



## Lab Testing Summary Report

September 2010

Report 100915

Product Category:

### Power Efficient Switches

Vendor Tested:



Products Tested:

**Catalyst**  
**C2960S-48TS-L**  
**C3560X-48T-S**  
**C3750X-48T-S**



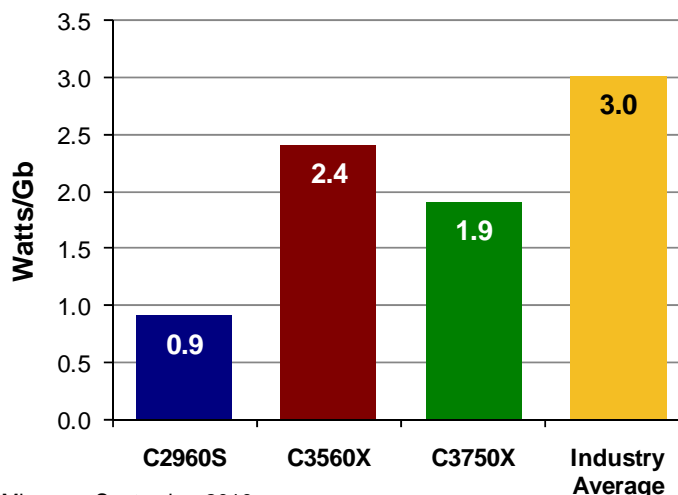
## Key findings and conclusions:

- Cisco Catalyst C2960S consumed 36% less Watts per Gigabit compared to the Industry Average
- C3560X and C3750X can be configured to use StackPower for sharing power efficiently
- Switch management allows scheduled online/offline mode
- EnergyWise software controls power consumption of network
- Both the C3560X and C3750X have two hot swappable fans and power supplies for easy upgrades and high availability

The Cisco Catalyst C2960S-48TS-L, C3560X-48T-S and C3750X-48T-S switches were evaluated by Miercom under the Certified Green Program for power consumption and energy efficiency. We analyzed the overall environmental impact and business enabling green benefits that the tested Cisco Catalyst switches offer.

In hands-on testing and data analysis, the Catalyst switches proved to be energy efficient, environmentally friendly and easily manageable Layer 2 and Layer 3 switching solutions. The three Cisco Catalyst switches are operational out-of-the-box using default settings. Additional configuration is provided through CLI and Web browser GUI. The switches are compatible with Cisco's EnergyWise software that manages power usage for optimum cost savings. With EnergyWise, devices can be placed into sleep mode when they are not needed so that power consumption is reduced.

**Figure 1: Cisco Catalyst Switches Power Efficiency**  
Watts per Gigabit, 100% Load, 1518-Byte Frame Size



Source: Miercom, September 2010

*The power consumption of the Cisco Catalyst switches at maximum load as a function of throughput. Lower values indicate higher power efficiency.*

## Power Consumption

Power measurements were taken of the Cisco C2960S-48TS-L, C3560X-48T-S and C3750X-48T-S switches with different Layer 2 and Layer 3 frame sizes and traffic loads. The effect of the various frame sizes on the power consumption was measured. Power consumption of the products was measured while they were at idle and with 70% and 100% traffic load. See [Figure 2 below](#) and [Figure 3 on page 3](#).

### C2960S-48TS-L

This switch has 48 10/100/1000 Base-T ports and four 1 GbE SFP ports. Power consumption for this switch was recorded using 1518-byte frames. The C2960S-48TS-L consumed 46.3 watts at idle with link, 48 watts at 70% traffic load and 48.2 watts at 100% load.

### C3560X-48T-S

The Cisco Catalyst C3560X-48T-S switch has 48 10/100/1000 Base-T ports and four 1GE SFP+ uplink ports, two upgradeable fans and power supplies. We measured power consumption of the switch using 1518-byte frame sizes while the switch was at idle, 70% load and 100% load. For Layer 2 traffic, results showed the switch consumed 119.4 watts at idle, 123.6 watts at 70% traffic load, and 124.5 watts at 100% load. Layer 3 traffic at idle registered 119.4 watts, 123.6 watts at 70% traffic load, and 124.4 watts at 100% load.

### C3750X-48T-S

This switch has 48 10/100/1000 Base-T ports, four 1GE SFP+ and two 10GE SFP+ uplink ports, two upgradeable fans and power supplies. Power consumption was tested using a 1518-byte frame size while the switch was running at idle, 70% and 100%. Tests run at Layer 2 on the C3750X-48T-S

consumed 124.8 watts while at idle, 126.5 watts at 70% and 128 watts while at 100% load. At Layer 3, the switch consumed 124.8 watts at idle, 127.1 watts at 70% and 128.1 watts at 100% traffic load.

When examining energy consumption based on a function of throughput, all the switches under test outperformed the industry average based on Watts per Gigabit. See [Figure 1](#) on page 1.

## Product Performance

Throughput performance of the C3560X and C3750X performed better than the Industry Average when focusing on watts used per port. Watts per Gigabit was measured at 100% load using a 1518-byte frame size at Layer 2 and Layer 3. At Layer 2 and Layer 3 the C3560X consumed 2.42 Watts per Gigabit. At Layer 2 and Layer 3 the C3750X consumed 1.90 Watts per Gigabit. The Industry Average for Layer 2 traffic at 100% using a 1518-byte frame size is 3.00 Watts per Gigabit.

## Product Efficiency

The Cisco Catalyst C2960S has 48 10/100/1000 Mbps auto-sensing ports and four 1G SFP uplinks. The C3560X and C3750X both have 48 10/100/1000 Mbps auto-sensing ports and four 1GE and 2 10GE SFP+ hot swappable uplink network modules.

The C3560X and C3750X have two upgradeable power supplies each. The switches also have two upgradeable dual-speed cooling fans. These are essential features that all switches should possess. As technology advances in power efficiency and cooling, these switches can be upgraded rather than replaced. See [Figure 4](#) on page 4.

The C3560X and C3750X can be configured to use the StackPower feature that requires between two and nine physical switches to enable power sharing

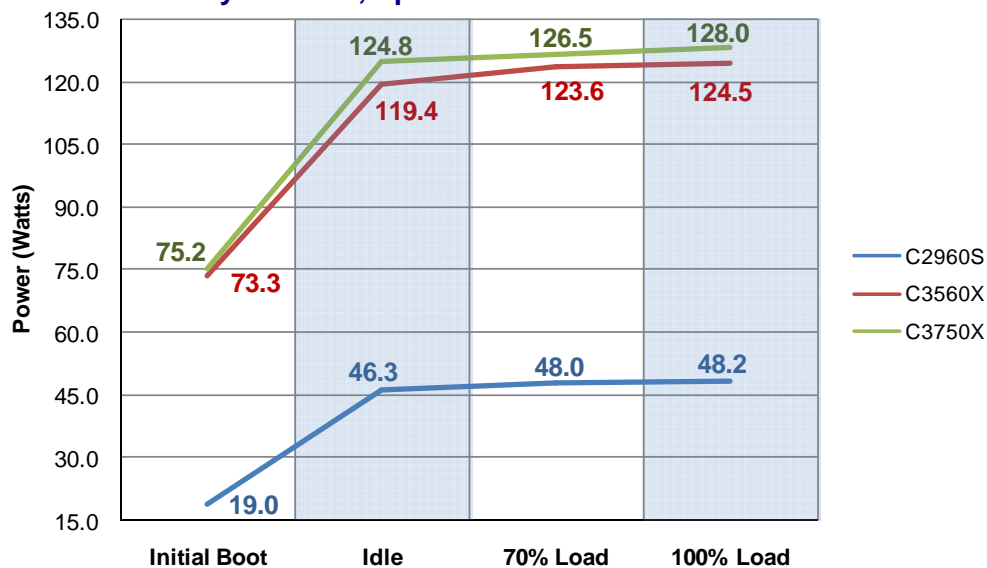
**Figure 2: Cisco Catalyst Switches Power Consumption Relative to Load**  
All ports loaded, 1518-Byte Frames, Specified Load

Model:	Idle	70% Load		100% Load	
		Layer 2	Layer 3	Layer 2	Layer 3
	Watts				
C2960S-48TS-L	46.3	48.0	N/A*	48.2	N/A*
C3560X-48T-S	119.4	123.6	123.6	124.5	124.4
C3750X-48T-S	124.8	126.5	127.1	128.0	128.1

*Comparison of power consumption for both Layer 2 and Layer 3 traffic with 1518-byte frames and at 70% and 100% link utilization. There was a minimal increase in watts consumed when comparing Layer 2 and Layer 3 traffic.*

*\*The C2960S-48TS-L supports Layer 2 only.*

**Figure 3: Cisco Catalyst Switches Power Consumption  
1518-byte Frame, Specified Load**



Source: Miercom, September 2010

*Power profile showing the power consumption in various modes of operation from power up, idle and 70% and 100% link utilization at 1518-byte frames for the switches under test.*

*This is a graphical display of the information in Figure 2 on the previous page.*

efficiency. StackPower technology reduces the number of power supplies needed per switch, and allows the switches to perform at optimum efficiency.

The three Catalyst switches can be easily managed via a secure Web browser interface with Cisco Network Assistant and CiscoWorks LAN Management System. The Cisco IOS CLI can be used for more thorough configurations via serial console, Telnet or SSH. Configuring interfaces, IP addresses, VLANs and many other features with the Cisco Web GUI makes it extremely easy to configure and takes very little time.

The C3560X and C3750X series switches are capable of using the Cisco StackWise feature that enables multiple switches to act as one. The switches in the stack use special stack interconnect cables that create a continuous connection between the switches. Once the switches in the stack are configured properly, the stack can be managed with a single IP address. Switches can be added or removed to and from the StackWise implementation without affecting performance. The C2960S series switch has a similar feature called FlexStack. FlexStack also combines multiple switches to act as one to gain redundancy and high availability.

## Business Processes

Cisco reduces waste output by engineering products that use fewer materials to operate. Cisco products are capable of being upgraded, refurbished and recycled, instead of being disposed of which would increase landfill waste.

Cisco aims to reduce both operational and environmental costs by offering new ways of communication and manageability. They believe that there is a need for working productively across distances without travel, to reduce emissions and keep the environment sustainable.

## Green Innovation

Cisco has two green programs that they endorse: EnergyWise and SmartGrid. Cisco's EnergyWise software controls power consumption of network devices to reduce overall cost and provide energy savings. Cisco's SmartGrid is a combination of products, technologies, services, and ecology-minded partners that optimize communications and reduce the operational cost and intricacy of the energy grid.

The Cisco Catalyst C2960S, C3560X and C3750X switches are able to run in higher temperature ranges so that fans run at lower speeds, lowering energy consumed by the fans. Cisco also has the ability for its switch power supplies to be put offline when they are not in use.

Since 2008, Cisco has reduced the amount of paper, plastic and metal materials that ship with their products. They have replaced these materials with more environmentally friendly solutions, such as using 100% recyclable materials and removing nonessential materials like magnets, rubber feet and generic cables.

## Affiliations and Standards

Cisco is affiliated with many Green programs, such as EnergyWise, SmartGrid, The Green Grid and Energy Star. They are associated with these programs to

**Figure 4: Cisco Catalyst Switch  
Physical Configuration**

Product	C2960S-48TS-L	C3560X-48T-S	C3750X-48T-S
Form/Design	Rack	Rack	Rack
Internal Power	1	2	2
Power Supplies	No	Yes	Yes
Fan/Module	1	2	2
Hot Swap Fans	No	Yes	Yes
Total Ports	52	52	52
10/100/1000	48	48	48
SFP	4-1GE	4-1GE	4-1GE or 2-10GE
Operating Temp	-5°C - +45°C	-5°C - +45°C	-5°C - +45°C
Watts – Idle with links up	46.3	119.4	123.9
Annual Cost*	\$20	\$70	\$72

\*Annual running cost is based on a 9.8 cents per kWh; for 12 hours daily with varying CPU utilizations. See Business Case for details.

increase customer awareness on how to lower operating costs and reduce their carbon footprint. In being part of these Green programs, Cisco is able to learn new Green technologies, as well as sharing their own ideas towards a greener environment.

Cisco Systems has been ranked at the top of Greenpeace's list for building energy management and technologies that boost renewable energy use and efficiency. They were awarded the 2010 Silicon Valley Water Conservation Award (SWCA) and two awards from PRNews for 2010 Corporate Social Responsibility (CSR): Overall Leader in CSR Practices and Best Green PR Campaign.

Cisco sponsors the Energy Efficient Ethernet project which has recently become the IEEE 802.3az standard. This standard focuses on determining when Ethernet switch ports should be put into a low-power idle mode.

## Business Case

The annual cost calculated is based on varying traffic from idle to maximum line rate. The savings calculated is compared to the Industry Average.

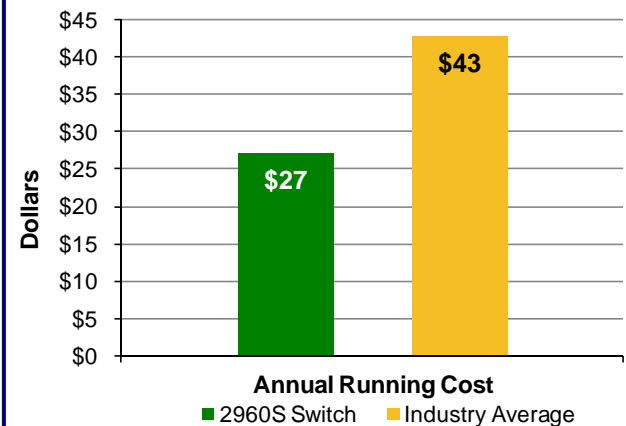
An annual power savings for up to 37% or \$16 is calculated for the C2960 Series Switch tested compared to the Industry Average. The annual usage of the switch is based on being deployed 12 hours per work day each week. During 60 working hours, 10 hours will be running at 100% load and 50 hours at 70% load. Weekends and the remaining 12 hours per day are idle/ready for a total of 108 hours per week. Annual cost is calculated by multiplying kilowatts by total hours; and then by 9.8 cents per kWh. See [Figure 5](#).

## Certified Green

Miercom conducts environmental analysis on products using holistic view, considering power efficiency, manufacturing, and other factors which are part of the product and its lifecycle. Power consumption and power efficiency are very important metrics for comparing products and are typically all that are discussed in other organizations' green reports. We believe a more comprehensive approach which reveals true business case savings to customers for the other environmental benefits a vendor's product may afford is a better approach.

Competitive indexing with industry average is achieved by comparing measured results from products in a given class. This comparison allows a single view of the annual cost for power consumption of a product, and comparison information that will help the user understand if the evaluated product affords an overall advantage for power efficiency.

**Figure 5: Cisco Catalyst 2960S Annual Cost  
All Ports Loaded, Annual Use Estimate**

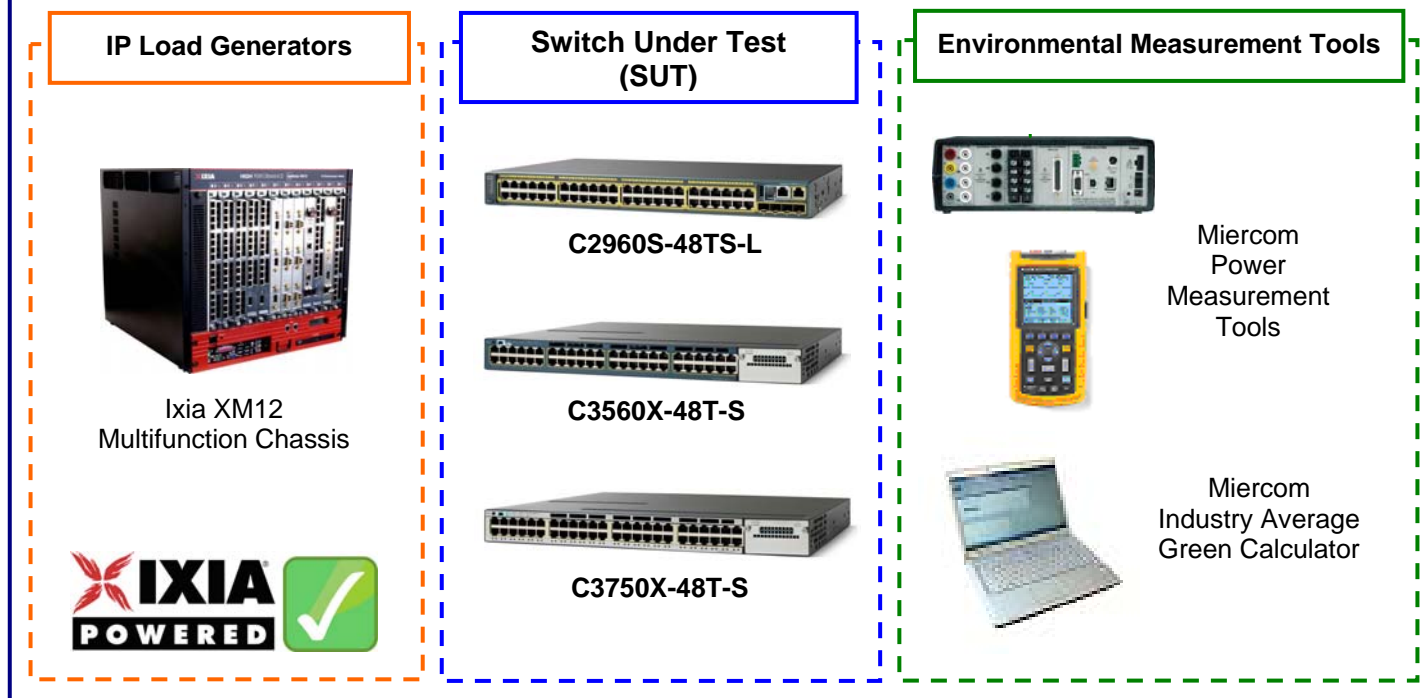


Source: Miercom, September 2010

**Estimated cost savings for the Cisco C2960S as compared to the Industry Average. Annual running cost is based on a 9.8 cents per kWh for 12 hours daily with varying CPU utilizations. See Business Case for details.**



## Test Bed Diagram



## How We Did It

Cisco Catalyst C2960S-48TS-L, C3560X-48T-S and C3750X-48T-S switches were evaluated for environmental impact by looking at the individual components, as well as features and capabilities. Testing was performed at Miercom Labs in Princeton, NJ and focused on power consumption and efficiency of the product. A full audit was additionally conducted to analyze the overall product-specific environmental impact.

Lab testing was conducted for power consumption under load. Measurements and audit results were verified with site survey assessments. The Cisco Catalyst C2960S-48TS-L, C3560X-48T-S and C3750X-48T-S were configured and tested using 48 10/100/1000 Base-T ports. We measured power consumption changes by scheduling the independent ports for power down and configuring them for rate changes via CLI and GUI. In addition, we measured the power consumption at idle with no traffic, no links, partial load and full load.

**Measuring Power Consumption:** The power consumption of the Cisco Catalyst switches were measured with varying network and link loads that a switch would typically experience in a real-world deployment. Power consumption was measured using Miercom power measurement tools. The SUT was loaded with traffic at various rates and packet sizes in accordance with RFC 2544 Benchmarking Methodology for Network Interconnect Development.

Power consumption measurements were taken while the system was idle with network link and with 70% and 100% load. Power consumption was measured while running Layer 2 traffic from the XM12 traffic generator from Ixia ([www.ixia.com](http://www.ixia.com)). Traffic was applied to each of the 1 GbE ports while stressing the product with features it supports.

Miercom recognizes Ixia as an industry leader in energy efficiency testing of networking equipment. Ixia's unique approach utilizes coordination of energy measurements with network traffic load – allowing energy consumption to be graphed against network traffic volume. Real-world traffic is generated by Ixia's test platform and test applications, principally IxAutomate for Layer 2 and 3 switching and routing traffic.

**Environmental Analysis:** Miercom's environmental review of the Cisco Catalyst C2960S-48TS-L, C3560X-48T-S and C3750X-48T-S switches also entailed an examination of the Cisco company-wide and product-specific environmental impact reduction efforts. Analysis included comparisons to the Industry Averages for competitive products that were also tested.

## Miercom Certified Green

The energy efficient characteristics of the Cisco Catalyst C2960S-48TS-L, C3560X-48T-S and C3750X-48T-S switches were evaluated by Miercom according to the Certified Green Testing Methodology. The switches met the required criteria to achieve the Miercom Certified Green Award.

Based on our hands-on testing and the verified representations made by Cisco, Miercom confirms that the Catalyst switches are designed to provide energy saving and environmentally sound switching solutions.

The Cisco Catalyst switches use the StackPower feature for sharing power efficiently and Cisco EnergyWise software to control power consumption. They proved to consume as much as 36% less power than similar switches.



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## About Miercom's Product Testing Services

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Miercom's private test services include competitive product analyses, as well as individual product evaluations. Miercom features comprehensive certification and test programs including: [Certified Interoperable](#), [Certified Reliable](#), [Certified Secure](#) and [Certified Green](#). Products may also be evaluated under the [NetWORKS As Advertised](#) program, the industry's most thorough and trusted assessment for product usability and performance.



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