

## IT MANAGERS FACE OFF 10GBASE-T AND SFP+ DIRECT ATTACH

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With 10 Gigabit Ethernet rapidly gaining traction in the data centers, IT managers are now faced with the challenge of choosing the right flavor of 10 Gigabit physical media. 10 Gigabit Ethernet is offered in two broad categories – Optical and Copper. Copper is the most commonly used means for connectivity in data centers; this paper addresses the tradeoffs between the effective choices in copper connectivity – 10GBASE-T and SFP+ Direct Attach. The purposes of this paper does not cover the legacy CX4 standard.

### STANDARDIZED INTEROPERABILITY

IT Managers value interoperability to leverage the investment in the existing infrastructure and for ease of manageability. Interoperability can be broken down into two primary subsets:

- Inter-operable *technology* to ensure performance regardless of which vendor/equipment is located on either side of the link, i.e. ease of manageability.
- Operable over existing, known *medium*; leveraging the infrastructure already in place and the knowledge-base for its maintenance.

### IEEE STANDARD – TECHNOLOGY & TWISTED PAIR COPPER CABLING

10GBase-T is a fully IEEE compliant Ethernet transport technology: IEEE 802.3an-2006. As an industry standard, this makes certain the technology is interoperable between vendors of silicon, NICs, Switches, and Routers.

To further ensure robustness and interoperability, the 802.3an standard specifies transport over standard, structured copper twisted pair medium:

#### IEEE 802.3AN-2006 10GBASE-T SUPPORTED CABLING

Cable	Link Segment Distance	Cabling Reference
Class E / Category 6	55 to 100 meters	ISO/IECTR-24750, TIA/EIA TSB-155
Class E / Category 6 unshielded	55 meters	ISO/IECTR-24750, TIA/EIA TSB-155
Class E / Category 6 shielded	100 meters	ISO/IECTR-24750, TIA/EIA TSB-155
Class F	100 meters	ISO/IECTR-24750
New Class E / Augmented Category 6	100 meters	ISO/IEC 11801 ed2.1, TIA/EIA-568-B.2-10

The concept of standard, structured cabling is to provide a long term underlying foundation of transmission infrastructure that follows a base set of engineering rules. 10Gbase-T retains and abides this by operating over the installed base of twisted-pair copper cabling already in place for lower-speed

applications. 10GBase-T allows a clear path of bandwidth upgradeability on an as-needed basis, by leveraging this existing twisted pair infrastructure.

#### **LEVERAGING THE INSTALL BASE MEDIUM**

Within a rack, given following link segment specifications, the same copper twisted-pair cabling will enable use with 100 Megabit Ethernet, 1 Gigabit Ethernet, or 10 Gigabit Ethernet operation. To extend this further, this same copper twisted-pair cabling is utilized outside the EDA zone, connecting with HDAs in the Data Center.

As a technology, 10GBase-T enables network managers to preserve their *knowledge*-base of Ethernet transport while seamlessly upgrading bandwidth capacity from 1 Gigabit to 10 Gigabit rates.

Additionally, network managers preserve their underlying *investment* in the maintenance of standard, structured cabling system.

Limitations arise in the use of SFP+ Direct Attach with the utilization of non-standard cabling infrastructure (twin-ax cabling directly attached by each vendor to the SFP+ housing cage) and the confinement to 10 Gigabit Ethernet only operation. Deviating from standard, structured cabling contradicts its underlying purpose to ensure a long-term, infrastructure-oriented foundation rather than a piece-meal grouping.

#### **FIELD TERMINATION**

As a standard structured cabling system, twisted pair cables are a known technology to Data Center cable technicians. Twisted pair cabling offers the ability to *field* terminate to as-needed, clean lengths in less than a minute. 10GBase-T implementations enable a clean, structured cable infrastructure.

SFP+ Direct Attach cables cannot be field-terminated. SFP+ uses a passive twin-ax cable assembly and connects directly into a SFP+ housing; they are specially terminated at the vendor site and must be purchased at pre-determined lengths. This adds overhead to cable management inventory and lack of clean, efficient cable infrastructure design.

#### **UNIVERSAL CONNECTIVITY – RJ45**

Twisted pair copper cabling utilizes a standard RJ-45 connector for termination. The RJ-45 connector, already utilized within the Data Center for 1000Base-T applications, ensures plug-and-play-ability of 1000Base-T and 10GBase-T applications over the twisted pair cable infrastructure regardless of switch, server, or adapter-card vendor on either end of the link. The IT Manager has the flexibility to connect 1000Base-T or 10GBase-T as needed over the same twisted-pair copper cabling (as long as link segment requirements are met) with the universal RJ-45 connector; there is no getting bogged down with end-to-end interoperability concerns or upgrade-ability concerns.

SFP+ Direct Attach cables are purchased by IT managers at pre-determined lengths with the SFP+ connector already attached. Often vendors will include certain “vendor security IDs” to ensure their own connections or performance on both sides of the link; adding overhead and limitations to Data Center design topologies. SFP+ Direct Attach inserts an additional form of cabling management, inventory overhead, and inter-operability limitations.

For Data Center IT Managers, the importance of technology inter-operability, of a standardized structured medium of transport, of plug-and-play-ability through universal connectors, and of the ability to easily upgrade existing bandwidth on an as-needed basis cannot be under-estimated.

### REACH

IEEE 802.3an-2006 10GBASE-T Ethernet standard specifies operation over standard, structured twisted-pair copper cable up to 100 meters. In contrast, 10G SFP+ Direct Attach is limited to 10 meters, with 5 to 7m reach more commonly available. SFP+ Direct Attach cables longer than 5 meters are exponentially higher cost compared to shorter cables.

In the Data Center environment, rack and equipment placement is a key factor for Energy Consumption. Limitations of  $\leq 10$  meters with SFP+ Direct Attach directly contradicts the increasingly dire need to meet best practices for grouping and placing of equipment.

IEEE 802.3an 10GBase-T standard allows for two modes of reach capability: 30 meters for short reach applications, and 55-100 meters for fuller reach applications. By segmenting the reach requirements, 10GBase-T embraces  $< 30$  meter within rack, top-of-rack, or rack-to-rack reach applications as well as end-of-row applications of 30-100 meters.

10Gbase-T over structured twisted-pair cabling meets the different reach requirements required for flexibility in the placement of rack and equipment while meeting cabling design rules.

### POWER AND POWER PER METER

At a Physical Layer (PHY) device level, 10GBase-T power consumption whether at full 100m reach or 30m short reach mode will be higher than SFP+ Direct Attach including the EDC chip. A 10GBase-T PHY, at the device level, can consume 4-5.5W per port compared to 2W per port for SFP+ Direct Attach.

A large misconception is viewing the pure wattage without incorporating inherent value-add parameters. For example, as discussed, 10GBase-T offers significant flexibility in reach to address best practices in equipment placement for Energy Consumption efficiencies as well to address multiple configuration usage reaches (within rack, rack-to-rack, and end-of-row). The best method to determine value in this is Power per Meter of Reach.

For 10GBase-T, the energy usage is calculated to be less than 0.06W/m (Watts per meter). In direct comparison, SFP+ Direct Attach energy usage will be 0.20m/W. SFP+ Direct Attach power per meter utilization is  $> 3X$  that of 10GBase-T.

In cases where energy consumption is a key concern, i.e. all Data Centers in today's environment, 10GBase-T over structured twisted pair offers the most efficient energy usage.

### 1 GIGABIT ETHERNET TO 10 GIGABIT ETHERNET... SAME CABLE, SAME CONNECTOR

Today's 10GBase-T solutions offer flexibility for seamless, Auto-Negotiated operation of 1 Gigabit Ethernet or 10 Gigabit Ethernet operation; 10 Gigabit Ethernet rates can be utilized when and as needed following link segment guidelines.

Limitations arise in the use of SFP+ Direct Attach in utilizing non-standard cabling infrastructure and the confinement to 10 Gigabit Ethernet operation.

## SUMMARY

As Data Center IT Managers face options in copper cabling within the EDA, they must take into consideration the key factors involved in deciding between 10GBase-T or SFP+ Direct Attach.

Reach is an important factor in enabling optimal equipment placement and conforming to standard, structured cabling practices. Energy consumption is a large concern among the data center community; maintaining the most favorable power per meter technology is key. Field termination, connectors, and standard cabling are all underlying factors in ensuring a clean, solid foundation of cable design. The ability to transverse multiple data rates is the basis for legacy support and future bandwidth growth.

In all these areas, 10GBase-T as part of the long-term IEEE standard is proof of its efforts.

### *10GBASE-T AND SFP+ DIRECT ATTACH*

Attribute	10GBASE-T	SFP+ Direct Attach
Reach	100m / 30m	<10m
Power	4W-SRM	2W
Power per Meter	<0.06	0.20
Field Termination Capability	Y	N
End-to-End Interoperability	Y	N
IEEE Standard	Y	N
Auto-Negotiable to 1G/100M	Y	N
Standard, Structured Cabling	Y	N

## ABOUT TERANETICS

Teranetics is a leading provider of silicon solutions that enable significantly higher data rates over structured copper cabling than are currently available in today's Ethernet network environments. Led by a team with exceptional expertise and experience in the development and application of mixed-signal semiconductor solutions and digital communication technologies, Teranetics is the first company to ship a production-ready 10GBASE-T semiconductor designed for next generation network applications. Teranetics is backed by a strong consortium of venture investors with in-depth experience and success in the semiconductor and data networking markets.

For More Information: [www.teranetics.com](http://www.teranetics.com)