QoS/GOS Management Measurements in IP/ATM and Wireless Environments

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Abstract: This paper illustrates some measurement examples and scenarios that can provide information which can be further used to build standardised MIBs to measure QoS/GOS in various different technologies. We show that network management and its tools can be used efficiently to collect and measure within scripts QoS/GOS related parameters.

1. INTRODUCTION

Building QoS into the Internet is one of the topics of current interest. New traffic management methods in the internet: Integrated services [1,2], differentiated services [3, 4, 5] and other QoS-architectures may enable provisioning several classes of service with different QoS-levels. The methods combine classification, priority mechanisms and reservation of bandwidth. There is currently much work on characterization of traffic in the Internet, like [6], which is useful in the classification and management of traffic. Both ITU-T and IETF have defined relevant QoS/GOS parameters [7-11] that could be used and measured to assess QoS for the Internet. These measurements have been mainly carried out in operator networks. However, several sub-scenarios outside operator networks can be identified and need to be issued. Managing these measurements is a growing issue, because it is very hard to measure remotely the real QoS/GOS of the end-user.

2. MEASUREMENT SCENARIOS AND ENVIRONMENTS

QoS/GOS parameters need to be measured or simulated in several different measurement scenarios and environments, using standardised solutions. We are performing measurements in IP/ATM networking environments and using standardised network management solutions. We have presented the following list of QoS/GOS-parameters that seem sufficient for fixed IP-networks: *delay, jitter, packet loss, connection blocking,* some connection *set-up times,* when relevant, and *transfer rate.* [16] There exist several ways to apply network management to measurements. Simple SNMP and its evolution path and remote monitoring MIBs [12], the OSI-based CMIP approach [13], TMN Q3-interfaces [14], various distributed object management architectures (e.g. CORBA), and policy-based networking. Our employment strategy uses simple SNMP. The basic network environment is illustrated in Figure 1. SNMP is used to query measurement-related information from the target device, and Perl script will perform the calculation of the parameter. In the Figure, Computer A has an SNMP agent and the measurement script, D has SNMPmanager and the C is the measurement target. B represents IP/ATM capable switch or router. Lately IETF has also designed a SNMP framework [17] and MIB structures for performance measurements [18].

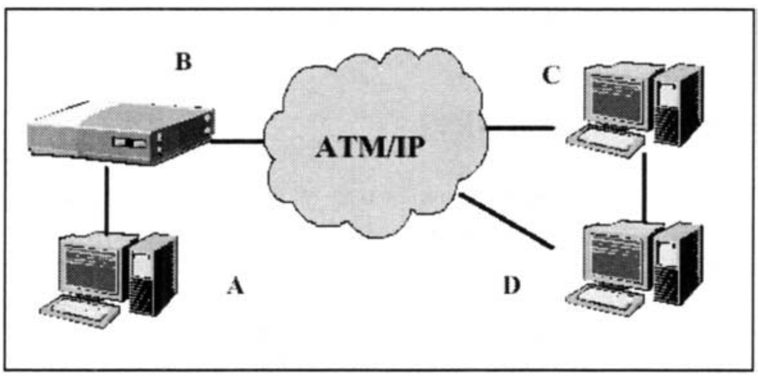

Figure 1. IP/ATM measurement environment

Subscriber access to the Internet can be achieved through various access methods where the traffic characteristics can be drastically different. Among these sub-scenarios we could clearly point out three different sub-scenarios; these are low bit-rate user access (e.g. analog modem), wireless packet-based access (e.g. GPRS), secure remote use (e.g. IP-VPN), which differ in traffic aspects and should be considered while developing QoS-measurement methods. We are performing these sub-scenario measurements, for instance, in a wireless packet environment. Our goal is to get appropriate information about the traffic characteristics and then build MIBs that are based on standardised solutions. However, at the moment these sub-scenarios need to be studied further in order to provide an analysis of existing QoS/GOS parameter applicability to these various measurement environments. In the last measurement environment (Figure 2) we implemented a system in which the network device could dynamically change the priority of the packet, based on the delay-measurement only. This environment differs from others because it does not yet provide SNMP manager and agent capability. However, other traffic management tools provided for the Linux environment were used to collect the data.

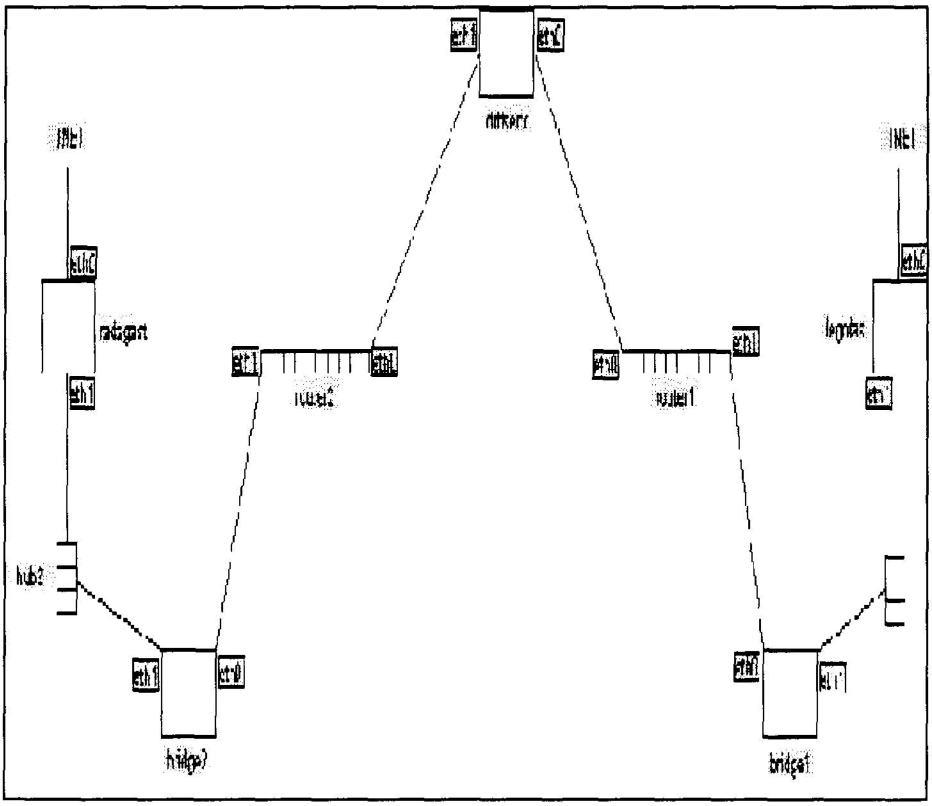

Figure 2. IP Priority measurement scenario

3. MEASUREMENT RESULTS AND OBSERVATIONS

3.1 IP/ATM networking QoWGOS measurements

Set-up delays are included in GOS-parameters. In the QoS-Internet set-up delay monitoring will be needed, e.g. in MPLS, which will modify the existing ATM considerably. In the measurements RMON is used for collecting measurement data, and RMON runs PERL scripts, which measure QoS/GOS-parameters. The script calculates the average of measured delays of *setup-connect* and *disconnect-release* and then initiates the SNMP agent and listens to the appropriate SNMP port and performs the measurement. These delays, however, are not directly implemented into ATM drivers or into ATM switches. Therefore, the UNI 3.1 signalling timers featured in [15] are used in measuring these timers, and the delays can be calculated respectively. This concept is further expanded to IP networks and its parameters. The loss could be measured from any device using SNMP MIBs. Among these live measurements from the University network we have measured IP-related QoS parameters using the above-mentioned technique. Below is a loss measurement example (Figure 3) of the live measurement of IP traffic.

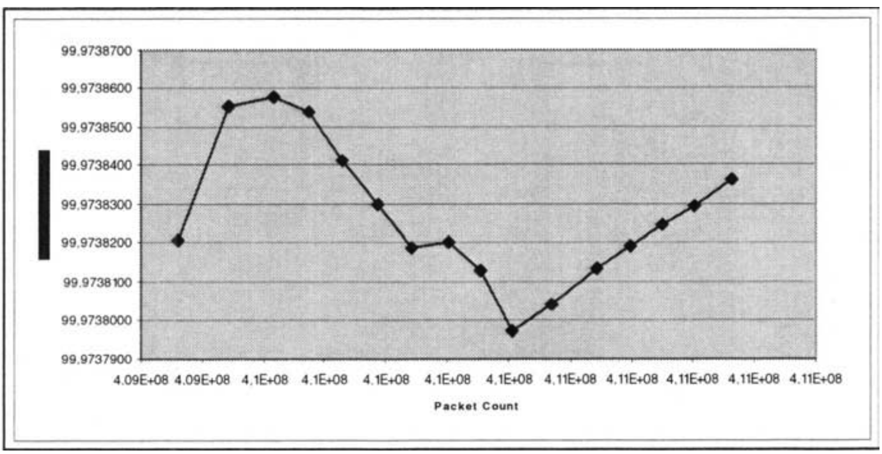

Figure 3. IP/ATM example measurement

3.2 Wireless sub-scenario QoS/GOS measurements

In wireless environment the Qos/GOS parameters could also play a more significant part in the non-congestion situation. But they will be particularly useful if congestion does occur. We have measured QoS/GOS parameters (mainly loss) in WLAN office environments. For each sub-scenario like this, one's own MRPs need to be identified. These measurement points (A, B and C) are illustrated in Figure 4. We have chosen these MRPs according to empirical measurements in the test environment.

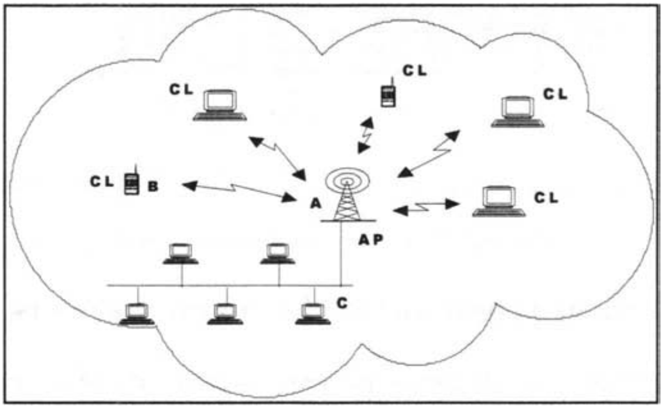

Figure 4. WLAN measurement reference points

We undertook several loss-measurement cases at all these measurement points. In Figure 5 there is a loss measurement sample from the MRP A in Figure 4, which means a measurement from the access point. The sample shows promising numbers for wireless data but one should note that it was tested from an access point with no congestion and no mobile units (clients) in use. These measurements are, however, initial measurements, since the test environment (Wireless Lappeenranta) is constantly under construction. This methodology will be expanded to other parameters even though current WLAN equipment does not provide any QoS/GOS parameter support itself. Mainly, the existing MIBs provide physical and link layer statistics, which could be used in GOS measurements.

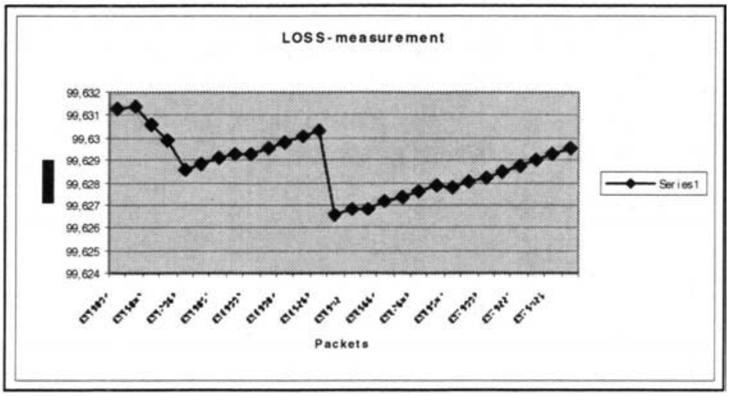

Figure 5. WLAN loss measurement example

3.3 Priority algorithm QoS/GOS measurements

Let us introduce an algorithm that reduces jitter. It can be implemented in any network device but is not essential. The algorithm can change the priority of an IP packet in order to speed it up or slow it down. The speed-up or slow-down process could be handled by, for example, using priorities. The implementation of the algorithm needs modifications to the standard IPv4 packet, but it could easily be included within IPv6 additional headers. The algorithm operates so that each device has a table built in for each segmented sub-network, and relevant service classes for various services. These classes contain information, several delay threshold values, counters and some constants. The algorithm uses sub-algorithms to make the measurements of, for instance, delay and its variation, and changes of priorities for the packets. Integration of this kind of algorithm into standardised network management (e.g. SNMP) needs to be studied further. In these measurements Linux tools were used. In the examples below, the charts illustrate delay classes of milliseconds, in which on the left hand side is the measured data without any priority algorithm in use, and on the right hand side the algorithm is in use. We clearly see the difference in delay classes.

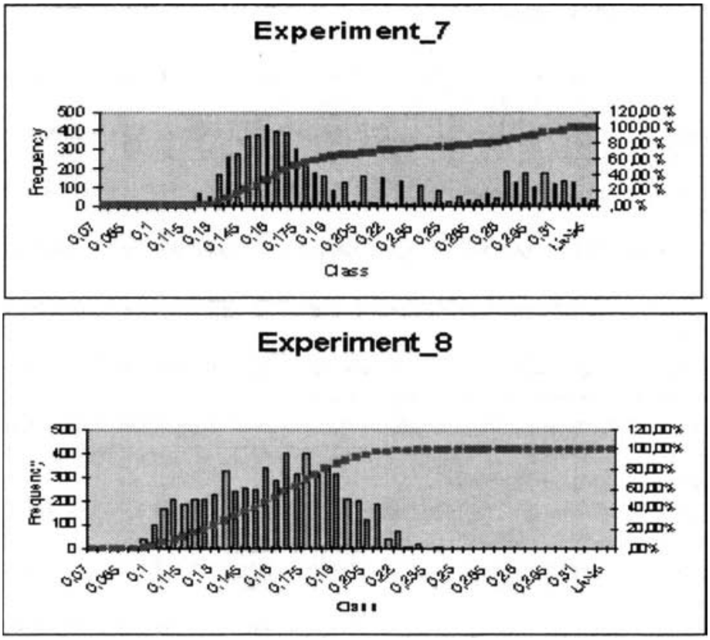

Figure 6. IP Priority measurement example

4. CONCLUSIONS

The paper presents some QoS/GOS parameter measurements and simulations performed using network management tools. It is clear that network management is a viable solution to the problem of collecting QoS/GOS statistics, and can be used to dynamically change the traffic pattern. However, most of the MIBs do not contain a lot of QoS/GOS data to be collected. Therefore it is not trivial to include the data collection directly, using MIBs. Within these measurements and simulations we try to find sufficient MIB structures that are not related to any architecture, scheme or other restricting technology. The MIBs themselves are quite simple, they do not perform, for example, a counting process of the delays. The scripts are used in calculations, in traffic control, in queue mechanisms etc. However, we have designed several proprietary MIBs both for ATM and IP QoS/GOS measurements. All the measurements are live measurements, not measured using test packets, as in PPM and 1.380 methods.

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