

Elastic Ethernet based on Converged Switch

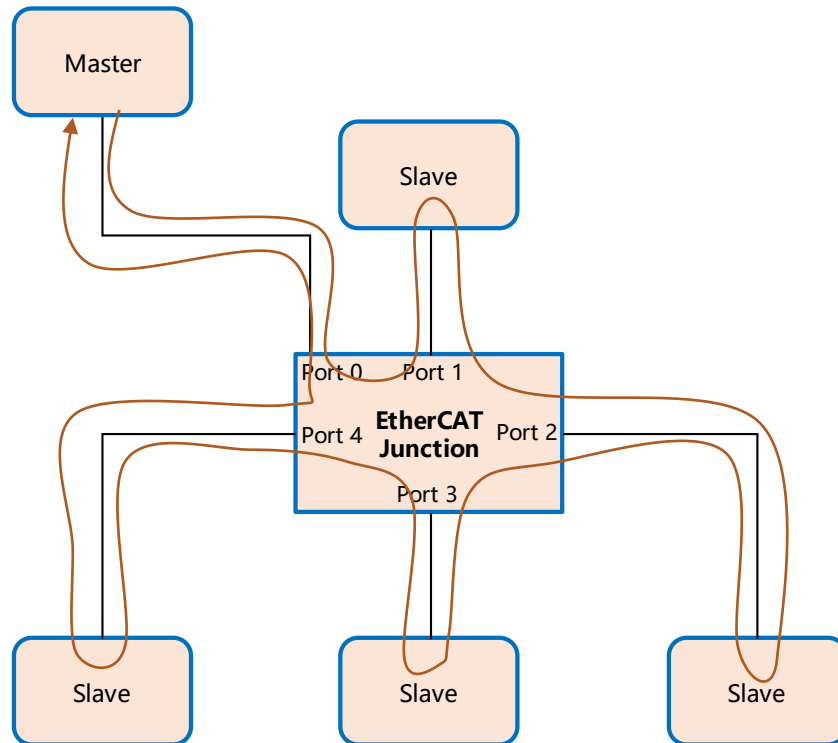
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Background

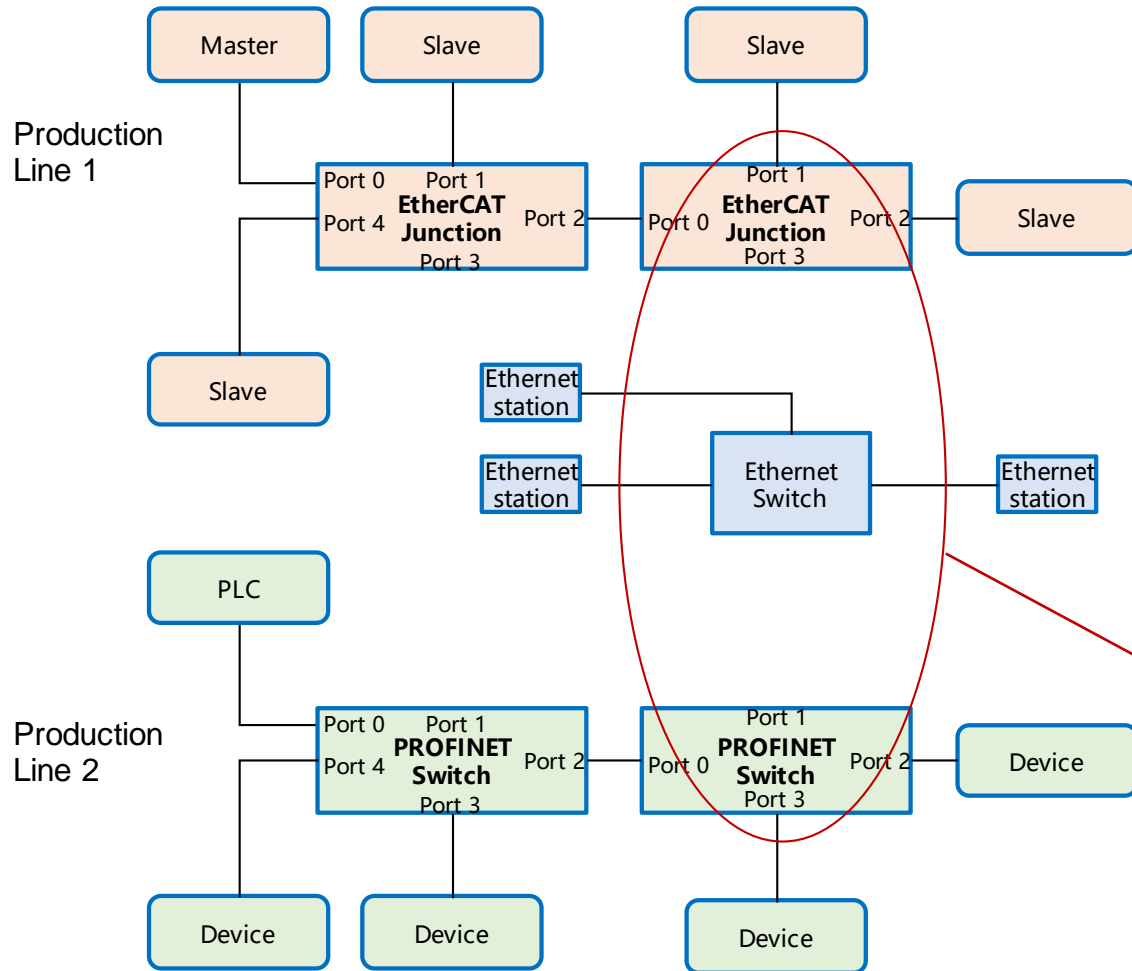
- Regarding Elastic Ethernet, several presentations were discussed, and leading the specific issues to be focused on.
 - ❑ 2021-05-16 [Industrial Network based on Convergent & Elastic Ethernet](#)
 - ✓ Weak determinism
 - ✓ Centralized management
 - ✓ Extreme low latency / jitter
 - ❑ 2021-05-06 [Convergent & 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?*

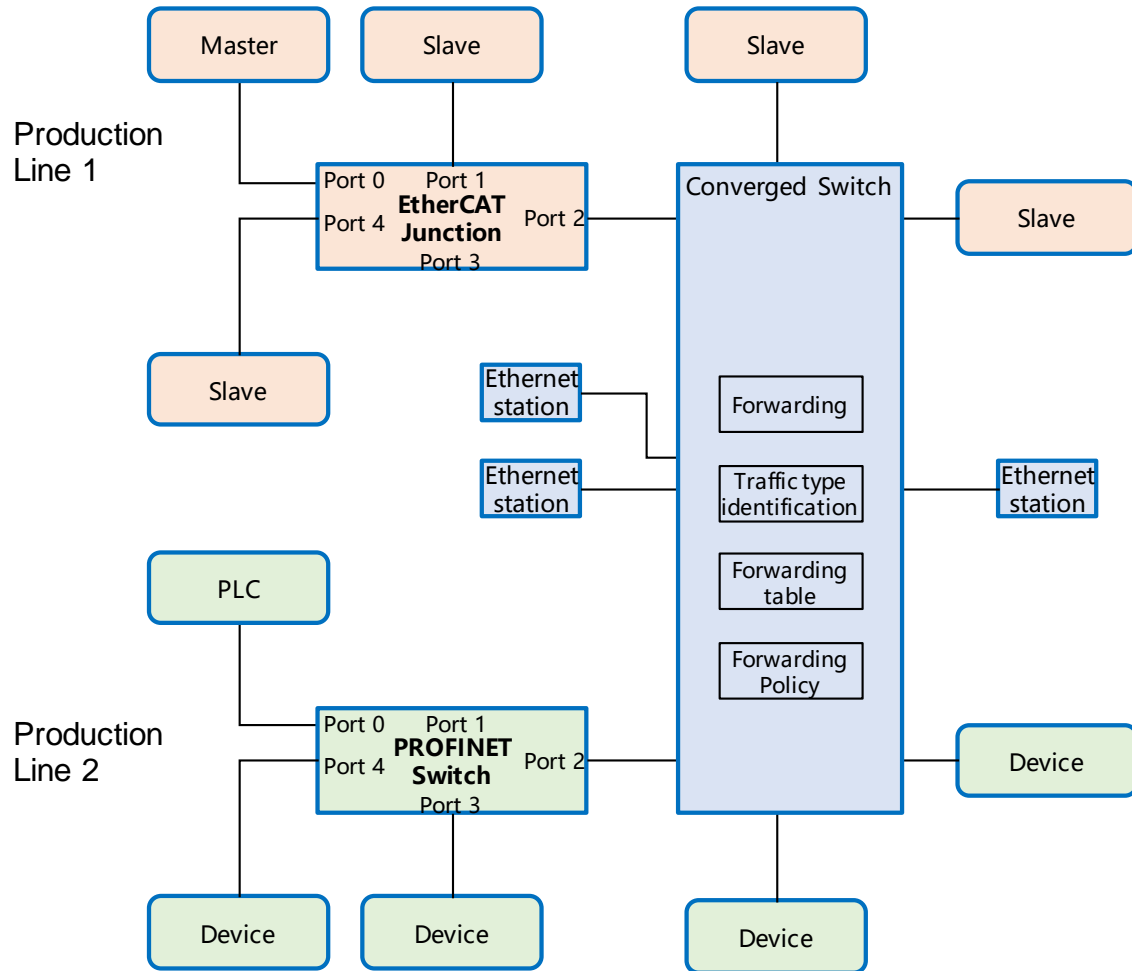
More Complicated Scenarios



- 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	<ul style="list-style-type: none"> one category of switch could afford multiple scenarios 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> centralized management based on converged switch leads to the overall effectiveness (e.g. proper traffic routing) 	<ul style="list-style-type: none"> to schedule each traffic of different kind, may lead to more complication of management, how to improve the management process and corresponding tool 	<ul style="list-style-type: none"> To provide unified tool to implement the management functionality
Extension	<ul style="list-style-type: none"> to plan from the whole viewpoint, and to be good to get the optimal extension solution 	<ul style="list-style-type: none"> to avoid affecting between different kinds traffics of existing & extended 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none">• 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	<p>An informal report documenting</p> <ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Huajie Bao (Huawei), or other volunteers
Timeline	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Weekly meeting or on-demand meeting• Welcome contributions

Thank you.