1.2.9 ISDN - PSTN Scenario 2.9- no answer from the called user

This scenario represents the case when there is no answer from the called user ("no user responding"), the network initiates call clearing to the calling user with the cause value # 18.

5.1.3 PSTN - ISDN Use Case 3

5.1.3.1 PSTN - ISDN Scenario 3.1 Basic call. The call is released from the calling user

This scenario represents the case when the call establishment is performed correctly. The call is released from the calling user.

5.1.3.2 PSTN - ISDN Scenario 3.2 Basic call The call is released from the called user

This scenario represents the case when the call establishment is performed correctly. The call is released from the called user.

5.1.3.3 PSTN - ISDN Scenario 3.3 Basic call with BC= 3,1 KHz audio - Fax with 33,6 kbit/s

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are not activated.

5.1.3.4 PSTN - ISDN Scenario 3.4 Basic call with BC= 3,1 KHz audio - Fax with 14,4 kbit/s

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are deactivated.

5.1.3.5 PSTN - ISDN Scenario 3.5 Basic call with BC= 3,1 KHz audio - Modem V.90

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are not activated.

5.1.3.6 PSTN - ISDN Scenario 3.6 - called user is user determined user busy

This scenario represents the case, when the called user is user determined user busy the network initiate call clearing to the calling user.

5.1.3.7 PSTN - ISDN Scenario 3.7 - no answer from the called user

This scenario represents the case when there is no answer from the called user ("*no user responding*"), the network initiate call clearing to the calling user.

5.1.4 PSTN - PSTN Use case 4

5.1.4.1 PSTN - PSTN Scenario 4.1 Basic call. The call is released from the calling user

This scenario represents the case when the call establishment is performed correctly. The call is released from the calling user.

5.1.4.2 PSTN - PSTN Scenario 4.2 Basic call The call is released from the called user.

This scenario represents the case when the call establishment is performed correctly. The call is released from the called user.

5.1.4.3 PSTN - PSTN Scenario 4.3 Basic call with Fax with 33,6 kBit/s (Super G3 Fax)

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are deactivated.

5.1.4.4 PSTN - PSTN Scenario 4.4 Basic call with Fax with 14,4 kBit/s

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly. The echo cancellers in the GW are activated.

5.1.4.5 PSTN - PSTN Scenario 4.5 Basic call with BC= 3,1 KHz audio - Modem V.34 (up to 33,6 kbit/s)

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are deactivated.

5.1.4.6 PSTN - PSTN Scenario 4.6 Basic call with BC= 3,1 KHz audio - Modem V.32 bis (4,8 kbit/s, 9,6 kbit/s 14,4 kbit/s)

This scenario represents the case when in the active call state (N10) the Fax transfer on the media and B-channels is performed correctly and the echo cancellers in the GW are activated.

5.1.4.7 PSTN - PSTN Scenario 4.7 - called user is user busy

This scenario represents the case, when the called user is user determined user busy the network initiate call clearing to the calling user.

5.1.4.8 PSTN - ISDN Scenario 4.8 - no answer from the called user

This scenario represents the case when there is no answer from the called user ("no user *responding*"), the network initiate call clearing to the calling user.

5.2 Metrics and design objectives

5.2.1 Delay probability - non-ISDN or mixed (ISDN - non-ISDN) environment

This clause defines **delay parameters** related to non-ISDN environment and mixed (ISDN - non-ISDN) environment. The values will be defined in TS 186 025-4 [i.2].

**Table 1: delay parameters related to non-ISDN environment
and mixed (ISDN - non-ISDN) environment**

Short description	Parameter Q.543 [2] Detailed description	IMS equivalent
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 [2] 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.	Home network - PES [5] For ANALOGUE SUBSCRIBER LINES connected to the AGCF or 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 AGCF/VGW until the AGCF/VGW 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 AGCF/VGW is unable to receive any call address information from the subscriber.
ISDN SUBSCRIBER LINES local exchange call request delay - Overlap sending	clause 2.3.2.2 [2] 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	Home network ISDN [3] 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 IMS [4]- 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 is passed back to the subscriber.
ISDN SUBSCRIBER LINES local exchange call request delay- Enblock sending	clause 2.3.2.3 [2] 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.	Home network - ISDN [3] 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. IMS [4] Call request delay is defined as the interval from the instant at which the INVITE message is received from the subscriber until the call 183 Session progress is passed back to the SIP subscriber.
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 [2] 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 [5] 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.

Short description	Parameter Q.543 [2]	IMS equivalent
Detailed description		
ISDN SUBSCRIBER LINES Alerting sending Delay for terminating traffic	clause 2.3.6.1.2 [2] 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 [3] 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 180 Ringing or ringing tone is sent backward toward the calling user IMS [5] Call request delay is defined as the interval from the instant at which the 180 Ringing is received from the terminating subscriber until the 180 Ringing is passed back to the originating SIP subscriber.
Alerting sending delay for internal traffic (the users are in same locations, controlled by same S-CSCF/P-CSCF)		
ANALOGUE SUBSCRIBER LINES Alerting sending Delay for internal traffic	clause 2.3.6.2 [2] 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 [5] 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.
ISDN SUBSCRIBER LINES Alerting sending Delay for Internal traffic	clause 2.3.6.2 [2] For calls terminating on DIGITAL SUBSCRIBER LINES, alerting sending delay is defined as the interval from the instant that an ALERTING message is sent to a DIGITAL calling subscriber line signalling system.	ISDN [3] For calls terminating on ISDN, alerting sending delay is defined as the interval from the instant that an ALERTING message is sent to a ISDN user. IMS [4] Call request delay is defined as the interval from the instant at which the 180 Ringing is received from the subscriber until the call 180 Ringing is passed back to the SIP subscriber.
Call set up delay: 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		
ISDN SUBSCRIBER LINES call set up delay using overlap signalling	clause 2.4.3.1 [2] Exchange call setup delay for originating outgoing traffic connections, digital subscriber lines Sending, 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.	Home network ISDN [3] Sending, 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 IMS [4] not applicable.

Short description	Parameter Q.543 [2]	IMS equivalent
Detailed description		
ISDN SUBSCRIBER LINES call set up delay using enblock signalling	clause 2.4.3.1 [2] Exchange call setup delay for originating outgoing traffic connections For call attempts using en-bloc sending.	Home network ISDN [3] 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 IMS [4] call set up delay: 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 from the S-CSCF to the outgoing signalling system e.g. I-CSCF, IBCF; MGCF.
Through-connection delay		
ISDN SUBSCRIBER LINES Through-connection delay	clause 2.4.4.2 [2] Through-connection delay For originating supplementary service call attempts 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.	Home network ISDN [3] 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 CONNECT ACKNOWLEDGEMENT messages have been passed to the appropriate signalling systems IMS [4] The through connection delay is defined as the interval from the instant that the 200 OK message is received from the called line signalling system until the through connection is established and available for carrying traffic and the 200 OK messages have been passed to the appropriate signalling systems.
Incoming call indication sending delay		
ISDN SUBSCRIBER LINES Incoming call indication sending delay, overlap sending	clause 2.4.5 [2] Incoming call indication sending delay (terminating and internal connections), digital lines The incoming call indication sending delay is defined as the interval from the instant at which the necessary signalling information is received from the signalling system to the instant at which the SETUP message is passed to the signalling system of the called digital subscriber line. In the case of overlap sending.	ISDN [3] The incoming call indication sending delay is defined as the interval from the instant at which the necessary signalling information is received from the INVITE received in the S-CSCF/P-CSCF to the instant at which the SETUP message is passed to the signalling system of the called digital subscriber line. In the case of overlap sending IMS [4] The incoming call indication sending delay is defined as the interval from the instant at which the necessary signalling information is received from the P-CSCF to the instant at which the INVITE message is passed to the called subscriber

Short description	Parameter Q.543 [2]	IMS equivalent
Detailed description		
ISDN SUBSCRIBER LINES Incoming call indication sending delay, en-bloc sending	clause 2.4.5 [2] Incoming call indication sending delay (terminating and internal connections), digital lines, en-bloc sending.	ISDN [3] The incoming call indication sending delay is defined as the interval from the instant at which the necessary signalling information is received from the INVITE received in the S-CSCF/P-CSCF to the instant at which the SETUP message is passed to the signalling system of the called digital subscriber line. IMS [4] The incoming call indication sending delay is defined as the interval from the instant at which the necessary signalling information is received from the P-CSCF to the instant at which the INVITE message is passed to the called subscriber (AGW/AGCF in case of PES).
Connection release delay:		
ISDN SUBSCRIBER LINES Connection call release delay	clause 2.4.6 [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 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 [3] 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. IMS [4] Connection release delay is defined as the interval from the instant when a BYE message is received 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 BYE message is passed to the other signalling system involved in the connection.
ISDN SUBSCRIBER LINES Exchange call release delay	clause 2.4.6 [2] Exchange call release delay, terminating and internal traffic connections.	ISDN [3] Exchange 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 BYE message is passed by the S-CSCF/P-CSCF. IMS [4] Exchange release delay is defined as the interval from the instant when a BYE message is received 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 BYE message is passed by the S-CSCF/P-CSCF.

5.2.2 Speech quality analysis

This clause defines a set of parameters which enables the speech quality analysis of the system under test. They are divided in three parts: speech quality, speech level and PESQ offset.

Table 2 shows the speech quality parameters based on PESQ.

Table 3 shows the speech level parameters.

Table 4 shows the PESQ offset parameters.

Table 2: Speech Quality parameters based on PESQ

Speech Quality Summary	
	P.862.1
Min	
Max	
Mean	
Std-Dev	

Table 3: Speech level parameters

Speech Level Summary (Optional)				
	Active Level	Peak	Noise	Signal to Interval Noise
Min				
Max				
Mean				
Std-Dev				

Table 4: PESQ offset parameters

Delay Summary - Delay (PESQ Time Offset)	
Min	
Max	
Mean	
Std-Dev	
Range	

5.3 Call Profiler Traffic Patterns

This clause defines call profiles which are nowadays implemented in benchmark test systems.

5.3.1 Saw Tooth

The Saw Tooth ramps up to a peak number of calls and then ramps down from peak.

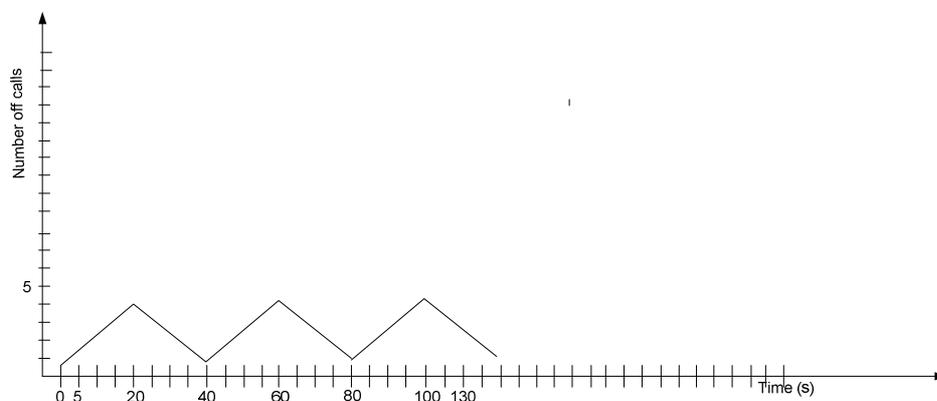


Figure 3: Example of saw tooth call profile

5.3.2 Blast

Blast - all calls go off-hook simultaneously, are connected for a specified time, and then disconnected.

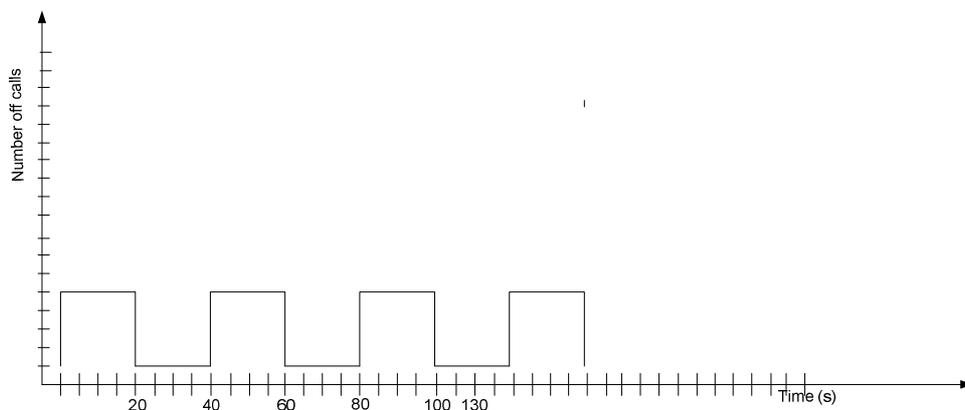


Figure 4: Example of saw tooth call profile

5.3.3 Rolling Blast

Rolling Blast - a defined set of channels go off-hook at once, and the pattern is repeated for all assigned channels.

5.3.4 Ramp

Ramp - gradually increases connected calls to a specified number and then maintains those number of calls.

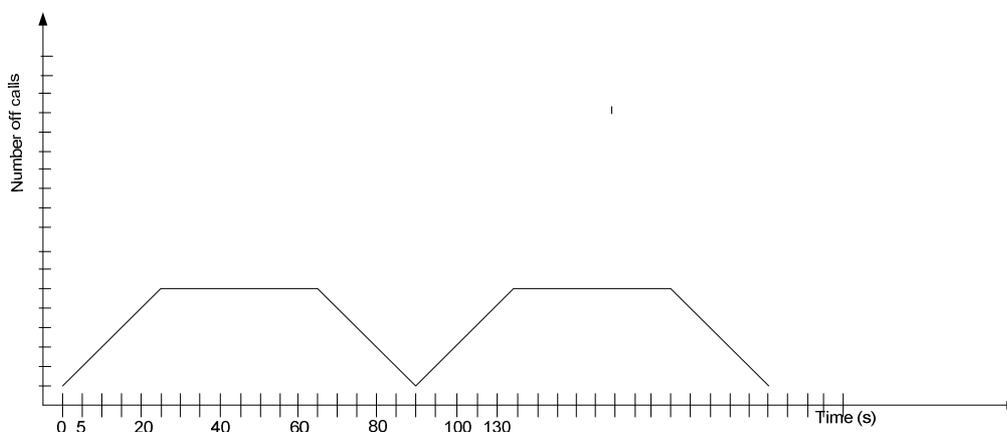


Figure 5

5.3.5 Steady Call Rate

Steady Call Rate - delivers a fixed, regulated call rate into the system under test.

5.3.6 Poisson Distribution

Poisson Distribution - defines call arrival rate by a statistical distribution.

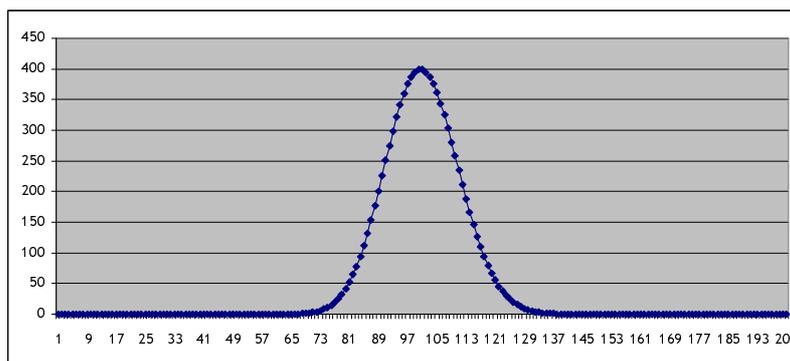


Figure 6

5.4 Load Concepts and Definitions

5.4.1 Processor Load

Processor load is the part of time the processor executes work, normally expressed in percent. The processor load consists of idle load, Traffic load and Usage load. The Idle load is the load that is not dependent on the traffic or other external activities.

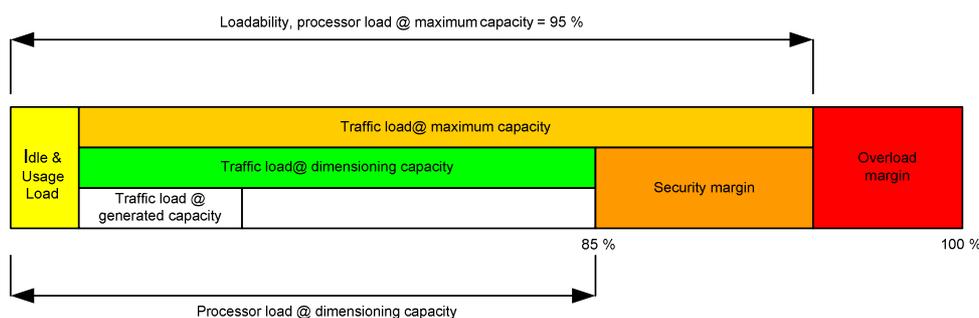


Figure 7: Processor load

The Usage load is the load that is reserved for the administration operations and maintenance activities during busy hour. The Traffic load is the load that results from handling traffic events that are directly related to calls; this load varies with the traffic intensity. The maximum capacity is the maximum processor load that a processor can handle without rejecting new calls. It is usually 95 % of the processor capacity. The Dimensioning factor is the ratio between the Maximum capacity and the Dimensioning capacity. The Dimensioning capacity is usually about 85 % of the processor capacity. The processor load is linear versus generated call intensity.

5.4.2 Reference Call and Workload Factors

To facilitate the calculation of processing capacity and the appropriate load profile the concept WorkLoad Factor (WLF) has been defined based on the reference call for each combination of traffic case and traffic signalling interface. The Reference Call (RC) is defined as a basic ISUP to ISUP call connected through two MGW in the same MGC domain.

Based on the workload factors for all different types of calls, the call intensities and the services used, one can express the total traffic load in an equivalent number of reference calls per second.

The dimensioning of any type of network depends on a number of different parameters such as utilization per channel, calls per second, mean holding time, type of accesses being involved, and type of services being requested.

The workload factor is implementation dependent. Following values for MGW are examples:

- MGW (ISUP) - AGW (ISDN) = 1

- MGW (ISUP) - SIP-I= 1,6
- SIP - SIP Transit= 2,1

For the calls with special features or services, additional WLF must be considered. Example of such services/features are:

- Inter-MGW ISUP calls with a late decision to activate Echo Control Device on the outgoing side.
- Calls where a Continuity Check has been requested.
- Calls needing announcements.
- Calls with IN services using GS devices.
- Calls requesting DTMF reception of dialled digits.
- Calls requesting supplementary services like CLIP, Call diversion and CW.

Depending of the configuration the workload factor for Call Controller, the workload factor for Gateway Controller and the workload factor for Media Gateways must be defined from the manufacturer of the SUT.

The call capacity for a signalling terminal is depending on the signalling protocol (i.e. SIP/SIP-I, H.323, SIGTRAN protocols and DNS/ENUM) and call type for control signalling over IP.

Table 5: Examples of signalling terminal capacities for different Protocols in %

Protocol	Call type	Capacity at 80 % load
SIP-I	Basic	26 % call legs/s
	PRACK	25 % call legs/s
	PRAC & PREC	13 % call legs/s
SIP	Basic	35 % call legs/s
	PRACK	32 % call legs/s
	PRAC & PREC	16 % call legs/s
H.323	Fast connect	43 % call legs/s
	Tunnelling	22 % call legs/s
	Separate H.245	17 % call legs/s
SIGTRAN	M3UA (ISUP)	73 % call legs/s
	IUA/DUA	100 % call legs/s
DNS/ENUM		100 % requests/s

Annex A (informative): Calls flows

This annex defines the calls flows which should be implemented to simulate ISDN - non-ISDN environment.

Figure A.1 presents the call flow for the - PTSN environment calling side.

Figure A.2 presents the call flow for the - PTSN environment called side.

Figure A.3 presents the call flow for the ISDN environment for voice calls calling side - overlap.

Figure A.4 presents the call flow for the ISDN environment for voice calls calling side - enblock.

Figure A.5 presents the call flow for the ISDN environment for voice calls called side.

Figure A.6 presents the call flow for the ISDN environment for data calls calling side.

Figure A.7 presents the call flow for the ISDN environment for data calls called side.

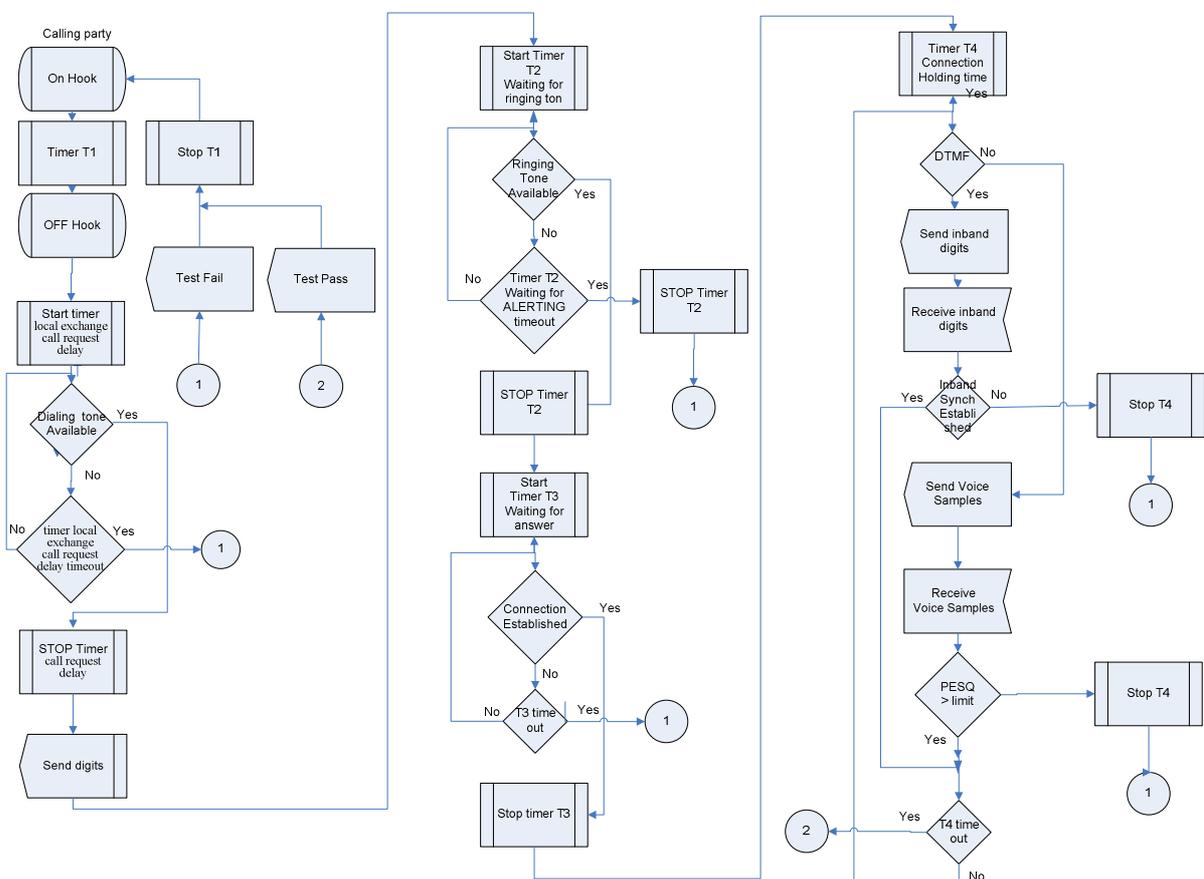


Figure A.1

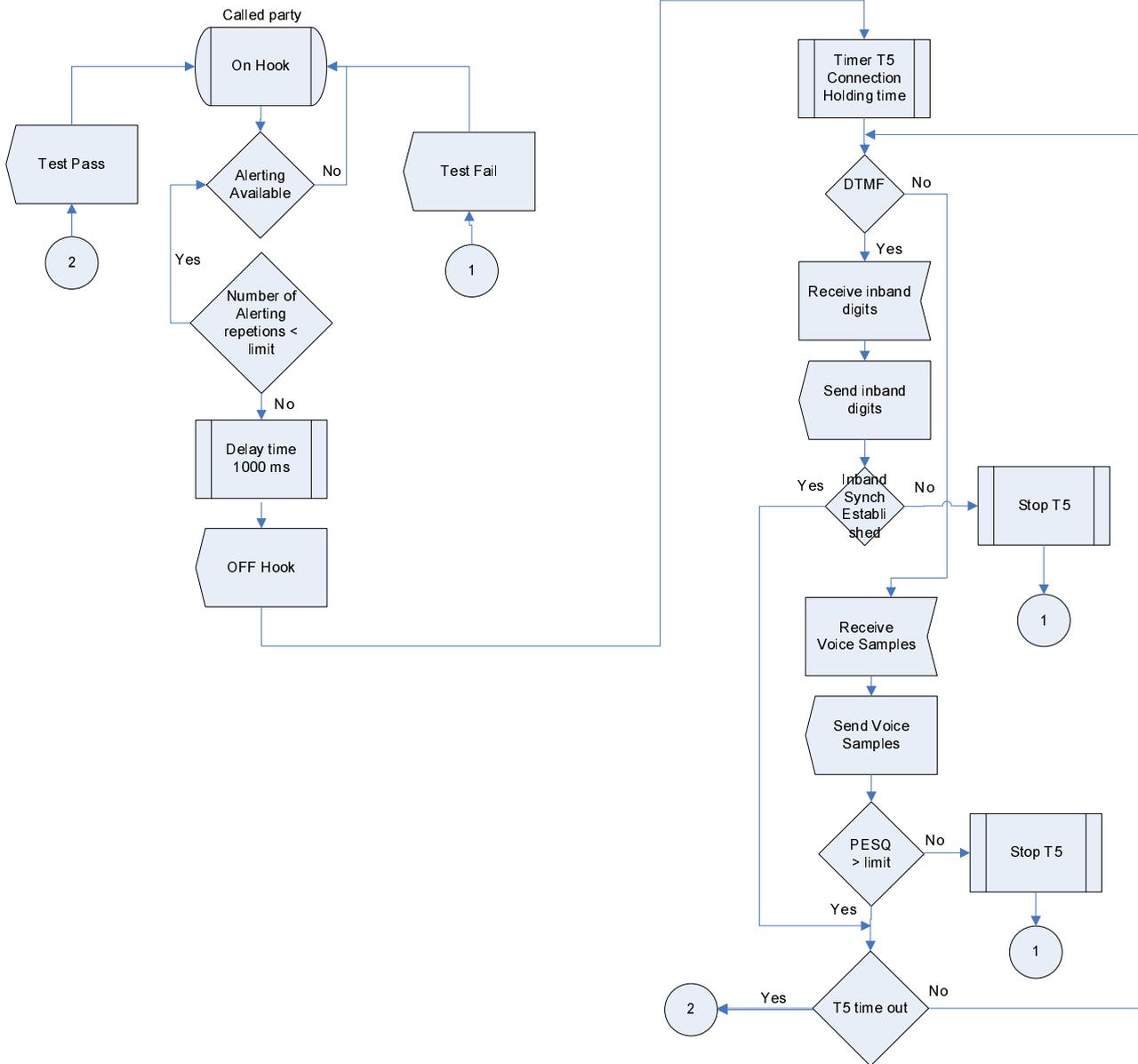


Figure A.2

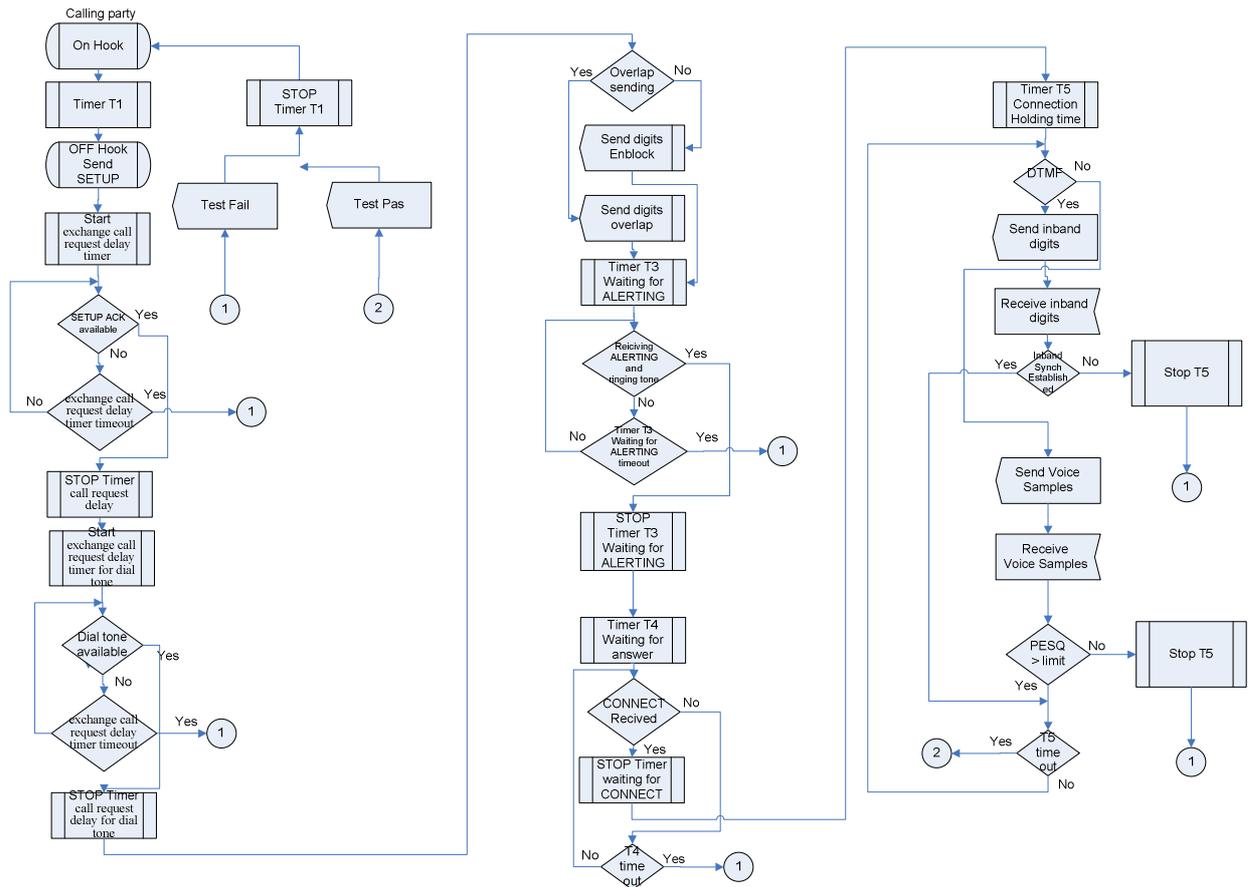


Figure A.3

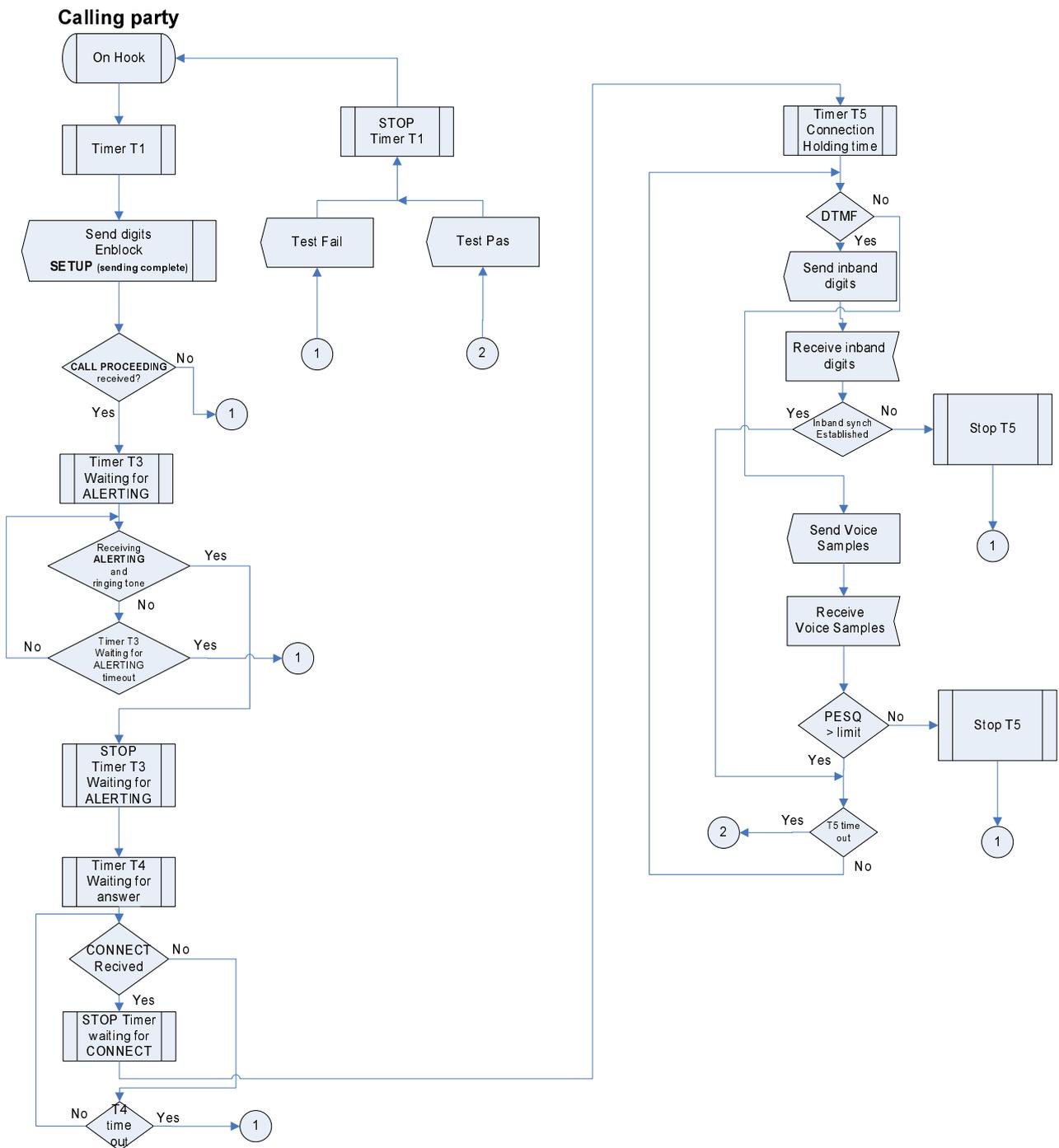


Figure A.4

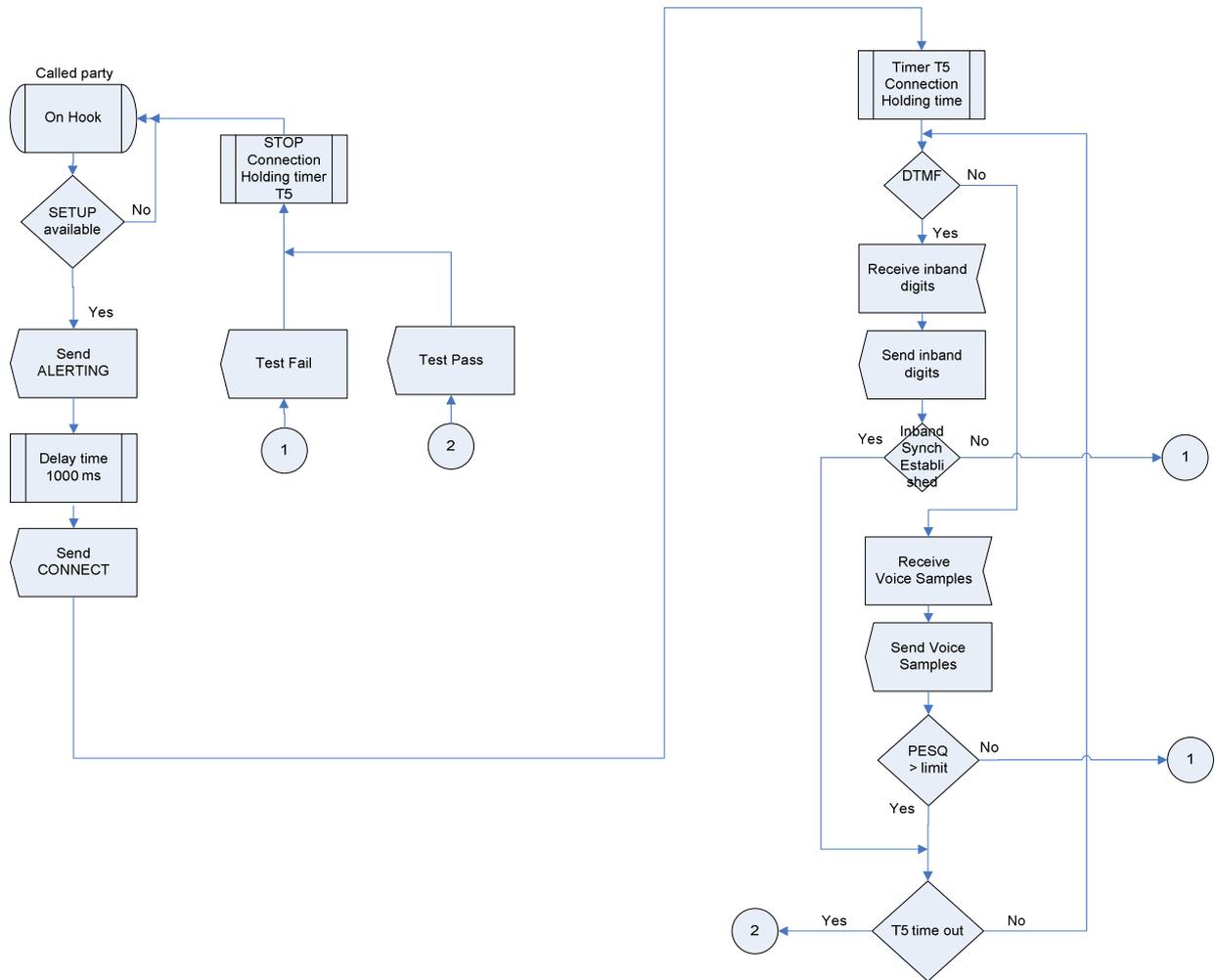


Figure A.5

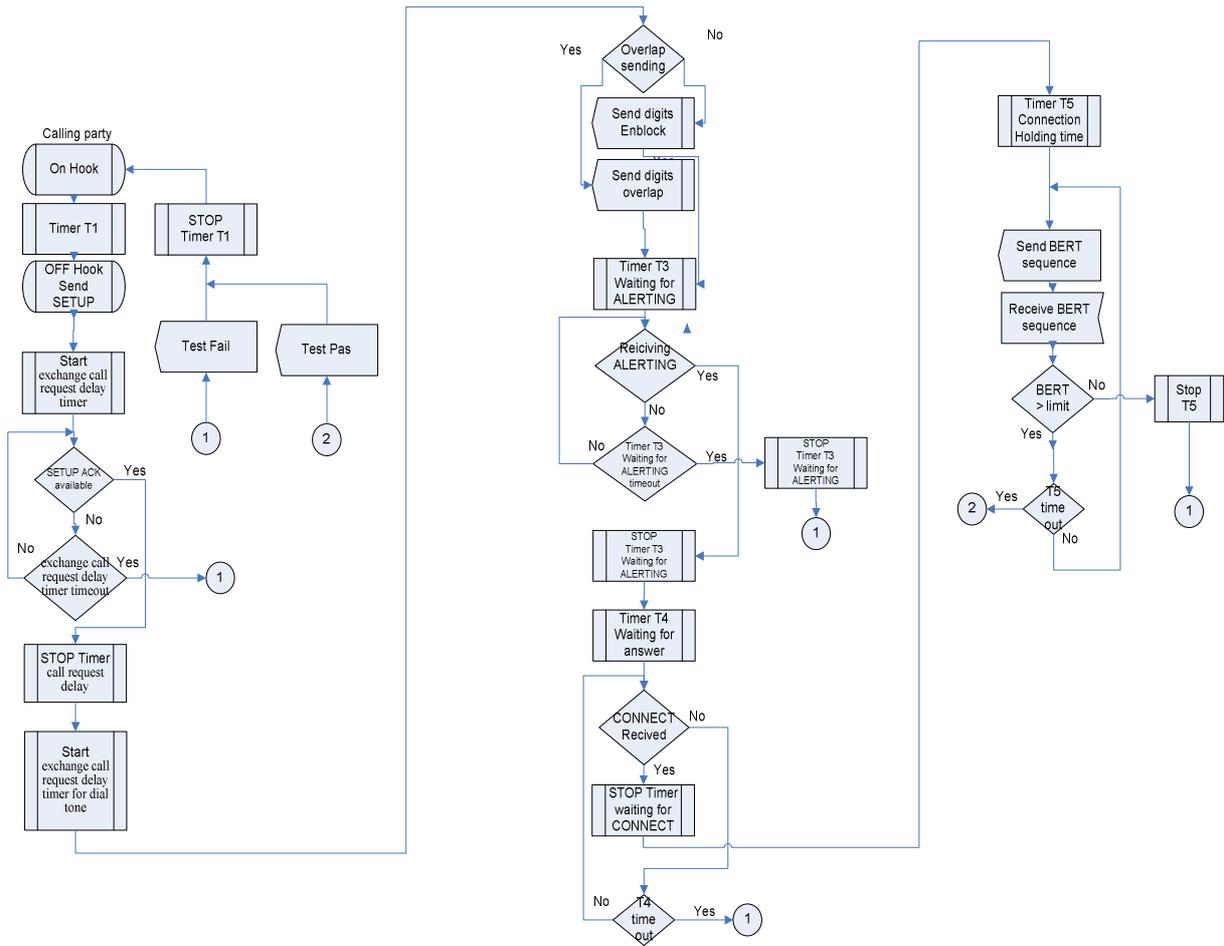


Figure A.6

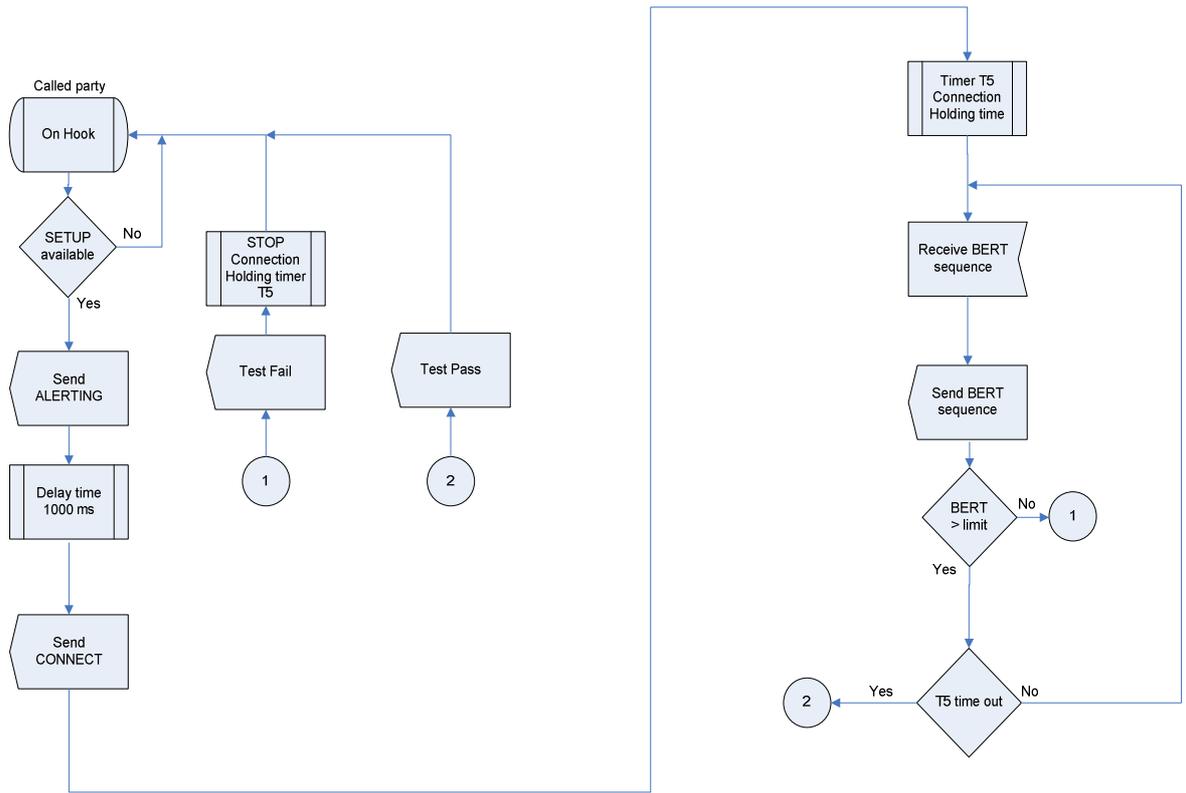


Figure A.7

Annex B (informative): Load profiles examples

This annex defines the load profiles to simulate ISDN - non-ISDN environments.

Figure B.1: the load simulates 2,0 CAPS, call duration 100 s, number of simulated users 200. The number of calls increases each 500 ms. After the call duration of 100 s the calls will be released. The call setup phase is marked orange, the call release phase blue.

Figure B.2: the load simulates 2,66 CAPS, call duration 15 s, number of simulated users 30. The number of calls increases each 500 ms. After a call duration of 15 s the calls will be released. In the time interval of 5 s are tested simultaneous ISDN call setups using five channels. In order to simulate a load of 2,0 CAPS, the increase of number of calls is changed to 1,5 per second.

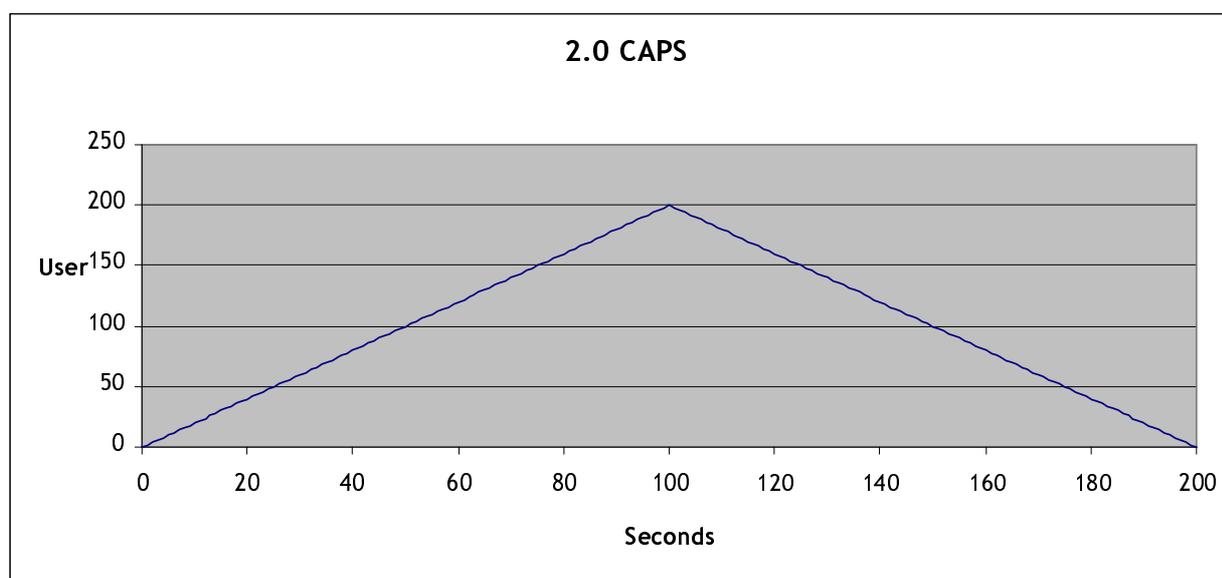


Figure B.1

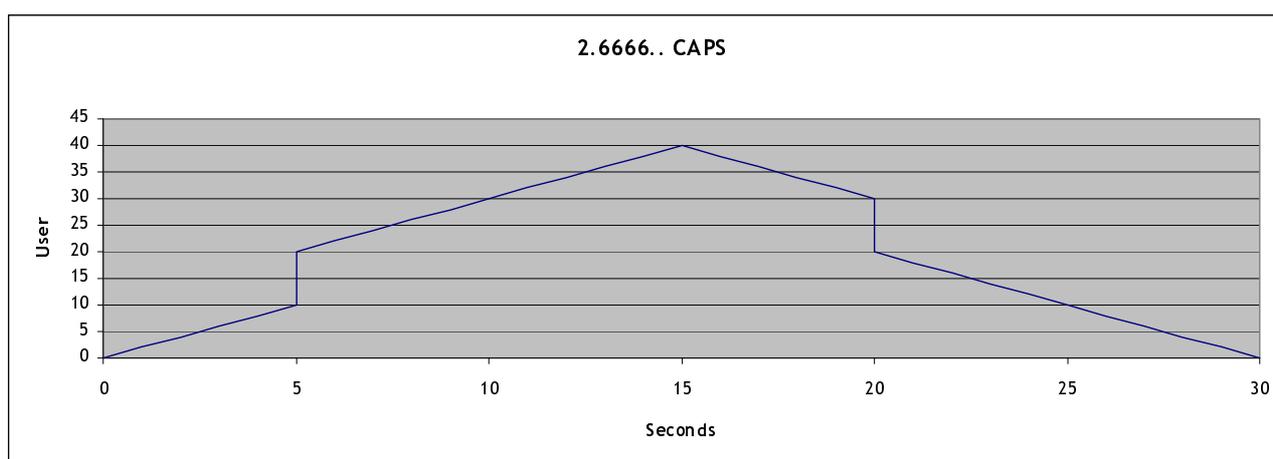


Figure B.2

Annex C (informative): Load traffic calculation

C.1 General

The nominal traffic load values specified for the dimensioning of the exchange are average values in the average week day busy hour. That means that the load values may be higher in the busy hour of an individual day. In order to guarantee the grade of service also under these conditions, a high load reserve of normally 20 % is specified.

That means that the exchange will work normally without entering overload even if the specified traffic load increases 20 %.

C.2 Calculation base on originated/ terminated traffic

The required call processing capacity depends on the number of calls offered to the exchange. The basic formula to calculate the required BHCA is:

$$\text{BHCA} = A \times 3\,600 / t_m$$

A = traffic

t_m = mean holding time

EXAMPLE 1:

- Local exchange with 1 000 analog subscribers
- Originating BHCA
- $A = \text{number of subscribers} \times \text{originating traffic per subscriber} = 1\,000 \times 0,02 = 20 \text{ Erl}$
- $t_m = \text{mean holding time for originating traffic} = 110 \text{ s}$
- $\text{BHCA} = 20 \times 3\,600 / 110 = 654,5 \text{ BHCA}$
- $\text{Load A} = 654,5 + 20 \% = 785,4 \text{ BHCA} = 0,218 \text{ CAPS}$

EXAMPLE 2:

- MSAN with 500 ISDN subscribers (2 lines) and 120 trunks
- Originating BHCA
- $A = \text{number of subscribers} \times \text{originating traffic per ISDN subscriber (2 lines)} = 1\,000 \times 0,11 = 110 \text{ Erl}$
- $t_m = \text{mean holding time for originating traffic} = 110 \text{ s}$
- $\text{BHCA} = 110 \times 3\,600 / 110 = 3\,600 \text{ BHCA}$
- $\text{Load A} = 3\,600 + 20 \% = 4\,320 \text{ BHCA} = 1,2 \text{ CAPS}$

EXAMPLE 3:

- MSAN with 34 ISDN PRA=1 020 Users
- Originating BHCA
- $A = \text{number of subscribers} \times \text{originating traffic per ISDN subscriber} = 1\,020 \times 0,7 = 714 \text{ Erl}$
- $t_m = \text{mean holding time for originating traffic} = 440 \text{ s}$

- BHCA = $714 \times 3\,600 / 440 = 5\,841,8$ BHCA
- Load A = $5\,841,8 + 20\% = 7\,010,1$ BHCA = 1,9 CAPS

C.3 ITU-T load definitions

C.3.1 Reference loads

Reference load A is intended to represent the normal upper mean level of activity which Administrations would wish to provide for on customer lines and inter-exchange activities. Reference load B is intended to represent an increased level beyond normal planned activity levels.

C.3.1.1 Reference load on incoming interexchange circuits

a) Reference load A:

- 0,7 erlangs average occupancy on all incoming circuits

$$\text{Call attempts/h} = \frac{0.7 \times \text{number of incoming circuits}}{\text{Average holding time in hours}}$$

NOTE: Ineffective call attempts should be included in reference call attempts.

b) Reference load B:

- 0,8 erlangs average occupancy on all incoming circuits with 1,2 times the call attempts/h for reference load A.

C.3.1.2 Reference load on subscriber lines (originating traffic)

Characteristics of traffic offered to local exchanges vary widely depending upon factors such as the proportions of residence and business lines that are served. Table C.1 provides reference load characteristics for lines typical of four possible local exchange applications. Also provided are representative ISDN cases which are discussed below. Administrations may elect to use other models and/or loads that are more suitable for their intended application.

In the following text, ISDN lines will be referred to as digital lines and non-ISDN lines as analogue lines.

Reference load A

Table C.1: Subscriber line traffic model - Non-ISDN subscriber lines with or without supplementary services

Exchange type	Average traffic intensity	Average BHCA
W	0,03 E	1,2
X	0,06 E	2,4
Y	0,10 E	4
Z	0,17 E	6,8

Table C.2: Subscriber line traffic model - ISDN digital subscriber access 2B + D

Line type	Average traffic intensity per B channel	Average BHCA per B channel	Average packets per second per D channel
Y'	0,05 E	2	0,05 (signalling), Data packets (see note)
Y''	0,10 E	4	0,1 (signalling), Data packets (see note)
Y'''	0,55 E	2	0,05 (signalling), Data packets (see note)

BHCA Busy hour call attempts.
NOTE: Data packet rates are for further study. These include teleaction and packet services data.

C.4 High load reserve

For a high load reserve of 20 %: **load B = 1,20 × load A.**

The BHCA values (load A) specified for the exchange models consider a high load reserve of 20 %.

If a high load reserve of e.g. 30 % is specified by the customer, the corresponding load A values can be calculated as follows:

- $\text{load A (30 \%)} = \text{load B} / 1,30 = 1,20 \times \text{load A (20 \%)} / 1,30$

Load B is in fact the fixed limit (maximum value) of the call processing capacity. Load A values are calculated from the load B values.

C.5 Overload

If more call attempts are offered to the Coordination Processor than the available call processing capacity under load B conditions (required BHCA > available BHCA-load B), overload control procedures will be activated, i.e. some call attempts will be rejected by the exchange.

Annex D (informative): Test reports

This annex defines a set of reports which enables the quality analysis of the system under test

Following test reports should be possible:

- Error detail report
- Error channel report
- Error summary report
- Error summary by channel
- Call detail
- Call detail channel
- Call summary
- Voice Quality Detail
- Voice Quality Channel detail
- Voice Quality Summary

D.1 Example of a Call Detail report

CALL DETAIL REPORT

Test Name: Basic Call

Start Time:

Stop Time:

Date	Time	Call ID	Server	Chan	Status	Called Number	Len	Lat ms	T1	T2	T3	T4

AVERAGE									
Date	Time	Calls Successful	Calls Failed :	Call Length	Latency ms	T1	T2	T3	T4

D.2 Example of a call summary report

CALL SUMMARY REPORT

Test Name: Basic Call

Start Time:

Stop Time:

Server	Channel	Attempts	Successful	Failure	Call Length (s)	Connect Latency (ms)

D.3 Example of a voice summary report

Test Name: VQ TEST

Start Time:

Stop Time:

SPEECH LATENCY REPORT

Server	Channel	Number of Tests	Average Speech Latency

Total Number of Tests:

Total Average Speech Latency:

DTMF REPORT

Server	Channel	Number of Failures

Total Number of Tests:

PESQ REPORT

Server	Channel	Number of Tests	Average PESQ Score	Average Offset
Total Averages:				

D.4 Example of a voice quality detail report

Test Name: VQ TEST

Packetsphere Test:

Start Time:

Stop Time:

SPEECH LATENCY REPORT

TimeStamp	Call ID	Server	Channel	Speech Lat

Number of Speech Latency Tests:

Average: (ms)

Minimum: (ms)

Maximum: (ms)

DTMF REPORT

TimeStamp	Call ID	Server	Channel	Expected Digits	Recieved Digits

Number of DTMF Test Failures:

PESQ REPORT

TimeStamp	Call ID	Server	Channel	PESQ Value	Offset time	Prompt Name

	Value	Offset time
Total Average:		
Minimum		
Maximum		

Number of PESQ Tests:

PESQ Score Above Threshold:

Annex E (informative): Bibliography

ETSI TR 121 905: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Vocabulary for 3GPP Specifications (3GPP TR 21.905 version 7.0.0 Release 7)".

ETSI TS 123 228: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); IP Multimedia Subsystem (IMS); Stage 2 (3GPP TS 23.228 Release 6)".

ETSI TS 124 247: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Messaging service using the IP Multimedia (IM) Core Network (CN) subsystem; Stage 3 (3GPP TS 24.247)".

ETSI ES 282 002 (V1.1.1): "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); PSTN/ISDN Emulation Sub-system (PES); Functional architecture".

History

Document history		
V2.1.1	January 2011	Publication