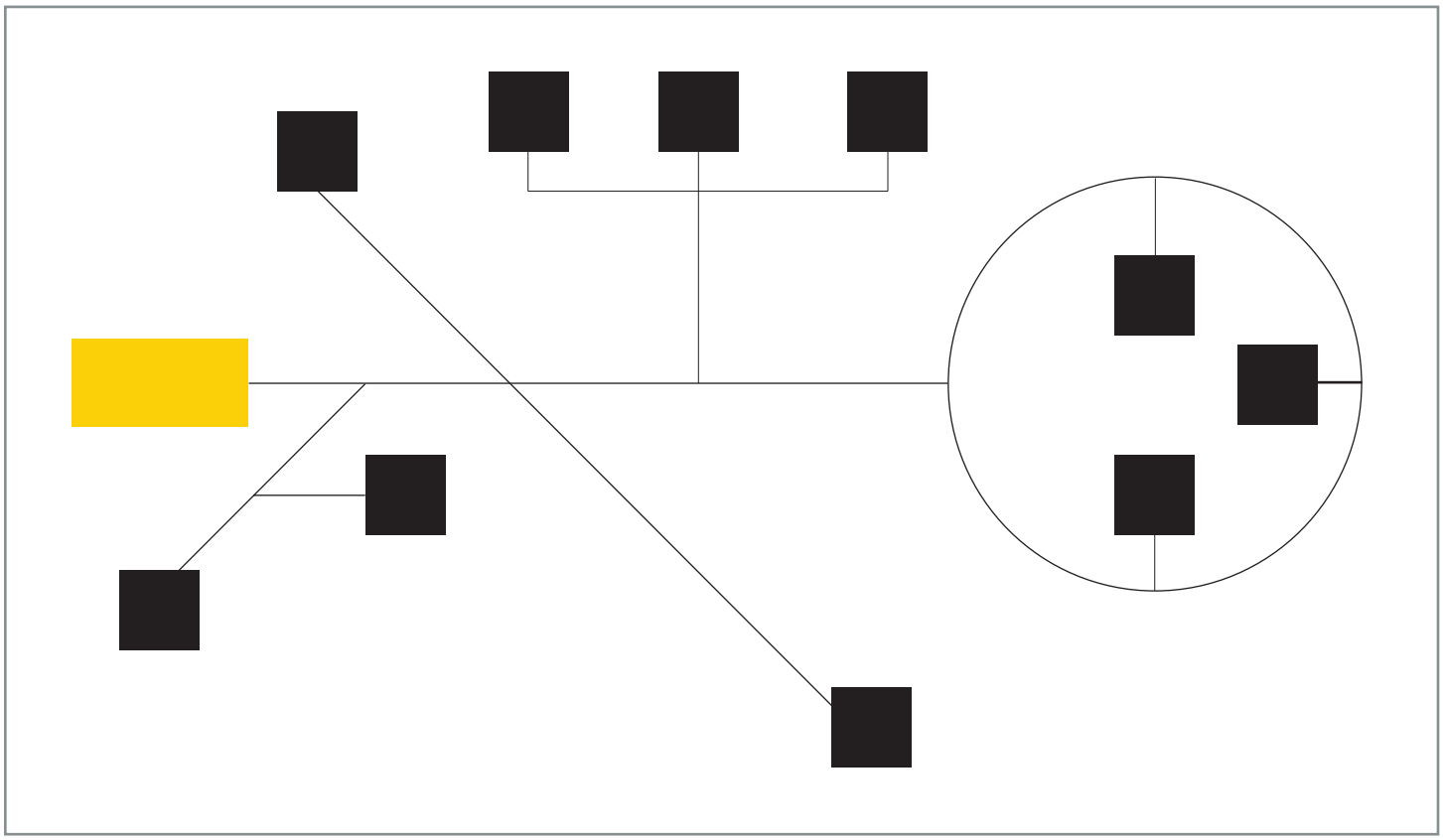
ECHELON®



Free Topology: Wired and Worry-less

Introduction

In the world of connected devices within Control Networking and as it transitions into the Industrial Internet of Things (IIoT) the need for wired communication has a long standing history and a bright future even as wireless communication gradually is adopted in this demanding environment. The IIoT is a special community of "things" that have a mission to monitor, control and faithfully serve the purpose of safe and optimal utilization of high value industrial and commercial assets such as buildings, factory equipment, public transportation, street lights, delivery of health care, electricity and other utilities and many more critical services and operations that we rely on daily. Most of these high value assets stay in commission for very long periods, in many cases under harsh environmental conditions while needing reliable communication throughout their life time. They have a need to be monitored and controlled reliably and securely by accompanying control devices and networks that can operate without the need for human intervention. It is not surprising that under such uncompromising requirements wired connectivity has been and will continue to remain the dominant method for creating IIoT control networks just as it is for conventional IT networks.

The Technology

Free Topology, conforms to the physical layer ISO/IEC 14908-2 Free-Topology Twisted Pair Channel Specification and addresses the unique connectivity requirements for IIoT control devices better than any other wired or wireless physical layer alternatives. With over 40 million Free Topology end points in service over couple of decades, running flawlessly in buildings, elevators, HVACs and numerous other control applications it is the proven and reliable workhorse of this industry. It runs on inexpensive unshielded or shielded twisted pair wires and supports a 78,125 bps bit rate. Data is transmitted using differential Manchester encoding, which is polarity insensitive. A Free Topology channel consists of up to 64 devices on a single network segment; or 128 devices along with a link power source, which supplies DC power to the devices on the channel. The Free Topology channel is singly terminated when used in an arbitrary topology. When the Free Topology channel is used in a bus topology, typically to achieve long distance, it is then doubly terminated. Distance limitations vary based on the topology (free or bus), and the type of cable used. For example, using a TIA Cat 5 unshielded twisted pair cable maximum wire length is 450m using a Free Topology, and up to 900m using a bus topology.. Using Belden 85102 cables and a doubly terminated bus topology, the maximum wire length can be 2700m. The total network length and number of devices may be extended by the use of routers, and/or physical-layer repeaters.

A conventional control system using bus topology wiring (such as RS-485) consists of a network of sensors and control outputs that are interconnected using a shielded twisted wire pair. In accordance with RS-485 guidelines, all of the devices must be wired in a bus topology to limit electrical reflections and ensure reliable communications. Additionally the shield MUST be terminated at all the nodes, and the two communications wires are polarity sensitive, hooking them up backwards in any one of the many nodes on the bus will create unreliable communications. In the case of Ethernet there is a need to install switches or hubs in a star topology with many restrictions on topology to avoid the creation of loops. The standard RJ-45 connectors require special tools and training to correctly terminate the cables. Thus there is a high cost associated with installing and maintaining the cable plant that links together the many elements of an RS-485-based or an Ethernet based control system. Bus topology wiring is more time consuming and expensive to install because the installer is unable to branch or star the wiring where convenient: all devices must be connected directly to the main bus. In the case of Ethernet all devices must connect to a switch or hub which adds cost and wiring constraints. Free Topology provides an elegant and inexpensive method of interconnecting the different elements of a distributed control system. The free topology architecture allows the user to wire the control devices with virtually no topology restrictions. Power is supplied by a local +5VDC power supply located at each node as shown in Figure 1.

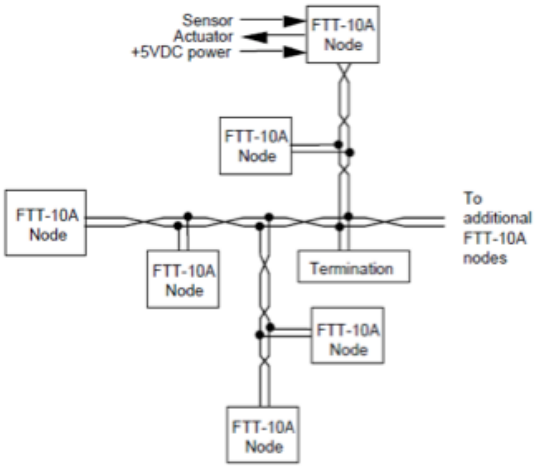


Figure 1: Free Topology System

Unlike bus wiring designs, free topology wiring supports star, loop, and/or bus wiring (figure 2). This design has many advantages. The installer is free to select the method of wiring that best suits the installation, reducing the need for advanced planning and allowing last minute changes at the installation site. If installers have been trained to use a particular style of wiring for all installations, free topology technology can be introduced with-

out requiring retraining. Retrofit installations with existing wiring plants can be accommodated with minimal rewiring, if any. This capability ensures that Free Topology can be adapted to both old and new projects. Finally, Free Topology permits systems to be expanded in the future by simply tapping into the existing wiring where it is most convenient to do so. This reduces the time and expense of system expansion, and keeps down the life cycle cost of the free topology network.

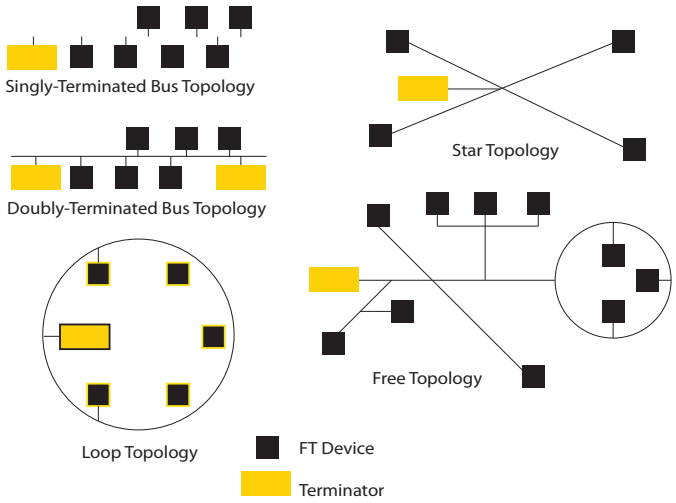


Figure 2: Typical Wiring Topologies Supported by a Free Topology System

Evolution

Free Topology when combined with LONWORKS® or IzoT™ control networking allows a simple and easy way to create peer-to-peer communities of control devices. Echelon's newest IzoT compatible FT 6050 Smart Transceiver integrates a Free Topology transceiver along with the Neuron core to create highly compact and reliable IP enabled control devices. Control devices and networks developed with Echelon's IzoT platform allow for the very first time, a number of new capabilities to run over Free Topology.

- Multi-drop IP: Free Topology can now be a multi-drop IP network preserving all its benefits of unrestricted topology, noise immunity and high reliability while carrying IP addressing down to individual control devices in the fieldbus.
- Multi-Protocol over Free Topology: Both native IP enabled LonWorks and BACnet/IP protocols can now be implemented within the same device as interchangeable personalities and these multiple protocols can be carried over the same Free Topology network.
- Coexistence of Control with Enterprise Computing: Utilizing IzoT Routers from Echelon, Free Topology based devices and networks can be part of a broader community of connected IP devices running over varied media and protocols such as Ethernet or WiFi or Meshed RF (802.15.4). The predicted deluge of Big Data that will be generated by control end points connected by Free Topology can now be networked seamlessly with traditional IP networks and enterprise computing resources, presumably where such BigData is best acted upon.

The Future

The world of control networking is undergoing an exciting transformation into the Industrial Internet of Things. Much of what is needed for the future of controls must be borrowed from the past and combined with the world of IP, BigData and Cloud computing and Echelon is uniquely endowed in building this transformation as it unfolds.

For more information visit: ***iiot.echelon.com***