

Sprint—Layer 2/Layer 3 Services Converged Over Common IP Backbone Via L2TPv3 in Cisco IOS Software

Newest version of tunneling protocol enables seamless high-speed Layer 2 tunneling and virtual private networking services along with Layer 3 IP benefits



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– Barry Tishgart, Director,
Data Product Management at Sprint

A network convergence strategy expected to get top attention from service providers in the next few years is the ability to offer traditional Layer 2 transport protocols over a Layer 3 native Internet Protocol (IP) core. Sprint is among the first companies to test and deploy a key technology that makes this possible—Layer 2 Tunneling Protocol Version 3 (L2TPv3)—which is available in Cisco IOS® Software Release 12.0(21)S or later and whose ratification by the Internet Engineering Task Force (IETF) as a standard is expected by the end of 2003.

A Prudent Migration Path to IP

In January 2003, Sprint announced the availability of Frame Relay, packet private line, and virtual local area network (VLAN) services via their IP and dense wave division multiplexing (DWDM) backbone. Estimated cost savings for some customers could be as high as 20% while higher speeds and new Layer 3 services would be gained. The savings is a factor of using existing customer premise equipment, lower costs for Sprint to maintain a converged network, and no extensive retraining for customer IT personnel. Another key benefit is seamless and inexpensive migration to a Layer 3 IP network for existing customers with Layer 2 connections.

"Our strategy is to evolve our IT platform into a multiservice network," says Barry Tishgart, Director, Data Product Management at Sprint. "We're starting by offering our customers IP-'charged' versions of traditional Layer 2 solutions and enabling them a seamless migration path from frame to IP-based VPNs."

How Layer 2 Tunneling Protocol Version 3 Works

Sprint and Cisco have pioneered the L2TPv3 transport standard, which is based on optimized extensions to the L2TP standard. L2TP served narrowband dial-up protocols and was designed to provide tunneling for Layer 2 circuits across packet-based data networks. These tunnels resemble virtual point-to-point or point-to-multipoint connections between customer sites. The newest enhancements allow it to run on high-speed devices such as routers and the session and tunnel ID space is increased from 16 to 32 bits, increasing the number of tunnels that can be built from 65,000 to four billion or more.

Using L2TPv3, Cisco 7000 Series Routers and Cisco 12000 Series Routers at the ingress to the SprintLink network encapsulate the Layer 2 payload with an L2TPv3 and IP header. The data now travels across the SprintLink network via a secure, authenticated L2TPv3 tunnel session. At the SprintLink egress point, the edge router removes both headers and returns the packet to its original Layer 2 format.

“Each edge router at our Sprint nodes runs pure IP and L2TPv3, so customers literally transition from Frame Relay to IP at the network edge,” says Steve Lacoff Senior Product Manager at Sprint. “When it gets encapsulated in L2TPv3 and IP, the customer’s service benefits from the redundancy of IP to give it the shortest route possible from Point A to Point B. Our IP architecture ensures that there are virtually no bottlenecks. It’s a very distributed architecture that provides great performance, reliability and security.”

An authenticated, secure tunnel session is established between two physical port interfaces or two logical sub-interfaces. L2TPv3 does not introduce any additional processing or protocols in the network core.

“It’s a lightweight protocol that we can easily implement throughout our network, literally a software upgrade,” says Lacoff.

An integrated Layer 2/3 IP network is designed to be less expensive than Frame Relay or private line networks that must be separately maintained. L2TPv3 reduces complexity as the need for edge routers to support every enterprise VPN routing table and Layer 3 routing environment is eliminated. Aside from enabling dynamic tunneling for multiple Layer 2 circuits, L2TPv3 moves Layer 2 traffic into the same network environment where newer applications like IP telephony, public branch exchange (PBX), and videoconferencing are available.

EXECUTIVE SUMMARY

BACKGROUND

Sprint is a global communications company serving more than 26 million business and residential customers in over 70 countries. With approximately 72,000 employees worldwide and nearly \$27 billion in annual revenues, Sprint is widely recognized for developing, engineering and deploying state-of-the-art network technologies, including the United States’ first nationwide all-digital, fiber-optic network and an award-winning Tier 1 Internet backbone. Sprint provides local voice and data services in 18 states and operates the largest 100-percent digital, nationwide PCS wireless network in the United States. L2TPv3 represents a methodical and seamless, cost-effective migration path for traditional Frame Relay customers over to an IP-centric VPN.

CHALLENGE

Sprint determined that major efficiencies and cost savings would result from delivering their legacy Layer 2 services over their IP infrastructure. The converged network would drive down the cost of providing Layer 2 services by leveraging the superior cost efficiencies of multi-service IP infrastructure, extend the footprint of their existing Layer 2 networks efficiently, and lower the cost of providing multiple services to customers through service bundling. Customers can seamlessly migrate from their traditional Frame Relay service to SprintLink Frame Relay (SLFR) with virtually no modifications to their CPE capabilities. Then, while on SLFR, they can gain confidence in the performance, reliability, and security of an IP core. When they are ready to migrate to an end-to-end IP VPN, that migration will be virtually seamless as well.

CISCO SOLUTION

Working with Cisco, Sprint helped create and deploy Layer 2 Tunneling Protocol Version 3 (L2TPv3), an advanced Layer 2 tunneling solution that is available in Cisco IOS Software. L2TPv3 allows service providers and large enterprises with native IP core networks to integrate and deliver high-speed Layer 2 tunneling or VPN services from their IP infrastructure.

RESULTS

Sprint’s new L2TPv3-based frame relay service is being introduced at a price that’s about 20% less than its comparable frame relay service derived from their native frame relay network, providing their customers with a compelling incentive to exploit IP network L2TPv3-based frame relay services. The seamless network integration is a software upgrade, invisible to customers, and it allows customers and providers to reduce their costs for Layer 2 administration, scale networks easily, and realize operational savings from implementing VPNs on the same infrastructure used to deliver Internet service. L2TPv3 allows Sprint to cost effectively transport existing traffic over their IP backbone while expanding their Layer 2 access revenue and introducing new IP services.

“Whether they are establishing a new Sprint network or migrating from a Frame Relay network, this migration to IP through L2TPv3 will be almost invisible to customers,” says Tishgart. “If they’re coming to us from another carrier, it will appear just the same as migrating from another provider. They won’t need new equipment or training for their staff. Going to an IP VPN is fairly seamless.”

Flexible Ramp Up for Customers

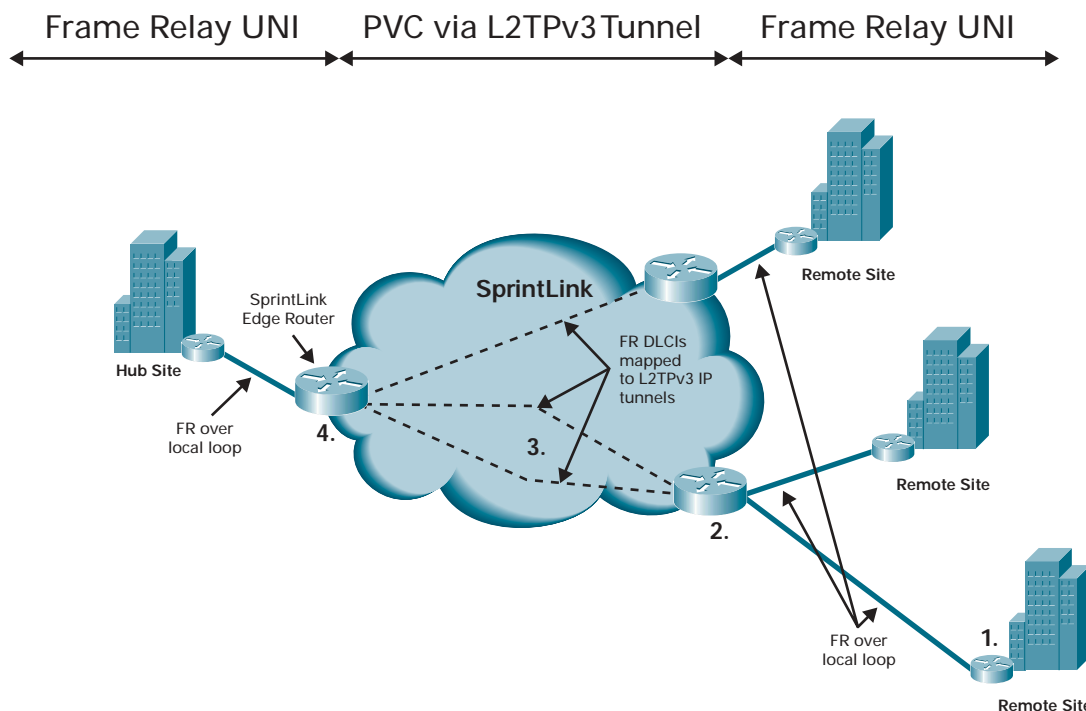
Sprint is promoting SprintLink Frame Relay service to both new and existing customers over the Layer 3 IP network. A data-only SprintLink Packet Private Line (PPL) service, providing private line emulation over the Layer 3 IP backbone, is also being offered. This service is especially cost effective for companies using long haul global links. Finally, SprintLink Virtual LAN Services allows customers to link disparate 802.1Q-based VLAN segments across the IP network. To the customer it appears as a single, seamless Ethernet LAN. This service is available to customers with local Ethernet access or collocated at Sprint data centers.

“Our customers might not have the money to upgrade to an enterprise-wide IP VPN in 2003, so they can do it partially,” says Tishgart. “It’s just a function of our rehoming the private virtual circuits into IP tunnels. Some customer solutions could include customer premise equipment and others could be completely network based and others a combination of the two.”

Is Frame Relay dead? Tishgart feels that is what the telecom industry believes.

“So we want the transition to IP to be less painful for customers. We’re not shutting the Frame Relay platform down but we know business needs are taking customers in this direction.”

Figure 1. SprintLink Frame Relay



For those interested in moving to IP-based VPNs, Sprint can design, implement, and support the solution. The estimates believe that many customers can save up to 20% due to more efficient management of the integrated infrastructure.

“We see this as an evolutionary step, moving from Frame Relay to IP VPN,” says Tishgart. “Customers have to gain confidence in the performance, reliability, and security of IP in the core before they migrate to an end-to-end IP VPN. And they will.”

Sprint’s roadmap for L2TPv3-enabled products includes a managed global VLAN that removes dependency on last mile Ethernet access at customer sites. Another coming feature is edge-based classes of service to let customer prioritize different traffic flows and establish a committed access rate for high-priority applications.

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