

Ten gigabit Ethernet – Questions and answers

1. Q: What is ten gigabit Ethernet?

Ten gigabit Ethernet is a series of standards in the Ethernet family of Local Area Network definitions from the 802.3 committee of the IEEE. It offers ten thousand million bits per second of data transmission.

2. Q: Does it actually exist yet?

Ten gigabit Ethernet is covered under a family of standards including;

IEEE 802.3ae – 10GBASE-FX	2002
IEEE 802.3ak – 10GBASE-CX4	2004
IEEE 802.3an – 10GBASE-T	2006
IEEE 802.3aq – 10GBASE-LRM	2006

3. Q: Can I buy products for Ten gigabit Ethernet?

The optical 10GBASE-FX family of products, 10GBASE-SR, 10GBASE-LX4 etc are in common use and readily available. 10GBASE-CX4 copper products are also available.

10GBASE-T and 10GBASE-LRM products were finally made available in 2009.

4. Q: What's the difference between these ten-gigabit products?

10GBASE-xyz - IEEE 802.3ae

The physical layer media is described as 10GBASE-xyz, where

x represents the wavelength of operation

= S short wave, 850 nm

= L long wave, 1300 nm

= E extra long wave, 1550 nm

y represents the technology used

= W (WAN using SONET ST-192 encoding)

= R (LAN using serial encoding)

= X (LAN using CWDM (Coarse Wavelength Division Multiplexing encoding)

z = the number of CWDM channels, if used

The full family is;

Name	Description
10GBASE-SR	850 nm serial LAN PHY
10GBASE-LR	1310 nm serial LAN PHY
10GBASE-ER	1550 nm serial LAN PHY
10GBASE-SW	850 nm serial WAN PHY
10GBASE-LW	1310 nm serial WAN PHY
10GBASE-EW	1550 nm serial WAN PHY
10GBASE-LX4	1310 CWDM

In addition there is a protocol called 10GBASE-ZR which is not part of the official standard but is offered by manufacturers to give an 80 km range over singlemode fibre.

10GBASE-SR – IEEE 802.3ae is the local area network variant working up to 300 m over OM3 multimode fibre and using the low cost laser (VCSEL) interface. It is the most common ten gigabit protocol used in the data centre environment. On the proposed OM4 fibre (available already under a number of brand names) it will achieve a 550 metre range.

10GBASE-CX4 – IEEE 802.3ak Transmits over 4-lanes in each direction over copper cabling similar to the variety used in InfiniBand technology. It is designed to work up to a distance of 15 m. This technology has the lowest cost per port of all 10Gb interconnects, at the expense of range.

10GBASE-LRM - IEEE 802.3aq, indicates a single channel 1300 nm laser transmitter that can achieve 220 metres ten-gigabit transmission distances over any existing multimode fibre. Apart from the expensive laser required it also uses special offset launch optical connectors and patchcords to overcome the differential mode delay problems of older fibres.

10GBASE-T - IEEE 802.3an. A specification for the transmission of ten gigabit Ethernet over existing Category 6 copper cables or a new standard of products called Augmented Category 6.

10GBASE-KR/KX4- IEEE 802.3ap is a copper Ethernet backplane for use up to 1 metre. This will only really be of interest initially to equipment manufacturers.

5. Q: Are there any other standards on their way?

IEEE 802.3av. Passive optical network. More of a telecommunications distribution method for Ethernet. Expected in late 2009.

IEEE 802.3ba . A range of 40 and 100 Gb/s protocols expected in 2010.

The targets agreed so far are;

Provide Physical Layer specifications which support 40 Gb/s operation over:

- at least 10km on SMF
- at least 100m on OM3 MMF
- at least 10m over a copper cable assembly
- at least 1m over a backplane

Provide Physical Layer specifications which support 100 Gb/s operation over:

- at least 40km on SMF
- at least 10km on SMF
- at least 100m on OM3 MMF
- at least 10m over a copper cable assembly

The short distance fibre system will use OM3 fibre and the MTP/MPO fibre array connector. The high speed and low cost of the 100 metre version will make it an ideal data centre technology as it will be based on arrays of the existing 10 Gb/s VCSEL laser. An OM4 performance will also be specified.

6. Q: How far can I transmit on 10GBASE-T?

On copper cable it should be up to 100 m on Augmented Cat 6, Cat 7 or Screened Cat 6. On unshielded Cat 6 UTP the standard IEEE 802.3an suggests 55 m but another Standard, TB 155, infers only up to 37 m.

On fibre cable the transmission distance can be anything from 26 m up to 40 km depending upon the fibre used and the optical interface on the transmission equipment. For new installations in the LAN environment we should expect 300 m on the standard OM3 fibre or 550 m using a premium grade OM4 fibre which is soon to be standardised. Over 550 m definitely requires the use of singlemode fibre which is a big jump in both technology and price. It is vital to match distance against the correct the ten-gigabit technology as equipment (and cable) prices can vary enormously and a cost engineering exercise is vital.

7. Q: What are the new cable standards?

For fibre, as mentioned above, the recent OM3 multimode optical fibre is best for new installations requiring distances up to 300 m or 550 m using the premium grade OM4 fibre. Beyond 550 m singlemode fibre, OS1 or OS2, must be used.

10GBASE-T has a limited capability on existing Category 6 but for new installations the forthcoming Augmented Category 6 or Cat6_A is recommended. These standards come in two groups. The first gives methods of installing and testing cabling to understand their performance relative to 10GBASE-T requirements and the second group are product standards for the new range of Cat6_A products. These standards are;

- ANSI/TIA-TSB-155 – Additional Guidelines for 4-pair 100 Ω Category 6 Cabling for 10GBASE-T Applications. –March 2007.
- ANSI/TIA/EIA-568-B.2-10 – Transmission performance specifications for 4-pair 100 Ω augmented Category 6 cabling. 2008.
- ISO/IEC 11801 Edition 2.1 – Information Technology – Generic cabling for customer premises. 2008.
- ISO/IEC 24750:2007 – Guidelines for support of 10GBASE-T over Copper Balanced pairs of Class E and Class F as per ISO/IEC 11801:2002 and IEEE802.3an.
- Draft EN 50173-99-1

8. Q: Do I need screened or unshielded copper cabling?

10GBASE-T works at relatively high frequencies, up to 500 MHz, and so interference getting into the cable and interference escaping from the cable is going to be a major issue. This is generically known as Alien Crosstalk. It can be solved by screening the cable or taking steps to physically separate and distance unshielded cables. The latter approach is covered in the Standards under the heading of 'mitigation' requirements. Some observers believe that the requirement for mitigation factors in real life installation scenarios may make UTP cables impractical for ten-gigabit use. Shielded cables will not suffer from alien crosstalk issues and can thus be installed in a conventional layout.

9. Q: Aren't shielded cables big and expensive?

Cat6A shielded cables are generally smaller than their unshielded counterparts and of a similar price. However shielded cables must be correctly terminated and earthed to work properly and so well trained installers are required.

10. Q: Do I really need ten gigabit Ethernet?

If you are using 100 Mb/s to the desk then gigabit Ethernet in the first layer (building backbone) is essential and then ten gigabit Ethernet for use in the next layer (campus backbone) or else serious bottlenecks and delays will occur for all users. There is also a major additional benefit of lowering the latency or delay in time-sensitive traffic such as video or VoIP. Ethernet starts to suffer delays once the network gets more than 40% loaded but increasing the available speed reduces this issue.