Traffic Management Becoming High-Priority Problem

Greg Goth

The technical problems of allocating and managing bandwidth over a particular connection and the passionate (and often less-than-fully informed) policy debate over network neutrality are now squarely on the same track. But it's unclear whether they will smoothly merge in a new era of technical and policy compatibility — or result in a train wreck of heavy-handed regulation, customer dissatisfaction, and technical inelegance.

Doc Searls, senior editor of *Linux Journal*, asserts that network neutrality entails not only the legal right to access any legitimate application but also the capability to upload digital goods and services.

"The Internet is not about 'consumer choice,'" Searls wrote in a February 2008 posting on his blog (http://blogs.law.harvard.edu/doc/2008/02/25/the-fcc-and-the-giant-zero). "We produce as well as consume. We need to be able to run our own servers. We need to be able to exercise supply as well as demand. We need symmetricality, not just neutrality."

A widely held counterargument to Searls' statement is that ISPs do indeed offer packages that would enable operators of "knowledge cottage" services to run servers and receive an abundance of bandwidth.

However, the most publicized network bottlenecks demonstrate that users at the network's far end don't need formally defined servers to distribute extremely large amounts of data. One notable example is the spike in P2P traffic over thin consumer-level connections, often with no business purpose involved, that now accounts for up to 80 percent of network traffic. That presents a problem, as explained by Stanislav Shalunov, BitTorrent's director of engineering.

At a presentation for the IETF's P2P Infrastructure workshop in May (http://shlang.com/talks/20080528-BitTorrent-position-IETF-P2P.pdf), Shalunov wrote, "When a user starts a typical implementation of BitTorrent today, multiple uploading TCP connections entirely saturate the uplink and fill the buffer in the bottleneck device, typically cable or DSL modem. This imposes an additional delay on all traffic, equal to the size of this buffer divided by the uplink bit rate. In typical home usage cases, this additional delay can range from a second to four seconds or so. An increase in RTT [round-trip time] of this magnitude not only starves out other TCP connections, it quickly makes real-time communication, such as VoIP [voice over IP] and games, entirely impossible."

"The majority of these networks are asymmetric, and yet the way they are being used is much more symmetrical," says Kurt Dobbins, chief technology officer for IP Services at Arbor Networks. "So what that says is the lower bandwidth link, typically the uplink, is going to be oversubscribed, which means it has to be managed in times of congestion. Or, economically manage it with service tiers, pricing, and what I've really been interested in, giving consumers economic incentives to help you manage the network."

Transparency and Foresight Needed

Network congestion has already caused service slowdowns and resulted in regulatory discipline from the US Federal Communications Commission. The FCC recently censured Comcast for throttling BitTorrent traffic without disclosing the practice to its users. At its heart, technology veterans say the problem is exacerbated by the ISPs' sales policies that offer falsely high data rates and "all you can eat" flat-rate pricing. Simultaneously, the high-level net neutrality debate often colors the very real problems of traffic management.

"One of the frustrating things, sitting on the sideline watching this play out in the press with net neutrality, is the perception [that] you can't manage the network, that it has to be unmanaged to be open and free," Dobbins says. "Our philosophy is fairness, and within that fairness, be free to access the content of your choice.

"We're really careful not to look at the content people are looking at, just looking at applications, and we never deny connections. We might slow a non-real-time app down and time-shift it to nonpeak hours, but you still maintain that connection."

Internet pioneer Larry Roberts, who was program manager for the original Arpanet, is now tackling the problem of traffic management with

his latest venture, Anagran. Roberts says a new era of transparency is feasible only if network operators can obtain detailed information about usage patterns of each individual user's connection and explain how communal bandwidth really is.

"Most of the public don't understand they're being compressed about 100-to-1 as they go into the Internet," Roberts says. "There's an expectation on the carriers' part that they'll use an average of 1 percent of their peak rate — and that's all they do use, generally."

However, Roberts says, typical users also expect that when they want to use the peak rate they've been sold, the network capacity will be there, and, "the point is, to make it work you have to share that bandwidth, and to share it you have to share it equally among subscribers, or at least as they pay for it."

Unfortunately, P2P and rich media's rise has made sharing bandwidth equitably far more difficult. As Klaus Mochalski, chief executive officer of Germany-based traffic management vendor ipoque says, infrastructure investment might appear to be a solution to a bandwidth shortage, "but just building infrastructure is not an answer. It's in the nature of P2P to use any available bandwidth."

The fact that a pronounced minority of Internet users use P2P connections doesn't make solving that equation any easier. In ipoque's 2007 study of protocol usage in Europe and the Middle East, P2P traffic accounted for more bandwidth usage than all other applications combined (www.ipoque.com/resources/internet-studies/internet-study-2007). P2P applications accounted for a low of 49 percent of Internet traffic in the Middle East, 83 percent in eastern Europe, and roughly 74 percent in Germany.

However, Roberts says focusing on P2P's voracious technology could be a crippling mistake.

"P2P is hurting network capacity the most right now, but it could be any application," he says. "My concern is the world will go that way to compete with P2P if we don't fix it to be equal. In other words, if we don't fix this, everybody will start changing and the world will become a rat race to try to use more flows — and the result will be we can't use NAT [network address translator], and everything falls apart."

Even if everything doesn't fall apart, technical innovation at the edge stands to suffer if carriers continue to architect asymmetric networks while users consume and produce more rich media.

"At this point, we have a chicken-and-egg problem with applications that are uploading from users' computers," Shalunov says. "On one hand, the uplink from users' homes is very narrow. The ISP assumes applications will generally download and never upload when they build their network. So, once that network is built, it becomes advantageous to write applications that mostly download and don't upload as much.

"In the past, the Internet has been a very innovative space. It is hard to guess popular future applications, but if you create the groundwork for being able to upload easily, what things will people build on that groundwork?"

A Convergence of Principle

While the legal wrangling between Comcast and the FCC continues, the company has instituted a protocol-agnostic traffic management approach, and the community is reaching a rough consensus about the future of equitable bandwidth allocation. Traffic management vendors such as Arbor — using technology developed at Ellacoya (purchased by Arbor in January), ipoque, and Anagran — are all offering some sort of flow analysis. Flow analysis is more efficient than packet-by-packet analysis (flows can be loosely defined as groups of packets with similar properties based on

News in Brief

Researchers launched the world's first computer network protected by **quantum encryption** at the **Secure Communications Based on Quantum Computing conference** in October. The network combines eight quantum-key-distribution links in a novel **quantum backbone network** connecting **Siemens** company sites across **Vienna** and in a nearby town. The key idea behind quantum encryption rests on the **Heisenberg Uncertainty Principle** — that you can't measure (or eavesdrop on) quantum information without disturbing it.

More information is available at www.secoqc.net.

Tim Berners-Lee has founded the **World Wide Web Foundation** with the goal of advancing "One Web that is free and open." The foundation will bring together **international experts** from all sectors to meet its goals of expanding the Web's capability and robustness and extending its benefits to "all people on the planet."

More information is available at www.webfoundation.org.

The **Internet Society's European Chapters Coordinating Council** has issued an *Aide Memoire* criticizing the French government's draft Hadopi law, which proposes that ISPs warn and sanction users who breach intellectual property laws. The European Commission is currently debating changes to such laws because of its concerns over how file sharing and digital downloads are impacting publishers' and artists' rights. ISOC-ECC's document notes that both the Hadopi law and similar discussions within the EC constitute a "disproportionate response to the objective of developing creative content online."

The Aide Memoire is available at www.isoc-ecc.org/docs/ipr2008/GRADUATED_RESPONSES_FIN2_040808.pdf.

News in Brief

ITU Secretary General Hamadoun Touré says there will likely be **4 billion global mobile cellular subscribers** by the end of 2008, making it "technically feasible to connect the world to the benefits of ICT." Touré, speaking in September at the **United Nations**, said the worldwide subscriber rate had surpassed the 50-percent-penetration mark early in 2008 and should reach 61 percent by year's end.

More information about cell phone use is available at www.itu.int/newsroom/press_releases/2008/29.html.

The ITU has also published recent reports on how mobile telephony is changing lives in Africa (www.itu.int/newsroom/press_releases/2008/10.html) and Asia (www.itu.int/newsroom/press_releases/2008/25.html).

As a lead-in to his keynote address on **"No-Tech Hacking"** at **Security Conference Toronto** in October, **Johnny Long** discussed the efforts of **Hackers for Charity**, an organization he started in 2007 to connect "the wealth and skills of the hacking community with charitable organizations in need." Today, Hackers for Charity provides references for hackers willing to use their technical skills to help charities, and accepts equipment and financial donations to **build computer classrooms** in underdeveloped countries.

More information is available at www.hackersforcharity.org.

The **Center for Democracy and Technology** submitted testimony to the **US Senate Constitution Subcommittee** in October calling on **the next president and Congress** to impose checks and balances on governmental national security measures and update the **Electronic Communications Privacy Act**.

The testimony is available at www.cdt.org/security/20081001_ruleoflaw_tes.pdf.

source, destination addresses, port numbers, and the transport layer type). Carriers can give traffic belonging to P2P flows, for example, lower priority than real-time interactive traffic such as VoIP and gaming traffic.

Some of the traffic management products, including ipoque's and Arbor/Ellacoya's, rely on deep packet inspection. Although Roberts says there are privacy concerns with DPI and that encrypted packets can bypass it, ipoque's Mochalski says the technology is necessary and a certain amount of trust given to network operators extends to DPI.

"DPI has become necessary simply because legacy methods for application and protocol classification based on UDP and TCP port numbers ceased to work," he says. "I agree that there is a big abuse potential through DPI. But the same is true for IP addresses, and we rely on our ISP not to make the list of IPs we visited available to the public. If you argue against DPI, you also need to argue against firewalls, virus scanners, and spam filters, which all use DPI techniques."

The industry appears to be reaching a consensus approach to traffic management and congestion control. The IETF held a birds-of-a-feather (BoF) session addressing the problem at its August meeting in Dublin. BitTorrent's Shalunov served as co-chair of the BOF session, entitled TANA (Transport for Advanced Networking Applications). Shalunov says the community involved overwhelmingly wants the effort to move forward to working group status.

The Distributed Computing Industry Association (www.dcia.info) is working on a standard intended to make P2P more efficient. The new standard, the Provider Portal for P2P (P4P), is designed to allow explicit information exchange between a network and the P2P applications traversing it in ways hitherto impossible (http://cs-www.cs.yale.edu/homes/yong/p4p.html). P4P gives pri-

ority to local peer connections over those from outside a P2P user's network, theoretically freeing up more hops globally; so does BitTorrent's congestion control feature, which is part of its Delivery Network Accelerator (DNA) technology.

Keeping It Simple for Now

Until and unless standards efforts take hold, some ISPs are moving away from flat-rate pricing toward tiered service and usage caps. Arbor's Dobbins says one UK-based ISP, Plusnet, has instituted caps but also includes an exemption for overnight activity.

"It gives consumers an economic incentive to use it heavily in off-peak hours," he says. "It shifts all the heavy usage, which would cause congestion in peak hours, to off-peak. Instead of having these big cycles of peak and idle usage, it basically flatlines to run at about 90 percent efficiency."

"That's a very dangerous path because it makes everybody start worrying about everything they do, and then they don't do as much. Many of us in the Internet community, especially those who were involved from the start, believe fixed pricing is the reason the network grew, and the controllers and companies didn't stop people from doing things because it didn't cost more."

BitTorrent's Shalunov says the widespread community discussion is a positive occurrence, regardless of the differences of opinion on service and technology specifics.

"At this point, we're moving toward more application-agnostic network management techniques, and I think that's very important and very good," he says. "Before the recent movement, we were getting closer to the point that, before you deployed a new application on the Internet, you almost had to ask permission from every ISP involved. That's not scalable."

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