

## University of Oregon *Multicast Extends the Reach of Education*



EDUCATION IS NO LONGER CONSTRAINED BY BRICK-AND-MORTAR WALLS OR GEOGRAPHIC BOUNDARIES. IN THE EDUCATION WORLD THE INTERNET IS AN INVALUABLE TOOL FOR INFORMATION RESEARCH AND COMMUNICATION. WITH MULTICAST TECHNOLOGY, THE INTERNET CAN GIVE STUDENTS VIRTUAL ACCESS TO ANY CLASSROOM IN THE WORLD. THE UNIVERSITY OF OREGON (UO) USES CISCO IOS® MULTICAST TECHNOLOGY TO COST-EFFECTIVELY DELIVER HIGH-QUALITY, REAL-TIME VIDEO AND AUDIO CONTENT TO A POTENTIAL AUDIENCE OF MILLIONS OF CONCURRENT USERS—WITHOUT NETWORK CONGESTION.

The UO managed the multicast of the October, 1999 NetAid concert event which is the largest Internet broadcast event to date. The event achieved an impressive near-perfect uptime rate on the Internet2 network, proving the maturity and performance of Cisco IOS Multicast features and the Cisco IP/TV product solution. The NetAid concerts highlighted the beginning of a long term initiative to end extreme poverty by using the power of the Internet to promote human development and change the way people help each other. The Netaid.org Foundation was jointly founded by Cisco Systems, Inc. and the United Nations Development Programme.

### Background

Renowned for its technology leadership, the UO has emerged as a national leader in the use of computers, e-mail, and the Internet to enhance education. As a founding member of the Internet2 network for educational institutions, the UO has earned grants and invested heavily in technologies that enable them to reach students beyond the Eugene campus at other universities.

The UO is a nationally recognized academic enterprise with more than 1200 faculty members who teach and mentor 17,000 students. The Eugene, Oregon campus is large enough for students to experience a comprehensive research university yet small enough to foster personal interaction

with faculty. The university prides itself on being a place where students study and interact with renowned scientists and scholars everywhere from the classroom to the laboratory, and the campus coffee shop. Joanne Hugi, Director of the Computing Center at the UO, leads a highly talented team of networking experts dedicated to providing the best technology solutions while managing their cost.

“As part of our philosophy of using technology to

advance education, the UO was one of the first higher-education institutions in the country to explore distance-learning programs, bringing professors and students in different locations together through interactive video. Therefore, the UO was an ideal partner for directing the multicast portion of the NetAid concert event sponsored by Cisco,” says Hugi.

### Problem

The UO needed a network that would allow them to simultaneously

deliver classroom content to students regardless of geographical location. The first distance-learning programs at the UO relied upon a combination of microwave relays and satellite networks, expensive solutions that limited deployment to dedicated learning centers, easily limiting their reach and influence. A successful distance-learning program needs to be more accessible and affordable than such first-generation solutions.

**“The Cisco IOS Multicast and Cisco IP/TV Internet broadcast solution delivers a reliable and quality Internet video experience, meeting the expectations of a very demanding audience.”**

**—Joanne Hugi,  
Director of Computing  
University of Oregon**

The rapid, worldwide expansion of the Internet starting in the early 1990s generated interest in using the Internet instead of dedicated television networks to deliver distance-learning content. The Internet can reach more locations at a much lower cost, and enables a new technical teaching and learning method—e-learning.

The first Internet-based e-learning applications used unicast technology, which presents technical difficulties that limit its usefulness. Because it generates a single stream for each user, the number of streams increases with the number of users. Therefore, a unicast network can serve only as many users as bandwidth allows, limiting its scalability. In the early days of the Internet, wide-area bandwidths were very low, making them useless for unicast, so the first applications were only useful in local-area networks, defeating the purpose of e-learning. Further, the first unicast applications were broadcast-oriented, gaining them an unsavory reputation for using all the bandwidth on a network, blocking other users from any access to network servers or printers.

### Solution

Multicast is a scalable solution because it efficiently delivers content while conserving network resources. The UO was one of the first institutions to implement native IP multicast technology throughout its network, and one of the first users of Cisco IOS Multicast technology. The combination of Cisco IOS Multicast features in the network and the Cisco IP/TV multicast application solves the scalability limitations of unicast. The primary advantage of multicast over unicast is that it replicates the video stream closest to users at the last possible point in the network, as opposed to unicast, which replicates a single video stream for each user at the source. Further, a multicast network can do more than solve the bandwidth limitation and scalability problems of unicast. Multicast uses network servers, routers, and switches more efficiently without the time delays inherent to unicast systems. Thus, a Cisco multicast solution met the UO's requirement for simultaneous content delivery critical for effective e-learning applications and made the UO a natural Cisco alliance for the NetAid concert events on October 9, 1999.

### The NetAid Internet Broadcast

The University of Oregon has a network based primarily on Cisco technology so the infrastructure was ready to support multicasting the NetAid concert event. The UO network has a collapsed backbone network architecture, with a Fast Ethernet core that will soon be upgraded to Gigabit Ethernet, and Cisco 7200 and 7500 series routers at the edges. The multicast network can receive and encode television signals from two on-campus satellite dishes. Multicast software is operated with a series of IP/TV servers in the Advanced Network Technology Center (ANTC) on campus. Multicast streams travel to the campus backbone through a 100-Mbps Ethernet interface on a Cisco 7507 router (Figure 1). The Cisco IP/TV system is programmable for delivering simultaneous streams at different speeds (from 256 kbps to full T1 rates), accommodating different user systems and enabling the highest possible quality. According to Hans Kuhn, Programmer for the Office of University Computing at the UO, "What we've done with multicast is take a satellite feed and put it out on the Internet2 as just another media, as if you were to put it out over the normal broadcast television infrastructure."

The campus network joins the Internet2 network via the Oregon giga POP. This POP connects to Abilene, Texas via two OC-3 (155 Mbps) packets over SONET (PoS) links, one via Denver, Colorado and the other via Sacramento, California, and resides on a Cisco 12008 gigabit switch router (GSR). UO also shares over 100 Mbps of commodity Internet transit via UUNet and CWIX. The UO network peers at the Oregon Internet exchange with Verio and other network service providers.

Cisco IOS Multicast features operating in Cisco routers and Catalyst® series switches include Protocol-Independent Multicasting (PIM), Multicast Source Discovery Protocol (MSDP), and Multiprotocol Border Gateway Protocol (MBGP). The Cisco IP/TV system uses multicast features in Cisco IOS Software to intelligently manage network resources. Cisco IP/TV was one of the first multicast applications on the market in 1995, and continual enhancements have kept it an industry-leading solution since its introduction.

The multicast network distributes network and commercial television programming to the campus, along with special events. So when Cisco Systems created the NetAid concert event to help fight extreme poverty worldwide, the UO team volunteered their multicast network to re-broadcast television feeds from the live concerts throughout the world. Where broadcast television companies presented only a few edited hours of the concerts, millions of viewers could enjoy the entire 12 hours of NetAid concerts on line.

Hugi explains that multicasting is the ideal medium for delivering in-depth content to targeted audiences, no matter how large. “Where a television station only shows a 10-second soundbite, we can broadcast an entire speech,” says Hugi. The UO team regularly multicasts guest speakers on campus.

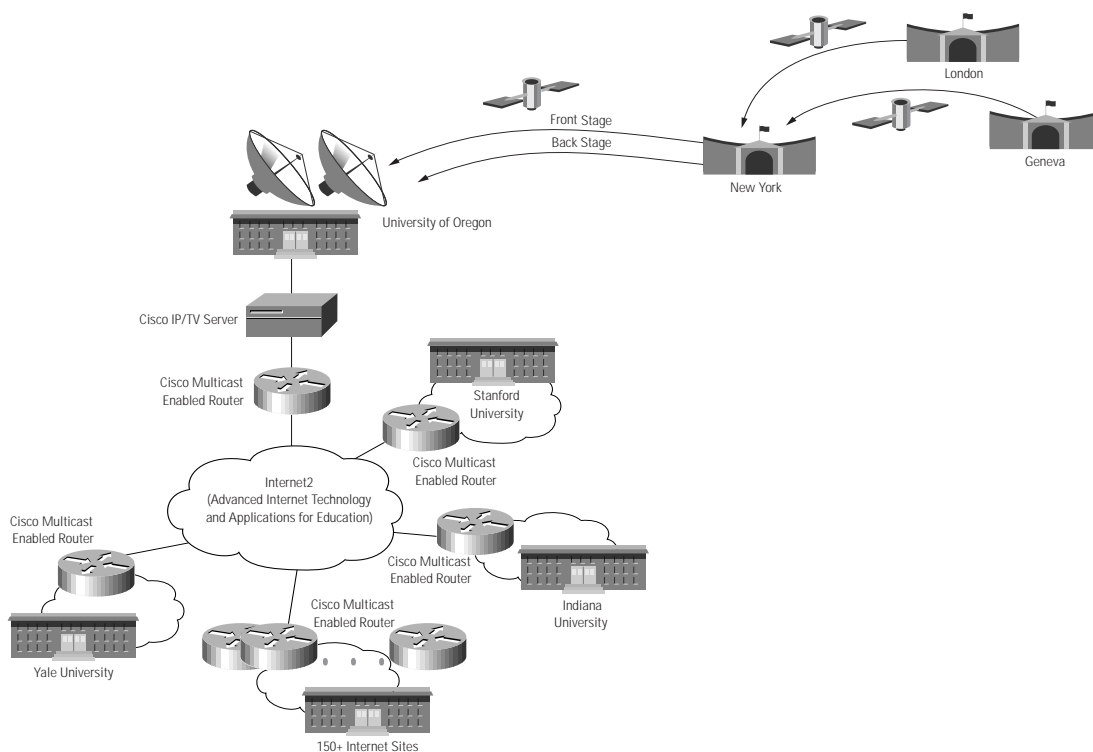
### Results

The Cisco NetAid concert multicast proceeded without any disruption in service for the entire 12 hours, delivering a near-flawless 99.98 percent uptime rate across the Internet2

network. With Cisco IOS Multicast solutions, the UO can deliver content to anyone with access to the Internet2 network, greatly expanding its reach and realizing its e-learning vision. NetAid is just one example of the content delivered via the multicast network at the UO. The UO students and faculty have made Cisco IP/TV an integral part of campus life.

Says Hugi, “The Cisco IOS Multicast and Cisco IP/TV Internet broadcast solution delivers a reliable and quality Internet video experience, meeting the expectations of a very demanding audience. One of the big problems with other Internet video technologies is that the picture quality is very poor. For Internet video, Cisco technology delivered an excellent picture. The success of the NetAid Internet2 broadcast event validates that the Cisco IOS Multicast and Cisco IP/TV solutions provide a comprehensive and scalable Internet broadcast solution. From distance learning, to broadcast theater, to sporting events, the Cisco multicast solution is ready for prime time.”

Figure 1 University of Oregon Multicast Network that Supported the NetAid Event



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