Taking the Nokia 5620 SAM into the Carrier SDN era for profitable, dynamic network services
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Introduction

In early 2017, Nokia will enable customers to enhance the value of their existing Nokia 5620 Service Aware Manager (SAM) deployments by integrating carrier software defined networking (SDN) modules from the Network Services Platform (NSP). These modules will enable more efficient IP and Optical cross-functional workflows for management and assurance, and provide SAM customers with a seamless evolution path to dynamic network services and Carrier SDN—at their own pace.

Together in one platform, the 5620 SAM and NSP create the ideal alliance of network management, assurance, and analytics with online network engineering designed to meet the operational needs of delivering dynamic network services in the Carrier SDN era. With this unified platform, operators will be able to set up services with the confidence of knowing that they can dynamically control the network to meet service requirements and keep pace with emerging issues that may impact quality of experience or lead to violations of SLAs.

The need for evolving Nokia 5620 SAM into the Carrier SDN era

Dynamic assurance and optimization

To stay competitive in the Carrier SDN era of networking, operators need to ensure that the on-demand network services they bring to market are delivered dynamically using automated provisioning unified with real-time network control. But evolving today’s deployments to meet the needs of dynamic network services takes more than just a focus on multi-layer services automation and network optimization. Integrated assurance capabilities are required to ensure effective realization of Carrier SDN use cases. More than ever, insightful analytics are needed to ensure operations keep pace by driving and automating smarter services placement on network resources so that requested SLAs can be honored.

Once a service was instantiated, operators continuously surveyed alarms/KPIs and took manual actions (or, at best, user-driven, partially automated actions) to continue safeguarding SLAs. As network service delivery becomes more dynamic and network demand and traffic patterns become less static and predictable, operators need a higher level of network and service supervision visibility and automated control. This is required in order to keep up with the higher rate of changes to the network and services. Assurance capabilities must leverage the SDN control layer so they can keep up with the dynamic provisioning and optimization capabilities of SDN networks. This means leveraging KPIs and analytics to drive automated policy-based optimization and operations, administration, and operations (OAM) actions that improve overall service health and network efficiency from initial delivery to day-to-day operations.
Many vendors have not addressed the need for analytics and assurance to dynamically drive control within the multi-vendor IP and optical network. To bring Carrier SDN from lab trials to live deployment, analytics and assurance with automated actions and abstracted day-to-day operations visibility will be critical.

This is where the unification of the 5620 SAM and the NSP becomes important. The 5620 SAM brings the analytics and assurance capabilities needed to drive dynamic network and services control. In the past, this was mated with offline traffic engineering tools that were ill-equipped and lacked the global IP/optical view and efficient, programmatic traffic engineering needed to deliver on-demand optimizations in the near real-time required for dynamic services delivery. The NSP is able to perform online network optimization in near real-time because it manages a centralized view for topology, link state, traffic engineering cost and real-time bandwidth utilization to enable end-to-end visibility. The NSP, much as the 5620 SAM, is designed to be service-aware so that it is able to adapt to real-time network utilization in order to continuously meet dynamic service requirements.

Because dynamic assurance is only as good as the data that feeds it, 5620 SAM-based policy triggers encompass analysis/correlations from both IP and optical layers, and from both physical and virtual domains. They provide visibility needed for operators to efficiently stay in step with network events, and provide the correlation needed to perform intelligent root-cause and services impact analysis.

Together, the NSP and the 5620 SAM can leverage key performance indicators (KPIs) to deliver intelligent steering and load-balancing of traffic. KPIs enable analytics-driven policies that automate actions to ensure critical SLAs are met and that optimal use of IP/optical assets is made. To avoid network congestion, traffic can be redirected at the granularity of flows, new multi-layer paths established, or existing paths resized dynamically, as dictated by policy. Dynamic tuning of network resources, (such as re-directing traffic flows and services onto alternate paths), will also free up assets to generate additional revenue for carriers.

Enhancing service provisioning automation

Existing 5620 SAM mode of operations (MOPs) for IP/MPLS and carrier Ethernet service provisioning, such as IP VPNs and E-pipes use configuration forms, service templates, and scripting that are manually executed. From a network engineering standpoint, there is the expectation that the operator has taken the necessary actions to ensure that there is sufficient capacity in the underlay network to carry the services.

Service provisioning is greatly simplified using the NSP with the introduction of YANG models for service abstraction. Specifically, the NSP services automation module, the Network Services Director (NSD) enables a policy-based and network-aware approach for intelligent path selection when placing services. For instance, when setting up an E-pipe service with QoS requirements
between two points, the NSD will check if an LSP is available with enough bandwidth to carry that E-pipe. If there isn’t, it will engineer and deploy a new LSP.

The NSD thus provides fully automated and autonomous service control. This is especially useful in the context of cloud services where end users generally want instant connectivity, according to a simplified set of standardized connectivity models.

When upgrading the 5620 SAM, the NSD and other NSP modules are the first option to consider for evolving the 5620 SAM to the Carrier SDN era. Operators who have both the 5620 SAM and the NSD modules of the NSP will enjoy the benefit of managing existing services with the 5620 SAM, as well as new ones with the NSD. The key enhancement to service provisioning with the NSD is that it provides Carrier SDN abstraction and automation across the multi-layer IP and optical network. In addition, NSD service placement is network-aware so that services are dynamically placed on network paths that meet their bandwidth demands and needed service performance requirements. As a Carrier SDN platform, NSP enables both unified services automation and dynamic network engineering that makes optimal use of existing network assets at service instantiation and continuously, through leveraging the 5620 SAM.

One of the tenets of SDN is the notion 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 NSD supports REST, and RESTconf north-bound interfaces, based on YANG models. It also supports service enhancements, such as multi-tenancy, bandwidth on-demand and calendaring. This enables open integration between the NSP and multi-vendor service orchestrators and next-generation OSS/BSS. In addition, the Nokia NSP Connected Partner Program will certify interoperability with any Nokia NSP integrated applications that are members of this program.

**Extending multi-vendor network visibility and control**

Operators require a consistent tool set for Carrier SDN and network management across multiple vendors’ equipment to gain efficiencies in cost savings and lower total cost of operations.

The 5620 SAM provides comprehensive multi-vendor support for configuration, provisioning, and life-cycle management capabilities across multi-vendor devices, domains, and network services. For its part, the NSP provides multi-vendor service provisioning automation with network-aware service placement. It also provides multi-vendor network optimization using standardized Carrier SDN protocols and by acting as a Path Computation Element (PCE).

The 5620 SAM provides continuous collection of multi-vendor KPIs that measure network-wide performance and service health across the multi-vendor network. These capabilities have been extended to the NSP. In addition, the advanced multi-vendor troubleshooting and dynamic
service/network assurance provided by the 5620 SAM have also been extended to Carrier SDN environments within the NSP to help resolve problems fast, before they impact end users or applications. Unique multi-vendor route analytics capabilities provide proactive control plane assurance and deliver visibility into the dynamic multi-vendor IP/MPLS routing plane and services. In addition, ease of integration within the existing operational environment helps network operators get the most from their existing multi-vendor investments.

Multi-vendor support give users the ability to use the rich set of 5620 SAM and NSP applications, as well as functionality for IP/MPLS devices. The following vendors’ IP/MPLS equipment is supported:

- Cisco
- Juniper
- Huawei

Multi-vendor support in the 5620 SAM is achieved through a robust adaption framework that creates a device independent network and service model through mediation device drivers that leverage NETCONF, SNMP, and CLI for south-bound communication to network elements.

The Nokia 5620 SAM is becoming a part of the NSP – an NSP module named NFM

As discussed, the 5620 SAM is a critical component of a full Carrier SDN solution. It is becoming an integrated module within the NSP through a comprehensive and feature-rich architecture enabled through a common NSP foundation (see NSP OS section below). Upgraded 5620 SAM deployments will continue to have right-to-use licenses for all the same 5620 SAM applications and web applications entitlements. All “Classic” versus “Premium” entitlements remain in place. All Nokia 5620 SAM “OSS Connected Partner Program” partner applications will now become members of the “Nokia NSP Connected Partner Program” at each application’s current partner tier (ConnectedPremier, ConnectedPlus, Connected). And the existing 5620 SAM OSS interface will continue to be maintained as the API for northbound integrations of these OSS applications. New next-generation OSS applications and service orchestrators will use the new, more abstracted NSP REST/RESTconf APIs.

The NSP Network Services Director (NSD) module can be optionally deployed to further simplify service provisioning through its abstracted YANG model and allow for intelligent path selection. These capabilities are available through the NSD GUI, as well as a REST API for northbound integrations. To enable evolution to standardized Carrier SDN control using a PCE for centrally optimized dynamic services, the NSD can be deployed with the NSP Network Resource Controllers (NRCs). The NSD and NRC REST APIs will
enable existing and new Nokia NSP OSS Connected Partner Program member applications to be part of an open ecosystem that will support multi-vendor Carrier SDN use cases.

With all deployment types and options, existing services managed by the 5620 SAM will continue to coexist and be managed and assured with new dynamic services introduced through the NSD. In addition, all managed networks and service types (for IP and optical as well as Carrier SDN) will benefit from a common set of advanced network and service assurance capabilities, such as fault management, supervision, OAM test validation, visualization of multi-layer topologies, analytics, reporting and more.

Within the new NSP software packaging, support for existing 5620 SAM features and managed devices will be available through the NSP Network Functions Manager (NFM). Customers looking to leverage IP/MPLS management capabilities (including for EPC, microwave and some RAN devices continuing to be supported – as per product road maps) will need to deploy the NFM-P module. Customers requiring optical management capabilities would deploy NFM-T (as described in the application note on the evolution of the Nokia 1350 Optical Management System (OMS) within the Network Services Platform).

NSP OS: The common Network Services Platform Operating System

As a foundation for platform unification, Nokia has architected a common Network Services Platform Operating System (NSP OS) that is at the core of the NSP. The NSP OS allows all applications within the NSP to have a common set of application services.

Existing 5620 SAM web apps will be available as common NSP OS applications. This means that the existing fault management, network and service supervision, as well as analytics apps will be integrated with all NSP modules. Lifecycle management and assurance of virtual network functions (VNFs), Control Plane Assurance Management (CPAM), and all other applications or equivalent features for IP/MPLS infrastructure management will be delivered by the NFM-P module.

Common application services will be shared by all NSP modules, including installation, data persistence, messaging, registry, logging, single sign-on, user management, etc. With a common installation for NSP modules, deployment will be simplified and made more flexible (for example, by allowing for independent upgrades of individual applications). Northbound integrations will benefit from a set of REST/RESTCONF APIs that will enable third-party application interoperability with all NSP modules and applications, as well as for access to both YANG and proprietary object models. The current 5620 SAM-O northbound interface will continue to be maintained so that existing OSS integrations continue to operate. Network mediation will be provided by the NFM modules, as well as from the CPAA and SR OS Virtual Machines. (See Figure 1).
Use cases

This section provides some use cases (Figures 2-5) regarding how to leverage NFM-P (5620 SAM) within the NSP alongside the NSD and the NRC modules to deliver dynamic services and drive greater efficiency in their networks.

Figure 2. IP/optical network-aware provisioning automation with service validation

1. "Gold" service provisioning request

2. Best path is selection to meet specific service requirements and constraints of "Gold" service policy

3. "Gold" service policy triggers action to automatically run OAM tests to validate that the provision service meets "Gold" performance standards

4. Service performance is validated

NSD
Automates service provisioning with smart placement onto best path that meets requirements

Assurance & Analytics*
Automates test creation, execution and reporting for immediate service validation

* Assurance & Analytics may be provided with NFM-P (5620 SAM) or NSD or NRC modules.
Figure 3. Bandwidth on demand for IP/optical services with LAG re-sizing

1. Monitors interface bandwidth utilization for services on LAGs
2. Bandwidth utilization threshold crossed on monitored LAG interfaces
3. Automates LAG re-size to increase bandwidth available to services
4. New interfaces added to LAGs
5. New IP links and associated optical channel now operational
6. Congestion is cleared

**NSD**
- Monitors bandwidth utilization for IP/MPLS interfaces on LAGs
- Provides NSD with TCA alarm

**Assurance & Analytics**
- Monitors for real-time event notification
- Automates LAG re-size

*Assurance & Analytics may be provided with NFM-P (5620 SAM) or NSD or NRC modules.*

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Figure 4. Traffic flow control for resolving congestion

1. Monitors for link congestion, collects flow stats
2. Detects congestion and identifies top elephant flows
3. Select traffic flows candidate for offloading to alternate path
4. Policy-based steering selects top flows re-direct to alternate path using NRC-F OpenFlow controller
5. Congestion is cleared

**NRC-(NRC-F)**
- Intelligently steers traffic flows at the edge nodes to alternate path during congestion

**Assurance & Analytics**
- Data collection, KPI/TCA management, reporting

*Assurance & Analytics may be provided with NFM-P (5620 SAM) or NSD or NRC modules.*
Figure 5. Traffic flow control with path computation and instantiation to resolve congestion

1. Monitors for link congestion, collects flow stats
2. Detects congestion and identifies top elephant flows
3. Select traffic flows candidate for offloading to alternate path
4. Detects no alternate path is available to re-direct
5. NRC-F triggers NRC-P to create new alternate path
6. NRC-P computes new path and creates it based on policy
7. Steers selected top flows to new alternate path (policy based) using NRC-F OpenFlow controller
8. Congestion is cleared

Assurance & Analytics*
Data collection, KPI/TCA management, reporting
NRC (NRC-F and NRC-P)
Creates new path and intelligently steers traffic flows

* Assurance & Analytics may be provided with NFM-P (5620 SAM) or NSD or NRC modules.

Customer deployment examples

Carrier SDN delivered consumer services with a prominent Southeast Asian service provider:

Figure 6. Consumer services use case from Southeast Asian CSP

Incumbent operator deploys new $100M service network with Carrier SDN:
- New IP/MPLS services delivered on-demand across IP/optical fabric
- Bandwidth dynamically matched to customer requirement

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Carrier SDN delivered business services with Tier 1 Asian operator:

Figure 7. Business services use case from Tier 1 Asian operator

Incumbent operator dynamically leverages new network bandwidth for mobile/residential web access:
- Light analytics used to predict traffic congestion towards web
- VIP flows redirected to high bandwidth network
- Proactively avoids service degradation for VIP content partners

Summary

Operators looking to evolve their 5620 SAM deployments to the Carrier SDN era at their own pace will be able to leverage their 5620 SAM as a critical component within the Nokia NSP. This unified platform will let operators set up services with the confidence of knowing that they will be able to dynamically control the network to meet service requirements and keep pace with emerging issues that may impact quality of experience or lead to violations of SLAs.

Together in one platform, the 5620 SAM and NSP create the ideal alliance of network management, assurance, and analytics with online network engineering designed to meet the operational needs of delivering dynamic network services in the Carrier SDN era.

Resources

Nokia Network Services Platform product page: networks.nokia.com/NSP

YouTube: NSP and 5620 SAM channel