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Power over Ethernet – Is My Data Safe?

With the network already playing an integral part of enterprise business, new applications continue to steer new hardware onto the network infrastructure. The introduction of Power over Ethernet (PoE) is significant in that these devices can be placed virtually anywhere with little regard to AC power wiring availability given that the more accessible structured cabling can be used for the required power. The question is: Can I be sure that I can implement Power over Ethernet over my NextLAN structured cabling system without compromising either safety or performance?

WHAT IS PoE?

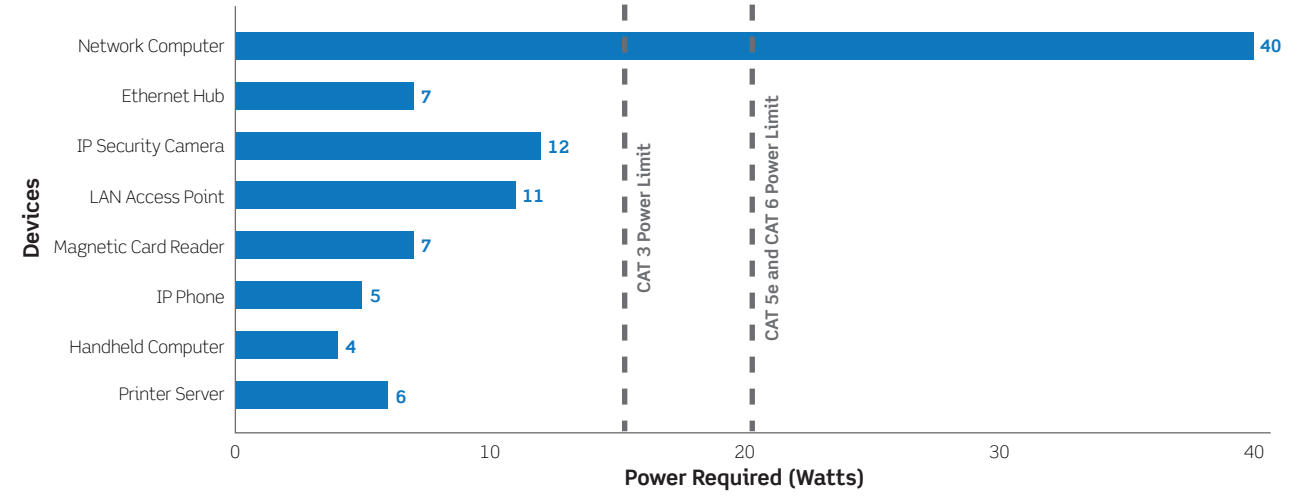
PoE is the ability of the active local area network switching equipment to insert dc power over the horizontal cabling to an end device without modifying the existing Ethernet cabling infrastructure. This technology initiative is supported by applicable industry standards. The specification itself is defined in IEEE 802.3af, which was ratified by IEEE in June of 2003. ANSI/TIA/EIA 568-B.1-6, which details the cabling infrastructure requirements, is currently in draft form with expected approval in early 2005. Although this specification is not yet final, it has been determined that components that comply with ANSI/TIA/EIA 568-B.2 or ANSI/TIA/EIA 568-B.2-1 will support PoE.

WHAT ARE THE APPLICATIONS FOR PoE TECHNOLOGY?

Figure 1 is a comprehensive look at the many applications for PoE. Today, implementation of PoE is popular for supporting primarily two technologies: IP telephony and wireless access. Since IP telephones require power, the network manager must choose to supply this power either externally via a 110 V AC outlet or internally through the structured cabling.

Like IP telephony, network managers must consider data and power for wireless access points with the added challenge of possibly powering a device that requires a powerline which runs through a plenum space. By using

Figure 1: Applications for PoE



the plenum rated communications cable that is already in that area to service users, costs are substantially reduced since commercial power does not need to be installed in an environment in which it is typically not found.

WHAT ARE THE BENEFITS OF PoE TECHNOLOGY?

Financial – The investment of the horizontal cabling infrastructure is maximized because new applications are taking advantage of the existing plant which means more costly AC power need not be installed. A clear example of this is found by examining a plenum pathway and space. While a plenum flammability rating has been available for communications cables for quite some time, this is not the case for power cables. Historically, if power cables had to pass through a plenum area, the cable must be installed in a plenum rated conduit which means additional labor costs associated with contracting an electrician as well as increased material costs for the installation.

Flexibility/Simplicity – A network connection and electrical power can now be provided with a single cable which simplifies installation and saves space. With Simple Network Management Protocol (SNMP), devices can be remotely monitored, powered on and off, and reset.

Mobility – Devices can be moved to convenient locations rather than predetermined places due to AC electrical power wiring availability.

Reliability – Centralized Uninterruptible Power Supplies (UPS) can guarantee power to the device in the event of a power failure.

HOW DOES PoE WORK?

Basically two devices are needed to implement PoE: a device that provides power and a device that receives and uses the power. Unfortunately for us, the two main standards bodies relative to this technology, TIA and IEEE, chose to call the same devices different names. IEEE refers to the device that provides power as the power source equipment (PSE) while TIA calls this device the DCPS or DC power sourcing equipment. IEEE refers to the device that receives the power as the powered device (PD) where TIA chooses the designation DCPL or DC power load equipment. For the purposes of this paper, we will use the IEEE designations.

Per specifications, not necessarily equipment or cable capabilities, the PSE will supply 48 V with a maximum current of 350 mA. After accounting for a voltage drop due to losses, a minimum of 13 W will be available for the PD. (Please note Figure 1 illustrates maximum wattage allowance per the specification for unshielded twisted pair cables as well as the power requirements for various devices.) It is important to realize that prior to supplying this power, the PSE will first determine which devices can accept its power. Not only does this help efficiency when supplying power, but more importantly, this feature ensures that non-compliant PoE equipment will not be damaged due to the injected power.

There are two modes of supplying this power: End Point and Midspan. One method is not necessarily better than the other, but one or the other may exhibit better financial or performance capability advantages. It is up to the end-user to deem which solution is best for his or her specific needs.

End Point – In an end point scenario, power is supplied directly from the Ethernet switch at one end of the cabling channel. The power is applied on either pins 1, 2-3, 6 or 4, 5-7, 8 depending on the active equipment. Because power and data may reside on the same pairs in this scenario, Gigabit Ethernet is supported by end point. End point devices are considered outside of the channel link and therefore do not count as a connection in the TIA designated four-connector channel.

Midspan – In the midspan scenario, power is supplied from devices located between the Ethernet switch and the device being powered or a point within the cabling channel. The power scheme utilizes unused pins 4, 5-7, 8. Because both power and data require dedicated pairs, midspan devices will support 10 Mbps and 100 Mbps transmission protocols, but not 1000 Mbps. As the midspan device is within the channel link, it does count as a connection in the TIA designated four-connector channel and must meet the performance requirements of that channel.

HAVE I COMPROMISED EITHER MY DATA OR SAFETY BY DEPLOYING POWER OVER THE STRUCTURED CABLING SYSTEM?

In both TIA and IEEE committees, a great deal of research was conducted to study the effects of the power and data being transmitted within the same cable. The study further explored the power being applied both on dedicated pairs and the same pairs that are transmitting Ethernet data.

In each case, both committees concluded that due to DC power and the low power consumption, there were no measurable effects on the data being transmitted. The power requirements developed are in accordance with the current edition of the National Electrical Code (NEC).

TESTING

Test Scope – Recently NextLAN engineers asked an independent testing laboratory to replicate a midspan scenario, since this configuration is most prevalent today, and perform testing to determine the increase in temperature for the connecting hardware when introducing power over the structured cabling channel link.

Test Procedures – The power was delivered via midspan power over two dedicated pairs. The structured cabling configuration consisted of a 100-meter channel in accordance with ANSI/TIA/EIA-568-B.1 which included 90 meters of horizontal cable and 10 meters of patch cords.

The power was applied for a period of three hours to the dedicated spare pins 4, 5-7, 8 which are the pairs that are not used for data transmission for 10 Mbps or 100 Mbps. With power being applied to these spare pairs, the impact on temperature for the data carrying pairs was recorded. Three hours is sufficient for temperature to stabilize after reaching maximum temperature. The maximum temperature rise was compared to UL 60950, which does not apply directly to this application, but gives us a comparison for the maximum allowable temperature rise (30 degrees Celsius) for communication jacks or products.

Three different wattage levels were applied. For our first test, 350 mA (16.8 watts) was applied as defined by the specifications. In addition, tests were conducted at 1.0 Amps (48 watts) and 1.5 Amps (72 watts) to look at power levels over today's limits that may be required for future applications. In all cases, a voltage level of 48 V dc was applied per the specifications.

The temperature rise was measured on pins 4,5-3,6 within the body of the work station jack and measured every ten minutes over the three-hour period. Significant rises in temperature will adversely affect insertion loss, which causes higher bit error rates and potentially equals compromised data. Figure 2 exhibits the minimum and maximum temperature readings taken while conducting the test. Additionally, Figure 2 details the maximum temperature rise for each wattage level applied for each channel tested. The maximum temperature rise for any of the tests was 3.5 degrees Celsius which is well below the UL 60950 specification. This modest increase in temperature has minimal impact on the data integrity of the channel.

Figure 2: Independent Testing Results

	NextLAN 5e+ Solution		NextLAN 6eX Solution	
	Pins 4,5	Pins 3,6	Pins 4,5	Pins 3,6
350 mA				
Minimum Temperature °C	18.7	18.7	18.4	18.4
Maximum Temperature °C	20.4	20.4	19.3	19.3
Maximum Rise °C	1.7	1.7	0.9	0.9
1 Amp				
Minimum Temperature °C	19.1	19.1	19.6	19.5
Maximum Temperature °C	20.9	20.9	23.0	23.0
Maximum Rise °C	1.8	1.8	3.4	3.5
1.5 Amp				
Minimum Temperature °C	20.5	20.3	20.3	20.1
Maximum Temperature °C	23.8	23.7	22.2	22.1
Maximum Rise °C	3.3	3.4	1.9	2.0

POWER OVER ETHERNET-FUTURE

As is the case with any successful technology, the advancement of the market and products forces committees to address whether existing standards need to be revised or enhanced to address current trends. There is presently a study group within IEEE 802.3 formed to review the applications that could use PoE technology and make recommendations for doubling the current power requirements to 30 watts. These applications could include powering laptop computers, security cameras that have higher power Pan-Tilt-Zoom, and other devices that require more than 15 watts of power. An area receiving a tremendous amount of scrutiny is if these increased power applications have the potential to compromise the data integrity of the Gigabit or 10 Gigabit Ethernet infrastructures.

CONCLUSION

Power over Ethernet continues to grow in popularity. Many applications today utilize PoE as specified in IEEE 802.3af and TIA/EIA-568-B.1-6 (draft) with further consideration being given for this technology to support higher power levels for additional applications to be specified in future updates to the standards. Based on independent test results, NextLAN Category 5e and Category 6 solutions easily meet today's specifications concerning Power over Ethernet as well and exhibit promising performance to allow for power increases in the future.