

Why Use Industrial Ethernet Switches?

1. Benefits of Industrial over Commercial Switches

Industrial Ethernet Switches are designed to operate in plant floor environments. The specifications of Industrial Ethernet switches (temperature, shock, vibration, etc.) meet or exceed the equipment being connected (PLC's, Ethernet I/O, HMI's, etc.). Most commercial Ethernet switches have commercial temperature ratings (0-40C), and do not publish shock and vibration specs. Most Industrial Ethernet Switches are rated for a minimum of 0-70C operation, and have excellent shock & vibration specs.

In addition, Industrial Ethernet switches are housed in rugged industrial style steel enclosures using Din-Rail or panel mounting. Most commercial switches and media converters cannot mount conveniently inside equipment enclosures.

Another added benefit derived from using Industrial Ethernet switches is redundant power inputs. Commercial switches rely on a single power supply to power the switch, while Industrial switches typically run off DC power, and have redundant power inputs. This allows the weakest link (the power supply) to have a hot standby back up, insuring maximum up time.

Industrial Ethernet switches carry a Class I Div 2, group ABCD rating while the commercial counterparts do not. This allows the Industrial Ethernet switches to operate where explosive gases are being used (very typical for industrial applications).

2. Alternatives

Because Ethernet has been available in the office environment long before industrial Ethernet equipment existed, the equipment is well known for its performance and reliability and low cost. Quite often, when companies evaluate the technology, they do not examine the alternatives of purchasing Industrial Ethernet Switches versus commercial switches and routers. However, In this instance, the evaluation is simple. Fortunately, Industrial Ethernet switches provide advantages over the 4 primary alternatives being used. All of these alternatives utilize commercial Ethernet switches and hubs, and are listed below:

- **Wire all connections to a climate-controlled environment.**

In this scenario, the customer will place commercial network equipment in a climate-controlled environment and run cable to every industrial Ethernet node. This is very costly and decreases reliability. Industrial Ethernet switches offers the opportunity to eliminate significant, expensive wiring efforts when compared to this approach.

- **Build climate-controlled environments in harsh areas.**

In this scenario, the customer, to reduce wiring costs, will build a climate-controlled environmental enclosure to house commercial equipment in a harsh environment (i.e. Nema 4 enclosures with Peltier coolers and bulkhead-mounted connectors). This is very costly and increases the number of components that can fail. Industrial Ethernet Switches can be installed directly in harsh locations, thus eliminating the need for expensive climate-controlled enclosures.

- **Simply use commercial equipment without regard to environmental mismatches.**

This is an alternative, but not a very good one. In this scenario, the customer utilizes commercial equipment in the harsh environment. This equipment is not rated for these environments and will probably fail and/or decrease the reliability of the system. In our discussions with customers utilizing this alternative, it was only implemented because they were not aware that industrial grade equipment was available. They are very open to utilizing Industrial Ethernet Switches.

In addition, many commercial switches use cut-through techniques, and can propagate bad packets on the network. However, Industrial switches use store and forward technology that perform CRC (cyclic redundancy checks), and insure the data integrity of any packets being forwarded.

- **Utilize Hubs instead of Switches**

While hubs are cheaper than switches they do not eliminate collisions, and hence create determinism issues associated with Ethernet Networks. The following discussion illustrates the basic difference between switches and hubs.

Difference between Ethernet Switches and Hubs

A hub, also known as a repeater, is a simple device that connects Ethernet nodes. Hubs forward data packets they receive from a single workstation to ALL ports. All users connected to a single hub or interconnected hubs share the same bandwidth. As nodes are added to the network, they compete for a finite amount of bandwidth (typically 10 or 100 Mbs). Therefore, data collisions are guaranteed when a hub is used and network determinism (the ability to guarantee a packet is sent/received in a finite amount of time) is impossible. This is the primary reason Ethernet has historically not been accepted in control applications. Most control systems have a definite time requirement for packet transmission (< 100ms). This cannot be guaranteed with a hub and is especially if the network is busy. You can imagine the problems this can cause in a mission critical control application.

This is analogous to a single lane road. You cannot get onto the road until traffic is clear. With a hub, you cannot send a packet until network traffic is clear.

Another analogy is a party line phone. If you shared a party line phone with 8 users, anytime any of the users received a call; your phone would ring. All users would have to answer to determine if the call was for them. In addition, no other user can use the phone while someone else is using it.

An Industrial Ethernet Switch, is a more complex device with built in intelligence to connect Ethernet nodes. The switch eliminates the problem of network determinism by providing full bandwidth with storage to a node or group of nodes. The switch eliminates all collisions that typically make Ethernet nondeterministic. A switch sends data only to the appropriate network port or segment, not the entire network as a hub does. The switch forwards data based on the MAC address (unique for each hardware device on the network) contained in the data packet. The switch must store the MAC addresses of every device it communicates with, requiring high-speed dual ported SRAM (hubs have no memory requirements). The switch determines the location of each node and establishes a temporary connection between itself and the node and terminates once the packet is transferred.

Using our highway analogy, we have turned the single lane road into an 8-lane highway. A lane can be dedicated to mission critical nodes insuring traffic can always get through in a pre-determined time.

Using the phone analogy, your phone rings only when the call is for you and you can use the phone when other people are using it.

Summary

In summary, an Industrial Ethernet Switch increases network bandwidth and provides network determinism for Industrial control applications, and provides the most cost-effective solution for industrial environments.