Design and Implementation Guide for Using Integrated Motion on EtherNet/IP

Allen-Bradley

Overview

The benefits of networked machines and equipment, lines, and factories are well-known, however the nature of networking has led to some complex scenarios.

Motion control brings a need for real-time synchronization to the network, but you may not always need a managed switch with Quality of Service (QoS) and CIP Sync on each machine. When linking multiple automation cells or machines together, however, a managed switch with QoS and CIP Sync must be used.

This guide is intended to help balance the needs of the application with the various network components.*

Guidelines

How can real-time applications be accomplished over a non-deterministic network like EtherNet/IP?

- Each time-sensitive device has its own internal clock, accurate to the nanosecond level
- These clocks are synchronized and tuned to a master clock over the network once per second
- This update mechanism is known as CIP Sync and is part of the IEEE 1588-2008 standard for time synchronization
- CIP Sync is designed to account for real-time latencies in the network and to allow the devices to ride through master clock changes

How is motion control accomplished over standard EtherNet/IP?

- The clocks in the servo drives are coordinated to the master clock using CIP Sync
- A packet of information is sent out to each drive in advance of when it is needed, so the drive can receive it and execute it when required
  - Think of these packets as “meeting invitations” with a location and a time, representing the key position and timestamp coordinates for the axis
  - This information may be received by the drives at random times due to network loading, but because they are sent in advance, the axes still arrive in their coordinated positions at the precise time
- The drive further interpolates its position between these points to ensure smoothness

* A more detailed guideline can be found in chapters 8 and 9 of the Converged Plantwide EtherNet/IP (CPwE) Design and Implementation Guide: http://literature.rockwellautomation.com/idc/groups/literature/documents/td/enet-td001_-en-p.pdf

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Guidelines *(cont'd.)*

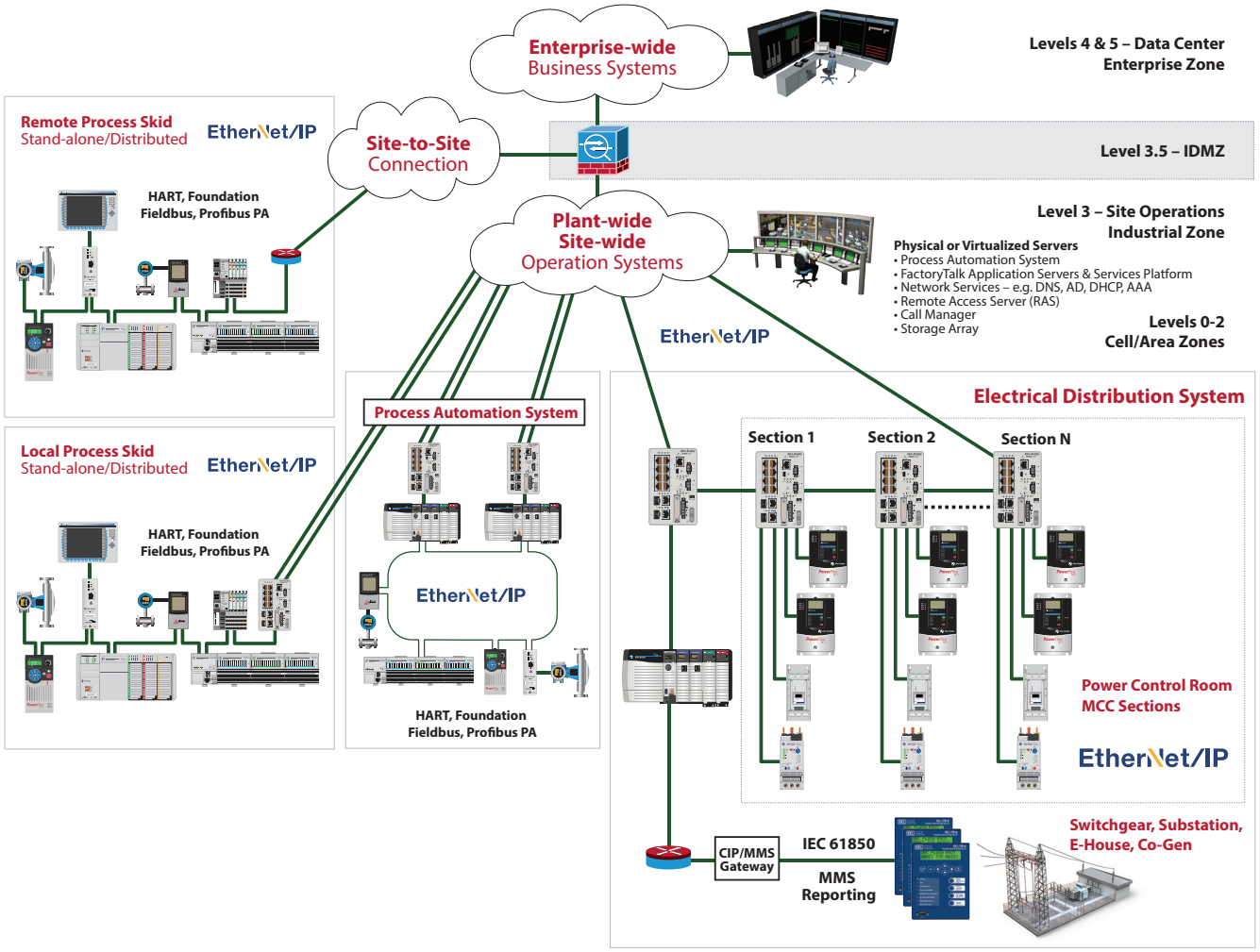
What could cause these time-sensitive devices to get out of sync and effect motion accuracy?

- Any traffic that interrupts the CIP Sync messages from being delivered accurately, including:
  - Unexpected network traffic without proper prioritization
  - Broadcast traffic without proper prioritization
  - Loops created using unmanaged switches (which could fault the system and stop production)

How can these disturbances be minimized and any risks mitigated?

- Use managed switches with QoS and CIP Sync where economically feasible
- Connect the time-sensitive devices that include embedded switches directly to the controller
- Protect any unmanaged switches used in manufacturing cells with managed switches where they tie into the greater network

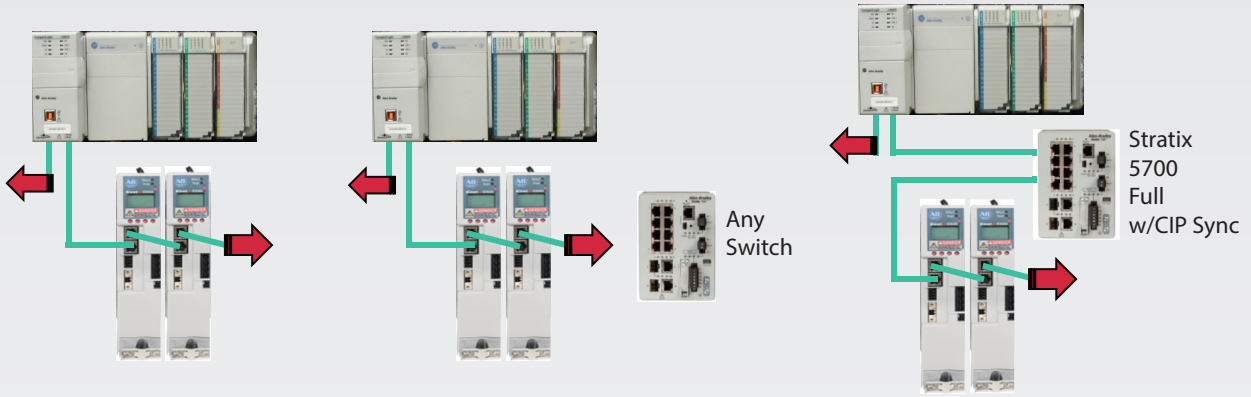
Reference Architecture



Design Guidelines

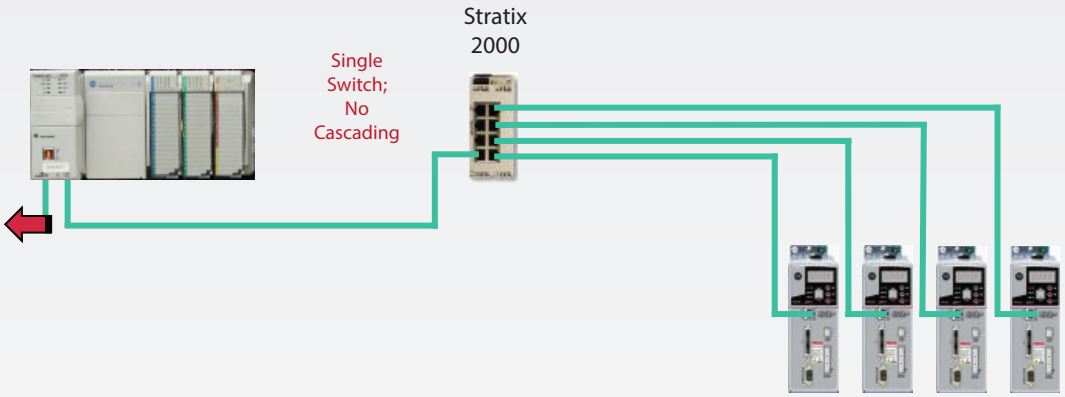
General guidelines for devices that include an embedded EtherNet/IP switch:

- Connect these devices directly to the controller without an interposing switch when possible
- Place any switches that do not include CIP Sync at the end of the line of embedded switch products
- Use a switch that includes CIP Sync if connected between the controller and time-sensitive devices
- Connect all other types of traffic to the red arrow points or to the switches



General guidelines for single-port EtherNet/IP products:

- Stratix 2000™ for standalone machine
- Stratix 5700™ (with QoS and CIP Sync) for a network machine



Drives and Motion Accelerator Toolkit

DMAT provides tools to assist with all facets of your design task, from selecting components and developing drawings, to writing code, laying out HMI screens, starting up your machine – and even troubleshooting.

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Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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