Universal Network Demarcation

Enabling Ethernet and wave services with the Nokia 1830 PSD

Application note
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Introduction

Carriers, cloud service providers, and internet content providers are under tremendous pressure to scale their networks to meet the continuously increasing bandwidth demands for business-critical enterprise applications, wholesale services, data center interconnect (DCI), storage extension, high-performance computing (HPC), and the growing shift to cloud services. Enterprise customers, who until now have only had modest WAN requirements, perhaps even relying on public internet connectivity or low-bandwidth IP services, now need low-latency, guaranteed private line services. This requires new solutions that deliver the increased bandwidth to many more end nodes and customer locations having size and power constraints as well as the need for service level agreement (SLA) assurance with proper network demarcation and operational simplicity.

Photonic Service Demarcation (PSD) addresses these challenges by providing a compact, high-capacity, low-delay, and easy-to-deploy solution. It delivers important features needed in the access nodes, enabling operators and service providers to benefit by providing MEF-compliant Carrier Ethernet and wavelength services (otherwise known as wave services or MEF63 Layer 1 subscriber service) in one platform.

Market drivers

Over the past decade, both Carrier Ethernet and private line wave services have been deployed in support of business-critical applications. The following section contrasts these two types of services, showing the applications supported and the service characteristics of each.

Wave services

Wave services today are characterized by highly available point-to-point, private line offerings where end customers have dedicated full-rate bandwidth over Layer 1 WDM or OTN networks. The services are often protocol-independent and offer extremely low-latency connectivity in support of applications that are latency-sensitive. Already over 100 service providers offer wave services today with more expected now that subscribers can benefit from standardized MEF63 Layer 1 subscriber services creating a consistent set of service attributes.

Layer 1 subscriber services are defined in a similar fashion to existing E-Line service constructs as defined within the MEF. Multiprotocol Layer 1 subscriber services provide cost-effective connectivity from the customer edge across single or multiple provider networks for bandwidth-intensive applications. Multiprotocol Layer 1 subscriber services offer the familiarity and simplicity of private lines to support low-latency, multiprotocol solutions including storage area network (SAN) extension, DCI, and HPC. To support these applications,
network operators demand Layer 1 subscriber solutions that provide the following attributes on products for the network edge:

- Higher full-rate services (e.g. 1 Gb/s to 100 Gb/s)
- Service transparency (Ethernet, FC, FICON, InfiniBand, SDH/SONET, OTN)
- High availability (99.999%)
- Extremely low latency (from 1 ms to 20 ms)
- Sync transparency (IEEE 1588v2 / SyncE)
- Layer 1 encryption for secure applications

**Carrier Ethernet services**

Ethernet has been used to provide WAN services for over a decade, delivering better bandwidth scalability at a lower cost per bit than the legacy private line services it was replacing. The definition of standardized OAM functions and broad availability of equipment has accelerated deployment of Carrier Ethernet-based networks and services. With the shift to higher speed services driven by the move to cloud-based services, larger data centers, and network functions virtualization (NFV) among others, the MEF has standardized Carrier Ethernet 2.0 (CE 2.0), which is in the process of global adoption and being expanded to include 100G.

A key pillar behind CE 2.0 is standardized interfaces and operational procedures for interconnect and access. This enables network operators to interconnect with one another with assurance of performance and adherence to global standards of interconnection. Thus, in addition to the point-to-point and multipoint services previously defined by the MEF, CE 2.0 now also brings new point-to-multipoint services as well as new access services, enabling operators and service providers to offer those services as well at business locations served by Ethernet-based premises equipment. Because of the sheer number of access locations that need to be connected, the premises equipment must be optimized for cost, power consumption, and size, all of which are critically important.

Applications served by CE2.0 can include a mix of private line services, VPNs, wholesale access, as well as cloud services. To support these applications, network operators demand carrier-grade Ethernet solutions that provide the following key attributes on products operating at the network edge:

- Full-rate Ethernet services (100 Mb/s to 10 Gigabit Ethernet (10GE))
- Carrier-class OAM tools to monitor optical fiber, the link layer and service layers
- Very low latency (< 20 ms)
- Low power, compact size
- Compatibility with Synchronous Ethernet (SyncE) and IEEE 1588
- Support for Precision Time Protocol (PTP)
Figure 1 contrasts the Carrier Ethernet and Wave service characteristics.

**Figure 1. Carrier Ethernet and wave services: applications and service characteristics**

<table>
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<tbody>
<tr>
<td>Transport network</td>
<td>Carrier Ethernet Network</td>
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<tr>
<td>Availability</td>
<td>WDM /OTN network</td>
</tr>
<tr>
<td>Rates</td>
<td>99.99%</td>
</tr>
<tr>
<td>L1 encryption</td>
<td>99.999%</td>
</tr>
<tr>
<td>Latency</td>
<td>1 Gb/s to 100 Gb/s</td>
</tr>
<tr>
<td></td>
<td>&lt;20 ms</td>
</tr>
<tr>
<td></td>
<td>&lt;1 to 20 ms</td>
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The need for network demarcation

When delivering services, whether they are Ethernet or wave services, carriers must be able to maintain SLAs between themselves and their end customers that define service parameters on an end-to-end basis. This entails separating their network domain from that of their end customer through a network demarcation device, usually termed a network interface device (NID). This separation allows the carrier to test and monitor its network all the way up to the customer’s premises, allowing them to manage the network [service] and to ensure that SLA performance requirements are met.

In many networks the demarcation point is implemented as a small Ethernet switch supporting a network interface and one or more customer-facing ports. A NID often implements OAM functions to assist the operator in monitoring, troubleshooting and localizing faults. A NID allows operators to effectively isolate the customer’s network when testing and monitoring the end-to-end link, thereby eliminating diagnostic errors due to end-customer activities. In some cases, NIDs require active cooling through the use of fans to enable operation over a wide temperature range. And in most cases, these traditional NIDs only support Layer 2 Carrier Ethernet services, precluding their ability to leverage existing Layer 1 optical networks and limiting service offerings to the service attributes associated with MEF-defined Carrier Ethernet services as outlined in the previous section.
Figure 2 shows the placement of the NID at the network edge where the access network could either be a Carrier Ethernet network or a wave transport network. Since the demarcation device is always in the data path, it is important that it be able to support wire-speed rates without introducing significant delay or jitter to avoid adversely impacting network performance. It also needs to provide robust OAM capabilities—supporting intelligent loopbacks, traffic monitoring and allowing tracking of the data stream. It should also support protection when needed for business-critical applications.

**1830 Photonic Service Demarcation**

The Nokia 1830 Photonic Service Demarcation (PSD) NID provides network demarcation and optical transport for Ethernet and wave services. The 1830 PSD NID can be configured in either OTN or Ethernet mode, providing universal support for both Layer 1 subscriber and E-Line services demarcation for wholesale, business services, DCI and cloud services. It supports accelerated service activation with automated installation and commissioning capabilities afforded through a simple-to-use commissioning application.
The Nokia 1830 PSD is a low-latency, compact and versatile NID designed for customer premises. It effectively extends the reach of the optical network in support of 10G (and in the future 100G) Ethernet or wave services. It enables operators to deliver SLA assured services where space and power consumption are constraints measuring less than 20 cm in width and 1RU high. It supports optical uplinks for Ethernet (1G/10G), TDM (sub-2.5G, 2.5G), and OTN (OTU1 and OTU2/2e) client services. The product simplifies the service provider solution to provide a demarcation point for a fully managed, protected single-port service. It reduces carrier costs by eliminating the need to engineer, order, stock and spare different card types for each service type or optical rate.

The client and line ports feature pluggable optics, so the different services can be easily provisioned. It leverages the Nokia portfolio of small form-factor pluggables (SFPs) used in other 1830 products, and Smart SFPs for TDM network migration (TSoP). And it is fully SNMP-managed by the Nokia Network Functions Manager for Transport (NFM-T), enabling seamless interworking with the Nokia 1830 Photonic Service Switch (PSS) portfolio to deliver the ultimate in performance, operational simplicity and space/power savings.

Applications and key parameters

The 1830 PSD integrates key functions of an Ethernet and OTN NID with carrier-class OAM within a single platform. This enables operators to simplify their edge networks by adding flexibility into the services supported using a common platform. Due to its compact size and low power requirements, the 1830 PSD can be deployed in various network scenarios. Table 1 shows its main applications.

Table 1. Key applications of the 1830 PSD

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<th>Application</th>
<th>Key parameters</th>
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<tr>
<td>Network extension</td>
<td>Provides E2E link/service OAM and CFM tools enable service activation testing and service monitoring to uphold SLAs</td>
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<tr>
<td>Network interconnection/access</td>
<td>Enables Ethernet and wave service connectivity while assuring SLAs in support of access to infrastructure resources</td>
</tr>
<tr>
<td>Service interworking</td>
<td>Integrated E-Line and Layer 1 subscriber services provide seamless services spanning technologies</td>
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The 1830 PSD is very versatile in being able to address either Ethernet or wave services within the same platform. This section describes some of the deployment scenarios where the demarcation device can be used.

**Network extension** in support of wholesale or retail services by service provider

- Cost-effective access (Ethernet or OTN) at customer premises, extending optical network with a “remote port”
- Service extension to out-of-footprint locations

![Service extension to out-of-footprint locations](image)

**Network interconnection/access** (service provider or private build)

- Cloud services—access to HPC, storage or other infrastructure through Ethernet or OTN network
- DCI/data center access (DCA)
- Direct connect—via fiber infrastructure (NID to NID)
• **Service interworking**
  - Integrated E-Line and Layer 1 subscriber services—end-to-end service offering connecting customer endpoints served by different network technologies
  - Media conversion/legacy interworking—connecting dissimilar networks (Ethernet to OTN) or legacy networks (SONET to OTN) without having to revamp existing network
Optical interfaces

The 1830 PSD supports a flexible range of interfaces in support of Ethernet and wave services as well as OAM related ports as indicated below. Future releases will add additional capabilities including support for 100G interfaces.

- **Client interfaces**
  - Ethernet: 1GE, 10GE
  - SDH/SONET: sub-2.5G, 2.5G, 10G*1
- **ITU-T G.709 Interfaces for the optical transport network**
  - OTU1, OTU2, OTU2e
- **Black & White (grey optics), bi-directional, CWDM, DWDM colored**
- **Management and debug ports**

A second interface on both the network and client sides is available and can optionally be used for path protection.

* Note: 10G SDH/SONET is a future release feature
Link and service OAM

The 1830 PSD supports link and service OAM. Link OAM is used for installation and service activation of new access links. The 1830 PSD is installed at the customer edge of the network and service personnel can use standard measurement equipment at the network center to perform extensive link monitoring and performance testing using the 1830 PSD as an active remote loopback device during service activation. After service turn-up, the access link is continuously monitored and link level alarms and performance monitoring reports are collected and reported to the network operations center.

The IEEE 802.1ag standard and ITU-T Y.1731 recommendation offer network monitoring tools that operate end-to-end at the service (Ethernet virtual connection) layer. Service OAM can be used at multiple levels to support monitoring of the access portion of the network. The 1830 PSD can be configured to support specific maintenance levels and maintenance domains, and can support multiple levels simultaneously. A typical application is to deploy the 1830 PSD at the customer premises; the customer can then use service OAM to monitor their own connection to verify that they obtain the services agreed in the SLA with their service provider. Additionally, the WaveSuite service enablement assurance application can be used to improve service monitoring and SLA assurance for optical connectivity services.

The 1830 PSD allows access network providers to continuously monitor the throughput, availability, and frame loss parameters that are critically important for their operator customers. It also supports path delay measurement on Ethernet and OTN networks for performance monitoring.
Automatic discovery and configuration

Given the sheer number of demarcation devices located at customer premise locations across the network, there is a requirement that the devices support plug-and-play deployment capabilities including automatic discovery and configuration, fast service activation, and report creation and troubleshooting to simplify the maintenance of the network.

The 1830 PSD is supported by the WaveSuite Commissioning Expert application that makes these tasks simple and intuitive using a mobile user interface that can run on the installer’s smartphone. The application aids network owners to install and configure the 1830 PSD demarcation devices across the network.

Upon arrival at a site, the installer simply installs the NID and corresponding SFPs and fibers, powers it up, and opens the smart commissioning application using his smartphone. Each NID is matched to the commissioning work order using NID type, location or other details. Once the NID is recognized by the smartphone application, the NID details along with the NID’s location are used to identify the commissioning data used to set up the data path and management connection. The state of the end-to-end service is then checked and status indicated via the status LED on the NID as well as via the smart commissioning application on the smartphone to alert the installer that it is now ready for use.

Figure 7. Simple and intuitive installation via WaveSuite Commissioning Expert
Conclusion

The 1830 PSD is a revolutionary NID addressing both Layers 1 and 2 network demarcation at customer premise locations in support of Ethernet and wave services. Its support for standardized Layer 1 subscriber services enables highly available, low-latency services needed for today’s demanding business-critical applications. It greatly reduces network complexity at the network edge, providing operators and service providers with robust OAM capabilities as well as smart commissioning tools enabling fast turn-up. And its compact size and low power draw enable a cost-effective solution at the network edge.

For additional information about the 1830 PSD, please visit https://networks.nokia.com/products/1830-photonic-service-demarcation.

Acronyms

CE 2.0 Carrier Ethernet 2.0
CFM connectivity fault management
CO central office
CPE customer premises equipment
CSoP Channelized SDH/SONET over Packet
CWDM coarse wavelength division multiplexing
DCA data center access
DCI data center interconnect
DWDM dense wavelength division multiplexing
ETH Ethernet
FC Fibre Channel
FICON Fibre Connection
GE Gigabit Ethernet
HPC high-performance computing
IEEE Institute of Electrical and Electronics Engineers
ITU-T International Telecommunication Union – Standardization Sector
MEF Metro Ethernet Forum
NID network interface device
NFV network functions virtualization
NMS network management system
NNI network-to-network interface
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Nokia Oyj
Karaportti 3
FI-02610 Espoo, Finland
Tel. +358 (0) 10 44 88 000

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