



AMP NETCONNECT XG CABLING SYSTEMS

***The Economic, High-Performance
Premises Cabling Solutions
Supporting Government Networks to
Ten Gigabits per Second***



TABLE OF CONTENTS

TABLE OF CONTENTS	2
INTRODUCTION	3
THE AMP NETCONNECT XG OPTICAL FIBER SYSTEM.....	4
THE AMP NETCONNECT XG SHIELDED COPPER SYSTEM	8
CONCLUSION.....	10

INTRODUCTION

Government end users are facing a series of economic forces that require re-thinking the traditional phone/data network and focus on the broader capabilities of IP-capable networks. The technological advances in IP technology and IP-based devices couple neatly with the rapid drop in costs for IP chipsets and electronic memory to offer a wider array of solutions that drive down or hold operational costs. Now, with proper planning and deployment, IP-base solutions are more capable than ever of improving service delivery to government constituents, assuring security and continuity through improved communications and coordination, and improving interoperability, operational effectiveness, and utilization for measurable government outcomes. Now, IP-based solutions are able to offer more services using installed data networks while avoiding the need for proprietary and isolated systems and products.

If history is any indication, these applications will continue to demand higher data transfer rates as new technologies use high-resolution graphics, high-definition videos, RFID, building automation systems and complex scientific modeling converge to accomplish the desired outcomes. This aggregation of bandwidth on IP networks will continue to pressure bandwidth requirements at the desktop, at the device location and on the backbone. As more users, some from anywhere in the world, are allowed access to the network, old 10Mb/s Ethernet, 100 Mb/s Fast Ethernet and even 1000Mb/s Gigabit Ethernet LANs will be insufficient. Accordingly, network managers have to look for even higher data rates than the 10/100 Mbit/s or even one gigabit per second.

While the need for a ten gigabit “pipe” may seem like overkill today, the rapid deployment of IP-based devices justifies installing 10 Gigabit Ethernet capability today as an investment in a network foundation for multiple services as well as inexpensive insurance policy against future re-cabling headaches. Just as the growing number of Fast Ethernet connections created the need for Gigabit Ethernet connections, so too has Gigabit Ethernet created the need for Ten Gigabit Ethernet (10000 Mb/s). Further, the capabilities of a 10 Gigabit Ethernet capable network will simplify infrastructure consolidation, improve the efficiency of data storage and retrieval, and enable the replacement of server hardware and legacy software systems.

Today's need was recognized years before, explaining why the IEEE 802.3ae task group spent over two years developing the 10GBASE-F Standard, which was published in 2002. The IEEE 802.3an



task group spent almost three years developing the 10GBASE-T Standard, which was published in July 2006. Ten Gigabit Ethernet (10GBASE-X) provides the solution for high-speed connections as a natural upgrade for extending the network cabling investment to ten gigabit per second speeds at a reasonable cost.

AMP NETCONNECT XG Cabling Systems all support the network migration from 10 Mb/s all the way to 10 Gb/s on the same cabling infrastructure. The **AMP NETCONNECT XG Optical Fiber System** offers high-bandwidth “850nm laser-optimized 50/125µm” multimode fiber cables, connectors, hardware and cable assembly components capable of running 10 Gigabit per second applications (Ethernet and Fibre Channel) for distances of 2 to 300 meters while supporting legacy applications just as well or even better than the standard laser-certified 50/125µm fibers. **The AMP NETCONNECT XG Shielded Copper Cabling System** utilizes the significant ANEXT reduction capabilities of a foil shield to negate crosstalk concerns between cables and provide high bandwidth with noise immunity.

Be ready to propose and deploy cost-effective solutions on the existing network infrastructure, as opposed to selecting proprietary and one-off solutions, and use the total value of IT solutions to obtain the desired business outcomes with AMP NETCONNECT XG Cabling Systems - install them today, use them today and use them tomorrow, too.

THE AMP NETCONNECT XG OPTICAL FIBER SYSTEM

Optical fiber has been a preferred media for military and government installations worldwide, and the many benefits of optical fiber are well-recognized. The high data rate capabilities, the noise immunity, the inherent security, the all-dielectric cable properties and the comprehensive support of multiple applications have all been used to justify optical fiber installations. As the technology matured and new innovations such as no-epoxy/no-polish optical fiber connectors were released, the optical fiber solution benefits even became very cost effective, triggering an even wider deployment.

Gigabit Ethernet and now 10 Gigabit Ethernet demand fast optical sources to support the rapid modulation rates necessary for intelligible bit streams, yet still need the low-cost advantages that

propelled Ethernet to become the most popular LAN application. The traditional and inexpensive light-emitting diode (LED) can be utilized only for applications running up to 622 Mb/s - the output is unreadable at faster data rates. Single-mode lasers, capable of higher speeds, have been available for many years, but are much more expensive and costly to operate than the common LEDs. Fortunately, today's cost-effective laser technology called the VCSEL (Vertical Cavity Surface Emitting Laser) provides short wavelength (850nm), high-speed, cost-effective 10 Gigabit data applications.

Of course, a source is only as good as its coupled fiber. Yesterday's 62.5/125µm and 50/125µm fibers were fine for use with LED sources, and newer laser-certified multimode fibers are even generally sufficient to support VCSELs used for Gigabit Ethernet in office-oriented networks. Yet even these fibers can support 10GBASE-F through 10GBASE-LX4 or 10GBASE-LRM electronics. 10GBASE-LX4 uses four single-mode sources and wave division multiplexing to obtain 10 Gb/s on legacy multimode fibers.

Fiber Type	Minimum OFL Bandwidth (@850nm)	Minimum Range
62.5/125µm	160 MHz•km	2-300m
	200 MHz•km	2-300m
50/125µm	400 MHz•km	2-240m
	500 MHz•km	2-300m
850nm Laser Optimized 50/125µm	2000 MHz•km Effective Modal Bandwidth	2-300m
Single-mode	N/A	2-10,000m

Table 1 - 10GBASE-LX4 (Single-mode Wave Division Multiplexing) Distances



10GBASE-LRM, released later than the other 10GBASE-F applications, was an attempt to provide a lower-cost version of 10 Gigabit Ethernet for legacy multimode fibers. Despite the initial intentions, obtaining the full 300m supported distance on multimode fibers proved to be too expensive on the electronics side, so a compromise of shorter distance support resulted.

Fiber Type	Minimum OFL Bandwidth (@850nm)	Minimum Range
62.5/125µm	160 MHz•km	0.5-220m
	200 MHz•km	0.5-220m
50/125µm	400 MHz•km	0.5-100m
	500 MHz•km	2-220m
850nm Laser Optimized 50/125µm	2000 MHz•km Effective Modal Bandwidth	2-220m

Table 2 - 10GBASE-LRM (Single-mode Serial) Distances

However, to take full advantage of the lowest-cost 10 Gb/s source technology - VCSEL technology - a higher capability fiber had to be developed to support the full 300 meters - a 2000 MHz•km bandwidth at 850nm fiber. Since the normal production of 50/125µm fiber is unlikely to produce such a fiber, modifications to the index of refraction profile (the fiber core's index of refraction vs. core position) of a **50/125µm** fiber provides the maximum bandwidth at **850nm**, not at 980nm. The result was a fiber the Standards call "850nm laser-optimized 50/125µm multimode fiber" or "OM-3" fiber. Tyco Electronics call it "XG Fiber".

Fiber Type	Minimum OFL Bandwidth (@850nm)	Minimum Range
62.5/125µm	160 MHz•km	2-26m
	200 MHz•km	2-33m
50/125µm	400 MHz•km	2-66m
	500 MHz•km	2-82m
850nm Laser Optimized 50/125µm	2000 MHz•km Effective Modal Bandwidth	2-300m

Table 3 - 10GBASE-SR (VCSEL Serial) Distances

The XG Fiber forms the foundation of the AMP NETCONNECT XG Optical Fiber System, which provides the best choice for future-proofing the intra-building cabling structure. This new fiber system not only works well with today's readily-available LED-based components, but also provides an effortless migration path into laser-based technology, making it the best choice for applications from 10 Megabits to 10 Gigabits.

Looking ahead to 40 Gb/s and even 100 Gb/s Ethernet, the XG Fiber is already capable. Even though the IEEE standard targets 100m as the supported distance on 8-fiber and 20-fiber based multimode cabling, the XG Fiber is the identified multimode optical fiber. Using the available MPO and PARA-OPTIX MPO technologies, networks can be designed with XG fibers to support four magnitudes of data rates - from 10 Mb/s to 100 Gb/s - on the same fiber type.

The XG Optical Fiber System is constructed of high-quality XG optical fiber components. Tyco Electronics offers a complete line of AMP NETCONNECT XG Optical Fiber Cables, a complete line of AMP NETCONNECT XG Connectors and a complete line of AMP NETCONNECT XG cable assemblies, including 12-fiber MPO and 24-fiber PARAOPTIX trunk cable assemblies and cassettes. The technical innovations of the AMP NETCONNECT XG Optical Fiber LIGHTCRIMP PLUS connectors provide quick and easy termination that survives fiscal scrutiny, and is eligible for the 25-year performance warranty.



THE AMP NETCONNECT XG SHIELDED COPPER SYSTEM

From the earliest days of wired communication, the benefits of shielded cabling have been thoroughly documented. Dating back to the early uses of coaxial cabling, the shield was the most effective way to reduce and eliminate incoming and radiated signals and thus, just like optical fiber, became the media of choice for military and classified government networks worldwide. Just like optical fiber, shielded twisted-pair cabling has been a preferred media for military and government installations worldwide, and the many benefits of shielded balanced twisted-pair cabling are well-recognized. The high data rate capabilities, the noise immunity, the inherent security, and the comprehensive support of multiple applications have all been used to justify shielded balanced twisted-pair installations.

As balanced cabling technology advanced, the cost benefits of unshielded balanced cabling often won over the bandwidth and security advantages of shielded cabling. The inevitable march of higher data rates continued to press the unshielded technologies to its limits, resulting in a steady stream of new categories - 3, 4, 5, 5e, 6 and now 6A. The release of the 10 Gb/s Ethernet Standard, however, exposed the limits of unshielded twisted-pair cabling, which needed bigger cables, less-dense connections and more electrical power to successfully transmit 10 Gb/s - going against the established smaller, denser and greener technology trends.

While, in an ideal world, the migration to 10 Gigabit Ethernet would be seamless on a generic cabling system, the 100m distance on Category 5e and Category 6 twisted-pair media was difficult for 10 Gb/s. At these data rates and frequencies (500 MHz), the radiated electrical noise (cross talk) from other cables becomes problematic. This "alien" cross talk (Alien NEXT or ANEXT) cannot be sampled, nor even easily measured, so it is not easily compensated like the pair-to-pair crosstalk was for Gigabit Ethernet. This drove the industry to pick two basic solutions to the alien crosstalk problem - space or a shield.

The space solution was adopted for unshielded twisted-pair Category 6A cabling systems, using larger cable diameters to increase the distance between cable pairs in the cable bundles and staggered connection ports to increase the distance between connectors at the patch panels. Expanding the cabling cross section in network installations has some serious economic impacts that aren't readily evident on a bill of materials. Larger cable bundles mean more obstruction to airflow, which decreases cooling air efficiency, and can require more or larger pathways. Less density means more panel space, which means more racks, more real estate and that costs more money.

Although there were many mitigation techniques proposed, there was little doubt that the foil shield of a shielded twisted pair (F/UTP – or foil around a UTP core) system would offer the necessary bandwidth and ANEXT performance to support 10 Gigabit Ethernet. That's good news for an industry anxious to prepare for 10G. Tyco Electronics offers a solid, standards-based solution in the AMP NETCONNECT XG Shielded Copper Cabling Solution, which offers the best combination of shielding, balanced twisted pairs and bandwidth to ensure a cabling solution that will meet the needs of the 10 Gigabit Ethernet application without mitigation.

Tyco Electronics is determined to offer our customers solid, standards-based solutions. That's why the AMP NETCONNECT XG Shielded Copper Cabling System was released. The XG Shielded Copper Cabling System offers the best combination of shielding, balance and bandwidth to ensure this cabling solution will meet the needs of the 10 Gigabit Ethernet application. This solution, coupled with the AMP NETCONNECT SL Series Installation Tool enables quick, efficient and effective installation of shielded networks. Unshielded cabling is no longer the lowest-cost, easiest-to-install, smallest solution for equivalent application and distance support. Performance and innovation make the AMP NETCONNECT XG Shielded Copper Cabling System the best choice for 10 Gigabit Ethernet twisted-pair cabling.

Detailed evaluations show the superior performance of shielded twisted-pair solutions. Further, when coupled with innovative termination technology (the AMP-TWIST or SL Series shielded jacks and SL Series Installation Tool), the shielded solution also becomes the cost-effective solution. The AMP NETCONNECT XG Shielded Copper System is constructed of high-quality XG Shielded Copper components. Tyco Electronics offers a complete line of AMP NETCONNECT XG Shielded Copper cables, a complete line of AMP NETCONNECT XG Shielded Copper connectors and a complete line of AMP NETCONNECT XG Shielded Copper cable assemblies.



As the technology matured and new innovations such as no-epoxy/no-polish optical fiber connectors were released, the optical fiber solution benefits even became very cost effective, triggering an even wider deployment.

CONCLUSION

You can trust Tyco Electronics with your 10 Gigabit decision. Tyco Electronics is the global leader in shielded copper cabling systems and optical fiber cabling systems – we know it all, inside and out. Tyco Electronics offers a complete product portfolio of AMP NETCONNECT XG Cabling Systems with no preference to one over any other. So you can count on Tyco Electronics to offer sound advice, knowledgeable comparisons, and provide quality products. Regardless of your choice of cabling media, there is one answer: Tyco Electronics.