

Huawei Sx700 Series Switches PoE Technology White Paper

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Contents

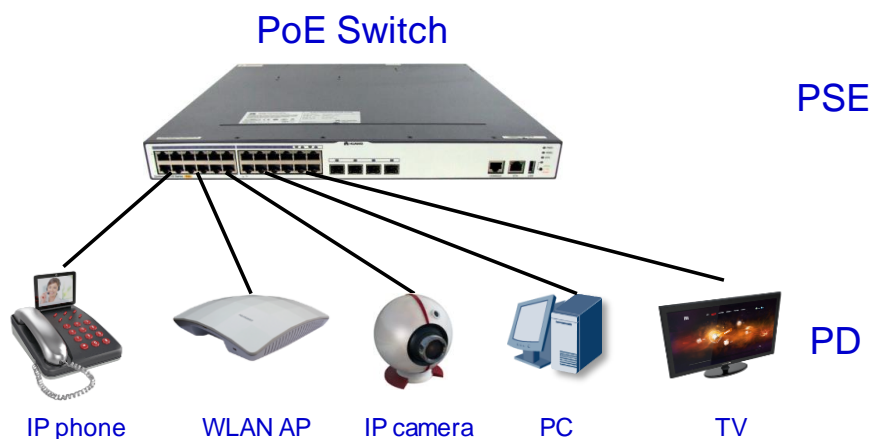
| | |
|---|----------|
| 1 Overview | 1 |
| 2 PoE Device Power Supply Modes..... | 3 |
| 3 PoE Device Power-on Process..... | 5 |
| 4 PoE Device Power Management | 6 |
| 5 Perpetual PoE and Fast PoE | 7 |
| 6 PoE Transmission Distance | 8 |

1 Overview

Power over Ethernet (PoE) is a technology that provides power along the 10BASE-T, 100BASE-TX, 1000BASE-T, 2.5GBASE-T, 10GBASE-T, or other Ethernet cable. PoE can effectively provide centralized power for terminals such as IP phones, WLAN Access Points (APs), chargers of portable devices, POS machines, cameras, and data collection devices. Terminals are PoE-powered when they access the network. Therefore, the indoor cabling of power supply is not required.

A PoE system consists of Power Sourcing Equipment (PSE) and Powered Devices (PDs). A PSE provides power, and a PD receives power from a PSE. As shown in Figure 1-1, the PoE switch functions as a PSE, and terminals such as IP phones, WLAN APs, and cameras are PDs.

Figure 1-1 Diagram of a PoE system



PoE technology facilitates installation and management, and ensures security and stability. It is widely used in scenarios such as home applications, WLAN construction, security protection, retail, and entertainment.

Currently, IEEE 802.3af-compliant PoE provides a maximum of 15.4 W power, while IEEE 802.3at-compliant PoE+ delivers up to 30 W power.

Nowadays, new service types and terminals are constantly emerging, which require higher PoE input power. To meet this trend, Huawei has actively engaged in the formulation of the IEEE 802.3bt standard (also known as PoE++). In compliance with IEEE 802.3bt (draft),

Huawei has developed and launched many PoE++ switches that provide a maximum of 60 W power. Beside these, Huawei has also unveiled the next-generation Universal Power Over Ethernet Plus (UPoE+) switch (S5720-14X-PWH-SI-AC) on the basis of IEEE 802.3bt. The UPoE+ function provides up to 90 W power, meeting the needs of more terminals.

The following table describes detailed performance parameters of PoE, PoE+, PoE++, and UPoE+ functions.

| Category | PoE | PoE+ | PoE++ | UPoE+ |
|-------------------------------|--------------|-----------------|----------------------|----------------------|
| Standard | IEEE 802.3af | IEEE 802.3at | IEEE 802.3bt (draft) | IEEE 802.3bt (draft) |
| Power supply distance | 100 m | 100 m | 100 m | 100 m |
| Classification | 0-3 | 0-4 | 0-8 | 0-4 |
| Maximum current | 350 mA | 720 mA | 720 mA | 960 mA |
| Voltage range at PSE | 44-57 V DC | 50-57 V DC | 50-57 V DC | 50-57 V DC |
| Power delivered by PSE | ≤ 15.4 W | ≤ 30 W | ≤ 60 W* | ≤ 90 W |
| Voltage range at PD | 36-57 V DC | 42.5-57 V DC | 42.5-57 V DC | 42.5-57 V DC |
| Maximum power available at PD | 12.95 W | 25.5 W | 54 W* | 81.6 W |
| Cable requirement | Unstructured | CAT-5 or better | CAT-5 or better | CAT-5 or better |
| Number of power line pairs | 2 | 2 | 4 | 4 |

*Remarks: A Huawei PoE++ port provides up to 66 W output power. After transmission over a 100-meter standard Cat5E cable, the maximum power available at PDs is 54 W.

PoE has many advantages, including the following:

- **Reliable:** Multiple PDs are powered by one device, facilitating power backup.
- **Easy to deploy:** Network terminals can be powered over network cables, without a need for external power sources.
- **Standards-compliant:** PoE complies with IEEE 802.3af, IEEE 802.3at, and IEEE 802.3bt standards, and uses globally uniform power interfaces. This capability ensures easy networking with PDs of different vendors.

2 PoE Device Power Supply Modes

According to the IEEE standard, a PSE is mainly used to provide power to PDs. There are two kinds of PSEs: Midspan PSE (the PoE module is installed out of the device) and Endpoint PSE (the PoE module is integrated into the device).

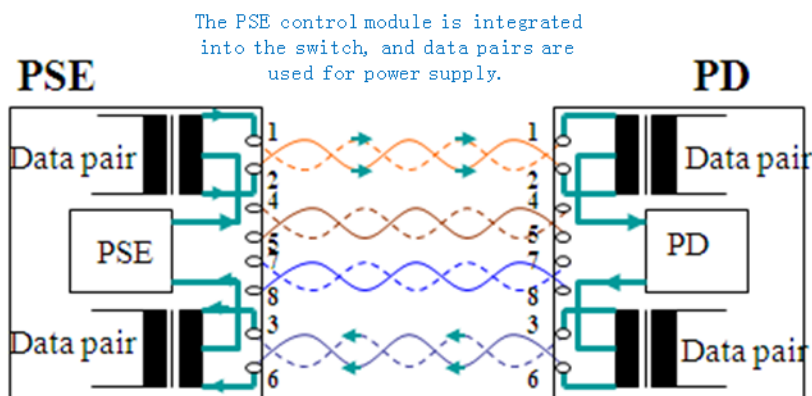
Huawei PoE-capable switches support built-in PoE modules and therefore belong to Endpoint PSEs. The Endpoint PSE is compatible with 10BASE-T, 100BASE-TX, 1000BASE-T, and 2.5GE BASE-T interfaces. Therefore, the Endpoint PSE is more widely used than the Midspan PSE.

The Endpoint PSE can provide power using two methods: Alternative A (data pairs 1/2 and 3/6) and Alternative B (data pairs 4/5 and 7/8).

- Alternative A: power supply through the data pairs

The PSE supplies power to PDs through data pairs 1/2 and 3/6. Data pair 1/2 acts as the positive polarity, and the data pair 3/6 acts as the negative polarity. 10BASE-T and 100BASE-T interfaces use data pairs 1/2 and 3/6 to transport data, while 1000BASE-T interfaces use all the four wire pairs (1/2, 3/6, 4/5, and 7/8) to transmit data. As DC power and data are transmitted on different frequencies, it is possible to simultaneously transmit power and data over the same wire pairs.

Figure 2-1 Endpoint PSE, Alternative A

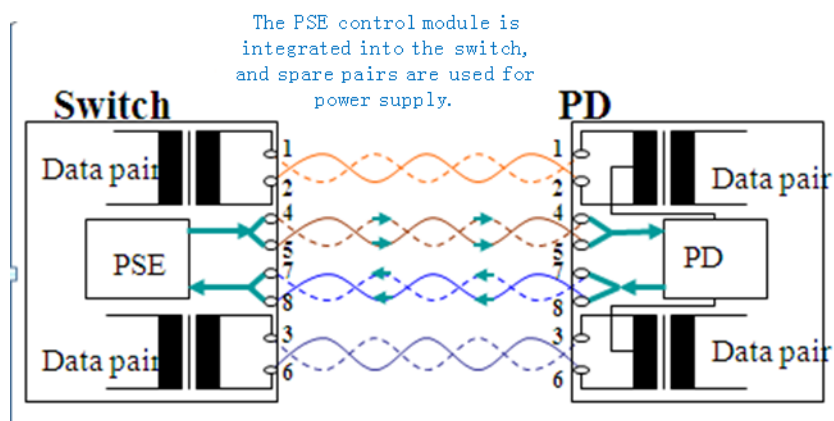


- Alternative B: power supply through the spare pairs

The PSE supplies power to PDs through spare pairs 4/5 and 7/8. The spare pair 4/5 acts as the positive polarity, and spare pair 7/8 acts as the negative polarity.

Generally speaking, a standard PD must support both Alternative A and Alternative B modes. However, the PSE is allowed to support only one of the two modes. Huawei S5720-14X-PWH-SI-AC, S5720-16X-PWH-LI-AC, S5720-28X-PWH-LI-AC, S5720I-SI, S5730-HI, and S6720-SI can function as the PSE to provide PoE++ power supply, and they support both the Alternative A and Alternative B modes. Other switch models, however, support only the Alternative A mode.

Figure 2-2 Endpoint PSE, Alternative B



3 PoE Device Power-on Process

The following describes the PoE device power-on sequence:

1. **Detection of PDs:** The PSE periodically transmits a low voltage with a limited current through its ports to detect PDs. If the PSE detects a resistance with a specified value, PDs that comply with IEEE 802.3af, IEEE 802.3at, or IEEE 802.3bt are connected to the PSE.
2. **Negotiation of power supply capability:** The PSE classifies PDs and negotiates power supply capability with PDs. Two methods are available to negotiate power supply capability: resolving the detected resistance value or using the Link Layer Discovery Protocol (LLDP).
3. **Start of power supply:** In less than 15 microseconds, the PSE starts to provide a low voltage to PDs, which is then raised to 48 V DC.
4. **Normal power supply:** After the voltage is reached to 48 V, the PSE provides stable and reliable 48 V DC power to PDs. The power available at PD does not exceed 30 W (90 W when Huawei S5720-14X-PWH-SI-AC is used as the PSE; 60 W when Huawei S5720-16X-PWH-LI-AC, S5720-28X-PWH-LI-AC, S5720I-SI, S5730-HI, or S6720-SI used as the PSE).
5. **Disconnection of power supply:** While power is being supplied, the PSE continuously detects the input current of PDs. The PSE cuts off the power supply to PDs and re-enters the PD detection procedure when the current of the PDs is reduced to the minimum value or increased sharply in the following situations:
 - The PDs are removed.
 - The PDs are short-circuited.
 - The power consumed at the PDs exceeds the power supply load of the PSE.

4 PoE Device Power Management

Huawei switches provide real-time power management functions that can implement management based on the real-time power of PDs.

For example, if a customer chooses a Huawei S5720-28P-PWR-LI-AC, the 24 ports on this switch support PoE/PoE+ power supply, with 370 W PoE in total. This switch does not invariably deliver 30 W for each port; instead, it manages the PoE power output of its ports based on the power consumption of PDs.

You can refer to the following table to calculate how many ports can provide PoE/PoE+ power.

| PD Power Consumption | Cable Transmission Loss | Number of Ports That Can Provide PoE/PoE+ Power |
|----------------------|-------------------------|---|
| 25 W | 4.3 W | 12 ports |
| 20 W | 2.54 W | 16 ports |
| 12.5 W | 0.9 W | 24 ports |

Huawei switches provide two power supply management modes: automatic and manual.

- Automatic mode

A Huawei switch (as the PSE) automatically powers on and off PDs based on power supply priorities of ports. The power supply priority of ports can be set to critical, high, or low, depending on the importance of PDs connected to the ports. When the output power approximates to the full capacity of the PSE, the PSE provides power first for the PDs connected to the ports of the critical priority and then for those connected to the ports of the high priority.

In the case of the same priority, Huawei S5700-LI, S2750-EI, S5720-HI, and S5720-EI series PoE switches preferentially provide power for the PDs connected to the ports with smaller port IDs. Other series PoE devices of Huawei supply power based on the power-on time sequence of PDs.

- Manual mode

Users can manually power on and off the PDs connected to ports. In manual mode, no power supply priority is configured. Powering on or off the PDs connected to a single port does not affect the PoE power supply on the other ports. When the output power approximates to the full capacity of the PSE, new PDs cannot be powered on. (Huawei S5720-16X-PWH-LI-AC, S5720-28X-PWH-LI-AC, S5720I-SI, S5730-HI, S5730-SI, S5730S-EI, and S6720-SI do not support this manual mode.)

5 Perpetual PoE and Fast PoE

Huawei switches support the perpetual PoE technology to deliver uninterrupted PoE power supply. A Huawei switch does not stop supply power to PDs even when a switch card is reset by running the reboot command. This capability ensures that PDs are not powered off during the switch reboot, eliminating the fault-triggered interruption accordingly. Huawei modular switches currently do not support perpetual PoE.

Huawei switches also support the fast PoE technology to ensure fast power supply. Huawei switches can supply power to PDs within 10s after they are powered on. This is different from common switches that generally take 1 to 3 minutes to start to supply power to PDs. Huawei's fast PoE capability greatly shortens the service interruption time caused by power supply interruption, and enables the switch and PD to start almost at the same time. That is, after the switch is fully started, PDs can immediately get powered and function properly.

Note: Huawei S5730-HI, S6720-SI, S5730S-EI, S5730-SI, S5720-16X-PWH-LI-AC, S5720-28X-PWH-LI-AC, and S5720I-12X-PWH-SI-DC support the fast PoE technology.

6 PoE Transmission Distance

6.1 Implementation Principle of 200-meter PoE power supply

The most important indicator in network cable transmission of electrical interfaces is the signal-to-noise ratio (SNR). To support a longer transmission distance, you need to reduce the SNR loss of the entire link. There are multiple components and media on the transmission link of electrical interfaces, including PHY chips, PCBs, interface connectors, and network cables on both ends. Based on these components and media, SNR parameters can be optimized to enable MultiGE electrical interfaces of Huawei PoE devices to support a maximum transmission distance of 200 m when they are connected to specific Huawei APs. The optimization methods include:

- Huawei uses shielded network cables to support a maximum transmission distance of 200 m. This is because the crosstalk between copper cables is serious when unshielded network cables are bundled together, which has the largest impact on the SNR. Shielded network cables can be used to optimize SNR parameters.
- Huawei tests the anti-interference capability of the PHY chips provided by vendors to ensure that each PHY chip supports a maximum transmission distance of 200 m. Additionally, Huawei enables vendors to customize PHY driver software according to Huawei's requirements to optimize SNR parameters over a long transmission distance.
- Huawei improves various signal attenuation indicators of connectors used by interfaces that support a maximum transmission distance of 200 m to optimize SNR parameters.

6.2 PoE Transmission Distance of 200-meter PoE power supply

The maximum PoE power supply distance supported by the S5720-28X-PWH-LI-AC, S6720-32C-PWH-SI-AC, and S6720-32C-PWH-SI is 200 m. The maximum PoE power supply distance supported by other switch models is 100 m.

When S5720-28X-PWH-LI-AC, S6720-32C-PWH-SI-AC, and S6720-32C-PWH-SI switches support a maximum PoE power supply distance of 200 m, the following restrictions apply:

- The switches can only be connected to APs of the specified models, including P7052DN/AP7152DN, AP6052DN, AP8082DN/AP8182DN, and AP7052DE.
- Supported PoE power supply standards include 60 w PoE++, 30 w PoE+, and 15.4 w PoE. There is a 5 w power loss per 100 m.
- The maximum PoE power supply distance can reach 200 m only when the following network cables are used.

| Device Model | Required Port | Required Network Cable |
|---|--------------------------------|---|
| S5720-28X-PWH-L I-AC | 8x2.5GE electrical ports | <ul style="list-style-type: none"> • Category 5e shielded twisted pair (Cat5e STP) • Category 6 shielded twisted pair (Cat6 STP) • Category 6A foiled/unshielded twisted pair (Cat6A F/UTP) • Category 6A shielded twisted pair (Cat6A STP) • Category 7 twisted pair (Cat7) |
| S6720-32C-PWH-SI -AC S6720-32C-PWH-SI | Right 8x2.5GE electrical ports | <ul style="list-style-type: none"> • Category 5e shielded twisted pair (Cat5e STP) • Category 6 shielded twisted pair (Cat6 STP) • Category 6A foiled/unshielded twisted pair (Cat6A F/UTP) • Category 6A shielded twisted pair (Cat6A STP) • Category 7 twisted pair (Cat7) |

S5720I-12X-PWH-SI-DC and S5720I-28X-PWH-SI-AC can be connected to Huawei cameras over a long distance. When ports of these switches work at the 100M rate, the maximum transmission distance can be 200 m. When ports of these switches work at the 10M rate, the maximum transmission distance can be 250 m.

- The supported camera models include: M2220-I, M2221-FL, M2221-VL, M2260-I, and M2220-I.
- When the transmission distance exceeds 100 m, cables of Cat5e or higher category must be used.