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Methodology for communication network dependability assessment and assurance

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The UK participation in its preparation was entrusted to Technical Committee DS/1, Dependability.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Methodology for communication network dependability assessment and assurance
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Méthodologie pour l'évaluation et l'assurance de la sûreté de fonctionnement des réseaux de communication
(CEI 62673:2013)

Methodik zur Beurteilung und Sicherstellung der Zuverlässigkeit von Kommunikationsnetzen
(IEC 62673:2013)

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Foreword

The text of document 56/1507/FDIS, future edition 1 of IEC 62673, prepared by IEC/TC 56 "Dependability" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62673:2013.

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In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61078	NOTE	Harmonised as EN 61078.
IEC 62198	NOTE	Harmonised as EN 62198.
IEC 60812	NOTE	Harmonised as EN 60812.
IEC 60300-3-11	NOTE	Harmonised as EN 60300-3-11.
IEC 60300-3-1	NOTE	Harmonised as EN 60300-3-1.
IEC 61165	NOTE	Harmonised as EN 61165

Annex ZA
(normative)
**Normative references to international publications
with their corresponding European publications**

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-191		International Electrotechnical Vocabulary (IEV) - Chapter 191: Dependability and quality of service	-	-
IEC 60300-3-15		Dependability management - Part 3-15: Application guide - Engineering of system dependability	EN 60300-3-15	
IEC 61907		Communication network dependability engineering	EN 61907	

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INTRODUCTION

Communication network dependability is highly influenced by the design and implementation of the network service functions, which aim to achieve user satisfaction in service performance.

Network evolution, service growth and functional renewal in communications have long been challenges to the providers of network services, not just for the broad range of services now in existence, but also for those service-related activities experienced by the end-users.

To sustain viable business in network services, it is prudent for the communications industry to provide the

- needed network service functions,
- adequate network capacity and performance capability,
- security of service,
- quality of service, and
- dependability of service.

This International Standard addresses one of the most important issues concerning the assessment and delivery of dependability of service to ensure network service performance. It also addresses the network dependability assurance strategies and methodology applications for enhancing and sustaining network operation.

This International Standard describes a generic methodology for dependability assessment and assurance of communication networks. It also provides relevant assessment and assurance methods to support communication networks for dependability engineering application, such as those conforming to IEC 61907 and ITU-T ¹ Recommendations concerning dependability.

It presents an approach for network dependability analysis and evaluation that ensures dependable network design for effective implementation.

The objective of this standard is to achieve a cost-effective solution for realizing the network dependability performance and to assure the benefits from the network dependability of service operation.

¹ ITU-T: International Telecommunications Union – Telecommunications.

METHODOLOGY FOR COMMUNICATION NETWORK DEPENDABILITY ASSESSMENT AND ASSURANCE

1 Scope

This International Standard describes a generic methodology for dependability assessment and assurance of communication networks from a network life cycle perspective. It presents the network dependability assessment strategies and methodology for analysis of network topology, evaluation of dependability of service paths, and optimization of network configurations in order to achieve network dependability performance and dependability of service. It also addresses the network dependability assurance strategies and methodology for application of network health check, network outage control and test case management to enhance and sustain dependability performance in network service operation.

This standard is applicable to network service providers, network designers and developers, and network maintainers and operators for assurance of network dependability performance and assessment of dependability of service.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-191, *International Electrotechnical Vocabulary (IEV) – Chapter 191: Dependability and quality of service*

IEC 60300-3-15, *Dependability management – Part 3-15: Application guide – Engineering of system dependability*

IEC 61907, *Communication network dependability engineering*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-191 and IEC 61907, as well as the following, apply.

3.1.1

communication network

system of communication nodes and links that provides transmission of analogue and digital signals

EXAMPLES Telecommunications networks, Internet, intranet, extranet, Wide Area Networks (WAN), Local Area Networks (LAN) and computer networking utilizing information technology.

Note 1 to entry: A network has its boundary. All nodes at the network boundary are called ends. In some applications, the term “node” is used instead of “end” as a communication access point to the network, as well as for interconnections between the transmission links.

Note 2 to entry: A “backbone” communication network consists of core network and high-speed transmission lines (national or international), connecting between major switching network nodes (interconnection of transmission lines) at various locations in a country or region.

3.1.2**dependability****network dependability**

ability to perform as and when required to meet specified communication and operational requirements

3.1.3**availability****network availability**

ability to be in a state to perform as required

Note 1 to entry: Availability depends upon the combined characteristics of the reliability, recoverability and maintainability of the network and on the maintenance support performance.

Note 2 to entry: Availability may be quantified using appropriate performance measures.

3.1.4**reliability****network reliability**

ability to perform as required, without failure, for a given time interval, under given conditions

Note 1 to entry: The time interval duration may be expressed in units appropriate to the network concerned.

Note 2 to entry: Reliability of a network depends upon the combined characteristics of the reliability, recoverability, maintainability and maintenance support performance of the constituent network elements.

Note 3 to entry: Given conditions include aspects that affect reliability, such as: mode of operation, stress levels, environmental conditions, and maintenance.

Note 4 to entry: Reliability may be quantified using appropriate performance measures.

3.1.5**maintainability****network maintainability**

ability to be retained in, or restored to a state to perform as required under given conditions of use and maintenance

Note 1 to entry: Given conditions include aspects that affect maintainability, such as: location for maintenance, accessibility, maintenance procedures and maintenance resources.

Note 2 to entry: Maintainability may be quantified using appropriate performance measures.

3.1.6**maintenance support****network maintenance support**

provision of resources to maintain a network

Note 1 to entry: Resources include human resources, support equipment, materials and spare parts, maintenance facilities, documentation, information and maintenance information systems.

3.1.7**maintenance support performance****network maintenance support performance**

effectiveness of an organization in respect of maintenance support for the network

Note 1 to entry: Maintenance support performance may be quantified using appropriate measures.

3.1.8**recoverability****network recoverability**

ability to recover from a failure, without corrective maintenance

Note 1 to entry: The ability to recover may or may not require external actions.

Note 2 to entry: Recoverability may be quantified using such measures as the probability of recovery within a specified time interval.

3.1.9

element

network element

subsystem or component of a communication network

EXAMPLES Terminals, nodes and switches.

Note 1 to entry: A network element may involve human input to perform its service function.

Note 2 to entry: Network elements are connected by network links.

3.1.10

link

network link

electrical, wireless or optical connection between network nodes

3.1.11

performance

network performance

ability to provide the service functions related to communications between users

[SOURCE: ITU-T Recommendation I.350:1988][1]²

3.1.12

management

network management

application of organized processes and resources to manage the performance, configuration, accounting, fault, and security activities

3.1.13

service function

network service function

program or application that interacts with the network users or within the network infrastructure to transmit or exchange data and information in the network

Note 1 to entry: A network service function may consist of hardware and software elements, and may involve human interactions for realizing a specific function.

3.1.14

network services

provision of network service functions and communication services to the network users

Note 1 to entry: Communication services are the network services subscribed by the end-users.

Note 2 to entry: A bearer service is a communication service function that allows transmission of user-information signals between user-network interfaces.

3.1.15

quality of service

collective effect of service performance that determines the degree of satisfaction of a user of the service

3.1.16

network failure

loss of ability of a network to perform as required

² References in square brackets refer to the Bibliography.

Note 1 to entry: The network failure may be due to, for example, equipment failure, natural disasters or human-caused disturbance.

3.1.17

network fault

state of inability of a network to perform as required, for internal reason

Note 1 to entry: In the context of network operation, a fault may be natural due to an abnormal condition, or malfunction resulting from a network element failure, or induced by external means such as fault injection.

Note 2 to entry: A degraded state in network performance is a situation where one or more performance characteristics do not conform to requirements.

3.1.18

service provider

organization that provides communication network services

EXAMPLES Telephone companies, data carriers, mobile service providers, Internet service providers and cable television operators.

Note 1 to entry: A network carrier or common carrier is an organization that transports a product or service using its facilities or those of other carriers, and offers services to the general public. The term communication carrier refers to various telephone companies that provide local, long distance or value added services.

3.1.19

user

party that employs the services of a service provider for direct network access

Note 1 to entry: A user may be a source or recipient of user information, or both.

Note 2 to entry: In some circumstances, a user of a communication service is also known as a subscriber.

3.1.20

integrity

network integrity

ability to ensure that the data contents are not contaminated, corrupted, lost or altered between transmission and reception

Note 1 to entry: Throughput is the rate of successful message delivery over a communication channel of a network service.

3.1.21

dependability performance

network dependability performance

ability to provide or demonstrate the performance characteristics of dependability in network operation to achieve network service objectives

Note 1 to entry: In the context of this standard, network dependability performance refers to the provision of full-end network services.

Note 2 to entry: A full-end network service is the provision of service connectivity established for all transmission and reception ends of a communication network.

3.1.22

dependability of service

network dependability of service

effect of providing the required dependability performance for user communications services

Note 1 to entry: In the context of this standard, network dependability of service refers to the provision of end-to-end (E2E) network services.

Note 2 to entry: An end-to-end network service is the provision of service connectivity established between the transmission and reception ends of a communication network.

3.1.23**security of service****network security of service**

effect of providing the required security for user communications services

3.1.24**service path****network service path**

connecting path by network links and nodes to establish user communications services

3.1.25**service flow****network service flow**

flow of information and data through the service path

3.1.26**service scenario**

operational situation in communication network for provision of network service functions and user service applications

3.1.27**network outage**

state of the network being unable to perform its primary function

3.2 Abbreviations

E2E	End-to-End
FRACAS	Failure Reporting, Analysis, Corrective Action System
FRU	Field Return Unit
HAZOP	Hazard and operability studies
MTTR	Mean Time to Restoration of Node/link
ND	Network Dependability
NFIT	Network Fault Insertion Test
NFMECA	Network Failure Modes, Effects and Criticality Analysis
OAMP	Operations, Administration, Maintenance, and Provisioning
OSI	Open System Interconnection
QoS	Quality of Service
RBD	Reliability Block Diagram
SLB	Service Logic Block

4 Overview of network dependability methodology**4.1 Need for network dependability methods**

A communication network is a system of systems that interacts with other networks to achieve multiple service performance objectives. A communication network is complex and its constituent systems are constantly changing and evolving. Appropriate methodology and technical approaches are needed for dependability assessment and assurance of the network.

From a network dependability assessment perspective, the classical dependability techniques for analysis and evaluation have a limited scope in network application. Existing dependability methods are often unsuitable for modelling complex network topology and difficult for analysis of multiple network configurations and network service paths to provide confidence in the evaluation results. Selective methods such as SLB, NFMECA, and network simulation suitable for network dependability analysis and evaluation can provide effective network solutions.