1   Introduction

This document describes the additional service entitled Performance monitoring for the services GTS Internet, GTS IP VPN and GTS Total Business.

2   Description of the application Performance monitoring

The additional service Performance monitoring is operated on a BaseN solution, which belongs to the sphere of applications intended for supervision and management of large infrastructures and here it is primarily intended for the area of performance management.

The BaseN application collects data on the status of individual pieces of equipment being monitored, their current utilization, and carries out a presentation of the data measured in real time.

The information provided by this application is to be used as an indicator of quality of the provided services and for easy verification of the actual status of the provided services.

The interactive graphs also provide high level information on historic data that may be used for precise planning of future needs or retroactive diagnostics of operational situations based on historical statistics in full time scale.

Information provided by this application cannot serve as the basis for the calculation of sanctions for non-compliance with the SLA, above all because all outages are recorded in this application. This includes, for instance, planned service outages, outages caused by the customer, etc., which are not included in the total unavailability of the service.

2.1   Basic description

The application collects data from the equipment and system being monitored. The system provides for long-term saving of the collected data. Data collection takes place periodically and the standard configuration for data collecting is every 4 minutes. The metered data are displayed immediately. Metering data for the period of the past 24 months are available in the same statistics together with the current samples.

A prediction of trends based on mathematical evaluation of the recent metering is available based on the available data. The prediction uses mathematical relationships of the recent metering values and it may differ significantly from the actual data and the technical capacities of the equipment. This function of the graphs is provided as indicative, as an aid for estimates and planning of statistically stable behaviours.

2.2   Change monitoring service

If there is a change monitoring service (change of technology to access the line, changing the interface) can occur when the change has already lost the measured data. This loss may in some way replace that user data measured at even unchanged Channel will export – see paragraph 5.1. Export of measured values, graphs.

2.3   Data collection

The application Performance monitoring carries out measurements in two basic ways:

§   By generating ICMP (Internet Control Message Protocol) packets;
§   By collecting data using the SNMP (Single Network Management Protocol) protocol.

Data is acquired from equipment in the GTS network, especially from PE routers, IP SLA agents and from terminal equipment located on customer premises, i.e. CE routers.

The collection of data on the results of ICMP measurements

The basic monitoring of the availability of individual customer localities is carried out by the generation of ICMP reports and the retroactive evaluation of replies received. On the basis of the monitoring of the response of individual equipment located at the customers' (CE routers) to the ICMP messages sent a decision is reached on the availability of the customer locality in question.

The collection of data from the interface of CE and PE routers using SNMP questions

Data is collected by the application directly from the interface defined of the CE and PE routers. This involves the collection of data for each defined locality. Data is primarily collected on workload and utilization of a line.

The collection of data on the utilization of QoS from the interface of the CE and PE routers using SNMP questions

Within the framework of defined operational classes at the customer's, data is collected on operating parameters within the framework of individual QoS classes. This involves the collection of data on utilization within the framework of a class, the number of lost packets and delayed packets.

Data collection from IP SLA agents using SNMP questions

Detailed data on the monitoring of availability is collected from the routers which are at the GTS Czech centre and are intended to monitor the response of individual customer localities. IP SLA agents are configured on the routers in such a way that they undertake a series of tests on the CE equipment. They measure jitter, delay, response and the loss of packets. IP SLA measurement generates traffic on the level 30 kbps as in case of VoIP usage is one voice channel.

Data collection from PE routers is available only for services in the Czech Republic.

Data collection is undertaken at intervals of every 4 minutes. The data is saved for 24 months in the database and then presented to customers by means of an online web interface.

2.3.1   ICMP protocol (Internet Control Message Protocol)

The agent which monitors the availability of CE equipment sends an ICMP message type 8 (echo request) to the target CE equipment. If the CE equipment receives this message, it responds to the source equipment (agent) in the form of an ICMP message type 0 (echo reply). If the source equipment (agent) receives this message, the target CE equipment is accessible. Within the framework of ICMP measurement 3 ICMP packets are sent every minute, which serve only for the basic diagnosis of the connection. Because a low number of ICMP packets is being sent, ICMP packet loss measurement dies not give completely precise results (e.g. the loss of a single ICMP packet generates 33% packet loss at any given moment of time).

2.3.2   SNMP protocol (Simple Network Management Protocol)

For the supervision of equipment and systems an SNMP protocol (Simple Network Management Protocol) is used as standard.

The SNMP is based on the communication of the control system with the supervised, managed controlled equipment. The SNMP works on the principle of "question – response" and its character is such that after sending a question it

does not have to wait for a response. It can send other questions or carry out other activities. For the needs of this communication the SNMP defines a restricted set of orders. The basic orders are Get and Set.

2.3.3   Cisco IP SLA agent

The GTS Czech network uses Cisco routers. This equipment, aside from its main activities of routing packets, has implemented IP SLA agents. This involves an "agent" – an application which can carry out various tests of availability and response of packets from the Cisco router by generating operations on any element of choice in the network, in any quality class configured (QoS).

The basic types of measurement carried out by the Cisco IP SLA agent are as follows: Packet Loss, Delay and the dispersal of delayed packets (Jitter).

The IP SLA agent carries out questions on any network equipment of choice and saves the measured values for further processing. By means of the SNMP protocol the measured values are accessible to applications which are able to continue to collect, save and present data.

2.4   Configured reports

Status Summary

Summarizing overview of all of the monitored services the participant, their current availability and graphical illustration of the location on the map.

Network Map

A graphic illustration of the location of monitored services on a map. The colour illustration of the locality indicates current service availability. The colour of the dot is a function of the summary status (colour) of the recent actual metering in the colour stripe of the Status Table. Clicking on the service displays the statistics of the locality selected.
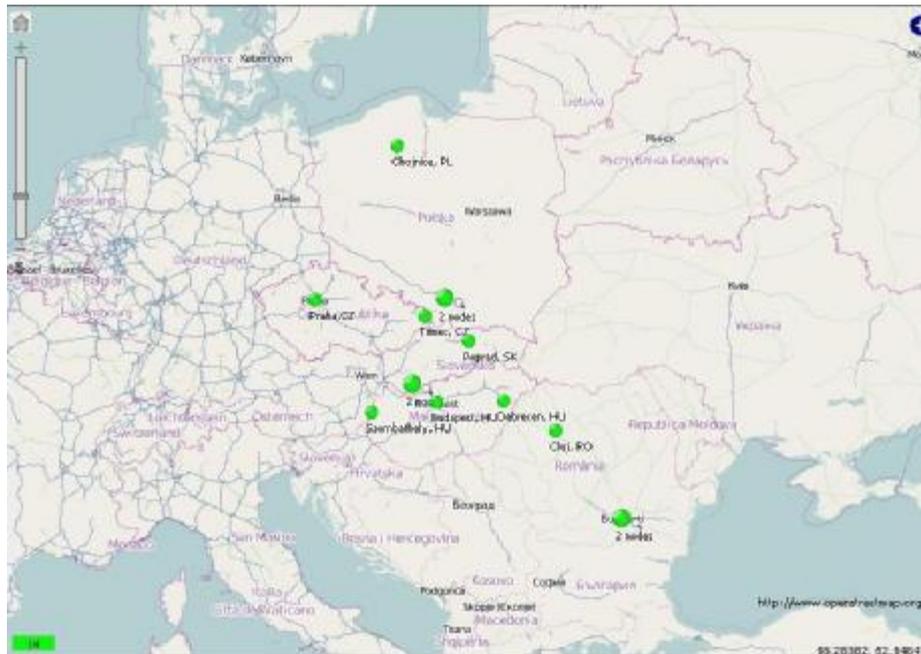
Status Table

An overview of monitored services and their current accessibility on the basis of an ICMP protocol. The coloured status indicator is divided into 5-minute intervals. The last minute monitored is the coloured strip on the very right, the status 2-3 minutes previously is in the centre, and the oldest measurement is on the very left. The status is automatically updated every minute.

Customer visualisation of coloured dots in Status Table and Network Map depends on existence on the availability of primary connections or primary connections, including backup connection (and CPE) In case the primary connection is with backup connection is displayed as unavailable (red) only if they are unavailable both circuits (primary and backup).

Other displayed reports are dependent on the type of service. We acquire access to reports on individual customer services by clicking on the left menu on the item reguired service (f.e. GTS IP VPN, GTS internet etc) . Subsequently localities are displayed along with an adress specification and with the identificator of the GN circuit of service included in Performance monitoring.

2.4.1 Reports for the services GTS Internet, GTS IP VPN and GTS Total Business without the additional service QoS

Basic Measurement:

§ WAN – measurement on an access line connected to the GTS network
- Utilization of connection in the direction of the customer (in) [%];
- Utilization of connection in the direction away from the customer (out) [%];
- Operation on the connection in the direction of the customer (in) [kbit/s, Mbit/s];
- Operation on the connection in the direction away from the customer (out) [kbit/s, Mbit/s];
- The interface bandwith [kbit/s, Mbit/s].

§ LAN – measurement of the interface of the CE router in the direction of the customer's local network
- Utilization of LAN interface in the direction away from the customer (in) [%];
- Utilization of LAN interface in the direction of the customer (out) [%];
- Operation on the LAN interface in the direction away from the customer (in) [kbit/s, Mbit/s];
- Operation on the LAN interface in the direction of the customer (out) [kbit/s, Mbit/s];
- The interface bandwith [kbit/s, Mbit/s].

2.4.2 Reports for GTS IP VPN and GTS Total Business with additional service QoS

2.4.2.1 Basic Measurement

The same reports are available as for the services GTS internet, GTS IP VPN and GTS Total Business without QoS.

2.4.2.2 QoS Measurement

Downstream and upstream reports of the distribution of operations in individual QoS classes along with a report on drop in operations:

§ Operation by individual classes after application of QoS policy [kbit/s, Mbit/s];
§ Report on operations which do not fit into individual classes (drops) [kbit/s].

2.4.2.3 IP SLA Measurement

Reports of IP SLA measurements are different for the Diamond class and other classes:

§ IP SLA reports for the Diamond class
- Average round trip packet delay [ms];
- Average packet loss [%];
- Average positive jitter [ms];
- Measurement of MOS score.

§　　IP SLA reports for the classes Silver, Bronze, Silver and Platinum

- Average round trip packet delay [ms];
- Average packet loss [%];

2.5　　Measured magnitudes

Traffic

The operation or traffic on the interface of the equipment – displays the transferred data in and out of the equipment – displayed in kbit/s or Mbit/s.

Utilization

A parameter showing in percentages the utilization of individual measured interfaces in respect of their maximum capacity.

Packet Delay

The packet delay parameter shows the time delay of packets in a given class within the framework of the provider's network. Delay in a network is calculated as the time difference between sending a packet from an ethernet port of the originating equipment and the acceptance of the entire packet on an ethernet port of the terminating equipment.

Packet Loss

Packet loss is a parameter which shows the absolute number of packets in a given class which are not delivered to the target equipment. This loss may be caused, for instance, by the non-availability of a line, a line error, the current overloading of a line (non/deliberate overloading, viruses, SPAM, DoS attacks, etc.), repeated outages on a given connection, etc.

Jitter

Variation of the size of packet delay or jitter show the dispersal of the delays of packets in the time segment measured and the given class.

MOS (Mean Opinion Score, standard per ITU-T)

A parameter showing the suitability of the class in question for the operation of applications working in real time, e.g. VoIP. A numerical value (1-5) expressing the quality of the connection for the transfer of real-time applications (e.g. VoIP), where 5 indicates the highest quality and 1 indicates the lowest.

Average values

The values are typically presented on the graphs as average values over selected period

- Selected DAY – the presented average values are calculated over 15 minutes period
- Selected WEEK – the presented average values are calculated over 2 hours period
- Selected MONTH – the presented average values are calculated over 12 hours period
- Selected YEAR – the presented average values are calculated over 7 days period

3   Benefits for customer

The same overview of current statistics of availability of individual localities is available to the customers as is available to employees of the GTS Czech supervisory centre.

This means that when reporting a fault there is no distortion of information because of different customer monitoring.

The customer overview of reports is divided up in such a way that the user can select which data it is relevant to monitor.

Basic measurement

This type of report makes it possible to ascertain if the connections of individual localities are sufficiently sized for operation. It is possible to monitor the most utilized branches, and the system draws attention to a possible problem during the communication of a branch. It helps identify which equipment/localities need to be paid more attention and monitored, or if any of the connections have a communication problem.

QoS measurement

This type of report makes it possible to ascertain if the QoS which the customer has defined and configured are sufficiently sized for operation. It is possible to monitor loading and loss rates within the framework of individual classes, and on this basis decide on the introduction of a new class or the reconfiguration of an existing class by another means or the transfer of operations to another class.

IP SLA m measurement

This report is very beneficial especially for customers who want to define/monitor QoS for IP telephony and within the framework of this class need to have the parameters met for the operation of IP telephony – Jitter, Delay, Packet Loss.

In the case of the remaining classes it is possible to monitor if they are being correctly used and configured in light of the customer's requirements, and whether it would not be appropriate to transfer an operation to another (less utilized) class.

4   Description of the customer interface

The customer has access to the interface of the application Performance monitoring by means of an internet browser from the website www.gts.cz, the section "Customer Login".
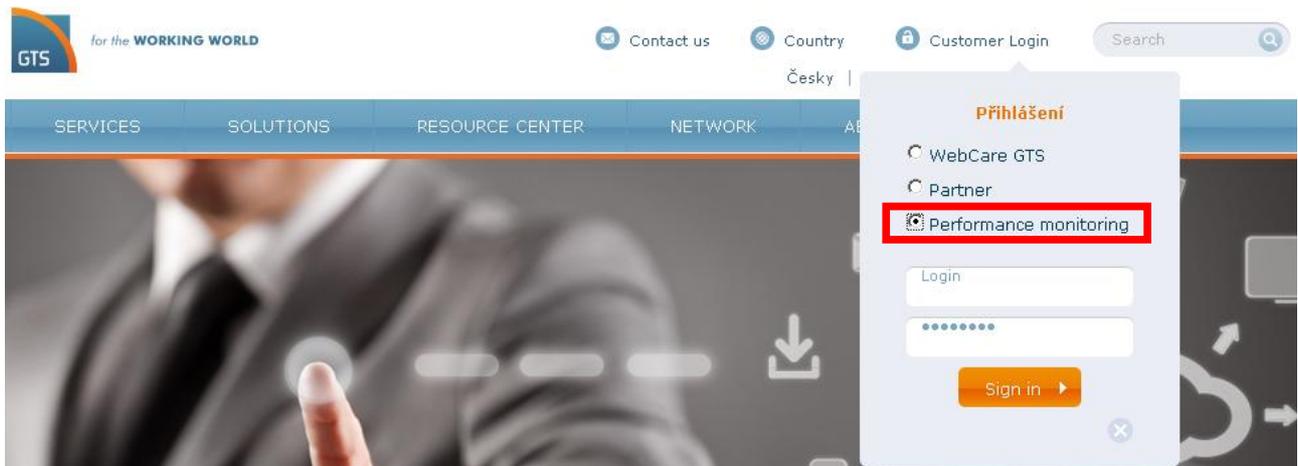
For authorisation and identification of a user a name and password are used which the customer receives when establishing the additional service Performance monitoring. After entering the name and password the Performance monitoring customer interface is displayed.

Structure of the customer interface

The customer interface is displayed above.

1. Overview of all services included in the Performance monitoring

2. Specific product included in the Performance monitoring

3. Displaying a list of all connections of a particular product in a geographic map

4. Displaying a list of all connections of a particular product in the table

5. Select individual services in a chosen location (region)

6. Sig out

Upon clicking on a specific service in the location (see item 5 in the above picture), further selection is offered in the form of tables. It is possible to select visualisation of specific metering (see item 7 in the above picture).


4.1 Monitoring of backup connections

If the primary connection with backup connection , there is link between both connections - see Figure below.
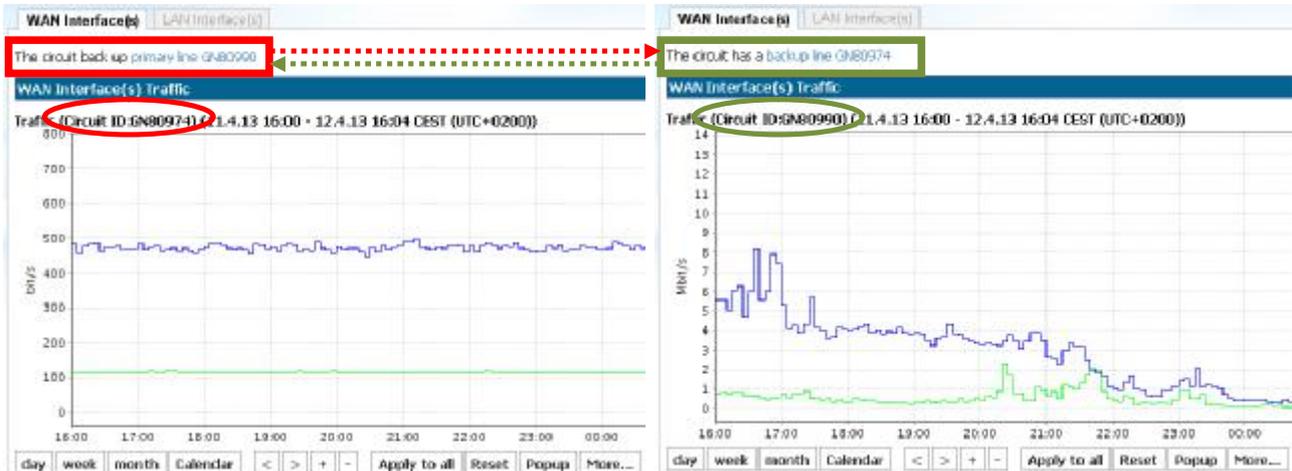
5 Control of the interface for the creation of graphs

5.1 Export of the measured values, graph

In the customer interface it is possible to export any graph (or data used) into Excel (e.g. as data for further processing) or a PDF document. Click on "More…", select "Export" bookmark and chose the required data format.
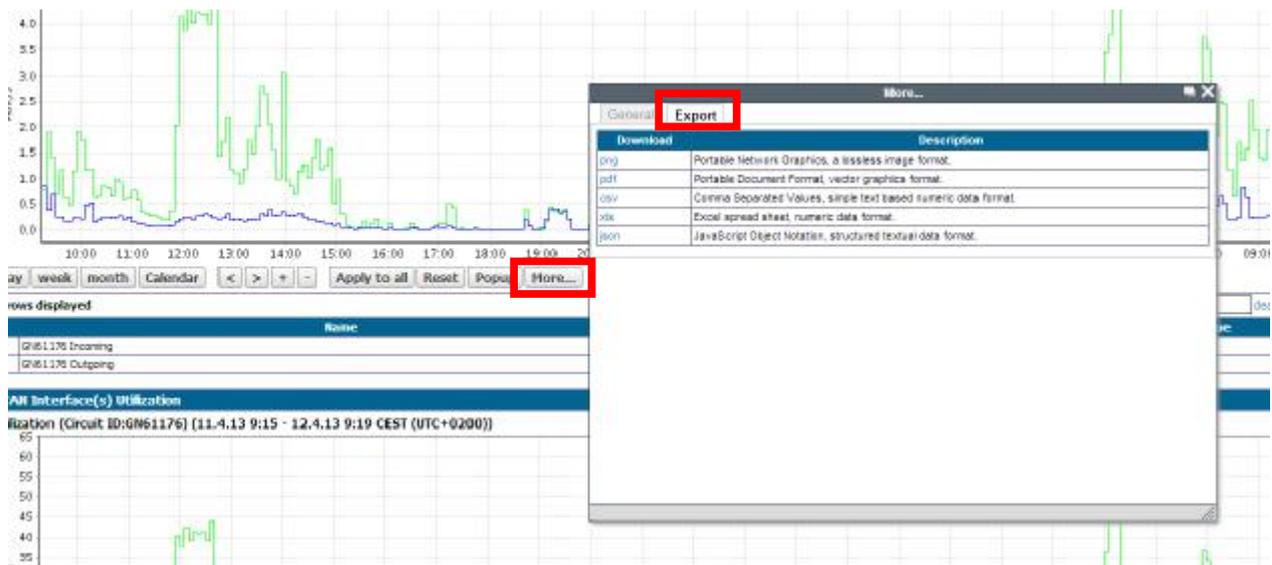
5.2 Display filter

In order to filter the interface displayed (or QoS classes) simply write the requisite interface (or QoS class) in the appropriate field "Filter…". If the filtration of more than one interface is required, simply divide the individual interfaces with a comma in the appropriate field "Filter…". Alternatively you can simply click on the row representing the measured interface.

Valid through 20. 05. 2013
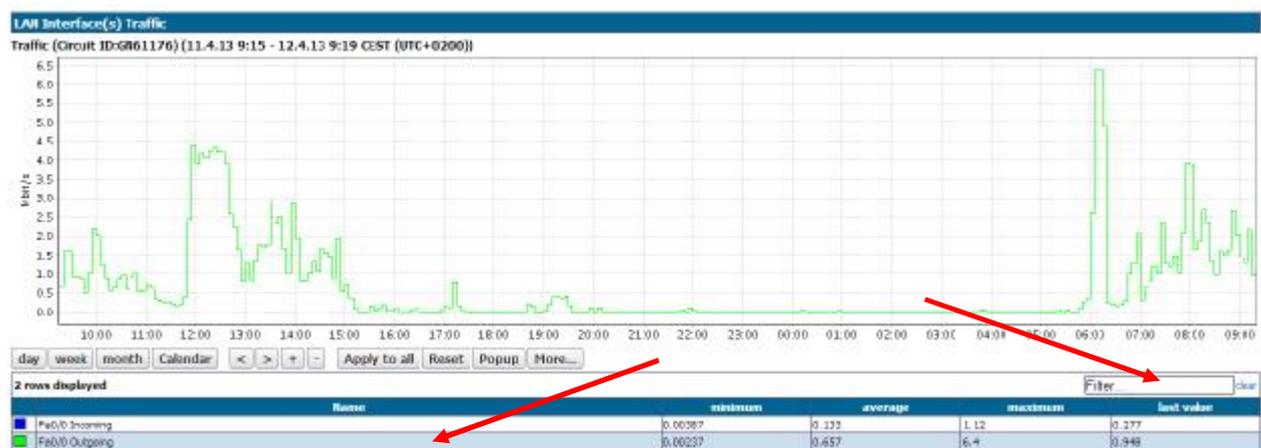
5.3   Zoom

In order to zoon-in of the particular part of the graph simply selected the required area by mouse simultaneously with the left button pressed.


5.4   Change of criteria

Following criteria can be changed for chart display:

*   DAY is a view of 1 day with 15-minute measurements interval (1d/15m)

*   WEEK is a view of 7 days with 2-hours measurements interval (7d/2h)

*   MONTH is a view of 30 days with 12-hours measurements interval (30d/12h)

*   YEAR is a view of 12months with 7-days measurements interval (12m/7d)

Moving between the displayed periods can be done by using the buttons << a >>.
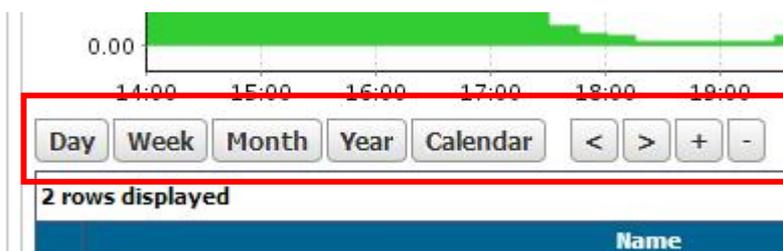
6 Examples of graphs

6.1 WAN/ LAN Interface Traffic

The graph shows data operations on WAN interface.
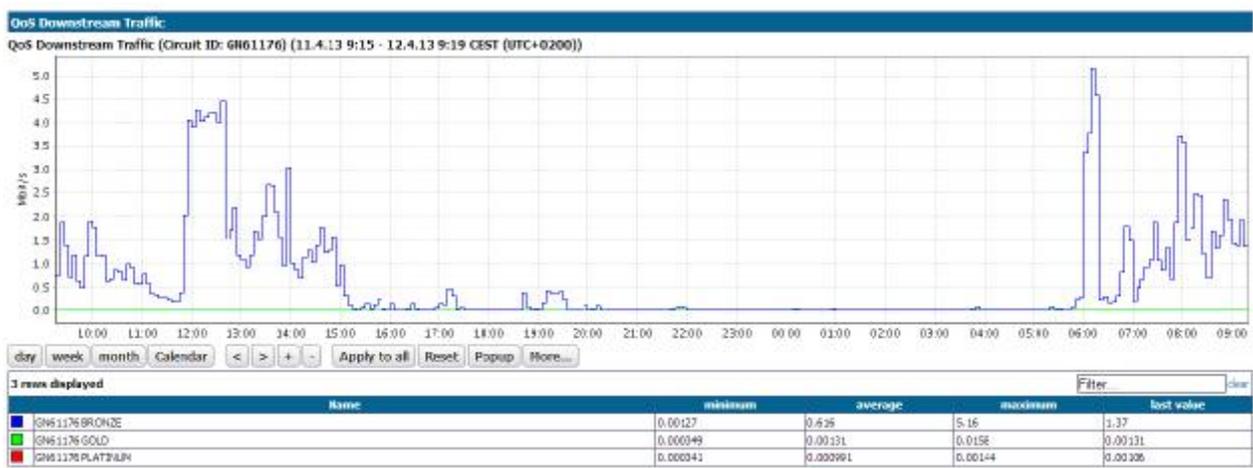
6.2 WAN/LAN Interface Utilization

The graph shows the utilization of WAN interface.

6.3 WAN/LAN Interface Speed

The graph shows the speed of the connection.

6.4   QoS Summary Downstream/Upstream

The graph shows data operations in time according to individual QoS classes after application of QoS rules.
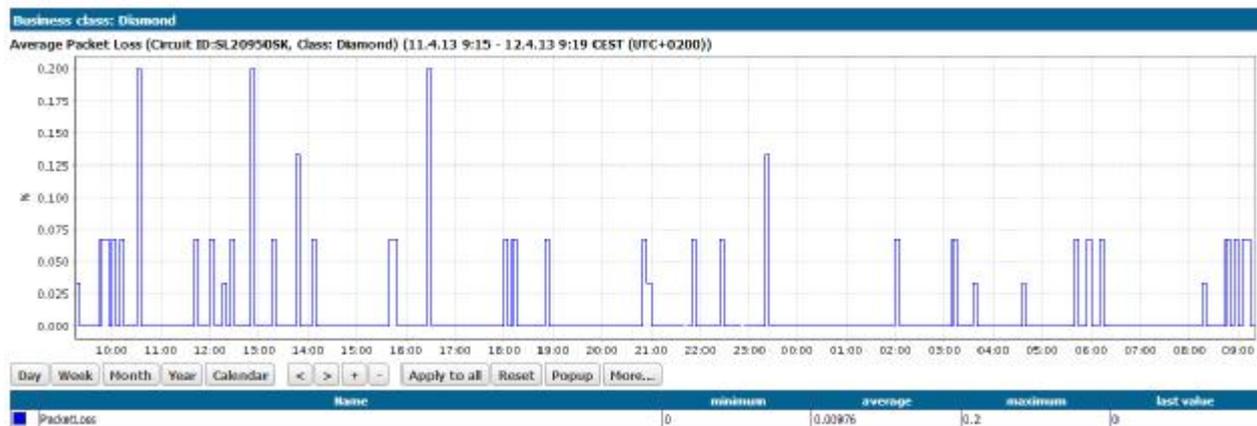
6.5   QoS Drops

The graph shows the operations which did not fit within the framework of the QoS classes configured in individual classes and had to be dropped.

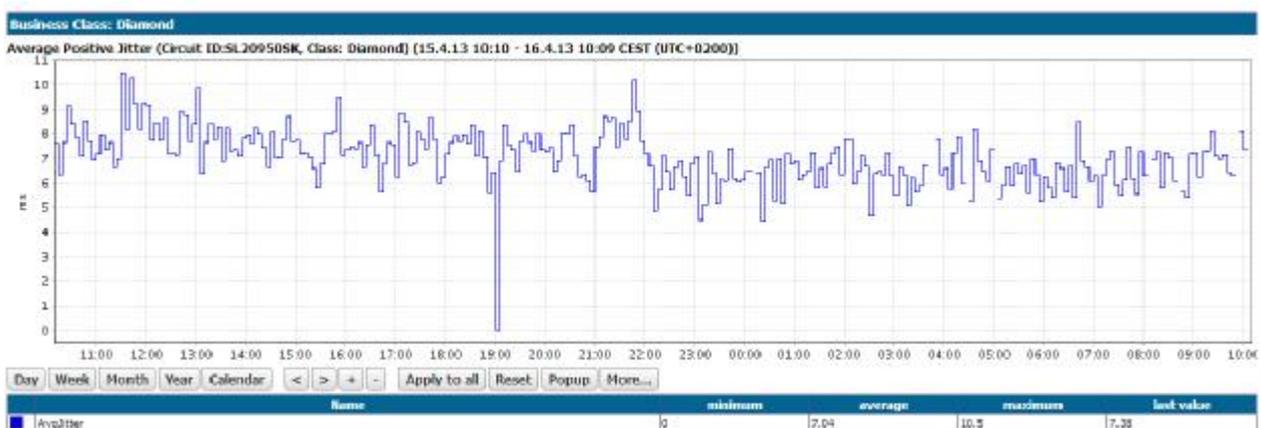## 6.6   Average Round Trip Delay

The graph shows the average delay of packets within the selected QoS class.

6.7 Average Packet Loss

The graph shows average packet loss within the selected QoS class.

6.8 Average jitter

The graph shows the average positive jitter within the framework of the Diamond QoS class.

6.9 MOS value

The graph shows the value of the MOS score within the framework of the QoS class Diamond.