Taking Advantage of Embedded Network Bandwidth with Protection Channel Access on the Cisco ONS 15454

Maintaining profitability and reducing costs are the focus in today's challenging market environment. Cisco Systems helps customers achieve these objectives by offering the embedded bandwidth and dependable technology on the Cisco ONS 15454 SONET and SDH Multiservice Provisioning Platforms (MSPP).

Background

Market conditions in the telecommunications sector as well as many others have changed, and service providers and enterprise companies now focus on making profitability gains from incremental investments in smart technology.

Hundreds of companies have deployed the Cisco ONS 15454. These companies are benefiting greatly from the industry-leading capabilities of this revolutionary platform, which delivers scalable transport bandwidth, multiservice interface support (DS-n/E-n, OC-n/STM-n, 10/100/1000-Mbps Ethernet, and more) matched to the metro market needs, simplified engineering and operations to lower technician training costs, and a competitive initial-cost model.

The Cisco ONS 15454 is built on a dependable Synchronous Optical Network (SONET/SDH) foundation, protocols used by all telecom service providers worldwide, helping to deliver the reliability and class of service now expected from voice networks. The addition of PCA enables the service providers to better utilize their network bandwidth to improve their overall profitability.

What is Protection Channel Access (PCA)?

SONET 2-and 4-fiber Bidirectional Line Switched Rings (BLSRs) as well as SDH 2-and 4-fiber Multiplex Section Sub-Network Protection Rings (MS-SPR), provide extreme resilience by reserving "protection" bandwidth for active circuits. This "protection" bandwidth sits idle until called upon by a network event that affects the "working" service path. PCA allows the "idle" protection bandwidth to be used for carrying traffic. (It does not provide physical-layer protection on the protection bandwidth.) PCA is a well-understood technology, and its implementation is documented by Telcordia in GR-1230-CORE, section 3.4 Extra Traffic (http://www.telcordia.com) and by the International Telecommunications Union in ITU G.841 (http://www.itu.org). Users can be confident in deploying the robust PCA technology.

A Mix of Protocols Is Key

SONET/SDH are the technology of choice for service providers and many large enterprise networks. However, large-scale deployments of PCA have been greatly limited by the need to understand how to best take advantage of the technology. The key to delivering additional revenue and reducing costs from deployed BLSR SONET or MS-SPR SDH bandwidth is understanding how to design a PCA network using both PCA and protected circuits along with higher-layer protocols (such as IP, Ethernet, MPLS fast-rerouting, Gigabit EtherChannel® (802.3ad), Spatial Reuse Protocol (SRP), Resilient Packet Ring (RPR)/Dynamic Packet Transport (DPT), fast Spanning Tree, and QoS). This technology coupling allows service providers and enterprises to meet application requirements for network availability, downtime, bandwidth, and cost. Depending upon the applications and network topology, implementing IP-PCA can potentially increase revenue up to 75 percent from a deployed service provider transport network. Enterprise customers can see network cost reductions of 30 to 50 percent through improved bandwidth utilization. These increased revenues and reduced costs require negligible capital investment, yielding significant financial benefit to both service providers and enterprise customers. Additionally, service providers gain a competitive advantage by using IP-PCA to offer reduced tariff packages to existing customers, and available bandwidth to potential new customers.

Applications for PCA

Some applications of PCA technology include:

- Service provider networks
  - Creation of an economical tariff selling unprotected circuits on the PCA bandwidth for customer applications that are not time-sensitive (such as database backups and supplementary Internet access bandwidth)
  - Creation of an intermediate tariff selling hybrid PCA and protected ring bandwidth solution to support multiple applications, taking advantage of higher-layer protocols for service availability and prioritization
  - Using PCA bandwidth for internal traffic needs, either unprotected or combined with higher-level protocols
- Enterprise networking
- Using PCA bandwidth to support multiple applications over a campus network, including low-priority Internet use (Web surfing), supplementary bandwidth to increase network performance (downloads), and support for large bandwidth user requirements for applications that are not time-sensitive (long-term projects).

Technologies to Use with PCA

PCA can be used in conjunction with the EtherChannel protocol as an implementation option. The EtherChannel protocol (802.1ad) allows the creation of a larger bandwidth interconnection using two or more individual interfaces. For example, Gigabit EtherChannel enables up to 8 Gigabit Ethernet interfaces to be coupled together to act as a logical 8 Gbps interface. The 802.1ad protocol provides network resiliency support by rebalancing data traffic across all interfaces in the event that an individual interface is rendered inoperable.

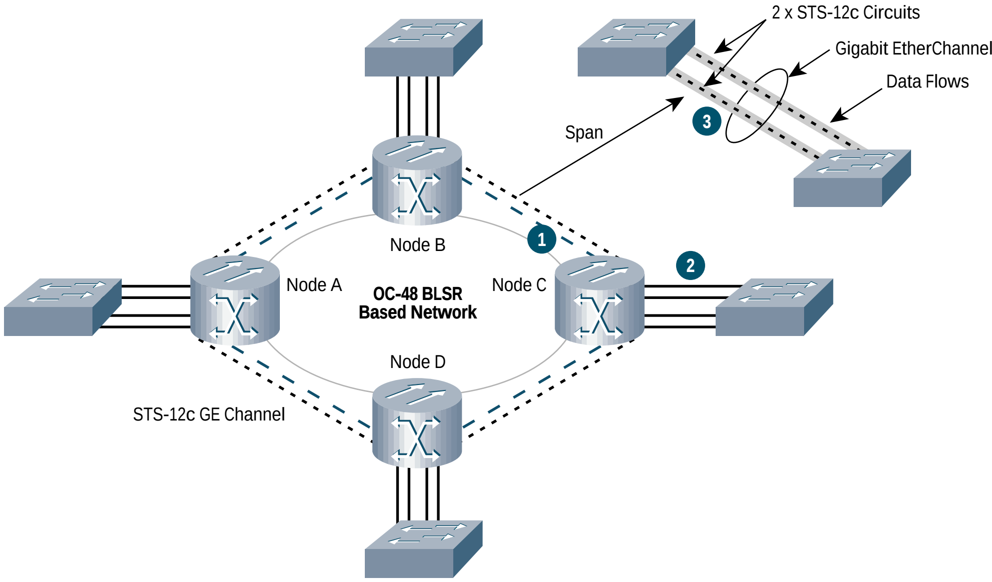
Figures 1 and 2 depict the interaction of the SONET 2F-BLSR with the Gigabit EtherChannel protocol. By using protected and PCA bandwidth on the 2F-BLSR networks along with Gigabit EtherChannel and Ethernet 802.1p priority tags, the network supports a wide range of customer applications with a solution that can provide:

- High bandwidth through the EtherChannel protocol
- High availability for mission-critical data by using the protected SONET bandwidth, EtherChannel fail over, and the Ethernet 802.1p priority mechanism
- Lower networking costs through use of the "unused" protection channels offered by PCA

This is just one example of how protocols can be combined to better take advantage of the capabilities of an installed 2F-BLSR network. Implementation of PCA technology in a SDH environment is analogous over 2 and 4-fiber MS-SPR networks.

Figure 1

Using PCA with Gigabit EtherChannel (Normal State)

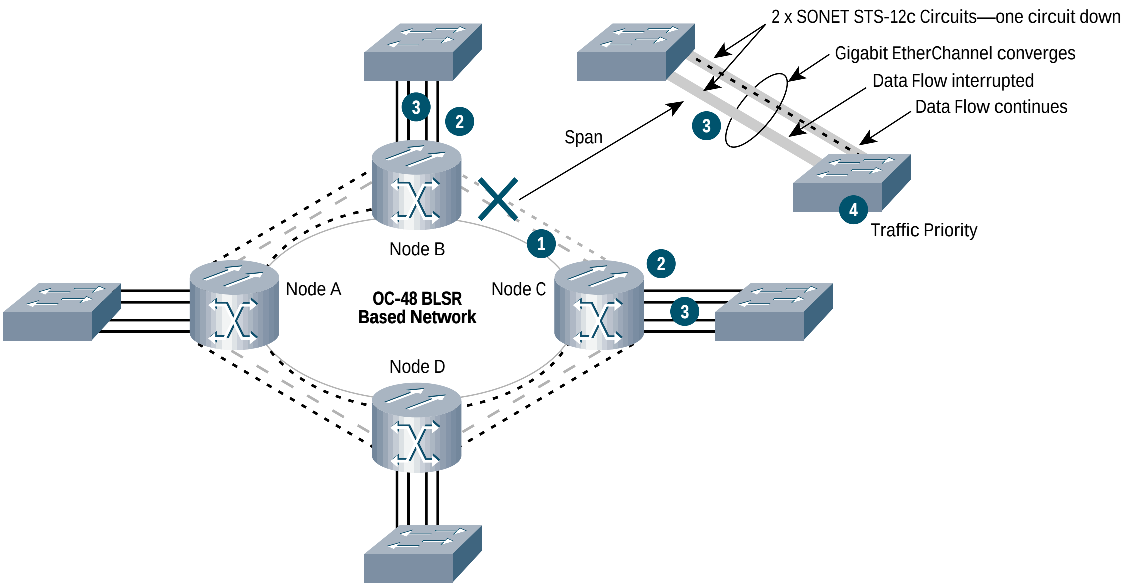


Protected Circuit
PCA Circuit
GE Link

- Two circuits are set-up on each span with one protected and one PCA circuit.
- Client interface is through two GE ports on two separate G1000-4 cards.
- Client switch is running Gigabit EtherChannel (link aggregation).

Figure 2

Leveraging PCA with Gigabit EtherChannel (Protection State)



Protected Circuit
PCA Circuit
GE Link

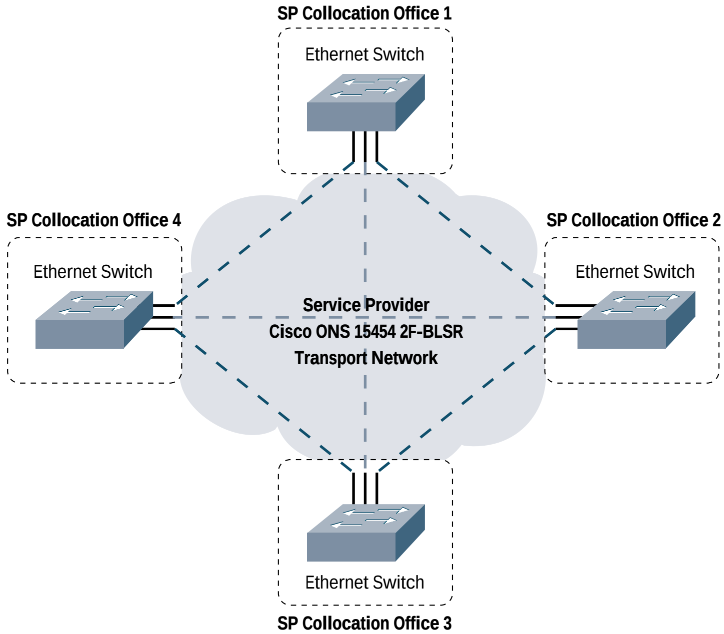
- Upon working traffic outage, the PCA circuit is interrupted.
- When the PCA circuit on the ONS 15454 GE circuit is interrupted, the GE lasers on the end-points are shut off until the circuit is restored.
- If a carrier loss is received on an ONS 15454 GE port, the system notifies far end to shut down far-end GE lasers.
- The L2 device identifies a down link, redirecting Ethernet traffic to the remaining active GE link(s) using link aggregation and 802.1P protocols (until GE circuits are restored).

Sample Service Provider Business Case

Utilizing the PCA bandwidth of a BLSR or MS-SPR network enables the service provider to sell bandwidth that, in effect, has a zero-cost base. Once installed, the network is assumed to have a fixed cost. Thus, the addition of PCA bandwidth adds incremental revenue (new circuits can be sold) for little incremental cost (of upgrading to a new software load).

Figure 3 shows a service provider network with the Cisco ONS 15454 installed, using two fiber BLSRs at an OC-48 optical line rate. The service provider's customer is looking to mesh a four-switch network over the service provider's network.

Figure 3
Example Network



The interface between the customer switches and the service provider's Cisco ONS 15454 transport network are via Gigabit Ethernet interfaces. The service provider bandwidth charges (tariff) per month are outlined in Table 1. Additionally, the assumed price of an OC-48 based, two-fiber BLSR Cisco ONS 15454 with the appropriate Gigabit Ethernet interfaces is $96,000.

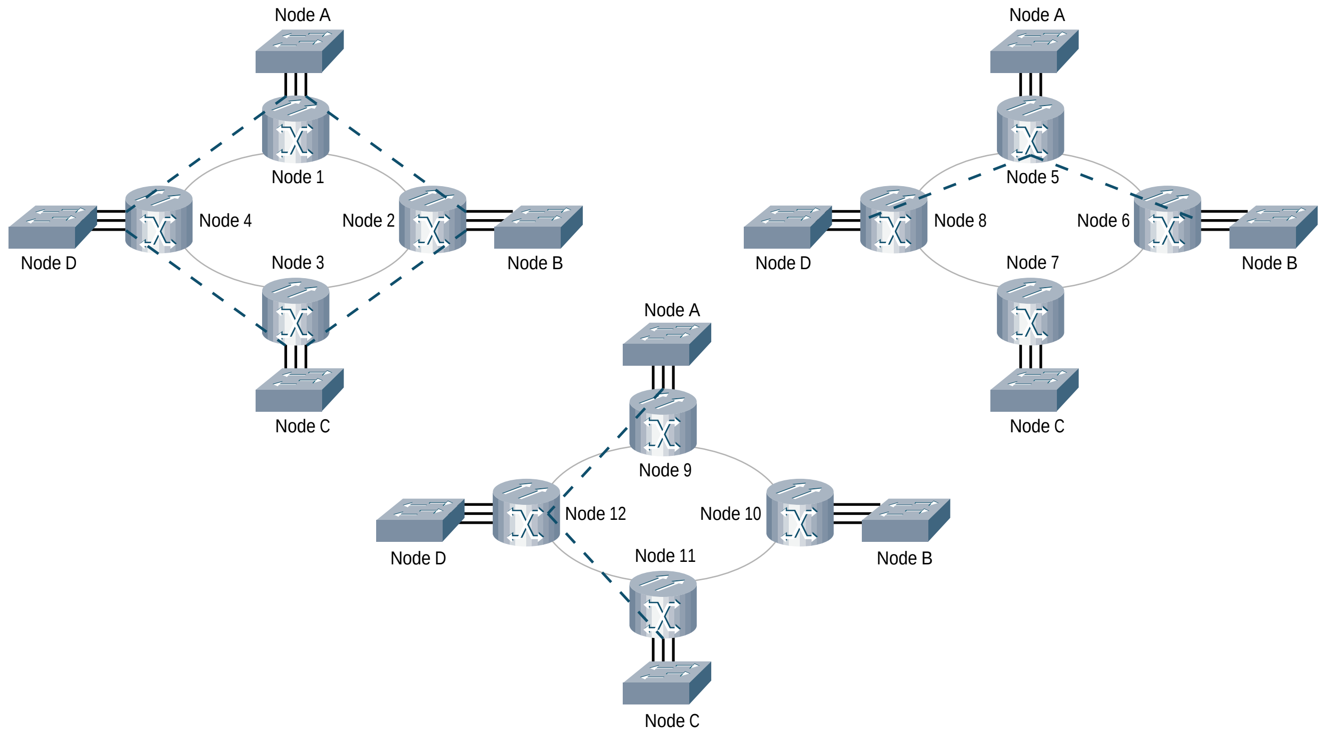
Table 1 Service Provider Circuit Pricing (Tariff) per Month

	STS-24	STS-12
Protected Bandwidth	$7,500	$3,750
PCA Bandwidth	$3,750	$1,875

Protected-Bandwidth-Only Network Example (no PCA)

With the above networking assumptions, if the customer requests to mesh their switch network using fully protected, Gigabit Ethernet bandwidth, which requires an STS-24 circuit, the total circuit price the service provider would charge is $45,000 per month (6 x $7500/STS-24 protected bandwidth circuit). To meet the customer's request, the service provider would require an OC-48 network consisting of three rings of four nodes with a total cost of $1,104,000 (12 nodes x $96,000/node), as depicted in Figure 4.

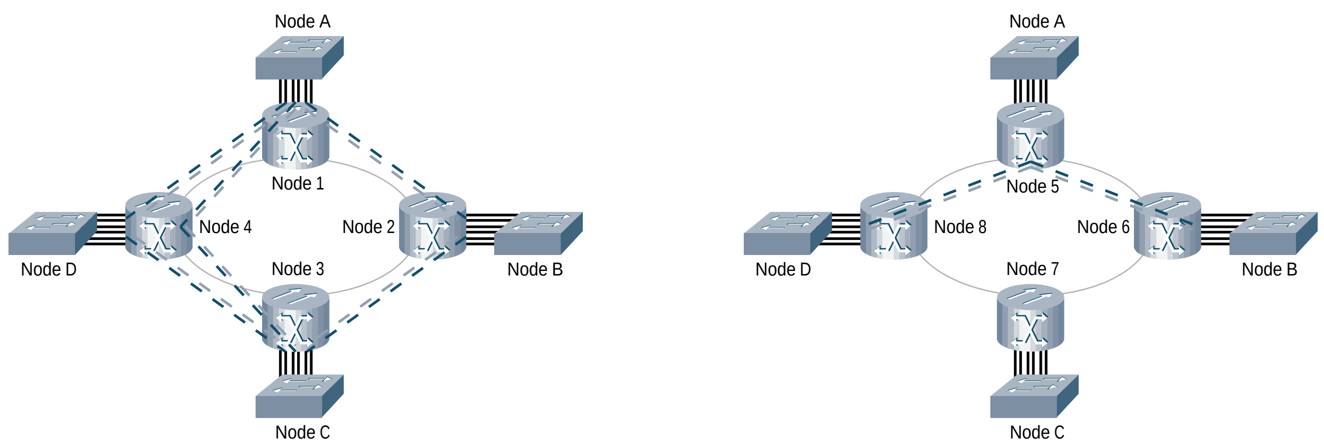
Figure 4
Service Provider Network without PCA



PCA-with-Protected-Bandwidth Network Example

This example uses the above network assumptions, with an additional customer request to mesh a switch network using a combination of fully protected bandwidth and PCA bandwidth utilizing rate-limited 600 Mbps Gigabit Ethernet circuits. With each circuit requiring an STS-12 bandwidth, the total circuit price the service provider would charge is $33,750 per month (6 x $37,500/ STS-12 protected bandwidth circuit + 6 x $1875/STS-12 PCA bandwidth circuit). To service this request, the service provider would require an OC-48 network consisting of two rings of four nodes with a total cost of $736,000 (8 nodes x $96,000/node), as depicted in Figure 5.

Figure 5
Service Provider Network with PCA



Network Example Comparison

Table 2 compares the above scenarios, showing the advantages of using PCA bandwidth for both the service provider and the service provider's customer.

Table 2 Network Comparisons

	Network with PCA	Network without PCA
Circuit Revenue	$33,750	$45,000
Quantity of 2F-BLSR Rings	2	3
Quantity of Nodes	8	12
NSP Network Cost ($45,000 per node)	$736,000	$1,104,000
Value of Remaining Network Bandwidth • Protected • PCA	$45,000 • 2xSTS-24 @ $7,500 ea • 2xSTS-12 @ $3,750 ea • 4xSTS-24 @ $3,750 ea • 4xSTS-12 @ $1,875 ea	$30,000 • 4xSTS-24 @ $7,500 ea • 0xSTS-12 @ $3,750 ea • 0xSTS-24 @ $3,750 ea • 0xSTS-12 @ $1,875 ea
Network Breakeven Point (months) = Network Cost Circuit Revenue	22	25

Table 2 shows how the service provider's customer can enjoy a 25 percent reduction in their monthly networking bill. The service provider reduces their capital expenditures by 33 percent, while expediting their ROI by three months, from 25 to 22. An additional benefit to the service provider is the increased value of the remaining network bandwidth. The ability to sell another 100 percent of the BLSR network opened up by PCA deployment, even at reduced circuit prices, significantly improves ROI and increases capacity for additional customer traffic.

Other benefits to using the PCA function include:

Service Provider Benefits

- Frees up bandwidth for additional revenue-generating services
- Competitive service offering that encourages customer loyalty
- Lower-cost bandwidth for higher profit margins
- Limited incremental PCA upgrade cost
  - One-time software license cost (remote upgrades supported)
  - Additional client service interfaces
  - No hardware upgrades or service interruption required
- Positioning of customer for future bandwidth upgrade (from STS-12c per interface to STS-24c)

Customer Benefits

- Ability to lower month costs for telecom related services
  - Customer in above example realizes ongoing $11,250 per period savings
- Affordable implementation of new, higher-bandwidth applications
  - Allows customer to be more efficient in their business practices

PCA used with higher-layer protocols opens up new revenue-generating service tariffs and improves overall profit margins.

Conclusion

Cisco provides the tools and products to deploy a cost-effective, multiprotocol networking solution, allowing greater network profitability and cost savings. Taking advantage of the powerful capabilities of the Cisco ONS 15454 SONET and SDH platforms enables a service provider or enterprise to build a robust, highly scalable, cost-effective networking solution. Upgrading a Cisco ONS 15454 network element to support PCA can be accomplished remotely and while in service, saving the cost of deploying technicians to remote facilities. Additionally, the Cisco ONS 15454 BLSR or MS-SPR networks deployed today, whether OC-12/STM-4, OC-48/STM-16 or OC-192/STM-64-based, are positioned to take advantage of PCA benefits.

CISCO SYSTEMS

Corporate 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: 408 526-4100

European Headquarters
Cisco Systems Europe
11 Rue Camille Desmoulins
92782 Issy-les-Moulineaux
Cedex 9
France
www-europe.cisco.com
Tel: 33 1 58 04 60 00
Fax: 33 1 58 04 61 00

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
Capital Tower
168 Robinson Road
#22-01 to #29-01
Singapore 068912
www.cisco.com
Tel: +65 317 7777
Fax: +65 317 7799

Cisco Systems has more than 200 offices in the following countries and regions. Addresses, phone numbers, and fax numbers are listed on the

Cisco Web site at www.cisco.com/go/offices

Argentina • Australia • Austria • Belgium • Brazil • Bulgaria • Canada • Chile • China PRC • Colombia • Costa Rica • Croatia
Czech Republic • Denmark • Dubai, UAE • Finland • France • Germany • Greece • Hong Kong SAR • Hungary • India • Indonesia • Ireland
Israel • Italy • Japan • Korea • Luxembourg • Malaysia • Mexico • The Netherlands • New Zealand • Norway • Peru • Philippines • Poland
Portugal • Puerto Rico • Romania • Russia • Saudi Arabia • Scotland • Singapore • Slovakia • Slovenia • South Africa • Spain • Sweden
Switzerland • Taiwan • Thailand • Turkey • Ukraine • United Kingdom • United States • Venezuela • Vietnam • Zimbabwe

MH/CI/0902