Registration and Reservation / Signaling

New Protocol Version supporting Decentralized Organized Networks

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Our Assumptions
TSN for Industrial Automation

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Required functionality for industrial TSN networks

- Industrial networks are typically structured hierarchical networks
- Network segments must have the ability to work independent
- Separating and joining of network segments must be possible without losing connectivity within the segment
- After power up dynamically communication relation will be establish
- The network must have the ability to add and remove network components and end stations add at every time
- The network is shared between multiple control applications and other services
- Control applications and services can go up and down at every time
- The network must guarantee most possible independence between different control applications

⇒ Static control applications mean not at all a static network configuration!
⇒ Static centralized network configuration will not fulfill all requirements for industrial automation networks!

⇒ **For industrial automation networks there is still a need for**
- dynamic centralized TSN network configuration and for
- dynamic decentralized TSN network configuration

Thoughts about centralized and decentralized organized Industrial Networks

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1. Static Centralized Organized Networks

- Within industrial automation there are a lot of established static centralized organized systems (e.g. EtherCat, PROFInet IRT, VARAN, …).

2. Dynamic Centralized Organized Networks

- SDN in data centers
- MPLS in backbones

3. Decentralized Dynamic Organized Networks

- Ethernet and Internet are well known decentralized organized Systems
- AVB is also a decentralized organized system

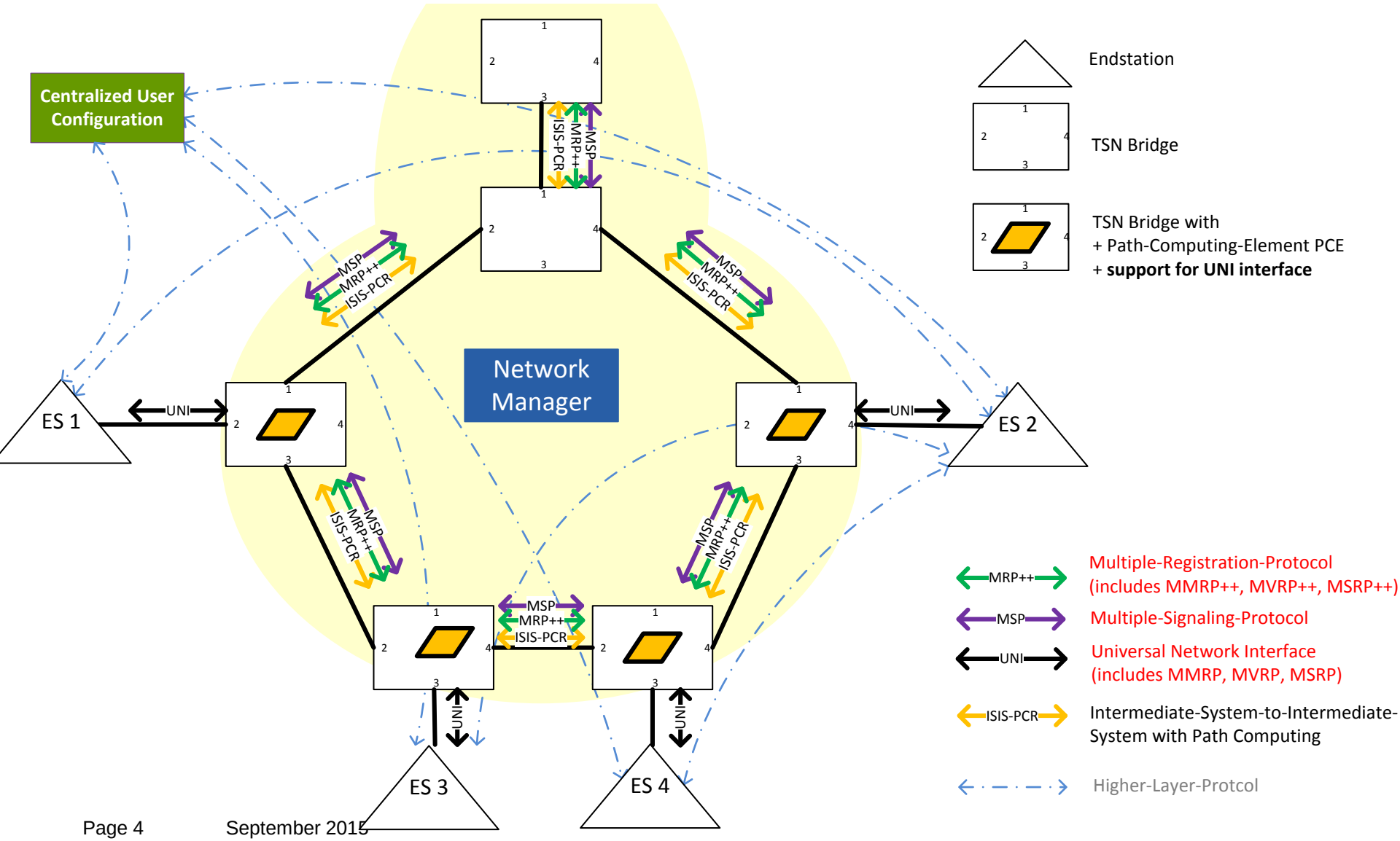
With introducing TSN in industrial automation, vendors are also requesting for a dynamic centralized or decentralized organized communication network.

One example is the ongoing discussion about OPC_UA over TSN!
See: http://www.ieee802.org/1/files/public/docs2015/tsn-munz-requirements-for-tsn-in-manufacturing-0515-v01.pdf

Example for a Decentralized Organized Network

Distributed Path Calculation (with PCE's)

Protocol based Registration (MRP++) and Reservation / Signaling (MSP)



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Reasons for splitting Registration and Reservation

Registration

- Network attributes have no direction
- Network attributes are not modified by registration
- Network attributes are typical valid over long time
- Huge amount of data caused by stream attributes
- Support for higher number of network attributes e.g. streams
- Extended network attributes to support new TSN features (e.g. seamless)
- Flexible network attribute combination for different features (e.g. streams)

Reservation / Signaling

- E2E signaling of current status with direction (upstream, downstream)
- Merge information along the path between source and sink
- Status can change more often -> requires a higher update rate
- Only few data e.g. status
- Support for higher number of network attributes e.g. streams
- Support new features e.g. rate constrained traffic class for services with bandwidth allocation at runtime

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Features of MRP++

- Only used for network attribute **registration**
- Network attribute forwarding along given path (context)
- Support for higher number of network attributes by
  - Fragmentation
  - Support for checksums
- Flexible encoding of network attributes (TLV like)
- One logical MRP++ PDU which carries the information of all MRP++ applications
  - Multiple VLAN Registration Protocol: MVRP++
  - Multiple MAC Address Registration Protocol: MMRP++
  - Multiple Stream Registration Protocol*: MSRP++

* MSRP: Multiple Stream Reservation Protocol

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Features of MSP

- Only used for network attribute **reservation / signaling**
- Status and data forwarding along given path (context)
- Merge / aggregate status and data along the path (upstream, downstream)
- Flexible encoding of status and data (TLV like)
- Supports different reservation / signaling applications
  - MSSP: Multiple Stream Signaling Protocol
    - Accumulated min. and max. Latency (Downstream)
    - Required Latency (Upstream)
    - Stream send state (Ready/Failed) (Downstream)
    - Stream receive state (Ready/Failed/ReadyFailed) (Upstream)
  - …

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Features of UNI

- Common interface for end stations and edge bridges to provide network organization independence

- Backward compatibility to current version of MRP and its application:
  - Multiple VLAN Registration Protocol: MVRP
  - Multiple MAC Address Registration Protocol: MMRP
  - Multiple Stream Reservation Protocol: MSRP

- End stations and edge bridges have to support the MPR participants functionality of the current MRP version

Request for new PAR supporting Decentralized Organized Networks

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Scope of the new project:

- Support for more streams. The current worst case limit is less than 500 streams; there are use cases that require two orders of magnitude greater than this.
- Mechanisms that allow Stream Reservation class (SR class) parameters to be configured
- Deterministic stream reservation convergence by separating registration and reservation / signaling.
- Inclusion of additional mechanisms in the stream reservation protocol that support new TSN features, such as higher reliability, latency requirements, and report latency changes due to network reconfiguration.
- Support for higher layer streaming sessions, remain compatibility to RSVP.
- User Network Interface (**UNI**) for routing and reservations to provide network organization independence for end stations and edge bridges.

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Thank you for your attention!!!!!

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