QoS support in IPv6 environments

Kopaonik, Serbia & Montenegro
2006

János Mohácsi, NIIF/HUNGARNET

Copy …Rights

- *This slide set is the ownership of the 6DISS project via its partners*
- *The Powerpoint version of this material may be reused and modified only with written authorization*
- *Using part of this material must mention 6DISS courtesy*
- *PDF files are available from www.6diss.org*
- *Looking for a contact?*
  - *Mail to : martin.potts@martel-consulting.ch*
  - *Or helpdesk@6diss.org*

Contributions

- Main author
  - Athanassios Liakopoulos, GRNET, Greece
- Contributors
  - Dimitrios Kalogeras, GRNET, Greece
  - Dimitrios Primpas, CTI, Greece

Presentation Outline

- Introduction to QoS
- Metrics
- QoS Architectures
- IPv6 header & QoS
- Configuration Examples
- Performance Tests in IPv6 environments
- Conclusions

Introduction to QoS

- QoS developments in IP networks is inspired by new types of applications:
  - VoIP, audio/video streaming, networked virtual environments, interactive gaming, videoconferencing, video distribution, e-commerce, GRIDs & collaborative enviroments, etc.
- **Quality-of-Service (QoS)** is a set of service requirements (performance guarantees) to be met by the network while transporting a flow.

Metrics

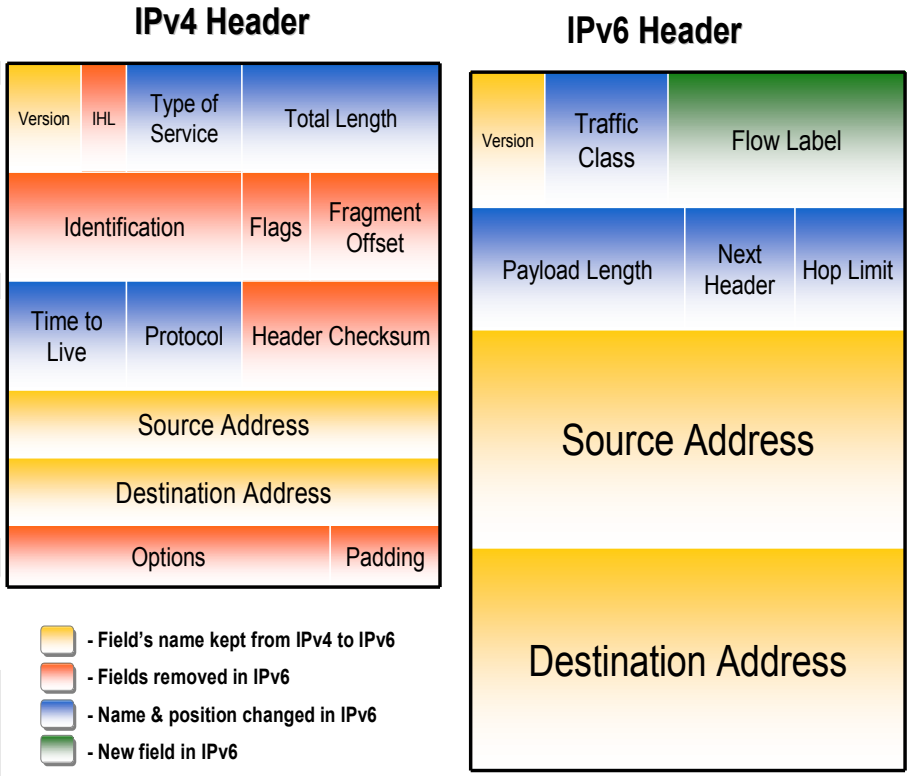
- Performance guarantees are usually assessed with the next metrics:
  - Bandwidth
  - Delay
  - Inter-packet Delay Variation – *Jitter*
  - Packet loss

QoS Architectures

- Best Effort Internet
- Integrated Services
  - Performance guarantees to traffic and resource reservations are provided on per-flow basis.
  - Guaranteed & Controlled Load Service
  - Scaling issues (per flow state information)
- Differentiated Services
  - Performance guarantees are provided to traffic aggregates rather than to flows.
  - Per-Hop Behaviours (PHB): EF & AF
  - Lack of any signalling protocol for resource allocation (admission control) and QoS mechanisms control.
  - Example of services: Premium, “Silver”, LBE

IPv6 & IPv4 Header Comparison

- The IPv6 header is redesigned.
  - Minimize header overhead and reduce the header process for the majority of the packets.
  - Less essential and optional fields are moved to extension headers



IPv6 and IPv4 headers are not *interoperable*.

QoS fields in IPv6 Header

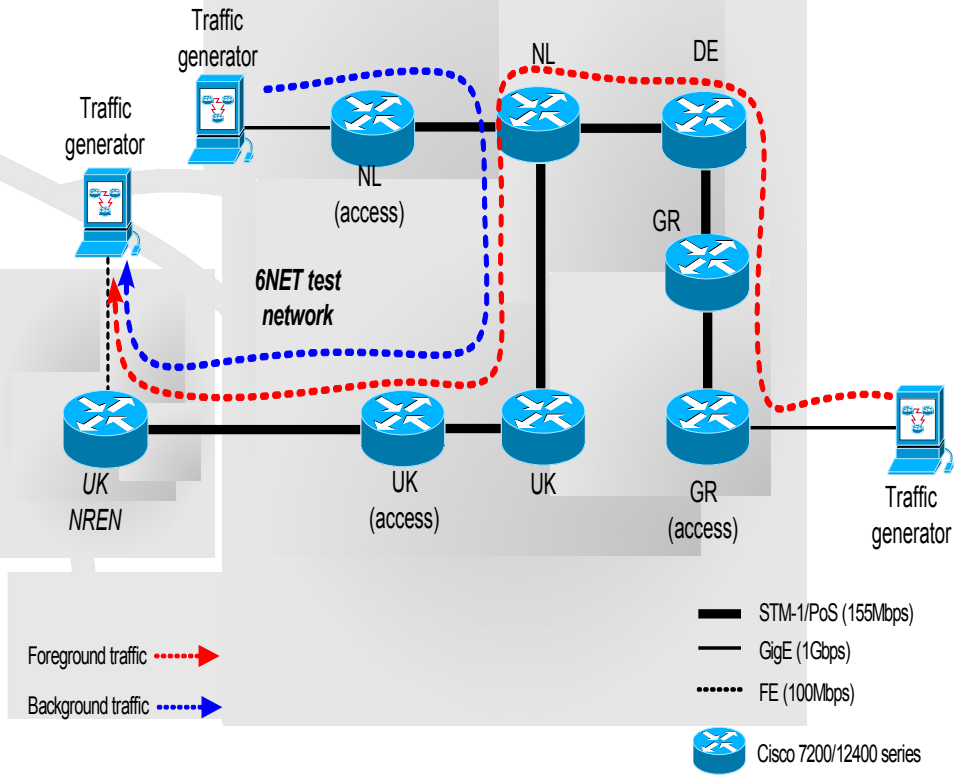
- Traffic Class
  - An *8-bit* field used to distinguish packets from *different classes or priorities*.
  - Provides the *same* functionality as the ***type of service*** field in the IPv4 header.
- Flow label
  - A *20-bit* field defining the packets of the flow.
  - Selected by the source and never modified in the network.
  - Fragmentation or encryption is not anymore problem, as in IPv4.

IPv6 QoS Performance Tests

- Test environment
  - IPv6-only 6NET research network
  - Dual stack GRNET production network

6NET Network

- Gain experience of IPv6 deployment.
- Network technical specifications
  - IPv6 only network!
  - STM-1 core links, up to 1Gbps access links.
  - **Cisco GSR12400 series routers in the core and 7200 series routers in the access.**
- Performance tests
  - Software-based traffic generators – *iperf*, *mgen* tools
  - "Qualitative" tests - Validate that PIP traffic experience better services than other traffic



http://www.6net.org

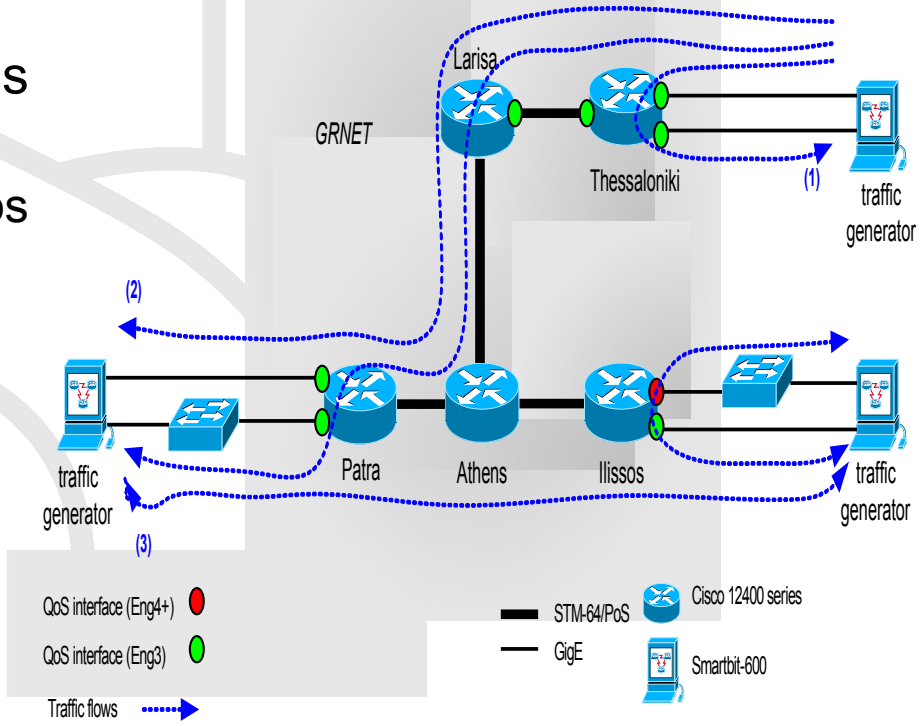
Results(1)

- Premium (high priority) traffic is protected from BE
  - Performance guarantees to IPv6 traffic remain the same under different levels of network congestion.
  - Classification, priority queuing and policing mechanisms operate as expected.
- New hardware / software does not do impose limitations in the support of IPv6 QoS
  - Achieved performance for IPv6/v4 traffic is identical.
- Old hardware / software may either lack some pieces of functionality or provide lower level services to IPv6 compared to IPv4 traffic.
  - Incomplete classification mechanisms, reduced switching capabilities.

(1) for equipment under test

GRNET Network

- GRNET is the *Greek National Research and Education Network (NREN).*
- Network technical specifications
  - Dual stack network!
  - STM-16 core links, up to 1Gbps access links.
  - **Cisco GSR12400 series with 4xGE (Eng3) and 10xGE (Eng4+) line cards.**
- Performance tests
  - Hardware-based traffic generators – Smartbit 600.
  - Collect accurate time-related statistics.



Results(1)

- CPU impact
  - No significant CPU load increase while switching IPv6 traffic in software-based platforms.
  - No CPU load increase for hardware-based platforms.
- Packet loss and latency measurements for IPv6 *best effort* traffic
  - In hardware-based platforms, there is no difference in IPv6 and IPv4 performance.
- Packet loss and latency measurements for IPv6 *high priority* traffic
  - In hardware-based platforms, there is no difference in IPv6 and IPv4 performance.
  - In software based platforms(1), IPv6 classifications is not currently supported.

(1) for equipment under test

Conclusions

- The IPv6 protocol, in terms of QoS support, is **neither superior nor inferior** to IPv4 counterpart. However, the *flow label* field in the IPv6 header is expected to ease provision of services in the future.
- Routers under test allowed the definition of a **common QoS policy** for IPv6 and IPv4 traffic. This simplifies the delivery of QoS in production networks.
- New hardware (or software) does not do impose limitations. On the contrary, old hardware (or software) may either lack some pieces of functionality or provide lower level services
  - Testing is needed.

Bibliography

- Miras D. et al., “A Survey of Network QoS Needs of Advance Internet Applications”, Internet2 Working Group, 2002
- ITU-T Rec Y.1451, “Network Performance Objectives for IP Based Services”, May 2002.
- Gozdecki J. et al., “Quality of Service Terminology in IP Networks”, IEEE Communications Magazine, March 2003
- Crawley E. et al., “ A Framework for QoS-Based Routing in the Internet”, IETF RFC2386, August 1998.
- “IETF IP Performance Metrics (IPPM) WG”, http://www.ietf.org/html.charters/ippm-charter.html
- ITU-T Rec. Y.1540, “IP Packet Transfer and Availability Performance Parameters”, December 2002.
- Braden R., D. Clark, and S. Shenker. “Integrated Services in the Internet Architecture: An Overview.” RFC 1633, Internet Engineering Task Force, June 1994.
- Wroclawski, J., "The Use of RSVP with IETF Integrated Services", RFC2210, September 1997.
- S. Shenker, C. Partridge, R. Guerin, “Specification of the Guaranteed Quality of Service”, RFC 2212, September 1997.
- J. Wroclawski, “Specification of the Controlled-Load Network Element Service”, RFC 2211, September 1997.

Bibliography

- J. Wroclawski, “Specification of the Controlled-Load Network Element Service”, RFC 2211, September 1997.
- Steven Blake, David Black, Mark Carlson, Elwyn Davies, Zheng Wang, and Walter Weiss. “An Architecture for Differentiated Services” RFC2475, December 1998.
- B. Davie et al., “An expedited forwarding PHB”, RFC 3246, March 2002.
- J. Heinanen, F. Baker, W. Weiss, and J. Wroclawski, “Assured forwarding PHB”, RFC 2597, 1999.
- Rudolf R. et al. “IP QoS Across Multiple Management Domains: Practical Experiences from Pan-European Experiments”, IEEE Communications Magazine, January 2003.
- Liakopoulos Ath. et al.” QoS Experiences in native IPv6 GRNET and 6NET networks” International Conference on Telecommunication Systems, Modeling and Analysis 2005 (ICTSM2005).
- S.Deering, R.Hinden, “Intenet Protocol, Version 6 (IPv6)”, RFC2460, December 1998.
- J.Rayahalme et. al., “IPv6 Flow Label Specification”, RFC3697, March 2004.

Revision Questions!

- What are the difference related to QoS between the IPv6 and IPv4 headers? Is there any improvement in the IPv6 and why?
- Shall we expect different performance guarantees for IPv6 and IPv4 traffic? Under which conditions?
- Is there any functionality limitations or security consideration in the deployment QoS services in a production network?