

**Bandwidth Management Tools, Strategies, and Issues**  
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**What is Bandwidth Management?**

Bandwidth management is a general term given to a collection of tools and techniques that an institution can use to reduce demand on critical segments of networks. Often bandwidth management may be applied on the WAN segment that connects the institution to the greater Internet. It may also be applied on critical internal segments, such as segments connecting campus residence halls to the rest of the network. CIO Magazine recently published a good overview article on bandwidth management titled "Bandwidth Trailblazers" [1].

Techniques brought to bear on bandwidth management include these:

- Data compression, to reduce the size of the data that must be transmitted.
- Local caching, to store frequently used data locally instead of transmitting it multiple times.
- Bandwidth prioritization, to allocate bandwidth based on the importance of the application.
- Distributed content, to move content from a single location to multiple locations nearer the end users.
- Blocking unauthorized traffic.
- Internet accounting packages, to track bandwidth usage and charge it back to customers (commonly used at Australian universities).
- User education, to educate users about the consequences of their actions and convince them to be good citizens on the network.

**Who Are the Primary Vendors of Bandwidth Management Products?**

Bandwidth management vendors currently operating in the marketplace include:

- Peribit Networks' SR-50 Sequence Reducer compresses data by eliminating repetitions using Molecular Sequence Reduction (MSR) technology [2].
- Expand Networks' ACCELERATORS combine data compression, caching, and prioritization techniques in combination [3].
- Allot Communications' NetEnforcer uses bandwidth prioritization, and their CacheEnforcer uses caching [4].
- Packeteer's PacketShaper uses bandwidth prioritization schemes to monitor, block, and throttle traffic [5].
- Intelligent Compression Technologies' AcceleNet and Xpress Suite use data compression [6].
- Akamai's EdgeSuite distributes content to a global network of servers [7].
- Akonix Systems' L7 Solution detects and blocks rogue protocols at the network's edge [8].
- Palisade Systems' PacketHound uses bandwidth prioritization schemes to monitor, block, and throttle traffic [9].
- Inktomi's Traffic Edge combines caching and filtering strategies [10].
- Digiquant's Internet Management System does Internet accounting and billing to end users [11].

- Hansen Technologies Hub does Internet accounting and billing to end users [12].

### **Why Is Bandwidth Management Important to Higher Education?**

A robust campus network with good connectivity to the Internet is no longer a luxury to higher education institutions; it is a necessity. Students and their parents consider good access to networked resources as a factor in their choices of institutions. It impacts both recruitment and retention. Students increasingly come to college expecting that the network will meet their educational needs, but they also expect it to provide their entertainment. Institutions wishing to factor this into their decision-making should favor prioritization schemes rather than blocking schemes. It is better from a management and public-relations perspective to throttle recreational traffic than to block it completely. Some bandwidth management products allow for recreational traffic to increase when business traffic is low.

As video and voice services also move to the network, managing bandwidth to provide quality of service for time-sensitive applications will become even more important. Research demands on bandwidth are also growing. Advanced research projects, such as SETI@home [13], UCSC Genome Bioinformatics [14], or Mars Exploration [15], make use of large groups of networked devices for massive calculations or to distribute large data sets through mirror sites. The Access Grid [16] supports human interactions with high-end audio and video, another high-bandwidth application.

Today we can buy more bandwidth for less money than in the past, and this trend will probably continue. Nevertheless, it is often not practical to meet the increased demand for bandwidth by simply buying more. Peer-to-peer computing [17] environments and applications such as Napster, KaZaa, Audio Galaxy, and Gnutella result in greater demand for bandwidth than colleges and universities can hope to afford. Each campus must decide when the cost of investing in a bandwidth-management strategy will cost less than buying more bandwidth. Investing in neither a bandwidth-management strategy nor more bandwidth will leave your campus network at risk of being hopelessly bogged down, to the point where no user is well served.

### **When Will Bandwidth Management Become Essential on Campuses?**

Bandwidth management becomes essential when the cost of adding enough bandwidth to meet demand exceeds the cost of investing in bandwidth-management technology. Expect this to happen to your campus soon if it has not already. Some campuses, usually smaller ones, can appeal to their students, faculty, and staff to be good citizens. This approach may work for a while, depending upon the values of the campus community. Other campuses, with larger staffs, can sometimes afford the staff time to track down users of excessive bandwidth and encourage or discipline them directly to control the problem. Automated bandwidth management tools work well, and are worth the expense, when these other techniques are no longer sufficient to solve the problem. Don't wait until your campus network is on its knees gasping for breath before you begin to explore your options.

### **How Is Bandwidth Management Evolving?**

Effective bandwidth management tools must evolve quickly to stay ahead of applications they are designed to control. Early attempts to manage bandwidth included blocking

certain ports in campus routers, but application developers quickly learned to change ports. Other applications disguise data that should be throttled as data that should have top priority. Bandwidth management tools must constantly be upgraded to stay ahead of the developers.

Bandwidth management tools are also evolving to handle larger and larger pipes. When my campus first investigated Packeteer's PacketShaper, the product could manage our DS3 link to our flagship campus in Minneapolis/St. Paul, but it could not manage the OC3 pipes from the flagship campus to the Internet. Now PacketShaper can manage up to 200 MB, so it can manage the OC3's, but it cannot manage the larger OC12 and OC48 pipes that some campuses are using. I expect that they will soon have a new product out to handle these bigger pipes.

Tools are also evolving to be able to apply different management rules to different groups of users on the campus network. Some products can apply different rules to different VLANs. We may also see evolution that allows management down to each individual device on the network.

### **What Are the Issues to be Addressed?**

Campus IT units getting ready to employ bandwidth management should develop a communication plan for the campus. Explain to the campus what you are doing and why. Be ready to explain how your approach minimizes the impact on academic freedom and avoids censorship. Emphasize the importance of giving all users fair access to resources as well as ensuring better access to resources that are more central to the mission of the campus.

Students will want to know why you are interfering with their access to entertainment if you throttle back peer-to-peer applications that support audio and video file swapping. Remember that this can be a retention issue, but other important retention issues are access to educational resources and the cost of education. If you do indeed throw more money at adding bandwidth to support unlimited recreational applications, it will drive up the cost of the student's education. If you allow unlimited access to recreational applications on limited bandwidth, students will not be able to reach legitimate educational resource materials. On our campus, we found that throttling applications rather than blocking them was more palatable to students. We assured them that when the bandwidth was not being used for educational and business applications, we were making it available for recreation. I personally took the time to respond directly to students who questioned and criticized what we were doing. While some went away mad, others grew to accept our approach when provided with more information. See [18] for an example of communication. Our student newspaper also did an article on this subject [19].

### **Conclusions**

After implementing bandwidth management in January 2002, I have become a believer in bandwidth management. It allows us to give appropriate priority to educational and business-related network traffic while at the same time allowing recreational traffic at lower priority. Our DS3 to the Internet is now more than adequate to meet our needs, although without bandwidth management it would be completely overloaded. Bandwidth

management will save us money on bandwidth while allowing us to provide better and more appropriate network access.

### Reference Sites

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17. Rutherford, E.(2000), "The P2P Report," *CIO Magazine*, July 12, 2000, [http://www.cio.com/research/knowledge/edit/p2p\\_content.html](http://www.cio.com/research/knowledge/edit/p2p_content.html)
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### Related Sessions at Educause 2002

Educause 2002 Track Session: It's Their Bandwidth...Let Them Decide  
Track 2, Thursday, October 3, 3:55 p.m. – 4:45 p.m., B303

Educause 2002 Constituent Group: Net Improvement  
Wednesday, October 2, 12:40 p.m. – 2:10 p.m., B301  
<http://www.educause.edu/memdir/cg/netimprov.html>

Educause 2002 Constituent Group: Network Management  
Thursday, October 3, 4:55 p.m. – 6:10 p.m., B215  
<http://www.educause.edu/memdir/cg/netman.html>