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Secure Data Extension in Single Point Applications

Go Beyond with Antaira's Industrial Ethernet-to-Fiber Media Converters

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Overview

This paper provides information about connectivity solutions for Ethernet-to-fiber media converters. It describes Antaira Technologies' Industrial Ethernet-to-fiber media converter (IMC and IMP series) specifications as well as an overview on how to go beyond standard Ethernet distance limitations of Ethernet-to-fiber media converters by:

- Choosing the right media converters for data extension
- Protecting data from environmental effects such as EMI (Electromagnetic Interference), surge and ESD
- Using media converters as part of the network
- Detecting unmanaged remote data transmission failure with LFP (Link Fault Pass-Through)
- Using PoE features for restricted power source applications

Trends and Benefits of Using Industrial Ethernet to Fiber Media Converters

Today, more and more industrial automation applications have been adopting industrial Ethernet-to-fiber media converters for remote field equipment data collection or monitoring. One of the major benefits of using industrial Ethernet-to-fiber media converters is the distance extension of data transmissions available by utilizing fiber-optics. Single-point monitoring applications can include, but are not limited to, remote pump station meter monitoring in water/wastewater treatment plants, oil well pump jack meter monitoring, and signaling data extension between road intersection traffic controls. Another great benefit industrial media converters are able to provide is the protection of data from the effects of electrical noise (EMI) found in many operating environments, such as IEDs from the bay level area or control room in power substations, or giant generators or motors found in heavy manufacturing factory floors. High quality data protection is possible with Ethernet to fiber media converters because of the way that data is transmitted; with light. Fiber-optic technology utilizes light to transmit data which is immune to electrical noise, unlike more traditional mediums that use electric signals. Fiber optical cables are also able to provide extended data communication for distances of up to 120Km.

Choosing the Right Media Converters for Data Distance Extension

As previously mentioned there are a lot of industrial applications that only require single-point connectivity to an Ethernet-based device at a remote section of the facility. With a traditional Ethernet cable this is not possible due to the distance limitation of typical Ethernet twisted-pair cables only allowing a maximum distance of 100 meters for communication. This challenge was addressed in the past by either utilizing multiple repeaters, every 100 meters, to achieve the distance requirements. Unfortunately, this can add potential points of failure to the network. In addition, the devices used in the past were typically commercial grade equipment plagued with high failure rates due to the harsh industrial environment they were placed in.

There are several key items to pay attention to when choosing the right media converters for data extension:

1. **Data rate** - For example, a typical industrial sensor or meter will have a limited data rate lower than 1 megabit. In this case a 100MB media converter is sufficient enough. On the other hand, if the device is a high resolution IP camera with more than a 100MB data rate, then a gigabit media converter is necessary.
2. **Fiber mode** – Most standard media converter fiber in today's market provide a multi-mode solution in 2Km, or single-mode solution in 15Km
3. **Wavelength** – Typically higher wavelength transceivers will support further distance capabilities. For example, an 850nm wavelength transceiver will result in maximum distance transmission of 550 meters; where as a 1310nm wavelength transceiver can reach ranges of about 2Km to 40Km.
4. **100MB fiber** – The standard 100Fx fiber connector in today's market has a SC or ST type interface, as shown in Figure 1.2. 100MB transceivers will start off with distance capabilities of 2Km and increase from there.

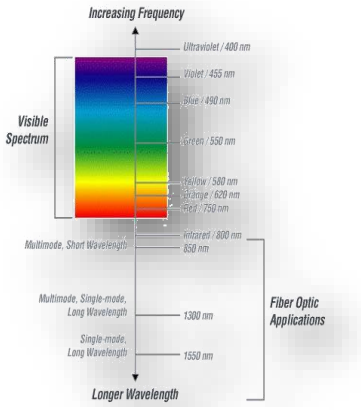

Figure 1.1 - Fiber Optic Wavelength

5. **Gigabit fiber** – The most popular standard in the market today is using an SFP (small form-factor pluggable transceiver) with a LC type interface, as shown in Figure 1.2. Gigabit fiber distance capabilities will start at 550M.
   **Traditionally, some devices require a SC or ST type interface for gigabit fiber connections, but this has been migrated to using a SFP interface as a standard in the market today, due to its cost-effectiveness and flexible solution.
6. **Power consumption** – a typical 100MB or gigabit media converter usually requires >5 Watts of power. When using a PoE powered media converter, the total power required will be dependent on the PD's (Powered Device) power consumption. For example, the PoE media converter itself requires 5 Watts, and a PoE camera may require 7 Watts. Therefore, users are required to have a power source that can support a minimum of 12 Watts.

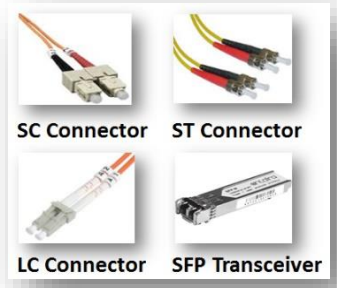

Figure 1.2 - Fiber Optic Connector Types

Antaira Technologies understands the requirements of industrial automation and harsh environment applications and provides industrial grade Ethernet-to-fiber media converters with high surge and ESD protection solutions. Antaira's industrial media converter families also support the following features:

- Compact and slim form factor for space saving installations
- Supports 10/100Tx to 100Fx built-in transceiver with options in SC/ST connection and multi or single-mode fiber
- Supports optional models with PSE (Power Source Equipment) IEEE 802.3af compliance; maximum 15.4W PoE power output
- Supports 10/100/1000Tx to 1000SX/LX SFP slot for gigabit fiber
- Built-in LLF (Link Loss Forwarding) and LFP (Link Fault Pass-Through) functions
- Safety approval with CE, FCC, and UL Class 1 Division 2 certifications
- Wide operating temperature support from -40 to 80C for extreme ambient weather environments

Figure 1.3 – Antaira Industrial Ethernet-to-Fiber Media Converter Family

Data Protection from the Effects of EMI (Electromagnetic Interference), Surge and ESD Environments

Most industrial applications for distance data extension are in a harsh environment. The challenges of EMI (Electromagnetic Interference), Surge and ESD (Electrostatic Discharge) are everywhere, and can cause data corrosion or possibly even damage an electronic device if standard electrical signals are being used.

EMI can be generated by the environment or other electrical devices in nearby surroundings; such as electromagnetic noise generated by the power lines at power substations, or a huge generator or motor turning on in a factory floor environment. The use of industrial Ethernet-to-fiber media converters will provide quality data transmission and prevent unwanted electrical noise, because fiber-optics transmit data with light, instead of electric signals.

Damaging surges may be produced by lightning, pumps being turned on or off, the energizing or de-energizing of a transformer, or a power source short. ESD can create sporadic electric energy causing damage to sensitive electronic devices. Electric sparks require a field strength resistance above approximately 4 kV/cm through air to prevent damage. Both surges and ESD can cause a range of harmful effects including gas or coal dust explosions, as well as failure of solid state electronics components such as integrated circuits.

Antaira's industrial Ethernet-to-fiber media converter series are designed with high surge protection in 3,000 volts and ESD protection in 6,000 volts to protect all equipment deployed in these types of environments.

Using Media Converters as Part of the Network

It is not uncommon in industrial facilities to have a small standalone network in a remote location that may need to be networked with the main infrastructure network. Ethernet switches could be implemented although this will be quite costly to use multi-port Ethernet and fiber switches to extend the distance between these locations. Whereas an industrial Ethernet-to-fiber media converter (as below Figure 1.4) between the networks will be a much more cost-effective solution.

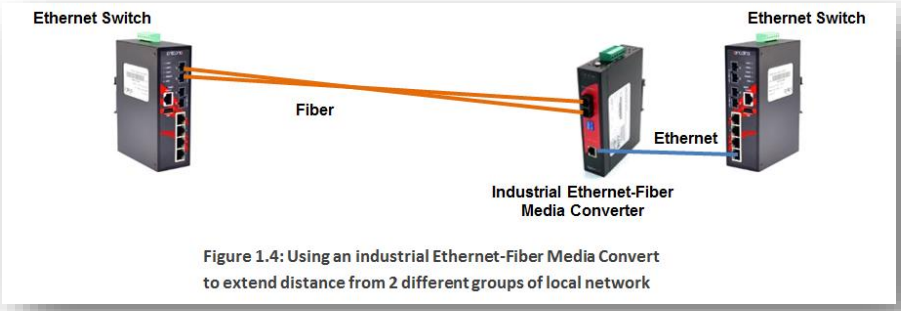

Figure 1.4: Using an industrial Ethernet-Fiber Media Convert to extend distance from 2 different groups of local network

Go Beyond with Ethernet-Fiber Media Conversion – LFP (Link Fault Pass-Through)

Many industrial applications with remote devices use media converters to collect data back to a remote SCADA system. Somehow though, it is difficult for remote SCADA systems to detect if the remote device being monitored has been damaged or has lost the data in transit.

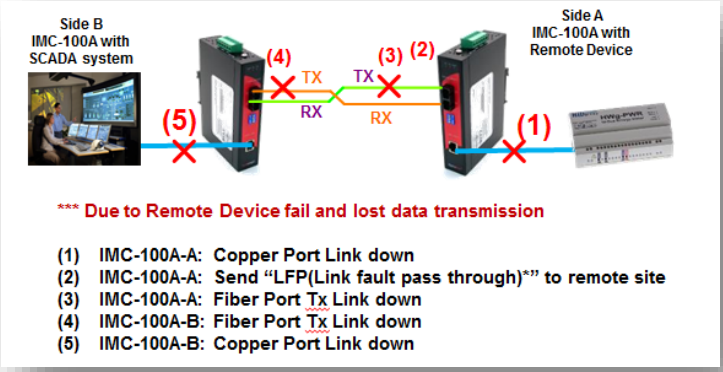

Figure 1.5– LFP (link fault pass-through) Function

Antaira's industrial media converters are built in with a LFP (link fault pass-through) function that can immediately alarm network administrators if there is a problem in the media link and provide efficient monitoring of the network, in order to minimize the loss caused by the link problem. This is done by utilizing the LLF (link loss forwarding) function, which will propagate a failure down the media path For example, the media converter on side A (remote side) has the TP link loss, the media converter will disconnect the transmit link on the fiber. The media converter on side B (local SCADA) will know there is a linkage error and also disconnect its TP link. Figure 1.5 describes the LFP function process with media converters, when a remote device is damaged or fails.

Important Reminder: Using Media Converters in Pairs

In the above Figure 1.5, it illustrates the media converters are being used in pairs. In fact, many engineers disregard this, use only one Ethernet-to-fiber converter, and the "Link Fault Pass-Through" function will not work properly. Using media converters in pairs is necessary for the "Link Fault Pass-Through" function to work properly. In addition, it is highly recommended to choose the same brand and same model when using the LFP function. This is because different vendors can have different types of transceiver wavelengths and may use proprietary protocols to run the LFP function that can cause compatibility issues.

Using the PoE Feature for Restricted Power Source Applications

Today, power over Ethernet (PoE) technology has matured and been adopted by many industries. It has been popular within industries such as transportation and security due in part to their large quantities of video surveillance applications. Industrial automation industry applications such as GigE vision systems and quality inspection systems with high resolution PoE function cameras have been adopting PoE with great success as well.

There are two standard terms in the market for PoE functional equipment that both fall under the PoE umbrella.

- **PSE** (Power Source Device – such as Ethernet switches or media converters) is the equipment that provides source power over Ethernet cables.
- **PD** (Powered Device – such as cameras, VoIP phones, access controllers, or wireless radio devices) is the equipment that requires power through the Ethernet cable to "power" on.

PoE technology was standardized by IEEE with two different levels of standards:

- **IEEE 802.3af** – also known as **standard PoE** in market, dictates that the maximum power delivered by the PSE be <15.4W, and power available at the PD be <12.95W (due to power loss through the cable).

- **IEEE 802.3at** – also known as **PoE+** in the market, dictates that the maximum power delivered by the PSE be <34.2W, and power available at the PD be <25.5W.

There are various PoE power output levels from different manufacturers in the market and the typical PSE manufacturers in the market are providing the maximum power delivery of 15.4W with standard PoE function, and 30W for PoE+.

Industrial PoE media converters allow for distance limitations beyond 100M to be overcome as well as being able to provide power to a device that is in an isolated location. For example, a single security PoE camera in a parking lot, a PoE wireless radio (i.e. company modem) on the top of a street post, a traffic monitoring PoE camera at the top of a traffic signal light are all remote and require a power source. By using a PoE media converter to provide data + PoE power at the same time can quickly and cost-effectively implement these PD's to a network and extend distance via fiber back to a remote control center.

Another point that requires additional attention when using PoE devices is that there are two different wiring standards:
What mode of wiring (Mode A or B) is used for the power being sent along the Ethernet cable, and
What standard PD is being used (IEEE 802.3af or 802.3at)?

As a friendly reminder, users are required to take into account the power consumption required from both the PSE (switch/media converter) the PD (i.e. PoE camera or wireless radio) to decide how much wattage the power supply needs to provide to support the PoE device and media converter. Please also keep in mind that power supplies have what is known as an output de-rating curve; as the ambient temperature increases the power supply will provide less total wattage.

Conclusion

The greatest benefits of using Antaira's industrial Ethernet-to-fiber media converters is that they provide effective data extension for large distances and provide EMI prevention with fiber-optics, high surge and ESD protection for the equipment, and long MTBF >450,000 hours on average. Flexible option models for data rate and PoE solutions are also available. Furthermore the units are compact, cost effectively designed to be slim in order to save valuable space within enclosures. Utilizing the LFP (link fault pass-through) function with Ethernet-to-fiber media converters is a great solution to any industrial automation application in order to alert remote SCADA systems or network administrators to take immediate action for any failure of a remote device. When utilizing the LFP option please keep in mind to activate the LFP function by:

1. Always using a pair of units with the same brand and model to avoid any compatibility issues
2. Testing the function before actually implementing it to remote sites

About Antaira Technologies, LLC

Antaira Technologies is a leading manufacturer and supplier of industrial device networking and industrial communication products. Antaira's turnkey industrial network connectivity solutions include industrial Ethernet switches, industrial Ethernet media converters, industrial wireless, and industrial serial communication, and provide reliable communication amongst the specialized devices and protocols in various industrial applications.