Application of IEEE 1588 in Industrial Automation and Motion Control Systems

Anatoly Moldovansky
Rockwell Automation
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Using time for control...

...not just network-based events!
IEEE 1588 Provides Time Synchronization Services

• Synchronization Services
  – The industrial market is driving the need for synchronization to a common time-base with sub-microsecond accuracy, node-to-node.

• IEEE 1588
  – Nanosecond Clock Resolution
  – +/- 100 nanosecond, or better, clock synchronization between distributed devices
Applications for Time Synchronization

- Sequence of Events Measurements
- Scheduled Outputs
- Synchronized Actuation
- Time-Stamped Data Logging
- Coordination with GPS Time

Typical Time Stamped Input
Applications for Time Synchronization

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Typical Scheduled Output
Distributed Motion Control

• Today’s distributed motion control applications are founded in mechanical line shafting designs. A single mechanical line shaft drives multiple subsystems using belts, pulleys or gear boxes.

• Typically, these applications are characterized as phase locked - or “lineshaft” applications. Like a large music box, all mechanical elements are timed and phased through mechanical means.
Distributed Motion Control

• Mechanical Lineshafts are inflexible
  – Single product design
  – Long product change-over
  – Run-time adjustments for re-phasing were non-existent or required expensive differential gear-boxes.
  – Wear and tear of mechanical components

• Much power was expended on moving machinery and not product.
Distributed Motion Control

- Mechanical designs have given way to electronic design control schemes
Distributed Motion Control

A Communications Network is Put in Place…
Distributed Motion Control

And the Result is an Electronic LineShaft!
Distributed Motion Control

- And the Result is an Electronic Lineshaft!
Why is Time Synchronization Required?

• Each Motion Controller Controls *Position over Time*
CIP Motion™

- There are Two Types of Connections that are Typically Used for Distributed Motion Control

Peer to Peer
CIP Motion™

- There are Two Types of Connections that are Typically Used for Distributed Motion Control

Control to Drive
CIP Motion Architecture

- Ethernet Switch
- CIP Drive
- CIP Controller (Consumer)
- Motion Axis Connection
- Drive Axis Connection
- MMI
- I/O
- EtherNet/IP
- CIP Sync: IEEE 1588 Time Synchronization

Demo
CIP Motion™ Demo