Alcatel-Lucent 5620 Service Aware Manager

The Alcatel-Lucent 5620 Service Aware Manager (SAM) goes beyond the traditional boundaries of element, network and service management. The 5620 SAM provides end-to-end network and service management across all domains of the converged, all-IP network – delivering unified operations, whether network services are running in a virtualized environment or on specialized hardware platforms.

The Alcatel-Lucent 5620 SAM maximizes operational efficiency network-wide across the domains of Alcatel-Lucent IP, IP-optical, IP-microwave and IP-wireless networks. End-to-end life-cycle management across both physical network functions (PNFs) and virtual network functions (VNFs) delivers operational consistency across the multi-technology network. Comprehensive provisioning capabilities support a wide range of network services. Advanced troubleshooting and service assurance help resolve problems before they impact end users or applications. Ease of integration within the existing operational environment helps network operators get the most from their investments.

The 5620 SAM continuously monitors service quality and network health through key performance indicators (KPIs) and key capacity indicators (KCIs), alerting operators proactively when remedial actions need to be taken. It unifies infrastructure management and assurance for VNF-based network services with VNF life-cycle management that includes threshold-based automation to scale up (or down) additional VNFs when needed.

Network management and operations support system (OSS) mediation capabilities provided by the 5620 SAM can be categorized into the following focus areas: Network Infrastructure Management, Network Infrastructure Assurance, VNF Management, Network Service Management and Network Service Assurance.

With the addition of the Alcatel-Lucent Network Services Platform (NSP) for multivendor IP/optical resource connectivity management, operators are able to further simplify service delivery through Carrier SDN abstraction and control. The NSP unifies service provisioning automation with on-demand network engineering to deliver network-aware service deployment that is continuously optimized to better meet bandwidth needs as traffic patterns fluctuate. With the NSP used in conjunction with comprehensive KPIs and analytics from the 5620 SAM, operators can set up automatic triggering of NSP policies to adapt and optimize network services in real time.

Tightly integrated within the 5620 SAM, the Alcatel-Lucent 5650 Control Plane Assurance Manager (CPAM) enables proactive assurance by delivering unprecedented visibility into the dynamic multivendor IP/MPLS routing plane and services. Augmenting the 5620 SAM with custom service portals and pre-certified OSS partner application integration further enhances its fit into even the most complex networks.

Independently proven to deliver quick and continuing return on investment, the 5620 SAM is widely deployed by more than 600 service providers world-wide, including in 95 percent of the top 60 service providers globally.

FEATURES	BENEFITS
Easy-to-use GUI and templates accelerate maintenance tasks	Minimized time and costs associated with the errors that commonly occur when a command-line interface (CLI) is used
Scripting-based deployment automation and control for network upgrades, configuration, provisioning and performance validation through flexible scripting options	Rapid introduction of new services and technologies that meet SLAs
Common provisioning for different service types [Layer 2 and Carrier Ethernet, WDM and optical transport network (OTN), Layer 3 MPLS VPNs and MPLS-TE]	Reduced cost of delivering multi-technology composite services by minimizing the risk of misconfigurations
Consistent management and assurance across both physical and virtual network functions	Unified operations across IP network services, including VNF management
Efficient collection of network statistics, OA&M diagnostics and state KPIs for service level agreement (SLA) monitoring, including at-a-glance dashboards	Proactive prevention of potential service-affecting problems before they impact customers
Powerful fault correlation and advanced troubleshooting visualization that help to quickly pinpoint the root cause of problems to speed resolution	Simplified problem isolation to quickly understand services impact, diagnose problems and resolve them
Open interfaces that enable integration with custom web portals, OSSs and business support systems (BSSs)	Increased productivity and flexibility with a management solution that easily adapts to allow cost-effective integration into the existing operational environment, enhancing workflows and processes

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Network infrastructure management

Alcatel-Lucent 5620 SAM network infrastructure management provides base Fault, Configuration, Accounting, Performance and Security (FCAPS) management with many advanced extensions. It accelerates configuration of network infrastructure by providing easy-to-use forms, as well as scripting to automate parameter configuration. External systems are able to access infrastructure management functionality through an open OSS interface. (See Table 1 for feature summary.)

More efficiency through service-aware model

The 5620 SAM object model maps relationships between network services and infrastructure across the multiple underlying technology layers of the all-IP network. This model enables many infrastructure management tasks to be performed more efficiently. For example, infrastructure configuration, maintenance and audits can be performed in bulk across a multitude of selected network elements, or all network elements along the path of a service. In addition, the model delivers an effective top-down approach to troubleshooting, which enables more rapid problem isolation to pin-point issues before they impact services.

Automated deployment and management

The advanced 5620 SAM scripting framework enables programmatic control to automate deployment of infrastructure, significantly reducing misconfigurations so services can be delivered faster and more reliably. Automation eliminates the need to individually configure each device in the service path – including everything from network and quality of service (QoS) policy configuration, to device operating system upgrades and provisioning for even the most complex end-to-end services spanning multiple technology domains.

After deployment, automated setup of comprehensive OAM diagnostics suites can be used to validate that performance requirements are met. For ongoing day-to-day operations, network auditing and reporting as well as bulk maintenance changes can also be automated. Scripts can be triggered by events (for example, after the discovery of a network element), scheduled or run on-demand. Control scripts can also use rules-driven logic to run other scripts.

OSS integrations may maximize efficiency by triggering 5620 SAM scripts for pre-processing. External applications listening to events through the 5620 SAM OSS interface may trigger scripts based on events. (See Figure 1.)

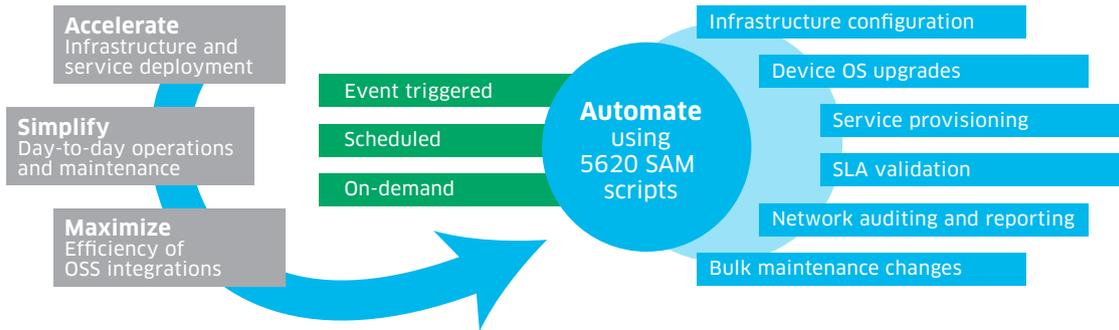**Figure 1. Automation through 5620 SAM scripts**

Table 1. Alcatel-Lucent 5620 SAM network infrastructure deployment, maintenance and management feature summary

CATEGORY	FEATURES
Network discovery and inventory	• Network discovery and data collection using various south-bound interfaces, such as: SNMP, NETCONF, CLI, (s)FTP, OpenFlow • Subnet-based auto-discovery of in-band and out-of-band network elements • Real-time synchronization with network element changes • Configurable MIB polling policies and schedules – for accounting statistics or OAM tests, for example • Highly scalable alarm and SNMP statistics collection • Network inventory hierarchy views and equipment views • OpenFlow management and monitoring – uses flow table on each OpenFlow switch to manage flows of routing information
Configuration and maintenance	• GUI-based configuration with concurrent, multiple object editing • Step-by-step form entry to simplify complex tasks and user-entry fields to add additional guidance • Device configuration, including for physical and logical resources, buffers, queuing and QoS marking/forwarding • Routing domain management including Interior Gateway Protocol (IGP) and Border Gateway Protocol (BGP) • Automated setup for IEEE 802.1ag/ITU-T Y.1731 standards-based Ethernet OAM, Two-Way Active Measurement Protocol (TWAMP) Light and MEF 35 service OAM performance monitoring • Rules-based backup, restore and upgrade of device software • Network configuration and policy audits to detect differences from a golden or device-specific configuration • Script management with control script logic-driven workflow execution • GUI builder to design customized forms and selection menus to set parameters for scripts
Infrastructure provisioning	• Rules-based bulk parameter configuration and auto-creation of objects, such as tunnels • Network service distribution point (SDP) provisioning • MPLS label-switched path (LSP) provisioning with automatic bidirectional, meshed SDP binding creation during service creation • GMPLS-UNI provisioning on routing instances, including GMPLS peers, paths, LSPs and tunnel group endpoints • Post-discovery control scripts to automate deployment and management for any managed devices. (See Figure 1.) • Third-party device provisioning using CLI scripts with security and version control
OSS interface	• Open north-bound interface enables external applications to integrate with full access to 5620 SAM managed infrastructure data

Network infrastructure assurance

Alcatel-Lucent 5620 SAM network infrastructure assurance provides comprehensive physical and logical network topology views, as well as infrastructure fault correlation, alarm management, OAM test-suites and integrated route analytics. (See Table 2 for feature summary.)

Advanced troubleshooting

Enabled by a sophisticated correlation and rules engine, advanced fault management visualization allows better sight into the magnitude and impact of faults within massive volumes of assurance data to help eliminate manual troubleshooting. Operators may also view events on a timeline to gain visibility into the sequence of when specific infrastructure configuration changes, state changes, and when OAM test failures and faults occur in relation to each other.

At-a-glance, network-wide distribution views, grouping correlated alarms to independent problems, help to determine which fault to investigate first by giving an understanding of which problems have the largest magnitude of impact. Problems can easily be isolated through clear views that show the root cause of a fault, including an impact tree of correlated faults.

Fault impact network hierarchy views give an understanding of affected infrastructure, and provide simple, more efficient cross-navigation workflows to configuration forms to accelerate problem resolution. (See Figure 2.)

Health and performance supervision

Highly scalable collection of real-time and historical statistics (such as for equipment and interfaces) provides comprehensive information needed to detect and troubleshoot performance issues.

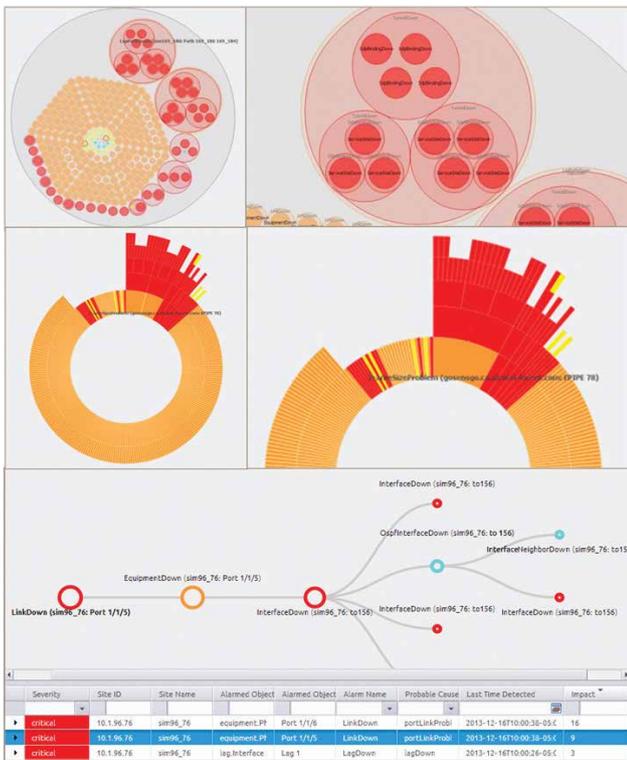**Figure 2. Advanced fault management visualization**

Figure 3. Infrastructure health and performance supervision

OAM test suites can be scheduled and compared to configurable parameters – such as jitter, delay and packet-loss metrics – to proactively detect network and service degradation. Rules-based alarm notifications, such as threshold-crossing alerts and escalating test failure alerts, further automate assurance and adherence to performance and QoS objectives.

Infrastructure-specific fault summary views and supervision dashboards enable operators to see fault trends, KPIs, OAM test results and other summary health indicators that enable proactive monitoring at-a-glance. (See Figure 3.) Operators may also run on-demand OAM tests from supervision views to investigate further.

Power management dashboards for specific device types provide summary views into power consumption totals and utilization trends for individual network elements or zones.

Custom applications for performance trends reporting

Alcatel-Lucent Network Management Services offer turnkey development of custom 5620 SAM web apps, such as for performance trends reporting. Based on the 5620 SAM web apps framework, custom apps can be developed quickly and cost effectively to address specific process and workflow requirements, resulting in more operational flexibility.

Network auditing

Automate network auditing and perform mass validation of configuration and policies distributed across many network elements against a common "golden" configuration or policy. Use managed CLI scripting to compare configuration on third-party devices. For example, comparison tools may be used after changing device operating system release versions to ensure that the previous configuration remains the same.

Alcatel-Lucent Network Management Services also offer custom scripting development and expert hands-on training on 5620 SAM scripting.

View of all physical, optical, routing, MPLS, service infrastructure layers

A variety of views and icon status indicators help to quickly diagnose and resolve service-affecting problems, from simple to complex. Service tunnel and physical topology maps allow visualization of all network resources. Optical service views provide a multi-layer topology that enables a better understanding of infrastructure relationships between DWDM, OTN and optical transport service layers. (See Figure 4.) The integrated 5650 CPAM enables visualization and highlighting of Layer 2 and Layer 3 services on an IGP topology.

Figure 4. 5620 SAM multi-layer optical topology
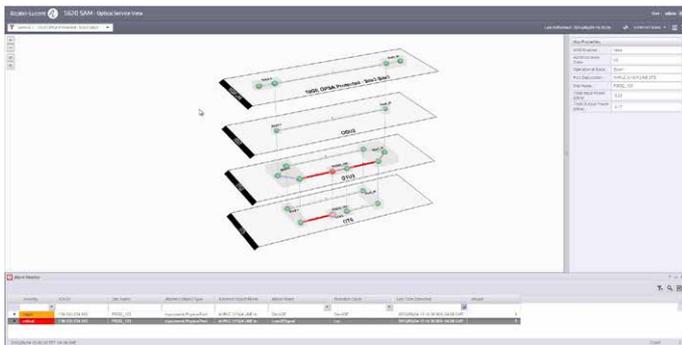
Assurance and management of third-party devices

5620 SAM Generic Network Element (GNE) support enables integration and discovery of third-party equipment for topology display, alarm surveillance (with MIB trap-to-alarm mapping), and statistics collection (interface MIB). Third-party support is also enabled for configuration and script management with deployment audits and validation.

The Alcatel-Lucent 5650 CPAM provides multivendor route analytics that inherently support third-party IP routing devices.

Route analytics

The Alcatel-Lucent 5650 CPAM is tightly integrated within the Alcatel-Lucent 5620 SAM to deliver a seamless multivendor route and path analytics within the Alcatel-Lucent Service Aware Management assurance offering. Together, they help to proactively assure the network and isolate potential problems before they affect services. The 5650 CPAM provides simplified control plane management through its real-time and historical visualization, troubleshooting, and analysis. With 5650 CPAM unprecedented end-to-end IP/MPLS infrastructure visibility and analysis enable an understanding of how the control plane topology and protocol changes impact IP routing, MPLS paths, service infrastructure and services. (For examples of 5620 SAM integrated route analytics, see Figure 5.)

The 5650 CPAM provides health monitoring for IGP (OSPF and IS-IS) and MPLS paths as well as BGP and IP VPN prefixes that tracks change history, event statistics and reporting for impact analysis. It also automates path and service tunnel OAM testing on IP or MPLS path changes to alert operators when performance issues emerge after re-routes occur. Protocol configuration audits combine IP/MPLS protocol configuration data from the 5620 SAM with 5650 CPAM change history tracking information to enable detection of misconfigurations. Offline simulation tools enable planned changes to be validated before being made in the live network and reduce the risk of maintenance or upgrades impacting performance due to unexpected routing behavior. The 5650 CPAM also provides management and troubleshooting for multicast as well as for IEEE 1588v2 PTP synchronization.

The 5650 CPAM uses 5620 SAM servers, databases and its OSS interface, making it a low-cost, low-risk investment. The two products share common user interface components for ease of use, a consistent operator experience and reduced training costs. The single north-bound API enables operators to complement traffic engineering and capacity planning applications with route analytics efficiently with the benefits of reduced OSS integration costs and lower deployment risks.

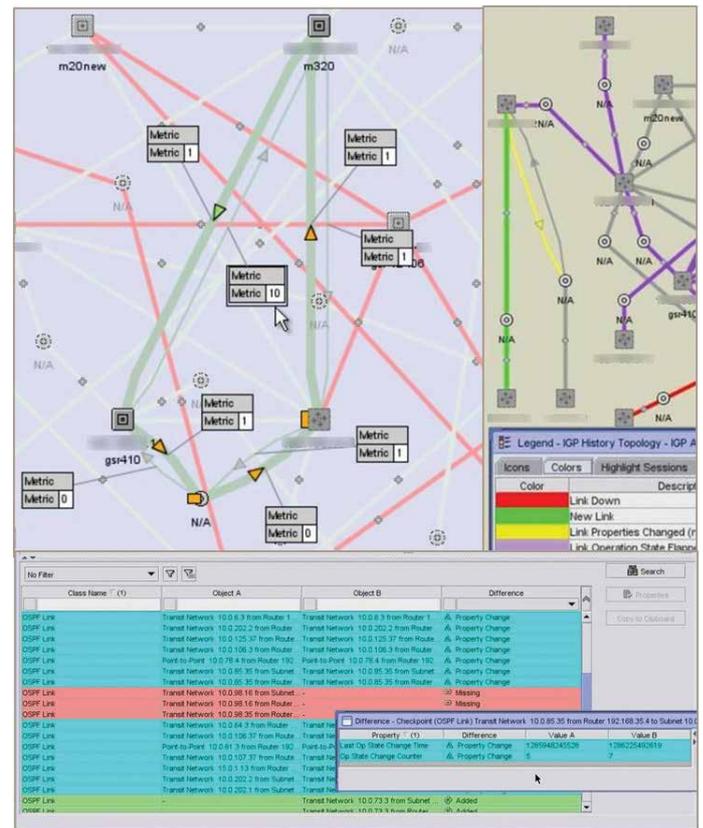Figure 5. Control plane assurance with the 5650 CPAM

Table 2. Alcatel-Lucent 5620 SAM network infrastructure assurance feature summary

| CATEGORY	FEATURES
Topology maps	• Physical topologies that support IEEE 802.1ab link adjacencies • IGP/BGP routing, MPLS, and multicast topologies through integrated 5650 CPAM • Multi-layer optical topologies, including hierarchy of OTS, OTU, ODU and service layers • Topology overlays provide fault status and additional troubleshooting information, such as port and link utilization statistics, or OAM test results with trace highlighting after point-and-click execution from a map
Alarm lists	• Multiple instances of alarm windows with custom filters • Direct navigation from alarms to affected and related objects • Extensive alarm filtering and search capabilities (including advanced logical constraint-based filtering through web GUI) • Customizable alarm information fields, including user-entry text fields • Flexible definition of rules for fault escalation, de-escalation and severity assignment
Advanced fault management visualization	• At-a-glance fault summary dashboards to view top unhealthy network elements with status KPIs and drill down to detailed alarms • Advanced fault visualization delivers an understanding of which faults to investigate first • Alarm correlation through rules engine to identify root cause of problem from symptoms • Network-wide distribution views grouping correlated alarms make magnitude of problem impact clear • Root-cause alarm impact tree visualization to easily navigate to root-cause or related alarms in tree • Event timeline view showing sequence of specific infrastructure configuration changes, state changes, OAM test failures and faults that occur in relation to each other • Top problem views enable a quick view of problem volume distribution based on alarm type • Network element investigation views allow easy access to device-specific configuration and alarm details • Network infrastructure hierarchy visualization for fault impact also provides cross-navigation to forms for further investigation • Web-based GUI for wider accessibility
Accounting and performance statistics collection	• Distributed, load-balanced statistics collection for accounting and performance data • Real-time and historical statistics retention and graphing

Infrastructure health and performance supervision	• Real-time and historical statistics to detect and troubleshoot performance issues
	• On-demand OAM test tools to gain performance metrics such as latency, delay and packet loss
	• Proactive assurance with scheduled OAM test suites to continually assess performance across various technology layers
	• Automatically generated OAM tests based on object or topology changes
	• Set threshold-crossing alerts for specific KPIs to notify operators immediately of emerging issues
	• Web-based domain-specific dashboards to summarize network health at-a-glance:
	  ¬ Infrastructure supervision with network element health status, KPIs and OAM testing
	  ¬ Power consumption totals and utilization trends per network element or zone
	• Custom 5620 SAM web applications for SLA reporting developed by Alcatel-Lucent Network Management Services

Network management integrated route analytics (5650 CPAM)	• Multivendor control plane visualization to detect and rapidly resolve routing issues • Tracking of changes from baseline configuration and topologies to current state • Auditing of IP/MPLS configuration and routing policy deviations from saved snapshot points • Path and prefix health and troubleshooting views • Auto-triggered OAM testing and alarms on routing changes • Offline simulation tools to reduce risk of unexpected routing behavior after planned network updates • Management and troubleshooting for multicast and IEEE 1588v2 PTP synchronization
OSS interface	• Open north-bound interface enables external applications to integrate with full access to 5620 SAM alarm, statistics and OAM data

VNF management

With Alcatel-Lucent 5620 SAM VNF management, EMS/NMS and VNF Manager (VNFM) functions (as defined by ETSI MANO) are now converged into a single platform that integrates with OpenStack for NFV Orchestration (NFVO). By unifying the VNFM function with 5620 SAM EMS/NMS functions, an operator can now more seamlessly manage and orchestrate VNFs. This makes it easy for operators to perform VNF life-cycle management functions from the same NMS that is used on a day-to-day basis for network operations. (See Figure 6)

When EMS/NMS and VNFM functions are converged:
- The creation of VNFs is simplified with configuration templates and automatic instantiation.
- Current EMS capabilities for performance and capacity monitoring are extended with VNF-related NFV Infrastructure measurement data.

Pre-configured threshold crossing conditions seamlessly trigger VNFM functions to either automatically take action or alert network operations. (This could be, for example, to dynamically scale out a VNF to provide more capacity to meet unforeseen demand.)

Figure 6. Converging ETSI MANO EMS/NMS and VNFM functions with the 5620 SAM
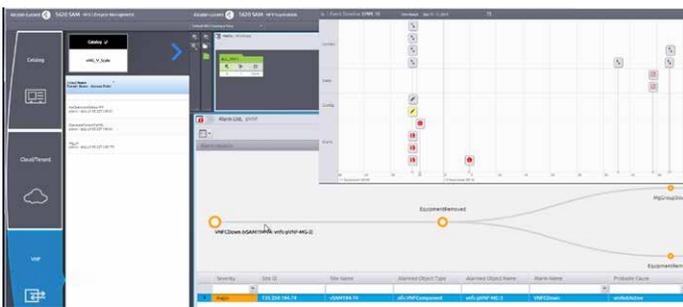
Consistent management for both physical and virtual network functions

With the 5620 SAM, traditional FCAPS management functions are now provided for both VNFs and PNFs. This enables a common and consistent approach for element and network management as well as for network infrastructure provisioning and assurance. This also provides the combined topology and logical connectivity model for the VNFs/PNFs that enables end-to-end network services visibility for delivering more comprehensive network-wide management and monitoring, as well as simplified integration into the existing OSS/BSS.

VNF life-cycle management

Through integrating EMS/NMS and VNFM functions, the 5620 SAM is able to manage VNFs across their entire life cycle in coordination with the NFVO, as well as to simplify overall coordination and adaptation for configuration and event reporting between 5620 SAM VNFM and the virtualized infrastructure manager (VIM). Both VNF and NFVI configurations are coordinated, easing the VNF application on-boarding process.

VNF management performed by the 5620 SAM includes:
- VNF catalogue-based instantiation
- Triggering the provisioning of cloud resources through OpenStack integration

- Validation through the NFVO that resources are being consumed by VNFs, performing VNF instance updates, handling VNF-related events and automated healing of VNFs, as well as ensuring the integrity of VNFs and all their components.

The 5620 SAM contains VNF Descriptors (VNFDs) to describe each VNF type, and their VNF components (underlying VM instances) including interdependencies. Each VNFD within the VNF Catalogue within 5620 SAM is used to direct the VNF on how to be monitored, healed and scaled.

The 5620 SAM provides VNF life-cycle management, monitoring and NFV assurance within a centralized application. This 5620 SAM NFV application is purpose-built to enable operators the flexibility of an NFV-focused tool-set in addition to common 5620 SAM applications for managing both PNFs and VNFs.

VNF monitoring and assurance

VNF instance-related NFVI KPI measurements are collected by the 5620 SAM using existing south-bound interfaces to provide a consistent KPI collection framework across PNFs and VNFs. Other KPIs and KCIs are also derived from VNF and NFVI measurement data through 5620 SAM VNFM analytics capabilities; the data being processed is collected by the 5620 SAM VNFM through its OpenStack integration. (See Table 3 for OpenStack integration details.) Elastic scaling is driven by pre-defined threshold events set for specific KPIs and KCIs to trigger scale out/in of VNFs. In addition, faults and other events (including threshold events) may also trigger pre-defined healing actions that may include VNF scaling actions.

Operators also gain troubleshooting simplicity with 5620 SAM advanced fault management and event correlation that is unified for PNFs and VNFs, including correlation across VNFs and NFVI layers, which may impact NFV service quality. With coordinated fault management and VNFM automated healing, operators will have both enhanced agility for more efficient day-to-day operations as well as visibility for better understanding whether current alarms are caused by the NFVI layer and normal maintenance activities, versus emerging issues that would require immediate investigation.

In addition, network infrastructure assurance with advanced visualization capabilities will speed problem assessment for both VNFs and PNFs. (See Network Infrastructure Assurance section above for more details) Specifically, advanced fault management and event correlation visualization enables superior troubleshooting visibility for isolating issues that span across multiple technology layers. And centralized NFV assurance is delivered by a purpose-built VNF-specific management and supervision application that provides specialized views and tools for monitoring VNF performance as well as the health of related network services.

VNF interfaces and OpenStack integration

5620 SAM VNF management consists of four external interfaces between external ETSI MANO components (See Figure 7):
- NFVO-VNFM: for NFVO executed VNFM functions
- VI-VNFM : for VNFM collection of VI data
- South-bound interface: for mediation to PNFs and VNFs
- North-bound interface: for NFVO and BSS/OSS integration

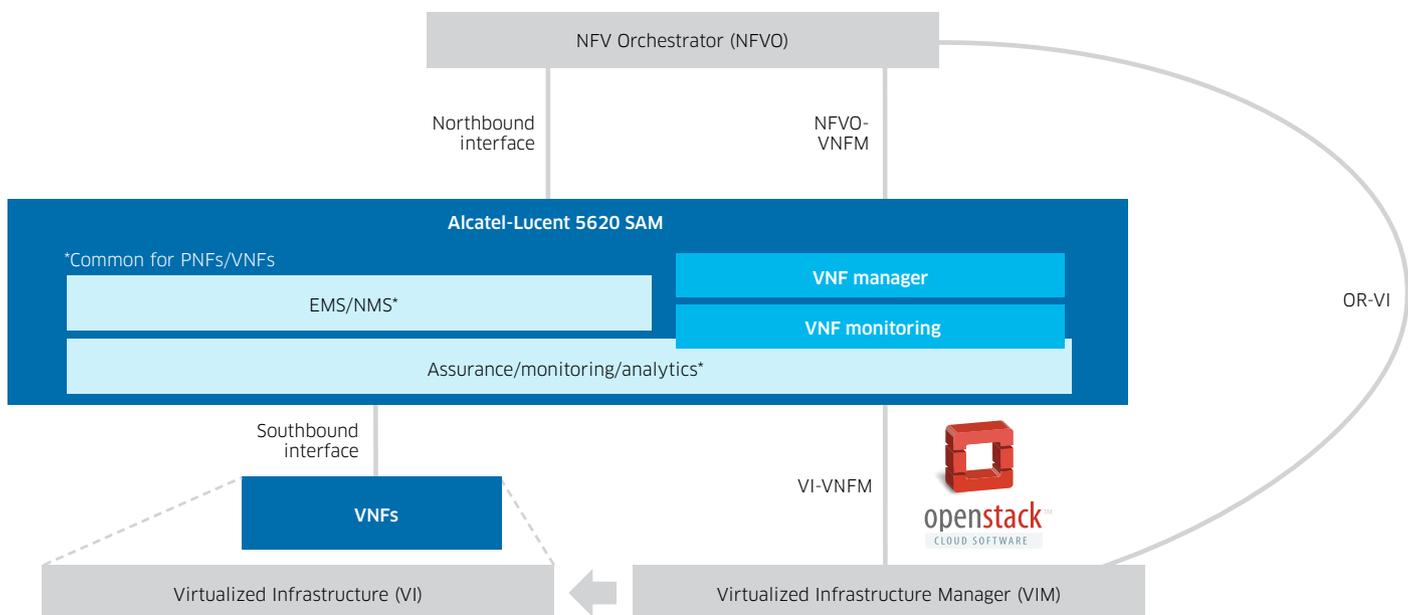**Figure 7. ETSI MANO EMS/NMS and VNFM functions provided by 5620 SAM**

Table 3. Alcatel-Lucent 5620 SAM services deployment, maintenance and management feature summary

CATEGORY	FEATURES
Converged ETSI MANO EMS and VNFM	• Consistent EMS/NMS management functions for both PNFs and VNFs across FCAPS, infrastructure provisioning, and network assurance and OSS/BSS integration (as described in Network Infrastructure Management and Assurance sections) • VNF Management and Monitoring (as described below) • External interfaces and OpenStack integration (as described below)
VNF Management	• Purpose-built app for centralized VNF life-cycle management • VNF life-cycle management ensures integrity of VNFs and all their components • VNF catalogue-based instantiation • Mediated provisioning for cloud resources through OpenStack integration • Validation of VNF resource consumption through NFVO integration • VNF instance updates • VNF-related event handling • Automated healing for VNFs
VNF Monitoring and Assurance	• Purpose-built app for centralized NFV monitoring and assurance • Consistent KPI collection framework across PNFs and VNFs • KPIs and KCIs derived from both VNF and NFVI measurements • Event-triggered VNF scaling • Event correlation across NFV service quality-impacting layers: NFVO, VNFs and NFVI • Network infrastructure assurance for both VNFs and PNFs. (See Network Infrastructure Assurance section.)
External interfaces and OpenStack integration (See Figure 6)	• NFVO-VNFM integration supports execution of VNF life-cycle management actions through OpenStack Heat and Nova APIs • VI-VNFM integration supports ¬ Monitoring VM status using Nova API ¬ Collection of performance metrics using Celiometer API ¬ Raising hardware alarms on NFVO notification using 5620 SAM north-bound API • Open north-bound interface for VNFM enables integration with network services orchestration applications

Network service management

Alcatel-Lucent 5620 SAM service management maximizes efficiency of service operations network-wide across the domains of the all-IP network. It accelerates service deployment with service templates and scripts for provisioning, rules-based QoS and accounting policy assignment, and automated SLA validation. External systems are able to access service management functionality through an open OSS interface. (See Table 4 for feature summary.)

Flexible provisioning options

Templates and workflows enable point-and-click service creation. Operators are guided step-by-step as they set up complex services for rapid provisioning and fewer errors. Templates also enable operators to customize and standardize their provisioning workflow to match internal processes. Layer 2 and Layer 3 services are provisioned in the same way, reducing delivery costs for different service types.

Provisioning verification

Newly activated services can be validated using a service test suite. Tests are automatically extended as services expand so test coverage does not drop off over time. Individual component tests for the newly provisioned entity are automatically created and include detailed test results.

Service accounting

The 5620 SAM collects accounting statistics to meet a wide range of billing requirements. Setup is accelerated by per-service accounting policy assignment that controls statistics collection for related service access ports. Third-party billing systems can also benefit from aggregated accounting statistics that are grouped per service, since it simplifies integration effort through using the 5620 SAM OSS interface.

Automated service deployment

The advanced 5620 SAM scripting framework enables programmatic control to automate service provisioning and accelerate time-to-market for new services. Everything can be automated from service creation to QoS policy assignment to service accounting policy setup for even the most complex end-to-end services spanning multiple technology domains. After deployment, setup of service test suites can be automated so that SLAs are continuously monitored. (See Figure 1 for more details on automation through 5620 SAM scripts.)

Services management

Services management provides a centralized view for listing services, performing maintenance and troubleshooting, including search filters, status indicators, and cross-navigation to configuration forms and topology maps for each corresponding service.

Table 4. Alcatel-Lucent 5620 SAM services deployment, maintenance and management feature summary

CATEGORY	FEATURES
Rapid service creation	• GUI-based service provisioning with concurrent, multiple object editing • Step-by-step form entry using service templates simplifies complex tasks with reduced user-entry fields • Network SDP provisioning • Rules-based auto-creation of service tunnels • Per-service policies on services to control statistics collection for billing requirements • Post-discovery control scripts to automate deployment and management for any managed devices (See Figure 1) • Third-party device provisioning using CLI scripts with security and version control
Provisioning and service deployment validation	• Single-click service validation through auto-generated OAM tests • Per-service network policy audits • Scripting-based service deployment audits and SLA validation
Services management support	• Layer 2 Ethernet (VPLS, VPWS/VLL), Layer 3 IP VPN, dynamic VPN (RADIUS policy auto-provisioned) and subscriber services • Composite services that combine multiple services into a unified managed service • Service connection admission control (CAC) to automate tunnel selection based on tracked bandwidth bookings
Cross-domain services management support	• IP-integrated optical transport services with WaveTracker power monitoring and light path tracing for DWDM and OTN, including for Layer 0 OCh or OTU, Layer 1 ODU and Layer 2 EPL or EVPL • IP-integrated Ethernet packet-based microwave services and IEEE 1588v2 PTP synchronization services • Data center dynamic virtualized services and SDN management for Nuage Networks, including for VXLAN, EVPN and software-defined VPN (SDVPN)
OSS interface	• Open north-bound interface enables external applications to integrate with full access to 5620 SAM managed services data

Network service assurance

The Alcatel-Lucent 5620 SAM delivers comprehensive service assurance from continuous SLA, performance and health monitoring, service topology visualization, and service impact fault visualization, as well as advanced service-to-infrastructure correlated troubleshooting. (See Table 5 for feature summary.)

**Table 5. Alcatel-Lucent 5620 SAM service assurance feature summary**

CATEGORY	FEATURES
Topology maps	• Service topologies give fault status view of underlying network infrastructure involved in the delivery of a service • Service topologies give an end-to-end service view for composite services that tie together multiple cross-technology segments • Topology overlays provide fault status and additional troubleshooting information, such as performance statistics, or OAM test results with trace highlighting after point-and-click execution from a map
Service supervision	• At-a-glance web-based dashboards for services and service group monitoring • High-level summaries and detailed supervisory views for monitoring service health using fault trends, KPIs and OAM service validation

SLA monitoring and Service Test Manager (STM)	• OAM and Service Assurance Agent (SAA) test validation of end-to-end services and underlying network layers
	• Proactive monitoring with scheduled OAM test suites to continually assess performance across various technology layers
	• Service infrastructure performance statistics provide additional service KPIs
	• Threshold-crossing alerts triggered on out-of-bound KPIs notify operators immediately of emerging issues before SLAs are violated
	• Tightly integrated with 5650 CPAM for:
	  ¬ Monitoring health of high-priority service paths and prefixes
	  ¬ Auto-triggered service infrastructure testing and alarms on routing changes

Root-cause and service impact analysis	• Advanced alarm visualization delivers an understanding of which problems impact the most services • Alarm correlation through rules engine to identify root cause of problem from symptoms • Root-cause alarm impact tree visualization to easily navigate to root-cause or related infrastructure and service alarms in tree • Service infrastructure hierarchy views show impacting alarms and provide cross-navigation to specific forms for further investigation • Web-based GUI for wider accessibility
OSS interface	• Open interface enables external applications to integrate with full access to 5620 SAM service assurance and accounting data

Service topologies

Service topologies help operators to proactively detect and troubleshoot service-affecting problems, from simple to complex. The 5620 SAM provides visualization for both Layer 2 and 3 service topologies, and IP/MPLS integrated optical transport services. Composite services can be created to enable better end-to-end service assurance for more complex service architectures that combine multiple service technologies. OAM diagnostics may also be enabled to allow SLA validation right from the service topology map using service tests with views of result summaries.

Together, the 5620 SAM and 5650 CPAM deliver multi-layer visualization and topology overlays to enable operators to see how services are tied to multiple network infrastructure layers. In addition, Service Routing maps are integrated through the 5650 CPAM for highlighting service paths on an IGP topology in order to investigate routing issues with potential services impact. (See Figure 8.)

Figure 8. Services highlighted on IGP topology
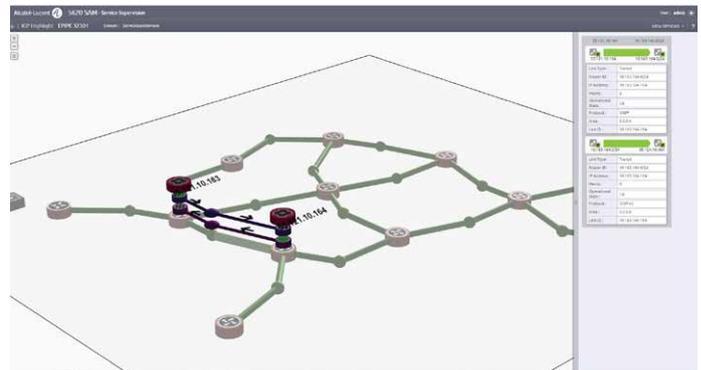
Service health monitoring and service test management

Extensive collection of service performance statistics and comprehensive SLA monitoring tools let operators verify services from end to end as well as individual service segments. Service test suites can simultaneously test every aspect of a group of services, including multi-layer OAM validation of service infrastructure performance. Test suites can also be set up to provide continual scrutiny of KPIs across various technology layers. In addition, performance monitoring thresholds set on activating OAM test suites and statistics counters enable operators to be alerted as issues emerge.

Third-party service performance management OSS integrations benefit from highly scalable statistics collection enabled through the 5620 SAM OSS interface.

Service supervision

At-a-glance dashboards for services and service group monitoring provide web-based summaries and detailed supervisory views for monitoring service health using fault trends, KPIs and OAM service validation. Operators may also run on-demand OAM service validation tests from service supervision views to investigate further.

Root-cause and service-impact analysis

The 5620 SAM allows operators to quickly pin-point the root cause of a problem and determine which users are affected through sophisticated visual insight. This service impact visualization is made possible through a comprehensive service-aware infrastructure model and an advanced alarm correlation engine that ties network infrastructure events to impacted services.

Service correlation rules combined with advanced fault management visualization enable easy service impact assessment of faults to help identify priority for investigation and accelerate troubleshooting. At-a-glance network-wide alarm distribution views give an understanding of problems with the most services impact. Problem diagnosis is simplified through clear views that show the root cause of a fault, including an impact tree of correlated faults. (See Figure 3 for examples of advanced fault management visualization.)

Third-party fault management OSS integrations, enabled through the 5620 SAM OSS interface, also benefit from configurable alarm suppression capabilities.

Platform

The Alcatel-Lucent 5620 SAM base platform provides the architecture, security and other facilities utilized by all 5620 SAM applications. It also provides a north-bound interface for OSS/BSS application integration. (See Table 6 for the platform feature summary.)

Table 6. Alcatel-Lucent 5620 SAM platform feature summary

CATEGORY	FEATURES
Architecture	• Distributed, high-availability architecture for redundancy and fast system failover • Server virtualization options using VMware vSphere and Linux KVM hypervisors
Security	• Operator profile management, including for controlled user access to NMS functions and network resources • User/OSS client activity logs • Server hardening to industry-standard best practices (for port use, protocol use, authentication, authorization, and so on) • RADIUS/TACACS+ authentication • SNMPv3 trap authentication • SSHv1/v2 to device and SFTP from device • Database error monitoring to scan for SQL injection attacks
OSS/BSS integration	• Open, bidirectional XML and JMS interfaces • Allows many simultaneous operational 5620 SAM OSS clients – 30 for XML API and 20 for JMS • Software development kit with sample code and developer's guide • Custom OSS web application interfaces developed through the Alcatel-Lucent Service Portal • Alcatel-Lucent OSS Connected Partner Program certifies integration between the 5620 SAM and market-leading OSS applications

Scalable, secure and flexible system architecture

High availability, system redundancy and fast system failover options allow operators to implement a highly secure network operations environment. The distributed architecture enables support for the largest networks and a massive volume of statistics.

Server virtualization

The 5620 SAM virtualized server deployment enables NMS or IT administrators to easily integrate the 5620 SAM into their standardized environment, reducing OPEX and taking advantage of generic solutions for redundancy and backup/restore. And virtualized server deployment can leverage existing IT technologies such as SAN capabilities for data replication, as well as hypervisor monitoring and maintenance tools.

The 5620 SAM supports service virtualization options using VMware vSphere and Linux KVM hypervisors.

User security with scope of command and span of control

Scope of command allows network administrators to define each operator's access to operations and commands. With span of control, network administrators can subdivide network resources and assign operators clear ownership, based on security privileges for their geographic location, organizational group, job function or individual responsibilities.

OSS/BSS integration

Full access to 5620 SAM functionality and network infrastructure/service management data is provided through an open OSS interface. All 5620 SAM applications, including the 5650 CPAM, share this common north-bound API accessible from a single platform.

External applications may integrate using request-based XML queries, which provide XML results for efficient parsing, as well as Java Messaging Service (JMS) notifications to trigger event-driven behavior.

OSS integrations may also maximize efficiency by triggering 5620 SAM scripts for pre-processing. External applications subscribed to JMS events through the 5620 SAM OSS interface may trigger scripts through the XML API based on these events. (See Figure 1 for more details on automation through 5620 SAM scripts.)

Typical OSS/BSS integrations would include applications for service activation/provisioning, fault management, performance reporting, SLA management, billing, traffic engineering and network capacity planning.

Alcatel-Lucent OSS Connected Partner Program

The Alcatel-Lucent OSS Connected Partner Program further reduces OSS integration time and costs by certifying integration of the Alcatel-Lucent 5620 SAM with applications from industry-leading independent software vendors.

Technical specifications

Operating environment

The Alcatel-Lucent 5620 SAM, Release 13, operates on the following:

- Main, database, auxiliary servers and clients
  - ¬ x86 platforms supported: HP® Intel-based
  - ¬ Operating systems supported: Red Hat® Enterprise Linux® (RHEL) 6
  - ¬ Databases supported: 5620 SAM Database embeds installation of Oracle® Database 12c

- ¬ Virtualization: VMware vSphere ESXi 5.0, 5.1 and 5.5 and Linux KVM on RHEL 6.3/6.4/6.5/6.6 using QEMU version 0.12.1.2
- Additional clients:
  - ¬ Microsoft® Windows® 7 and 8 Professional (32-bit and 64-bit editions)
  - ¬ Microsoft® Windows® Server 2008R2*/2012 (also for client delegate servers; *including support for Citrix XenApp 6.5 and 7.6)

Minimum hardware requirements for Alcatel-Lucent 5620 SAM, Release 13

APPLICATIONS	X86 PLATFORM
5620 SAM main server: • It is recommended that the 5620 SAM server be installed on a workstation separate from that of the 5620 SAM database for large-scale deployments	• 1 quad core CPU • 24 GB RAM • 4 disk drives, minimum 146 GB each
5620 SAM database (Oracle Database 12c): • Stores network objects and configuration • 5620 SAM server can be installed on a workstation separate from that of the 5620 SAM database for large-scale deployments • RAID 0 and 1+0 technologies are supported • Storage area network (SAN) storage is supported with 4 GB or faster optical connections with dedicated Fibre Channel connection between hosts and storage arrays	• 1 quad core CPU • 16 GB RAM • 4 disk drives recommended, minimum 146 GB each
5620 SAM auxiliary statistics collector server: • Dedicated server required for large-scale deployments • For 5620 SAM logToFile large-scale collection • Dedicated server required for call trace and debug trace data collection	• 2 quad core CPUs • 16 GB RAM • 8 disk drives, minimum 146 GB each
5620 SAM client: • GUI presentation front end • Only one client should be installed per platform	• 1 CPU, 2 GHz or higher • 1 GB dedicated RAM • 1 GB available disk space • 1280 × 1024 display resolution
5620 SAM client delegate and third-party remote display server: • Single client install for multiple GUIs for multiple users • Citrix is recommended third-party remote display software • X11 protocol and native X displays supported	• 4 CPU cores • 24 GB dedicated RAM • 1 GB available disk space For a maximum of 15 concurrent GUIs. Increased hardware specifications are required as number of concurrent GUIs increases.

Note: Hardware recommendations may vary depending on scale of deployment. Contact your Alcatel-Lucent representative for the Alcatel-Lucent 5620 SAM Planning Guide for hardware requirements and platform sizing recommendations.

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