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The Importance of Reference Architectures in Manufacturing Networks

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Technical Track

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What is a Reference Architecture?

An architecture is the fundamental organization of a **system**, the **relationships** between its **components** and the environment, and the **principles** governing its design and evolution

Why Reference Architectures for Manufacturing?:

- **Factory networks have somewhat unique considerations from traditional Enterprise IT environments**
 - ▶ Unique protocols & use of multicast traffic
 - ▶ Determinism and real-time requirements
 - ▶ Different availability, security, and safety considerations
 - ▶ Physical requirements – driving unique products & topologies
 - ▶ Need to provide & control vendor access
 - ▶ Often decision making outside IT control – although often influenced by IT
- **Existing architectural models don't address these concerns**
- **Significant growth in Ethernet based automation protocols driving the need for specific switching & routing, security, and wireless design guidance**

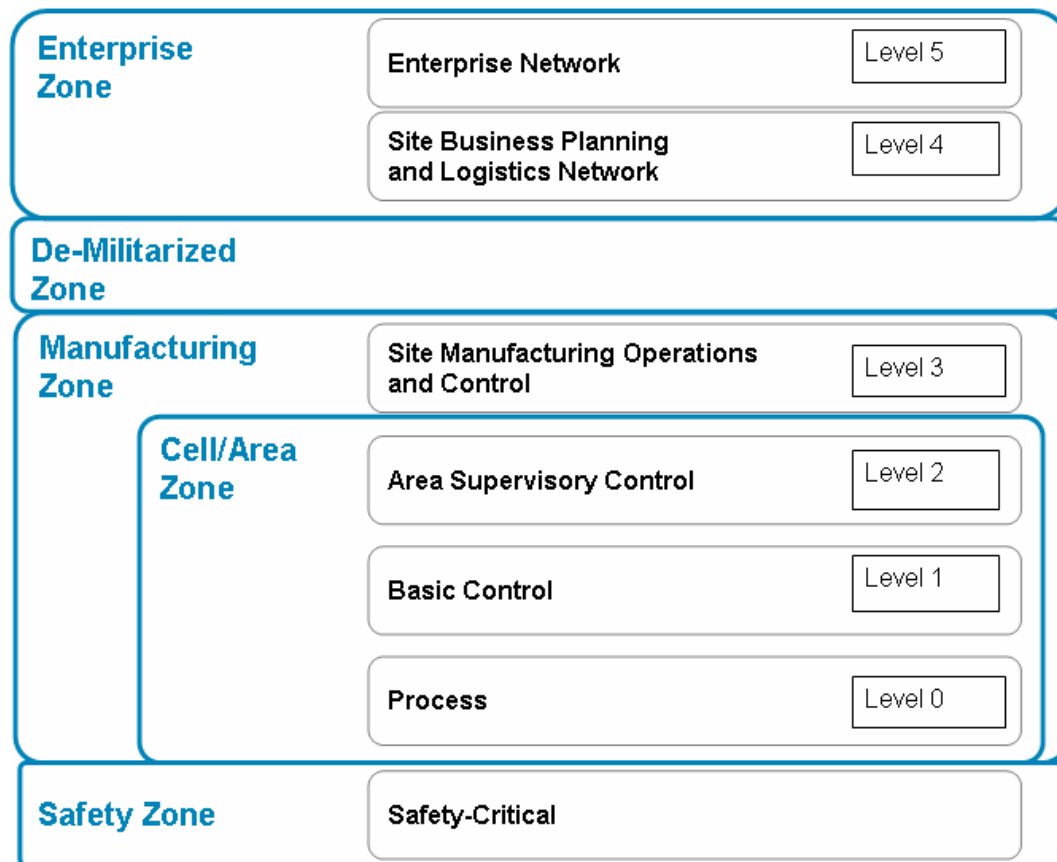
Key Benefits

- **All involved parties can increasingly focus on a common solution which**
 - ▶ Reduces risk of deployment by relying on known and tested solutions
 - ▶ Simplifies decision making
 - ▶ Enables more re-use
 - ▶ Provides consistent models, capabilities, and equipment
 - ▶ Helps customers buy solutions to meet their business issues, rather than components and left to put the pieces together themselves
 - ▶ Improves service and support by relying on proven solutions and a reference within which to work
- **A focal point on which vendors and partners can:**
 - ▶ Educate their field, partners and market,
 - ▶ Provide best practices and guidance that will enable consistent design and implementation standards
 - ▶ Direct their solutions and support to provide better service
- **Customers Realize significant cost savings.**
- **Bridge cultural gaps between organizations (e.g. IT and Production) bringing the expertise and knowledge of each together**
- **Enable continuous innovation by designing with the future in mind**

Key Attributes of a Ref. Arch.

- **Compatibility** with the unique industrial protocols
- Determinism and real-time networking **performance requirements** of automation and control applications usually defined as latency, jitter and minimal packet loss
- **Availability** of the automation and control systems and the network has a direct correlation to the operational efficiency of a production facility
- **Manageable** by a group of people that are not trained or experts in network technologies or administration
- **Logical Segmentation** that safely and securely integrates the isolated networks of the production facility with the Enterprise and external networks to share data, services and access
- **Security** is always critical and even more so when the integrated network introduces the security risks of the Internet and enterprise network to the control system
- **Scalability** to meet the widely varying sizes of production facilities and the growth they may go through
- **Physical Constraints** of the production floor

Framework for an Automation & Control IE Network



- Enterprise Zone for IT networks
- DMZ as a buffer zone to securely share data & services
- Manufacturing zone where critical production floor systems exist
- Cell/Area zone where devices and controllers reside

- Concept of Levels from Purdue Reference Model & ISA SP95.
- Concept of Zones from ISA SP99

An example Network Architecture

Design and test with the following in mind:

- Hierarchical approach to segment key network functions
- Security built-in
- High-availability options described
- Multiple topologies
- Network services configured
 - ▶ multicast management (IGMP),
 - ▶ Quality of Service (QoS),
 - ▶ Availability (e.g. Spanning Tree),
 - ▶ VLANs for segmentation
- Expandable for future functions

