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888-722-5625

# The cabling must fit for the next 20 years

By Bob Tarrant, business development manager  
BTR division, RIA CONNECT Inc., Tinton Falls NJ

## Network technology in harsh industrial environment - an example of a water treatment plant

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s the de facto standard crossing over from the IT field of use, Ethernet technology is becoming more and more important to consider for factory floor cabling systems as business requirements demand integration of manufacturing systems with the existing LAN / WAN infrastructure.

Recent positive field experiences and the creation of new devices designed for improved industrial communication increasingly strengthen the demand for Industrial Ethernet technology. Ubiquitous today as a common network protocol for office communication systems, it follows that virtually unlimited solutions and products based upon Ethernet communication standards will be developed for the converging office and industrial network.

While we should expect that special interest groups will continue working for some period of years to perfect the forthcoming ISO/IEC standard 24702 for Industrial EtherNet/IP, we are able to define today the passive Ethernet infrastructure – the physical wiring and associated connectivity solutions – which can be installed with a suitable network topology in order to plan and develop a future-proof Industrial Ethernet network. From the example of a water treatment plant, basic conditions and requirements for the Industrial Ethernet physical layer (PHY) are considered here.

Prediction of the future direction of the basic wiring is highly dependent upon the expectation that bandwidth requirements for industrial networks will grow enormously, perhaps exponentially as our colleagues from IT can readily attest. Industrial planners concerned with network design and the wiring infrastructure should therefore consider this carefully. The increasing demands on network communication over time depend substantially upon two megatrends. On the one hand, as microprocessor costs are reduced, a continuous increase in the volume of data one must count increases with the increasing number of intelligent field devices and M2M networks being deployed and integrated with the office LAN / WAN network.

On the other hand, as the standardization effort for the Industrial Ethernet TCP/IP application evolves, parallel Ethernet services (as in the OSI 7-layer model) beyond what exists today in the office standards are certain to further increase the volume of data. The overall result is that the number of Industrial Ethernet ports installed is expected to increase by about 6 times over the next 5 years (source: ARC Advisory Group, 2005) and, bandwidth requirements for these ports will be even faster in the future.

As one transfers these established trends to application inside a water treatment plant, it quickly becomes clear that it is important to consider within the scope of network planning and design, the long service life expected from a water purification plant – 20 years or even more! The basic wiring must deliver as much future security as possible to ensure the limitations in current knowledge relating to evolving standards and future network expansions do not render today's investment in the cable plant as inadequate, thus limiting the service life of the facility. Further, it must be guaranteed that future recording requirements due to forthcoming regulations can be merged into the existing data network infrastructure without loss of operating capability.

## Current standardization efforts at International Standards

Organization/International Electrotechnical Commission (ISO/IEC) provide a very good starting place for a concept of ruggedized design in structured cabling (see Figure 1). In addition, the successful concepts

from the IT office environment, such as star topology, form the basis of the cabling concept in the water treatment facility. The 3- or 4-step hierarchical star structure which is described in the upcoming ISO/IEC standard 24702 especially makes sense in a widely dispersed application such as a water treatment plant remotely located in a multi-use facility on a large piece of land (see Figure 2).

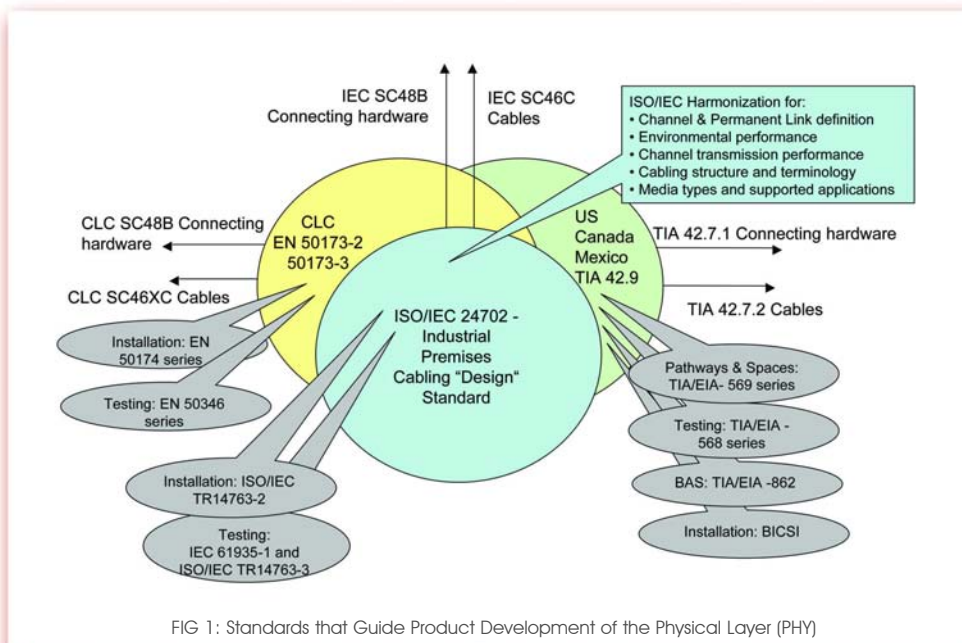


FIG 1: Standards that Guide Product Development of the Physical Layer (PHY)

This design ensures that remote points of the plant can be supplied with network connections and still be guaranteed coverage by the entire IT network infrastructure. Considering the large number and diverse types of electrical signals, and the commercially available range of sensors and remote field devices for a water treatment plant, proper design of an industrial network is a real challenge. To extract the most value from remote devices, the availability of a decentralized control network is essential. In addition, it is an important requirement to be able to provide redundant paths to the network without large expenditure.

The combination of floating output and balanced copper twisted pair Cat. 6 Ethernet cable can be used depending upon specific site conditions, such as distance. A traditional floating output solution is often preferred over longer distances to a single remote device and this still makes sense. Another limitation in copper Ethernet cabling is application to areas that require a lightning protection system. Note here that there is a major trade off in the possibility of ground potential differences due to traditional lightning protection methods, and there could be a resulting loss of signal integrity and/or some increased noise.

For that reason, it could make sense situationally to consider Ethernet over fiber optic cabling for the longer runs to a remote area, such as a water treatment site, that requires network power and redundancy. The relatively more economical twisted pair over copper technology in Cat. 6 Ethernet network designs has advantage in all other situations for application inside the remote site cable plant and additionally offers important transmission power reserves due to the high bandwidth of up to 250 MHz. (Editor's note: the increased 500MHz bandwidth as specified by the newly ratified IEEE 10GBase-T standard was not considered at the time of this writing because the standard is not yet published).



FIG 3: IP67 mount hardware with plug side locking clamp



FIG 4: DIN rail mount hardware with dust cover

## Industrial rugged network connection components

Apart from the topics such as network topology, redundancy and volume of data, the extended requirements for our water purification plant example should also consider the performance of network connection components. Perhaps most obviously, the components must withstand extreme variations in temperature as well as exposure

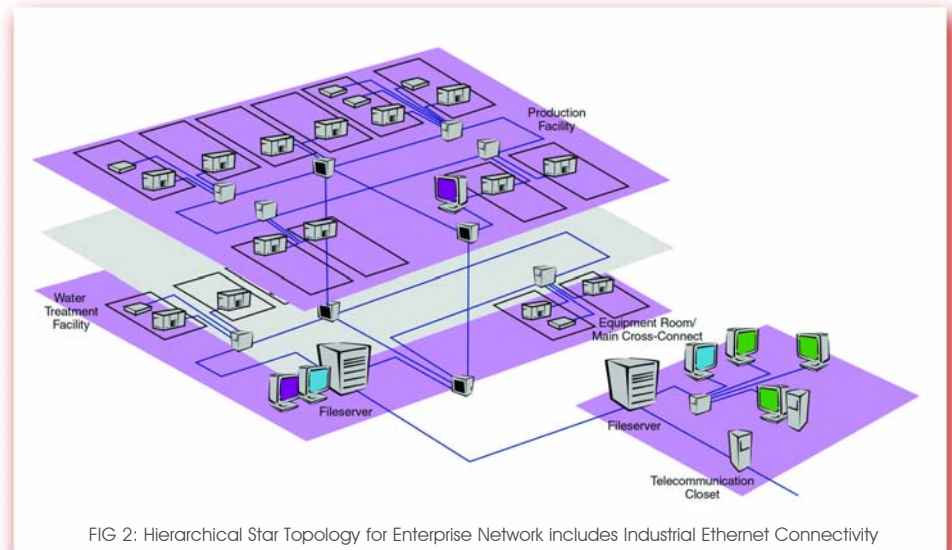


FIG 2: Hierarchical Star Topology for Enterprise Network includes Industrial Ethernet Connectivity

to UV radiation. Just as important is the protection from contamination due to moisture and dust, which must also be guaranteed both in the connected and unconnected position. Also meaningful is an appropriate mechanical robustness, because a damaged data box in the field can have serious consequences for the plant operations group a few years down the road.

Often the assembly location of the data connection points is very different in the plant environment (compared to the office environment) and the remote data connections must meet enclosure ratings, such as NEMA 4X, IP 44 and IP 67 (see Figure 3). Another major difference in the plant environment is the installation cabinet in the control room; normally IP 20 mounted on a DIN rail will serve the purpose in a 19 inch rack mounting in a control room environment (see Figure 4). These types of control cabinets and special-purpose environmentally rated housings provide an excellent environment for local consolidation points using Cat.6 insulation displacement connection (IDC) technology.

In many industrial applications no such 19 inch machine distribution cabinet is available and the connection and distribution components are to be accommodated, if possible, within the existing store of industrial housings. These housings may or may not offer a DIN rail as a mounting option. The space for this type of machine distributor or consolidation point is usually severely limited therefore, small connection components must be used along with some custom design IP44 and IP67 wiring boxes (see Figure 5).

During the installation and construction phase of the network, simple make

up and assembly of the connection system plays a fundamental role in the performance of the network cabling system. Often, the installation crew handling the field termination components is the difference between a trusted network connection, or a network connection that is never trusted. A constant, consistent mounting technique brings clear advantages for the Installer and ultimately, the end user. For this purpose, easy-to-use field termination connectivity systems rated for Cat. 6 or better that are based upon insulation displacement connection (IDC) technology are available (see Figure 6). Designed for use with no special tools, these modules promote safe handling and reduced labor costs during the installation phase of the network project.



Figure 6: E-DAT Field Termination Module with RJ45 to Insulation Displacement Connectivity (IDC). T568A Wire Color Code shown here. Shield Connectivity Spring Provides Equipotential Bonding to DIN Rail Grounding Clips (see Figure 4).



FIG 5: IP44 Mount Hardware with Lock

BTR NETCOM GmbH develops and manufactures network components which can be installed without special tools and can be used in more than 20 different application systems.

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