



Presentation title : IMS/PES Platform Performance Benchmark

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Workshop

**IMPLEMENTATION EXPERIENCE OF NETWORK PERFORMANCE PARAMETERS CONTROL
SYSTEMS AND GRANTING REQUIRED LEVEL OF SERVICES QUALITY ON THE OPERATOR
NETWORKS. SENSOR NETWORKS – AS OPTIMIZATION TOOL FOR VEHICULAR TRAFFIC FLOW**

Moscow

27-29 April 2011

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Workshop

IMPLEMENTATION EXPERIENCE OF NETWORK PERFORMANCE PARAMETERS CONTROL SYSTEMS AND GRANTING REQUIRED LEVEL OF SERVICES
QUALITY ON THE OPERATOR NETWORKS. SENSOR NETWORKS – AS OPTIMIZATION TOOL FOR VEHICULAR TRAFFIC FLOW



Why is IMS Benchmarking needed?

- Goal - performance benchmark for PSTN/ISDN Emulation Sub-system (PES) components
 - Performance and scalability testing of all PSTN/ISDN Emulation Sub-system (PES) and related components with simulated real-world traffic
 - Measurement and analysis of important QoS parameters
 - Regression Tests with applications after Release Change
- Why
 - Creation of objective means to compare overall PSTN/ISDN Emulation Sub-system (PES) of different systems by performance (and price)
 - Check ability of hardware/software to run the PSTN/ISDN Emulation Sub-system (PES)
- How
 - Define standard scenarios and traffic models for the work load
 - Define the metrics to be measured
 - Standardize the test procedure, the test parameters and the Benchmark test report
- Where
 - Standardization of IMS benchmarking at ETSI TISPAN WG6; ETSI TC INT
 - Version 2.0 of PSTN/ISDN Emulation Sub-system (PES) benchmarking available

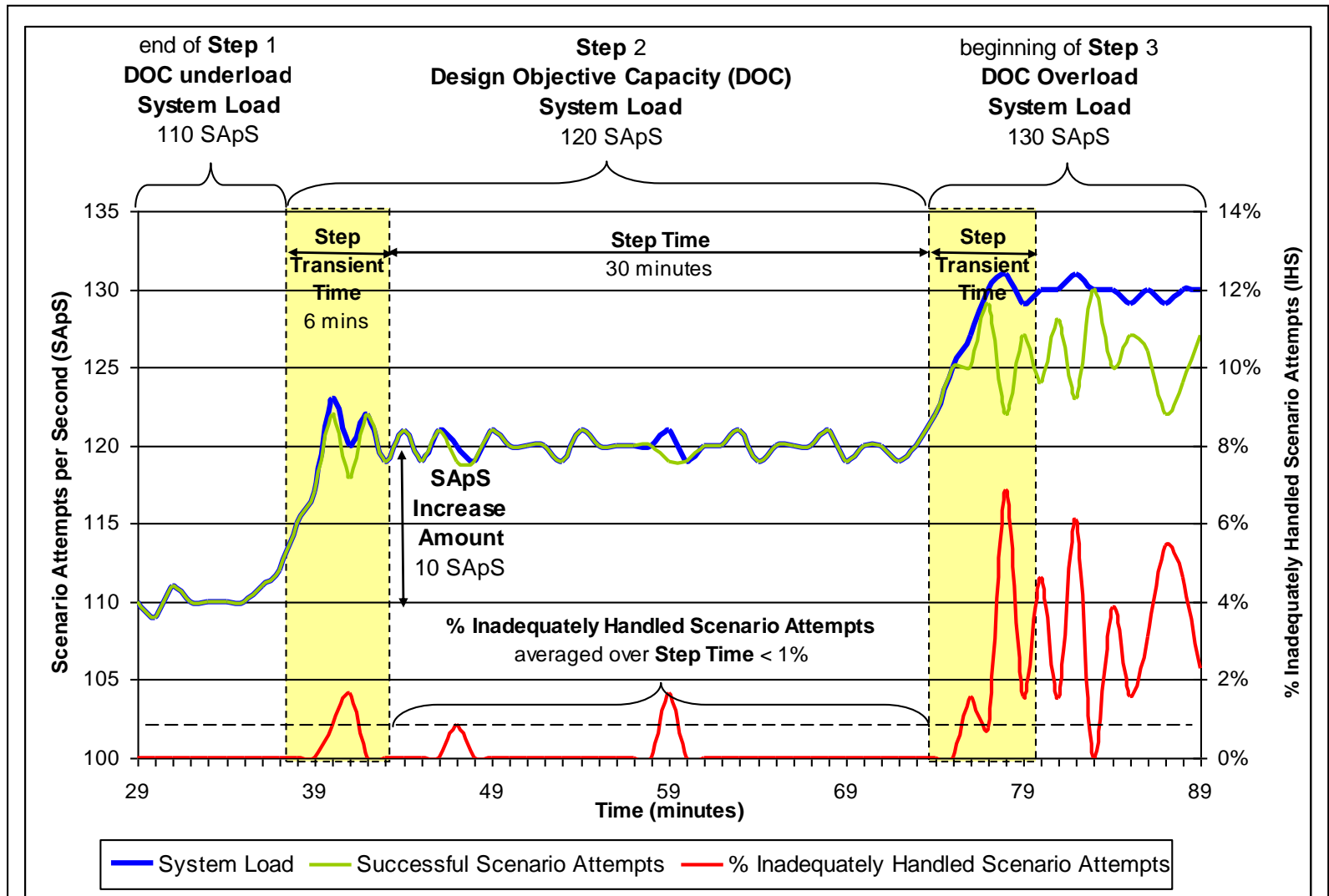
History

- **June 2005** - FOKUS and INTEL demonstrated a proof of concept for IMS Benchmark at VON
- **March 2007** - IMS Benchmark published as TS 186008: parts 1-3
- **January 2011** - PSTN/ISDN Emulation Sub-system (PES) published as TS 186025: parts 1-2

Standard Specification Parts

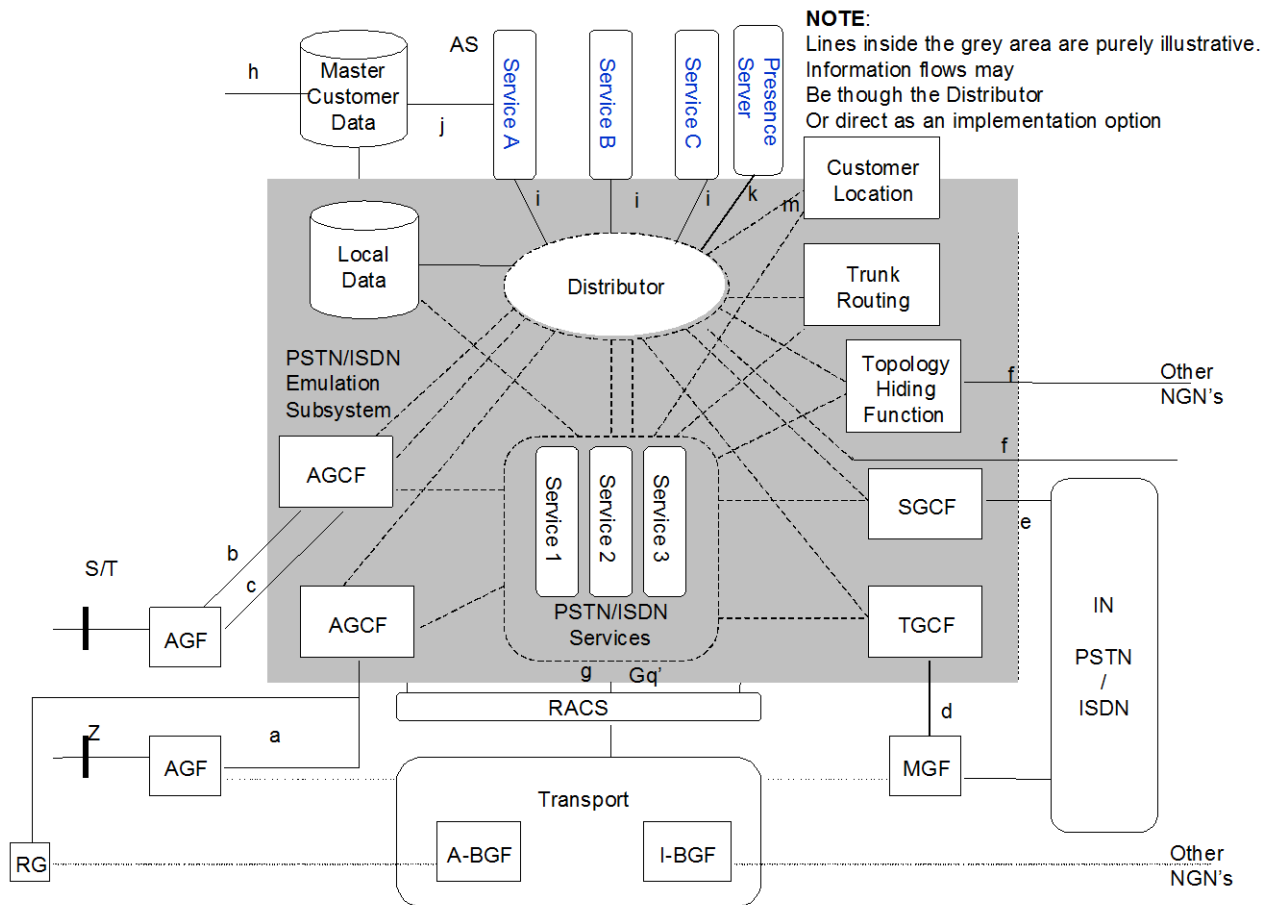
- Specification Parts
 1. Core Concepts: Benchmark descriptions, architectures, processes, and information models
TS 186 025-1 V.2.1.1
 2. Subsystem Configurations and Benchmarks: The document contains the specific benchmarking use-cases and scenarios, along with scenario specific metrics and design objectives.
TS 186 025-2 V.2.2.1
 3. Traffic Sets and Traffic Profiles: defines an initial benchmark test through the specification of a traffic set, traffic-time profile and benchmark test procedure.
 4. Reference Load network quality parameters : defines Reference Load network quality parameters for the use cases.
TS 186 025-4 Available Juli 2011

Motivating Example

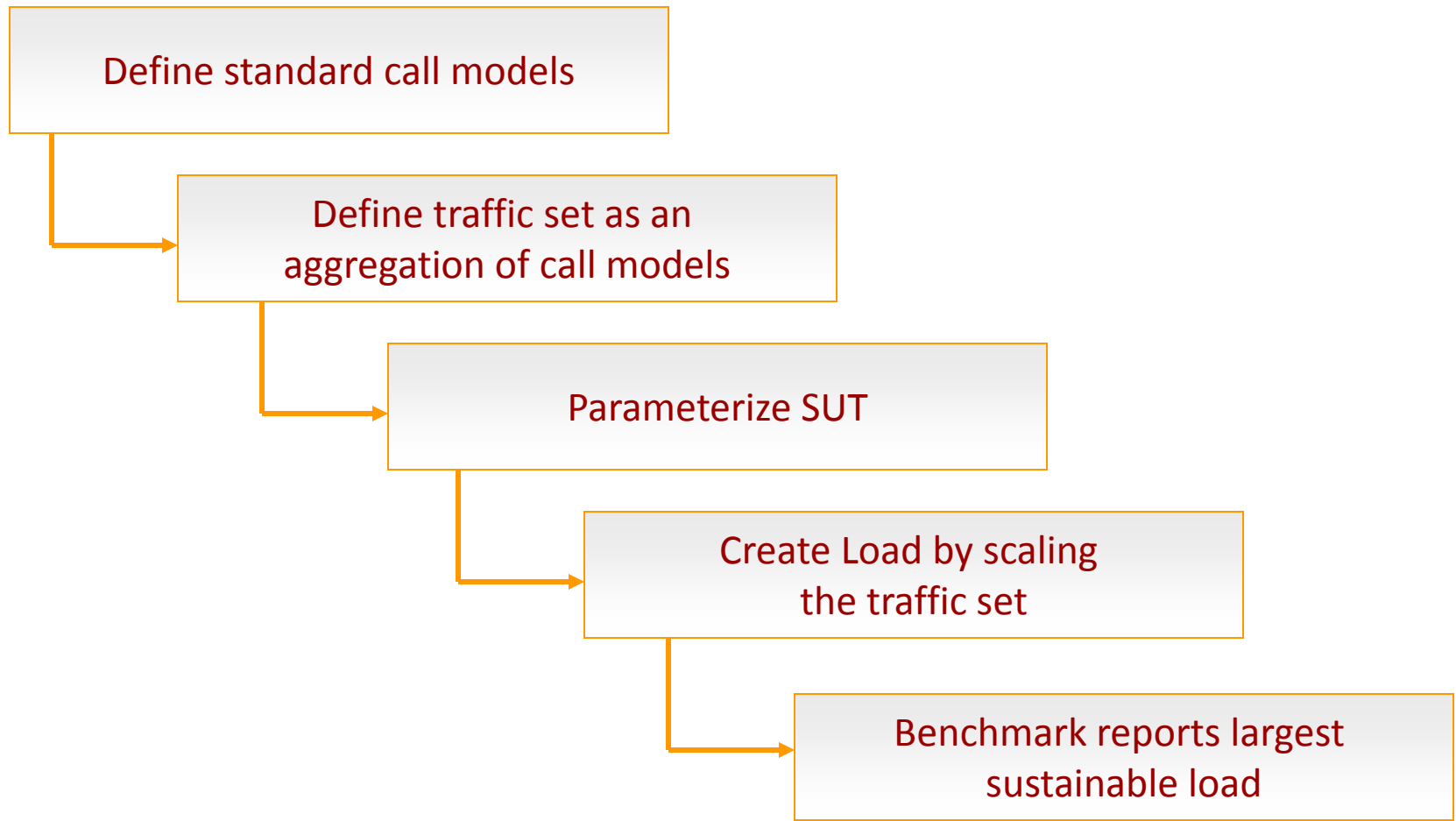


Scope of the IMS/PES Performance Benchmark

Part 1, Section 5

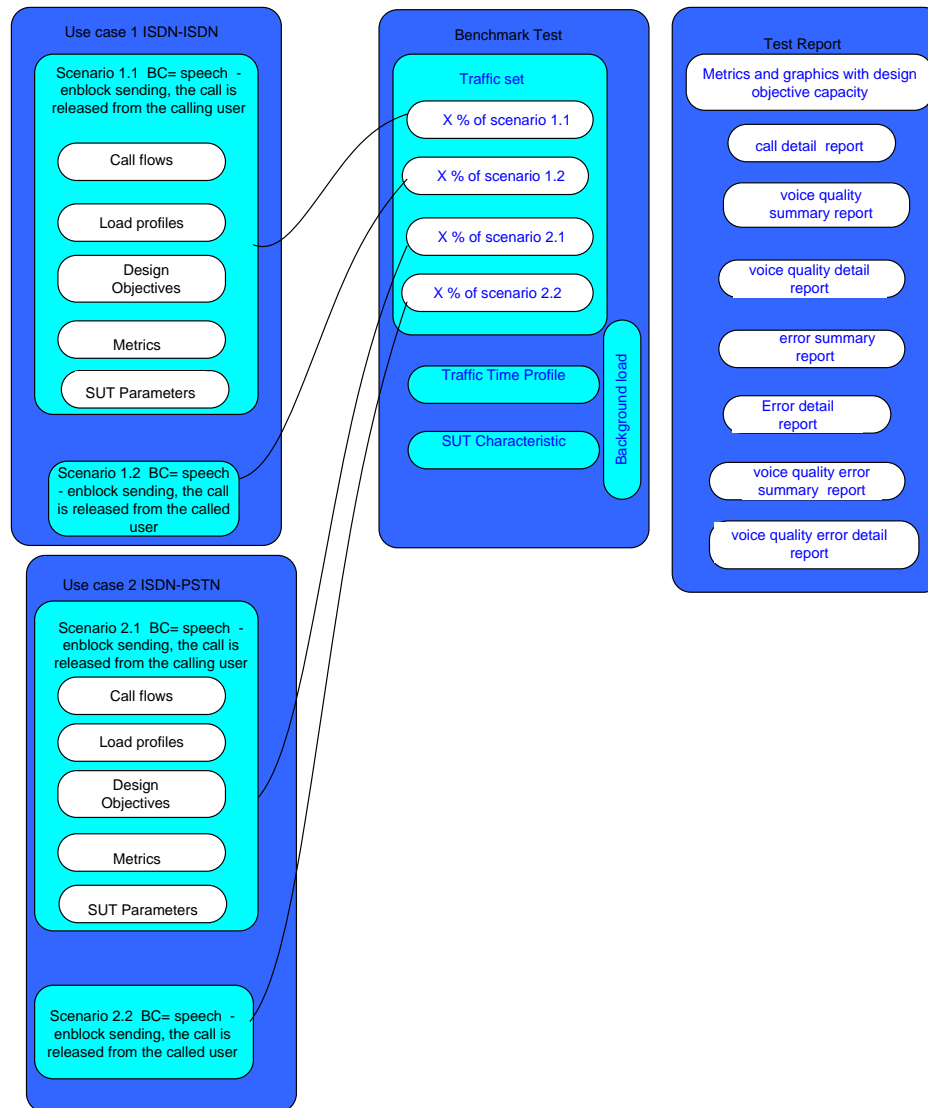


Benchmark Development Process



Benchmark Information Model

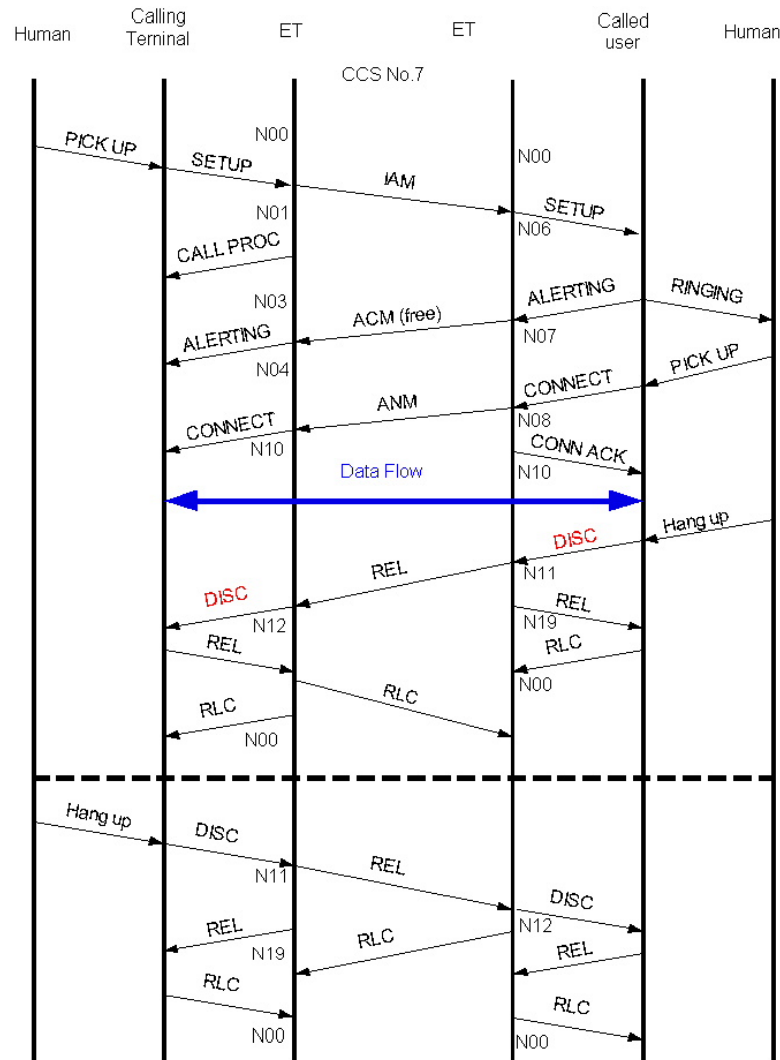
Part 1, Section 4



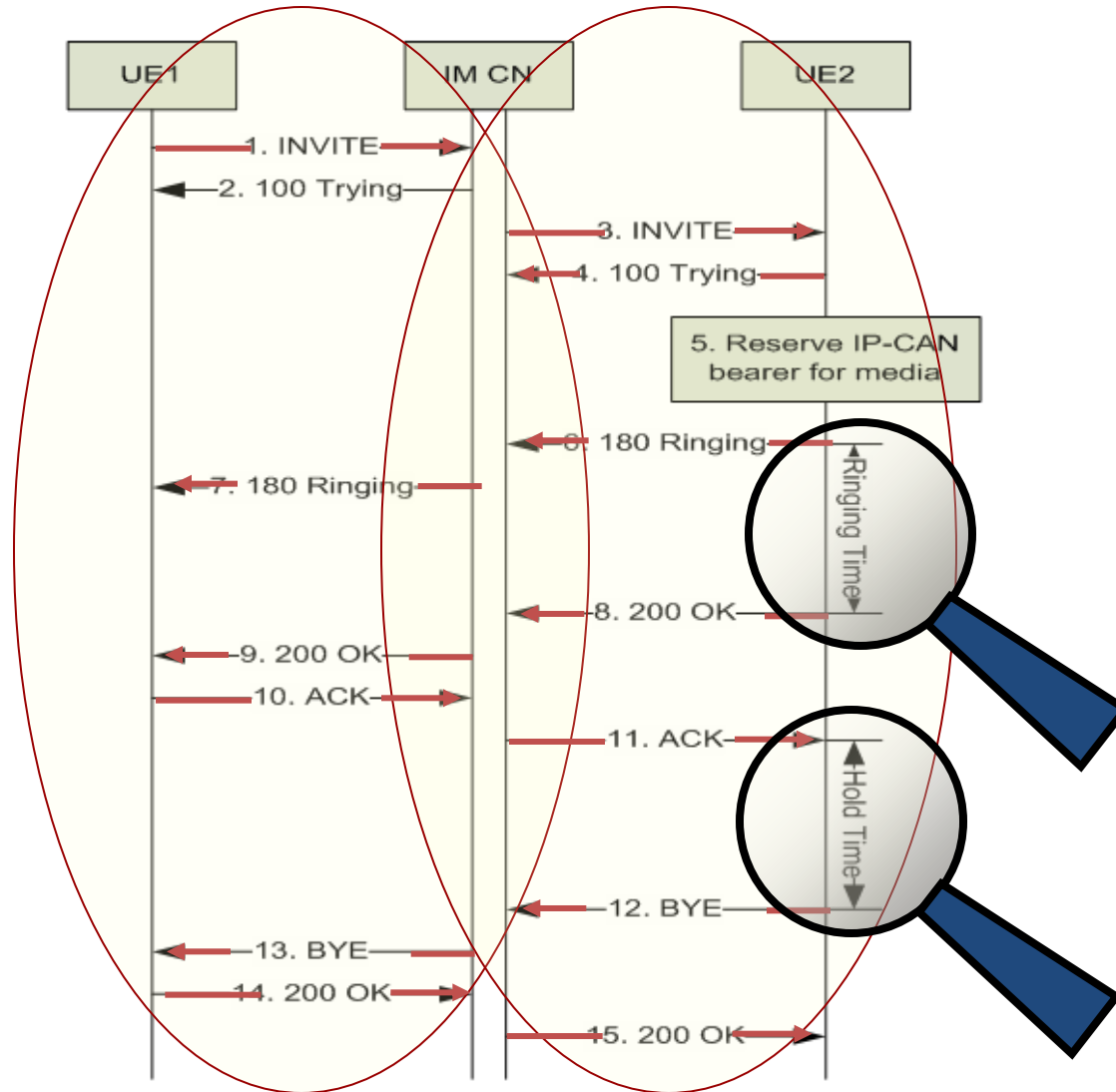
Use-case

- The top level of the individual behavioural model is the use-case. A use-case describes the goal that a user has in interacting with a system, the various actors (e.g. other users, network elements) that participate in the use-case, the basic course of events that are carried out by the user and the SUT, the design objective of the use-case, the possible outcomes that apply to the use-case, and the metrics to be collected.

Scenario Example: ISDN Call



Scenario Example: IMS Call



Call Scenarios (1)

Successful Call

- ❖ ISDN - ISDN Scenario 1.1 Basic call with BC= speech - enblock sending; The call is released from the calling user
- ❖ ISDN - ISDN Scenario 1.2 Basic call with BC= speech - enblock sending; The call is released from the called user
- ❖ ISDN - ISDN Scenario 1.3 Basic call - overlap sending with BC= speech ;: The call is released from the calling user
- ❖ ISDN - ISDN Scenario 1.4 Basic call with BC= 3,1 KHz audio - Fax with 33,6 kbit/s ; The call is released from the calling user
- ❖ ISDN - ISDN Scenario 1.5 Basic call with BC= 3,1 KHz audio - Fax with 14,4 kbit/s; The call is released from the calling user
- ❖ ISDN - ISDN Scenario 1.6 Basic call with BC= 3,1 kHz with PI#3 The call is released from the calling user
- ❖ ISDN - ISDN Scenario 1.7 Basic call with BC= 3,1 kHz with PI#3The call is released from the called user
- ❖ 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); The call is released from the calling user
- ❖ ISDN - ISDN Scenario 1.9 Basic call with BC= 3,1 kHz - Modem V.34 (up to 33,6 kbit/s) The call is released from the calling user
- ❖ ISDN - ISDN Scenario 1.10 Basic call with BC= UDI - enblock sending
- ❖ ISDN - ISDN Scenario 1.11 Basic call with BC= UDI - enblock sending .The call is released from the calling user

Failed Call

- ❖ ISDN - ISDN Scenario 1.12 - called user is user determined user busy
- ❖ ISDN - ISDN Scenario 1.13 - no answer from the called user
- ❖ ISDN - PSTN Scenario 2.8 - called user is user determined user busy
- ❖ ISDN - PSTN Scenario 2.9- no answer from the called user
- ❖ PSTN - ISDN Scenario 3.6 - called user is user determined user busy
- ❖ PSTN - ISDN Scenario 3.7 - no answer from the called user
- ❖ PSTN - PSTN Scenario 4.7 - called user is user busy
- ❖ PSTN - PSTN Scenario 4.8 - no answer from the called user

Call Scenarios (2)

Successful Call

- ❖ ISDN - PSTN Scenario 2.1 Basic call with BC= speech - enblock sending. The call is released from the called user
- ❖ ISDN - PSTN Scenario 2.2 Basic call with BC= speech - enblock sending . The call is released from the calling user. The call is released from the called user
- ❖ ISDN - PSTN Scenario 2.3 Basic call - overlap sending with BC= speech ; The call is released from the calling user
- ❖ ISDN - PSTN Scenario 2.4 Basic call with BC= 3,1 KHz audio - Fax with 33,6 kbit/s; The call is released from the calling user
- ❖ ISDN - PSTN Scenario 2.5 Basic call with BC= 3,1 KHz audio - Fax with 14,4 kbit/s; The call is released from the calling user
- ❖ 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); The call is released from the calling user
- ❖ ISDN - PSTN Scenario 2.7 Basic call with BC= 3,1 kHz - Modem V.34 (up to 33,6 kbit/s); The call is released from the calling user
- ❖ PSTN - ISDN Scenario 3.1 Basic call. The call is released from the calling user
- ❖ PSTN - ISDN Scenario 3.2 Basic call The call is released from the called user
- ❖ PSTN - ISDN Scenario 3.3 Basic call with BC= 3,1 KHz audio - Fax with 33,6 kbit/s
- ❖ PSTN - ISDN Scenario 3.4 Basic call with BC= 3,1 KHz audio - Fax with 14,4 kbit/s
- ❖ PSTN - ISDN Scenario 3.5 Basic call with BC= 3,1 KHz audio - Modem V.90
- ❖ PSTN - PSTN Scenario 4.1 Basic call. The call is released from the calling user

❖ Successful Call

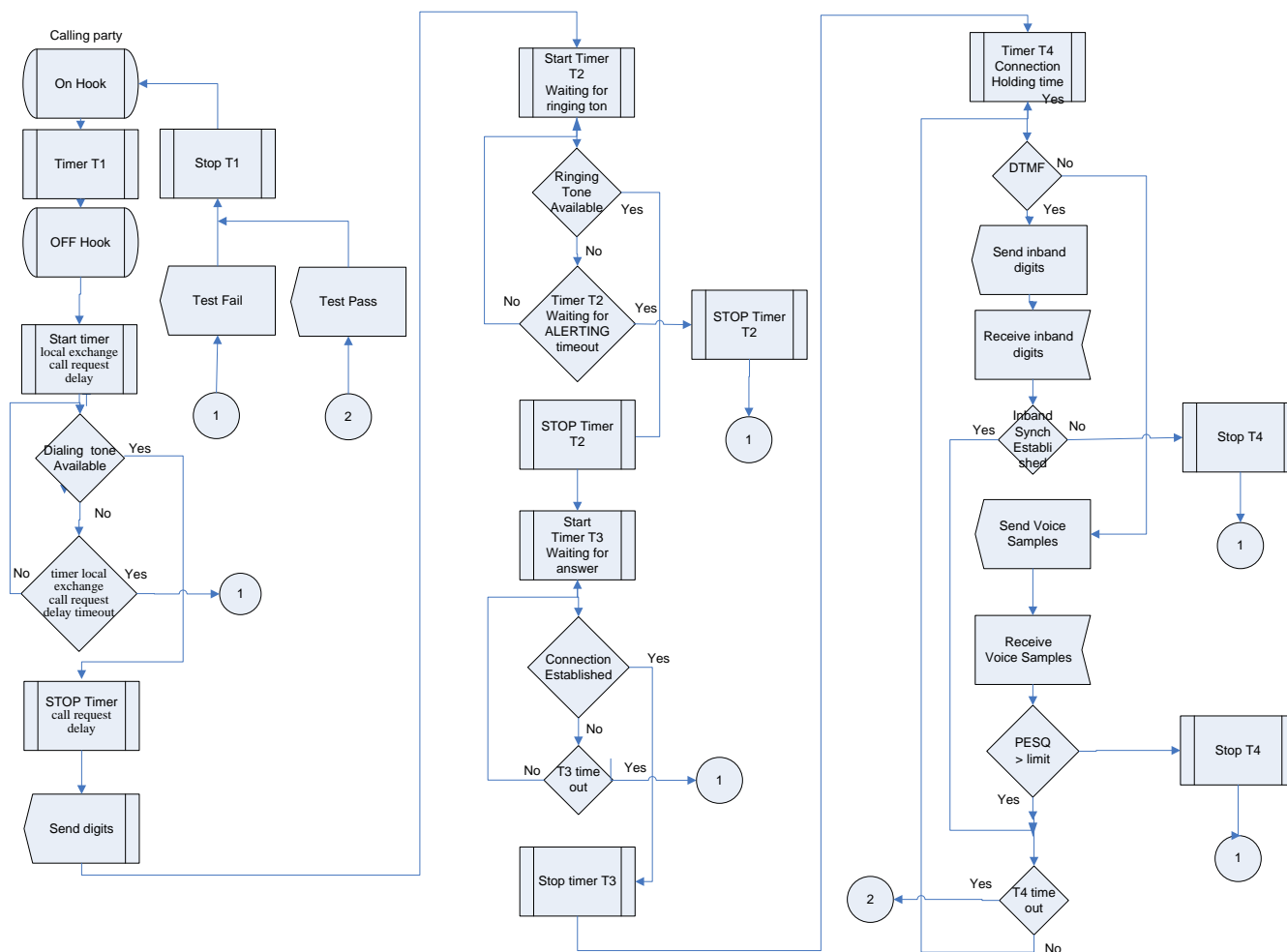
- ❖ PSTN - PSTN Scenario 4.2 Basic call The call is released from the called user.
- ❖ PSTN - PSTN Scenario 4.3 Basic call with Fax with 33,6 kBit/s (Super G3 Fax)
- ❖ PSTN - PSTN Scenario 4.4 Basic call with Fax with 14,4 kBit/s
- ❖ PSTN - PSTN Scenario 4.5 Basic call with BC= 3,1 KHz audio - Modem V.34 (up to 33,6 kbit/s)
- ❖ 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)

Call Flow

- The call flows defines the characteristic message flows, the tones and announcement for a specific interface

Call flow example

PTSN environment calling side



Load profile (1)

- To facilitate the calculation of processing capacity and the appropriate load profile the concept workload factor has been defined based on the reference call for each combination of traffic case and traffic signaling interface. The reference call (RC) is defined as a basic ISUP to ISUP call connected through two MGW in the same 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.

Load profile (2)

- 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

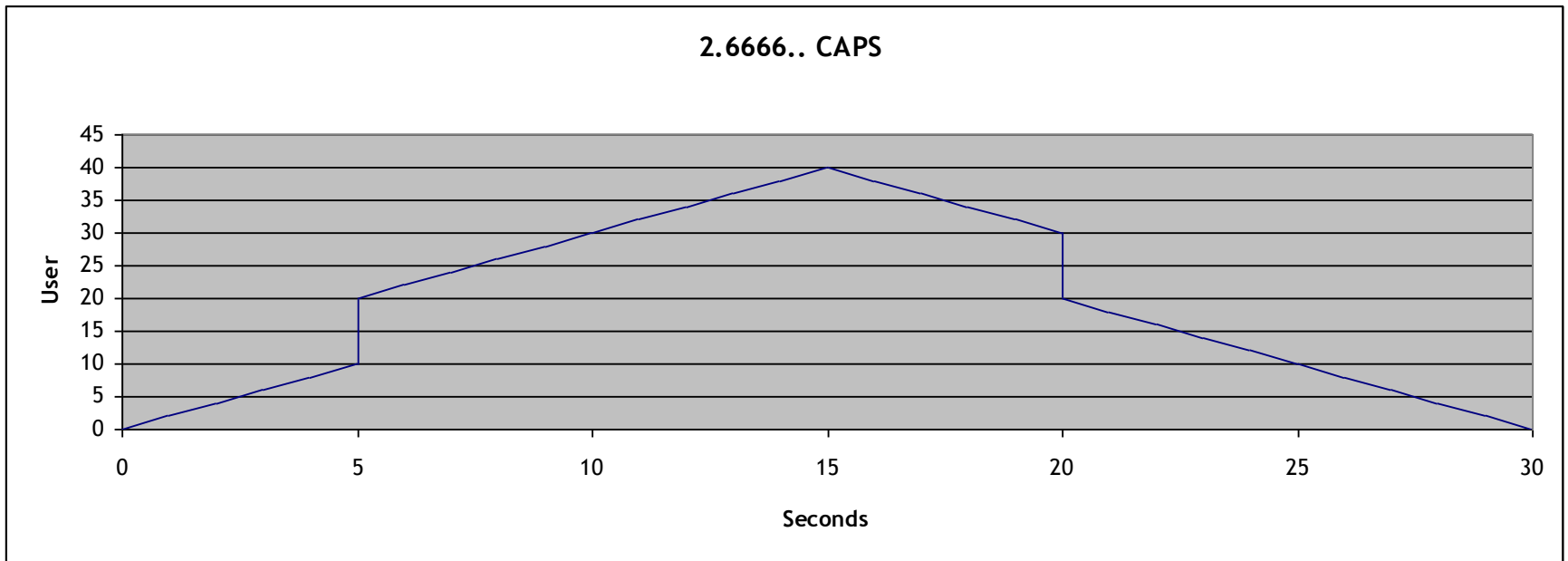
Examples of signalling terminal capacities for different Protocols in %

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

Load profiles examples (1)

- 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.

Load profiles example (2)



Metrics

- The metrics of a use-case describe the measurements collected from the execution of a scenario attempt. Typical metrics include response times and message rates. If a scenario is selected for execution in a benchmark test, its metrics are collected.

Metrics and design objectives

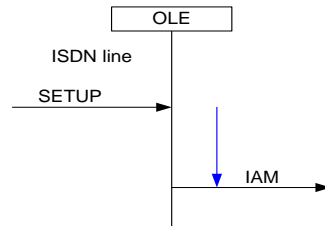
Delay probability (1)

Meaning of timers	Parameter 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 enblock signalling	<p>§ 2.4.3.1 [2] 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</p>	<p>ISDN [3] 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 or terminating Gm interface</p> <p>or</p> <p>Call set-up delay 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 Note: if SC (#) is not included the setup delay may increase up to the digit collection timer (15 s)</p> <p>IMS [4] 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</p>	≤ 600 ms	800 ms	≤ 800 ms	≤ 1200 ms

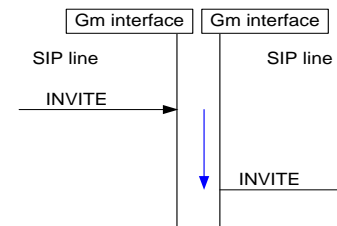
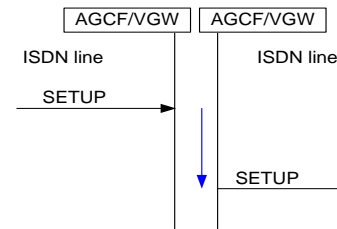
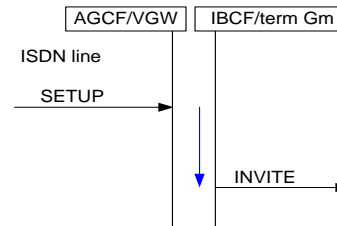
Metrics and design objectives

Delay probability (2)

Q.543



IMS



Design Objective (DO)

- The Design Objective (DO) describes the acceptable rate of inadequately handled scenario attempts for a use-case. When a benchmark test is executed, scenarios from various use-cases are selected and executed, thereby becoming "scenario attempts".
- If the frequency of inadequately handled scenario attempts (IHSAs) exceeds the design objective, then the Design Objective Capacity (DOC) has been exceeded.

SUT configuration and parameters

- This element describes the exact inventory of hardware and software of which the SUT is constructed, a complete description of its configuration and parameter settings as well as characteristics of the interfaces that connect to the test system (like interface bandwidth and latency, interface security characteristics).

Benchmark test

- A benchmark by definition measures the behaviour of a population of users. To accomplish this, the behaviours of individual users must be aggregated into input traffic to the SUT. The input traffic must be realistic, in the sense that a population of users would perform such actions in the real world, and in the sense that statistical variation in user behaviour is similar to statistical variation that would occur in the real world.

Traffic set

- The traffic set is a collection of scenarios which are determined to be likely to co-occur in a real-world scenario. The scenarios need not come from the same use-case. Within a traffic set, each scenario has an associated relative occurrence frequency, interpreted as the probability with which it would occur in the course of the test procedure.

Traffic Set Example

- Traffic mixture: a combination of percentages of all scenarios

Use Case Section	Test Scenario	Scenario % of System Load	Scenario Arrival Distribution	Scenario Duration Distribution
ISDN – ISDN Use case 1	Scenario1.1	20 %	Poisson	Mean = 110 sec
	Scenario 1.2	20 %	Poisson	Mean = 110 sec
ISDN- PSTN Use case 2	Scenario 2.1	15 %	Poisson	Mean = 90 sec
	Scenario 2.2	15 %	Poisson	Mean = 90 sec
PSTN – ISDN Use case 3	Scenario 3.1	15%	Poisson	Mean = 90 sec
	Scenario 3.2	15 %	Poisson	Mean = 90 sec

Benchmark report

- A test report is a document, with accompanying data files, that provides a full description of an execution of a benchmark test on a test system. The SUT and test system, as well as their parameters, are described in sufficient detail that an independent test site can replicate the test. The results of the test include data, represented as charts and data sets, depicting the behaviour of the SUT over the elapsed time of the test; of other observations and exceptions noted during the test.

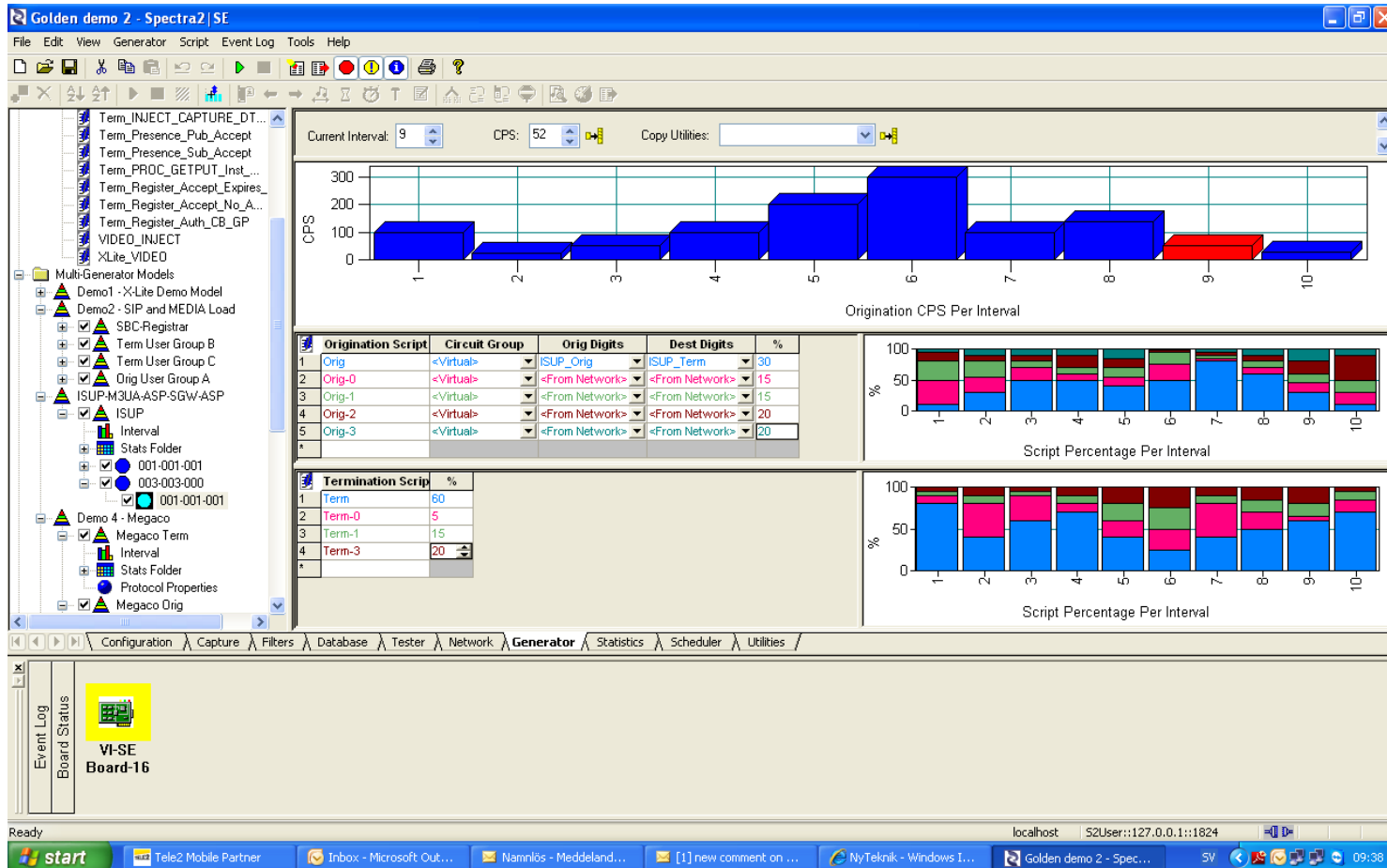
Example of a call detail report

- **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

Benchmark Information Model in the reality



Call flow example in the reality

The screenshot displays a call flow design tool interface. The main workspace shows a call flow diagram with tracks labeled [0] through [7]. The tracks contain various call flow parts such as DELAY, RPTST, PAR, RPTST, SEQ, DELAY, MC, and AC. The parts are color-coded: red for DELAY, pink for RPTST, light blue for PAR, light green for SEQ, and dark blue for MC and AC. The diagram is organized into a grid with columns for each track and rows for each part.

On the left, a workspace tree shows the project structure:

- Solution 'Fujitsu.hws', (3 projects)
 - etsi_2ports_AC_30calls_new Script
 - pri_dass_dpnsb_both_dirs Script
 - use_this_overnight Script
 - use_this_overnight Tracks
 - PRI_MC
 - PRI_AC
 - DASS_MC2
 - DASS_AC2
 - DPNSS_MC2
 - PRI_MC2
 - PRI_AC2
 - DPNSS_MC
 - DPNSS_AC

On the right, the Properties panel shows the MakeCall Properties:

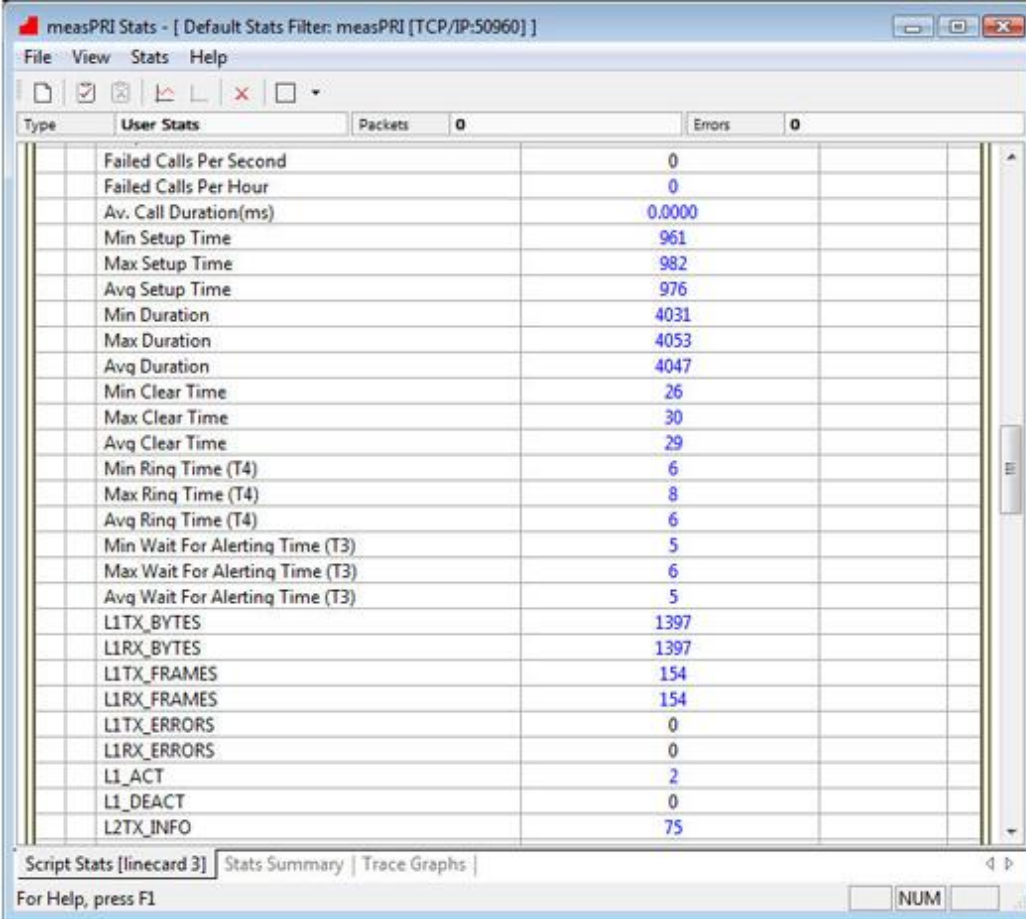
- MakeCall Properties
 - General Properties
 - Enabled
 - TIMEOUT: 0
 - COMPLETION
 - CAUSE
 - TYPE
 - ENBLOC
 - CALLEDNO: TRUE
 - CALLINGNO: TRUE
 - CODEC
 - BEXCLUSIVE
 - BCHAN
 - Parameter Type: Variable
 - BCHAN: pribchan3
 - TEL
 - Parameter Type: String Variable
 - TEL: tel_pri_to2
 - FROMTEL
 - Parameter Type: String Variable
 - FROMTEL: tel_pri_from2
 - DESTCALLAPP
 - Parameter Type: Number

At the bottom, a legend lists call flow parts:

- Alignment: Used to Align Call Parts
- Assign Variable: Assign a global variable to a local one
- Comment: Add comment to the script file
- Database: Write a database message
- Delay: Delay (ms)
- Evaluate: Set a variable to the value of an expression

The bottom status bar shows the current path: ISDN \ PRI \ DASS \ DPNSS \ CAS \ ISDN_BRI_S \ ISDN_BRI_U \ FXS \ FXO \ H.323 \ SIP \ ELT1 \ Path Testing \ Control

Metrics and design objectives in the reality – statistic



measPRI Stats - [Default Stats Filter: measPRI [TCP/IP:50960]]

File View Stats Help

Type User Stats Packets 0 Errors 0

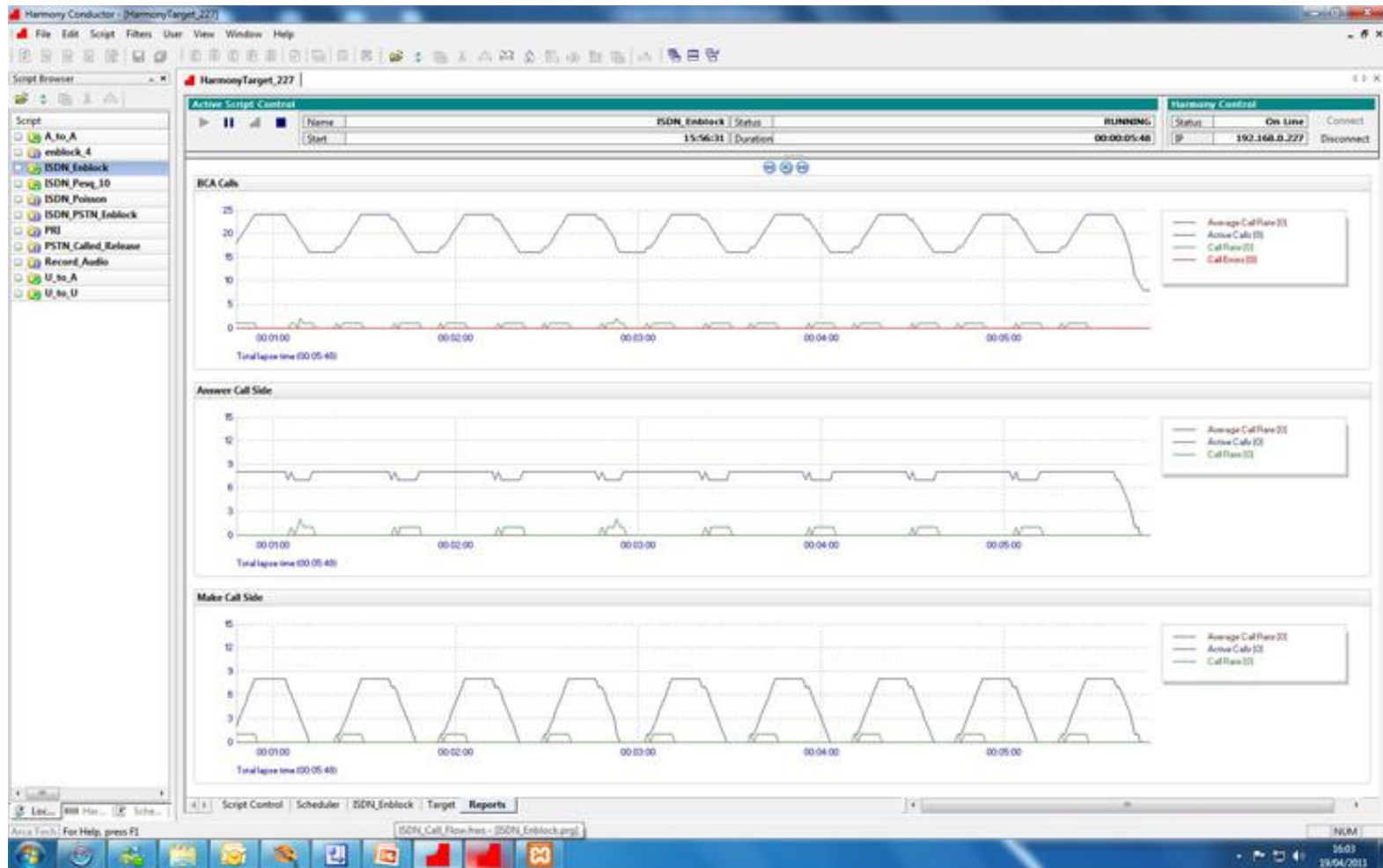
Type	User Stats	Packets	Errors
	Failed Calls Per Second	0	0
	Failed Calls Per Hour	0	0
	Av. Call Duration(ms)	0.0000	
	Min Setup Time	961	
	Max Setup Time	982	
	Avq Setup Time	976	
	Min Duration	4031	
	Max Duration	4053	
	Avq Duration	4047	
	Min Clear Time	26	
	Max Clear Time	30	
	Avq Clear Time	29	
	Min Ring Time (T4)	6	
	Max Ring Time (T4)	8	
	Avq Ring Time (T4)	6	
	Min Wait For Alerting Time (T3)	5	
	Max Wait For Alerting Time (T3)	6	
	Avq Wait For Alerting Time (T3)	5	
	L1TX_BYTES	1397	
	L1RX_BYTES	1397	
	L1TX_FRAMES	154	
	L1RX_FRAMES	154	
	L1TX_ERRORS	0	
	L1RX_ERRORS	0	
	L1_ACT	2	
	L1_DEACT	0	
	L2TX_INFO	75	

Script Stats [linecard 3] Stats Summary | Trace Graphs |

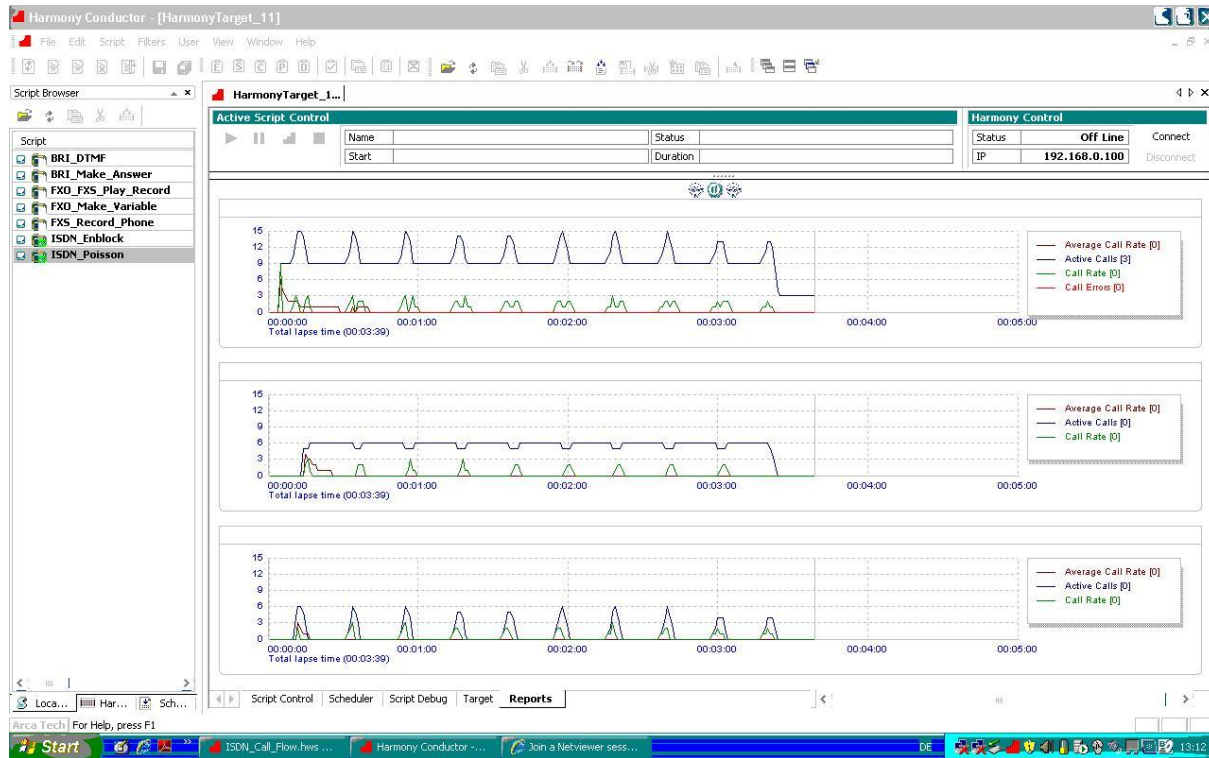
For Help, press F1

NUM

Metrics and design objectives in the reality - charts for ramp traffic



Metrics and design objectives in the reality - charts based on Poisson traffic



Example of a call detail report in the reality

The image shows a screenshot of a software application window titled "ISDN_Pesq_10 PESQ - [Default PESQ Event Filter: ISDN_Pesq_10 [TCP/I...". The window contains a menu bar (File, View, Stats, Help), a status bar, and a main content area. The main content area is divided into several sections:

- Reference and Degraded Files:**
 - Reference File: pesqgood_alaw.wav - Samples[67220]
 - Degraded File: record.wav - Samples[72000]
- Waveform Visualizations:** Two blue waveforms are displayed, one for the reference file and one for the degraded file, showing the audio signal over time.
- PESQ Results Logs:** A table with the following data:

Call ID	Reference	Degraded	State	PESQ Score
4	pesqgood_alaw.wav	record.wav	OK	4.483707
- Footer:** "For Help, press F1" and a "NL" button.

In the background, another window titled "PESQ Results" is visible, displaying a detailed call detail report with various technical parameters and statistics.

Questions?

Thank you for your attention