Implementation of Host-based Overlay Multicast in Support of Web Based Services for RT-DVS

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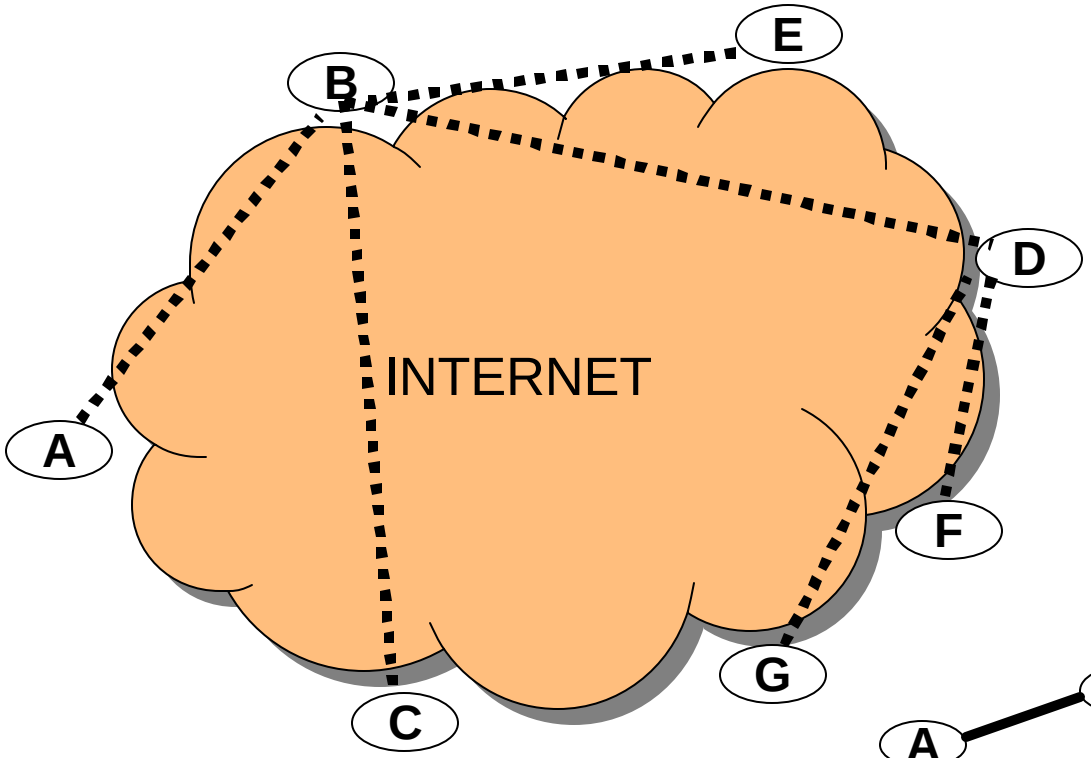
Network Service Requirements for Real Time Distributed Virtual Simulation

- Network Quality of Service (QoS)
  - end-to-end capacity, latency, jitter, and packet loss in a statistical sense
- Multicast
  - many-to-many group communication
- Reliable Multicast Transport
  - high confidence of delivery
- End-to-end network status and performance monitoring
  - need to know what the network is doing for you
- Multi-sensor systems
  - must manage streaming data with low latency

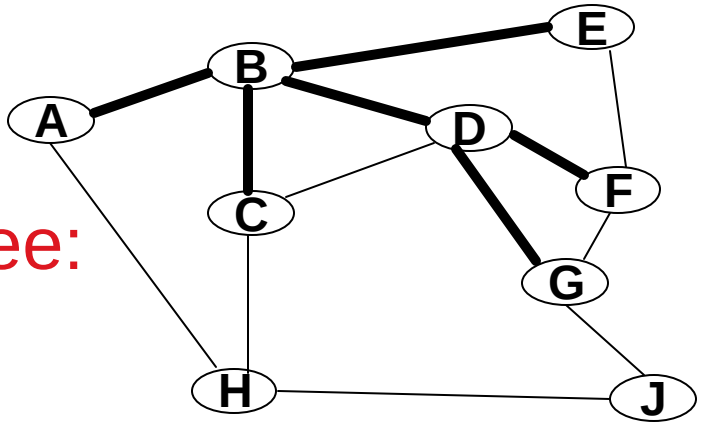
Internet Multicast Services Today

- IP multicast over the Internet not widely deployed
- IETF initial focus is on one-to-many multicast
- Commercial viability lacking for IP multicast in the Internet
- Result: interest in multicast based on end systems not network
  - End-to-end argument: push complexity up the stack
  - Example: TCP is complex, IP is simple

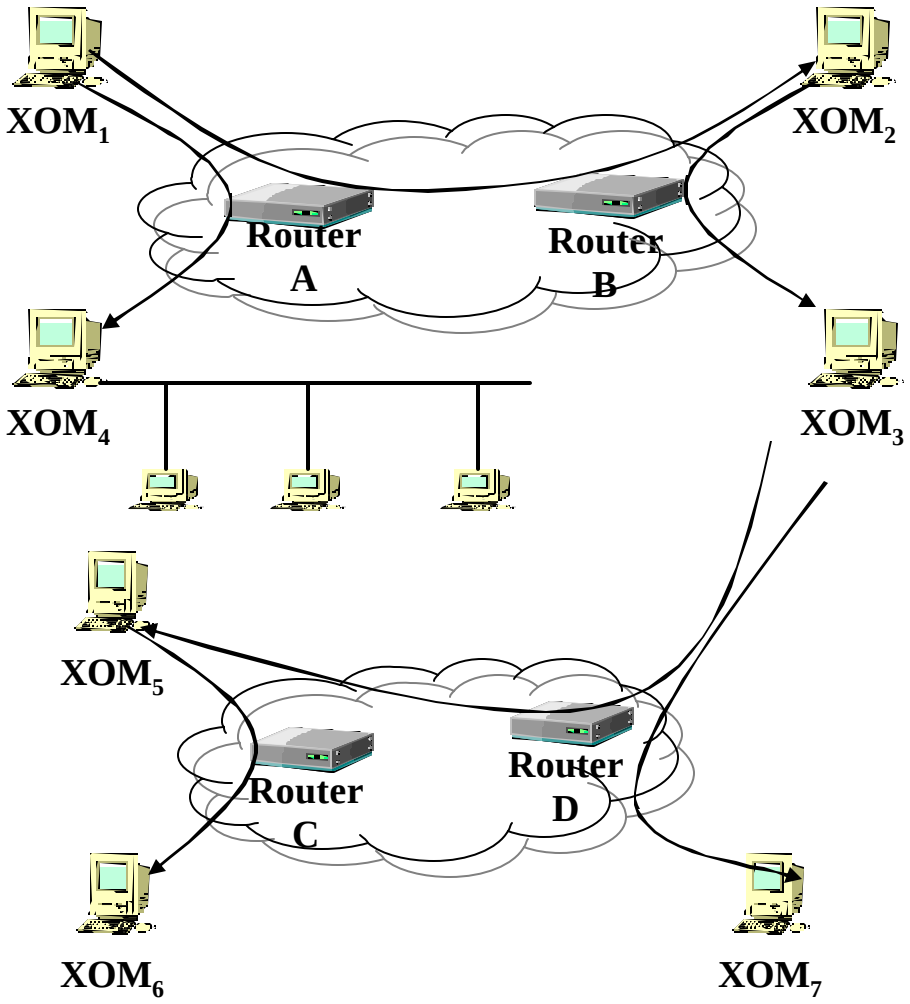
Overlay Multicast Tree



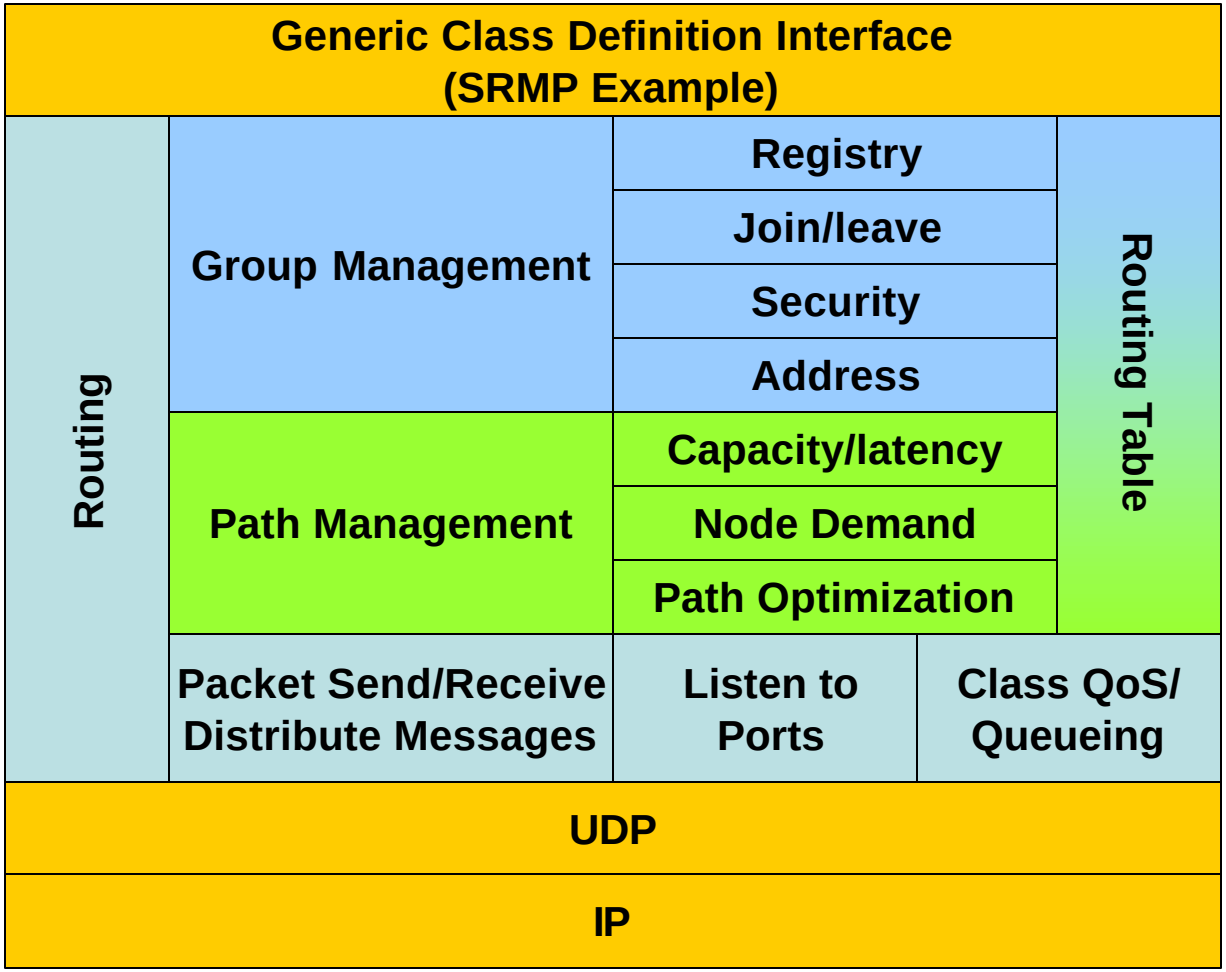
IP Multicast tree:



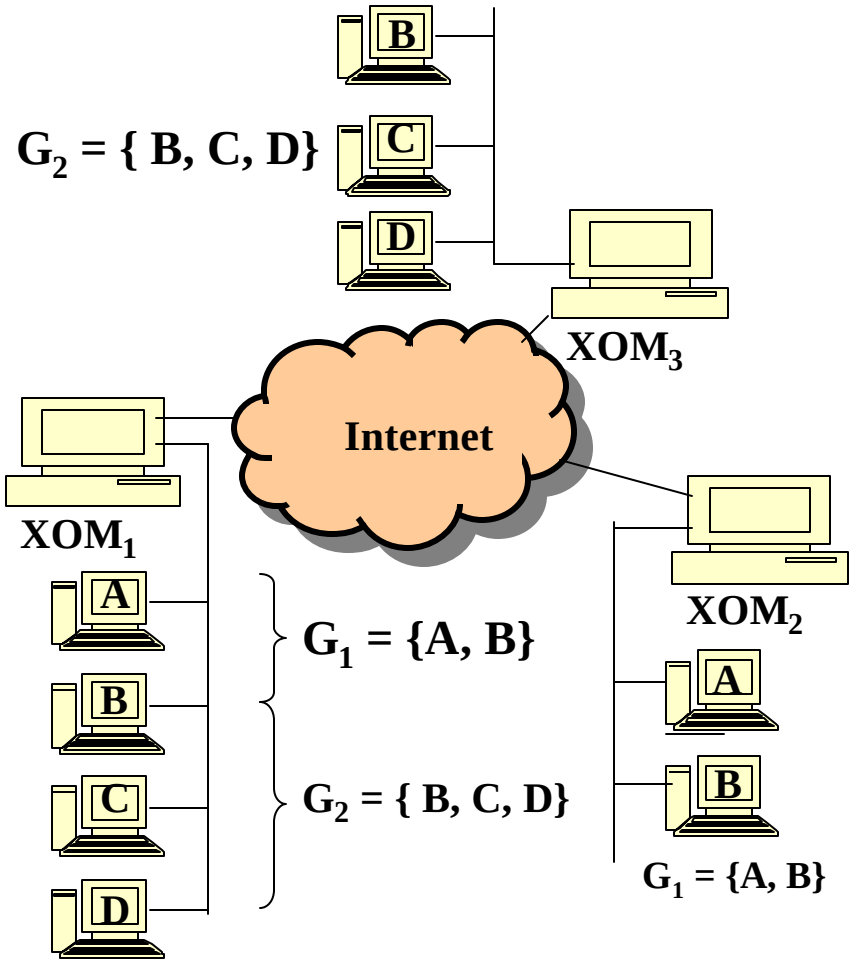
XOM Overlay


XOM1
XOM2
Router A
Router B
XOM4
XOM3
XOM5
Router C
Router D
XOM6
XOM7

XOM Layers


Generic Class Definition Interface
(SRMP Example)
Routing
Group Management
Registry
Join/leave
Security
Address
Path Management
Capacity/latency
Node Demand
Path Optimization
Routing Table
Packet Send/Receive
Distribute Messages
Listen to
Ports
Class QoS/
Queueing
UDP
IP

XOM Group Membership



Application B sending implies routing to group $G_3 = \{G_1 ? G_2\}$

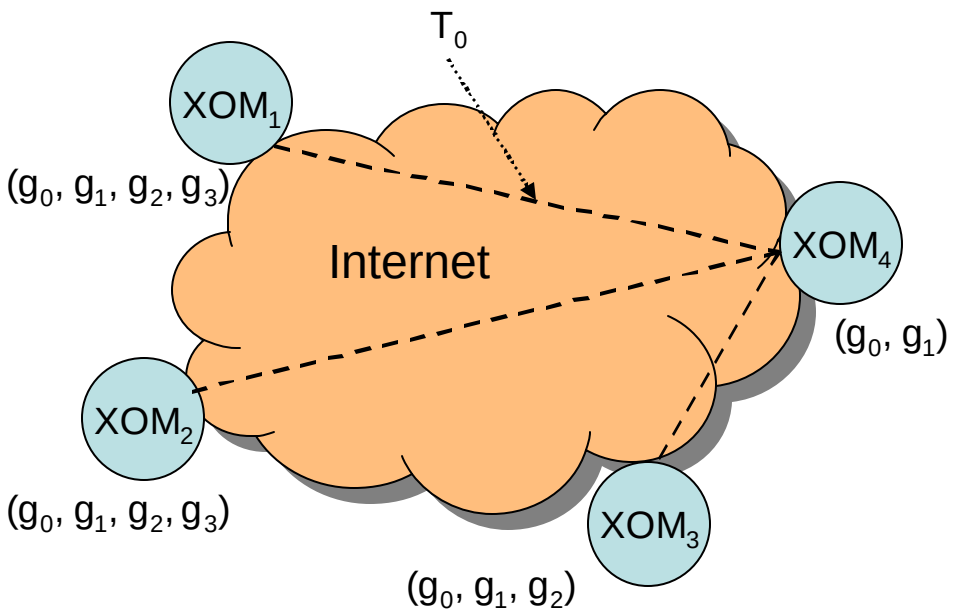
Group Aggregation Overlay
(Optimum Path Overlay)

Multicast Groups

Group	Members
g_0	$XOM_{1,2,3,4}$
g_1	$XOM_{1,2,3,4}$
g_2	$XOM_{1,2,3}$
g_3	$XOM_{1,2}$

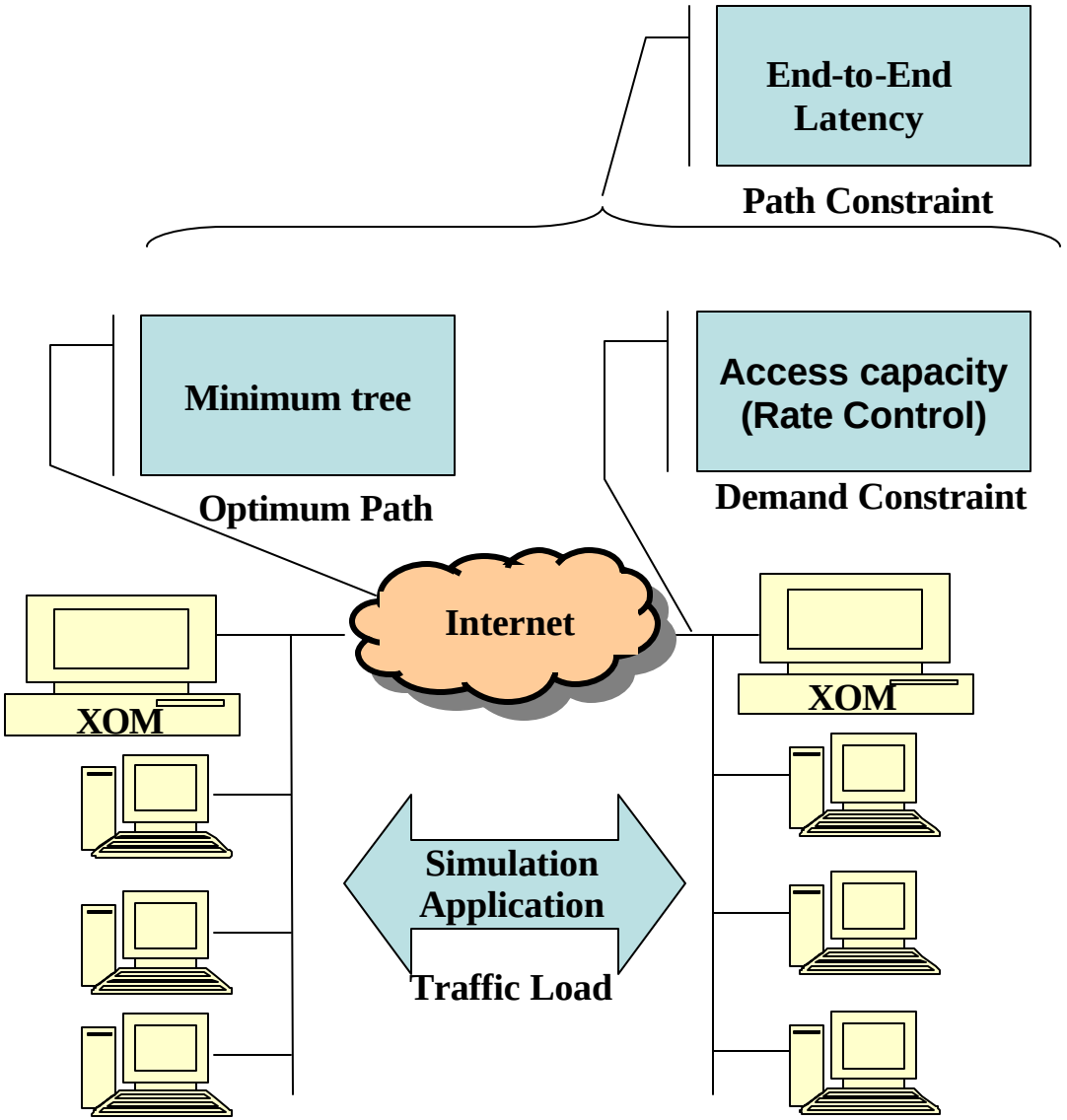
Aggregate Trees

Tree	Tree Links (arcs)
T_0	1-4, 4-2, 4-3



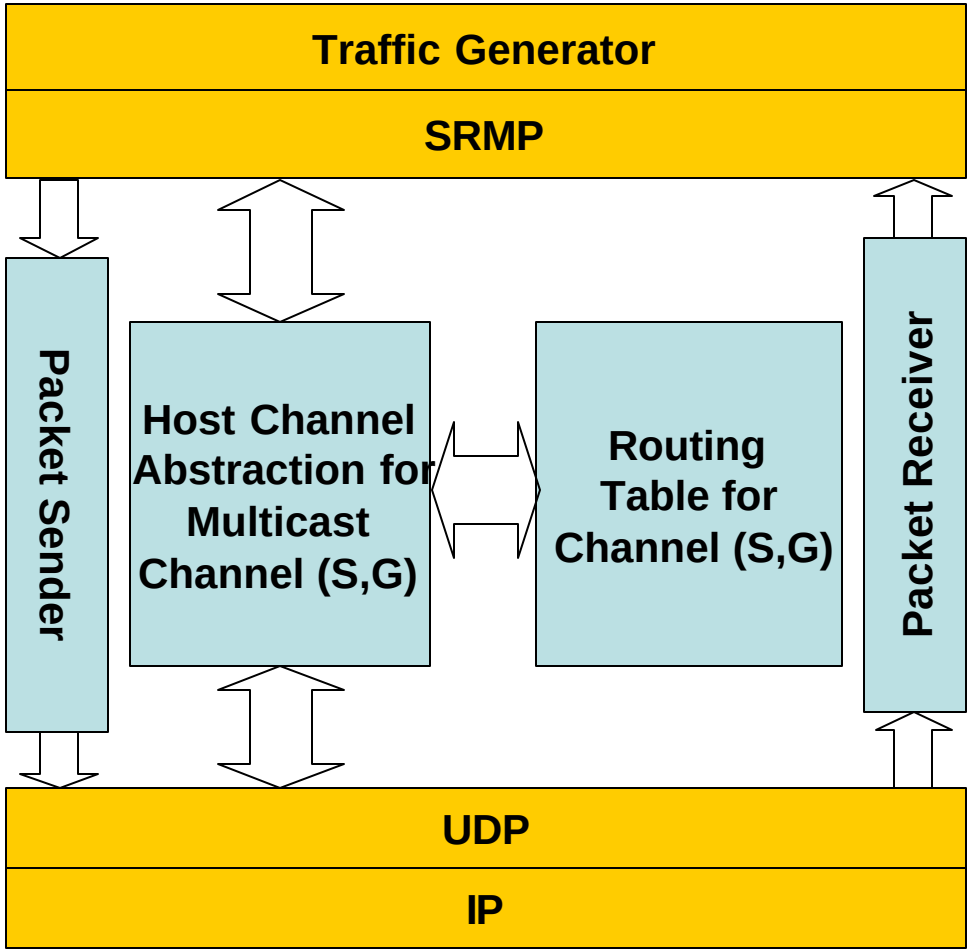
Groups g_0, g_1, g_2, g_3 share one aggregate tree T_0. T_0 is a perfect match for g_0 and g_1, but is a leaky match for g_2 and g_3. Trades off path utilization inefficiency for lower path management overhead.

Overlay Routing Constraints

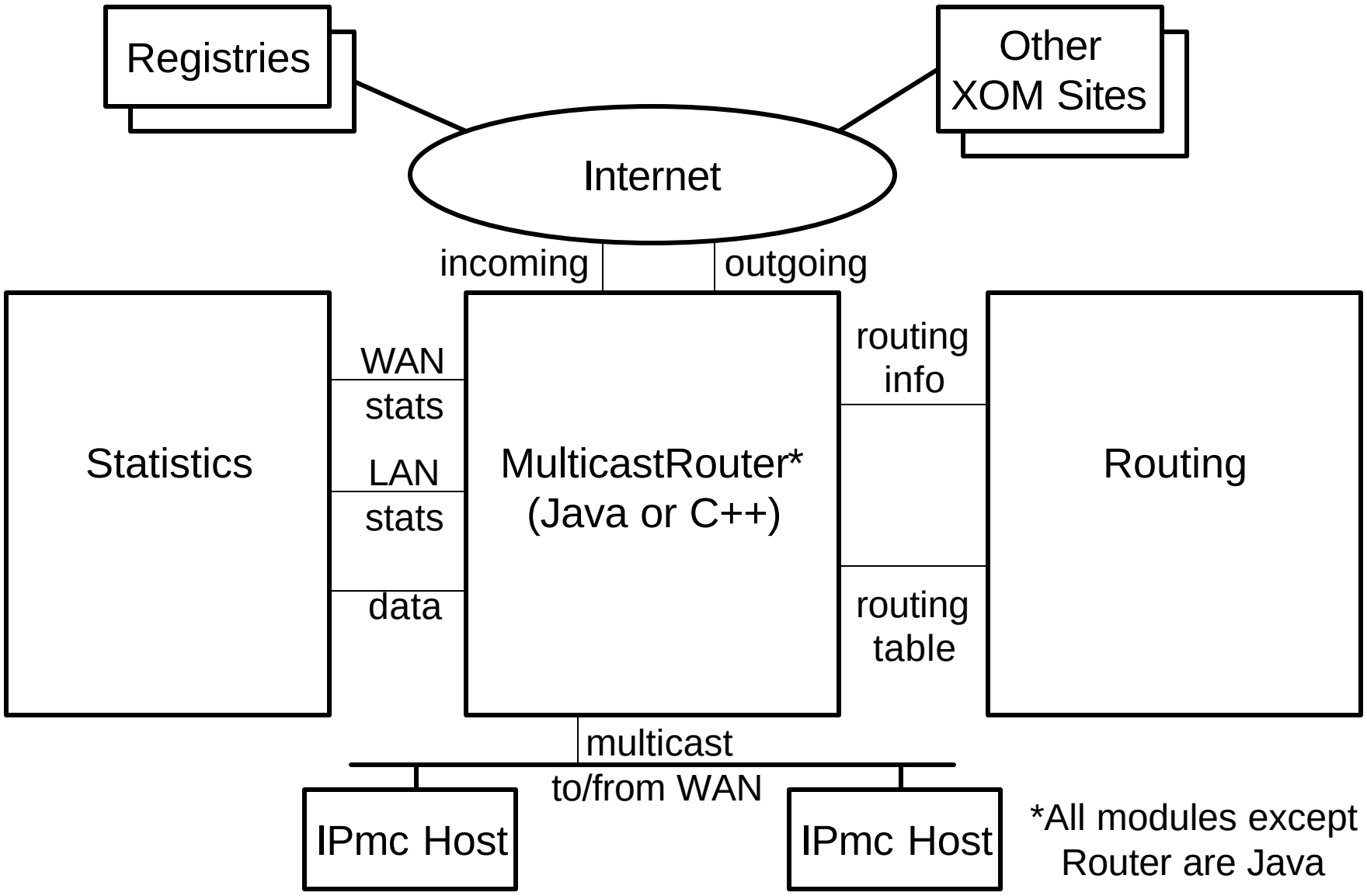


XOM Functional Model

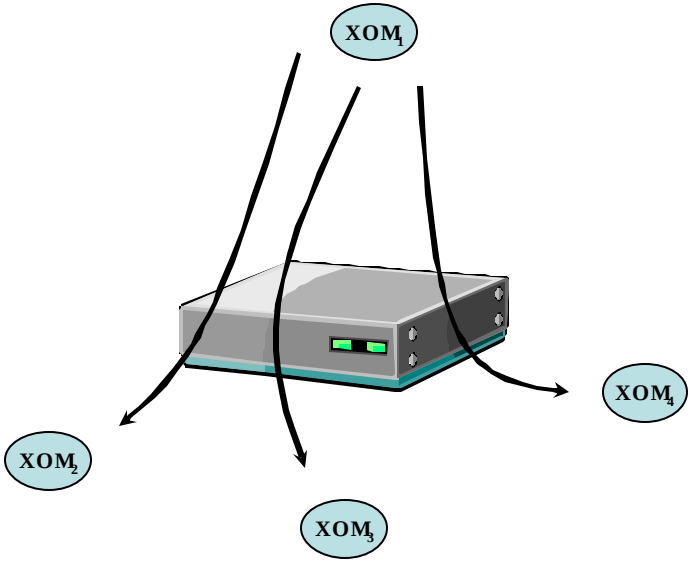
Prototype Test Scenario



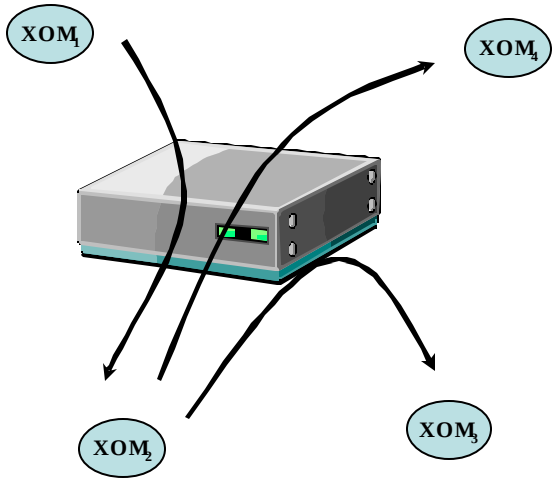
XOM Prototype



XOM Lab Test Scenarios

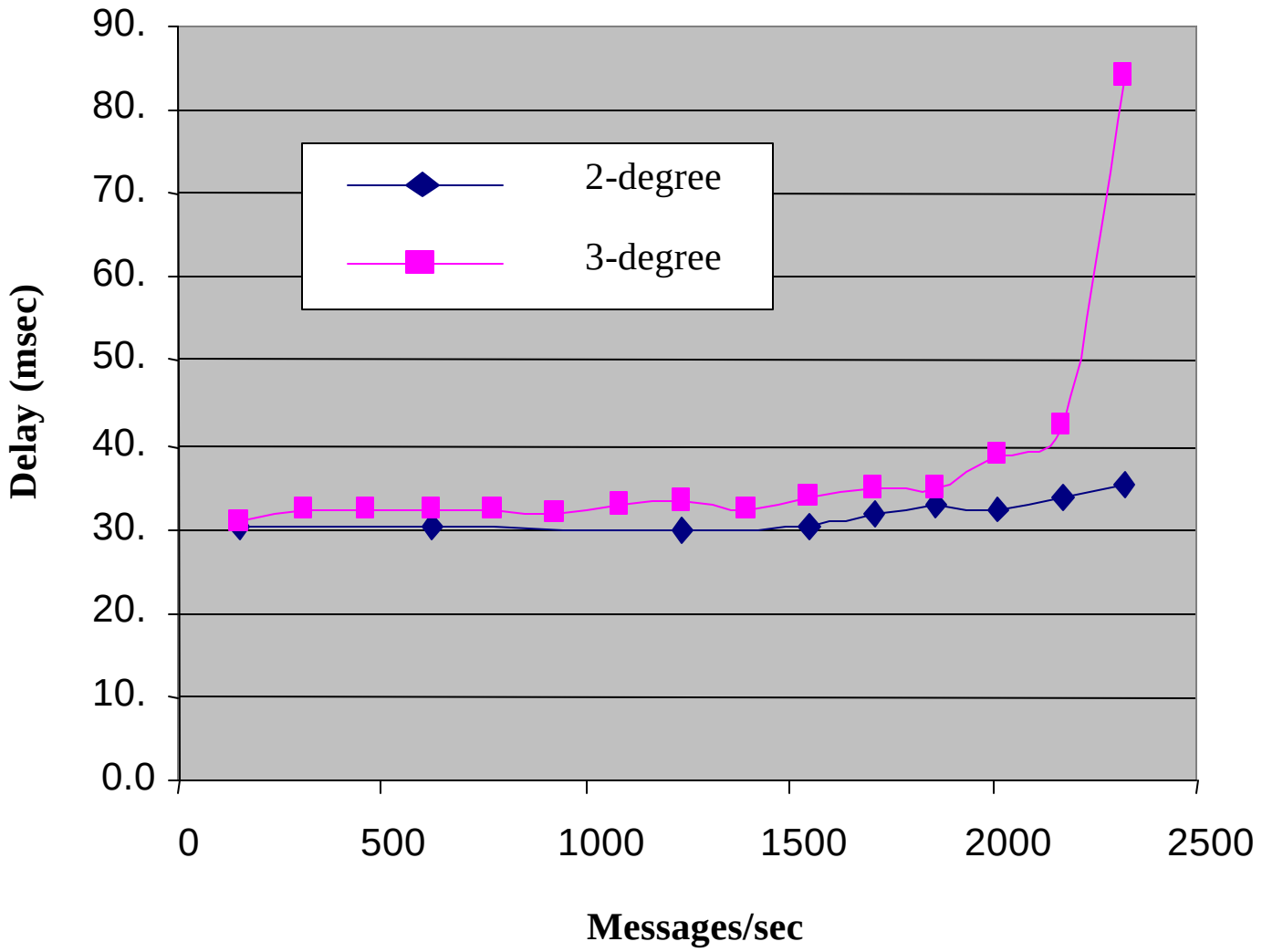


Test 1. XOM *n*-degree of 3



Test 2. XOM *n*-degree of 2

Message Delay



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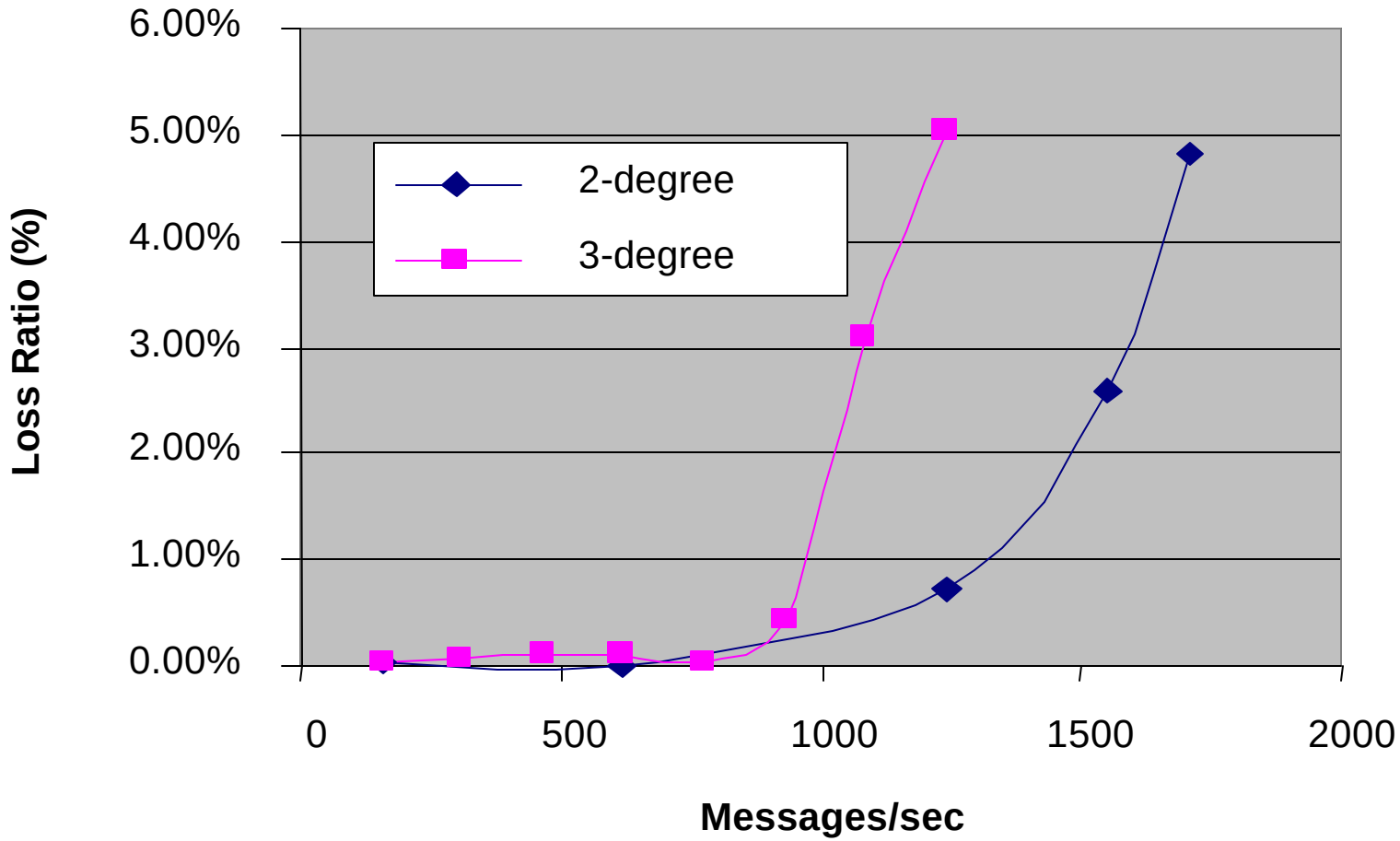
Message Loss Ratio



Conclusions and Future Work

Initial results indicate overlay networking is a promising strategy for providing many-to-many multicast in the open network environment of DS-RT.

We are working on an architecture specification based on the properties of distributed simulation traffic plus recent networking research.

NPS is working on a Web-service-based registry and routing information system.