Industrial Bridged and non-Bridged End Stations

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RELIABLE SYNCHRONIZED NETWORKING

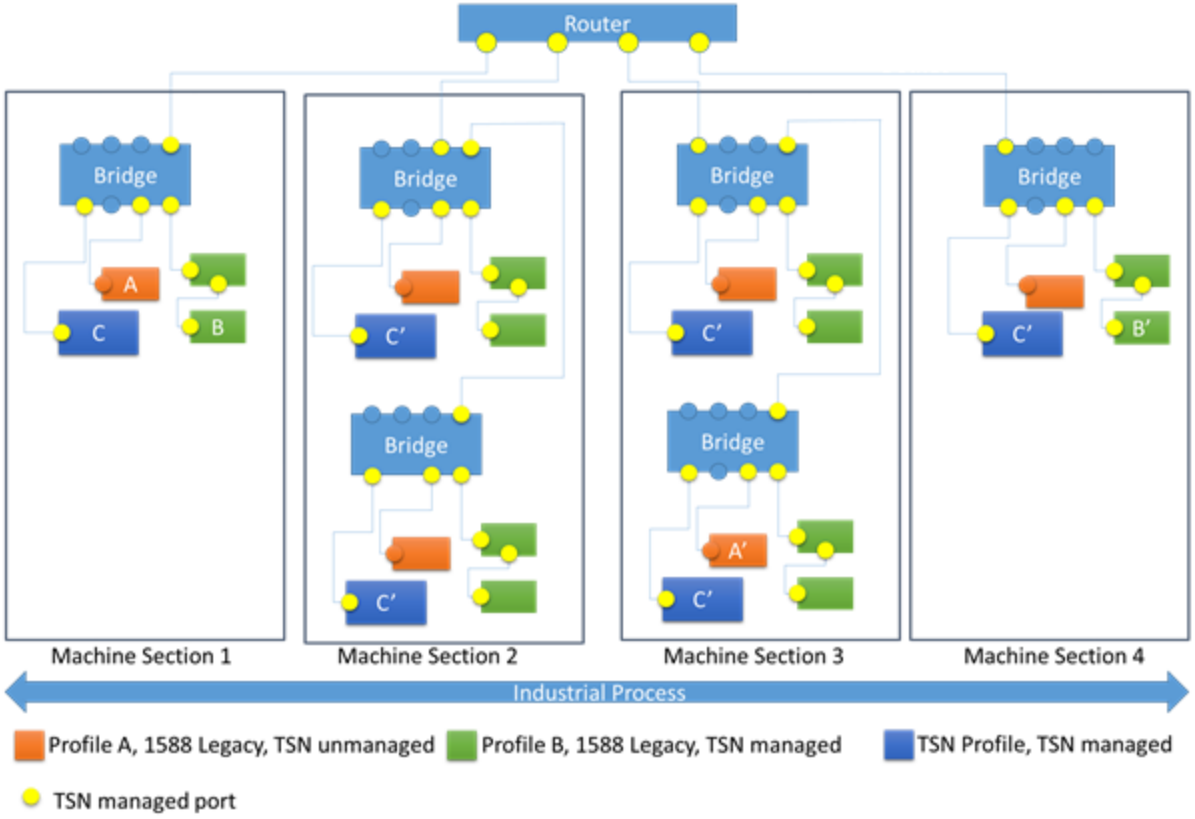
Definitions

- *TSN based system:* - A TSN based system refers to any system that incorporates the core functions and technologies defined by the IEEE-802.1 TSN set of standards. This document will define the core set that is important to the industrial market.
- *TSN-based services:* - Those functions defined within the 802.1 TSN set of standards that provide a benefit or utility to the overall TSN system and which act as a small functional component in the overall TSN solution. Such examples would include time synchronization services as delivered via 802.1AS-REV and scheduling services as defined by 802.1Qbv.
- *End-Station User Configuration Protocol:* - The native industrial protocol associated with an end-station which has been traditionally used to configure that end-station for use in a control application. Examples of these protocols would be CIP, Profinet, EtherCat and Sercos.
- *Remote Management Unit.(RMU):* - A mechanism that converts CNC southbound configuration messages into the End Station User Configuration Protocol. This is sometimes called a “proxy”
- *Bridged End Station:* An end station that operates with an IEEE 802.1 bridge embedded within or alongside it.

Definitions

- *Constrained End Station:* – An End Station which is limited in memory or processing capability.
- *Constrained Bridged End Station:* – A Bridged End Station which is limited in memory or processing capability.
- *Brownfield End Station:* – An End Station or a Bridged End Station which was designed before the existence of TSN technologies and which is installed in an existing system. It should be expected that limited firmware updates are possible.
- *TSN Data Gateway:* – A mechanism that transfers non-TSN data stream onto a TSN stream.
- *Time Gateway:* - A mechanism that translates time between various time domains. An example would be between an 802.1AS domain and an IEEE-1588 time domain.

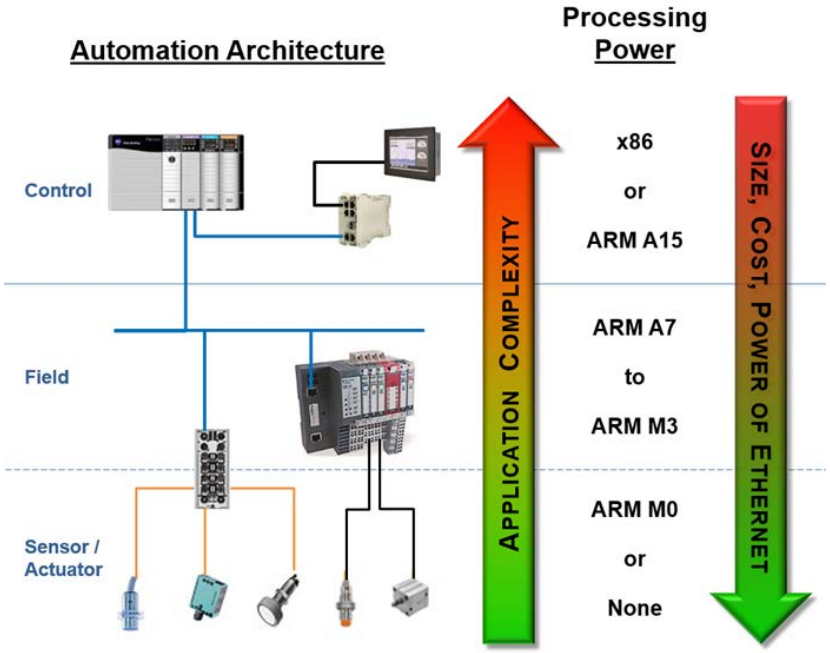
Industrial Use Case



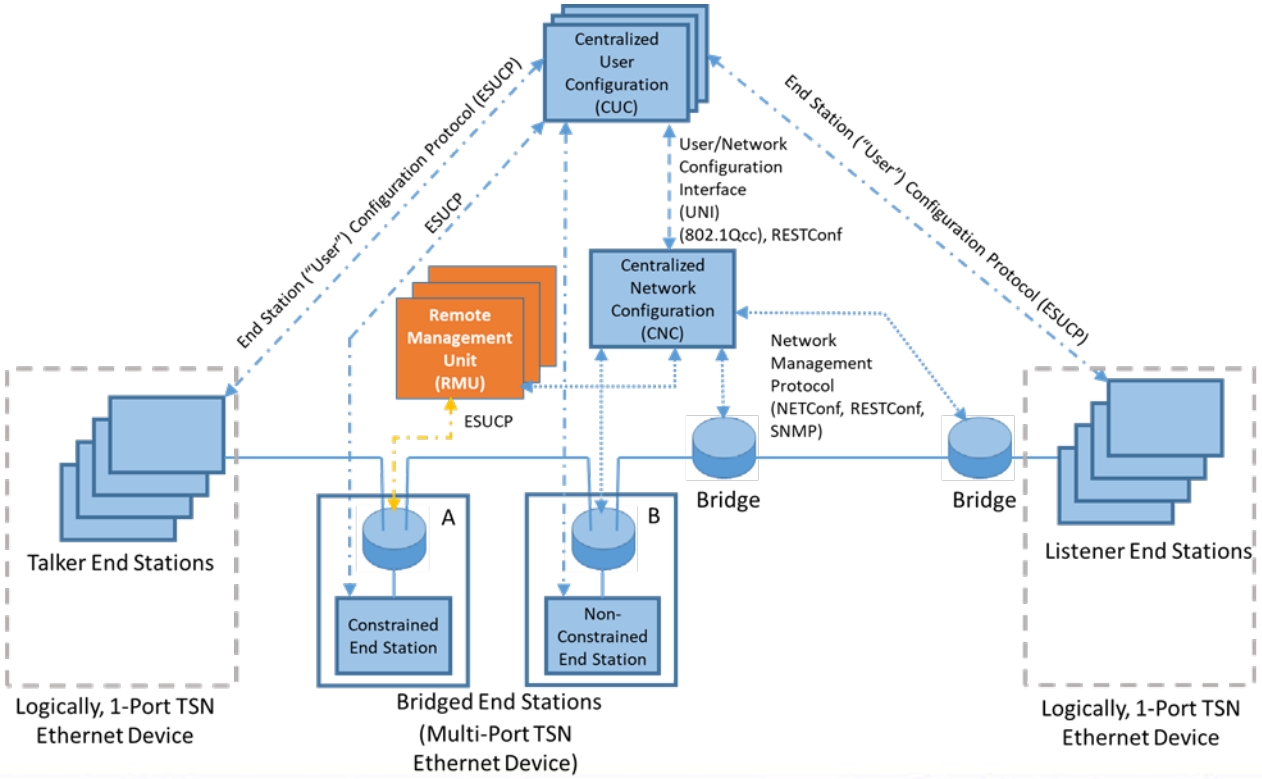
Note: TSN managed denotes a product that incorporates the 802.1 TSN technologies for traffic management as defined by this profile. TSN unmanaged refers to a product that was designed prior to the 802.1 TSN technologies.

- The life cycle of an average industrial installation is very long
  - 20 years is typical
  - Require migration mechanisms to move to new technologies
    - Time Gateways
    - TSN Gateways
    - Natural place for gateways: Bridges
- Modular construction
  - Machine sections supplied by individual OEMs
  - Composable system design
    - Requires VLAN segmentation for functional bounding
  - Large end users will replicate machines many times and distribute globally across multiple locations
    - IP addressing schemes duplicated
    - “Cookie cutter” approach often requires NAT

Constrained Devices



Constrained Devices & RMU's



Constrained devices have limited processing power and memory

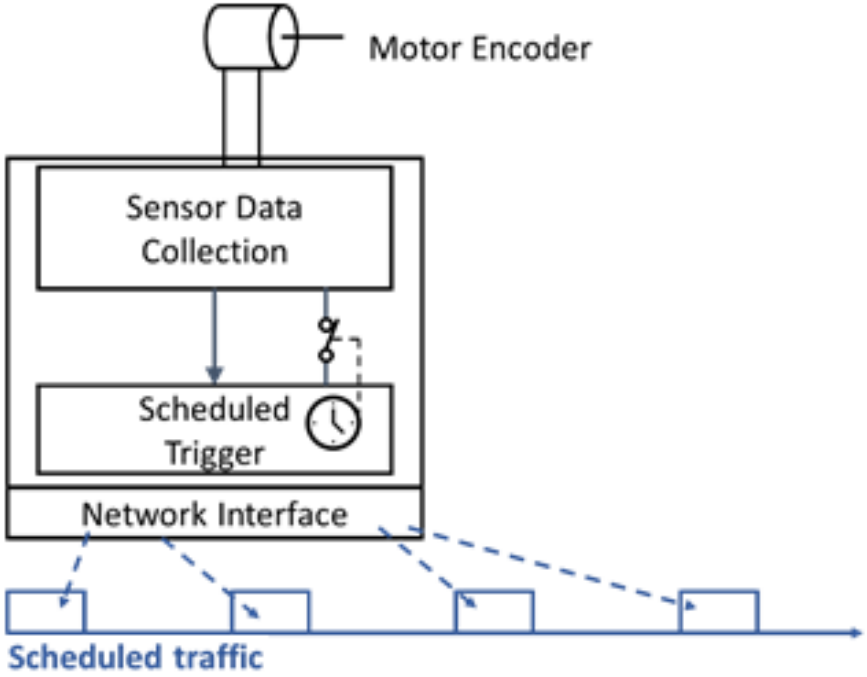
- Won't support multiple stacks for bridge configuration and end-station configuration
- Require Remote Management Unit Function between CNC and Device to translate bridge configuration functions.
- Uses native end station configuration protocol
  - Typically Industrial Standard Protocols like CIP, Profi, etc.
  - Native protocol will need to expand to include additional services

End Station Profile Draft Proposal

	Bridged End Station (non-constrained)	Bridged End Station (constrained)	Non-Bridged End Station
Time Synchronization	802.1AS-REV	802.1AS-REV	802.1AS-REV
Preemption	Preemption	Preemption	Preemption (optional)
Scheduling	Qbv	Qbv	Qbv (optional)
Bridge Config	NETCONF or RESTCONF	ESUCP via RMU	N/A
Device Config	ESUCP	ESUCP	ESUCP (CUC Protocol)
Policing	Qci (optional)	Qci (optional)	N/A
Redundancy	CB (optional) RSTP, MSTP	CB (optional) RSTP, MSTP	CB (support through an adjacent bridge.) (Optional)
Discovery Services	LLDP	LLDP via RMU	LLDP (transmit only)
	Get / Set parameters (interval, payload, jitter, latency)	Get / Set parameters (interval, payload, jitter, latency)	Get / Set parameters (interval, payload, jitter, latency)
Number of queues	8	8	N/A

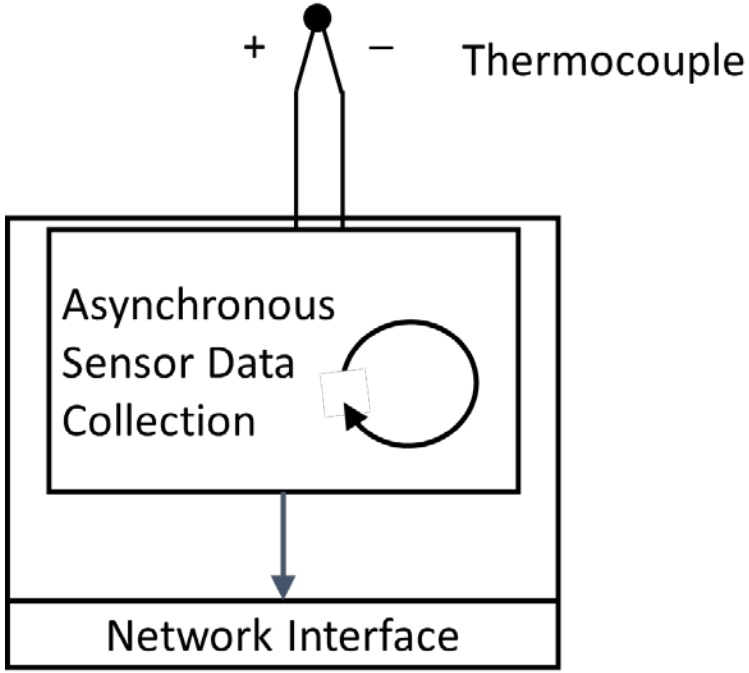
This work now a function of IEC/IEEE 60802 Joint Project

Device Types: Time Triggered Send



- Critical data delivery
- Synchronized with network
- Traffic must be delivered by a specific deadline
- No bridge function
- Requires support for Qbv
- Very fast updates and sampling

Device Types: Machine and Process I/O



- Critical data delivery
- No synchronization with network
- Traffic must be delivered with bounded latency
- No bridge function
- No requirement for Qbv, however updates are cyclic
- Update and sampling: Fast to medium times

Conformance Testing