

XMSF Overlay Multicast Status Report

Mark Pullen, Dennis Moen & Fei Zhao
George Mason University
{dmoen,mpullen,fzhao}@gmu.edu

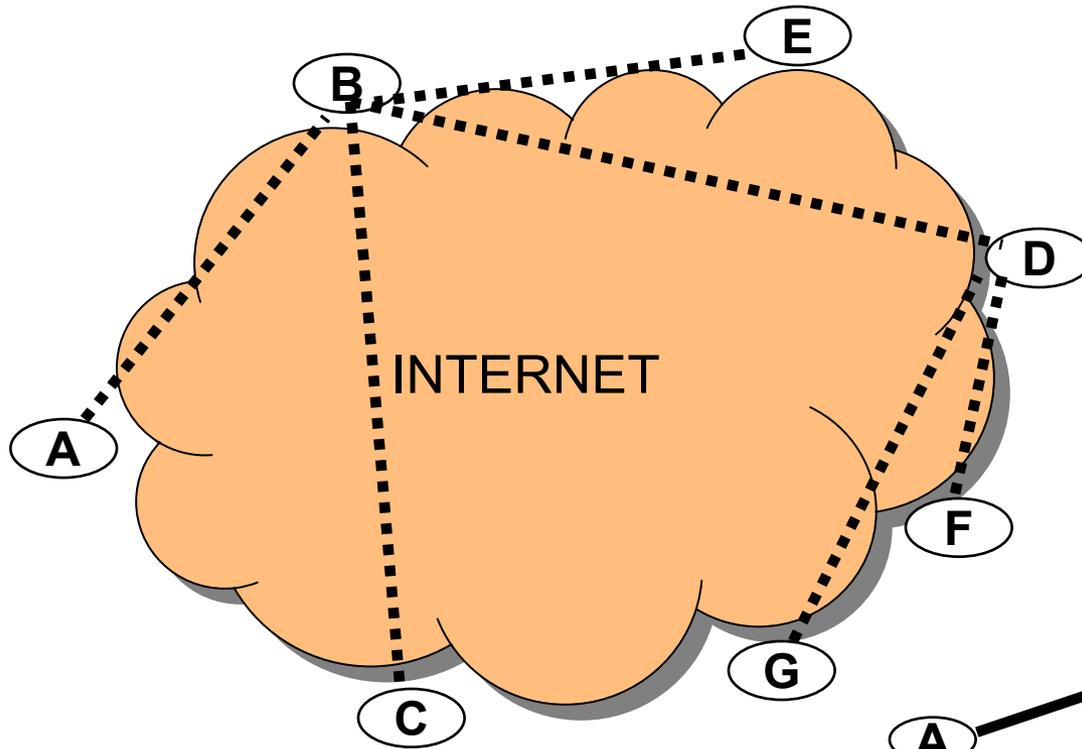
Network Service Requirements for Real Time Distributed Virtual Simulation

- 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

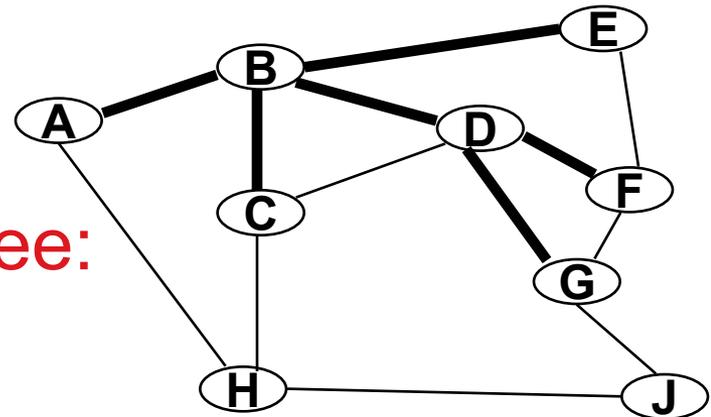
Internet Multicast Services Today

- 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 in end systems not network
 - End-to-end argument: push complexity up the stack
 - Example: TCP is complex, IP is simple

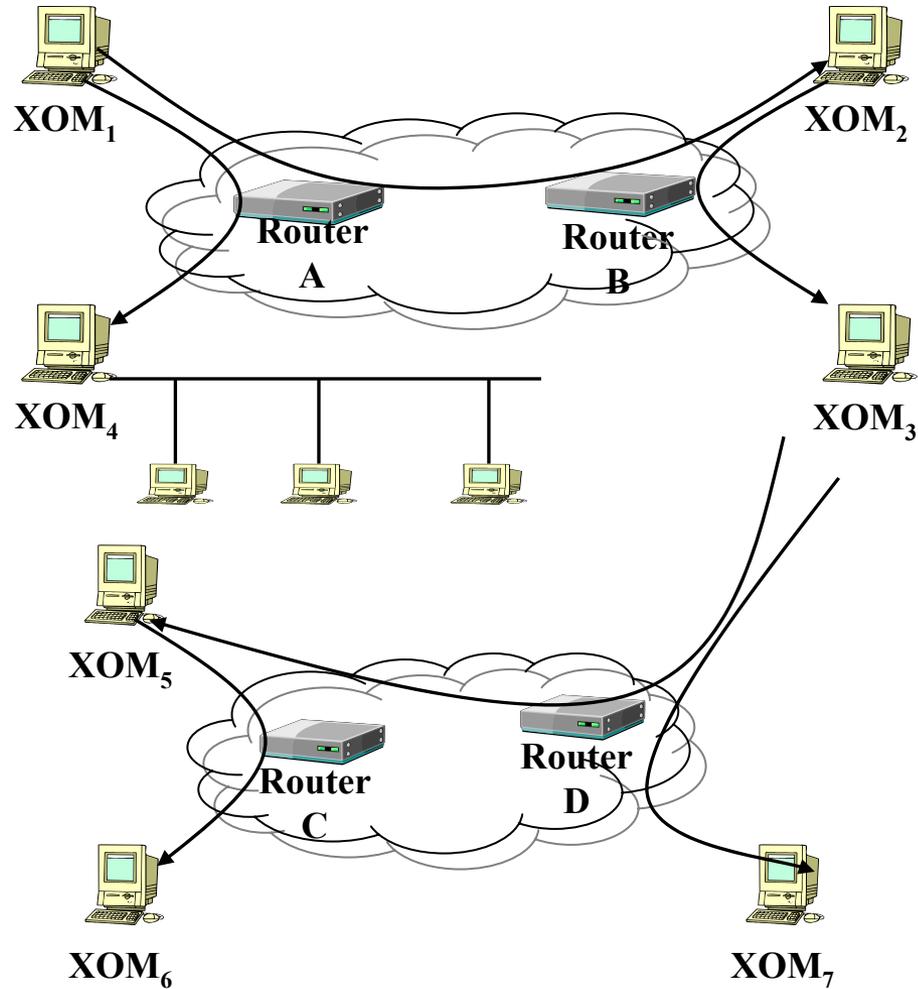
Overlay Multicast Tree



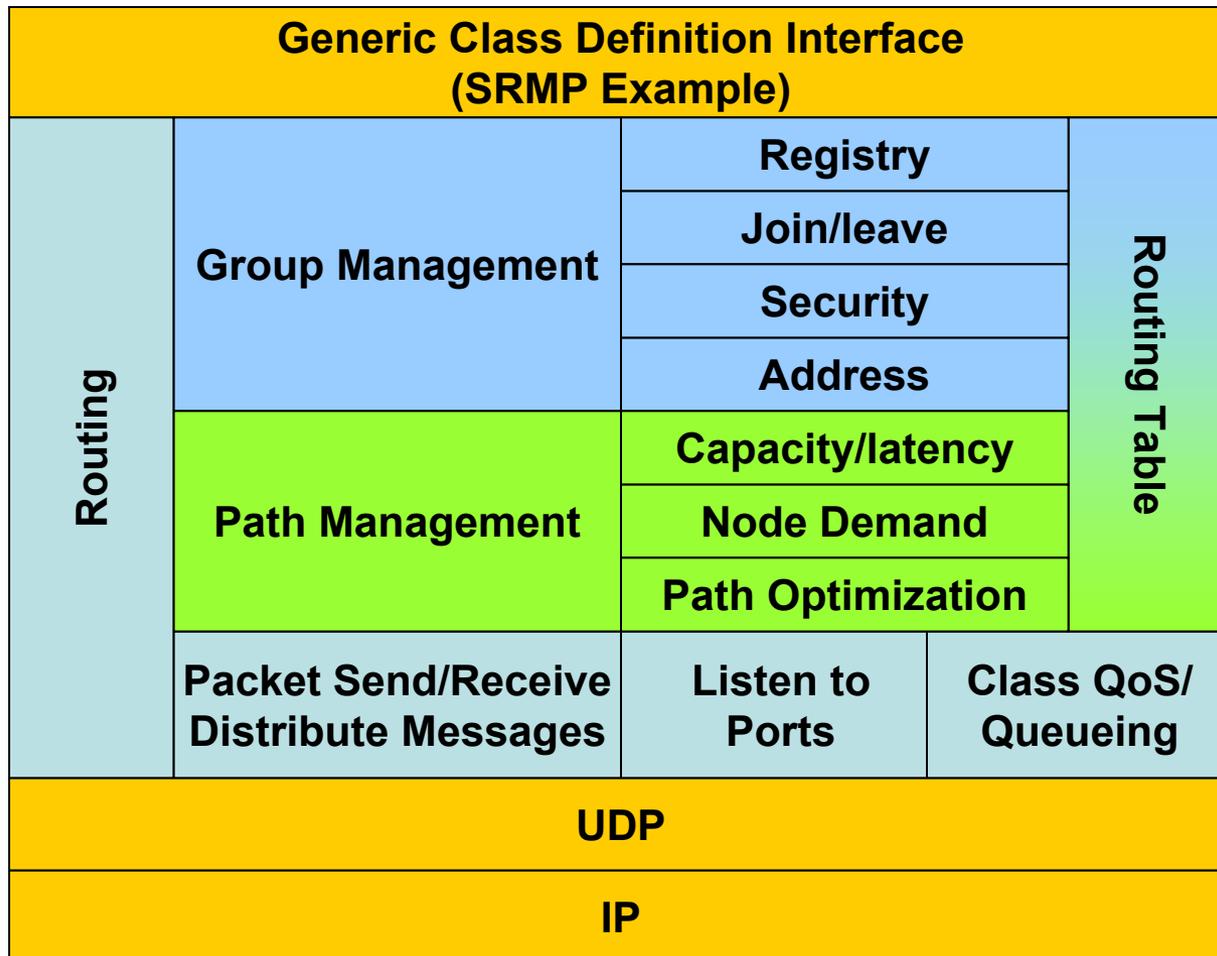
IP Multicast tree:



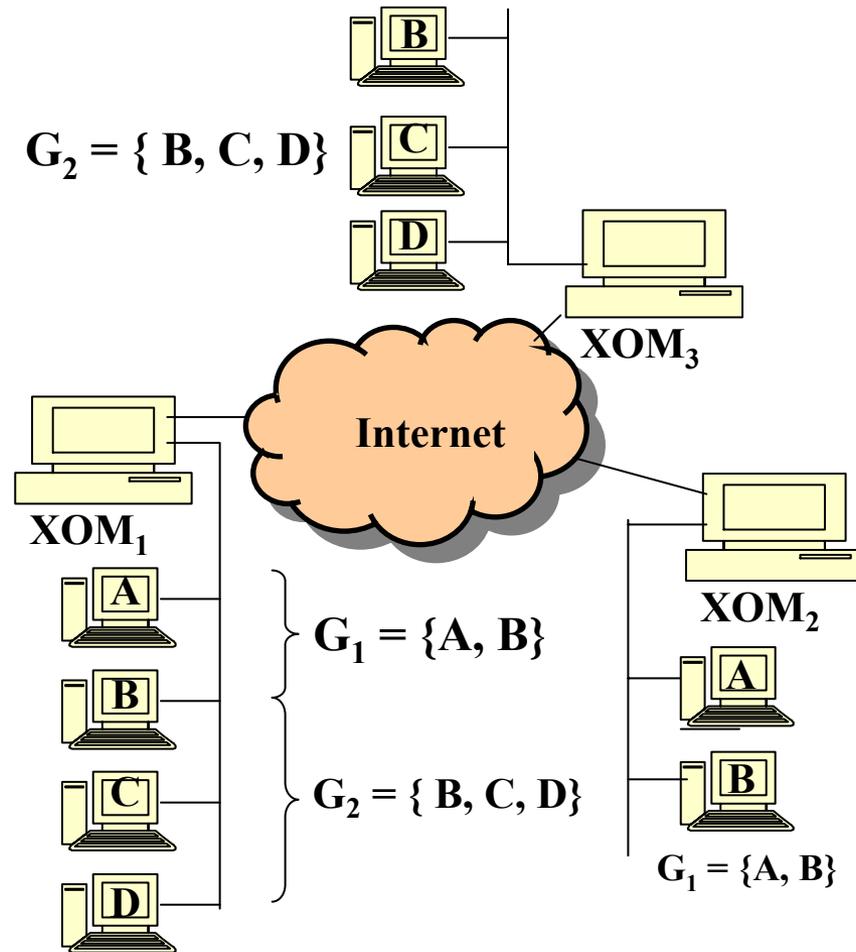
XOM Overlay



XOM Layers



XOM Group Membership



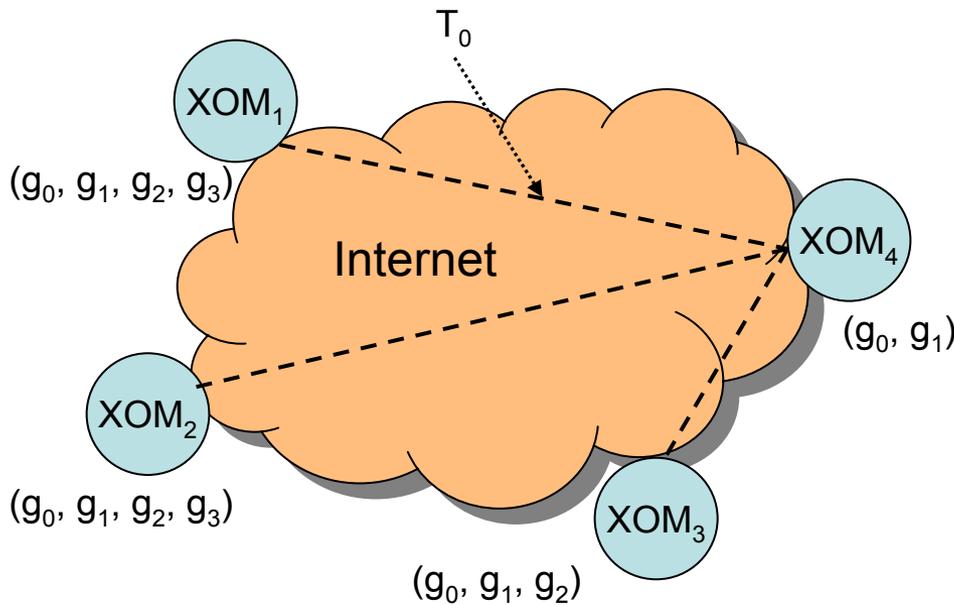
Application B sending implies routing
to group $G_3 = \{G_1 \cup G_2\}$

Group Aggregation Overlay (Optimum Path Overlay)

Multicast Groups

Aggregate Trees

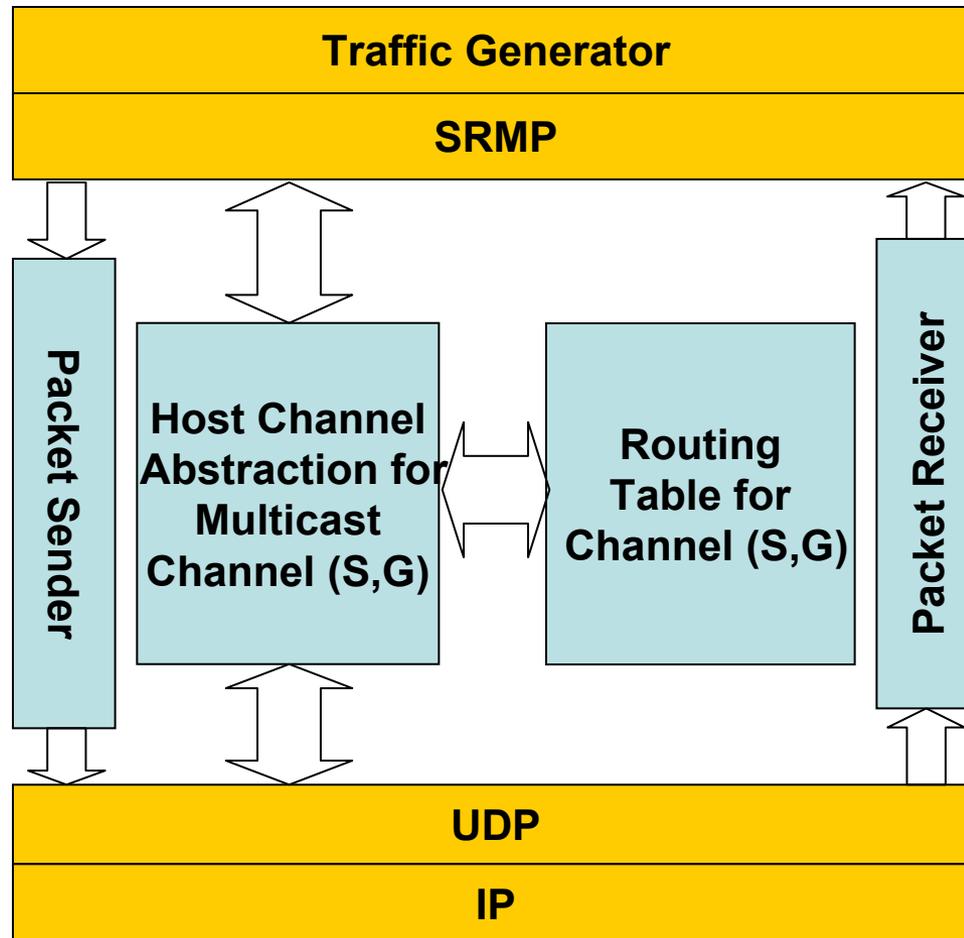
<u>Group</u>	<u>Members</u>	<u>Tree</u>	<u>Tree Links (arcs)</u>
g_0	XOM _{1,2,3,4}	T_0	1-4, 4-2, 4-3
g_1	XOM _{1,2,3,4}		
g_2	XOM _{1,2,3}		
g_3	XOM _{1,2}		



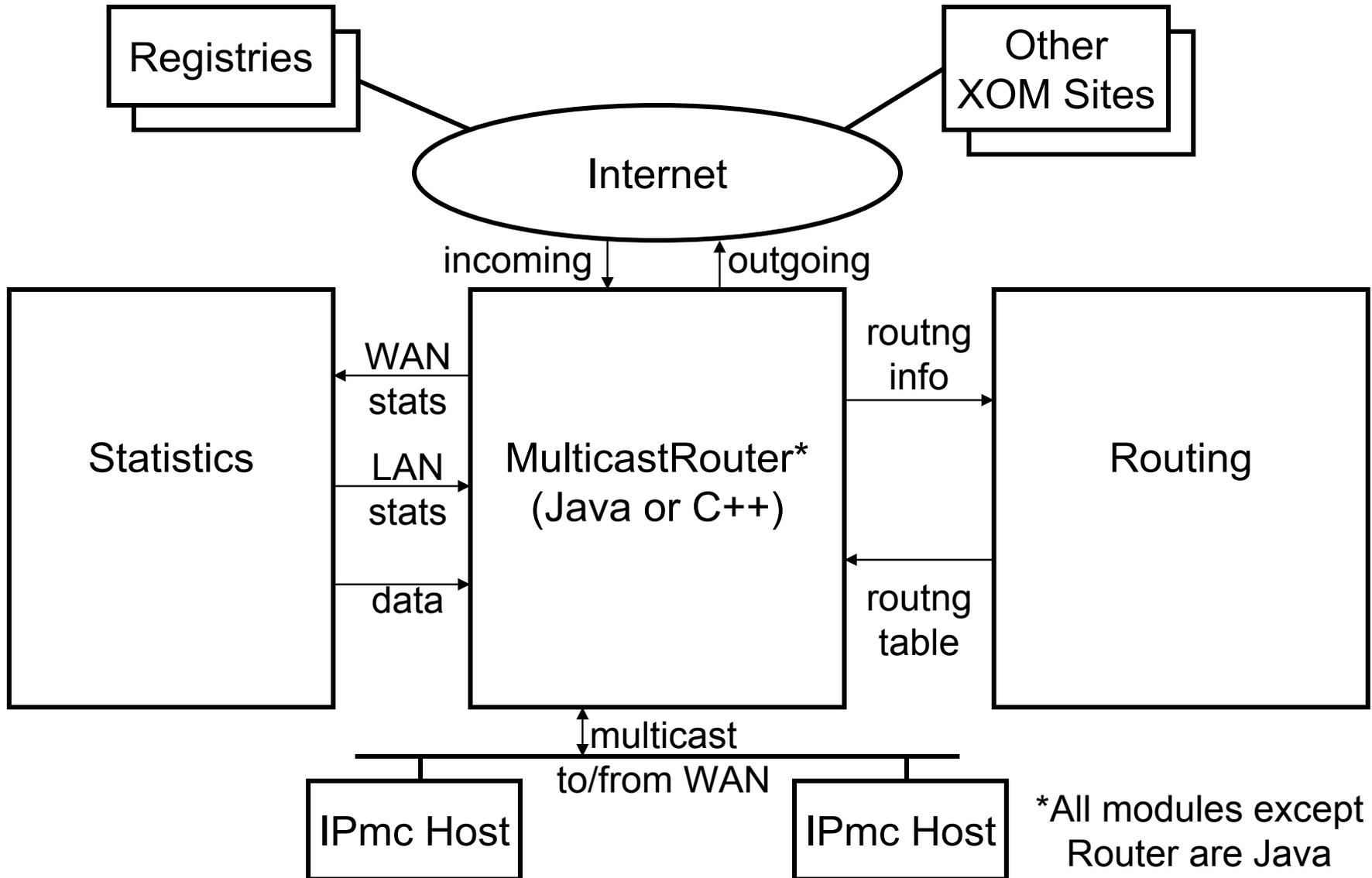
Groups g_0, g_1, g_2, g_3 share one aggregate tree T_0 . T_0 is a perfect match for g_0 and g_1 , but is a leaky match for g_2 and g_3 . Trades off path utilization inefficiency for lower path Management overhead.

XOM Functional Model

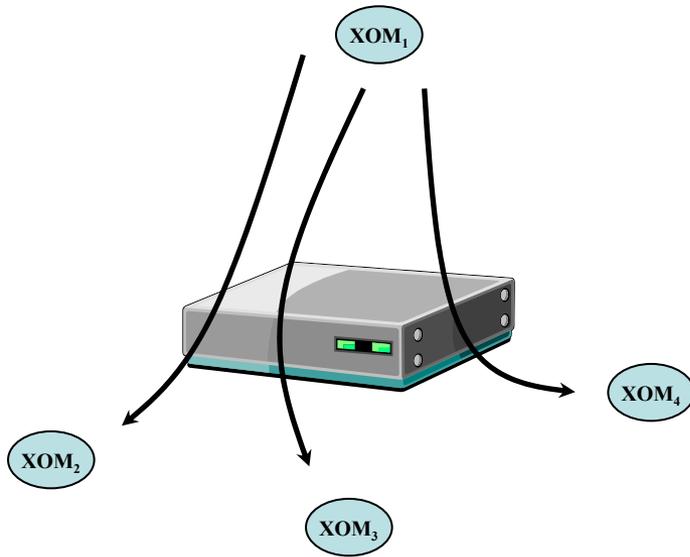
Prototype Test Scenario



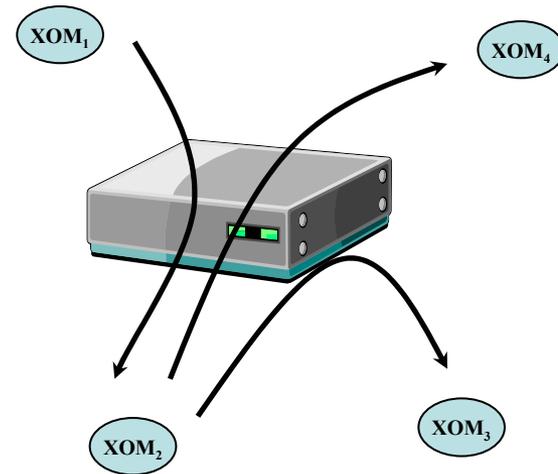
XOM Prototype



XOM Lab Test Scenarios

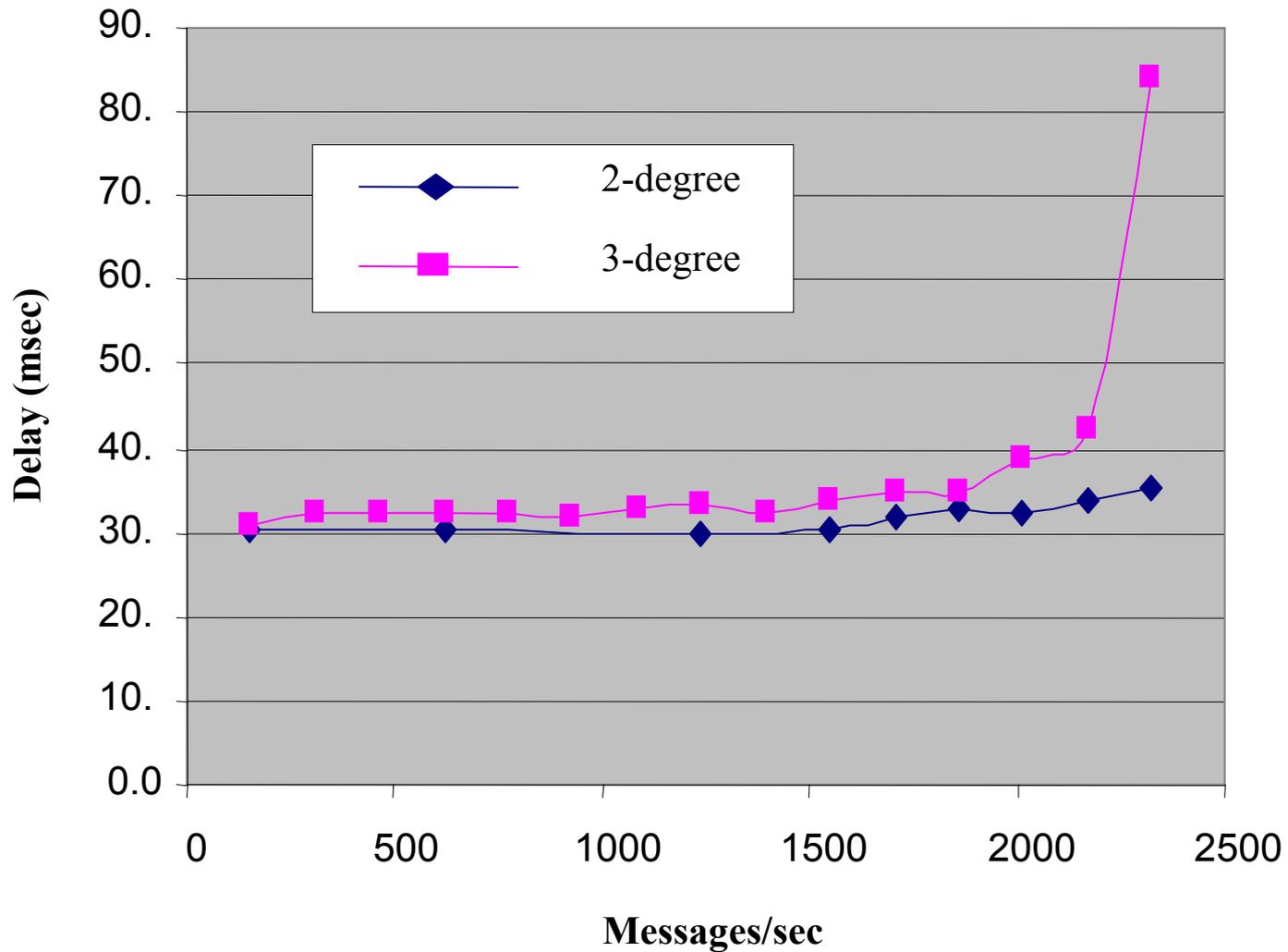


Test 1. XOM n -degree of 3

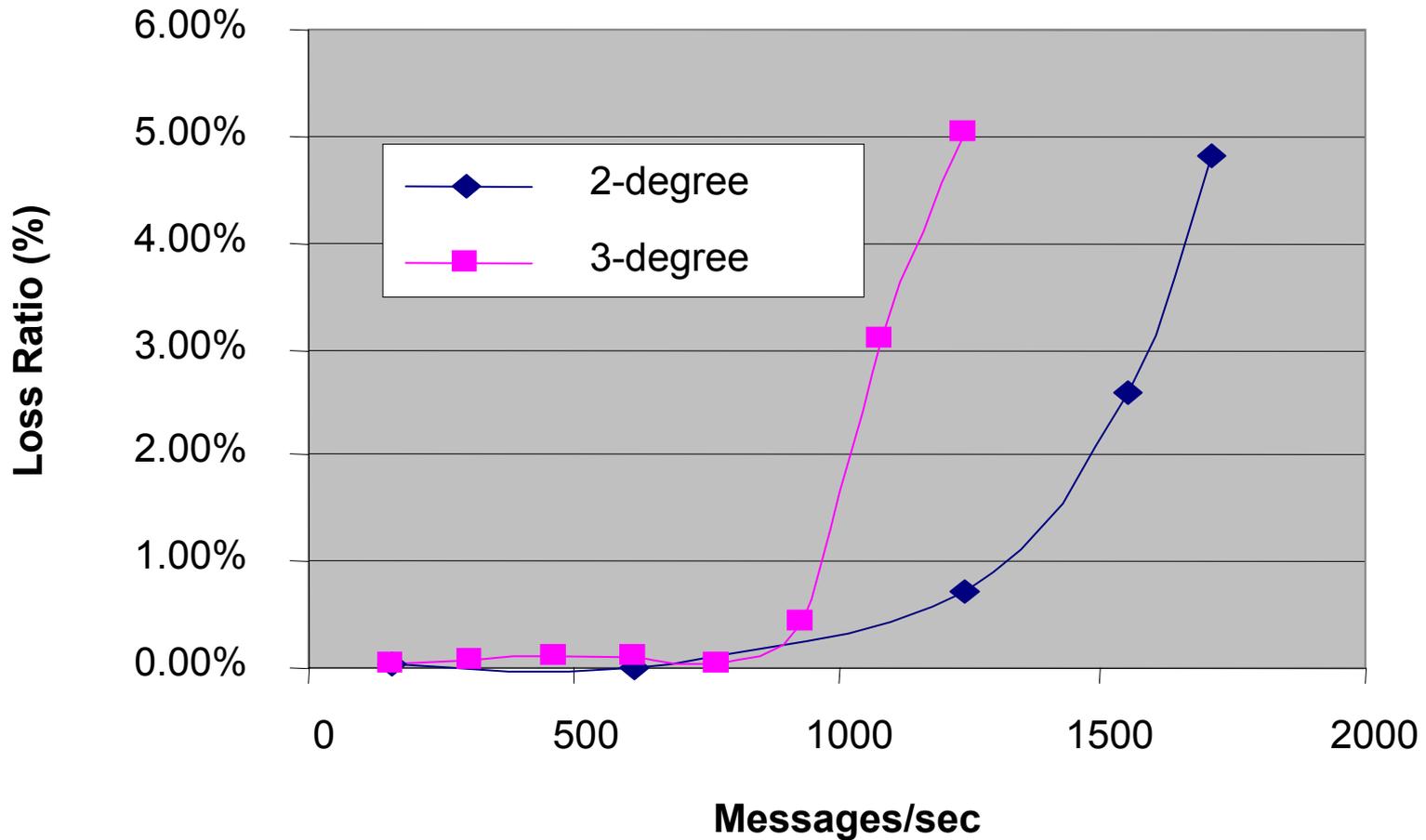


Test 2. XOM n -degree of 2

Message Delay



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 internet environment of the XC2I.

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

A working experimental prototype derived from NPS and GMU student work will be demonstrated this evening in the SAVAGE lab.

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

The more advanced system will be demonstrated at I/ITSEC in collaboration with SAIC, supporting a multicast HLA federation.