Cisco Catalyst SmartOperations Solutions Guide

Lower TCO by Activating Embedded Switch Tools that Automate Lifecycle Management Operations

What Is Cisco Catalyst SmartOperations?

Cisco® Catalyst® SmartOperations is a comprehensive toolkit of network services built into the foundation of Cisco Catalyst LAN switches. These embedded capabilities simplify and automate switch lifecycle management tasks and the quality-of-service (QoS) policy enforcement that real-time voice and video network traffic requires. There are about a dozen of these network service features, which together form the **Cisco Catalyst SmartOperations Toolkit** ("SmartOperations"), and they ship on Cisco Catalyst platforms running LAN Base or higher software. Cisco Catalyst SmartOperations tools lower total cost of ownership (TCO) by simplifying and automating network planning, deployment, monitoring, and troubleshooting.

Cisco Catalyst SmartOperations Toolkit

Targeted at automated LAN switch lifecycle management, SmartOperations delivers:

- Productivity savings
- Increased efficiency
- Reduced switch and network downtime
- Improved user experiences
- Support of new network services

Goals of This Guide

This document is intended to familiarize you with the Cisco Catalyst SmartOperations tools by defining each one and explaining how it can best be used to your operational advantage with sample use cases. The document is also intended to demonstrate how bundling these automated planning, deployment, monitoring, and troubleshooting features into the baseline switch product pays dividends over the life of Cisco Catalyst switches by reducing operational costs. Operating expenses now account for up to 70% of the total cost of ownership for access switching networks, according to a recent analysis by Forrester Consulting[1].

This document is not a deep technical dive into how to configure each SmartOperations tool. Instead, it's intended to serve as a starter overview guide to explain what's in the toolkit, what each feature does, and its primary use cases. The goal is to educate Cisco Catalyst customers and encourage them to activate and benefit from the built-in features. You'll find an at-a-glance summary matrix showing which use cases and applications benefit the most from which features and which switching platforms support which SmartOperations tools starting on page 9 References to other documents where you can find further information about specific configuration steps and technical details are included in the descriptions of each SmartOperations feature starting on page 4.

[1] The Total Economic Impact™ of Cisco Catalyst Access Switching, A Commissioned Study Conducted by Forrester Consulting On Behalf of Cisco Systems, January 2012.

Making Accurate Product and TCO Comparisons

Because most enterprises are under budgetary pressure to accomplish more while spending less, it's important to consider the inherent value-add of Cisco Catalyst SmartOperations when doing side-by-side product evaluations and TCO calculations. Accounting for the time savings and operational efficiencies of these capabilities, which include zero-touch deployment, helps make sure that your comparative assessments are accurate.

For simplicity's sake, buyers are frequently tempted to compare just upfront capital costs. However, equipment costs alone don't take into consideration the longer term operational expense savings derived by activating and using SmartOperations tools, which require no extra software licensing or product purchases.

TCO, not just capital expenditures (CapEx), is what represents the bottom line, and Cisco's automated, intelligent software lowers your network TCO by reducing IT workloads, the time required to make network changes, and system and network downtime. The result is lower expenses associated with all equipment and network lifecycle issues. In addition, IT staff gains back time to focus on other higher-priority, strategic projects. And end users get a productivity boost, because the switches and Ethernet network are available to users a greater percentage of the time.

Forrester Consulting has analyzed the return on Cisco Catalyst access switches over a five-year period for a composite organization of 2,500 employees. Forrester estimates that Cisco Catalyst access switching provides up to 14 percent lower TCO (CapEx and operating expenses (OpEx) combined) than access switching products other than Cisco Catalyst. The use of Cisco Catalyst SmartOperations tools accounts for about a quarter of those 14 percent lower costs. The Forrester results are summarized in Table 1.

Table 1. Sample Cisco SmartOperations ROI Calculation. These Sample Savings Are Based on a Composite Organization of 2,500 Employees Supporting 5,788 Devices that Forrester Synthesized, Based on Interviews with Five Cisco-Supplied Customers and an Online Market Survey of 104 Senior Network Managers

Feature	Metric	Initial	Year 1	Year 2	Year 3	Year 4	Year 5
Smart Install	Reduction in initial and ongoing configuration costs - switches	$3,645	$331	$331	$331	$331	$331
Auto Smartports	Reduction in initial testing and configuration costs - devices		$46,733				
Auto Smartports	Reduction in ongoing configuration of devices		$6,024	$6,024	$6,024	$6,024	$6,024
Smart Install	Reduction in overprovisioning	$133,257					
Annual Total		$136,902	$53,088	$6,355	$6,355	$6,355	$6,355
Combined Total Savings		**$136,902**	**$189,990**	**$196,345**	**$202,700**	**$209,055**	**$215,410**

Source: The Total Economic Impact™ of Cisco Catalyst Access Switching, A Commissioned Study Conducted by Forrester Consulting On Behalf of Cisco Systems, January 2012

Evaluations can be deceptive, because competitive products often ship with very different levels of embedded value. Some LAN switches, for example, might carry an initial attractive price tag but require additional software licenses or hardware investments to reach functional parity with more feature-rich products. Or they might not even have the ability to support those competitive functions at all. Similarly, the more feature-rich products might carry an upfront CapEx premium but have the tools enterprises need to recoup the premium quickly and then gain even more in operational savings. Cisco Catalyst LAN switches with built-in SmartOperations tools, for example, support several features that don't exist in competing LAN switching solutions.

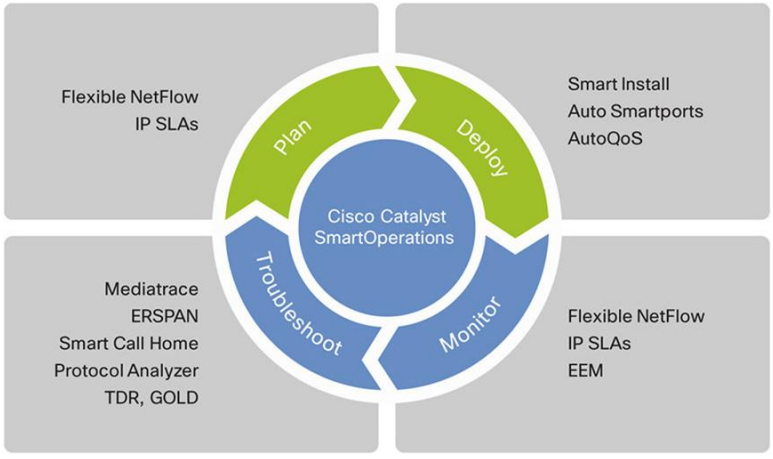
Using SmartOperations software, you can auto-configure new switches simply by plugging them into an already-imaged Cisco Catalyst switch (using a unique feature called **Smart Install**). Another unmatched feature is the ability to dynamically reconfigure the VLAN and QoS of a switch port based on the device type that's plugged into it (**Auto Smartports**). The switches also uniquely identify, at both the network element and application level, where in the network path a session has failed (IP service-level agreements, or **IP SLAs**); detect events and automatically take policy-based corrective action (Embedded Event Manager, or **EEM**); and provide visibility into jitter, latency, and packet loss metrics on hop-by-hop application flows (**Mediatrace**) for performance control of real-time and other traffic.

The key for enterprises, of course, is to make sure to activate the features so that they can exploit the full, enhanced value of their Cisco Catalyst switches. The next section describes how SmartOperations features map to network lifecycle management tasks and suggests best use cases for all SmartOperations features.

Mapping SmartOperations to Lifecycle Management Tasks

The basic lifecycle of network equipment such as Cisco Catalyst switches involves planning for needed network capacity and port speeds to meet service-level agreements (SLAs) and avoid overprovisioning; deploying the equipment; monitoring switches and network links for performance, uptime, and resource usage; and quickly troubleshooting any issues that the monitoring function detects. Automating one or more aspects of each of these lifecycle steps accelerates an enterprise's ability to meet resource demands, scale, reduce help desk calls, and generally keep the network operational with less IT time and effort than if each function had to be accomplished manually. Each Cisco Catalyst SmartOperations tool assists in one or more lifecycle management function (see Figure 2).

Figure 1. Lifecycle Management Functions. Each SmartOperations Tool Automates One or More Phases Off a Switch's Lifecycle Management



Plan: Assess Requirements and Avoid Overprovisioning

Capacity planning is necessary so that enterprises can assess current and future network resource requirements. Visibility into network traffic flows, including which users and applications are traversing the network, when and where, is necessary for optimum LAN design and configuration. The following two SmartOperations features are primary features for capacity planning.

Cisco IOS Flexible NetFlow

Cisco IOS® Flexible NetFlow collects and reports information about several aspects of every traffic flow, filtered as desired by the network administrator on the various Layer 2 and Layer 3 header fields. Among these detected attributes are network interface number, VLAN ID, source and destination IP addresses, and packet priority (QoS). This tool provides you with deep and varied visibility into how network assets are being used and how the network is behaving. Flexible NetFlow's data capture over time helps enterprises anticipate network growth and plan upgrades to increase the number of network infrastructure devices, ports, or higher bandwidth interfaces, while avoiding overinvestment in unneeded resources. For further information, reference http://www.cisco.com/go/netflow.

Cisco IOS IP Service Level Agreements (SLAs)

Cisco IOS IP SLAs collect a variety of network performance measurements between Cisco devices to help you determine if a connection is live. They also conduct edge-to-edge network availability monitoring, so that you can determine the network's readiness to deploy new IP services, such as voice, video, virtual desktop interface (VDI)/Cisco Virtual Experience Interface (VXI), and mission-critical business apps. Before you deploy video, for example, you can validate QoS by creating synthetic traffic with a profile similar to that of to real traffic, conduct test calls, and determine if your conditioning indeed delivered acceptable performance. This reduces OpEx in many ways; one is that you don't prematurely deploy video on a network that doesn't work, which would create support problems and undermine user confidence in using the service going forward. You can also avoid costly, unnecessary overprovisioning of resources by using IP SLAs. For further information, reference http://www.cisco.com/go/ipsla.

Deploy: Accelerate Provisioning Times with Automation

Deploying new network services such as voice, video, and VDI/VXI quickly and affordably requires a healthy measure of automation so that limited IT staff don't have to perform the same configuration tasks over and over again, switch by switch. Three SmartOperations tools in particular assist in deployment automation.

Smart Install

Smart Install is a plug-and-play configuration and image-management feature that provides zero-touch deployment for new switches. You can use it to set up a primary switch as a centralized management "director" that then autoconfigures additional equipment with the same software images or different images based on rules setup. A typical use case is in organizations with a number of distributed branch-office sites, such as a bank or a school district. If branch sites have more than one switch, centralized IT staff can configure one switch or router in each branch over the network; that device serves as the director. Local personnel then simply plug the other switches into the director to automatically download their configurations. In cases where there's a large central site and several single-switch branch locations, the enterprise might want to have all switches shipped to the central location for staging, image them using a director switch, then send autoconfigured switches to the sites where they are simply plugged in. For further information, reference http://www.cisco.com/en/US/docs/switches/lan/smart_install/release_12.2_52_se/configuration/guide/concepts.html. For Smart Install activation steps, visit http://www.cisco.com/en/US/docs/switches/lan/smart_install/release_12.2_52_se/configuration/guide/tasks.html.

Auto Smartports

Auto Smartports dynamically configures switch ports based on the device type plugged into them. When the switch detects a new device on a port, it applies the appropriate policies associated with that particular device type to the port and then removes the policies when the device disconnects. For example, when a Cisco IP phone is plugged in, Auto Smartports automatically applies the Cisco IP phone profile, which carries specific QoS priority markings and a dedicated voice VLAN ID number (for prioritizing the delay-sensitive voice over IP [VoIP] VLAN over other traffic types). The feature uses a variety of mechanisms to discover devices, including Cisco Discovery Protocol, Link Layer Discovery Protocol (LLDP), Dynamic Host Configuration Protocol (DHCP), and Organizationally Unique Identifiers (OUIs) in media-access control (MAC) frame headers. The tool is most useful for organizations that partition their traffic into multiple VLANs and for eliminating the need to label ports for specific devices for static use and then having to make manual configuration changes if they want to use the ports for other device types. For further information, reference http://www.cisco.com/en/US/docs/switches/lan/catalyst4500/12.2/54sg/configuration/guide/automacr.html. For enabling/activating Cisco Auto Smartports, reference http://www.cisco.com/en/US/docs/switches/lan/catalyst4500/12.2/54sg/configuration/guide/automacr.html#wp1220519.

AutoQoS

Cisco AutoQoS automates the five main aspects of QoS deployment: application classification, policy generation, configuration, monitoring/reporting, and consistency. It makes sure that network resource and metric profiles for each application (minimum required network capacity and maximum-tolerated jitter, delay, and packet loss) follow applications across the network, port to port. Automating QoS across the network this way is especially important for real-time voice and video application traffic, which can't tolerate break with QoS policy. For further information, reference http://www.cisco.com/en/US/products/ps6656/products_ios_protocol_option_home.html.

Monitor: Deep Visibility, Rich Diagnostics

Several types of monitoring are required for a number of specific network control purposes. Among them: determining network readiness for a new application deployment, gauging network and application performance and SLA status, security, and troubleshooting.

Cisco IOS Flexible NetFlow

As described in the "Plan" section, Flexible NetFlow provides an audit trail to help you understand network utilization peaks and trends. Flexible NetFlow will let you understand who is using the network, the destination of traffic, when the network is utilized, and the type of applications consuming bandwidth. The deep level of data that can be mined using the Flexible NetFlow tool not only helps in capacity planning, but also assists in troubleshooting, makes sure that QoS parameters are appropriately subscribed per flow, and measures the effects of a new application on network performance. For further information, reference http://www.cisco.com/go/netflow.

Cisco IOS IP SLAs

Cisco IOS IP SLAs, also described in the "Plan" section, help IT stay on top of the ongoing health of the network. Cisco Catalyst network operators use them to get to monitor overall network and application performance and to accurately detect any SLAs in danger of falling out of compliance. Doing so can tell you if performance is degrading before your users complain. It can also let you know if a previously good path in the network needs more capacity.

The tool, unique to Cisco, allows enterprises to increase network reliability by validating network performance, proactively identifies network issues, and eases the deployment of new IP services. For further information, reference http://www.cisco.com/go/ipsla.

Embedded Event Manager (EEM)

Cisco IOS Embedded Event Manager (EEM) detects real-time network events and can automatically execute a set of actions on those events. For example, EEM detects faults and then alerts network administrators or takes automated corrective action. EEM has numerous uses enabled through its scripting capabilities, which allow network administrators to define an event on which EEM should take an action that might involve generating a specific syslog message, invoking a specific command-line interface (CLI) command, or invoking a script to start a series of predetermined actions.

For example, EEM can work in concert with Cisco IP SLAs to detect a network connection that has failed and trigger a failover to a redundant path. EEM can also be used for the simple energy management of Power over Ethernet (PoE) devices. For example, an enterprise wanting to conserve energy can set an EEM policy to shut down the power of some or all switch ports at night, then activate them again when the next work day begins. The major benefit comes from the fact that users can easily insert custom logic into network devices. EEM allows customers to effectively reduce operational expenses and protect their long-term investment on network infrastructures. EEM's primary use cases:

- IP SLAs integration
- Energy management
- Automating packet captures based on flow data
- Extending Simple Network Management Protocol (SNMP) management information base (MIB) with customized MIB objects

For further information, reference http://www.cisco.com/go/eem or visit the Cisco EEM scripting community at http://www.cisco.com/go/ciscobeyond.

Troubleshoot: Fast Problem Resolution Boosts Network Availability

The automation of network troubleshooting is vital for keeping the network available and performance at acceptable levels. Manually hunting for problem spots or even having to sit at a monitor watching for issues is not particularly efficient considering tight IT staff budgets. More effective is for the system to ping IT staff if a "danger" parameter is being approached or, better yet, to remedy the issue at hand on its own.

Smart Call Home

Smart Call Home-enabled devices continually send status updates to the Cisco Technical Assistance Center (TAC), where the updates are processed. The TAC automatically either makes leading practice recommendations or opens a service request. Smart Call Home can automate return material authorization (RMA) cases based on hardware failure notifications, greatly cutting down the time it takes to get replacement parts in hand. Smart Call Home devices also periodically send configuration and inventory data to the TAC, so Smart Call Home can proactively notify administrators about field notices and PSIRT advisories that affect their devices. The feature also stores a history of their configurations, so there is a record in case something breaks while making configuration changes. Note that a related tool, Call Home, doesn't involve the Cisco TAC: You simply use the feature on your device to directly send you periodic alerts, inventory, and configuration data, typically by email.

The tools allow IT staff to spend less time monitoring the network and speeding resolutions for higher network uptime at a lower operational cost. For further information, reference http://www.cisco.com/go/smartcallhome.

Generic Online Diagnostics (GOLD)

Generic Online Diagnostics (GOLD) is a framework for monitoring the health of network hardware at a scheduled time of day or at runtime. Extending the ability to run these diagnostics outside of normal switch startup time can go a long way to providing network managers with information about the health of their network hardware and, more importantly, can facilitate better network availability.

For further information, reference http://www.cisco.com/en/US/products/ps7081/products_ios_protocol_group_home.html.

Mediatrace

Cisco Mediatrace is a tool unique to Cisco SmartOperations and provides automated, hop-by-hop troubleshooting of video streams. Mediatrace helps isolate network degradation problems without having to log into each network node along the path manually. It discovers an IP flow's path, dynamically enables monitoring capabilities on the nodes along the path, and collects information on a hop-by-hop basis about the status of the connection. This capability is particularly important for delay-sensitive, real-time voice and video traffic, such as Cisco TelePresence® sessions, and for mission-critical business applications. However, it is also useful for basic data transmission troubleshooting. With the tool, you can conduct a reachability check and, if it is unsuccessful, see where the connection has been interrupted, at both the connectivity and application level. The types of Mediatrace data collected include the following:

- DSCP
- Input/output interface names
- Input/output interface bytes
- Input/output interface packets discarded
- Management IP address
- Layer 2 node discovery
- Packets lost (RTP)
- Flow bytes observed
- Byte rate
- Loss rate (RTP)
- Flow packets observed
- Packet loss event
- Jitter (RTP)
- Input/output interface speed
- Route change notification
- TCP round-trip time

For further information, reference http://www.cisco.com/en/US/solutions/collateral/ns340/ns856/ns156/ns1094/whitepaper_c11-653899.html.

Encapsulated Remote SPAN (ERSPAN)

Encapsulated Remote SPAN (ERSPAN) monitors traffic on one or more ports or VLANs and sends the monitored traffic to one or more destination ports on a remote chassis, separated from your switch by a Layer 3 routed network. ERSPAN eliminates the need to invest in a separate hardware analyzer tool ("sniffer") to manually connect, capture, and analyze packets at specific ports. Instead, you can connect from any port in your network and virtually mirror traffic and analyze packets from any port on any remote switch for improved efficiency, productivity, and return on investment (ROI). For further information, reference http://www.cisco.com/en/US/docs/switches/lan/catalyst6500/ios/12.2SX/configuration/guide/span.html.

Protocol Analyzer/Wireshark

Enterprises can use the built-in Cisco Protocol Analyzer tool for a variety of purposes. Among them are to analyze network problems; document regulatory compliance; monitor network usage for capacity planning and SLA enforcement; debug client/server communications and network protocol implementations; and verify adds, moves, and changes. Like ERSPAN, this built-in analyzer eliminates the need to purchase external probes ("sniffers") for these functions. The analyzer tool is based on the industry-standard Wireshark open-source packet analyzer code. For further information, reference http://www.cisco.com/en/US/docs/switches/lan/catalyst6500/ios/12.2SX/configuration/guide/mpa.html.

Time Domain Reflectometer (TDR)

TDR is a measurement technique that helps pinpoint cabling issues by determining the characteristics of electrical lines by observing reflected waveforms. The feature injects a test signal into the cable and measures reflections caused by non-uniform impedance. In this way, it can detect cable breaks and is useful for troubleshooting cable connectivity issues. TDR determines opens, shorts, terminated states, and the fault distance from the switch. It enables the proactive testing of the cable, easing operational support of a network configured with Cisco Catalyst switches, reducing time to isolate and correct Layer 1 problems. If the cabling is not capable of supporting the line rate, it will automatically drop to make sure of connectivity. For further information, reference https://supportforums.cisco.com/docs/DOC-18983.

Summary of Deployment Use Cases and Platform Support

Networks now must support a large and varied mix of application services, which differ in their network resource requirements. The Cisco SmartOperations Toolkit makes sure that links remain functional, each app has the QoS profile required, speedy troubleshooting keeps network applications live, and data about network usage is continually gathered for new application deployment planning. Table 2 shows which use cases and applications benefit most from which features, and Table 3 delineates which features run on which Cisco Catalyst switch platforms.

Table 2. Sample SmartOperations Use Cases

Branch Office Deployment*	Network Refresh	Unified Communications Including Voice/Video Collaboration	Virtual Desktop Infrastructure (VDI)/Cisco Virtual Experience Infrastructure (VXI)
• Smart Install • Auto Smartports • EEM • Smart Call Home • GOLD • ERSPAN • TDR	• Flexible NetFlow • IP SLAs • Smart Install • Auto Smartports • TDR	• Flexible NetFlow • IP SLAs • Auto Smartports • AutoQoS • EEM • Mediatrace • Protocol Analyzer	• Flexible NetFlow • IP SLAs • EEM • Protocol Analyzer
Note that there are many other situations, not shown, that also can benefit from the various SmartOperations tools.			

* Consisting of switches, routers, IP phones, and wireless access points per Cisco Smart Business Architecture (SBA) Guide.

Table 3. SmartOperations Platform Support

Lifecycle Phase/ SmartOperations Tool	Cisco Catalyst 6500	Cisco Catalyst 4500	Cisco Catalyst 3xxx	Cisco Catalyst 2xxx
Plan				
Flexible NetFlow	Yes	Yes	Yes	No
IP SLA	Yes	Yes	Yes	Yes (Responder only)
Deploy				
Smart Install	Roadmap	Roadmap	Yes	Yes (Client only)
Auto Smartports	No	Yes	Yes	Yes
AutoQoS	Yes	Yes	Yes	Yes
Monitor				
Flexible NetFlow	Yes	Yes	Yes	No
IP SLA	Yes	Yes	Yes	Yes (Responder only)
EEM	Yes	Yes	Yes	No
Troubleshoot				
Smart Call Home	Yes	Yes	Yes	Yes
GOLD	Yes	Yes	Yes	No
Mediatrace	Yes	Yes	Yes	No
ERSPAN	Yes	No	No	No
Protocol Analyzer	Yes	Yes	No	No
TDR	Yes	Yes	Yes	Yes

SmartOperations Relationship to Cisco Network Management Applications

Cisco Catalyst SmartOperations tools target the quick and efficient rollout and management of new switch deployments and refreshes. SmartOperations tools are activated directly on the switches for operational automation benefits, and they can also run in a complementary fashion to Cisco Prime network management application modules.

SmartOperations functions are generally enhanced when used in conjunction with Cisco Prime LAN Management Solution (LMS), Network Control System (NCS), Collaboration Manager (CM), and other Prime applications. The Prime applications bring graphical interface simplicity and multi-switch, network wide correlation of monitoring data to the management of Cisco Catalyst switches and other Cisco equipment. However, SmartOperations **does not require** Cisco Prime applications in order to function and deliver automated operational and productivity benefits.

In addition, specific Cisco Borderless Networks services such as TrustSec, Medianet and EnergyWise, as well as specific Cisco high-availability technologies, are not part of the Cisco Catalyst SmartOperations framework. However, they, too, can be used in tandem with SmartOperations to further exploit SmartOperations features for additional operational benefits and associated savings.

Conclusion

Cisco offers unique capabilities in SmartOperations on Cisco Catalyst switches that automate and simplify the daily tasks network administrators face. In doing so, SmartOperations helps you avoid overprovisioning through accurate planning, saves time by automating deployment, and delivers effective network monitoring through rich diagnostics and deep application visibility. Competitive product evaluations and cost comparisons should account for SmartOperations capabilities, which are embedded in the base switches, because they sharply reduce OpEx, which has been shown to account for more than three-fourths of a LAN switch's TCO. TCO matters, and Cisco Catalyst SmartOperations tools lower it, making Cisco LAN switches a better buy.

For further information, reference http://www.cisco.com/go/smartoperations.

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 C07-697706-00 02/12