Demartek 25 Gigabit Ethernet (25GbE) Deployment and Installation Tips

Practical information for deploying 25GbE Technology

Introduction

Upgrading your computer networking infrastructure to 25GbE technology will certainly provide additional room for bandwidth and connectivity growth, but there are some practical considerations that must be addressed in your deployment and installation planning. 25GbE cables, connectors, transceivers, network adapters, and network switches in many cases are compatible with the older 10GbE technology but have different characteristics.

You may be designing a new data center or simply want to upgrade a few components in rack – either way, there are things about 25GbE technology that you need to know that may not be obvious.

Storage Interface Comparison

This document is a 25GbE supplement to the ***Demartek Storage Interface Comparison*** page on our website. This reference page is updated periodically with detailed information regarding history, roadmaps, transfer rates, encoding schemes, cabling, connectors and more.

Recent Ethernet History: 10GbE and 25GbE

Until approximately 2016, the fastest single-lane speed for Ethernet equipment was 10 Gbps per lane. Higher speeds were achieved by bundling multiple lanes of 10GbE in parallel. For example, 40GbE was achieved by running four ("quad") lanes of 10GbE (4 x 10 Gbps) and 100GbE was achieved by running ten lanes of 10GbE (10 x 10 Gbps) in parallel. When running multiple lanes in parallel, different connectors are required.

Beginning in approximately 2016, 25GbE technology became available that increased the single-lane speed for Ethernet to 25 Gbps per lane, a 2.5x increase in speed. 25GbE operates at a single-lane clock rate of 25.78 GHz, which delivers 2.5 times the data throughput rate of 10GbE. The extra throughput is obtained through the clock speed, not by adding extra lanes.

25GbE technology gives us a new and simpler path to achieve higher speeds such as 50GbE, 100GbE and beyond. Using this new technology, 100GbE is achieved by bundling four lanes of 25GbE (4 x 25 Gbps), which is a simpler way to achieve 100GbE than by using the more complex ten lanes of 10GbE.

25 Gigabit Ethernet (25GbE) Deployment and Installation Tips

Demartek
March 2018

Forward Error Correction (FEC) Mismatches

With this 25 Gbps Ethernet speed, there are new things to consider. This higher speed requires the use of Forward Error Correction (FEC) in most instances. There are two types of FEC with today's 25GbE and it is important to correctly identify the type of FEC used by the components you plan to deploy.

> ***RS-FEC*** – Reed Solomon FEC as defined by IEEE 802.3by clause 108, this FEC is the most similar to 802.3bj clause 91. RS-FEC is currently used for 100Gbps technology. This standard is useful for robust error correction but penalizes the user with increased latency.

> ***FC-FEC*** – Firecode FEC as defined by IEEE 802.3by clause 74. This standard is used for bursty errors needing less error correction capability and is suitable for environments with good signal integrity.

Not all components support both types of FEC or automatically detect the appropriate FEC mode. This means that you need to confirm the FEC supported by the cable and its connector/transceiver, the network adapter port, and the network switch port. For some active components such as network adapters or switches, FEC may be disabled by default, which can cause some confusion. Some adapters and switches that support both types of FEC have a feature that will automatically detect the type of FEC in use for that connection. It may be called "SmartAN" (AutoNeg) or "FEC polling", depending on your vendor. However, this feature may be disabled by default in some cases – which seems ill-advised.

Many 25GbE/100GbE switches and adapters support both FEC modes. However, some switches and adapters may have a default FEC setting that does not match the FEC of the cable. These must match to achieve a consistent data link.

If the FEC settings do not match for all the components in the length of the connection, then non-obvious difficulties may arise in a particular connection. If there is a mismatch, some adapters and switch ports may show a link light but will not be able to consistently pass data across that link, or these may operate with **degraded performance**. For others, there may be no link light until the appropriate FEC settings have been made for all the components in that link.

FEC is particularly important when using direct attach copper (DAC) cables. Certain lengths of DAC may require one type of FEC while other lengths may require the other type of FEC.

Connectors

Connectors for 25GbE technology use transceivers either attached to the cable or as separate "optics", depending on the type of cable. The technology for these connectors is different than for 10GbE technology as they operate at different clock speeds.

The Small Form-factor Pluggable (SFP) connector for 25GbE is known as SFP28 because it can run up to 28 Gbps. This same SFP28 technology can be found in other interfaces such as Fibre Channel. For 10GbE, this connector is known as "SFP+." SFP+ is an improvement over the original SFP technology that was used for speeds less than 10 Gbps.

When four lanes are bundled together, the connector used is usually the "Quad SFP," or QSFP. The same naming convention ("+", "28", etc.) applies for the speeds as with the single-lane SFP technology.

	Single-lane	Quad-lane
10GbE	SFP+	QSFP+
25GbE	SFP28	QSFP28*

*QSFP28 may also be known as QSFP100

Network Interface Cards (NICs) or adapters can be ordered with or without transceivers ("optics"). The same is true for network switches. These typically use the SFP or QSFP style of connectors.

25 Gigabit Ethernet (25GbE) Deployment and Installation Tips

Demartek
March 2018

Cable Differences and Lengths

There are differences in cabling between 10GbE technology and 25GbE technology. For a given cable type, the distance supported by 25GbE is generally shorter than the distance supported by 10GbE technology.

For multi-mode fiber-optic cables, the Telecommunications Industry Association (TIA) Engineering Committee TR-42 states that OM3 is the minimum requirement and OM4 is recommended. These cables require a separate optical transceiver mounted in the adapter or switch port. Optical transceivers draw power from the adapter or switch port.

Active Optical Cables (AOC) are fiber-optic cables with a transceiver mounted on each end. At longer distances, AOC cables are thinner and more flexible than passive DAC cables.

Passive direct attached copper (DAC) are copper cables with a transceiver mounted on both ends of the cable. The lengths supported for 25GbE are less than for 10GbE. Furthermore, DAC cables require different transceivers for 25GbE technology. Passive DAC cables do not draw power.

Active DAC cables are similar to passive DAC but have repeaters imbedded in the transceivers that draw power in order to boost the signal.

The cable distances supported are described in the tables below.

Cabling – 10GbE and 25GbE Distances Supported

Fiber-optic	OM1*	OM2*	OM3	OM4
10GbE	33m	82m	300m	400m
25GbE	–	20m	70m	100m

* OM1 and OM2 are not supported for new installations

AOC	Distance
10GbE	Up to 30m
25GbE	Up to 30m

Passive DAC	Distance
10GbE	Up to 7m
25GbE	Up to 5m

Active DAC	Distance
10GbE	Up to 15m
25GbE	–*

* no 25GbE Active DAC cables were available on the market at the time of this writing.

25GbE SFP28 Cable Standards (Copper)

For copper cables, there are three standards, each with a different signal loss budget and FEC support.

Cable Type	Loss (dB)	FEC
CA-N	12.98	No FEC
CA-S	16.48	FC-FEC
CA-L	22.48	RS-FEC

The cable performance also depends on the gauge (AWG) and quality of the cable used. In general, thinner gauge cables result in shorter distances while thicker gauge cables support longer distances.

RJ45 Copper Cables and Connectors

In 2017, the TIA-942-B data center cabling standard was approved. A new Category 8 (Cat 8) twisted pair cable was announced and is expected to support 25 Gbps (25GBASE-T) and 40 Gbps (40GBASE-T) applications when these become available in the future. Cat 8 cable is similar to the familiar Cat 5e/6/6a cables with RJ45 connectors except that it supports the higher speeds at distances up to 30m. Class I (Cat 8.1) and Class II (Cat 8.2) have been introduced. Cat 8.1 is backward compatible. Cat 8.2 operates with TERA and GG45 connectors and uses different shielding than Cat 8.1.

Conclusion

25GbE technology is the basis of the future of Ethernet for the next few years and is the springboard for faster speeds that are on the horizon. Now is a good time to begin migrating or upgrading to 25GbE.

25 Gigabit Ethernet (25GbE) Deployment and Installation Tips

Demartek
March 2018

The most current version of this report is available at https://www.demartek.com/Demartek_25GbE_Deployment_Tips_2018-03.html on the Demartek website.