ETSI GS ZSM 002 V1.1.1 (2019-08)

Zero-touch network and Service Management (ZSM); Reference Architecture

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Reference
DGS/ZSM-002ed111_Arch

Keywords
architecture, management, network, service

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 - NAF 742 C
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Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Zero touch network and Service Management (ZSM).

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).

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1 Scope

The present document defines and describes the reference architecture for the end-to-end Zero-touch network and Service Management (ZSM) framework based on a set of user scenarios and requirements documented in ETSI GS ZSM 001 [i.9].

The reference architecture employs a set of architectural principles, described further in the present document, and a service-centric architectural model to define at a high level a set of management services for zero-touch network and service management. It also defines means of management service integration, communication, interoperation, and organization. Procedures and detailed information models are beyond the scope of the present document.

The reference architecture also defines normative provisions for externally visible management services, defined as part of the reference architecture, as well as recommendations for their organization. It is assumed that the architectural patterns introduced in the present document can be used not only for the ZSM framework, but also for architecture and design of individual management services.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI GR ZSM 005: "Zero-touch network and Service Management (ZSM); Means of Automation".

[i.2] Boyd, J.R.: "The Essence of Winning and Losing", June 1995.

[i.3] Kephart, J. and D. Chess: "The Vision of Autonomic Computing", IEEE Computer, vol. 36, no. 1, pp. 41-50, DOI 10.1109/MC.2003.1160055, January 2003.

[i.4] Miller, D.E.: "A new approach to model reference adaptive control", IEEE Transactions on Automatic Control, Volume: 48, Issue: 5, May 2003.

[i.5] EU General Data Protection Regulation (GDPR).

NOTE: Available from https://eugdpr.org/.

[i.6] Telemanagement Forum Open Digital Architecture Project.

NOTE: Available from https://www.tmforum.org/collaboration/open-digital-architecture-oda-project/.

[i.7] ETSI TS 128 533: "5G; Management and orchestration;Architecture framework (3GPP TS 28.533)".

NOTE: Available at https://www.etsi.org/deliver/etsi_ts/128500_128599/128533/.

[i.8] ETSI GS ZSM 007: "Zero-touch network and Service Management (ZSM); Terminology for concepts in ZSM".

[i.9] ETSI GS ZSM 001: "Zero-touch network and Service Management (ZSM); Requirements based on documented scenarios".

3 Definition of terms, symbols, abbreviations and conventions

3.1 Terms

For the purposes of the present document, the terms given in ETSI GS ZSM 007 [i.8] and the following apply:

NOTE: If the same term is defined in both ETSI GS ZSM 007 [i.8] and in the present document, the definition in the present document takes precedence.

cross-domain data services: services that allow to share data with authorized consumers across management domains

external visibility: property of a ZSM service that indicates whether the scope of the service consumption spans outside the management domain

NOTE: Conventions for external visibility are defined in clause 3.4.

integration fabric: management function that plays both the roles of service consumer and service producer and which facilitates the interoperation and communication between management functions

key performance indicator: measurement of a specific aspect of the performance of a service that can be used in a service level objective

managed entity: managed resource or managed service

NOTE: Examples of managed entities are infrastructure resources, such as virtual network functions (VNF), physical network functions (PNF), and services such as cloud services, NFV network services, CFSs, RFSs.

managed resource: resource that is managed by one or more ZSM services

managed service: service that is managed by one or more ZSM services

management domain: scope of management that federates together management services, that enables their exposure towards external service consumers and that is delineated by a business, administrative, technological or other boundary

management function: logical entity playing the roles of service consumer and/or service producer

NOTE: The implementation details of a management function are not covered in the present document.

management service: See "ZSM service".

service capability: specific part of a ZSM service

NOTE: Examples of service capabilities are defined in the sub-clauses "Provided management services" of clauses 6.3, 6.4, 6.5 and 6.6 of the present document.

service consumer: role of an entity consuming one or more ZSM services

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service end-point: interface through which service capabilities are offered and consumed

service level agreement: part of a business agreement between a service provider and a customer, specifying the committed service quality and quantity in terms of service level specifications, and the associated consequences in case the service level objectives are not met

service level objective: element in a service level specification that is defined in terms of parameters, and related metrics, thresholds and tolerances associated with the parameters

service level specification: specification of the minimum acceptable standard of service

service producer: role of an entity offering one or more ZSM services

ZSM framework consumer: entity outside the ZSM framework that uses one or several of the management capabilities offered by the ZSM framework

NOTE 1: ZSM framework consumers may be non-human entities (e.g. digital store fronts, web portals, BSS components, other ZSM framework instances) or human users.

NOTE 2: ZSM services offer machine-consumable interfaces. They may also allow interfacing with human users using e.g. a GUI, web portal or application.

ZSM service: set of offered management capabilities

NOTE: In the present document, the terms "ZSM service" and "management service" are used interchangeably.

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3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI GS ZSM 007 [i.8] and the following apply:

NOTE: If the same abbreviation is defined in both ETSI GS ZSM 007 [i.8] and in the present document, the definition in the present document takes precedence.

3GPP	3rd Generation Partnership Project
AI	Artificial Intelligence
BSS	Business Support System
CDS	Cross-domain Data Services
CFS	Customer Facing Service
CPU	Central Processing Unit
CRUD	Create-Read-Update-Delete
CRUDL	Create-Read-Update-Delete-List
E2E	End-to-End
EP	End-Point
ETSI	European Telecommunications Standards Institute
FM	Fault Management
GDPR	General Data Protection Regulation
GR	Group Report
GS	Group Specification
GUI	Graphical User Interface
IEEE	Institute of Electrical and Electronics Engineers
IF	Integration Fabric
IP	Internet Protocol
IPR	Intellectual Property Right
ISG	Industry Specification Group
KPI	Key Performance Indicator
LI	Lawful Intercept
MANO	MANagement and Orchestration
MAPE-K	Monitor-Analyse-Plan-Execute plus Knowledge

MD	Management Domain
ML	Machine Learning
MRACL	Model-Reference Adaptive Control Loop
NBI	North Bound Interface
NFV	Network Functions Virtualization
NIST	National Institute of Standards and Technology
OODA	Observe, Orient, Decide, Act
PM	Performance Management
PNF	Physical Network Function
RFS	Resource Facing Service
SBI	South Bound Interface
SDN	Software-Defined Network
SLA	Service Level Agreement
SLO	Service Level Objective
SLS	Service Level Specification
SON	Self-Organizing Networks
TS	Technical Specification
VIM	Virtualized Infrastructure Manager
VLAN	Virtualized Local Area Network
VNF	Virtualized Network Function
XaaS	X-as-a-Service
ZSM	Zero-touch network and Service Management

3.4 Conventions

The present document defines ZSM services in a table that provides the name of the service, information about the visibility of that service outside the management domain where the service producer is located, information on the capabilities of that service and whether or not the capabilities are mandatory to provide.

The table format is reproduced below.

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Table 3.4-1: Service definition template

Service name		Name of the service
External visibility		MANDATORY/CONDITIONAL (define condition)/OPTIONAL
Service capabilities		
	First capability (M/C/O)	Capability description.
	Next capability2 (M/C/O)	…
NOTE: (if needed, e.g. to define conditions.)		

The external visibility (or "ExtVis" in short) defines whether the service:

- shall always (i.e. without condition) be visible to consumers that are external to the management domain in which the producer resides (external visibility set to MANDATORY);
- shall be visible to external consumers if certain conditions are met and may be visible to external consumers otherwise (external visibility set to CONDITIONAL); or
- may be visible to external consumers (external visibility set to OPTIONAL).

If the external visibility is defined as CONDITIONAL, a condition is defined either in the "External visibility" row or in the "NOTE" row. ZSM services that are defined with optional external visibility are not required to be supported in ZSM.

The external visibility of data services and integration fabric services is documented separately as it depends on the scope. Hence, the "external visibility" row is not contained in tables that define a data service or an integration fabric service.

The capabilities offered by the service are defined under "Service capabilities". A capability can be mandatory (M) which means it shall be offered if the service is offered, conditional (C) which means it shall be offered under certain conditions if the service is offered or optional (O) which means it may be offered if the service is offered. For a conditional capability, the condition is defined in the description of the capability, or in the "NOTE" row. The description can contain normative statements to provide a finer-granular definition of the level of support for parts of a capability.

EXAMPLE 1: A capability to manage models could include items such as "create", "read", "update", "delete" and "list", where "create", "read" and "delete" are mandatory and "list" and "update" are optional. This can be documented as follows: "Manage models (M) -- Manage (create, read, update, delete, list) models. Create, read and delete shall be supported whereas update and list may be supported". In this case, the capability to manage models is mandatory to support, which implies that create, read and delete are mandatory and update and list are optional.

EXAMPLE 2: This example assumes that the "Manage models" capability is optional: "Manage models (O) -- Manage (create, read, update, delete, list) models. Create, read and delete shall be supported whereas update and list may be supported". In this case, the normative statements only apply if the "Manage models" capability is offered. In other words, if the "Manage models" capability is offered, create, read and delete are mandatory and update and list are optional.

4 Architecture principles

4.1 Introduction

The overarching design goal of ZSM is to enable zero-touch automated network and service management in a multi-vendor environment.

This clause introduces a number of architecture principles applicable to the ZSM framework reference architecture. These principles guide the way of designing the ZSM architecture to achieve the design goal stated above in order to allow fully automated network and service management.

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4.2 The principles

4.2.1 Principle 01: Modularity

A modular architecture avoids monoliths and tight coupling, and consists of self-contained, loosely-coupled services, each with a confined scope which interact over well-defined interfaces.

4.2.2 Principle 02: Extensibility

An extensible architecture allows addition of new services, service capabilities and service end-points without breaking backward-compatibility and requiring changes to existing service designs, implementations and interactions.

4.2.3 Principle 03: Scalability

A scalable architecture allows deployments that can be adapted to satisfy the increasing or decreasing demand of the managed entities, and/or to various scales of the geographic distribution of these entities. Based on the principle of modularity (Principle 01), modules can be independently deployed and scaled.

4.2.4 Principle 04: Model-driven, open interfaces

An architecture that is based on model-driven approach performs the management of services and resources through the use of information models that capture the definition of managed entities in terms of attributes and supported operations. The models are defined independent from the implementation of the managed entities in order to facilitate portability, reusability and to allow vendor-neutral management of resources and services.

4.2.5 Principle 05: Closed-loop management automation

Closed-loop management automation is a feedback-driven process. It seeks to reach and preserve a set of objectives without any intervention external to the specific loop.

NOTE: Closed loops (e.g. using the stages Observe, Orient, Decide, Act) allow e.g. self-optimization, improvement of network and resource utilization, and automated service assurance and fulfilment.

4.2.6 Principle 06: Support for stateless management functions

The architecture supports inclusion of management functions that separate processing from data storage.

4.2.7 Principle 07: Resilience

Management services are designed to, as far as possible, provide and maintain configurable levels of their offered functionalities in face of degradation of the infrastructure and other management services. They also have the ability to return to normal operation when the degradation has been resolved.

4.2.8 Principle 08: Separation of concerns in management

In the ZSM framework, two different management concerns are distinguished: domain management and end-to-end service management across management domains. In practice, there can be a hierarchy of management domains.

Inside a management domain, resources and services based on these resources are managed. The complexity of domain resources can be abstracted from service consumers outside of the management domain.

The end-to-end cross-domain service management manages end-to-end services that span multiple management domains, and coordinates between management domains using orchestration. In this context, end-to-end services may span multiple management domains provided by different administrative entities (e.g. different network service providers or external partners).

Decoupling of management domains and end-to-end service management across domains avoids monolithic systems, allows to reduce the complexity of the overall service, and enables independent evolution of each management domain and of end-to-end management.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:
https://standards.iteh.ai/catalog/standards/sist/995b1838-6992-4678-98b7-7bc3332cd5a8/etsi-gs-zsm-002-v1.1.1-2019-08

4.2.9 Principle 09: Service composability

Management services exposed by the management domains can be combined to create new management services.

4.2.10 Principle 10: Intent-based interfaces

Intent-based interfaces aim to hide complexity, technology- and vendor-specific details from the user by exposing high-level abstractions.

Intent-based interfaces express the consumer request(s) in a declarative form. A declarative form assumes the ability of e.g. the target system and its service producers to understand the request(s).

4.2.11 Principle 11: Functional abstraction

Functional abstraction is defined as the ability to generalize the behaviour of related entities, allowing to encapsulate details of multiple variants of those entities into a single one. Functional abstraction supports several other principles, such as replicability, scalability and composability.

4.2.12 Principle 12: Simplicity

The architecture has minimal complexity while still meeting the functional and non-functional requirements.