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Technology Update

Next Generation BASE-T and Power over Ethernet

- Twisted pair copper applications are developing at an unprecedented rate

- Category 8 will support 40GBASE-T and 25GBASE-T in the data center

- Future Ethernet, PoE and wireless technologies will benefit from enhanced Category 6 and Category 6A cabling

Rapid changes to BASE-T

It's generally said when something moves at glacial speed, it is moving very slowly. Fifteen years have passed since the introduction of 1000BASE-T and for many years the effective data rates changed very little. 10GBASE-T was introduced 8 years ago but Category 6A has yet to establish itself as the preferred cable for installation. Much of this was due to the lack of a perceived need, as the data lines feeding the switches were not filled to capacity by the attached devices. However, even glaciers can break free and exhibit massive changes to the landscape in a very short time. Today there is a flurry of activity in and around the IEEE involving the copper twisted pair. There are no less than four iterations of BASE-T now under consideration and new variants of Power over Ethernet (PoE) are under development. The landscape has been shifting and technology is rapidly adapting to the new needs.

Data Centers: 40GBASE-T vs. 25GBASE-T

Nearly two years ago, the IEEE undertook efforts to start the development of the next generation of BASE-T. Instead of the traditional 10X incremental step and 100m reach which was a factor in the delayed rollout of 10GBASE-T, the study group decided to set focused goals for a data center environment that would be readily achievable, allowing for a rapid development cycle yet provide a meaningful bump in bandwidth. The results of those decisions have yielded a set of draft specifications for Category 8 components intended for data center deployment with a 30m reach and two connectors in a channel. This is a substantial deviation from the traditional 4 connector 100m channel the enterprise customer has come to expect. It is an indication that the standards are taking a more holistic approach to the development cycle factoring in such things as near term feasibility, power consumption, and deployment.

In the short course of a year, the IEEE has begun development on 25Gbps Ethernet variants of optical, backbone and twinaxial solutions. These 25Gbps Ethernet lanes were originally developed under the 100Gbps (4x25Gbps) fiber optic effort. Currently, the state of the art chips in a switch provide up to 25Gpbs Ethernet lanes. Therefore, an external 40Gbps channel would consume two internal 25Gbps switch lanes. However the remaining unused 10Gbps capacity is not recoverable, making external 25Gbps channels the natural choice to maximize the efficiency and utilization of switch components. Additionally, the 400Gbps optical task force is considering this lane speed in the interest of fully utilizing readily available technology. Following the IEEE rapid acceptance of the single lane 25Gbps optical and twinaxial projects, the BASE-T group decided to initiate efforts to develop 25GBASE-T to position twisted pair in the best possible position for use in the data center in intra-rack and middle of row deployments.

Does this mean 40GBASE-T and Category 8 are dead? Not by any means. 25GBASE-T is expected to utilize the Category 8 work already developed by the cabling standards committees. The intent remains to deliver a standard that can be deployed rapidly and fit easily within the boundaries of electronics and cabling. It is projected that 25GBASE-T would require significant bandwidth beyond Category 6A and attempting to deploy 25Gbps over Category 6A would significantly extend the development time and possibly lead to a problematic rollout. Additionally, there is a goal within the IEEE to increase the switch chip bandwidth by a factor of two for 50Gbps of throughput. This would allow an inbound 40GBASE-T channel to occupy only one lane within the switch. However those developments are a number of years ahead in the future and the difficulties and economies of scale may alter the plans yet again.

Enterprise: 2.5GBASE-T and 5GBASE-T

It's been since before the turn of the century that Category 5e was ratified and 1000BASE-T was developed to transport data from the closet to the office. During that time it has served us well delivering a robust secure pipeline for the flow of data. For many years, 5e was "good enough" and with no foreseeable need other than physical robustness to consider a higher grade of cabling, many continued to install this cable. However,

the enterprise infrastructure is starting to bulge at the seams and some cracks are beginning to appear. It's a bit ironic that wireless is the technology to push the wired infrastructure beyond the 1G threshold. Yet within the year, the industry is expecting 802.11ac access points capable of aggregating traffic in excess of 1Gbps back to the controller. Approximately 7 Gbps capability is expected within two years. 802.11ad, intended to make the office cubicle wireless, is also expected to exceed the capacity of 1000BASE-T.

In an attempt to ease these wireless technology implementations, silicon manufactures are experimenting with transmitting 2.5 Gbps and 5 Gbps over Category 5e and Category 6 cabling respectively. It is their intent to utilize existing cabling infrastructure to allow for a simple upgrade path by replacing only the electronics at the ends of the cable. It is expected that an IEEE study group will be created with the goal to specify a method to deliver 2.5Gbps within the specified 100MHz bandwidth of 5e and 5 Gbps within the specified 250MHz bandwidth of Category 6. While this may give reassurance to some that they can now double their capacity over existing installed cabling, it should not convince those who are in the process of installing new infrastructure to use Category 5e.

What is not clear at this time is the susceptibility of these systems to alien crosstalk within cable bundles and their subsequent ability to transmit over 100m under duress. In general for UTP cabling, as the internal channel performance increases, the ability to reject alien interference improves but this parameter was never specified for category 5e and category 6 cabling. Additionally, many of these deployments will likely utilize Power over Ethernet (PoE) creating elevated temperatures within the bundles of cables. Moving to higher grades of cabling with performance above the minimum Category 6 requirements, will likely reduce the alien crosstalk susceptibility, reduce the signal loss due to heat and provide the added performance required for these higher speeds under adverse conditions. However, even this approach may be shortsighted, as these new BASE-T technologies are intended to ease 802.11ac adoption, and they fall short of the maximum capacity needed for the 6.9Gbps aggregate throughput expected by 2016. Installing TIA recommended Category 6A for wireless

deployments continues to provide the best solution for extending useful life of the infrastructure.

Next Generation: Power Over Ethernet

The IEEE is currently working on the next generation of Power over Ethernet in an attempt to fill the growing need for increased power delivery and improved efficiencies. The proliferation of intelligent building devices and industrial automation will continue to grow over the next several years. Several variants of these devices are expected to require increased power to perform increasingly heavy or complex functions in areas that are sometimes inconvenient or hard to route traditional AC power. The IEEE task force agreed to raise the current 30W power delivery to a minimum of 49W for a successful project, however the latest proposals have focused upon two classes of power delivery which are currently bounded by 60W and 100W.

To address the needs of 802.11ac access points, the PoE task force has agreed to support 10GBASE-T and one silicon manufacturer has successfully demonstrated an implementation. Support for 2.5GBASE-T and 5GBASE-T will likely be added after the successful creation of the respective task force. In order to increase system efficiency, all four pairs of a Category channel will be used for current delivery. The task force is working to establish the specifications which will allow backward compatibility to older standards compliant equipment as well as ensuring pre-existing proprietary 4 pair power delivery systems do not cause catastrophic issues. However the work to increase the available power to devices has raised some concerns about heat generation within the infrastructure.

The standards groups of ISO and TIA are investigating the impact of increased power distribution upon the installation practices and Category cabling. TIA is updating their TIA TSB-184: Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling in anticipation of these greater demands upon the infrastructure. Evidence within the committees continues to mount in support of the use of higher grade cabling with increased copper content to minimize the heat generation and maximize the installation flexibility in adverse environments. Where bundles of minimally compliant Category 5e cables may be limited in their ability to deliver power to these newly attached devices, others comprised of 6A will be able to service the devices at higher power levels and increased distances in less than optimal environmental conditions.

Conclusion

Within the last three years, our increasing rate of data consumption has created the demand for the development of a number of projects to increase channel speeds and the abilities to power devices.   Advances in wireless technology have had a dramatic impact upon the quantity of data and locations where we consume it. It is natural that this change is extending into the enterprise and modifying the landscape. TIA TSB-168-A currently recommends providing two drops of Category 6A cable, such as LANmark™-10G2, for wireless deployments. The rationale is to provide flexibility for increased access point deployment and the expected additional bandwidth becoming available in approximately 2-3 years. LANmark-XTP with its increased isolation, ability to deliver power and tolerance of heat, provides an additional layer of security for your wireless network. Additionally, Power over Ethernet is evolving to supply greater quantities of power to devices at faster speeds. The increase in supplied power comes at the expense of heat generation and the advice to install cabling with greater performance such as enhanced category 6 or Category 6A is sound and can be rationally extended to the entire enterprise floor. Berk-Tek's LANmark-1000, -2000, -10G2 and -XTP provide the bandwidth and power capacity to assure the operation of these developing technologies even under adverse conditions not anticipated during standards development. The cascade of new technologies destined to change the landscape have the standards groups working on an unprecedented number of twisted pair projects, proving twisted pair technology will continue to meet the unanticipated demands of tomorrow.

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