



## 10Gbps Ethernet Media Converter

### KEY BENEFITS

- Simple, easy and cost effective way to convert 10Gbps Ethernet data stream between fiber and copper wire without costly switch with 2 interfaces.
- Full duplex Wirespeed forwarding without bottleneck
- Subsidiary device for 10Gbps Ethernet Transmission without fiber.
- Common used SFP+ fiber interface and RJ-45 connector.
- Portable small size case that is easy to be installed anywhere in office or control room.
- Plug fiber/cable and then it works, as easy as general switch without extra configuration.

### MAIN APPLICATIONS

- Media Converter for network backbone.
- Connection between fiber based and copper wire based 10Gbps Ethernet equipment.
- Apply to Telecommunication room, R&D laboratory, Data center, etc.

### WHAT'S IN THE BOX

Shipping package includes:

- XG2 x 1
- Cat.6a cable x 1
- Console cable x 1
- Power cord x 1
- Power adapter x 1

### OVERVIEW



**XG2** is 10Gbps Ethernet media converter between fiber and copper wire. No matter what kind of media applied for 10Gbps Ethernet, it used to be the optical fiber as the media for transmission. Until recently, 10GBASE-T that based on IEEE 802.3an which was formally announced at June 2006, uses Cat.6a/Cat.7 cable as transmission media with RJ-45 connector becomes a commercial standard in the market. With this kind of

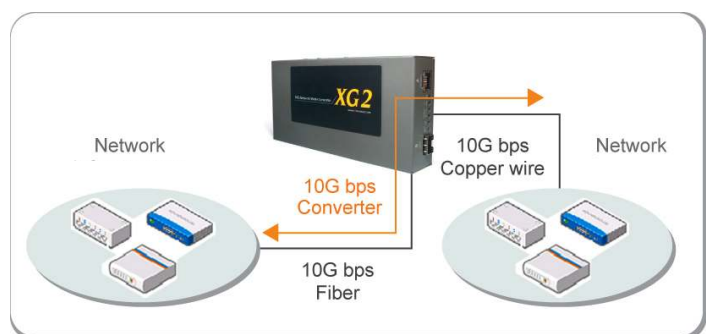
revolutionary and cost-effective solution, 10Gbps speed Ethernet transmission is not as costly as fiber before.

However, the possible transmission length of 10GBASE-T is up to 100 meter only, hence, data transmission between two far away places with 10GBASE-T is not possible. Using fiber as the media still dominates transmission of long distance. How will you configure network between these 2 media? Here comes the **XG2** for the best solution.

**XG2** is a media converter for connection between 10GBASE-R and 10GBASE-T. For example, administrator of ISP can has FTTx service from Central Office to the user's street or large organization building by fiber. Without extra equipment specialized for fiber, **XG2** converts media from fiber to copper wire, and then distributed to any nearby location with 10Gbps Ethernet switch, or to xDSL modem via DSLAM. Data stream can be transmitted with copper wire cable easily and cost effectively afterward.

**XG2** is also the best subsidiary device for test on network equipment. NuStreams 10Gbps Ethernet fiber module for NuStreams chassis and this **XG2** are perfect combination for test between 10GBASE-T/10GBASE-R Ethernet equipment.

**XG2** is a 2 ways converter with RJ-45 and SFP+ connector. Data stream can be converted bi-directionally from 10GBASE-R to 10GBASE-T and vice versa. With full duplex Wirespeed forwarding capability between these 2 media, **XG2** bring you the best and simple solution for the 10Gbps Ethernet conversion between media of copper wire and fiber.





## KEY FEATURES

- Real-Time conversion between 10GBASE-T and 10GBASE-R
  - Interface of 10GBASE-T that based on IEEE 802.3an
  - Interface of 10GBASE-R that based on IEEE802.3ae
- Conversion of media type between fiber (SFP+ connector) and twisted pair copper wire (RJ-45 connector).
- Real-time LED display of running status
  - SFP+ status: Remind user the SFP+ fiber connector is connected
  - LR status: Connector of LR Transceiver is plugged. LED is off when connector of SR Transceiver is connected. 10GBASE-LR, a Long Range Optical technology, delivers serialized 10Gbps Ethernet over a 1310 nm wavelength connection on single-mode fiber via IEEE 802.3 Clause 49 64B-66B Physical Coding Sub layer (PCS) using a line rate of 10.3125.
  - Link/Rx status: Display the Network linked/Receive status
  - Loopback status: Indicate the Loopback test status of A and B ports. Loopback test is the method to send out signal and quickly back to the same source entity to test the transmission and route problem of infrastructure.
  - System operation status
- Console and USB port for extra management (optional)
- Both SFP+ and RJ-45 port can connect to other 10Gbps Ethernet switch for expansion. It will not obstruct the original Ethernet traffic.
- Subsidiary device for test on 10Gbps Ethernet switch with 10GBASE-T and/or 10GBASE-R ports
- Powered by 12V DC from external adapter.
- High speed 10Gbps fiber/copper wire converter without packet loss.
- Test loopback function via console port.

## SPECIFICATIONS

- **Interface:**
  - **Left Side:**
    - ◆ One 10Gbps RJ-45 port
    - ◆ One 10Gbps SFP+ port (mini-GBIC)
  - **Right Side:**
    - ◆ One RS-232 console port (RJ-45 connector)
    - ◆ One Power jack.
- **Wirespeed Cable Length:**  
Up to 100 meters Cat.6a cable for Wirespeed transmission
- **Transceiver (PHY)**  
Teranetics chip for 10GBASE-T and NETLOGIC chip for 10GBASE-R
- **Power Source Type:**  
AC 90V~240V to 12V DC adapter
- **Temperature:**  
Operating: 0°C ~ 40 °C (32°F ~ 104°F)  
Storage: 0°C ~ 50 °C(32°F ~ 122°F)

- **Humidity:**  
Operating: 0% ~ 85% RH  
Storage: 0% ~ 85% RH
- **Dimensions:**  
175 mm x 85.9 mm x 32.6 mm
- **LED Display :** Five LED (SFP+, LR, Link/Rx, Loopback A,B (↶), SYS)
  - **SFP+:** SFP+ fiber connector is connected
  - **LR:** Connector of 10GBASE-LR Transceiver is plugged.
  - **Link/Act:** Network is linked/active for A and B ports
  - **Loopback A,B (↶):** Indicate the Loopback mode of A and B ports is enabled at the same time
  - **SYS:** System status

## RELATED PRODUCTS

- **XM-28L1:**  
10Gbps Ethernet test module for NuStreams chassis



**XM-28L1**

- **XM-28L1CX4:**  
10Gbps Ethernet test module with CX4 connector for NuStreams chassis



**XM-28L1CX4**

## OPTIONAL ACCESSORY

- **SFP+ Transceiver**  
SFP+ Transceiver is required for XG2 to connect with optical fiber.  
Recommended SFP+ Transceivers below is fully tested for your request.

OPTOWAY Part No.*	10GBASE	Distance	Wavelength (nm)	Package
<b>SPM-2100WG</b>	SR / SW	300 / 82 / 33 M	850 VCSEL	LC SFP+
<b>SPS-2110BWG</b>	LR / LW	10 KM	1310 DFB	LC SFP+

\* Information is subject to change by their own manufacturer. Please contact with sales representatives for the detail of purchase.



## ETHERNET SPECIFICATIONS

### 10Gbps Ethernet vs. Gigabit Ethernet

#### 10Gbps Ethernet

The 10 Gigabit Ethernet standard was first published in 2002 as IEEE Std 802.3ae-2002 and it is the fastest of the Ethernet standards. It defines a version of Ethernet with a data rate of 10 Gbps, ten times as fast as Gigabit Ethernet and it always connect with other device in full-duplex mode.

#### Gigabit Ethernet

Gigabit Ethernet (GbE or 1 GigE) is a term describing various technologies for transmitting Ethernet frames at a rate of a gigabit per second. Half duplex gigabit links are allowed by the specification; however, common link to gigabit Ethernet switch is full duplex.

Note: **XG2** is the media converter for 10Gbps Ethernet. It works for 10Gbps speed Ethernet link only. Link at other speed is not available

### 10GBASE-R vs. 10GBASE-T

#### 10GBASE-T (copper wire)

##### overview

10GBASE-T, or IEEE 802.3an-2006, is a standard released in 2006 to provide 10 gigabit/second connections over unshielded or shielded twisted pair cables, over distances up to 100 meters (330 ft). 1000BASE-T cable infrastructure can also be used for 10GBASE-T, allowing a gradual upgrade from 1000BASE-T and auto-negotiation to select which speed to use. 10GBASE-T has higher latency and consumes more power than other 10 gigabit Ethernet physical layers.

##### Connectors

10GBASE-T uses 650 MHz versions of the venerable IEC 60603-7 8P8C (RJ-45) connectors already widely used with Ethernet.

##### Cables

10GBASE-T works up to 55 m (180 ft) with existing Category 6 cabling. In order to allow deployment at the usual 100 m (330 ft), the standard uses a new partitioned Category 6a cable specification, designed to reduce crosstalk between UTP cables.

#### 10GBASE-R (fiber)

##### Overview

10GBASE-R is 10Gbps Ethernet connection that is based on IEEE802.3ae. It uses fiber as transmission media with different specifications of fiber, connector and transceiver. XG2 uses two standards, 10GBASE-LR and 10GBASE-SR.

#### 10GBASE-SR

10GBASE-SR ("short range") uses 64B/66B encoding and 850 nm wavelength lasers. It is designed to support short distances over deployed multi-mode fiber cabling, it has a range of between 26 meters (85 ft) and 82 meters (270 ft) depending on cable type. It also supports 300 meters (980 ft) operation over new, 50  $\mu$ m 2000 MHz\*km OM3 multi-mode fiber (MMF).

The transmitter can be implemented with a VCSEL (Vertical Cavity Surface Emitting Laser) which is low cost and low power. MMF has the advantage of having lower cost connectors than SMF (single-mode fiber) due to its wider core.

10GBASE-SR delivers the lowest cost, lowest power and smallest form factor optical modules.

#### 10GBASE-LR

10GBASE-LR is a Long Range Optical technology delivering serialized 10 gigabit Ethernet over a laser with 1310 nm wavelength connection on single-mode fiber via IEEE 802.3 Clause 49 64B-66B Physical Coding Sub layer (PCS) using a line rate of 10.3125 .

Single-mode optical cabling is used to interconnect transceivers at a distance spaced at 10 kilometers (6.2 mi), but it can often reach distances of up to 25 kilometers (16 mi) with no data loss.

Fabry-Perot lasers are commonly used in 10GBASE-LR optical modules. Fabry-Perot lasers are more expensive than VCSELs (mentioned above) but their high power and focused beam allow efficient coupling into the small core of single mode fiber.

#### Fiber Specification

Fibers which support many propagation paths or transverse modes are called multi-mode fibers (MMF). Fibers which can only support a single mode are called single-mode fibers (SMF). Multi-mode fibers generally have a larger core diameter, and are used for short-distance communication links and for applications where high power must be transmitted. Single-mode fibers are used for most communication links longer than 200 meters.

Fiber Jacket	Meaning
Yellow	Single-mode optical fiber, long distance connection
Orange	Multi-mode optical fiber, short distance connection



## Cable for 10GBASE-T

### Overview

10GBASE-T cable infrastructure can also be used for 1000BASE-T allowing a gradual upgrade from 1000BASE-T. For longer distance connection or better performance, Cat.6a or above is suggested for 10Gbps Ethernet connection. Table below is suggestion for cabling of different standards

### Category of UTP network cable

#### Cat 5

Provides performance of up to 100 MHz, and was frequently used on 100 Mbit/s Ethernet networks. May be unsuitable for 1000BASE-T gigabit Ethernet.

#### Cat 5e

Provides performance of up to 100 MHz, and is frequently used for both 100 Mbit/s and Gigabit Ethernet networks.

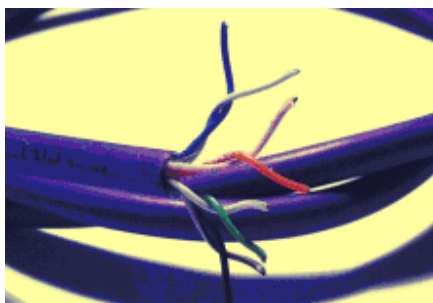
#### Cat 6

Provides performance of up to 250 MHz, more than double category 5 and 5e.

#### Cat 6a

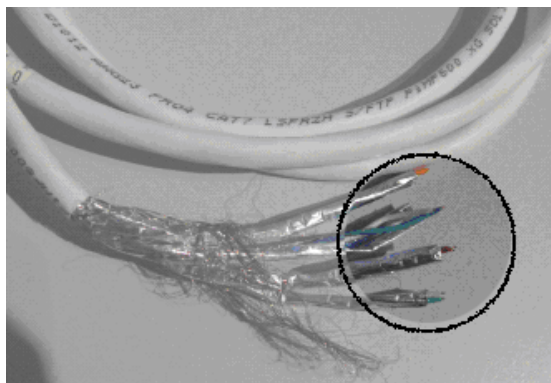
Provides performance of up to 500 MHz, double that of category 6. Suitable for 10GBASE-T.

All the cables above do not have individually-shielded pairs



#### Cat 7

This standard specifies four individually-shielded pairs (STP) inside an overall shield. Designed for transmission at frequencies up to 600 MHz.



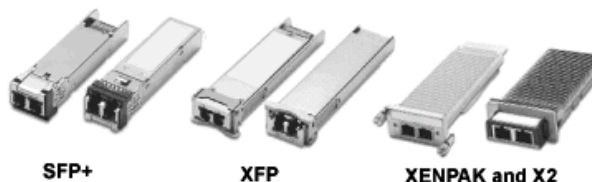
## SFP+ and Other Transceiver for Fiber

SFP+ is a variant of the SFP optical transceiver (also sometimes called a "mini-GBIC"). The SFP has been shipping in volume for years in Gigabit Ethernet and 1-, 2-, and 4-Gigabit Fiber Channel applications. The SFP+ module enhances the mechanical form factor of the SFP to add improved signal integrity and EMI shielding appropriate to higher data rates, and defines new electrical interface specifications.

The SFP+ module become the highest density and lowest cost option for 10-Gigabit Ethernet optical links, with the tradeoff of more high-speed design work up front for the host-card designer.

SFP+ optical transceivers also have the potential to offer significantly lower cost than the existing modules. The cost reductions will come from eliminating redundant silicon and significantly simplifying the design and test of the module to make them more similar to low-cost Gigabit Ethernet optical transceivers.

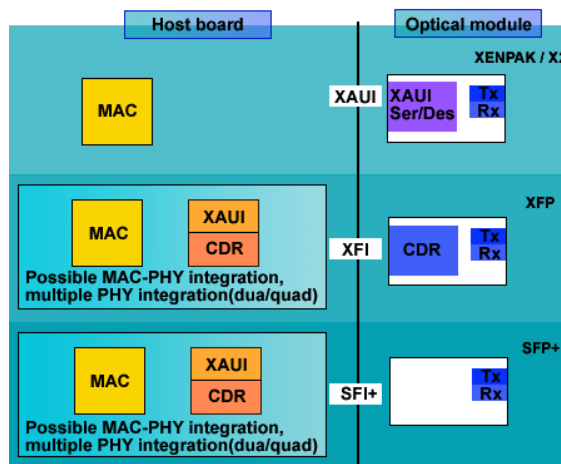
There are several transceivers available in the market



SFP+ has the smallest form factor with higher-density host card architectures than other modules can support.

Form factor comparison			
Form factor	Size(in.)	Max. DC Power dissipation(W)	Max. slots per line card
XENPAK	4.7x2	6	8
X2	2.7x1.6	4	16
XFP	2.7x0.7	2.5	30
SFP+	2x0.5	1	48

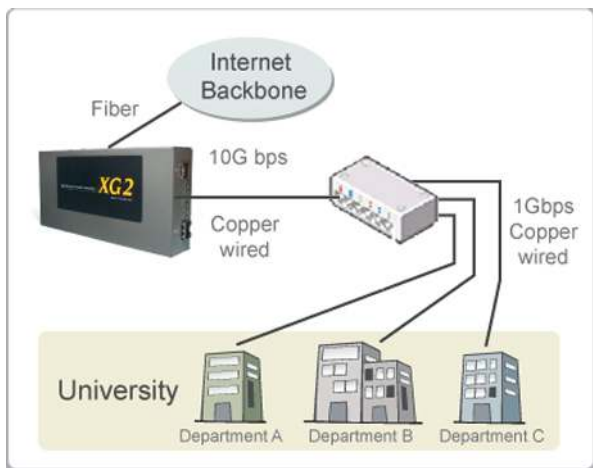
SFP+ reduces the design and architecture in the module of Transceiver and moves these function to host board to reduce cost, as illustrated below



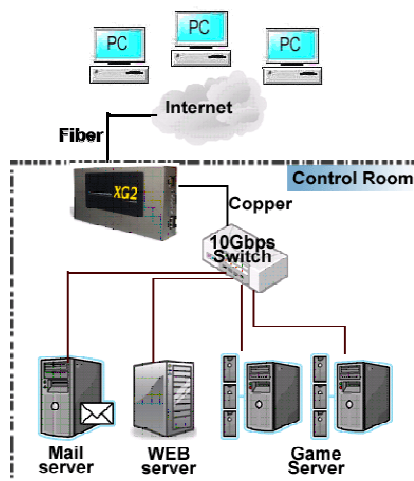


## Application for 10Gbps Switch

10Gbps speed Ethernet connection may not be common seen in the office, however, administrator may has Gigabit Ethernet in the control room of office already. Get a 10Gbps Ethernet connection from backbone and distribute it to different Gigabit Ethernet segment for different building or organization is practical and more cost-effective. Here is an example of possible plan.

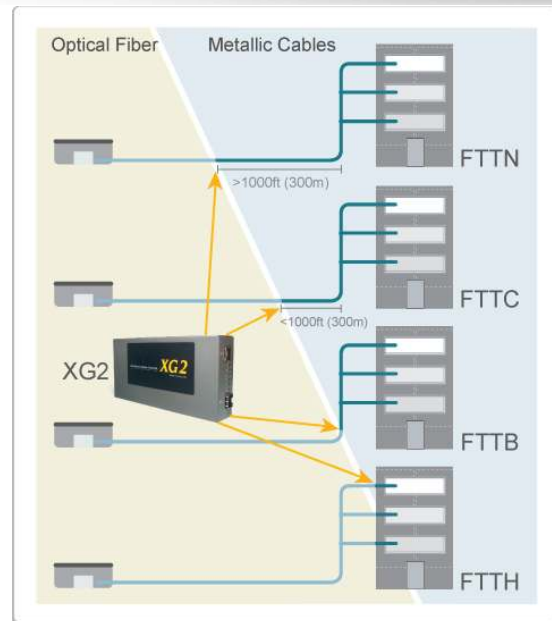


For ISP or online game company. **XG2** may also save lots of money for cabling your control room. ISP runs lots of customer's service such as e-mail server, web server or any co-located network service on the control room. These equipments may not have interface for the connection of fiber. For online game company, administrator may have lots of online game servers that need high speed connection to backbone in the control room.



## Application for FTTx

A schematic illustrating how the FTTx architectures vary with regard to the distance between the optical fiber and the end-user. The building on the left is the central office; the building on the right is one of the buildings served by the central office. The dotted rectangles represent separate living or office spaces within the same building.



Fiber to the x (FTTx) is a generic term for any network architecture that uses optical fiber to replace all or part of the usual copper local loop used for telecommunications. The four technologies, in order of an increasingly longer fiber loop are:

- Fiber to the node / neighborhood (FTTN)
- Fiber to the curb (FTTC) / Fiber to the kerb (FTTK)
- Fiber to the building (FTTB)
- Fiber to the home (FTTH)

For the time before, if the client has requirement of lots bandwidth, ISP has to cabling several fibers with gigabit connection to the same location and distributes the connection by Gigabit switch or media converter to copper wired destination.

Depending on the bandwidth required for client. ISP configures a **XG2** media converter between the connection of light blue and dark blue line. With 10Gb Ethernet conversion between fiber and copper wire, ISP can provide heavy-weight bandwidth service that is closer to the client without spending too much cost.

The white line can be converted by **XG2** and then distributed by 10Gbps Switch as illustrated above. It also can be distributed by **DSLAM** with xDSL connection to client

## DSLAM

A **D**igital **S**ubscriber **L**ine **A**ccess **M**ultiplexer allows telephone lines to make faster connections to the Internet. It is a network device, located in the telephony exchanges of the service providers, that connects multiple customer Digital Subscriber Lines (DSLs) to a high-speed Internet backbone line using multiplexing techniques. By placing remote DSLAMs with **XG2** media converter at locations remote to the telephone company central office (CO), telephone companies provide DSL service to locations previously beyond effective range. Technologies such as VDSL provides high speed, short-range link are used often in FTTx service



### Test with NuStreams-2000i chassis

NuStreams -2000i and 600 are the test chassis for Ethernet network. For NuStreams -2000i, in addition to modules required for running this equipment, it can attach up to 16 test modules for Ethernet test on different transmission media or speed. It is perfect for test in lab or for examination of mass production.

There are varied kinds of module can be attached to the chassis. XM-28L1 and XM-28L1CX4 are two modules for 10Gbps Ethernet test.

#### XM-28L1 module:

##### Interface

10 Gigabit Ethernet (10GBASE-R): XFP port x 1

##### 10 Gigabit Ethernet

XFP supports XFP MSA transceivers

##### Auto-negotiation

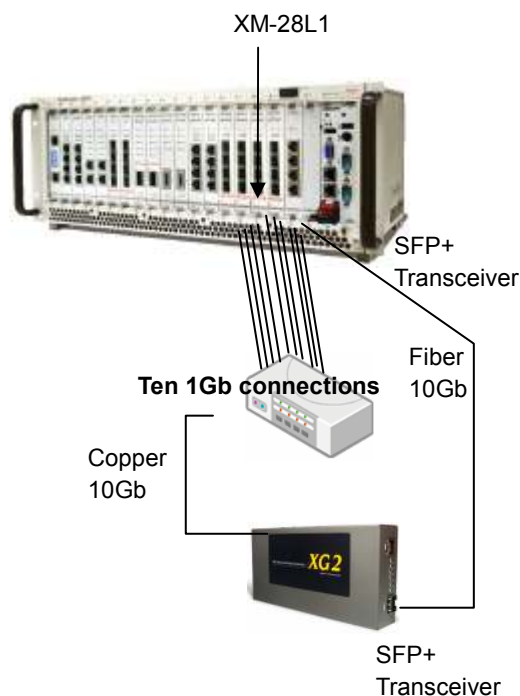
10GBASE Full Duplex Mode

##### LEDs

SYS, Link/Tx, Rx/Err, Trigger, XFP

With this module, the chassis and **XG2**, operator can test the 10Gbps DUT between fiber and copper wire media, such as the illustration below.

Note: Although XM-28L1 is equipped with XFP transceiver, it can communicate with SFP+ transceiver of **XG2**. The size and specification of transceiver are independent from the Ethernet protocol transmit and receive inside fiber.

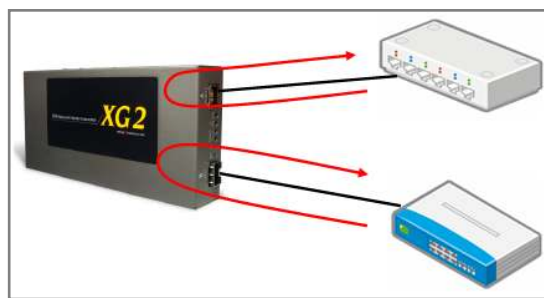


### Loopback test function of XG2

**XG2** has loopback function for the trouble shooting of network. Loopback test is the method to send out signal and quickly back to the same source entity to test the transmission and route problem of infrastructure. Test equipment with this troubleshooting technique sends specific patterns, and counts any errors that come back (BERT, Bit Error Rate Test).

From the operation of console port, user can active loopback test. When it is enabled, data stream from test equipment to the XG2 flows returns to their source entity.

Here it illustrates how loopback works.



### Connection from fiber to XG2

Different from RJ-45 connector, the fiber can be removed from SFP+ transceiver easily. At two end of fiber, it has connector that can attach to SFP+ transceiver. There are two fibers for one SFP+ transceiver. One fiber is for receiving and one fiber is for transmission. Left connector below is called LC connector that can attach to SFP+ transceiver.



When SFP+ transceiver is plugged into the XG2, the LED of SFP+ is Amber. If the inserted SFP+ transceiver is attached by a fiber with LC connector with going on signaling, the LED becomes Green. The LED of LR is either Green for 10BASE-LR mode or Amber for 10BASE-SR mode.

### CONTACT INFORMATION

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