How Cisco IT Migrated TDM Local Access from SONET to OC-192 Infrastructure

OC-192 on Cisco ONS 15454 increases network speed, saves money, and improves manageability.

Cisco IT Case Study / Optical / Cisco ONS 15454: When Cisco Systems® needed to extend its own local access infrastructure from eight buildings to 26, the company migrated from separate synchronous optical network (SONET) rings at OC-48 bandwidth for each building to a unified, campuswide infrastructure based on Cisco ONS 15454 SONET multiservice provisioning systems running at OC-192 speeds. This case study describes the world's first Cisco ONS 15454 retrofit, how Cisco made the transition, and the business benefits to the company. Cisco customers can draw on Cisco IT's real-world experience in this area to help support similar enterprise needs.

"The expanded SONET footprint means we can self-manage local access capacity in more buildings, and extend the access infrastructure to unlit buildings as their capacity needs grow. We don't have to involve our LEC as early in the process when we order circuits because we're not reliant on their capacity."

– Keith Brumbaugh, Cisco Network Engineer

BACKGROUND

Cisco's headquarters in San Jose, California comprise approximately 50 buildings linked together by a local area network (LAN) provisioned on dark fiber that Cisco owns or leases. To connect outside the campus, employees access the public switched telephone network (PSTN) via a synchronous optical networking (SONET) time-division multiplexed (TDM) LAN. The network connects Cisco buildings on the San Jose campus to the local exchange carrier (LEC) central offices and interexchange carrier (IXC) points of presence (POPs). "Essentially, the local access network provides Cisco with connectivity to the outside world, whether that's the Cisco WAN, the PSTN, or the Internet." explains Keith Brumbaugh, network engineer.

LECs and IXCs use SONET technology for TDM local access because of its high bandwidth capacity and inherent reliability and resilience. At Cisco, local access circuits delivered over the SONET infrastructure range from T1 (1.544 Mbps) and T3 (45 Mbps), to OC-3 (155 Mbps) and OC-12 (620 Mbps), to Gigabit Ethernet (1000 Mbps).

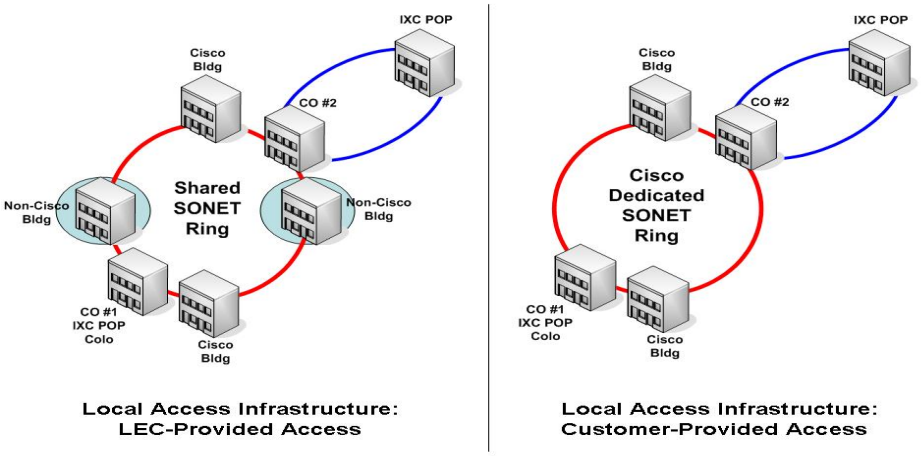
Either the LEC or its customer can own the campus infrastructure; this affects pricing as well as bandwidth capacity planning. When the LEC owns the infrastructure and leases it to the customer, the customer pays tariff rates, which are monthly circuit lease charges based on bandwidth. Early termination fees apply if a business unit moves to a different building or otherwise no longer needs the circuit. And because LEC capacity can be shared by multiple companies in a neighborhood, a company that orders more capacity might discover that another company nearby ordered all remaining capacity just the day before—resulting in delays in order fulfillment while additional LEC capacity is provisioned.

When a company owns its own local access infrastructure, in contrast, it pays the LEC a fixed monthly fee for the infrastructure, and then a much smaller monthly usage fee as circuits are provisioned. The result is significantly lower monthly costs—14 percent lower, in Cisco's case. The company can acquire more capacity simply by upgrading the equipment at the endpoints. What's more, capacity management is vastly simplified because capacity is dedicated to

the company and not shared with other companies in the neighborhood (Figure 1).

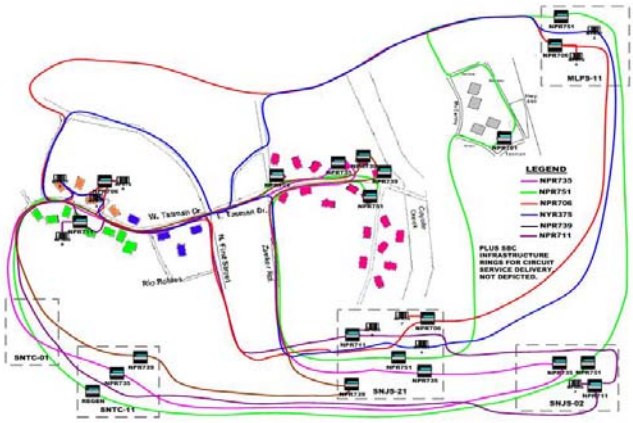
"Whether customer-provided access or LEC-provided access is more cost-effective comes down to circuit volume," explains Brumbaugh. "For buildings with sufficiently high LEC capacity needs, customer-provided access saves money. For buildings with lower capacity needs, LEC-provided access is more economical."

Figure 1. LEC-Provided Access vs. Customer-Provided Access



Cisco combines both approaches. Until 2004, the eight headquarters buildings with the highest circuit volume connected to the LEC via six individual OC-48 SONET rings that Cisco owns (Figure 2). The remaining 40-plus buildings, which had lower circuit volume requirements, connected via SBC's SONET infrastructure, which Cisco leased. "Until recently, bringing fiber to those buildings would have cost more than we'd save from the lower monthly rates, so customer-provided access was not cost-effective," Brumbaugh explains.

Figure 2. Cisco Local Access SONET Infrastructure in 2004



CHALLENGE

The situation changed in 2003, when local access usage at 18 additional buildings had increased to a level where customer-provided access would be more economical. Unfortunately, the legacy infrastructure consisted of unconnected SONET rings. Each was managed separately, complicating the process of adding the "unlit" buildings to the SONET rings, or even adding more SONET capacity for buildings already on the rings.

"Our 'spot solution' for customer-provided access—one or two rings per building—had major drawbacks in terms of management and costs," says Scott Reubelt, IT project manager. Those drawbacks included:

- A high management burden for six separate SONET rings.
- Inefficient capacity planning, which was performed ring by ring. Some rings were overused, even while others remained underused.
- Large footprint and power requirements for the legacy equipment supporting the SONET rings. The LEC had purchased the equipment from another vendor before Cisco entered the market with the Cisco ONS 15454 after acquiring Cerent in 1999.

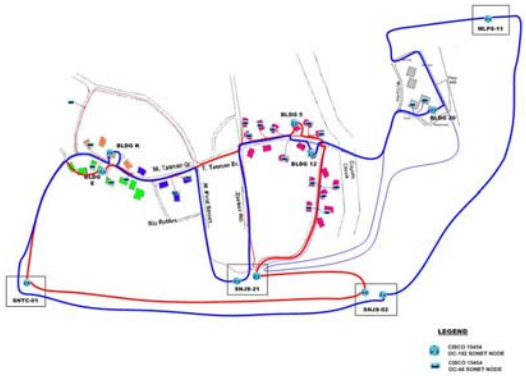
Cisco decided to refashion its customer-provided access network to cut costs, simplify management with a campuswide solution, and gain more control over capacity management. The plan: migrate from the disconnected legacy SONET TDM local access infrastructure to a next-generation, higher-bandwidth infrastructure powered by the Cisco ONS 15454 Multiservice Provisioning Platform (MSPP).

The challenge would be making the transition without disrupting mission-critical services, such as PSTN access and Cisco.com, the company's e-commerce and customer support Website. The migration was new territory. Although Cisco had successfully installed local access infrastructures based on the Cisco ONS 15454 platform, including one in 2000 in Research Triangle Park, North Carolina, those were brand-new, greenfield deployments. "Cisco headquarters would be the first location to transition from a legacy SONET infrastructure to a Cisco-powered, next-generation solution for customer-provided access," says Brumbaugh. And timing was crucial—the existing LEC contract would expire in six months.

SOLUTION

The new local access infrastructure, which relies on one or two Cisco ONS 15454 switches at each location, interconnects 26 Cisco buildings (the original eight, plus 18 more) with four SBC central offices (Figure 2). Installing the Cisco ONS 15454 switches in multiple LEC locations provides redundancy and fault tolerance (Figure 3).

Figure 3. Cisco Local Access SONET Infrastructure in 2005



Planning

Cisco IT faced the daunting challenge of migrating more than 800 voice, video, and data circuits from the old to the new infrastructure without disruption. The breakdown: 702 T1, 89 T3, 4 OC-3, one OC-12, and two Gigabit Ethernet circuits.

Careful coordination was needed to ensure that someone on the Cisco campus and someone at the SBC central office would repatch the circuits from the legacy optical platform to the Cisco ONS 15454 platform at the same time. "We developed a detailed project plan to avoid missteps and outages, coordinating the migration through multiple

meetings with SBC and the individual circuit owners," says Reubelt. The logistics were especially complex because individual circuits were owned by different groups within Cisco, including the IT groups responsible for WAN, extranet access, Internet access, certain labs, and voice circuits.

As the project manager for the San Jose SONET migration, Reubelt developed a program to set expectations for the affected groups within Cisco. "We met with the various teams to explain what would happen, the timeframes, and commitments we had agreed to with the vendor," says Reubelt. "We made clear that we had to meet schedules in order to avoid penalties. We also asked them about their requirements for the cutover, such as whether it could happen during business hours."

Cutover

Each cutover required coordination between SBC and the Cisco group that owned the circuit. After Cisco personnel removed a circuit from use, an SBC technician at Cisco repatched that circuit from the legacy SONET switch to the Cisco ONS 15454 switch, while another technician onsite at the SBC central office moved the cross-connect at the same time. This procedure took five to ten minutes per circuit, during which time the circuit was unavailable. Once the circuit was repatched, the circuit owner verified proper operation before putting it back in service. "Although we incurred downtime on individual circuits, we experienced no downtime for critical services because traffic was rerouted across a redundant path," says Brumbaugh.

Each migration was scheduled during off-peak hours to minimize impact. Cisco personnel followed the company's established change-management procedures to schedule each outage and avoid generating false network-management alarms.

RESULTS

The migration began in December 2004. The largest circuits, as well as all circuits used for revenue-generating activity, were cut over by April 2005, and the remaining T1 circuits will be transitioned over during the second and third quarters of CY2005. To date, the migration has been accomplished with no critical service disruptions.

Easy Expansion to Additional Buildings

The main advantage of the migration to the Cisco ONS 15454-based infrastructure is that more buildings—26 instead of eight—enjoy the benefits of customer-provided access, including cost savings, simplified capacity planning, and reduced equipment footprint and power requirements. "As the local access requirements in additional buildings increase to the point that the upfront fee for customer-provided access becomes worthwhile, we can extend our SONET infrastructure to those buildings," says Brumbaugh. "Extending the ring won't require downtime because SONET rings are self-healing. Whether we connect a building to the campuswide ring comes down to a business decision based on circuit volume. It's no longer about whether we have the capacity or the technology."

Greater Control over Capacity Planning

"The expanded SONET footprint means we can self-manage local access capacity in more buildings, and extend the access infrastructure to unlit buildings as their capacity needs grow," says Brumbaugh. "We don't have to involve our LEC as early in the process when we order circuits because we're no longer reliant on their capacity." For example, suppose Cisco needs an OC-3 circuit between headquarters and a partner site. In the past, in an unlit building, Cisco IT might not discover that the capacity wasn't available until it placed the order, delaying the project launch while the LEC provisioned more capacity. "Now, with our own local access infrastructure, for more buildings, we need to know where we stand with capacity," says Reubelt. "Say we're going to move a lab to another building. The provisioning team can run usage and capacity reports on demand to immediately assess the capacity of the new building and determine whether we need additional capacity."

Reduced Monthly Costs

After paying a one-time fee to the service provider for a dedicated SONET infrastructure, Cisco pays 14 percent less in monthly bills than it paid for single-building connections, according to Reubelt, even though providing OC-192 access to a site is ordinarily more expensive than providing OC-48 to the same site. “We’re able to spread the cost across more buildings,” he says.

Reliability

Some of the buildings that were previously added to the ring had circuits running over copper. These circuits now run over a fully protected SONET infrastructure, which is inherently redundant and more reliable.

Reduced Footprint and Real Estate Savings

Each lit building has one or more racks of Cisco ONS 15454 switches, delivering OC-192 capacity in a much smaller footprint than the previous OC-48 switches (Figure 3). “In terms of equipment volume, it’s like going from hi-fi in the living room to a transistor radio, without losing hi-fi quality,” says Reubelt.

Real estate cost savings are considerable. New construction costs for the San Jose campus are US$150 per square foot, plus $6.65 per square foot in yearly operating costs. “A five-rack area for the legacy SONET equipment would require 160 square feet, or $24,000,” says Reubelt. “With our legacy solution, providing OC-48 access in 26 buildings for any new construction would have cost Cisco $624,000 plus an additional $27,664 in sustaining operating costs. By deploying the Cisco ONS 15454 switch, we avoided this capital expense while freeing space for expansion or for other network initiatives.”

Figure 4. Legacy Infrastructure (Background); Cisco ONS 15454 Infrastructure (Foreground)

Discovery and Disconnection of Unused Circuits

An unexpected benefit of the migration was the discovery of unused circuits. “During periods of rapid business growth at Cisco, when workgroups moved frequently, cleanup efforts such as ordering a circuit disconnect were a lower priority than expanding the business and providing excellent customer service,” says Brumbaugh. “During our premigration inventory, we discovered unused circuits ranging from 1-MB voice lines to T1 and T3 lines. Disconnecting them saved Cisco from paying unnecessary fees.”

NEXT STEPS

Having completed the migration of its large data circuits within the San Jose headquarters campus, Cisco is now in the process of migrating its T1 and Primary Rate Interface (PRI) voice circuits in San Jose as well.. To ensure that phone service won't be disrupted during the cutover, Cisco will "busy out" each circuit as it is migrated so that calls will roll over to the next available line. "We're scheduling the cutover for non-peak hours when losing the capacity from one circuit won't be noticed, so we'll experience no business impact," says Brumbaugh.

Most other Cisco locations don't have the volume to make customer-provided access more cost-effective than LEC-provided access, so additional migrations are not imminent. If that changes, Cisco IT is prepared to make the transition.

LESSONS LEARNED

Reubelt attributes the success of the migration to careful planning and coordination. "Decide which circuits to migrate and coordinate the schedule closely with the service provider," he says. "Once you've migrated one circuit successfully, regardless of the type of circuit, you can follow the same process for the remaining circuits. Have a backup procedure in case there's a problem."

Brumbaugh regards the transition as "a big non-event," which, he adds, is the ultimate compliment from IT professionals. "We experienced none of the problems that I anticipated for a project of this size. The key was good coordination, good planning, and good procedures."

FOR MORE INFORMATION

To read the entire case study or for additional Cisco IT case studies on a variety of business solutions, visit Cisco on Cisco: Inside Cisco IT www.cisco.com/go/ciscoit

NOTE

This publication describes how Cisco has benefited from the deployment of its own products. Many factors may have contributed to the results and benefits described; Cisco does not guarantee comparable results elsewhere.

CISCO PROVIDES THIS PUBLICATION AS IS WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Some jurisdictions do not allow disclaimer of express or implied warranties, therefore this disclaimer may not apply to you.

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

Europe Headquarters
Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: +31 0 800 020 0791
Fax: +31 0 20 357 1100

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at **www.cisco.com/go/offices.**