TECHNICAL REPORT

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First edition
2001-08

Electrical safety –
Classification of interfaces for equipment to be connected to information and communications technology networks

Sécurité électrique –
Classification des interfaces pour les matériels destinés à être connectés à des réseaux de traitement de l'information et de communication

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Sécurité électrique – Classification des interfaces pour les matériels destinés à être connectés à des réseaux de traitement de l'information et de communication

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CONTENTS

Page

FOREWORD 3
INTRODUCTION 5

Clause

1 Scope 6
2 Reference documents 6
3 Terms and definitions 7
3.1 Definitions from IEC 60950 7
3.2 Additional definitions for this document 8
3.3 Abbreviations 9
4 Reference configuration 10
5 Safety categories of interfaces provided for connection to an information and communications technology network 12
5.1 SELV circuits 12
5.2 TNV circuits 12
5.3 User information 12
6 Phenomena affecting the safety of interface ports 12
6.1 Network Environment 0 13
6.2 Network Environment 1 13
7 Determination of circuit type 13

Annex A Consideration of interface phenomenon 14
Annex B Worked examples of certain network interfaces 17
Annex C Conditions for Network Environment 0 19
Annex D Voltage ranges of SELV circuits and TNV circuits 20

Bibliography 21

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL SAFETY – CLASSIFICATION OF INTERFACES FOR EQUIPMENT TO BE CONNECTED TO INFORMATION AND COMMUNICATIONS TECHNOLOGY NETWORKS

FOREWORD

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IEC 62102, which is a technical report, has been prepared by technical committee 74: Safety and energy efficiency of IT equipment.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
74/568/CDV	74/580/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until 2002-11. At this date, the publication will be:

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

This document, which is purely informative, is not to be regarded as an International Standard.

A bilingual version of this technical report may be issued at a later date.

INTRODUCTION

This technical report is a guide to the determination of the interface requirements for equipment in terms of safety. It lists a number of interfaces and indicates the safety category of each listed interface. This technical report does not contain sufficient detail for conformance testing purposes, except when used in conjunction with product standards such as IEC 60950.

The equipment safety standard IEC 60950 specifies the requirements for categories of circuits as **SELV circuits, TNV circuits** and **hazardous voltage circuits** (among others). For stand-alone equipment it is a relatively simple matter to determine the different categories of circuits. However, an equipment which has data port interfaces is intended to be connected to other equipment, either locally or via a network. In this case, the safety categories of the interfaces which will be connected together have to be compatible with each other. Furthermore, the category of the interface of the remote equipment may be unknown. This is the case in systems where telecommunication equipment and data processing equipment are connected together via different types of interfaces and networks.

To overcome this situation it is necessary to classify the interfaces of equipment in such configurations according to the application and to select the safety category for the interfaces of the equipment and for the type of the network. Similarly, the interfaces have to be classified for protection against damage of the equipment and of the network. Aspects of protection are dealt with in the ITU-T K series of Recommendations.

ELECTRICAL SAFETY – CLASSIFICATION OF INTERFACES FOR EQUIPMENT TO BE CONNECTED TO INFORMATION AND COMMUNICATIONS TECHNOLOGY NETWORKS

1 Scope

This technical report applies to equipment interfaces. These interfaces within the equipment may be connected to **telecommunication networks**, they may form part of the **telecommunication network** infrastructure or they may provide localized transfer of data. This technical report provides guidance on the classification of interfaces in accordance with the circuit types defined in IEC 60950 following an analysis of the **telecommunication network** characteristics.

This technical report only covers equipment appropriately interconnected. Furthermore, it does not address damage caused by one equipment to another equipment to which it is connected. Exceptionally, interfaces may be designed for higher or lower levels for special applications. In such cases it should be ensured that only interfaces having the same safety category and protection level are connected together. This is based on the available specifications of the equipment manufacturers and network providers, and on information regarding the installation category of the mains interface.

This technical report is intended to be used by equipment designers, network operators, network regulators/authorities, standards writers and network installers. It is applicable to various interfaces of equipment. Network presentations are not equipment and so are not covered by IEC 60950; hence they are also not covered by this technical report. However, it is necessary to consider the characteristics, installation and presentation of **telecommunication networks** when determining what equipment interface requirements apply (e.g. **SELV circuit, TNV-1 circuit, TNV-2 circuit, TNV-3 circuit** etc.).

If a standard other than IEC 60950 is used for designing the equipment and its interface (e.g. IEC 62151 in conjunction with other product safety standards), then the corresponding requirements of these other standards are to be preferred.

If there is a conflict between this technical report and a more detailed specification, the latter prevails.

This technical report applies regardless of ownership or responsibility for installation and maintenance of the equipment or network.

NOTE Terminal equipment is often connected to customer premises cabling when used in a business environment, and there are standards covering such cabling.

2 Reference documents

IEC Guide 112, *Guide on the safety of multimedia equipment*

IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60364 (all parts), *Electrical installation of buildings*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60950, *Safety of information technology equipment*

IEC 61312-1, *Protection against lightning electromagnetic impulse – Part 1: General principles*

IEC 62151, *Safety of equipment electrically connected to a telecommunication network*

ISO/IEC 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

ITU-T Recommendation K.20, *Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents*

ITU-T Recommendation K.21, *Resistibility of telecommunication equipment installed in customer's premises to overvoltages and overcurrents*

ITU-T Recommendation K.27, *Bonding configurations and earthing inside a telecommunication building*

ITU-T Recommendation K.31, *Bonding configurations and earthing of telecommunication installations inside a subscriber's building*

3 Terms and definitions

For the purposes of this technical report, the specified terms and definitions from IEC 60950 as well as the following additional definitions apply.

3.1 Definitions from IEC 60950

3.1.1
a.c. mains supply
the external a.c. power distribution system supplying power to the equipment. These power sources include public or private utilities and, unless otherwise specified, equivalent sources such as motor-driven generators and uninterruptible power supplies

3.1.2
hazardous voltage
a voltage exceeding 42,4 V peak, or 60 V d.c., existing in a circuit which does not meet the requirements for either a **limited current circuit** or a **TNV circuit**

3.1.3
limited current circuit
a circuit which is so designed and protected that under both normal operating conditions and single-fault conditions, the current which can be drawn is not hazardous

3.1.4
primary circuit
a circuit which is directly connected to the **a.c. mains supply**. It includes, for example, the means for connection to the a.c. **mains supply**, the primary windings of transformers, motors and other loading devices

3.1.5
secondary circuit
a circuit which has no direct connection to a **primary circuit** and derives its power from a transformer, converter or equivalent isolation device, or from a battery

3.1.6
SELV circuit
a **secondary circuit** which is so designed and protected that under normal operating conditions and single-fault conditions, its voltages do not exceed a safe value

3.1.7
TNV circuit (including TNV-1 circuit, TNV-2 circuit, TNV-3 circuit)
a circuit which is in the equipment and to which the accessible area of contact is limited and that is so designed and protected that, under normal operating conditions and single-fault conditions, the voltages do not exceed specified limit values

3.1.8
telecommunication network
a metallically terminated transmission medium intended for communication between equipments that may be located in separate buildings, excluding:

- the mains system for supply, transmission and distribution of electrical power, if used as a telecommunication transmission medium;
- television distribution systems using cable;
- **SELV circuits** connecting units of data processing equipment

NOTE 1 The term **telecommunication network** is defined in terms of its functionality, not its electrical characteristics. A **telecommunication network** is not itself defined as being either a **SELV circuit** or a **TNV circuit**. Only the circuits in the equipment are so classified.

NOTE 2 A **telecommunication network** may be:

- publicly or privately owned;
- subject to transient overvoltages due to atmospheric discharges and faults in power distribution systems;
- subject to longitudinal (common mode) voltages induced from nearby power lines or electric traction lines.

NOTE 3 Examples of **telecommunication networks** are:

- a public switched telephone network;
- a public data network;
- an Integrated Services Digital Network (ISDN);
- a private network with electrical interface characteristics similar to the above

3.1.9
service personnel
persons having appropriate technical training and experience necessary to be aware of hazards to which they may be exposed in performing a task and of measures to minimize the risks for themselves or other persons

3.1.10
user
any person, other than **service personnel**

3.2 Additional definitions for this document

3.2.1
antenna interface
a port for connection of a radio frequency antenna to equipment

3.2.2
coaxial cable interface
a port for connection of a coaxial cable providing for asymmetrical transmission to equipment

NOTE In this technical report, the use of both indoor and outdoor twisted pair cables is considered separately.

3.2.3
network termination point
the physical point at the boundary of a network intended to accept the connection of a terminal equipment or to be interconnected to another network

3.2.4
paired conductor interface
a port for connection of a cable providing for symmetrical transmission (e.g. twisted pair) to equipment

NOTE In this technical report, the use of both indoor and outdoor twisted pair cables is considered separately.

3.2.5
terminal connection point
the physical point of the terminal equipment intended to be connected to a network

3.3 Abbreviations

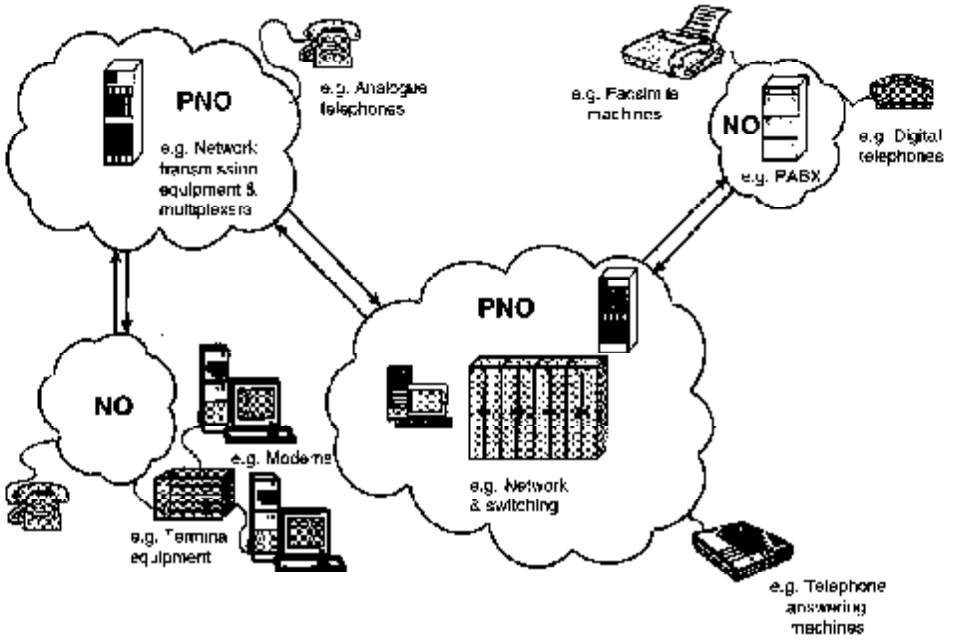
For the purposes of this technical report, the following abbreviations apply to Clause 4, annex B and annex C:

ADSL	Asymmetric Digital Subscriber Line
FSP	Remote Power Supply
ISDN	Integrated Services Digital Network
LAN	Local Area Network
LEPM	Primary Multiplex
LPZ	Lightning Protection Zone
LTU	Line termination unit
NCP	Network Connection Point
NO	Network Operator
NT	Network Termination
NTBA	Network Termination, Basic Access
NTP	Network Termination Point
NTU	Network Terminating Unit
PABX	Private Automatic Branch Exchange
PCM	Pulse Code Modulation
PNO	Public Network Operator
PSTN	Public Switched Telephone Network
SDH	Synchronous Digital Hierarchy
TA	Terminal Adapter
TCP	Terminal Connection Point
TE	Terminal Equipment
ZWRBA	Regenerator, Basic Access

4 Reference configuration

Figure 1 illustrates a hypothetical configuration of "network clouds" giving examples of the types of equipments covered by this technical report. Certain of these equipments will only have one or two interface types, others may have many. Certain of the "network clouds" will be elements within the PSTN (where the possibility of more than one network operator exists) and others may be private networks. The equipment connected to this "network cloud" and part of the "network cloud" itself can be any type covered by the scope of this technical report.

This technical report provides a framework for safety requirements and protection levels by reference to the particular examples given in figures 1 and 2. Configurations not covered should be treated using the same principles.



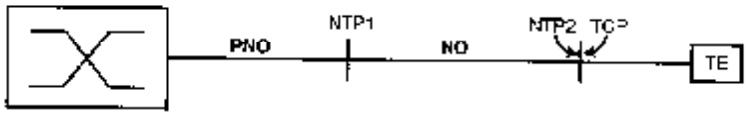
IEC 1229/01

Figure 1 – Reference configuration

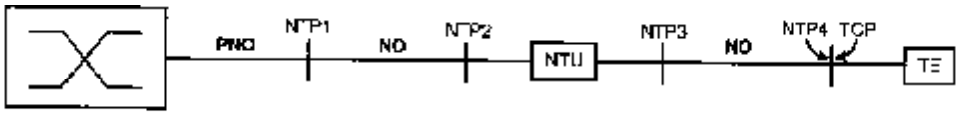
Where, in a practical situation, an equipment has two or more interfaces of different types, it is normally necessary to provide safety separation within the equipment between those interfaces in accordance with IEC 60950.

Figure 2 illustrates examples of possible network configurations. Included are some of the network elements involved in such networks and an indication of the various commercial organizations, both Public Network Operators (PNOs) and Network Operators (NOs) generally (who could be public or private) that are involved in providing network infrastructures to service the end-customer.

Example 1



Example 2



Example 3

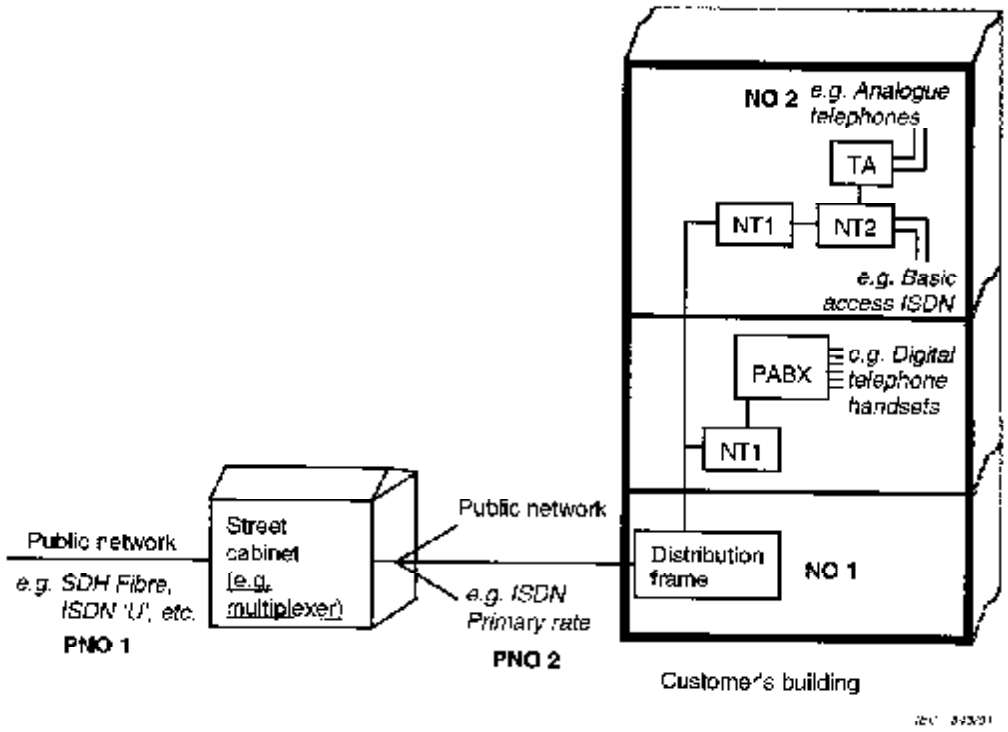


Figure 2 – Example network configurations

5 Safety categories of interfaces provided for connection to an information and communications technology network

NOTE Both primary circuits and secondary circuits can be subject to transient overvoltages. Refer to IEC 60950.

5.1 SELV circuits

The requirements for **SELV circuits** are as specified in IEC 60950.

5.2 TNV circuits

The requirements for **TNV circuits** are as specified in IEC 60950. **TNV circuits** are further sub-divided into **TNV-1 circuits**, **TNV-2 circuits** and **TNV-3 circuits**, depending on their nominal operating voltage and on the likelihood of their being subject to overvoltages.

5.3 User information

The safety classification (e.g. **SELV circuit**, **TNV-1 circuit**, **TNV-2 circuit** or **TNV-3 circuit**) of ports for networks, and any restrictions applicable to the network topology (e.g. whether they are in a Network Environment 0 or Network Environment 1, see 6.1 and 6.2) are to be stated in the manufacturer's documentation supplied with the equipment if confusion could result in a safety hazard (see 1.7.2 of IEC 60950).

NOTE Depending on the design of the interface, it is possible for one port to be suitable for connection to more than one type of circuit in other equipment. For example, consider circuitry in an equipment which meets the requirements for a **SELV circuit** and where the telecommunication interface port is separated from this circuitry in accordance with 6.2.1 of IEC 60950; the telecommunication interface port would be suitable for connection to either a **SELV circuit** or a **TNV-1 circuit**.

For equipment intended to be installed by the **user** it is recommended to either:

– provide **telecommunication** interface ports with circuitry intended for connection to a Network Environment 1 (i.e. a **TNV-1 circuit** instead of a **SELV circuit**, or a **TNV-3 circuit** instead of a **TNV-2 circuit**); or

provide sufficient information in the **user** instructions to avoid connection to a **telecommunication network** in a Network Environment 1.

6 Phenomena affecting the safety of interface ports

Annex A identifies a number of phenomena, some of which can affect a **telecommunication network** in such a way that an overvoltage can be induced and transmitted to the interface port of the equipment. These phenomena are typically independent of the normal operating voltage on the circuit, but can be affected by the circuit impedance.

To determine the safety status of circuits within the equipment for connection to a particular network it is necessary to know:

– the normal operating voltage on the **circuit** (due to the circuit under consideration and any voltages coming from the **telecommunication network**);
– the severity and frequency of overvoltages;
– if the circuit presents an energy hazard;
– if the circuit is supplied from a limited power source.

6.1 Network Environment 0

A **telecommunication network** is considered to be in a Network Environment 0 if the following conditions apply to all parts of that network:

a) the possible effect of indirect lightning has been reduced (for details, see annex C, point 1);

b) the possibility of having different earth potentials has been reduced (for details, see annex C, point 2);

c) the possibility of power cross/contact has been reduced (for details, see annex C, point 3);

d) the possibility of induced transients and voltages has been reduced (for details, see annex C, points 4 and 5).

6.2 Network Environment 1

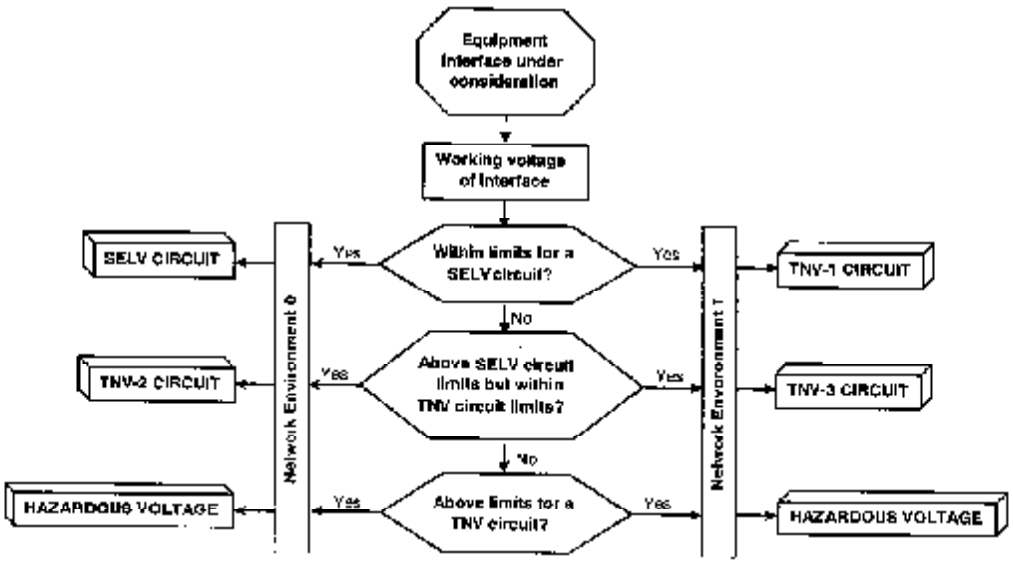
A **telecommunication network** is considered to be in a Network Environment 1 if one or more of the requirements for a Network Environment 0 are not fulfilled.

7 Determination of circuit type

In order to determine which circuit type is applicable to a particular interface it is necessary to know:

- the operating voltage (or current for certain circuits) under normal and single-fault conditions within the equipment; and
- if the network is a Network Environment 0 or a Network Environment 1.

This is shown in figure 3:



NOTE 1 Requirements for remote power feeding circuits are being developed by IEC TC 74.

NOTE 2 The requirements for separating **SELV circuits** and **TNV circuits** from **hazardous voltages** are as specified in IEC 60950. A **hazardous voltage** can exist in a primary circuit or a secondary circuit.

Figure 3 – Flowchart for determination of circuit type

Annex A

Consideration of interface phenomenon

Table A.1 – Consideration of interface phenomenon

Phenomenon	Interface port to be covered	Existing Standards/Other documents	Safety considerations
Normal operating voltage	Outdoor paired conductor		**TNV-1 circuit** (if within limits for a **SELV circuit**) or **TNV-3 circuit** (if within limits for a **TNV circuit**), due to induced overvoltages or **hazardous voltage**.
	Outdoor coaxial cable		**TNV-1 circuit** (if within limits for a **SELV circuit**) or TNV-3 circuit (if within limits for a **TNV circuit**), due to induced overvoltages or **hazardous voltage**.
	Indoor paired conductor		Could be **SELV circuit**, **TNV-1 circuit**, **TNV-2 circuit**, **TNV-3 circuit** or **hazardous voltage**.
	Indoor coaxial cable		Could be **SELV circuit**, **TNV-1 circuit**, **TNV-2 circuit**, **TNV-3 circuit** or **hazardous voltage**.
	AC mains supply		**Primary circuit, hazardous voltage**.
	Outdoor antenna	IEC Guide 112	Covered by the surge test of IEC 60065, 10.1. Could be **TNV-1 circuit** (if within voltage limits for a **SELV circuit**) or **TNV-3 circuit** (if within limits for a **TNV circuit**).
Induced disturbance due to lightning	Outdoor paired conductor		Network installation must limit transients to 1,5 kV per IEC 60950.
	Outdoor coaxial cable		Network installation must limit transients to 1,5 kV per IEC 60950.
	Indoor paired conductor	IEC 61312-1	Covered by 1,5 kV transient requirement of IEC 60950 for **TNV-1 circuits** and **TNV-3 circuits** if the installation provides adequate protection means.
	Indoor coaxial cable	IEC 61312-1	Covered by 1,5 kV transient requirement of IEC 60950 for **TNV-1 circuits** and **TNV-3 circuits** if the installation provides adequate protection means.
	AC mains supply		This is covered by IEC 60664-1.

Table A.1 *(continued)*

Phenomenon	Interface port to be covered	Existing Standards/Other documents	Safety considerations
Direct lightning stroke	Outdoor paired conductor		The voltages expected as a result of a direct lightning stroke on a paired conductor cable are in excess of those considered by IEC 60950 and so are beyond the scope of this technical report.
	Outdoor coaxial cable		The voltages expected as a result of a direct lightning stroke on a coaxial cable are in excess of those considered by IEC 60950 and so are beyond the scope of this technical report.
	Antenna		The voltages expected as a result of a direct lightning stroke on an antenna are in excess of those considered by IEC 60950 or IEC 60065 and so are beyond the scope of this technical report.
Induced by electric traction systems	Outdoor paired conductor		Requirements of ITU-T Directives, volume VI, were considered when writing IEC 60950 and so no further action is required for **TNV-1 circuits** and **TNV-3 circuits**.
	Outdoor coaxial cable		Requirements of ITU-T Directives, volume VI, were considered when writing IEC 60950 and so no further action is required for **TNV-1 circuits** and **TNV-3 circuits**.
ESD			Not regarded as a safety issue.
Surges due to high voltage switching	**AC mains supply**	IEC 60664 series	Covered by IEC 60664 series
Differences in earth potential	Outdoor paired conductor		Ensure that interfaces are separated from earth in accordance with IEC 60950 6.2.1 c).
	Outdoor coaxial cable		Ensure that either the installation meets ITU-T Recommendation K.27 or ITU-T Recommendation K.31, as applicable to the installation, or that interfaces are separated from earth in accordance with IEC 60950 6.2.1 c).
	Indoor paired conductor		Covered by consideration of Network Environment, which cross-refers to equipotential bonding per IEC 60364. For Network Environment 1, the interfaces should be treated as for outdoor paired conductors.
	Indoor coaxial cable		Covered by consideration of Network Environment, which cross-refers to equipotential bonding per IEC 60364. For Network Environment 1 the interfaces should be treated as for outdoor coaxial cables.
Power cross (direct contact)	Outdoor paired conductor	ITU-T Recommendations K.20, K.21	
	Outdoor coaxial cable		

Table A.1 *(continued)*

Phenomenon	Interface port to be covered	Existing Standards/Other documents	Safety considerations
Mains induced	Outdoor paired conductor		Ensure that the installation meets ITU-T Recommendation K.27 or ITU-T Recommendation K.31, as applicable to the installation.
	Outdoor coaxial cable		Ensure that the installation meets ITU-T Recommendation K.27 or ITU-T Recommendation K.31, as applicable to the installation
	Indoor paired conductor		Ensure that the installation meets ITU-T Recommendation K.27 or ITU-T Recommendation K.31, as applicable to the installation.
	Indoor coaxial cable		Ensure that the installation meets ITU-T Recommendation K.27 or ITU-T Recommendation K.31, as applicable to the installation.

Annex B

Worked examples of certain network interfaces

Table B.1 provides some worked examples of common network interfaces. This table recognizes that interfaces for information and communications technology networks are often standardized regionally or nationally, rather than internationally. It is not intended for this list to be exhaustive.

Table B.1 – Worked examples of certain network interfaces

NOTE The referenced document in column two may not contain the actual interface name as stated in column one, but may describe an equivalent interface.

Interface or connection point	Documents relevant for the interface	Approximate operating voltage	Earthing [d]	Network environment per clause 6	IEC 60950 circuit category
ADSL	ANSI T1.413 [1,3]	28 V peak	no	1	TNV-1
V.5.1	ETS 300 324-1	±8 V d.c.	no	1	TNV-1
V.5.2	ETS 300 347-1	±3 V d.c.	no	1	TNV-1
X.24	ITU-T V.11 / X.24	±6 V d.c.	yes/no	0	TNV-1/SELV
Centronics/parallel interface (PC)	Manufacturer's specification	5 V d.c.	yes/no	0	SELV
Video interface (PC)	Manufacturer's specification	5 V d.c.	yes/no	0	SELV
RS 232 C/V.24	ITU-T Rec. V.24	±15 V d.c.	yes/no	0	SELV
RS 232/V.28	ITU-T Rec. V.28	±12 V d.c.	yes/no	0	SELV
RS 422	ITU-T Rec V.11	±6 V d.c.	yes/no	1/0	TNV-1/SELV
RS 485	ITU-T Rec V.11	±6 V d.c.	yes/no	1/0	TNV-1/SELV
Ethernet 10Base5	ISO/IEC 8802-3	±2 V d.c.	no	1	TNV-1
Ethernet 10Base2	ISO/IEC 8802-3	±2 V d.c.	no	0	SELV
Ethernet 10BaseT	ISO/IEC 8802-3	±2 V d.c.	no	0	SELV
G.703	ITU T Rec. G.703	±3 V d.c.	no	1/0	TNV-1/SELV
[Unchannelled] E1	ETS 300 418, ETS 300 247	±2 V d.c.	no	1/0	TNV-1/SELV[e]
ISDN S0 bus	ETS 300 012-1	40 V d.c.	no	1/0	TNV-1/SELV[e]
ISDN U/K0	ETSI TS 102 080	1,5 V d.c.	no	1	TNV-3
"48 V" station battery[b]	ETS 300 132-2, ANSI T1.315-1994	max. –57 V d.c.	yes/no	0	SELV
"60 V" station battery[b]	ETS 300 132-2	max. –75 V d.c.	yes/no	0	TNV-2
Analogue PSTN 48 V battery	ETS 300 001	–57 V d.c. 80 V [c] a.c.	yes/no	1	TNV-3
Analogue PSTN 60 V battery	ETS 300 001	–75 V d.c. 80 V a.c.[c]	yes/no	1	TNV-3
PCM11VA TR (LTU side)	ETS 300 001	–75 V d.c. 00 V a.c.[c]	yes	0	TNV-2
PCM11VA SISA (LTU side)	UB2 TS 0076/96	±1,5 V d.c.	yes	0	SELV
PCM11VA UB (LTU side)	ETS 300 132-2	–75 V d.c.	yes	0	TNV-2
PCM11TA TR (NTU side) Analogue PSTN	ETS 300 001	31 V d.c. 40 V a.c.[c]	no	1	TNV-3

Interface or connection point	Documents relevant for the interface	Approximate operating voltage	Earthing [c]	Network environment per clause 6	IEC 60950 circuit category
FSP Remote power supply	EC 60950	110 V d.c.	no	0	TNV-3
PCM2FA UK0	ITU-T Rec. G.703	115 V d.c.	no	1	TNV-3
PCM2VA UK0 (LTU side)	ITU-T Rec. G.703	115 V d.c.	no	1	TNV-3
PCM2VA TIn (LTU side)	ETS 300 001	–75 V d.c 60 V a.c.[d]	yes	0	TNV-2
PCM2TA UK0 (NTU side)	ITU-T Rec. G.703	115 V d.c.	no	1	TNV-3
PCM2TA TIn (NTU side)	ETS 300 001 ETS 300 659-2	31 V d.c. 40 V a.c.[d]	no	1	TNV-3
LEPM V2M (LTU side)	ETS 300 233 ITU-T Rec. G.703	±6 V d.c.	no	0	SELV
ZWRBA UK0 (LT, NT)	ETSI-TS 102 080	115 V d.c.	no	1	TNV-3
NTBA UK0	ETSI-TS 102 080	115 V d.c.	no	*	TNV-3
NTBA S0	ETS 300 012-1	40 V d.c.	no	0/1	SELV / TNV-1

[a] Additional information may need to be provided by manufacturers, see 5.3.

[b] Interface for DC powering of any other equipment, e.g. datacom equipment in telecommunication facilities, is also covered in ETS 300 132-2.

[c] Ringing signal.

[d] PPE (functional and protective earth), 1 not marked in table.

[e] Standard and safety requirements are under consideration.

Annex C

Conditions for Network Environment 0

1) The possible effect of indirect lightning (i.e. lightning that does not directly strike the network conductors but which nevertheless induces a voltage in them) has been reduced by measures described in IEC 61312-1, protection zone LPZ 1.

2) The possibility of having different earth potentials existing at different points on the network has been reduced to a level where electric shock is unlikely, e.g. by connecting all equipment within the network to the same equipotential bonding system (see IEC 60364).

NOTE 1 Although an equipotential zone provides protection for people from electric shock, it does not necessarily protect the interconnecting cables from overcurrents. These overcurrents can cause overheating with the resultant risk of fire. Examples of measures that may be applied to prevent such overcurrents include reducing the level of potential difference by suitable building cable practice (see ITU-T Recommendation K.27 or ITU-T Recommendation K.81, as applicable to the installation) and isolation of the equipment interfaces from earth.

NOTE 2 In the USA, a network telecommunication conductor is considered to be Network Environment 1 when there is a possibility of accidental contact to an **a.c. mains supply** operating at greater than 300 volts r.m.s. with respect to earth.

3) The possibility of power cross/contact between the network and the **a.c. mains supply** is unlikely, e.g. by preventing such an occurrence by appropriate installation practices or by ensuring that either the conductors of **the a.c. mains supply**, or the conductors of the network, or both, are insulated for the highest working voltage of the **a.c. mains supply**, as described in IEC 60364.

4) The possibility of **mains**-induced transients, surges and power faults, due to capacitive, inductive or common impedance coupling is unlikely due to electrical isolation from, and physical co-ordination of, the network conductors and the wiring of the **a.c. mains supply**.

5) The possibility of voltages induced by electrical traction is unlikely due to there being sufficient distance between the **telecommunication network** and such traction systems.

Annex D

Voltage ranges of SELV circuits and TNV circuits

Table D.1 – Voltage ranges of SELV circuits and TNV circuits

	Normal operating voltage	
Overvoltage from telecommunication network possible?	Within SELV circuit limits	Exceeding SELV circuit limits but within TNV circuit limits
Yes	TNV-1 circuit	TNV-3 circuit
No	SELV circuit	TNV-2 circuit

NOTE Refer to IEC 60950 for further information.

Bibliography

ANSI T1.315-1994, *Telecommunications – Voltage Levels for DC-Powered Equipment – Used in the Telecommunications Environment*

ANSI T1.413-1998, *Telecommunications – Network and Customer Installation Interfaces – Asymmetric Digital Subscriber Line (ADSL) Metallic Interface*

Deutsche Telekom AG, TS 0076/96. *QD2-Interface*

ETS 300 001, *Attachments to the Public Switched Telephone Network (PSTN); General technical requirements for equipment connected to an analogue subscriber interface in the PSTN*

ETS 300 012-1, *Integrated Services Digital Network (ISDN); Basic User Network Interface (UNI); Part 1: Layer 1 specification*

ETS 300 132-2, *Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (d.c.)*

ETS 300 233, *Integrated Services Digital Network (ISDN); Access digital section for ISDN primary rate*

ETS 300 247, *Business Telecommunications (BT); Open Network Provision (ONP) technical requirements; 2 048 kbit/s digital unstructured leased line (D2048U) Connection characteristics*

ETS 300 253, *Equipment Engineering (EE); Earthing and bonding of telecommunication equipment in telecommunication centres*

ETS 300 324-1, *V interfaces at the digital Local Exchange (LE); V5.1 interface for the support of Access Network (AN); Part 1: V5.1 interface specification*

ETS 300 347-1, *V interfaces at the digital Local Exchange (LE); V5.2 interface for the support of Access Network (AN); Part 1: V5.2 interface specification*

ETS 300 416, *Transmission and Multiplexing (TM); Availability performance of path elements of international digital paths*

ETS 300 659-2, *Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display (and related) services; Part 2: Off-hook data transmission*

ETSI TS 102 080 V1.3.1, *Transmission and Multiplexing (TM); Integrated Services Digital Network (ISDN) basic rate access; Digital transmission system on metallic local lines*

ITU-T Recommendation G.703, *Physical/electrical characteristics of hierarchical digital interfaces*

ITU-T Recommendation K.11, *Principles of protection against overvoltages and overcurrents*

ITU-T Recommendation K.17, *Test on power-fed repeaters using solid-state devices in order to check the arrangements for protection from external interference*

ITU T Recommendation K.22, *Overvoltage resistibility of equipment connected to an ISDN T/S bus*

ITU-T Recommendation V.11, *Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s*

ITU-T Recommendation V.24, *List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)*

ITU-T Recommendation V.28, *Electrical characteristics for unbalanced double-current interchange circuits*

ITU-T Recommendation X.24, *List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) on public data networks*

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