Title:	Document Version:
Deliverable D4.4 **First Year Public Trial and Evaluation Report**	1.9

Project Number:	Project Acronym:	Project Title:
IST-2001-37611	6QM	IPv6 QoS Measurement

Contractual Delivery Date:	Actual Delivery Date:	Deliverable Type* - Security**:
30/11/2003	16/07/2004	R – PU

* Type: P - Prototype, R - Report, D - Demonstrator, O - Other
** Security Class: PU- Public, PP – Restricted to other programme participants (including the Commission), RE – Restricted to a group defined by the consortium (including the Commission), CO – Confidential, only for members of the consortium (including the Commission)

Responsible and Editor/Author:	Organization:	Contributing WP:
César Olvera	Consulintel	WP4

Authors (organizations):

Miguel Ángel Díaz (Consulintel), Jordi Palet (Consulintel), Guido Pohl (Fokus), Emile Stephan (FT), Lidia Yamamoto (HEL), David Diep (HIT).

Abstract:

This document describes the work done in the public trials done by 6QM during the first year.

The document has been extended to include a longer period, considering the project extension.

Keywords:

IPv6 Test-bed, Public Trails, QoS Measurement.

Revision History

The following table describes the main changes done in the document since created.

Revision	Date	Description	Author (Organization)
v1.0	17/09/2003	Document creation	César Olvera (Consulintel)
v1.1	26/10/2003	Added contributions from FT and FOKUS	César Olvera (Consulintel)
v1.2	15/12/2003	Added User Groups Information	Miguel Ángel Díaz (Consulintel)
v1.3	22/01/2004	Content updated	César Olvera (Consulintel)
v1.4	12/02/2004	Content updated	César Olvera (Consulintel) Miguel Ángel Díaz (Consulintel)
v1.5	15/03/2004	Content updated	César Olvera (Consulintel)
v1.6	11/06/2004	Content updated	César Olvera (Consulintel)
v1.7	15/07/2004	Added contributions	César Olvera (Consulintel)
v1.8	16/07/2004	Added contributions	Miguel A. Diaz (Consulintel)
v1.9	16/07/2004	Final review	Jordi Palet (Consulintel)

Executive Summary

This document describes the work done in the initial public trials successfully done by 6QM during the first year in IST 2002, November 2002, CeBIT, February 2003, and Madrid 2003 Global IPv6 Summit, May 2003.

In addition, considering the project extension, and because its relevance, the description of the most complete public demonstration of 6QM prototype showed until now during 6NET Spring 2004 Conference & Eurov6 Showcase, 18th-19th May 2004 in Brussels, is also included.

The main goal with the initial Public trials was to show and test early demonstrators for the system under construction that allows outsiders to get a glimpse on the development work. Also, the idea is reach a good dissemination of project results and to facilitate cooperation with other projects.

Table of Contents

Table of Figures

1. INTRODUCTION

The 6QM "Public Trial and Evaluation Reports" deal with three important activities regarding evaluation and validation of 6QM components:

- Public Trials (A4.4.1).
- Evaluation (A4.4.2).
- Selection of User Groups (A4.3).

This D4.4 describes the main aspects of these activities as base of the public trials done by 6QM.

Then, the document also describes the public trials successfully done during the first year in IST 2002, November 2002, and Madrid 2003 Global IPv6 Summit, May 2003. Finally the recent Eurov6 showcase in Brussels, May 2004, has also been included.

2. EVALUATION AND VALIDATION OF 6QM COMPONENTS

D4.4 deliverable deals with three important activities regarding evaluation and validation of 6QM components.

2.1 Public Trials (A4.4.1)

The Public trials are intended to carry out visible demonstrations to make the project results publicly available. Exploiting the experience and results of the previous internal trials, the aim is to know the best combination of components and refine the testing scenario in order to show a proper interaction among all the project elements. Real users will be integrated for these trials, provided by the A4.3 activity (Selection of User Groups activity, see below in this introduction). Proper agreement of the whole consortium will be needed, mainly because this kind of events is the most important public interface of 6QM project with the society. The goal is to realize at least one yearly public trial event which makes use of project results in large-scale test-beds and which involves a significant number of external actors.

The public trials involve several tasks for a complete scope, including to:

- Define the specific target of each trial.
- Specify the components needed to accomplish the trial target.
- Define the scenario of each trial.
- Run trial and coordinate the process.
- Produce a general trial report.
- Provide feedback on issues that may or must be changed or improved.
- List future work to do.

2.2 Evaluation (A4.4.2)

Evaluation is a critical activity to be performed in any project as 6QM, which is dealing with new network architectures, adapted devices and next generation services and applications.

The evaluation activity involves several tasks for a complete scope, including to:

- Define specific criteria to perform this evaluation activity. Some key parameters, such as, proper QoS support and IPv6 integration, network and application scalability, and robustness, will be considered.
- Identify mechanisms and tools to be used for evaluating the different components in semi-real scenarios. Some of them can be 6QM-based small network test-beds, traffic generators, and so on.
- Identify features that need to be evaluated as well as the parameters that need to be considered. This information will be extract from the inputs received from all the related WPs requiring some evaluation of their results.
- Run the evaluation process itself. An important topic to consider here is the integration within the evaluation of different analysis tools that can be used to extract information about the behavior of the trials and services and specially to compare with the results obtained in the different trials.

- Provide feedback, according to the criteria previously defined, to partners involved in the specific elements that has been evaluated.

These evaluation tasks are used to design, prepare and carry out several test and evaluation activities that will be applied to 6QM outputs and prototypes. Among these test and evaluation activities are remarkable those that will be used for make both internal and public trails.

2.3 Selection of User Groups (A4.3)

In order to make a realistic evaluation for 6QM, the project needs to define real user environments where we can test the scalability of this technology, functionality and performance, to verify that is as good as it was initially expected.

The A4.3 activity deals with de definition of a significant group of final users before starting every internal or external trial. It is important to choose the users within a broad-spectrum especially in order to evaluate and get feedback from a wide range of scenarios and traffic kinds.

Usually, in a first phase the 6QM trials just require a small number of users groups in order to check the functionality. Then in a second phase, the trials will involve a higher number of users groups that could be further scaled if it is necessary.

The main characteristics of the specific groups selected for each trial will be reported as a particular section in the description of the correspondent trial.

3. PUBLIC TRIALS

This section describes the Public trials done during IST 2002, November 2002, and Madrid 2003 Global IPv6 Summit, May 2003. The Eurov6 showcase trial, May 2004 is also included.

These events had delegates and speakers from several countries, and several IST projects were present with different technical demonstrations. This means that these events are an excellent chance for public trial from both technical and dissemination point of view.

3.1 IST 2002, "IPv6 QoS Measurement System"

IST 2002 Event was held at Copenhagen, 4th-6th November 2002. The project demonstrated the 1st version of the IPv6 QoS Measurement System.

France Telecom (FT) presented on behalf of 6QM, two demonstrations:

- IPPM REPORTING MIB proxy agent.
- Dual stack IPPM Probe for UDP & TCP.

3.1.1 Specific targets

Nevertheless the early stage of 6QM project by this date, it was an early public trial looking for a better dissemination of its project results and to facilitate cooperation with other projects. The main goal was to show and test and early demonstrators for the system under construction that allows outsiders to get a glimpse on the development work starting from early phases in the project.

3.1.2 Components needed and run trial

The demonstrations included the following issues:

3.1.2.1 IPPM REPORTING MIB proxy agent

To provide the applications with a better visibility of the end-to-end quality of service among composite IP networks, there is a need of peering points to exchange interdomain end-to-end performance measurements. The IPPM REPORTING MIB proxy agent controls the sharing of the resources of its measurement system. It controls the setup of both aggregated measures and reporting. The demonstration consisted in a stand-alone proxy that permits granted peers to perform aggregated metric measurements on the network measures already performed in the proxy measurement system.

3.1.2.2 Dual stack IPPM Probe for UDP & TCP

To measure IPv6 network end-to-end performance FT has developed a dual stack IPv6 probes for measuring the performance of IPv6 UDP and TCP applications. The system of measure setups for the IST demonstration consisted in a set of probes performing IPv6 IPPM metrics measures. One of the probes was located on the FT IPv6 experimental network, named VTHDv6, and the others were based in the IST exhibition hall.

3.1.3 Trial scenario

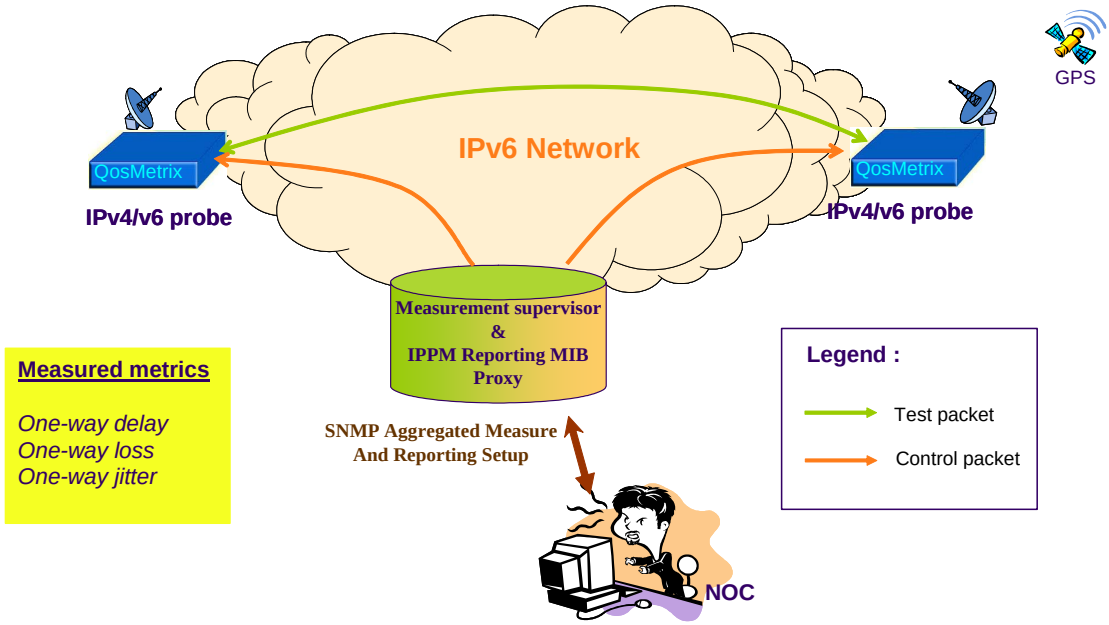

Figure 3-1: FT Dual stack IPPM Probe for QoS Measurement

3.1.4 Feedback

During these trials had been gathered important information for the future work of design and develop within 6QM.

3.1.5 Future work

Since this trial, the future work includes:

- Integration IPv6 probe and IPPM REPORTING MIB.
- Integration of Spatial metrics.
- Standard packet test: Measurement Packet Header.

3.2 Madrid 2003 Global IPv6 Summit

The Madrid 2003 Global IPv6 Summit was held in Madrid, 12th-14th May 2003.

3.2.1 Distributed IPv6 IPPM Metrics Measurement

France Telecom updated the demonstrations done at the IST 2002 Conference:

- The IPPM Reporting MIB proxy agent.
- The Dual Stack IPPM Probe.

3.2.1.1 Specific targets

The main targets of this system are to:

- Provide a distribute measurement system to generate real IPv6 services traffic to calibrate the passive probes developed by 6QM.

- Get operational constraints usable for active or passive measurement systems.
- Work toward coupling the QoSmetrix active measurement system with flows information exported by routers IPFIX meters.

3.2.1.2 Components needed and run trial

The measurement system consists of the following main components:

- IPPM Proxy and SNMP agent.
- Five QoSmetrix NetWarrior (IPPM and RTP probe).
- One QoSmetrix NetAdvisor (Management software for NetWarrior).

The demonstration was held as follow:

3.2.1.2.1 IPPM Reporting MIB Proxy Agent

The IPPM Reporting MIB proxy agent controls the sharing of the resources of its measurement system. The demonstration consists of a stand-alone proxy that permits granted peers to perform aggregated metric measurements on the network measures already performed in the proxy measurement system.

3.2.1.2.2 Dual stack IPPM Probe

The dual stack IPPM Probe, provided by QoSmetrix, allows for measuring the performance of IPv6 UDP and TCP applications. The demonstration consists of a set of probes performing IPv6 IPPM metrics measurements. One of the probes is located on the FTR&D IPv6 experimental network, VTHDv6, the others are deployed locally in the Madrid IPv6 Summit demonstrations room.

3.2.1.3 Trial scenario

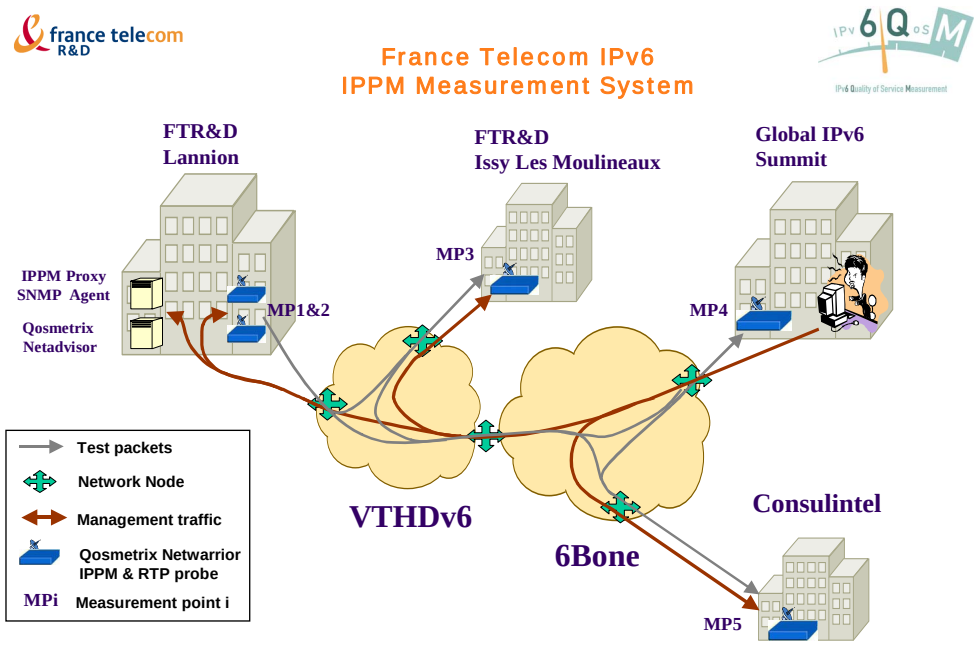

Figure 3-2: IPv6 IPPM Metrics Measurement & Management

3.2.1.4 Feedback

During these trials had been gathered important information regarding:

- Calibration information for the passive probes that are been developed by 6QM.
- Operational constraints information usable for active or passive measurement systems.

3.2.2 Content Delivery and Measurements in Satellite Networks

FOKUS presented on behalf of 6QM this demonstration on Non-intrusive Measurements for IPv6 over satellite networks. Also, the demonstration was a presentation of the 6QM prototype.

6QM related functionality was firstly shown at CeBIT Hannover, 12th-16th March by FOKUS. The scenario presented there was a solution for transmission of multimedia streams over hybrid networks. Live video and audio streams are transmitted to mobile devices using IPv6 multicast over satellite, terrestrial and WLAN networks. The measurement tools presented already included in a rudimentary form some of the functionality planned for the integrated 6QM system. An update of this demonstration scenario was installed for the Madrid 2003 Global IPv6 Summit, for which also measurement components provided by Hitachi had been integrated into the demonstration system.

3.2.2.1 Specific targets

The main targets of this system were to:

- Show the 6QM prototype.
- Show Non-intrusive Measurements of IPv6 traffic.
- Perform and demonstrate Passive Measurements in presence of multimedia traffic.

3.2.2.2 Components needed and run trial

There was a continuous installation in Birlinghoven, Germany (IPv6 source network) with a satellite uplink dish. The location of the IPv6 Summit in Madrid, Spain (IPv6 remote network) has been connected via satellite link; therefore, a small satellite dish has been mounted on top of the conference venue (hotel Auditorium).

A video and audio stream has been sent from Birlinghoven to Madrid. The transmitted stream was encapsulated in IPv6 on multicast addresses on the receiving side of the satellite link. The traffic of this audio/video application has been used to perform and demonstrate Passive measurements in presence of existing application traffic.

At the IPv6 Summit, one-point and multi-point measurements were executed. Bandwidth measurements for instance represent one-point measurements; whilst one-way delay measurements are represents of multi-point measurements.

3.2.2.3 Trial scenario

Regarding the arrangement used during the demonstration, there are basically two locations, Birlinghoven and Madrid. A satellite links the two locations in order to stream IPv6 audio/video traffic. The measurement probes have been installed in a host within the IPv6 source network in Birlinghoven and within the IPv6 remote network in Madrid respectively. Figure 3-3.

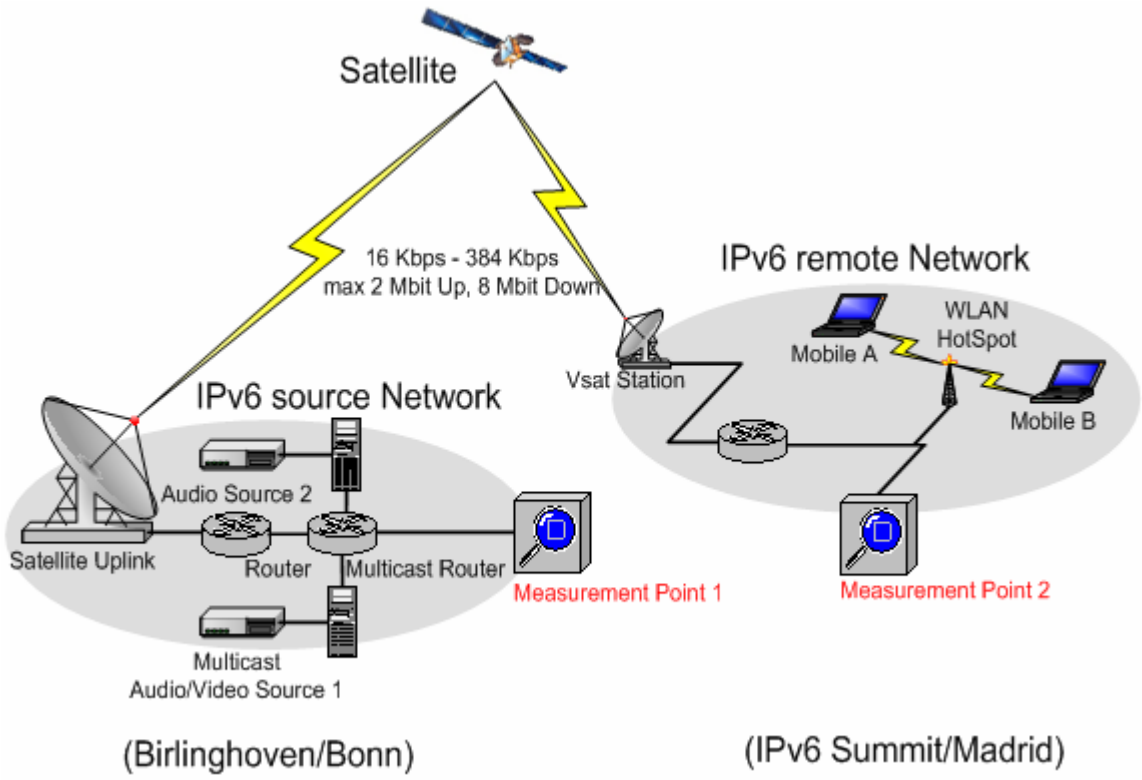

Figure 3-3: Content Delivery and Measurements in Satellite Networks

Figure 3-4 shows that the measurement data have been collected and evaluated at a third instance in Berlin. The measurement system provides an http-based representation of measurement configuration and measurement results, so that we were able to behold the measurement results at the Summit's location.

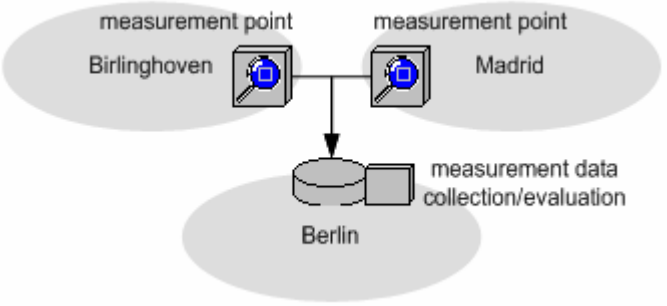

Figure 3-4: Components Location

3.2.2.4 Feedback

Two examples of Measurement results are shown in Figure 3-5. The left side is a time series of one-way delays for packets of the mentioned audio/video stream. There are periods during which the delay increases for packets of the stream. This is most probably inherent to the mechanisms used for transmitting the content via satellite, i.e. caused by buffers. The right side of figure is the distribution of the delays (the mean for the delay lies roughly around 300 ms.).

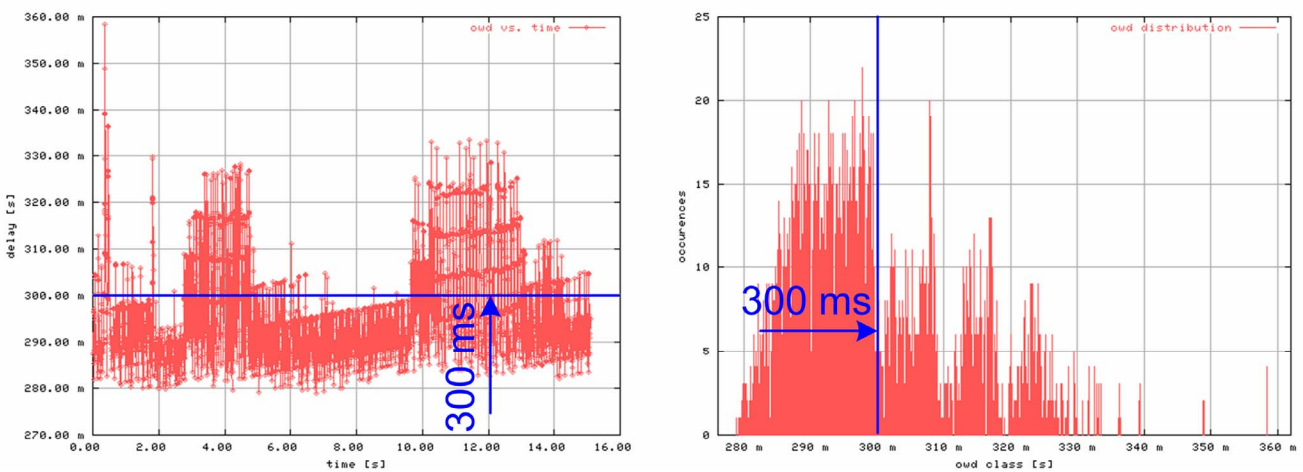

Figure 3-5: Examples of Measurement Results

3.2.2.5 Future work

Based on the measurement results obtained by 6QM prototype, in future trials a validation of guarantees given in a SLA could be used.

3.3 Eurov6 Showcase

6NET Spring 2004 Conference & Eurov6 Showcase was held in Brussels, 18th-19th May 2004.

3.3.1 Fairness for Online Gaming: Distributed QoS Measurements for IPv6

Nowadays, the more complete public demonstration of 6QM prototype was held during trhe Eurov6 Showcase. This demonstration needed the definition and set up the demonstration IPv6 connectivity between Germany, Japan and Spain, using native IPv6 networks as Euro6IX, 6NET, BELNET, WIDE and others as 6Bone. Also, there had been installed and tested the applications for the measurement: Quake2 patched for IPv6 and IPv6 video streaming. All these items were jointly used with 6QM measurement probes distributed in Brussels (Belgium), Berlin (Germany), Japan and Madrid (Spain).

3.3.2 Specific targets

The main targets of this demonstration were to:

- Show the features of the 6QM prototype.
- Show Non-intrusive Measurements of IPv6 traffic.
- Perform and demonstrate Passive and Active Measurements in presence of real applications like Online Games and Multimedia traffics.

3.3.3 Components needed and run trial

The demonstration tried to show real measures obtained by capturing real application traffic which traversed real IPv6 networks among sites distributed world wide. The applications used for generating traffic were Quake2 IPv6 patched along with Video Streaming.

There is a permanent production IPv6 (and IPv4) Windows Media Server Series 9.0 located at Consulintel which was used to serve the media content during the demonstration. In order to show the media flow, the proper media player was required.

There was also installed a Quake2 Server in Fokus to be used during the demonstration. This server allowed the Quake2 IPv6-patched clients, which were distributed among the different sites, starting the shared game.

Finally, in order to make the measurements, different probes attached to the local networks on each site were needed along the controller which was in charge of configuring properly the probes as well as storing the captured traffic and calculating the results. The synchronization of each measurement component was realized by means of local NTP servers.

3.3.4 Trial scenario

Figure 3-6 shows the scenario deployed during the Eurov6 demonstration. Each site was connected each other though IPv6 networks and all of them had the required 6QM probes to capture the ingoing/outgoing IPv6 traffic. Each probe was locally synchronized by means of NTP servers deployed in each site (dotted red line in Figure 3-6). It is important to obtain precise results.

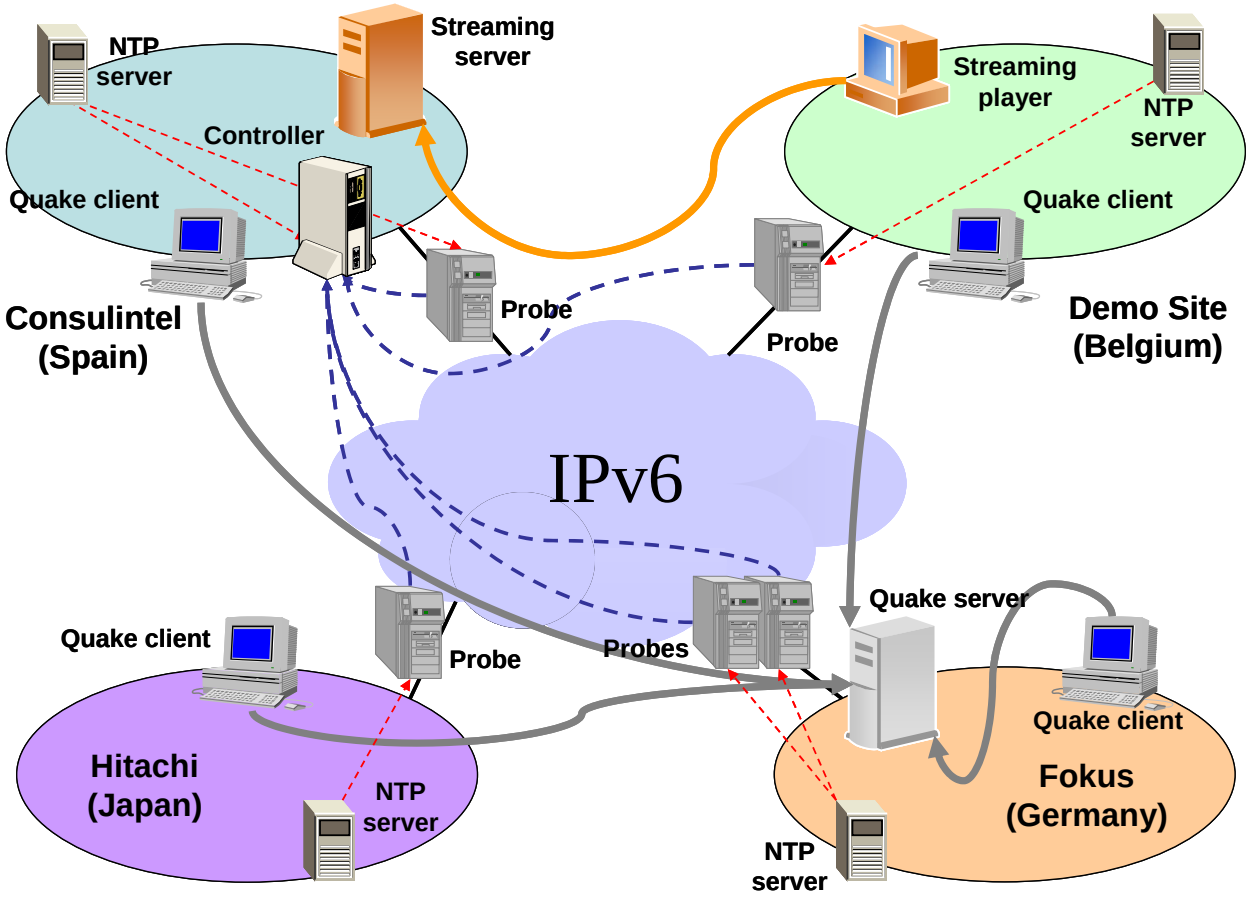

Figure 3-6: Scenario Deployed during the Eurov6 Demonstration

The 6QM Controller is permanently hosted at Consulintel and all the captured traffic was sent to it after each measurement (dashed blue line in Figure 3-6).

On the other hand, the video streaming connection was made between the Eurov6 demonstration site (Brussels) and Consulintel (Madrid), the orange line in Figure 3-6.

Finally several Quake2 IPv6-patched games were played with the participation of several players located in all the sites. All the Quake2 IPv6-patched clients required to connect to the Quake2 IPv6-patched server located at Fokus (Germany), so a lot of IPv6 traffic coming from different sites towards Germany was very useful to test different network conditions. Along with the above explained components, it was also necessary to count with different connection elements like switches, hubs and routers (GW in Figure 3-7) in order to mount the proper network infrastructure in each site. A more detailed picture of the network infrastructure deployed during the Eurov6 demonstration is shown in Figure 3-7.

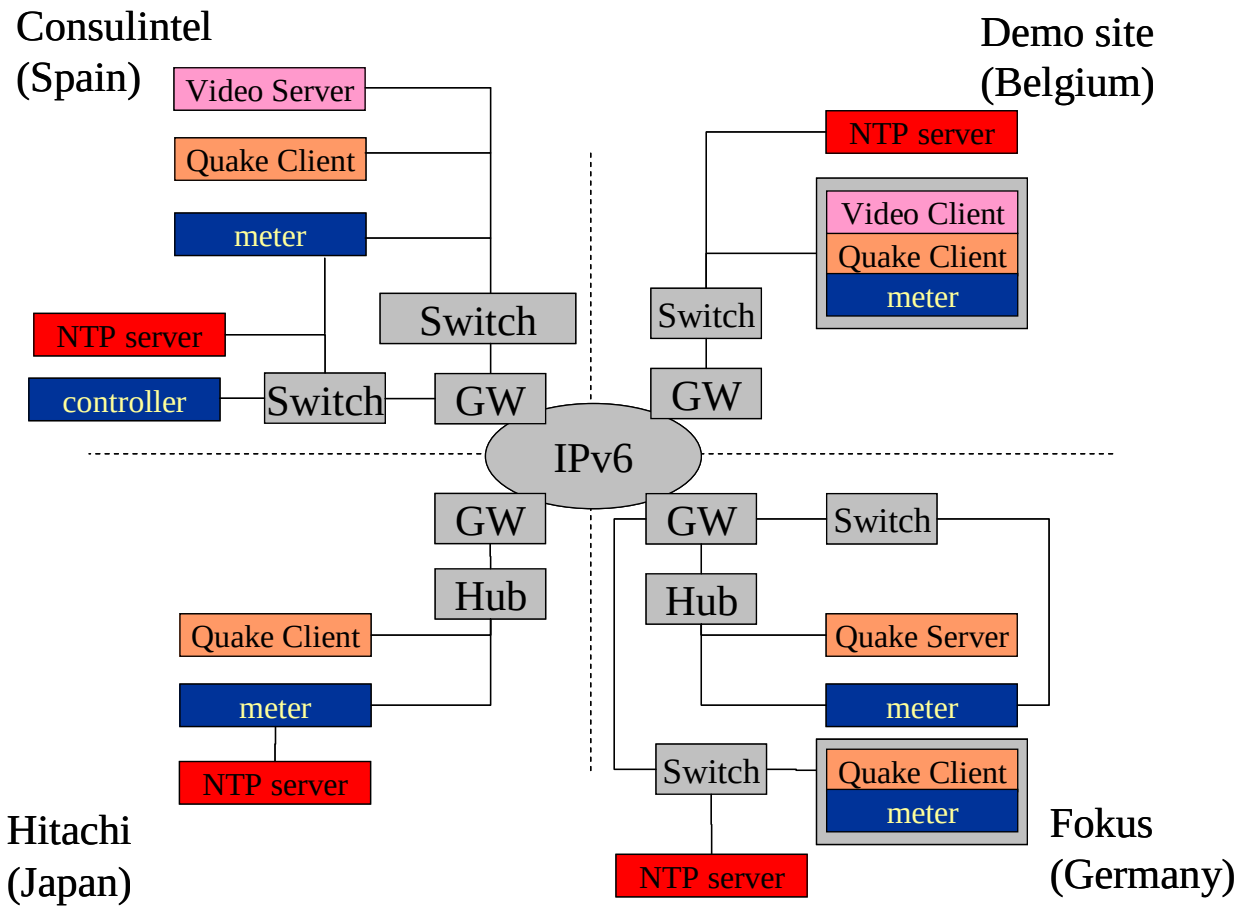

Figure 3-7: Detailed Network Infrastructure

3.3.5 Feedback

Different results were obtained during the Eurov6 demonstration which validates the work done until now within the 6QM project.

As example, Figures 3-8 shows two snapshots regarding the bandwidth consumed on the Fokus (Germany) link along with the one-way-delay measured between Fokus (Germany) and the different sites.

Measurements were made while four players were playing the Quake2 game. Players were located at the four distributed sites showed above.

Given the fact that each site had its own probe, it was easy to show one-way-delays between remote Quake2 IPv6-patched players and the centralized Quake2 IPv6-patched server. The most significant delays in Figure 3-8 is the high value measured between Germany and Japan, which is around 800 ms.

On the other hand, negative delays only show that the measured flow was on the contrary direction to the configured one on the measurement.

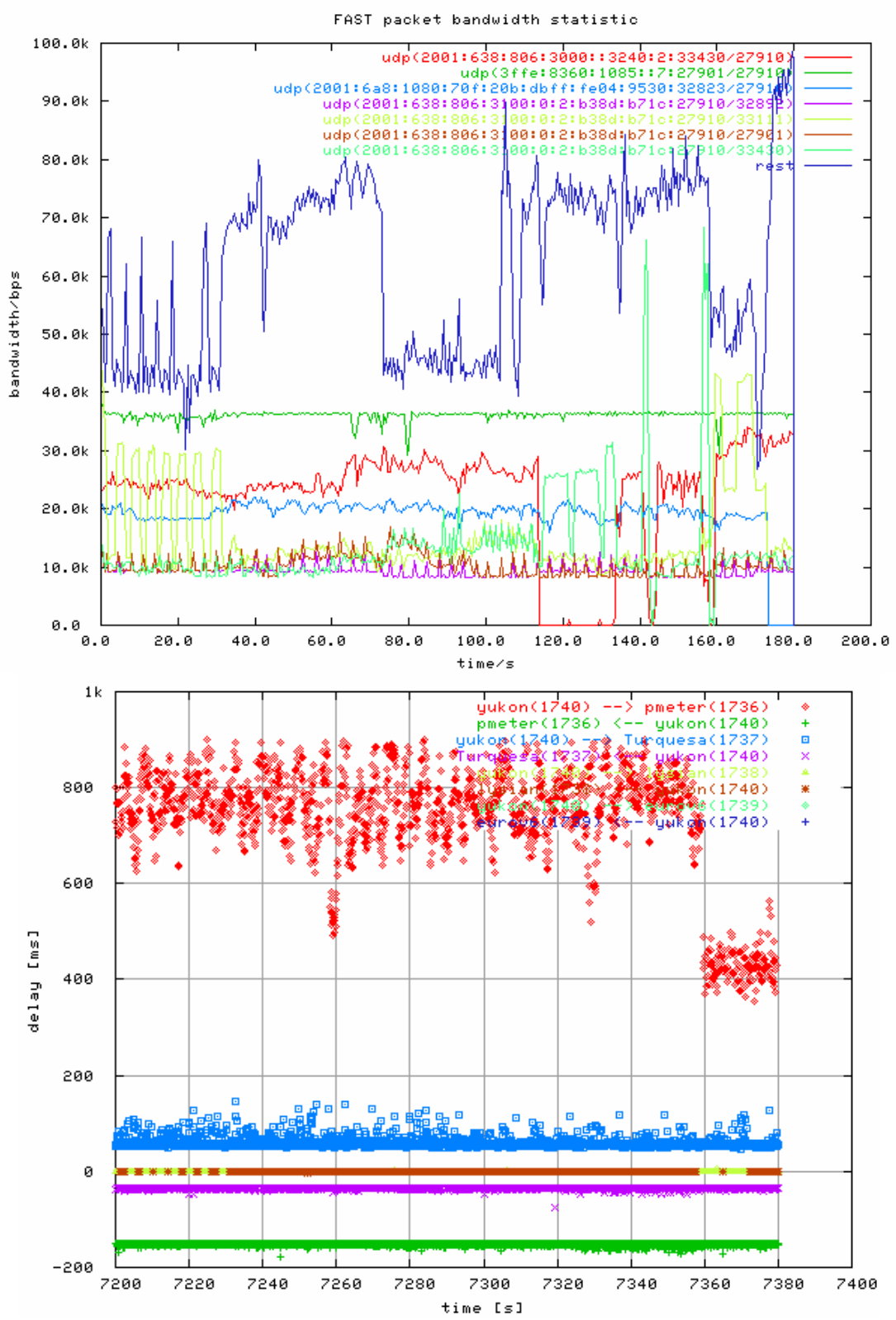

Figure 3-8: Examples of Eurov6 Demonstration Measurement Results

3.3.6 Future work

Based on measurement results obtained by 6QM prototype and the experience gained during the Eurov6 demonstration, future trials can be planned to refine the demonstrations.

3.4 First ETSI Remote IPv6 Interoperability Plugtests

Finally, it is important to remark that HEL and Consulintel participated in the 1st ETSI Remote IPv6 Interoperability Plugtests event during the Madrid 2003 Global IPv6 Summit on12th-14th May 2003. This Plugtests event interconnected several sites in the entire world in native IPv6.

- ETSI (Sophia-Antipolis, France).
- Hitachi Europe (Sophia-Antipolis, France).
- IRISA (Sophia-Antipolis, France).
- Madrid 2003 Global IPv6 Summit (Spain), http://www.ipv6-es.com.
- Consulintel (Spain).
- BT (Spain).
- Spirent Communications (Spain).
- Hitachi (Spain).
- Université Libre de Bruxelles (Belgium).
- TAHI (Japan).
- ChungHwa Telecom (Taiwan).
- TTA (Korea).
- New Hampshire University (USA).

This test session was the first remote IPv6 interoperability event organized by ETSI in the framework of the Plugtests activity. Several tests were performed, including QoS, DNS, Mobile IPv6 and BGP4+. The test coordination was managed from ETSI using the ISABEL IPv6 videoconferencing system.

4. EVALUATION

As was stated before, the evaluation tasks are been used to design, prepare and carry out several test and validation activities that are been applied to 6QM outputs and prototypes.

As the public trials are an important activity for 6QM, it is crucial to gather as much information as possible during the realization of those trails. In this way we can count with information not only for the right evaluation of the different aspect of the trial, but as well information for future trials.

Then, information as follow is collected, integrated and saved for current and future reference for the different trials.

4.1 Trial Information Example

4.1.1 Title

Distributed IPv6 IPPM Metrics Measurement

4.1.2 Description

Scope of this document

Details of the IPPM REPORTING MIB demonstration for the Madrid 2003 Global IPv6 Summit.

Abstract

This demonstration shows the usage of an IPv6 IPPM measurement system to control the quality of IPv6 services. The system is made of two components, the IPPM measurement system of QoSmetrix and the IPPM proxy of France Telecom. The probes are distributed on France Telecom IPv6 Network, VTHDv6, at Consulintel office, and at the Madrid 2003 Global IPv6 Summit venue. The probe manager and the IPPM proxy are located in the France Telecom Lab of Lannion.

The system of measure monitors the QoS of the traffic of IPv6 services (HTTP, RTP, …) exchanged between the points of measures. It measures IPPM metrics and RTP metrics.

The IPPM Proxy is an implementation of the IPPM REPORTING MIB. Its management framework allows users to set up aggregated measures to be performed on results of networks measure exchanged between the probes.

Coupling these two components will allow results of IPPM measures performed among composite networks to be exchanged between administrative domains.

The services that we will see in this demonstration are:

- IPPM measures over a world wide IPv6 network: These measures perform IPPM metrics such as latency, packets loss and jitter.

- RTP measures over a world wide IPv6 network: These measures perform 80 different RTP metrics.
- IPPM REPORTING MIB agent: The agent allows the creation of aggregated measure reports and the production of measure reports based on results previously stored in the agent.

What is new?

- A Full IPv6 (and IPv4) IPPM and RTP Measurement system (Measures are performed per network services).
- A MIB interface for exchanging in the Quality of Service measurement results.

Addition to IPv6 environments

The system of measure provides both the capability of measuring intra domain performance and the capability of exchanging results between administrative areas. Measurement peering should permit to determine end-to-end QoS, based on the concatenation of measurements results exchanged.

Risk

- The IPPM REPORTING MIB agent is a prototype.
- Standard MIB browser do not permit smart MIB interface.
- The Murphy's law!

Who

Emile Stephan (Leader).

Where

Madrid 2003 Global IPv6 Summit, Madrid Spain.

When

12th-14th May 2003.

Event information

http://www.ipv6-es.com.

4.1.3 SNMP Agent Demonstration Platform

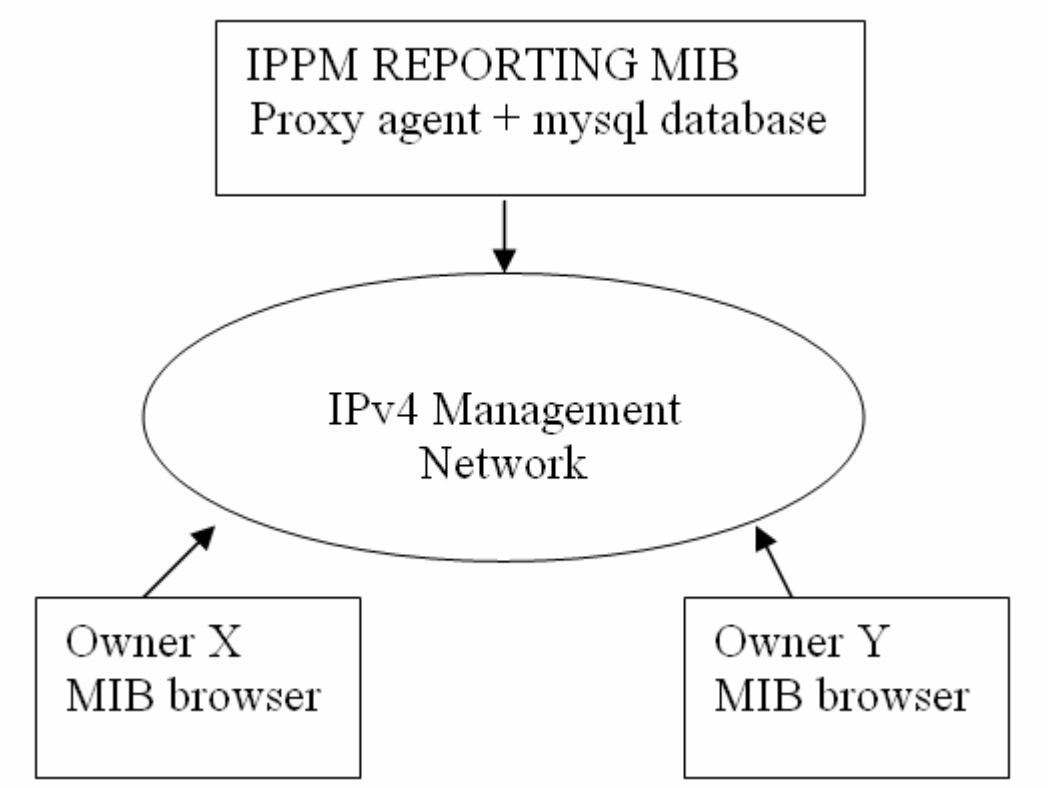

Figure 4-1: Map of the IPPM REPORTING MIB Proxy Agent

SNMP agent

The SNMP agent implementing the IPPM REPORTING MIB runs on Linux.

MIB browser X

A freeware MIB browser on Linux.

MIB browser Y

A MIB browser on Windows.

Needs

For SNMP agent and MIB Browser:

- 1 PC IPv4 on Linux and mysql.
- 1 PC IPv4 on Linux.
- 1 PC IPv4 on Windows 2000.
- An Ethernet 100Mbps IPv4 network.

For the Measurement system:

- 5 QoSmetrix NetWarrior (IPPM and RTP probe).
- 1 QoSmetrix NetAdvisor (Management software for NetWarrior).

4.1.4 Conclusion

The demonstration of the IPPM REPORTING MIB presented the state of the art for a standard management of standard metrics.

A full operative IPv6 (and IPv4) IPPM and RTP Measurement system is showed.

5. SELECTION OF USER GROUPS

To evaluate the project components in realistic conditions, it is needed to define a set of real users making use of next generation services and applications, depending on WP2 inputs.

Indeed, the selection of a broad spectrum of users from different groups is an important activity as will give a realistic and useful feedback about the commercial application of the technology and specially the services offered in several scenarios (commercial and research networks, among others).

One key element of 6QM is the wide scope and high level of usability of this technology. In order to make a realistic evaluation we need to define real user environments where 6QM can test the scalability of this technology, functionality and performance, to verify that is as good as it was initially expected.

The A4.3 activity deals with the definition of a significant group of final users before starting every internal or public trial. The main characteristics related with these specific groups will be reported as a particular section in every trial-related deliverable (D4.4 “First Year Public Trial and Evaluation Report”, this document, and D4.6 “Second Year Public Trial and Project Evaluation Report”).

5.1 Definition of User Groups

There are a number of different ways to classify the Internet users, according to their type of connectivity, their bandwidth requirements, their used services and so on. However, for 6QM project purposes, the best way to classify them is to consider where the user is connected to the Internet because it will give us information about the network requirements, kind of traffic generated, needed SLA and so on.

Also, this approach let us make a user sub-classification according to the most used services by each user group in order to help us to choose the users that should be involved in the trials that are been carried out within the project.

According to this point of view, we should consider how the Internet topology is, in general, currently structured by seeing the Figure 5-1.

In that top-down view, the users that are placed at the bottom of the topology can be considered as end-users. Within the 6QM project scope, we can consider that this kind of users is basically (but not exclusively) traffic consumers, in the sense that there is more traffic received by the users than traffic sent by them. We should note that this trend is quickly changing with the avenue of peer to peer applications, and probably IPv6 will increase this.

On the other hand, we can also consider the traffic generators that send the traffic to the end users. They are not shown in the picture for simplicity but we can easily identify some of them, like e-companies, content providers, ISPs, etc. Depending on the network requirements they can be attached to other different point than local ISP.

Finally, anther kind of users that is implicitly present in the picture can be grouped as monitoring centers. Its main goal is to have real-time information about the status of the network, links and

so on. Most of them are located within each IX, AS or ISP. They can be considered as both traffic generator and traffic consumer since they have to send/receive management information.

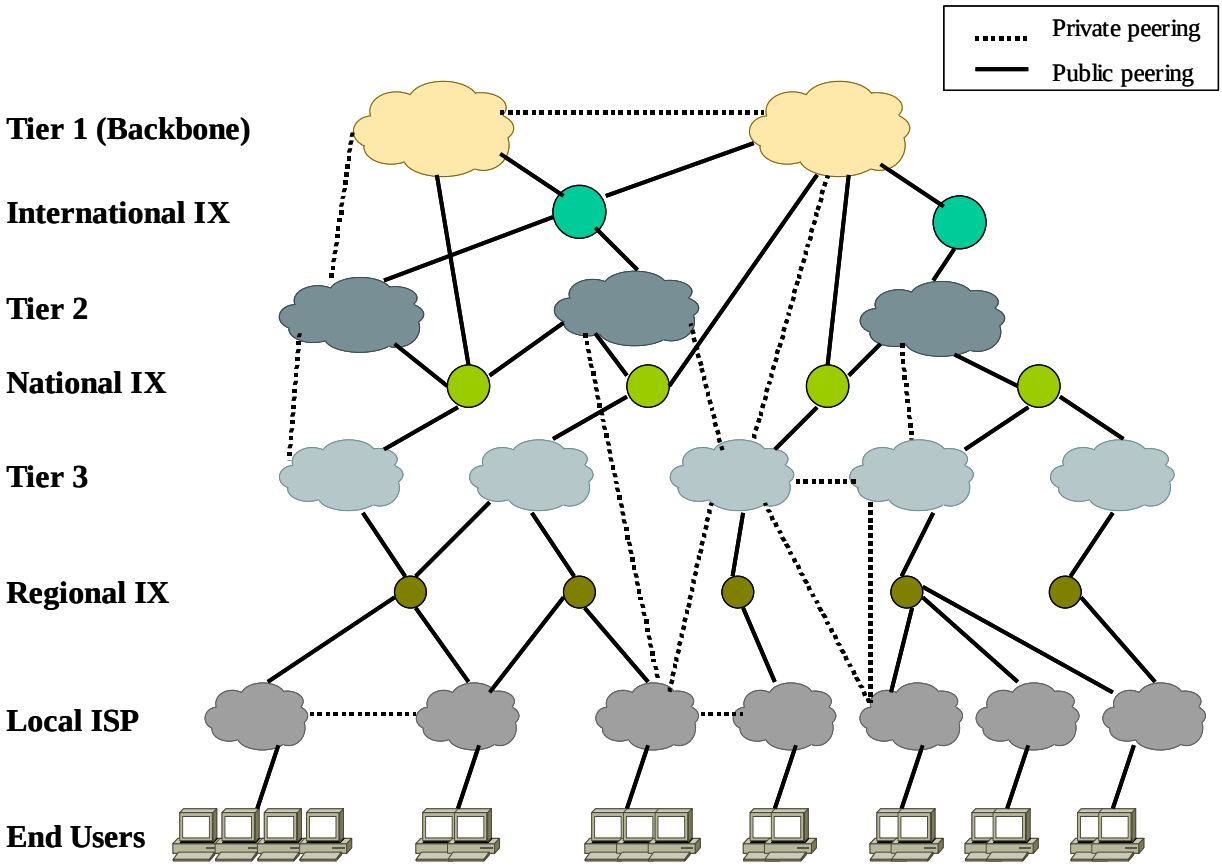

Figure 5-1: Internet Topology

This view is independent of the IP version used in the Internet, so we can consider that the topology shown in Figure 5-1 is valid for both IPv4 and IPv6.

For simplicity we can reduce to two groups the above classification because the key point for all of them is the bandwidth required. So we can consider:

- End User for traffic consumers.
- Service Provider Users mainly for traffic generators and/or traffic monitors.

Bandwidth is an excellent criterion for making a coarse-grained classification of user groups since it gives us a good idea of the amount of traffic that each user generates/consumes, which will have to be measured by the probes in the trials.

Figure 5-2 shows the coarse-grained bandwidth requirements for both types of user groups considered, according to the type of applications/services that they can demand.

5.1.1 End Users

According to the above criterion, End Users are located at the bottom of the Internet topology and they are mainly traffic consumer. They are attached to the Internet by means of ISDN, xDSL, PLC or Cable-modem.

Other connectivity means like analog modem through telephone lines are not considered since the current trends show that people is moving quickly to broadband, due to currently prices for enjoying this kind of technology is cheaper than the past and they offer better bandwidth.

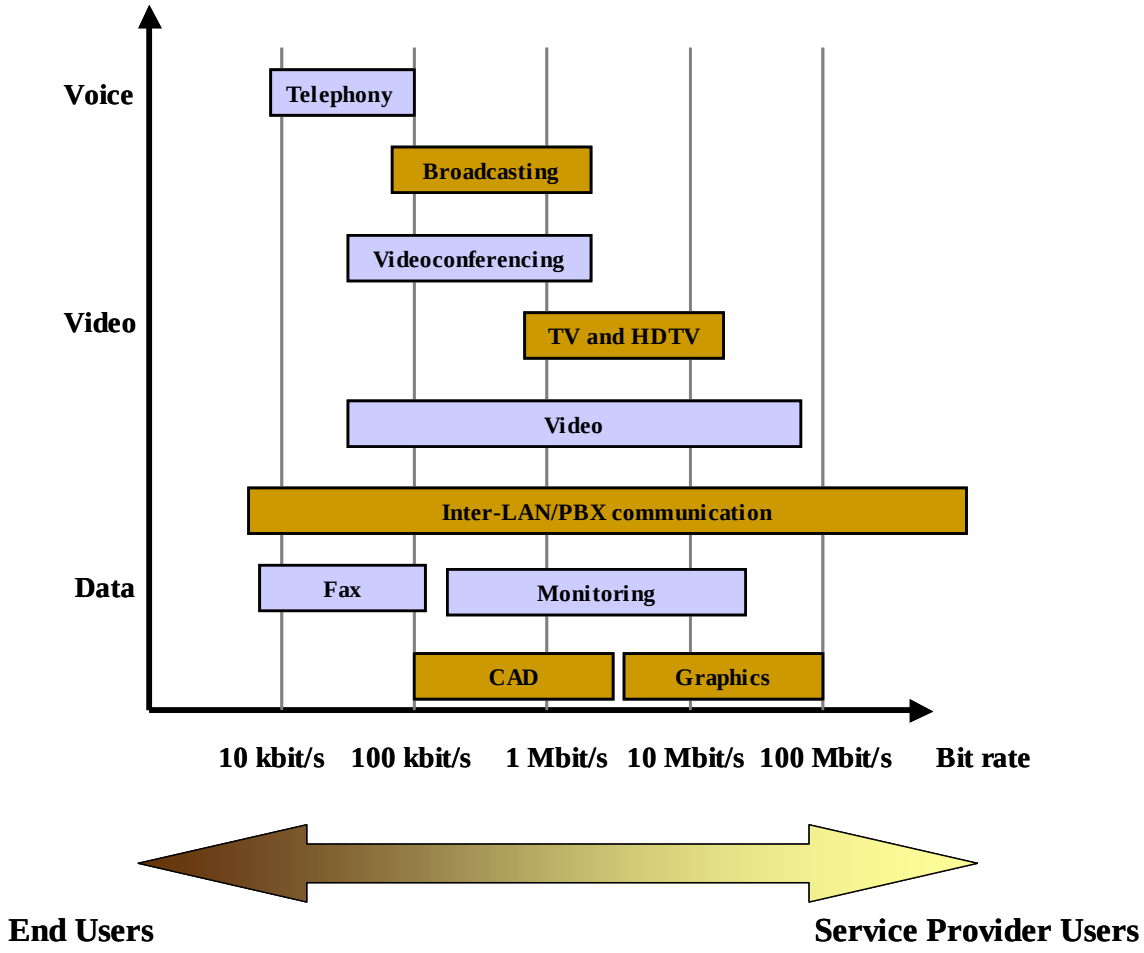

Figure 5-2: Users Bandwidth Requirements

End User is a coarse classification for grouping several types of users, like the following:

- **Residential Users:** They are mainly home users that get connectivity mainly for entertainment. They have not usually LAN into their home.
- **Professional Users:** Subscribers are professional home users or SOHO. They usually are teleworkers that get connectivity for professional purposes and some times have an internal LAN.
- **Business Users:** This type of users is mainly small business users. They also get connectivity for professional purposes and always have an internal LAN in order to interconnect all the hosts located within the enterprise. We consider business users like service users, that is, they do not offer any kind of service to the Internet, and instead they only use them. It is important this clarification because the network requirements depend on it.

5.1.1.1 Services Used

This group of users uses similar wide range of services which include the following:

- **Connectivity and networks**

- VPN for secured communications

- **Communication services**
  - Voice and videoconference
  - E-learning services
  - Multicast
  - GRID applications
- **E-enterprise services**
  - Web
  - FTP
  - E-mail
  - E-bank
  - E-commerce
  - E-health
- **Entertainment**
  - Video streaming
  - Peer-to-Peer applications
  - Network Games

5.1.1.2 Network Requirements

Due to the type of service and application of this group of users, no big network requirements are needed. Indeed, they usually get connectivity through xDSL lines, so no more than 1 Mbps is required.

Following the IETF and RIR recommendations, all the users will get a /48 prefix for their IPv6 network, in order to allow subnetting at any time. No limitations are foreseen related to flow identification bounded to this kind of users.

5.1.1.3 SLA Considerations

Within WP2, the deliverable D2.1 defines several types of SLAs to be used within the 6QM project scope. There is not one SLA for each type of service that users are going to use, but only three SLAs are defined which are listed bellow:

- SLA for HTTP-like service.
- SLA for FTP-like service.
- SLA for VoIP-like service.

Although it seems to be a low number of SLAs, they are defined for the commonest services used by the users. Such services have different features in terms of transport protocol used, bandwidth required, traffic constraints, reliability, etc, so they can be used as good basis for other kind of services for this user group.

Thus, we only have to choose the SLA that better fits to the service to be measured according to simple general criteria like the followings:

- Reliable services with moderate time constraints: SLA for HTTP-like service.
- Reliable services with low time constraints: SLA for FTP-like service.

- Unreliable services with high time constraints: SLA for VoIP-like service.

If the service to be measured cannot be easily identified to an SLA according to the previous criteria, we can use the following table[1] which defines in depth the features of each kind of traffic.

Feature	VoIP-like traffic	FTP-like traffic	HTTP-like traffic
BW need	Low (VoIP) Moderate (Video)	Moderate/high	Moderate (simple content)
Packet loss sensibility	High	High	Moderate
Latency sensibility	Very high	Very low	Moderate
Jitter sensibility	Low	Very low	Very low

Figure 5-3: 6QM SLAs to be Used for End Users

5.1.1.4 Candidate Users

Bellow, some types of users belonging to this user group are shown. They are candidates to be involved in the 6QM trials. The list is only a sample of users and it can be completed further.

- Residential users.
- E-health users.
- Grid users.
- Multicast users.
- Small business.
- Teleworkers.
- Education centers.

5.1.2 Service Provider Users

As explained, we can consider this user group formed by companies that offer any kind of service to the Internet community. They usually have important network requirements in terms of bandwidth, due to they have to attend a lot of users.

But not only service providers can be considered within this user groups, but also Internet Service Providers (ISP), level-N Carriers, and so on. Also Network Operation Centers (NOC) can be included within this group.

Therefore, this kind of users can be attached to the Internet to other level different than the Local ISP. They usually get connectivity by means of link with high bandwidth like E1-E3 links, fiber optic, LMDS, etc.

In general, they are users related to the provision of services, management tasks and network issues.

One interesting point for ISP and carrier users is that they used to have private peering in order to exchange traffic. They are users that can be interested in QoS, so they used to require SLAs

[1] *From deliverable D2.1, figure 6.1*

for allow it. Furthermore, since they belong to different domains, they are good candidates for participating in inter-domain measurements, just in case.

5.1.2.1 Services Used

These kinds of users are interested in the following services:

- **Connectivity and networks**
  - CDN (Content Delivery networks)
  - VPN for secured internal communications
  - Monitoring tasks
- **Content Management services**
  - Processing with encoding facilities in MPEG1, 2 and 4
  - Contribution services, not only live but also off line
  - Storage and directory facilities, in order to allow services like distributed databases and web
  - Monitoring tasks
- **Content Distribution services**
  - Mirroring and caching services
  - Streaming that allows a real time visualization of a video
  - e-News Papers
  - IP multicast Push services for the delivery of even large amounts of data by the partners premises (and remote PoPs)
  - Content Portals
- **Communication and e-enterprise services**
  - E-learning services
  - Voice and videoconference
  - Collaborative work services
- **E-enterprise services**
  - Information management services
  - Web sites and portal hosting

5.1.2.2 Network Requirements

Many of these users are very near of Internet backbone, so they usually manage a lot of traffic. A wide range of bandwidth will have to be taken into account, from tens of Megabytes to hundreds of Gigabytes. This can mean a big limitation when choosing the candidates since the probes to be used in the trials cannot be fast enough for capturing all the traffic. Also the data collector system should have enough storage capacity.

ISP and Carriers usually will have a /32 prefix network or ever lower. This means that a lot of end user communications will travel through their networks, so a lot of flows will have to be managed. This point can be other limitation when measuring end-to-end QoS.

5.1.2.3 SLA Considerations

In principle, we can consider for these users the SLAs already defined in D2.1 which were presented in the previous section. However, if any trial is going to be made with the participation of several ISP/Carriers, it would be interesting to know particular SLAs among them for measuring any kind of traffic in accordance with it.

On the other hand, in spite of the current 6QM SLAs seem to be enough for most of the traffic, it has been detected a minor limitation. All of them are defined for one-to-one communication; none considers one-to-many communications. Content Providers making multicast video streaming, can be interested in different measures distributed along the whole path to all the end users. May be it would be interesting think of a SLA that takes into account the particular features of this kind of traffic.

5.1.2.4 Candidate Users

Bellow, some types of users belonging to this user group are shown. They are candidates to be involved in the 6QM trials. The list is only a sample of users and it can be completed further.

- ISPs.
- Carriers.
- IXs.
- NOCs.
- TV broadcast providers.
- Content Portals.
- e-News Papers.
- e-Learning providers.
- e-Commerce providers.
- Web hosting.
- Data hosting.

5.2 Final Classification

The Figure 5-4 summarizes groups, users, services/applications and SLAs that are candidates to be used in 6QM trials.

In this way we have categorized candidate users, their features, kinds of traffic that they are interested and so on. This data is along the features which are going to be checked in each trial. The date is very important because is going to define the network topology of each trial.

User Group	Candidate Users	Candidate Services/Applications to be measured	SLA to be used
End Users	residential users	VPN for secured communications	SLA for HTTP-like service
	e-health users	Voice and videoconference	SLA for FTP-like service
	grid users	E-learning services	SLA for VoIP-like service
	multicast users	Multicast services/applications	May be will be necessary to define a new SLA for multicast service
	small business	GRID applications	May be Private SLA from ISPs/Carries
	Teleworkers	Web	
	education centers	FTP	
Service Provider Users	ISPs	e-mail	
	Carriers	Web: e-bank e-commerce e-health e-news paper e-learning	
	IXs	Video streaming	
	NOCs	Peer-to-Peer applications	
	TV broadcast providers	Network Games	
	Content Portals	Web sites and portal hosting.	
	e-News Papers	Network Management	
	e-Learning providers	Mirroring and caching services	
	e-Commerce providers	Monitoring tasks	
	Web hosting	Web and data hosting	
	Data hosting		

Figure 5-4: Summary of Users, Services and SLAs to be Used

6. FUTURE WORK

6QM partners are currently doing internal tests and evaluations of performance and may be interoperability/conformance (in case during the project life other products are available in the market with follow the same standards), for the component system developed by partners in order to assure the success of the 6QM outputs. Note that there are not internal isolated trials but inter-partner tests and collaborations that enforce the evaluation process of all the different elements taken into account within the 6QM project.

Then, the outputs of these internal tests will be the base of presentations to IPv6 community in public trials as much as available resources permits.

It is important to remark that both internal and external trials are mainly based in installation and evaluation of the prototype shipped by WP3. With this prototype the consortium have a homogeneous system to perform consistent measurement tests on a world wide scale.

7. SUMMARY AND CONCLUSIONS

The components of 6QM systems need to be evaluated in terms of performance, functionality and interoperability. As part of this activity, the current D4.4 deliverable describes the public trials carried out during the first year of the project.

Thus, the current document deals with three important activities regarding evaluation and validation of 6QM components:

- Public Trials (A4.4.1).
- Evaluation (A4.4.2).
- Selection of User Groups (A4.3).

This D4.4 describes the main aspects of these activities as base of the public trials done by 6QM.

The main goal with the first public trials is to show and test the early demonstrators for the system under construction that allows outsiders to get a glimpse on the development work. Also, the idea is reach a good dissemination of project results and to facilitate cooperation with other projects.

8. REFERENCES

[1] http://www.ericsson.com/support/telecom/tsm/tsm-7-1.shtml

[2] http://www.apnic.net/meetings/12/docs/TWNIC-PROPOSAL-Broadband.htm

[3] http://telecom.esa.int/telecom/www/object/index.cfm?fobjectid=7864

[4] 6QM deliverable D2.1: “Specification on metrics to be used in 6QM project”

[5] 6QM deliverable D4.3: “First Year Internal Test Report”

[6] 6QM deliverable D5.3 “Report on Liaisons”