

PACKET DESIGN'S TRAFFIC EXPLORER HELPS COVAD WIRELESS KEEP 'NET' WORKING

Routing and Traffic Visibility Let Leading Wireless ISP Make Smarter Decisions About Network Expansion, Peering - Even When to do Repairs

In the hyper-competitive business of providing Internet access services to enterprises, gaining an edge in effective network planning and operation can make a critical difference. That's especially true for fixed-wireless Internet service providers (WISPs) who sell access over wireless microwave links that provide freedom from the constraints of physical local loop access, but whose RF-based access-layer bandwidth must be vigilantly managed.

Network engineers at San Jose, Calif.-based Covad Wireless (www.covadwireless.com), founded in 1999 as NextWeb and now a subsidiary of Covad Communications Group, know this all too well. Operating one of the nation's largest fixed-broadband wireless networks, the company has thousands of business customers in the metropolitan San Francisco/Silicon Valley, Los Angeles/Orange County, Las Vegas and Chicago areas who purchase services ranging from T1 replacement to high-capacity 100-megabit-per-second access – and who demand the same performance and reliability they expect over wired networks.

One of the chief advantages of fixed-wireless Internet services is their flexibility in providing network access without depending on the local exchange carrier (LEC) for service delivery. The challenge is that, while wired networks provide dedicated physical fiber or copper cabling from telecom central offices to customer premises, wireless service is provided by covering a geographical area with shared, high-bandwidth RF frequency.

"Most broadband providers already struggle with managing a complex, shared core IP network," said Vikas Khanna, director of engineering at Covad Wireless. "With fixed-wireless, we don't provide a dedicated single wireless pipe to each customer – that sort of architecture doesn't exist in the wireless world. Because WiMax-based network systems are designed as a point-to-multipoint architecture, most of our wireless network access sites have multiple customers connected to them, so we have to do a balancing act with traffic across all those links."

That balancing act was made more difficult by the fact that Khanna and his staff had limited visibility into their network routing and traffic. The company was using a mix of "home grown" management tools and generic NetFlow collectors that generated useful

traffic information for specific monitored links, but gave no information on what happened to the traffic once it moved beyond the link. Without an end-to-end view of traffic movement, there was no way to understand the impact of routing changes on that traffic.

"There was a lot we wanted to know about our traffic," Khanna said. "We realized there was more information to be analyzed, but we didn't know how to go about getting it."

At meetings of the North American Network Operators Group (NANOG), a forum for service providers, Khanna learned about a network management product called Traffic Explorer, from Packet Design (www.packetdesign.com) of Palo Alto, Calif. Traffic Explorer was introduced in 2006 as the first network management system to map traffic flows onto the network routes over which they flow, showing traffic as it moves in real time across the entire routed network topology. Service providers gain an end-to-end, "topology-aware" view of network traffic, broken down by application or class of service (CoS), that gives them the information they need to find hidden network problems, speed the troubleshooting process and ensure there is sufficient bandwidth to meet service-level agreements. They can also strengthen change-management processes and drastically reduce the service impacts of misconfigurations by accurately modeling the effects of network changes or new customers on the actual, as-running network, rather than using an offline approximation of the network.

Since deploying Traffic Explorer in the fall of 2007, Covad Wireless engineers use it on a regular basis to more fully understand network-wide routing and traffic patterns. Traffic Explorer has replaced the organization's previous traffic-flow collection tools because it not only collects NetFlow data but provides much more granular information about that data and the network paths it traverses.

"With Traffic Explorer we can now watch traffic moving in real time across our entire network," Khanna said. "For internal engineering use, it tells us not only how much traffic is going to a specific destination, but what types of traffic are in the mix, so we can intelligently apply QoS policies by traffic type. For external purposes, we have far more forensic information to credibly defend our network's performance and to justify those policies to users, such as knowing whether traffic from a specific customer or application type has grown significantly in a given month."

Traffic Explorer Used "Every Time There's a Network Issue"

Traffic Explorer comes into play "every time there's a network issue, from troubleshooting to general maintenance to proactive planning," he said. "From allocating loads across network links to determining which other providers we should peer with, it gives us the right information to make educated decisions."

Khanna cited the recent example of customers complaining of slower than usual access speeds. Whereas once it might have taken quite some time to locate the source of this problem, his team logged into Traffic Explorer and could see immediately that one of the network's main backhaul links had gone down. "Before, even if we had suspected that the link had been the problem and that our traffic wasn't flowing over optimal paths, the only way to make sure was to keep checking different systems until we confirmed the issue," he said. "Traffic Explorer either confirms our suspicions right away or tells us where the problem really lies."

On another occasion, because of an error in the way the default operating parameters were set on the network's routers, traffic was being directed to a peripheral part of the network which was built with lower capacity than the intended path. Traffic Explorer enabled network engineers to quickly identify a misconfiguration that was responsible for the problem, model changes to the router settings, and validate that the changes would correct the problem – all before actually putting the changes into effect. Before Traffic Explorer, Khanna said, "we'd have to go to specific routers and play around with different settings to see if they'd fix the problem, while affected customers bore the brunt of the service issue."

It's Not Our Problem – and Here's Proof

Traffic Explorer has helped Covad Wireless engineers address problems that don't even stem from its own network. "We had a problem with a route flap [a route that goes up and down, causing intermittent outages] caused by a faulty network interface on one of our primary router vendor's boxes," Khanna recalled. "We told the vendor about the problem and they were struggling to confirm it, because standard SNMP monitoring tools, which can only poll the links every few minutes, indicated the link was fine. I had their technician log into Traffic Explorer and she could instantly see exactly what was happening."

In addition to troubleshooting problems that are having an obvious impact on customers, Traffic Explorer from time to time has alerted Covad Wireless engineers to problems they hadn't even been aware of, because they had been masked by the complex behavior of IP routing protocols.

"One very common problem that occurs in large networks like ours is 'asymmetric routing,' where traffic will take a different path between two given points depending on the direction it is traveling," Khanna said. "One path might be preferred because it has plenty of capacity, while the other may be more congested or prone to delays. If traffic volume is fairly low, users may not even notice. But we want to know about it because it could potentially have a significant impact on delay-sensitive applications such as voice."

Proactive use of Traffic Explorer to "find problems before they become problems" came in handy when Covad Wireless acquired another wireless service provider in the Chicago area, Khanna said. "When we had the chance to see their network for the first time, we connected Traffic Explorer, quickly generated an 'asymmetrical path' report, and found a lot of routing anomalies they weren't even aware of, cases of real inefficiencies where traffic wasn't flowing over the optimal links. We were able to find and quickly correct them."

Knowing if Something Will Go Wrong – Before it Does

Beyond defensive troubleshooting and proactive maintenance, Covad Wireless uses Traffic Explorer for what-if scenarios, to determine how network changes will impact customers before actually implementing those changes. "At the end of the day we're a service provider, and a great customer experience translates directly into a healthier business," Khanna said. "When it comes to network changes and their potential impact on the customer experience, we go through a careful change-management process, and Traffic Explorer is a vital tool in our network management 'tool chest' for designing and implementing such changes."

For example, if a new router is being added, it is first modeled using Traffic Explorer to show how existing traffic will adjust to the expanded topology. If the new router is not in the core of the network, it may not be desirable to have bulk traffic running over it; but existing configuration parameters in other routers may cause traffic to automatically use the newly installed router anyway. Traffic Explorer's modeling capability will show in advance whether this will happen, allowing engineers to take corrective measures to ensure that bulk traffic avoids the new router node if desired. "Without Traffic Explorer, modeling this type of network event would not only be very difficult, but also time-intensive," Khanna said. "With Traffic Explorer, we'd know with just a few clicks what needed to be done."

This capability carries over into Covad Wireless' capacity planning. "We can define the capacities of links between given routers across our backbone, use Traffic Explorer to simulate failures on specific links, and visually see where the traffic will be rerouted," he said. "We can even add varying amounts of new traffic to the network to pinpoint exactly when a given link will become saturated so we know when we'll need to expand the network again."

The Bottom Line – Money Saved on Peering Relationships, Daily Operations

In several scenarios, Covad Wireless' use of Traffic Explorer has translated directly to the bottom line.

Internet service providers have multiple ways to provide customers with Internet access. They can purchase Internet bandwidth from other, larger ISPs, known as "paid transit relationships." A more advantageous solution, if equivalent traffic volumes are moving in both directions between two ISPs, is "settlement-free" peering, often done through major Internet exchange points. In the past, settlement-free peering could be hard to justify, however, because it was difficult for an ISP to determine how much traffic leaving its network was destined for a neighbor ISP's customer, and how much would transit through the neighbor to yet another ISP. Since Traffic Explorer makes such information readily available, a provider can not only ensure that inter-provider traffic volume is within contracted ranges, but potentially reduce costs by moving traffic from paid transit to settlement-free peering.

"If you're a smaller provider," Khanna said, "the bigger service or content providers won't even talk to you because you don't have enough traffic to justify the administrative cost of a direct, settlement-free relationship. You'll have to connect through another ISP and pay for their transit service to reach the destination network. With Traffic Explorer we can go to potential peers and tell them exactly how much and what types of traffic we have going to a destination, validating that a peering relationship would be beneficial. With transit costs averaging \$25 per megabit from a decent upstream provider, that's valuable information that can mean significant savings."

Closer to home, Covad Wireless engineers have shared the power of Traffic Explorer with the company's Network Operations Center (NOC), which is responsible for both installation of new customer equipment and repairs to existing equipment.

"Before, if a link went down, the NOC staff would send an unqualified escalation to the engineering group and wait until we figured out what happened," Khanna said. "If it happens now, they can use Traffic Explorer to see right away if it's a backup link that has no immediate impact on customers. Not only does that keep my group from having to drop what we're doing to deal with it, but it also prevents the field operations staff from delaying a revenue-producing customer installation to make a repair that might not be critical anyway."

About Packet Design, Inc.

Packet Design, Inc., pioneered the field of route analytics and is the leading supplier of network appliances that provide routing-layer visibility into IP networks. The company's products create an accurate layer 3 topology map, analyze routing events, and provide a unique end-to-end, "path-aware" view of network traffic (including MPLS-VPN customer traffic), letting network engineers quickly pinpoint network problems and accurately model

changes. Packet Design solutions help manage networks in hundreds of organizations, including many of the world's largest service providers, global enterprises (financial, retail pharmaceutical and other firms), government agencies and educational institutions.

Packet Design was founded in March 2003 by serial entrepreneur and former Cisco Chief Technology Officer Judy Estrin and former Cisco Chief Scientist Van Jacobson. For more information, visit www.packetdesign.com.

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