# Introduction to
# 10 Gigabit Ethernet

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# Introduction

This document introduces some basic knowledge about 10 Gigabit Ethernet. It includes cable media, MSAs (multi-source agreements, the modularized adapter sets), and the solutions which **QSAN** provides. Users will learn the knowledge and make the right choice of their needs.

# Cable media

## Fiber

Basically, optical fiber can be divided into two classifications: single-mode fiber (**SMF**) and multi-mode fiber (**MMF**). The comparison table is listed below:

| Fiber type | Core size of cable | Distance | Light source | Benefit | Shortcoming | Cable color |
|---|---|---|---|---|---|---|
| **MMF** | 50 or 62.5 μm | Less than 300M | Low-cost laser or LED | Cheaper, easy to manufacture, lower power consumption | Short distances | Orange |
| **SMF** | 8~9 μm | Over 10Km by diff. fiber standards | High power, collimated laser | Long distances | Expensive, Higher power consumption | Yellow |

The fiber solutions used by 10 Gigabit Ethernet are definded by IEEE 802.3ae. It includes fiber -SR, -LR, -ER, and –LX4. Here we take an example of -SR and –LR.

| Common name | IEEE standard | Wavelength (nm) | Cable type | Distance |
|---|---|---|---|---|
| **10GBASE-SR** | 802.3ae | 850 | MMF | Up to 300M |
| **10GBASE-LR** | 802.3ae | 1310 | SMF | 10KM |

## Copper

The copper solutions used by 10Gigabit Ethernet are 10BASE-CX4 (IEEE 802.3ak), 10BASE-T (IEEE 802.3an), and the SFP+ Direct Attach. Here is the comparison table.

| Common name | IEEE standard | Cable type | Distance | Benefit | Shortcoming |
|---|---|---|---|---|---|
| **10GBASE-CX4** | 802.3ak | CX4, similar to the one used by **InfiniBand™** technology | 15M | Low latency, low cost, low power | Short reach, bigger form factor |
| **SFP+ DA** | N/A | Passive Twin-Axial (2 pair copper) cables | 10M | Low latency, low cost, low power small form | Short reach |

| | | | | factor | |
|---|---|---|---|---|---|
| **10GBASE-T** | 802.3an | Cat 5e<br>Cat 6<br>Cat 6a<br>Cat 7 | 45M<br>55M<br>100M<br>100M | Most popular calbe media | High latency, high power |

# MSA (Multi-Source Agreements)

There are several PHY modules availabe for 10 Gigabit Ethernet. The PHY modules have different form factors which are not defined by IEEE, but are standardized by a group of industry participants through what is known as a **Multi-Source Agreement (MSA)**. They are XENPACK, XPAK, X2, XFP and SFP+. All medias provide different pluggable interfaces for fiber or copper. Here is the comparison table.

| | MSA | Speed | Size | Available modules |
|---|---|---|---|---|
|  | **XENPAK** | 10Gb | 4.8 x1.4 x0.7 inch | CX4, 10GBASE-T and fiber modules. |
|  | **XPAK/X2** | 10Gb | 2.7 x1.4 x 0.4 inch | CX4 and fiber modules. |
|  | **XFP** | 10Gb | 2.7 x 0.7 x0.4 inch | CX4, and fiber modules |
|  | **SFP+** | 10Gb for Ethernet 8.5Gb for fiber channel | 2 x 0.5 x 0.4 inch | Fiber, and DA (copper) |

Please see the picture below, the size of each interface is evident.
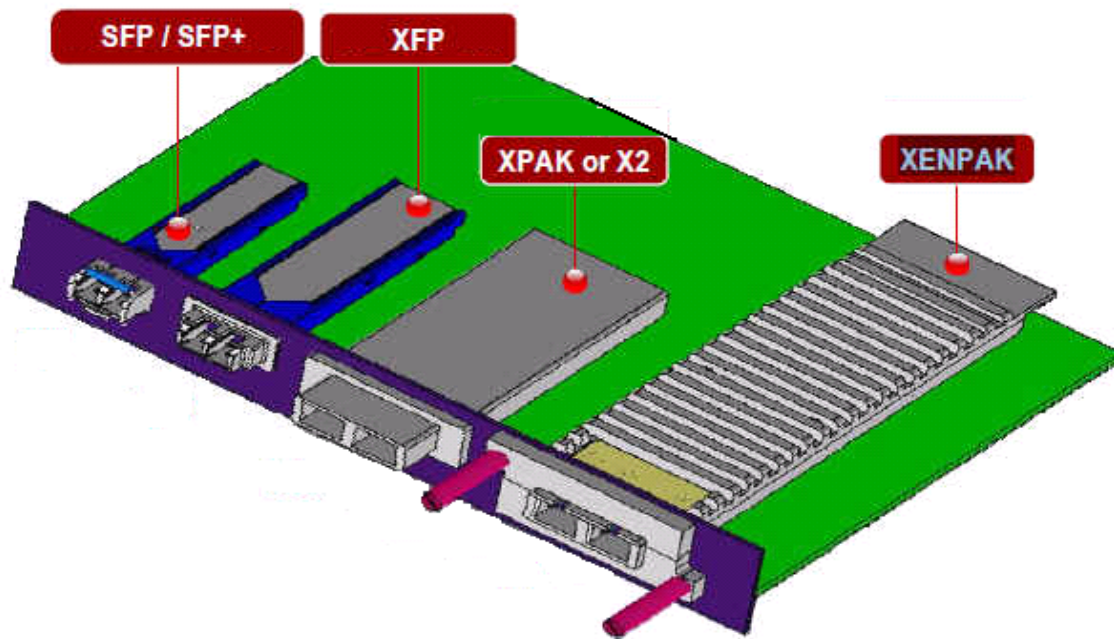
## What QSAN provides on P500H

**QSAN P500H** provides two different interfaces for data transmission by switching daughter boards. One is the SFP+ and the other is CX4.

### SFP+

The daughter board, DXE, provides two SFP+ ports and let users choose the proper pluggable modules. For short range usage, less than 10 meters, user can choose the DA (Direct Attach) cable as a cheaper solution than the fiber one. For long range usage, up to 300 meters, user can choose the SR transceiver and MMF fiber cable as a flexible and reliable solution.
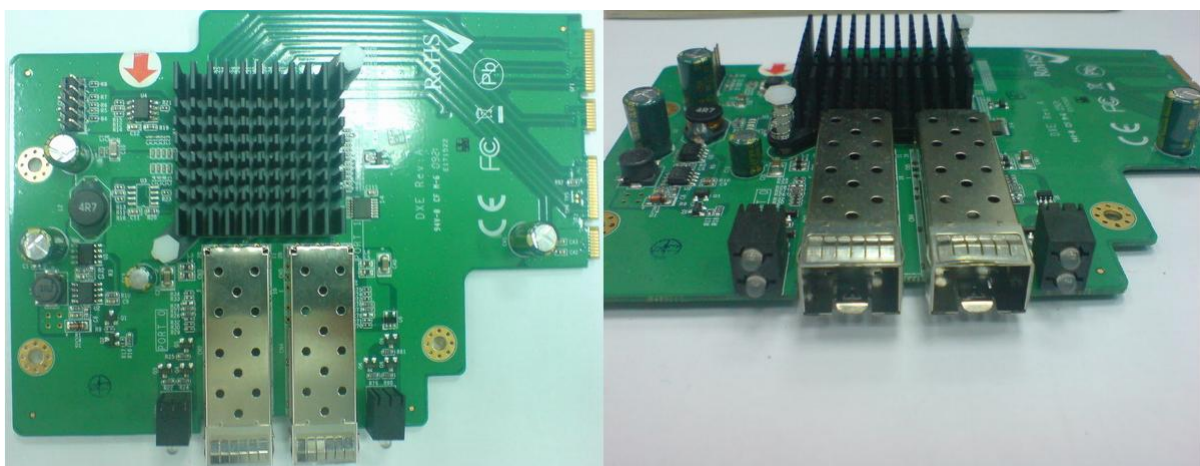


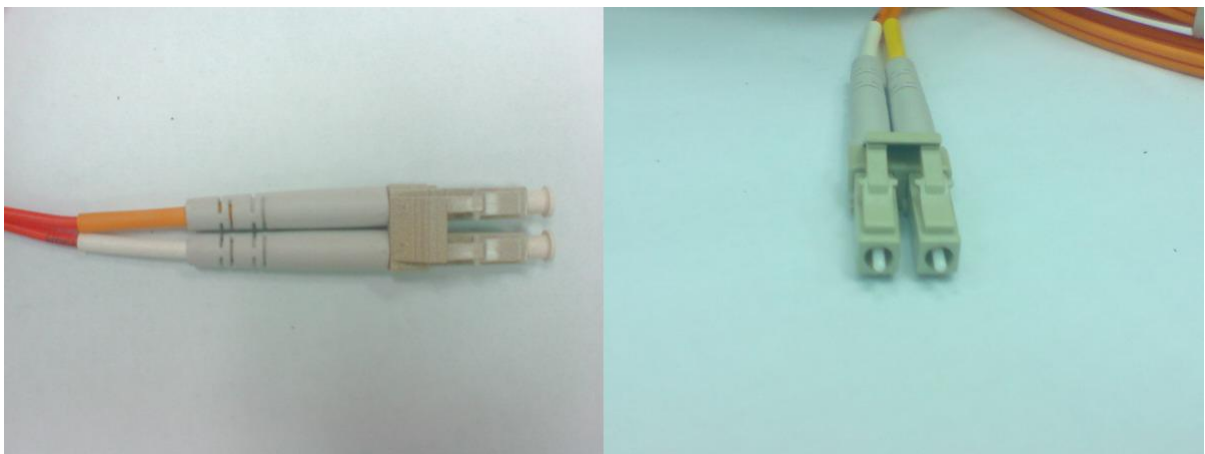**Figure 1, DXE daughter board**

**Figure 2, SFP+ -SR transceiver**



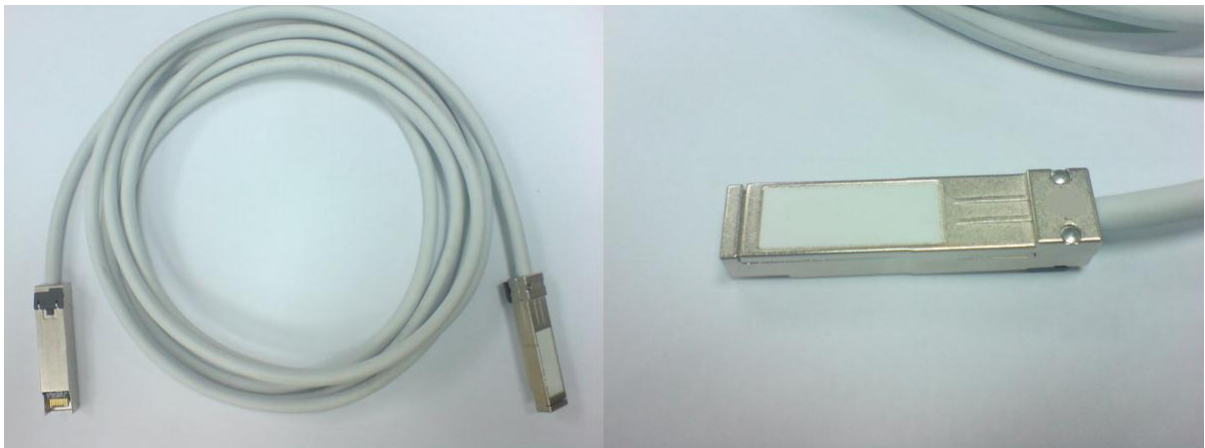**Figure 3, MMF fiber cable with LC connector**



**Figure 4, SFP+ Direct Attach cable**

## CX4

The daughter board, DCE, provides two CX4 connectors. Because the DCE board does not have optical components and CX4 cable is cheaper than fiber, the TCO (Total Cost of Ownership) of CX4 solution will much less than the optical. But the disadvantages are that CX4 cable has short range feature (less than 15 meter) and the form factor is larger than SFP+.
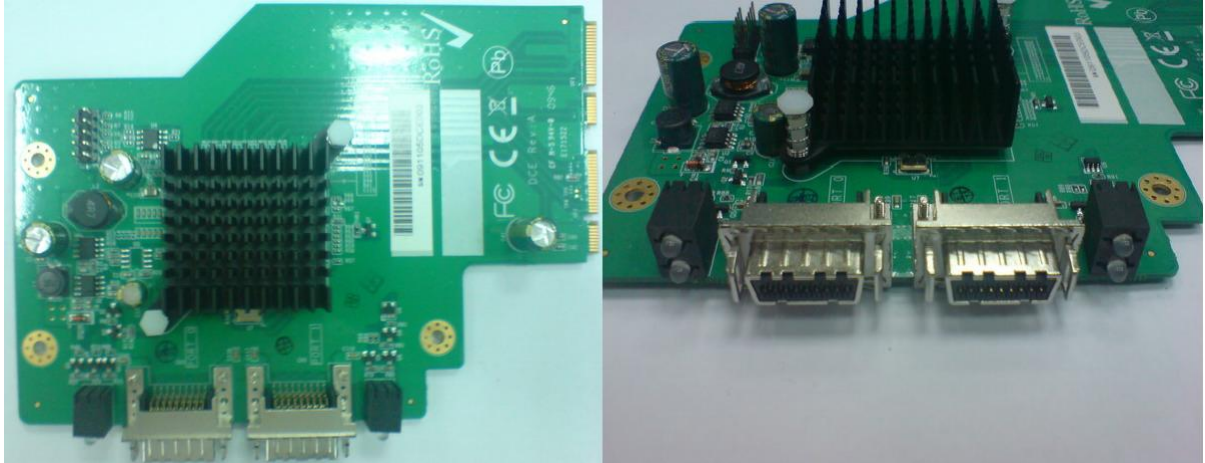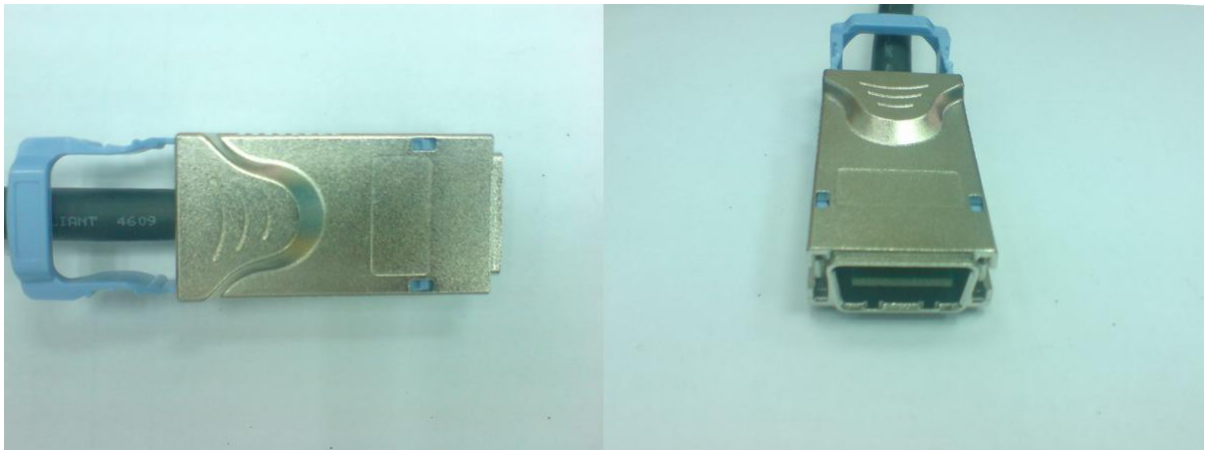
**Figure 5, DCE daughter board**


**Figure 6, CX4 cable**

# Summary

There are several physical layer standards and some interfaces MSA provided to carry the electrical signal of 10 Gigabit Ethernet. Each one has its pros and cons, some are cheaper, some are smaller, and some have long range feature. User has to consider both of the price and convenience at the same time when integrating 10 Gigabit solution of storage, such as **P500H**, into an existing network environment.

# References

- 10 Gigabit Ethernet
  http://en.wikipedia.org/wiki/10_Gigabit_Ethernet

- 10 Gigabit Ethernet – Alphabet Soup Never Tested So Good!
  http://www.webcitation.org/5j5GctcM9