Connected Factory PROFINET

PROFINET is an all-encompassing industrial Ethernet protocol, which has evolved from the history of widely used industry protocols, such as PROFIBUS, using several common features. Real-time communication between industrial automation devices aligns PROFINET's abilities with modern manufacturing application needs.

The Cisco® Connected Factory - PROFINET Cisco Validated Design (CVD) integrates many of the benefits of PROFINET, including the protocol's open platform model, which allows Cisco to produce PROFINET-certified switching products. Profinet International (PI) certifies Cisco's compliance with PROFINET standards, while the product platform's performance is captured in the CVD "Connected Factory - PROFINET." PROFINET uses standard Ethernet frames, which are readily supported on Cisco Industrial Ethernet (IE) 2000, 3000, 4000, and 5000 Series Switches, shown in Figure 1.

The Media Redundancy Protocol (MRP) is an industry-standard network resiliency protocol within PROFINET networks, defined within the International Electrotechnical Commission (IEC) 62439-2 standard, supported in Cisco Industrial Ethernet 2000 and 4000 Series Switches. Within the Connected Factory - PROFINET solution, MRP enables rings of compliant industrial Ethernet switches to overcome a single segment failure with recovery times much faster than those provided by traditional Spanning Tree Protocol (STP) methods. MRP, and Cisco's own Resilient Ethernet Protocol (REP), are both recognised within the Connected Factory - PROFINET solution as suitable for PROFINET-based industrial automation applications and natively supported within select models of the industrial Ethernet series switches.

Resilient Automation Network Infrastructure

The Connected Factory - PROFINET solution provides a perfect match between the PROFINET protocol and MRP-based resilient network architecture. PROFINET-based industrial automation applications are time sensitive; network services, applications, devices, and equipment are each dependent upon command and control traffic delivery within very tight time constraints for network-induced delay.

Cisco's PROFINET-specific architecture includes design guidance to achieve real-time PROFINET communication, network resiliency, and requirements for industrial automation at the manufacturing plant floor.

The Cisco Connected Factory - PROFINET solution defines a resilient network architecture for industrial automation applications and devices running on the plant floor, utilising the MRP protocol as the ring's state-aware protocol. Each of the validated PROFINET architectures consists of industrial automation devices, such as robots, sensors, actuators, and drives. PROFINET-compliant human-machine interfaces (HMIs) are validated within the Connected Factory - PROFINET architecture, providing operators with visual status reports and control of local industrial automation devices. Controllers, such as programmable logic controllers (PLCs), and distributed I/O devices are also validated within the Connected Factory - PROFINET architecture.

The Connected Factory - PROFINET architecture establishes strict traffic segregation, protecting industrial automation applications from external and internal interruptions. Disruptions in the control network, even in time spans as small as milliseconds, create the greatest effects on the functioning of the production facility. Network resiliency is the primary consideration within the Cisco Connected Factory - PROFINET architecture, as shown in Figure 2.

Connected Factory - PROFINET Solution Benefits

Cisco presents a PROFINET architecture designed to reduce risks to production downtime through the use of a resilient network architecture capable of network convergence times based upon trusted IEC 62439-2 standards. Through the implementation of a validated architecture, improved plant uptime is achieved from a focus on industrial automation application availability. A validated architecture is capable of reliably communicating critical information from machines and applications through better-managed network resources. Device management compliance utilises industry-standard General System Description (GSD) files and supervisor applications for Cisco Industrial Ethernet PROFINET-compliant switches.

Industrial Automation Approach

The Connected Factory - PROFINET architecture provides network resiliency to devices, equipment, and applications found in an industrial automation environment. Industrial automation requirements frequently differ from those of a typical IT network. The Connected Factory - PROFINET solution architecture is based upon industrial automation applications and related devices' specifications, unlike enterprise applications, which often accept best effort network performance.

The Connected Factory - PROFINET architecture is based upon a dual-layer approach; the lower layer, or cell/area zone (level 0–2), is where most of the real-time PROFINET traffic moves between industrial automation devices. The upper layer, or manufacturing zone, acts as an aggregation point for one or more cell/area zones.

Although the Connected Factory - PROFINET architecture utilises standard Ethernet, which is the basis for a typical IT network, industrial automation devices commonly have unique dependencies, which drive design considerations based upon the needs of the industrial automation applications themselves.

Design Considerations

The cell/area zone is the primary region of the plant where industrial automation activities are performed; it is important to consider this zone as an isolated entity of the manufacturing environment. Network availability and performance are the most important considerations when designing an industrial automation network that supports the cell/area zone.

Supporting an industrial automation network requires a different skillset than those found in an IT network; persons with traditional IT background should consider formal training courses in industrial Ethernet technologies to improve how the operations and IT organisations interoperate.

Prior to the deployment of the industrial automation network, several industrial Ethernet–oriented design considerations should be made, including the characteristics of all PROFINET devices utilising the industrial automation network. Interconnectivity and interoperability between all industrial automation devices, including applications that might reside outside of the cell/area zone, such as a historian, remote access, network security, and access control, are each taken into consideration within the Connected Factory - PROFINET architecture. Factors including real-time communications, availability needs of the industrial automation applications, and placement of MRP-capable devices each have an influence in the operability of the network. Consideration is also given to the manageability of all devices within the cell/area zone, including the industrial Ethernet series switches.

Resiliency and Industrial Automation

Choosing the right network convergence protocol is based upon the industrial automation application and hardware dependencies. Other factors, influenced by application and hardware, include failover time requirements, topology

limitations, and requirements imposed by the use of the PROFINET I/O protocol itself. The Connected Factory - PROFINET architecture validates two different convergence methods, both of which support PROFINET automation traffic.

Media Redundancy Protocol (MRP)

PROFINET-compliant industrial Ethernet switches support two roles within an MRP ring. In a ring topology, only one switch or industrial automation device can act as a media redundancy manager (MRM), and all other devices will act as the media redundancy client (MRC). The purpose of the MRM is to keep the ring loop free and provide redundancy when failure happens. The MRM does this by sending control packets from one ring port and receiving them on its other ring port.

Resilient Ethernet Protocol (REP)

The Connected Factory - PROFINET architecture includes PROFINET communications within a REP converged topology. Cisco's REP utilises a ring network topology as core to the convergence process. Each ring segment is a collection of Ethernet ports chained together. As with MRP, the ring is defined by the administrator, who architects the network configuration. The REP protocol, like MRP, runs only on defined interswitch segments, producing minimal traffic, while allowing for maximised industrial automation traffic network access.

Summary

When selecting a resiliency technology for a PROFINET deployment, industrial automation applications and device factors each influence how the network is to be deployed. The Connected Factory - PROFINET CVD provides design and implementation guidance with resiliency, performance, uplink media type, tolerance, latency, and jitter each considered. The Connected Factory - PROFINET solution presents a PROFINET- compliant architecture, based upon PROFINET International–certified products, supporting overall plant uptime and sustained productivity. Industrial automation applications drive the selection of hardware, which supports the application's performance needs. The underlying resiliency technologies supported by Cisco Industrial Ethernet Series Switches help to serve the application's availability needs. The Connected Factory - PROFINET architecture is designed to meet industrial automation application, device, and production needs to realise maximum productivity potential.

Amplicon

Amplicon has operated in the Factory Automation sector for decades and offers the full Cisco Industrial Ethernet switches range.

Call our trained Sales Engineers to discuss your requirements, the application, and the best solution to ensure your infrastructure is future-proofed, reliable and fit-for-purpose. You can also visit the Amplicon website: https://www.amplicon.com/Data-Comms/ to review a range of products to enable full Factory Automation.