CASE STUDY

Tellabs® Optical Solutions: Enabling Service Providers to Get More Out of IP Networks

This case study demonstrates how Tellabs Optical Solutions enable service providers and enterprises to optimize IP networks to improve performance and reduce operating costs.

Over the past decade, network cost models showed that converging traffic onto an IP-router based network created a lower cost network that was simpler to maintain than legacy SONET/SDH and WDM networks. Service providers saw an opportunity to take advantage of the promise of IP-based networks: better flexibility, shared transport and enhanced service features.

While core IP networks are proven to be more flexible and support enhanced service features, they come with higher total costs of ownership (TCO). Tellabs offers an enhancement that reduces capital expenses and operating expenses (CapEx and OpEx), improves network resiliency and service availability, enables greatly expanded network capacity and consolidates multiple service types on a single platform.

By incorporating the Tellabs® 7100 Optical Transport System (OTS), an integrated packet and optical transport platform that efficiently transports packet traffic, service providers can increase network performance while reducing network TCO.

This business case demonstrates how the Tellabs 7100 OTS, unlike some other optical transport technologies, enables further network consolidation and positions the service provider to more easily grow network capacity as needed in the future.

The IP Trend

The service provider migration to IP networks was fueled by the desire to reduce network costs and simplify operations. The goal was to collapse all services onto a single network, eliminating the need to deploy and maintain multiple parallel networks (e.g. separate TDM, ATM, Frame Relay and IP networks). In most cases, the earlier networks shared WDM and even TDM elements (ADMs and digital cross-connects) and the only parallel portions of the networks supported ATM, Frame Relay and IP.

When IP router line rate connection requirements matched the bit rates of SONET/SDH ADMs and DWDM, it was possible to connect the routers directly using WDM wavelengths, cutting out the ADMs and digital cross-connects on high-capacity IP network connections. Over time, more networks were constructed entirely of routers interconnected by fiber or WDM (over fiber), justified by studies promising significant overall network cost savings.

Underlying this trend to some degree is a lack of understanding regarding network layering. Many decision makers believed that migrating all services to IP would only require IP routers and fibers for network interconnection. In reality, a network based on IP routers still contains all of the same Open System Interconnection (OSI) network layers. An IP network (IP being Layer 3 or the "Network Layer" on the OSI model), must still have a "Data Link Layer" (OSI Layer 2) to make connections, and a "Physical Layer" (OSI Layer 1) to provide the physical connectivity over which those connections can be established.

What IP network convergence changed is where intelligence was placed and which layers addressed network functions. In the move to IP routers, little or no consideration was paid to which layer was best suited for which necessary network function.

Realities of IP Networks

Service providers now realize that the migration to IP router-based networks is not producing expected results, and is, in fact, generating unintended consequences. Mainly, IP network costs are higher than projected based on several factors:

- Increased router and port requirements — The migration of services to IP transport resulted in increased need for routers and router ports to tunnel traffic. Even for routed services, the intermediate routers in the path of a point-to-point or point-to-multi-point service simply forward traffic between the ingress and egress routers. So, the vast majority of most router ports deployed in IP networks only satisfy basic transport functions.
- Increased network capacity requirements — Many services actually require more bandwidth over IP than they did on a TDM network. For example, a Plain Old Telephone Service (POTS) that required 64kbps on a TDM network might utilize 100kbps of capacity as Voice over IP (VoIP). Sophisticated mechanisms are used to reduce the overall capacity required by services over IP, many of which work well for some services. However, private line services and services with guaranteed bandwidth requirements consume more network capacity on an IP network than they did on a TDM network.
- Increased restoration times — Services transported over IP router-based networks typically suffer from much slower restoration times following a service degradation or outage than SONET/SDH networks. This time it takes for services to restore on IP routers is also not deterministic. It is dependent on the number of services impacted by the failure. It is not uncommon for services to be down for several seconds or more when they are being protected by IP routers alone.

- Higher Latency — Due to the higher processing requirements for IP packets, IP routers increase the time required for data to traverse a network, as compared to the Ethernet or optical switching systems. This increased latency is typically small relative to the time it takes signals to propagate over long distance optical fibers, though it is still significant to many business customers.
- Decreased redundancy — IP routers, initially designed for enterprise networks, were not built to the same set of stringent redundancy requirements of TDM and WDM equipment. As larger and larger routers were built, redundancy was achieved by using parallel routers. The result is the need for additional routers that require a high number of port cards simply for router interconnection.

The Tellabs® 7100 Optical Transport System Eases the All-IP Burden

The Tellabs 7100 OTS addresses the limitations of IP networks by offloading IP traffic from routers that can be handled equally well from a functional perspective, and at a much lower cost, via Carrier Ethernet and optical facilities. Routers continue to handle Layer 3 service features. However, many services can take advantage of the lower latency, faster switch times, and more deterministic performance gained by traversing the packet optical layers of the Tellabs 7100 OTS. In addition, services that continue to rely on the IP routers perform better due to lower utilization after other traffic is offloaded to the Tellabs 7100 OTS.

Service provider traffic can be separated into different categories including private line traffic, IP business services and IP Internet traffic. Different network operators choose slightly different ways of categorizing and engineering traffic for optimal cost and performance characteristics. Not all of these traffic types require IP routing across the entire expanse of the carrier network and can benefit from the advantages of the Tellabs 7100 OTS packet optical solution.

Transitioning traffic to Tellabs packet optical transport should not require changing already defined traffic categories. Rather, it's best to determine which existing traffic types are best suited for router-based transport and which traffic types can take advantage of packet optical transport.

The transport functionality enabled to support IP router traffic over Tellabs packet optical solutions is somewhat dependent on the IP router settings employed (e.g. protection mechanisms, congestion and degradation mechanisms, and hold-off timer settings). For the most part, the Tellabs packet optical solution looks like a transparent pipe to the (higher layer) IP routers. As a result, the routers operate as though they were directly connected.

The following two examples illustrate the operational cost reduction and improved network performance using Tellabs packet optical solutions.

Global Multiservice Operator

A global multiservice operator (GMO) has subscribers across Latin America, South America, and Europe, with presence in over 20 countries. The GMO had several strategic initiatives:

- Diversify revenue and streamline architectures to compensate for declines in wireline revenues with wireless, broadband and video
- Bundle and converge services: mobile, long distance, broadband, Internet and fixed line services
- Gain market share
- Increase revenues from video and data

The GMO's major challenge is managing Internet bandwidth growth in the core and improving resiliency. Tellabs proposed a solution after comparing costs of a core based on "IP Core" versus a core based on "Optical Ethernet."

The GMO's existing core router network topology (see Figure 1) was inefficient with all traffic flowing through Layer 3 network elements (IP routers) even though best effort (Internet) traffic was basically point-to-point in nature (between the Access Switch Routers and the Internet Routers).

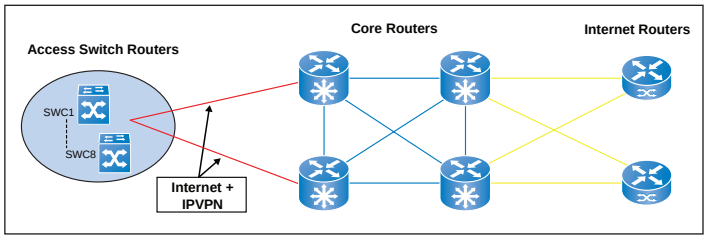

Figure 1. High-level overview of existing GMO network topology with all traffic flowing through IP routers.

Tellabs proposed an enhancement to the GMO's network topology that incorporates the Tellabs 7100 OTS (see Figure 2).

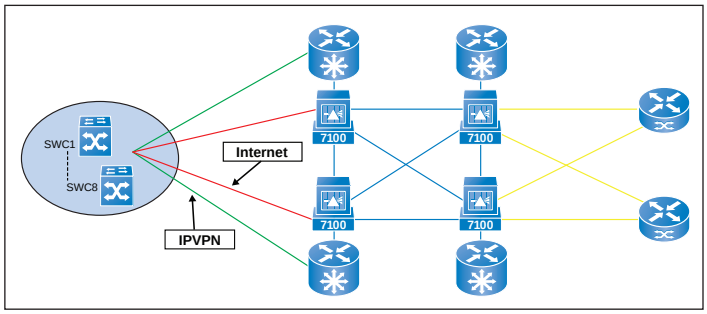

Figure 2. High-level overview of network architecture with the Tellabs 7100 OTS to increase resiliency and reduce operating costs.

* Not yet available

The Tellabs architecture benefits are two-fold: increased resiliency and reduced cost.

Resiliency is improved by providing high speed optical and Ethernet switching to restore traffic after lower layer network degradations and failures. IP VPN routed traffic is still handled by routers. Unrouted traffic is only transported on the Tellabs 7100 OTS. All traffic is protected using the Tellabs 7100 OTS transport protection options, greatly reducing the restoration time after failures as compared to transport through core routers alone.

Costs are reduced with the new architecture by offloading Internet traffic to the lower-cost Tellabs 7100 OTS, as compared to router-based transport. Because Internet traffic is transported instead of routed, the number of 10GE interfaces needed on routers is reduced, lowering overall required router capacity.

Enterprise Network

The Tellabs 7100 OTS packet optical solution is also beneficial for enterprises to reduce network costs and improve performance.

The enterprise network in this case study consisted of a fully redundant IP and MPLS router architecture, interconnected by 10Gbps links. These links were underutilized pipes that resulted in extra network costs such as high construction cost for adding new fiber links.

The enterprise's starting architecture utilizes IP routers with MPLS to manage the connections (Figure 3).

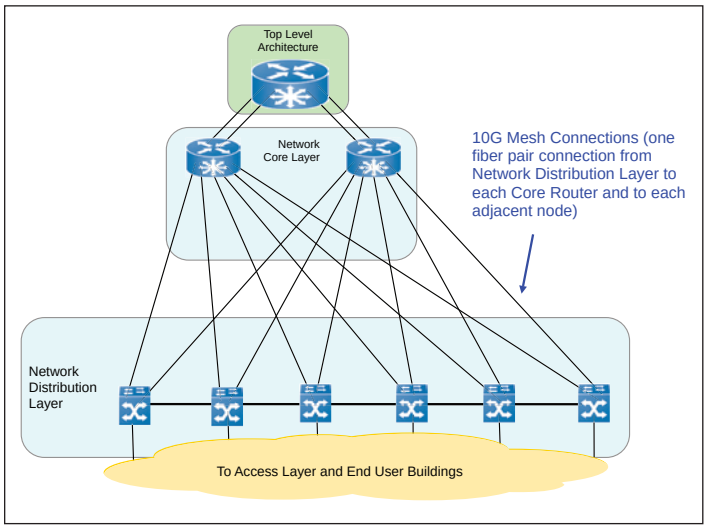

Figure 3. High-level overview of the enterprise's starting architecture with six network distribution layer locations.

Tellabs proposed a phased approach to improving the enterprise network architecture. The first phase added the Tellabs 7100 OTS for DWDM only to replace the individual links interconnecting the routers. This allows the connections to share capacity on a single pair of fibers with each connection utilizing a dedicated wavelength. Phase one provided full redundancy with a point-to-point DWDM application, but still required excess capacity (a full 10G) between each Core Router and each Network Distribution Layer (NDL) Router.

The second phase of the Tellabs rollout migrated traffic from fixed 10Gbps connections between routers to optimize connections using Ethernet in three steps (Figure 4):

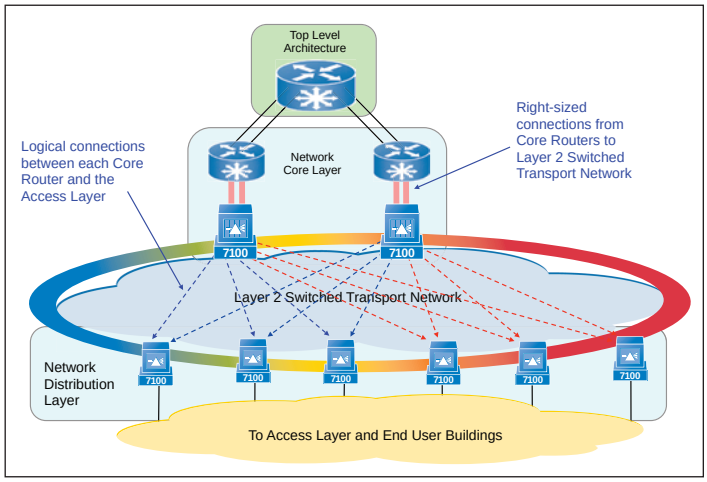

Figure 2. High-level overview of the enterprise network utilizing Tellabs 7100 OTS to more efficiently transport traffic.

1. Implement Layer 2 switching using Tellabs 7100 OTS integrated Ethernet service modules.

2. Use 10Gbps Layer 2 network to aggregate traffic and switch to appropriate destinations, enabling the enterprise to:

- Control broadcast traffic through VLANs and virtual switches
- Reduce core router ports by only paying for actual bandwidth required
- Reduce the quantity of 10Gbps transponders in DWDM equipment, particularly at the core
- Create logical mesh without costly physical fiber connections

3. Optimize the NDL locations by pulling all traffic into the Tellabs 7100 OTS for significant economic savings (eliminating the need for the NDL routers). The resulting savings include:

- CapEx: Equipment, fiber construction, software
- OpEx: Installation, maintenance, provisioning, troubleshooting, power and space

The result was an optimized network that took advantage of Tellabs integrated Ethernet and optical capabilities in the Tellabs 7100 OTS, to right-size the connection from the Core Routers all the way to the Access Layer.

Tellabs Solution Benefits

The Tellabs optical transport solution for improving IP router-based networks has many benefits:

- **CapEx Savings:** Service providers can realize immediate CapEx savings by combining Layer 2 aggregation and optical transport to reduce the number of 10GE router ports. The result is lower router capacity requirements and significantly lower overall costs. Without Layer 2 switching, each 10GE link interconnects two router ports. With Layer 2 switching, 10GE between a router and a Tellabs 7100 OTS can be utilized by the actual capacity required to one or more routers. With Layer 2 functionality, the Tellabs 7100 OTS switches traffic based on VLANs, to connect traffic to the appropriate router port. In some cases, the Tellabs 7100 OTS can eliminate the need for aggregation routers where capacities are low and/or backhaul costs are low. The combined savings of reduced ports and gained router capacity using the Tellabs packet optical solution is often more than 50%.
- **OpEx Savings:** Operational savings can also be significant. The integration of functionality into fewer network elements simplifies network maintenance and reduces space requirements. This results in lower warranty, technical support and service costs. Power consumption is also reduced for operating network elements and maintaining HVAC environments. These ongoing cost savings should not be overlooked when comparing different architectural options.
- **Integration Advantages:** Tellabs 7100 OTS integrated ADM functionality and TDM switching enables further network consolidation. Traffic not already migrated to the IP/MPLS network can be carried through the same Tellabs 7100 OTS network, further reducing the need for legacy TDM network elements.
- **Network Resiliency and Service Availability:** When lower layer network degradations and failure between routers occur, the Tellabs 7100 OTS provides high speed optical and Ethernet switching to restore traffic. The same router connectivity (fully redundant without a single point of failure) is provided for Layer 3 traffic, with reduced restoration times for outages between routers. Traffic that does not require Layer 3 functionality is also protected using the Tellabs 7100 OTS transport protection options. These greatly reduce the restoration time (down to below 50ms in some cases) after failures as compared to transport through the IP routers. The Tellabs solution provides more alternative routes for restoring traffic (using the ROADMs) beyond the simple redundancy offered by point-to-point connections, and costly dedicated router ports and capacity. This benefit results in higher service availability and fewer customer complaints, without the increased cost for the same benefit using routers.
- **Future Growth:** The Tellabs 7100 OTS provides nearly unlimited bandwidth expansion using the same platform. The service provider can immediately save CapEx upon installation. Incremental expansion costs are also minimized. The capacity on a given link can grow from 10Gbps up to 88 wavelengths of 40Gbps each — allowing for future expansion of the network.

Committed to Service Providers and Network Operators

Tellabs partners with service providers and network operators to investigate the benefits of using our packet optical solution for enhancing their IP networks. We can greatly ease your transition to a new network architecture and help you achieve the cost savings and improved network performance you desire. Tellabs offers a wide range of network assessment, installation, and management services to help improve network efficiency and service performance.

If you are interested in learning more about how the Tellabs packet optical solution can enhance your IP network, please contact your Tellabs sales representative for a more detailed presentation.

Definitions:

ADM: Add/Drop Multiplexer

ATM: Asynchronous Transfer Mode

DWDM: Dense Wave Division Multiplexing

OSI: Open Systems Interconnection

ROADM: Reconfigurable Optical Add/Drop Multiplexing

TDM: Time Division Multiplexing

WDM: Wavelength Division Multiplexing

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