SOLUTION BRIEF

Transport-as-a-Service
Using Compact OTN to Virtualize Wavelength Capacity for Layer1 Services Delivery

Introduction

The increased focus on the network edge combined with the continued migration of everything to the Cloud and the emergence of the Internet of Things (IoT) requires a new class of flexible, on-demand connectivity supported by deterministic performance, high reliability and strict service security.

Long used in core backbone networks to efficiently manage high volumes of traffic, Optical Transport Network (OTN) technology effectively uncouples usable capacity from the optical carrier channel itself and provides a mechanism for managing individual service flows that is independent from managing the raw capacity provided by wavelength division multiplexing (WDM) technology.

The new generation of compact OTN systems leverages this field proven technology using the latest advances in network processor chipsets to enable a new 'Transport-as-a-Service' model with the performance requirements that today's high capacity, high value services demand.

What is OTN?

"OTN" is an acronym for Optical Transport Networking

It is a Layer 1 transport protocol defined by the ITU G.709 and G.798 standards (among others)

Also commonly called 'digital wrapper,' OTN provides an efficient and globally accepted way to multiplex different services onto optical channels.

OTN wraps each client payload into a container without altering any client or overhead bytes

Unlike SONET or SDH, OTN preserves the client's native structure, timing information, and management information.

It allows different traffic types—including Ethernet, storage, and digital video, as well as SONET/SDH—to be carried inside a single Optical Transport Unit (OTU) frame.

Facts & Figures:

- Widely deployed for over 20 years, OTN is a field-proven technology with a long history of performance and efficiency

- The Optical Wavelength Services market is expected to grow to $7.1B by 2028, a robust 9.5% CAGR from $3.8B in 2021 (see Figure 1)

- SMEs make up over 30% of the total wavelengths services market

- Wavelength services below 10G account for more that 50% of the market demand (see Figure 1)

- On the hardware side, OTN transport equipment will be a $10B market by 2024 while OTN switching systems will represent about $6.5B

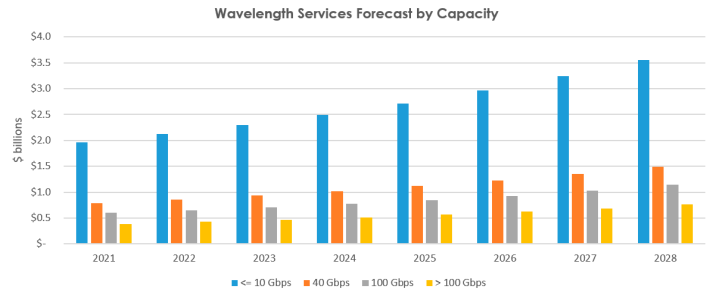- OTN hardware is outgrowing the overall optical equipment market by more than double

Figure 1 - Wavelength services forecast by capacity (Source Adroit Research)

The Challenge

As illustrated in the previous section, Optical Wavelength Services is a healthy and growing market but it remains directed primarily at high bandwidth users like wholesale service providers, large enterprises, state and federal governments and universities that are capable of fully utilizing an entire 10G, 100G or even 400G wavelength.

Smaller bandwidth users tend to be shut out of this market due to the high cost of services which start around $2,000 or more per month for a 10G service plus set up charges and per mile/per kilometer charges for extended distance links.

These potential customers want the benefits of having secure, dedicated capacity with high service availability that wavelength services bring but don't have the bandwidth requirements—or the budget—to justify paying for a full 10G service. While packet-based Layer 2 and Layer 3 services are available to serve this market, they can be difficult and labor intensive to provision, only provide shared capacity with 'best efforts' delivery and can suffer from performance issues due to congestion, latency and jitter (see Figure 2).
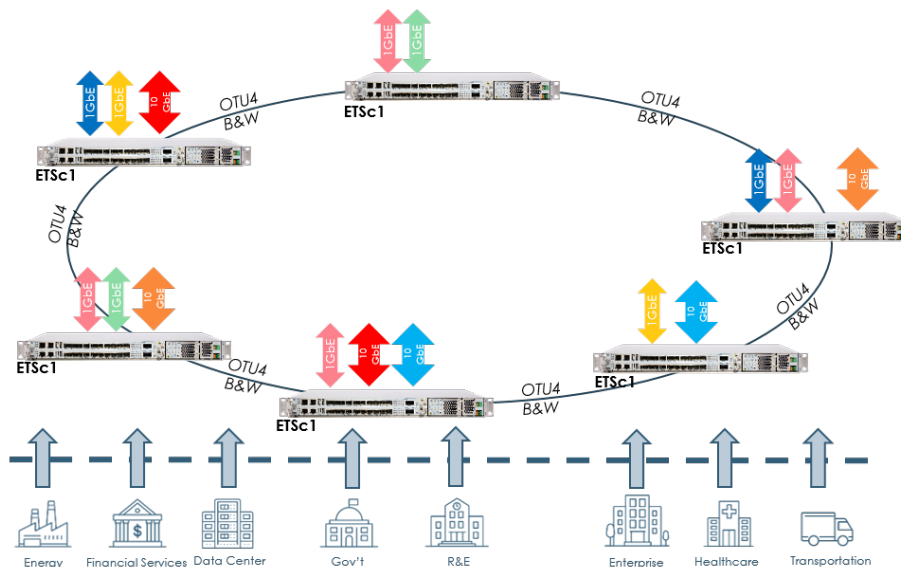

Figure 2 - Optical wavelength services delivery using compact OTN

To address this opportunity, the challenge for service providers is twofold. First they need a way to compartmentalize the total capacity of a wavelength dividing it into sub-line rate increments of varying sizes to accommodate a wide range of customer requirements. Second, they need to be able to deploy it quickly from any access node which requires the ability to configure (and reconfigure) the association between any two ports on the network without having to build new facilities each time.

Leveraging the optical layer in this manner enables a new 'Transport-as-a-Service' (TaaS) model called in which each sub-rate increment or 'slice', no matter how small or large, has its own dedicated capacity that is segregated at Layer 1 so it is not impacted by any other 'slices' on the same wavelength. What's more, each slice is capable of supporting any service protocol and provide connectivity between any two end points without sacrificing the benefits of full wavelength services (see Figure 3).
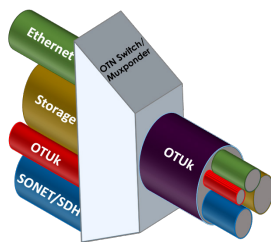

Figure 3 - Service segregation using OTN

OTN 'virtualizes' the optical capacity using a multi-tiered hierarchy that can be sized for any service rate from Gigabit Ethernet (1.25 Gbps) to 400GbE using Optical Data Unit (ODU) frames of different rates to support different services (see Figure 4).

ODU Frame	Frame Rate	Client Service
ODU0	1.244 Gbps	1GbE / 1G FC
ODU1	2.498 Gbps	STM-16 / OC-48 / 2G FC
ODU2	10.037 Gbps	STM-64 / OC-192 / 8G FC / 10G FC / 10GbE WAN
ODU2e	10.399 Gbps	10GbE LAN
ODU3	40.319 Gbps	STM-256 / OC-768 / 40GbE
ODU3e	41.785 Gbps	4 x ODU2e
ODU4	104.794 Gbps	100GbE
ODUc2	210 Gbps	200GbE
ODUc4	421 Gbps	400GbE

Figure 4 - OTN service hierarchy

To support custom service rates (e.g., 5Gbps) that fall in between the pre-defined speeds shown in Figure 4, ODUflex allows any arbitrary number of ODU0 (1.25Gbps) frames to be combined together to create an OTUk frame of any size. In this case, individual ODUo frames are associated by setting the appropriate bits in the OTUk header so they can occupy any available capacity on the wavelength—whether contiguous or not—and be managed as a single logical frame.

Whatever the size of the ODU container, it uses dedicated bandwidth along the entire path from source to destination and can be switched from optical link to optical link at any OTN node to ensure it takes the most optimal path, and also for service protection. As each service remains separate from any other service on the network, they can be switched and managed independently with their own performance monitoring, statistics and service level agreement (SLA) reporting.

With this capability, even a single wavelength is capable of supporting a menu of different services like Layer 1 private lines, optical virtual private networks (OVPNs), and even 5G backhaul.

Ekinops360 ETSc Compact OTN Switching Platform

The Ekinops360 ETSc is a new generation of compact OTN switching and transport equipment. It is based on the latest chipset technology that provides lower power consumption, heat dissipation and smaller form factor allowing more compact devices that can now be extended to the network edge.

Extending OTN to the edge is the key to enabling the TaaS model as the ODU-based partitioning remains intact all the way to the customer's door with all the required performance monitoring and management.

With three interchangeable form factors, ETSc can be deployed in a variety of locations depending on capacity requirements.

At 6Tbps in 6 rack units (RU) height, the ETSc6 is capable of supporting very high volume locations in minimal space. The ETSc2 supports up to 2Tbps capacity in 3RU for medium size aggregation sites while the ETSc1 is designed for smaller, access sites where its 1RU size provides an ideal fit (see Figure 5).
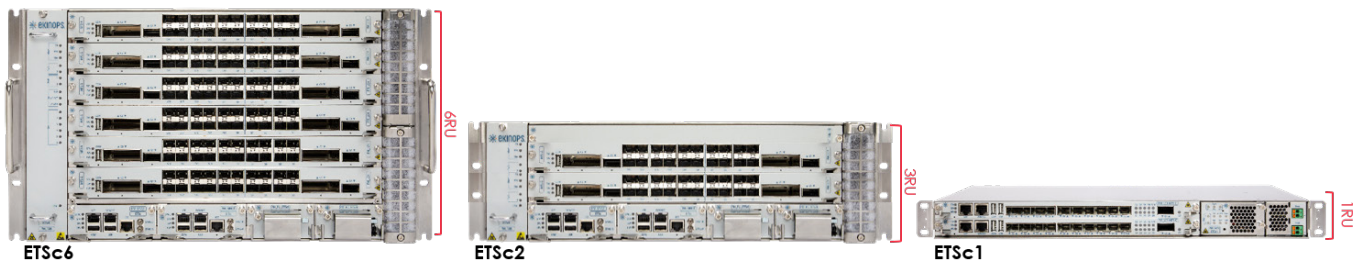
Figure 5 - Ekinops360 ETSc product family

Features

- Scalable OTN switching and coherent WDM transport capacity in a single shelf
- Configurable for pure switching, pure transport or mixed applications
- Multiple form factors for space, power and capacity optimization per site
- 500Gbps per slot, scalable to 1Tbps
- Agnostic, non-blocking, packet-ready switch fabric
- Centralized switch fabric for larger nodes and blade-based, through-backplane switching for low capacity sites

- Point-and click service provisioning
- Automatic discovery
- Common software management and feature set shared across all shelves
- Redundant management, switching, timing and power
- ASON-based control plane
- Multiple protection and restoration schemes—1+0, 1+1, 1+R, SNC/S 1+1 protection with TCM
- Low cost pluggable optics for all tributary and line ports—B&W and DWDM

Management

Part of Ekinops' Compose software suite, Celestis NMS is the gateway for managing the ETSc platform delivering service-based management tools for both the Ekinops360 OTN and WDM product lines. An easy to use graphical user interface (GUI) provides an at-a-glance status of all network elements, services and alarms with the ability to drill down to the port level on line card in any device. Point-and-click service provisioning allows a NOC operator to establish trails and services along any optical path. ODUk-level performance monitoring and service management allows traffic to be protected and restored on a per-service basis prioritized based on its SLA.

Celestis NMS has a distributed architecture in order to ensure flexibility for managing a variety of network technologies, high availability, high performance and scalability. ETSc management system applications can be installed in a single standalone server for managing small networks or in multi-server clusters to ensure high availability and scalability when managing large networks.

SDN-capable, Celestis NMS connects to the network elements via NETCONF while the Northbound interface (NBI) is based on REST/JSON and SNMP for easy integration into higher layer network controllers, orchestrators and OSS/BSS.

Conclusion

Today's new compact OTN systems based on the latest generation of chipset technology can now extend the benefits of a tried-and-true technology—flexible capacity, bandwidth efficiency, deterministic performance, security, ease of management, reliability—all the way to the very edge of the network. The small form factor and low power consumption now make it possible to migrate what has historically been a core switching function to any access or aggregation node for greater efficiency and service creation capability.

With OTN end-to-end, a new TaaS model is possible allowing service providers to expand their market for optical wavelength services to include smaller users who may not have the bandwidth requirements for a full capacity wavelength. OTN's ability to partition the capacity of a wavelength into smaller units of almost any size from 1G to 100G fills the demand gap for those customers who desire the benefits of Layer 1 connectivity but can't justify the cost.

The Ekinops360 ETSc platform is among these new generation systems driving this service-oriented evolution. Advanced OTN switching capability combined with simplified network provisioning, monitoring and management gives service providers a powerful new tool to harness the full capability of their transport networks opening them to new market opportunities.

About Ekinops

Ekinops is a leading provider of open and fully interoperable Layer 1, 2 and 3 solutions to service providers around the world. Our programmable and highly scalable solutions enable the fast, flexible and cost-effective deployment of new services for both high-speed, high-capacity optical transport networks and virtualization-enabled managed enterprise services

Our product portfolio consists of three highly complementary product and service sets: Ekinops360, OneAccess and Compose.

- Ekinops360 provides optical transport solutions for metro, regional and long-distance networks with WDM for high-capacity point-to-point, ring and optical mesh architectures, and OTN for improved bandwidth utilization and efficient multi-service aggregation.

- OneAccess offers a wide choice of physical and virtualized deployment options for Layer 2 and Layer 3 access network functions.

- Compose supports service providers in making their networks software-defined with a variety of software management tools and services, including the scalable SD-WAN Xpress.

A global organization, Ekinops (EKI) - a public company traded on the Euronext Paris exchange - operates in 4 continents.

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