HELSINKI UNIVERSITY OF TECHNOLOGY
Networking Laboratory

Measurements on Differentiation of Internet Traffic

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Background

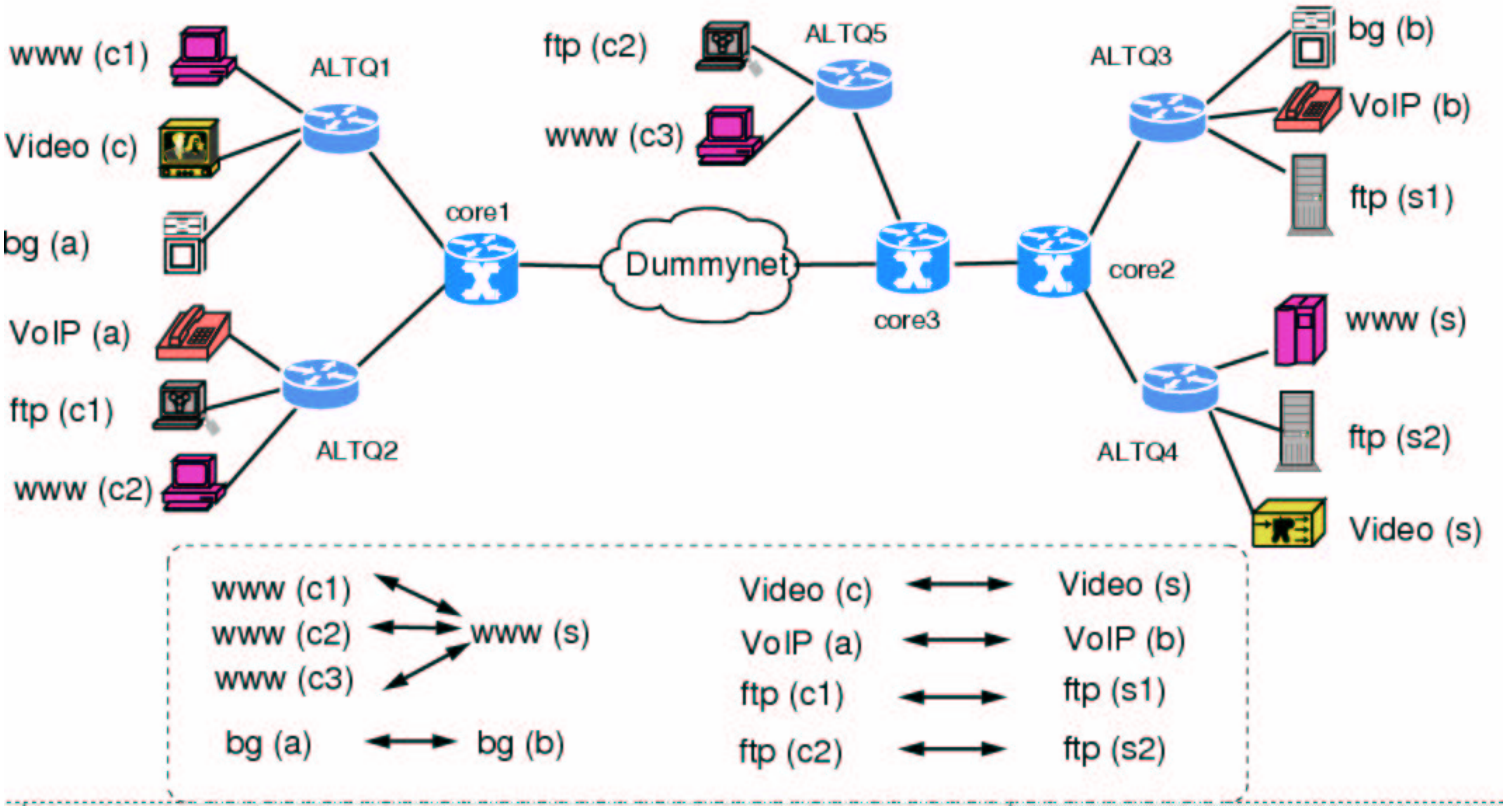
- Current Internet is based on a best effort packet delivery
  - In the case of network congestion especially the real-time applications are not able to operate properly
- Standardized Quality of Service (QoS) architectures
  - Integrated Services (Intserv)
  - Differentiated Services (DiffServ)
- IntServ failed due to scalability problems
- DiffServ is the most promising architecture to provide better service than today

Objectives

- Perform network measurements
  - Create an isolated fully functioning DiffServ network for traffic measurements with various traffic sources
    - Basically a QoS capable mini-Internet
- Get better understanding on differentiation principles and problems
- Compare results to simulations conducted earlier

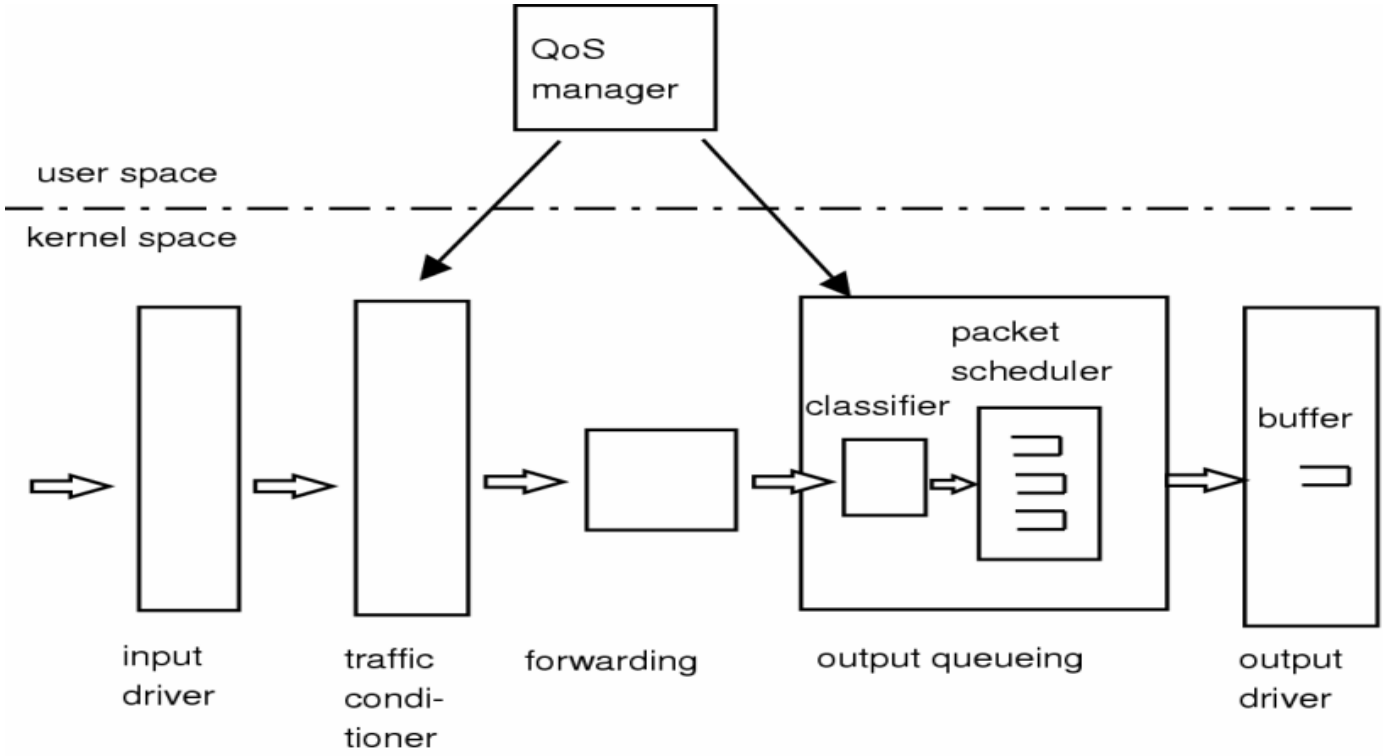
Measurement network

- Routers: generic PC-hardware (low cost and flexible!)
  - AMD 1300 MHz/256 MB
  - 4 * 3Com 10/100 Ethernet NICs



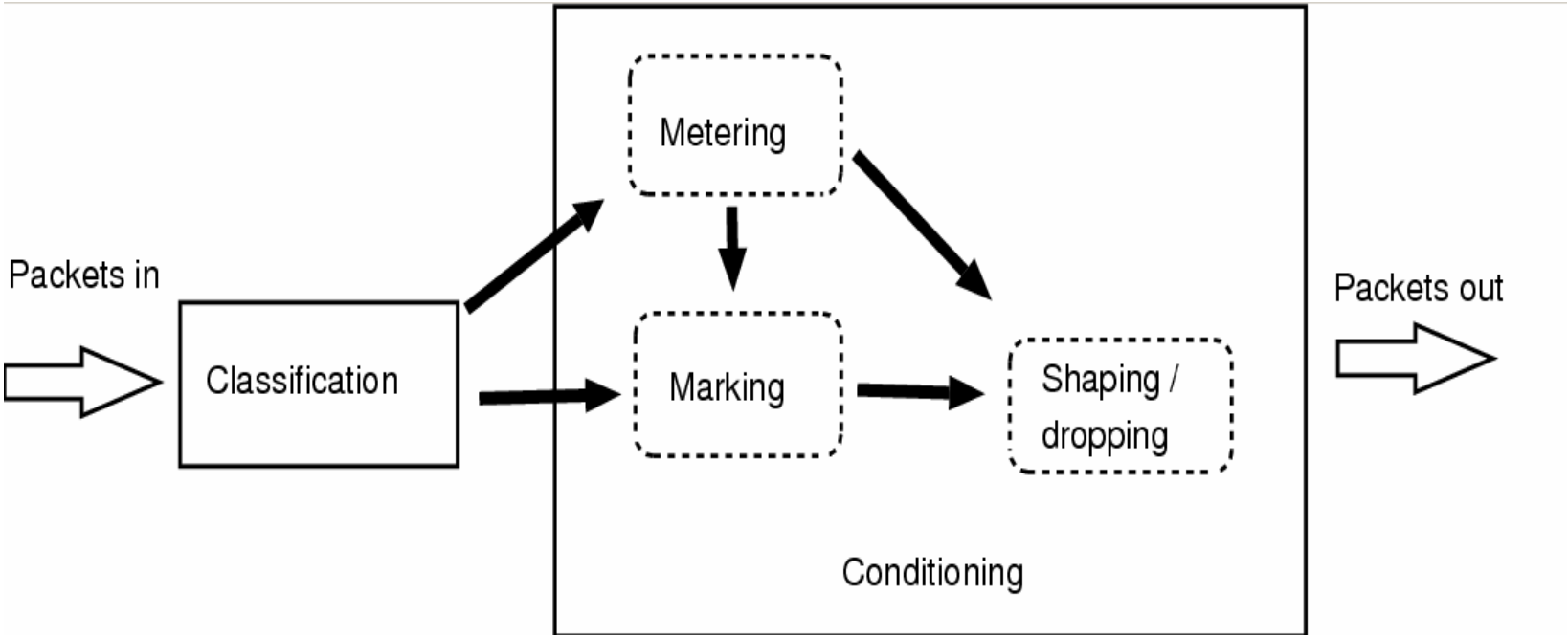
Implementing QoS

- FreeBSD 4.5 OS patched with ALTQ-package
  - Provides necessary QoS mechanisms to implement DiffServ



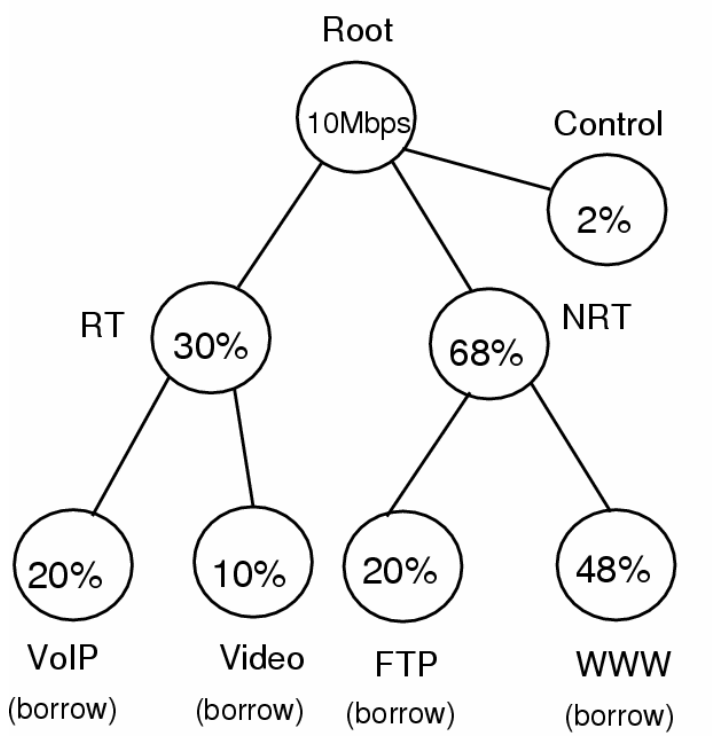
DiffServ

- DiffServ model includes two conceptual elements:
  - classification
  - conditioning



CBQ

- Class Based Queueing (CBQ)
  - Partitioning and sharing of link bandwidth by hierarchically structured classes
    - Each (leaf) class has its own queue



Emulated applications

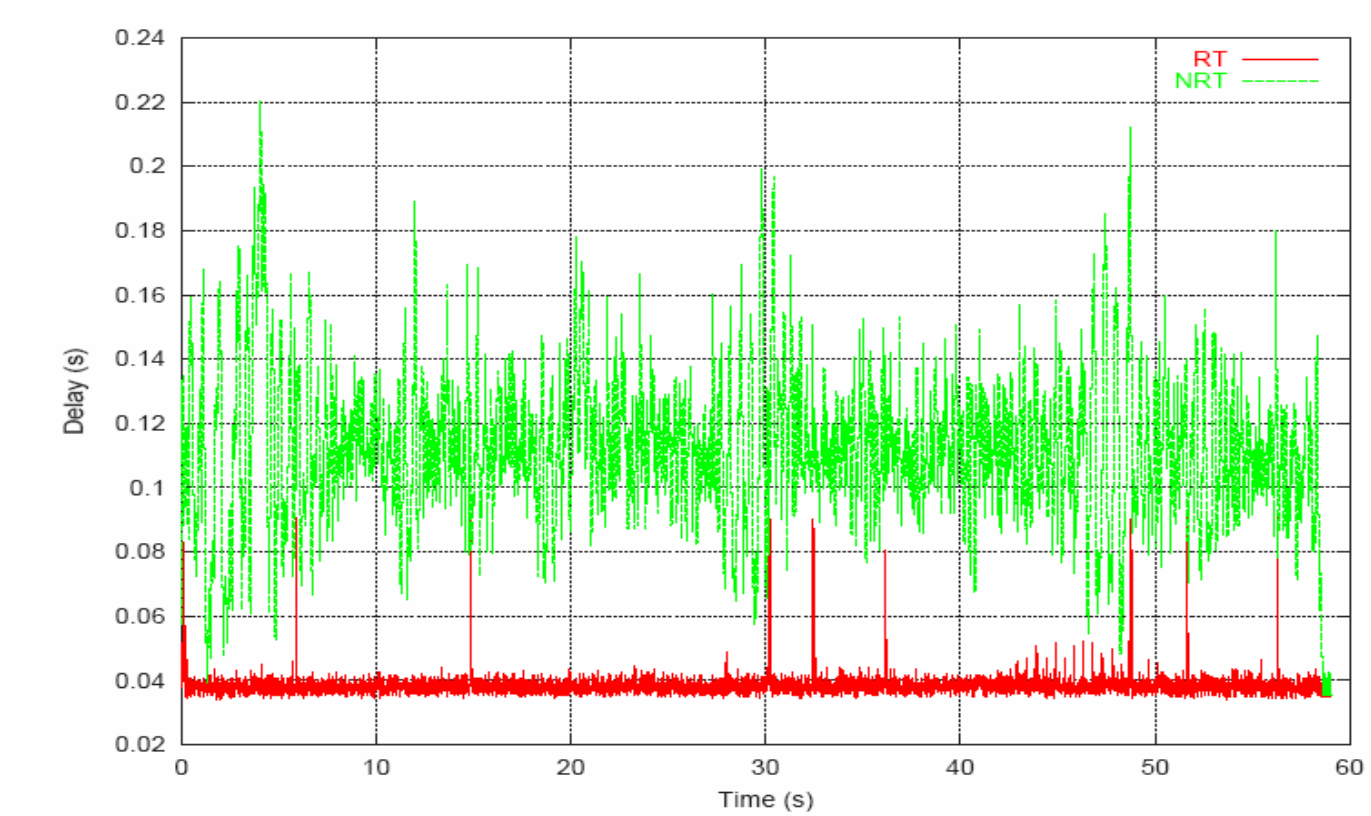
- VoIP
  - Contant bit rate stream bi-directionally
  - G.711 μ-law voice coding with 20 ms framing
  - Mapping to PSQM voice scoring system (0.4→6.5)
- Video streaming
  - Varying bit rate application
  - MPEG-4 encoded video stream from a movie (trace file)
  - Mean bitrate 130 kbps, max 595 kbps
- FTP / P2P
  - Long lasting file transfers
  - Packets size of 1500 B (MTU)
- HTTP
  - Short ‘interactive’ connections (bursty in nature)
  - Reading time chosen as a random time between 0-12 s

Measurements

- Level of differentiation
  - How many traffic classes are needed?
- Differentiation principle
  - What should be the differentiation policy?
- Provisioning aspects
  - Is ALTQ/CBQ capable of satisfying the provisioning goal?
- Symmetry of differentiation
  - In what class should the TCP ACKs be delivered?

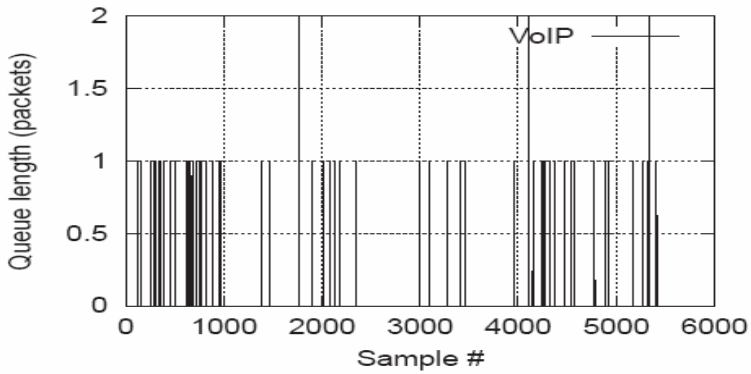
Measurement results

- Controlled delay behaviour with two traffic classes
  - The use of real-time applications with hard requirements (e.g. IP telephony) is possible

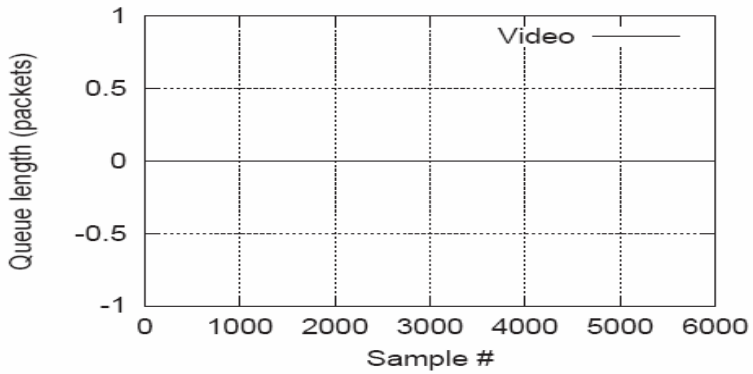


Measurement results

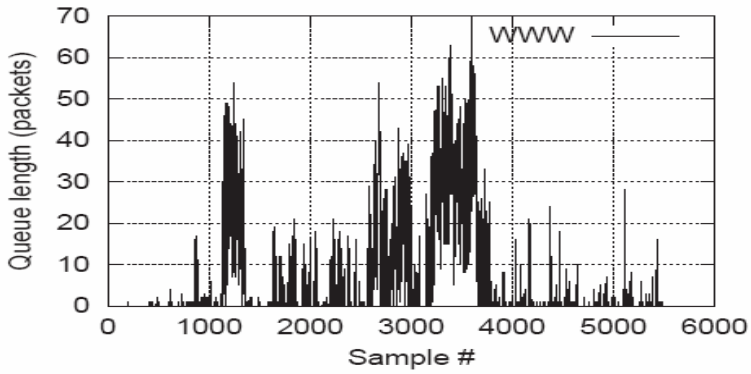
- Each traffic type in its own class (queue)
  - Easier to control



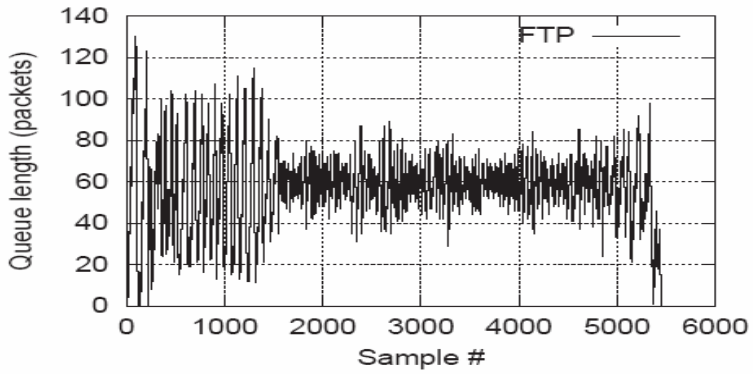
(a) VoIP class



(b) Video class



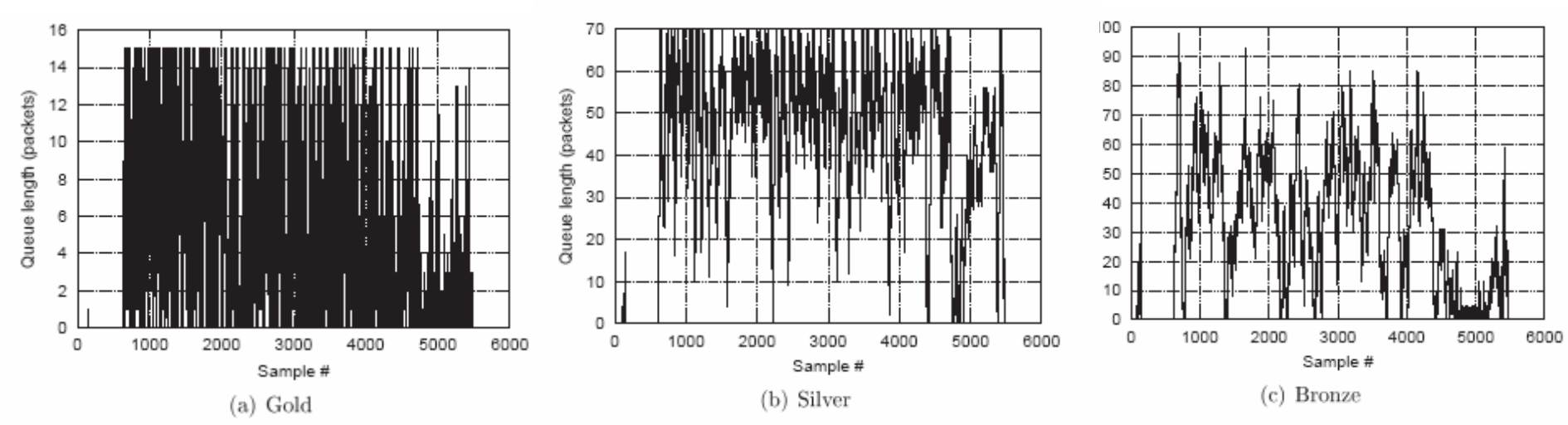
(c) WWW class



(d) FTP class

Measurement results

- Olympic Service Model does not take into account traffic requirements nor characteristics
  - Interference issues



Conclusions

- Differentiation policy has to take traffic requirements into consideration
  - Controllable and predictable service quality
- Two traffic classes is the minimum
  - One class for real-time traffic and one class for non-real time traffic
- Long and short TCP flows should be separated
- The symmetry of differentiation did not seem to play important role

Conclusions (cont.)

- ALTQ/CBQ can be used to provide isolation between traffic classes
  - Controlled delay behaviour for delay sensitive applications
- ALTQ/CBQ works in general, but…
  - Problems in the borrowing feature
    - Not all excess capacity can be utilized

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Thank you!

Questions ?