DETERMINISTIC6G

Some Thoughts on Multiple Configuration Domains

Kick-off for problem statement

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Disclaimer

- This presentation does not provide solution.
- The goal if this presentation is to provide some food for thought to kick-off the discussions

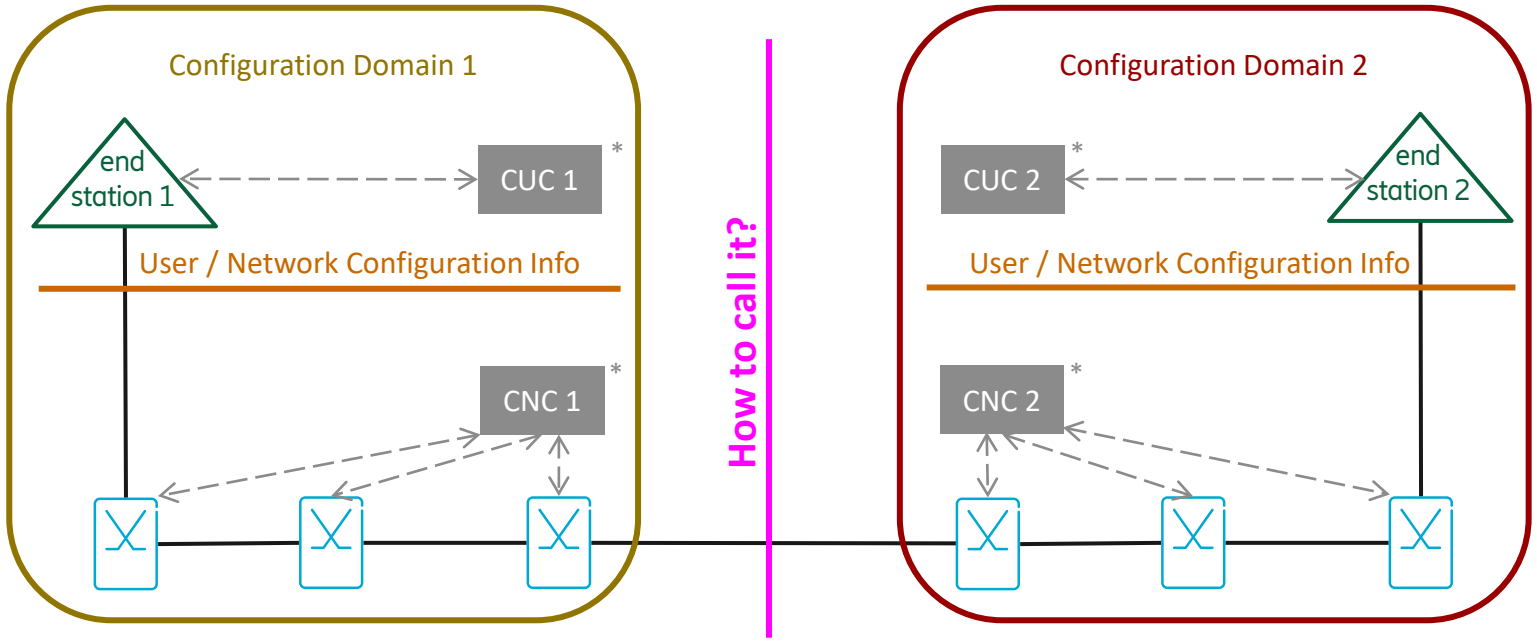
Background

- IEEE Std 802.1Qdj-2024:
  3.1 Configuration Domain: A set of stations that are under a common configuration and management scheme, and a single administration.

- Some earlier considerations:
  [1] https://www.ieee802.org/1/files/public/docs2021/new-farkas-inter-domain-considerations-0721-v01.pdf
  - **Consideration 1**:
    Ideally, inter-domain configuration would be specified such that if one choses a particular configuration model for intra-domain, then not mandated to implement features of another configuration model for inter-domain

High-level Illustration of Configuration Information

- Q1: How to call the configuration information between configuration domains?
  - Network / Network Configuration Info?
  - Inter-domain Configuration Info?
  - Something else?



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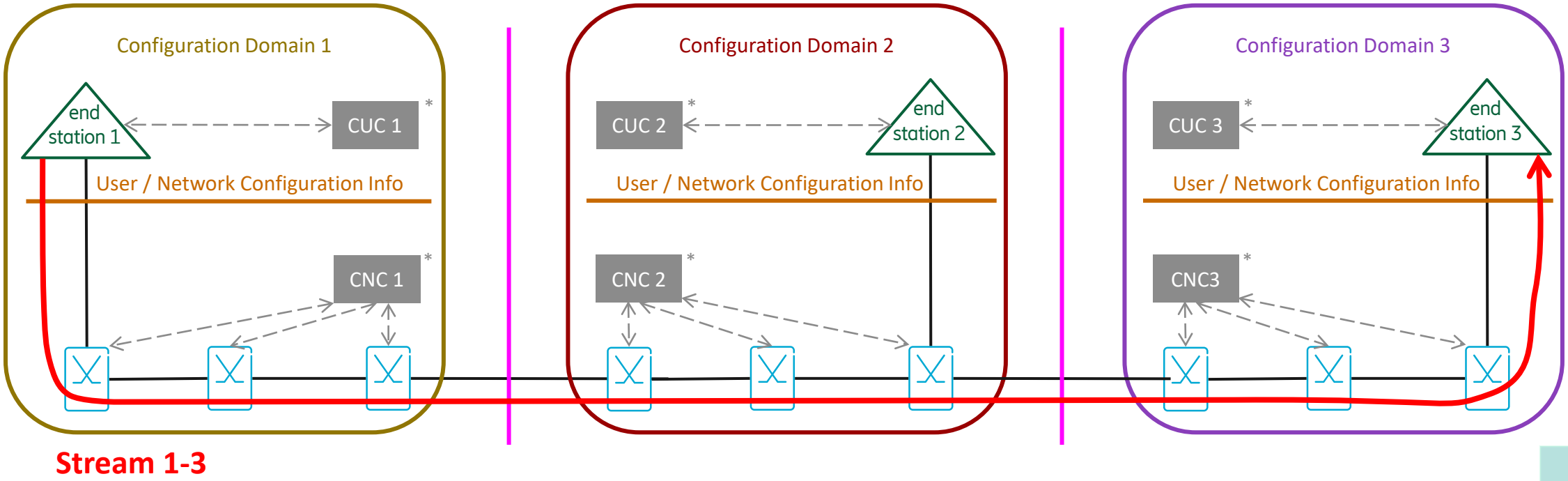
Potentially: Transit Configuration Domain(s)

- For instance, Domain 2 is transit domain for Stream 1-3



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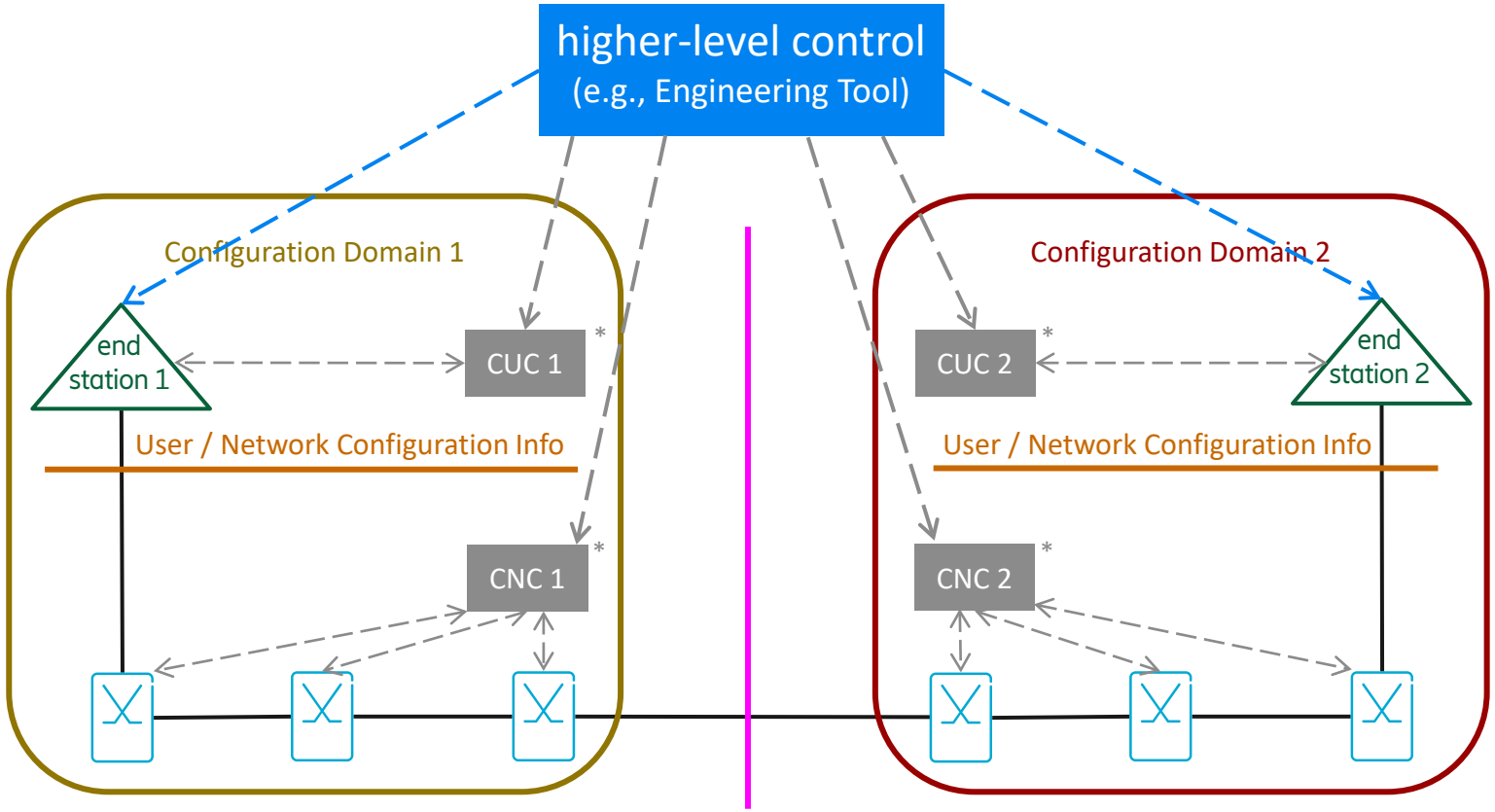
Some Questions

- Q2: Single vs Multiple administration for the different domains
  - Both should be addressed
- Q3: Configuration Domains vs MST Regions
  - See in the following
- Q4: How to figure out which end stations need to communication to each other?
  - See in the following
- Configuration Domains vs (g)PTP Domains ***– to be subject of a future presentation***
  - Note 1: Ultimately, irrespective of configuration domains, the corresponding end stations have to have the same notion of time as well as the bridges in between them if, e.g., Transmission Gates and/or Stream Gates operate in the bridges
  - Note 2: See 6.2.13 in IEC/IEEE 60802 for IA: “Any valid gPTP domain number as specified in IEEE Std 802.1AS-2020 can be used”

A Use Case: Industrial Automation (IA)

- Can be considered under single administration?
- A higher-level entity, e.g., Engineering Tool, can control which end stations communicate to each other



Configuration Domains vs MST Regions

- Bridges in an MST Region have the same MST Configuration Identifier (MCID), i.e., same VID → FID → MSTID allocation (otherwise, MSTP forms distinct MST Regions)
- If different VIDs are used in different Configuration Domains, then these Configuration Domains cannot be part of the same MST Region

- Basic Industrial Automation (IA) use case, as per IEC/IEEE 60802 (6.4.2.4):
  - Two MSTIs are required to be supported
    - CIST: MSTID = 0
    - TE-MSTID: 0xFFF
  - VIDs are assigned to the CIST by default
  - IA time-aware streams and IA-streams are assigned to the TE-MSTID

What Tasks To Be Solved?

- Task 1: Establish data communication
  - Stream Identification
  - (potentially, VID translation, priority regeneration at domain boundaries)
- Task 2: Meet QoS requirements
  - Task 2.1: meet delay requirements
    - Maximum delay
    - Maximum delay variation
  - Task 2.2: meet reliability/availability requirements
    - Potentially, establish redundant communications

Task 1: Establish data communication

- Stream identification
  - Stream identification should be set all right in each Configuration Domain a given Stream traverses
  - Stream transformation may be required if different stream identification is used in different configuration domains
  - VID is part of each stream identification method
- VID values
  - Different domains may use different VID values for a given Stream
  - VID translation or Stream transformation may be required
- Priority regeneration
  - Priority regeneration may be used at Configuration Domain boundary, see, e.g., IEC/IEEE 60802
- Q5: Who sets up VID translation, Stream transformation, priority regeneration, etc.?
  - Q5.1: Who communicates to the different Configuration Domains what values to use?
  - These questions apply both to centralized and distributed resource reservation approaches

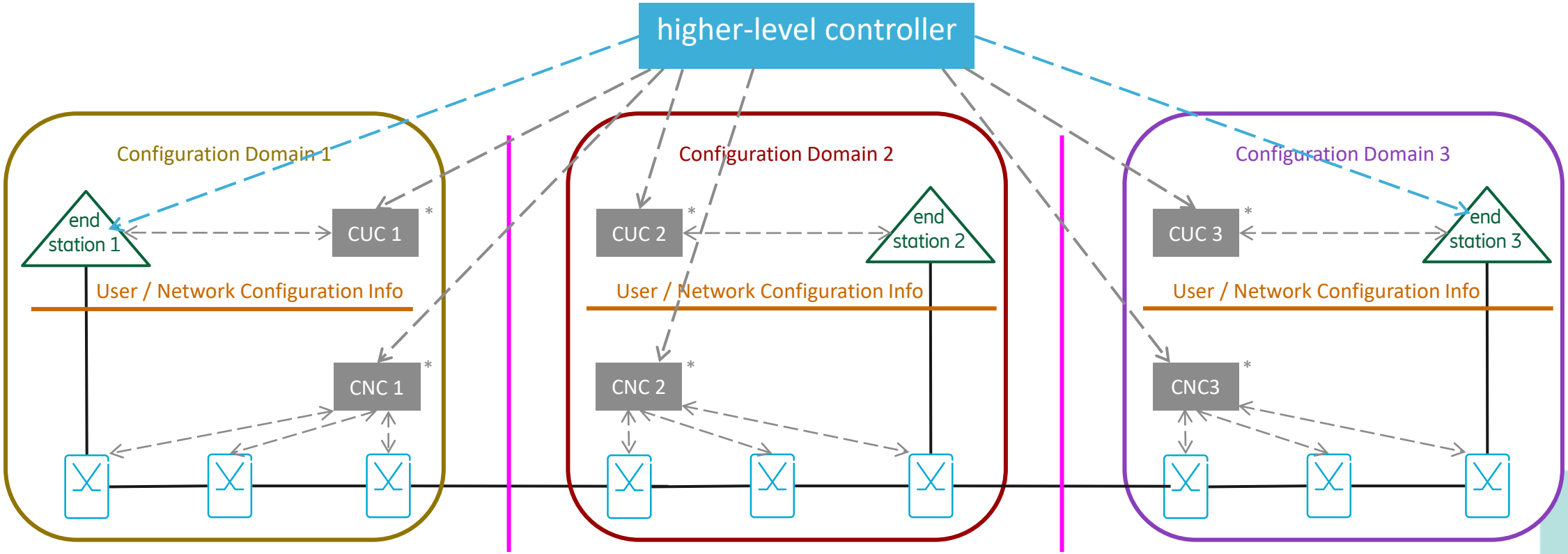
Task 2: Meet QoS requirements

- Task 2.1: meet delay requirements (e.g., maximum delay, maximum delay variation)
  - **Q6: Who divides the delay (delay variation) budget for the different configuration domains?**
    - especially in case of configuration domains under different administration

- Task 2.2: meet reliability requirements
  - If reliability requirements are so stringent, then “service protection”, e.g., FRER, needs to be set up in each Configuration Domain the given Stream traverses
    - This requires multiple boundary ports and coordinated set-up of FRER
  - Q7: How to set-up service protection, incl. maximally disjoint fixed paths and FRER?
    - especially in case of configuration domains under different administration

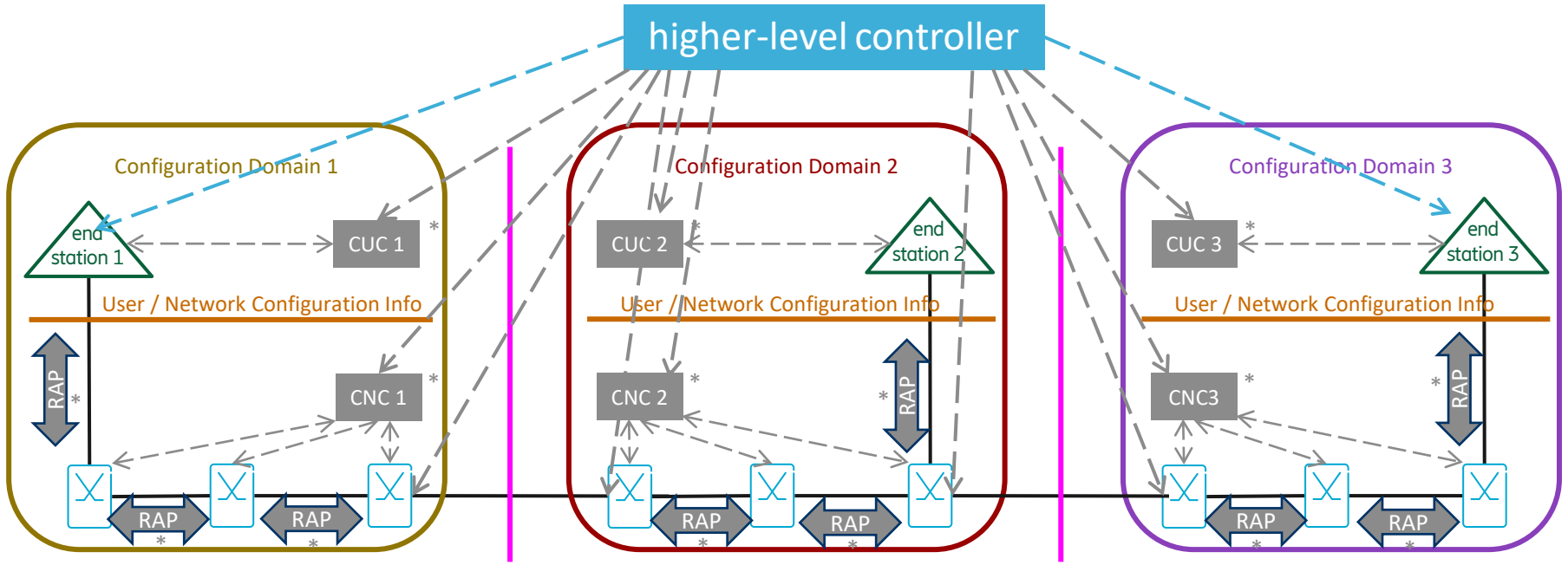
A Possibility In Case of Single Administration

- A high-level controller could implement the tasks for multiple configuration domains
- (It is also called Hierarchical SDN if the configuration domains apply centralized approach)



Is There Any Other Way for Industrial Automation?
(In case of Single Administration)

- In IA, some tasks are solved by a central entity even in case of distributed resource reservation in a single configuration domain, e.g., Streams use traffic engineered VIDs (allocated to the TE-MSTID), whose establishment requires a central entity, see more here (e.g., page 9)
- For instance, VID translation, Stream transformation **cannot** be set by a distributed protocol



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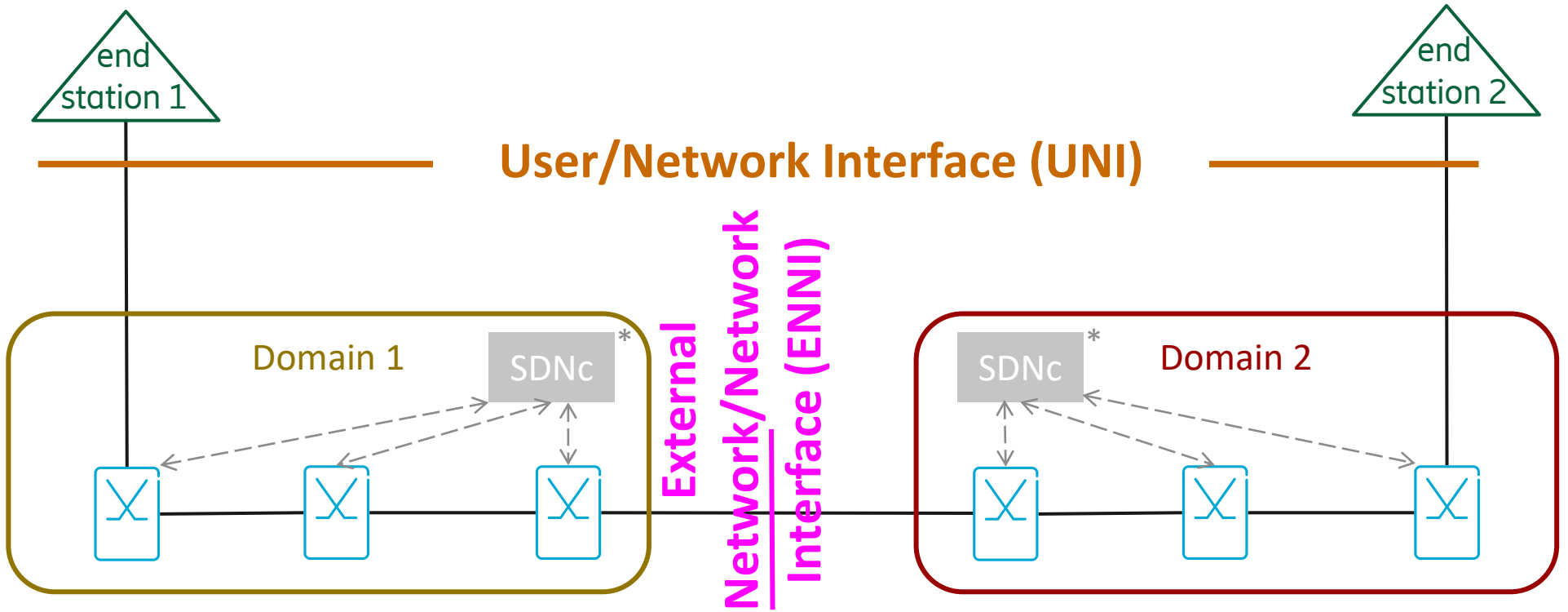
What To Do In Case of Distinct Administration?

- Any other viable approach than Service Level Agreement (SLA)?
- Should we follow a model similar to Carrier Ethernet Service defined by MEF? (see, e.g., ENNI).



Further Thoughts?

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