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**5G;
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(3GPP TS 28.100 version 18.0.0 Release 18)**

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Foreword

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- 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.

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1 Scope

The present document specifies the concepts for autonomous networks, autonomous network level, and that use cases , requirements and solutions for the levels of autonomous functions in a 3GPP 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".
- [2] 3GPP TS 28.312: "Management and orchestration; Intent driven management services for mobile networks".
- [3] 3GPP TS 28.535: " Management and orchestration; Management Services for Communication Service Assurance; Requirements".
- [4] 3GPP TS 28.532: "Management and orchestration; Generic management services".
- [5] 3GPP TS 28.541: "Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3".
- [6] 3GPP TS 28.622: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [7] 3GPP TS 28.552: "Management and orchestration; 5G performance measurements".
- [8] 3GPP TS 28.554: "Management and orchestration; 5G end to end Key Performance Indicators (KPI)".
- [9] 3GPP TS 32.422: "Telecommunication management; Subscriber and equipment trace; Trace control and configuration management".

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].

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 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

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].

ANL	Autonomous Network Level
AON	Autonomous Network

4 Concepts and background

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 network management and control. The ultimate goal for autonomous network is to enable telecommunication system (including management system and network) to be governed by itself with minimal to no human intervention by utilizing the autonomy mechanisms (including intelligence mechanism, e.g. AI/ML, and automation mechanism, e.g. rule-based automatic control, and other mechanisms to enable the autonomous network). 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 is 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 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.

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

NOTE: The network and service planning is not addressed in the present document.

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.

Note: autonomy in communication service layer is not specified in the present document.

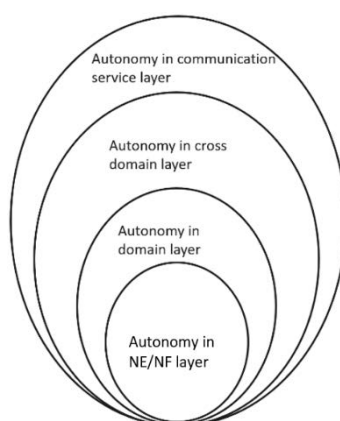


Figure 4.3.3-1: Autonomy for different management scope

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 control information 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. More information of intent handling see the Intent driven management defined in 28.312[2].
- **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.). More information of Awareness see corresponding Monitor of Management control loops defined in 28.535 [3].
- **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. More information of Analysis see corresponding Analytic of Management control loops defined in 28.535 [3].
- **Decision:** The group of tasks which evaluate and decide the necessary operation for execution, e.g. network configuration or adjustment. More information of Decision see corresponding Decision of Management control loops defined in 28.535 [3].
- **Execution:** The group of tasks which execute the operations. More information of Execution see corresponding Execution of Management control loops defined in 28.535 [3].

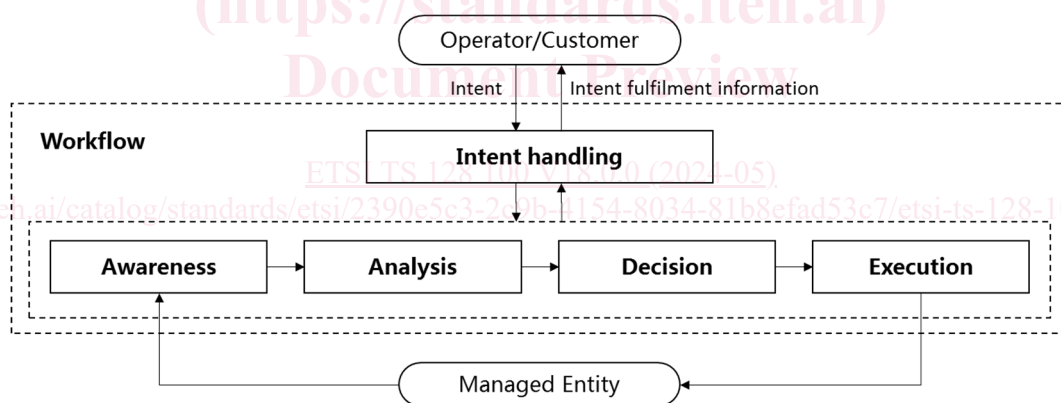


Figure 4.3.4-1: Categorization of the tasks in the workflow for evaluating autonomous network levels

5 Framework approach for evaluating autonomous network levels

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

- "Human" represents corresponding tasks are accomplished by human or human utilizing the tools for network and service management and orchestration.
- "Human & System" represents corresponding tasks are accomplished by collaboration of human and telecom system, the detailed collaboration pattern depends on the scenario, which is not addressed in the framework approach for evaluating autonomous network levels.
- "System" represents corresponding tasks are fully accomplished by telecom system.