Cisco ONS 15454 Optical Transport Platform

Restoration Flexibility with the Addition of Four-Fiber BLSR

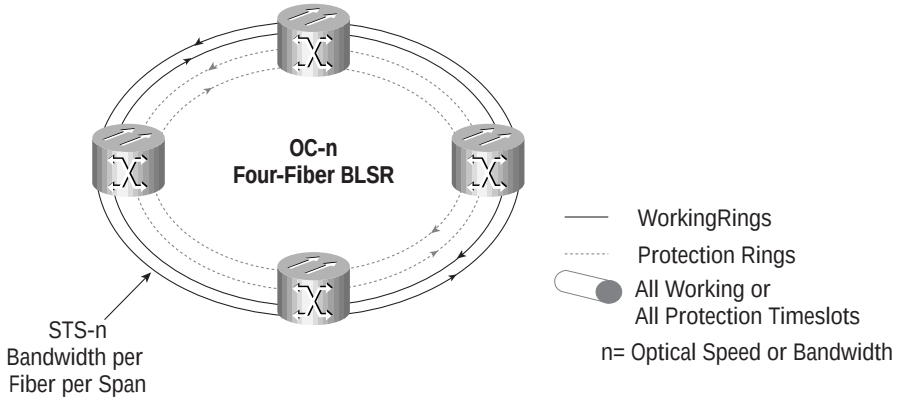
Background

The Cisco ONS 15454 optical transport platform has gained tremendous success in the market. The combination of supercharged SONET, integrated optical networking, unprecedented multiservice interfaces, and its radical economics enables service providers to deploy a single, multiuse platform to transport their time-division multiplexing (TDM) based private-line services on the same fiber as the growing requirements for data services. In addition, the platform's flexibility to support any networking type whether ring, linear point to point, linear ADM, or mesh and also now any protection mechanism including four-fiber BLSR, two-fiber BLSR and UPSR, 1+1 APS (uni- or bidirectional), or path protected mesh networking (PPMN). The Cisco ONS 15454 eliminates the need to deploy multiple equipment types throughout the service provider network. This flexible platform architecture simplifies all aspects of a service provider's business, including system engineering, purchasing, warehousing, training, and sparing, helping to lower the overall long-term costs of deploying the transport network.

Application Description

Large interexchange and some metro service providers leverage four fiber BLSR technology (Telcordia GR-1230-CORE) for their interoffice facility networks. BLSR networks, with their inherent ability to efficiently support distributed traffic patterns, plus the extended restoration that four fiber BLSR provides, proves ideal for IOF networks carrying large amounts of mission-critical traffic. Four-fiber BLSR networks, although requiring double the fiber of a two-fiber BLSR restoration scheme, service providers gain twice the bandwidth capacity per span with a significant increase in reliability through the support of both span switching and ring switching upon a nodal failure. Figure 1 shows a high-level view of a four-fiber BLSR configuration.

Figure 1 Four Fiber BLSR Architecture

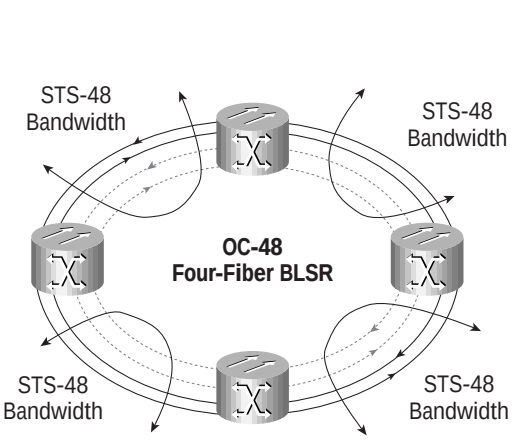


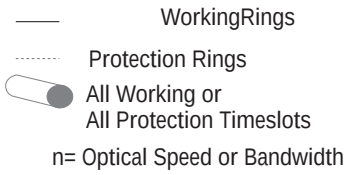
Networks deployed using four-fiber BLSR technology utilize four fibers between adjacent network elements. Two of the four fibers are dedicated to working traffic, with the traffic traveling in opposite directions, while the remaining two fibers are for protection bandwidth, again with the traffic traveling in opposite directions. Each fiber transports either all working traffic or all protection traffic, as opposed to a two-fiber BLSR network, whereby each fiber dedicates one half its bandwidth for working traffic and the other half for protection. As previously mentioned, BLSR restoration is the preferred protection mechanism for interoffice facility networks due to its ability to reuse bandwidth on each fiber span. This enables efficient bandwidth utilization in networks displaying distributed traffic patterns. To achieve this bandwidth reuse capability, the BLSR restoration reserves half the bandwidth of each span for circuit protection. This protection bandwidth is available to transport any traffic requiring span bandwidth, resulting from a failure in the network. This protection bandwidth could be considered "shared" among all the circuits. In the four-fiber BLSR network, as seen in the OC-48 example in Figure 2, each fiber span supports STS-48 of bandwidth. Thus, the total network bandwidth can be calculated using the following formula:

Four-fiber network bandwidth = Ring speed x number of spans - Total STS Pass-Through node traffic

Thus, in a perfect OC-48 network where all traffic originates and terminates on adjacent nodes, the total ring bandwidth would be 192 STS1s.

Figure 2 Example: OC-48 Four Fiber BLSR Maximum Bandwidth





Total bandwidth of a Four-Fiber BLSR ring equals:

- Ring speed x Number of Spans = Total STS Pass-Through Node Traffic
- Four-Fiber BLSR ring bandwidth greater than Two-Fiber BLSR and UPSR ring bandwidths
- Best for meshed traffice patterns
- Allows reuse of timeslots on the ring
- STS-192 maximum ring capacity for above example - (46 x 4 - 0=STS1s)

This bandwidth capability is in stark contrast to a UPSR based OC-48 network, where the total ring capacity is equal to the ring speed (48 STS1s). The reason for this lies in the fact that for each circuit created, the UPSR restoration mechanism creates two copies of the circuit, routing one copy on each of the counter rotating fibers. These two copies consume bandwidth on each fiber span, around the entire ring.

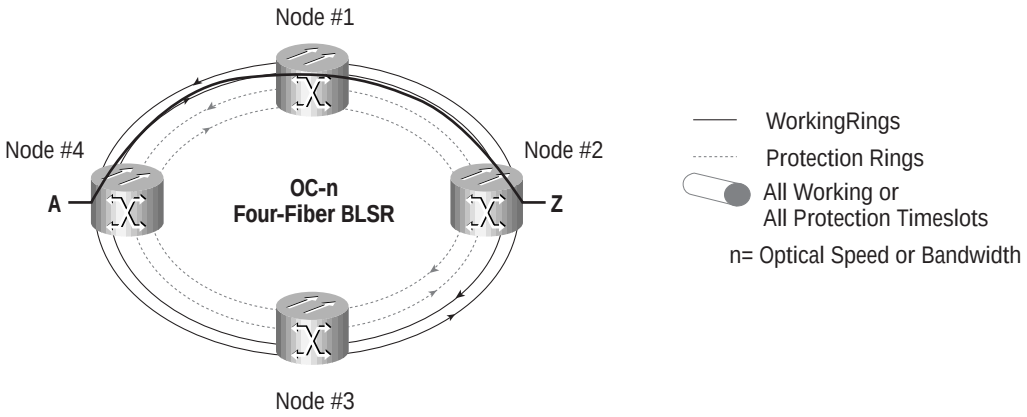
The second benefit of the four-fiber BLSR network is its extreme reliability. In addition to ring switching found on two-fiber BLSR networks, the four-fiber BLSR protection mechanism provides span switching. In addition to providing a second level of resiliency, span switching allows the service provider to perform fiber maintenance and troubleshooting on a span-by-span basis, without the worry of leaving the network in an unprotected state. If a fiber is taken out of service during a maintenance window (span switch to protection fiber), the network will still be protected via the ring switching mechanism within the four-fiber BLSR restoration scheme.

To illustrate the benefits of four-fiber BLSR restoration, Figure 3 depicts a four-node Cisco ONS 15454 network leveraging four fiber BLSR restoration protocol. A circuit (A-Z) has been created between node 4 and node 2, passing through node 1.

Figure 4 displays a fiber failure on the working fiber between node 1 and node 2. As a result of the fiber failure, node 2 signals to node 1, via the K1 and K2 bytes, that it is no longer receiving signal on the working fiber. As a result, node 1 initiates a span switch, whereby the traffic is switched to the protection fiber facility between node 1 and node 2, as depicted in Figure 3, restoring circuit A-Z in less than 50 ms. When a second network failure occurs, this time on the protection fiber between node 1 and node 2, as shown in Figure 5, the four fiber protection mechanism utilizes its ring switching capability and redirects the signal to avoid the fiber spans between node 1 and node 2. Thus, node 1 redirects the signals received from node 4 back to node 4 over the protection fiber, which ultimately arrives back on node 2, restoring the circuit A-Z in under 50 ms. Thus, the network has experienced two network failures without impact to circuit A-Z for greater than 100 ms (2 x 50 ms).

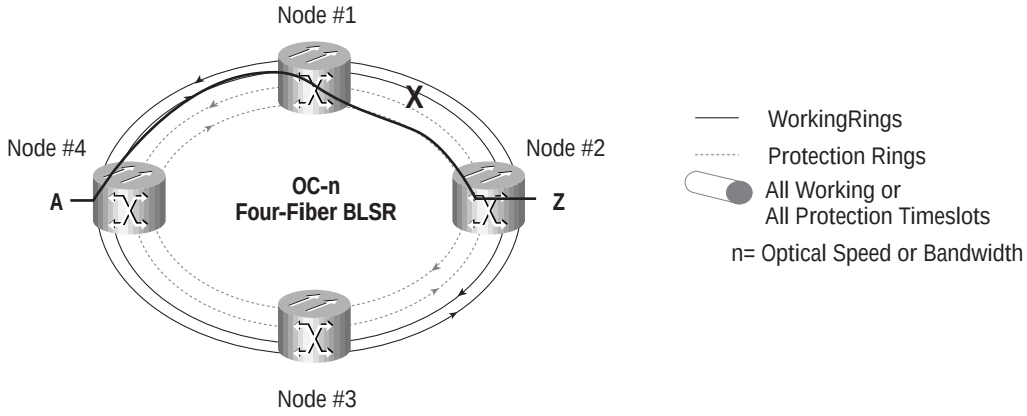
The four-fiber BLSR networks provide a true carrier-class method of transporting customer traffic. An additional benefit of a four-fiber network is its ability to transport large contiguous bands of bandwidth between adjacent network elements. As an example, if the network depicted in Figure 4 was deployed using OC-48 line interfaces, a service provider could offer customer services of up to OC-48c, possibly for use in data connections between Internet service provider (ISP) routers. These large bandwidth connections would be fully protected, providing all the line and path switching offered by the four-fiber restoration mechanism. Additionally, due to the ability to reuse span bandwidth, the service provider's network would still have bandwidth available to carry other customer traffic.

Figure 3 Example: OC-48 Network with A to Z Circuit



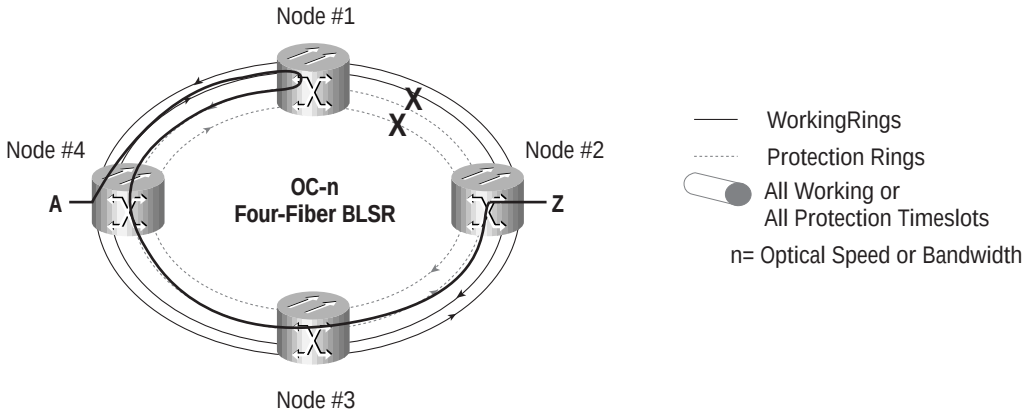
Cisco Solution

Figure 4 Example: OC-48 Network with Fiber Failure



The Cisco ONS 15454 optical transport system will support four-fiber BLSR restoration with the delivery of Release 3.1 software. The four-fiber BLSR implementation will follow the Telcordia GR-1230-CORE specifications. Additionally, the Cisco ONS 15454 will add protection channel access (PCA) in Release 3.2. Protection channel access allows service providers to use the protection bandwidth to build unprotected preempted circuits, which could be offered at lower prices for customers looking for cost-effective bandwidth for services protected by higher layer protocols (such as TCP/IP). This bandwidth may also be used for internal service provider traffic requirements. The Cisco ONS 15454 has the flexibility to support four-fiber BLSR restoration on OC-48 or OC-192 interfaces and in networks with up to 24 nodes. Nodes deploying four-fiber BLSR will also continue to support other ring types, including up to four rings utilizing UPSR restoration. These UPSR rings could be a mixture of line rates, including OC-3, OC-12, OC-48, or OC-192, allowing service providers to aggregate traffic from subtending networks and nodes onto their four-fiber backbone ring.

Figure 5 Example: OC-48 Network with Second Fiber Failure



The Cisco Advantage

The Cisco ONS 15454 optical transport solution offers significant advantages over legacy network elements offering four-fiber BLSR technology including:

- Multiple restoration types:
  - The Cisco ONS 15454 platform supports two- or four-fiber BLSR, UPSR, linear APS, and path-protected mesh networking (PPMN). This allows service providers to deploy the platform in all areas of transport networking applications including the interoffice network, normally deployed using two of four-fiber BLSR restoration, as well as the collector or fiber to the building networks, normally leveraging UPSR restoration.
- Common line cards and chassis:
  - Optical line cards are not restoration-type dependent. Thus, sparing costs and technician confusion are significantly reduced. Also, as networks change and evolve, the user has the ability to simply redeploy optical circuit packs as necessary.
- Single software load:
  - One software load will support all the restoration types listed above. And, no need to decide at ordering time which type will needed. No software right to use licenses are required for each protection type. Once the software is purchased, all features an functionality are available to the user.
- Common chassis:
  - A common chassis supporting all optical interface speeds allows the technician to spend time deploying bandwidth and services instead of in the training room learning about multiple equipment platforms. Many equipment vendors have individual platforms by optical line speed (OC-3, OC-12, and so on) and many by restoration mechanism (UPSR, 2F BLSR), causing confusion as which to order and also as to having the right platform for the application. The Cisco ONS 15454's line rate and restoration flexibility eliminates the possibility of having the wrong platform.
- Multiservice interface selection:
  - DS1 through OC-192, Ethernet, Fast Ethernet, and Gigabit Ethernet interfaces are all supported on any network configuration. This eliminates the "missing interface" found with many vendor's bit-rate specific product offerings.

The Cisco ONS 15454 is the leader in metro optical transport market. With more than 25,000 network elements deployed across 600 customers, the Cisco ONS 15454 platform has proven itself as the "best-in-class" product for service providers looking for a competitive advantage in the telecommunications market.

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