61200740L1-30.1D
March 2015

ADTRAN

Technology Brief

PoE and Power Management

This document explains the technology and applications involved with Power over Ethernet (PoE) and ADTRAN's Power Management feature. A brief introduction outlines the basics of these technologies. Applicable technical specifications and standards used in the development of the technologies are included. This is followed by a more thorough explanation detailing the specifics of the technologies, as well as specific examples of their use in a real world setting.

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Introduction

PoE is a technology that is used to transmit electrical power (along with data) to remote devices over a standard twisted-pair cable on an Ethernet network. PoE is used to provide power to a variety of network appliances including, but not limited to, IP phones, IP cameras, and wireless access points (APs). PoE can be a cost-effective and convenient method of powering devices in currently existing areas where upgrading the infrastructure is prohibited by a variety of factors.

Power Management is a feature that, as its name implies, manages the available power output of a power sourcing unit. It works in conjunction with PoE, and is a feature in certain ADTRAN units where the potential usage of supported PoE devices exceeds the total available electrical power that can be supplied by the powering unit.

Technology Specifications and Standards

The current PoE standard is governed by clause 33 contained in IEEE 802.3af (IEEE 802.3-2005). The specification that will supersede the current standard in the near future is IEEE 802.3at.

Power Management is not an industry regulated technology and functions according to ADTRAN specifications.

Technology Overview

Power over Ethernet

PoE can be used in 10Base-T and 100Base-TX networks, as well as in 1000Base-T (Gigabit Ethernet) applications due to a phantom power technique that allows power to be transmitted over data transmission wire pairs. PoE provides 48 VDC over two pairs of a CAT 3/CAT 5e Ethernet cable. The maximum current of 400 mA provides a maximum load power of 15.4 W prior to power losses within the system.

The IEEE specification for PoE requires that at least two devices be present in the network for operation. These devices represent two different types. These types are powered devices (PDs) and power sourcing equipment (PSE).

A PD is a device that operates on power supplied by a PSE rather than conventional means. PDs cover a broad range of network equipment, and can operate in one of two modes, A or B. The mode that is used is determined by the PSE. The two modes differ in the wire pairs/pins used in the process. Mode A uses pins 1, 2, 3, and 6 while mode B uses pins 4, 5, 7, and 8. Consequently, mode B requires that a 4-pair cable be used. In order to indicate its compliance with IEEE standard 802.3af, the PD places a 25 KΩ resistance between the powered pairs. In order to stay powered, the PD must use 5 to 10 mA continuously for at least 60 ms with no greater than 400 ms since its last use.

The PSE device is classified in one of two ways, as a midspan or an endspan. A midspan simply functions as a power supply for the PD and is placed between the non-PoE switch and the PD, having no effect on the data. An endspan combines an Ethernet switch with the necessary hardware to transmit PoE along with the data. Midspans are typically used when there is no need to add a new switch to the network but rather to add PoE capability to an existing network.

PoE+

PoE+ is a higher powered version of PoE. PoE+ is necessary to support devices, such as 802.11n access points, pan tilt zoom (PTZ) cameras, and other class 4 devices whose power demands exceed the capabilities of standard PoE. Units that support PoE+ can provide a maximum of 25.5 W of power per port. Depending on the number of ports utilizing PoE or PoE+ and the total internal power of the units power supply, a full 25.5 W may not be available for each port. If there is insufficient power available to support the request of a PD, the power could be limited. Use the **show power inline** command to determine if there is insufficient power to support a PD. The limited case is only valid for PoE+ devices that use link layer discovery protocol (LLDP) to negotiate power.

Power Management

The Power Management feature measures, in real time, the total power used by all connected PDs. The difference in the total allocated power and the total available power from the unit is called the available power.

When the Power Management feature detects a PD connected to a port in the unit, it determines if there is enough available power for the device based on the PD's power budget requirement. The PD will fall into one of five classes that dictates the maximum amount of power that it will use. These classes can be found in the table below. A PD uses resistance to indicate its power class to the PSE. If the power requirement of the PD is within the range of the available power on the PSE, and the total allocated power is below the guard band (a value that serves as a buffer for the total allocated power), then the PSE allows power to be transmitted to the PD. If there is not enough available power, then power is not allowed on the port. If something causes the total allocated power to exceed the limit of the PSE, then the power management feature begins shutting down the power to ports, starting with the highest port numbers, until it is below the threshold that the PSE is capable of supplying.

Class	Description	Power Budget Requirement	PD Range
0	Default	15.4 W	0.44 to 12.95 W
1	Optional	4.0 W	0.44 to 3.84 W
2	Optional	7.0 W	3.84 to 6.49 W
3	Optional	15.4 W	6.49 to 12.95 W
4	Reserved	> 15.4 W	15.4 to 25.5 W

Technology Example

There is no configuration necessary for either PoE or power management. Each technology functions according to its specifications. The following example shows the output of the **show power inline** command. This command shows the total available power of the unit along with the allocated power and status of each connected PoE device. Ports 1 through 17 are class 0 devices, each using 10 W of power. The guard band of this device is 166 W. With 170 W currently being consumed, the device on port 19 has been denied power. If one of the currently powered ports were to decrease its power consumption, or one of the devices were disconnected so that the allocated power fell below the guard band, then port 19 would power up.

#show power inline
Total Power: 185.000W
Total Power Used: 170.000W
Total Power Available: 15.000W
Average Total Power Used: 167.500W
For a new device to be powered, there must be at least 19W available power.

Interface	Admin	Status	Power	Class(Watts)
swx 0/1	auto	Delivering	10.000	Class 0
swx 0/2	auto	Delivering	10.000	Class 0
swx 0/3	auto	Delivering	10.000	Class 0
swx 0/4	auto	Delivering	10.000	Class 0
swx 0/5	auto	Delivering	10.000	Class 0
swx 0/6	auto	Delivering	10.000	Class 0
swx 0/7	auto	Delivering	10.000	Class 0
swx 0/8	auto	Delivering	10.000	Class 0
swx 0/9	auto	Delivering	10.000	Class 0
swx 0/10	auto	Delivering	10.000	Class 0
swx 0/11	auto	Delivering	10.000	Class 0
swx 0/12	auto	Delivering	10.000	Class 0
swx 0/13	auto	Delivering	10.000	Class 0
swx 0/14	auto	Delivering	10.000	Class 0
swx 0/15	auto	Delivering	10.000	Class 0
swx 0/16	auto	Delivering	10.000	Class 0
swx 0/17	auto	Delivering	10.000	Class 0
swx 0/18	auto	Searching	0.000	N/A
swx 0/19	auto	Denied	0.000	N/A
swx 0/20	auto	Searching	0.000	N/A
swx 0/21	auto	Searching	0.000	N/A
swx 0/22	auto	Searching	0.000	N/A
swx 0/23	auto	Searching	0.000	N/A
swx 0/24	auto	Searching	0.000	N/A

NetVanta 1131 RPS/EPS

The NetVanta 1131 Redundant Power Supply (RPS)/Extended Power Supply (EPS) is designed to function in conjunction with certain NetVanta units. The NetVanta 1131 RPS/EPS has three RPS outputs and one EPS output for use with RPS/EPS equipped NetVanta switches. Refer to Table 1 on page 6 for a list of supported switches.

When connected, the RPS will provide 120 W of redundant or backup power should the internal power supply fail. The units will automatically switch to RPS when needed, providing uninterrupted power to the unit.

When an EPS is connected to a switch with EPS support, the EPS may be used to provide backup PoE or, in some cases, additional PoE. Refer to Table 1 on page 6 to determine EPS support for each switch. When an EPS provides additional PoE, the internal and external supplies will use load sharing to provide up to 740 W of power for PoE applications. If the internal power supply fails, the EPS will provide up to 370 W of power for PoE applications. The units will automatically switch to EPS when needed.

Table 1: PoE Capabilities of NetVanta Switches

Model / Part Number(s)	802.3af (PoE)	802.3at (PoE+)	RPS Support	EPS Support for Backup PoE	EPS Support for Additional PoE	PoE Power Available without an EPS	Number of PoE Capable Ports
NetVanta 1224 Series 1200580L1 1200584L1	X					370 W	24
NetVanta 1234 Series (1st, 2nd, and 3rd Gen.) 1700595G1 1702595G1 1703595G1	X					370 W	24
NetVanta 1235P 1700595G10	X		X	X	X	370 W	24
NetVanta 1238P (1st, 2nd, and 3rd Gen.) 1700599G1 1702599G1 1703599G1	X					370 W	48
NetVanta 1531P 1700571F1	X	X				65 W	8
NetVanta 1534P (1st Gen.) 1700591G1	X					370 W	24
NetVanta 1534P (2nd Gen.) 1702591G1	X	X	X	X		370 W	24
NetVanta 1534P (2.1 Gen.) 1702591G2	X	X	X	X	X	370 W	24

Table 1: PoE Capabilities of NetVanta Switches

Model / Part Number(s)	802.3af (PoE)	802.3at (PoE+)	RPS Support	EPS Support for Backup PoE	EPS Support for Additional PoE	PoE Power Available without an EPS	Number of PoE Capable Ports
NetVanta 1535P (1st Gen.) 1702595G10	X		X	X		370 W	24
NetVanta 1535P (1.1 Gen.) 1702595G20	X		X	X	X	370 W	24
NetVanta 1544P (1st Gen.) 1700545G1	X					370 W	24
NetVanta 1544P (2nd Gen.) 1702545G1	X	X	X	X		370 W	24
NetVanta 1544P (2.1 Gen.) 1702545G2	X	X	X	X	X	370 W	24
NetVanta 1638P 4700569F1	X	X	X	X	X	370 W	48