Qosmotec

Software Solutions GmbH

Technical Overview

"Lab Test System LTS"

TABLE OF CONTENTS

0 Document Control

0.1   Imprint

Qosmotec Software Solutions GmbH
Schloss Rahe Strasse Str. 3
52072 Aachen
Germany

Telefon: +49 241 8797 510
Fax: +49 241 8797 515
Internet: http://www.qosmotec.com/

0.2   Document Description

This document gives an overview about the Qosmotec Call Generator and integrated Lab Test Platform LTS. It is intended to give potential customers a first technical insight into the architecture and the product's capabilities.

Lab Test System LTS

1 System Description

The Qosmotec LTS is a call generation and mobile network test automation platform for load, stability and regression tests of mobile networks in the test bed. An unlimited number of mobiles and datasticks can be controlled, from a central, database driven system. The main characteristics and application areas of the Qosmotec LTS are

- Automatic execution of functional end-to-end test sessions.

- Performance measurements based on quality parameters as perceived by the end user (e.g. call setup times, voice quality, data throughput statistics),

- Network assessment based on quality parameters indicating the mobile network performance (e.g. packet flow statistics)

- Call generation in combination with mobility simulation in the lab (control of Qosmotec Air Interface Simulator and Propagation Effects Replicator)

- Call generation in combination with automatic SIM Card exchange (for inbound and outbound roaming tests, billing verification, etc.)

Various mobiles phones from different vendors or datasticks are employed for using the system for specific functional test features (see chapter 6) and wireless technologies.

The LTS System consists of a central and multi-user accessible **Application and Database Server**, controlling various types of test equipment. The integration capabilities of the LTS platform are visualized in Figure 1.
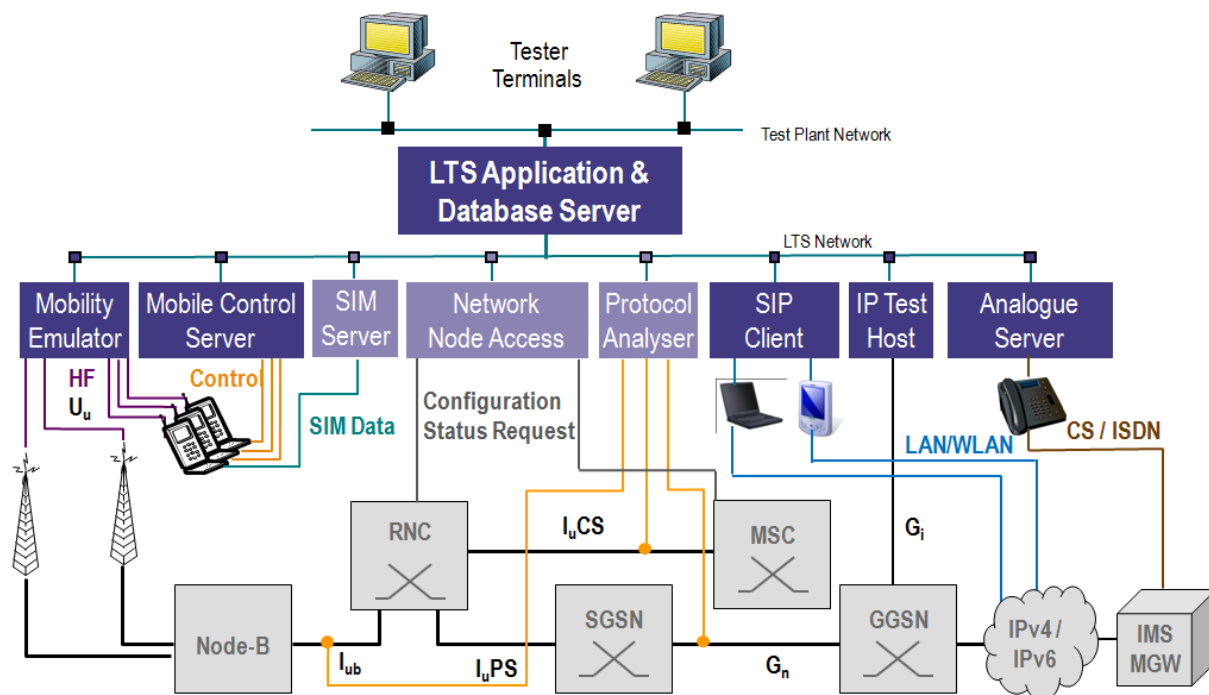

Figure 1: The LTS integrated test solution

Lab Test System LTS

The essential part is the *Mobile Control Server*, responsible for call generation. Technology dependent, one Mobile Control Server can generate calls on 3 – 32 mobiles in parallel. Nevertheless it is possible to cascade the system with a several Mobile Control Servers to achieve a higher number of mobiles to be used in parallel. Mobiles can easily be added to the system and are automatically recognized and registered in the database. New mobile types can be integrated by administrator users.

The UEs used for testing can be industrial radio modules, datasticks or handsets / smartphones. Industrial radio modules are available for all radio access technologies from 2G to 4G as well as for CDMA, CDMA2000 and EV-D0 and for all typical frequency sets. Up to 8 of these radio modules are delivered in a compact industrial rack chassis, that also contains the mobile control server. SIM card slots as well as RF connection are accessible from outside. Figure 2 shows such a rack chassis. For commercial UEs (datasticks and smartphones), Qosmotec provides shielded boxes, so that each UE is shielded individually from external RF disturbances. Up to 8 of those boxes fit on a industrial rack shelf and are connected via USB to the mobile control servers. Figure 3 shows the setup in a rack.

For adding fixed line network telephony into the test automation process, Qosmotec provides a *PSTN Control Server*. Up to 8 analogue lines (RJ-11 interface) can be used for call generation and reception.

The third supported telephony function is VoIP. A **SIP client** that typically runs on a mobile control server can register to any VoIP server in the test lab, generate and receive voice calls. During the call, it reports statistics on the voice link and transmission quality.

Figure 2: Rack mountable chassis for up to 8 industrial radio modules

Lab Test System LTS

Figure 3: Rack setup for commercial UEs - 8 shielded boxes on a rack shelf, connected to 8 mobile control servers in a blade chassis

For packet switched data call generation typically an **IP Test Host** is used in the system, which serves as data server for all tested data applications. The IP Test Host is connected to the G_i interface to be the other end point of the data chain through the network. In a laboratory setup and with the newest implementation of NDIS drivers on the mobile control server, downlink datarates of up to 42 Mbit/s (DC-HSDPA and HSPDA+) or 100 Mbit/s (LTE cat. 3) can be achieved.

A specific strength and unique identifier of the LTS integrated test solution is the simulation of mobility within the call tests by integration of an **Mobility Emulator QPER** *(Qosmotec Propagation Effects Replicator)*. QPER is inserted into the RF link between base stations / (e)NodeBs and mobile antenna and varies signal strength and phase (in MIMO scenarios) during the test runs. On this way, handover situations as well as various conditions on the air interface (e.g. shadowing, fast fading, disturbances) can be provoked and replicated in the test lab.

Another optional extension of the LTS system is the integration of a **SIM Server Array**. SIM cards in the mobiles are replaced by adapters, which are capable of retrieving SIM Card information via software. The SIM Server array can be configured of variable sizes from 32 up to more than 1000 SIM cards, each of which can be freely assigned to any of the mobiles. This enables the system to support international roaming tests (inbound and outbound) and subscriber tariff tests by populating the array with SIM Cards of various facilities or operators.

Lab Test System LTS

Figure 4 shows a typical setup of a LTS system, integrating mobility simulation with QPER and remote SIM access for the test mobiles.
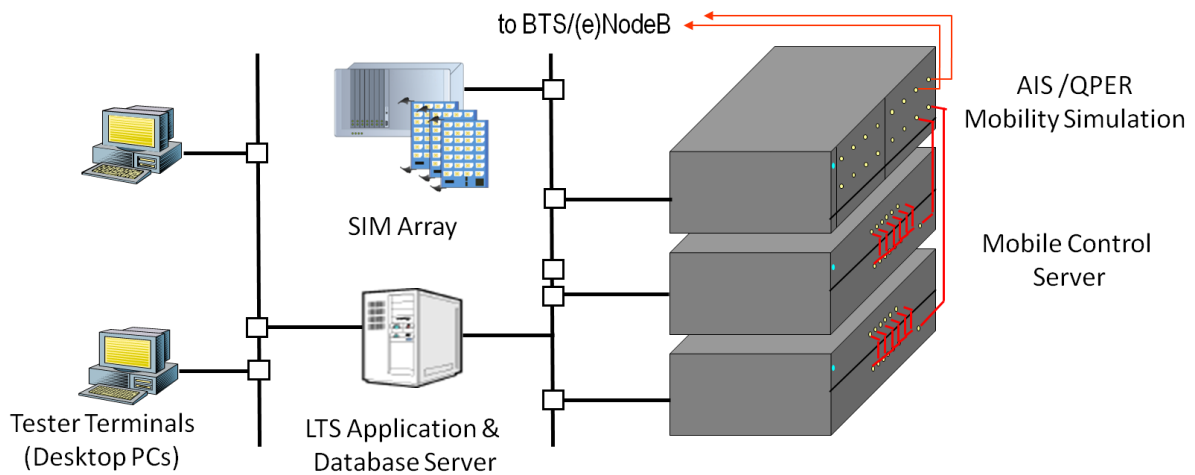
Figure 4: LTS setup including software controlled SIM selection and mobility simulation

Optionally and on demand, additional test tools are integrated into the LTS integrated test platform as it has been displayed in Figure 1. Strong network analysis capabilities are especially provided by the **Network Node Interface**, which allows to request information from network nodes during the test process and integrate the responses into the test verdict.

2 Test Features

The system is capable of the following test features:

- Voice Calls (Mobile Originated and Mobile Terminated)

- PSTN Calls (Landline Originated and Landline Terminated)

- VoIP Calls (Outgoing and Incoming)

- Voice Quality analysis based on PESQ standard

- Circuit Switched Data Calls (Mobile Originated and Mobile Terminated)

- SMS (Sending, Reception and Content Evaluation)

- USSD messages

- DTMF (e.g. VAS and Voice Mailbox control)

- Supplementary Services

    o Call Forwarding

    o Call Waiting

    o Call Conferencing

    o Call Barring

    o Calling Line Identity Presentation / Restriction

- Definition of PDP Context

- Definition of Quality of Service Profiles (2.5G and 3G) and setting of connected parameters:

    o Precedence class, Delay Class, Reliability Class, Mean Throughput Class, Peak Throughput Class

    o Traffic Class, Maximum & Guaranteed Bitrate (UL / DL), SDU delivery parameters (in-sequence order, error ratio, delay, traffic handling priority)

- Activation / Deactivation of PDP Context

Lab Test System LTS

- Packet Switched Data Transmission:

    o Ping

    o FTP (UL and DL)

    o HTTP

    o WAP

    o E-Mail (SMTP and POP3)

    o UDP Streaming

- MultiRAB (CS Voice + PS Data)

- Data Throughput Measurements and Statistics (Uplink and Downlink)

- Software controlled assignment of remote SIM Cards to mobile phones

- Network registration and deregistration

- Automatic and manual operator selection

- Radio access technology selection (2G, 3G, 4G)

- eMLPP Priority subscription and registration

- Voice Group Call Services

- Voice Broadcast Services

3 Test Cases

An easy-to-use **Test Case Editor** allows to assemble test cases from predefined test steps, each describing an atomic action on a mobile or within the integrated test platform. The test steps are sorted by topics in categories and can be added to test cases by simple drag and drop actions as displayed in Figure 5. The set of available test steps depends on the test packages, that come with the LTS system (see chapter 7).

Test cases can control one or several mobiles. If more than one mobile is used, the test case editor offers a possibility to synchronize the execution during the test run.

With each test step assigned to a test case the list of configurable parameters is extended. This parameter list can be customized regarding

- the default values

- the possibility to see and edit parameters for the user of a test case

- potential automatic settings based on the used test mobiles

After test case preparation, the test cases are added to the database, so that they can be used for automated test campaigns as well as for individual and immediate execution.
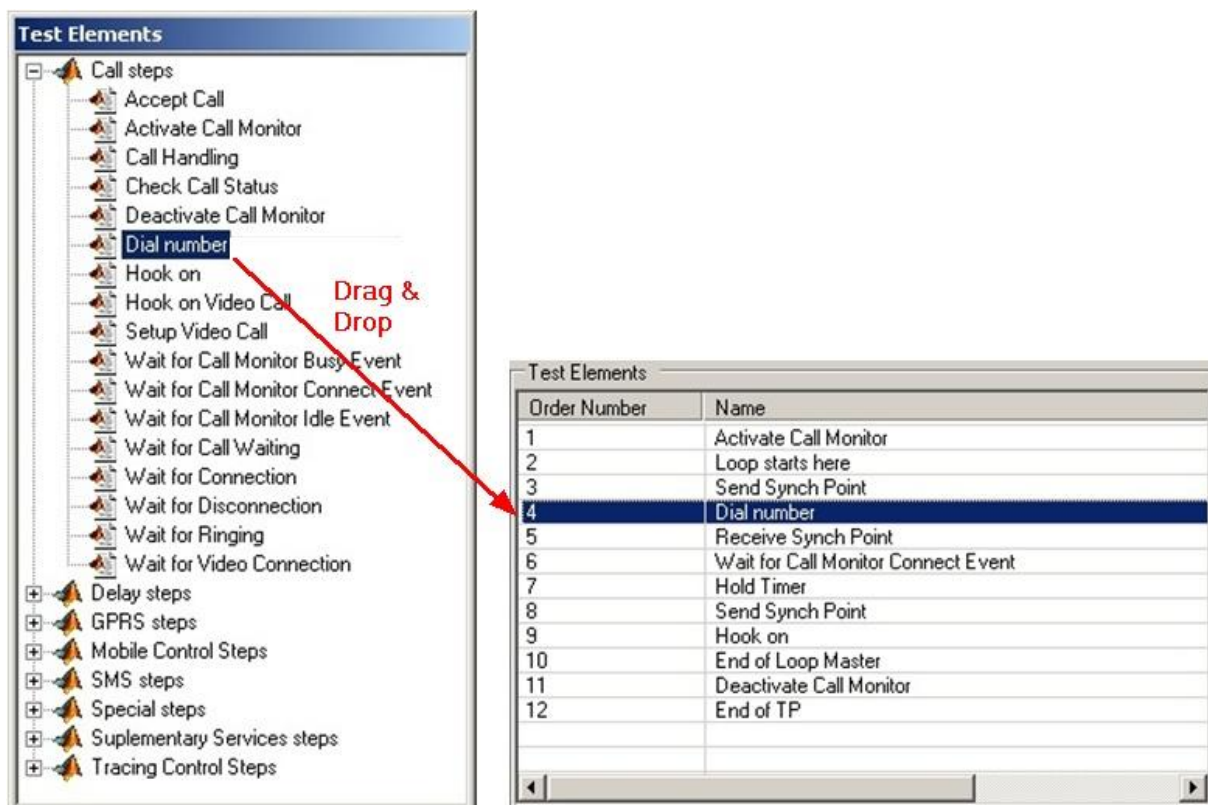

Figure 5: Assembling a test case

4 Test Execution

LTS offers two methods for test execution:

- Immediate execution of a single test case

- Scheduled execution of test case within an automated test campaign

For immediate execution, a wizard is available, which helps to assign resources (mobiles and SIM cards – in case that they need to be selected separately from a SIM server) and to change parameterization. This process is visualized in Figure 6. If default parameters shall be used, test cases can be started with a few mouse clicks, the results can be followed in real time in the already open test results view.
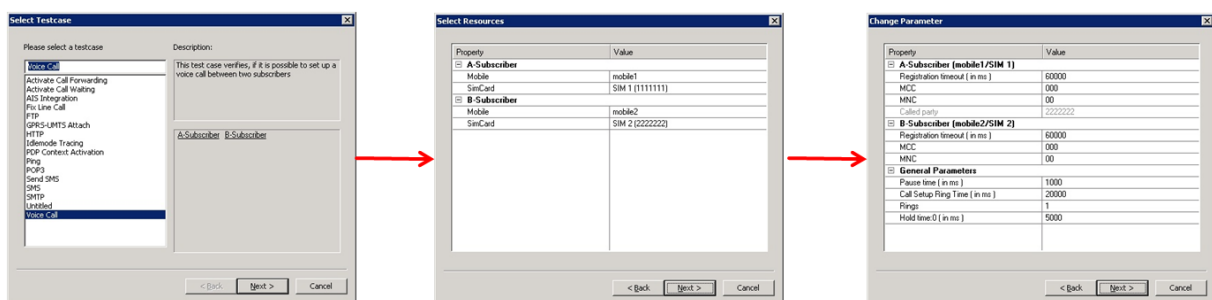

Figure 6: Wizard for immediate execution of a single test case

For automated execution of several test cases in a test campaign, LTS provides a test scenario editor. Test cases are dragged and dropped into a scenario, filled with mobiles and SIM cards (which appear as own resources, if they can be selected separately from a SIM server) and parameterized. Figure 7 shows the creation of test campaigns.

If LTS is combined with QPER for simulation of mobility in the lab, movement scenarios can be easily selected by means of a previewer from the database, or newly created, starting the QPER software right from the test scenario editor.

LTS also offers a tool support for avoiding overlapped resource usage. Within a scenario, the test cases can be graphically arranged using the test scenario scheduler. Resource conflicts are highlighted and can easily be resolved with tool support for parallel or sequential test execution. This is shown in Figure 8.

At submission time, a test scenario is verified against other already scheduled campaigns and potential conflicts are indicated. The availability of resources can also be checked by a user in advance opening a resource calendar that displays the reservation times for each mobile and SIM card in the system.
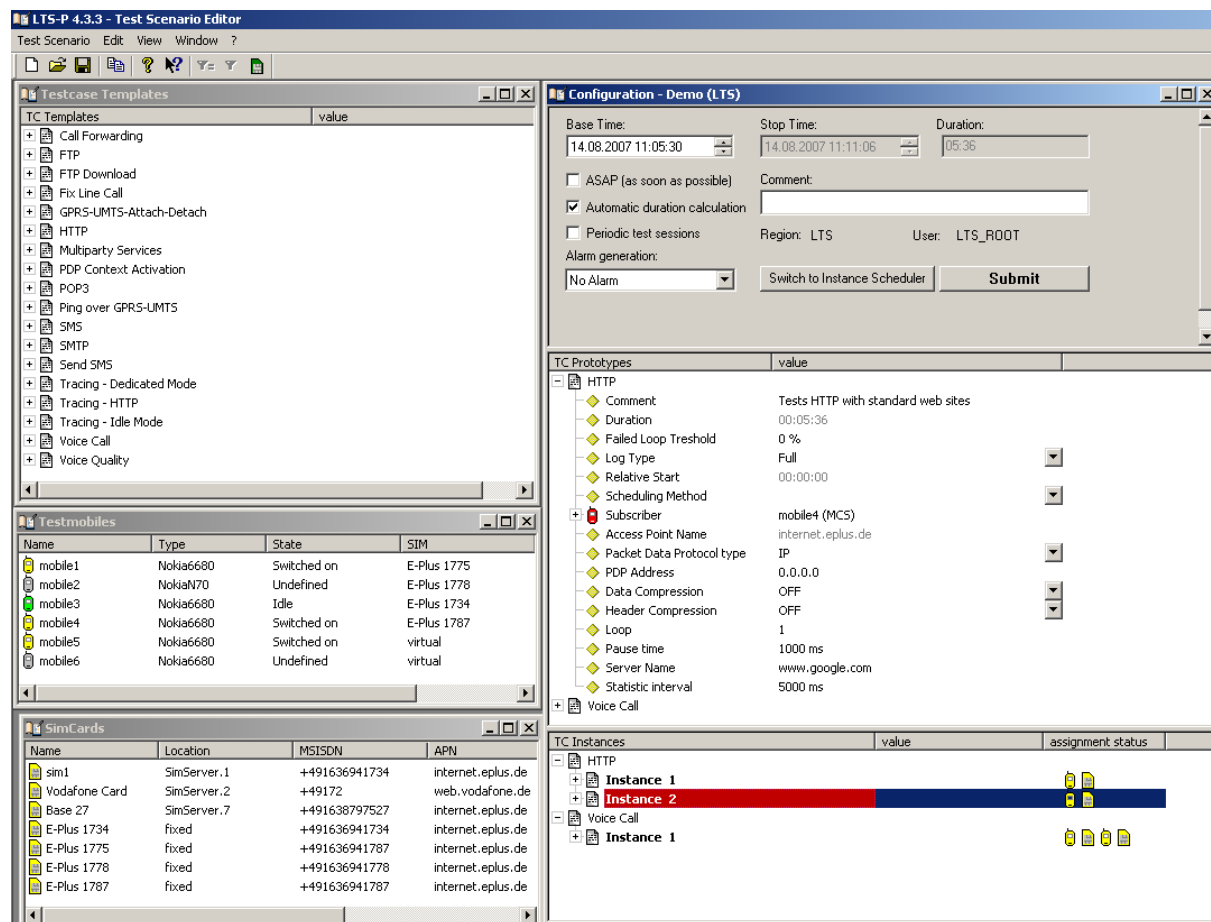
Lab Test System LTS
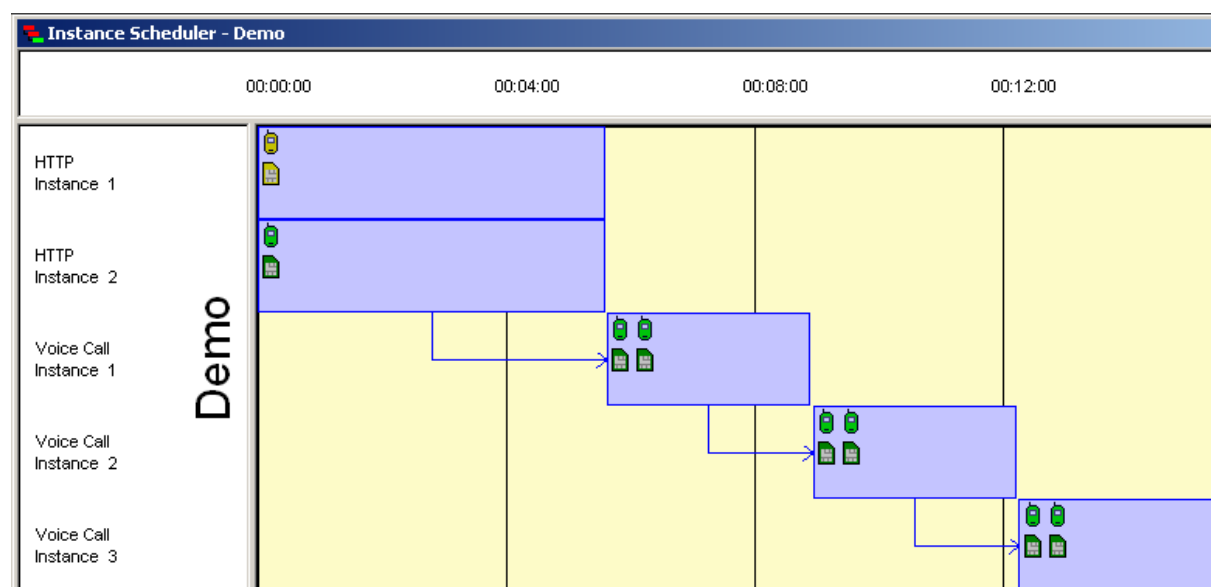

Figure 7: Test Scenario Editor

Figure 8: Scheduling the test cases within a test scenario

5 Test Results

The results of test cases are displayed in LTS on session basis. The Test Result View offers several views on the execution results.

- Execution statistics

- Detailled execution log

- Quality parameter views

- Position views (in case of mobility simulation with QPER)

All views can easily be filtered by test case or by resource. Furthermore, all result views are synchronized with each other, i.e. selecting a test result in one window automatically shows or highlights the results in other windows for the same time stamp or within a time frame window. This enables to user to analyze the reasons for occurred failures, abnormalities or other peculiarities during test execution. The synchronization of test results is shown in Figure 9.

For IP sessions, the complete TCP Dump can be stored in the LTS database, so that it is available for deeper analysis. From the LTS Result viewer, the TCP dumps can be opened with Wireshark on data session basis.

Test results can be exported into a text format for later post processing or result reporting.
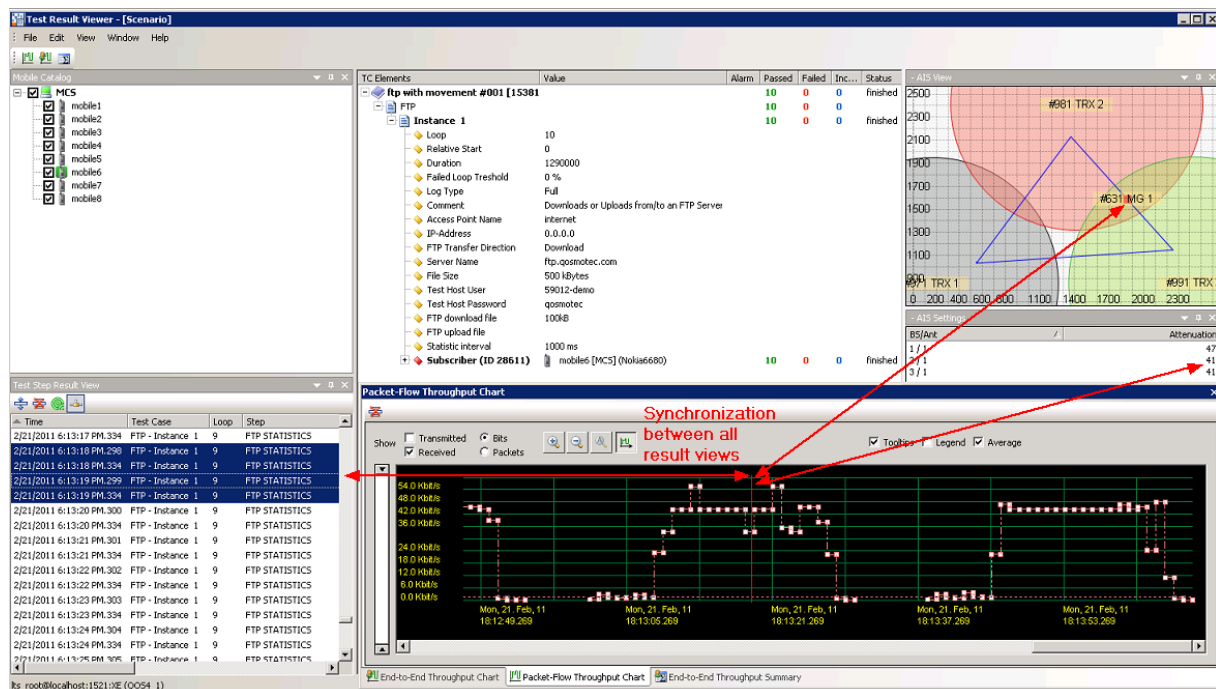

Figure 9: Test Result View with synchronized windows for all received results

6   External Interfaces

Instead of using the Graphical Test Scenario Editor, Test Scenarios can also be scheduled from externally via a console application. This **Automation Interface** for test scenario execution makes the integration with other test execution environments very convenient and simple to realize.

As a **Monitoring System Interface**, LTS uses the Simple Network Protocol (SNMP). LTS sends out SNMP traps, containing the results on of single steps and whole executions as well as the collected data. These can be retrieved and analyzed in any monitoring system. This allows to configure dedicated test case or KPI monitoring independent from the test scenarios, they are belonging to. Figure 10 shows this on the example of voice calls. All calls executed by the system over a whole night are recorded and displayed in a single statistics without taking into account who has executed the test or what else was tested in the tests. So this function can not only be used for reporting purposes, but also for getting a very good overview about all the different network activities generated by the LTS.
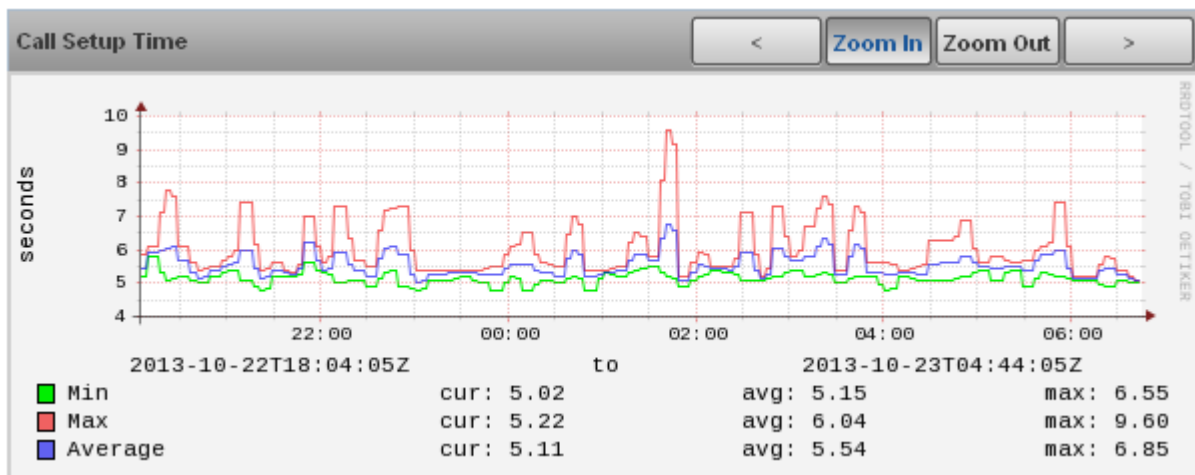
Figure 10: Monitoring of network test activities using the SNMP interface

7   Test Packages

The following sections describe the various test package. Each test package allows to run a certain set of test functions and is licensed individually for each LTS system. The availability of test packages might depend on the setup of the system and the used handsets. Not all handsets support all listed test functions for automation purpose. Thus, the availability of a test package for a specific LTS setup needs to be checked individually.

7.1   Voice Calls

This test package contains all necessary test functions to control mobile phones for Mobile Originating Calls, Mobile Terminating Calls, Mobile to Mobile Calls and Call Conferences. The Calling Line is displayed by LTS, if the Service Calling Line Identity Presentation is activated and the Calling Line is not suppressing the number transmission. The setup of a connection is indicated on the Originator site, if the mobile supports the feature connected line presentation. Call interruptions are indicated including their reasons, if the mobile supports the interrogation of extended call error reports.

7.2   PSTN Calls

This test package contains all necessary test functions to control PSTN lines for outgoing and incoming calls. Up to 8 PSTN lines can be controlled in parallel.

7.3   VoIP Calls

This test package contains all necessary test functions to register on a VoIP server in the test lab and to generate outgoing and detect and accept incoming calls using the SIP protocol. During an active connection the voice transmission path is verified and statistics on the data transfer are collected to assess the link quality.

7.4   Packet Switched Data

This test package contains all necessary test functions for specifying PDP Context Parameters, Quality of Service classes and settings (network technology dependant) and data transfers. The supported data applications are ICMP, FTP, HTTP, WAP, SMTP and POP3.

This test package is applicable to all packet switched data transmission technologies from GPRS/EDGE to LTE and it is supported for commercially available mobile phones, datasticks and wireless modules. The number of connectable mobile stations per server depends on the transfer rate of the wireless technology and ranges from 32 for GPRS data transfer rates to 3 for LTE. To support high speed data transfer on the downlink with up to 100 Mbps on the downlink, NDIS drivers (commercially only available for Windows systems) have been implemented on the Linux mobile control server.

All data applications can be used with any external server, but it is highly recommended to setup a dedicated test host with responding servers per data application in order to achieve comparability of the test results. It has to be taken into account that for execution of parallel data test sessions from one Mobile Control Server different destination addresses have to be used. For this reason it is recommended to configure the test host with multiple network interfaces corresponding to the number of data test sessions that shall be executed coincidentally from one Mobile Control Server.

7.5 SMS

This test package contains all necessary test functions to control mobile phones for Mobile Originated SMS, Mobile Terminated SMS and Mobile to Mobile SMS. SMS can be generated by the system with a specified length or the SMS text can be specified by the tester. The length per SMS is restricted to 160, the decomposition and composition of long SMS is a mobile feature out of the scope of LTS. The contents of the SMS is verified on the receiver. Supported character set for SMS is ISO-8859-1 (Latin-1).

7.6 Supplementary Services

This test package contains all necessary test functions for activating the Supplementary Services Call Waiting, Call Forwarding and Call Barring. These test functions can be used for a simple verification of the availability of the service or they can be combined into functional tests in combination with the functions from voice call test packages for testing also the correct execution of the respective service in the network.

7.7 Speech Quality

This test package contains all necessary test functions for transmitting a speech sample between two mobiles in a call. The sample is recorded on the receiver side and a referenced speech quality assessment is performed according to the standardized PESQ algorithm (PESQ score according to P.862 and mappings to P.862.1, P862.2, P.800 and G.107 scales). A recommended voice sample of about 30 seconds length is supplied with the package.

7.8 Mobility Emulation

This test package contains all necessary test functions to integrate the Qosmotec Propagation Effects Replicator QPER into the LTS test automation capabilities. Mobility sceneries and table files created with QPER are stored in the central LTS database. While controlling a mobile, LTS can in parallel take over the control of the movement of the corresponding mobile group, which is done by the execution control functions in QPER when using it stand-alone. The test functions can be integrated into the test cases, so that movements are started under certain test conditions and that further mobile actions can be synchronized with the signal strength environment experienced by the mobile.

AIS integrates smoothly into LTS. The QPER sceneries stored in the LTS database can be loaded with a handy preview mechanism, QPER can be started from within the LTS test scenario editor. The LTS result viewer supports full synchronization between QPER positions and attenuator settings with all other test results.

7.9 Automated SIM Card Selection

This test package integrates a SIM Server into the LTS System. SIM Cards are not directly inserted into the mobile, but the phone is equipped with an adapter, which retrieves its SIM Card information at runtime from a SIM Server hosting from 32 up to several hundreds of SIM Cards. From the user point of view, this package is handled without any additional test functions, but lists the SIM Cards as separate resources of the system (see Figure 7 in chapter 4), which can be assigned to test cases independently from the selected mobile.

Lab Test System LTS

7.10 Network Node Interfacing

This test package contains all necessary test functions to synchronize the test automation process of LTS with the status of network nodes. Prerequisite for this is, that the network nodes are accessible via telnet or ssh and accept textual commands. While controlling a mobile, LTS can in parallel send commands to network components and analyze their responses. Further mobile actions or the verdict of a test can depend on the received results. A powerful scripting language based on regular expressions ensures, that this test package can be applied universally and offers a high flexibility of parameterization.

7.11 GSM-R

This test package contains all necessary test functions for ASCI-functionality (Voice Group Call Service, Voice Broadcast Service, eMLPP Supplementary Service) and is employed for automation of functional tests in GSM-R environments. Test cases provided in this package are based on the ERTMS GSM-R QoS Test Specification O-2475.