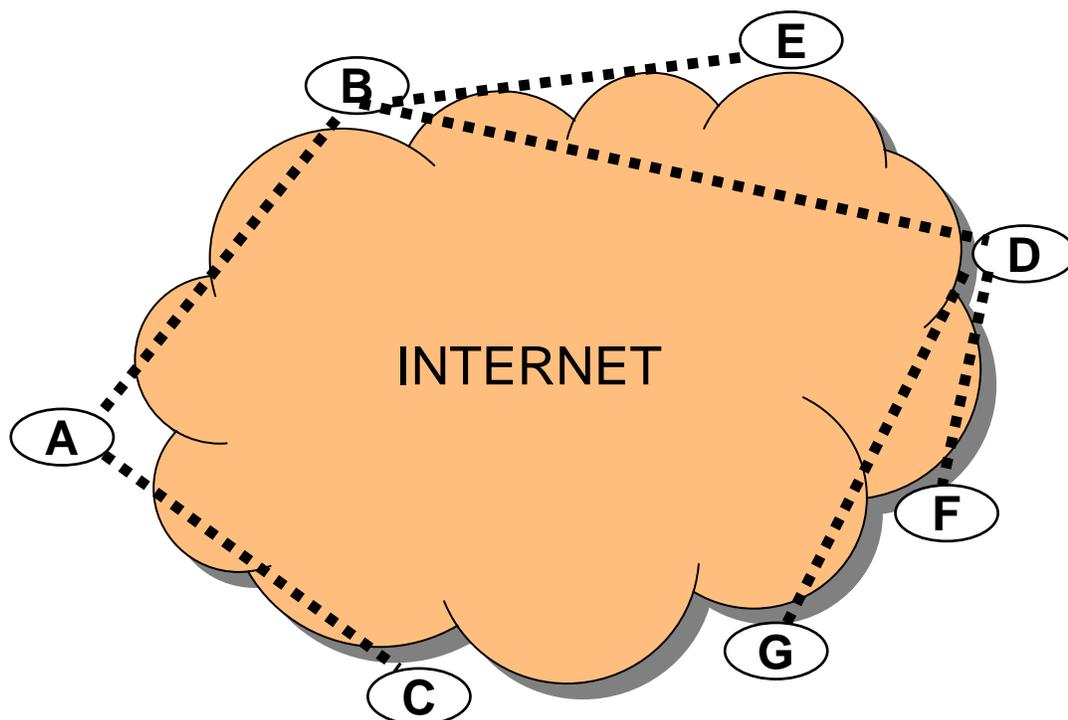




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## Network Costs Reduced for Distributing Simulations Worldwide

Simulations can now be distributed world-wide at a much lower network cost. The Defense Modeling and Simulation Office (DMSO) in partnership with George Mason University, the Naval Postgraduate School and SAIC has developed multicast communication capability over any Internet Protocol network. From its Extensible Modeling and Simulation Framework (XMSF), DMSO's team is executing XOM, or XMSF Overlay Multicast. No special multicast network is needed. There is no custom network engineering – it just takes a download and running one XOM per site. Each Runtime Infrastructure message, Protocol Data Unit, etc. is sent only once, to reach all participants.



The 2002 meeting of experts that kicked off the XMSF strongly endorsed use of commercial Internet/Web technologies for interoperating defense simulations and C4I systems. However, they identified a few technology gaps that need to be addressed if XMSF is to realize its large potential. Among the missing capabilities is many-to-many multicast networking for efficient information exchange among distributed components. With typical "unicast" networking, information to be shared must be sent separately to every participating distributed component. As the number of sites increase the numbers of distributions increase exponentially. For example, there is a 380-fold increase in traffic when you increase the number of distributing sites from 2 to 20! By contrast, with multicasting the data cross the network only once: traffic from 20 sites means only 20 distributions. A multicast version of the Internet Protocol exists, and is often used in local area networks, but has seen little deployment in wide area networks. Defense networks such as the Defense Research and Engineering Network (DREN) don't like the added complexity of IP multicast, while commercial Internet Service Providers have developed no business model that will let them sell Internet-wide multicasting.

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# Success Stories

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Fortunately, the XMSF experts identified a potential gap-filler: Overlay Multicast, also called End-System Multicast. Various university research programs (most notably, MIT and Carnegie-Mellon University) have demonstrated how computers, working over a normal unicast network, can cooperate to achieve the traffic-reducing effect of one-to-many multicast. However, research products are two important steps away from the needs of distributed simulation:

- Overlay Multicast needs to be adapted for use with the many-to-many group communications required for distributed simulation (currently it supports the one-to-many needs of entertainment and conferencing)
- New intermediate protocols must be developed to use multicast in the Web service environment

DMSO is tackling the first of these problems through the XOM project, now being executed by these partners, who also are among the early advocates of XMSF:

- *George Mason University C3I Center* has the lead, with responsibility for developing the many-to-many Overlay Multicast architecture and producing a working prototype XOM that will be available on an open-source basis.
- *The Naval Postgraduate School MOVES Institute* is responsible for Web-service based management of network routing information.
- *SAIC San Diego* is responsible for demonstrating the effectiveness of XOM in an HLA-1516 environment.

The basic model of XOM operation is that standard IP multicast is used on the site's local area network. One computer per site runs the XOM software to "tunnel" the multicast traffic to other sites' XOMs, which cooperate to distribute the traffic among themselves without redundancy. Work at GMU and NPS already has produced an initial prototype that has demonstrated the ability to link multiple sites at traffic rates up to 5,000 messages per second in each multicast group using normal laboratory workstations. A definitive architecture for many-to-many Overlay Multicast with Web service routing information distribution will be produced by the end of 2004. The prototype will be demonstrated at I/ITSEC 2004 and thereafter will be available both for initial use in distributed simulations and also as a baseline for further development and standardization. It will include a basic status system capable of showing traffic levels exchanged via multicast across the wide-area network.

The Joint Forces Command recently expressed an interest in early use of XOM. It is expected that many other parts of the Defense simulation and C4I communities will benefit from this new capability made available under DMSO support.

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