Conclusion

- Current guaranteed performance schemes are rigid
- To provide *flexibility,* connection management can be used to control and monitor connections
- Control achieved by using **Dynamic Connection Management Scheme**
- All algorithms designed and extensive simulation experiments conducted
- Monitoring and Control functionality currently being implemented using the Tenet protocols and SNMPv1

Implementation

Control (DCM)

- DCM scheme used to modify traffic and performance requirements and routes.
- Client communicates to DCM policy manager through socket interface
- DCM Manager then directs SNMP agent
- RT MIB defines traffic/ performance/route parameters.
- SNMP sets used on RT MIB objects to initiate modifications.

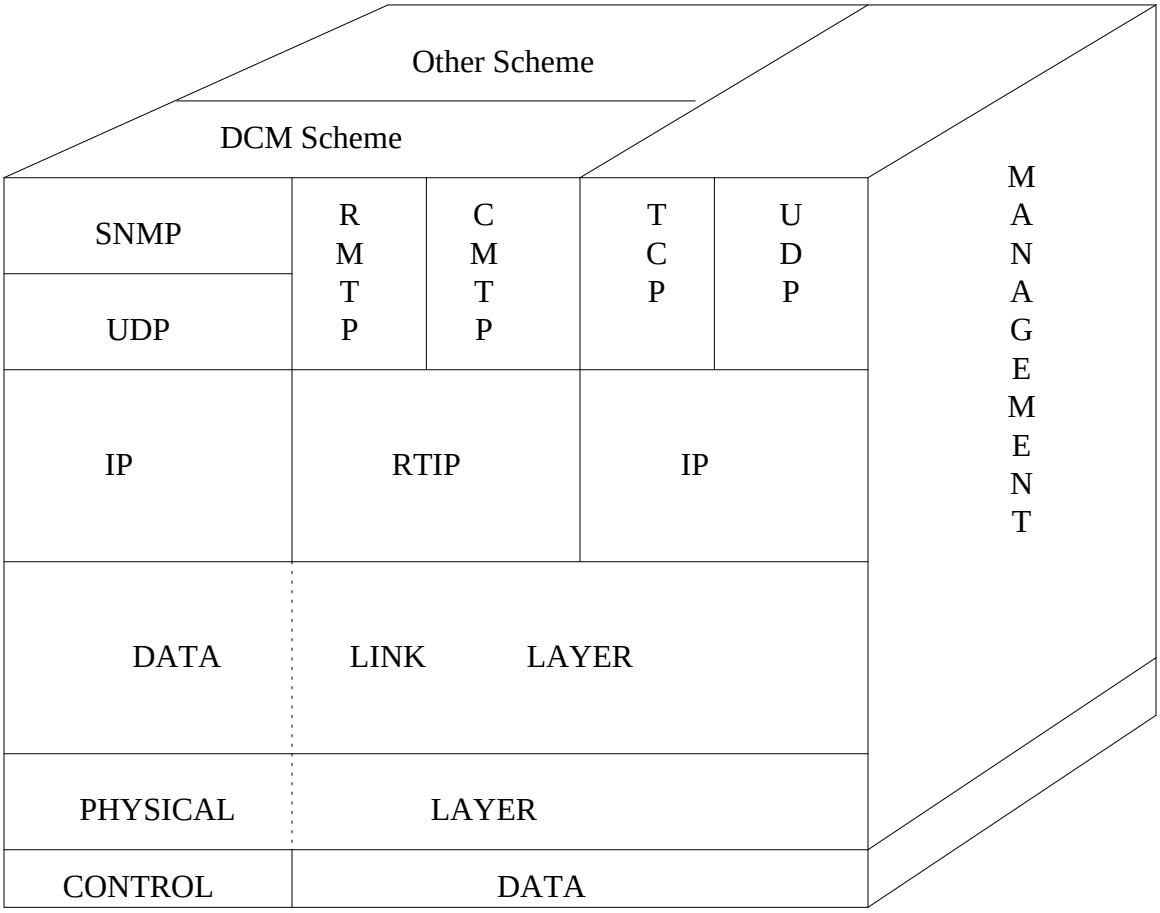
Implementation

Monitoring (RMTP/RTIP)

- Collecting actual traffic and performance measurements for verification of guarantees
- Collecting clients performance requirements and routes to facilitate high level management decisions.
- RMTP/ RTIP MIBs defined under SNMP SMI format.
- SNMP *get* commands used to query MIBs

Implementation

Protocol Stack



Implementation

Environment (Protocols):

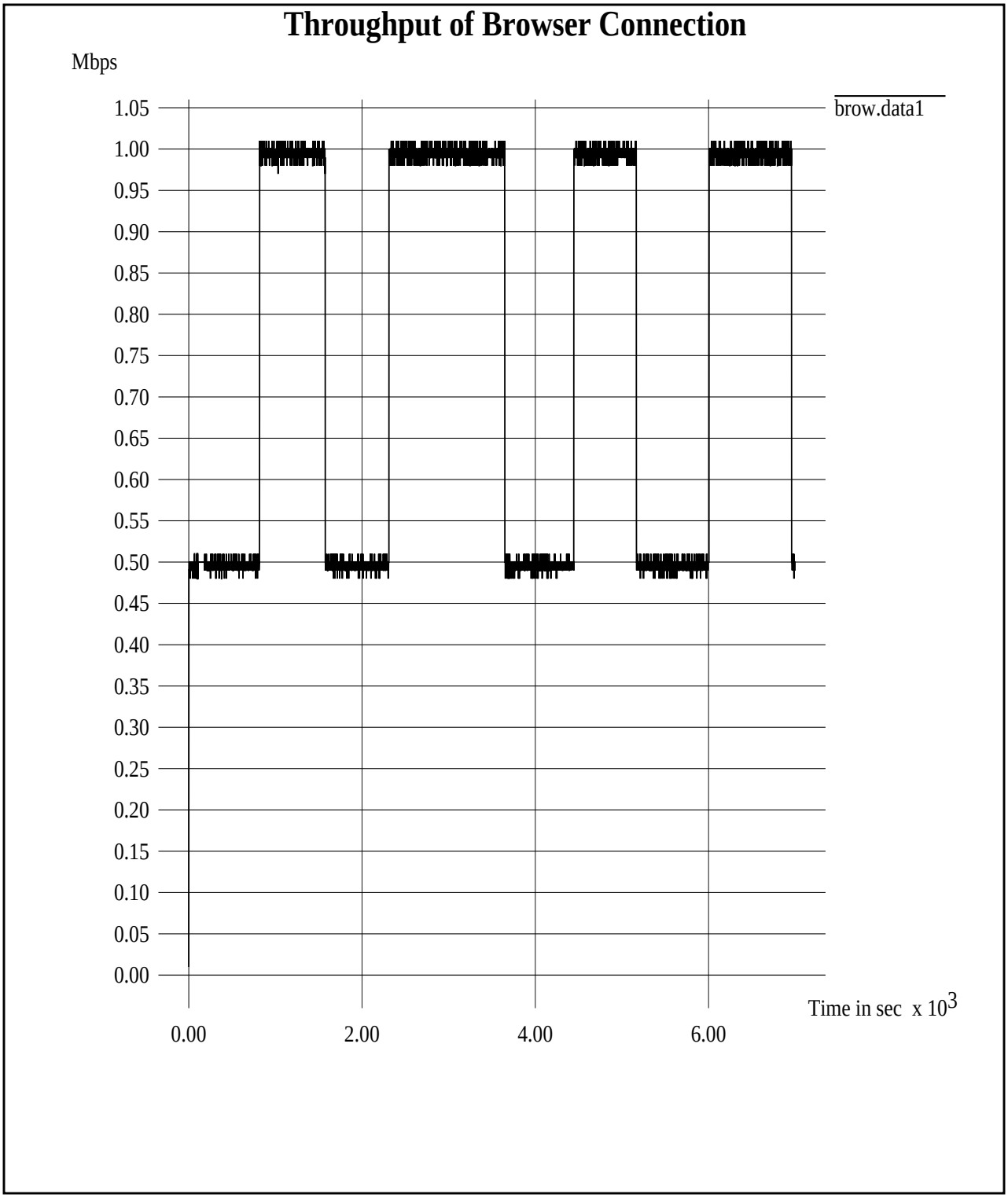
- Tenet protocol suite 1 with Ultrix 4.2a.
- Monitoring and control achieved using SNMPv1
  - widespread presence of SNMP
  - simplicity
  - availability of source code

Simulation Experiment

Results:

Metrics	Values
# of Modifications	8
# of Route Changes	3
Maximum Setup Times	123.5 ms
Average Setup Times	102.4 ms
Maximum Packet Delay	77.0 ms
Average Packet Delay	70.1 ms
# of Out-Of-Seq. Pkts.	0
Avg. Mechanical Switch	0.3 - 0.5 s

Simulation Experiment (Results)



Simulation Experiment

Experimental Details:

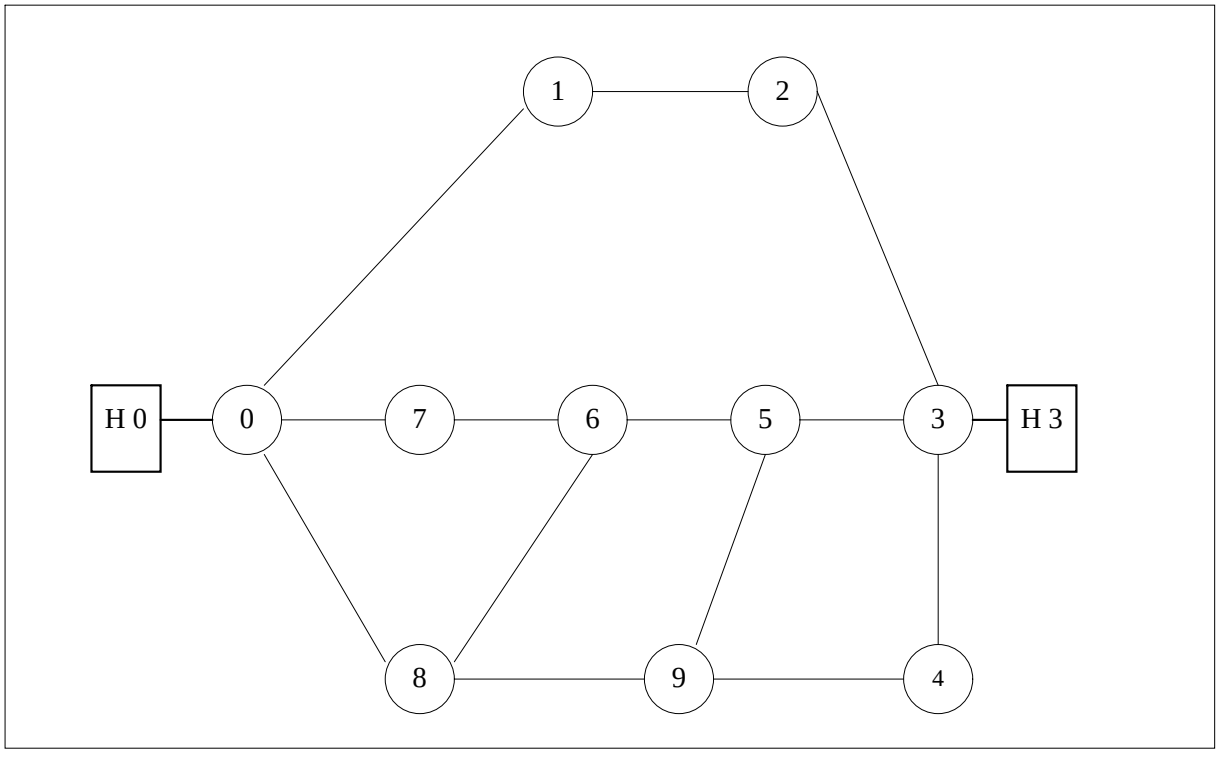
- Browsing periods statistically determined
- Real-time load on system (Ave. bandwidth 68% , Max. 78%)
- Other real-time traffic used to cause route changes

Parameters	Playback	Fast Browse
Xmin(ms)	15.6	7.8
Xave(ms)	15.6	7.8
I (ms)	1000	1000
Smax(b)	1024	1024
D (ms)	80	80
Bandwidth	0.51 Mbps	1.0 Mbps

Simulation Experiment

Lossless Digital Image Browser

- Lossless browsing implies different bandwidth rates
- All links 10 Mbps (propagation delay 10 and 20 ms)
- Connection between H0 and H3



Dynamic Connection Management

DCM Scheme is a collection of algorithms:

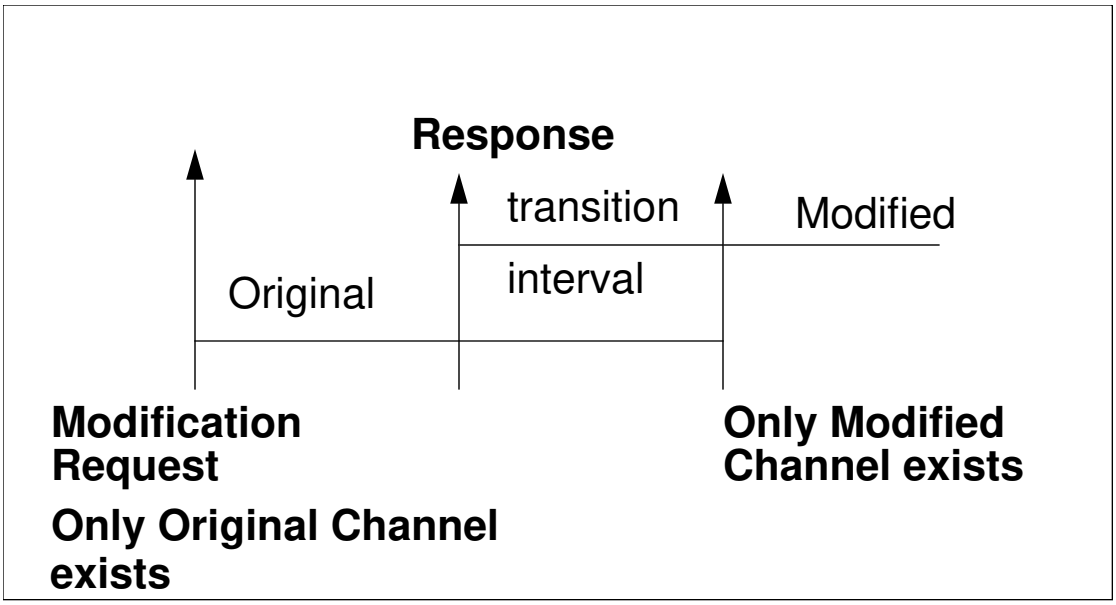
- Channel Administration Algorithm: does the admission control tests based on *resource-sharing constraints*
- Routing Algorithm: determines route based on network state and client's demands subject to *resource-sharing constraints*
- Transition Algorithm; supports *No-violation* modification to prevent performance violations

Features:

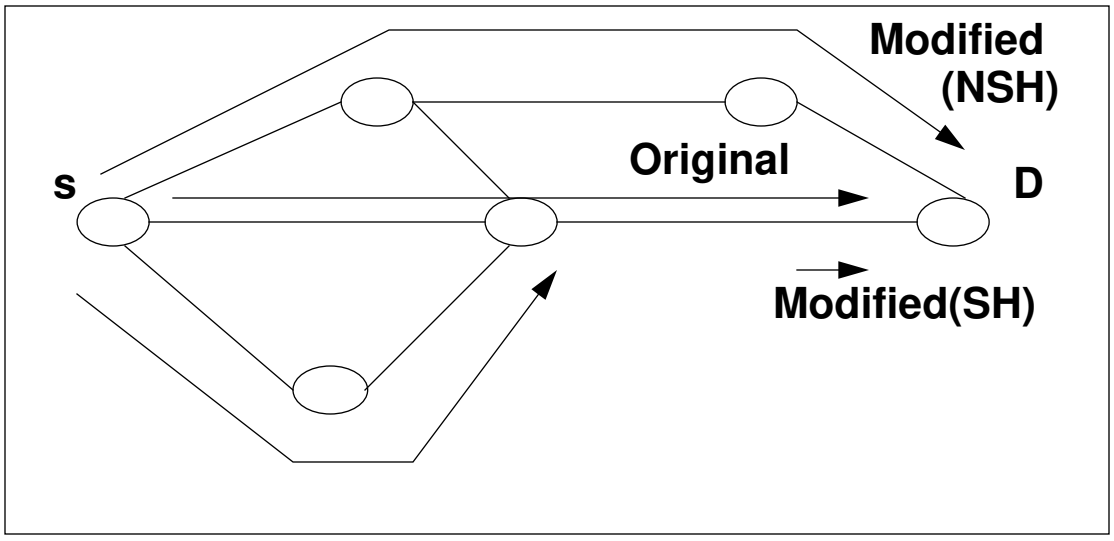
- Can support *global* and *local* control

Dynamic Connection Management

DCM Scheme:



Reservation: (Sharing vs Non-Sharing)



Dynamic Connection Management

DCM (control)

- Composed of DCM scheme and DCM policies
- DCM scheme enriches the Tenet contract by accommodating *flexibility*
- Scheme provides ability to modify
  - *traffic characteristics* and *performance requirements*
  - route

  subject to a *modification contract*
- Modification contract specifies *No-violation* or *Bounded-violation* transition

Connection Management:

Real-Time Connection Management:

- Provide the network with ability to monitor and control real-time connections
- Monitoring achieved by recording aggregate traffic and performance values of packets in connections
- Control achieved by the **Dynamic Connection Management Scheme**

Related Work

Current Schemes:

- Guarantees on traffic specification, delay bounds, jitter bounds and loss bounds
- Resource reservation and route selection done at establishment time and fixed for lifetime of connection
- e.g. Tenet (*Ferrari, et al.*), ISPN (*Clark, et al.*), ATS (*Lazar, et al.*),etc.

Related Work:

- ST-II protocol (*Topolcic, et al.*), Capacity Based Session Reservation Protocol (*Tokuda, et al.*), plaNET (*Cidon, et al.*)

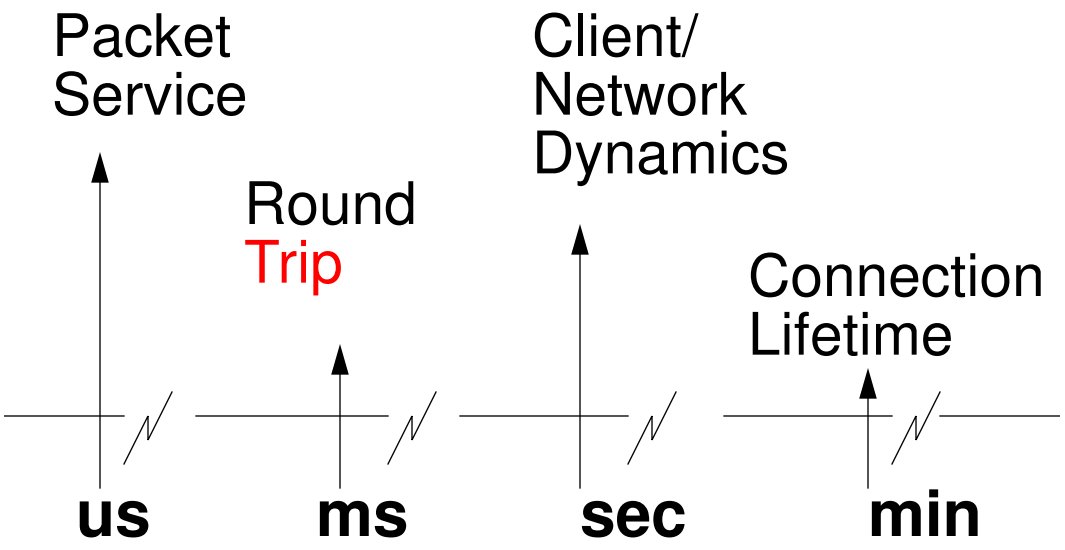
Proposed Solution

Connection Management:

- provide ability to adapt to these dynamics by modifying the *traffic, performance characteristics* and *route* of the connections (*control*)

- provide network with the ability to determine the client's and network's real-time state (*monitoring*)

Problem Definition



Client Dynamics:

- Initial parameter tuning, lossless digital image browsing, mobile hosts

Network Dynamics:

- Media scaling, load balancing, multicast connection management

Problem Definition

Guaranteed Performance Services in Packet-Switched Networks.

Characteristics of services:

- Guarantees traffic specifications and performance requirements
- Connection-oriented and reservation based
- Resource allocation and route selection done at establishment time and fixed for lifetime of connection

Problem

- Cannot adapt to the *dynamics* of the network state or the client demands

Outline

- Problem Definition
- Proposed Solution
- Related Work
- Connection Management
- Control - Dynamic Connection Management (DCM)
- Implementation
- Conclusion

Real-Time Network Management: On the Monitoring and Control of Guaranteed Performance Connections

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