

Operational Efficiency on Cisco Catalyst Switches

Introduction

In today's economic environment more than ever, businesses around the world are focusing on ways to simplify every facet of the business to both increase efficiency and reduce costs. Although networks have evolved over recent years to become an intrinsic part of the fabric of every business, even the network is not immune to this attempt at simplification. Network managers, like their business peers in the organization, are investigating ways to optimize the network's use and efficiency levels.

The Cisco® Campus Network Fabric has numerous operational features and capabilities built into its Cisco Catalyst® switching platforms that can help customers today. These features can help organizations improve operational efficiency in their networks. This paper will explore some of these innovations and enhancements.

Operational Efficiency

Operation efficiency is a foundation of the Cisco Campus Network Fabric and focuses on automation features, being green, and total cost of ownership. These three elements form an umbrella across a number of technological features and enhancements to the Cisco Catalyst switching platforms that set it apart from others in the industry.

Automation

Network automation forms the first part of the Cisco Campus Network Fabric platform. Deployment, monitoring, and troubleshooting of network devices along with audit and compliance have formed the traditional base of operational challenges faced by many network managers. Future new operational challenges such as application awareness, service deployment, and adaptive network services are likely. The Cisco Catalyst switching platforms include a variety of automation and management tools that can help network managers optimize and enhance the manageability and operational efficiency of their networks.

Network application awareness is becoming increasingly important, in part because of the growth of hard-to-track data such as peer-to-peer traffic and emerging technologies such as desktop virtualization. The Cisco® Catalyst® 6500 Supervisor Engine 32 PISA (Programmable Intelligent Services Accelerator) is the first Cisco hardware platform for which hardware-based application awareness and inspection are provided. This platform provides hardware-based Network-Based Application Recognition (NBAR), allowing network managers the ability to inspect and classify more than 100 different protocols ranging from Skype to Kazaa to Citrix and more. For day-zero worms, Flexible Packet Matching (FPM) provides a regular expression mechanism to inspect data up to 4096 bytes deep and match on a bit pattern to stop and drop matching traffic. FPM and NBAR combined form the basis of future developments that can be expected to take this technology further in both capabilities and performance.

Adaptive network services imply increasing the intelligence of network devices to act on and facilitate management actions for specific network events. Embedded Event Manager (EEM) provides such an intelligent management base for network devices to perform this capability. A series of event detector processes designed to monitor explicit operational aspects of the switch are built into Cisco IOS® Software. They can be primed to look for a specific event, and when that event occurs, they can act as a trigger to start up a user-loaded script. That script can then be invoked to perform a series of actions to remedy, troubleshoot, or facilitate a set of actions. This unique capability, which is a part of Cisco Catalyst switching platforms, can significantly enhance the network's operational efficiency. Its ability to automate common administration tasks and to act quickly on set events both raises the effectiveness of the network and frees up administrator time to focus on work that provides higher returns to the organization.

Many Cisco customers are starting to utilize EEM, which has numerous uses that are enabled through its scripting capabilities. The user can define an event (or multiple events) on which EEM should take action: for example, generating a specific syslog message, invoking a specific CLI command, inserting or removing a line card, or having a system resource such as CPU or memory usage cross a threshold to trigger invoking a script. When that event occurs, a script can be invoked to start a series of predetermined actions. The script has the ability to invoke any combination of CLI commands, generate custom Simple Network Management Protocol (SNMP) traps or syslog messages, conduct email and page alert network operations, and more. Its abilities are only limited by the imagination of the administrator. The power of EEM is now available across both the Cisco Catalyst 6500 and 4500 modular switching platforms as well as the Cisco Catalyst 3750 family of switches.

Generic Online Diagnostics (GOLD) is a framework under which network administrators can monitor and check the health of network hardware. Traditionally, diagnostics are run at the time of system startup and are performed to check system hardware. With the demands on continued availability placed on many of today's networks, the time between cold startups is increasing. This means the likelihood of catching potential problems can often be reduced. The GOLD framework allows these diagnostics to be run at a scheduled time of day or at runtime. Extending the ability to run these diagnostics outside of normal 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.

Combining EEM and GOLD provides the basis for Smart Call Home, a new Cisco SMARTnet[®] Service that offers proactive diagnostics, real-time alerts, and personalized web-based reports. If a potential problem arises, Smart Call Home can automatically detect it and generate a Cisco Technical Assistance Center (TAC) service request that is routed to the right person for a particular problem. This improves high availability through proactive and faster issue resolution.

Cisco IOS Software has many management tools that can enhance the operational experience for network administrators. Smartports is a macro tool that enables a group of Cisco IOS Software commands to be invoked using a single command string. Configuration rollback avoids the potential for misconfigurations to affect availability. The command history log tracks invoked commands and can be used to assist with troubleshooting what might have affected network availability. Enhanced Remote SPAN (ER-SPAN) provides a means to mirror traffic across an IP network to a remote sniffer (or probe) for further inspection. A multitude of show commands provide better insight into the switch operations. NetFlow top talkers highlight data flows that constitute the portion of data flows that use a greater proportion of bandwidth. The **show diagnostic sanity** command checks the health and viability of the running configuration, highlighting errors that could compromise the switch operationally. The **show platform hardware capacity** command provides an insight into switch resource consumption, and the information gained from this output can be used as input into network capacity planning. More recent enhancements such as the mini protocol analyzer provide in-box analysis of data traffic, creating a capture file that can be saved locally or exported for further analysis by tools such as Wireshark. The list of features that apply here is by no means complete and is very extensive.

One of the biggest areas of focus for future enhancements is improvements for services deployment. Work in this area will look to enhance the abilities of the network to reduce the overhead of deploying purpose-specific appliances or services modules into the network that provide firewalling, intrusion detection and prevention, networking monitoring, load balancing, VPN service, and more. It is often necessary to traffic-engineer data paths between different services nodes, which can require the configuration of policy-based routing, VLAN stitching, Web Cache Control Protocol (WCCP), and more. The aim of future enhancements in this area will be enabling the network to take over service node registration and configuration and allowing the network to participate in forwarding service node-bound traffic.

Energy Sustainability

Energy sustainability (or being green) is a primary concern for many IT network managers and a continued part of the Cisco Catalyst switching platform's current technology base and future roadmap. Cisco's green initiative is helping to reduce the negative effects of networking equipment on the environment while also enhancing business returns.

Power use is the most evident and high-profile aspect of advances in green technology in today's networking devices. The introduction of technologies such as inline power, higher density, and higher speed interfaces might appear to have placed an additional burden on the power load of network devices, but rather it has forced Cisco engineering minds to develop ways to simplify power usage in the face of higher power demands from these new technologies.

Moore's Law describes a long-term trend that new computer hardware developments would double in speed and capacity every two years while also reducing in cost. Application-specific integrated circuits (ASICs) typify this and have seen huge improvements in scalability and performance over recent years. Demands in power associated with this incremental growth have not stopped. To address this extended need, innovations such as those in the Cisco Catalyst 4500 modular switch are starting to appear in many Cisco platforms. From Cisco IOS Software Release 12.2(50)SG and onward, undercover optimization enables the switch to turn off power to unused ports on E-series line cards running with the Cisco Catalyst 4500 Supervisor Engine 6-E. This feature is not CLI based and cannot be configured by an administrator. Rather, it is an automatic feature designed to simplify power usage in the switch. More importantly, this feature has no effect on switching behavior or performance. It only affects power usage and ultimately works to help reduce power costs for running the switch.

Inline power is another area of focus for energy sustainability and power enhancements. The IEEE standardized inline power with the release of the IEEE 802.3af standard in 2004. This standard defines four classes of power: Classes 0, 1, 2, and 3. Class 3 devices can support as much as 15.4 watts (W) of power, while Class 2 devices support as much as 7W of power, and therein lies a problem for some device types. What happens to a device that only needs, for example, 10W of power? The answer is this device would need Class 3 power because the power supplied by Class 2 is not sufficient. In this manner, however, potentially more watts are delivered to the device than required, resulting in wasted power and energy.

Link Layer Discovery Protocol (LLDP) and Cisco Discovery Protocol offer two ways to overcome this issue. Each protocol provides the means to enable a device to "negotiate" the actual amount of power required. As a result, exact power requirements can be supplied for the attached device without any wastage occurring. Multiply this fact over hundreds or perhaps thousands of devices, and this reduction in supplied power can yield significant savings for an organization. Furthermore, refining power requirements to the exact needs of the network allows network managers to size more specific power supplies, uninterruptible power supplies (UPSs), and power circuits. This factor can also contribute to reducing the operational cost base of the network.

Moving forward, Cisco has announced EnergyWise, which is an architecture and management framework for optimizing power use in network devices. First announced on the Cisco Catalyst 3750 family of switches, this framework has now been announced on the Cisco Catalyst 6500 and 4500 modular switching platforms as well. The network will discover Cisco EnergyWise-manageable devices, monitor their power consumption, and take action based on business rules to reduce power consumption. Power and priority levels can help ensure that high-priority devices remain online, while lower priority devices can be shut down or operate on reduced power. Dimming unused IP phone displays is an example of how this particular aspect of Cisco EnergyWise can be applied. The framework also supports device location, which can enable customers to better understand power profiles and usage across the network. Cisco EnergyWise can help promote reductions in energy consumption, which directly affects greenhouse gas emissions created by the worldwide building infrastructure.

Moving the technology clock forward, Cisco will continue to innovate on the green front. Some of the enhancements under consideration include sleep modes for switches based on usage, lower power fans, noise-canceling mechanisms, intelligent usage-based power supplies, and other chassis optimizations that can help reduce power and emissions.

Total Cost of Ownership

Investment protection is a primary factor in any organization's decision-making process when extending its infrastructure. Cisco Catalyst switching platforms have provided a leading example in the industry for how network platforms should offer investment protection.

One example is the Cisco Catalyst 6500 switching platform, which exemplifies the Cisco investment protection story. Cisco has released four generations of supervisor engine modules. The Cisco TAC continues to support the first generation, the Cisco Catalyst 6500 Series Supervisor Engine 1A, even though it has reached its end-of-sale date. The current generation supervisor engine, the Cisco Catalyst 6500 Series Supervisor Engine 720, introduced in 2003, is expected to have a lifetime of 15 years. Despite that fact, Cisco is working to help ensure that investment protection and support for upcoming hardware for this modular switching platform stay in place for many years to come.

With both the Cisco Catalyst 6500 and 4500 now nearly 10 years old, it is important to realize that hardware purchased at first customer ship back in 1999 can still operate in those modular chassis today. This is simply investment protection at its best.

It is not only the modular platforms that have provided investment protection, but also the Cisco Catalyst fixed switching platforms. With the introduction of the Cisco Catalyst 3750-E switch platform, they can be incorporated into an existing non-E-Series Cisco Catalyst 3750 switch stack, thus allowing both platform generations to interoperate together under a common management address.

It is not only the hardware platforms that reflect this investment protection focus. The lifecycle of Cisco Catalyst switching software is also being enhanced through extended maintenance releases and periodic maintenance. Extended maintenance releases are ideal for long-term maintenance support. They incorporate 24 months of regular maintenance rebuilds, provide six additional months of Product Security Incident Response Team (PSIRT) support, and are guaranteed to be Safe Harbor tested. They also have an overlap of from 6 to 12 months with the next extended maintenance release to help ensure a smooth transition.

Cisco SMARTnet Service and Advanced Services allows users to access and upgrade Cisco IOS Software images without issue and additional cost. Advanced Services use Cisco engineers, who can work with customers to gain a better understanding of the customer network. These Cisco engineers can then combine this knowledge with their knowledge of Cisco IOS Software releases to recommend implementation strategies for upgrading and moving to new software releases.

Combining extended lifecycles for hardware and software with additional support services yields one of the most powerful investment protection stories for Cisco Catalyst switching platforms in the industry today.

Summary

In today's world, operational efficiency is a primary concern for many network managers. The need to make use more efficient is crucial, and the ability of a networking device to facilitate this functionality is becoming a more important element of a device's capability.

Cisco Catalyst switches include a number of technological capabilities that can help improve the operational efficiency of the organization's network. Investment protection is an important part of the Cisco Catalyst switching product development objective, providing better returns for customers that invest in this networking platform. Green

enhancements are important concerns for Cisco's engineers, who are continually exploring many ways to make the platform more energy and power efficient. Cisco IOS Software is feature rich and provides many automation and management tools that provide more insight into everyday operational aspects of the switch. When combined, these three important elements serve to make the Cisco Catalyst switching platforms an excellent choice for helping ensure the networking platform provides the greatest levels of operational efficiency.



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