TSN inter domain communication concept

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Continuation of work from …
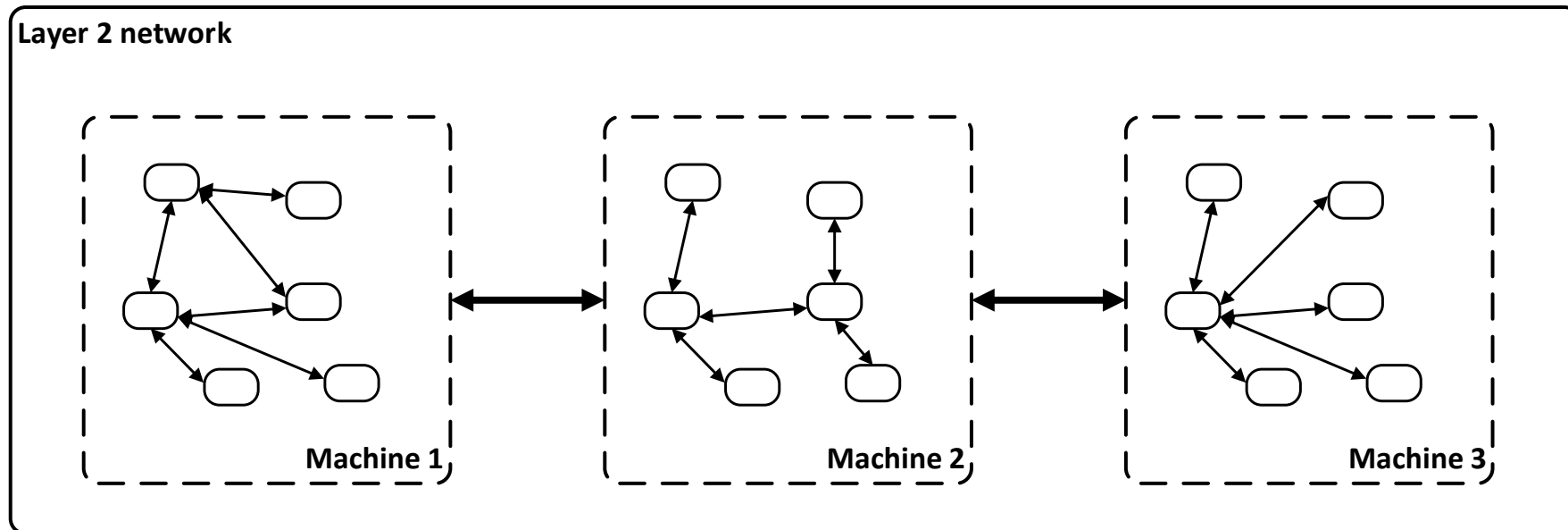
- "Use Cases IEC/IEEE 60802" by IEEE/IEC 60802
  http://www.ieee802.org/1/files/public/docs2018/60802-industrial-use-cases-0918-v13.pdf

- "TSN Interdomain Communications" by Mark Hantel (Rockwell Automation)
  http://www.ieee802.org/1/files/public/docs2018/60802-Hantel-TSN-Interdomain-Communications-0718.pdf

- "TSN Configuration Interaction" by Lihao Chen (Huawei Technologies)
  http://www.ieee802.org/1/files/public/docs2019/new-chen-TSN-Configuration-Interaction-0719-v01.pdf

Mission and Scope

- **TSN domain [IEC/IEEE 60802, Rev d1-1]:**
  - The term "TSN domain" is work in progress in IEC/IEEE 60802:
    "A TSN domain is an administrative group of devices."

- **Problem statement: How can the use cases (e.g. machine-to-machine communication) be realized?**
  - Machines can be in different TSN domain
  - Converged TSN (multiple applications) should run on top of the whole Layer 2 network
  - Any configuration model (e.g. centralized or distributed) can be applied inside a TSN domain
  - ➜ Goal: One solution for communication between TSN domains

- **Concept:**
  - **TSN domains are considered as black boxes**
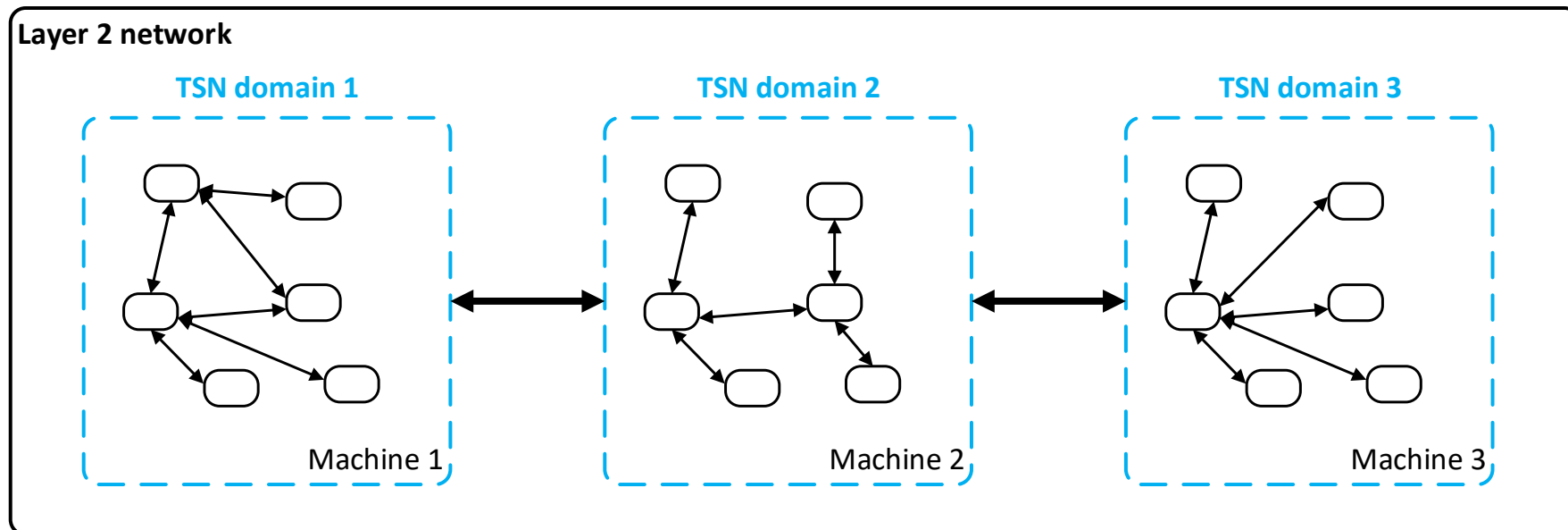 - **TSN domains should be specified in P802.1Qdj**

Why TSN domains in IEC/IEEE 60802?

- **TSN domains** are required:
  - To assign TSN functional responsibility and provide an operational guarantee of a subsystem to a supplier (e.g. for one machine or production cell)
    - While working within the product limitations of the used automation components (constrained devices)
  - Structuring of the network using TSN domains reduces the complexity (e.g. path finding, resource management)

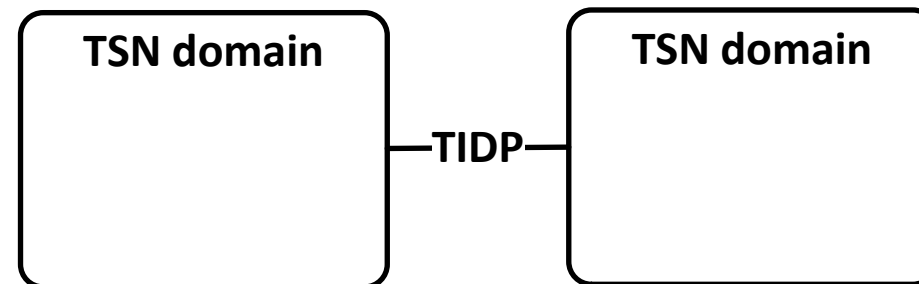Layer 2 network — Machine 1, Machine 2, Machine 3

Why TSN domains in IEC/IEEE 60802?

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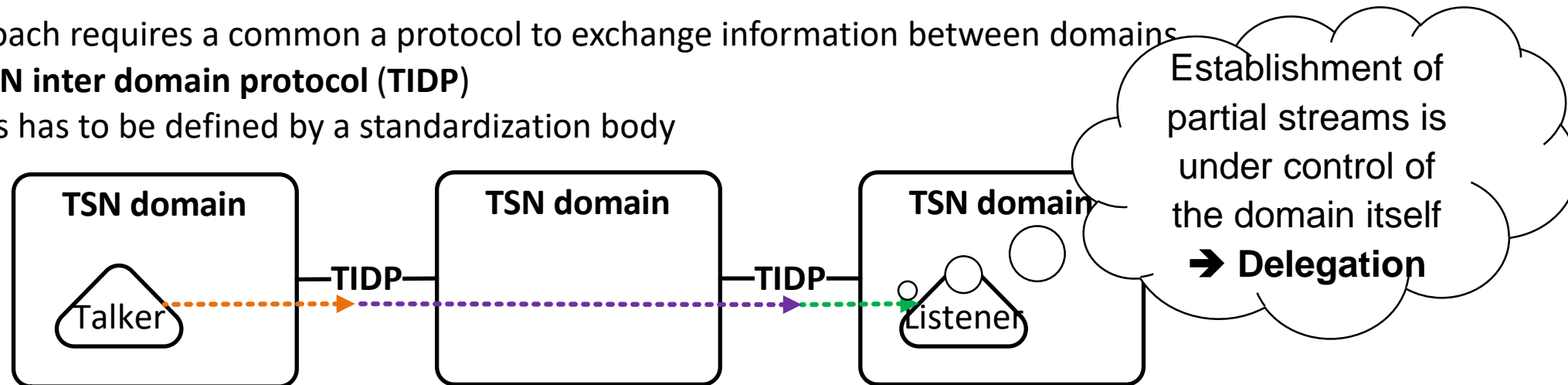# Approach: Considering TSN domains as black boxes

- **TSN domains are black boxes**, i.e. their internals doesn't matter to the outside world
  - Each TSN domain is responsible for the stream establishment and teardown inside its domain

- Black box approach requires a common a protocol to exchange information between domains
  - Let's call it **TSN inter domain protocol** (**TIDP**)
  - Obviously this has to be defined by a standardization body

```
┌─────────────────┐         ┌─────────────────┐
│   TSN domain    │         │   TSN domain    │
│                 │──TIDP──│                 │
│                 │         │                 │
└─────────────────┘         └─────────────────┘
```

- Similar activities in IEC/IEEE 60802 (e.g. Huawei "CCP based on LRP"[1])

[1] http://www.ieee802.org/1/files/public/docs2019/new-chen-TSN-Configuration-Interaction-0719-v01.pdf
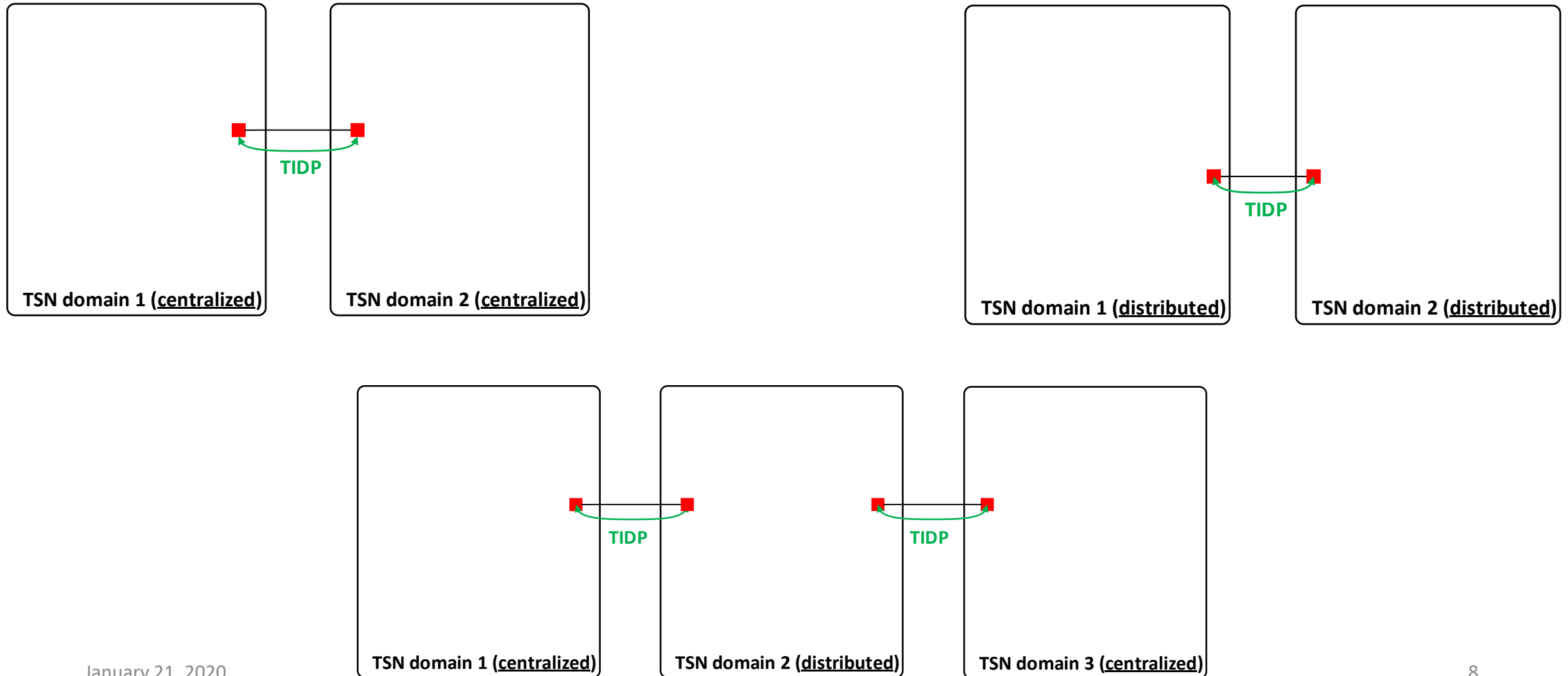
Approach: Considering TSN domains as black boxes

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Establishment of partial streams is under control of the domain itself
➔ **Delegation**

- Similar activities in IEC/IEEE 60802 (e.g. Huawei "CCP based on LRP"[1])

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Approach: Considering TSN domains as black boxes in different scenarios

TSN domain 1 (<u>centralized</u>)   TSN domain 2 (<u>centralized</u>)   TSN domain 1 (<u>distributed</u>)   TSN domain 2 (<u>distributed</u>)

TIDP

TIDP

TSN domain 1 (<u>centralized</u>)   TSN domain 2 (<u>distributed</u>)   TSN domain 3 (<u>centralized</u>)
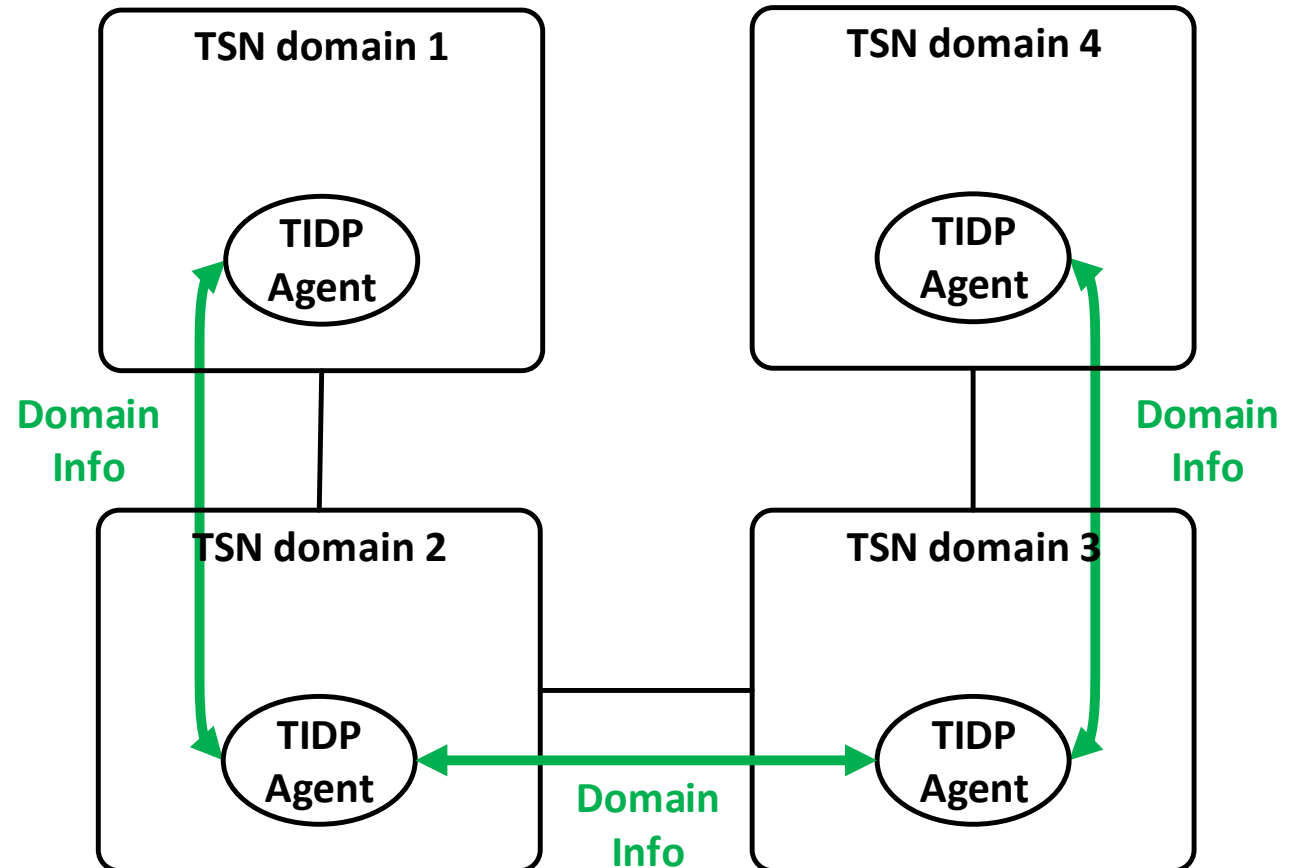
TIDP   **TIDP**

Approach: Considering TSN domains as black boxes in different scenarios – inside view
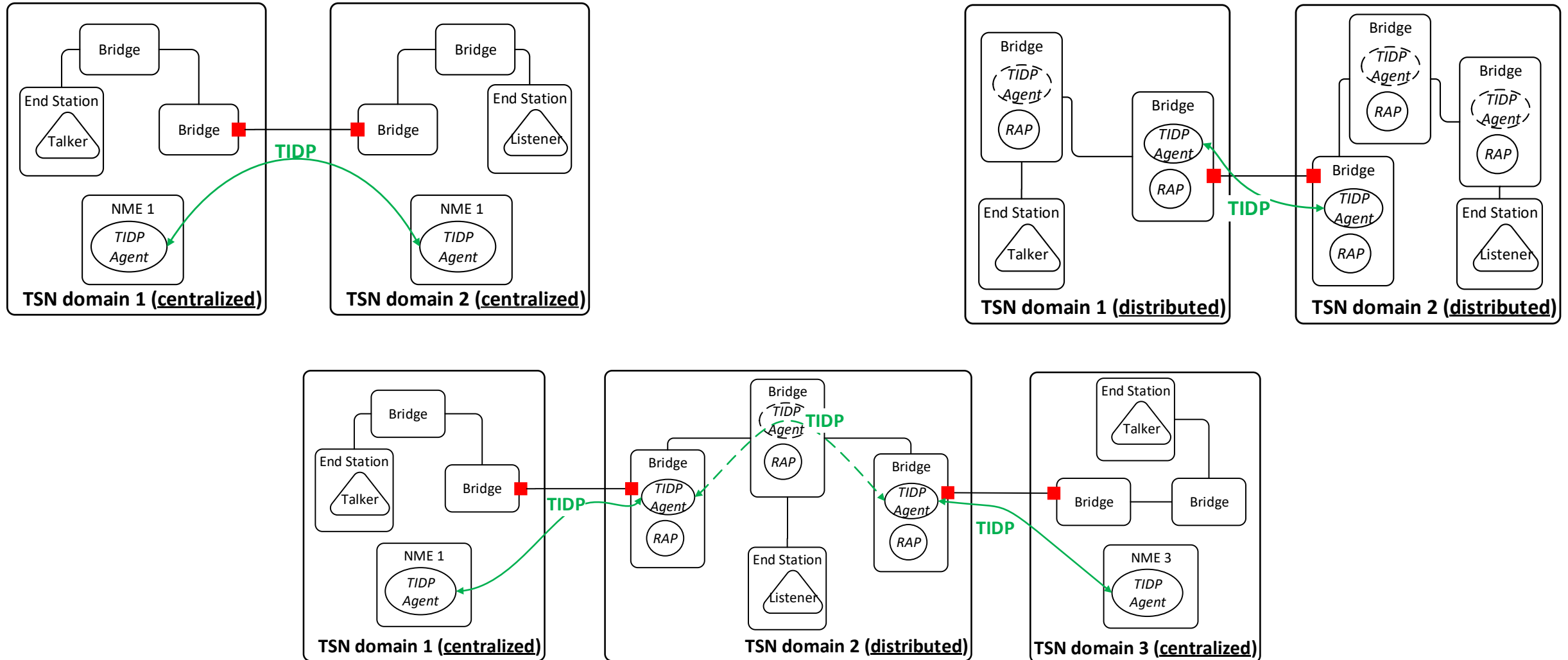
TIDP: Exchange of TSN domain information

- Finding a path to a destination is necessary

- **Exchange of organizational information**:
  - Own TSN domain IDs
  - Reachable TSN domain IDs
  - Address of TIDP agent
  - ...

Note: TSN domains may be centralized or distributed

TIDP: Establishment of TSN inter domain streams

- **Setup of TSN inter domain streams:**
  - Stream information:
    - Who is the talker?
    - Who is/are the listener?
    - QoS parameters (e.g. TSpec)
    - TSN domain of listener
    - Address of listener inside domain
  - Result of stream establishment must be propagated back
  - …
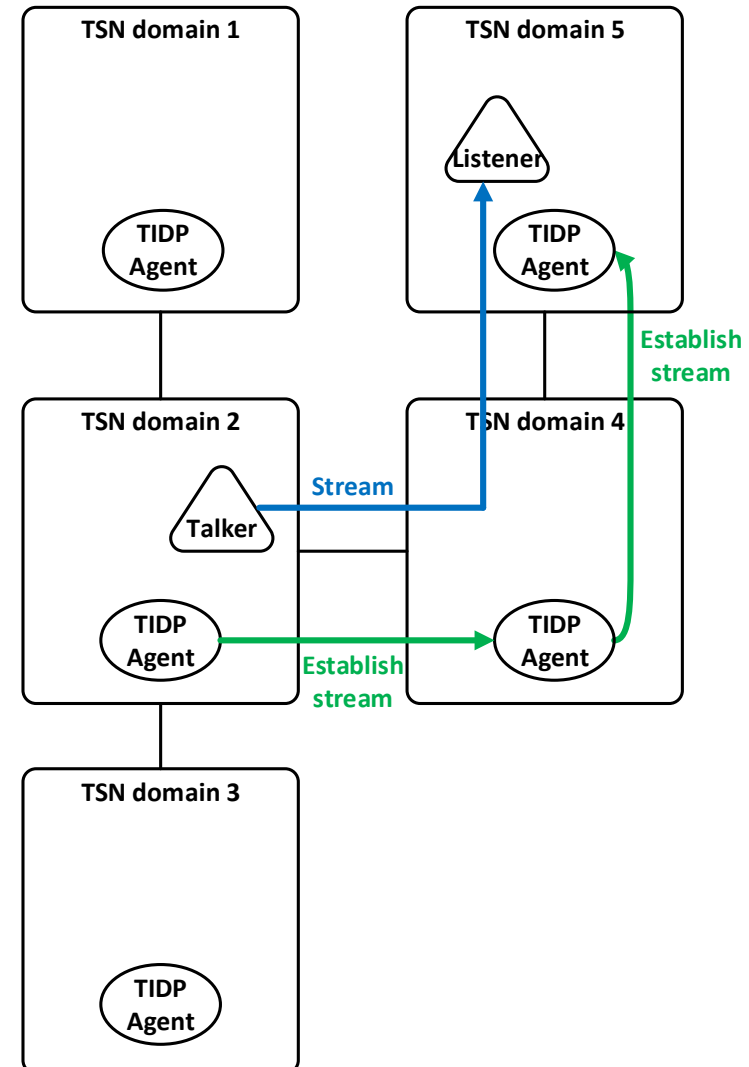
Summary

- TSN domain concept seems suitable for structuring layer 2 networks (e.g. into different machines)
- TSN domain as a black box allows usage of centralized and distributed configuration model in one layer 2 network

- TSN inter domain communication is necessary
- TIDP as a proposal for the one TSN inter domain communication protocol

- Idea: TIDP should be based on LRP

Questions?