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Stage 2 and stage 3
(3GPP TS 28.536 version 16.8.0 Release 16)**



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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

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- x the first digit:
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 - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

- can** indicates that something is possible
- cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

- will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

Introduction

The present document describes closed control loop assurance solution enabling a service provider or an operator to continuously deliver the requested level of communication service quality to the customer and is part of a TS-family covering the 3rd Generation Partnership Project Technical Specification Group Services and System Aspects Management and orchestration of networks, as identified below:

TS 28.535: Management Services for Communication Service Assurance; Requirements

TS 28.536: Management Services for Communication Service Assurance; Stage 2 and stage 3

The solution described builds upon the management services specifications as identified below:

TS 28.530: Management and orchestration; Concepts, use cases and requirements

TS 28.533: Management and orchestration; Architecture framework

TS 28.532: Management and orchestration; Generic management services.

TS 28.540: Management and orchestration; 5G Network Resource Model (NRM); Stage 1

TS 28.541: Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3

TS 28.531: Management and orchestration; Provisioning

TS 28.545: Management and orchestration; Fault Supervision (FS)

TS 28.550: Management and orchestration; Performance assurance

TS 28.552: Management and orchestration; 5G performance measurements

TS 28.554: Management and orchestration; 5G End to end Key Performance Indicators (KPI)

1 Scope

The present document describes the management services for communication service assurance and specifies stage 2 and stage 3 for closed control loop communication service assurance solution that adjusts and optimizes the services provided by NG-RAN and 5GC.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] Void
- [3] 3GPP TS 28.550: "Management and orchestration; Performance assurance".
- [4] Void
- [5] 3GPP TS 28.622: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [6] 3GPP TS 28.541: "Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3".
- [7] 3GPP TS 28.532: "Management and orchestration; Generic management services".
- [8] 3GPP TS 32.302: "Telecommunication management; Configuration Management (CM); Notification Integration Reference Point (IRP); Information Service (IS)".
- [9] 3GPP TS 28.531: "Management and orchestration; Provisioning".
- [10] 3GPP TS 32.160: "Management and orchestration; Management service template".
- [11] 3GPP TS 29.520: "5G System; Network Data Analytics Services; Stage 3".
- [12] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".
- [13] 3GPP TS 28.554: "Management and orchestration; 5G end to end Key Performance Indicators (KPI)".
- [14] 3GPP TS 28.625: "State Management Data Definition Integration Reference Point (IRP); Information Service (IS)".
- [15] ITU-T Recommendation X.731: "Information technology - Open Systems Interconnection - Systems Management: State management function".
- [16] Void

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

| | |
|-------|-----------------------------------|
| COSLA | Closed control loop SLS Assurance |
| CSC | Communication Service Customer |
| CSP | Communication Service Provider |
| IOC | Information Object Class |
| IS | Information Service |
| JSON | JavaScript Object Notation |
| YAML | YAML Ain't Markup Language |
| MDAS | Management Data Analytics Service |
| MDT | Minimization of Drive Tests |
| MnS | Management Service |
| NF | Network Function |
| NRM | Network Resource Model |
| NSSI | NetworkSlice Subnet Instance |
| NWDAF | NetWork Data Analytics Function |
| QoE | Quality of Experience |
| SLA | Service Level agreement |
| SLS | Service Level Specification |

4 Communication service assurance service

4.1 Stage 2

4.1.1 Void

4.1.2 Model

4.1.2.1 Imported and associated information entities

4.1.2.1.1 Imported information entities and local labels

| Label reference | Local label |
|-------------------------|-------------|
| TS 28.622 [5], IOC, Top | Top |

4.1.2.1.2 Associated information entities and local labels

| Label reference | Local label |
|--|--------------------|
| TS 28.622 [5], IOC, SubNetwork | SubNetwork |
| TS 28.541 [6], IOC, NetworkSlice | NetworkSlice |
| TS 28.541 [6], IOC, NetworkSliceSubnet | NetworkSliceSubnet |
| TS 28.622 [5], IOC, ManagedElement | ManagedElement |
| TS 28.541 [6], attribute, serviceProfileId | serviceProfileId |
| TS 28.541 [6], attribute, sliceProfileId | sliceProfileId |

4.1.2.2 Class diagram

4.1.2.2.1 Relationships

This clause depicts the set of classes that encapsulates the information relevant for this MnS. This clause provides an overview of the relationships between relevant classes in UML.

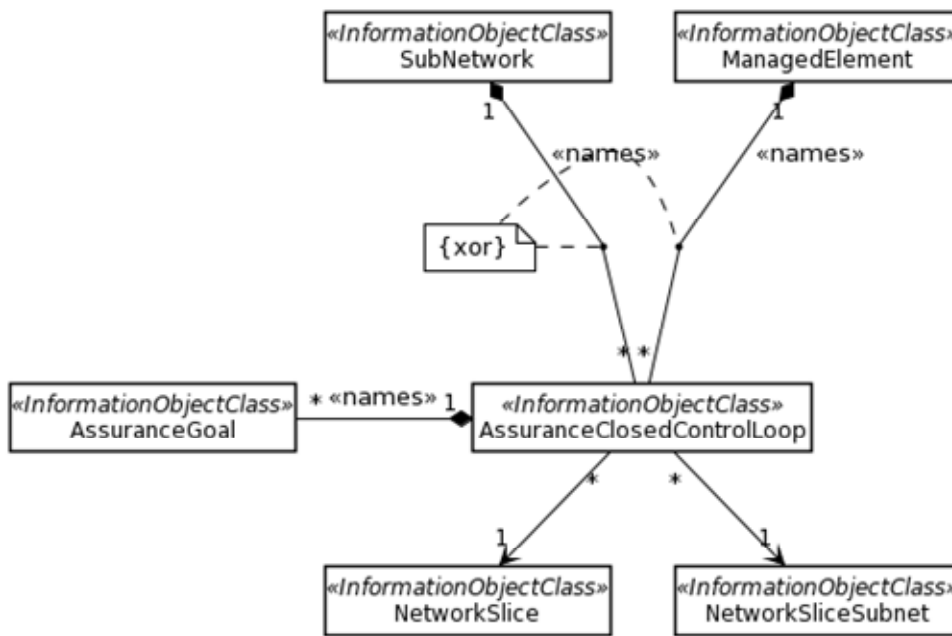


Figure 4.1.2.2.1.1: Assurance management NRM fragment

4.1.2.2.2 Inheritance

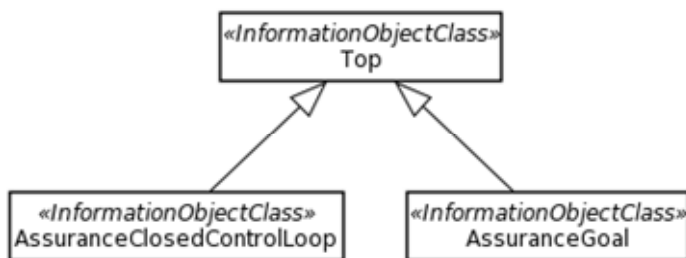


Figure 4.1.2.2.2.1: Assurance management inheritance relationships

4.1.2.3 Class definitions

4.1.2.3.1 AssuranceClosedControlLoop

4.1.2.3.1.1 Definition

This IOC represents assurance closed control loop, an assurance closed control loop monitors and adjusts the resources associated with a `NetworkSlice` or `NetworkSliceSubnet` in order to meet the objectives described by one or more assurance goals. The capabilities include:

- state management of an `AssuranceClosedControlLoop`
- to keep track of the lifecycle of an `AssuranceClosedControlLoop`

A consumer can check the effectiveness of the `assuranceClosedControlLoop` by consulting the performance measurements [12] and KPI's [13] associated with the target and comparing values of the targets with the values of the characteristics related attributes reported by the performance assurance service.

4.1.2.3.1.2 Attributes

| Attribute name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|--|-------------------|------------|------------|-------------|--------------|
| <code>operationalState</code> | M | T | F | F | T |
| <code>administrativeState</code> | M | T | T | F | T |
| <code>controlLoopLifeCyclePhase</code> | M | T | T | F | T |

4.1.2.3.1.3 Constraints

No constraints have been defined for this document.

4.1.2.3.1.4 Notifications

The common notifications defined in clause 4.1.2.5 are valid for this IOC, without exceptions or additions.

4.1.2.3.2 AssuranceGoal

4.1.2.3.2.1 Definition

This class represents the subset of attributes (typically characteristics attributes) from an SLS, i.e. a `ServiceProfile` or a `SliceProfile`, that are subject to assurance requirements. A single instance of `AssuranceGoal` represents a list of assurance targets. The assurance goal includes information about the time a goal should be observed and the status of the the goal fulfilment

NOTE: A `NetworkSlice` or `NetworkSliceSubnet` can support multiple instances of `AssuranceGoal`.

4.1.2.3.2.2 Attributes

| Attribute name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifiable |
|---|-------------------|------------|------------|-------------|--------------|
| <code>assuranceTargetList</code> | M | T | F | F | T |
| <code>sliceProfileId</code> | CM | T | T | F | T |
| <code>serviceProfileId</code> | CM | T | T | F | T |
| <code>observationTime</code> | M | T | T | F | T |
| <code>AssuranceGoalStatusObserved</code> | O | T | F | F | T |
| <code>AssuranceGoalStatusPredicted</code> | O | T | F | F | T |
| Attributes related to role | | | | | |
| <code>networkSliceRef</code> | CM | T | T | F | T |
| <code>networkSliceSubnetRef</code> | CM | T | T | F | T |

4.1.2.3.2.3 Attribute constraints

| Name | Definition |
|-----------------------|--|
| sliceProfileId | Condition: the AssuranceGoal applies to a NetworkSliceSubNet |
| serviceProfileId | Condition: the AssuranceGoal applies to a NetworkSlice |
| networkSliceSubnetRef | Condition: the AssuranceGoal applies to a NetworkSliceSubNet |
| networkSliceRef | Condition: the AssuranceGoal applies to a NetworkSlice |

4.1.2.3.2.4 Notifications

The common notifications defined in subclause 4.1.2.5 are valid for this IOC, without exceptions or additions.

4.1.2.3.3 Void

4.1.2.3.4 Void

4.1.2.3.5 AssuranceTarget <<dataType>>

4.1.2.3.5.1 Definition

This data type represents a single attribute name-value-pair of which one or more are included in an AssuranceGoal.

4.1.2.3.5.2 Attributes

| Attribute name | Support Qualifier | isReadable | isWritable | isInvariant | isNotifyable |
|----------------------|-------------------|------------|------------|-------------|--------------|
| assuranceTargetName | M | T | F | F | T |
| assuranceTargetValue | M | T | F | F | T |

4.1.2.3.5.3 Attribute constraints

No constraints have been defined for this document.

4.1.2.3.5.4 Notifications

The common notifications defined in clause 4.1.2.5 are valid for the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

4.1.2.4 Attribute definitions

4.1.2.4.1 Attribute properties

The following table defines the properties of attributes that are specified in the present document.

Table 4.1.2.4.1.1

| Attribute Name | Documentation and Allowed Values | Properties |
|------------------------------|---|--|
| controlLoopLifeCyclePhase | It indicates the lifecycle phase of the AssuranceClosedControlLoop instance. allowedValues: PREPARATION, COMMISSIONING, OPERATION and DECOMMISSIONING. | type: Enum multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| assuranceTargetName | The name of the attribute which is part of AssuranceTarget. The assuranceTargetName shall be equal to the name of an attribute in the relevant ServiceProfile or SliceProfile. The relevant ServiceProfile or SliceProfile is identified by the attribute serviceProfileId or sliceProfileId in the AssuranceGoal. | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| assuranceTargetValue | The value of the attribute which is part of AssuranceTarget | type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| assuranceTargetList | This is an attribute containing a list of AssuranceTarget(s) that are part of an AssuranceGoal | type: AssuranceTarget multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False |
| observationTime | It indicates the time duration over which an AssuranceGoal is observed. The observation time is expressed in seconds. | type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| assuranceGoalStatusObserved | It holds the status of the observed goal fulfilment to the assuranceGoal allowedValues: "FULFILLED", "NOT_FULFILLED" | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| assuranceGoalStatusPredicted | It holds the status of the predicted future goal fulfilment to the assuranceGoal allowedValues: "FULFILLED", "NOT_FULFILLED" | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| networkSliceRef | It holds the reference to the NetworkSlice instance subject to assurance requirements | type: DN multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| networkSliceSubnetRef | It holds the reference to the NetworkSliceSubnet instance subject to assurance requirements | type: DN multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False |
| operationalState | It indicates the operational state of the AssuranceClosedControlLoop instance. It describes whether the resource is installed and partially or fully operable (ENABLED) or the resource is not installed or not operable (DISABLED). allowedValues: "ENABLED", "DISABLED". The meaning of these values is as defined in 3GPP TS 28.625 [14] and ITU-T X.731 [15]. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: DISABLED isNullable: False |

| | | |
|------------------------------|---|---|
| administrativeState | It indicates the administrative state of the AssuranceClosedControlLoop instance. It describes the permission to use or the prohibition against using the AssuranceClosedControlLoop instance. The administrative state is set by the MnS consumer. allowedValues: "LOCKED", "UNLOCKED". The meaning of these values is as defined in 3GPP TS 28.625 [14] and ITU-T X.731 [15]. | type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: LOCKED isNullable: False |
| NOTE 1: Void NOTE 2: Void | | |

4.1.2.4.2 Constraints

No constraints have been identified for this document.

4.1.2.4.3 Notifications

This subclause presents a list of notifications, defined in [7], that provisioning management service consumer can receive. The notification parameter `objectClass/objectInstance`, defined in [10], would capture the DN of an instance of an IOC defined in the present document.

4.1.2.5 Common notifications

4.1.2.5.1 Alarm notifications

This clause presents a list of notifications, defined in TS 28.532 [7], that an MnS consumer may receive. The notification header attribute `objectClass/objectInstance`, defined in TS 32.302 [8], shall capture the DN of an instance of a class defined in the present document.

| Name | Qualifier | Notes |
|--|-----------|-------|
| <code>notifyNewAlarm</code> | M | -- |
| <code>notifyClearedAlarm</code> | M | -- |
| <code>notifyAckStateChanged</code> | M | -- |
| <code>notifyAlarmListRebuilt</code> | M | -- |
| <code>notifyChangedAlarm</code> | O | -- |
| <code>notifyCorrelatedNotificationChanged</code> | O | -- |
| <code>notifyChangedAlarmGeneral</code> | O | -- |
| <code>notifyComments</code> | O | -- |
| <code>notifyPotentialFaultyAlarmList</code> | O | -- |

4.1.2.5.2 Configuration notifications

This clause presents a list of notifications, defined in TS 28.532 [7], that an MnS consumer may receive. The notification header attribute `objectClass/objectInstance`, defined in TS 32.302 [8], shall capture the DN of an instance of a class defined in the present document.

| Name | Qualifier | Notes |
|---|-----------|-------|
| <code>notifyMOICreation</code> | O | -- |
| <code>notifyMOIDeletion</code> | O | -- |
| <code>notifyMOIAttributeValueChanges</code> | O | -- |
| <code>notifyEvent</code> | O | -- |

4.1.3 Procedures

4.1.3.1 SLS Assurance Procedure

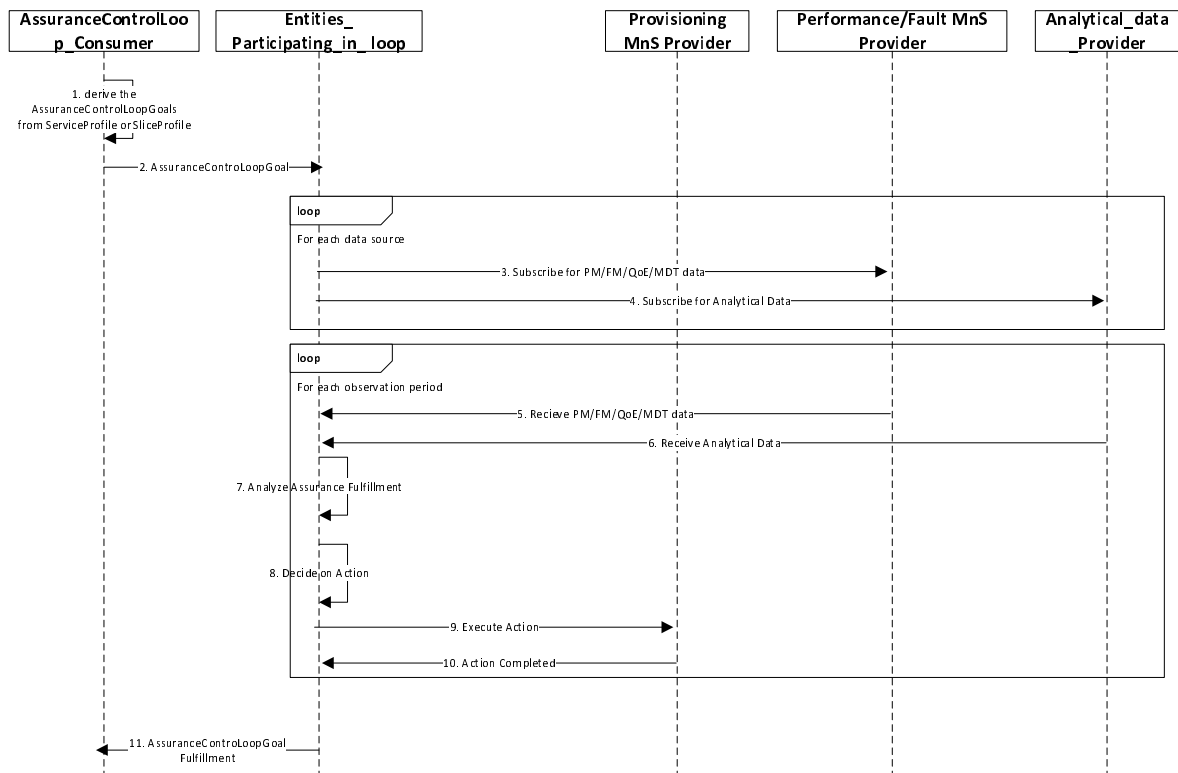


Figure 4.1.3.1.1 SLS assurance procedure

For the purpose of the procedure shown in Figure 4.1.3.1.1 "entities participating in the loop" refers to any entity in the 3GPP management system responsible for the functioning of an ACCL to ensure the AssuranceControlLoopGoal required by an AssuranceControlLoop_Consumer.

1. AssuranceControlLoop_consumer derives AssuranceControlLoopGoal from the ServiceProfile or SliceProfile.
2. AssuranceControlLoop_consumer provides the AssuranceControlLoopGoal to Entities_Participating_in_loop by utilizing the provision management services defined in as defined in clause 11.1.1.3 of TS 28.532 [7].

NOTE 1: In case the Entities_Participating_in_loop represents CrossDomain_Entities_Participating_in_loop, the AssuranceControlLoopGoal is the attribute(s) of the ServiceProfile. In case the Entities_Participating_in_loop represents Domain_Entities_Participating_in_loop, the AssuranceControlLoopGoal is the attribute(s) of the SliceProfile.

3. Entities_Participating_in_loop subscribes the related performance data (e.g., the packet delay related measurements), fault data, QoE data (e.g., buffer level) and MDT data from respective sources by utilizing the Operation establishStreamingConnection as defined in clause 11.5.1.1 of TS 28.532 [7].
4. Entities_Participating_in_loop, optionally, subscribes the related analytical data from MDAS producer or network functions, e.g., NWDAF. In case of NWDAF as a provider, Nnwdaf_EventsSubscription Service as defined in clause 4.2 of TS 29.520 [11] is used.
5. Entities_Participating_in_loop collects the related performance, fault, QoE and MDT data (e.g., the packet delay related measurements), fault data, QoE data (e.g., buffer level) and MDT data from respective sources by utilizing the Operation reportStreamData as defined in clause 11.5.1.3 of TS 28.532 [7].
6. Entities_Participating_in_loop, optionally, collects the related analytical data from MDAS producer or network functions, e.g., NWDAF. In case of NWDAF as a provider, Nnwdaf_AnalyticsInfo Service as defined in clause 4.3 of TS 29.520 [11] is used.

7. Entities_Participating_in_loop assesses if the AssuranceControlLoopGoal has been fulfilled.
 8. Entities_Participating_in_loop assesses if and which action to take in case the AssuranceControlLoopGoal has not been fulfilled.
 9. As per the mitigation action (e.g., scale out) resources are changed, the generic provisioning management service as defined in clause 11.1 of TS 28.532 [7] is utilized for the same.
 10. Action completed.
- NOTE 2: The Entities_Participating_in_loop continues to monitor and analyse the performance and perform the adjustment until the attribute(s) of SliceProfile is assured.
11. AssuranceControlLoop_consumer receives the confirmation of assurance fulfilment from Entities_Participating_in_loop by utilizing the provision management services defined in clause 11.1.1.3 of TS 28.532 [7].

4.2 Stage 3

4.2.1 Solution Set (SS) for JSON/YAML

The JSON/YAML solution set is documented in clause B.2.

Annex A (informative): Control loop deployed in different layers

A.1 Introduction

This example gives a high-level view of control loops deployed in different layers, which consists of control loop in communication service layer, control loop in network slice layer, control loop in network slice subnet layer and control loop in NF layer, as described as Figure A.1.1, where the analytic could be leverage MDAS, and different control loops can provide input (interact with) to other control loops (in the same layer or different layers) and obtain the output from other control loops (in the same layer or different layers).

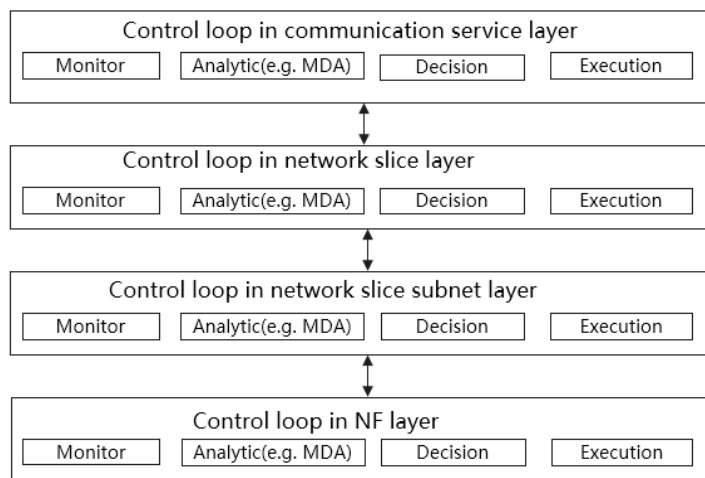


Figure A.1.1: Control loop in different layers

A.2 Control loop in communication service layer

SLA/SLS requirements provided from CSC are translated into serviceProfile, which represents the requirements for communication service assurance to the CSP. Coordination between control loop in communication service layer and control loop in network slice layer is needed to calculate the communication service resource requirements and to assure the communication service SLA/SLS requirements.

When the communication service is active, network slice performance is monitored and analysed for the communication service according to end user service experiences.

If service degradation occurs or it is predicted, the 3GPP management system could take actions, i.e. the allocated resources are scaled up or the SLS is adjusted based on pre-agreement/interaction between CSP and CSC.

A.3 Control loop in network slice layer

After receiving SLA/SLS requirements from service profile and completing the network slice provisioning, the network slice performance (e.g. KPI, QoE) are monitored and reported. Compared to the SLA/SLS requirements from service profile, when network slice performance is not met, the 3GPP management system identifies the root cause and may reconfigure the resources according to analytical report from MDAS producer. The network slice resources are also modified accordantly in case the network slice performance requirement needs to be changed based on communication service requirement adjustment.

A.4 Control loop in network slice subnet layer

After decomposing service profile to slice profile, the performance requirements for each network slice subnet are obtained. The 3GPP management system could have the capability of service observation (e.g., the supervision to the NSSI) based on MDAS. Based on such observation and comparison with initial subnet performance requirements, management actions on the NSSI might be performed if NSSI performance requirements fulfillment indicates a problem. Another possible scenario is that, when the NSSI performance requirement is changed because of the network slice modification management action, the NSSI resources might be also reconfigured.

A.5 Control loop in NF layer

NOTE: The control loop in NF layer is not addressed in the present document.

Annex B (normative): OpenAPI definition of the COSLA NRM

B.1 General

This annex contains the OpenAPI definition of the COSLA NRM in YAML format.

The Information Service (IS) of the COSLA NRM is defined in clause 4.

Mapping rules to produce the OpenAPI definition based on the IS are defined in TS 32.160 [10].

B.2 Solution Set (SS) definitions

B.2.1 OpenAPI document "TS28536_CoslaNrm.yml"

```
openapi: 3.0.1

info:
  title: coslaNrm
  version: 16.4.0
  description: >
    OAS 3.0.1 specification of the Cosla NRM
    © 2020, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

externalDocs:
  description: 3GPP TS 28.536 V16.4.0; Cosla NRM
  url: http://www.3gpp.org/ftp/Specs/archive/28_series/28.536/

paths: {}

components:
  schemas:

#----- Type definitions -----

  ControlLoopLifeCyclePhase:
    type: string
    enum:
      - PREPARATION
      - COMMISSIONING
      - OPERATION
      - DECOMMISSIONING

  ObservationTime:
    type: integer

  AssuranceGoalStatusObserved:
    type: string
    enum:
      - FULFILLED
      - NOT_FULFILLED

  AssuranceGoalStatusPredicted:
    type: string
    enum:
      - FULFILLED
      - NOT_FULFILLED

  AssuranceTarget:
    type: object
    properties:
      assuranceTargetName:
        type: string
      assuranceTargetValue:
```

```

    type: string

AssuranceTargetList:
  type: array
  items:
    $ref: '#/components/schemas/AssuranceTarget'

```

#----- Definition of concrete IOCs -----

```

MnS:
  oneOf:
    - type: object
      properties:
        SubNetwork:
          $ref: '#/components/schemas/SubNetwork-Multiple'
    - type: object
      properties:
        ManagedElement:
          $ref: '#/components/schemas/ManagedElement-Multiple'

SubNetwork-Single:
  allOf:
    - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
    - type: object
      properties:
        attributes:
          allOf:
            - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/SubNetwork-Attr'
    - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/SubNetwork-ncO'
    - type: object
      properties:
        AssuranceClosedControlLoop:
          $ref: '#/components/schemas/AssuranceClosedControlLoop-Multiple'

ManagedElement-Single:
  allOf:
    - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
    - type: object
      properties:
        attributes:
          allOf:
            - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/ManagedElement-Attr'
    - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/ManagedElement-ncO'
    - type: object
      properties:
        AssuranceClosedControlLoop:
          $ref: '#/components/schemas/AssuranceClosedControlLoop-Multiple'

AssuranceClosedControlLoop-Single:
  allOf:
    - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
    - type: object
      properties:
        attributes:
          type: object
          properties:
            operationalState:
              $ref: 'TS28623_ComDefs.yaml#/components/schemas/OperationalState'
            administrativeState:
              $ref: 'TS28623_ComDefs.yaml#/components/schemas/AdministrativeState'
            controlLoopLifeCyclePhase:
              $ref: '#/components/schemas/ControlLoopLifeCyclePhase'
        AssuranceGoal:
          $ref: '#/components/schemas/AssuranceGoal-Multiple'

AssuranceGoal-Single:
  allOf:
    - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
    - type: object
      properties:
        attributes:
          allOf:
            - type: object
              properties:
                observationTime:
                  $ref: '#/components/schemas/ObservationTime'
                assuranceTargetList:
                  $ref: '#/components/schemas/AssuranceTargetList'

```

```
    assuranceGoalStatusObserved:
      $ref: '#/components/schemas/AssuranceGoalStatusObserved'
    assuranceGoalStatusPredicted:
      $ref: '#/components/schemas/AssuranceGoalStatusPredicted'
    serviceProfileId:
      type: string
    sliceProfileId:
      type: string
    networkSliceRef:
      $ref: 'TS28623_ComDefs.yaml#/components/schemas/Dn'
    networkSliceSubnetRef:
      $ref: 'TS28623_ComDefs.yaml#/components/schemas/Dn'

#----- Definition of JSON arrays for name-contained IOCs -----
SubNetwork-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/SubNetwork-Single'

ManagedElement-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/ManagedElement-Single'

AssuranceClosedControlLoop-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/AssuranceClosedControlLoop-Single'

AssuranceGoal-Multiple:
  type: array
  items:
    $ref: '#/components/schemas/AssuranceGoal-Single'

#----- Definitions in TS 28.536 for TS 28.623 -----

resources-coslaNrm:
  oneOf:
    - $ref: '#/components/schemas/MnS'
    - $ref: '#/components/schemas/AssuranceClosedControlLoop-Single'
    - $ref: '#/components/schemas/AssuranceGoal-Single'
    - $ref: '#/components/schemas/SubNetwork-Single'
    - $ref: '#/components/schemas/ManagedElement-Single'
```

Annex C (normative): AssuranceClosedControlLoop state management

An AssuranceClosedControlLoop is a logical object in the management system that represents complex interaction between the assurance information and configuration information of a grouping of resources. At any time, the management system needs to know the state of an AssuranceClosedControlLoop.

The ITU-T X.731 [15], to which [14] refers, has defined the inter-relation between the administrative state and operational state of systems in general. Figure X.1 shows the state diagram of an AssuranceClosedControlLoop, where the number in the Figure identify the state changes. The explanations for the state changes are described in Table C.1.

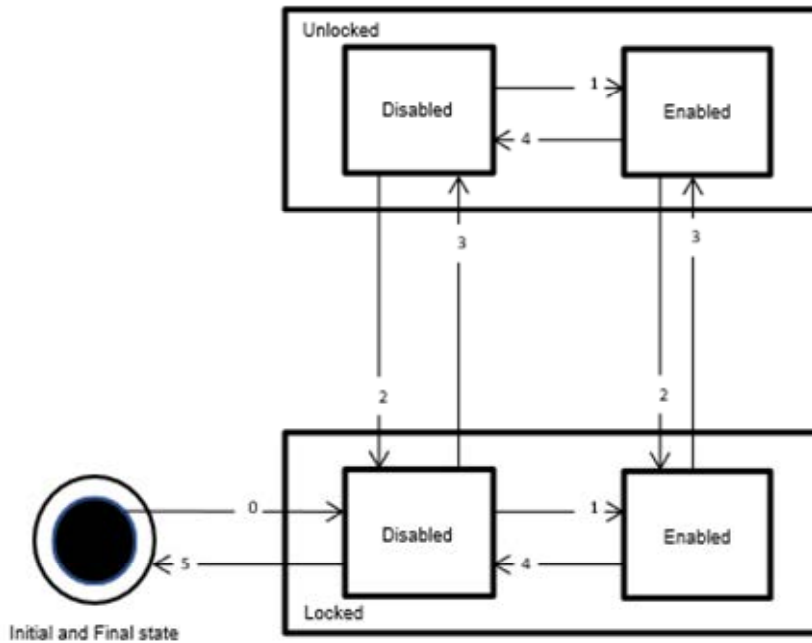


Figure C.1: AssuranceClosedControlLoop state diagram

In an AssuranceClosedControlLoop deployment scenario, the interactions between various management services allow the reconfiguration of the resources controlled by the AssuranceClosedControlLoop based on predefined goal(s). The interactions specified under the column "The state transition events and actions" of Table C.1 shall be present for the state transition.

Table C.1: The AssuranceClosedControlLoop state transition table

| Trigger number | The state transition events and actions | State |
|----------------|--|---------------------------------|
| 0 | The Assurance MnS producer responds positively to the "create ACCL" message, the ACCL is created and the state is set to Locked | Locked & Disabled |
| 1 | The Assurance MnS producer has assurance goals to fulfil and starts or resumes operation by setting the operational state to Enabled | Locked & Enabled |
| 2 | The Assurance MnS consumer suspends operation of the ACCL by setting the administrative state to Locked | Locked (Enabled or Disabled) |
| 3 | The Assurance MnS consumer resumes operation of the ACCL by setting the administrative state to Unlocked. | Unlocked |

| | | |
|---|--|--------------------------------------|
| | | (Enabled or Disabled) |
| 4 | The Assurance MnS producer does not have any assurance goals to fulfil and suspends operation by setting the operational state to Disabled | Disabled (Locked or Unlocked) |
| 5 | The Assurance MnS producer responds positively to the "delete ACCL" message, the ACCL is deleted, and the state is set to NULL (the Initial and Final state) | NULL |

NOTE: The trigger numbers in the first column represent the state changes in Figure C.1

Annex D (informative): Change history

| Change history | | | | | | | |
|----------------|---------|-----------|------|-----|-----|---|-------------|
| Date | Meeting | TDoc | CR | Rev | Cat | Subject/Comment | New version |
| 2020-07 | SA#88e | | | | | Upgrade to change control version | 16.0.0 |
| 2020-09 | SA#89e | SP-200749 | 0001 | - | F | Update control loop deployed in different layers with SLA decomposition | 16.1.0 |
| 2020-09 | SA#89e | SP-200750 | 0004 | - | F | Add references to clause 4.1.2.3 | 16.1.0 |
| 2020-09 | SA#89e | SP-200750 | 0005 | - | F | Correct title and add references in clause 4.1.1 | 16.1.0 |
| 2020-09 | SA#89e | SP-200750 | 0006 | - | F | Remove Editor's Note in clause 4.1.1 | 16.1.0 |
| 2020-09 | SA#89e | SP-200750 | 0007 | - | F | Replace Editors Note in clause Annex A.5 with a Note | 16.1.0 |
| 2020-09 | SA#89e | SP-200750 | 0003 | - | F | Add abbreviations to clause 3.3 | 16.1.0 |
| 2020-12 | SA#90e | SP-201050 | 0008 | - | F | Update references to other specifications | 16.2.0 |
| 2020-12 | SA#90e | SP-201056 | 0011 | - | F | Update and make closed control loop term consistent | 16.2.0 |
| 2020-12 | SA#90e | SP-201056 | 0013 | - | F | Add Annex on state management | 16.2.0 |
| 2020-12 | SA#90e | SP-201056 | 0016 | - | F | Implement Assurance Closed Loop model changes | 16.2.0 |
| 2020-12 | SA#90e | | | | | Correction in history table of SP numbers | 16.2.1 |
| 2021-03 | SA#91e | SP-210151 | 0017 | - | F | Remove conflicting attribute definitions | 16.3.0 |
| 2021-03 | SA#91e | SP-210151 | 0018 | - | F | Clarify modelling of AssuranceGoal | 16.3.0 |
| 2021-03 | SA#91e | SP-210151 | 0019 | 3 | F | Correct OpenAPI definition of the COSLA NRM | 16.3.0 |
| 2021-03 | SA#91e | SP-210151 | 0022 | - | F | Remove overview from stage 2 description | 16.3.0 |
| 2021-03 | SA#91e | SP-210151 | 0025 | 2 | F | Correct the misalignment information for COSLA NRM | 16.3.0 |
| 2021-03 | SA#91e | SP-210151 | 0027 | 1 | F | Add explanation of entities in closed loop | 16.3.0 |
| 2022-06 | SA#96 | SP-220497 | 0045 | - | F | Fixing OpenAPI Discoverability issue in CoslaNrm.yaml stage 3 | 16.4.0 |
| 2022-06 | SA#96 | SP-220497 | 0047 | - | F | OpenAPI file name and dependence change for coslaNrm.yaml | 16.4.0 |
| 2022-06 | SA#96 | SP-220504 | 0051 | - | F | Minor correction on the format for cosla yaml file | 16.4.0 |
| 2022-06 | SA#96 | SP-220504 | 0053 | - | F | Correct attribute properties of assuranceTargetList | 16.4.0 |
| 2022-06 | SA#96 | | | | | CR implementation issues in Annex B.2.1 | 16.4.1 |
| 2023-09 | SA#101 | SP-230940 | 0060 | 1 | F | Rel-16 CR for TS28.536 Fix ambiguous description in SLS Assurance Procedure | 16.5.0 |
| 2024-06 | SA#104 | SP-240812 | 0073 | 1 | F | Rel-16 CR TS 28.536 Correct issues for assurance management NRM fragment | 16.6.0 |
| 2024-09 | SA#105 | SP-241168 | 0096 | 1 | F | Rel-16 CR TS 28.536 Correction to using data types | 16.7.0 |
| 2024-12 | SA#106 | SP-241635 | 0100 | - | F | Rel-16 CR TS 28.536 Fix issues in SLS Assurance Procedure | 16.8.0 |

History

| Document history | | |
|-------------------------|----------------|-------------|
| V16.0.0 | July 2020 | Publication |
| V16.1.0 | November 2020 | Publication |
| V16.2.1 | January 2021 | Publication |
| V16.3.0 | April 2021 | Publication |
| V16.4.1 | August 2022 | Publication |
| V16.5.0 | September 2023 | Publication |
| V16.6.0 | July 2024 | Publication |
| V16.7.0 | October 2024 | Publication |
| V16.8.0 | January 2025 | Publication |