**3GPP TSG-SA5 Meeting #156S5-243544**

**19 - 23 August 2024, Maastricht, Netherlands**

**Source: Nokia**

**Title: Rel-19 pCR TR28.867 Solution for action-execution-time conflict**

**Document for: Approval**

**Agenda Item: 6.19.4**

# 1 Decision/action requested

***The group is asked to discuss and agree on the proposal.***

# 2 References

[1] 3GPP TR 28.867: “Closed control loop management” v0.3.0

# 3 Rationale

The use cases on CCL conflicts management describes action-execution-time conflicts as one of the conflicts that need to be managed. This pCR is to add a solution for managing action-execution-time conflicts

# 4 Detailed proposal

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| **First Change** |

5.6 Use case 6: CCL conflicts management

5.6.1 Description

Multiple CCLs could co-exist and concurrently act within the same environment. The CCLs can affect one another, in the worst cases leading to conflicts. The different kinds of conflicts are summarized by Table 5.6.1-1.

5.6.1-1: Types of potential conflicts among CCL instances for goals g1, g2 and g3

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| Conflict Type | Description | CCL-A | CCL-B | Comments |
| Target Conflict | For CCLs C1 and C2, when same at least 1 target of a goal is present in both CCL asking for different outcomes on that target on same controlled entity (ME1). | Control Scope: ME1  Goal targets:   * Load > 90% (to maximize resource utilization) * latency < 10ms | Control Scope: ME1  Goal target:   * Load < 90% (to avoid congestion) | Conflict among the targets within the goals - due to different required target outcomes |
| Action Conflict | For CCLs C1 and C2, when both C1 and C2 is trying to configure the same characteristics of same target entity (gNB-g1) in contradiction. | **Example 1** | | Conflict due to configuration actions at execution step because both CCL want different contradicting value for a particular characteristic of gNB-g1.  Effect: even when executed at different times, the value may ping-pong continuously. |
| Goals target:   * Throughput > 10gbps   Actions:   * Target Entity: gNB-g1 * Target Change: scale-out virtual resource | Goals target:   * EC is < 10KVA   Actions:   * Target Entity: gNB-g1 * Target Change: scale-in virtual resource |
| **Example 2** | |
| Goal target:   * HO failure is < 2%   Actions:   * Target Entity: gNB-g1 * Target Change: set CIO to a small **positive** value{to guarantee HOs with low chances of HO failure} | Goal target:   * Load < 80%   Actions:   * Target Entity: gNB-g1 * Target Change: set CIO to a small negative value [to advance HOs and move load to other cells] |
| Indirect target conflict | For CCLs C1 and C2, when C1 [optimize handover] and C2 [minimize interference] have different goals but the actions of C1 affect the goals of C2 | Goal target:   * HO failure is < 2%   Actions:   * Target Entity: gNB-g1 * Target Change: reduce CIO {to reduce chances of HO failure} | Goal target:   * SINR > 10dB   Actions:   * Target Entity: gNB-g1 * Target Change: lower antenna tilt | By reducing antenna tilt to minimize interference C2 affect the HO goal target of C1 |
| Action Execution Time Conflict | For CCLs C1 and C2, when both C1 and C2 are trying to configure the same characteristics of same target entity (gNB-g1) in contradiction. | Goals:   * Throughput > 10gbps   Actions:   * Target Entity: gNB-g1 * Target Change: scale-out * Target Time: 04:00 | Goals:   * EC is < 10KVA   Actions:   * Target Entity: gNB-g1 * Target Change: scale-in * Target Time: 04:00 | Conflict due to the time of executing the configuration actions at the execution step |
| Scope conflict | For CCLs C1 and C2, C1 and C2 have different goals and actions but their scopes are overlapping – e.g. C1’s control scope (i.e. the controlled entities in the network) is part of C2’s measurement scope (i.e. the measured entities in the network) | Measurement scope: cells g1  Control Scope: g1  Goal targets:   * EC/bit is < 1WA   Actions:   * Target Entity: gNB-g2 * Target Change: switch off g2 | Measurement scope: cells g1, g2, g3, g4  Control Scope: g2  Goals:   * Load < 80%   Actions:   * Target Entity: gNB-g2 * Target Change: change CIO | By switching off g2, C1 affects the scope which C2 reads for its load distribution measurements |

The CCL may detect or observe events that identify the possibility of any one of the above conflicts. The conflict can be avoided using some information or the policies (e.g., priority) provided by the consumer. If the conflict actually occurs, the CCL MnS producer should support services to inform MnS consumers the confirmed detected conflicts. This may also include informing MnS consumer about the potential conflict.

5.6.2 Potential Requirements

REQ-CCL-CONFLICT-1: The MnS Producer for CCL management should support a capability to detect a potential or actual conflict.

Note: A potential conflict is where some events are observed that indicate that there may be a conflict, but the CCL MnS Producer cannot conclude that it is a conflict. So, the CCL can indicate this so that some other entity e.g. the MnS consumer takes responsibility to confirm the conflict.

REQ-CCL-CONFLICT-2: The MnS Producer for CCL management should support a capability to inform an authorized MnS consumer about a potential conflict that has been detected.

REQ-CCL-CONFLICT-3: The MnS Producer for CCL management should support a capability to confirm a detected potential goal, action, indirect target, action execution time, scope conflict.

REQ-CCL-CONFLICT-4: The MnS Producer for CCL management should support a capability to resolve a goal, action, indirect target, action execution time, scope conflict that has been detected.

REQ-CCL-CONFLICT-5: The MnS Producer for CCL management should enable authorized MnS consumers to provide information that can be used to avoid the conflict.

REQ-CCL-CONFLICT-6: The MnS Producer for CCL management should enable authorized MnS consumers to provide information that can be used to resolve the conflict.

5.6.3 Potential Solutions

5.6.3.C Potential Solution C: action-execution-time conflict coordination

Note: This solution focusses on the requirement on

* detection of potential action-execution-time conflicts

Avoidance of action-execution-time conflicts5.6.3.C.1 Required capabilities and interactions.

Information on action plans for alignment and selection

Each CCL deployed in the network has a set of scopes for which it takes responsibility and actions that it can execute within those scopes and from which the CCL derives the decision and action plans that should be executed. An action plan is the combination of a set of actions that can be taken and the scopes under which those actions can be applied. To minimize conflicts (e.g., where the scopes overlap), the CCLs align the action plans, for example, through a coordinator CCL that selects which action plan to execute and when. Thereby,

* The CCLs inform the coordinator CCL about their respective action plans. The action plans contain information of target resources, scheduled time for execution, and may include other additional information such as historical results of the proposed actions.
* the coordinator CCL assesses each plan and choose the most appropriate combination of action plan(s) based on the selection policy. The appropriateness of action plan(s) or their combinations can be evaluated by multiple means and by using, for instance, historical data and/or operational data.
* Notify the selected action plan(s) to the related CCLs and/or the coordination CCL.

Information on detected action-execution-time conflict

Coordinating actions among multiple CCLs requires that there is a supervisory action-critic functionality that oversees the actions of the different CCLs. The action-critic functionality which may be part of coordinator CCL that takes the responsibility for the end-to-end performance of the Network.

For a given CCL, the action-critic receives the recommended changes from the CCLs, evaluates them to see: 1) if they overlap with other proposed changes from other CCLs, and 2) what their likely effects may be. To determine the likely impacts, the action-critic may rely on network states analytics capabilities which discretize the state of the network into specific discrete scenarios and provide insights on performance characteristics in those scenarios. Such insights may for example characterize whether the network is in a scenario of low traffic and normal performance or scenario of normal traffic and anomalous performance.

Where there are likely conflicts and expected undesired impacts, the orchestration functionality decides the changes that should be executed on the network to minimize concurrent changes on the same network resources. The selection of actions to be accepted may be based on the priorities of the CCLs or the priorities of their goals and targets.

The coordination CCL then provides feedback to the CCL instance (s) regarding their recommended actions. The feedback may include information on which actions can be executed or not as well as information on the expected effects of the CCLs actions. Feedback may also include redefining the allowed control parameter spaces and ranges of the individual CCLs (i.e. which parameters the CCL should not control any further or the range in which the CCL may set the value of a control parameter).

5.6.3.C.2 Information objects to realize required capabilities and interactions

* Introduce an IOC for a critiquing the actions of the CCLs, say called CCLExecutionTimeCoordination. It may be name contained in subnetwork or a managed Function, e.g., in a CoordinationCCL.
  + Introduce a datatype and corresponding attribute on the CCLExecutionTimeCoordination to represent the proposed actions from a given CCL, say called CCLCMPlan. The CCLCMPlan should as minimum include:
    - the identifier of the CCL instance,
    - the set of network resources that are targeted to be reconfigured by the CCL, i.e., the set of managed objects on which the CCL wants to execute actions and the set of attributes to be reconfigured and their desired new values.
    - the time and/or conditions under which the reconfiguration is planned to be executed
    - where applicable, the expected impact of those actions
    - an indication, say called CMPlanEvaluationInterval interval which indicates the time within which the CCL expects feedback, e.g. corresponding to the time by which the CCL may need to execute the panned actions.
  + Note 1: the CCLCMPlan may be a list of provisioning management operations or may use the constructs developed in the ongoing study on plan management.

Note 2: the CCLCMPlan may also be an attribute on the CCL. If so, the CCLCMPlan should be notifiable, so that when the CCL constructs the CCLCMPlan, it notifies the CCLs that have subscribed to it (e.g. the coordinator CCL) of the said CCLCMPlan which when updated is then notified to the CCLExecutionTimeCoordination

* Extend the CCL with information needed to support the evaluation of the proposed actions of the CCL.
  + Add to the CCL an attribute for the proposed actions as described above.
  + Introduce an attribute for the priority of the CCL or its goals. For example, the priorities may be assigned based on a fixed scale of say [1,10] where the lowest number indicates the lowest priority. The priority may indicate a general priority of the CCL that is not specific to the resolution of execution-time conflicts.
  + Introduce a datatype and corresponding attribute on the CCL to represent the feedback from the CCLActionCritic, say called CCLCMFeedback.
    - The CCLCMFeedback includes, for the list of proposed actions, an indication of which those actions should not be executed
    - The CCLCMFeedback may include, for the list of proposed actions, an indication of the expected impact of each of those actions
    - The CCLCMFeedback includes for the set of managed objects that are controlled by the CCL, the set of control parameters that should never be controlled by the CCL and/or the ranges of values which the control parameter can never be set into.

5.6.4 Evaluation of solutions

The potential solution described in clause 5.8.3.C is a fully NRM-based approach that extends the existing NRM to coordination of CCL action plans as a way of minimizing action-execution-time conflicts. The solution allows CCLs to expose their action plans to a coordination functionality, say a coordination CCL and to receive feedback form the coordination CCL about the consumer to directly configure the scope of a CCL. In addition, it enables an actions plans coordination functionality (e.g. a coordination CCL) to evaluate the conflicts and provide feedback on which actions plans can be executed or not including details on which specific actions may for example be completely avoided in future. Therefore, the solution described in clause 5.8.3.C is a feasible solution for action-execution-time conflict coordination.

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| **Next Change** |

# 6. Conclusions and Recommendations

It is recommended to move on to the normative specification development phase for the use case on

* action-execution-time conflict coordination, the normative specification development should follow the solution outlined in clause 5.8.3.C