GPRS SGSN Capacity Testing

COMPUTING COMMUNICATIONS VIDEO

▶ Ensure GPRS SGSN products operate at full load under various traffic conditions and create load conditions that support comprehensive functional and diagnostic testing. Build mobile networks that process traffic reliably and error free under real-world load conditions.

Core Network Trends

A trend in wireless core infrastructure development is that fewer network elements (such as SGSN's – Serving GPRS Support Node) handle more subscribers and more traffic. This trend is driven by demand from operators to lower operating costs of their networks.

Today, an increasing number of mobile phones that are sold globally are GPRS capable. As a result, most subscribers that enter the network consume system resources from the SGSN: the mobile phone "attaches" to the SGSN and remains registered.

For network equipment manufacturers, the growth and evolution of mobile data applications results in challenges to develop and test large and scaled network elements. Usually, several shelves of processing cards have to be combined to one network element in order to be able to provide the required levels of performance.

What are the side effects of combining multiple shelves to one network element? What happens if the number of subscribers in a service area reaches the limit of what the network element can handle? – Testing real-world and worst-case scenarios prior to deployment becomes essential.

Capacity Testing

The way to verify and ensure the ability of a network element to handle large quantities of subscribers is capacity testing. The focus of capacity testing is to emulate the maximum number of expected subscribers with their typical signaling and service usage behavior.

Capacity Test Objectives

Following is a list of the main capacity test objectives:

– Test the system to it's maximum subscriber capability

– Overload the network elements to point of failure to determine weak design elements

– Verify the system stability over extended periods of time with high and changing subscriber volumes

– Find memory leaks

– Generate background traffic for functional tests

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Typical Problems Resolved by Capacity Testing

Following are three brief examples of how a powerful capacity test application can resolve typical full load traffic problems:

1. Service providers may experience an increasing number of service glitches as the number of GPRS subscribers increase in their network.

   To isolate the problem the service provider can use the capacity tester to emulate a GPRS RAN towards the SGSN. A test simulating an increasing GPRS load on the SGSN quickly uncovered bottlenecks in the link between the SGSN and the HLR. Then the link capacity can be increased and the GPRS service glitches would disappear.

2. A network equipment manufacturer needs to identify the internal processing bottlenecks in the SGSN. Network operators have reported that a few hundred sessions works perfectly fine but data calls are being dropped when subscribers' data applications ramp to a hundred thousand sessions.

   To isolate the problem an engineer can use a protocol tester Tektronix K1297-G20 to create an ever-increasing load towards the SGSN. By monitoring statistics and operational indicators from the SGSN, the engineer is able to diagnose internal processing problems that only became manifest under higher loads.

3. An engineer wants to ensure that memory fragmentation is not resulting in memory leaks and degrading SGSN performance.

   The Tester is used in a longer-term soak test under various load conditions while memory utilization and SGSN performance are monitored for stability over time.

GPRS SGSN Capacity Test Application

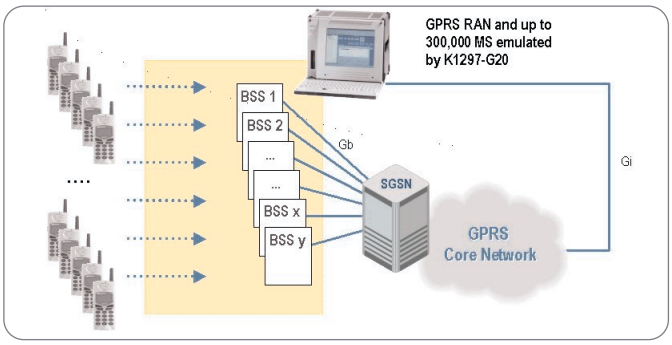
Description

This application allows network equipment manufacturers and operators to validate the capacity of a GPRS core network element (SGSN and GGSN) prior to deployment or release of a new SW load.

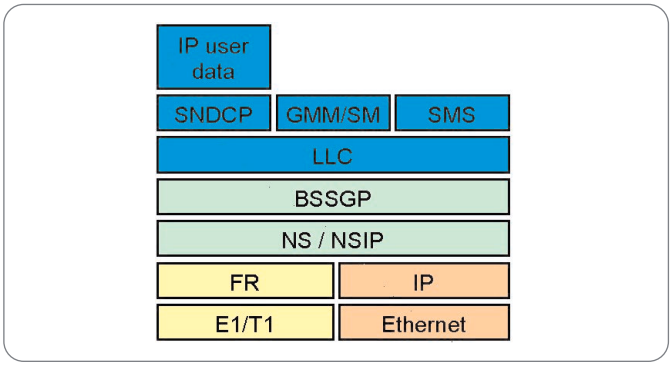
Features

The K1297-G20 Capacity Test Application emulates the GPRS Radio Access Network (RAN) at the Gb interface with up to 300,000 mobile GPRS subscribers.

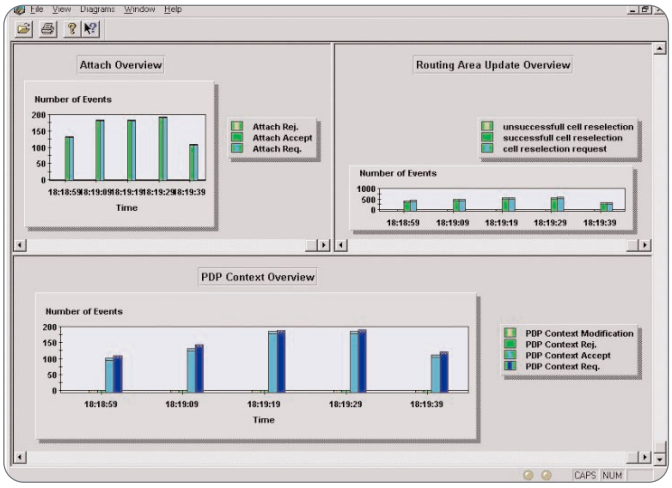
At the Gi interface, the K1297-G20 emulates an ISP thus generating traffic in DL direction to the GPRS subscriber.



▶ ***Figure 1.*** *The K1297-G20 replaces the GPRS RAN and emulates up to 300,000 subscribers. Downlink data can also be generated by connecting to the Gi interface.*



▶ ***Figure 2.*** *GPRS Gb interface protocol stack.*



▶ ***Figure 3.*** *The easy-to-read and effective graphical representation of sessions statistics available with Tektronix K1297-G20, allows technicians to easily diagnose processing problems.*

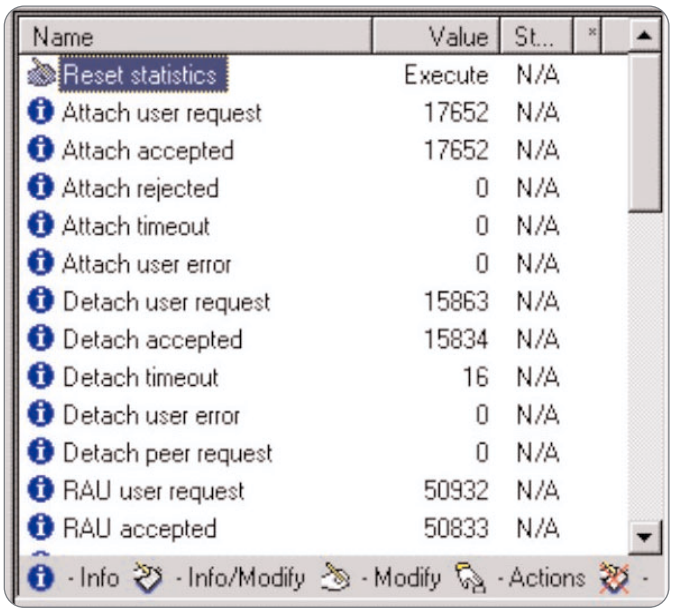
The following GRPS procedures are supported:

– Attach

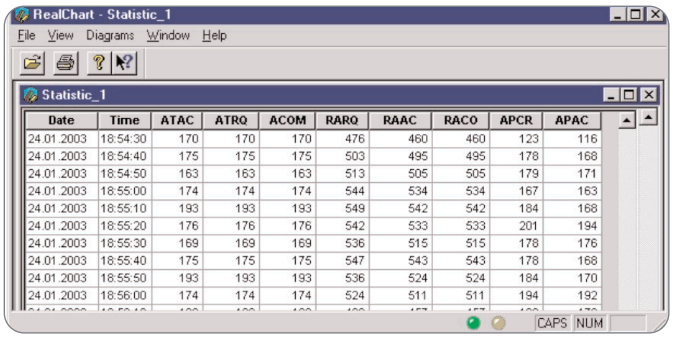
– Detach

– PDP Context Activation

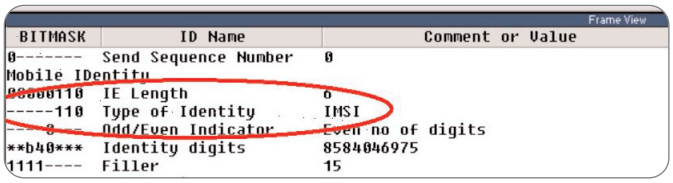
– PDP Context Deactivation



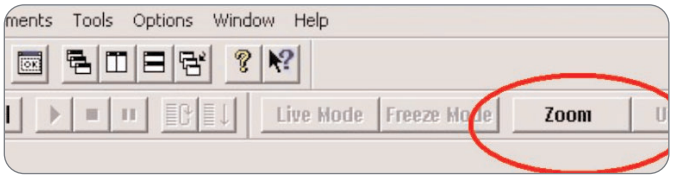
▶ ***Figure 4.*** *A comprehensive set of session statistics is necessary to allow full control of network behavior.*



▶ ***Figure 5.*** *Online statistics in tabular form represent the system performance (e.g. total number of successful vs. unsuccessful procedures; count of GMM/SM messages within a time interval).*



▶ ***Figure 6.*** *Decoding down to bit-level for all parameters of a message.*



▶ ***Figure 7.*** *A click on the "Zoom" button will extract all messages that belong to one particular call, even from a large recording.*

– PDP Context Modification

– Intra/Inter-SGSN RAU with simultaneous data transmission

– PTMSI Reallocation

– Paging PS

– Uplink/Downlink Data Send (Ack/Unack)

– Uplink/Downlink Data Receive (Ack/Unack)

– SMS Send

– SMS Receive

Additionally, the following GPRS features are fully supported:

– Ciphering (signaling and data)

– Header Compression (RFC1144, RFC2507)

– Data Compression (V.42bis)

– SNDCP Segmentation/Reassembly

– Gb over IP

– IPV6

Test Configuration

Protocol stacks and subscriber parameters are configured using the K1297-G20 Emulation Scenario Editor. Special configuration tools let the user manage large ranges of subscribers easily.

The subscriber call behavior is modeled using a Call Profile editor. Each Call Profile represents a user-defined range of subscribers that represent certain call behavior.

To start a test run, all Call Profiles can be started simultaneously or each of them separately.

Test Analysis

A variety of test analysis features allow the user to verify system performance and troubleshoot if needed.

Statistics Function

The Statistics function allows generating statistics for up to 100 user-defined events (e.g. message types). A measurement interval can be set so that the measurements reflect the system performance behavior over time. Results can be stored to disk for later analysis or can be displayed online in graphical or tabular format.

Protocol Data Capturing and Offline Analysis

All traffic can be captured and written to disk. Offline-analysis tools provide detailed message decodes and allow the user to filter on specific protocol events.

Additional call trace and zoom functions enable time-efficient analysis and troubleshooting.

Performance Data

All values below specify the performance of one Application Processor Board (AP-4)/Prime Interface Board (E1/T1) pair.

Up to three pairs can be installed in one K1297-G20 (Benchtop mainframe).

GbIP will require an Ethernet Interface Board instead of Prime Board. The performance values will be equal or higher.

	Per AP-4/ Prime pair	Per Protocol Tester
Concurrent subscribers and contexts		
Attached subscribers	100,000	300,000
Active contexts	50,000	150,000
Number of physical E1/T1 Links	4	12
Max. Signaling performance[*1]		
with 1% of subscribers	1,400 Mobility Events[*2]	4,200 Mobility Events[*2]
with 20% of subscribers	880 Mobility Events[*2]	2,640 Mobility Events[*2]
with 100% of subscribers	70 Mobility Events[*2]	210 Mobility Events[*2]
Signaling performance with Ciphering[*1]		
(measured with 20,000 subscribers)	770 Mobility Events[*2]	2,310 Mobility Events[*2]
Max. user data generation (UL)[*3]		
Acknowledged	400 kbit/s (with 20,000 sub.)	1,200 kbit/s (with 60,000 sub.)
Unacknowledged	650 kbit/s (with 20,000 sub.)	1,950 kbit/s (with 60,000 sub.)

[*1] All values in the table are typical values determined by means of benchmark testing with real network equipment (SGSN and GGSN). Actual performance may vary based on configuration and DUT performance.

[*2] A Mobility Event is one GMM/SM signaling message that is either sent or received by the tester.
Example: An Attach/Detach procedure counts as five Mobility Events: AttachRequest, AttachAccept, AttachComplete, DetachRequest, DetachAccept. Therefore, e.g. 2,640 Mobility Events/s translate in an Attach/Detach rate of 528 Attach/Detach per second.

[*3] UL = Uplink. Downlink user data generation on Gi interface requires an Ethernet board; the max. data throughput is significantly higher than with Prime board (ca. 4 Mbit/s per Ethernet board).

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