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Seamless Deployment and Operation of Pluggable Optical Engines in Any Network Platform

Nokia Transcend Intelligent Pluggables Manager: bringing the holistic, end-to-end optical networking operational capabilities of DWDM transponders to intelligent pluggable optics in any network platform

Managing Coherent Pluggable Optics Across Multiple Host Device Types

The deployment of coherent pluggable optics in a variety of network platforms such as routers, switches, compute platforms, and even 5G radio units is gaining traction in the market and has the potential for tremendous growth. But the introduction of host-based coherent pluggable optics raises operational questions, and the lack of seamless, converged operational models for software-configurable pluggables slows down this adoption, as shown in the Omdia report, "2022 Trends to Watch: Optical Networks."

Coherent pluggable optics subsume transport features that traditionally reside in DWDM platforms, and therefore require solutions that offer the optical networking operational capabilities that operators rely on when using DWDM transponders. This includes Layer 0/1 visibility and simple, end-to-end management of the optical layer to match the procedures and operational methods established for the transport domain. However, until now, the management of pluggable modules has been handled by the host device via register-based protocols, such as CMIS/C-CMIS, the (Coherent) Common Management Interface Specification. The host device itself is managed via command line interface or a network management system or controller connected to an OSS/BSS or orchestrator, and it is responsible for translating these commands into the CMIS register-based interface. This approach has several shortcomings:

- Register-based protocols offer limited visibility of the optical transport layer and sparse management options for the pluggable devices when compared to what a transponder can provide. This becomes more of an issue as coherent pluggables grow more intelligent and provide advanced functionalities previously supported only at the transponder level, enabled by progress in DSPs and opto-electronics. Intelligent coherent pluggable optics are already capable of supporting features such as point-to-multipoint traffic aggregation at Layers 0/1, management of remote modules, advanced streaming telemetry, optical power analysis, discovery of network topology, and software-driven capacity allocation. These functions require more powerful management solutions than register-based management protocols can offer.

Benefits of Transcend Intelligent Pluggables Manager

- Increase competitiveness using advanced optical transport networking features in intelligent coherent pluggable optics:
  - Take advantage of intelligent optical modules in a pluggable form factor, which unleash functionalities previously only supported at the transponder level, with fast service turn-up and advanced troubleshooting
  - Support new cost- and power-efficient point-to-multipoint network configurations for traffic aggregation
- Streamline the operation of coherent pluggable-based optical networks:
  - Gain end-to-end optical network and service visibility across all types of host platforms
- Offer new and differentiated services with rapid introduction of innovation in the network:
  - Decouple the introduction of innovative optical transport features in pluggables from support in the host device
  - Deploy those features across multiple host types and vendors, independent of operating systems and configuration models
  - Simplify interoperability and deployment cycles
- Seamlessly integrate the optical management of host-based optics in the back office and network control architecture:
  - Expose coherent pluggable optics to higher management layers as virtual transponders for simple integration into any software environment

- When the management of a pluggable module is handled by its host device, the pluggable optic's information models are embedded in the host device. To introduce new functionality into the module, new information models need to be agreed upon and implemented by all modules and host devices, tying together their development and deployment cycles and delaying the rollout and adoption of innovative features in the pluggable optic.

- When the management of a pluggable module is handled by its host device, the module functionalities that are available to the operator are bounded by the specific support offered by that host platform. The feature set that can be consistently managed and used in a network consisting of coherent pluggables residing in a variety of host platforms is limited to the set of functions common to all hosts.

- When the management of a pluggable module is handled by its host device, the management of the optics is assumed by a Layer 2/3 controller:

  - This will break down the traditional separation between management of the Layer 0/1 domain and the Layer 2/3 domain. This separation is at the basis of many current architectural blueprints for network control and orchestration, ensuring smooth integration into existing back offices. Furthermore, many CSPs have separate organizations operating the IP and optical domains; the blurring of boundaries between these domains can significantly impact their present mode of operation.

  - Additionally, Layer 2/3 controllers have minimal understanding of optics and do not offer the support for dedicated optical workflows and functions that optical domain transport controllers do.

What is the best way to address these challenges and bring the holistic, end-to-end optical networking operational capabilities of DWDM transponders to intelligent pluggable optics?

Introducing Intelligent Pluggables Manager

Nokia Transcend Intelligent Pluggables Manager (IPM) enables the management of intelligent coherent pluggable optics as virtual transponders, regardless of the network platform they are deployed in.

IPM is a software application implementing the dual-management paradigm defined in the Open XR Optics Forum's Network Management Specification. IPM is available within Nokia's Transcend Open Optical Toolkit, a portfolio of network automation solutions addressing the specific concerns of open optical networking.

Figure 1: Nokia's Intelligent Pluggables Manager offers holistic transport management of intelligent coherent pluggable optics hosted in networking platforms such as routers, switches, compute servers, or radio units

The images shown are for illustration purposes only and may not be an exact representation of the product.

IPM supports advanced optical functionalities available in intelligent coherent pluggable optics, such as:

- Point-to-point capacity allocation at Layers 2/3, using point-to-multipoint traffic aggregation at Layers 0/1 for cost and power efficiency

- Management of remote modules via a separate out-of-band control channel

- Streaming telemetry

- Optical spectrum/power analysis

- Dynamic bandwidth allocation

- Virtualized network transponder functionality and "transport to Layers 2/3" demarcation points

IPM's architecture is designed to allow the rapid introduction of optical functionalities that are not yet available but are expected to be developed in the future within intelligent coherent pluggables, such as probabilistic constellation shaping and programmable baud rates to extend capacity-reach. IPM decouples the optical functionality from the host device, which is paramount to bringing disaggregated open optical networking to life for a wide range of application use cases. IPM offers a complementary management path that is host agnostic, providing a solution that works consistently across platform types and vendors, and that can be seamlessly upgraded and extended as pluggables evolve. With IPM, new features can be added to the optics without upgrading the host's software, facilitating and accelerating the introduction of optical innovation in the network.

IPM handles the optical transport features of the modules, offering end-to-end Layer 0/1 visibility and optical transport domain-specific support. IPM exposes the pluggable optics as disaggregated virtual transponders to existing higher management layers (hierarchical controllers, network orchestrator, or OSS/BSS), allowing consistent integration into the existing software environment via API. Layers 2/3 continue to be managed by the operator as before.

With its extensible and scalable approach, IPM solves the challenges of managing intelligent coherent pluggable optics deployed in any host platform.

How Intelligent Pluggables Manager Works

IPM augments the current management approach of pluggable modules, adding a management path that allows the advanced transport optical aspects to be managed independently from the host device.
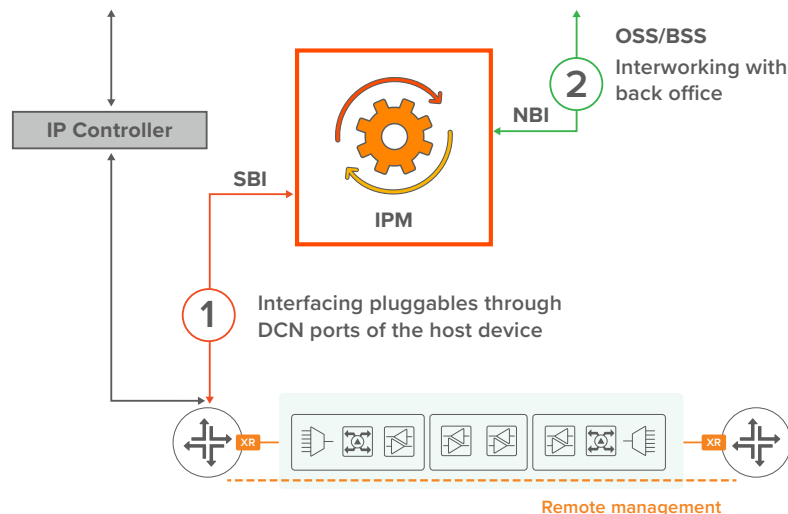

Figure 2: Intelligent Pluggables Manager at work: providing a dual-management interface to the operator back office for coherent pluggable optics

IPM's main building blocks include a server-/cloud-based controller and a software communication agent that runs as a guest application on the host device. The controller communicates to the back office through an open, REST-based northbound interface (NBI). This enables the integration of the pluggables network and its services into the customer operations support system, business support system, or multi-layer network orchestrator. The controller southbound interface (SBI) communicates to the module through the communication agent via the DCN ports of the host. While the communication agent simplifies some operational aspects of the solution, the IPM controller can also interface with the module using a management VLAN over the data path in cases where the agent is not available.

Additionally, IPM provides remote management of far-end devices. Both intelligent optics and hosting devices can be managed through an out-of-band control channel. This enables the management of remote devices via the local module that is managed by a DCN-accessible hosted device.

IPM enables a dual-management approach to pluggables management, with a clear separation of control functions: the traditional management of the pluggables by the host device is sufficient for simple applications and continues to be responsible for bringing up the modules upon installation and configuring the basic module interfaces. IPM augments this capability by providing access to optical parameters in the modules, including wavelength, bandwidth, and subcarrier assignment; power levels; performance and alarm monitoring; and advanced diagnostics and troubleshooting. IPM is also responsible for performing functions of the end-to-end optical transport layer such as network topology discovery and inventory, as well as point-to-multipoint configuration. For simple use cases, the host can be exclusively used for module configuration, and IPM can be used only for monitoring, offering extended visibility and troubleshooting.

In the dual-management paradigm, the same management network and even the same IP address used to manage the host device are reused to manage the pluggable modules within that host.

Intelligent Pluggables Manager Deployment

IPM is implemented using modern cloud-native technologies. Based on microservices and deployable in containerized environments, its controller is easy to deploy and upgrade in any ecosystem, whether server or cloud based. The concept of deploying a host-agnostic software agent in a host device is becoming common in the industry. Many router vendors and operating systems support this approach to extend and customize device functionalities.

IPM can be deployed as a standalone application but can also be deployed integrated into Transcend NMS (TNMS) or Transcend Controller (TC), functioning as a mediation layer between the NMS/controller southbound interface and intelligent pluggable optics.

Nokia offers a range of professional and support services to ease the deployment and operation of open networks. Among them, Nokia's software consulting services help operators in the deployment of Intelligent Pluggables Manager in their own specific tooling ecosystems, with integration services available for assisting northbound integration with OSS/BSS systems. Nokia's software consulting services have a long history in working with operators, combining unique software integration and development capabilities with target-oriented consulting for business process optimization.

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Summary

IPM streamlines the operation of optical networks based on coherent pluggable modules. It enables advanced optical transport features in coherent pluggable optics, unleashing functionalities previously only supported at the transponder level. IPM supports the open optical network paradigm and allows for faster introduction of innovation in the network. It seamlessly integrates into existing back offices and network control architectures, leveraging the same management network and even the same IP address used to manage the host device to manage the pluggable modules within that host.

Nokia's Intelligent Pluggables Manager is the software application of choice to minimize any operational complexity brought about by the move of coherent optical engines from DWDM transponders into pluggables deployed in host devices.