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Recommendation

ITU-T M.3384 (04/2023)

SERIES M: Telecommunication management, including TMN and network maintenance

Telecommunications management network

Intelligence levels of artificial intelligence-enhanced telecom operation and management

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Recommendation ITU-T M.3384

Intelligence levels of artificial intelligence-enhanced telecom operation and management

Summary

Recommendation ITU-T M.3384 provides definitions, classifications, object selection and an automatic evaluating mechanism for the evaluation of the intelligence levels of artificial intelligence-enhanced telecom operation and management systems that comply with the framework specified in Recommendation ITU-T M.3080.

History *

Edition	Recommendation	Approval	Study Group	Unique ID
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Keywords

AITOM, artificial intelligence, artificial intelligence enhanced telecom operation and management, intelligence level.

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T M.3384

Intelligence levels of artificial intelligence-enhanced telecom operation and management

1 Scope

This Recommendation describes the principles for intelligence levels of artificial intelligence-enhanced telecom operation and management (IL-AITOM) systems that follow the framework specified in [ITU-T M.3080]. This Recommendation can be used as a guideline to plan the evolution of intelligent operation and management systems. This Recommendation includes:

– specification and classification rules for IL-AITOM;

– evaluated objects of IL-AITOM;

– general architecture of intelligence levels evaluation of AITOM;

– typical use cases (see Appendices I and II).

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T M.3080] Recommendation ITU-T M.3080 (2021), *Framework of artificial intelligence enhanced telecom operation and management (AITOM)*.

[TMF GB991] GB991, *TM Forum's core frameworks concepts and principles* v22.5.0 (2022). Parsippany, NJ: TM Forum. Available [viewed 2023-06-19] at: https://www.tmforum.org/resources/standard/gb991-tm-forums-core-frameworks-concepts-and-principles-v22-5-0/

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 artificial intelligence (AI) [b-ISO/IEC 2382]: An interdisciplinary field, usually regarded as a branch of computer science, dealing with models and systems for the performance of functions generally associated with human intelligence, such as reasoning and learning.

3.1.2 artificial intelligence pipeline [ITU-T M.3080]: A set of logical nodes, each with specific functionalities, that can be combined to form an artificial intelligence (AI) application in systems of telecom operation and management.

3.1.3 artificial intelligence sandbox [ITU-T M.3080]: An environment in which artificial intelligence (AI) models can be trained and tested, and their effects on the network are evaluated.

3.1.4 capability customization [ITU-T M.3080]: Personalized capability, which does not exist in the capability directory, customized for external customers to meet their requirements.

3.1.5 common artificial intelligence model repository [ITU-T M.3080]: The part of the archive that contains and manages the artificial intelligence (AI) models, constructed by general algorithms, such as classification algorithms, and is thus responsible for the storage and preservation of the AI models.

3.1.6 computing engine framework [ITU-T M.3080]: A framework which provides an operation environment or coding resources in the context of artificial intelligence (AI)-based applications or developments.

3.1.7 customer-oriented marketplace [ITU-T M.3080]: A collection of functional sets that exposes capability to external telecom customers, especially enterprises and industries. The exposed capability includes applications, service, data and artificial intelligence (AI) capability.

3.1.8 function block [b-ITU-T M.3010]: The smallest (deployable) unit of TMN management functionality that is subject to standardization.

3.1.9 intent [b-ITU-T X.1257]: The user reason or purpose for initiating the interaction with a service provider.

3.1.10 management service [b-ITU-T M.3010]: A management service is an offering fulfilling specific telecommunications management needs.

3.1.11 monitor [b-ITU-T Q.9]: A functional unit that observes and records selected activities within a system for analysis.

3.1.12 orchestration [b-ITU-T Y.3100]: In the context of IMT-2020, the processes aiming at the automated arrangement, coordination, instantiation and use of network functions and resources for both physical and virtual infrastructures by optimization criteria.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 action implementation: A stage determined according to the process of decision or policy so that it can be implemented effectively in the system.

3.2.2 intelligence level of artificial intelligence-enhanced telecom operation and management: Classification for application of automation capabilities including those enabled by the integration of artificial intelligence techniques in a set of systems that follows the framework of artificial intelligence-enhanced telecom operation and management.

3.2.3 intent mapping: A process to translate intent into specific configurations and policies in order to make a system recognize user reason or purpose.

3.2.4 operation stage: General subsets for process of telecom operation and management.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

5G fifth Generation

AI Artificial Intelligence

AITOM Artificial Intelligence-enhanced Telecom Operation and Management

IL-AITOM Intelligence Levels of Artificial Intelligence-enhanced Telecom Operation and Management

IMT-2020 International Mobile Telecommunications-2020

O&M Operation and Maintenance

QoS Quality of Service

SDO Standards Development Organization

SLA Service Level Agreement

5 Conventions

In this Recommendation:

The phrase "is required" indicates a requirement that must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

The phrase "is recommended" indicates a requirement that is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

6 Overview

Considering the operation and maintenance (O&M) complexity of the international mobile telecommunications-2020 (IMT-2020) and beyond network is increasing significantly and the flexibility requirements are getting higher and higher, network intelligence becomes a key issue for achieving more efficient, cost-effective, and flexible network O&M and service management. However, it is not clear how to evaluate the levels of artificial intelligence-enhanced telecom operation and management (AITOM).

This Recommendation specifies and classifies intelligence levels applied to a system based on the framework of AITOM [ITU-T M.3080] (AITOM-based system). The functions of this set of systems support end-to-end standard operation stages that comply with [TMF GB991]. The value and effectiveness of specified set of systems are to support services provided to customers.

This Recommendation specifies a method for evaluating AITOM-based systems. Applications for evaluating the levels on several representative use cases are also introduced. Architecture scenarios for integrating this evaluation method into the unified architecture specified in [ITU-T M.3080] are also described in this Recommendation.

7 Specification and classification rules for IL-AITOM

7.1 Specification of IL-AITOM

IL-AITOM is the level division from low to high, in terms of intelligence capabilities for evaluated objects in operation, maintenance and application of AITOM-based systems. In the process of realizing the various requirements of AITOM, the participation of relevant personnel and the system is an important factor in evaluating the intelligence of AITOM-based systems. The higher the level of intelligence, the fewer the workflows that must be manually involved or the lower the degree of manual involvement in related workflows.

The "intelligence" specified is all behaviours that use machines instead of humans to analyse, decide and act. This is a general concept of intelligence, covering both narrow AI, including machine learning or deep learning, and automation based on rules or theories.

IL-AITOM has detailed specifications for six levels, ranging from manual system (level 0) to full intelligence AITOM (level 5).

Level 0 does not exist in the intelligence levels of AITOM-based systems; however, to preserve the integrity of this Recommendation, level 0 is retained.

These level specifications, along with additional supporting terms and definitions provided herein, are used to describe the full range of intelligence features in AITOM.

– **Level 0: Manual**, at which all types of work processes for operation and management are completed manually without the system.
– **Level 1: System assisted**, at which a few tasks are automatically completed by an AITOM-based system according to manually specified rules, but most tasks still require manual assistance.
– **Level 2: Preliminary intelligence**, at which, with system assistance, all execution tasks are automatically completed by the AITOM-based system.
– **Level 3: Intermediate intelligence**, at which, with preliminary AITOM intelligence, all data collection tasks are automatically completed by AITOM-based systems.
– **Level 4: Advanced intelligence**, at which, with intermediate AITOM intelligence, all analysis tasks are automatically completed by AITOM-based systems.
– **Level 5: Full intelligence**, at which all types of work process for operation and management are completed intelligently by AITOM-based systems.

7.2 Classification rules for IL-AITOM

Based on the IL-AITOM specifications, the classification rules for these levels are listed in Table 7-1.

Table 7-1 – Classification rules for IL-AITOM

Level/Name		Dimensions of intelligent closed-loop				
		Action implementation	**Data collection**	**Analysis**	**Decision**	**Intent mapping**
Level 0	**Manual**	Human	Human	Human	Human	Human
Level 1	**System assistance**	Human and system	Human and system	Human	Human	Human
Level 2	**Primary AITOM intelligence**	System	Human and system	Human and system	Human	Human
Level 3	**Intermediate AITOM intelligence**	System	System	Human and system	Human and system	Human
Level 4	**Advanced AITOM intelligence**	System	System	System	System	Human and system
Level 5	**Full AITOM intelligence**	System	System	System	System	System

Determining dimensions is a required step, and all dimensions create a complete closed-loop from the requirement to the realization. From intent mapping to data collection, to analysis, decision and action implementation, these five dimensions run through the entire implementation process of AITOM, forming a closed-loop control. Intelligent closed-loop under the operator-provided intent or policy is introduced as the cornerstone of AITOM. This closed-loop must be cross-domain and per-domain to address the challenges in managing AITOM. As shown in Table 7-1, five widely applicable dimensions are abstracted from the general implementation process of AITOM intelligence. It makes use of the following applicable dimensions.

a) **Intent mapping** involves translation of the intentions for management and operation or business services into specific configurations and strategies, as well as feedback on the actual achievement of the intentions. These tasks affect one or more of task groups, such as data collection, analysis, decision-making and action implementation. The interface is the most complicated and has the most difficulty to realize intelligence. The closed-loop is not interrupted by a manual-based intent management process, so the urgency of its intelligence demand is the lowest.

b) **Data collection** involves collection of raw data, necessary data processing (such as data cleaning, enhancement and standardization), and data management.

c) **Analysis** involves data analysis (including feature data pre-processing) of collected data to obtain the context information of the current operating environment, services and customers (perception analysis), and the judgement basis for intelligent decision-making (strategic analysis).

d) **Decision** involves determination of O&M policies according to the result given by the analysis process, then formulation of management and operation based on AITOM-based systems.

e) **Action implementation** involves entry into operation of AITOM-based systems, according to the policies determined in the decision process.

Based on the principles in Table 7-1, the degree of human or system participation and five assessment areas, namely intent mapping, action implementation, data collection, analysis and decision, require consideration in the evaluation of IL-AITOM.

AITOM-based system intelligence capability levels are identified in the following order based on the ways of task implementation.

a) **Human** indicates that the corresponding tasks are completed by people or people using management and operation tools.

b) **Human and system** indicates that the corresponding tasks are completed by people and the system. The specific collaboration method of the human and the system is not specified in the overall method, and requires description according to the specific use case.

c) **System** indicates that the corresponding tasks are completed by the telecommunication system, including using methods of automatic rules, machine learning, deep learning, etc.

NOTE – The levels apply to the intelligence feature(s) that are engaged in any given instance of operation of an AITOM. As such, although a given AITOM instance is equipped with several intelligence function blocks that are capable of delivering multiple intelligence features, which perform at different levels, IL-AITOM exhibited in any given instance are determined by the feature(s) that are engaged. For more detailed intelligence level information, methods and procedures, see clause 8.

The degree of integration of human and system has an impact on evaluated results. These can be defined in detail by the evaluating executor. Specific details are not given in this Recommendation.

The classification rules of IL-AITOM follow.

1. **Rules of level 0**: Manual. The tasks are manually operated, designed, and deployed. The whole process cannot be separated from human manual intervention.

2. **Rules of level 1**: System assistance. Part of the action implementation and data collection tasks are automatically completed by AITOM-based systems according to specific rules. At this level, AITOM-based systems can help humans improve execution efficiency and perceived efficiency of network management and operation.

3. **Rules of level 2**: Preliminary AITOM intelligence. All action implementation tasks are automatically completed by AITOM systems. Part of the tasks of data collection and analysis are automatically completed by a system according to manually specified strategies. At this

level, the AITOM-based system can help users according to manually specified policies (decisions are still manually implemented by users) to achieve a closed-loop process.

4. **Rules of level 3**: Intermediate AITOM intelligence. All action implementation and data collection tasks are automatically completed by AITOM systems. Part of the analysis and decision-making tasks are automatically completed by a system according to the manually specified strategy. At this level, AITOM-based systems can implement closed-loop automation based on manually specified automation strategies.
5. **Rules of level 4**: Advanced AITOM intelligence. All tasks of action implementation, data collection, analysis and decision-making are automatically completed by a system. Based on the intent management strategy, the system can automatically complete part of the intent management tasks. At this level, AITOM-based systems can not only independently realize the closed-loop, but also realize intent-driven closed-loop automation based on intent translation strategies and intent feedback mechanisms.
6. **Rules of level 5**: Full AITOM Intelligence. Autonomous operation in all scenarios.

8 Object and evaluation result of IL-AITOM

8.1 Evaluated objects

In AITOM, the intelligence level is not evaluated by a single scenario or dimension. It is necessary to fully consider the operation stage, the end-to-end AITOM-based system and specific service, to comprehensively measure the IL-AITOM.

An evaluated object needs to be specified before the intelligence levels evaluation. The evaluated object that needs to be selected has three features. More specifically, first, specification of the service that needs to be evaluated is required. Second, specification of the operation stage of the service is required, such as planning and construction, fulfilment, assurance, and invoicing and revenue, for which see [TMF GB991]. Third, based on the specified service and operation stage, the selected target of system granularity can be big or small, which can be a function block, a function set or a whole AITOM-based system. In Figure 8-1, the three features, (service, operation stage and system granularity) are abstracted as three axes, and their intersections on each axis uniquely determine the object to be evaluated.

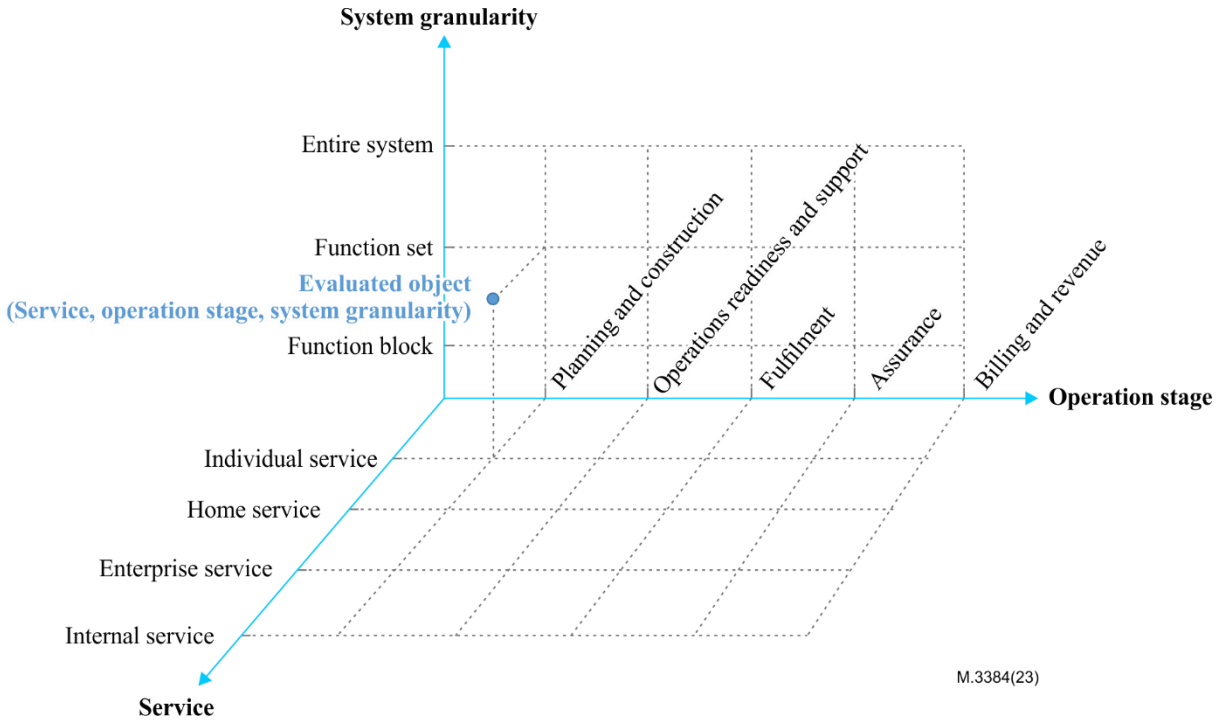

Figure 8-1 – Selection model of evaluated object for IL-AITOM

8.1.1 Service

Service is the collection of capabilities provided by network operators to external customers. These services can be divided into four major categories: individual service; home service; enterprise service; and internal service.

– **Individual service** needs to provide fast and reliable service solutions designed for small businesses such as mobile positioning and fifth generation (5G) messages.

– **Home service** is responsible for creating services such as home entertainment and education. Typical services are content delivery networks and broadband access.

– **Enterprise service** builds solutions for businesses to enable them to keep moving forward with industry-leading services. The service works with the public sector to reimagine learning, modernize government, and transform networks. The typical products are those of virtual private networks, 5G slice and Internet data centres.

– **Internal service**: This kind of service provides applications, such as systems for office automation or management support, for internal users of AITOM.

8.1.2 Operation stage

IL-AITOM evaluation can be implemented at different operation stages, as shown in Figure 8-1. Its complexity is affected by the specific scenarios to which it is applicable, and AITOM intelligence that is suitable for all scenarios and the evaluation goes throughout the entire lifetime of an AITOM. For the functions of each operation stage, see [TMF GB991].

– **Planning and construction** is the capability delivery vertical process in [TMF GB991]. Capability delivery includes network planning and construction. This stage specifies, plans and implements all necessary infrastructure (such as applications, IT infrastructure and networks) and partnerships, determines requirements, capabilities and designs, as well as developing new or enhanced infrastructure.

– **Operations readiness and support** concerns operations readiness and supports the vertical process of [TMF GB991]. This stage is responsible for management support, such as human

resource configuration and management process for the operation process, and preparation for the fulfilment, assurance and invoicing areas.

– **Fulfilment** is the fulfilment vertical process in [TMF GB991], and is responsible for providing customers with their requested products in a timely and correct manner. It translates the customer's business or personal needs into a solution, which can be delivered using the specific products in the portfolio of the enterprise. It informs customers of the status of their purchase order, ensures completion on time, as well as ensuring a satisfied customer.

– **Assurance** is the assurance vertical process in [TMF GB991], and is responsible for the execution of proactive and reactive maintenance activities to ensure that services provided to customers are continuously available and performing to service level agreement (SLA) or quality of service (QoS) performance levels. This stage continuously monitors resource status and performance to proactively detect possible failures. This stage collects performance data and analyses them to identify potential problems and resolve them without impact on the customer. It manages the SLA and reports service performance to the customer, receives trouble reports from the customer, informs the customer of the trouble status, and ensures restoration and repair, as well as ensuring a satisfied customer. The assurance stage also includes network optimization, such as energy-saving optimization and SLA or QoS performance optimization.

– **Invoicing and revenue** is the invoicing and revenue vertical process in [TMF GB991], and is responsible for the collection of appropriate usage records, determining charging and invoicing information, production of timely and accurate invoices, for providing pre-invoice use information and invoicing to customers, for processing their payments and collecting payments. In addition, it handles customer enquiries about invoices, provides invoicing enquiry status and is responsible for resolving invoicing problems to the customer's satisfaction in a timely manner, as well as supporting prepayment for services.

8.1.3 System granularity

IL-AITOM is implemented in different systems, and the size of the system granularity also has an impact on its complexity. For example, the intelligence of the whole AITOM-based system management is more challenging than that of a single function. The whole AITOM-based system requires the introduction of more complex mechanisms (such as multi-set data collection, cross-set data correlation analysis, and cross-set decision-making correlation impact analysis and coordination) to achieve collaborative management in the AITOM-based system.

The system granularity of AITOM intelligence is shown in Figure 8-2, including the following.

– **Function block intelligence level**: AITOM intelligence only acts within the granularity of a specific function block in AITOM. The levels of function block intelligence of the AITOM architecture can be used as a factor to evaluate AITOM intelligence levels, and AITOM function block intelligence can be evaluated based on the function block (such as the service management function block of the management service layer).

– **Function set intelligence level**: AITOM intelligence only affects the granularity of the function set. The function set of the AITOM architecture can be used as a factor to evaluate the IL-AITOM, and the intelligent classification of AITOM functional domains can be carried out based on the function set (e.g., AI engine or customer-oriented marketplace).

– **Entire system intelligence level**: AITOM intelligence simultaneously acts on the granularity of the whole AITOM-based system consisting of multiple sets. The entire AITOM-based system is used as the evaluation factor of the IL-AITOM, and the AITOM-based system intelligence evaluation can be carried out based on the overall AITOM-based system.

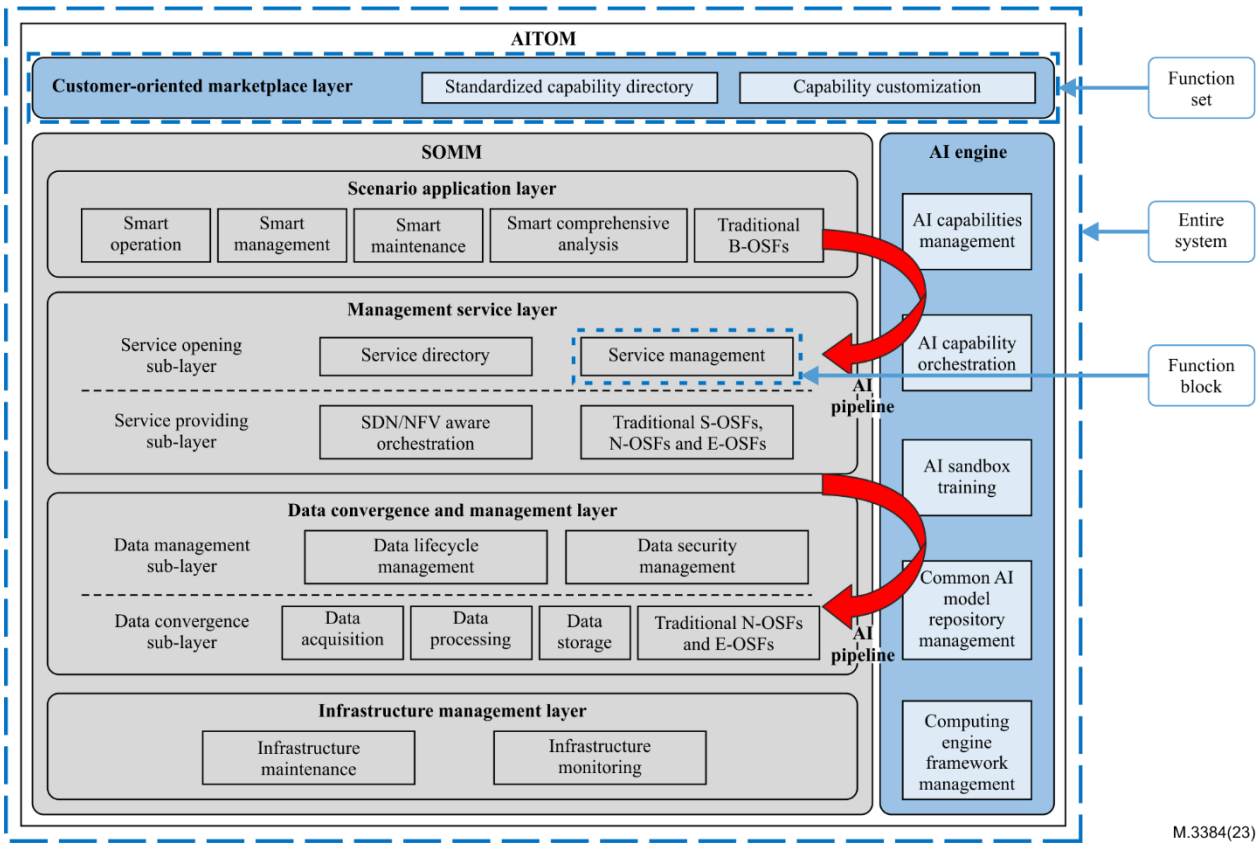

Figure 8-2 – System granularity of evaluating levels in AITOM

8.2 Intelligence level evaluation result of an evaluated object

According to the object described in clause 8.1, generation of an axis indicating the intelligence levels is required.

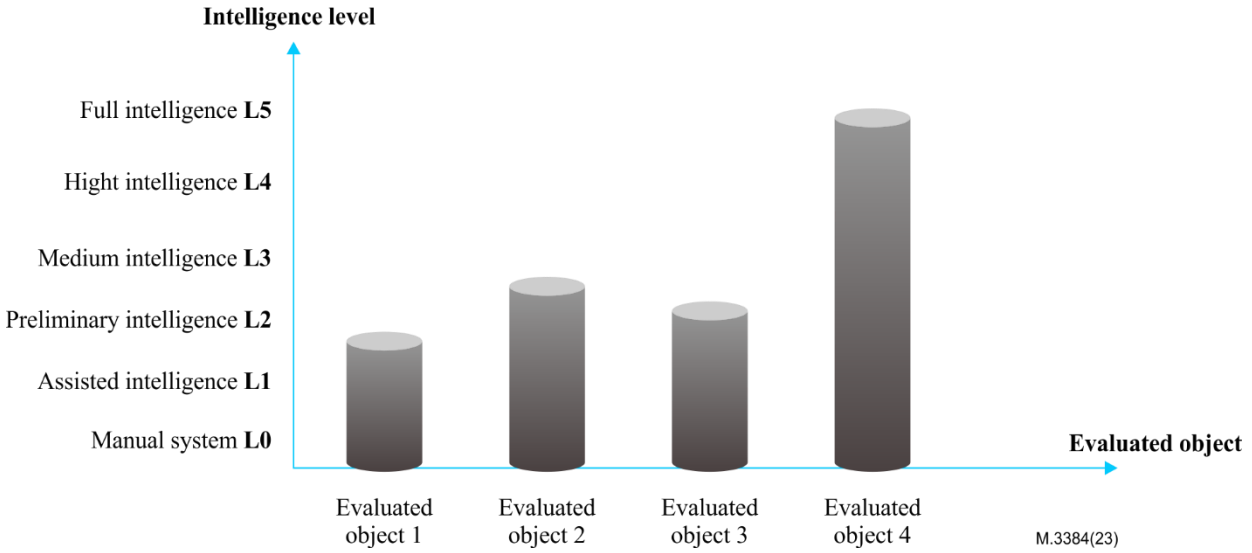

Figure 8-3 – Diagram of intelligence levels for evaluated objects

In Figure 8-3, based on the specified evaluated object, L0 to L5 indicate the levels of the given object, and the height of each histogram cylinder indicates the level of intelligence. Figure 8-3 shows the result of intelligence level evaluation result of each object that consists of certain services and scenarios. The overall intelligence levels of the entire system are a comprehensive reflection of the intelligence levels of several individual operation stages, system granularities and services.

There should be some possibilities an object consists of certain system granularity, operation stage and service is not suitable for intelligence evaluation. For example, AI sandbox training is treated as a function block in the AI engine. It is basically used in an internal environment, so it has a capability delivery scenario, rather than one of invoicing and revenue. So, this object is not applicable.

9 Mechanism of automatic evaluation for IL-AITOM

[ITU T M.3080] defines the customer-oriented marketplace layer and AI engine. Thus, there is a need to monitor and update the rating report based on functionality updates in AITOM, e.g., the third party software provider may access the marketplace and need to get an AI service. The customer's intent needs to be analysed by the marketplace and translates as a command of requirement that can be analysed by AITOM-based systems. According to the requirement, the micro service is created by the AI engine after the process of AI capability orchestration.

After receiving a collection command, the monitor collects the corresponding data and sends them to the intelligence level classification module. The intelligence level classification module analyses the data collected by the monitor and evaluates the intelligence level of the evaluated object.

An automatic evaluation mechanism for IL-AITOM is recommended to get the result of intelligence level via monitoring and evaluating, which can work across different implementations of smart operation maintenance and management, AI engine and marketplace, as well as exposing the level programmatically from the Intelligence level classification using application programming interfaces. See Figure 9-1.

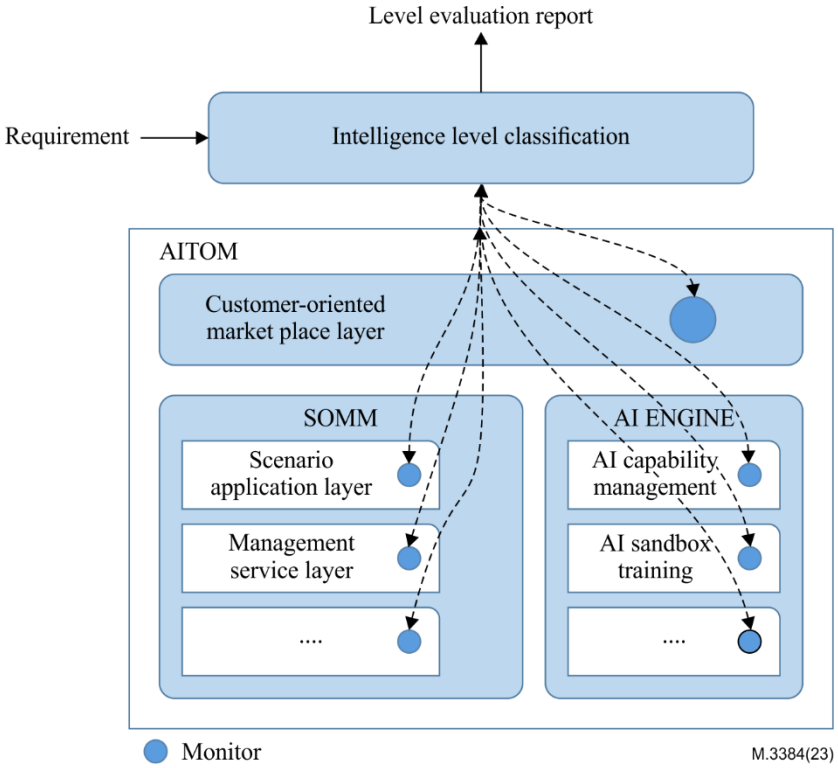

Figure 9-1 – Mechanism of automatic evaluation for IL-AITOM

Appendix I

A use case on intelligence level of energy-saving management

(This appendix does not form an integral part of this Recommendation.)

Title	Application of intelligence level in energy-saving management
Description	Scenario: energy-saving management is a typical application of AITOM framework in [ITU-T M.3080], and it belongs to the internal service in cost management and control of AITOM. AI-based 5G energy saving technology belongs to a key technology in the assurance stage of base station energy saving. The related function set through the AI pipeline of an AITOM framework includes blocks for data acquisition, data storage, data processing, feature data pre-processing, AI energy-saving model repository, AI-based energy-saving strategy, AI based energy-saving capability management and command interaction. NOTE – For a mapping relationship between functional block diagram for energy-saving management of 5G RAN system with AI and AITOM framework, see [b-ITU-T M.3381]. For energy-saving management of AITOM, the evaluated object for IL-AITOM consists of: – service: internal service; – operation stage: assurance; – system granularity: function set
Evaluation dimensions	• **Intent mapping: Human** The evaluated object of energy-saving management in an AITOM-based system does not have the ability of intention translation for energy-saving management. The change of specific configurations and strategies, as well as feedback on the actual achievement of the intentions, are performed by people. • **Data collection: System** The requirements for energy-saving management can be parsed from the customer-oriented marketplace layer and other layers of an AITOM-based system, and mapped into AI sandbox and AI capability orchestration. This process is manually completed by system (AI capability requirement parsing function in AI capabilities management). Energy-saving management can also automatically collect the data needed according to the requirement of energy-saving management parsed by the system. • **Analysis: Human and system** Based on the collected data, the AITOM-based system can perform data analysis. An energy-saving management problem is automatically discovered by the system according to human-specified rules, related solutions can be suggested by the system with the help of an expert system. 40% Manual participation, 60% system automation participation. Therefore, it is implemented by people and the system. • **Decision: Human and system** Based on the operation and maintenance policies specified by people, the AITOM-based system can automatically decide the solution for telecom operation and management for energy-saving management. 60% Manual participation, 40% system automation participation. Therefore, it is implemented by people and the system. • **Action implementation: System** According to the decisions and policies determined in the decision process, an AITOM-based system can automatically adjust the parameters of an energy-saving management model and implement it on the AITOM-based system.

Title	Application of intelligence level in energy-saving management
Intelligence level results	See Table 7-1 and the implementation method of clause 9, by applying the classification rules on IL-AITOM, the intelligence level result of the evaluated object for energy-saving management is level 3 (intermediate AITOM intelligence).

Appendix II

A use case on intelligence level of wilderness areas factories

(This appendix does not form an integral part of this Recommendation.)

Title	Application of intelligence level in wilderness areas factories
Description	Scenario: An enterprise owns several factories in different regions, applying AITOM to support telecom operation and management. Some of the factories in wilderness areas may lack engineers to conduct telecom operation and management. In this situation, the intelligence of AITOM in these areas should be relatively higher than in others. However, it is not necessary for all factories to apply AITOM with such high intelligence except wilderness factories. In this use case, evaluating IL-AITOM to use in different factories is recommended. To be consistent with the three features of evaluated objects introduced in clause 8, the evaluated object of this case consists of: – service: enterprise service; – operation stage: fulfilment operation stage; – system granularity: entire system
Evaluation dimensions	• **Intent mapping: Human and system** The evaluated object of wilderness areas factories in AITOM can conduct intention translation to a certain degree. The tasks of translating business services or feedback on the actual achievement of the intentions could be performed by people and the system. • **Data collection: System** The AITOM-based system of wilderness area factories have the ability to achieve fully automatic data collection according to the requirement parsed by the system. • **Analysis: System** The AITOM-based system can analyse collected data. Also, the system can analyse strategically according to the context information obtained and the relative judgement basis configured in advance. • **Decision: System** Based on the operation and maintenance policies determined by people, the AITOM-based system can automatically decide the solution of telecom operation and management for wilderness areas factories. • **Action implementation: System** According to the decisions and policies given in the decision process, the AITOM-based system can automatically adjust the parameters of service model of the factory and implement on the AITOM-based system.
Intelligence level results	See Table 7-1 and the implementation method of clause 9, by applying the classification rules on IL-AITOM, the intelligent level result of the evaluated object for wilderness areas factories is level 4 (Advanced AITOM intelligence).

Appendix III

Gap analysis between this Recommendation and other telecommunication standards

(This appendix does not form an integral part of this Recommendation.)

Similar to the IL-AITOM in the telecommunications industry, the automotive industry has identified clear requirements for automatic driving of motor vehicles and has already carried out related research and industrialization work. Relevant research results from the automotive industry can be used as reference for both IL-AITOM and other standards.

In 2014, the Society of Automotive Engineers (SAE) proposed the automatic driving levels in SAE [b-SAE J3016], clarifying the 6-level automatic driving rating standard (L0～L5), which have become widely accepted and used by the automotive industry. Both IL-AITOM and other current telecommunication standards have set the same number of levels (L0-L5) as SAE for the convenience of understanding.

The theory of evaluating autonomous network levels both in ITU-T and other standards development organizations (SDOs) has been researched.

[b-ITU-T Y.3173] establishes a framework for evaluating intelligence levels of future networks including IMT-2020. It is applicable to both the whole network and its O&M system. However, it provides only a theory for the method and does not provide sufficient detail about how to evaluate levels in the AITOM system.

Some topics are also under study in ETSI and 3GPP. In 3GPP SA5, the study of automation levels in the 5G network is in progress. It raises many use cases in mobile networks on how to evaluate the automation levels.

The ETSI Experiential Networked Intelligence Industry Specification Group (ENI ISG), is studying the factors affecting the network autonomicity level from a technical point of view and has identified them as man-machine interface, decision-making participation, data collection and analysis, degree of intelligence and environment adaptability. The abilities of network intelligence is a focus in this ISG.

[b-TMF IG1218] specifies autonomous networks level and describes its concepts, which include methodology and approach, operational processes, underlying sub-processes and tasks, as well as task evaluation criteria. For the content in this Recommendation, it mainly focuses on the theory of automation levels and less on the content of operation and management.

These studies mainly focus on some specific fields and formats, such as theory, mobile network and network virtualization. Additionally it is not quite clear for the AITOM system, e.g., these researches only give guidance on L0-L5 levels and their basic features, but it is hard to evaluate the levels in the AITOM system, because of lack of standards on measurement parameters in this system.

For ITU-T SG2 and other SDOs, there is a lack of studies on how to evaluate the automation levels in O&M systems, especially the AITOM system.

So, having an industry-approved method for evaluating automation levels in the AITOM system as soon as possible looks necessary.

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