HIGHSPEED ETHERNET ›
THE NEED FOR SPEED

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WHITE PAPER

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EXECUTIVE SUMMARY

Over the years structured cabling systems have evolved significantly. This demonstrated change can be attributed to advancements in computer networking and information technology. Recently, the never-ending need for fast data transmission and efficient network performance is only second to the demand for server virtualization, converged data centers, cloud computing, and the advent of high-bandwidth applications like video-on-demand and social media. The predominant demand for high speed data transmission comes from the data center where high-bandwidth is a top requirement for switching, routing and aggregation points for service provider backbones, along with SAN and server interconnections. However, business enterprises that require super high-speed computing such as universities, hospitals, and research facilities will also deploy high-speed Ethernet across their computer networks. These drivers dictate keen planning to ensure enterprise networks and data centers are designed and run efficiently. These market dynamics require that IT managers today consider a migration path towards 10/40/100 Gbps Ethernet to meet future network requirements.

"Twisted pair copper cabling remains the preferred cabling media for Ethernet enterprise networks"

Today's IT managers often choose 1 GbE over twisted pair copper cabling (1000BASE-T) and wireless (10/100BASE-T) for low bandwidth applications. Twisted pair copper cabling remains the preferred cabling media for Ethernet enterprise networks and Wi-Fi remains the preferred choice for 100 Mbps links. A new standard for Wi-Fi (802.11ac) requires 10 Gb links and provides high capacity and high quality mobile real-time applications like video and voice. Additionally, applications like Voice over IP (VoIP), IP video, and Power over Ethernet (PoE), along with demand from growing economies such as China and India will continue to drive requirements for copper cabling. New technical advancements will no doubt reinforce twisted pair copper cabling's designation as the preferred cabling media due to its low cost, ease of installation, and low maintenance. However, fiber is currently the preferred cabling media for high-bandwidth in data centers. Multimode OM3 and OM4 fiber are the preeminent choice for data centers requiring high-bandwidth 40/100 GbE applications. The recent development of 40/100 GbE standard by the IEEE (Institute for Electrical and Electronics Engineers) will help accelerate adoption of 10GbE since higher-speed 40 GbE links are needed to aggregate 10 GbE switch connections.

To address this need for speed the IEEE as well as the TIA (Telecommunication Industry Association) and the ISO (International Standards Organization) work groups have progressively developed standards to support greater bandwidth, lower latencies, and lower power consumption. The IEEE has developed high speed Ethernet standards such as the 802.3an (10GBASE-T) and 802.3ba (40/100 GbE over OM3 and OM4 fiber and twinax copper cable). The IEEE 802.3bq task force is now actively working towards the development of 802.3bq standard (40GBASE-T, 40GbE over twisted pair copper cable). To this end, the TIA and ISO cabling standards are also working towards the development of Category 8 standards. Category 8 will fully support IEEE's 802.3bq (40GBASE-T) application.

The IEEE 802.bq task force officially began its work in September 2012. The task force is composed of industry experts from the physical layer, active equipment, structured cabling, and test equipment manufacturers. The decision to move forward with development of 802.bq was based on assessment of the NGBASE-T study group that bandwidth requirements will continue to grow. The study group determined that 40 GbE over twisted pair cabling is feasible and will provide an upgrade path from 10 GbE. This will allow twisted pair cabling to be positioned alongside fiber and copper twinax cabling to support 40 GbE. 802.3bq is expected to be more cost effective than fiber cabling and twinax cabling for Ethernet networks. 802.3bq will also support distances longer than twinax's seven meter limitation which makes 802.3bq an ideal choice for data centers. Twisted pair cabling with the RJ45 connector has always been the technology of choice for

IT professionals because of its low cost and ease of use. Another key advantage of BASE-T technology is auto-negotiation. Auto-negotiation allows interoperability between mismatched equipment speeds without manual configuration. This is not supported with fiber cabling.

The TIA and the ISO cabling standards bodies are also developing specifications for 40 GbE channel requirements. In 2011, the TIA TR42.7 Copper Cabling Engineering Sub-committee setup a task group to establish parameters to support 40 GbE bandwidth applications. The TIA 42.7 sub-committee is now fast tracking this work and is meeting every two months. The new structured cabling standard is expected to be published as "ANSI/TIA-568-C.2-1 Balanced Twisted-Pair Telecommunication's Cabling and Components Standard, Addendum 1: Specifications for 100 Ω Next Generation Cabling". This new cabling category will be referred to as Category 8. This new cabling system is expected to be backwards compatible with prior Category twisted pair cabling systems (i.e. Cat 5e, Cat 6, and Cat 6A) as desired by the IEEE.

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In September 2012, the ISO WG3 (Working Group 3) submitted a technical report on transmission requirements to support 40GbE to the IEEE 802.bq task force for consideration of supporting 40GbE. The report is composed of two major sections. The first section describes channels constructed out of existing Cat 6A and Cat 7A components used in Class EA and FA channels with bandwidth up to 1.6GHz. The second section describes Category 8.1 and 8.2 components required to build Class I and Class II channels. The Class II channels are based on an improved version of ISO Class FA channels with bandwidth up to 2.0 GHz. The conclusion of the report indicates that existing Class EA channels may support 40GbE but only up to 10-15m, while Class FA channels may support 40 GbE up to 50m. Therefore, a two connector Class FA channel, up to 50m, may be a valid option for 40GbE. Additionally, the ISO WG3 is also developing qualification limits to determine if currently installed Class EA and FA systems will support the IEEE 802.3bq protocol. It's unlikely that installed Class EA cabling systems will support 40 GbE, but they are hopeful that existing Class FA installations will. It's important to note that while the ISO WG3 has indicated that a 50m Class FA channel may support 40 GbE, it's unlikely that this channel will be compatible with the IEEE 802.3bq standard. This is because existing current Class FA channels contain cable that's only suitable for 1000MHz bandwidth and these use proprietary Cat 7A connectors that are incompatible with the RJ45 connector interface which violates the IEEE "must have" requirement for the RJ45 connector interface. Some Class FA systems require special hybrid patch cable assemblies to be compliant with IEEE 802.3 Ethernet BASE-T standards.

Other topics being addressed by the 802.3bq task group include consideration for shorter lengths specifically for data center environments. This is important because it's likely that the 802.3bq Ethernet application will primarily be used in data centers where switch-to-server end-of-row links are typically 35m or less. Experts agree that 35m would cover 95% of all length requirements for data center applications. Therefore, the conventional 100m maximum four connector channel length is not considered at this time. It's also likely that the IEEE 802.3bq standard will specify a maximum two connector channel length of 30m.

"Upgrading to high speed Ethernet delivers many advantages."

The standards task groups are also focusing on specifications around a shielded twisted pair cabling system instead of UTP (unshielded twisted pair). UTP cabling has not been excluded but experts agree that shielded cable best mitigates alien crosstalk (AXT). Alien crosstalk is defined as unwanted signal coupling from one balanced twisted-pair cable, or connector, to another. AXT is not a problem for lower bandwidth network applications such as 10/100BASE-T and 1000BASE-T; however, AXT is a major issue for higher bandwidth applications such as 10GBASE-T. This was established when 10GBASE-T was developed. Experts from the TIA and ISO cabling bodies agree that AXT was the most significant challenge when developing 10GBASE-T. There are two known methods to mitigate AXT. The first method is achieved by adding space between cables and port outlets. Cable manufactures typically increase the cable's outer jacket diameter to create space between adjacent cables. The other, and more effective, mitigation method is achieved by wrapping a metal foil around the twisted pairs. The study groups also specified that EMI (electromagnetic interference) suppression is highly desired. A well-known method to suppress EMI is to use shielded cables and shielded connectors. This is why many structured cabling manufactures exclusively offer 10 GbE shielded twisted pair cabling systems when the IEEE ratified 802.3an standard for 10GBASE-T 2006.

Upgrading to high speed Ethernet delivers many advantages. The most significant advantage centers on design flexibility, due to the modularity, and relatively low cost of structured cabling systems. Other measureable benefits include productivity gains and decreased operating costs. Upgrade paths from 1 GbE to 10 GbE to 40/100 GbE are plentiful. These initiatives require IT managers to consider not only hardware and cabling requirements but also the various options for 10/40/100 GbE over fiber, twinax, or twisted pair cabling. Key factors supporting informed decisions include cost of ownership, application requirements, and proper consideration for the limitations of fiber and copper cabling systems (i.e. distance and density). Proactive planning and implementation today can eliminate the high cost and inefficiency of randomly adding 40G or 100G ports in the future. An upgrade strategy that provides for all aspects of 10/40/100 GbE hardware and structured

cabling system capabilities is optimal. By adhering to IEEE 802.3, TIA-568 and ISO 11801 industry standards, IT managers can confidently ensure the reliability and functionality of their computer networks, today and in the future. Industry standards were specifically developed to keep pace with the continually evolving bandwidth requirements of high speed network applications and to provide the foundation for a coherent upgrade strategy.

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CONCLUSION

In conclusion, the IT managers of today's business enterprise networks and data centers are bombarded by demand for high-speed data transmission which delivers on-demand content anytime and anywhere. This continual demand for fast data transmission and efficient network performance is fueled by requirements to support server virtualization, converged data centers, and cloud computing, as well as the advent of high-bandwidth applications like video-on-demand and social media. Business enterprises and consumers alike require high-speed applications at work, on the go, and at home. To keep pace with the demand for high-speed Ethernet IT managers must implement a cohesive structured cabling 10/40/100 GbE upgrade plan which leverages and adheres to industry standards.