NOKIA

Automated and optimized management of optical transport networks in SDN deployments

The evolution of the Nokia 1350 Optical Management System (OMS) within the Network Services Platform

Application note

Executive summary

Metro and wide area communications networks are undergoing a significant architectural transition to achieve greater network efficiency and on-demand service delivery using software defined networking (SDN). To help our customers benefit from this transition, we are enhancing the existing optical network management capabilities of the Nokia 1350 Optical Management System (OMS) by integrating them with the automation, optimization, and assurance capabilities provided by our carrier SDN offering—the Network Services Platform (NSP). This paper summarizes the drivers of this activity and describes the high value opportunities unlocked by 1350 OMS/NSP integration. These include:

- A rich and evolving applications suite, particularly in analytics and assurance capabilities, which will be made available to the management of optical transport networks, thus enhancing the 1350 OMS capabilities in this area.
- Network operators will be able to reap the benefits of a self-paced path to SDN automation and optimization of optical transport networks and services, which retains and enhances the existing capabilities and interfaces of the 1350 OMS.
- Unified IP/optical control and management will be enhanced beyond the capabilities of the Optical Integration Module (OIM) for the 5620 SAM and the 1350 OMS. Integration within the NSP will enable highly efficient cross-functional workflows, automation and dynamic network engineering, delivering assurance and optimization.

Contents

Introduction

The propagation of enterprise cloud-based architectures and bandwidth-intensive applications, both mobile and fixed, is having a profound effect on the communications network infrastructure. This is driving strong growth in the number of mobile base stations, data centers, colocation facilities, and internet exchanges, as well as a correspondingly rapid increase in the requirement for high-bandwidth optical transport. Cloud services and Internet of Things applications demonstrate dynamic traffic patterns and unpredictable duty cycles. This generates the requirement that optical transport network interconnections become more dynamic; they must be rapidly instantiated and re-engineered on demand to efficiently accommodate shifting traffic patterns in relatively short time frames. To stay competitive in the cloud era of networking, operators need to ensure that the network services they bring to market are delivered dynamically using automated provisioning unified with real-time network control.

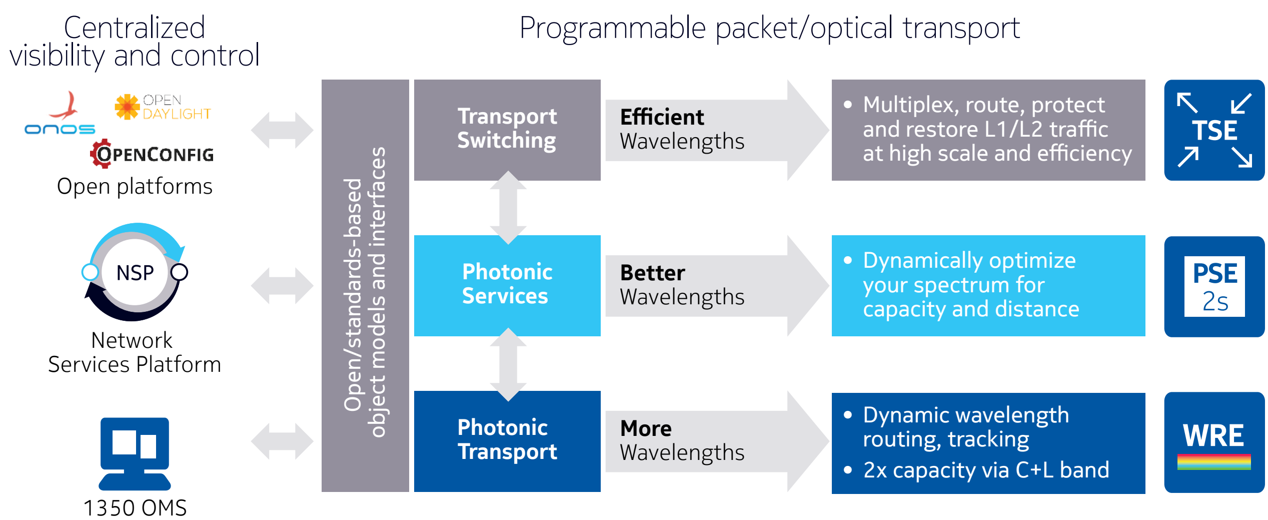
In addition, as routers utilize more 100GE interfaces and enterprises demand more 100G (and higher) bandwidth connectivity services, a new level of scale and economic efficiency is required from optical transport networks. The advantages of IP/Optical integration rapidly become evident in this environment, and particularly in the overall multi-domain management and engineering of IP and Optical network resources.

Integrated assurance capabilities (automated OAM, etc.) are required to ensure network services are fully operationalized. Insightful analytics are needed more than ever to enable operations to keep pace by driving and automating smarter services placement on network resources so that requested SLAs can be honored with the most efficient infrastructure utilization.

The goal of the Nokia carrier SDN architecture in the Network Services Platform (NSP) is to efficiently address these emerging requirements. The NSP functionality complements and extends that which is available with the 1350 OMS. The NSP brings abstraction of network and service attributes to accelerate service definition and re-configuration. The NSP can perform online network optimization in near real-time because it manages a centralized network view for topology, link state, traffic engineering cost and real-time bandwidth utilization to enable end-to-end visibility. It was also designed to be optical (wavelength, sub-wavelength), Ethernet, and IP service-aware so that it is able to adapt to real-time network utilization in order to continuously meet dynamic performance requirements. The 1350 OMS brings a valuable set of functionality for the operationalization of optical transport services, including Operations, Administration and Maintenance (OAM) mechanisms and analytics capabilities to monitor Key Performance Indicators (KPIs).

The Nokia 1830 Photonic Service Switch (PSS) is highly programmable and based on an easily controlled dynamic chipset. The 1830 PSS can be managed and controlled by: the NSP, the 1350 OMS and also by third party management and control platforms, (see Figure 1). Nokia is collaborating with leading vendors and providers to drive standardization of northbound/southbound APIs and object models to ensure compatibility with third party platforms and network elements".

Figure 1. Management and Control Choices for the 1830 PSS



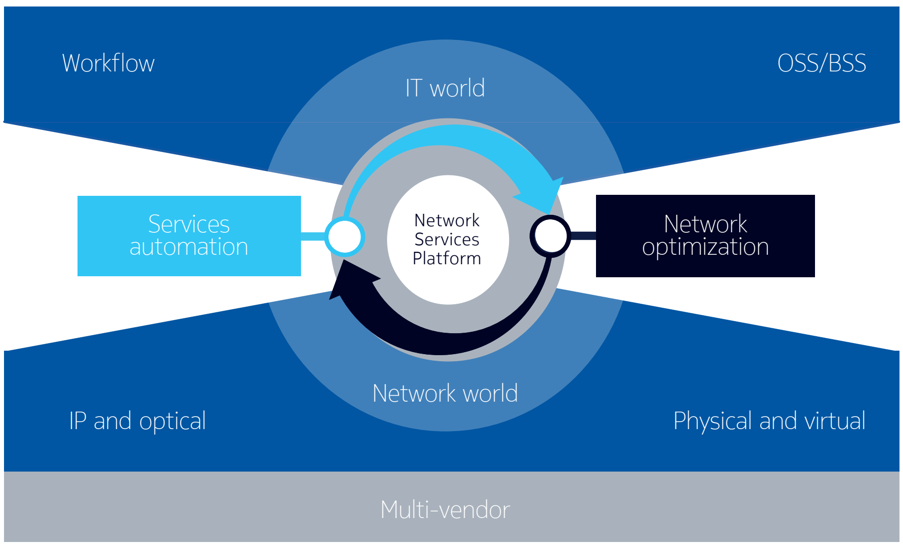
In addition, the NSP's open architecture supports integrations of advanced applications (including, for example analytics, bandwidth on demand/calendaring, multi-vendor/multi-layer visualization, resource virtualization, network automation and optimization). These apps integrate with and enhance existing 1350 OMS capabilities to deliver more efficient monitoring, troubleshooting, and assurance.

This document describes the combination, in a single platform, of the 1350 OMS and NSP to create an industry-leading blend of network management, assurance and analytics with online network engineering, designed to meet the operational needs of dynamic services management.

The new Network Services Platform

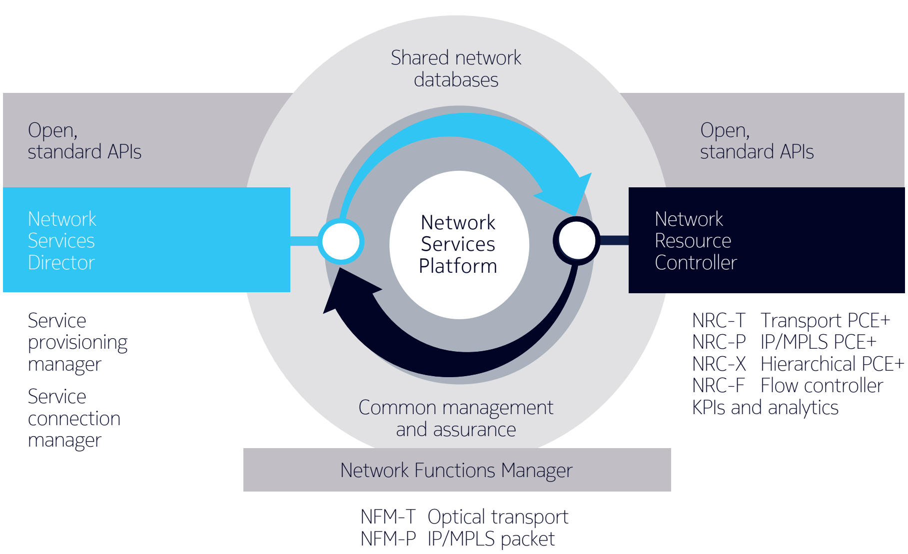
The carrier SDN capabilities of the NSP architecture allow network operators to deliver on-demand network services quickly, cost-effectively, and with scalability (see Figure 2). This is achieved using service automation, network optimization, and comprehensive assurance mechanisms.

Figure 2. Nokia Network Services Platform concept



The principal components of the NSP are: the Network Functions Manager (NFM), the Network Resource Controller (NRC) and the Network Services Director (NSD). (See Figure 3).

Figure 3. Nokia Network Services Platform and associated modules



The NFM-T will deliver the functionality of the 1350 OMS in managing optical devices within the new NSP software packaging. It will continue to play a core role for Nokia optical network operations supporting OAM mechanisms and analytics monitoring KPIs to drive assurance sustaining actions by the network operator or autonomously and dynamically by the NRC-T. The 1350 OMS deployments can be smoothly upgraded to new releases within NSP. Upgraded 1350 OMS deployments will continue to have right-to-use licenses for all the same 1350 OMS applications and entitlements. The 5620 SAM management capabilities will be available from a network functions manager module for IP/MPLS management named NFM-P.

The NRC leverages centralized, intelligent network control capabilities so that operators can quickly adapt to changing demand and traffic patterns and optimize their networks to run more efficiently. The NRC modules are able to calculate optimal paths through the network for a given set of business and technical constraints by leveraging centralized views of all available assets/topologies and their current state. The NRC-T manages the creation of transport services path connections. The NRC-T can optionally operate in concert with the NFM-T to provide dynamic, autonomous assurance. The Network Resource Controller – Packet (NRC-P) augments the IP/MPLS network with centralized PCE software derived from Nokia's highly scalable and widely deployed service router routing code base to dynamically create and manage Label Switched Paths (LSPs) across IP network elements. The NRC-X dynamically creates optimal paths across multiple domains that are separated by IP/optical or vendor boundaries. This is especially critical for hybrid IP/optical networks where multi-layer path stitching and provisioning is often a long and complex process. The NRC-Flow (-F) module can manage the routing of specific IP traffic flows to improve overall network performance and maintain KPIs.

The NSD is primarily concerned with providing a tailored abstraction of the network to automate and simplify the instantiation of services. The NSD uses network abstraction to simplify how the network—and the multi-layer services it supports, including IP and Ethernet VPNs—appear to the IT/OSS layer so that services can be defined and enhanced more dynamically than ever before. This is accomplished by presenting only the subset of network services and endpoints relevant to a specific application, thereby greatly reducing the complexity to which the application is exposed. Because NSD abstraction is inherently multi-tenant, operators can empower different business groups with their own network views and span of control.

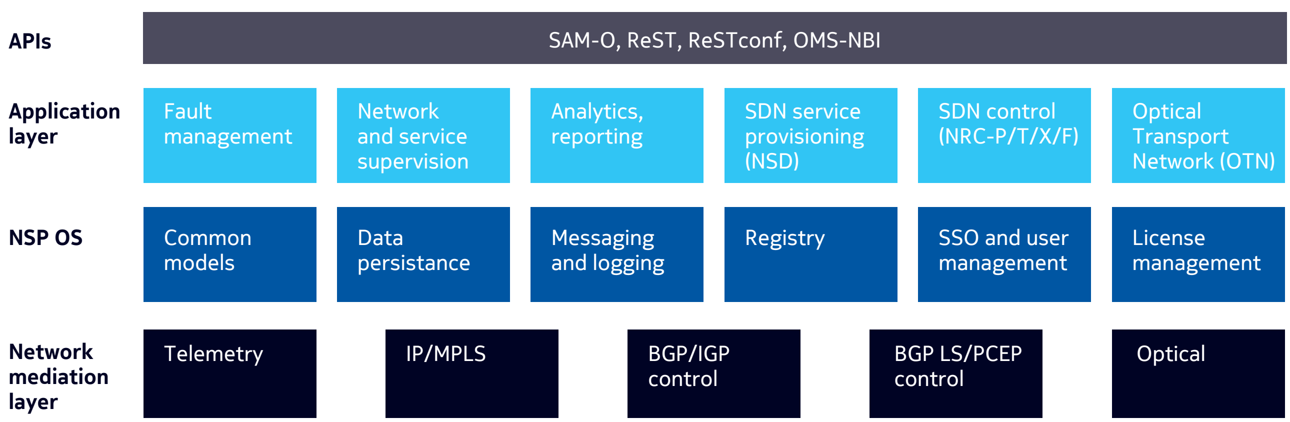
The NSP has an open, modular architecture allowing either one, both, or neither of the NSD and NRC component instances to be selected, depending on the operational and business goals of the network operator. Other applications, including those from third parties, can be easily integrated into the open NSP architecture to refine network operations and boost efficiency.

One of the fundamental tenets of SDN is the concept that applications or third-parties can use north-bound interfaces on the SDN Controller to "program" the network, according to their needs. To that end, the NSP supports RESTful north-bound interfaces, based on YANG models.

NSP OS: The common Network Services Platform Operating System

Nokia has architected a common Network Services Platform Operating System (NSP OS) to provide an open applications environment to accelerate application development and integration—both from Nokia and third- party organizations. The goal was to disaggregate monolithic management functions to create a range of selectable capabilities, seamlessly tied together by the NSP OS. The NSP OS brings modularity, consistency, and structure to the NSP, allowing users to select desired functions and seamlessly navigate between tasks. These capabilities result in highly efficient workflows and enhanced troubleshooting, while increasing GUI usability. (See Figure 4.)

Figure 4. NSP OS: The common Network Services Platform Operating System



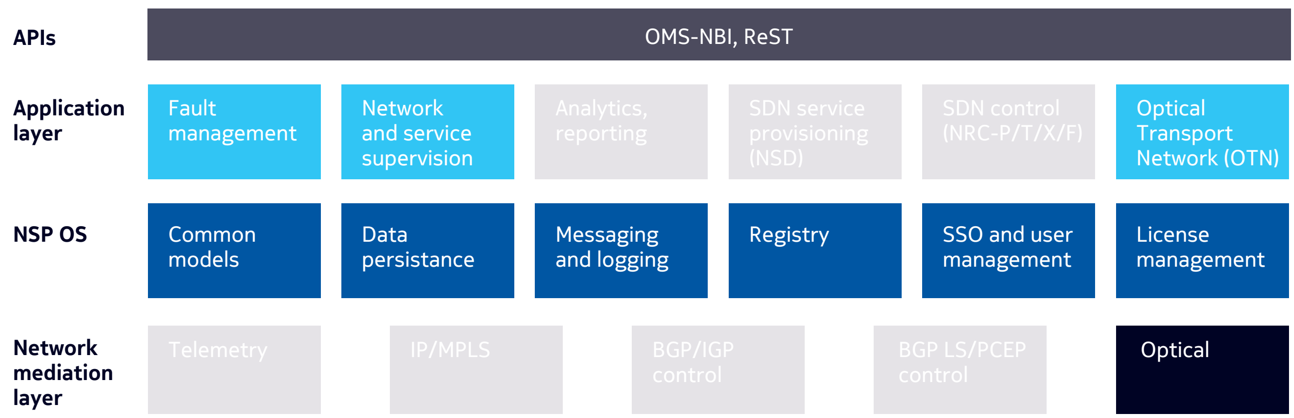
Existing web apps will be available as common NSP OS applications for all modules, (as applicable). For example, the existing fault management, network and service supervision, and analytics apps will be available as common apps for the NFM-T, as well as other modules. Applications or equivalent features for optical infrastructure management will be delivered by the NFM-T module.

Common facilities will be shared by all NSP modules. These include installation, cross-domain multi-layer object models, persistence, messaging, registry, logging, single sign-on and user management. With a common installation methodology for all NSP modules, deployment will be simplified and made more flexible. For example, independent upgrades of individual applications will be allowed in some cases.

The disaggregation and modularization of functionality enables customization of a particular network operator’s NSP environment using the selection of the suite of apps and modules that best serve their operational requirements and business goals.

Figure 5 shows the applicable suite of components that comprise the NFM-T. Because the NSP apps are industry standards-compliant they are interoperable with third party management and control platforms like ONOS and ODL. For example, the assurance functions in NFM-T can be used to provide common assurance across NFM-T managed and ONOS controlled network domains.

Figure 5. Standard optical network management, NFM-T (former 1350 OMS)



Use cases

Use case: Nokia 1350 OMS operating model continuance

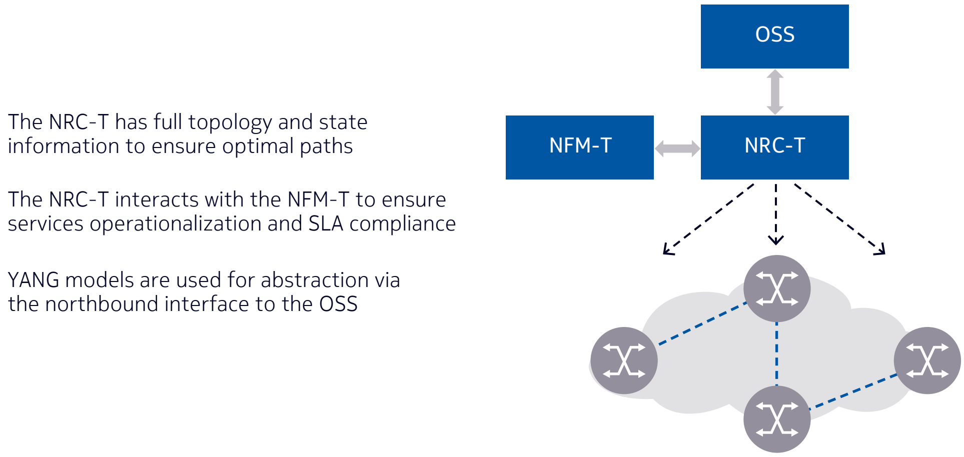
Some operators may choose to preserve their existing network management processes and procedures. In this use case, the NFM-T substitutes for the 1350 OMS and all functions and interfaces are preserved. Operators will have access to a new set of multi-layer assurance applications, initially in smart fault management (FM) and evolving to include capabilities, such as network supervision (NS) and service supervision (SS).

Use case: Dynamic optical path establishment using NRC-T

The NRC-T is based on proven control plane software from the industry-leading Nokia 1830 Photonic Service Switch (PSS) and complements intelligent optical switches by providing optimized dynamic path computation using centralized network views.

The NRC-T has up-to-date topology and state information and takes physical layer knowledge into consideration to ensure that optimal paths are computed. The NRC-T acts in concert with the NFM-T to ensure that services are fully operationalized and that SLA compliance is established and maintained. YANG models are used for abstraction to simplify service provisioning using the north bound interface to the OSS in this open architecture.

Figure 6. Dynamic optical path establishment using NRC-T

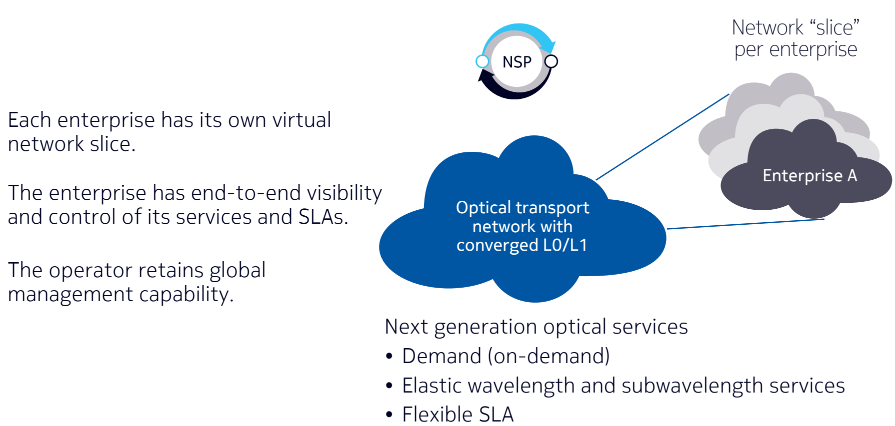


Use case: NaaS with multi-tenancy and slicing

The NSP enables the creation of virtual network slices, also known as network partitioning, allowing the independent existence of multiple tenants on a single physical infrastructure. Each enterprise on the operator's network has its own virtual network, distinct, secure and independent of other enterprises' services and of the operator's own production network.

The enterprise has complete end-to-end visibility of its services and the ability to monitor service level agreements (SLAs), turn up new services, change bandwidth between sites, re-route services between sites, and rapidly adapt to changing service requirements or network conditions. The operator retains a global view of the network and the ability to manage and monitor all elements.

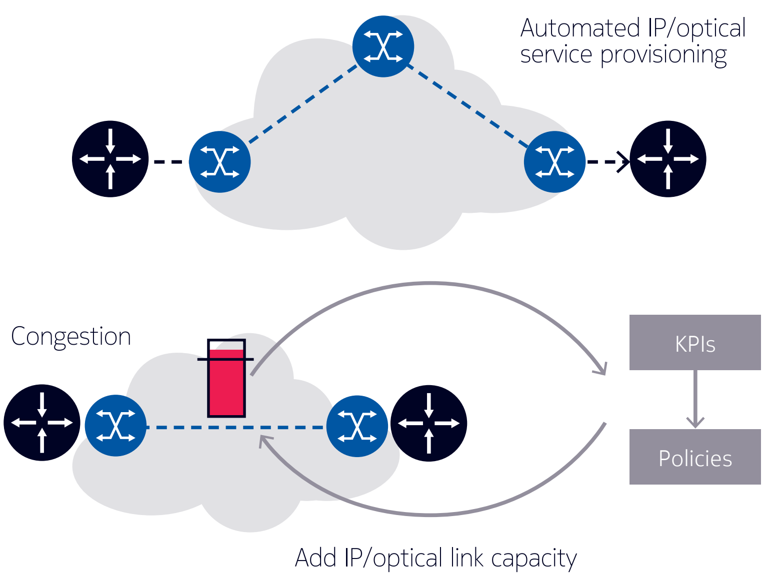
Figure 7. NaaS with multi-tenancy and slicing



Use case: IP/Optical optimization: Resizing paths and link groups dynamically for service assurance

Ultimately service assurance can evolve beyond the delivery of an indication of network performance versus KPIs. The NSP can 'close the loop' for service assurance, and it will be possible for the network to automatically adjust in order to maintain SLA compliance by adding bandwidth on demand. For example, an optical channel could be added automatically to a link aggregation group (LAG), if congestion that could impact KPIs is detected at Layer 2 or Layer 3. This type of behavior could also be scheduled based on anticipated changes in traffic levels over time.

Figure 8. Resizing paths and link groups dynamically for service assurance



Conclusion

As networks transform to cloud-based architectures, offered services are simultaneously becoming more dynamic; they must be rapidly instantiated and re-engineered to efficiently accommodate shifting traffic patterns in relatively short time frames. Efficient multi-layer integration is rapidly becoming key in the global management and engineering of dynamic and high bandwidth IP and optical transport network resources. Advanced assurance and analytics that scale with dynamic provisioning are needed to ensure that operators have the visibility required to keep pace with monitoring and managing dynamic network resources and services.

To address these trends, Nokia is taking advantage of the opportunity to migrate (and fully preserve) 1350 OMS capabilities to the NSP. This migration will realize high-value opportunities in bringing SDN-based management to optical infrastructure. These include:

- A rich and evolving applications suite, particularly in analytics and assurance capabilities, which will be made available to the management of optical transport networks, enhancing the 1350 OMS capabilities in this area.
- A self-paced path to SDN automation and optimization of optical transport networks and services, which will retain and enhance the existing capabilities and interfaces of the 1350 OMS.
- Unified IP/optical control and management that will be enhanced beyond the capabilities of the Optical Integration Module (OIM) for the 5620 SAM and the 1350 OMS. Integration within the NSP will enable highly efficient cross-functional workflows, as well as automation and dynamic network engineering, delivering assurance and optimization.

This transition will be seamless. Operators who do not wish to take advantage of new functionality will be able to retain their current operating model fully intact until they wish to leverage the new capabilities.

United, in a single platform, the 1350 OMS, as the NFM-T within the NSP, creates an industry-leading blend of network management, assurance and analytics along with on-line network engineering. All of this is designed to meet the operational needs of dynamic services management in the cloud era.

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