

# Bandwidth Management Solutions for Network Operators

White Paper

*Bandwidth management using deep packet inspection (DPI) is a relatively new field for network operators. This white paper uses a challenge-solution approach to explain how this technology can help to solve many of the issues that arise from growing user numbers generating ever more traffic with a large variety of new applications. The challenges are illustrated with real-world numbers taken from ipoque's Internet Study 2007. A selection of possible solutions helps network operators to pick the most appropriate ones based on their specific requirements.*

## Internet Service Providers & Carriers

### Challenges

Internet service providers (ISPs) often struggle with a disproportionately high bandwidth usage by a relatively small portion of their subscribers. This disparity is caused by high-bandwidth applications such as peer-to-peer file sharing (P2P), video streaming and large file downloads from file hosting services (DDL). The following two charts – taken from ipoque's Internet Study 2007 – put the relative user numbers of these applications plus Web browsing, Voice over IP (VoIP) and instant messaging (IM) in contrast with the traffic they generate.

The challenge ISPs face is twofold: On one side, these kind of new services are the very reason for new subscribers to sign up for broadband Internet access. On the other side, the excessive use by too many simultaneous users certainly drives up infrastructure costs, but, more importantly, may adversely affect the quality of experience (QoE) for interactive applications such as Web browsing, Internet telephony or online gaming.

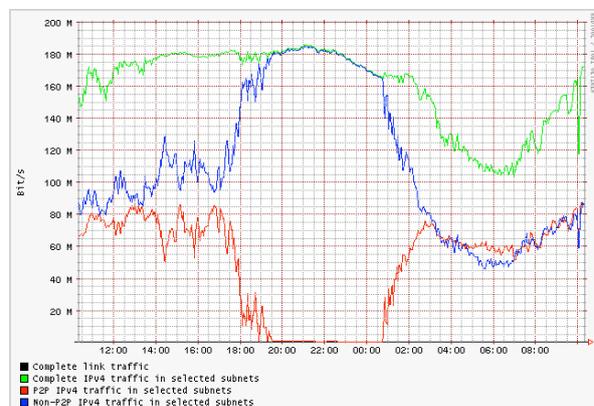
### Top ISP Challenges

- Poor application performance and QoE during congestion causes low customer satisfaction
- 10% of subscribers use 90% resources
- Missing information on subscriber application usage
- Regulatory requirements for Internet telephony based on Voice over IP (VoIP)
- Legal copyright protection requirements for P2P file sharing networks

### Application Priority Management

The simplest solution is a priority management that favors important applications over less important with a huge bandwidth usage. It can be as simple as having a single bandwidth management rule that assigns P2P file sharing a lower priority than all other traffic. This approach is not only simple and highly effective, it also provides a fair bandwidth sharing model for all subscribers. P2P users get all the available bandwidth, but as soon as the demand of other applications rises, for instance during office hours, P2P is slowed down to accommodate for the increased demand.

The screenshot below is taken from the statistics section of a PRX Traffic Manager deployed at an ISP network and shows the effect of this simple one-rule configuration. Clearly visible is the mirror-like behavior of the P2P (red) and non-P2P (blue) line. As non-P2P traffic rises in the late afternoon – due to mostly residential customers – P2P traffic is pushed back all the way down to zero to make room for the more important traffic. This picture alone provides an idea of how poor the network performance would be without this kind of traffic management.



### Advanced Priority Management

Using multi-tiered priorities enables the offering of improved quality of experience (QoE) for interactive and real-time applications. For instance, all Voice over IP (VoIP) traffic gets the highest priority, Web browsing and audio and video streaming get high priority, P2P file sharing gets the lowest priority and everything else the default priority.

The result is that VoIP packets will be dropped last, which can only happen if the link is saturated with VoIP – a very unlikely situation. P2P packets are always dropped first until no P2P is possible, if the demand from all other applications is that high. And between these two, Web browsing and streaming will operate faster in a congestion situation than all other, non-time-critical applications.

### Tiered Service Model

Most ISPs use either volume-based or flat rate pricing models – with the latter being what customers have come to expect. If a significant portion of subscribers is excessively using their available bandwidth with services like P2P file sharing, the infrastructure costs will rise – not only for the operator, but for all subscribers, even those not using P2P at all. As these are the majority, the result is that most subscribers are unfairly over-charged.

Going back to a volume-based charging model for all customers is usually out of question. Instead, many ISPs revert to data rate limitation for these power users. As this indiscriminately slows down all applications, it also degrades the service quality (QoS) of interactive applications. This means poor service and drives valuable customers away.

A much better approach is a multi-tier bandwidth model with optional per-subscriber allowances for high-bandwidth application traffic. As a result, a standard flat rate Internet access can be offered at a lower price. If customers would like to use P2P file sharing, they can simply book an option that gives them a certain monthly download volume. The result is a much fairer pricing model for all customers.

Important interactive applications such as Internet telephony (VoIP), instant messaging (IM) and Web browsing could always be given a guaranteed bandwidth and higher priority to ensure high QoE and customer satisfaction at all times. In addition, an ISP offering its own VoIP service can offer special QoS guarantees as a key differentiator from third-party offerings.

### Regulatory and Legal Issues

PRX Traffic manager can be used to enforce legal requirements ISPs may face based on local laws. P2P file sharing traffic can be filtered for copyright-protected content. This can be accomplished using ipoque's unique BitTorrent tracker whitelisting. BitTorrent, as opposed to most other P2P networks such as eDonkey, Kazaa, Soulseek, Filetopia and WinMX is significantly used to exchange legitimate content including open source software, online games updates and large, public-domain multimedia files.

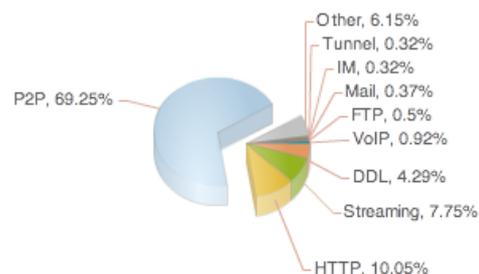
The content control for P2P networks can also be done on file level. In the method, each file's unique hash value is checked against a reference database of legitimate or undesired content. This works not only for BitTorrent, but for most popular P2P file sharing networks.

In addition to P2P, some legislations require special control of Internet telephony. PRX Traffic Manager allows to flexibly monitor VoIP traffic, including SIP, Skype, H.323 and IAX, and to define subscriber-specific rules to manage the call behavior.

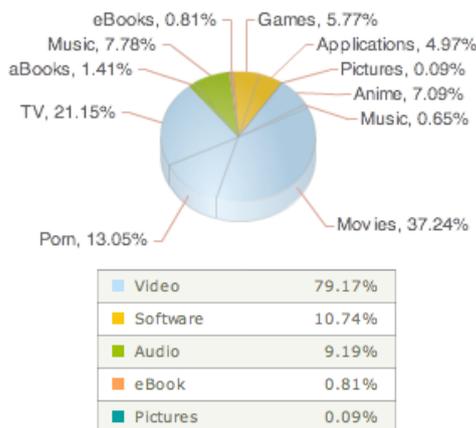
### Schools and Universities

#### Challenges

Operators of educational and research networks at schools and universities face a number of very unique challenges. Their often high-speed Internet connectivity in combination with largely unrestricted access expose these organizations to bandwidth-hogging applications such as peer-to-peer (P2P) file sharing and media streaming. P2P applications like BitTorrent and eDonkey still consume well over 50% of the available bandwidth. Audio and video streaming applications embedded in Web sites like YouTube grow in popularity. The following chart shows the protocol distribution at German universities and is taken from ipoque's Internet Study 2007:



While this has an adverse impact on the overall network performance and keeps driving the communication costs, particularly file sharing also has a legal implication as most of the exchanged content violates copyright laws. The next chart shows the types of files exchanged over P2P networks at German universities. It is important to note that this includes not only downloads, but also uploads, where the university network hosts the mostly copyright-protected content. Depending on local legislation, this can potentially have serious legal implications.



### Top Challenges at Schools & Universities

- Students' overuse of undesired applications
- Copyright violations due to P2P file sharing
- Regulatory requirements for Voice over IP (VoIP) and particularly Skype
- Poor application performance and QoE during congestion decreases staff productivity

### Bandwidth Management

Bandwidth management using the deep packet inspection (DPI) technology of ipoque's PRX Traffic Manager to reliably identify high-bandwidth applications such as P2P file sharing can significantly reduce network traffic. One option is to simply prioritize important applications such as Web browsing, e-mail and Voice over IP (VoIP) to guarantee a high quality of experience to their users even at times of high traffic load.

In addition, the data rates available for P2P file sharing can be limited to a level that leaves enough resources available for more important applications. Optionally, each student can be assigned a monthly allowance of P2P traffic through the PRX Traffic Manager's subscriber management.

### Legal File Sharing

PRX Traffic Manager offers a unique feature to provide full access to legal P2P file sharing resources such as Linux distributions, open source software and NASA imagery. Nearly all of this legal P2P content is distributed using BitTorrent. By putting all acceptable sources in the BitTorrent whitelist, such content can be accessed without restrictions, while access to all other, undesired content can be blocked. Many of ipoque's educational customers have implemented an online submission procedure that allows students to request additional BitTorrent sources to be white-listed.

### About ipoque

ipoque is the leading European provider of DPI solutions for Internet traffic management and analysis. Designed for Internet service providers, enterprises and educational institutions, ipoque's PRX Traffic Manager allows to effectively monitor, shape and optimize network applications. These include the most critical and hard-to-detect protocols used for peer-to-peer file sharing (P2P), instant messaging (IM), Voice over IP (VoIP), tunneling and media streaming, but also many legacy applications.