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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

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

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

Autonomous network is one of the important topics in 5G network. Complexity of 5G network increases with large number of devices and diversity of services. Different autonomous mechanisms are introduced by the industry to reduce the complexity of mobile network and service management. Moving from a manual operating network to a fully autonomous network requires a stepwise progression. For each step there are different capability and performance level of autonomy. Thus the concept of autonomous network levels and corresponding requirements are introduced to describe and evaluate each level in details.

# 1 Scope

The present document specifies the concepts, use cases and requirements for the levels of autonomous network.

# 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".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP 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 3GPP TR 21.905 [1].

**Autonomous Network**: telecommunication system (including management system and network) with autonomy capabilities which is able to be governed by itself with minimal to no human intervention.

**Autonomous Network Level**: describes the level of autonomy capabilities in the autonomous network.

**Network and Service Planning**: Editor's Note: network and service planning is FFS.

**Network and Service Deployment**: processes of allocation, installation, configuration, activation and verification of specific network and service.

**Network and Service Maintenance**: processes of monitoring, analysing and healing of the network and service issues.

**Network and Service Optimization**: processes of monitoring, analysing and optimizing the network and service performance.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

<ABBREVIATION> <Expansion>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP 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 3GPP TR 21.905 [1].

AON Autonomous Network

ANL Autonomous Network Level

# 4 Concepts and background

*Editor's note: this clause will contain the concept of autonomous network levels, dimensions for evaluating autonomous network levels.*

## 4.1 Autonomous network concept

The network become complex due to large number of devices and diversity of services. Different autonomy mechanisms are introduced in the industry to reduce the complexity of mobile network management and control. The ultimate goal for autonomous network is to enable telecommunication system (including management system and network) within the autonomy mechanisms (e.g. AI/ML) to be governed by itself with minimal to no human intervention. Autonomous network can reduce the operating expenditure (OPEX) associated with the autonomous management and control of the complexity network and improve the service experience to enable various vertical industries (e.g. autonomous vehicle, smart city). Following are concepts related to autonomous network.

- Autonomous network level is used to describe the level of autonomy capabilities in the autonomous network.

- Self-Organization Network, Management data analytics, Intent driven management, closed loop SLS assurance are examples of enablers for autonomous network.

## 4.2 Autonomous network level concept

Different autonomy mechanisms in the telecommunication system may lead to different capabilities of autonomy and different operation efficiency on network management and control workflow, and indicates the level of autonomy of the network. The term Autonomous network level is used to describe the levels of autonomy capabilities in the autonomous network to improve the efficiency for network management and control. Participation of the human and telecommunication system in the network management and control workflow are different for each level and are important factors to evaluate the autonomous network levels. For each autonomous network level, some tasks can be performed by telecommunication system, some performed by human, and some performed by cooperation of human and telecommunication system. For example, in the highest autonomous network level, all tasks are performed by telecommunication system.

*Editor's Note: the concept of autonomous network and autonomous network level need to be revised and coordinated with other SDOs.*

## 4.3 Dimensions for evaluating autonomous network levels.

### 4.3.1 Introduction

This clause describes the dimensions i.e. scenarios, management scope and workflow, which can be used for evaluating autonomous network level.

### 4.3.2 Scenarios

The autonomous network can be implemented for different scenarios, the complexity of autonomous network depends on the detailed scenarios where it is applied. Also it will be more challenging for the telecommunication system to achieve the autonomous network for full scenarios than for certain scenarios. The autonomy capabilities of the scenarios will impact the autonomous network level for the whole autonomous network.

Following are scenario types categorized by network and service management process for autonomous network:

* Network and service planning
* Network and service deployment
* Network and service maintenance
* Network and service optimization

*Editor's note: network and service planning is FFS.*

### 4.3.3 Management scope

The autonomy can be implemented in different scopes, the complexity of autonomous network depends on its applicable scope. For example, it will be more challenging for the telecommunication system to achieve the autonomous network on cross domain network layer than domain network layer, because more autonomy mechanism needs to be introduced for the coordination between different domains. The autonomy capabilities of the management scope will impact the autonomous network level for the whole autonomous network.

Following are applicable scopes for autonomous network:

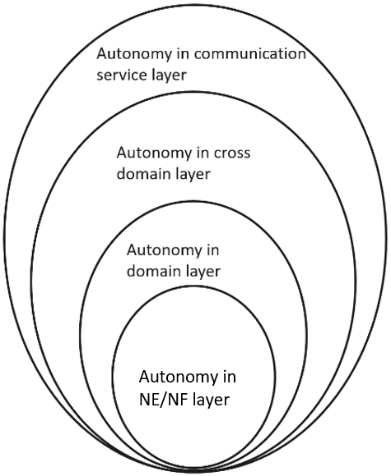
- Autonomy in NE/NF layer, which means the autonomy mechanisms are executed in the NE/NF.

- Autonomy in domain network layer, which means the autonomy mechanisms are executed in the MnF(s) in domain.

- Autonomy in cross domain network layer, which means the autonomy mechanisms are executed in the MnF(s) in cross domain.

- Autonomy in communication service layer, how to execute the autonomy mechanisms are executed in MnF(s) for communication service.

*Editor's Note: autonomy in communication service layer is FFS.*



**Figure 4.3.3-1: Autonomy for different management scope**

### 4.3.4 Workflow

Workflow is used to describe the necessary steps to achieve certain management and control purposes. A workflow is composed of one or more management and control tasks. Each workflow task may be accomplished by human, or accomplished by telecommunication system with human assistance, or accomplished by telecommunication system without human intervention. The autonomy capabilities of the tasks in the workflow may impact the autonomous network level.

Following are the categorization of the tasks in a workflow:

- **Intent handling:** The group of tasks which translate network or service intent from operator or customer into detailed operations and/or policies which may affect one or more of the following groups of tasks (i.e. awareness, analysis, decision, execution), also evaluate and feedback intent fulfilment information (e.g. the intent is satisfied or not) based on the detailed network and service information.

- **Awareness:** The group of tasks which include network and service data (e.g. configuration data, performance data, alarm data, etc.) collection and necessary data pre-processing (e.g. data cleaning, filtering, statistics, etc.) with the purpose of monitoring network and service information (including network and service performance, network and service anomaly, network and service event, etc.).

- **Analysis:** The group of tasks which analyse the obtained network and service information (e.g. network and service status, network and service issues and so on) or based on the historical network and service information to further predict the future change trend of the above network and service status, and make recommendation for decision.

- **Decision:** The group of tasks which evaluate and decide the necessary operation for execution, e.g. network configuration or adjustment.

- **Execution:** The group of tasks which execute the operations.

*Editor's Note: the relationship between the above categorization of the tasks and the other standardized features including intent driven management and COSLA is FFS.*

# 5 Framework approach for evaluating autonomous network levels

*Editor's Note: the framework approach for evaluating autonomous network levels need to be revised and coordinated with other SDOs.*

A framework approach for evaluating autonomous network levels is as following, which is used for evaluating the autonomy capability of telecom system.

**Table 5-1: Framework approach for evaluating autonomous network levels**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Network autonomy level | | Task categories | | | | |
| Execution | Awareness | Analysis | Decision | Intent handling |
| L0 | Manual operating network | Human | Human | Human | Human | Human |
| L1 | Assisted operating network | Human & Telecom system | Human & Telecom system | Human | Human | Human |
| L2 | Preliminary autonomous network | Telecom system | Human & Telecom system | Human & Telecom system | Human | Human |
| L3 | Intermediate autonomous network | Telecom system | Telecom system | Human & Telecom system | Human & Telecom system | Human |
| L4 | Advanced autonomous network | Telecom system | Telecom system | Telecom system | Telecom system | Human & Telecom system |
| L5 | Full autonomous network | Telecom system | Telecom system | Telecom system | Telecom system | Telecom system |
| Note 1: Human reviewed decision have the highest authority in each level if there is any confliction between human reviewed decision and telecom system generated decision.  Note 2: The order of above five task categories does not reflect the workflow sequence. | | | | | | |

**Level 0 manual operating network**: No categorization of the tasks is accomplished by telecom system itself.

**Level 1 assisted operating network**: A part of the execution and awareness tasks are accomplished automatically by telecom system itself based on human defined rules. At this level, telecom system can assist human to improve the execution and awareness efficiency.

**Level 2 preliminary autonomous network**: All the execution tasks are accomplished automatically by telecom system itself. A part of the awareness and analysis tasks are accomplished automatically by telecom system itself based on human defined policies. At this level, telecom system can assist human to achieve the closed loop based on human defined policies.

**Level 3 intermediate autonomous network**: All the execution and awareness tasks are accomplished automatically by telecom system itself. A part of the analysis and decision tasks are accomplished automatically by telecom system itself based on human defined policies. At this level, the telecom system can achieve the closed loop automation based on the human defined closed loop automation policies.

**Level 4 advanced autonomous network**: All the execution, awareness, analysis and decision tasks are accomplished automatically by telecom system itself. And intent handling tasks can be partly accomplished automatically by telecom system itself based on human defined intent handling policies. At this level, telecom system can achieve the intent driven closed loop automation based on human defined intent handling policies, which means the telecom system can translate the intent to the detailed closed loop automation policies and translate the detailed network and service information to intent fulfilment information (e.g. the intent is satisfied or not) based on human defined intent handling policies.

**Level 5 fully autonomous network**: The entire network autonomy workflow is accomplished automatically by telecom system without human intervention. At this level, telecom system can achieve the whole network autonomy.

Note: Above framework approach for evaluating autonomous network levels is applicable for evaluating the autonomous network level from both management scope and scenario perspective. The overall autonomous network level of the whole telecom system is a comprehensive reflection of autonomous network level of the individual management scope and scenarios, which means in fully autonomous network level, the telecom system can achieve the whole network autonomy for all management scopes and scenarios.

# 6 Use cases and requirements

## 6.1 Network and service planning scenarios

*Editor’s Note: this clause will contain the typical management use cases corresponding to telecom network and communication service planning scenarios and related management requirements for each autonomous levels. The management requirements include architecture requirements, enhancements of management and orchestration, important data and data collection policy and key management requirements on autonomous network related features.*

## 6.2 Network and service deployment scenarios

*Editor's Note: this clause will contain the typical management use cases corresponding to telecom network and communication service deployment scenarios and related management requirements for each autonomous levels. The management requirements include architecture requirements, enhancements of management and orchestration, important data and data collection policy and key management requirements on autonomous network related features.*

## 6.3 Network and service maintenance scenarios

*Editor's Note: this clause will contain the typical management use cases corresponding to telecom network and communication service maintenance scenarios and related management requirements for each autonomous levels. The management requirements include architecture requirements, enhancements of management and orchestration, important data and data collection policy and key management requirements on autonomous network related features.*

### 6.3.1 Autonomous network level for fault management

*Editor's Note: whether the following use case need to be generalized for common maintenance scenarios is FFS.*

#### 6.3.1.1 Introduction

Fault management use case refers to the entire workflow of network fault management, autonomy of fault management can help the network operator to reduce OPEX by reducing manual involvement in such tasks and to enhance user experience and reduce network and service failure time by reducing the time for network fault supervision and recovery. However, full autonomy of fault management is a long term goal, it will be beneficial for operator to achieve this goal step by step and have clear view on which typical issues can be addressed by utilizing network autonomy mechanism in corresponding steps. The requirements for each autonomous level for fault management autonomy are different.

#### 6.3.1.2 Workflow

Following are the entire workflow for fault management:

**Intent handling:**

- **Task A:** Fault management policies generation. The group of tasks of generating the fault management related rules and/or policies (e.g., alarm filtering rules, fault recognition and root cause analysis policies, fault recovery policies) based on fault management intent (e.g. reduce fault recovery response time to a certain value, reduce network and service failure times to a certain value within a specific duration).

- **Task B:** Fault management intent fulfilment evaluation. The group of tasks of evaluating fault management intent fulfilment information (e.g. corresponding fault recovery response time is satisfied or not).

**Awareness:**

- **Task C:** Fault related information collection. The group of tasks which collect the alarm information and other fault related information (e.g. performance information and configuration information etc.).

- **Task D:** Alarm filtering. The group of tasks which filter the alarms collected in Task C based on the filtering rules specified. A single network fault may generate a large number of correlative alarms over space and time, therefore it is considered advantageous to have methods filtering the redundant alarms. Reporting only effective alarms without redundant alarms would improve the efficiency of alarm management.

**Analysis:**

- **Task E:** Fault recognition. The group of tasks which recognize the fault and its category (including fault domain, fault type) based on the alarm information and other fault related information.

- **Task F:** Fault prediction. The group of tasks which predict the potential fault and its category based on the performance information and other fault related information.

- **Task G:** Fault root cause analysis (RCA). The group of tasks which analyse the detailed root cause of the network and service failure.

- **Task H:** Fault recovery mechanism analysis. The group of tasks which analyse the possible fault recovery mechanisms based on the fault root cause, thereby generate the feasible options (e.g. recommended recovery solutions).

**Decision:**

- **Task I:** Fault management action generation. The group of tasks which evaluate the feasible options and determine the fault recovery solutions and other corresponding actions (e.g. clear of alarms, storage and retrieval of alarms).

**Execution:**

- **Task J:** Fault management action execution. The group of tasks which execute the fault recovery actions and other corresponding actions.

Note: If the faulty resource has no redundancy (e.g. backup equipment/board/battery/transport link) and all the fall back recovery actions are not available nor effective, then the subsequent fault recovery actions (e.g. replace physical equipment/board/battery, repair the physical connector/fibre/cable, repair the power supply, etc.) are considered as beyond the capabilities of the telecom system. And those actions execution is excluded from the consideration of autonomous network level classification.

#### 6.3.1.3 Classification of autonomous network level

Level 0:

- All the tasks in the fault management workflow (Task A, Task B, Task C, Task D, Task E, Task F, Task G, Task H, Task I, Task J) are accomplished by human.

Level 1:

- Telecom system executes the tasks of fault related information collection (Task C) automatically based on predefined rules, and the tasks of fault management action execution (Task J) based on specified action execution rules. Telecom system can also execute the tasks of alarm filtering (Task D) based on specified alarm filtering rules.

- All the other tasks in the fault management workflow (Task A, Task B, Task E, Task F, Task G, Task H, Task I) are accomplished by human.

Level 2:

- Compared to Level 1, telecom system can additionally executes the tasks of fault recognition (Task E) based on specified rules. The tasks of fault management action execution (Task J), fault related information collection (Task C) and alarm filtering (Task D) are fully accomplished by telecom system based on specified rules.

- All the other tasks (Task A, Task B, Task F, Task G, Task H, Task I) are accomplished by human.

Level 3:

- Compared to Level 2, telecom system can additionally execute the tasks of fault root cause analysis based on specified analysis policies (Task G). For certain network faults, telecom system can also additionally execute the tasks of fault recovery mechanism analysis (Task H) and action generation (Task I) based on specified fault management policies.

- All the other tasks (Task A, Task B, Task F) are accomplished by human.

Level 4:

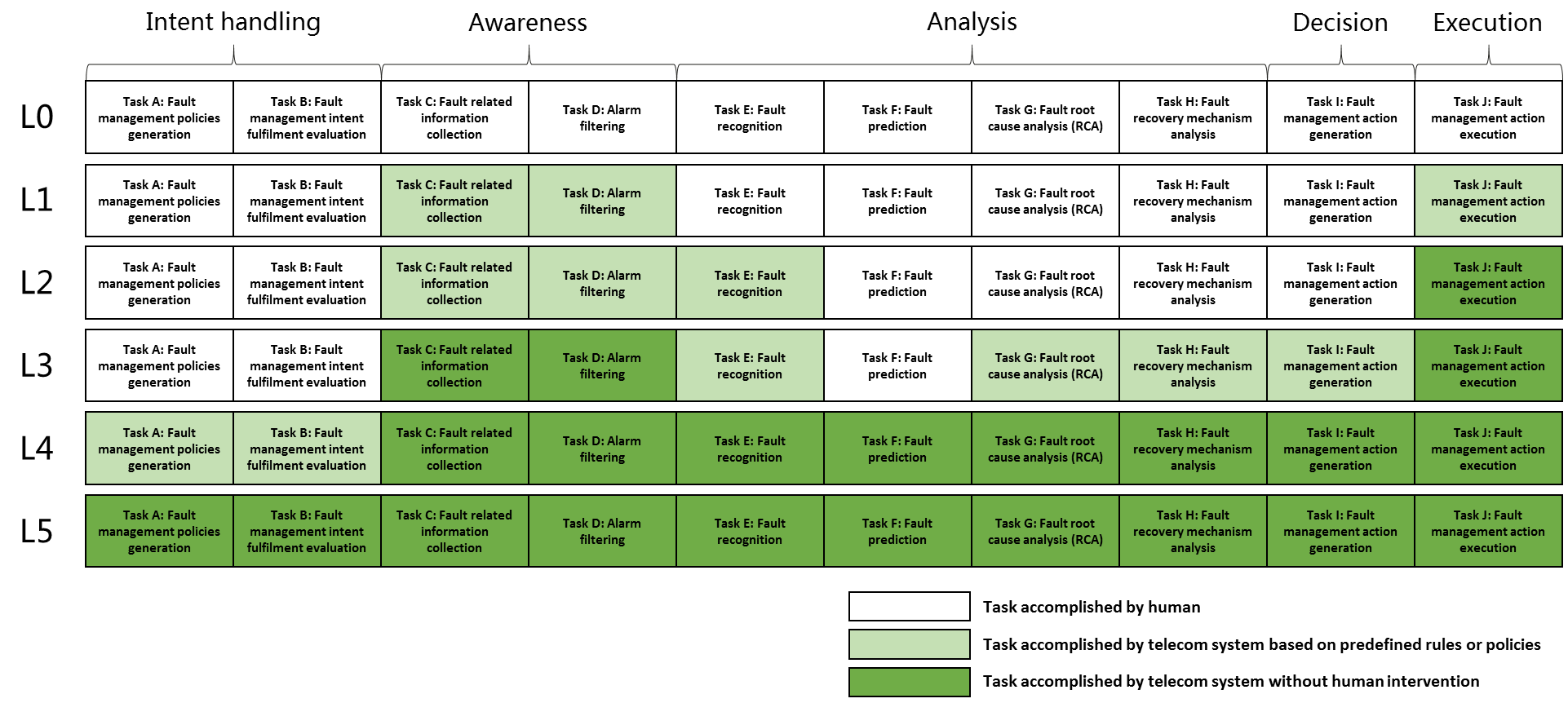
- Compared to Level 3, the telecom system can additionally execute the task of fault prediction (Task F). For certain scenario, telecom system additionally execute the tasks of fault management policies generation (Task A) and fault management intent fulfilment information evaluation (Task B) based on specified intent handling policies. The tasks of fault recovery mechanism analysis (Task H) and action generation (Task I) are accomplished automatically by telecom system without human intervention.

- Intent handling policies can be pre-defined and specified by human.

Level 5:

- The entire fault management workflows is accomplished by telecom system without human intervention and human predefined rules or policies.

- Human can optionally supervise the fault management action generated by telecom system.



**Figure 6.3.1.3-1: Classification of autonomous network level for fault management**

#### 6.3.1.4 Requirements

Following are the functional requirements and interface requirements for 3GPP management system to support each autonomous network level (except for level 0) for fault management.

*Editor’s note: all requirements that do not have any stage 2 and 3 solution shall be deleted before this TS is made public.*

##### 6.3.1.4.1 Requirements to support autonomous network level 1

**REQ-ANL-Level\_1-FM-FUN-1** The 3GPP management system shall have autonomy capability to execute the network recovery actions (including reset the hardware/software, switch to the backup hardware, rollback to the backup software/firmware) based on the specified fault recovery rules.

**REQ-ANL-Level\_1-FM-FUN-2** The 3GPP management system shall have autonomy capability to collect fault related data (including alarms, events, signalling data, performance data, configuration data and environment data) based on specified collection rules.

**REQ-ANL-Level\_1-FM-FUN-3** The 3GPP management system shall have autonomy capability to filter the alarms based on the specified filtering rules.

**REQ-ANL-Level\_1-FM-MnS-1** The 3GPP management system shall have the capability allowing its authorized consumer to specify the fault recovery rules.

**REQ-ANL-Level\_1-FM-MnS-2** The 3GPP management system shall have the capability allowing its authorized consumer to specify the fault related data collection rules.

**REQ-ANL-Level\_1-FM-MnS-3** The 3GPP management system shall have the capability allowing its authorized consumer to specify the alarm filtering rules

**REQ-ANL-Level\_1-FM-MnS-4** The 3GPP management system shall have the capability allowing its authorized consumer to obtain fault related data (including alarms, events, signalling data, performance data, configuration data and environment data).

**REQ-ANL-Level\_1-FM-MnS-5** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the filtered alarm data.

##### 6.3.1.4.2 Additional requirements to support autonomous network level 2

**REQ-ANL-Level\_2-FM-FUN-1** The 3GPP management system shall have the autonomy capability to recognize the fault category (including fault domain and type) based on specified fault recognition rules.

**REQ-ANL-Level\_2-FM-MnS-1**. The 3GPP management system shall have the capability allowing its authorized consumer to specify the fault recognition rules.

**REQ-ANL-Level\_2-FM-MnS-2** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the fault recognition information (including fault domain and type information).

##### 6.3.1.4.3 Additional requirements to support autonomous network level 3

**REQ-ANL-Level\_3-FM-FUN-1** The 3GPP management system shall have autonomy capability to analyse the root cause of the network fault based on specified fault root cause analysis policies.

**REQ-ANL-Level\_3-FM-FUN-2** The 3GPP management system shall have autonomy capability to analyse and generate the recommended fault recovery mechanism and determine the fault recover actions to be executed based on specified fault recovery mechanism analysis and decision policies.

**REQ-ANL-Level\_3-FM-MnS-1** The 3GPP management system shall have the capability allowing its authorized consumer to specify the fault root cause analysis policies.

**REQ-ANL-Level\_3-FM-MnS-2** The 3GPP management system shall have the capability allowing its authorized consumer to specify the fault recovery mechanism analysis policies.

**REQ-ANL-Level\_3-FM-MnS-3** The 3GPP management system shall have the capability allowing its authorized consumer to specify the fault recovery mechanism decision policies.

**REQ-ANL-Level\_3-FM-MnS-4** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the root cause of the network fault.

**REQ-ANL-Level\_3-FM-MnS-5** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the recommended fault recovery mechanism.

**REQ-ANL-Level\_3-FM-MnS-6** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the fault recovery actions to be executed.

##### 6.3.1.4.4 Additional requirements to support autonomous network level 4

**REQ-ANL-Level\_4-FM-FUN-1** The 3GPP management system shall have autonomy capability to generate or update fault management policies according to fault management intent based on specified intent translation policies.

**REQ-ANL-Level\_4-FM-FUN-2** the 3GPP management system shall have autonomy capability to evaluate fault management intent fulfilment based on specified intent evaluation policies.

**REQ-ANL-Level\_4-FM-FUN-3** The 3GPP management system shall have autonomy capability to predict the potential fault.

**REQ-ANL-Level\_4-FM-MnS-1** The 3GPP management system shall have the capability allowing its authorized consumer to specify the fault management intent.

**REQ-ANL-Level\_4-FM-MnS-2** The 3GPP management system shall have the capability allowing its authorized consumer to specify the fault management intent translation policies.

**REQ-ANL-Level\_4-FM-MnS-3** The 3GPP management system shall have the capability allowing its authorized consumer to specify the fault management evaluation policies.

**REQ-ANL-Level\_4-FM-MnS-4** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the fault management fulfilment information.

**REQ-ANL-Level\_4-FM-MnS-5** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the potential fault prediction information.

##### 6.3.1.4.5 Additional requirements to support autonomous network level 5

**REQ-ANL-Level\_5-FM-FUN-1** The 3GPP management system shall have autonomy capability to generate the fault management intent translation and evaluation policies.

## 6.4 Network and service optimization scenarios

*Editor's Note: this clause will contain the typical management use cases corresponding to telecom network and communication service optimization scenarios and related management requirements for each autonomous levels. The management requirements include architecture requirements, enhancements of management and orchestration, important data and data collection policy and key management requirements on autonomous network related features.*

### 6.4.1 Autonomous network level for radio network coverage optimization

*Editor's Note: whether the following use case need to be generalized for common optimization scenarios is FFS.*

#### 6.4.1.1 Introduction

Radio networks are geographically distributed, and mobile user activity varies significantly in different places and at different times of day. To achieve the optimal coverage, a set of initial coverage configuration parameters (e.g. coverageShape, digitalTilt and digitalAzimuth) may not always meet the requirements. Therefore, the coverage configuration parameters need to be adjusted in a differentiated manner with the change of the radio network environment. It’s complex for the adjustment due to multiple factors needs to be considered, e.g. interference control, huge data and frequent traffic changes. So introducing the autonomous network level for radio network coverage optimization will benefit for operator to achieve the full autonomy goal step by step and have clear view on which typical issues can be addressed by utilizing autonomy mechanism in corresponding steps. The requirements for each autonomous level for radio network coverage optimization are different.

#### 6.4.1.2 Workflow

Following are the entire workflow for the radio network coverage optimization:

**Intent handling:**

- **Task A**: Coverage optimization policies generation and determination. The tasks of generating and determining the coverage optimization related policies (e.g., weak coverage issue identification policies, weak coverage analysis policies and coverage parameters adjustment policies) based on received coverage optimization intent (e.g. coverage targets(e.g. weak coverage ratio) for the specified areas).

- **Task B**: Coverage optimization intent evaluation. The tasks of evaluating coverage optimization intent fulfilment information (e.g. corresponding coverage targets are satisfied or not).

**Awareness:**

- **Task C**: Coverage related information collection. The tasks of collecting coverage related data, including coverage performance data (i.e. performance measurement, MDT data), coverage configuration data (e.g. coverageShape, digitalTilt and digitalAzimuth) and environment data (e.g. electronic map)).

**Analysis:**

- **Task D**: Coverage issues identification. The tasks of analysing the coverage performance (e.g. geographical grid based coverage performance) and identifying the coverage issues (e.g. weak coverage, coverage hole, overshoot coverage) and corresponding location.

- **Task E**: Coverage deterioration prediction. The tasks of analysing current coverage performance and historical coverage performance, predicting the coverage performance trend in the future and identifying potential coverage performance deterioration in advance.

- **Task F**: Coverage issue analysis. The tasks of analysing the root cause (e.g. affected Cells) of the identified or predicted coverage issues.

- **Task G**: Coverage adjustment solutions generation. The tasks of generating the recommended coverage adjustment solution which can address the identified or predicted coverage issues.

**Decision:**

- **Task H**: Coverage adjustment solutions evaluation and determination. The tasks of evaluating the recommended coverage adjustment solutions, and deciding the coverage adjustment solutions to be executed.

**Execution:**

- **Task I**: Coverage adjustment solutions execution. The tasks of adjusting and configuring the coverage related parameters (e.g. selection of coverageShape, digitalTilt and digitalAzimuth).

#### 6.4.1.3 Classification of autonomous network level

*Editor’s note:* *following classification of autonomous network level needs to be revised based on the discussion of the framework approach for evaluating autonomous network level in clause 5.*

**Level 0:**

- All the tasks in the radio network coverage optimization workflow (Task A, Task B, Task C, Task D, Task E, Task F, Task G, Task H, Task I) are accomplished by human.

**Level 1:**

- Telecom system executes the tasks of coverage adjustment solutions execution based on the specified coverage related parameters (Task I). Telecom system also can execute the tasks of coverage related information collection based on the specified collection rule (Task C). At this level, telecom system can assist human to improve the execution and awareness efficiency for radio network coverage optimization.

- All the other tasks in the radio network coverage optimization workflow (Task A, Task B, Task D, Task E, Task F, Task G, Task H) are accomplished by human.

**Level 2:**

- Compared to Level 1, telecom system additionally executes the tasks of coverage issues identification, coverage issue analysis based on the specified coverage issue identification and analysis rule (Task D, Task F). At this level, telecom system can assist human to achieve the closed loop for radio network coverage optimization based on human defined rules.

- All the other tasks in the radio network coverage optimization workflow (Task A, Task B, Task E, Task G, Task H) are accomplished by human.

**Level 3:**

- Compared to Level 2, telecom system additionally executes the tasks of coverage adjustment solutions generation (Task G) and coverage adjustment solutions evaluation and determination (Task H) based on the specified coverage adjustment policies and evaluation policies. At this level, the telecom system can achieve the closed loop automation for coverage optimization based on the human defined optimization policies.

- All the other tasks in the radio network coverage optimization workflow (Task A, Task B, Task E) are accomplished by human.

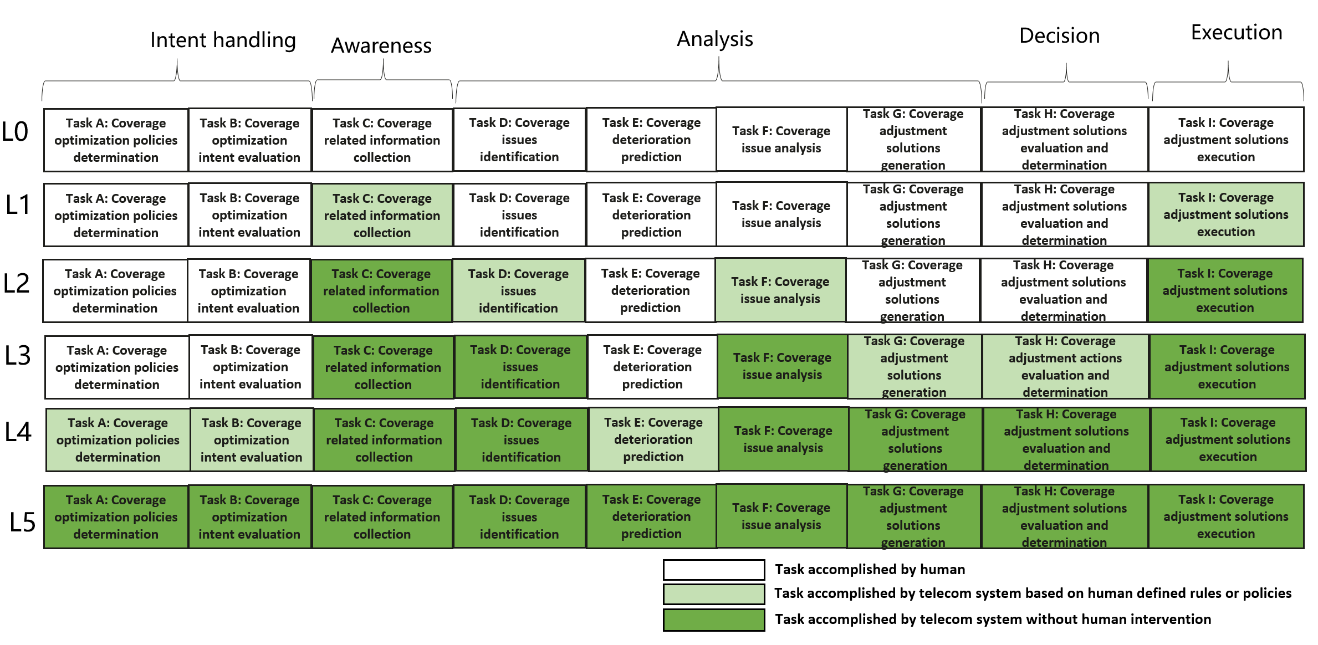
**Level 4:**

- Compared to Level 3, the telecom system additionally executes the tasks of coverage deterioration prediction (Task E), coverage optimization policies determination (Task A), and coverage optimization intent evaluation (Task B) based on received coverage optimization intent and intent translation/evaluation policies. At this level, telecom system can achieve the intent driven closed loop automation for radio network coverage optimization based on human defined intent translation and evaluation policies

- The intent translation and evaluation policies maybe pre-defined and specified by human to assist the telecom system.

**Level 5:**

- Telecom system can autonomously execute the entire workflow of radio network coverage optimization for all scenarios, which means the telecom system can achieve the full autonomy for radio network coverage optimization for full scenarios.

  
Figure 6.4.1.3-1 Classification of autonomous network level for coverage optimization

#### 6.4.1.4 Requirements

Following are the functional requirements and interface requirements for 3GPP management system to support each autonomous network level (except for level 0) for radio network coverage optimization.

*Editor’s note: all requirements that do not have any stage 2 and 3 solution shall be deleted before this TS is made public.*

##### 6.4.1.4.1 Requirements to support autonomous network level 1

**REQ-ANL-CovOpt-Level\_1- FUN-1** The 3GPP management system shall have autonomy capability to adjust coverage related parameters based on the specified coverage configuration parameters.

**REQ-ANL-CovOpt-Level\_1-FUN-2** The 3GPP management system shall have autonomy capability to collect coverage related data (including coverage performance data, coverage configuration data and environment data) based on specified collection rules.

**REQ-ANL-CovOpt-Level\_1-MnS-1** The 3GPP management system shall have the capability allowing its authorized consumer to specify the coverage configuration parameters.

**REQ-ANL-CovOpt-Level\_1-MnS-2** The 3GPP management system shall have the capability allowing its authorized consumer to specify the coverage related data collection rules.

**REQ-ANL-CovOpt-Level\_1-MnS-3** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the coverage related data (including coverage performance data, coverage configuration data and environment data).

##### 6.4.1.4.2 Additional requirements to support autonomous network level 2

**REQ-ANL-CovOpt-Level\_2-FUN-1** The 3GPP management system shall have autonomy capability to identify the coverage issue based on the specified coverage issue identification rule.

**REQ-ANL-CovOpt-Level\_2-FUN-2** The 3GPP management system shall have autonomy capability to diagnose the coverage issue based on the specified coverage issue diagnose rule.

**REQ-ANL-CovOpt-Level\_2-MnS-1** The 3GPP management system shall have the capability allowing its authorized consumer to specify the coverage issue identification rule.

**REQ-ANL-CovOpt-Level\_2-MnS-2** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the coverage issue.

**REQ-ANL-CovOpt-Level\_2-MnS-3** The 3GPP management system shall have the capability allowing its authorized consumer to specify the coverage issue analysis rule.

**REQ-ANL-CovOpt-Level\_2-MnS-4** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the coverage issue analysis result.

##### 6.4.1.4.3 Additional requirements to support autonomous network level 3

**REQ-ANL-CovOpt-Level\_3-FUN-1** The 3GPP management system shall have the autonomy capability to analyse and generate the recommended coverage adjustment solutions based on specified coverage adjustment policies.

**REQ-ANL-CovOpt-Level\_3-FUN-2** The 3GPP management system shall have autonomy capability to evaluate the recommended coverage adjustment solutions and determine the coverage adjustment solutions to be executed based on specified coverage adjustment decision policies.

**REQ-ANL-CovOpt-Level\_3-MnS-1** The 3GPP management system shall have the capability allowing its authorized consumer to specify the coverage adjustment policies.

**REQ-ANL-CovOpt-Level\_3-MnS-2** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the recommended coverage adjustment actions.

**REQ-ANL-CovOpt-Level\_3-MnS-3** The 3GPP management system shall have the capability allowing its authorized consumer to specify the coverage adjustment decision policies.

##### 6.4.1.4.4 Additional requirements to support autonomous network level 4

**REQ-ANL-CovOpt-Level\_4-FUN-1** The 3GPP management system shall have autonomy capability to determine or update coverage optimization policies according to coverage optimization intent based on specified intent translation policies.

**REQ-ANL-CovOpt-Level\_4-FUN-2** the 3GPP management system shall have autonomy capability to evaluate coverage optimization intent fulfilment result based on specified intent evaluation policies.

**REQ-ANL-CovOpt-Level\_4-FUN-3** The 3GPP management system shall have autonomy capability to predict coverage performance deterioration.

**REQ-ANL-CovOpt-Level\_4-MnS-1** The 3GPP management system shall have the capability allowing its authorized consumer to specify the coverage optimization intent.

**REQ-ANL-CovOpt-Level\_4-MnS-2** The 3GPP management system shall have the capability allowing its authorized consumer to specify the coverage optimization intent translation policies.

**REQ-ANL-CovOpt-Level\_4-MnS-3** The 3GPP management system shall have the capability allowing its authorized consumer to specify the coverage optimization evaluation policies.

**REQ-ANL-CovOpt-Level\_4-MnS-4** The 3GPP management system shall have the capability allowing its authorized consumer to obtain the coverage optimization fulfilment information.

**REQ-ANL-CovOpt-Level\_4-MnS-5** The 3GPP management system shall have the capability to obtain the coverage performance deterioration prediction information.

##### 6.4.1.4.5 Additional requirements to support autonomous network level 5

**REQ-ANL-CovOpt-Level\_5-FUN-1** The 3GPP management system shall have autonomy capability to generate the coverage optimization intent translation and evaluation policies.

Annex <A> (normative):  
<Normative annex for a Technical Specification>

Annex <X> (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **Tdoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2020-08 | SA5#132e | S5-204084 |  |  |  | Initial draft TS | 0.0.0 |
| 2020-08 | SA5#132e | S5-204555  S5-204086  S5-204087 |  |  |  | 1. pCR 28.100 Add skeleton  2. pCR 28.100 Add Scope  3. pCR 28.100 Add definitions and abbreviations | 0.1.0 |
| 2020-11 | SA5#134e | S5-206180  S5-206352  S5-206353  S5-206354  S5-206355  S5-206356  S5-206357 |  |  |  | 1. pCR 28.100 Update skeleton for clause 5  2. Add concept of autonomous network and autonomous network level  3. pCR TS 28.100 Add use case and requirements for coverage optimization  4. pCR 28.100 Add Introduction  5. pCR 28.100 Add definition for network and service management scenario types  6. pCR 28.100 Add dimensions for evaluating autonomous network levels  7. pCR 28.100 Add framework approach for evaluating autonomous network levels | 0.2.0 |
| 2021-02 | SA5#135e | S5-211229  S5-211443  S5-211459 |  |  |  | 1. pCR 28.100 Update clause 4.3.4 workflow  2. pCR TS 28.100 Update use case for coverage optimization  3. pCR 28.100 Add use case and requirements for fault management | 0.3.0 |