IPv6 Quality of Service Measurement

6QM Solution for IPv6 QoS Measurements

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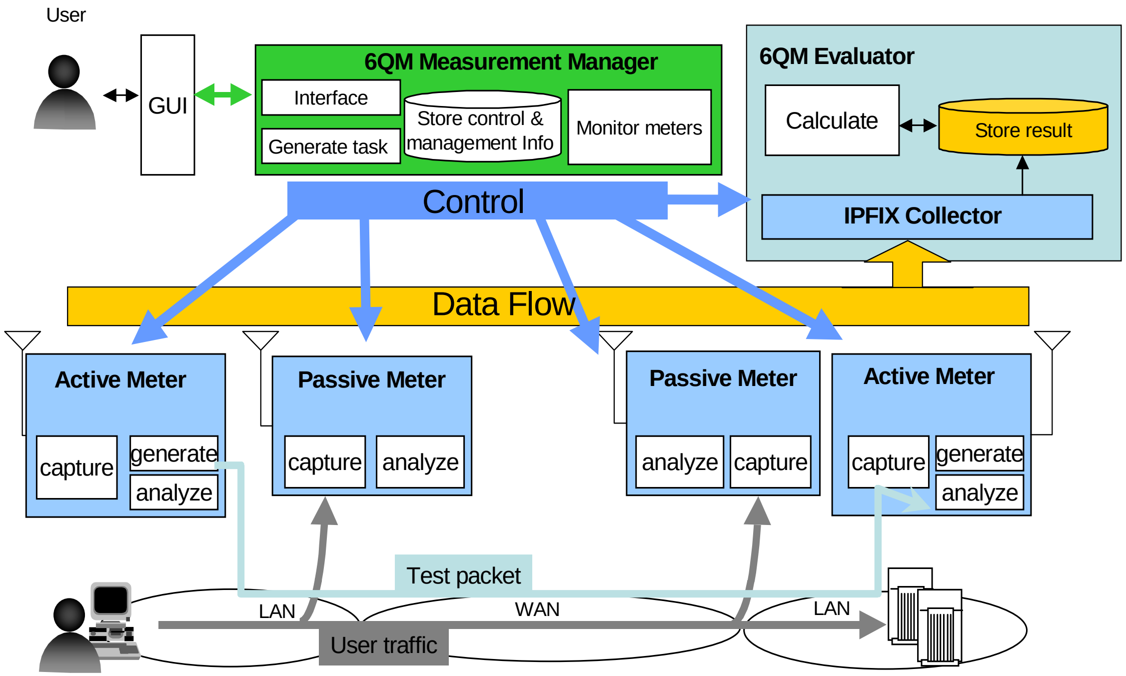
Introduction

- The QoS measurement system is a key element to verify the QoS available within networks. There are not many products available which support IPv6 QoS measurement, so the prototype system developed by the IST project 6QM (IPv6 QoS Measurement) aims to be a good reference for this kind of products.
- This presentation describes:
  - Main characteristics of 6QM OpenIMP prototype, which is pretty fully operational according to its specifications for measurements on Passive only, Active only and Passive and Active combined modes.
  - Some key characterization tests and results done to prototype in order to provide to the users the confidence in its results and not overcome its limits.
  - Finally, an on-line demonstration including several 6QM probes, deployed in Europe and Japan is done.

Measurement System Overview

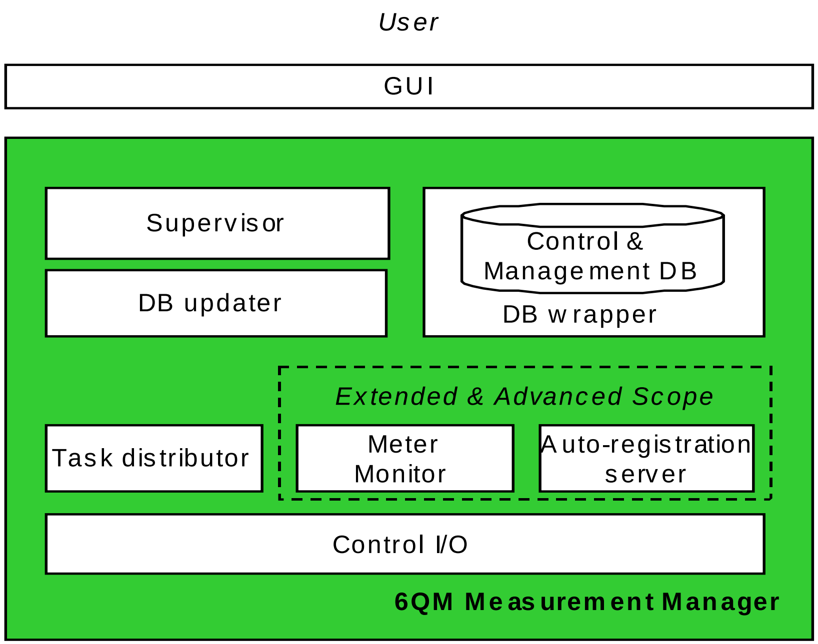
- The Measurement System is called “OpenIMP” and it is able to measure several QoS parameters within IPv6 networks
  - It is software developed for both Linux and FreeBSD OSs
- It introduces new concepts on the measurement field. Some of the more relevant features are the following:
  - support for IPv6 traffic, even 6in4 tunneled traffic
  - passive only mode
  - active only mode
  - passive and active combined mode
  - interdomain measurements
- It makes reports about the commonest QoS parameters like loss, one way delays etc, so it is a good tool to know the real QoS in the network

Functional Architecture



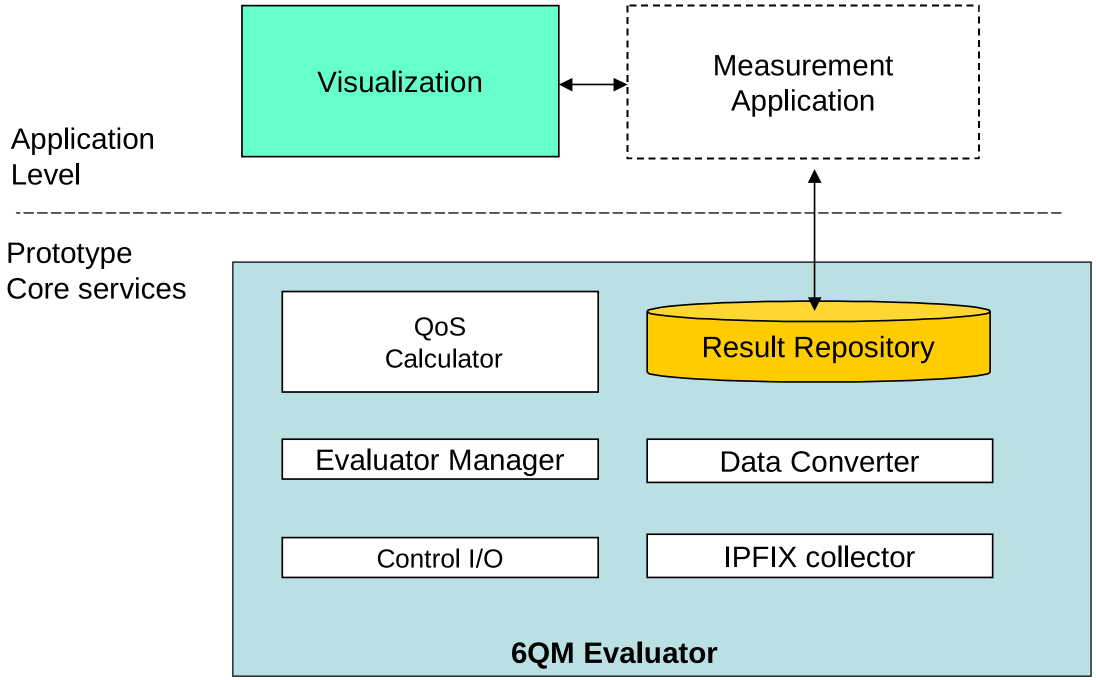
- 6QM measurement system consists of:
  - N distributed probes
  - one Controller
  - one Data Evaluator/Collector
  - the shell/GUI to send/receive commands to the probes

Controller Component



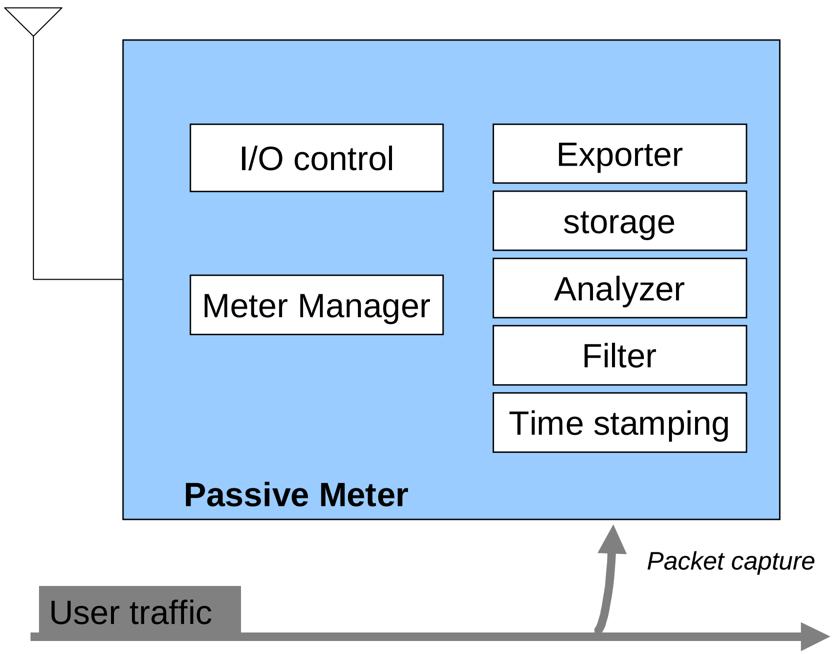
- It is in charge of doing all the system management tasks.
- It makes the commands to setup a measurement on the meters taking into account parameters like type of measure, start time, duration, filter, etc.
- Furthermore it implements a monitor system to inform the user about the availability and status of the meters.
- The web-based GUI is used by the user in order to interact to the controller

Evaluator/Collector Component



- It is a component with a double task:
  - firstly it receives and stores the data sniffed by the meters
  - furthermore it is in charge of calculating the results about delays, deviations and data loss

Meter Component

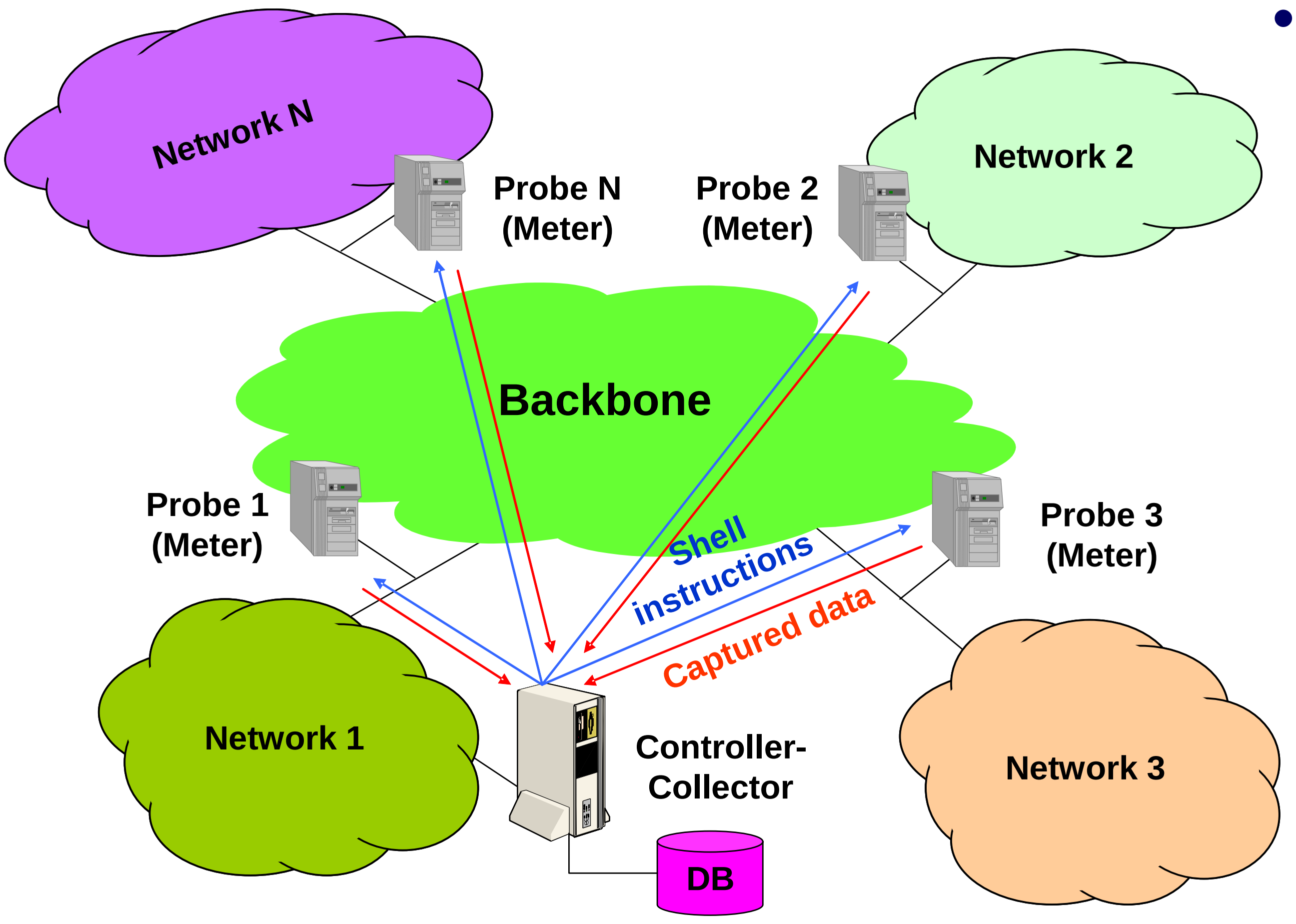


- It is in charge of capturing the network traffic according to the configuration sent by the controller.

  Each meter is attached to the network which the QoS deployment needs to have a check.

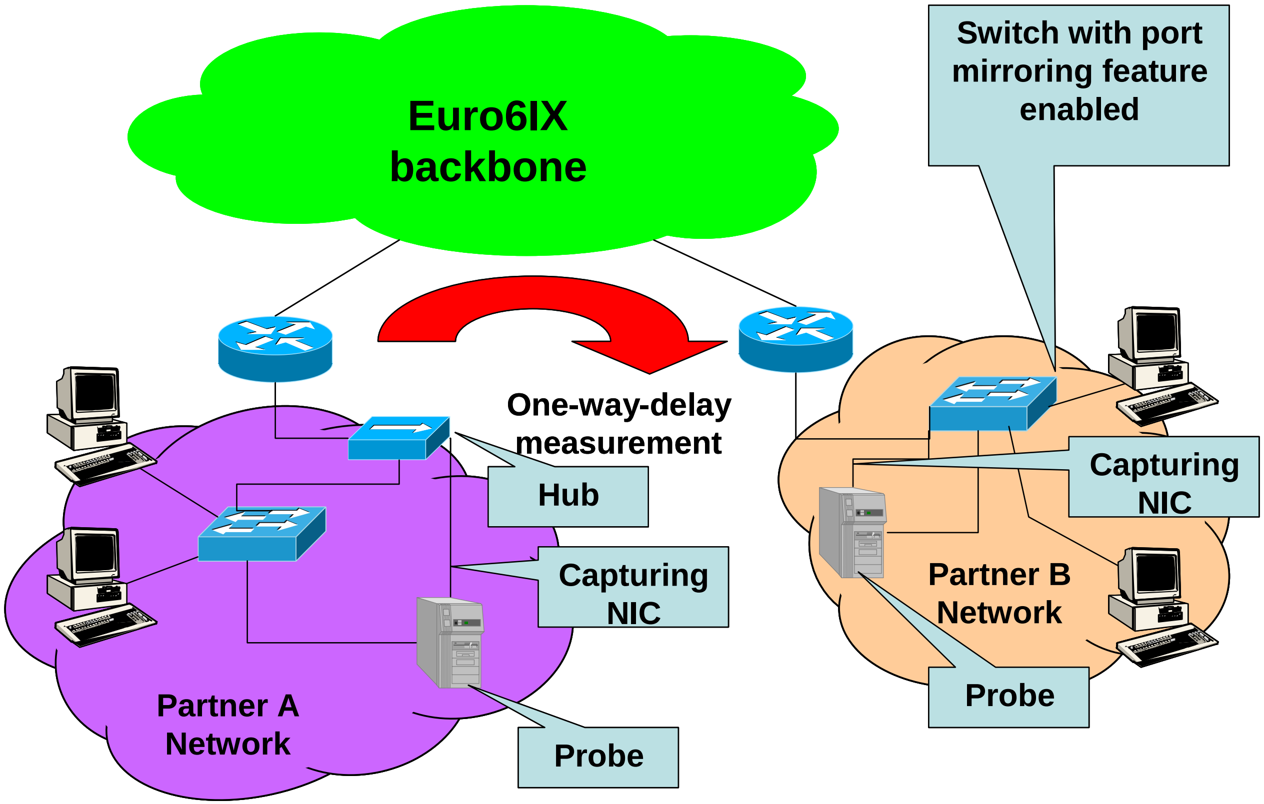
  It supports three working modes:
  - Passive. It is used when there is enough network traffic to extract QoS result.
  - Active. It is the opposite case and artificial traffic is generated to be sent from one meter to other in order to measure the QoS. Calculations are made only over artificial traffic.
  - Combined mode. A traffic threshold if fixed, so when enough real traffic is in the network, calculations are made with it, but if the network traffic decreases, then automatically artificial traffic is generated and the QoS calculations do not stop.

Deployment of 6QM prototype



- The typical deployment consist of:
  - N distributed probes located at each network under test
  - one Controller/Data Collector
  - the shell/GUI to send/receive commands to the probes

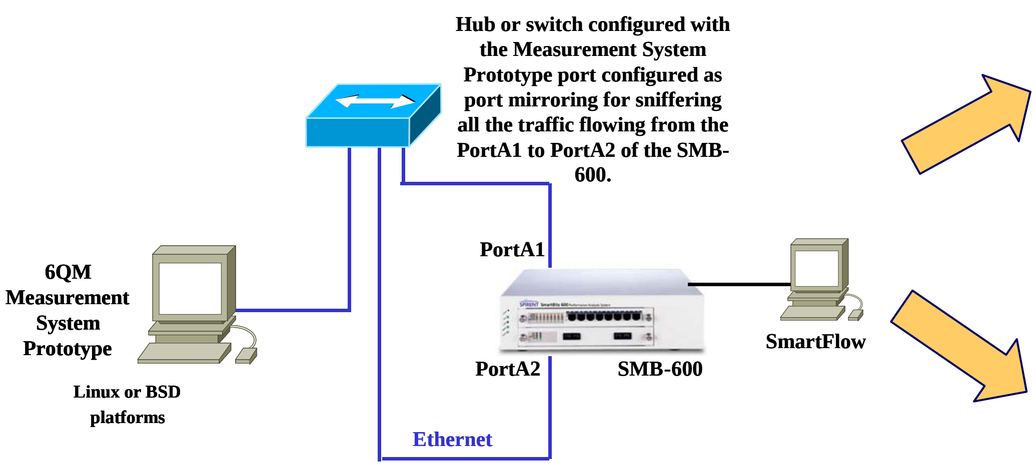
Deployment of 6QM prototype



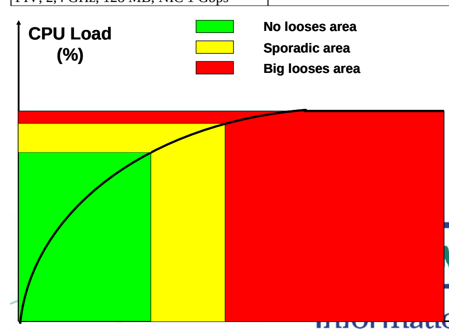
- The recommended place to install the probes is into the network of each domain deploying QoS capabilities
- It can be used either switches or hubs to connect the probes

Laboratory Tests (I)

1. Performance tests
   - know the rate limits for different hardware which the prototype can successfully work, without loose packets
   - measure the CPU load evolution vs. traffic rate



Features of hardware	Limit rate without looses
Microprocessor dependant tests	
PII, 300MHz, 128 MB, NIC 100 Mbps	
PIII, 500 MHz, 128 MB, NIC 100 Mbps	
PIV, 1 GHz, 128 MB, NIC 100 Mbps	
PIV, 2,4 GHz, 128 MB, NIC 100 Mbps	
Memory amount dependant tests	
PIII, 500 MHz, 64 MB, NIC 100 Mbps	
PIII, 500 MHz, 128 MB, NIC 100 Mbps	
PIII, 500 MHz, 256 MB, NIC 100 Mbps	
PIII, 500 MHz, 512 MB, NIC 100 Mbps	
PIV, 2,4 GHz, 64 MB, NIC 100 Mbps	
PIV, 2,4 GHz, 128 MB, NIC 100 Mbps	
PIV, 2,4 GHz, 256 MB, NIC 100 Mbps	
PIV, 2,4 GHz, 512 MB, NIC 100 Mbps	
PIV, 2,4 GHz, 1 GB, NIC 100 Mbps	
NIC dependant tests	
PIV, 2,4 GHz, 128 MB, NIC 10 Mbps	
PIV, 2,4 GHz, 128 MB, NIC 100 Mbps	
PIV, 2,4 GHz, 128 MB, NIC 1 Gbps	

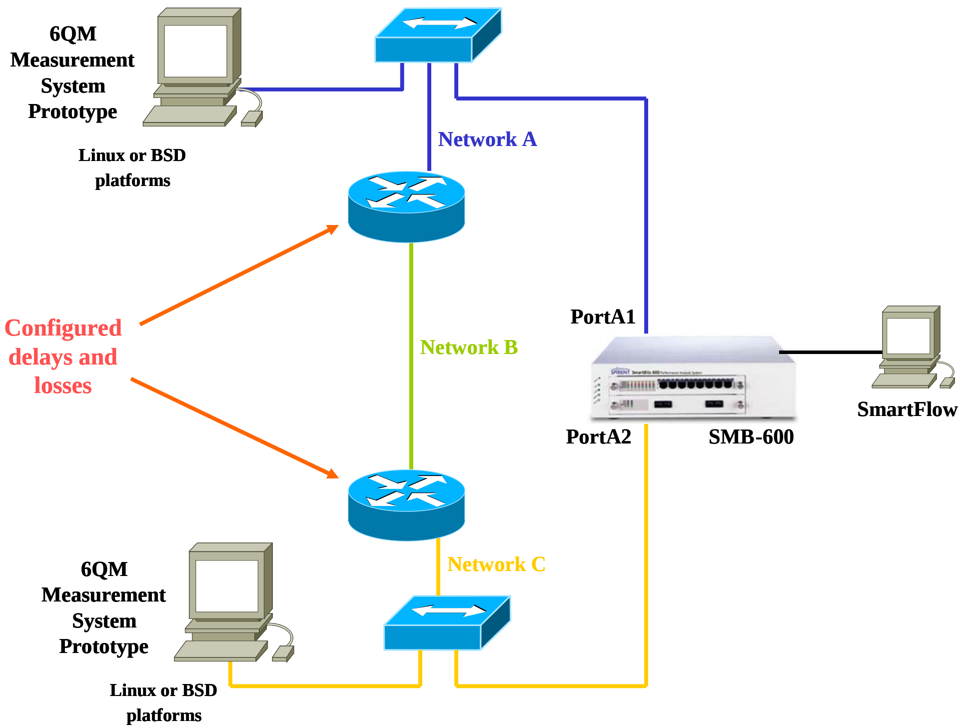


Laboratory Tests (II)

2. Influence of number of filtering rules in the meter
    - check if the performance of the meter can be influenced by the complexity of the rule
    - make different tests with different rules to see how they affect the performance
3. Header fields tests
    - check if the prototype can be considered fully IPv4/IPv6 compliant
    - the goal is to identify possible bugs in the software that led the system badly work with any configuration
4. Influence of BW used for data export for given some configuration

Laboratory Tests (III)

5. Calibration tests
   - know how accurate the system is
   - check results for
     - total traffic volume
     - total packet captured
     - one-way-delay
     - jitter
     - total loss



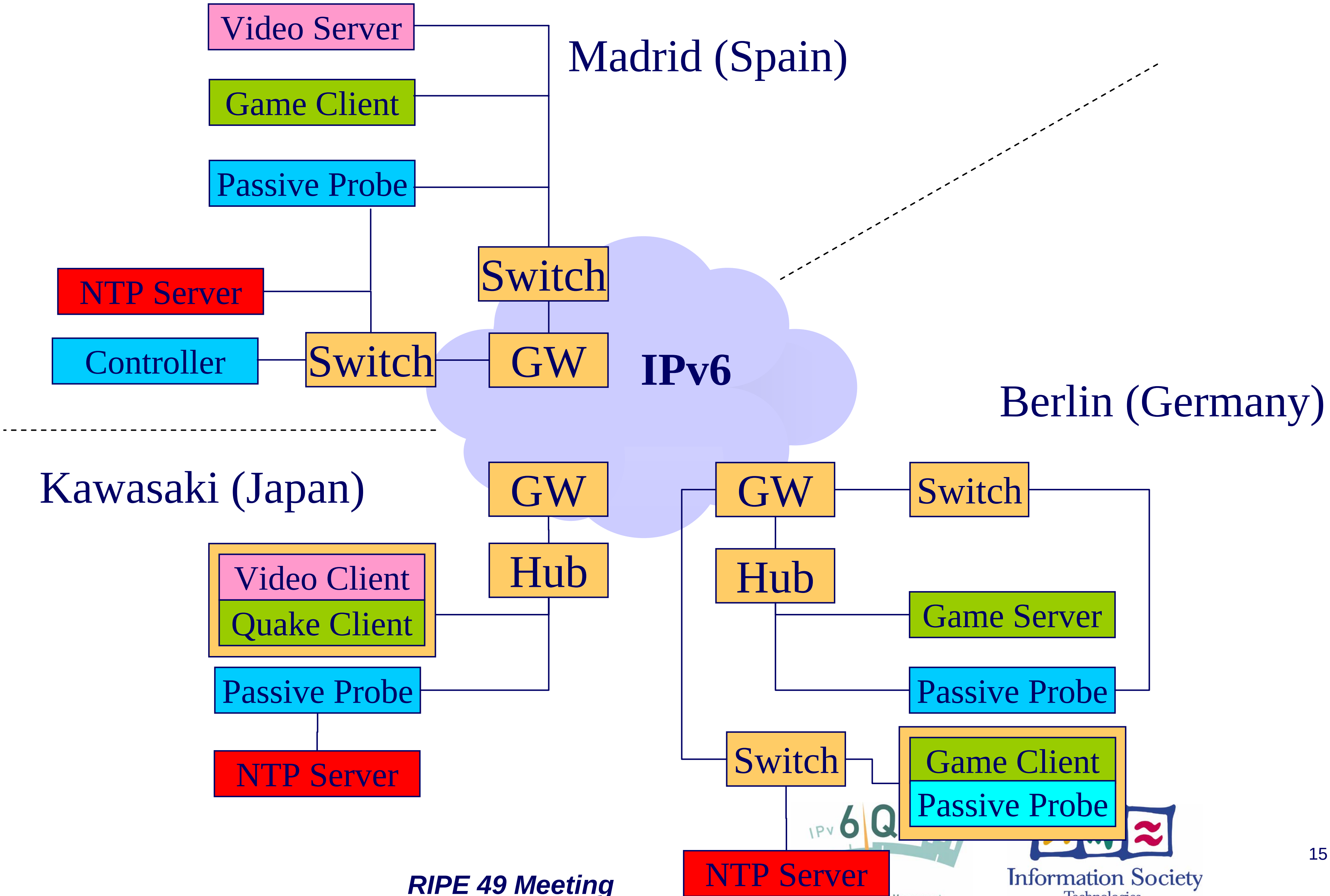
Real Networks Tests

- After the laboratory tests, the next step is to deploy and evaluate the 6QM prototype into a real native IPv6 networks in order to know all the issues related to its use in the field
- The goal is to get information for evaluate and validate the prototype in addition of generate initial data on QoS parameters and status of the IPv6 networks that participate in the deployment

Public Trials or Demonstrators

- Successful external trails at
  - IST 2002 in October 2002
  - CeBIT in February 2003
  - Madrid 2003 Global IPv6 Summit in May 2003
  - 6NET Spring 2004 Conference & Eurov6 Showcase in May 2004
    - “Fairness for Online Gaming: Distributed QoS Measurements for IPv6”, among Germany, Japan and Spain, using native IPv6 networks as Euro6IX, 6NET, BELNET, WIDE and others as 6Bone
    - Quake2 patched for IPv6 and IPv6 video streaming. All these items were jointly used with 6QM measurement probes distributed in Brussels, Berlin, Japan and Madrid

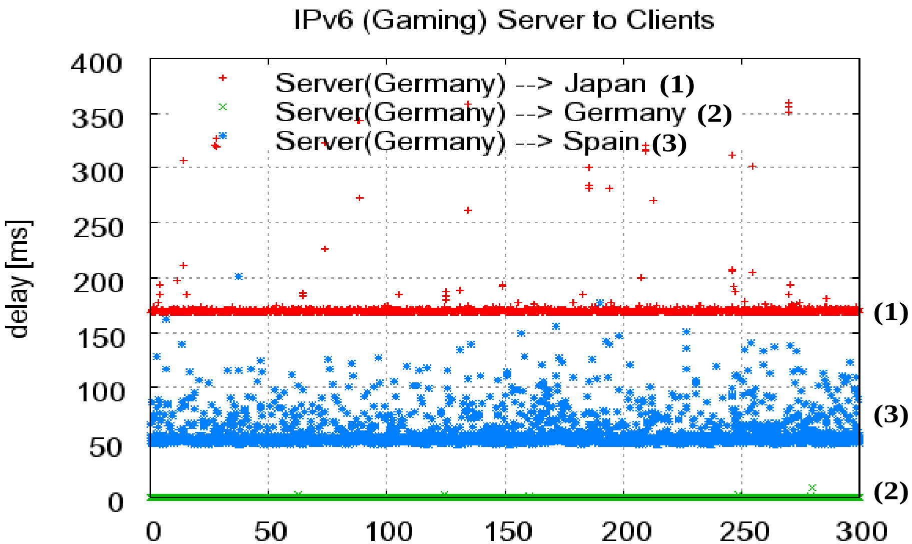
Demonstration Scenario

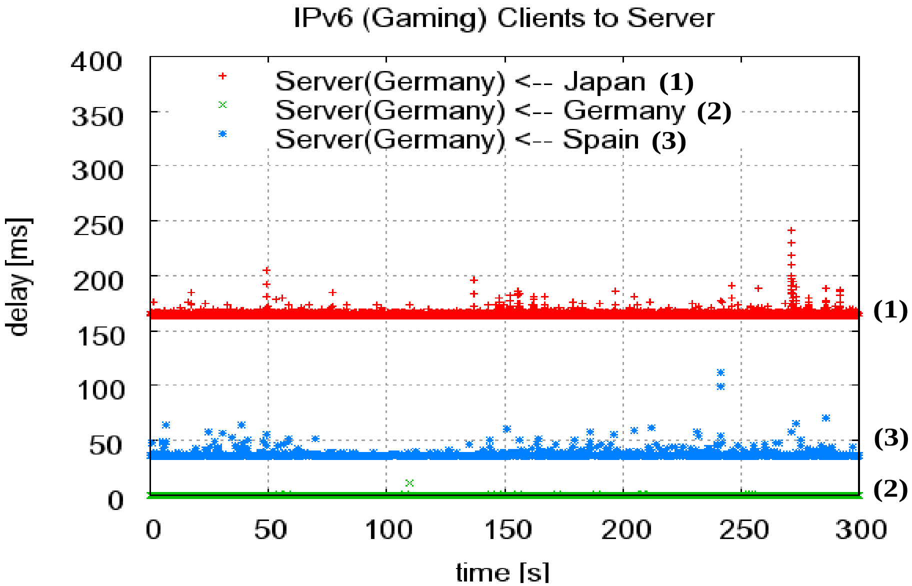


Meters Synchronization

- As distributed measurement point has been considered, it was crucial good synchronization among them to have coherent time measurements
- Due to the high distance among the measurement points, it was needed to use independent time sources
  - Spanish site: the synchronization is performed by means of a Stratum 1 NTP server connected to a GPS receiver via LAN connection.
  - German site: a dedicated NTP server via LAN connection for the measurement infrastructure is connected to a GPS receiver using also the receiver's pulse-per-second signal.
  - Japanese site: the passive meter is connected directly to a Stratum 1 NTP server via a cross-cable.
- The achievable accuracy (in terms of a resulting clock offset) under these conditions can be established within the range of sub-milliseconds

Game Measurement Results

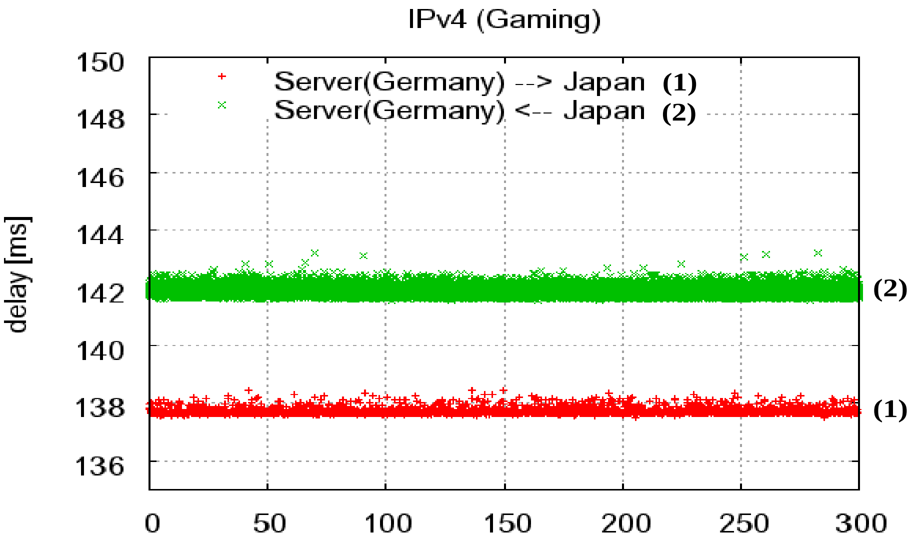


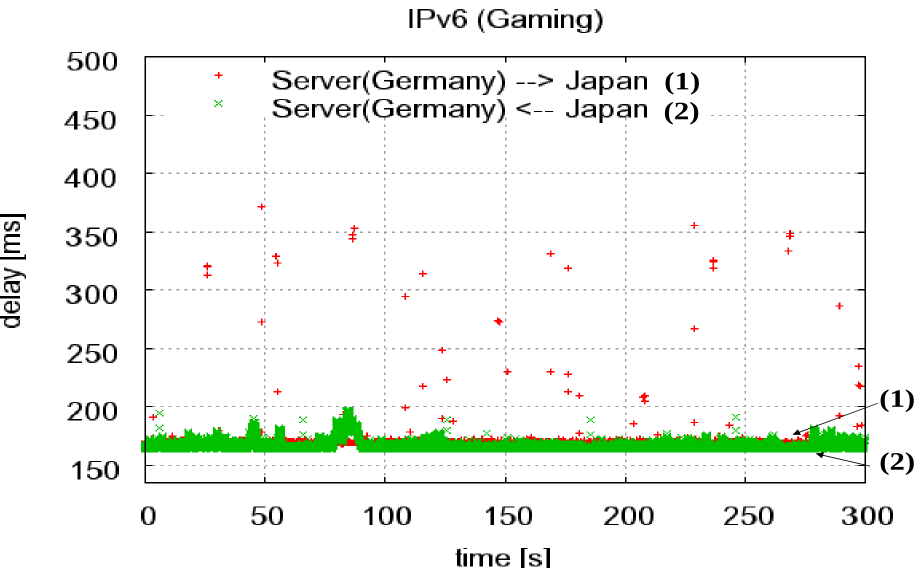


	Server to Client		Client to Server	
Location	**Mean (ms)**	**Deviation (ms)**	**Mean (ms)**	**Deviation (ms)**
Japan	170.9	13.3	164.2	1.3
Spain	58.6	14.6	36.7	3.7
Germany	0.2	0.2	0.3	0.1

- Delay is larger from Japan to Europe than just within Europe
- Some asymmetry was noticed between forward and backward performance for both Spain and Japan due to the asymmetric routing.

IPv4 vs IPv6 Results





	Server to Client		Client to Server	
Connec-tion	Mean (ms)	Devia-tion (ms)	Mean (ms)	Devia-tion (ms)
IPv4	137.7	0.1	141.9	0.2
IPv6	172.2	14.6	166.7	4.2

- Comparison between IPv4 and IPv6 measurements have interesting results.
- In the server to client path, IPv6 presented a latency +24% higher than IPv4 (+33.5 ms)
- On the reverse path IPv6 presented a latency +18% higher than IPv4 (+24.8 ms)
- Difference in maximum delay was also different values: 143 ms for IPv4 versus 372 ms for IPv6

Demonstration

Thanks !

- Questions?
- Acknowledgments:
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