Elastic Ethernet based on Converged Switch

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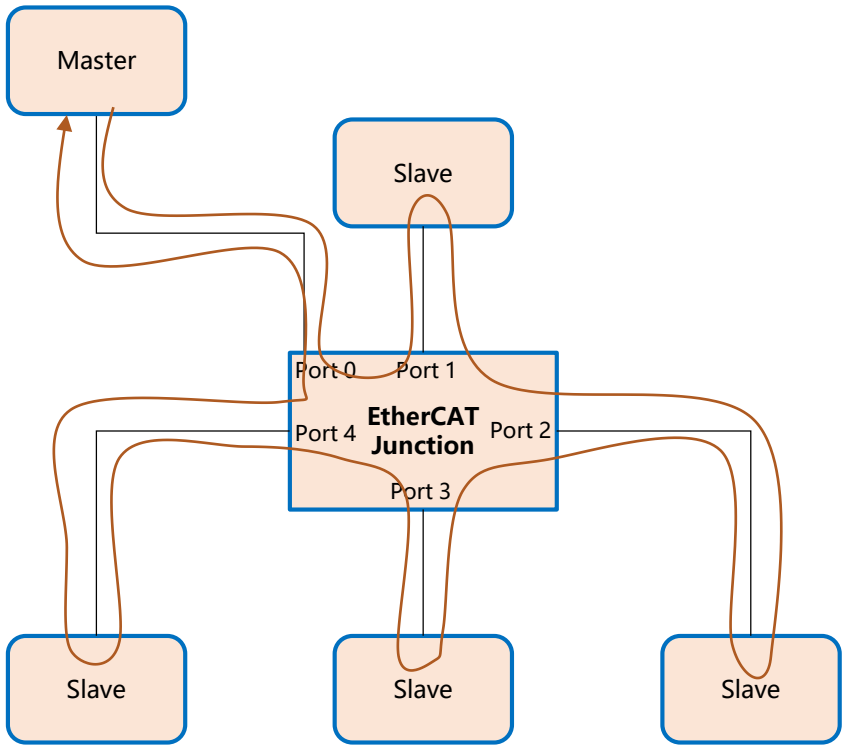
Background

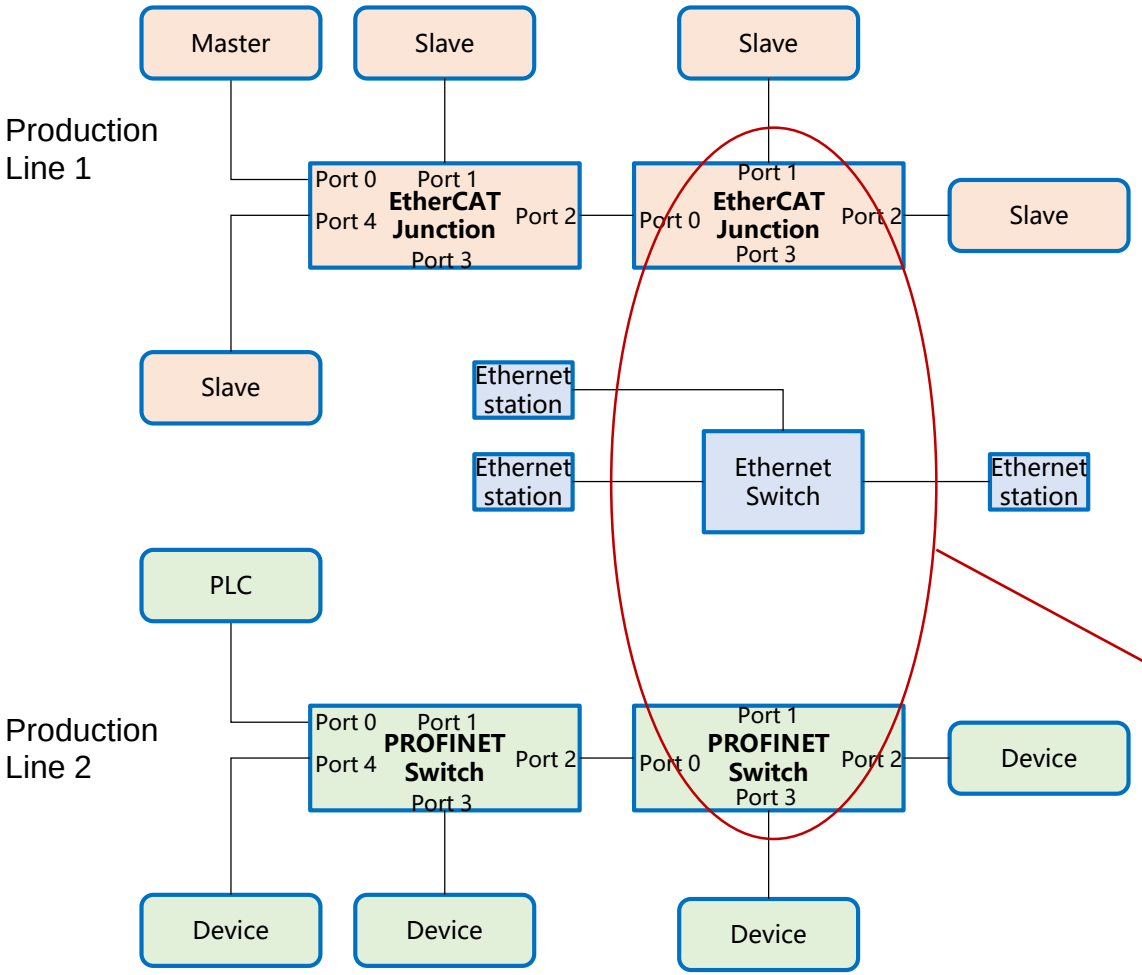
- Regarding Elastic Ethernet, several presentations were discussed, and leading the specific issues to be focused on.
  - 2021-05-16 Industrial Network based on Convergent & Elastic Ethernet
    - ✓ Weak determinism
    - ✓ Centralized management
    - ✓ Extreme low latency / jitter
  - 2021-05-06 Convergent & Elastic Ethernet Networking for Industry
    - ✓ Convergent industrial network based on Ethernet
  - 2021-04-07 Elastic Ethernet Networking for Industry
    - ✓ Elastic Ethernet framework
  - 2021-11-18 Low Latency Discussion for Ethernet Networking
    - ✓ Extreme low latency / jitter analysis
- This presentation discusses one of the issues, analyzes the pros & cons, and explores a potential solution.
- Finally, to talk about the study item proposal if possible.

An Example of EtherCAT Network with Star Topology



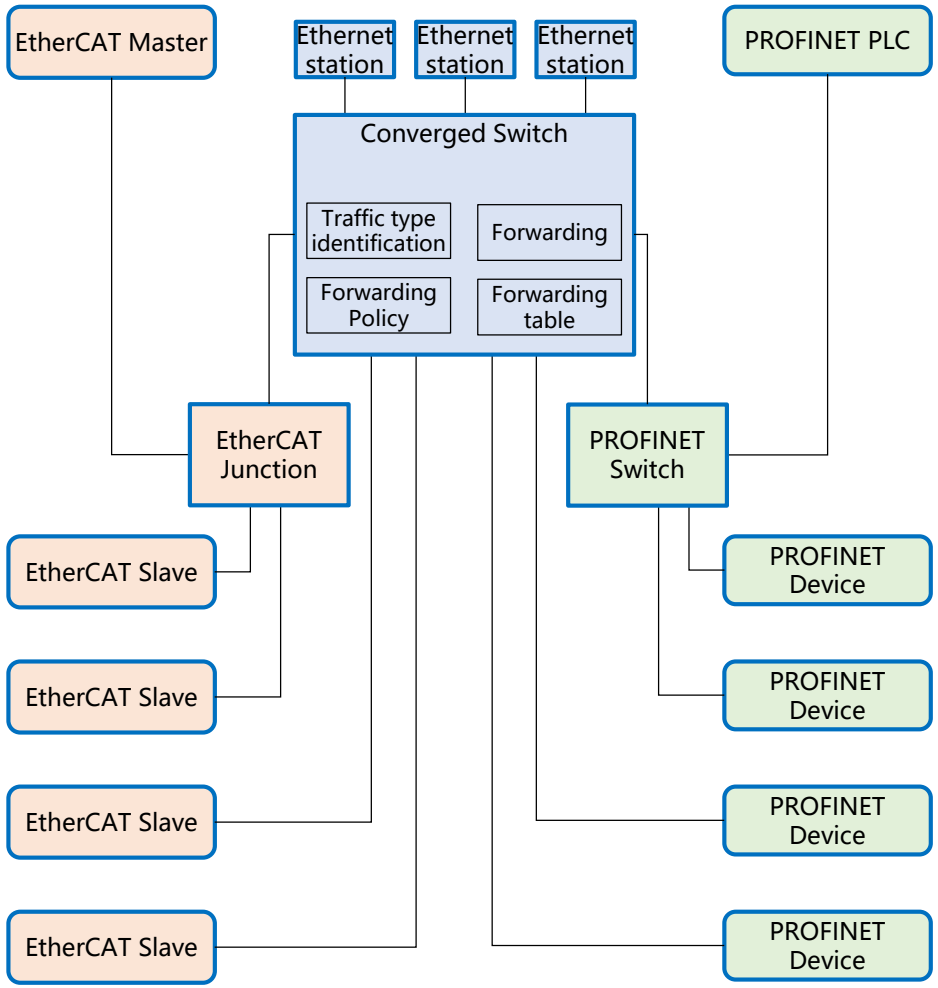
- The basic principle is that internally the EtherCAT frames continue to be transported in a logical ring:
  - the EtherCAT master sends the frame on the port 0 of the EtherCAT junction
  - this frame passes each port & each slave once,
  - and is returned to the master through port 4 & port 0.
- But the EtherCAT junction **cannot be used as an Ethernet bridge**.
- *Is it possible to forward EtherCAT frames & standard Ethernet frames simultaneously in a converged forwarding device?*

More Complicated Scenarios



- Different production line use different industrial networks via different industrial frame forwarding devices.
- Because the devices are discrete, the whole systems are connected as daisy chain topology, and each switch nodes connect the devices as star topology.
- Nearby some switch nodes, there are some Ethernet switches / stations or devices of other industrial network.
- *Is it possible to forward EtherCAT frames, PROFINET frames & standard Ethernet frames simultaneously in a converged forwarding device?*

Converged Switch



- The converged switch could forward standard Ethernet, EtherCAT frames and PROFINET frames simultaneously.
- With multiple new forwarding rules, the converged switch could support a few kinds different traffic type / forwarding mode of different Ethernet-based industrial networks.
  - First, set the forwarding policy & forwarding table according to each type of traffic
  - Then, as the service running,
    - ✓ each frame from the ingress port will be first checked the traffic type,
    - ✓ then the specific frame will be forwarded according to the forwarding rule & table.
- Moreover, the Converged Switch should assure the QoS for each industrial network.

How to assure the QoS based on Converged Switch

- Centralized Management
  - Collect & manage attributes and QoS request of different kinds of traffic
  - Unified to manage bandwidth resource & time slots
  - Schedule different traffic of different industrial production line / cell
  - Distribute the result rules of scheduling to different kinds of devices
- Improve the forwarding delay
  - Cut-through forwarding
  - Payload optimization according to frame size
- Questions to be studied
  - How to be agile to centralized management as the network scales out or is updated?

The Pros & the Cons of Converged Switch

Category	Pros	Cons	Potential Solution
Forwarding	• one category of switch could afford multiple scenarios	• Unease to support some forwarding mode different from standard Ethernet • risk of QoS, how to assure the low latency / jitter, to avoid the affecting between different kinds of traffic	• To support different forwarding mode based on converged switch with new designed forwarding table • To improve the mechanism of forwarding process for different kinds of traffic
Management	• centralized management based on converged switch leads to the overall effectiveness (e.g. proper traffic routing)	• to schedule each traffic of different kind, may lead to more complication of management, how to improve the management process and corresponding tool	• To provide unified tool to implement the management functionality
Extension	• to plan from the whole viewpoint, and to be good to get the optimal extension solution	• to avoid affecting between different kinds traffics of existing & extended	• To provide unified tool to implement the extension & management functionality

Next Steps

- To explore converged switch solutions to assure the QoS of existing industrial services and standard Ethernet services
  - There are 2 basic request should be satisfied: topology & forwarding. As it's not possible to change the devices currently, we have to support the different topology & forwarding mode of existing industrial network.
  - The third & important request is to assure the QoS for the existing devices.
  - Finally, how to adjustment network effectively, as the network changing or extension according to the service requirements.
- To initiate a study item for this converged switch solution as following potential aspects.
  - Study item to be proposed in next slide.

Proposal for Nendica Study Item

- For Nendica to initiate a study item on **Converged Elastic Ethernet Network**

To be studied	• Elastic topology / forwarding for different industrial scenarios. • Feasibility of assuring QoS for all devices connected by the converged switch. • Feasibility of Scheduling mechanism to mitigate or avoid the impact to devices. • Feasibility of Centralized & effective management / scheduling. • Other related aspects (high available, security, etc.) requested by industrial scenarios.
Deliverable	An informal report documenting • Summary requirements of industrial scenarios unsatisfied by current industrial networks • Potential benefits from Converged Elastic Ethernet Network • Impact & optimization of evolving technologies • Possible standardization recommendations
Leader	• Huajie Bao (Huawei), or other volunteers
Timeline	• Start in June 2022, finish in Nov 2022 • Draft version Aug 2022 • Call for comments Sept 2022 • Approval Study Item Report & corresponding work item Nov 2022
Work schema	• Weekly meeting or on-demand meeting • Welcome contributions

Thank you.