Cisco ASR 9000 Network and Service Management

Solution Overview

The ASR 9000 network and service management solution provides operational excellence using the Cisco IOS® XR System Management Framework and an open, extensible network management system (NMS) and operations support system (OSS) Platform. This results in continuous systems operations and service flexibility to meet service provider requirements.

Overview

The carrier-class Ethernet networks are evolving with the multitude of services using the same infrastructure. The need for dense Ethernet- Gigabit Ethernet- and 10 Gigabit Ethernet-based transport is led mainly by the convergence of services such as voice, video, high-speed data, and mobility on this Carrier Ethernet network. The Cisco® IP Next-Generation Network (NGN) framework provides a flexible and scalable architecture to support this growth.

The Cisco ASR 9000 Series is a dense Carrier Ethernet services and transport platform with the ability to offer any-play services, including voice, video, mobility, and high-speed data for both residential and business service offerings. The Cisco ASR 9000 Series extends the IP NGN Carrier Ethernet design for aggregation and edge networks (Figure 1).

Because of the complexity of today's network infrastructure, the ability to operate these networks and manage the network elements has become a prime requirement for all service providers worldwide. The Cisco ASR 9000 comes with a comprehensive set of hardware and software functions to allow smooth operation, administration, maintenance, and provisioning (OAM&P) of these services in the most flexible manner possible.

Figure 1. Cisco ASR 9000 Series

This paper describes the various components of the network operations and network management functions available for the Cisco ASR 9000 Series platform. It provides insights into the Cisco flagship, open, extensible management framework, the Cisco Active Network Abstraction (ANA), and describes how this framework helps manage all aspects of Carrier Ethernet services and network elements. Cisco ASR 9000 Series manageability also provides the ability to manage the IP-over-dense wavelength-division multiplexing (IPoDWDM)-related optics, providing a full coverage for a typical service provider deployment.

The paper first discusses Cisco ASR 9000 Series system management functions, and then reviews the architecture, features, and functions of the Cisco ANA framework as it applies to Carrier Ethernet service activation, provisioning, assurance, and management. It concludes with a review of some key benefits for service providers.

Cisco ASR 9000 Embedded Management

The Cisco ASR 9000 Series is built to meet the scale and growth of Carrier Ethernet services. The system management functions are well-built to serve the needs of various service provider customers, to help them activate, provision, assure, manage, and bill for these services. The following are some important aspects of this operational and management portfolio that are part of the base system:

- In-band management ports: The router offers dual 10/100/1000 Ethernet ports for in-band management per control-plane engine; the ports are secured from spoof and denial-of-service (DoS) attacks.
- Cisco ASR 9000 Embedded Management framework: The embedded instrumentation and management interfaces in the router are the most important components of its manageability. If the router does not have the proper instrumentation and access to the information and control, operators and OSS applications will not be able manage it.

  The Cisco ASR 9000 Series offers embedded fault, configuration, accounting, performance, and security (FCAPS) management capability that goes beyond basic router instrumentation. By incorporating most of the management processing previously performed by external management applications, the Cisco ASR 9000 Series can respond to events and requests more quickly and consolidate and report data to help OSS systems scale.
  - Cisco Craft Works Interface (CWI): Basic device configuration with a craft-like interface
  - IOS-XR data interface (aka IOX Data I/f): Configuration by using EMACS-like interface
  - Service console: Troubleshooting and fault monitoring
  - Alarm subsystem: Fault monitoring
  - Practical Extraction & Reporting Language (PERL) scripting toolkit for rapid Extensible Markup Language (XML) development: Basic system configuration
  - Embedded security to protect the system using secure management access through Secure Sockets Layer (SSL), Secure Shell (SSH) Protocol, TACACS+, and RADIUS-based authentication, authorization, and accounting (AAA)
- Ethernet OAM framework: This framework offers end-to-end Carrier Ethernet management, including support of 802.3 OAM and Connectivity Fault Management (CFM) technologies for end-to-end troubleshooting.

The Cisco ASR 9000 Series provides a comprehensive framework with many tools through the embedded interfaces for flexible use for various service provider needs using an embedded system management architecture and related interfaces.

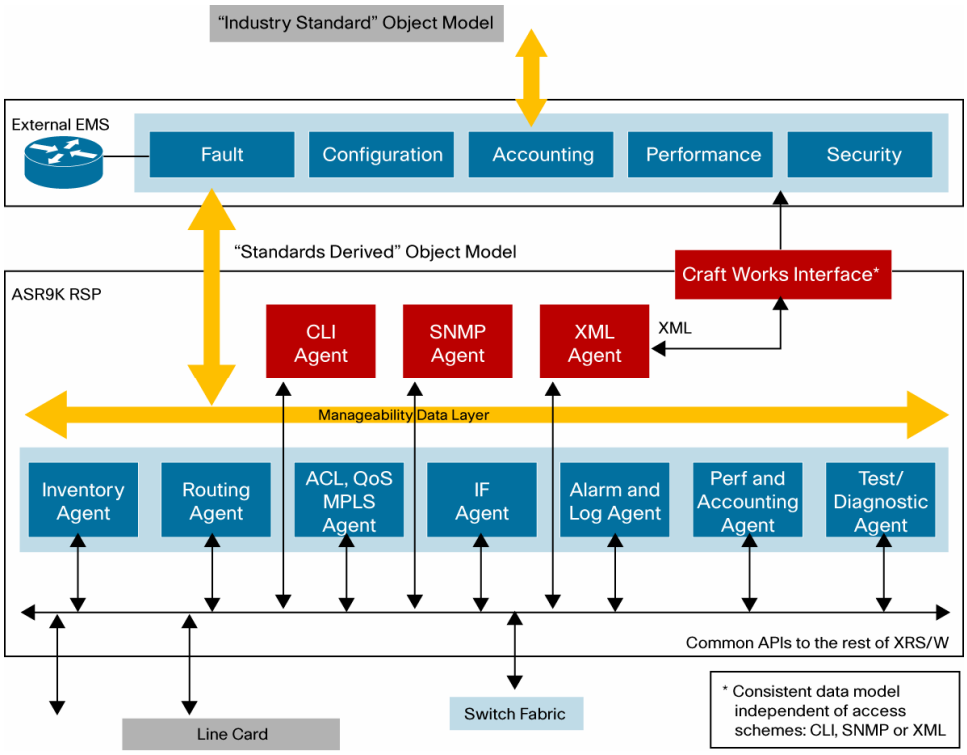
Embedded Interfaces

To use the information and control enabled by embedded instrumentation, a routing platform must offer access through interfaces and software known as application programming interfaces (APIs). These interfaces should be published and based on industry standards. If the interfaces are proprietary, service providers pay significantly higher costs for the service integration of the device into their existing OSS infrastructures. Service providers will continue to pay higher costs to maintain the integration as the OSS evolves, raising the total cost of ownership (TCO).

The Cisco ASR 9000 Series supports both physical interfaces and standard API access (Figure 2) to the instrumentation embedded within Cisco IOS XR Software, including an internal metadata model that maintains management consistency across access schemas, whether it is a command-line interface (CLI), Simple Network Management Protocol (SNMP), or XML:

- Physical interfaces: Because a network connection to a failing or initializing device may not be available, the Cisco ASR 9000 Series supports serial console and auxiliary ports and 10/100/1000 Ethernet management interfaces on route processors. As the management entry points of the Cisco ASR 9000, the route-switch-processor (RSP)-based Ethernet interfaces are not in the routing table or advertised security, and they also support ACL control to filter management access traffic according to security policies like any other system interface.
- Cisco ASR 9000 CLI: As with most networking devices, CLI is a traditional management method with which operators are comfortable. Users familiar with the Cisco IOS Software CLI will quickly learn and adapt to the Cisco IOS XR Software CLI.
- SNMP: Although not always the most efficient, SNMP is one of the most pervasive protocols used by management systems. To support integration with most OSS applications -- event management in particular -- Cisco IOS XR Software supports an extensive list of MIBs and multiple versions of SNMP, including SNMPv1, v2c, and v3. The Cisco ASR 9000 MIBs constitute an extensive set of open interfaces for constant manageability at device and service levels.
- XML: Perhaps the most popular for provisioning integration, XML provides an excellent mechanism for formatting, encoding, and transmitting complex data between routers and management applications.

Figure 2. Cisco ASR 9000 with Cisco IOS XR Software Embedded Manageability Architecture



The Cisco ASR 9000 Series programmatic interface is provided by XML. Its rich schema enables rapid development of management scripts and customized applications for router configuration and monitoring. Using the XML interface, client applications can access Cisco ASR 9000 management data by encoding the request within an XML stream and sending it to the router over a variety of transport methods such as XML over Telnet or SSH. The query result is returned to the client in XML format. XML tags are defined and published in router XML schema documents and used by client applications to encode and decode XML streams. For example, a tagged response may be used to customize the presentation and format the data display, thus eliminating the need to parse unformatted ASCII text, which is frequently used with text-based responses.

Cisco ANA Framework: Cisco ASR 9000 Element and Service Management

With Cisco ANA software, we offer an innovative approach for managing service provider networks. Cisco ANA creates a virtualized, service-oriented network model that reflects the near-real time state of every network element. It delivers an end-to-end visualization of the entire network in a vendor-neutral environment. It successfully addresses service provider requirements for manageability, including service fulfillment and service assurance, making it a comprehensive offering that reduces complexity and costs.

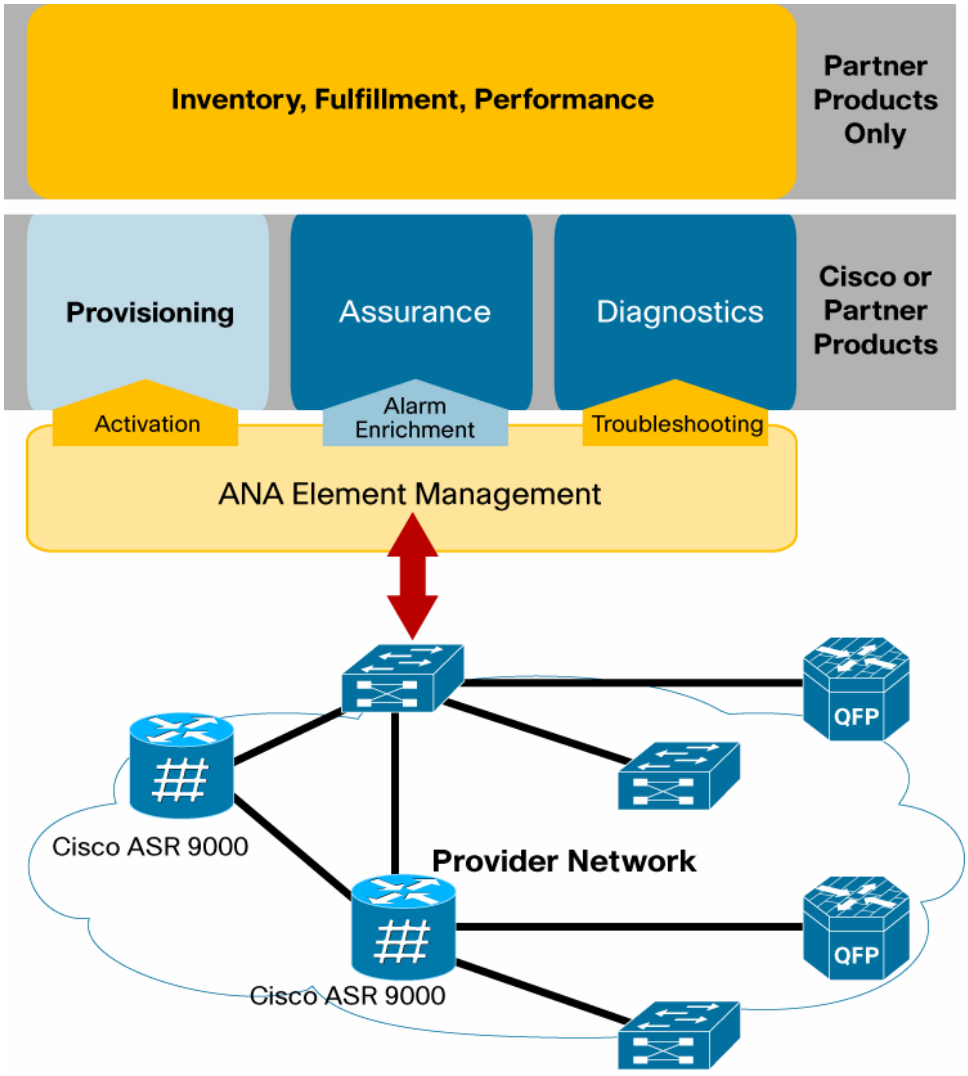
Cisco ANA software represents a management framework that enables end-to-end, service-level management in very large vendor-neutral, multitechnology, multiservice networks. This long-awaited, elegant solution is designed to manage converged, multiservice infrastructures based on the Cisco IP NGN architecture. The overall Cisco ANA-based solution is built on a virtualized network model. This model creates a device-agnostic element management system that allows you to enable efficient service fulfillment, create service-level views, enable service-specific fault and performance management, and integrate billing systems. Cisco ANA is a flexible framework

that vastly simplifies service provisioning, configuration, monitoring, and troubleshooting processes to reduce operational expenditures, shorten time to revenue, and increase customer satisfaction.

Combining the Carrier Ethernet management infrastructrure available on the Cisco ASR 9000 Series with Cisco ANA provides a scalable and sustainable architecture for service discovery, activation, and management for various Carrier Ethernet Layer 2 and Layer 3 services.

The Cisco ASR 9000 with ANA application support provides Carrier Ethernet service activation, service assurance, element management, and standardized open interfaces for OSS and business-support-system (BSS) and partner applications. Figure 3 provides an overview of the architecture.

Figure 3.



Element Management

The Cisco ASR 9000 with ANA provides essential aspects of a service provider element management system (EMS).

Discovery: Discovery of the network, physical and logical modeling of the devices, and physical topological representation

Fault: Device-level fault and event management (includes SNMP and syslog traps)

Configuration: Template-based configuration, Virtual Network Element image management, and network-element configuration archive facility

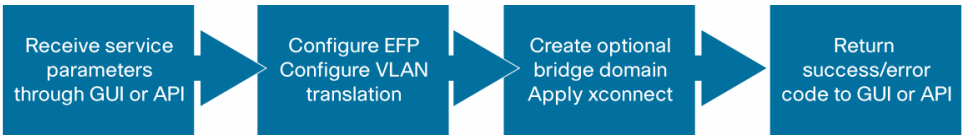
Performance: Near-real time data collection for user-selected parameters on Cisco IOS XR Software-based devices

Security: Role-based access control (RBAC) capabilities for complete lifecycle management

Carrier Ethernet Service Management

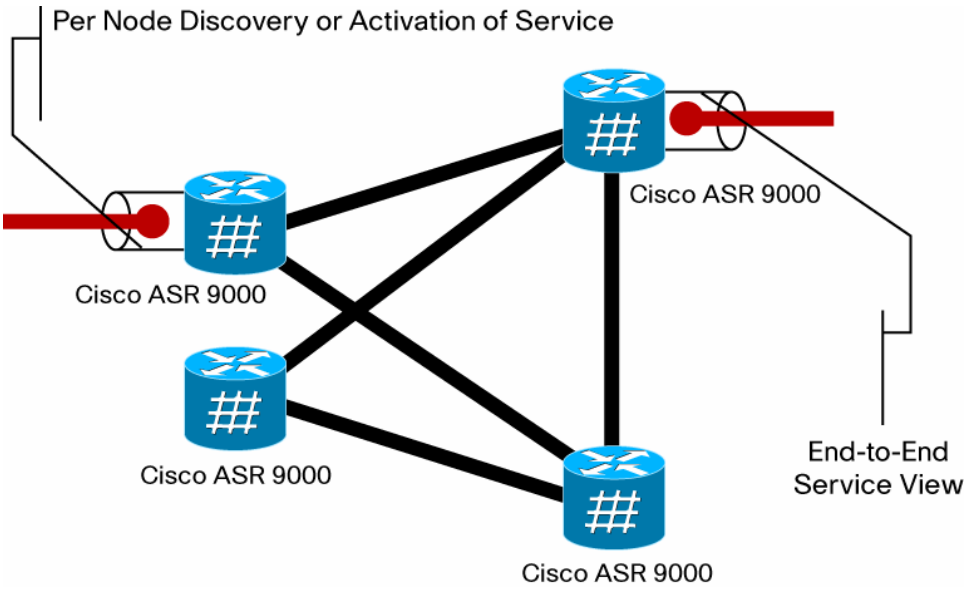
The ability to effectively discover, activate, and manage overall Carrier Ethernet services -- essential for scalable service provider networks -- is enabled by the service management platform. The Cisco ANA and Cisco ASR 9000 Series provide an extensive set of service management functions with the ability to discover, activate, and manage services such as point-to-point (E-Line), and point-to-multipoint (E-LAN) services. The service activation follows some critical steps on each service endpoint node for a given service (Figure 4).

Figure 4. Service Activation Work Flow



The resulting end-to-end service view is available through the Cisco ANA GUI for further analysis and troubleshooting. The end-to-end view can be depicted as shown in Figure 5:

Figure 5. E-Line Service View with Cisco ASR 9000 and Cisco ANA



Video Service Management with Cisco ASR 9000

Advent and growth of video is accelerating the need for elimination of human error as well as improving mean time to repair (MTTR), thus calling for effective network management for video and IPTV. Service providers are looking for end-to-end video provisioning and troubleshooting to have competitive offerings. Cisco provides proactive, automated, and scalable troubleshooting information for video flows in a service provider Carrier Ethernet network. The availability of such information translates directly into operating expenses (OpEx) savings for the service providers using such systems.

The Cisco ASR 9000 Series, along with the Cisco Video Assurance Management Solution (VAMS), provides a proactive video monitoring and troubleshooting system that works in conjunction with the Cisco ASR 9000 system resources and multicast functions, SNMP MIBs, and other Cisco products such as Cisco Multicast Manager to provide an end-to-end video flow troubleshooting and monitoring capability. This monitoring is further enhanced by the ability to perform root-cause analysis to isolate the problem and the integration with OSS and BSS systems.

Additionally, Cisco VAMS provides integration with the Cisco ANA framework using the trap receiver destination as well as additional hooks.

Benefits of Cisco ASR 9000 Video Assurance follow:

- Reduced MTTR
- Enhanced video quality of experience
- Proactive video-transport monitoring
- Events correlations to the effect on the service
- Increased operational efficiency

Conclusion

Profitable service provider networks depend on next-generation routing platforms that offer continuous system operation and exceptional service flexibility. The key to delivering high availability and service delivery for Carrier Ethernet routing platforms is a robust network management solution. Through the support of embedded instrumentation, interfaces, and application services, Cisco ASR 9000 Series Routers offer an evolution of both Carrier Ethernet and its manageability, along with the integration with the existing OSS and BSS. The Cisco ANA framework allows the distinctive end-to-end element and service management of the Cisco ASR 9000 system. Video as an influencing factor for triple-play residential services (data, voice, and video) will benefit greatly from the Cisco ASR 9000 system and the supporting management infrastructure.

For More Information

End-to-end service-level management with Cisco Active Network Abstraction (ANA): http://www.cisco.com/en/US/prod/collateral/netmgtsw/ps6504/ps8203/ps6776/prod_white_paper0900aecd80504547.html.

Ethernet OAM review: http://www.cisco.com/en/US/prod/collateral/routers/ps368/prod_white_paper0900aecd804a0266_ns577_Networking_Solutions_White_Paper.html.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV
Amsterdam, The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Printed in USA C11-501304-00 10/08