Requirements and Scenarios for Industry Internet Addressing

draft-km-industrial-internet-requirements-00

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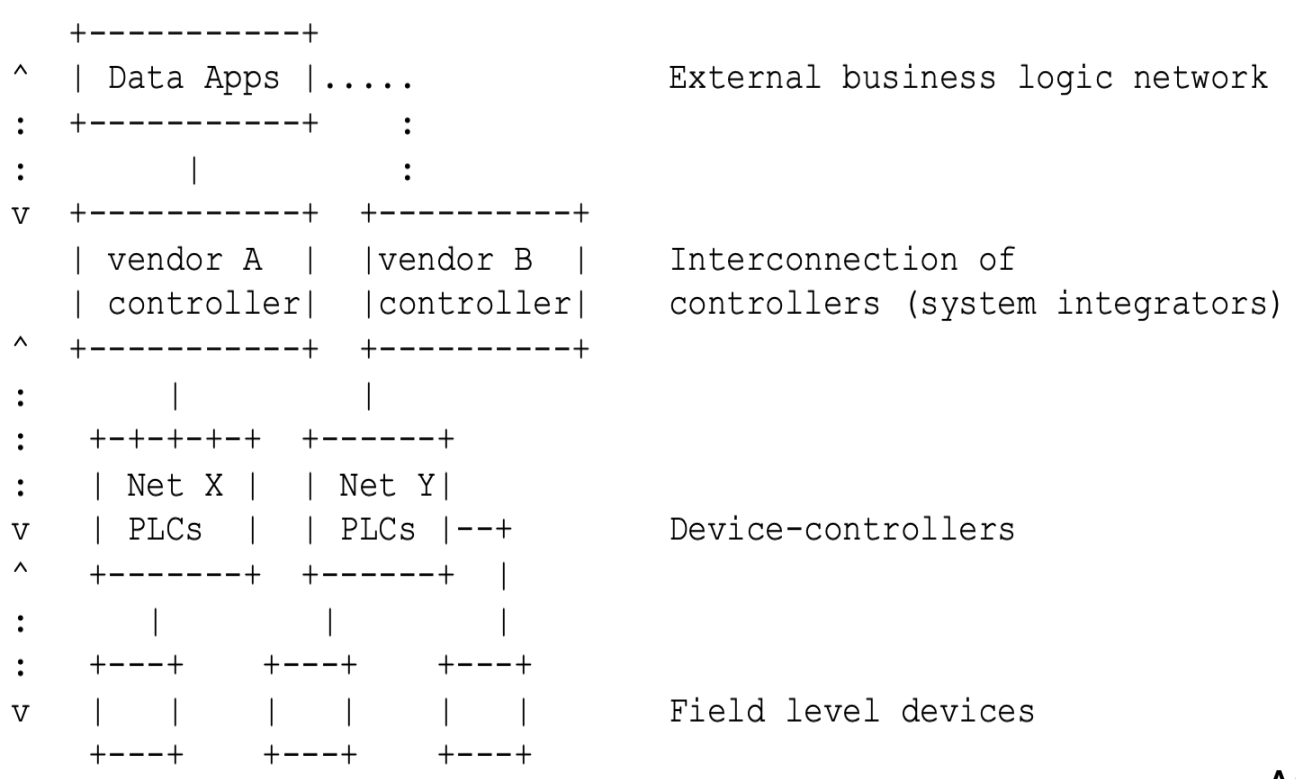
Discussion Points

- State of Industry Control Networks – Reference Model
- Scenarios & Challenges from emerging trends
- Where the related work is done?
- Possible functional areas to discuss

Industry Control Networks



The Business logic over Internet Protocols

IP/TCP.

E.g., supply chain, quality assurance, inventory management, sales, etc.

The Operations over Industry Network Protocols

E.g., Manufacturing sites, plants, production sites, agriculture, factories, etc.

Automation = Connectivity of {OpsTech} + {InfoTech}

Properties and Nuances in Industrial Networks

- Location bound:
  - Device specific location changes are rare.
  - However, does not imply that the network resources get efficiently utilized.
- Security by separation:
  - Typically, attack vectors are minimized by separating IT infrastructure from OT.
- Communication patterns:
  - Client server, sensor data, actuator data, app specific data etc.
- Wired devices:
  - A bulk of machines are over wired network;
  - Constraints vary from current active IoT devices related work in standardization work. device lifetime, or power-requirements are not typical constraints. Instead, direct process control mechanisms are more important.
- Time centric behavior:
  - The control devices requiring deterministic behavior covered under the DetNet.

Challenges with the current state

- Dealing with Heterogeneity of Industry Protocols
  - More than 100 protocols: controller sits behind one protocol and control devices behind the other protocols.
  - Stateful gateways for translations.
- Automation Impact
  - Scale –Automation adds more sensors, more data on the wire. This stresses the ‘engineered networks’ by making them more compute and data intensive.
  - OT Fabric stretch to Edges or Clouds – moving from hardware PLCs to software or virtual PLCs.
  - Must achieve same level of reliability and resilience as factory floor (on-prem).

Scenarios

1. OT/IT Convergence
   - Decisions to move IT servers on factory floors or transport data out of the floors.
   - Overheads relating to IP headers not suitable for Industry protocols.
2. Virtualization
   - Of processes, PLCs to make them location agnostic
   - Digital Twin instances from underlying collection of devices.

Scenarios

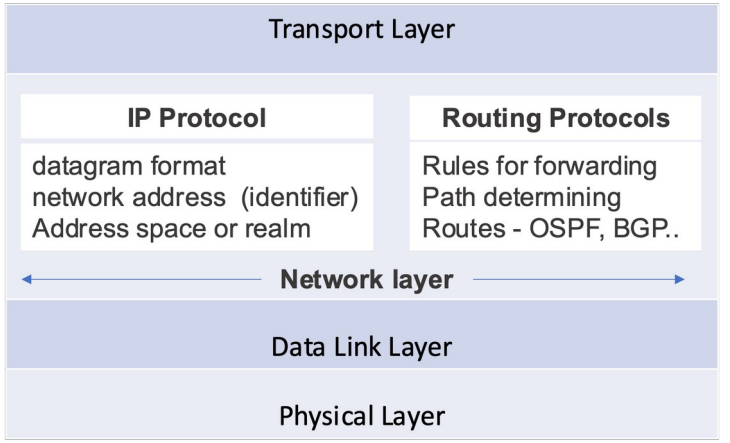
3. Implications of Data growth from new use cases:
   - Even though the size of network remains the same, data generated is much higher.
   - Compute intensive scenarios
     - E.g., use of cameras installed for visual inspection to determine the quality of manufactured product generates a high bandwidth demand.
   - Variety of Infrastructure Networks
     - Digital transformation of factory infrastructure. E.g., Building automation - lights, A/C, thermostat control
     - Accidents and Emergency situations – floor safety and security
   - Higher remote processing engagement with IT world compute intensive applications

Relevance to Other Standards Work

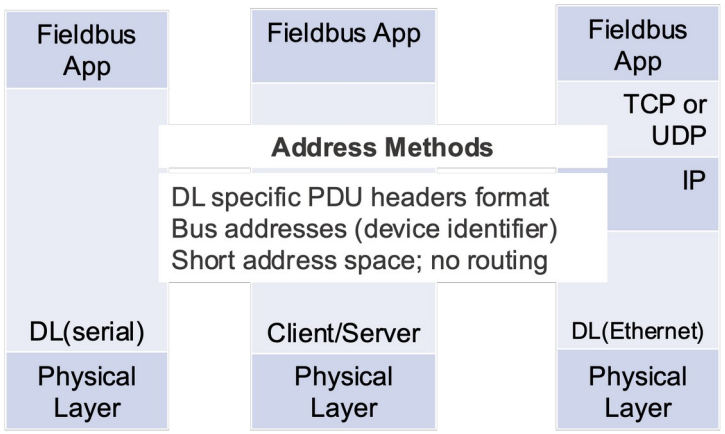
- Detnet for TSN and time-centric constraints.
  - All latency, reliability aspects coordinate with DETNET.
- IoT device related work is quite related to onboarding, lifecycle, compressed headers – constrained device centric.
  - Onboarding, Lifecycle, security for wired devices will be quite different.
- Several addressing related efforts
  - References in the document
- TSN is developing a profile for industry automation
  - Ethernet centric. How to capture field-bus device requirements.

Address Structure Variance

- IP Address
  - Fixed number of bytes that identifies a node
- Industrial Protocols
  - Different process control zones have their own address space
  - Do not have a network layer (LAN scoped control area)
  - Protocol format conversions happen on the fly - devices of one protocol often connect to controller of other protocols



a) Internet Network Stack

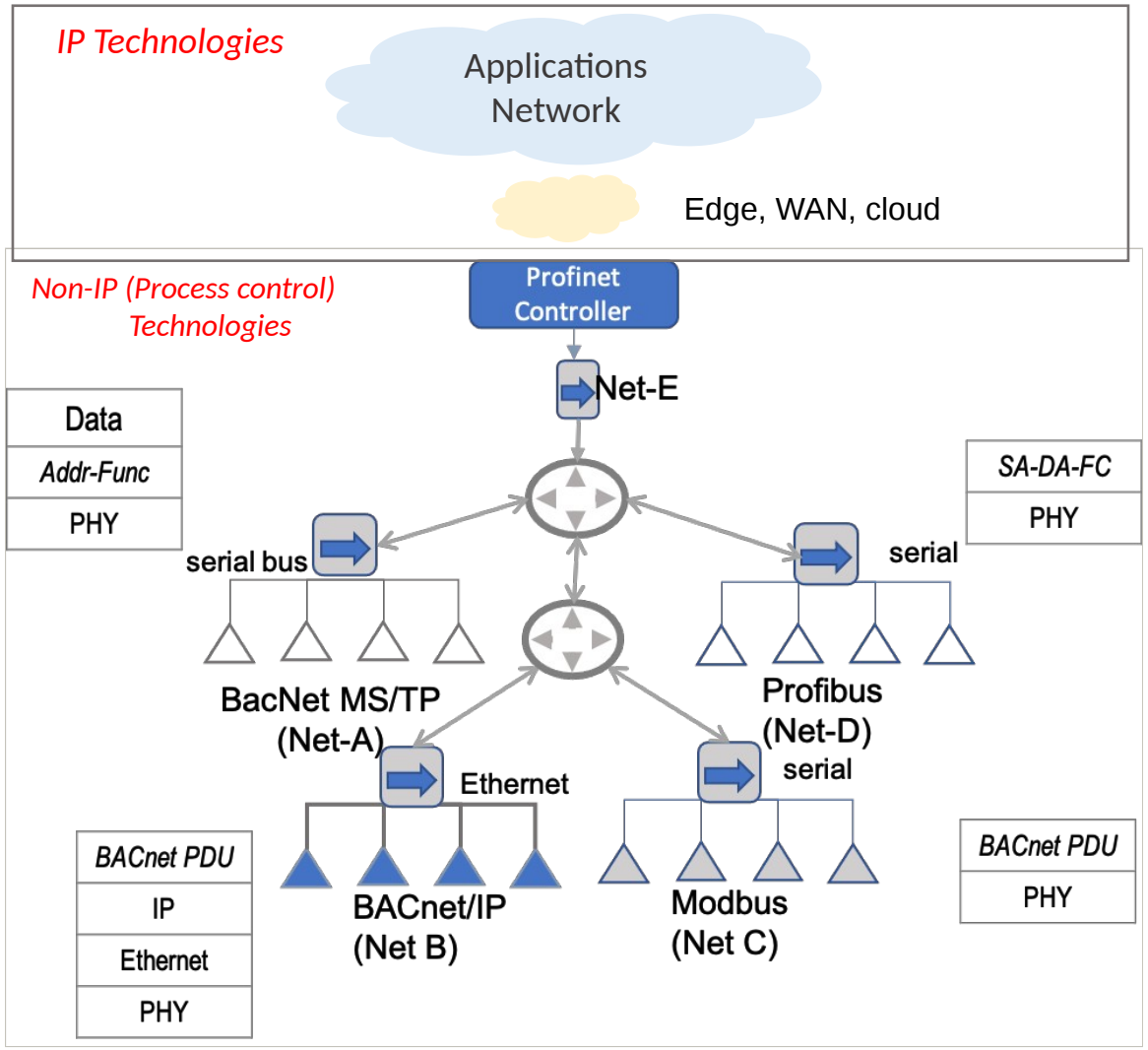


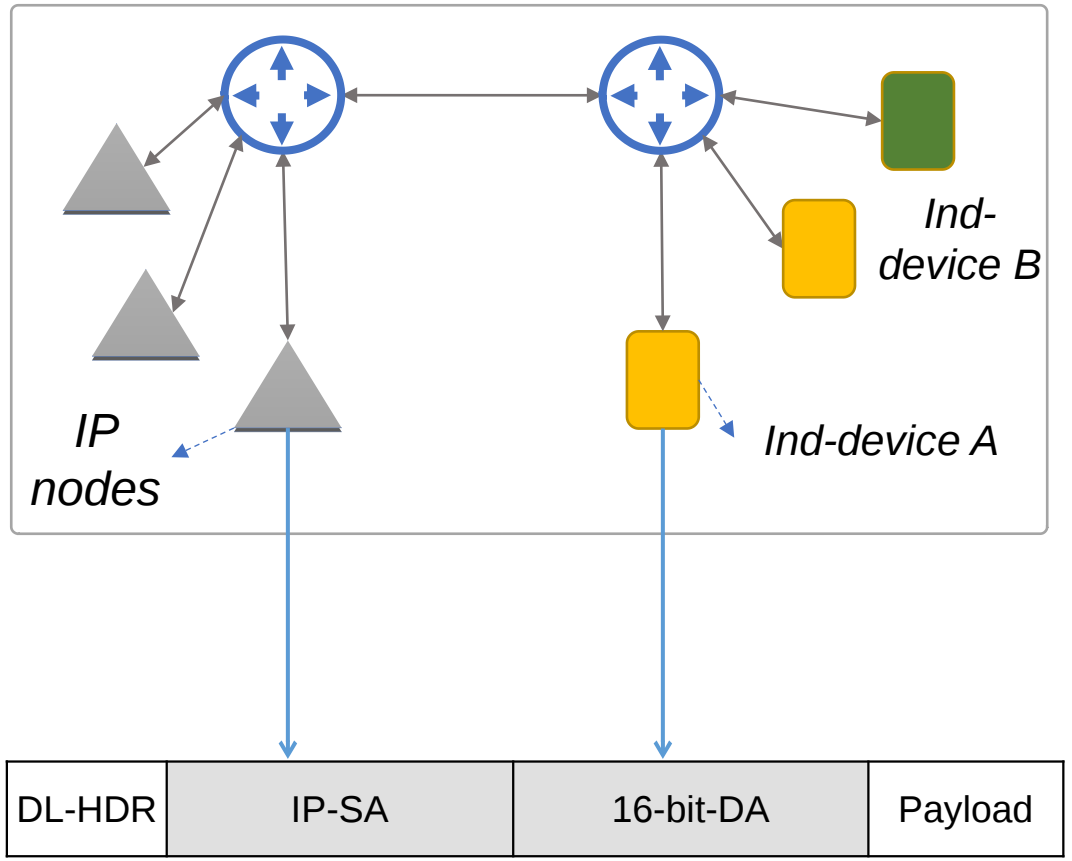
b) Industry OSI Stacks

Potential work-areas

- Device side of work - Common Network format which is friendly to both OT and IT applications.
  - Typical actuator and sensor data is small
  - Evaluate compressed header SCHC, ROHC (?)
  - Or a newer flexible address structure.
- Network specific work - Encap-free communication between devices with different address schemes
  - Short Device addresses on the wire (today fieldbus address are 1-byte, to have uniqueness, it needs to be coupled with some semantics – such as location, controller, applications, etc.
- Network Layer for Industrial Devices
  - Address of an industrial device is same at PHY, MAC and application level.
  - Usecase: with virtual PLCs, you will need to be able to find your controller/device.

OT/IT Integration Approach at Network level





Some new kind of structure

Open Questions

- Value in supporting IT and OT network technologies.
- Address-Framework - format of reachability on wire will support different addresses formats/spaces?
- Using “something-over-IP” (encapsulated over IP) has its own cost, translation overhead and complexity.
- Bring in the stakeholders
- Other things?

Thanks!
Comments and feedback