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Performance Evaluation of the XMSF Overlay Multicast Prototype

Dennis M. Moen
J. Mark Pullen
George Mason University, C3I Center
dmoen@gmu.edu, mpullen@gmu.edu

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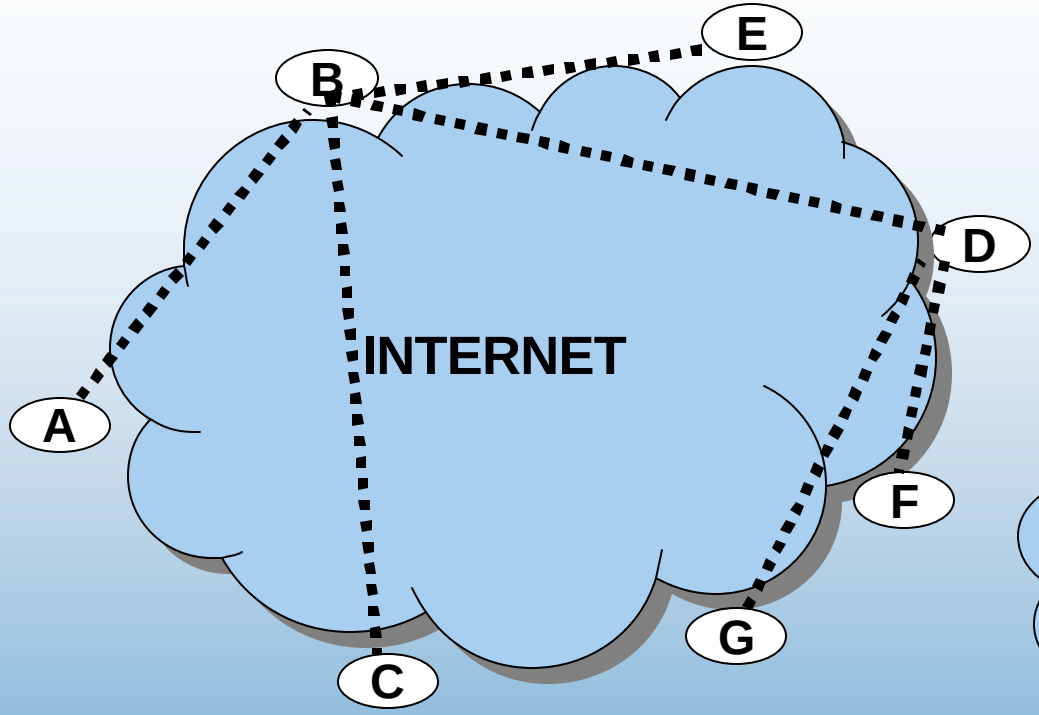
Network Service Requirements for Real Time Distributed Virtual Simulation

- 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

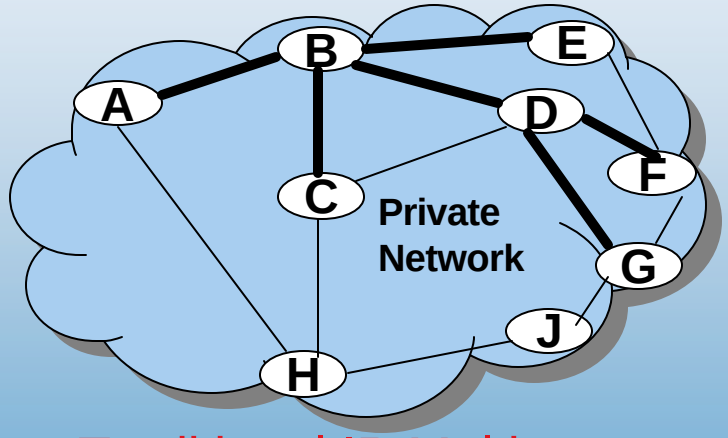
- IP multicast over the Internet not widely deployed
- IETF initial focus is on one-to-many multicast
- Commercial viability lacking for IP multicast in the Internet
- Result: interest in multicast based on end systems not network
  - End-to-end argument: push complexity up the stack
  - Example: TCP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

XOM Cross-Network Overlay Multicast



Overlay Multicast:

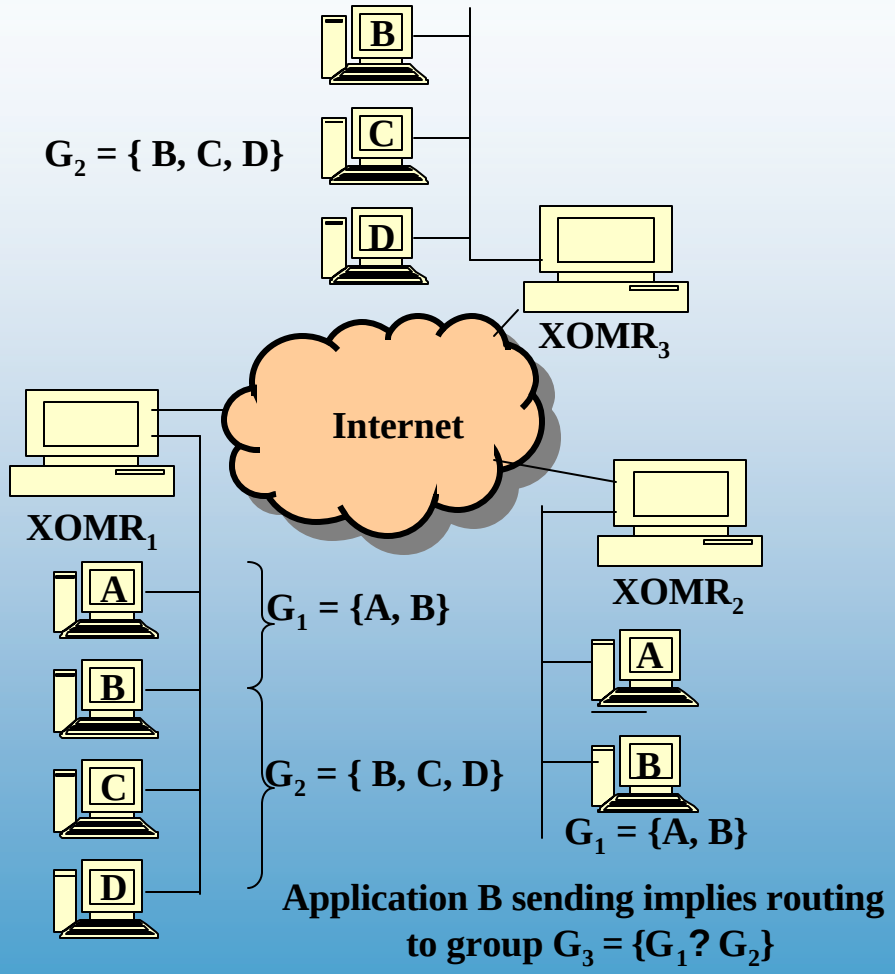
- Many-to-Many
  - Many senders to same group
  - Source-Based Trees
- Open Network
  (Independent of Management Domain)
- Responsive to Application
  - End-to-End QoS Considerations
  - Group Management Efficiency



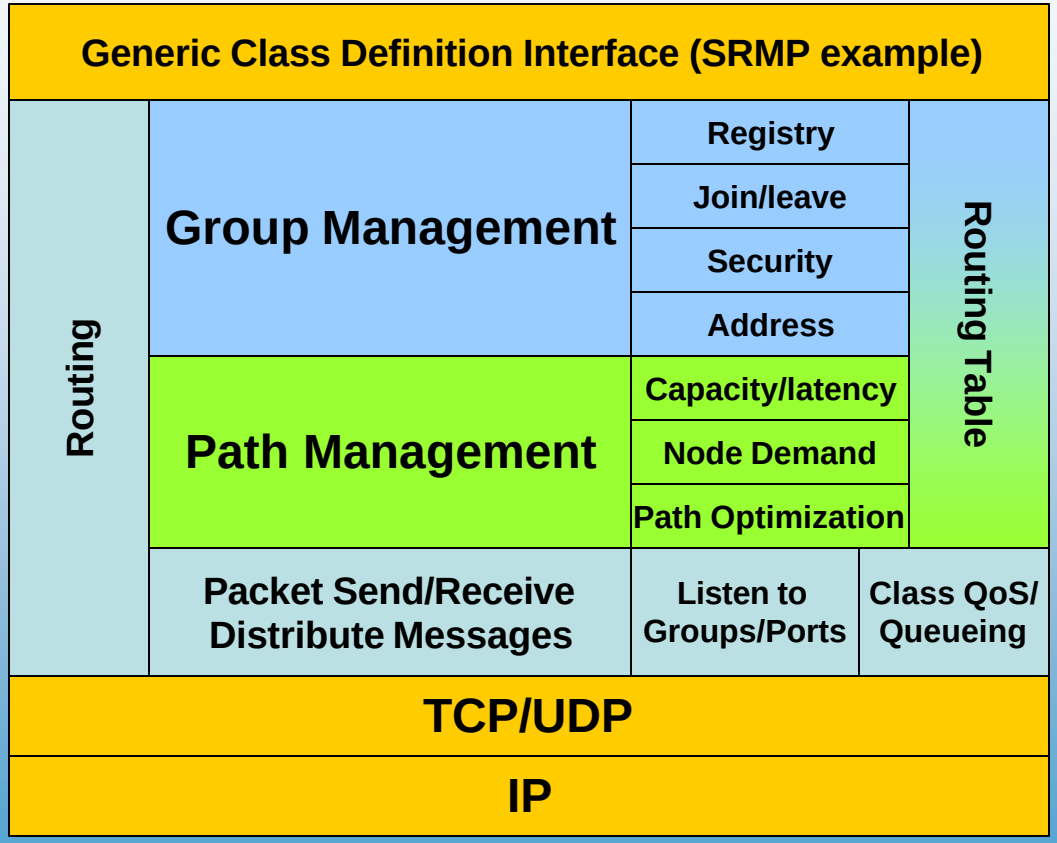
Traditional IP Multicast:

- Usually One-to-Many
  - Single Sender
  - Core/root-Based Tree
- Closed Network
  (Single Management Domain)
- Insensitive to application

XOM on Subnet with Group Management

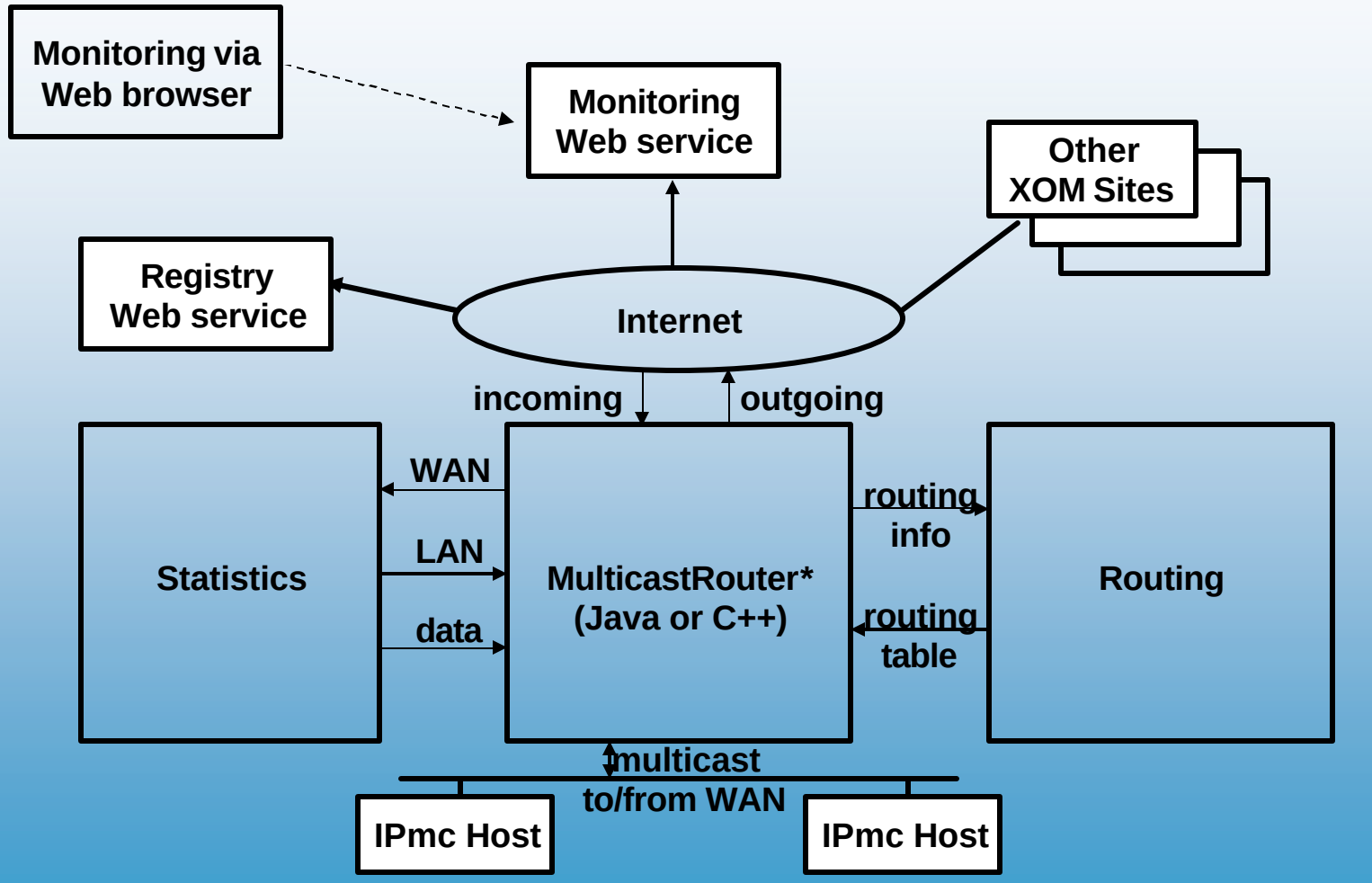


XOM Architecture



- Group Management
- Partner Discovery via Registry
- Performance Measurement for Path Management
- Periodic Routing Update to Each Partner

XOMR Prototype



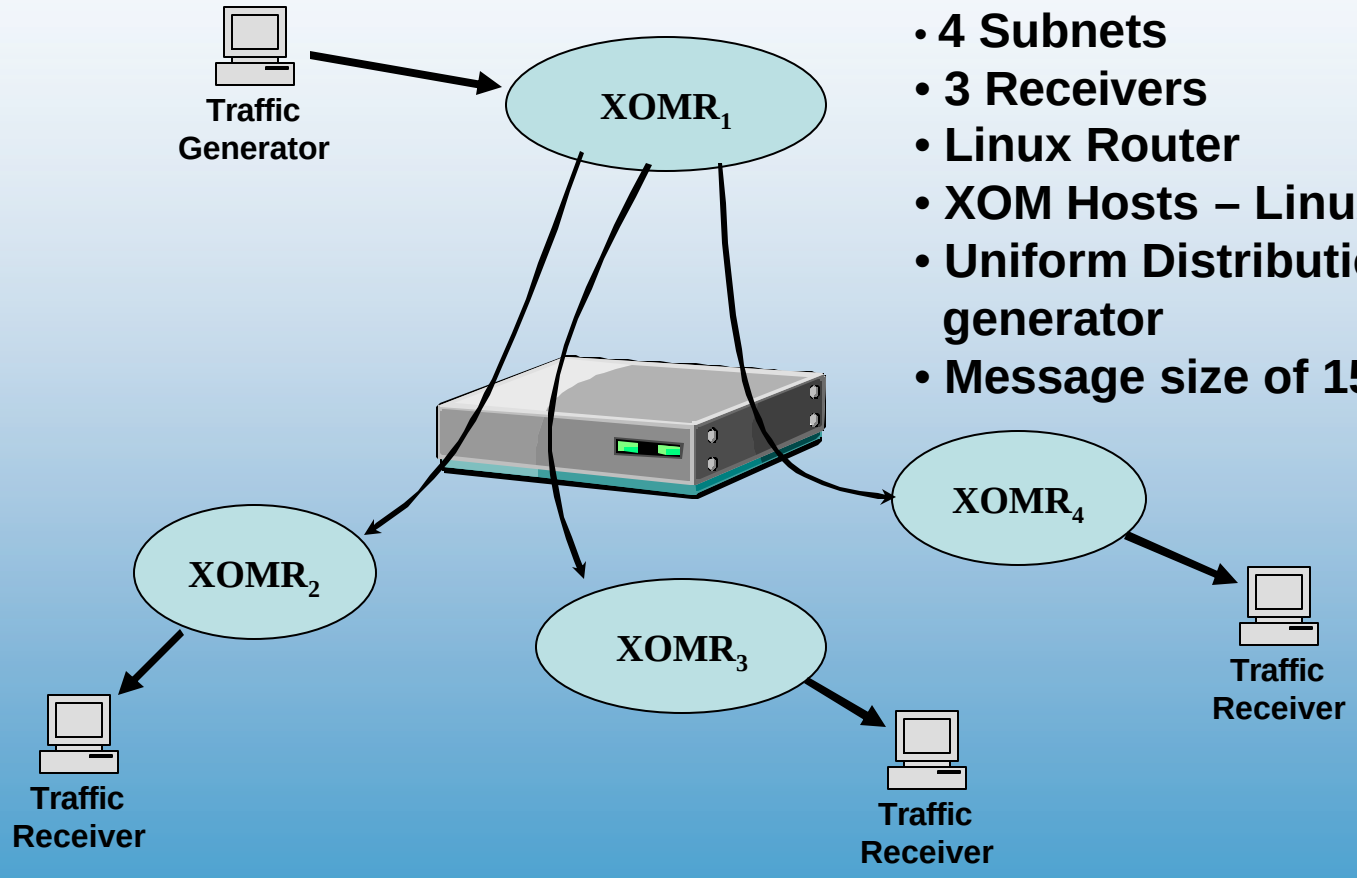
*All modules except Router are Java

XOMR Configuration Parameters

registryAddress	**InetAddress of registry, 0 if none**
numberOfMulticastGroups	**count of groups/ports we will support**
numberOfPortsPerGroup	**count of ports each group will support (non-overlapping)**
lowestMCAddress	**first group address to multicast from the subnet, dotted decimal notation (other addresses follow in sequence)**
lowest port	**first UDP port to multicast (each address will get one port in sequence)**
routingUpdateInterval (optional)	**time in ms between routing updates (default 10 s)**
thisSubnetMaskBits (optional)	**number of bits used for routing in subnet address (default 24)**
useTCP (optional)	**0 for UDP tunnels, 1 for TCP tunnels (default 0; 1 does not work yet)**
partnerHostAddress (optional in future, when Registry becomes available)	**zero to MAX_PARTNERS IP addresses, in dotted decimal format, to be used as partners without checking the registry**

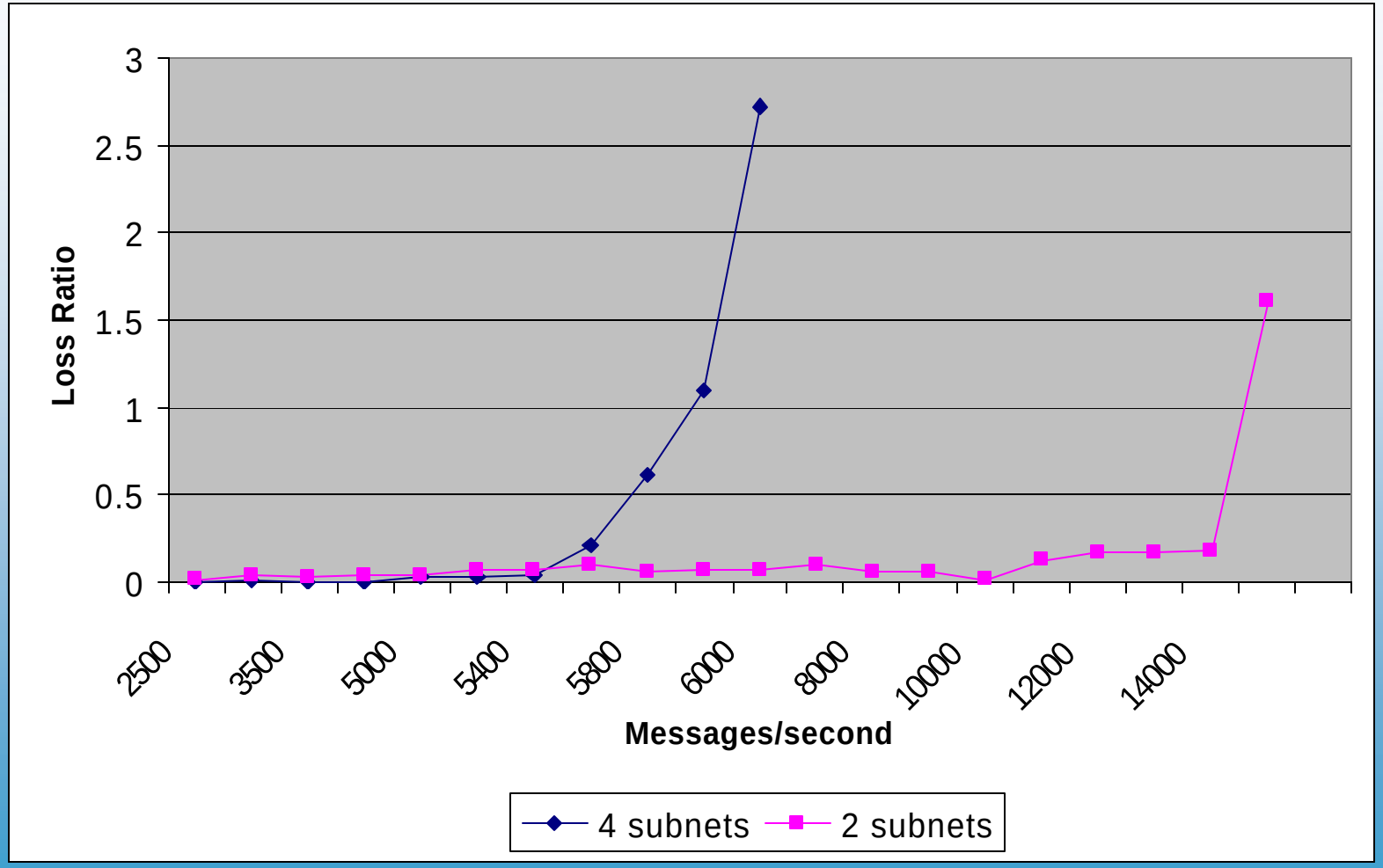
Laboratory Performance Testing

Performance Test



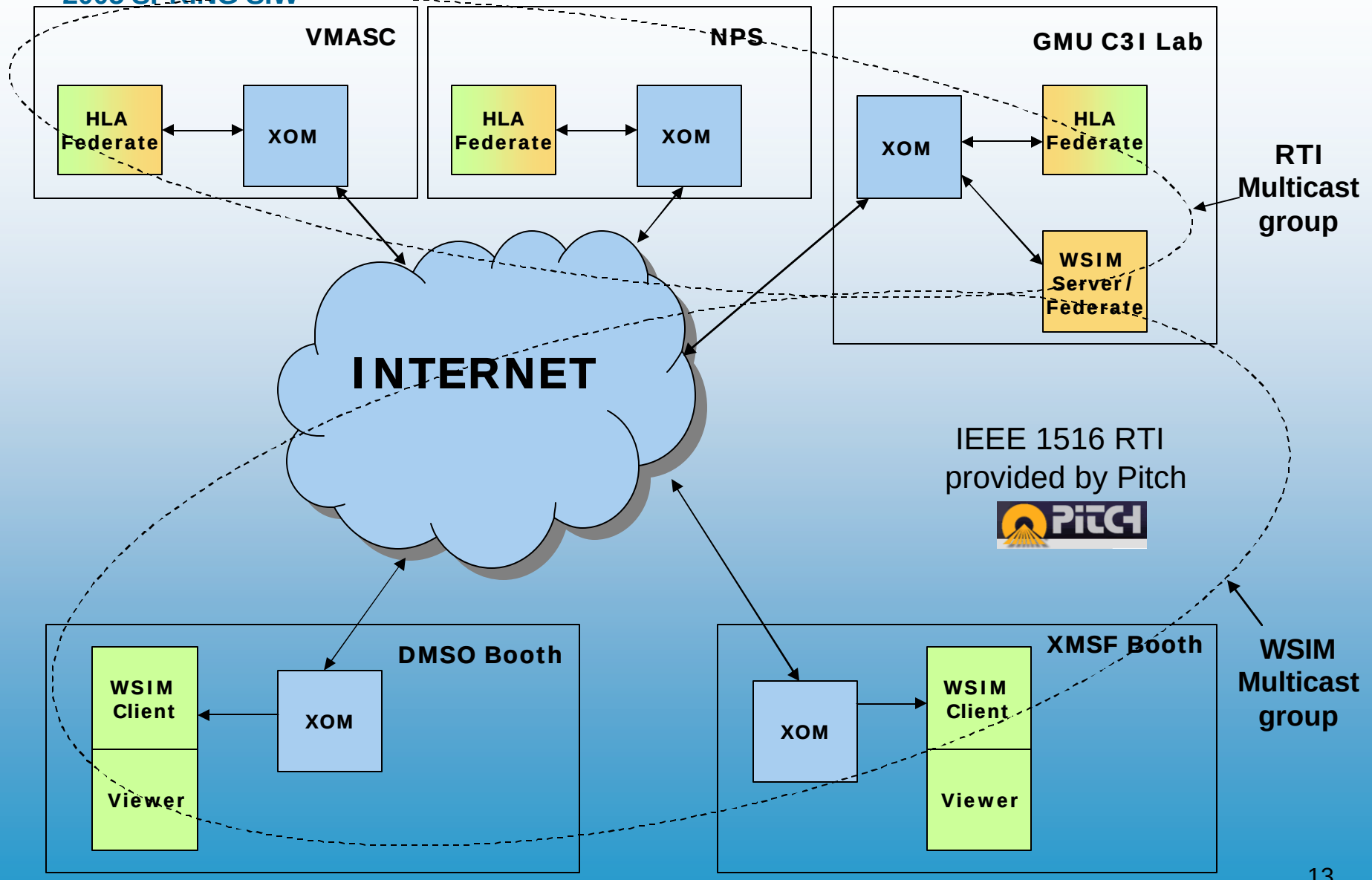
- 4 Subnets
- 3 Receivers
- Linux Router
- XOM Hosts – Linux
- Uniform Distribution Traffic generator
- Message size of 150 bytes

Laboratory Test Results

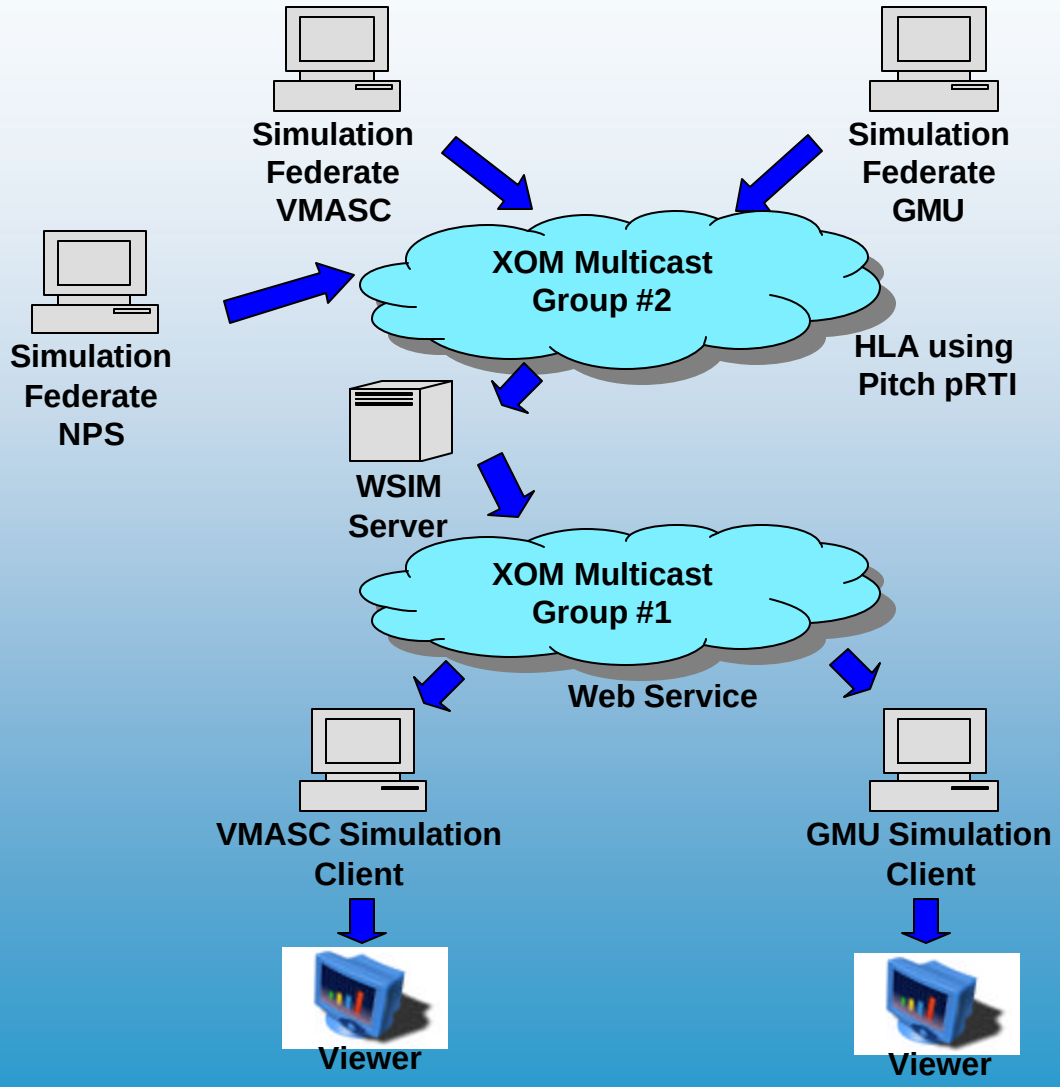


Wide Area Demonstration

XOM Demo : HLA 1516 RTI and Web Service Interest Management



Tier Relationship for Multicast Demonstration



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 T.
- Complete an architecture specification based on the properties of distributed simulation traffic plus recent networking research.
- NPS is developing a Web-service-based registry and routing information system.
- Use next version of prototype in live simulation exercise
- Demonstrate use of WSIM and XOM to accomplish multicast streaming of user-selected information

Acknowledgements

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- IEEE 1516 RTI provided by Pitch
- Other Participants: NPS and SAIC

Additional Information available at http://netlab.gmu.edu/xom