Cisco Catalyst 6500 Energy Sustainability

Introduction

National security, environmental, and resource supply concerns will force governments to implement green initiatives and incentives. Business ramifications will result from policies that local, state, and federal governments implement around the world. As traditional energy supplies decrease and newer - but more costly - renewable supplies are brought online, organizations will be forced to look for more efficient ways to deploy their data networks to meet stricter government regulations and prevent negative effects on profitability.

Cisco has recognized this impending effect on the IT community for some time and has been building products and developing new technologies to assist organizations in this transition. This document describes the energy sustainability characteristics of the Cisco® Catalyst® 6500 Series Switch. This switch offers the latest technologies to enable organizations to meet the green requirements of today while providing a flexible architecture to address the necessities of tomorrow. This paper covers the following topics:

- Energy Savings
- Operational Efficiency
- Innovative Business Practices

Energy Savings

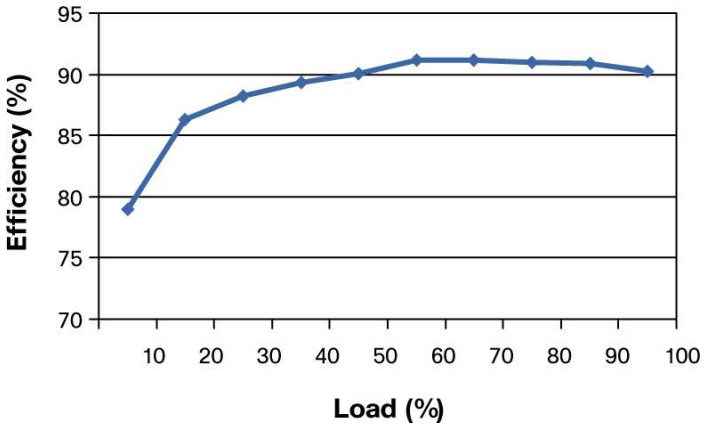
One of the most direct ways that organizations can achieve their goals to become greener is to deploy solutions that offer improved energy efficiency. Even though power related to network equipment is just a fraction of an enterprise's overall power usage, the Cisco Catalyst 6500 Series Switch has made advancements in power management and infrastructure consolidation that allow IT groups to deploy more energy-efficient architectures. These enhancements include higher-efficiency power supplies, Cisco EnergyWise technology, intelligent power management, virtualization, and others.

Power Management: Power-Supply Efficiency

Cisco has made several hardware enhancements in the area of energy efficiency for the Cisco Catalyst 6500 Series Switch. The most pronounced change has been in the efficiency of the power supplies. When this switch was first introduced, the efficiency of the power supplies was in the range of 80 percent. With the ratification of IEEE 802.3af Power over Ethernet (PoE) in 2003, the demand for power delivery in the data network increased dramatically as customers began to converge their data and voice networks. Recognizing this reality, Cisco developed higher-capacity power supplies for the Cisco Catalyst 6500 Series Switch to meet this new demand, and at the same time

took advantage of new technology to provide power supplies with efficiency in the 91-percent range. Figure 1 shows an actual AC power supply efficiency curve of the 6000W power supply.

Figure 1. AC Power-Supply Efficiency



Going from 80 to 90 percent may not sound like a lot, but consider the environmental and financial effect that such a change entails:

Example 1: Power-Supply Efficiency Savings

A switch with 384 IEEE Class 3 devices (15.4W each) = ~5913.6W from the system power supplies.

A power supply with 80-percent efficiency draws ~7392W from the power source (19.25W per device).

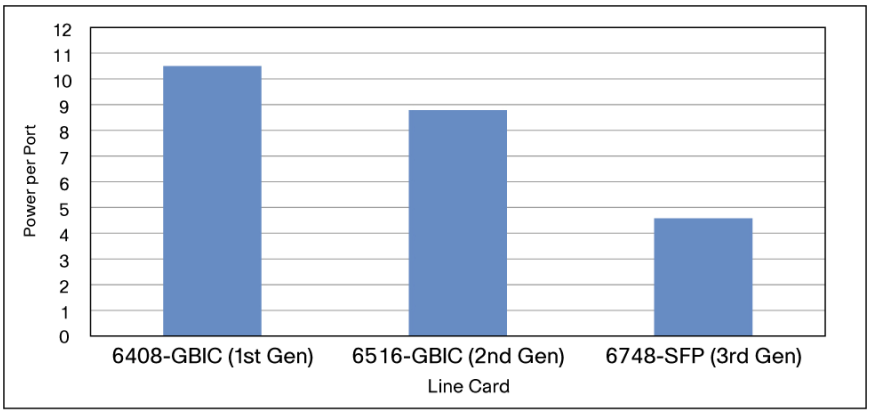
A power supply with 90-percent efficiency draws ~6571W from the power source (17.11W per device).

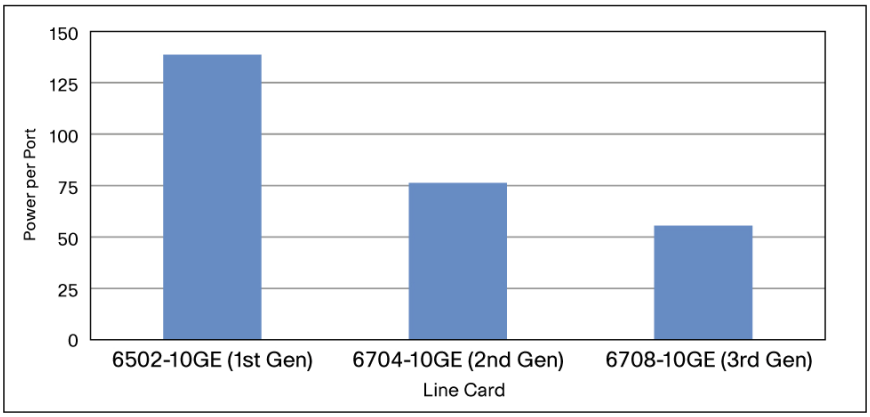
As is evident, the difference is ~821W for this one access switch. If these devices are powered on 12 hours a day for 365 days, the savings amounts to ~3596 kilowatt-hours per year per switch. Some organizations run these devices 24 hours a day, in which case the savings would double. The financial savings from a power perspective are somewhat obvious, but the environmental savings may not be so apparent. When considering all power sources, a kilowatt-hour of electricity generation creates ~1.25 lb of CO_2. Moving to more efficient power supplies would result in a savings of ~4500 lb of CO_2 per access switch. Because governments around the world are looking at carbon taxes, usually based on tons of CO_2 generated, the improvement of power-supply efficiency will further add to profitability by resulting in lower tax burdens.

Power Management: Performance-to-Power Gain

Although increases in power-supply efficiency might seem to have the largest effect on an organization's desire to reduce its carbon footprint, other hardware enhancements on the Cisco Catalyst 6500 Series Switch will also further the goal to become greener. The ability to move more data with fewer components allows organizations to deploy more efficient architectures. Figure 2 shows how improvements in technology have resulted in the ability to transmit more information while increasing power efficiency.

Figure 2. Gigabit Ethernet and 10 Gigabit Ethernet Power Efficiency Improvements on Cisco Catalyst 6500 Line Cards





Further enhancements, such as the ability to dynamically apply power to only certain portions of the hardware based on traffic usage, are being investigated. These hardware enhancements will allow organizations to deploy architectures to solve their information requirements while moving toward a greener infrastructure to meet the needs of an environmentally changing world.

Power Management: Cisco Discovery Protocol, LLDP, and Power Policing

Ever since Cisco began deploying prestandard PoE, the Cisco Catalyst 6500 Series Switch has been able to interact with Cisco Discovery Protocol-enabled devices to dynamically assign power. This interaction allows the system to more efficiently distribute power to powered devices by using Cisco Discovery Protocol to determine exactly how much power a powered device requires. For example, if an IEEE Class 3 Cisco phone comes online, the system first allocates 15.4W from the power budget to meet the IEEE Class 3 requirement. When the phone is online, the system and phone communicate using Cisco Discovery Protocol, and part of that communication includes the actual power requirement of the phone. The system compares the actual power requirement with what was originally allocated. If the actual requirement is lower, then the system changes the allocation to match the actual requirement. Now that IEEE 802.1ab Link-Layer Discovery Protocol (LLDP) is available, it may be possible to extend this capability to devices that are not Cisco Discovery Protocol-capable in the future.

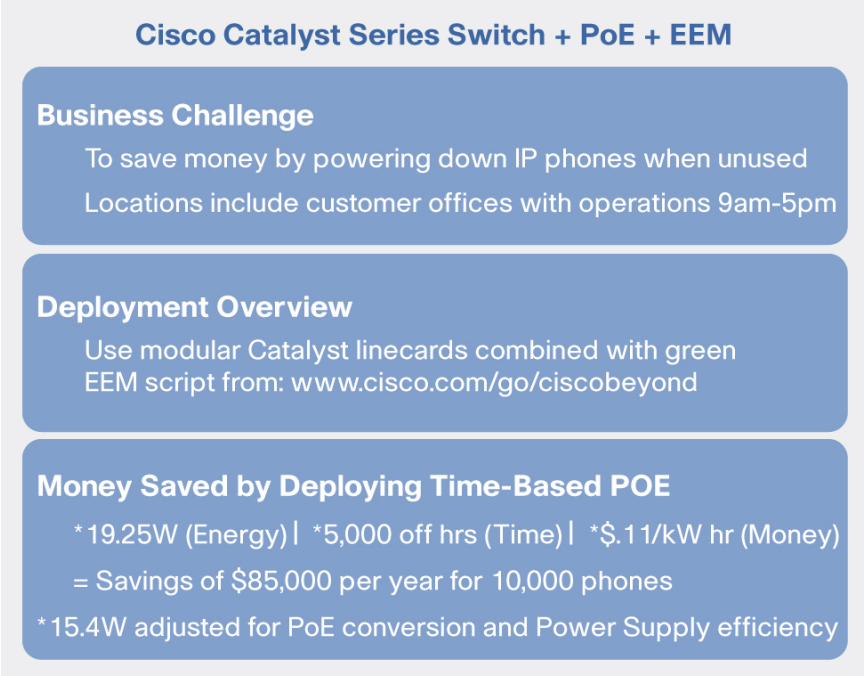
In addition to Cisco Discovery Protocol and LLDP, the Cisco Catalyst 6500 Series Switch supports manual configuration of the amount of power allocated to a port supporting a powered device. This support, which began with Cisco IOS® Software Release 12.2(33)SXH, requires the Cisco Catalyst 6500 PoE Daughter Card (part number WS-F6K-48-AF). For example, consider an IEEE 802.3af Class 3 powered device that does not support Cisco Discovery Protocol and requires only 10W to operate. By default the system will allocate 15.4W for this powered device to comply with the IEEE 802.3af standard, thereby wasting 5.4W from the power budget. Manually setting the

power allocation to the 10W the device actually requires allows for more efficient use of power resources. Thus the organization does not need to buy more equipment and run more electrical circuits than are necessary.

Power Management: Embedded Event Manager

Beginning with Cisco IOS Software Release 12.2(18)SXF5 for the Cisco Catalyst 6500, the Embedded Event Manager (EEM) feature allows for the creation of custom scripts to execute commands based on system events. One of the more useful events is the timer event, which is essentially similar to a CRON operation in other environments. This timer event allows the engineer to instruct the system to execute a script at a specific time based on the internal clock of the switch. This feature can be very advantageous for power management, especially in an environment that is not operational 24 hours a day. Figure 3 shows an example of how EEM has been used to provide a customer with a more energy-efficient infrastructure, resulting in financial savings and a lower environmental effect.

Figure 3. Time-Based PoE Using Embedded Event Manager



This example shows just the financial benefit, but we can also calculate the environmental benefit of deploying this intelligent power management capability with EEM. As we saw previously, every 1 kilowatt-hour of electricity averages ~1.25 lb of CO_2 release. Example 2 illustrates what this organization is saving:

Example 2: CO_2 Savings from Intelligent Power Management

19.23W[1]/phone * 10,000 phones = 192,300W

192,300W/1000 = 192.3 kilowatts

192.3 kilowatts * 5000 hours = 961,500 kilowatt-hours

961,500 kilowatt-hours * 1.25 lb CO_2/kilowatt-hour = **1,201,875 lb CO_2 saved**

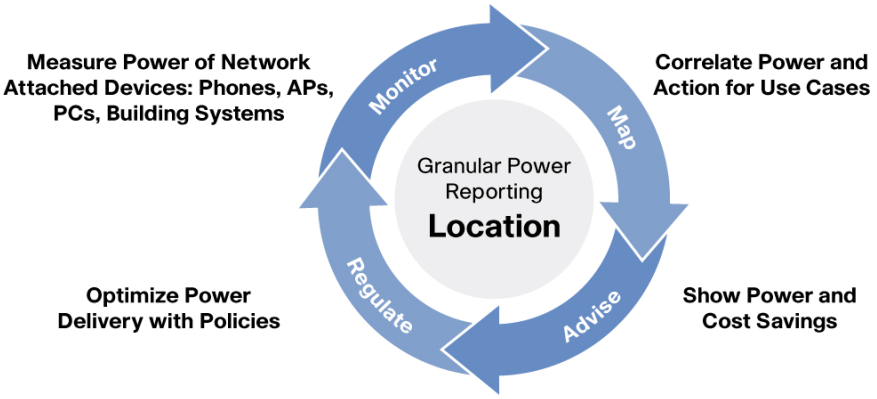
[1] This number will vary based on power supply and PoE conversion efficiency.

By simply using a script to shut off their phones when not needed, this organization is saving $85,000 and reducing its carbon footprint by more than 600 tons. Additional savings could be realized by a minor modification of this script to turn off not only the phones but also the line cards to which the phones are attached. EEM gives engineers the ability to execute any system command after the system detects the required event.

Power Management: Cisco EnergyWise Phase I

Starting with Cisco IOS Software Release 12.2(33)SXI4, the Cisco Catalyst 6500 Series Switch supports Cisco EnergyWise phase I and phase II. Cisco EnergyWise phase I delivers the same intelligent power management as we saw in the EEM example, except it can be extended across the entire infrastructure of a facility to include such devices as. Cisco EnergyWise is an industrywide initiative that Cisco and several other vendors are undertaking to address the areas illustrated in Figure 4.

Figure 4.

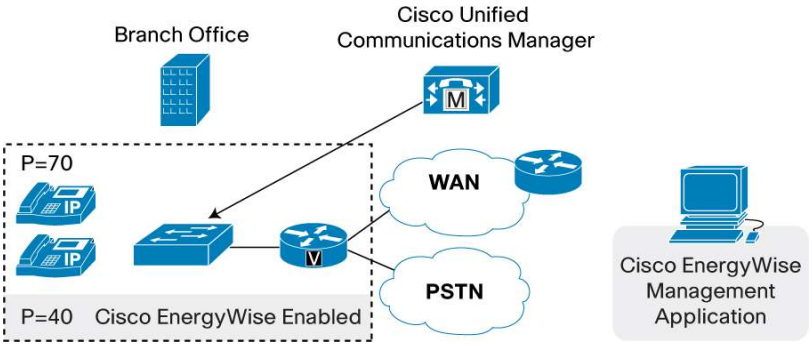


Cisco EnergyWise technology gives an organization an in-depth overview of its power consumption and allows for the consumption to be altered based on policies that can react in real time to changing environmental conditions. You can centrally maintain and distribute Cisco EnergyWise policies to all Cisco EnergyWise entities (that is, any device that communicates with a Cisco EnergyWise Network). You can assign each Cisco EnergyWise entity a priority so that you can write a policy that affects a subset of Cisco EnergyWise entities instead of all of them.

Consider the EEM example in Figure 3. What if the customer wanted one phone to be on at all times for emergency purposes? That scenario is possible with the EEM script by having a corporate policy to have all emergency phones in a certain port in a chassis (for example, port 48 or slot 1). Then you could write the script to shut down all ports except that one.

What happens, though, if somebody who is unaware of the corporate policy moves that phone to a different port and leaves the emergency port with no phone connected? The phone will go offline and there will be no emergency services in that location until the problem is remedied. Cisco EnergyWise can solve this problem by using separate priorities for Cisco EnergyWise entities, no matter where they are in the network. Figure 5 shows how Cisco EnergyWise technology can enable the same time-based PoE policy that is possible with EEM.

Figure 5. Time-Based PoE Using Cisco EnergyWise Technology

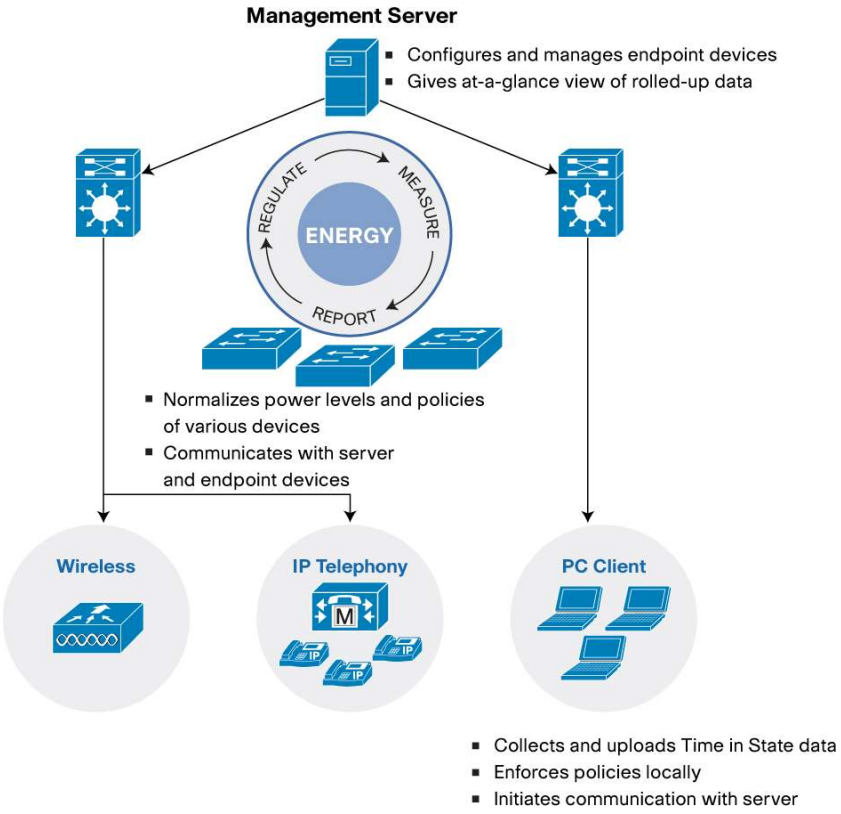


In this example, the Cisco EnergyWise Management Application would send out a policy to all of the registered Cisco EnergyWise neighbors telling them to shut down all devices with priority < 50. Thus the phone on the top, which might be the emergency phone, would not be affected because its priority is greater than 50. All other devices whose priorities are less than 50 - phones, access points, or anything else that is Cisco EnergyWise-aware - will be shut down. If someone moved the phone with priority 70 to another spot within the network, it would not matter because the priority does not change.

Power Management: Cisco EnergyWise Phase II

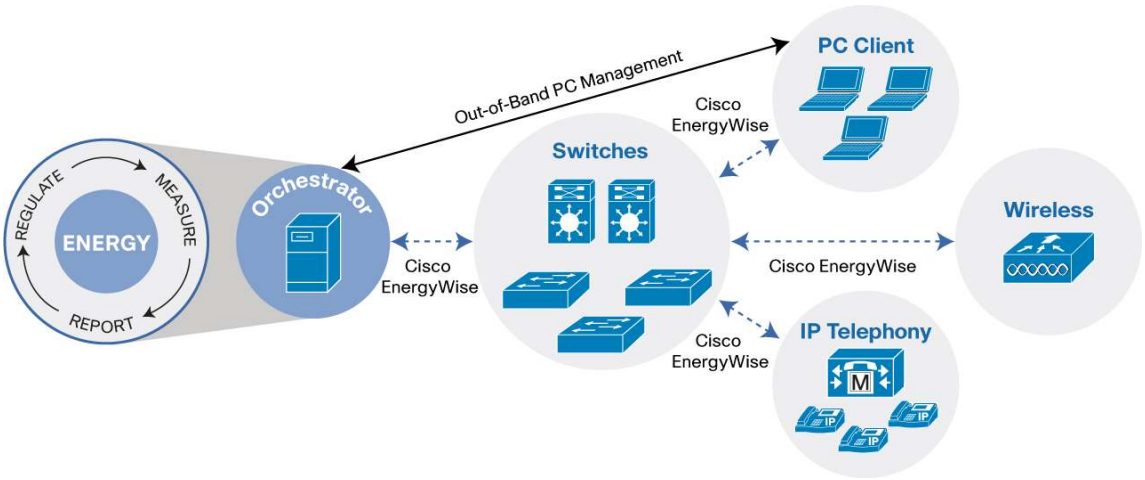
Cisco EnergyWise phase II extends the ability to monitor devices and enforce policies beyond PoE devices to laptops, desktops, and servers. As part of the Cisco EnergyWise phase II infrastructure, Cisco is partnering with a company called Verdiem, which has created a client that can run under a Windows OS (other OSs to follow). This client, called Surveyor, communicates with a Cisco EnergyWise management system to report power information and to enforce policies configured on the management system. Figure 6 shows how the Surveyor client operates within a Cisco EnergyWise infrastructure.

Figure 6. Surveyor Client in Cisco EnergyWise Infrastructure



Cisco EnergyWise phase II also introduces the Cisco EnergyWise Orchestrator management infrastructure for Cisco EnergyWise deployments. You can use the Cisco EnergyWise Orchestrator, which provides customizable management-level reports to communicate energy savings, to measure, report, and regulate energy consumption of a broad array of IT devices. The Cisco EnergyWise Orchestrator controls power states of all IT devices through the technology and provides comprehensive power management for PCs through an additional out-of-band protocol. The Cisco EnergyWise Orchestrator can be on a single server or can be scaled up and out by installing the multiple services on individual physical servers. Figure 7 shows how the orchestrator fits into a Cisco EnergyWise infrastructure.

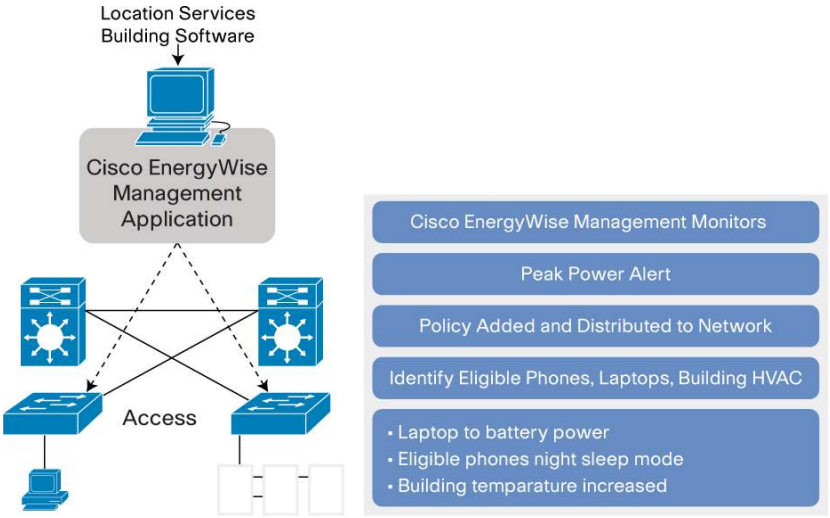
Figure 7. Surveyor Client in Cisco EnergyWise Infrastructure



Power Management: Cisco EnergyWise Future

The future plans for Cisco EnergyWise to interact with multiple different systems attached to the network make it a much more powerful tool than a standalone script. When the proper applications and application programming interfaces (APIs) are available, Cisco EnergyWise will be able to manage not only PoE devices and PCs but also heating, ventilation, and air conditioning (HVAC) systems and other building control systems. Consider the example in Figure 8.

Figure 8. Peak Power Monitoring with Cisco EnergyWise Technology



In this example, the Cisco EnergyWise Management Application is monitoring the total power draw of the entire building and comparing that to the available power from the utility. If the power level approaches a predetermined range of the maximum power available, or if the area starts to suffer a temporary drop in power because of a rolling brown-out, the Cisco EnergyWise Management Application can detect these situations and take action. Based upon predefined response policies, Cisco EnergyWise might be able to:

- Notify the HVAC control system to change temperature by a certain amount
- Notify laptops to begin running on battery until they are drawn down to a certain remaining percentage
- Send eligible phones into sleep mode, or change operating mode from color to black-and-white
- Turn off eligible light fixtures

These capabilities will not be available in the first two phases of Cisco EnergyWise implementation, but they are the types of initiatives that Cisco is promoting with other vendors across the networking, PC, and building control systems industries. The Cisco Catalyst 6500 Series Switch is an integral part of these types of networks, and Cisco EnergyWise support is an important initiative that will allow the platform to maintain its leadership role in the area of green IT.

Infrastructure Consolidation: Virtualization

The Cisco Catalyst 6500 Series Switch offers a variety of virtualization technologies that enable organizations to achieve a greener infrastructure. Virtualization may offer the biggest benefit in this area, but most customers still view virtualization as primarily an enabler of separation for security purposes. Part of this reasoning is due to the relative newness of green initiatives, but it is also because virtualization has been valued too lightly to date.

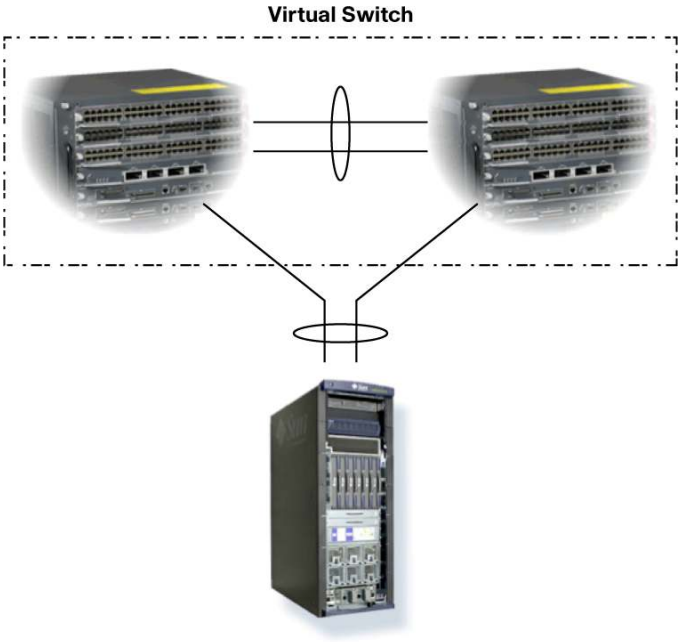
When discussions about virtualization are held, most people talk about Multiprotocol Label Switching (MPLS), Virtual Route Forwarding (VRF) instances, server virtualization, or perhaps some new virtualization technology. What most people rarely consider is a technology that has been used for more than a decade: Virtual Local-Area Networks (VLANs). If your organization is using VLANs, then you are using virtualization. Although it is perhaps not as exciting

or innovative as some of the newer virtualization technologies, from an energy sustainability perspective the VLAN is just as effective as any of the others.

The green benefit of virtualization is realized when organizations deploy one common infrastructure to meet the diverse needs of their customer bases. Whether it is a service provider using virtualization (maybe MPLS) to segment customers, a hospital system using virtualization (maybe VLANs) to meet regulatory requirements for patient data, or an enterprise customer using virtualization (maybe VRF-lite) to segment areas of the business, all are deploying one single architecture instead of multiple independent architectures to meet their requirements.

The Cisco Catalyst 6500 supports MPLS, VRF-lite, and VLANs. A new virtualization technology called the Virtual Switching System (VSS) was introduced on the Cisco Catalyst 6500 in 2008. This new virtualization technology allows two Cisco Catalyst 6500 Switches to be bundled together to appear as one device. As a result, devices connecting to a VSS see a single device to which they can form a Cisco Multichassis EtherChannel (MEC) by connecting one uplink to each switch in the VSS. This feature has some definite advantages from a network management and support perspective (for example, no need to support Hot Standby Router Protocol [HSRP] or Virtual Router Redundancy Protocol [VRRP] and no need to rely on the Spanning Tree Protocol for loop management), but it also helps organizations become more energy-efficient. This deployment is shown in Figure 9.

Figure 9. Virtual Switching System in the Data Center



As organizations continue to virtualize their server infrastructure with technologies such as those offered by VMware, link usage will be increase dramatically as a single server begins to act as multiple servers. If each uplink from the server in Figure 9 is 10/100/1000, then as overall bandwidth handled by the server approaches 1 Gbps, the network administrator has two choices. One is to add another server to the infrastructure, but this solution would require power for another server and provisioning of cooling and rack space. The second choice is simply to add an additional pair of uplinks to the server and add those to the existing MEC that is formed with the VSS. Although this solution will also incur additional power and cooling, it will not be nearly as much for a pair of network interface cards (NICs) (or a single dual-interface NIC) as it would be for another server.

The evolution of 10 Gigabit Ethernet allows organizations to further virtualize their server infrastructure and become more energy sustainable. Without having to worry about the limitations of a 1-Gbps link, network engineers can maximize the number of virtual machines on a single server, thereby preventing the need to deploy more physical

hardware and incur costs associated with increased power and cooling. Although the Cisco Catalyst 6500 Series Switch has supported 10 Gigabit Ethernet fiber interfaces for many years, Cisco has released a new 10BASE-T line card (WS-X6716-10G-3C/3CXL) that well positions the Cisco Catalyst 6500 to catch the transition to 10 Gigabit Ethernet LAN-on-motherboard (LOM) when the industry moves in that direction. This transition will allow Cisco customers to more easily and cost-effectively deploy a virtualized server infrastructure.

Whether an organization is deploying VMware, MPLS, VLANs, VRF-lite, or VSS, virtualization technologies provide energy sustainability by allowing for a common architecture to support the organization's needs. The virtualization capabilities of the Cisco Catalyst 6500 Series Switch have continued to evolve with the needs of our customers, and now the additional green benefit of these technologies is being realized.

Infrastructure Consolidation: Virtualized Services

In addition to Layer 2 and Layer 3 virtualization, the Cisco Catalyst 6500 supports services modules offering virtual contexts that allow organizations to deploy Layer 4-7 services in a way that will help them meet their green initiatives. The Cisco Catalyst 6500 Series Firewall Services Module (FWSM), Cisco ACE 4710 Application Control Engine Appliances, and the Cisco Virtual Private Networking Services SPA Interface Processor (VPN Services SIP) can each be divided into as many as 250 individual contexts, allowing any port in the chassis to become services-enabled. This feature offers an especially compelling advantage from an energy sustainability perspective because you need to deploy only a single blade to take the place of potentially 250 individual devices that would all require their own power, cooling, and rack space.

To assist in the deployment of virtualized services, Cisco has developed two reference architectures: Cisco Catalyst 6500 Borderless Services Node (BSN) and Datacenter Services Node (DSN). The Cisco Catalyst 6500 BSN allows you to order a Cisco Catalyst 6500 Series system that includes a VSS-capable Supervisor Engine VS-S720-10G-3C, two FWSMs, and one Cisco Wireless Services Module (WiSM) to deliver 8 Gbps of combined services throughput to service this emerging need and meet customer demand for integrated mobility and security. The BSN solution will demonstrate how critical products and technologies such as FWSM, WiSM, VSS, and identity come together to deliver an integrated services solution.

The Cisco Catalyst 6500 DSN is a dedicated services chassis that houses three FWSMs and one application control engine, providing up to 15 Gbps of secure load-balancing system throughput. The DSN enables cloud services by integrating firewall security and application delivery along with the integration of third-party solutions and monitoring.

Figure 10 shows an example of how virtualized services can benefit an organization's effort to become more efficient.

Figure 10. Virtualized Services Modules vs. Appliances

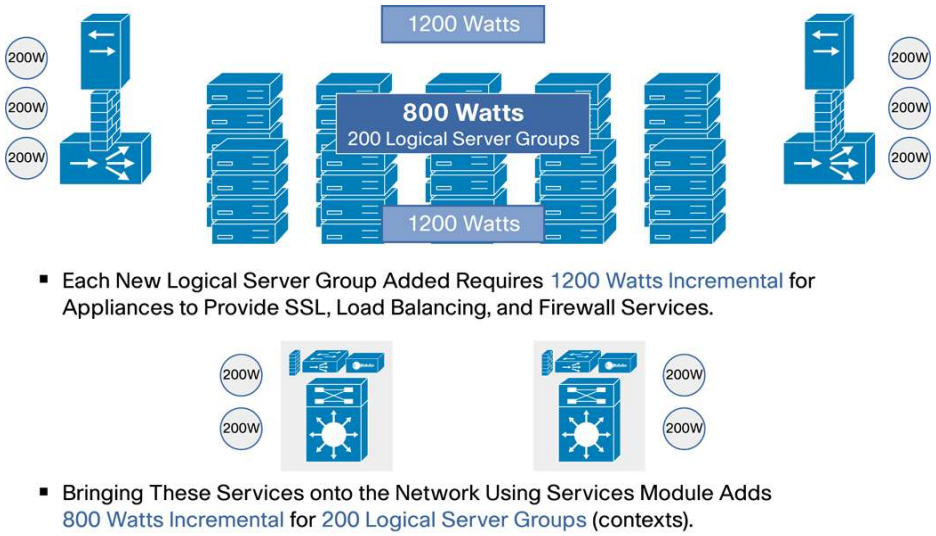


Figure 10 shows that for every new logical server group that is added, you must add a pair of load balancers, firewalls, and Secure Sockets Layer (SSL) termination devices if you want to follow the appliance model. If each of these were to draw 200W, then for every additional logical server group an additional 1200W of power is required. By using virtualized service modules to achieve this same result, four modules would be required to achieve the same level of support, with a total power requirement of 800W.

Assume that an organization decides that it does not need 200 logical server groups, but rather 5. The results follow:

Appliance Model

Five logical server groups

Ten firewalls @ 200W each = 2000W

Ten load balancers @ 200W each = 2000W

Ten SSL terminators @ 200W each = 2000W

Total power consumption = 6000W (6 kW)

6 kW * 24 hours/day * 365 days/year = **52,560 kilowatt hours/year**

1.25 lb CO_2/kilowatt hour * 52,560 kilowatt hours/year = **65,700 lb CO_2/year**

$.12/kilowatt hour * 52,560 kilowatt hours/year = **$6307.20/year**

Virtualized Service Model

Five logical server groups

Two firewalls @ 200W each = 400W

Two application control engines (Load balancing + SSL termination) @ 200W each = 400W

Total power consumption = 800W (0.8 kW)

0.8 kW * 24 hours/day * 365 days/year = **7008 kilowatt hours/year**

1.25 lb CO_2/kilowatt hour * 7008 kilowatt hours/year = **8,760 lb CO_2/year**

$.12/kilowatt hour * 7008 kilowatt hours/year = **$840.96/year**

By deploying a virtualized services model, even for a small deployment such as shown in the five logical server group example, organizations can realize immediate gains in their efforts to become greener and more profitable. One must also consider the dollars saved by the reduced amount of cooling as well as the lower environmental effect by not requiring the production of 30 devices when just 4 will meet the service requirements. Service virtualization is another difference-making technology that makes the Cisco Catalyst 6500 a smart choice for organizations looking to increase profitability and decrease their carbon footprint.

Operational Efficiency

Unlike energy savings that can offer a directly measured green benefit, operational efficiency is more difficult to quantify. The Cisco Catalyst 6500 Series Switch has long had a philosophy of sustainable operations, as demonstrated by the extensibility and longer lifecycles of the two platforms.

Platform Extensibility

Because of the flexible modular architectures of the Cisco Catalyst 6500, you can extend the capabilities of the platform without performing a complete network overhaul. The addition of new supervisor engines can deliver new services to older line cards, eliminating the need to upgrade an entire chassis to take advantage of new features. Thus as industry trends changed from 100 Mbps to 1 Gbps to 10 Gbps, the platform has adapted by simply developing new interface modules to adjust to the evolving needs of the network. The Cisco Catalyst 6500 allows for interface modules of different generations to coexist in a single chassis, providing organizations with a smoother transition from one architecture to the next. From a financial perspective, this scenario allows IT groups to implement new technologies at a lower cost by supporting a “pay-as-you grow” philosophy of technology migration. From an energy sustainability perspective, the amount of e-waste is significantly reduced. Consider the following example:

Example 3: E-Waste Reduction Through Platform Extensibility

2001

Company XYZ purchases a Cisco Catalyst 6500 to act as a data center server aggregation device, providing 10/100 connectivity to the servers and multi-Gbps port channels (using the Supervisor Engine 2 gigabit-interface-converter [GBIC] interfaces) for uplink. The list price (based on $US) of such a configuration would have been:

One Cisco Catalyst 6509 chassis @ $9,500 each = $9,500

Two 2500W power supplies @ $3,000 each = $6,000

Two Supervisor Engine 2 engines @ $28,000 each = $56,000

Six 48-port 10/100 line cards @ $18000 each = $108,000

Total = $179,500

2004

Because of increased business and two acquisitions since 2001, Company XYZ needs to upgrade half of its data center servers to 10/100/1000 to meet expanded data demands. It also needs to provide 10-Gbps uplinks to handle the traffic demands on the network.

2008

Company XYZ has been implementing server virtualization with VMware, causing its link usage to climb but the physical server count to be cut in half. The company currently has a standard Layer 2 infrastructure with spanning tree and HSRP, but needs something more robust and easy to manage because of increased video traffic in the network.

In 2004, Company XYZ purchases the following to meet its new demands (list prices in $US, not including potential trade-in credits):

One fan tray 2 @ $500 each = $500

Two Supervisor Engine 720-3B engines @ $28,000 each = $56,000

One 4-port 10 Gigabit Ethernet line card @ $20,000 = $20,000

Three 48-port 10/100/1000 line cards @ $15,000 each = $45,000

Total = $121,500

Because the Cisco Catalyst 6500 allows different generations of modules to operate in the same chassis, Company XYZ can keep all of its 10/100 line cards in the chassis and still deliver the higher data requirements. In addition, new features of the Supervisor Engine 720 such as IPv6, MPLS, generic routing encapsulation (GRE), and Enhanced Unicast Reverse Path Forwarding (URPF) can be applied to the older 10/100 ports without upgrading those modules in any way. If the Cisco Catalyst 6500 did not have this capability, Company XYZ would have had to buy a new chassis, new power supplies, and three additional line cards to replace its older line cards. This purchase would have added more than $50,000 to the cost of the project (per switch) and would have increased the e-waste for Company XYZ because it would have needed to rid itself of this redundant equipment instead of carrying it forward. It would have also increased the overall environmental effect of the project because of the manufacture and shipping of the new chassis, power supplies, and line cards.

In 2008, Company XYZ decides that it will upgrade its Cisco Catalyst 6500 Switches to support VSS to make its architecture more robust to meet its evolving video needs. To achieve this goal the company purchases (list prices in $US, not including potential trade-in credits):

One Supervisor Engine 720-10G @ $38,000 = $38,000

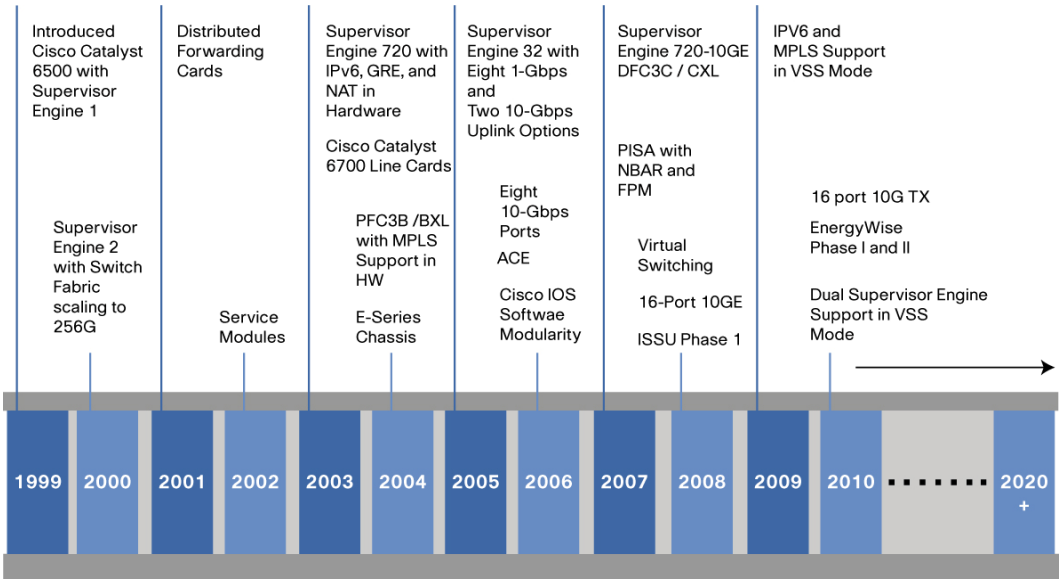
Total = $38,000

Because Company XYZ's server count has been cut in half by virtualization, the company can trade in its remaining 48-port 10/100 modules. VSS mode supports the following system components as configured before the purchase of the Supervisor Engine 720-10G: the 4-port 10 Gigabit Ethernet and 48-port 10/100/1000 line cards purchased in 2004, the fan tray 2 purchased in 2004, and the Cisco Catalyst 6509 chassis purchased in 2001. One of the Supervisor Engine 720-3B engines can be traded in or redeployed because in 2008 VSS mode supported only a single supervisor engine in each chassis of the VSS. The Cisco Catalyst 6500 architecture is saving Company XYZ in excess of $75,000 (per switch) because the existing chassis, line cards, and power supplies do not have to be replaced, and the amount of e-waste is drastically reduced for the same reason.

Extended Lifecycles

The Cisco Catalyst 6500 Series Switch is engineered to provide industry-leading investment protection to ensure that the architecture you deploy today can be incrementally changed as the needs of your organization evolve. This scenario allows for a pay-as-you-grow implementation that allows IT groups to more quickly deploy new technology while reducing costs (refer to example 3) and moving toward meeting green initiatives. Figure 11 shows the platform longevity for the Cisco Catalyst 6500.

Figure 11. Cisco Catalyst 6500 Investment Protection



Innovative Business Practices

The desire to meet energy sustainability initiatives and improve profitability line will encourage organizations to begin changing their business behavior. Remote collaboration technologies such as Cisco WebEx™ meeting applications, Cisco TelePresence™ conferencing applications, and Cisco Unified Communications applications are enabling organizations to make more efficient use of workspaces as well as allowing them to implement work models that reduce travel and make telecommuting more feasible. The Cisco Catalyst 6500 Series Switch is an integral part of the architectures supporting these initiatives because of its robust architecture and quality-of-service (QoS) portfolio.

Remote Collaboration Technology Support

The Cisco Catalyst 6500 Series Switch is well-positioned to support the collaboration technologies that can enable organizations to transition to a greener footprint. Most of these technologies revolve around high-bandwidth, high-priority traffic that must be guaranteed from end to end to maintain a high-quality interaction. From a raw bandwidth perspective, the Cisco Catalyst 6500 Series Switch meets the needs of these evolving technologies. The Cisco Catalyst 6500 can support up to 720 Gbps per individual system or 1.44 Tbps when using the VSS. This support is achieved by providing a dedicated 80 Gbps per slot (bidirectional) with distributed forwarding technology that can drive more than 700 Mpps in a VSS.

Raw bandwidth is not the only factor to consider when determining if a platform can adequately support collaboration technologies that demand guaranteed transmission throughout a network. QoS capabilities of the infrastructure are just as important. The Cisco Catalyst 6500 Series Switch has hardware-based QoS mechanisms that guarantee high-priority traffic will be transmitted through the network if congestion conditions arise. This level of support is achieved by implementing per-port strict priority queues into which this high-priority collaboration traffic can be placed. Traffic in these strict-priority queues will always be transmitted before traffic in the lower-priority queues, guaranteeing full link bandwidth for the high-priority traffic if needed.

The final major consideration for support of high-priority collaboration traffic is the availability of the network. Collaboration traffic is sensitive to delays, requiring a network architecture that can recover quickly from an outage and can support upgrades with little to no effect on traffic. The Cisco Catalyst 6500 supports hardware availability features such as redundant supervisor engines, redundant power supplies, and online insertion and removal (OIR) of line cards. It also supports link redundancy through Cisco EtherChannel technology, equal cost multipath (ECMP), and MEC (for VSS only), which can redirect traffic in sub-seconds if a link fails.

For software availability, the Cisco Catalyst 6500 supports Nonstop Forwarding with Stateful Switchover (NSF/SSO) for sub-second and stateful failover between redundant supervisor engines. The Cisco Catalyst 6500 with Cisco IOS Software Release 12.2(33)SXI and newer code supports Enhanced Fast Software Upgrades (EFSU) to enable software upgrades that have less effect in dual-supervisor engine systems. When using EFSU in a VSS, at least 50 percent of the VSS is available at all times during the upgrade process.

Green Effect of Remote Collaboration

The Cisco Catalyst 6500 Series Switch has the necessary features and architectural robustness to support collaboration technologies and help achieve an organization's green initiatives. Following is an example of how Cisco is using these technologies to transition to a greener organization.

Cisco has been using new collaboration technologies very aggressively on a switching infrastructure largely based on the Cisco Catalyst 6500 Series Switch. Figures 12 through 14 show the green effect that Cisco has experienced as a result of deploying these technologies and enabling the Cisco Virtual Offices.

Figure 12. Cisco TelePresence Effect Within Cisco

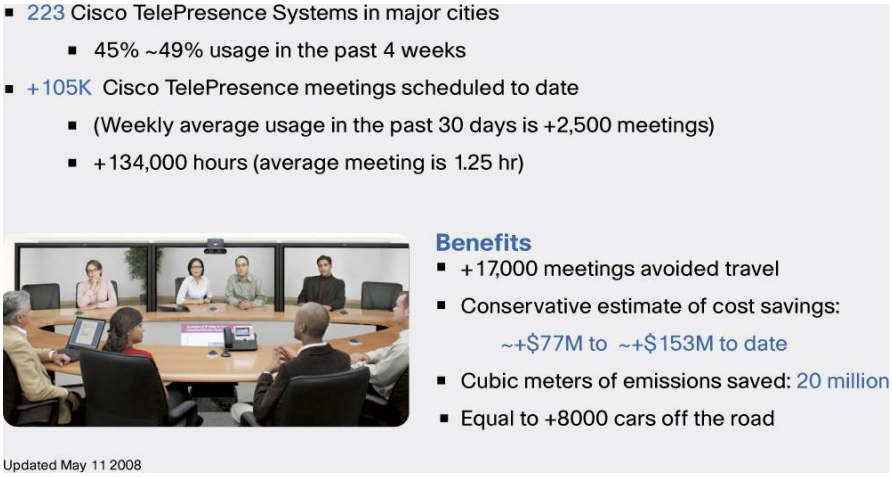


Figure 13. Effect of Cisco Unified MeetingPlace and Cisco WebEx Applications Within Cisco

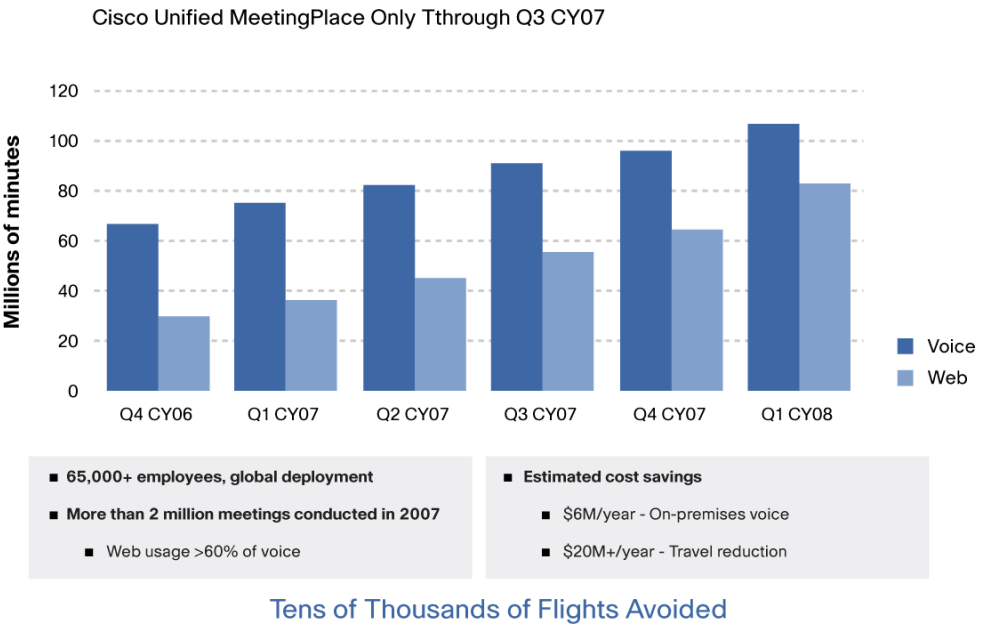
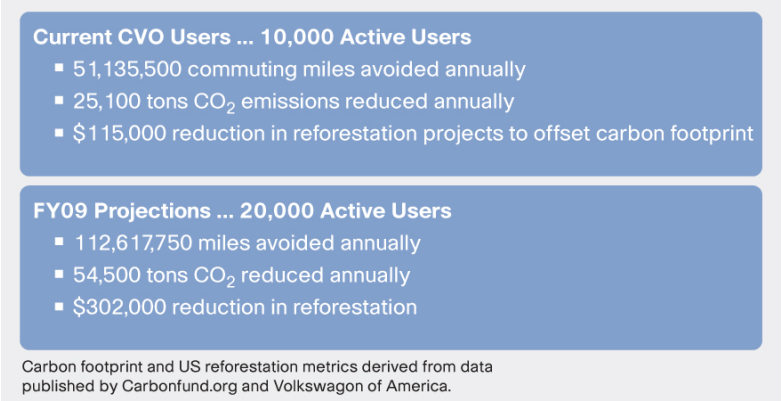


Figure 14. Cisco Virtual Offices



The numbers in Figures 12 through 14 indicate that new collaboration technologies can dramatically affect profitability and can contribute significantly to meeting green initiatives. The Cisco Catalyst 6500 Series Switch has the necessary architecture and features to enable an organization to realize these gains, and new features and architectures are being developed that will allow the platform to continue this support as new technologies emerge.

Conclusion

As we move forward into the 21st century, organizations will face added pressure to become more environmentally friendly as a result of changing public perception about our effect on our environment. Responding to these changing perceptions, governments around the world have already begun to enact tougher environmental policies to address national security, environmental, and resource supply concerns. To comply with these policies and prevent a negative effect on profitability, organizations are looking at ways to transition to data networks with a higher level of energy sustainability.

The Cisco Catalyst 6500 Series Switch offers numerous solutions to enable organizations to make this transition, and Cisco will continue to invest in new energy-efficient technologies as new challenges arise. Increased energy savings through enhanced power management and infrastructure consolidation, operational efficiency through platform extensibility, and longer lifecycles and innovative business practices resulting from new collaboration technologies make the Cisco Catalyst 6500 Series Switch a sensible choice for organizations that need to meet the green initiatives of the 21st century.

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Printed in USA C11-626528 10/10