

Recommendation

ITU-T M.3042 (03/2025)

SERIES M: Telecommunication management, including
TMN and network maintenance

Telecommunications management network

Framework of communication network health evaluation

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Telecommunication management, including TMN and network maintenance

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Recommendation ITU-T M.3042

Framework of communication network health evaluation

Summary

Recommendation ITU-T M.3042 introduces the framework of communication network health evaluation, definition of communication network health index, evaluation objects and the weighted value of index scoring method. This Recommendation also provides the communication network health evaluation process.

History *

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Recommendation ITU-T M.3042

Framework of communication network health evaluation

1 Scope

This Recommendation specifies the framework of communication network health evaluation, including index definition, common indexes, evaluation method and evaluation process.

It is applicable to evaluate the risk of operator's public networks and industry specific private networks.

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 E.800](#)] Recommendation ITU-T E.800 (2008), *Definitions of terms related to quality of service*.
- [[ITU-T E.802](#)] Recommendation ITU-T E.802 (2007), *Framework and methodologies for the determination and application of QoS parameters*.
- [[ITU-T E.840](#)] Recommendation ITU-T E.840 (2018), *Statistical framework for end-to-end network-performance benchmark scoring and ranking*.
- [[ITU-T G.808](#)] Recommendation ITU-T G.808 (2016), *Terms and definitions for network protection and restoration*.
- [[ITU-T M.60](#)] Recommendation ITU-T M.60 (1993), *Maintenance terminology and definitions*.
- [[ITU-T M.3208.1](#)] Recommendation ITU-T M.3208.1 (1997), *TMN management services for dedicated and reconfigurable circuits network : Leased circuit services*.
- [[ITU-T X.641](#)] Recommendation ITU-T X.641 (1997) | ISO/IEC 13236:1998, *Information technology – Quality of service: framework*.
- [[ITU-T X.739](#)] Recommendation ITU-T X.739 (1993) | ISO/IEC 10164-11:1994, *Information technology – Open Systems Interconnection – Systems Management: Metric objects and attributes*.
- [[ITU-T X.1812](#)] Recommendation ITU-T X.1812 (2022), *Security framework based on trust relationships for the IMT-2020 ecosystem*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 availability [ITU-T E.802]: Availability of an item to be in a state to perform a required function at a given instant of time or at any instant of time within a given time interval, assuming that the external resources, if required, are provided.

- 3.1.2 capacity** [ITU-T X.641]: The amount of service that can be provided in a specified period of time.
- 3.1.3 configuration management** [ITU-T M.60]: A set of TMN management functions which exercise control over the extension or reduction of a system, the status of the constituent parts and the identity of their allocation.
- 3.1.4 disaster recovery** [ITU-T E.800]: All activities associated with the restoration of a network provided service after disasters. Examples of such disasters are fire, earthquakes, vandalism, bombings, or software malfunctioning.
- 3.1.5 fault** [ITU-T E.800]: The inability of an item to perform a required function, excluding that inability due to preventive maintenance, lack of external resources or planned actions.
- 3.1.6 fault localization** [b-ITU-T I.113]: A specific action for locating a faulty entity, by internal or external test systems when fault information is insufficient.
- 3.1.7 GlobalNetScore** [ITU-T E.840]: This represents global network score, i.e., the relative overall quality across various networks or operators against the best performing network. GlobalNetScore is calculated across all services.
- 3.1.8 item; entity** [b-ITU-T G.911]: Any part, device, subsystem, functional unit, equipment or system that can be individually considered.
- 3.1.9 maintainability performance** [ITU-T M.60]: The ability of an item under stated conditions of use, to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources.
- 3.1.10 mean time to repair (MTTR)** [ITU-T E.800]: The expectation of repair time for a statistically significant number of repairs carried out from the instant a fault has been reported to the instant the service restored for use by the customer and usually expressed as the arithmetic mean.
- 3.1.11 metric (also called 'indicator')** [ITU-T E.800]: Value calculated from observed attribute/s of a measure.
- 3.1.12 network operator** [b-ITU-T M.3320]: An organization which operates a telecommunications network. A Network Operator may be a Service Provider and vice versa. A Network Operator may or may not provide particular telecommunications services.
- 3.1.13 network performance** [ITU-T E.800]: The ability of a network or network portion to provide the functions related to communications between users.
- 3.1.14 operations** [b-ITU-T E.4110]: The operations process is the traditional heart of the service provider (SP) enterprise for ensuring across the value chain within and between service providers that all key business objectives and customer experience are supported. The operational environment includes provisioning, configuration, activation and billing of products and services both on the network stratum as well as on the service stratum. It includes all operations processes that support the customer (and the network) operations and management, as well as those that enable direct customer operations with the customer. These processes include both day-to-day and operations support and readiness processes. The view of operations also includes sales management and supplier/partner relationship management.
- 3.1.15 protection** [ITU-T G.808]: The use of pre-assigned capacity between nodes.
- 3.1.16 reliability performance** [ITU-T E.800]: The ability of an item to perform a required function under given conditions for a given time interval.
- 3.1.17 repair (corrective maintenance)** [ITU-T E.800]: The maintenance carried out after fault recognition and intended to restore an item to a state in which it can perform a required function.

3.1.18 resource utilization [ITU-T X.739]: The amount of capacity in use. Resource utilization can be measured as instantaneous or as an estimate of the mean over a time interval. Instantaneous resource utilization is the amount of capacity in use at a given point in time. Estimated mean resource utilization is an estimate of the mean resource utilization, taken over a time interval.

3.1.19 restoration; recovery [ITU-T M.60]: That event when the item regains the ability to perform a required function after a fault.

3.1.20 security [ITU-T E.800]: The term 'security' is used in the sense of minimizing the vulnerabilities of assets and resources. An asset is anything of value. A vulnerability is any weakness that could be exploited to violate a system or the information it contains.

3.1.21 service accessibility performance [ITU-T E.800]: The ability of a service to be obtained, within specified tolerances and other given conditions, when requested by the user.

3.1.22 service integrity performance [ITU-T E.800]: The degree to which a service is provided without excessive impairments, once obtained.

3.1.23 service provider [ITU-T M.3320]: A general reference to an entity who provides telecommunication services to Customers and other users either on a tariff or contract basis. A Service Provider may or may not operate a network. A Service Provider may or may not be a Customer of another Service Provider.

3.1.24 service retainability performance [ITU-T M.60]: The ability of service, once obtained, to continue to be provided under given condition for a requested duration.

3.1.25 supply chain [ITU-T X.1812]: A network of organizations that are involved, through upstream and downstream linkages, in the processes and activities that produce value in the form of products and services in the hands of the ultimate consumer.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 communication network health: Operating state of a communication network based on availability, reliability, security and maintainability.

3.2.2 communication network health index: A single summary indicator expressed in quantitative terms indicating the degree of communication network health.

3.2.3 network toughness: The ability of a network to preserve its normal operating state.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AHP	Analytic Hierarchy Process
CERRDRPR	Core Equipment Room Remote Disaster Recovery Protection Rate
CPU	Central Processing Unit
DCGW	Data Centre Gateway
EMS	Element Management System
EoR	End of Row switches
ETL	Extract Transform Load
IMT-2020	International Mobile Telecommunications-2020
IP	Internet Protocol
ISQR	Infrastructure Security Qualified Rate

ME	Maintenance Efficiency
MTTR	Mean Time To Repair
NAR	Network Availability Rate
NE	Network Element
NEFRR	Network Entity Fault Report Rate
NPQR	Network Performance Qualified Rate
NRPR	Network Redundancy Protection Rate
NSQR	Network Security Qualified Rate
NT	Network Toughness
OMU	Operation and Management Unit
ORCMCR	Operation Related Configuration Management Compliance Rate
PoCF	Proportion of Capacity Forecasting
PoFP	Proportion of Fault Prevention
RRCMCR	Reliability Related Configuration Management Compliance Rate
RUQR	Resource Utilization Qualified Rate
SCQR	Supply Chain Qualified Rate
SIPQR	Service Integrity Performance Qualified Rate
SRPQR	Service Retainability Performance Qualified Rate
SSAQR	Service Successful Accessibility Qualified Rate
ToR	Top of Rack switches
VCR	Version Compliance Rate
VNF	Virtual Network Function
VNFM	Virtual Network Function Manager
VSQR	Virtual Network Function Security Qualified Rate

5 Conventions

In this Recommendation:

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

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

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option, and the feature can be optionally enabled by the network operator or service provider as defined in [ITU-T M.3208.1]. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

6 Communication network health index evaluation framework

With the rapid development of the telecommunications industry and the complexity of communication network increasing greatly, the difficulty of ensuring network stability is growing significantly. Therefore, communication network health must be evaluated to resist potential risks using a communication network health index. The communication network health index framework contains four levels of indexes, as shown in Figure 1.

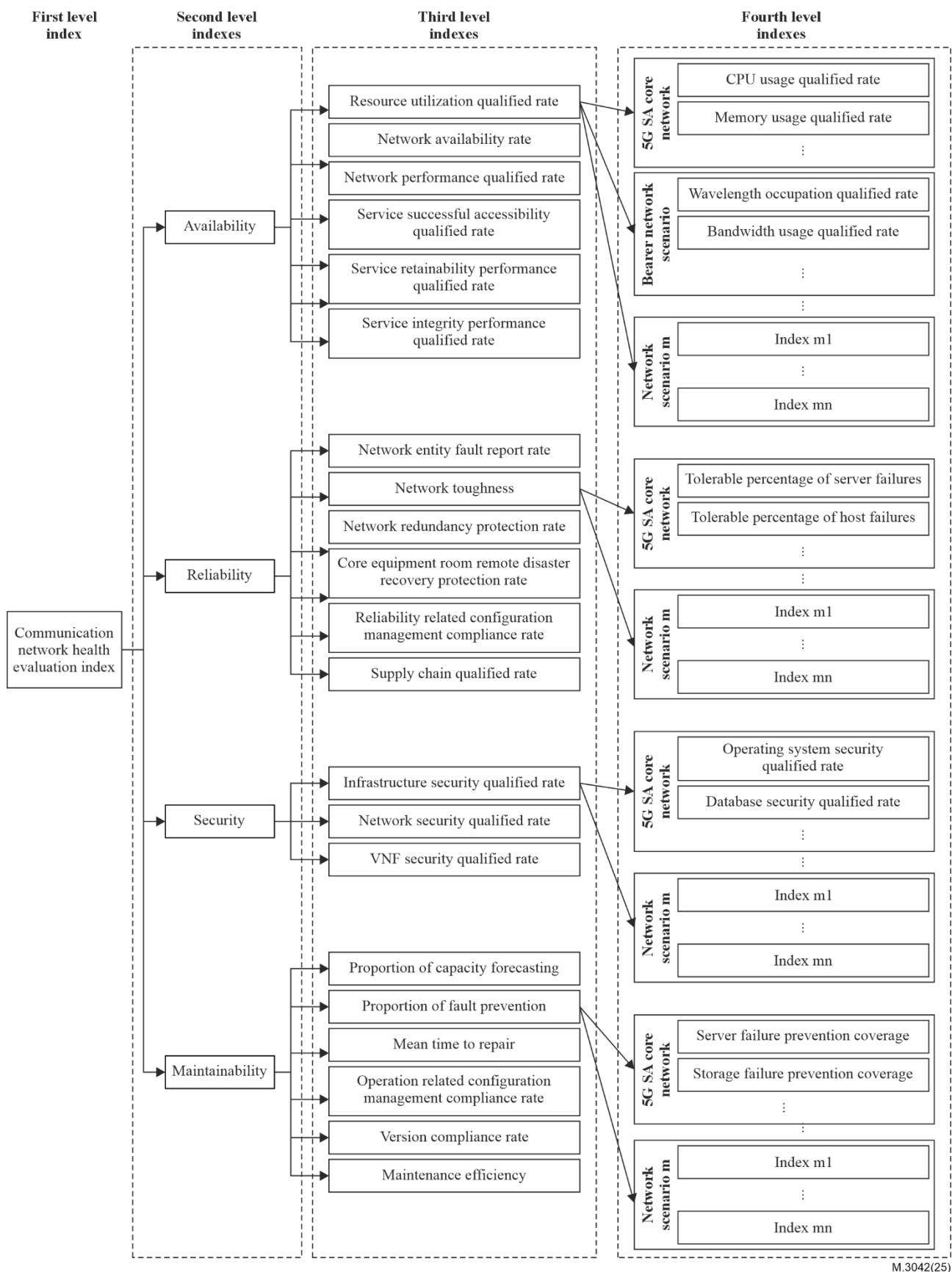


Figure 1 – Communication network health evaluation index framework

6.1 First level index

The first level index includes one index named "Communication network health", which is calculated by the sum of weighted second-level indexes.

6.2 Second-level indexes

The second-level indexes include four indexes named availability, reliability, security and maintainability. Each second-level index is calculated by the sum of weighted third-level indexes that are related.

6.3 Third-level indexes

The third-level indexes include 21 indexes altogether which belong to the different second-level index.

- The availability index is calculated by the sum of third-level indexes such as the resource utilization qualified rate, network availability rate, network performance qualified rate, service successful accessibility qualified rate, service retainability performance qualified rate, service integrity performance qualified rate.
- The reliability index is calculated by the sum of third-level indexes such as network entity fault report rate, network toughness, network redundancy protection rate, core equipment room remote disaster recovery protection rate, reliability related configuration management compliance rate and supply chain qualified rate.
- The security index is calculated by the sum of third-level indexes such as infrastructure security qualified rate index, network security qualified rate index, VNF security qualified rate index.
- The maintainability index is calculated by the sum of third-level indexes such as proportion of capacity forecasting index, proportion of fault prevention index, MTTR index, operation related configuration management compliance rate index, version compliance rate index and maintenance efficiency index.

Each third-level index is calculated by the sum of weighted fourth level indexes that is related.

6.4 Fourth level indexes

The fourth level indexes include central processing unit (CPU) usage qualified rate index, memory usage qualified rate index, disk usage qualified rate index, etc. The fourth level indexes are specified according to the evaluated network object such as IMT-2020 standalone or non-standalone network or network.

7 Communication network health evaluation method

7.1 First level index scoring method

Communication network health index is calculated by the sum of weighted second-level indexes, scoring method is described in Equation (1).

$$T = w_1 K_1 + w_2 K_2 + w_3 K_3 + w_4 K_4 \quad (1)$$

where:

T represents the communication network health index score.

K_1, K_2, K_3, K_4 represent second-level indexes that denote availability, reliability, maintainability and security, respectively.

w_1, w_2, w_3, w_4 represent weight; the definition of the weights for T is outside the scope of this Recommendation. The example of weights determined by the analytic hierarchy