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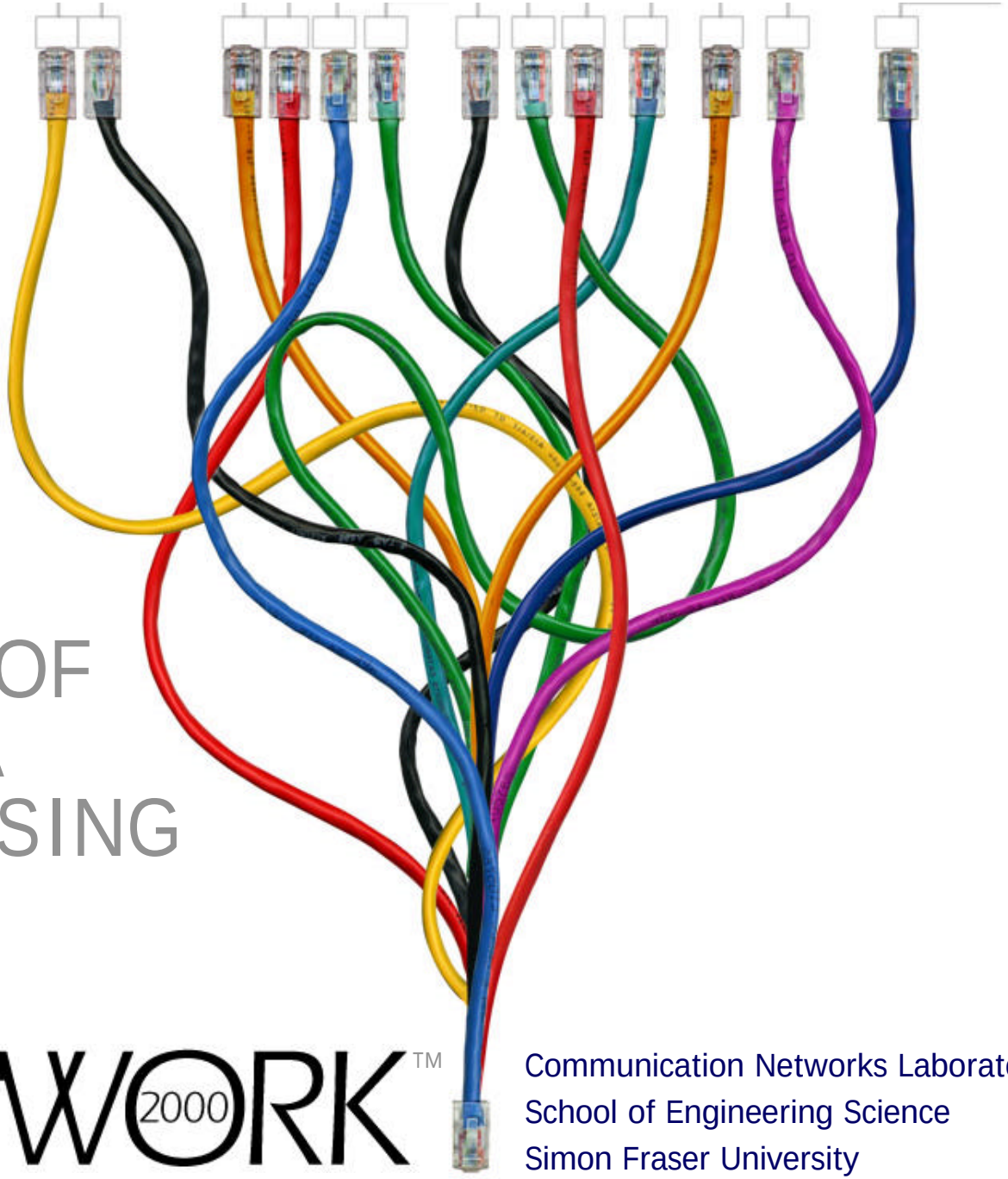

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SIMULATION OF PACKET DATA NETWORKS USING OPNET

OPNETWORK 2000™

Communication Networks Laboratory
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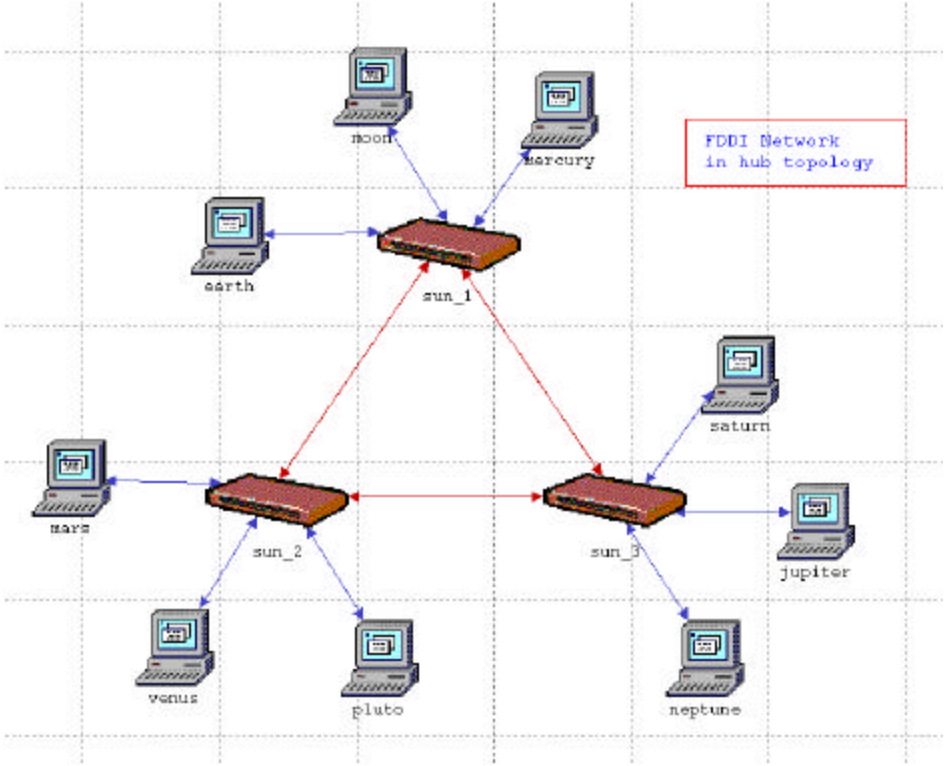
Road map

- Introduction to FDDI
- Fiber Distributed Data Interface (FDDI)
  - hub configuration
  - client-server configuration
- Introduction to ATM
- Asynchronous Transfer Mode (ATM)
  - ATM service categories
- Concluding remarks

Introduction to FDDI

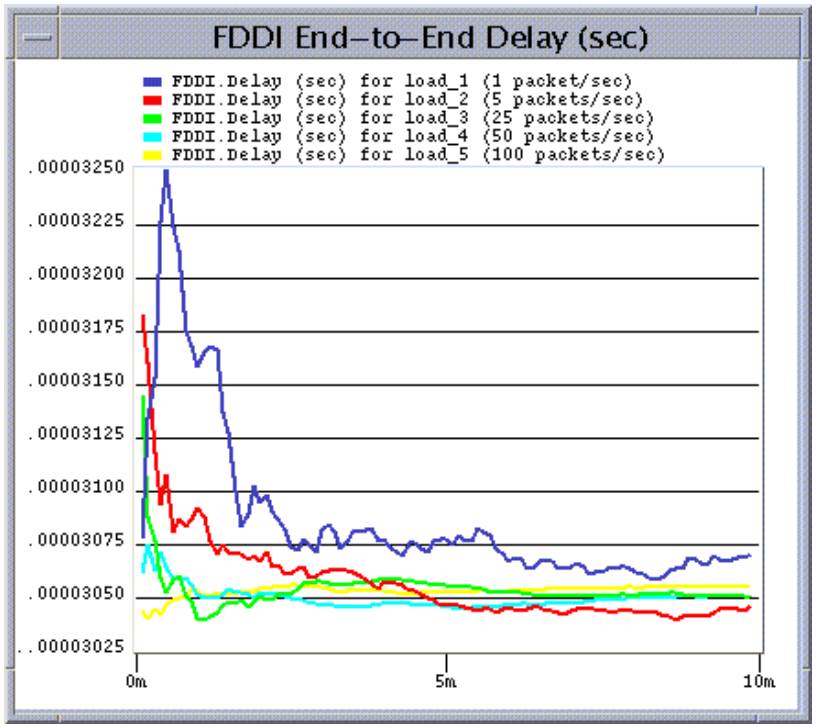
- FDDI
  - LAN technology that supports 100 Mbps rate.
  - Up to 500 communicating stations configured in a hub or ring topology.
  - Uses a timed-token access protocol.
  - Model available in OPNET library. Users can change parameters like number of stations attached to the ring, load, bandwidth allocation to each station, and target token rotations time (TTRT).
  - We consider two FDDI network topologies: hub configuration and client-server configuration.

FDDI hub configuration



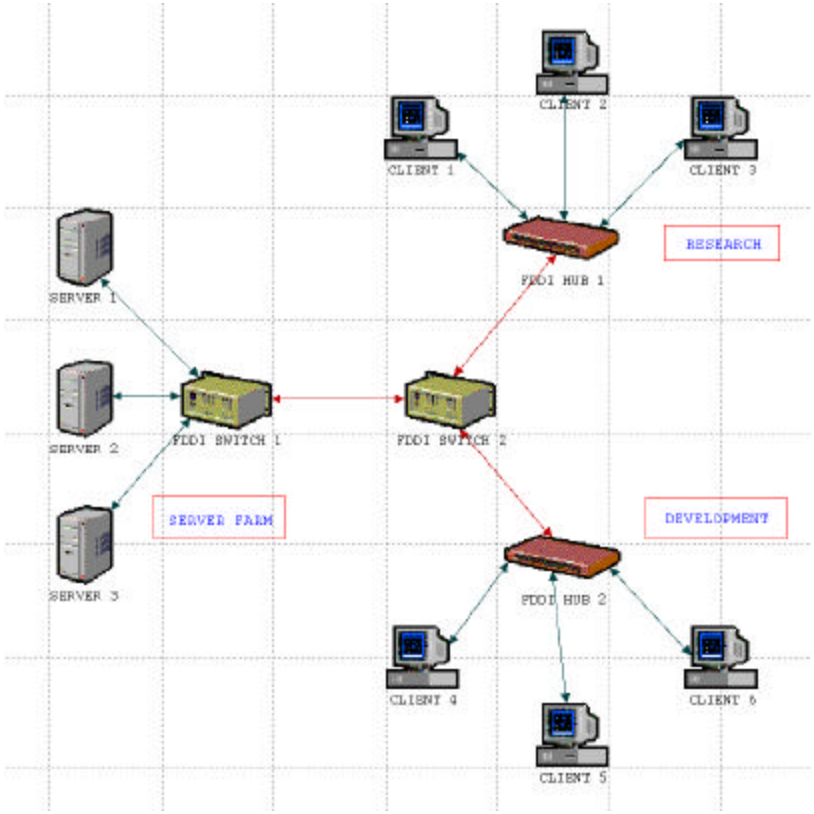
Network consists of 3 concentrators (connected with FDDI duplex links) and 9 stations (connected to the ring via concentrators).

FDDI hub configuration (cont.)



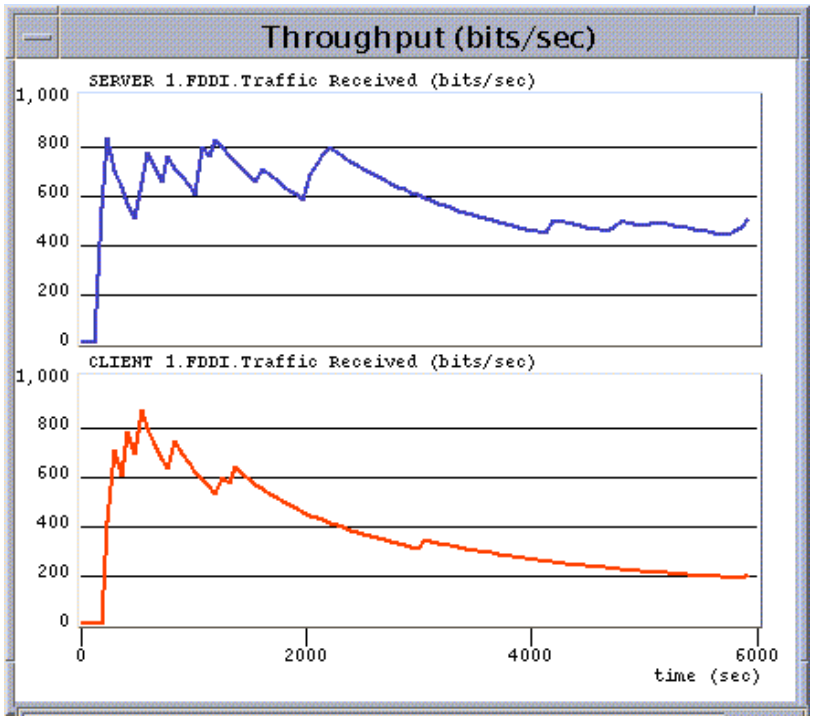
End-to-end delay (sec) plots, with load parameter (mean number of packets sent by the source) varying from 1 to 100 packets per second. Delay levels off with time, which indicates that the network is stable.

FDDI client-server configuration



Clients are connected to the network via hubs. Hubs and servers at different locations are connected via two FDDI switches.

FDDI client-server configuration (cont.)



Throughput (bits/sec) plots of Server 1 (top) and Client 1 (bottom). Once stabilized, server's throughput is twice as large as the client's throughput, which is to be expected because the number of servers is smaller than the number of served clients.

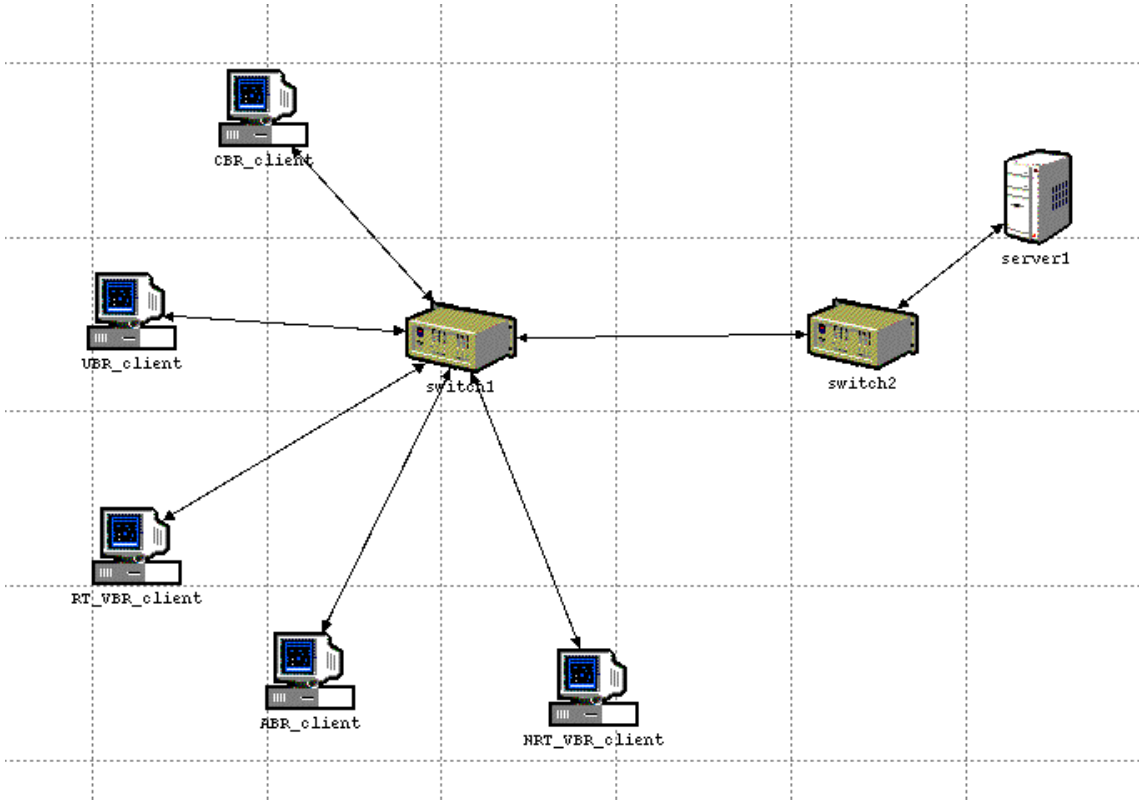
Introduction to ATM

- ATM
  - Emerging technology for backbone support in high-speed networks.
  - Transports different types of information including voice, data, and multimedia.
  - Different applications require different QoS and therefore different service categories.
  - Five different service categories: CBR, ABR, RT_VBR, NRT_VBR, and UBR. Each provides a different QoS and a different traffic management procedure.
  - Some QoS parameters: max cell transfer delay (max CTD), peak-to-peak cell delay variation (PP_CDV), cell loss ration (CLR).
  - Some network management functions: connection admission control (CAC), usage parameter control (UPC), ABR flow control.

Introduction to ATM (cont.)

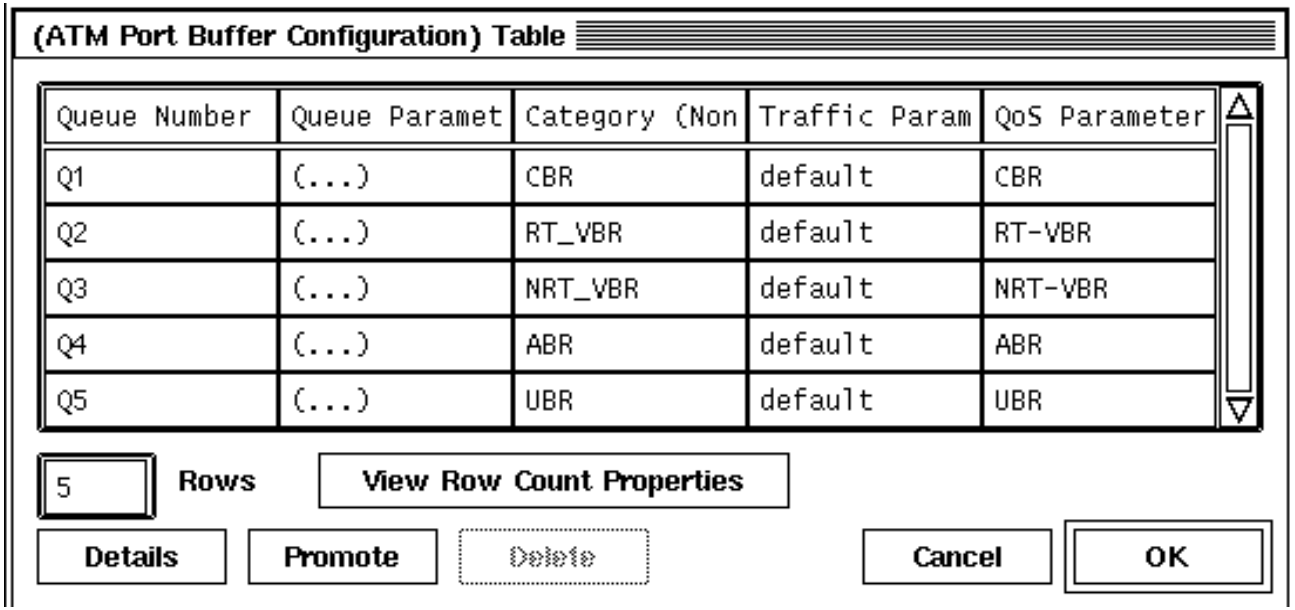
- CBR: To support real time applications with tight constraints on delay variation. Have to specify PCR and CDVT.
- ABR: not for real-time traffic. No bounds on delay or delay jitter. Supports feedback to control source rate.
- RT_VBR: supports bursty real time applications with tight constraints on delay and delay jitter. Characterized by PCR, SCR, and MBS.
- NRT_VBR: supports non real time but bursty application. No delay constraints. Low cell loss ratio is expected. Open loop service (controlled by end systems through UPC)
- UBR: best effort service. No commitment over PCR and MCR. Not fair. Used for file transfer and email.

ATM client-server network

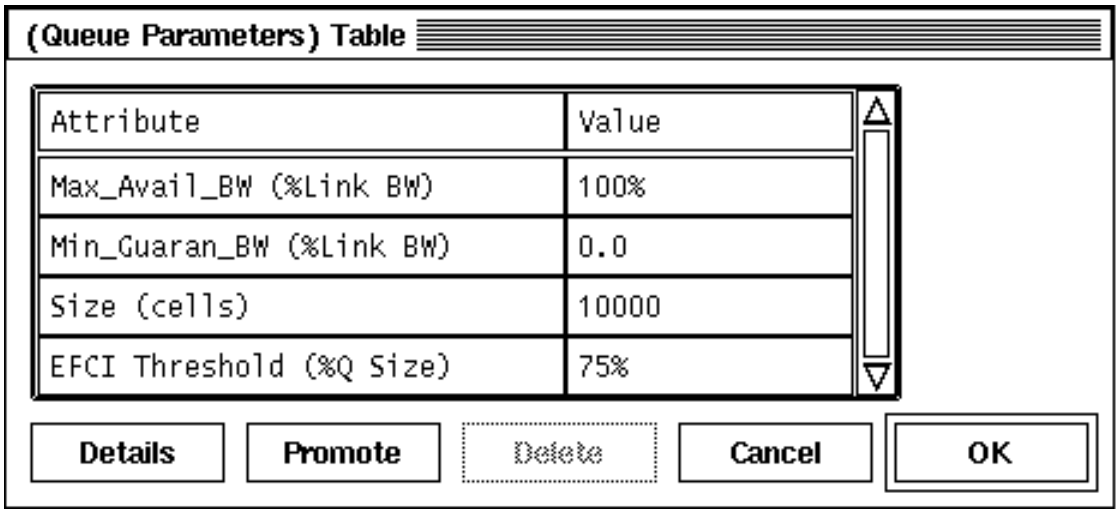


Network consists of two switches, an ATM server, and five clients requesting five distinct service categories. Traffic received by CBR client has a constant bit rate, while all other clients receive bursty traffic.

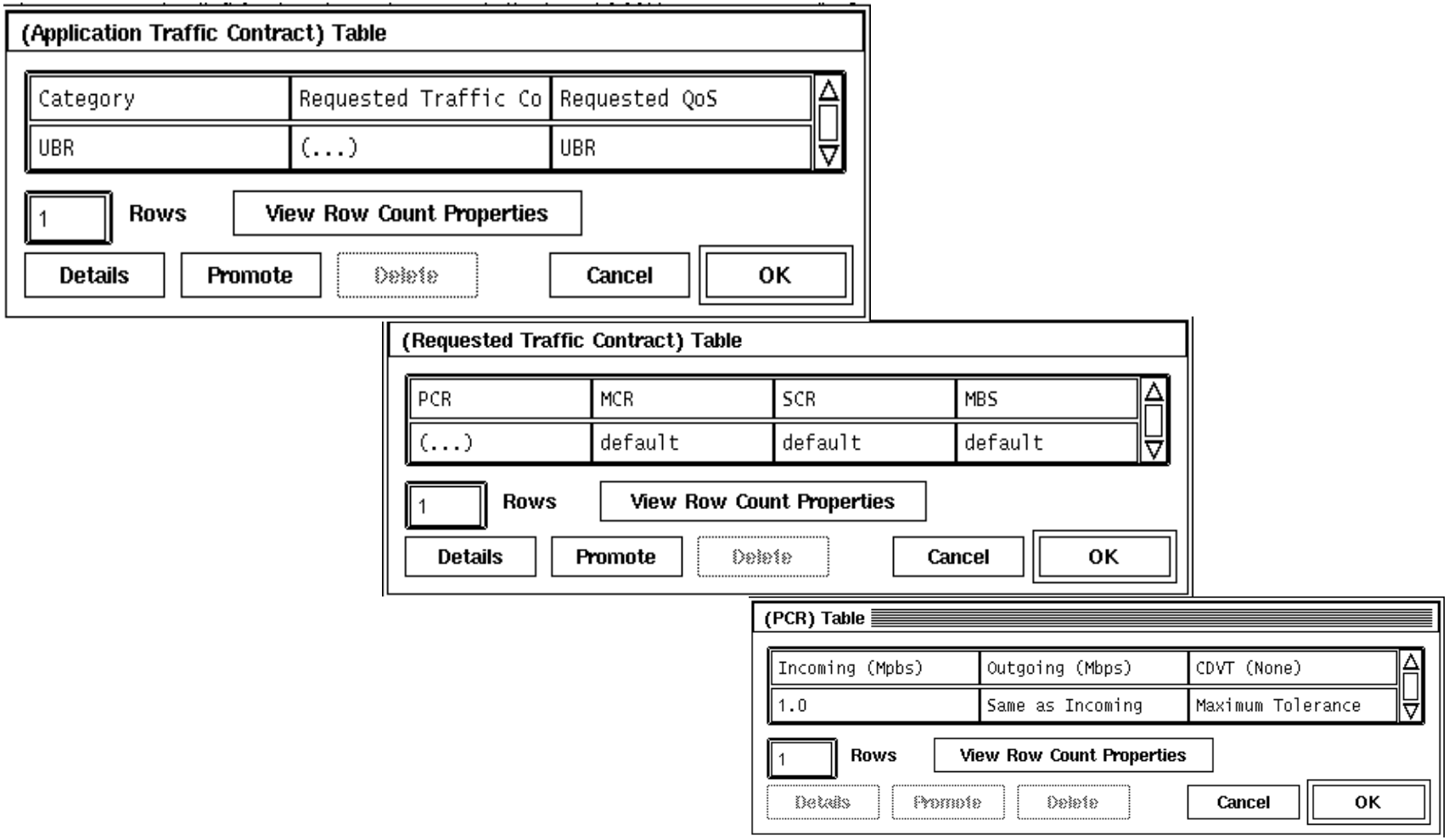
Some node model attributes



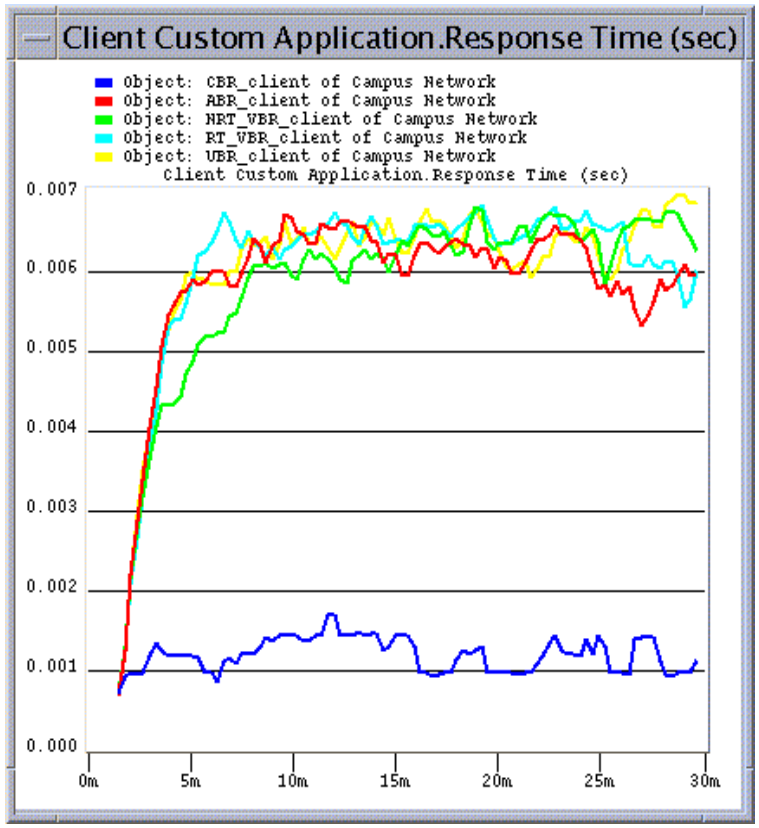
Some node model attributes (cont.)



Some node model attributes (cont.)

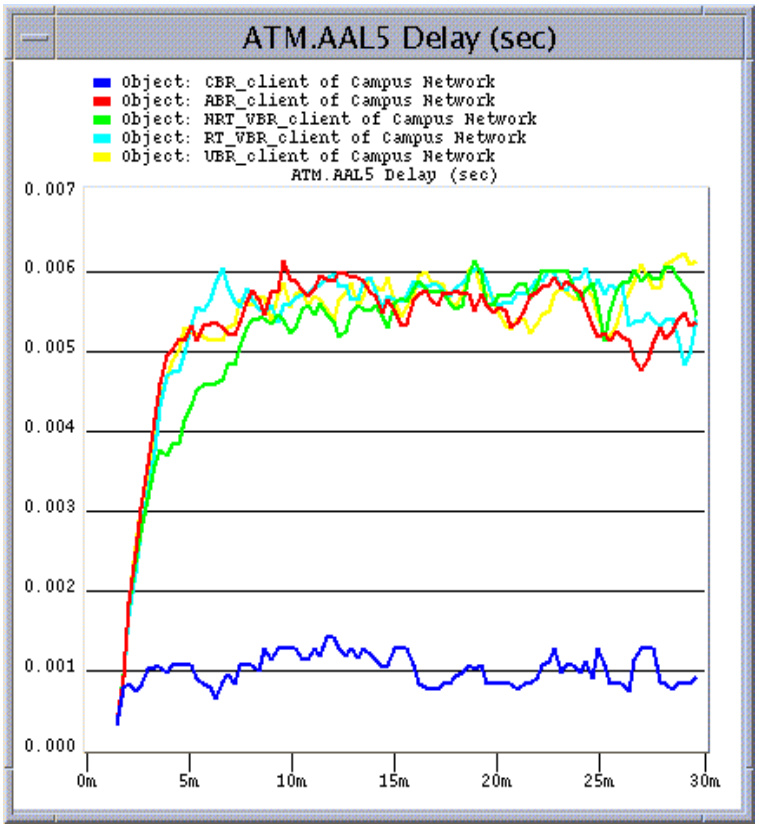


ATM client-server network (cont.)

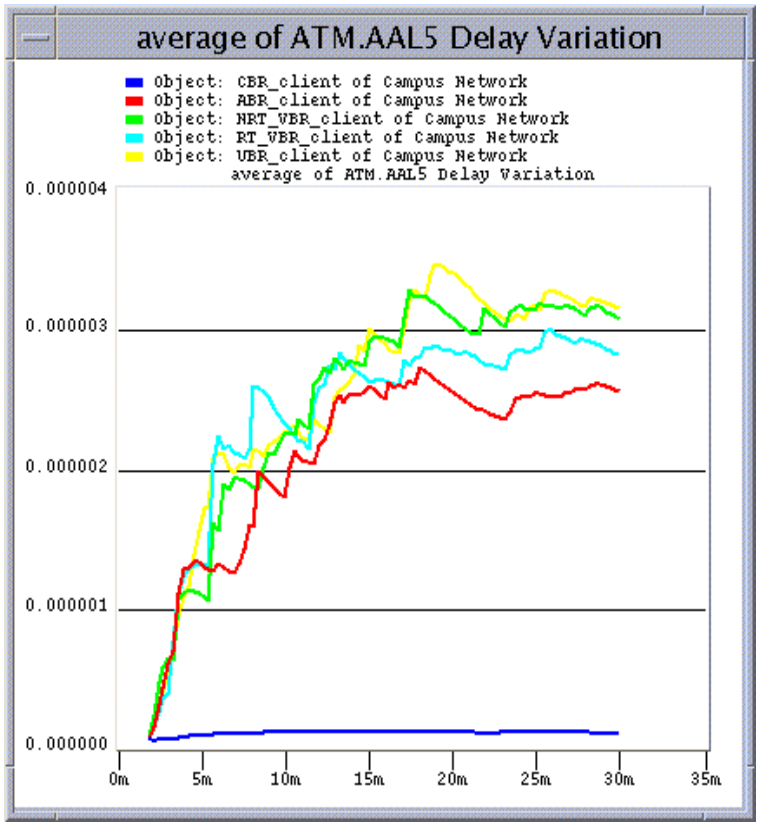


Response time (sec) for each client is the time it takes from sending a request to the server and receiving a response from it. The CBR client has the smallest response time and hence the best QoS.

ATM client-server network (cont.)



Propagation delay (sec) is the smallest for the CBR source, which has the best QoS.



Average delay jitter is almost zero for the CBR source, which has the best QoS.

Concluding remarks

- We simulated two commonly used packet data network technologies: FDDI and ATM.
- Two FDDI and one ATM network scenarios were implemented.
- We used simulations to compare the performance of various service categories in ATM networks.
- We showed that CBR traffic delivers the least response time, delay, and delay jitter among ATM service categories.

References

- [1] ANSI X3.139-1987, *Fiber Distributed Data Interface (FDDI) - Token Ring Media Access Control (MAC)*: *http://www.ansi.org*.
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- [6] OPNET Contributed Model Depot: *http://www.opnet.com/services/depot/home.html*.