Industrial Profile for IEEE 802.1BA

Siemens

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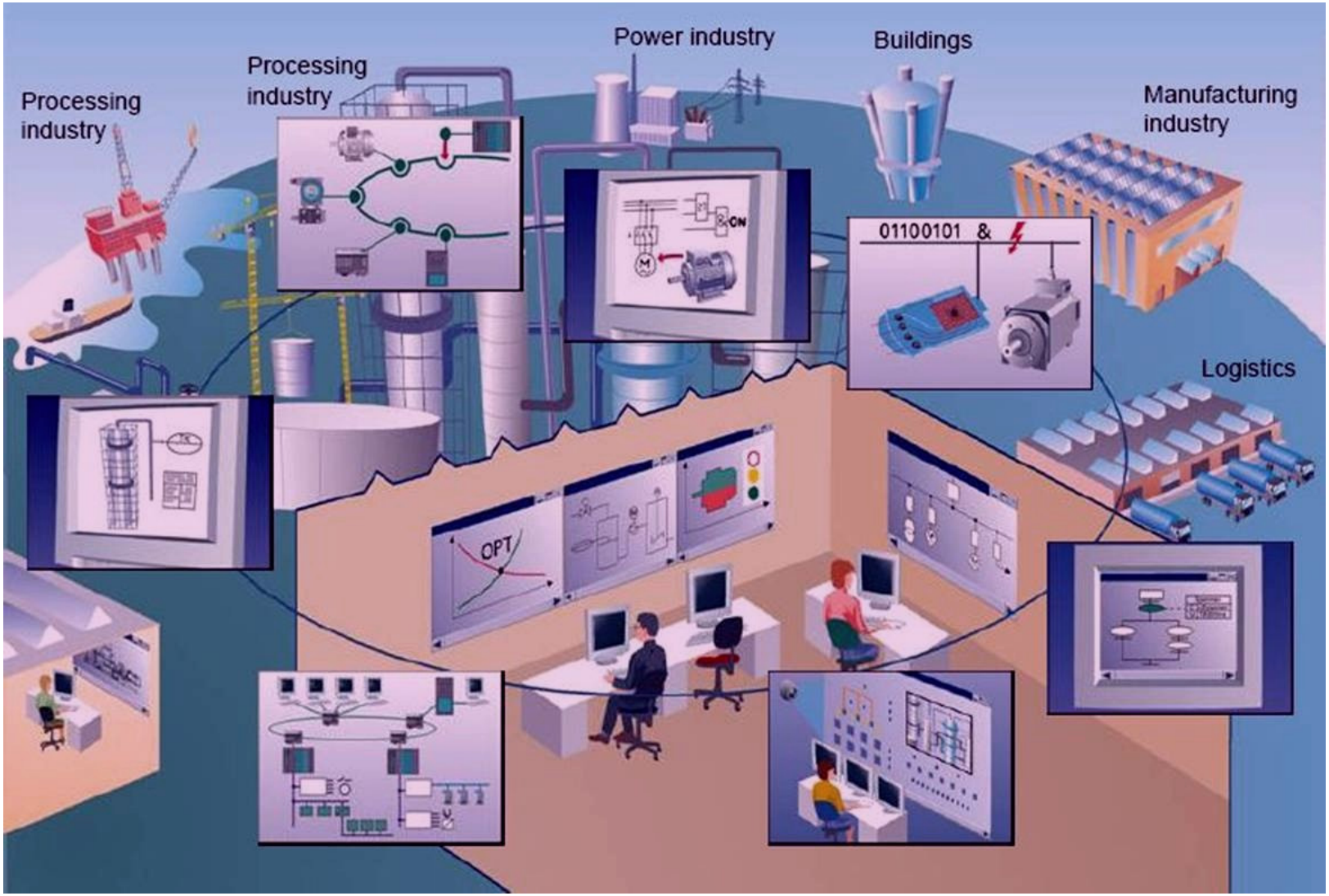
Industry


Processing industry
Processing industry
Power industry
Buildings
Manufacturing industry
Logistics
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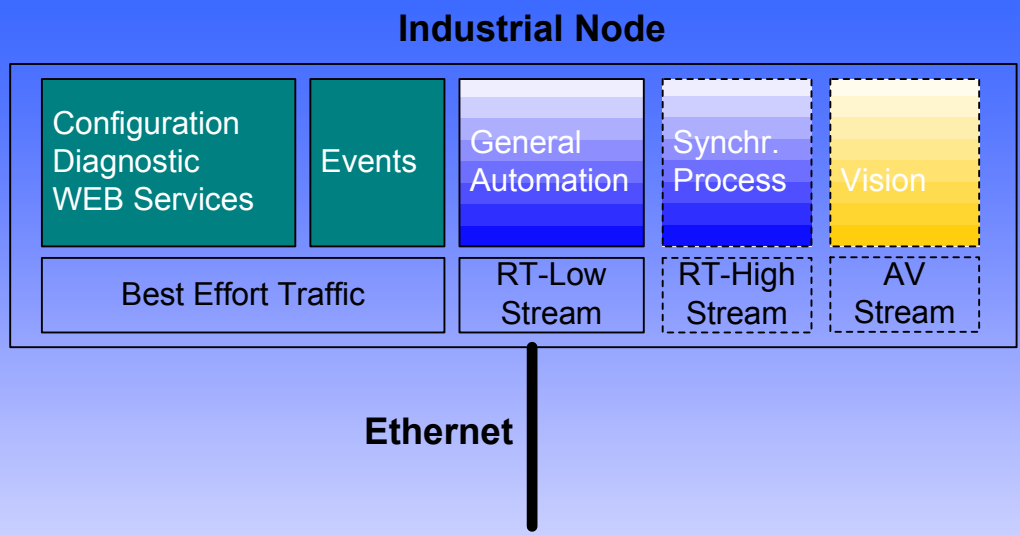
Communication Services in Industry



- **Best Effort Traffic**
  - Configuration
  - Diagnostic
  - Web Services
  - Events
  - …
- **RT-Low Streams**
  - General Automation to exchange typical anlog an digital values (manufactoring and process industry)
- **RT-High Streams**
  - Motion Control to exchange typical anlog and digital values (synchronized processes)
- **AV Streams**
  - Vision Systems (inspection, identification, tracking, counting and measurement)

Streams for Time Sensitive Data in Industry

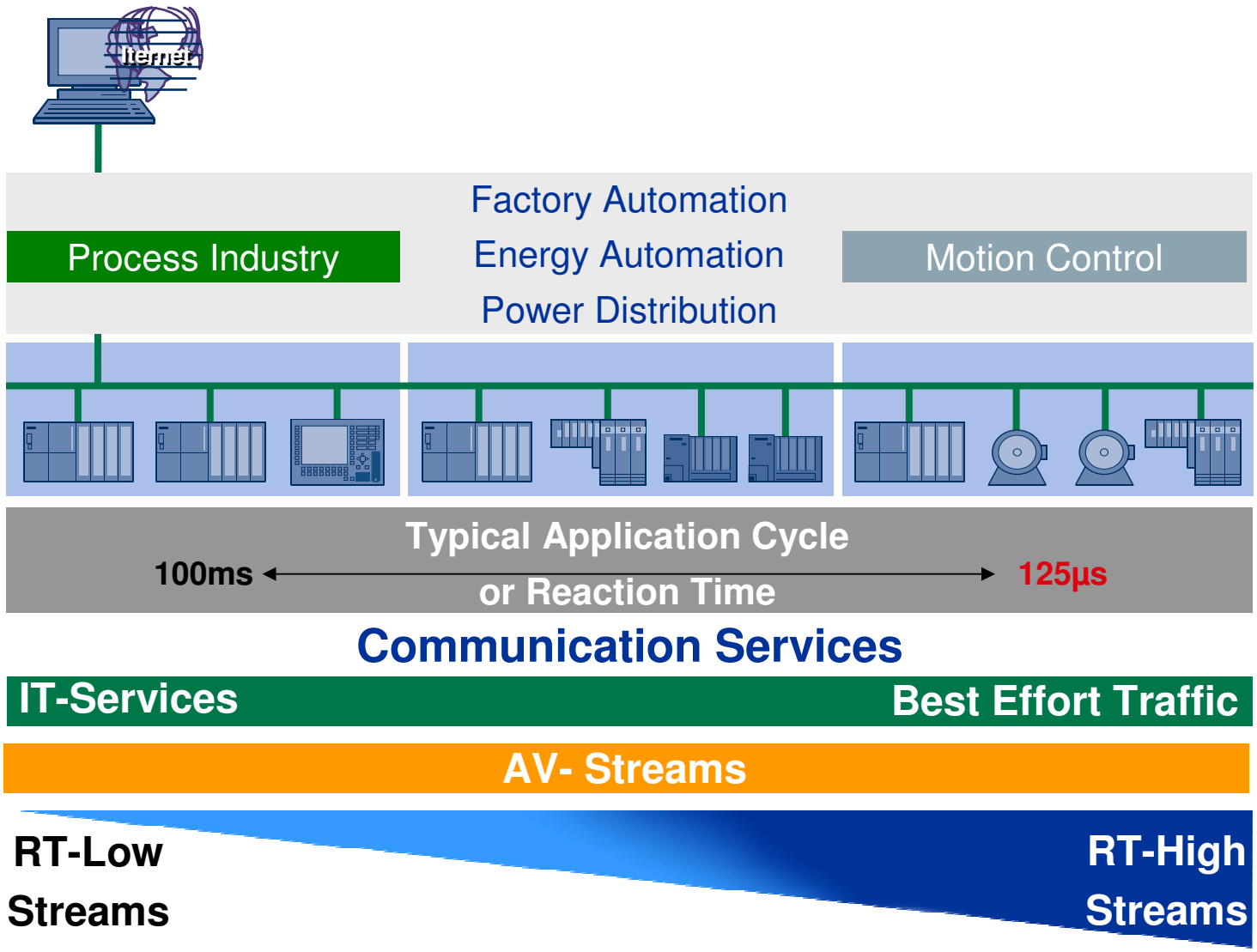
RT-Streams:

- **time sensitive Data**
- **periodic transmission**

Guaranteed QoS for RT-Streams along the end-to-end path:

- **guaranteed low latency (low delay variation / jitter)**
- **guaranteed ressources (no packet loss)**
- **guaranteed bandwidth (throughput)**
- **deterministic behaviour in case of high network load**

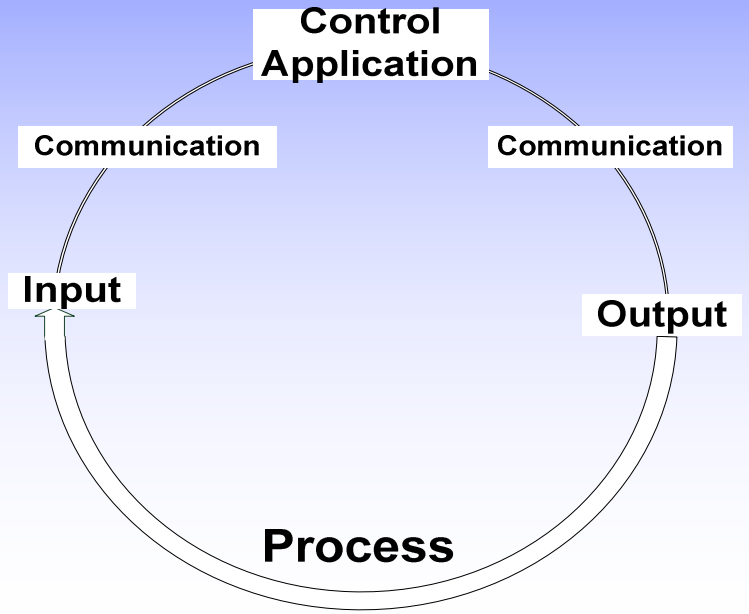
Industrial Communication



Application Model in Industy (1)

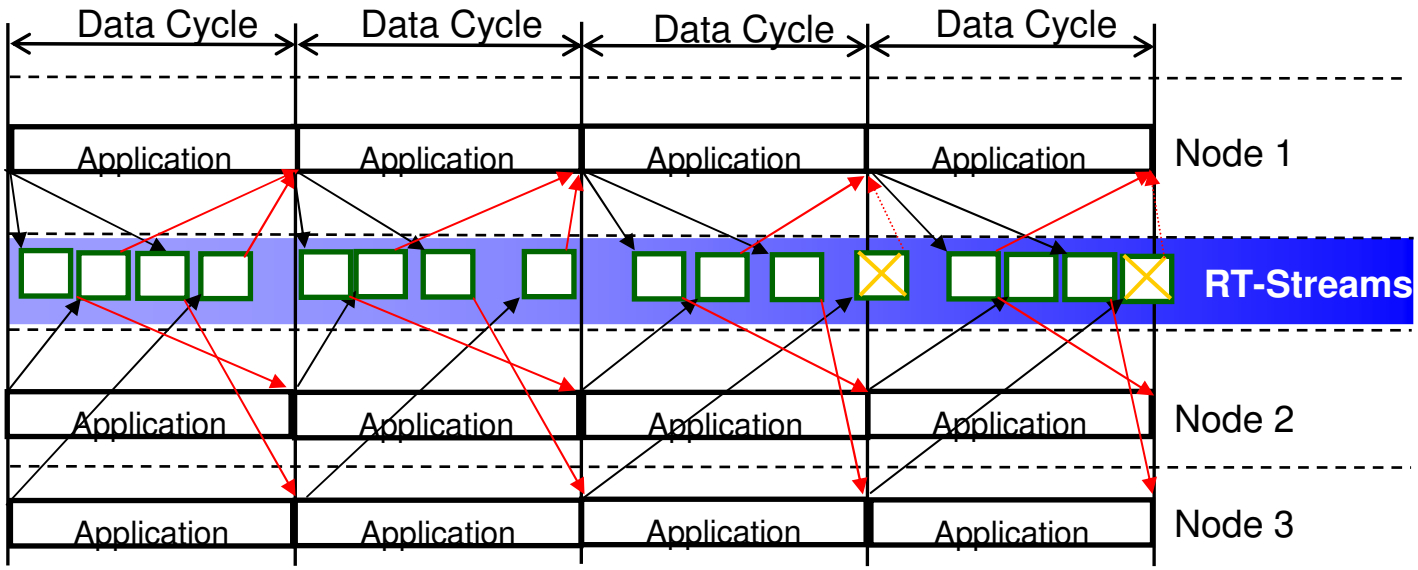
The application model for RT-Streams in industry <u>is different</u> from the application model used for AV-Streams.

- **Closed Loop application (real procecss, control application and communication)**
- **Dead time shall be kept small to get short reaction time**



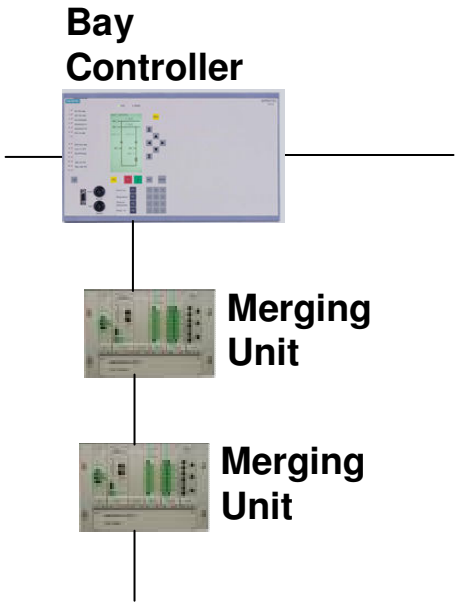
Application Model in Industy (2)

- Control applications are synchroniced
- Minimized jitter for communication and application
- No buffering for RT-Data (just in time)
- Consistent process image is required

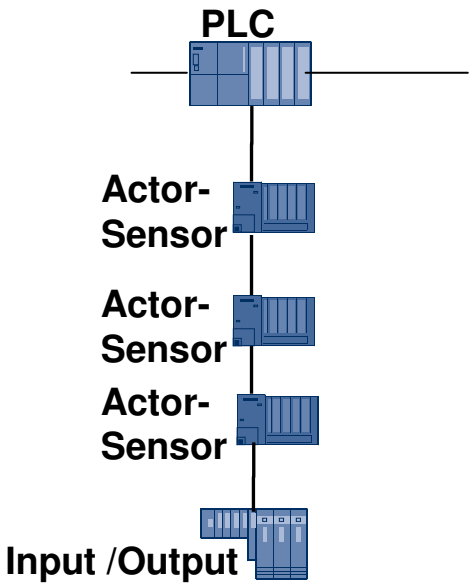


Use Cases

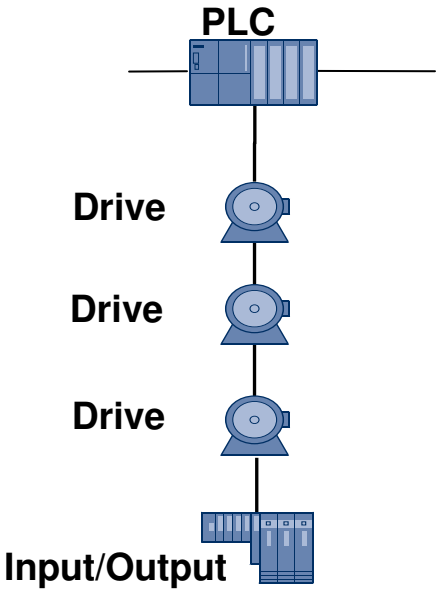
Power Distribution (IEC 61850)



Factory Automation Power Industry



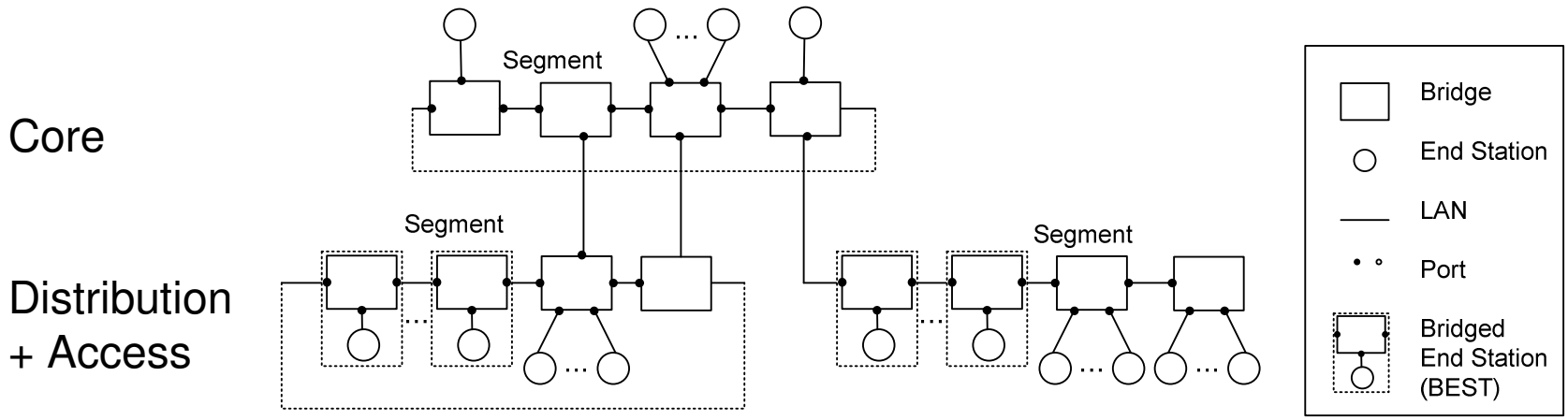
Motion Control



- ***RT-Low Streams***
  - Data Length < 300 bytes
  - Data Cycle < 1ms
  - 32 devices per line
  - Latency < 1ms

- ***RT-High-Streams***
  - Data Length < 100 bytes
  - Data Cycle ~ 125µs (typical)
  - Up to 16 devices in line
  - Latency < 125µs

Typical Topology for Bridged LANs in Industry



Linear Topology (Line, Ring)

- Applications mostly feature distributed linear dimension, i.e. production lines
- The network is tailored to the application, i.e. line topologies
- To reduce total cost, 2-port-bridges are integrated into the end stations
- For enhanced availability, lines are closed to rings
- Homogeneous segments (100MBit or GBit)

Requirements for RT Streams

- **Low Latency for RT Streams**
  - RT-Low Streams: Latency < 1ms over 32 hops, data < 300 Bytes
  - RT-High Streams: Latency < 125µs over 16 hops, data < 100 Bytes
    (-> avoid interference Best Effort Traffic with RT Traffic)
- **Transmission Period for RT Streams**
  - RT-Low Streams: 500µs .. 4ms
  - RT-High Streams: 125µs .. 1ms
- **Synchronization**
  - End point time synchronization accuracy over 64 hops < 1µs

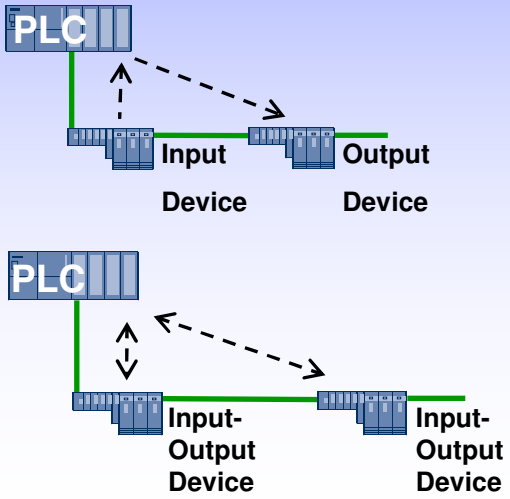
Requirements for RT Streams

- **Routing for AV and RT Steams**
  - No loss of AV and RT Streams caused by RSTP during network reconfiguration
  - Shortest Path for RT Streams (low latency)

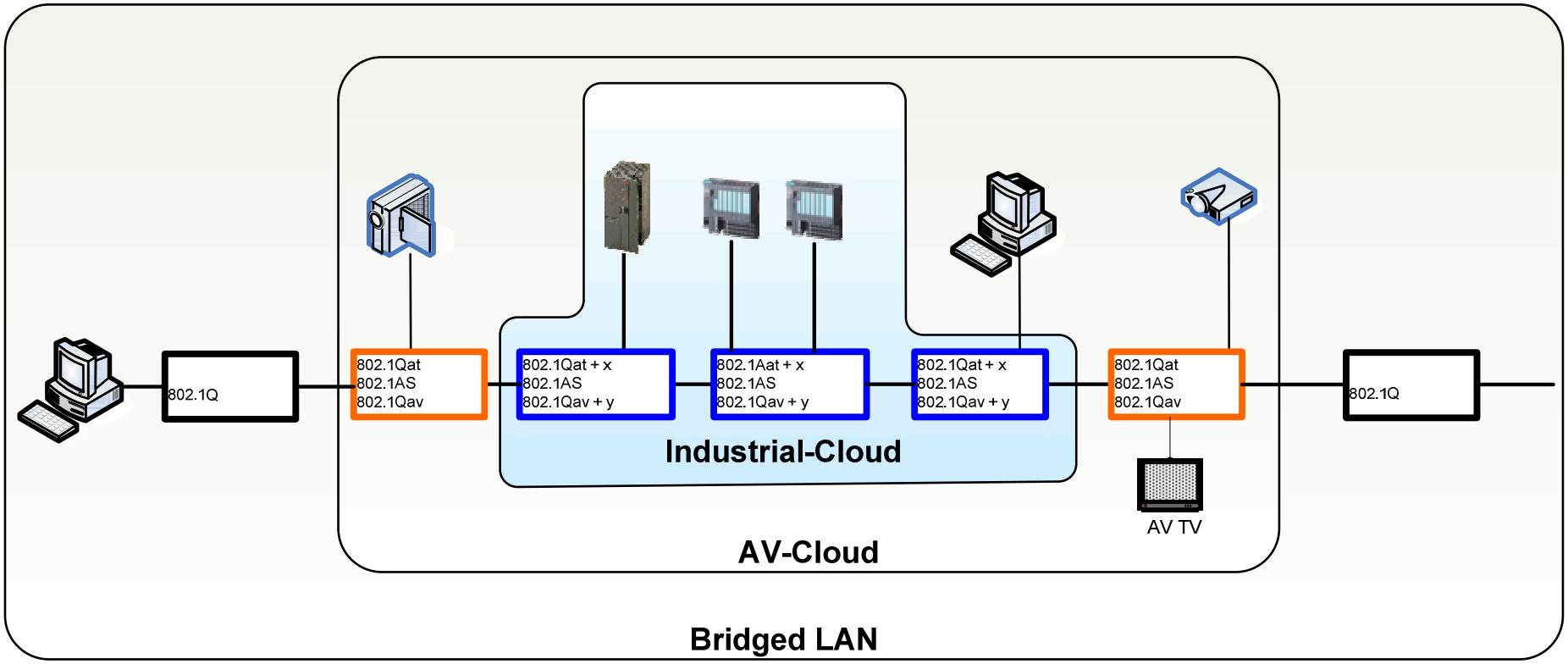
  -> do not use learning mechansim for RT Streams

- **Redundancy**
  - Alternate path for RT Streams (i.e. in ring topology)

- **Communication Relation for RT Streams**
  - Unidirectional RT Streams (**Publisher -> Subscriber**)
  - Bidirectional RT Streams (**Client <-> Server**)



Integration of Industrial Communication in network



Open Issues

AVB and 802.1 includes mechanism to control AV Streams. Simular mechansim may be used for RT-Streams.

- Include extensions for stream handling to reduce latency?
- Can we describe the extensions in an industrial profile?
- How to proceed for industrial profile?

Thank you !