

# TSN – brownfield compatibility

*Lihao Chen*

*Huawei Technologies*

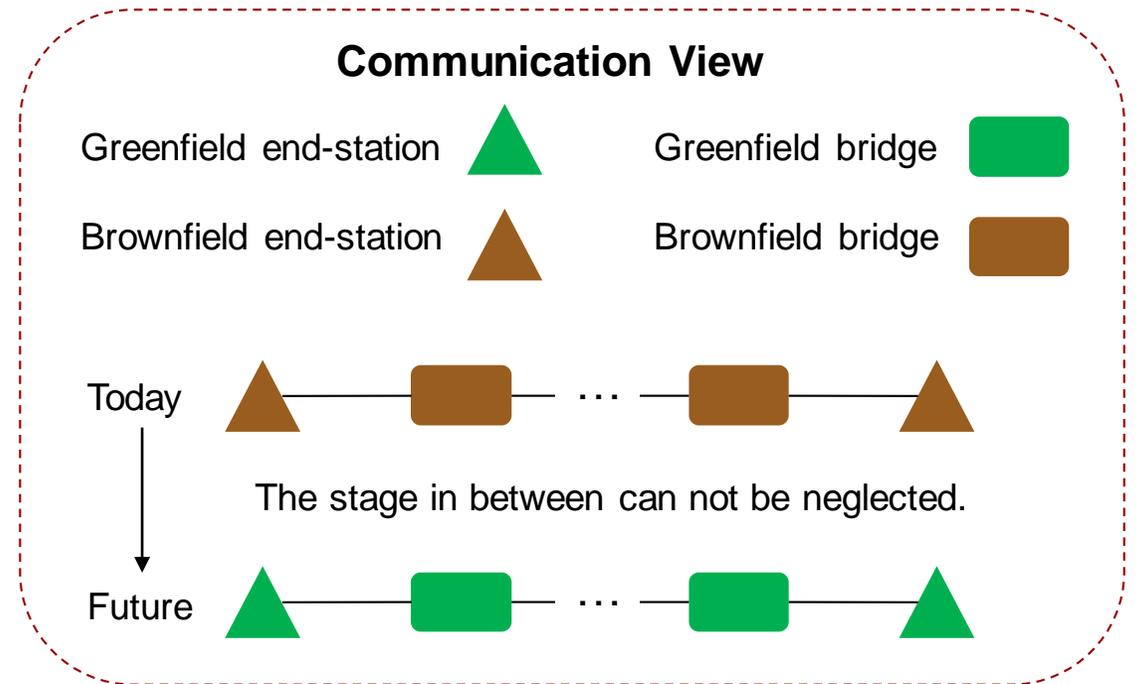
# Background

- Use cases:
  - Use case 11: Fieldbus gateway.
  - Use case 12: New machine with brownfield devices.
  - Use case 17: M2M/C2C Communication
  - ...
- Requirements:

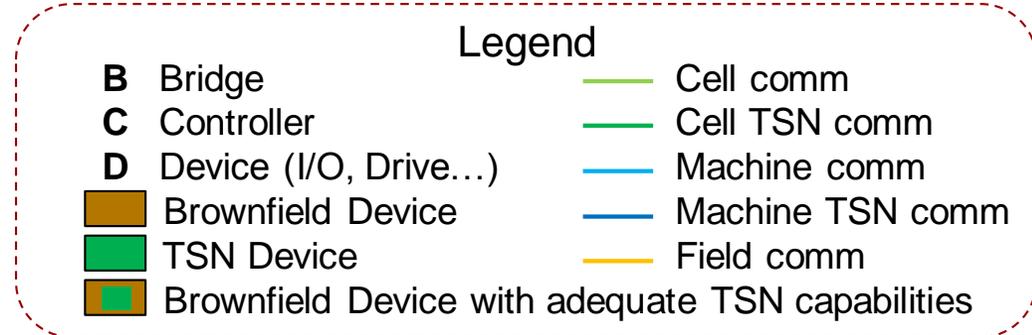
**R11** The TSN-IA profile shall support the extension of brownfield installations.

**R12** The TSN-IA profile shall support connection of existing (for e.g. migration) or non-TSN devices to TSN domains with as little as possible disturbance of existing modes of operation.

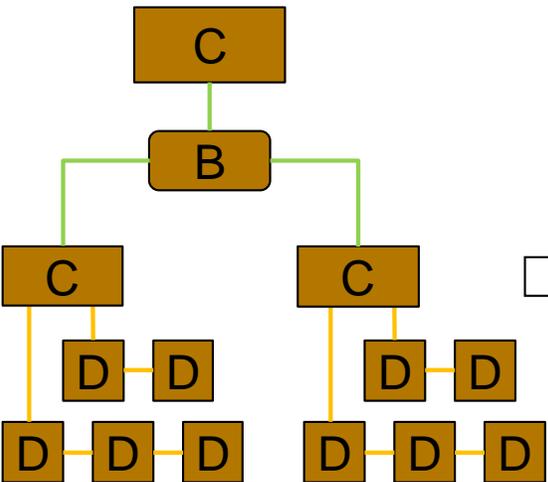
- **How should compatibility issue be addressed in the TSN-IA profile?**



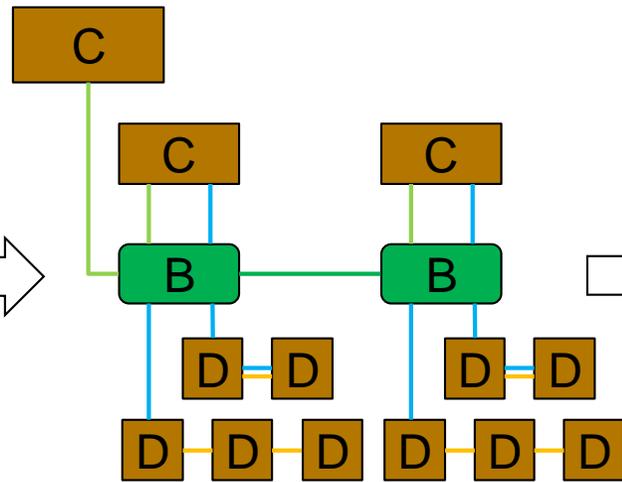
# Possible way of evolution



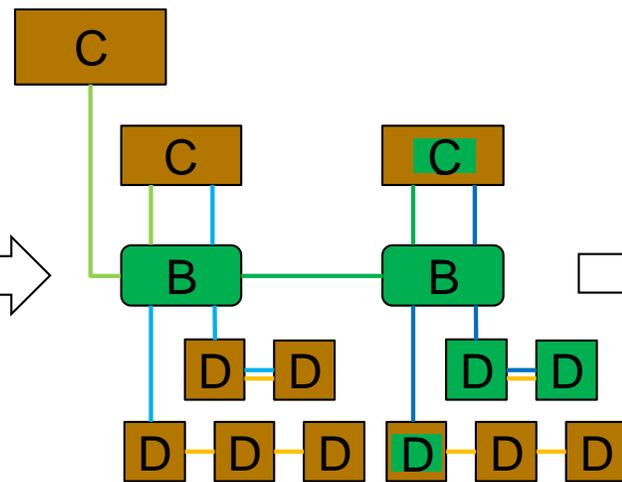
Structure as of today  
(A topology abstraction from 1)



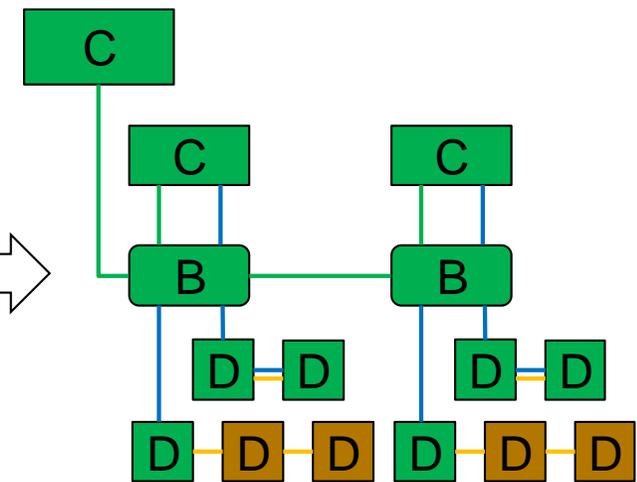
TSN bridges enable flexible topology and fieldbus-over-TSN communication



End-stations and bridged end-stations gradually 'turn green'



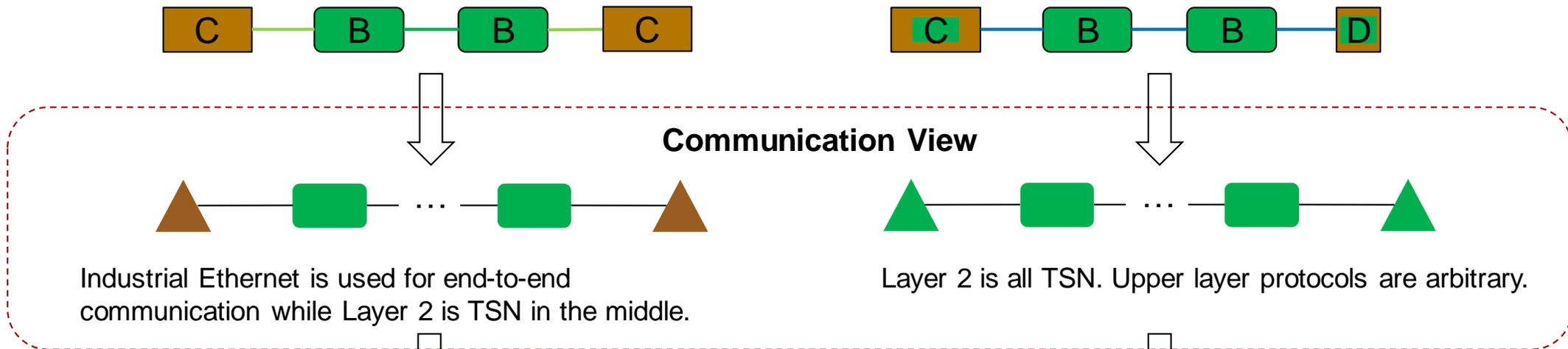
Possible structure with TSN  
(A topology abstraction from 1)



Of course, how will this process really be could only be determined by 'time' and is out of P60802's scope. However, we can get clues about what P60802 needs to do, especially the compatibility issue for the intermediate stages.

Reference 1: <http://www.ieee802.org/1/files/public/docs2018/60802-essler-additional-use-case-0718-v01.pdf>

## 2 communication scenarios



Compatibility issues are related to:

### Bridges

- Guarantee end-to-end performance of brownfield flows.  
Deadline, bounded latency, bandwidth, ...
- The performance of TSN-IA flows must not be harmed.
- Configuration mechanism is needed.

Idea: Compatibility specification of TSN-IA bridges are needed. See next pages.

### End-stations

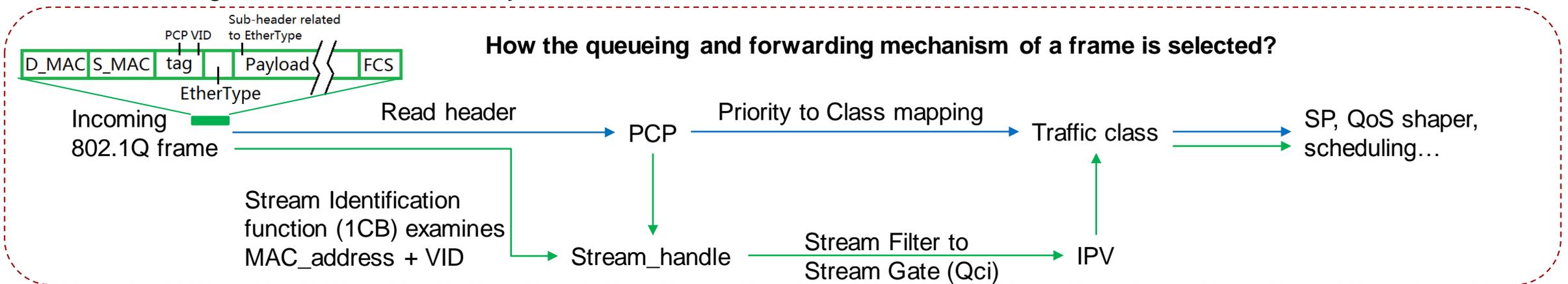
The end-station is either

- A brownfield end-station which is TSN-IA profile conformant, or
- A TSN-IA profile conformant end-station which supports a specific brownfield (Industrial Ethernet) protocol

Idea: No explicit compatibility specification for TSN-IA end-stations.

# Bridge: Data plane consideration

- **Requirement: Brownfield frames are queued and forwarded with a proper mechanism.**
  - If the brownfield traffic type is isochronous cyclic real-time, that frame should be treated similarly as greenfield isochronous cyclic real-time traffic frames.

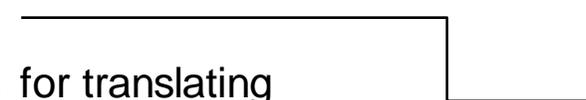


- The green path seems better (more flexibility and function enhancement possibilities)
  - The key is to examine EtherType and the Sub-header (to know the 'SubType' of the brownfield frame).
  - 802.1CBdb will define a more generic Stream Identification function extension, reference: Christophe Mangin's presentation at <https://1.ieee802.org/tsn/802-1cbdb/>
- **Proposal: 60802 should define profiles for brownfield stream identification**
  - Specifying a rule/guideline for 'EtherType+SubType to Traffic class' mapping.

# Bridge: Control plane consideration

- **Requirement: Configure rightly, then try to be close to Plug-and-play.**
- Need a proper way of reservation or configuration for brownfield streams
  - To make the brownfield end-station capable of using standard SRP/RAP or sending its configuration info to CUC/CNC (via SRP, OPC-UA, etc.), which seems not so practical and possibly of out 60802's scope.
  - To set the network all-manually, which seems practical but not good enough.
  - Possible idea 1 → □ To set user configuration info (to CUC) manually and let CUC/CNC finish the job, seems better.
  - Possible idea 2 → □ To let bridges recognize brownfield streams and translate its behavior to TSN configuration info, then make reservation or tell CUC. This is the plug-and-play idea but seems risky, as the first several brownfield data frames are going through the TSN network without any reservation or scheduling.
  - Relevant concerns by Stephan Kehrer, [Time Sensitive Networking \(TSN\) in brownfield applications](#)
- **What should 60802 do?**

- For idea 1, specifying a guideline/mechanism for translating brownfield stream requirement (talker behavior) to standard TSN parameters, i.e.
- For idea 2, specifying a guideline/mechanism for translating brownfield frames to TSN configuration info (and rules for adding new brownfield devices to the network, e.g., a safety margin?).



<u>TLV</u>	<u>TLV Type</u>	<u>TLV Length</u>
<a href="#">TrafficSpecification</a>	<a href="#">11</a>	<a href="#">9</a>
<a href="#">TSpecTimeAware</a>	<a href="#">12</a>	<a href="#">12</a>
<a href="#">UserToNetworkRequirements</a>	<a href="#">13</a>	<a href="#">5</a>

# Next steps

If we could reach a rough consensus on this matter (that something should be written in the profile to address the compatibility issue), then we can discuss:

- 1. Details of what should be specified. May need help from experts of different Industrial Ethernet / fieldbus technologies.
  - Brownfield stream/frame identification.
  - Brownfield stream's behavior to TSN configuration info translation.
- 2. How to add to the profile (e.g., bridge requirement/options or standalone) ?

# Questions?

Thank you