How Cisco IT Redesigned India WAN to Improve Communications and Connectivity

New WAN delivers significant cost savings, lower latency, and faster circuits.

Cisco IT Case Study / Routing and Switching / WAN Redesign in India: This case study describes Cisco IT's internal deployment of high-speed WAN links to Cisco intranet and extranet sites located in India. Customers can draw on Cisco IT's real-world experience in this area to help support similar enterprise needs.

"As India began to assume greater strategic importance to our company, it was imperative to improve quality and reliability and also reduce the latency of telecommunications between India and Cisco headquarters in San Jose, and between India and the entire Asia Pacific region. We also wanted to be sure that any solution could accommodate growing needs for bandwidth capacity and keep operations functioning through potential disasters."

– Keith Brumbaugh, Cisco IT Global Network Engineer

BACKGROUND

Cisco Systems®, like many large technology enterprise companies, has had operations in India for many years. Initially, these operations had a manufacturing and development focus. More recently, however, the focus has broadened to include branches of the Cisco® Global Technical Response Center (GTRC), which manages internal technical support; the Cisco Operations Communications Center (OCC), which manages internal incident response; and several call centers.

As recently as 1999, 12 E1 (2 Mbps) circuits and one D3 (45 Mbpsl) circuit connected Cisco headquarters in San Jose, California with various sites in India, which is part of the Cisco Asia Pacific region. Although traffic was light, connections were often overwhelmed. Performance was poor, and service outages were frequent. One circuit was usually down; on occasion, all circuits would fail at the same time, isolating India from the rest of Cisco.

CHALLENGE

Underlying the need to improve the links between India and the U.S. and between India and the rest of Asia Pacific operations were several important business drivers:

- As Cisco conducts an increasing number of business-related functions in India, operations there more closely resemble Cisco's normal production environment Essentially, communications links between Cisco India and Cisco headquarters needed to be upgraded in order to be congruent with the business and technical mission in India.
- Given the changing mix of business, development, and manufacturing functions performed throughout Cisco's Asia Pacific region, communications between India and Singapore and India and Hong Kong, in particular, needed improvement.

- Demand for bandwidth has increased and is anticipated to grow significantly in the coming years. As India continues to assume more IT, technical, and operations support duties, emerging needs for bandwidth to support sophisticated voice, video, and desktop conferencing applications must be met.

Adding to the complexity of responding to these scenarios was the Indian telecommunications infrastructure. As of the late 1990s, India had little copper or fiber in-ground wiring and tended to rely on microwave transmission towers, not always a satisfactory solution. In addition, the Indian telecommunications industry—monopolistic and limited by government regulation—could not provide the pricing, quality, or customer service Cisco was accustomed to in other countries.

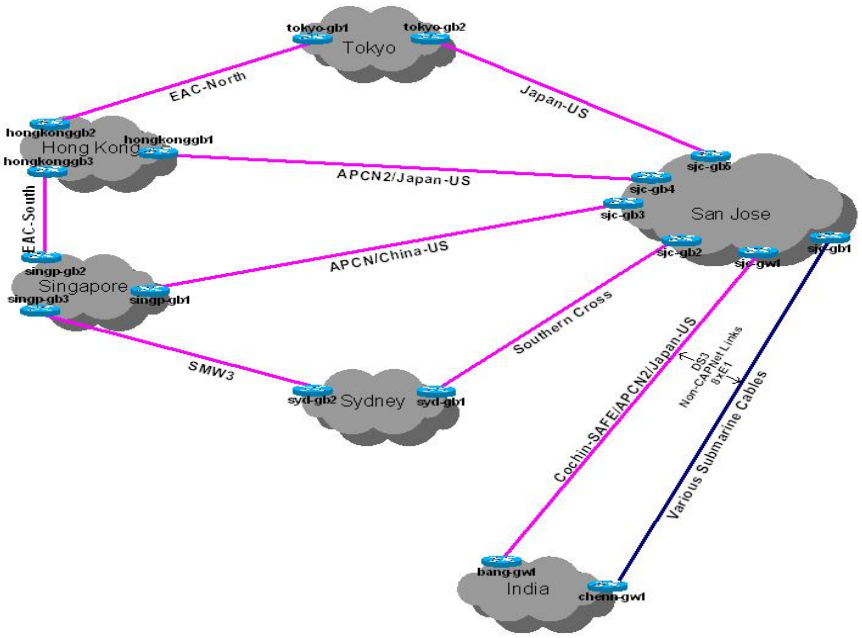
"Fortunately, the regulatory structure in India has improved significantly over the past few years," says Keith Brumbaugh, Cisco IT Global Engineer. "Competition is greater, and we're seeing increased flexibility. Still, telecommunications costs are high, compared to the rest of the region. We probably pay about a quarter in Japan of what we pay in India. On the other hand, just a few years ago, we were paying 10 times what we pay now."

The Connectivity Situation

At the time that Cisco IT began to address India's WAN connectivity, India connected to headquarters in San Jose only, primarily because it was much less expensive to provision circuits between those two locations than between India and other Asia Pacific locations. That and the fact that most of India's WAN activity was development traffic between San Jose and Bangalore, Chennai, and other India locations determined the configuration.

The Cisco IT redesign team quickly realized that high latency between India and other sites in the Asia Pacific region was literally "built in" to the design (Figure 1). All communications between India and other sites in the Asia Pacific region had to pass through San Jose, crossing the Pacific Ocean not once, but twice. Latency was not a problem initially, because there was very little direct communications between India and other Asia Pacific sites. However, as the nature of business in the region evolved, high latency had become a real handicap

Figure 1. Cisco India WAN Connectivity Prior to Redesign



SOLUTION

The redesign team knew that a proposed WAN configuration would need to address the latency concerns between India and the rest of Asia Pacific by adding connectivity between Chennai and Singapore. This approach would also provide diverse and redundant WAN connectivity between India and the rest of Cisco. To achieve this goal without creating problems for Cisco's global WAN backbone, the Cisco All Packet Network (CAPNet), it was clearly necessary to transform India into a CAPNet site. The internal Cisco network uses Enhanced Interior Gateway Routing Protocol (EIGRP) summaries and delays to ensure deterministic routing, i.e., that traffic always flows over the path with the lowest latency. The India WAN architecture would need to use this as well.

The team also decided to add a new Digital Signal Level 3 (DS-3) circuit between Chennai and Singapore and to upgrade the existing San Jose-Singapore connection by adding a second DS-3 or an Optical Carrier 3-155 Mbps (OC-3) digital optical transmission leased line. The team's engineers believed that this configuration would not only meet near-term bandwidth needs, but that each circuit would provide reliable, fault-tolerant backup for the other.

Handling Normal Traffic Flows

Interface delay commands determined traffic flow under both normal and failure conditions—a standard CAPNet practice. Traffic to and from Bangalore and Chennai that was bound for other Asia Pacific sites would travel through Singapore. This routing would minimize in-region latency—traffic would no longer have to cross the Pacific Ocean to San Jose. Traffic to and from Bangalore bound for the U.S. and the Europe, Middle East, and Africa (EMEA) region would use the San Jose-Bangalore link.

Dealing with Circuit Failure

The team knew that any WAN redesign must be able to respond to failures on several different circuits:

San Jose-Bangalore—If this circuit failed, traffic to and from India would be routed through the Singapore-Chennai link. When traffic reached Singapore, it would be transmitted by the San Jose-Singapore link if it was bound for the U.S. or EMEA. A major concern was that this routing could overload the San Jose-Singapore link during peak hours and affect traffic between India, the U.S., and EMEA, and traffic from Singapore and connected sites.

Singapore-Chennai—If this circuit failed, all traffic to and from India would be routed through the San Jose-Bangalore link, including India traffic bound for other Asia Pacific locations. Given current traffic loads, bandwidth on this link would be sufficient even at times of peak use.

San Jose-Singapore—If this circuit failed, traffic from Singapore would be routed through Hong Kong, and all traffic bound for Bangalore and Chennai from the U.S. would use the San Jose-Bangalore link. All traffic from India to other Asia Pacific locations would continue to use the Singapore-Chennai circuit. Given current traffic loads, bandwidth on this link would be sufficient even at times of peak use.

Designing for Diversity

The redesign team was acutely aware that it needed to reduce the chance that India could be cut off by multiple circuit failures. "We decided to provision the San Jose-Bangalore STM-1 and the Singapore-Chennai STM-1 on completely diverse, that is, separate, undersea cables," says Brumbaugh. We put the San Jose-Bangalore circuit on the Cochin-SAFE/APCN2 cable that goes from Cochin to the U.S. via Malaysia and Japan, and we provisioned Singapore-Chennai on the I2I cable that connects Singapore and Chennai directly."

The team also realized any design alternatives must address the possible failure of any circuits that had

been engineered and provisioned before adding India to the CAPNet.

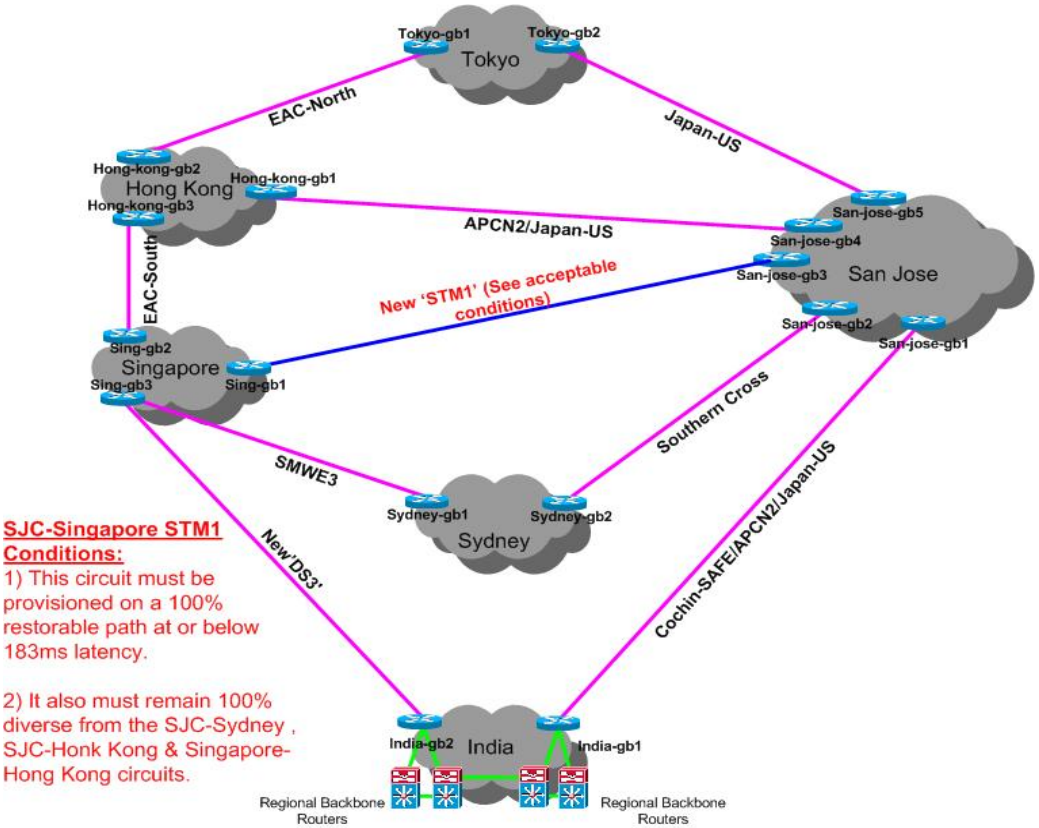
Japan-U.S. cable failure—A failure of this cable would be likely to affect Japan, Hong Kong, Bangalore, and any WAN sites connected through them. If this occurred, all traffic from Japan, Hong Kong, and India would be routed to San Jose via the San Jose-Singapore circuit.

APCN2 cable failure—A failure of this cable would probably affect Hong Kong, Bangalore, and WAN sites connected through them. If this occurred, all traffic from Hong Kong and India would be routed to San Jose via the San Jose-Singapore circuit.

Two Design Alternatives

The design team developed two alternatives it believed would provide improved latency for India within the Asia Pacific region, as well as additional WAN bandwidth needed to support India's increasingly important role. Option 1 included an upgrade of existing Bangalore-San Jose and Singapore-San Jose links, along with a new Chennai-Singapore circuit (Figure 2). Option 2 eliminated the Singapore-San Jose circuit altogether. It included a new Chennai-Singapore circuit, upgraded Bangalore-San Jose connectivity, and also required upgrades to the existing Singapore-Hong Kong and Hong Kong to San Jose circuits (Figure 3).

Figure 2. India/Asia Pacific WAN Redesign Option 1

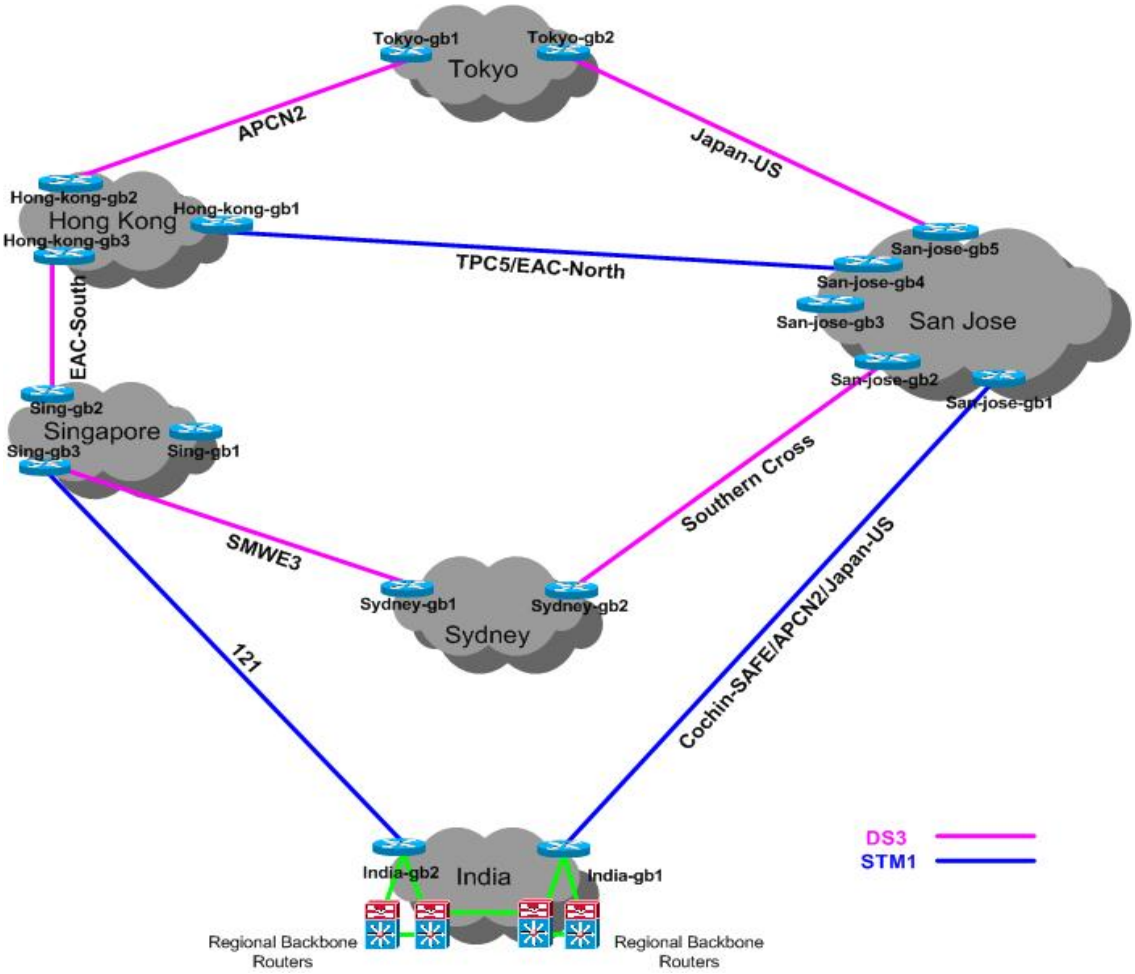


Initially, the design team preferred Option 1, because it required only a single DS-3 upgrade to OC-3. Option 1 also maintained the existing CAPNet circuit alignment within the Asia Pacific region. However, Option 1 depended on the telecommunications carrier's ability to deliver a San Jose-Singapore Circuit that met the following conditions:

- The circuit must be provisioned on a 100-percent restorable path at or below 183 ms of latency.
- The circuit must be 100-percent separate from the San Jose-Sydney, San Jose-Hong Kong, and Singapore-Hong Kong circuits.

Unlike Option 1, Option 2 eliminated the San Jose-Singapore circuit but required upgrades to two of the three CAPNet circuits in Hong Kong. Option 2 also required that cable diversity between San Jose-Japan and San Jose-Hong Kong be addressed—while maintaining the lowest possible latency for all circuits.

Figure 3. India/Asia Pacific WAN Redesign Option 2



The additional trans-Pacific circuit in Option 1 was problematic from both latency and diversity standpoints because of the lack of cable options. The team chose Option 2 because it maximized diversity configurations and provided the best possible latency for the entire region. For Singapore, Option 2 maintained the necessary diversity and did not adversely impact latency for traffic originating in or traveling through Singapore and going to the U.S.

RESULTS

The India WAN redesign has delivered immediate benefits in the form of reduced costs and more reliable connectivity between India, other locations in Asia Pacific, and San Jose. In addition, latency has dropped significantly. “If groups in Sydney and Bangalore want to do a videoconference or a conference call, the situation is vastly better,” says Keith Brumbaugh. “Overall, latency has decreased to about 150 milliseconds from half a second—and that’s true for most any location in Asia. What it means is that voice and video applications are possible now, where they were significantly limited before this redesign.”

In terms of cost, the team has estimated that cost reduction measures and disconnecting the problematic San Jose-Singapore circuit has saved Cisco approximately US$200,000 a month, or $2.4 million a year. These savings were due in large part to decreases in leased line costs in the region. In addition, the new WAN links into India are considerably more stable than circuits used in the past. Performance and reliability for the Indian circuits are on par with the best Cisco has in the Asia Pacific region.

NEXT STEPS

Over the past 5 years, India has gained in strategic significance within Cisco. Within the next 6 to 10 years, the country will begin to host a mix of business and technical functions that more closely resemble those at Cisco headquarters.

Cisco IT sees two primary IT tasks in India. First, Cisco network and circuit designers must stay ahead of ever-growing bandwidth consumption and changes in telecommunications technology. The team is considering an IP virtual private network (IP VPN) and Multiprotocol Label Switching (MPLS) in an effort to evolve the current network in the years ahead. Second, they continuously analyze ways to control costs.

Cisco is currently adding a CAPNet circuit between Bangalore and Amsterdam, which is due to be in production by May 2006. This circuit will provide a direct path between Asia Pacific and Europe, significantly reducing latency for inter-regional traffic. Latency of 500 ms will decrease to less than 300 ms for most of Asia Pacific, and less than 200 ms for India. Primary influences for the new circuit are an Oracle 11*i* order entry system between India and Amsterdam and the need to improve connectivity for real-time voice and video for developers across these regions.

“Upgrading our communications with India has been both challenging and rewarding,” says Brumbaugh. “We know there is more work to do. That’s the nature of constantly improving technology and continually increasing demand. We’re pleased that we’ve significantly improved what we started with, and we’re well-positioned to handle growth going forward.”

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