ETSI TS 128 100 V17.0.0 (2022-05)

TECHNICAL SPECIFICATION

5G;
Management and orchestration;
Levels of autonomous network
(3GPP TS 28.100 version 17.0.0 Release 17)

Reference

DTS/TSGS-0528100vh00

Keywords

5G

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00   Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or
print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any
existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI
deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.
Information on the current status of this and other ETSI documents is available at
https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

If you find a security vulnerability in the present document, please report it through our
Coordinated Vulnerability Disclosure Program:
https://www.etsi.org/standards/coordinated-vulnerability-disclosure

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of
experience to understand and interpret its content in accordance with generally accepted engineering or
other professional standard and applicable regulations.
No recommendation as to products and services or vendors is made or should be implied.
No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law
and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness
for any particular purpose or against infringement of intellectual property rights.
In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not
limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property
rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages
for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use
of or inability to use the software.

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and
microfilm except as authorized by written permission of ETSI.
The content of the PDF version shall not be modified without the written authorization of ETSI.
The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2022.
All rights reserved.

ETSI

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM**® and the GSM logo are trademarks registered and owned by the GSM Association.

Legal Notice

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

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under http://webapp.etsi.org/key/queryform.asp.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

iTeh STANDARD
PREVIEW
(standards.iteh.ai)

ETSI TS 128 100 V17.0.0 (2022-05)
https://standards.iteh.ai/catalog/standards/sist/1e1b0142-
fd30-49da-96be-822e656018a6/etsi-ts-128-100-v17-0-
0-2022-05

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.

iTeh STANDARD
PREVIEW
(standards.iteh.ai)

ETSI TS 128 100 V17.0.0 (2022-05)
https://standards.iteh.ai/catalog/standards/sist/1e1b0142-
fd30-49da-96be-822e656018a6/etsi-ts-128-100-v17-0-
0-2022-05

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.
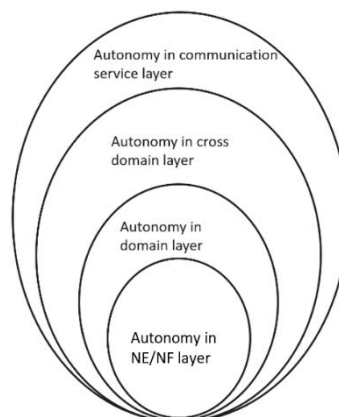

Figure 4.3.3-1: Autonomy for different management scope

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].
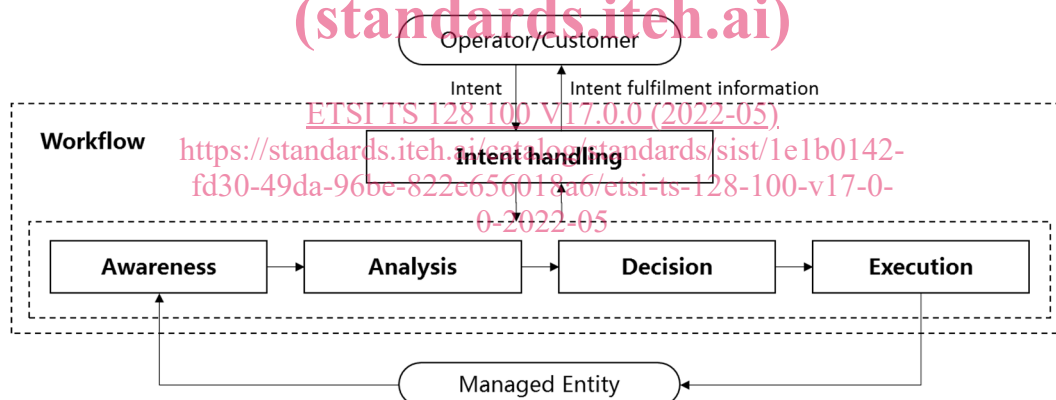

Figure 4.3.4-1: Categorization of the tasks in the workflow for evaluating autonomous network levels

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.

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

Autonomous network 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 control information. 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 control information. At this level, telecom system can assist human to achieve the closed loop based on human defined control information.

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 control information. At this level, the telecom system can achieve the closed loop automation based on the human defined closed loop automation control information.

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 control information. At this level, telecom system can achieve the intent driven closed loop automation based on human defined intent handling control information, which means the telecom system can translate the intent to the detailed closed loop automation control information 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 control information.

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 1: 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.

Note 2: The control information in the present document represents the information which can be formatted as rules or policies to assist/control the system to perform corresponding tasks in an autonomous manner.