TSN Management

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Motivation – help with the management part of the profile

- Propose an informative TSN control plane model, which is

  - Capable of covering every TSN management scenarios of Industrial Automation.

  - Consistent with existing contributions.

- Use this model as a reference to

  - Give a 'management function table' which can be used when drafting the profile.

  - Summarize the existing gaps and discuss potential ways of solution.

- Discuss these two topics in more details:

  - CNC-CNC communication and multi-domain configuration (Page 8-10).

  - Network management of constrained devices (Page 11-13).

802.1Qcc TSN Configuration Model Recap

RP (Registration Protocol): MRP/LRP
UNIP: User-Network Interface Protocol: MSRP/RAP/…
NMP (Network Management Protocol): SNMP/NETCONF/RESTCONF…
**UMP** (User Management Protocol)

Please note:
These are not new definition proposals, just in order to facilitate the expression in this presentation.
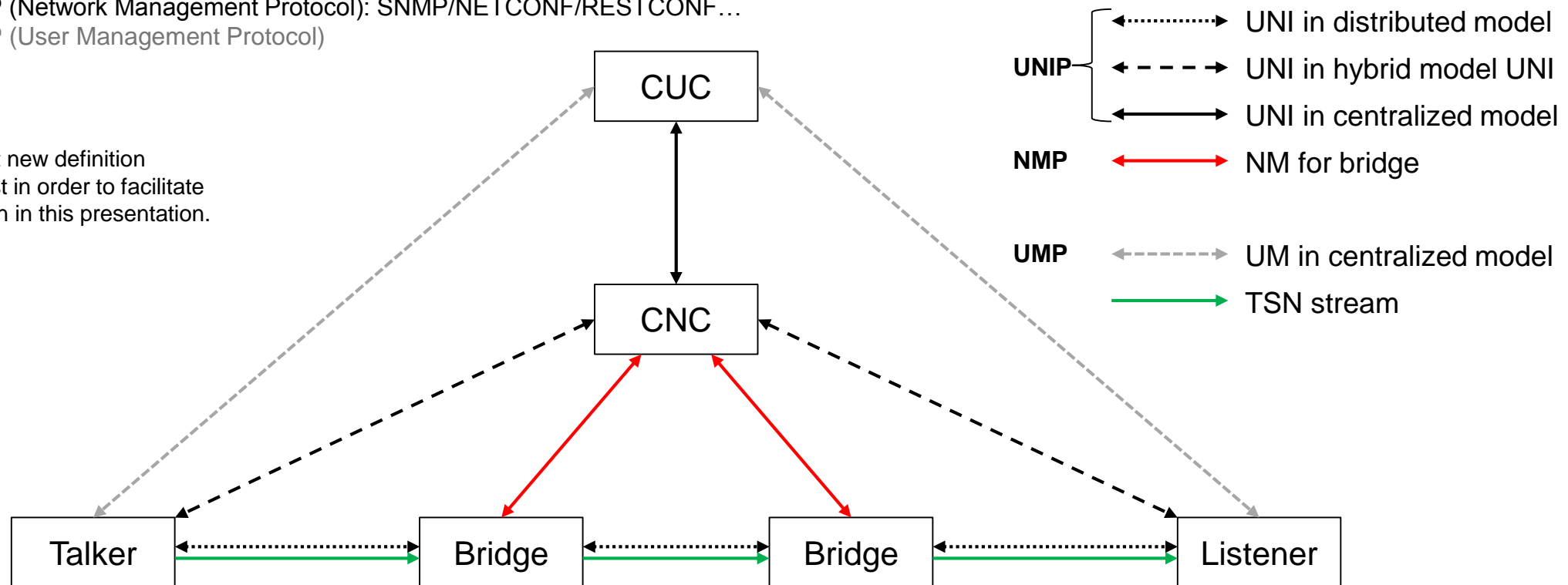
- ➤ This model combines the fully distributed model, the hybrid model, and the fully centralized model.
- ➤ A node (rectangle) represents a function, not a device. (E.g., a Talker can exist in either an end-station or a bridged end-station.)
- ➤ An arrow means two nodes are connected. Don't care how the nodes are specifically connected in implementation.

Part 1: The Fully Distributed Model

Function	Need to support
Talker/Listener	RP-UNIP
Bridge	RP-UNIP

→
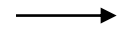
The meaning of this table:
If the fully distributed model is used for management, the Talker/Listener should support RP-UNIP, and the Bridge should support RP-UNIP.

This table could be used as a reference when drafting the profile.

- ➢ RP-UNIP means MRP-MSRP, LRP-RAP, etc.
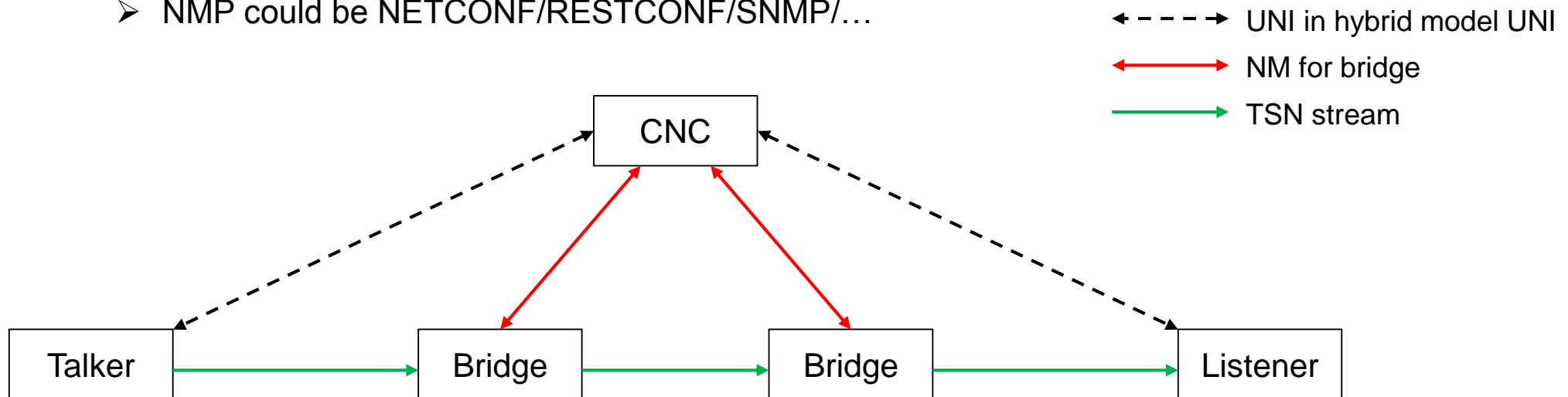- ➢ Solution already exists.

◄┄┄┄┄► UNI in distributed model

──────► TSN stream

| Talker | ◄┄┄► | Bridge | ◄┄┄► | Bridge | ◄┄┄► | Listener |
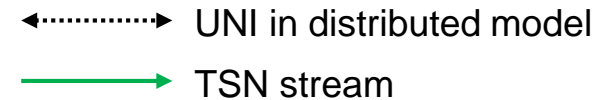
Part 2: The Hybrid (distributed user, centralized network) Model

Function	Need to support
Talker/Listener	RP-UNIP
Bridge	NMP+RP-UNIP*
CNC	NMP+RP-UNIP

*: TBD. see ①

➤ NMP could be NETCONF/RESTCONF/SNMP/…

- - - ▶ UNI in hybrid model UNI
◀——▶ NM for bridge
——▶ TSN stream

① If the network connection between Talker and CNC crosses a bridge, then the bridge should have RP-UNIP capability.

Part 3: The Fully Centralized Model

Function	Need to support
Talker/Listener	UMP*
Bridge	NMP
CNC	UNIP+NMP
CUC	UNIP+UMP*

*: TBD. The UMP is out of 802.1 scope, also out of 60802 scope?
➤ The UNIP between CUC and CNC could be RP-UNIP/RESTCONF/…

Legend:
- UNI in centralized model
- NM for bridge
- UM in centralized model
- TSN stream
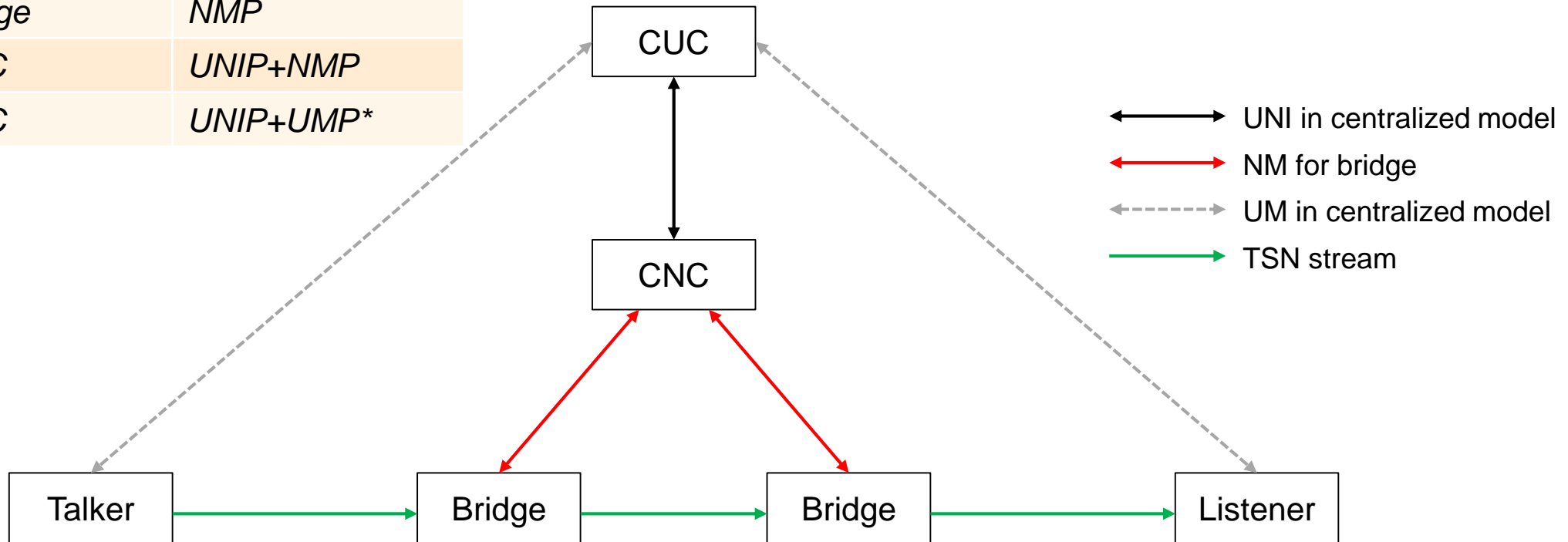
What's new with 60802?

The Basic **Management Function Table**

Function	Distributed	Hybrid	Centralized
Talker/Listener	RP-UNIP	RP-UNIP	UMP*
Bridge	RP-UNIP	NMP+RP-UNIP*	NMP
CNC	/	NMP+RP-UNIP	UNIP+NMP
CUC	/	/	UNIP+UMP*

This table may need to be expanded when drafting a specific profile, e.g., the profile for IA.

Two new points:

- **CNC-CNC communication and Multi-domain configuration.**
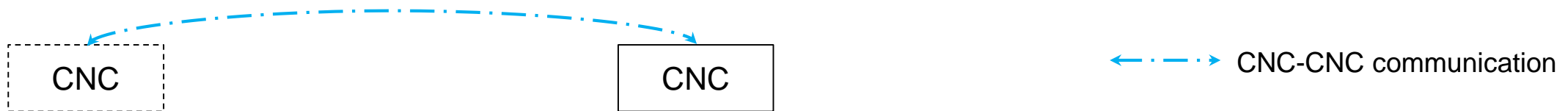- **Network management of constrained devices.**

Part 4 (new): The Controller-Controller Model

Function	Need to support
CNC	CCP*

*CCP: Controller-Controller Protocol. TBD.

CNC-CNC communication could support:
① CNC selection and failover within one domain.
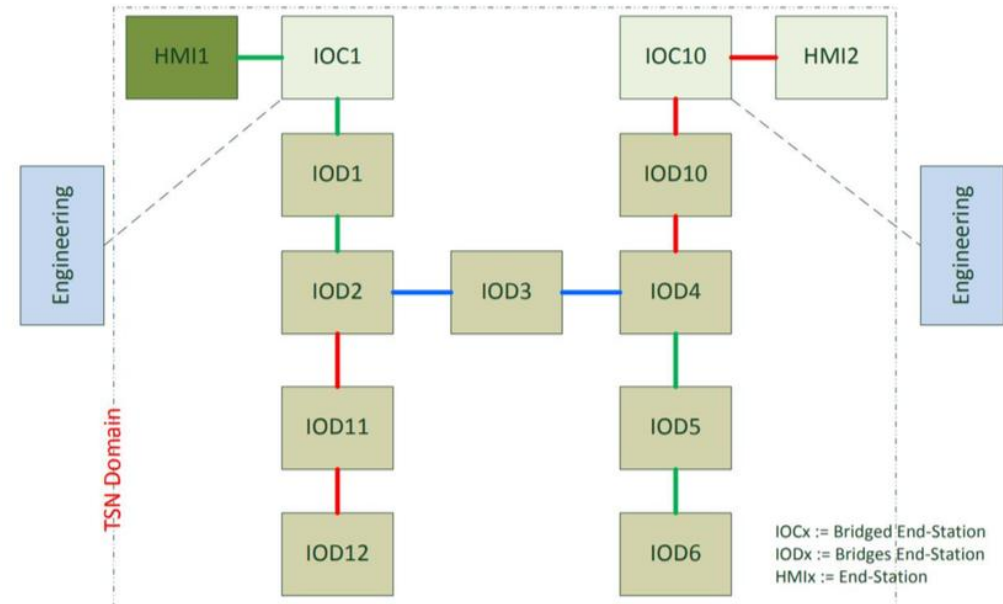② Inter-domain user information (e.g., stream configuration requirement) exchange.
③ …

The CCP could be based on a Registration Protocol, i.e., RP-CCP.

More considerations from:
http://www.ieee802.org/1/files/public/docs2018/60802-stanica-convergence-coexistence-0718-v03.pptx

Alignment to current consideration – Multiple CNCs in one domain

Assumption: Each CNC is able to configure the whole TSN domain.
➢ Agreed. Database is synchronized between CNCs. MRP/LRP has a data synchronization mechanism.

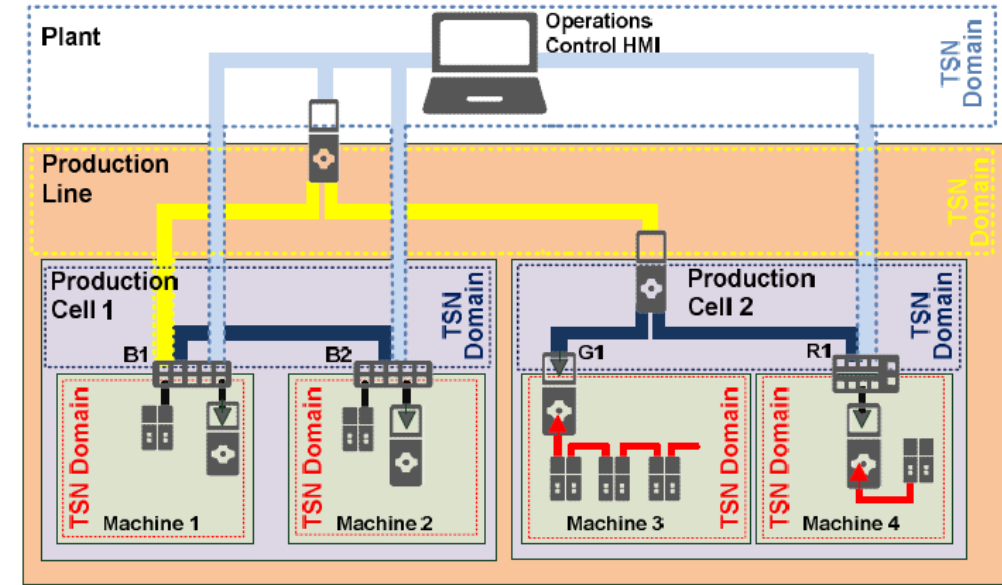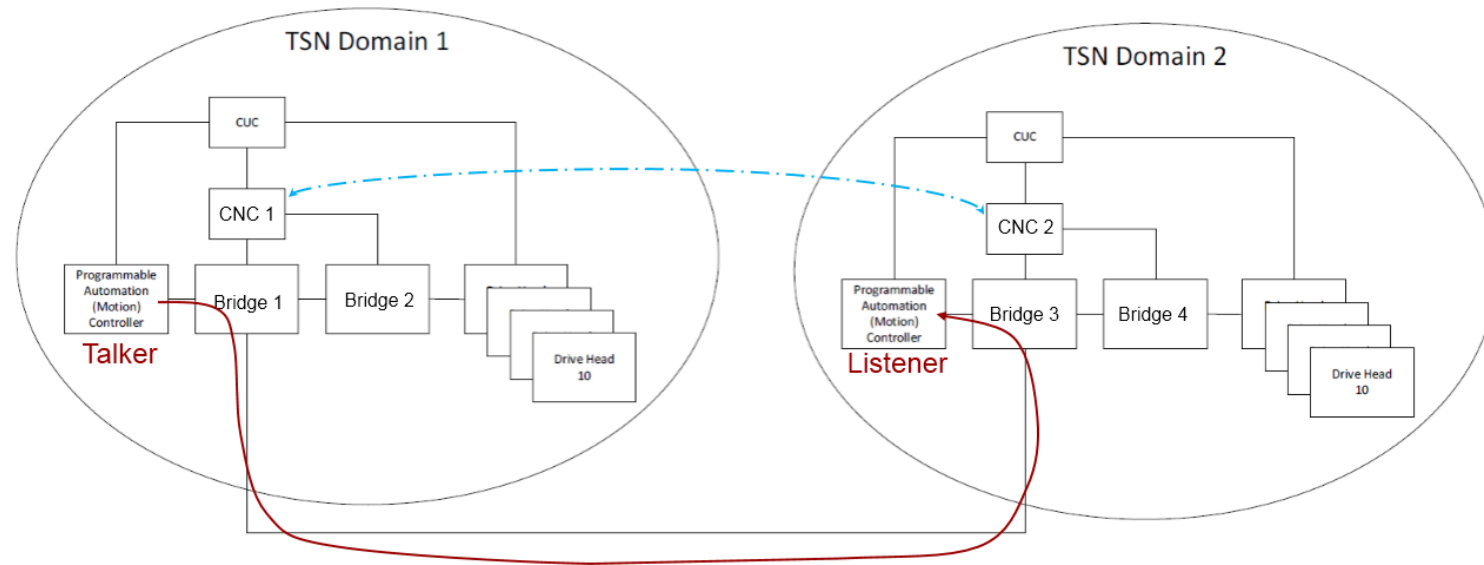How could unneeded multiple writing of the same NM data be avoided?
➢ A CNC selection mechanism could be the answer. Only the selected-CNC is in charge of configuration.

What's more – How should CNCs be detected? How to select? What if the selected-CNC fails?
➢ May use MRP/LRP with a new application protocol (CCP) to declare CNC capabilities, select, and detect failure.

http://www.ieee802.org/1/files/public/docs2018/60802-Steindl-ConfigurationModelAlignment-0918-v02.pdf

Alignment to current consideration – Inter-domain communication

Example: The red TSN stream crosses TSN domain 1 and 2.

Assumption:
- Multiple TSN domains will often be implemented in one bridge/router/gateway. One port must only be a member of a single TSN domain.
- New: A port of TSN Domain 1 must not be managed by a CNC of TSN Domain 2.

Gaps:
- The Talker UNI information is sent to CNC 1 only. CNC 1 needs to send something to CNC 2.
- What's more, CNCs need to know the exact path of the stream, or, the domain boundary information.

http://www.ieee802.org/1/files/public/docs2018/60802-Hantel-TSN-Interdomain-Communications-0718.pdf

Part 5 (new): Network Management for Constrained Devices

| Function	Need to support
Bridge	NMP or NMP-light*
CNC	NMP

→ *: TBD. If we decide to distinguish constrained devices, and if the constrained devices won't support, say NETCONF, then we might need a NMP-light.

➢ NMP-light could be based on RP/UMP/…

This is a constrained device!

NMP
- NM for bridge
- ← - - → NM-light
- ⟶ TSN stream
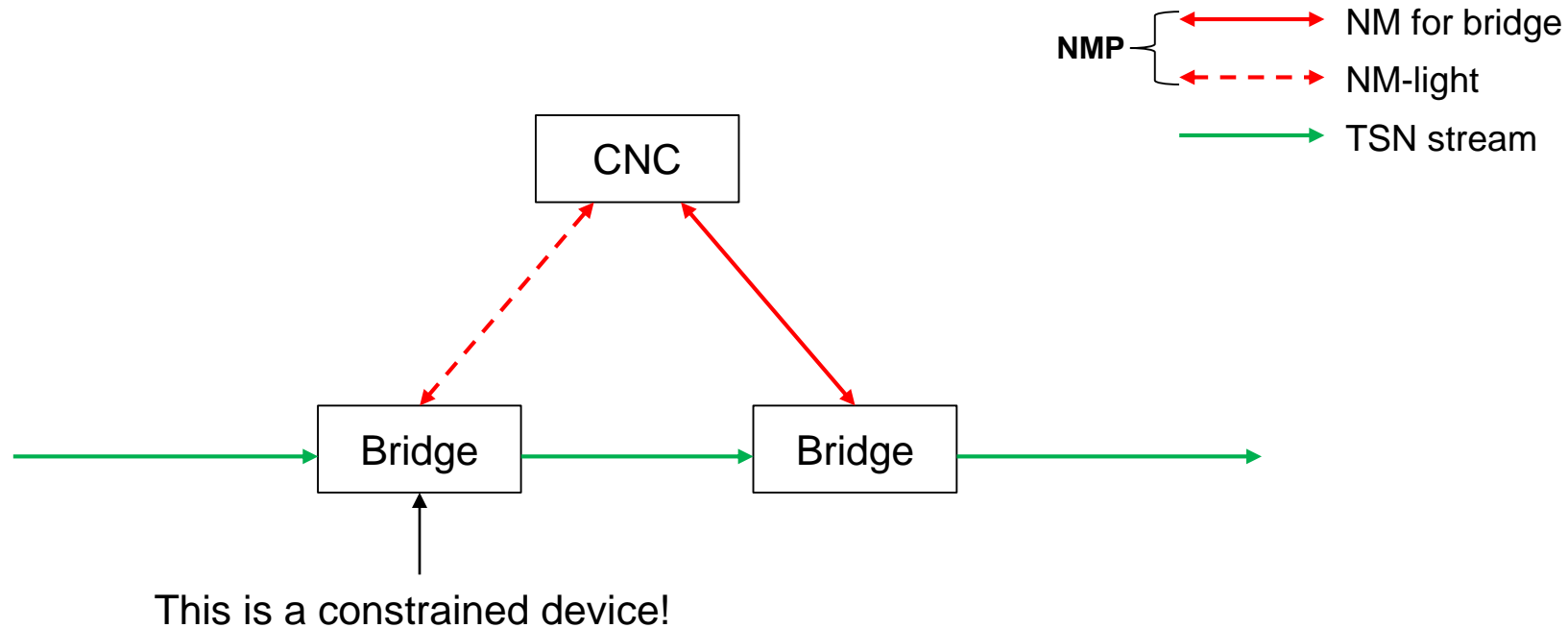
Alignment to current consideration – Constrained Devices

➢ If RMU could be regarded as one of the CNC functions, then these two models are the same.
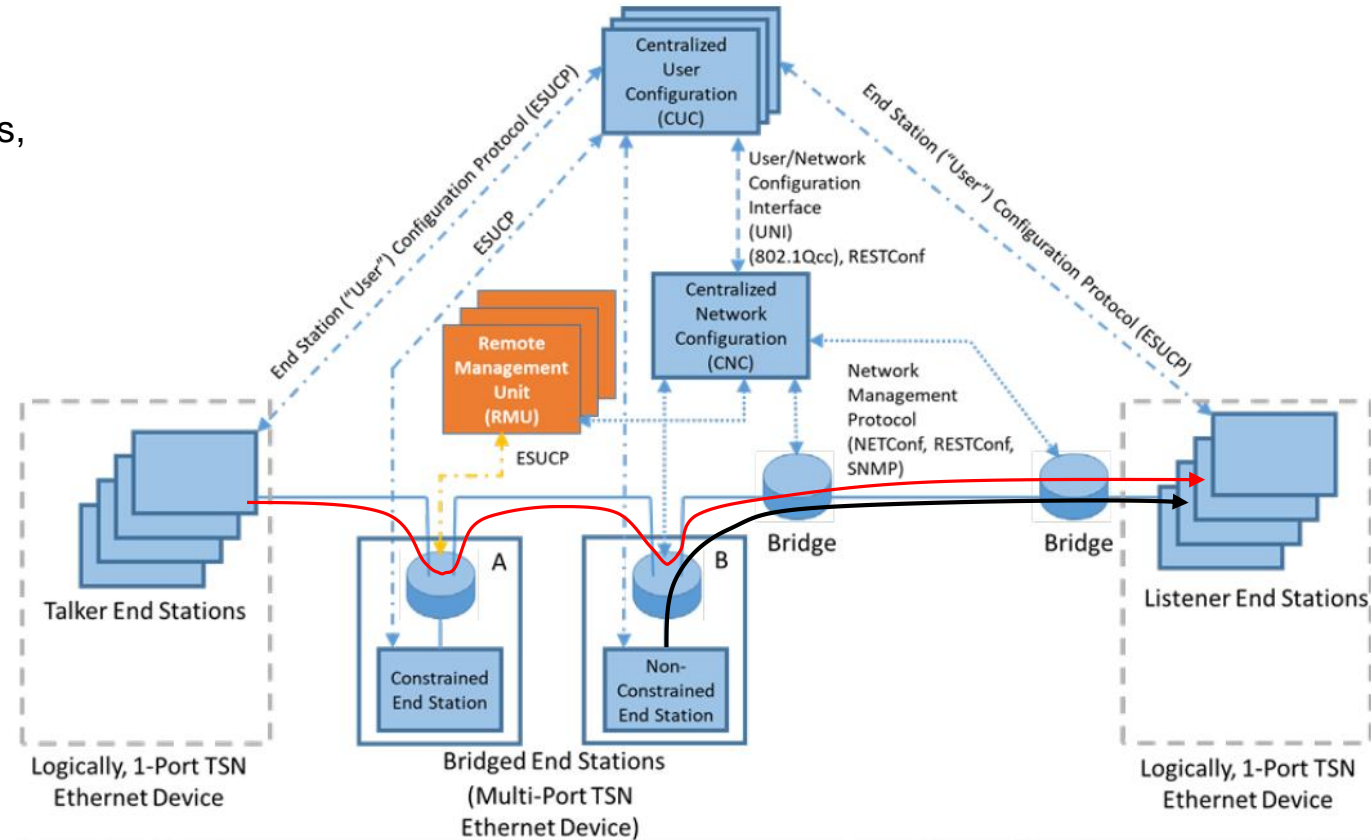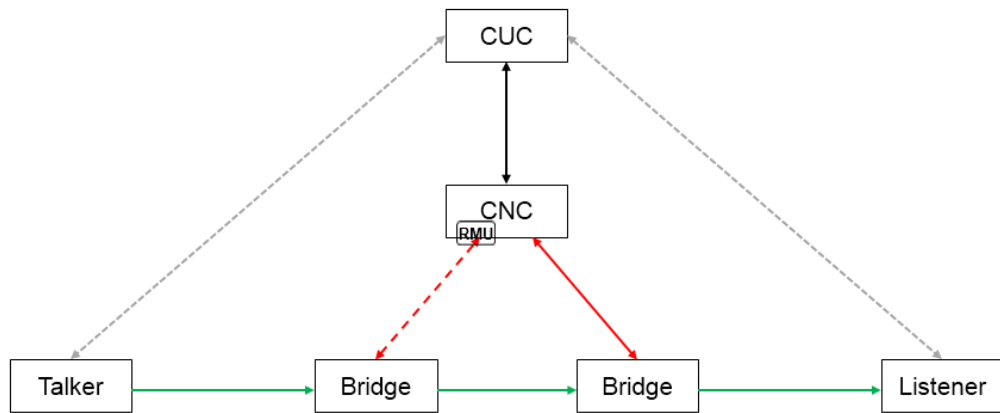
For the fully centralized model, as Talker/Listener needs to support UMP(ESUCP), it is reasonable to use an expanded UMP as NMP-light.
● E.g., the constrained end station A supports one specific ESUCP, and that ESUCP could be expanded to include NM capabilities.

For the hybrid model, as Talker/Listener needs to support RP-UNIP, it is reasonable to use an expanded RP-UNIP as NMP-light.

http://www.ieee802.org/1/files/public/docs2018/60802-Zuponcic-Bridged-non-Bridged-End-Stations-1118-v01.pdf

Open discussion:
What if Registration Protocol could be used for network management?

- Link-local Registration Protocol is designed to facilitate the creation of **application protocols** that distribute information through all or part of a network. LRP is optimized for databases on the order of 1 Mbyte.

- The **application protocol** defines data model (attribute) and the attribute propagation mechanism within a system.

- Data model: could use the management YANG models (Qcp, Qcw, …) as reference.

- Mechanism (bottom right): Application 1 for NMP (new), application 2 for UNIP (e.g., RAP).
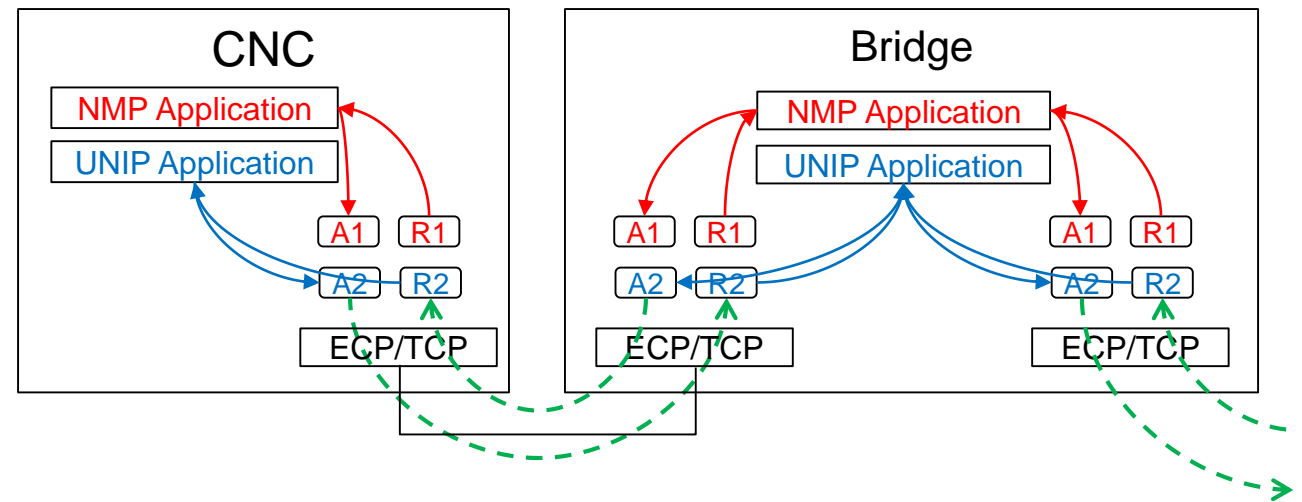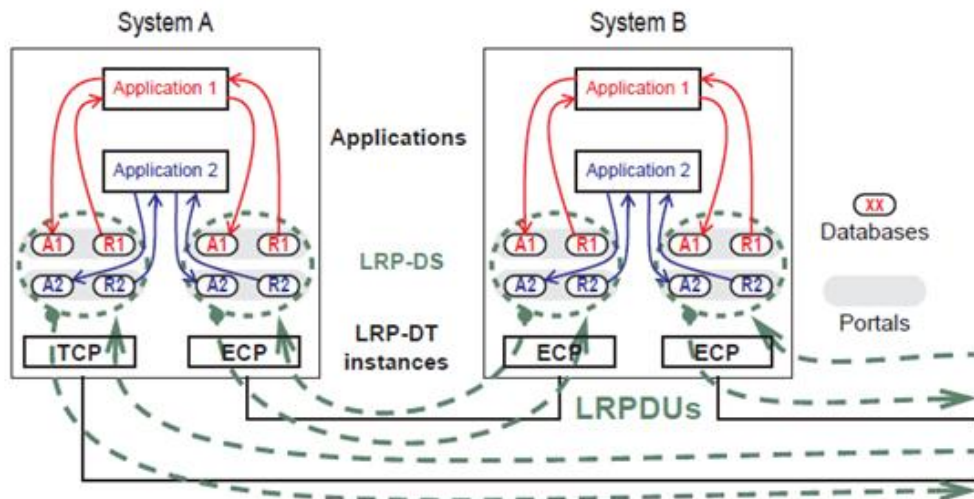
Alignment to current consideration – Management data propagation

➤ Engineering refers to specific interfaces of CUC and CNC.

➤ IOCx – IODx refers to both UM(CUC-user) and NM(CNC-bridge).

➤ UM (User Management): again, out of scope?

➤ NM (Network Management) : NETCONF / RP-NMP / …
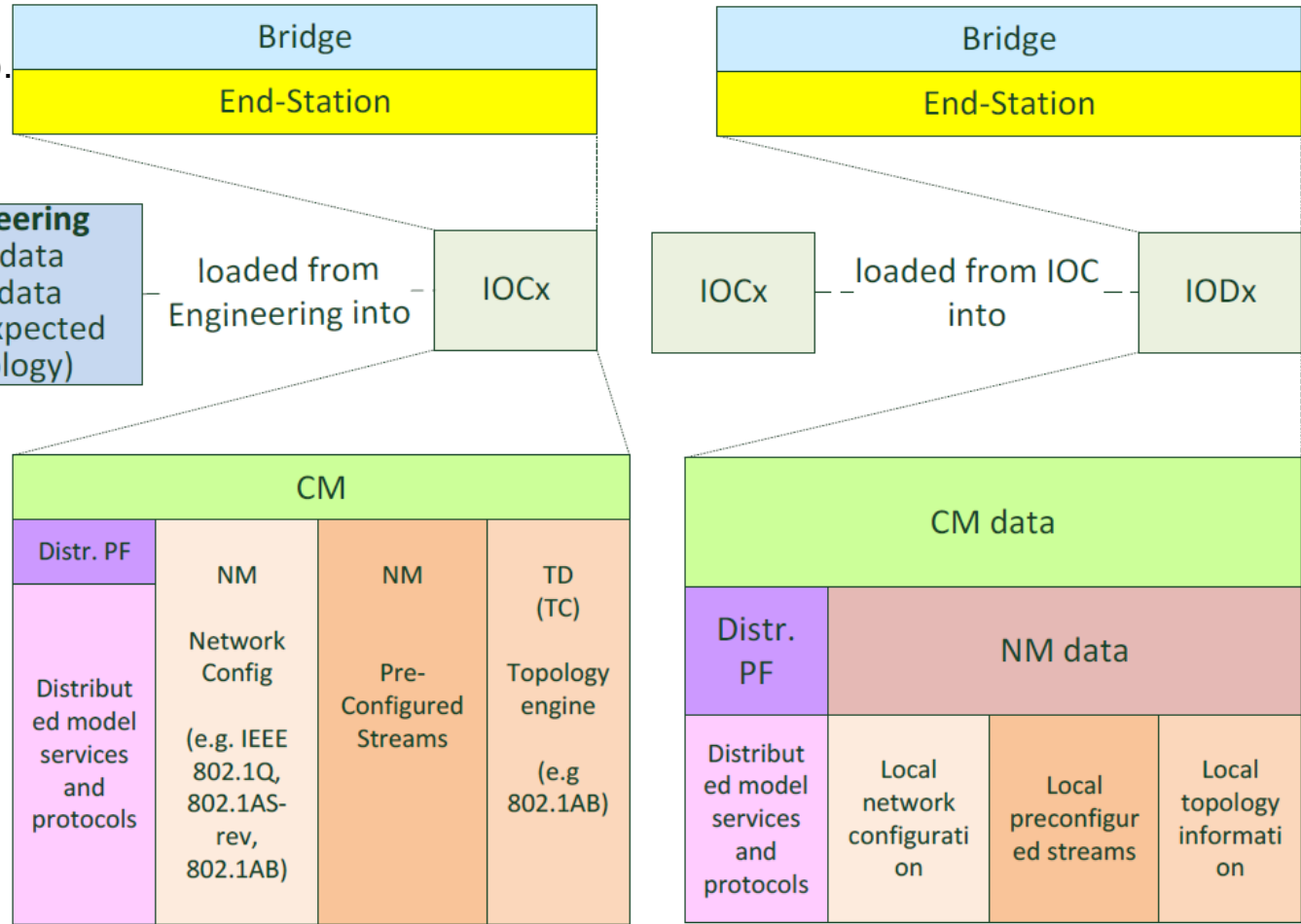
CM: Communication relation Management

How to draft the management part of the profile

The Enhanced **Management Function Table**

*: TBD

Function	Distributed	Hybrid	Centralized
Talker/Listener	RP-UNIP	RP-UNIP	UMP*
Bridge	RP-UNIP	NMP(or NMP-light*)+RP-UNIP*	NMP(or NMP-light*)
CNC	/	NMP+RP-UNIP+CCP*	UNIP+NMP+CCP*
CUC	/	/	UNIP+UMP*

How to use this table when drafting the profile?
- To select optional features. See 802.1BA 7.2.1.

O	optional
O.n	optional, but support of at least one of the group of options labeled by the same numeral n is required

- E.g., for a Talker/Listener, RP-UNIP (MRP-MSRP / LRP-RAP) is *O*.
  for a Bridge, RP-UNIP and NMP (and NMP-light) are *O.1*.

Why no Bridged end-station?
- It is a device which has both Talker/Listener and Bridge functions, just add them up.
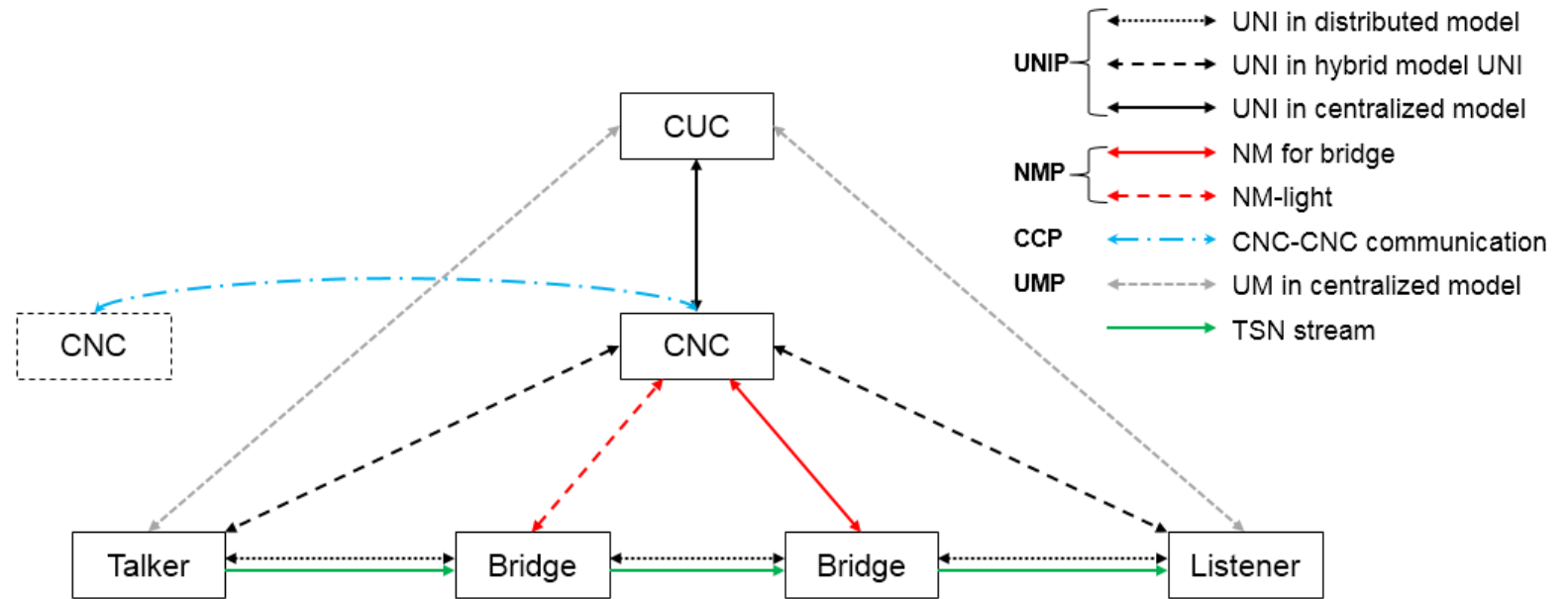
Why need to define CNC and CUC functions?
- Interoperability.
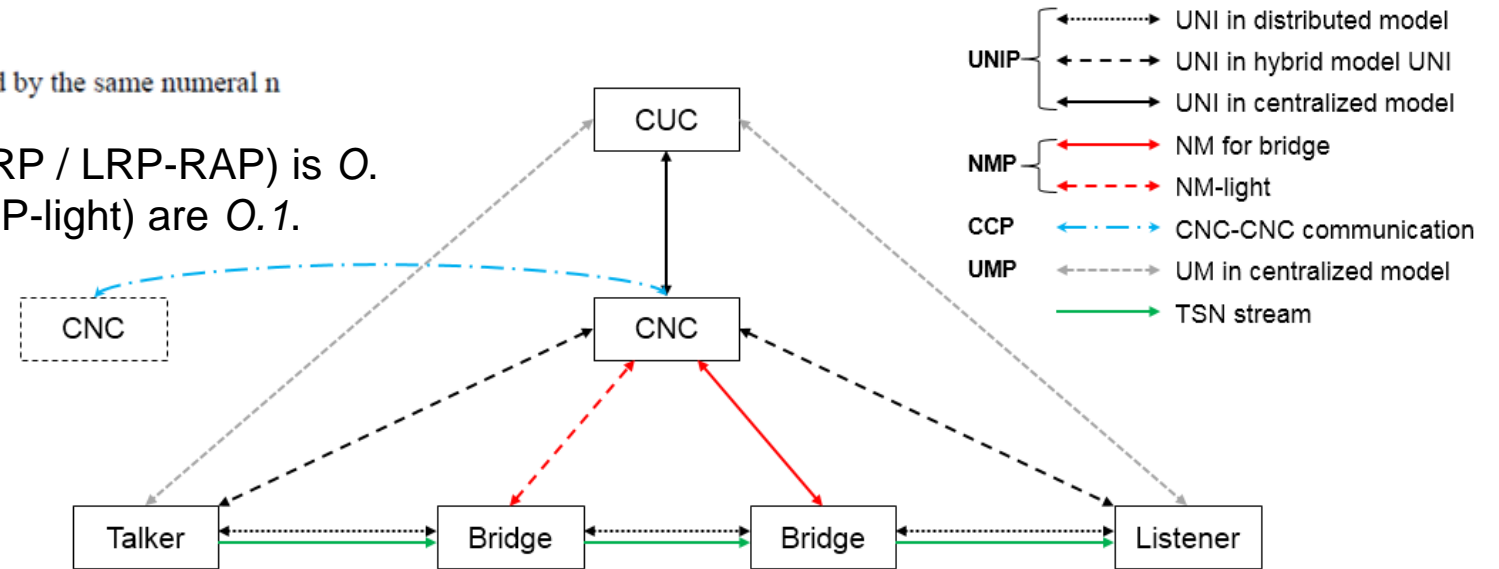
Gaps

- For those gaps listed below, we should consider which are 802.1 issues and which are 60802 issues.

- A contribution for the Controller-Controller Protocol may be following.

Gaps	Description	How?
Talker UNI for UNIP in distributed, hybrid, and centralized model	Additional (industrial automation specific) attributes and application function may be needed.	Might be covered by 802.1 Qdd, 60802 could follow and input.
Third party UNI[1] for UNIP in centralized model	Additional attributes based on Talker UNI and application function.	Might need new 802.1 projects if a clear need is found.
Use RESTCONF/YANG as the CUC-CNC UNI	Qcc has defined YANG for current UNI attributes.	Update YANG accordingly if UNI is expanded.
Network management using NETCONF/… with YANG model	Some YANG projects already finished, some ongoing, some upcoming.	60802 could follow and input if needed.
RP-based network management	Need to define application functions and attributes.	**How's everyone's feeling about this idea?**
Controller-Controller Protocol for CNC-CNC communication and multi-domain configuration	Need to define application functions and attributes if using RP-CCP.	**Self-defined by 60802 or might need a new 802.1 project?**

1) http://www.ieee802.org/1/files/public/docs2018/dd-finn-RAP-LRP-MSRP-Qcc-0918-v03.pdf

Thank you