

Qosmet – A solution for measuring Quality of Service

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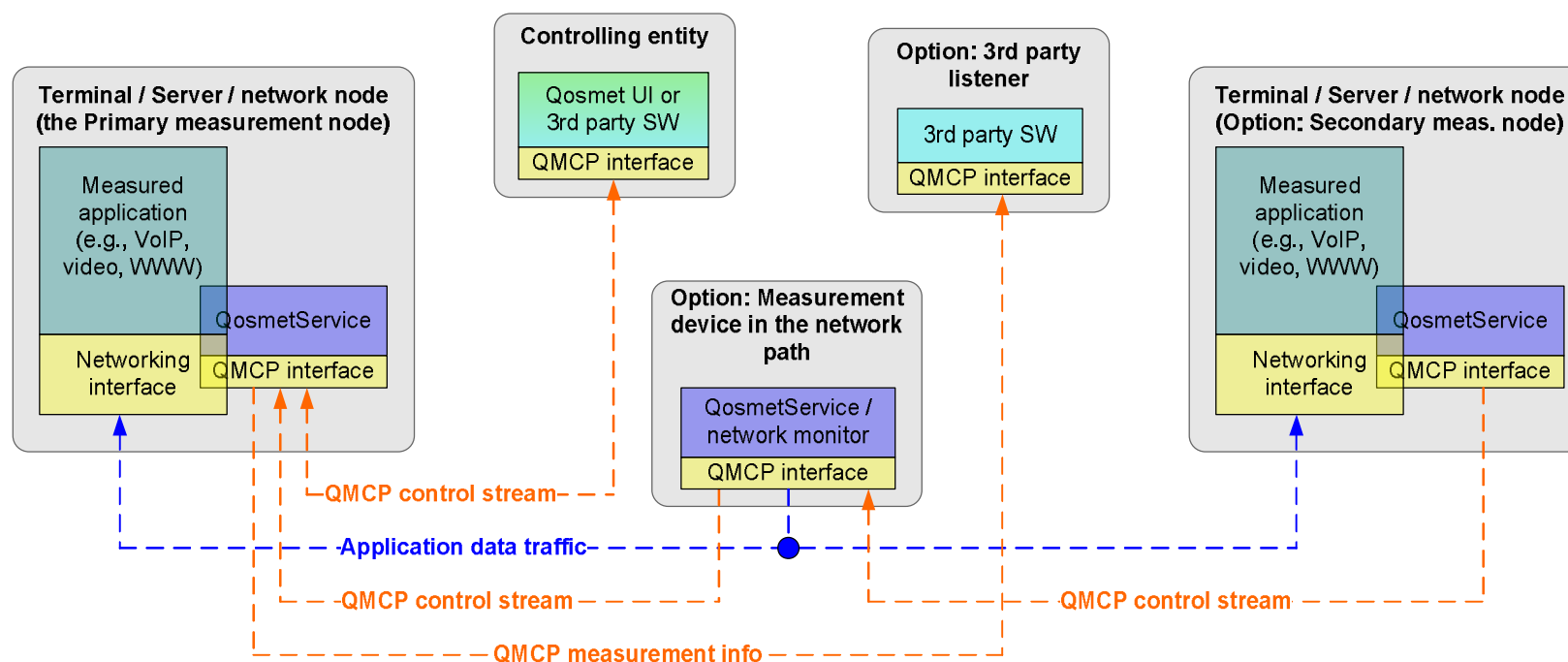
Qosmet Overview

- Qosmet is a solution for passive measuring/monitoring of one-way QoS (Quality of Service) performance from the application's point of view in the desired network path.
- The results can be evaluated in real-time or stored for latter analysis.
- Measurement results can be used to trigger events in real-time.
- Qosmet is at it's best when measuring the QoS of real-time applications (e.g., VoIP, video conferencing, IPTV), but practically any IP based application can be measured.
- The solution is based on light-weight measurement agents, enabling the measurements to be remotely invoked and controlled at any time.
- Possible users include operators, service providers, service developers, administrators, network and measurement equipment manufacturers, researchers, and end-users.
- The solution is developed by a neutral research organization, VTT

Benefits

- Discover how the applications/services really perform over the network.
- The measurements are passive, i.e., overhead is minimized.
- Allows quality based alerts & actions
- A 3rd party solution can fully control the measurements (M2M-operation).
- Enables also bottleneck tracing
- Supports long term performance monitoring, e.g.,
 - Are there certain periods of time, when the service quality is not tolerable?
- The solution is a light-weight SW, so it could stand by in all the potentially interesting network nodes.
- Measurements can be carried out also over a NAT.

Qosmet 2.x Architecture

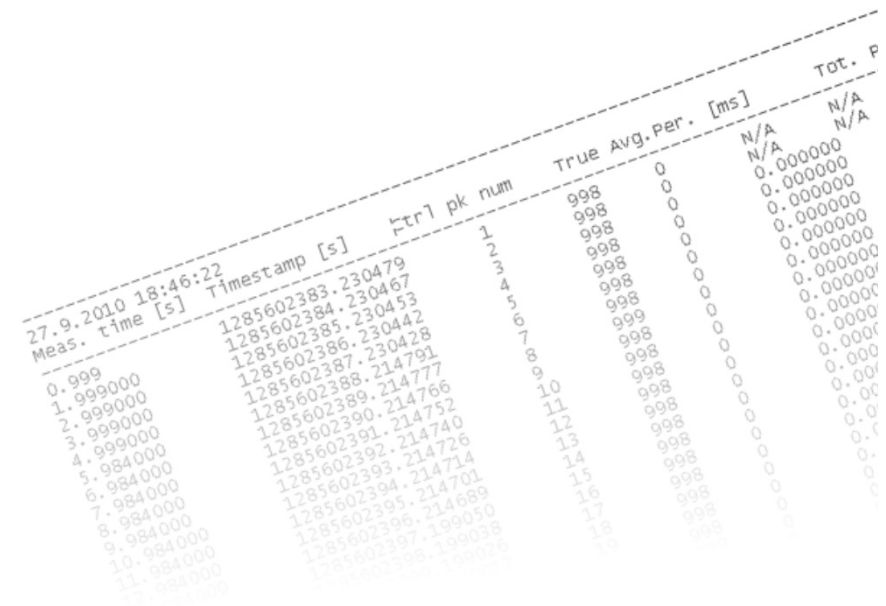


- Modular structure - Qosmet Service is located in measurement points
- QMCP (QoS Measurements Control Protocol) allows full remote control of measurements
- Measurements can be performed by Qosmet UI or any QMCP capable SW
- Easy integration with 3rd party SW
- A single Service supports numerous independent measurements.
- Easy QoS measurement results distribution to 3rd party receivers.
- Option: support for multipoint measurements (distributed calculation)

Measurement output (1/2)

The mostly used statistics include:

- QoS statistics:
 - Delay
 - Jitter (average and absolute)
 - Packet loss
 - Connection break statistics
- Traffic statistics:
 - Load
 - Volume of data
 - Packet sizes
- QoE: (Pseudo-subjective analysis)
 - Accurate VoIP quality with PSQA in MOS scale
 - General application QoE with GQoSM



Meas. time [s]	Timestamp [s]	Tr1 pk num	True Avg. Per. [ms]	Tot. P
0.999	1285602383.230479	1285602383	998	N/A
1.999000	1285602384.230467	1285602384	998	0.000000
2.999000	1285602385.230453	1285602385	998	0.000000
3.999000	1285602386.230442	1285602386	998	0.000000
4.999000	1285602387.230428	1285602387	999	0.000000
5.984000	1285602388.214791	1285602388	998	0.000000
6.984000	1285602389.214777	1285602389	998	0.000000
7.984000	1285602390.214766	1285602390	998	0.000000
8.984000	1285602391.214752	1285602391	998	0.000000
9.984000	1285602392.214740	1285602392	998	0.000000
10.984000	1285602393.214726	1285602393	998	0.000000
11.984000	1285602394.214714	1285602394	998	0.000000
12.984000	1285602395.214701	1285602395	998	0.000000
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14.984000	1285602397.199050	1285602397	998	0.000000
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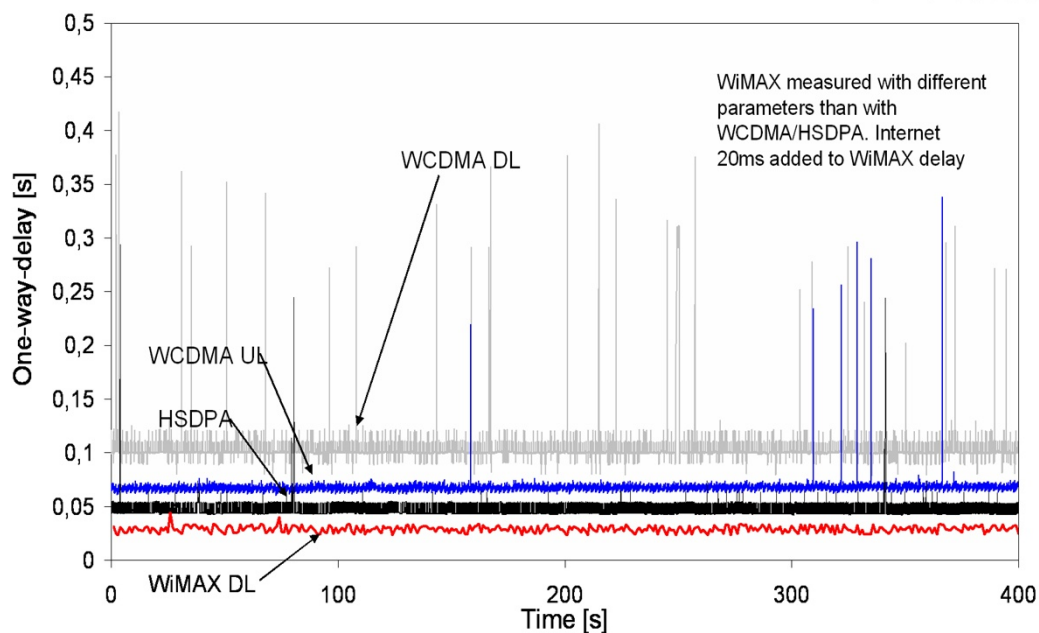
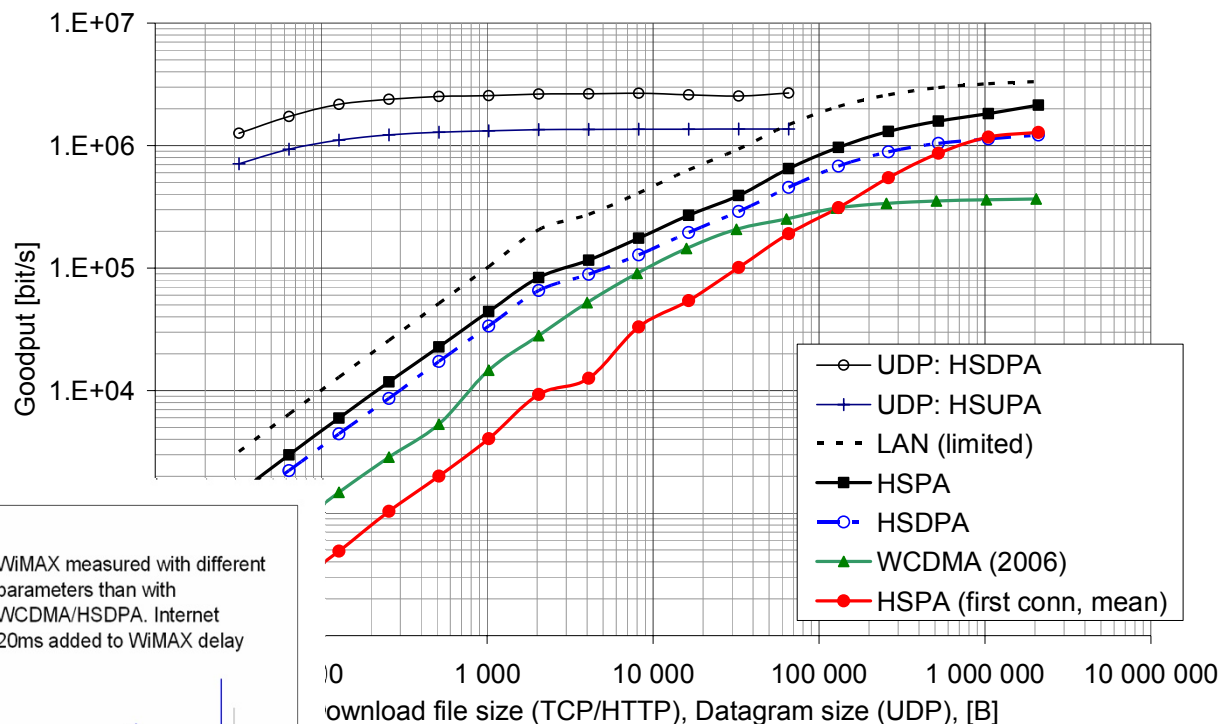
Measurement output (2/2)

- All the collected statistics are one-way statistics.
 - Send and received directions are evaluated separately.
- Qosmet produces average as well as per packet accurate results.
- The results are calculated in real-time.
- The measurement can be defined for
 - a single application flow,
 - aggregation of selected flows or,
 - all the traffic between the measurement points.
- The measurement results can be also output to a file.
 - Post analysis with statistical tools like MATLAB or MS Excel
- Delay, jitter, and packet loss calculations follow the principles presented in IETF RFC's

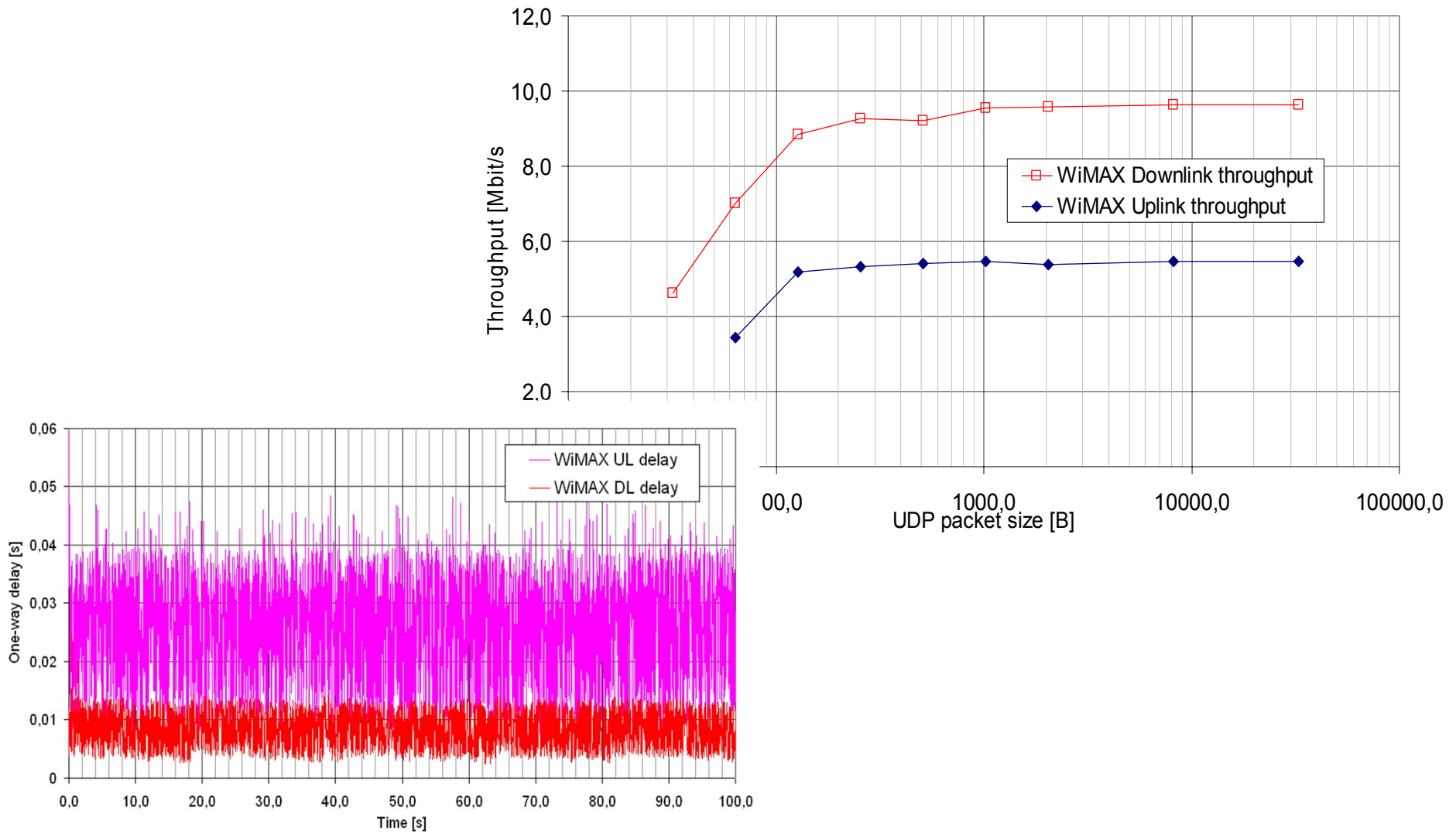
Requirements

- Windows, Linux, Android, or Maemo based platform in each measurement point
 - As Qosmet uses Pcap libraries, the minimum performance requirement is that Pcap runs properly.
- The application under interest
 - One can use also traffic generators, e.g., for maximum throughput measurements
- If accurate delay is desired, clock synchronization between the measurement points is needed.
 - NTP, PTP, GPS
 - VTT has developed special GPS synchronization drivers for Windows providing better than 50 μ s synchronization accuracy.

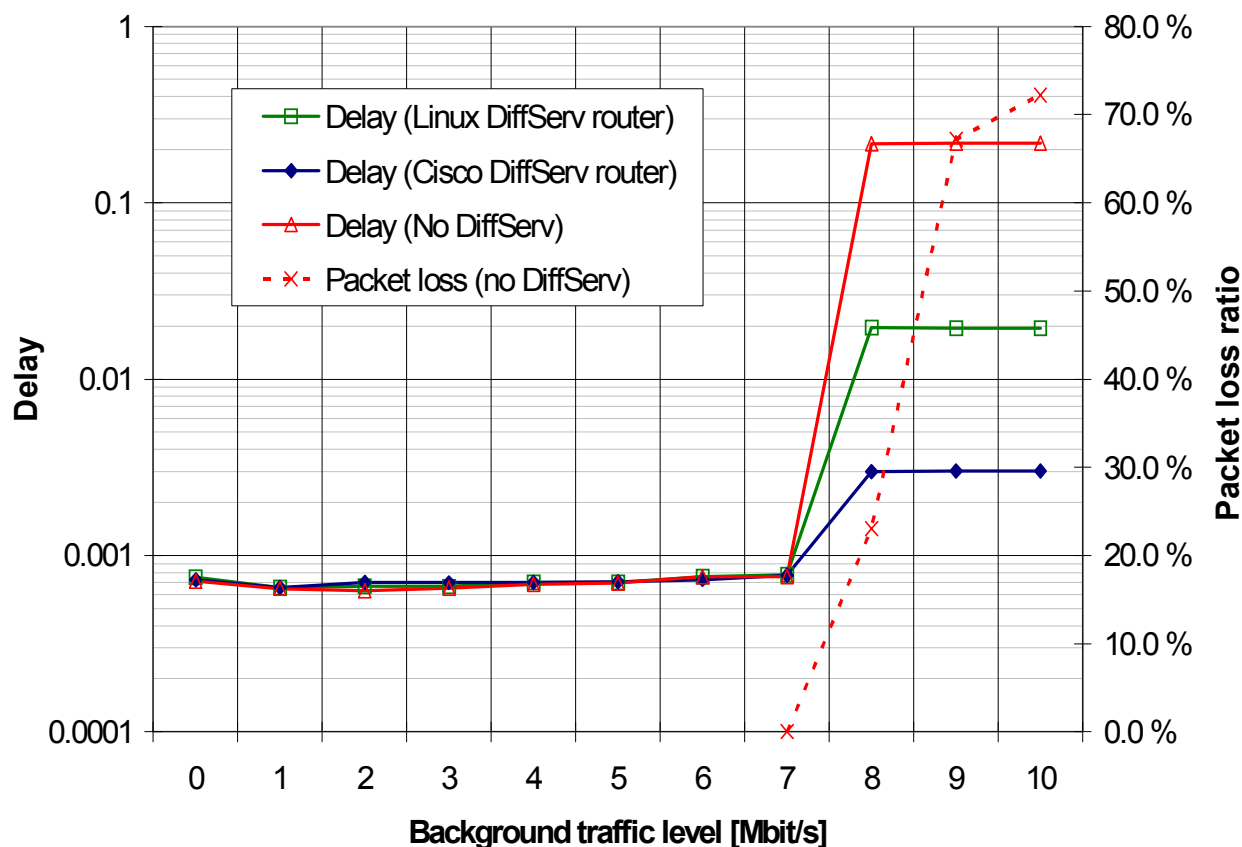
Qosmet Measurement Examples: WCDMA and HSPA Delay and Goodput Performance



Qosmet Measurement Examples: WiMAX Performance

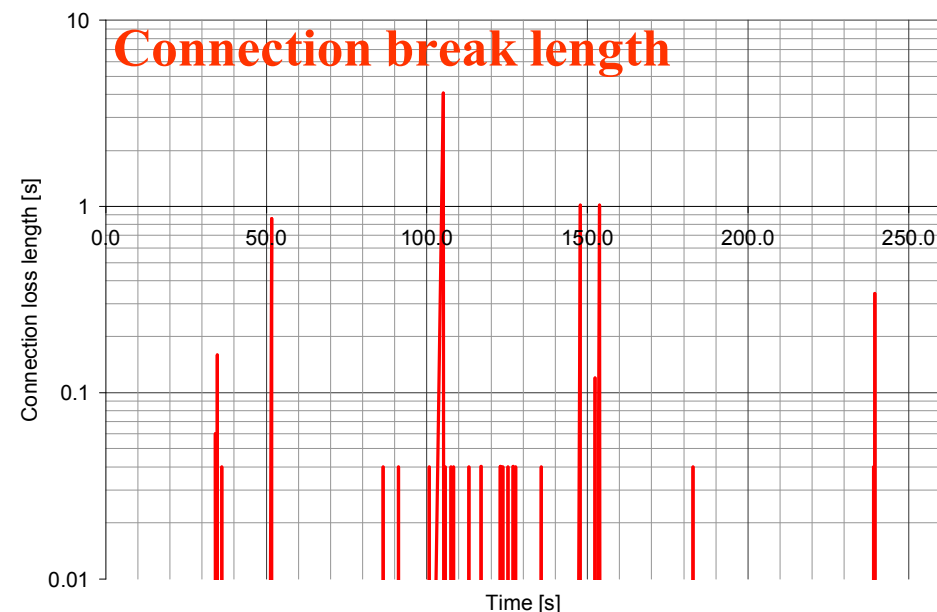
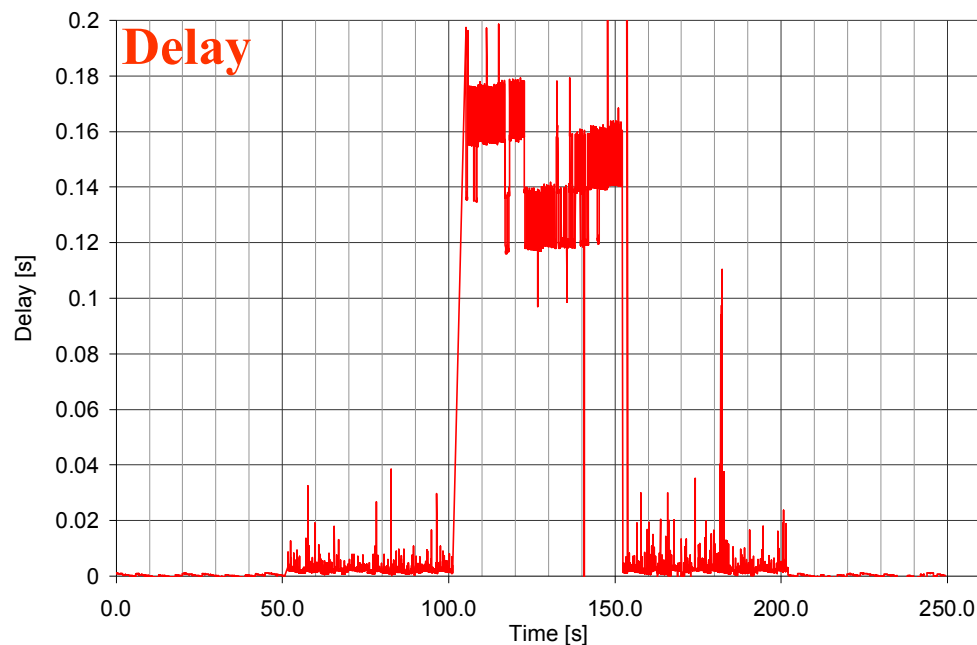


Qosmet Measurement Examples: Testing Traffic Prioritization (DiffServ)



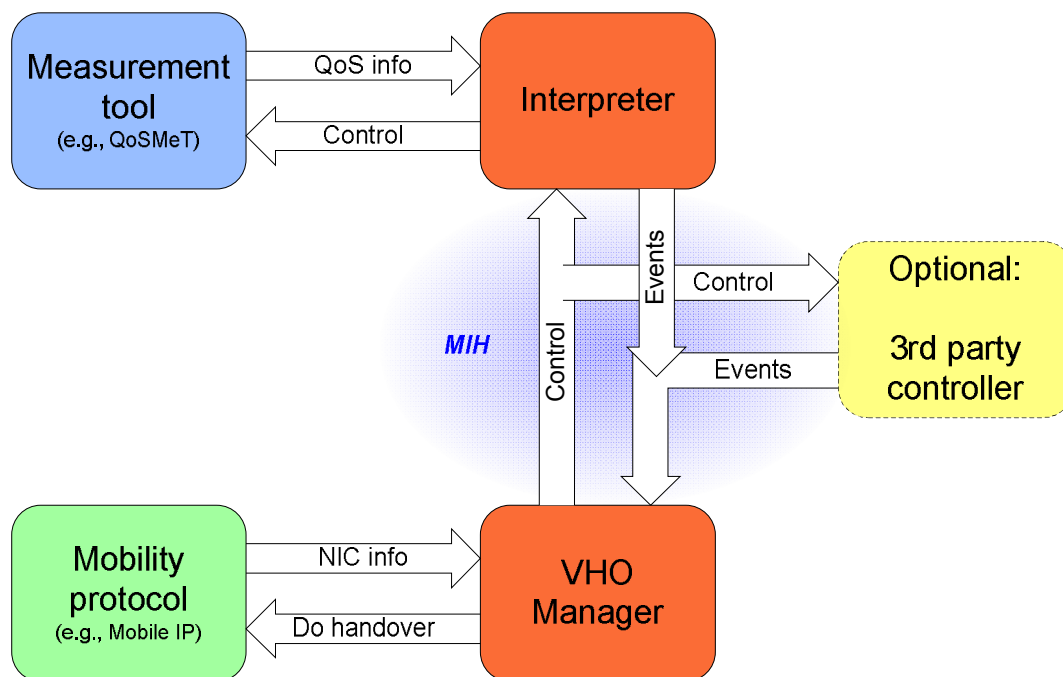
- Running a VoIP application in a 10 Mbit/s link with Differentiated Services (DiffServ) while increasing background traffic load (not time critical data)
- DiffServ allows VoIP conversation to continue even though background traffic level exceeds the network capacity (no packet loss with DiffServ)
- Clear differences in delay behavior between Linux SW router and Cisco's router

Qosmet Measurement Examples: VHO Measurements



- A simple vertical handover scenario (VoIP application using Mobile IP):
LAN → WLAN → 3G (WCDMA) → WLAN → LAN
- Great differences in delay and jitter between network technologies (e.g., 3G/WCDMA delay is only barely acceptable for conversational applications)
- At worst, connection break can last seconds when performing a handover to 3G/WCDMA because of the channel allocation process.

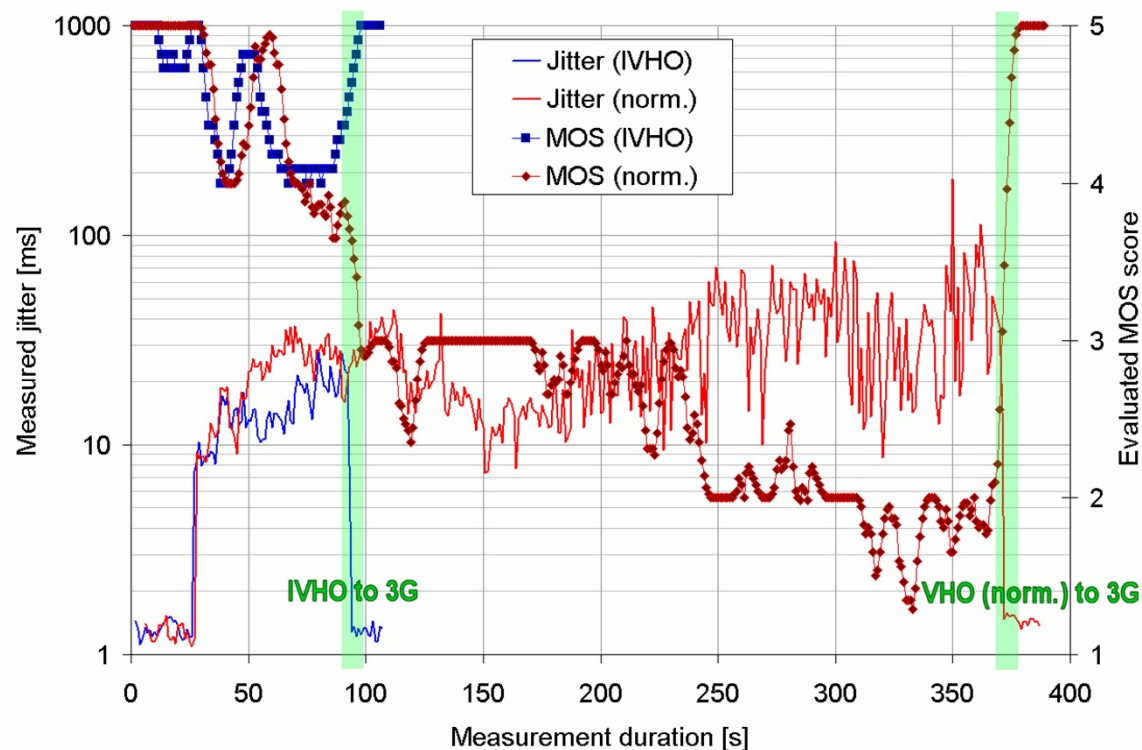
Example: Qosmet's use in assisting VHO decisions, Intelligent Mobility (1/2)



QoS-guided VHO:

- Qosmet measures E2E connection in real-time.
- Interpreter listens measured performance information, and based on the set thresholds, triggers VHO manager.
- VHO manager listens triggers and controls the Mobility protocol.
- Network side guidance can be also included.
- MIH-interoperable system

Example: Qosmet's use in assisting VHO decisions, Intelligent Mobility (2/2)



- Example: streaming video over WLAN under deteriorating conditions.
- The intelligent vertical handover (IVHO) solution is able to perform a HO before notable quality deterioration happens.
- The traditional mobility implementations do not have means to detect the real IP-level quality.

Related Publications & IPR

Selected publications

- J. Prokkola, M. Hanski, M. Jurvansuu, M. Immonen, "Measuring WCDMA and HSDPA Delay Characteristics with QoSMeT," In proceedings of IEEE International Conference on Communications (ICC 2007).
- M. Jurvansuu, J. Prokkola, M. Hanski, P. Perälä, "HSDPA Performance in Live Networks," In proceedings of IEEE International Conference on Communications (ICC 2007).
- P. Perälä, M. Jurvansuu, J. Prokkola, "Combined Terminal and Network Measurement System for Bottleneck Localization," In proceedings of Tridentcom 2008.
- J. Prokkola, P. Perälä, M. Hanski, E. Piri, "3G/HSPA Performance in Live Networks from the End User Perspective," In Proceedings of IEEE International Conference on Communications (ICC 2009).
- E.Piri, J. Pinola, I. Harjula, and K.Pentikousis, "Empirical Evaluation of Mobile WiMAX with MIMO," In Proc. 5th IEEE Broadband Wireless Access Workshop (co-located with IEEE GLOBECOM), Hawaii, USA, November 2009.

IPR

- J. Hiltunen, P. Ruuska, J. Prokkola, M. Varela, "Method for selecting communications network utilizing quality of service measurements," An international patent application, PCT/FI2010/050707, submitted 09/2010.
- 3 VTT's invention reports related to the topic, going possibly for patenting

Knowledge Distribution

Related VTT's contract research work / consultation

- A project with NSN, 2011
 - Qosmet used for performance measurements
- Two projects for Finnish Defense Forces, 2009 – 2011
 - Qosmet used for performance measurements
- A project for 7Signal Ltd., 2008
 - VTT's measurement tool knowledge used for product development

Research project cooperation

- Celtic IPNQSIS, 2011 – 2012
 - Qosmet developed forward and used for performance measurements
- TALOS, 2008 – 2012
 - Qosmet developed forward, and used to evaluate communications quality in real-time.
- Celtic Easy Wireless 2, 2008 – 2011
 - Qosmet developed forward, used for performance measurements, and used in assisting VHO decisions
- IST Games@Large project , 2007 – 2010
 - Qosmet used for performance measurements
- Celtic SCALNET, 2008 – 2010
 - Qosmet is used to assist scalable video coding

Licenses

- Several commercial pilots under work
- Educational free licenses granted for some European Universities.
- Trial licenses granted for some companies.

Offerings

- Qosmet solution
 - Licensing the solution as such
 - Integrating the solution to a 3rd party tool
 - Light integration: QMCP-capability is implemented to a third party tool, bringing the capability to fully control measurements.
 - VTT can offer the QMCP interface description and SW library for free.
 - Full integration: Qosmet core functionalities are directly integrated to a third party tool.
 - Implementing Qosmet-like features to a third party tool
 - Customization is possible
- Measurement services
 - Technology validation & performance tests of new applications over different networks running different devices, etc.

More information

- Up-to-date information about Qosmet is provided in <http://www.cnl.fi/qosmet.html>