CNC-CUC Interaction for IEC/IEEE 60802

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6 Required functions for an industrial network

6.9 CNC

6.9.3 CNC-CUC Interaction

6.9.3.1 General

The following text describes in detail the actions 2 to 5 shown in Figure 2. These CNC-CUC interactions specified in 6.9.3.2, 6.9.3.3 and 6.9.3.4 are based on the following preconditions:

a) CNC is activated to manage the configuration domain.

b) CUC knows the IP address of the CNC.

c) Security setup has been performed.

d) CUC is part of the configuration domain.

e) CUC knows the domain-id of the configuration domain.

f) CUC is registered by cuc-id at CNC.

6.9.3.2 Add Stream Operation

Add stream operation is performed when an application requests an establishment of one or more new streams. It is expected that CNC handles each add stream operation as “establish all or no streams”.

EDITOR’S NOTE : Should CUC be able to choose if the add stream operation is to be performed as “establish all or no streams” or not? P802.1Qdj does not support this choice currently.

CUC shall use the following steps:

a) CUC receives the stream requirements from the middleware.

b) CUC requests a stream-id for each stream that needs to be established using the RPC defined in the ieee802-dot1q-tsn-config-uni module. There are two possible outcomes:

   1) CUC receives a stream-id for each stream as a response from CNC.

   2) There is no free stream-id for one or more streams. The strategy for CUC behaviour in this case depends on the way the pool of streams is managed (one pool per CUC or one pool per configuration domain).

c) The CUC creates and locks the candidate datastore. There are two possible outcomes:

   1) Candidate datastore is available and locked by the CUC.

   2) Candidate datastore is not available due to the lock imposed by another CUC. Wait and retry is the only possible strategy. Concurrent requests and/or pipelining is not supported.

EDITOR’S NOTE : non-blocking requests might be possible depending on the outcome of the currently ongoing discussion in the P802.1Qdj. Steps c), d), e) and f) would be merged in one RPC call in this case. RISK: starvation problem occurs.

d) CUC creates an entry for each stream at the CNC using the ieee802-dot1q-tsn-config-uni module and sets the stream parameters.

e) CUC calls validate and commit operations for the candidate datastore. The changes are validated by the CNC before the commit is accepted or refused.

f) CUC calls compute_planned_and_modified_streams RPC from the ieee802-dot1q-tsn-config-uni module. There are two possible outcomes:

   1) OK: compute of at least one stream has started. CUC awaits the configure_streams_completed notification.

   2) NOK: compute has not started due to invalid input parameters or similar error.

g) The CUC receives the configure_streams_completed notification from the CNC, which contains the failure-code for each requested stream.

h) CUC informs the middleware that the streams have been established.

6.9.3.3 Remove Stream Operation

Remove stream operation is performed when an application requests removal of one or more streams. CUC shall use the following steps:

a) CUC receives the stream removal request from the middleware.

b) CUC calls remove_streams RPC from the ieee802-dot1q-tsn-config-uni module. There are two possible outcomes:

   1) OK: the removal of at least one stream has started. CUC awaits remove_streams_completed notification.

   2) NOK: stream removal has not started due to invalid input parameters or similar error.

c) The CUC receives the remove_streams_completed notification from the CNC, which contains the failure-code for each stream whose removal was requested.

d) The CUC informs the middleware that the streams have been removed.

6.9.3.4 Modify Stream Operation

Modify stream operation shall be implemented as a sequence of the remove stream operation as defined in 6.9.3.3 and the add stream operation as defined in 6.9.3.2.

6.9.3.5 Topology Changes

6.9.3.5.1 IA-Station Fault

In the case of a malfunction of an IA station, CNC discovers the topology change and recognizes that the path used for a stream is broken. The status-info node of the affected streams in the ieee802-dot1q-tsn-config-uni module is updated accordingly by the CNC. CUC is informed of the status-info change via YANG subscription. It is the responsibility of the middleware to deal with this situation e.g., by requesting the stream removal.

6.9.3.5.2 IA-Station Fault Clearance

After an IA-Station fault described in 6.9.3.5.1, the IA-station can be repaired or replaced and reintroduced into the network. In this case CNC discovers the topology change. Streams are not reconfigured automatically. The value of the status-info node in the ieee802-dot1q-tsn-config-uni module is changed after the repair/replacement. CUC is informed of the status-info change via YANG subscription. It is the responsibility of the middleware to deal with this situation e.g., by calling the compute_and_configure_streams RPC in the ieee802-dot1q-tsn-config-uni module.

EDITOR'S NOTE : Update of the status-info of the affected stream is required in order to inform the CUC about the fault clearance. The failure code must provide the information if the failed streams might be successfully recomputed.

6.9.3.5.3 CUC Removal and Addition

CUC removal and addition can occur in the case of a CUC fault followed by fault clearance or CUC replacement. CUC addition and/or removal occurs also in the context of plug and produce of machine modules.

There are two possible behaviours of the CNC:

a) CNC removes the whole CUC tree including all streams from its configuration domain

b) CNC keeps the whole CUC tree including all streams

New CUC can use the operation described in 6.9.3.2. to request establishment of new streams.

EDITOR'S NOTE: Should 60802 specify a mechanism that handles CUC removals and additions? Should P802.1Qdj enable CUC to choose between CNC behaviours a) and b) e.g., during onboarding? Should the scenario with CUCs that are not part of the configuration domain be considered?

6.9.3.5.4 CNC Fault

The streams are not interrupted in the case the CNC is removed, but resource allocation cannot be changed.

6.9.2.4.5. CNC Fault Clearance

Reinitialization of the configuration domain occurs as soon as the new CNC is added to the configuration domain.

EDITOR'S NOTE : Is mechanism for CNC replacement required for the edition 2 of the profile?