

Energy Saving Technology White Paper

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Huawei Technologies Co., Ltd.

Address: Huawei Industrial Base
Bantian, Longgang
Shenzhen 518129
People's Republic of China

Website: <http://www.huawei.com>

Email: support@huawei.com

About This Document

Overview

This document describes energy saving technologies on S series switches. S series switches provide the sleep mode, EEE for electrical interfaces, and automatic shutdown for optical interfaces in idle state.

This document describes energy saving modes on S series switches and how to configure energy saving.





Intended Audience


This document is intended for:

- Data configuration engineers
- Commissioning engineers
- Network monitoring engineers
- System maintenance engineers

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
 DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
 WARNING	Indicates a hazard with a medium or low level of risk which, if not avoided, may result in minor or moderate injury.
 CAUTION	Indicates a potential hazard which, if not avoided, could cause equipment damage, data loss, and performance degradation or unexpected results.
 TIP	Indicates a tip that may assist in solving a problem or save time.

Symbol	Description
 NOTE	Provides additional information to emphasize or supplement important points in the main text.

Change History

Changes between document issues are cumulative. The latest document issue contains all changes made to previous issues.

Issue 01 (2012-08-13)

Initial commercial release.

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1 Energy Saving Technologies

About This Chapter

1.1 Introduction

Energy saving technologies efficiently use energy, reduce network operation costs, and extend device lifespan.

1.3 Application

1.1 Introduction

Definition

Energy saving technologies detect device usage and dynamically control the power of fan modules, lasers, and interfaces to control the switch power. The technologies enable the switch to enter the sleep state in the idle time range when they are not used. Huawei S series switches provide intelligent fan speed adjustment, automatic laser shutdown (ALS), Energy Efficient Ethernet (EEE), intelligent port dormancy, and device dormancy.

Objective

As network technologies rapidly develop, high-broadband access services are required by increasing subscribers, and cloud services are required by increasing enterprises. Because LAN access is the most convenient high-broadband access mode, LANs are applied in more and more scenarios, and will be deployed more widely in enterprises and buildings in the future. Currently, energy saving issues become urgent because:

- Network devices work for 24 hours continuously, consuming a large amount of power.
- Countries around the world advocate energy conservation and emission reduction.

Huawei has been devoted to energy saving for many years. During product development, Huawei provides comprehensive energy saving technologies to reduce device consumption and extend device lifespan.

Benefits

Energy saving technologies efficiently use energy, reduce network operation costs, and extend device lifespan.

1.2 Working Principles

1.2.1 Overview

The switch uses appropriate energy saving modes, port dormancy, intelligent fan speed adjustment, and dynamic CPU frequency adjustment to reduce the power consumption.

- Energy saving modes
To meet different application requirements in various scenarios, S5700LI series switches provide the following three energy saving modes:
 - Standard energy saving mode
This mode is enabled by default when the S5700LI switch is running. The mode has no special requirements for operation, maintenance, and application scenario of a device, and is applicable to the scenario where core networks are deployed or services are busy.
 - Basic energy saving mode
In this mode, the switch shuts down idle components or enables these components to sleep after the switch dynamically detects the running status of these components. This mode affects the startup speed of the user that is not configured with any services or the user that is not online.
 - Deep energy saving mode
In this mode, the switch shuts down idle components or enables these components to sleep, and adjusts the power consumption of normally running services according to service requirements. This mode is applicable to scenarios (for example, the access scenario) where the response time is in the allowed range and the performance meets the requirement.
- Energy saving on an electrical interface
The system provides power for each interface. Even though an interface is idle, it consumes the same power as working interfaces, wasting power. EEE and port sleep enable the system to reduce the power on an electrical interface when the interface is idle and to restore the power when the interface starts to transmit data. This reduces power consumption in the system.
- Energy saving for an optical interface
The ALS technology controls the pulse of the laser of an optical module by detecting the Loss of Signal (LoS) on an optical interface. After detecting the LoS signal on an optical interface, the system shuts down the laser of optical module, saving power.
- Intelligent fan speed adjustment
The switch fan modules use the intelligent fan speed adjustment technology. The fan modules monitor the temperature of key components. If a sensitive component overheats, the fan speed increases; when the temperature is lower than the normal range, the fan speed decreases. The fan modules reduce power consumption and noise.

1.2.2 EEE

EEE was the IEEE 802.3az standard defined by the Institute of Electrical and Electronics Engineers in 2010. This standard supports the low power idle (LPI) mode at the physical layer of all Ethernet Base-T transceivers (100 Mbit/s, 1 Gbit/s, or 10 Gbit/s) and backplanes. In a word, in LPI mode, the power consumed by devices at both ends of a network is reduced when the Ethernet is idle, and the power supply resumes when the Ethernet transmits data. In the traffic model, as shown in Figure 1-1, the Ethernet is idle for most of the time. Therefore, EEE can be applied in various scenarios. Compared with the active mode, the 1000Base-T saves the power of 70% to 90% in LPI mode. Figure 1-2 shows the comparison between the power consumed when the EEE function is enabled and disabled. The result shows that a large amount of power is saved when the EEE function is enabled.

Figure 1-1 Traffic model in the typical desktop application (100 Mbit/s)

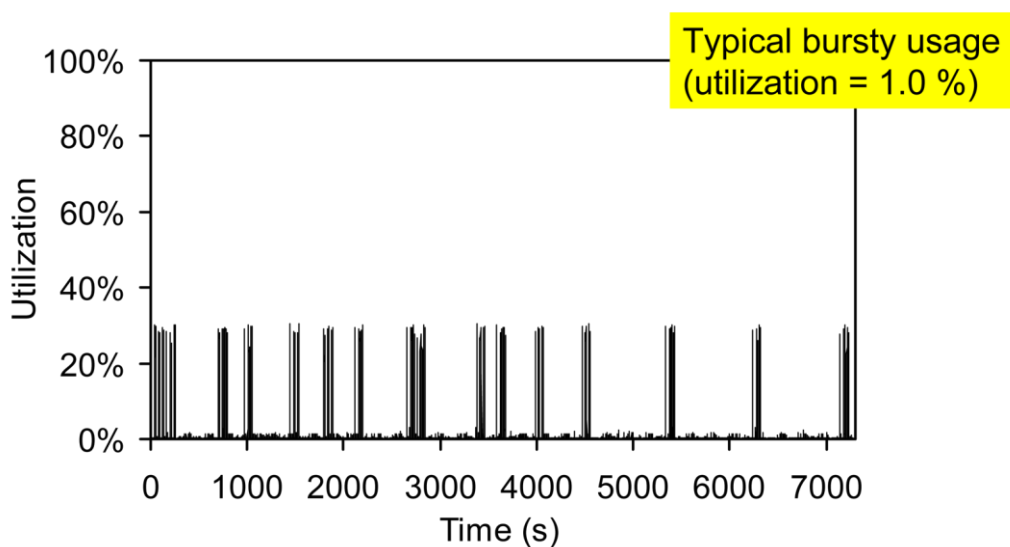
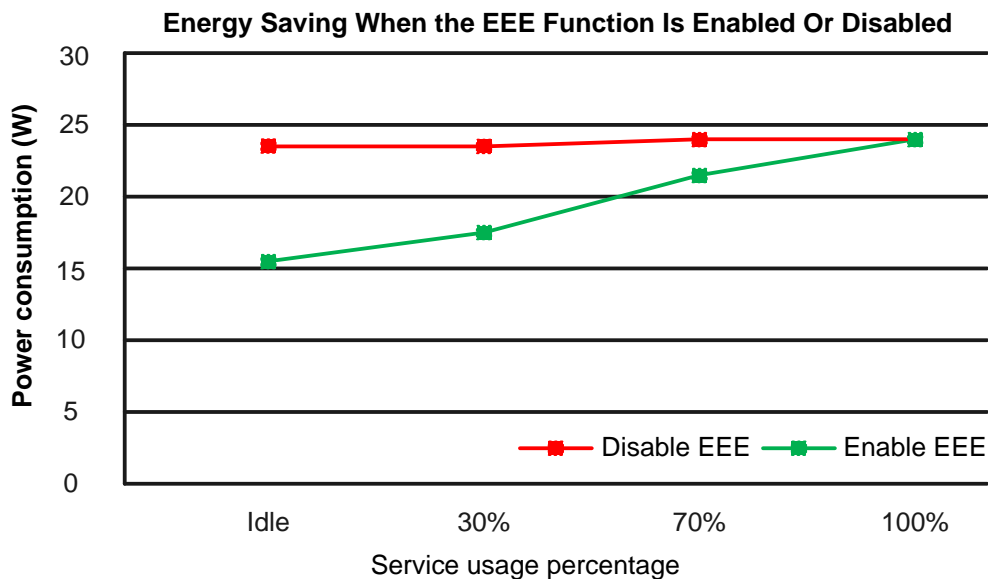


Figure 1-2 Energy saving effect when the EEE function is enabled or disabled

EEE configuration is as follows:

1. Enable auto-negotiation.

```
<Quidway> system-view
[Quidway] interface gigabitethernet 1/0/1
[Quidway-GigabitEthernet1/0/1] negotiation auto
```

2. Enable EEE.

```
[Quidway-GigabitEthernet1/0/1] energy-efficient-ethernet enable
```

1.2.3 Automatic Port Sleeping

Box switches provide automatic port sleeping. When the link is faulty or the network cable is removed, the port enters the sleep state. When the link recovers and the device detects carrier signals, the port starts to work.

To enable port sleep, run the following commands:

```
<Quidway> system-view
[Quidway] interface gigabitethernet 0/0/1
[Quidway-GigabitEthernet0/0/1] port-auto-sleep enable
```

1.2.4 Intelligent Fan Speed Adjustment

Chassis switches support intelligent fan speed adjustment. The switch adjusts the fan speed by monitoring the temperature of the optical module on the board and controls the temperature within the allowed range. When the temperature of the optical module is higher than the upper threshold, the fan module increases the fan speed to speed up heat dissipation. When the

temperature of the optical module falls below the lower threshold, the fan module decreases the fan speed to save power.

Set the upper threshold to 60 °C and lower threshold to 50 °C.

```
<Quidway> system-view
[Quidway] set transceiver temperature threshold 50 60 all
```

1.2.5 ALS

If faults occur on a fiber link, data transmission is interrupted. However, optical interfaces on the switch are not disabled. Continuous working of lasers on the optical modules wastes energy and brings potential risks. The ALS technology controls the pulse of the laser of an optical module by detecting the LoS on an optical interface. After a link is faulty, LoS signals are sent continuously. After detecting LoS signals, the switch determines that the link is faulty. Then the switch shuts down the laser of the optical module. The ALS mechanism protects operators against laser injury and saves energy.

To enable ALS, run the following commands:

```
<Quidway> system-view
[Quidway] interface gigabitethernet 0/0/1
[Quidway-GigabitEthernet0/0/1] als enable

[Quidway-GigabitEthernet0/0/1] display als configuration interface gigabitethernet
0/0/1
```

```
-----
Interface           ALS      Laser      Restart      Interval(s)  Width(s)
                   Status   Status     Mode
-----
GigabitEthernet0/0/1  Enable   Off        Auto         100          2
-----
```

1.2.6 Dynamic CPU Frequency Modulation

Dynamic CPU frequency modulation is the most efficient energy saving method used when the system operates properly. The technology helps save energy while ensuring device functions and performance. In addition, this technology supports fast switching between the fast clock and slow clock modes. In fast clock mode, the CPU working frequency is high, and therefore the consumed power is large. In slow clock mode, the CPU working frequency is low, and therefore the consumed power is small. This technology has been widely used in the IT industry for many years. The S5700LI series intelligent low-power-consumption switches support the technology, and therefore are applicable to various scenarios. When a device is in sleep mode, the device automatically enables the dynamic CPU frequency modulation so that the CPU can work in slow clock mode and reduce power consumption. When the device resumes working, the CPU operates in fast clock mode to enhance device performance.

1.2.7 AHM

AHM is a solution put forward by Huawei to manage the sleep mode of network devices.

The sleep mode is the lowest power consumption state of a device. In this state, all chips except the CPU of the device work in energy saving mode and the device disables all service functions. However, the device can be awakened at the preconfigured time or by a user command so that it responds rapidly and enters into the normal state.

The prerequisite for a device to enter the sleep mode is that the device supports the deep energy saving mode. The device enters into the sleep mode when meeting the following conditions:

- The device works in deep mode. By default, the standard energy-saving mode is used.
- A time range applies to the device in sleeping mode.
- No awakening port is in Up state during the period at which the ports status is detected continuously.
- The device is in deep energy saving mode. To set the deep energy saving mode, use the following command:

```
[Quidway] set power manage mode 4
```

To check the energy saving mode used by the device, use the following command:

```
[Quidway] display power manage mode  
4 (Deep mode)
```

The deep energy saving mode acts like the switch of the sleep function. To disable the sleep function, use other energy saving modes without having to modify sleep settings. The sleep function is disabled if the standard energy saving mode is used.

- A device does not work at certain time. You can apply a time range to the device in dormancy state. When dormancy conditions are met, the device automatically enters the dormancy state during the time range. To set a sleep time range, use the following command:

Set the sleep time range to 0:00–7:00 in workdays.

```
[Quidway] time-range sleeptime 0:00 to 7:00 working-day
```

Make the sleep time range take effect.

```
[Quidway] sleep time-range sleeptime
```

The sleep time range is optional. If no time range is set, the device detects sleep conditions all day, that is, the sleep time range is all day.

- During sleep detection, all awakening ports of the device are not in Up state. That is, all awakening ports can set up connections with the devices such as a PC in power-off state. After the PC is powered off, ensure that no power supply is provided to its NIC. The method of setting a port as a non-awakening port is as follows:

Set GigabitEthernet0/0/1 as a non-awakening port.

```
[Quidway] set power manage non-awaken-port interface GigabitEthernet0/0/1
```

- If no awakening port is detected in use during the period, the device enters the dormancy state and stops transmitting services. The method of setting the sleep detection interval is as follows:

Set the sleep detection interval to 10 minutes.

```
[Quidway] set power manage interval 10
```

A device awakens from the sleep mode when meeting one of the following conditions:

- A user logs in to the device through a serial port and presses **Ctrl+W** to make the device awaken.
- A user connects to an awakening port.
- If a sleep time range is set, the device awakens after the time range ends.



CAUTION

When a device enters into the sleep mode, its service functions are disabled.

When a device is deployed in the middle of a ring network or a tree network, it is recommended that the sleep function be not enabled on the device. Once the device enters into the sleep mode, the service functions of other devices are disabled.

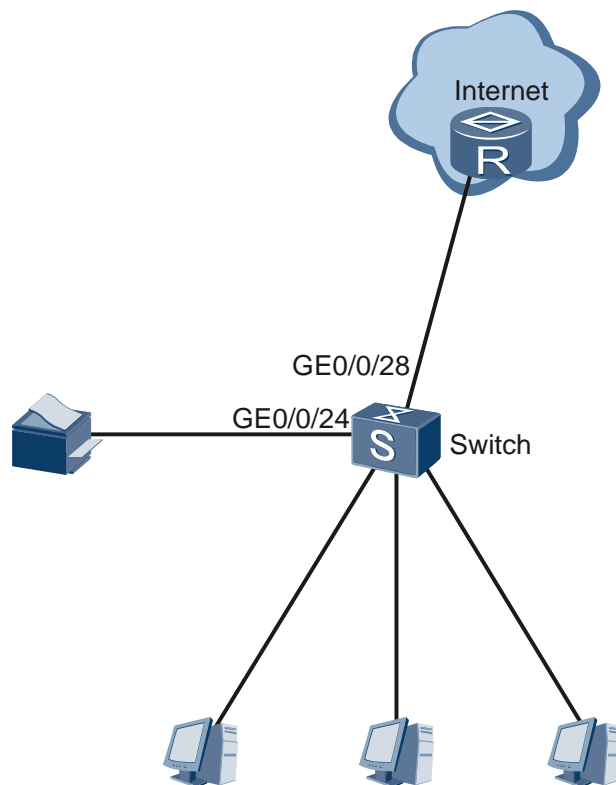
When a device is in the sleep mode, the network cable (including the null network cable) can be connected to an awakening port to make the device awaken. That is, the device receives an Up request from an awakening port.

After the PC connected to an awakening port is powered off, ensure that no power supply is provided to its NIC (by performing configuration in the power management of BIOS). Otherwise, the device fails to enter the sleep mode or awakens from the sleep mode.

1.3 Application

1.3.1 Typical Network Application

As shown in Figure 1-3, the S5700-28P-LI is deployed in a large-sized enterprise network. The device has 28 GE ports. There are 23 GE ports for connecting PCs, one GE port for connecting the printer, one GE port for connecting the upstream network device, and three idle GE ports. The port numbers are assigned sequentially. The employee attendance system of the enterprise is 8:00 am–6:00 pm and some employees work for extra hours sometimes.

Figure 1-3 Configuring the sleep mode**Configuration analysis:**

According to the network characteristics, the device is rarely used after work hours from Monday to Friday and enters into the sleep mode all day on Saturday and Sunday. To facilitate the employees who come early and leave late, one hour is reserved. The sleep time range for workdays is 00:00–7:00 in the morning and 19:00–24:00 in the night. The sleep time range for rest days is 00:00–24:00. GigabitEthernet0/0/24 is connected to the printer, GigabitEthernet0/0/28 is used as the uplink port, and GigabitEthernet0/0/25 to GigabitEthernet0/0/27 are idle. In this way, the five ports are configured as non-awakening ports. The device can awaken through an awakening port. By calculation, the device has opportunities to enter the sleep mode in 70% of its operating time.

Solution:

1. Set three sleep time ranges. If no time range is set, the device performs all-day detection. The sleep time ranges are as follows:
 - Monday to Friday: 00:00–7:00
 - Monday to Friday: 19:00–24:00
 - Saturday to Sunday: 00:00–24:00
2. Set GigabitEthernet0/0/24 as a non-awakening port.
3. Set GigabitEthernet0/0/25 to GigabitEthernet0/0/28 as non-awakening ports.

Configure the switch.

#

```
set power manage mode 4
```

```
sleep time-range sleeptime
set power manage non-awaken-port interface GigabitEthernet0/0/24
set power manage non-awaken-port interface GigabitEthernet0/0/25
set power manage non-awaken-port interface GigabitEthernet0/0/26
set power manage non-awaken-port interface GigabitEthernet0/0/27
set power manage non-awaken-port interface GigabitEthernet0/0/28
#
time-range sleeptime 00:00 to 07:00 working-day
time-range sleeptime 19:00 to 00:00 working-day
time-range sleeptime 00:00 to 00:00 off-day
#
```