Efficient Networks with OTN Switching

OTN is a mature technology for Layer 1 networks and is used today in many different networks of various types. OTN switching, however, is a relatively new capability of OTN for some network operators, even for those who are familiar with other uses of OTN. OTN switching has been deployed as the core technology by some of the largest telecommunications carriers in the world, due to its great ability to enhance the efficiency of network operation and deployment.

Optimized Network and bandwidth efficiency

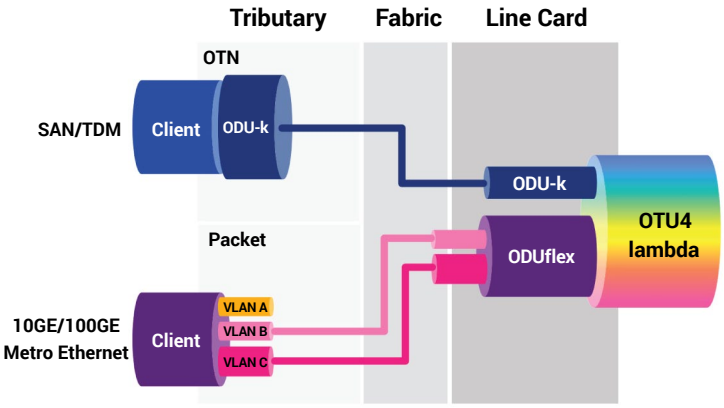
Enhanced Per-Service protection and restoration options

Future-proof SDN-based applications and service support

Greater Savings by optimized multilayer coordination

OTN Technology

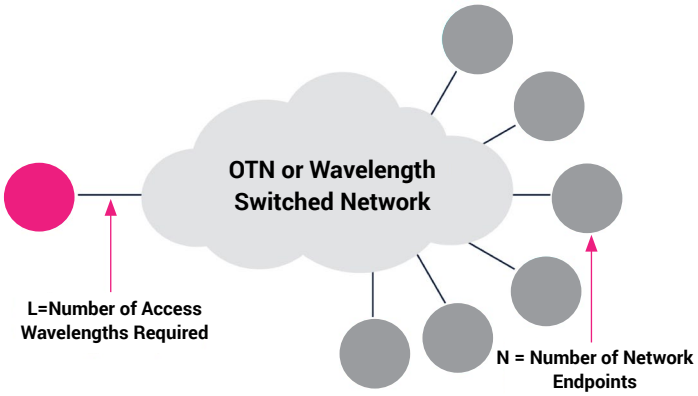
OTN was developed as an alternative to SONET/SDH that is optimized for modern data-centric networks. OTN has advanced features, making it a popular technology for network designs, including integrated forward error correction (FEC) and the ability to efficiently encapsulate and standardize a wide variety of signal types. By combing multiple signals onto a single wavelength, OTN multiplexing can be used to increase wavelength efficiency immensely. OTN switching has the ability to combine and re-combine OTN signals in a network flexibly, for improved overall network efficiency.



The most popular use of OTN is for signal extension via FEC. Even signals that do not exploit any other feature of OTN can benefit from FEC. OTN wrappers are routinely included on telecommunications equipment for this purpose. OTN multiplexing is a popular application in WDM equipment for muxponding. In muxponders, OTN is used to stack multiple lower-speed signals onto a higher-speed wavelength to improve the efficiency of the wavelength infrastructure. OTN switching is becoming more popular in larger telecommunications networks to improve overall efficiency by combining signals from multiple sources via an OTN fabric.

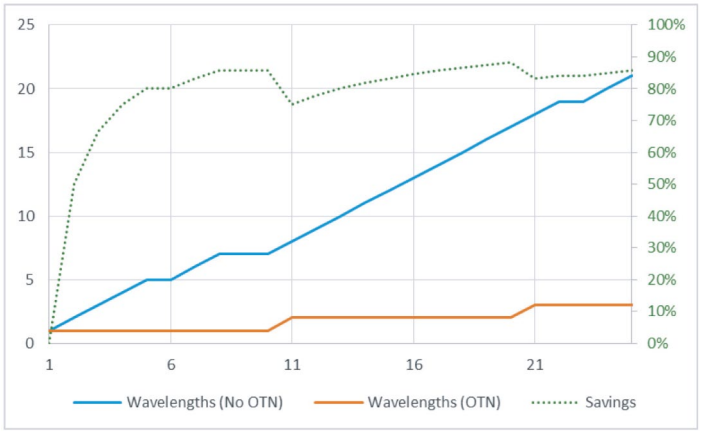
Case Study

A simple case study vividly demonstrates the efficiencies of OTN switching in the core of the network. In the case shown, services are being provisioned from an access point into the network on 100Gbps OTU4 wavelengths. The access point can be a connection to a metro network, to a large enterprise, to a data center, or to another subnetwork. For simplicity, the services being provisioned are all OTU2 10Gbps (10GbE, FC10G, etc.) services. Services are being provisioned to up to N individual endpoints in the network, and the model calculates the number of wavelengths required to the access point.



For the trivial case of a single endpoint, OTN switching does not offer any benefit. However, as the number of endpoints increases along with the distribution of services among them, the benefits of OTN switching escalate.

In the graph shown, a network with 8 endpoints is modeled (N=8). Note that for the OTN switching model (orange line), the number of wavelengths required increases only when an OTU4 is filled with ten OTU2s, resulting in a predictable step graph. For the non-OTN model (blue line), a new wavelength must be added for every endpoint when the first service is added to that endpoint - and again after 10 services have been added to that endpoint. As services are added randomly, this results in an unpredictable increase in wavelengths required at the access point. As a result, the savings in number of wavelengths (green dotted line) exceeds 50%.



As the number of endpoints increases, the potential savings also increases. In the next graph, the number of endpoints has been increased to 50 (N=50). Again, the non-OTN line (blue) rises unpredictably as services are added randomly, while the OTN switched line (orange) adds wavelengths in a regular pattern. The wavelength savings in this model exceed 80%.

Note that the savings shown for a network based on 100Gbps wavelengths with 10Gbps services also apply to a 10Gbps-based network with 1Gbps services. Therefore, the benefits of OTN switching are not limited just to very high-capacity, multiple-100G networks.

The wavelength savings would be even greater if a realistic mix of lower-rate services were added to the model, since lower-rate signals would still need a dedicated wavelength in the non-OTN model. In the OTN model, subrates as low as OTU0 (1Gbps) can be efficiently routed and re-routed via OTN switching. In a network with larger bandwidth services (e.g. 100Gbps direct services), the wavelength savings could be somewhat less in the model. However, at no point would the number of wavelengths in the non-OTN network be more than the number of wavelengths in an OTN switched network. In addition to the significant capital savings represented by the reduced number of wavelengths, there are operational savings inherent in the predictable nature of growth in the OTN switched model. New wavelengths are added in a predictable way over time, allowing a network operator to predict when and where new hardware is required.

Additional Benefits

Network efficiency is just one of the benefits offered by OTN switching. Other benefits include:

1

Enhanced Protection Offerings

Automatic Switch Optical Network (ASON) architectures can be enabled by OTN switching, allowing robust protection at the service layer of the network. In contrast with a wavelength switched optical network (WSON), ASON provides greater granularity and protection options for services on an optical network.

2

Multilayer Optimization

The integration of an OTN layer with an integrated Layer 2 (Ethernet) transport layer allows multilayer optimization schemes that result in even greater network efficiency. Optimization schemes, such as router bypass, enabled by OTN switching, provide significant CAPEX/OPEX savings.

3

SDN Integration

Transport SDN is defined to include the wavelength and OTN layers, and applications based on SDN enable new services and new operational efficiencies for optical networks. Revenue-generating services such as BandWidth on Demand (BWoD), scheduled services, and more are already being developed and deployed, based on an OTN switched architecture.

These benefits and others complement the network efficiencies described in the model above, and enable even more intelligent network designs for modern networks.

Ribbon Solutions

Ribbon's Apollo optical product line offers OTN wrapping, multiplexing, and switching capabilities from the edge of the network to the core.

- Apollo's transponders offer flexible OTN wrapping of a wide variety of client signals from Fibre Channel to Ethernet to SONET/SDH and others.
- Apollo's muxponders offer the ability to combine lower-speed signals via OTN multiplexing and line rates from 100Gbps to 400Gbps.
- Apollo's fabric-less switching modules offer the ability to build a distributed OTN switching fabric across multiple cards on a pay-as-you grow plan, which can be applied in deployments from the edge to the core.
- Apollo's 99xx series of optical platforms offer integrated OTN switch fabrics, ranging from 400Gbps to 16Tbps, for deployment from the access to the core of an OTN switched network.
- Apollo incorporates Layer 2 switching that can be used jointly with OTN switching, to fully optimize a data-centric network.

Boost Your Bottom Line

OTN switching offers significant network efficiencies for networks with a variety of lower speed signals that are carried on a high speed backbone. Even in simple models, the network infrastructure savings can be 50% to 80% or more, due to more efficient usage of high-speed wavelengths. In addition, there are operational savings, such as enhanced protection capabilities, multilayer optimization, and SDN integration that further increase the business case for integrated OTN switching.

Ribbon offers a full line of transport products that take advantage of the benefits of OTN technology in general and OTN switching in particular.

About Ribbon

Ribbon Communications (Nasdaq: RBBN) delivers communications software, IP and optical networking solutions to service providers, enterprises and critical infrastructure sectors globally. We engage deeply with our customers, helping them modernize their networks for improved competitive positioning and business outcomes in today's smart, always-on and data-hungry world. Our innovative, end-to-end solutions portfolio delivers unparalleled scale, performance, and agility, including core to edge software-centric solutions, cloud-native offers, leading-edge security and analytics tools, along with IP and optical networking solutions for 5G. We maintain a keen focus on our commitments to Environmental, Social and Governance (ESG) matters, offering an annual Sustainability Report to our stakeholders. To learn more about Ribbon visit rbbn.com.

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