EtherCAT Relay Function

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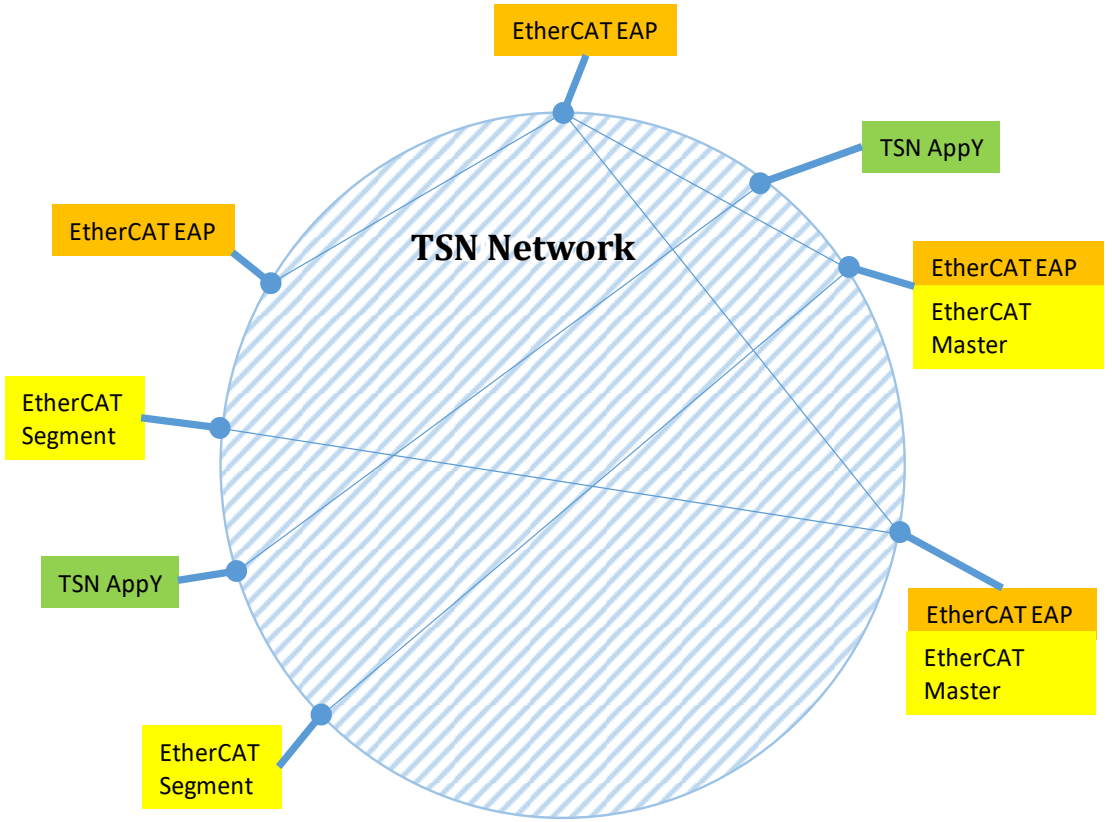
Huajie Bao (baohuajie@huawei.com, Huawei)

Objective

- This presentation is the follow-up discussion of the contribution EtherCAT Relay Function, and try to discuss in further details regarding Slides 8 and 10 of this contribution as mentioned in the minutes.
- This presentation includes contributions from Karl Weber & Marcel Kießling, thanks very much.
- Note that this presentation only expresses the opinions and views of the author, not of the EtherCAT Technology Group, please refer to www.ethercat.org for detail.
- If some points of EtherCAT wrong or unproperly understood, welcome to point out and discuss.

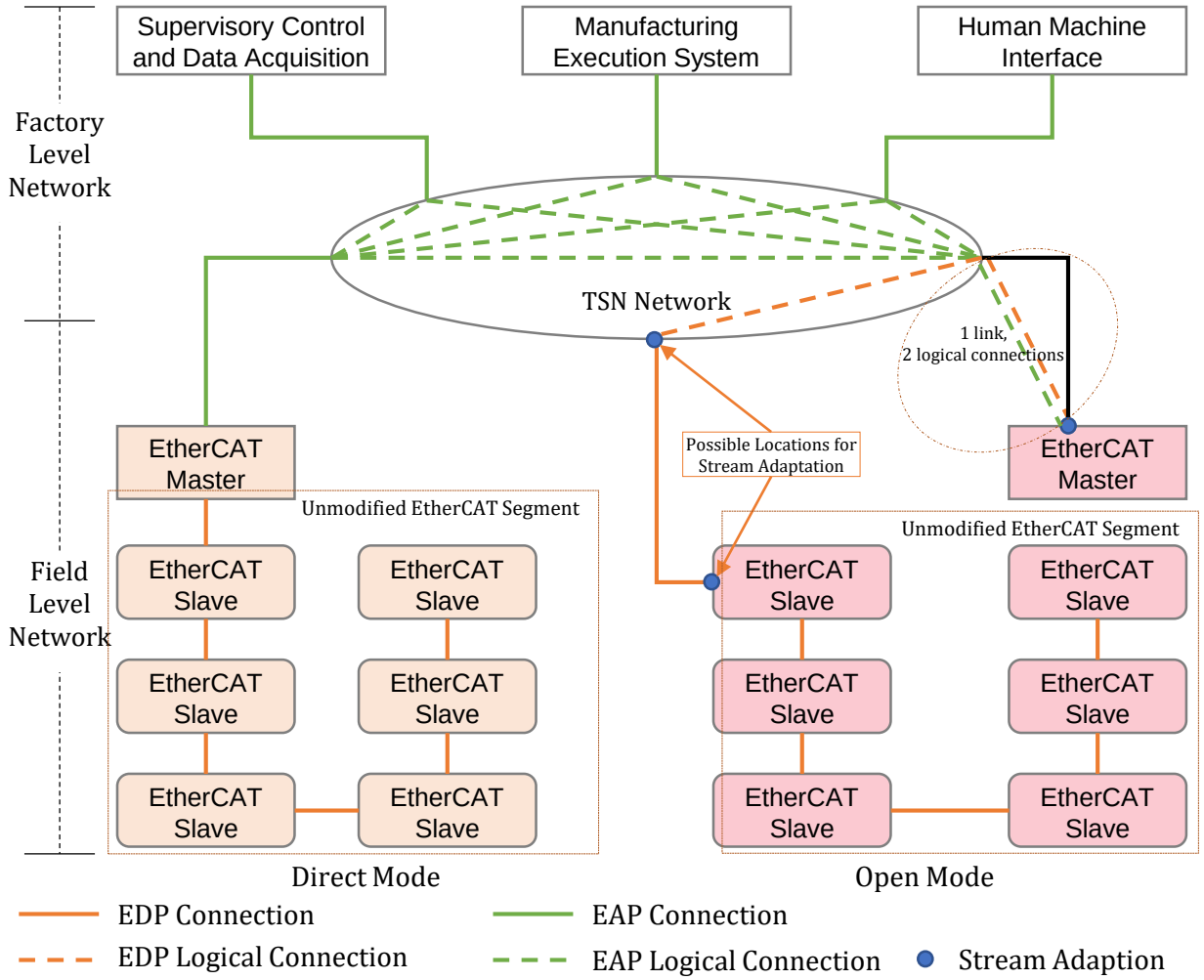
The EtherCAT Devices Connected with TSN Network

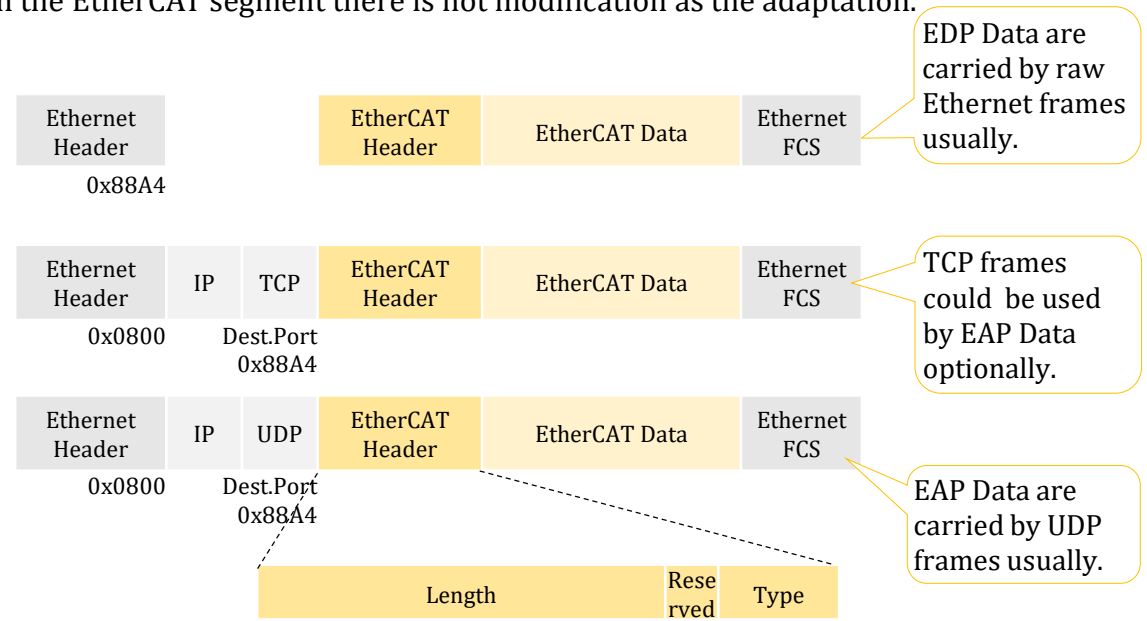


- As the figure left, copied from the slide 8 of the previous contribution, it briefly illustrate that the EtherCAT devices (master, segment of slaves, EAP devices or systems) and other type of applications, all of them are connecting to TSN network.
- Obviously, the streams between theses devices / systems request different communication cycle (hundreds of milliseconds, dozens of milliseconds, or microseconds etc.), as they carry out different functionalities and are deployed in different areas of a factory.
- Certainly, the EtherCAT could satisfy all of the requirements.
  - EtherCAT Device Protocol (EDP)
    - ✓ High real-time requirements, used for field level network
    - ✓ Master to slaves / segment
  - EtherCAT Automation Protocol (EAP)
    - ✓ The timing constraints are weaker with communication cycle of milliseconds level, used for factory level network
    - ✓ Master to master, master to MES / HMI or some management, monitor tools

EAP and EDP

- The up-level systems communicate with EtherCAT masters via EAP, The EtherCAT masters communicate with EtherCAT slaves via EDP.
- Both of the two parts implement the data exchange covering from up-level system to underlying devices.
- There are some stream adaptations to handle the MAC address as the blue point, and in the EtherCAT segment there is not modification as the adaptation.

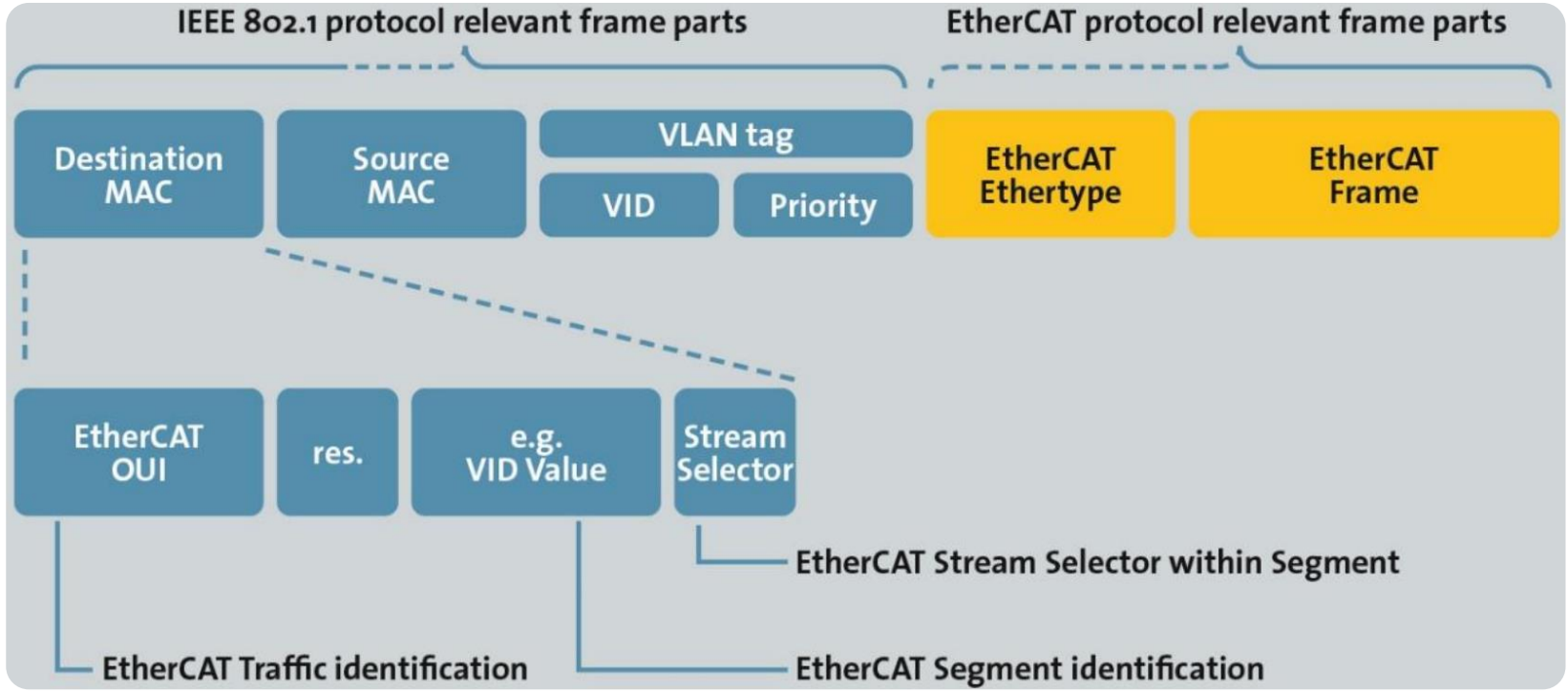




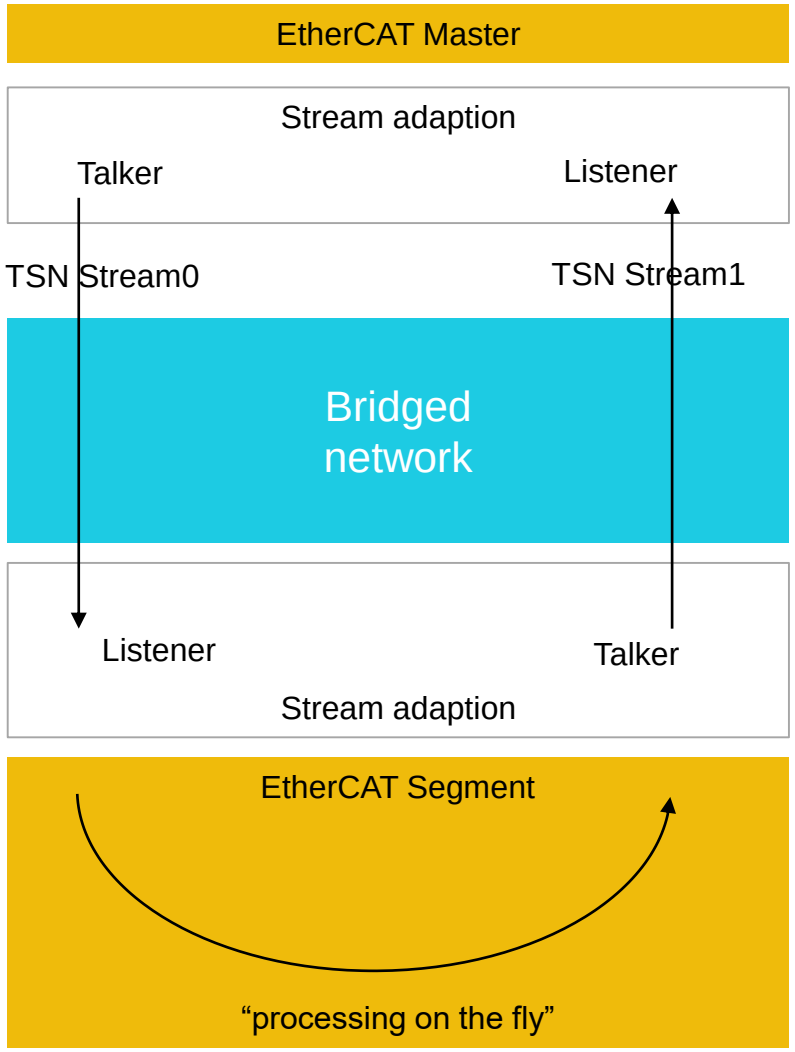
Field	Data Type	Value / Description
Length	11 bit	Length of the EtherCAT data
Reserved	1 bit	Reserved, 0
Type	4 bit	EtherCAT protocol type 1: EDP 4: EAP Process Data (cyclic) 5: EAP Mailbox Data (acyclic)

The Dedicated & Structured Design of MAC Sub-Field

- As the figure below, it is copied from the slide 10 of the previous contribution, It's not a new definition, it just **separate the MAC field** and obey the existing rules, **locally administer** to do some identification, handling or filtering functionalities requested by EtherCAT services .
  - **EtherCAT OUI**, applied by EtherCAT Technology Group, it could be used to identify the EtherCAT traffic and avoid MAC confliction while administering locally.
  - **Segment identification**, to identify the segment which the EtherCAT master is communicating with and associate with corresponding parameters (send interval, data amount etc.), which could be used by the master devices communicate with corresponding segments respectively.
    - ✓ Similarly, the same identification mechanism could be used to identify the EAP system hosts.
  - **Stream selector**, to identify a specific type of stream between the master and the segment, streams sent from master to slave segment have an even stream selector x, while the corresponding stream sent back from slave segment to master has an odd stream selector x+1.



EtherCAT Stream Adaption



- As the figure left, it is copied from the slide 9 of the previous contribution.
- The EtherCAT stream adaptation is a logical unit located as following two parts, which could be implemented at different physical devices.
  1. Located between an EtherCAT master and a bridged LAN, it’s usually implemented in the EtherCAT master device.
  2. Located between a bridged LAN and an EtherCAT segment, it can be implemented in the first slave of the EtherCAT segment (that is Open Mode EtherCAT slave device) or in the bridge connected an EtherCAT segment (that is standard & general EtherCAT slave device).
- The EtherCAT stream adaptation
  - Sender side: set the specific MAC addresses for streams according to the locally administered rules
  - Received side: identify, filter the MAC addresses, and handle of MAC addresses (e.g. exchange the DMAC & SMAC etc.).

Enlightenments to the Study Item

- In a factory, as EtherCAT related scenarios are covering not only high real-time scenarios (EDP) but also weaker timing constraint scenarios (EAP).
  - From the whole factory view, the study item to check & study whether it is related with some weaker timing constraint scenarios.
- The EAP entities and EDP entities connect to a TSN network, and assure all QoS requirements based on TSN and EtherCAT standard.
  - Compatibility leads to stability, it's a good example for the study item, and it's valuable to draw lessons from it.

Thank you.