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PN-3-0092

**Telecommunications Infrastructure Standard
for Data Centers
Draft 1.0
February 6, 2003**

NOTICE:

This contribution has been prepared to assist the TR-42 Standards Committee. It is offered to the Committee as a basis of discussion and is not a binding proposal on the members of the TR-42.1. The proposed requirements presented in this document are subject to change in form and technical content after more study. Members of the TR-42.1 specifically reserve the right to add to, or revise, the statements contained herein.

This document is a working draft for review and use by the TR-42.1 members only. It is intended to serve as the basis for discussion and further development of the TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard.

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Telecommunications Infrastructure Standard for Data Centers

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FOREWORD

(This foreword is not considered part of this Standard.)

Approval of this Standard

This Standard was approved by TIA/EIA Subcommittee TR-42.1, TIA/EIA Engineering Committee TR-42, and the American National Standards Institute (ANSI).

ANSI/TIA/EIA reviews standards every 5 years. At that time, standards are reaffirmed, rescinded, or revised according to the submitted updates. Updates to be included in the next revision should be sent to the committee chair or to ANSI/TIA/EIA.

Contributing organizations

More than 60 organizations within the telecommunications industry contributed their expertise to the development of this Standard (including manufacturers, consultants, end users, and other organizations).

The TR-42 Committee contains the following subcommittees that are related to this activity.

- TR-42.1 - Subcommittee on Commercial Building Telecommunications Cabling
- TR-42.2 - Subcommittee on Residential Telecommunications Infrastructure
- TR-42.3 - Subcommittee on Commercial Building Telecommunications Pathways and Spaces
- TR-42.4 - Subcommittee on Outside Plant Telecommunications Infrastructure
- TR-42.5 - Subcommittee on Telecommunications Infrastructure Terms and Symbols
- TR-42.6 - Subcommittee on Telecommunications Infrastructure and Equipment Administration
- TR-42.7 - Subcommittee on Telecommunications Copper Cabling Systems
- TR-42.8 - Subcommittee on Telecommunications Optical Fiber Cabling Systems
- TR-42.9 - Subcommittee on Industrial Telecommunications Infrastructure

Documents superseded

This Standard is the first edition.

Relationship to other TIA standards and documents

The specifications and recommendations of this standard will take precedence for use in data centers.

- ANSI/TIA/EIA-568-B.1, *Commercial Building Telecommunications Cabling Standard; Part 1 General Requirements*

- 1 • ANSI/TIA/EIA-568-B.2, *Commercial Building Telecommunications Cabling Standard; Part 2*
2 *Balanced Twisted-Pair Cabling Components*
- 3 • ANSI/TIA/EIA-568-B.3, *Optical Fiber Cabling Components Standard*
- 4 • ANSI/TIA/EIA-569-B, *Commercial Building Standard for Telecommunications Pathways and*
5 *Spaces*
- 6 • ANSI/TIA/EIA-606-A, *Administration Standard for Commercial Telecommunications*
7 *Infrastructure*
- 8 • ANSI/TIA/EIA-J-STD-607, *Commercial Building Grounding (Earthing) and Bonding*
9 *Requirements for Telecommunications*
- 10 • ANSI/TIA/EIA-758, *Customer-Owned Outside Plant Telecommunications Cabling Standard*

11 This Standard contains references to national and international standards. Where appropriate,
12 international standards are used.

- 13 • National Electrical Safety Code (NESC)
14 (IEEE C 2)
- 15 • Life Safety Code (NEC)
16 (NFPA 101)
- 17 • National Electrical Code (NEC)
18 (NFPA 70)

19 In Canada, the National Building Code, the National Fire Code, Canadian Electrical Code (CSA
20 C22.1), and other documents including CAN/ULC S524, CAN/ULC S531 may be used for cross-
21 reference to NFPA 72, NFPA 70 section 725-8 and section 725-54.

22 Useful supplements to this Standard are the Building Industry Consulting Service International
23 (BICSI) *Telecommunications Distribution Methods Manual*, the *Customer-owned Outside Plant*
24 *Design Manual*, and the *Telecommunications Cabling Installation Manual*. These manuals
25 provide recommended practices and methods by which many of the requirements of this
26 Standard may be implemented.

27 Other references are listed in annex G.

28 Annexes A, B, C, D, E and F are informative and not considered to be requirements of this
29 Standard.

1 INTRODUCTION

2 1.1 Purpose

3 The purpose of this Standard is to provide information on the factors that should be considered
 4 when planning and preparing the installation of a data center or computer room. It is intended for
 5 use by designers who need a comprehensive understanding of the data center design including
 6 the facility planning, the cabling system, and the network design. The standard will enable the
 7 data center design to be considered early in the building development process, contributing to the
 8 architectural considerations, by providing information that cuts across the multidisciplinary design
 9 efforts; promoting cooperation in the design and construction phases. Adequate planning during
 10 building construction or renovation is significantly less expensive and less disruptive than after
 11 the facility is operational. Data centers in particular can benefit from infrastructure that is planned
 12 in advance of applications and customer requirements to facilitate staged growth of the network
 13 and preserve initial capital expenditure.

14 This document in particular presents an infrastructure topology for accessing and connecting the
 15 respective elements in the various cabling system configurations currently found in the data
 16 center environment. In order to determine the performance requirements of a generic cabling
 17 system, various telecommunications services and applications were considered. In addition, this
 18 document addresses the floor layout topology related to achieving the proper balance between
 19 security, rack density, revenue potential and manageability.

20 The standard intends to specify a generic telecommunications cabling system for the data center
 21 and related facilities whose primary function is information technology. Such application spaces
 22 may be dedicated to a private company or institution, or occupied by one or more service
 23 providers to host Internet connections, and data storage devices.

24 The diversity of services currently available, coupled with continual addition of new services,
 25 means that there may be cases where limitations to desired performance occur. When applying
 26 specific applications, it is cautioned to consult application standards, regulations, equipment
 27 vendors, and system service suppliers for applicability, limitations, and ancillary requirements.

28 This document recognizes that data centers can be categorized according to whether they serve
 29 the private domain ("enterprise" data centers) or the public domain ("internet" data centers).
 30 Enterprise facilities include private corporations, institutions or government agencies, and may
 31 involve the establishment of either intranets or extranets. Internet facilities include traditional
 32 telephone service providers, unregulated competitive service providers and related commercial
 33 operators. The topologies proposed in this document, however, are intended to be applicable to
 34 both in satisfying their respective requirements for connectivity (internet access and wide-area
 35 communications), operational hosting (web hosting, file storage and backup, database
 36 management, and etc.), and value-added services (application hosting, content distribution, and
 37 etc.). Failsafe power, environmental controls and fire suppression, and system redundancy and
 38 security are also common requirements to both types of facilities.

39 1.2 Specification of criteria

40 In accordance with EIA Engineering Publication, EP-7B, two categories of criteria are specified;
 41 mandatory and advisory. The mandatory requirements are designated by the word "shall";
 42 advisory requirements are designated by the words "should", "may" or "desirable" which are used
 43 interchangeably in this Standard.

44 Mandatory criteria generally apply to protection, performance, administration and compatibility;
 45 they specify the absolute minimum acceptable requirements. Advisory or desirable criteria are

1 presented when their attainment will enhance the general performance of the cabling system in
2 all its contemplated applications. A note in the text, table, or figure is used for emphasis or for
3 offering informative suggestions.

4 **1.3 Metric equivalents of US customary units**

5 The majority of the metric dimensions in this Standard are soft conversions of US customary
6 units; e.g., 100 millimeters is the soft conversion of 4 inches.

7 **1.4 Life of this Standard**

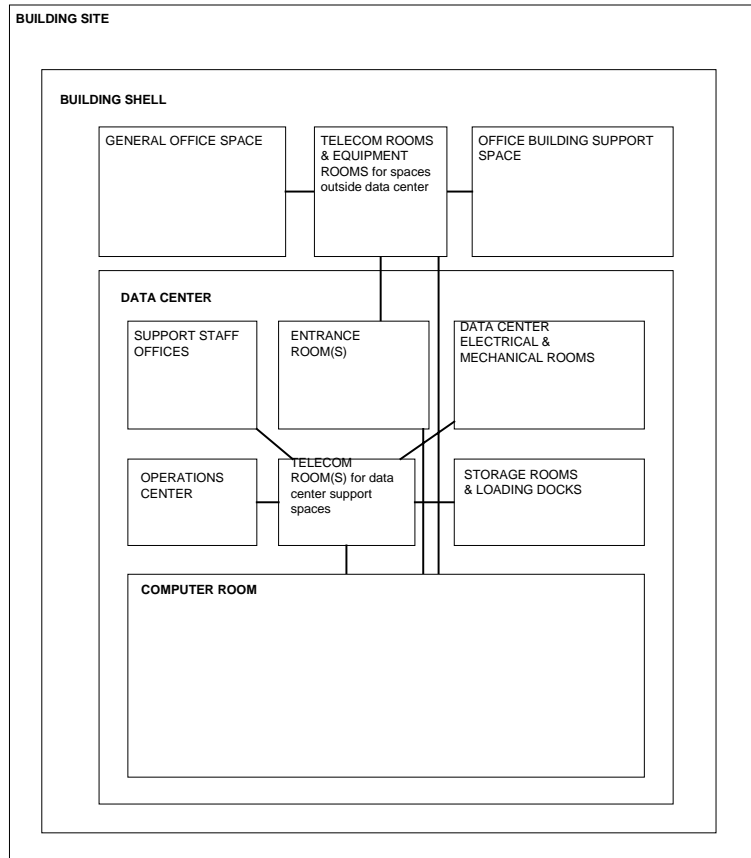
8 This Standard is a living document. The criteria contained in this Standard are subject to revisions
9 and updating as warranted by advances in building construction techniques and
10 telecommunications technology.

11 **1.5 Relationship of data center spaces to other building spaces**

12 Figure 1 illustrates the major spaces of a typical data center and how they relate to each other
13 and the spaces outside of the data center. See clause 5 for information concerning the
14 telecommunications spaces within the data center.

15 This standard addresses telecommunications infrastructure for the data center spaces, which is
16 the computer room and its associated support spaces.

17 Telecommunications cabling and spaces outside of the computer room and its associated support
18 spaces are illustrated in Figure 1 to demonstrate their relationships to the data center.



1

2

Figure 1: Relationship of component in a data center

3 **1.6 Tiering**

4 This standard includes specifications for facility requirements for the data center. The normative
 5 requirements specified in this standard are the minimum requirements. However, data centers
 6 are often designed for much higher levels of availability and security. This standard includes
 7 information for four tiers relating to various levels of availability and security of the data center
 8 facility infrastructure. Higher tiers not only correspond to higher availability and security, but also
 9 lead to higher construction costs. Annex E of this standard provides detailed information for each
 10 of the four tiering levels.

11 **1.7 Consideration for professionals involvement**

12 Data centers are designed to handle the requirements of large quantities of computer and
 13 telecommunications equipment. Therefore, telecommunications and information technology
 14 professionals should be involved in the design of the data center from its inception. In addition to
 15 the space, environmental, adjacency, and operational requirements for the computer and
 16 telecommunications equipment, data center designs need to address the requirements of the
 17 telecommunications pathways and spaces specified in this standard.

1 **2 Scope**

2 **2.1 General**

3 This Standard specifies the minimum requirements for telecommunications infrastructure of data
4 centers and computer rooms including single tenant enterprise data centers and multi-tenant
5 Internet hosting data centers. The topology proposed in this document is intended to be
6 applicable to any size data center.

7 **2.2 Normative references**

8 The following standards contain provisions that, through reference in this text, constitute
9 provisions of this Standard. At the time of publication, the editions indicated were valid. All
10 standards are subject to revision; parties to agreements based on this Standard are encouraged
11 to investigate the possibility of applying the most recent editions of the standards indicated. ANSI
12 and TIA maintain registers of currently valid national standards published by them.

- 13 • ANSI/TIA/EIA-568-B.1-2001, *Commercial Building Telecommunications Cabling Standard:*
14 *Part 1: General Requirements*
- 15 • ANSI/TIA/EIA-568-B.2-2001, *Commercial Building Telecommunications Cabling Standard:*
16 *Part 2: Balanced Twisted-Pair Cabling Components*
- 17 • ANSI/TIA/EIA-568.B.3-2000, *Optical Fiber Cabling Components Standard*
- 18 • ANSI/TIA/EIA-569-A-1998, *Commercial Building Standard for Telecommunications Pathways*
19 *and Spaces*
- 20 • ANSI/TIA/EIA-606-A-2002, *Administration Standard for Commercial Telecommunications*
21 *Infrastructure*
- 22 • ANSI/TIA/EIA-J-STD-607-2001, *Commercial Building Grounding (Earthing) and Bonding*
23 *Requirements for Telecommunications*
- 24 • ANSI/TIA/EIA-758-1999, *Customer-Owned Outside Plant Telecommunications Cabling*
25 *Standard*

26

3 DEFINITION OF TERMS, ACRONYMS AND ABBREVIATIONS, AND UNITS OF MEASURE

3.1 General

This clause contains the definitions of terms, acronyms, and abbreviations that have special technical meaning or that are unique to the technical content of this Standard. Special definitions that are appropriate to individual technical clauses are also included.

3.2 Definition of terms

The generic definitions in this clause have been formulated for use by the entire family of telecommunications infrastructure standards. Specific requirements are found in the normative clauses of this Standard. For the purposes of this Standard, the following definitions apply.

access floor: A system consisting of completely removable and interchangeable floor panels that are supported on adjustable pedestals or stringers (or both) to allow access to the area beneath.

access provider: The operator of any facility that is used to convey telecommunications signals to and from a customer premises.

active cross-connect: A facility enabling the termination of cable elements and their interconnection or cross-connection by electronic means.

administration: The method for labeling, identification, documentation and usage needed to implement moves, additions and changes of the telecommunications infrastructure.

alternate entrance: A supplementary entrance facility into a building using a different routing to provide diversity of service and for assurance of service continuity.

backbone: 1) A facility (e.g., pathway, cable or conductors) between any of the following spaces: telecommunications rooms, common telecommunications rooms, floor serving terminals, entrance facilities, equipment rooms, and common equipment rooms. 2) in a data center, a facility (e.g. pathway, cable or conductors) between any of the following spaces: entrance rooms or spaces, main distribution areas, horizontal distribution areas, telecommunications rooms.

backbone cable: See **backbone**.

bonding: The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

building backbone: Cabling for interconnecting telecommunications spaces from the telecommunications entrance facility to a horizontal cross-connect within a building.

cabinet: A container that may enclose connection devices, terminations, apparatus, wiring, and equipment.

cabinet (telecommunications): An enclosure used for terminating telecommunications cables, wiring and connection devices with a hinged cover, usually flush mounted in the wall.

cable: An assembly of one or more insulated conductors or optical fibers, within an enveloping sheath.

- 1 **cabling:** A combination of all cables, jumpers, cords, and connecting hardware.
- 2 **centralized cabling:** A cabling configuration from the work area to a centralized cross-connect
3 using pull through cables, an interconnect, or splice in the telecommunications room.
- 4 **channel:** The end-to-end transmission path between two points at which application-specific
5 equipment is connected.
- 6 **common equipment room (telecommunications):** An enclosed space used for equipment and
7 backbone interconnections for more than one tenant in a building or campus.
- 8 **Computer room:** An architectural space whose primary function is to accommodate data
9 processing equipment.
- 10 **conduit:** (1) A raceway of circular cross-section. (2) A structure containing one or more ducts.
- 11 **connecting hardware:** A device providing mechanical cable terminations.
- 12 **connector (plug), duplex; optical fiber:** A remateable device that terminates two fibers and
13 mates with a duplex receptacle.
- 14 **consolidation point:** A location for interconnection between horizontal cables extending from
15 building pathways and horizontal cables extending into furniture pathways.
- 16 **cross-connect:** A facility enabling the termination of cable elements and their interconnection or
17 cross-connection.
- 18 **cross-connection:** A connection scheme between cabling runs, subsystems, and equipment
19 using patch cords or jumpers that attach to connecting hardware on each end.
- 20 **Data center:** a building or portion of a building whose primary function is to house a computer room
21 and its support areas.
- 22 **demarcation point:** A point where the operational control or ownership changes.
- 23 **distribution frame:** A structure with terminations for connecting the cabling of a facility in such a
24 manner that interconnection or cross-connections may be readily made.
- 25 (1) **main:** When the structure is located at the entrance facility or main cross-
26 connect and serving the building or campus.
- 27 (2) **intermediate:** When the structure is located between the main cross-connect
28 and the telecommunications room.
- 29 **electromagnetic interference:** Radiated or conducted electromagnetic energy that has an
30 undesirable effect on electronic equipment or signal transmissions.
- 31 **entrance room or space (telecommunications):** A space in which the joining of inter or intra
32 building telecommunications backbone facilities takes place.
- 33 **equipment cable; cord:** A cable or cable assembly used to connect telecommunications
34 equipment to horizontal or backbone cabling.
- 35 **equipment distribution area:** the computer room space occupied by equipment racks or
36 cabinets.

- 1 **equipment room (telecommunications):** An environmentally controlled centralized space for
2 telecommunications equipment that usually houses a main or intermediate cross-connect.
- 3 **fiber optic:** See **optical fiber**.
- 4 **ground:** A conducting connection, whether intentional or accidental, between an electrical circuit
5 (e.g., telecommunications) or equipment and the earth, or to some conducting body that serves in
6 place of earth.
- 7 **grounding conductor:** A conductor used to connect the grounding electrode to the building's
8 main grounding busbar.
- 9 **horizontal cabling:** 1) The cabling between and including the telecommunications
10 outlet/connector and the horizontal cross-connect. 2) The cabling between and including the
11 building automation system outlet or the first mechanical termination of the horizontal connection
12 point and the horizontal cross-connect. 3) in a data center, horizontal cabling is the cabling from
13 the horizontal cross-connect (in the main distribution area or horizontal distribution area) to the
14 outlet in the equipment distribution area or zone distribution area.
- 15 **horizontal cross-connect:** A cross-connect of horizontal cabling to other cabling, e.g.,
16 horizontal, backbone, equipment.
- 17 **Horizontal distribution area:** a space in a computer room where a horizontal cross-connect is
18 located.
- 19 **identifier:** An item of information that links a specific element of the telecommunications
20 infrastructure with its corresponding record.
- 21 **infrastructure (telecommunications):** A collection of those telecommunications components,
22 excluding equipment, that together provide the basic support for the distribution of all information
23 within a building or campus.
- 24 **interconnection:** A connection scheme that employs connecting hardware for the direct
25 connection of a cable to another cable without a patch cord or jumper.
- 26 **intermediate cross-connect:** A cross-connect between first level and second level backbone
27 cabling.
- 28 **intermediate distribution frame:** See **distribution frame**.
- 29 **intra-building telecommunications backbone:** A pathway or cable facility for interconnecting
30 telecommunications service entrance rooms, equipment rooms, or telecommunications rooms
31 within a building. See building backbone.
- 32 **jumper:** An assembly of twisted-pairs without connectors, used to join telecommunications
33 circuits/links at the cross-connect.
- 34 **link:** A transmission path between two points, not including terminal equipment, work area
35 cables, and equipment cables.
- 36 **main cross-connect:** A cross-connect for first level backbone cables, entrance cables, and
37 equipment cables.
- 38 **Main distribution area:** The space in a computer room where the main cross-connect is located.

- 1 **main distribution frame:** See **distribution frame**.
- 2 **mechanical room:** An enclosed space serving the needs of mechanical building systems.
- 3 **media (telecommunications):** Wire, cable, or conductors used for telecommunications.
- 4 **mode:** A path of light in an optical fiber.
- 5 **modular jack:** A female telecommunications connector that may be keyed or unkeyed and may
6 have 6 or 8 contact positions, but not all the positions need be equipped with jack contacts.
- 7 **multimode optical fiber:** An optical fiber that carries many paths of light.
- 8 **multipair cable:** A cable having more than four pairs.
- 9 **optical fiber:** Any filament made of dielectric materials that guides light.
- 10 **optical fiber cable:** An assembly consisting of one or more optical fibers.
- 11 **passive cross-connect:** A facility enabling the termination of cable elements and their
12 interconnection or cross-connection by means of jumpers or patchcords.
- 13 **patch cord:** A length of cable with a plug on one or both ends.
- 14 **patch panel:** A connecting hardware system that facilitates cable termination and cabling
15 administration using patch cords.
- 16 **pathway:** A facility for the placement of telecommunications cable.
- 17 **private branch exchange:** A private telecommunications switching system.
- 18 **pull box:** A housing located in a pathway run used to facilitate the placing of wire or cables.
- 19 **radio frequency interference:** Electromagnetic interference within the frequency band for radio
20 transmission.
- 21 **screen:** An element of a cable formed by a shield.
- 22 **screened twisted-pair (ScTP):** A balanced cable with an overall screen.
- 23 **service provider:** The operator of any service that furnishes telecommunications content
24 (transmissions) delivered over access provider facilities.
- 25 **sheath:** See **cable sheath**.
- 26 **shield:** A metallic layer placed around a conductor or group of conductors.
- 27 **singlemode optical fiber:** An optical fiber that carries only one path of light.
- 28 **splice:** A joining of conductors, meant to be permanent.
- 29 **star topology:** A topology in which telecommunications cables are distributed from a central
30 point.

- 1 **telecommunications:** Any transmission, emission, and reception of signs, signals, writings,
 2 images, and sounds, that is, information of any nature by cable, radio, optical, or other
 3 electromagnetic systems.
- 4 **telecommunications entrance point:** See **entrance point (telecommunications)**.
- 5 **telecommunications entrance room or space:** See **entrance room or space**
 6 **(telecommunications)**.
- 7 **telecommunications equipment room:** See **equipment room (telecommunications)**.
- 8 **telecommunications infrastructure:** See **infrastructure (telecommunications)**.
- 9 **telecommunications media:** See **media (telecommunications)**.
- 10 **telecommunications room:** An enclosed architectural space for housing telecommunications
 11 equipment, cable terminations, and cross-connect cabling.
- 12 **telecommunications space:** See **space (telecommunications)**.
- 13 **topology:** The physical or logical arrangement of a telecommunications system.
- 14 **uninterruptible power supply:** A buffer between utility power or other power source and a load
 15 that requires continuous precise power.
- 16 **wire:** An individually insulated solid or stranded metallic conductor.
- 17 **wireless:** The use of radiated electromagnetic energy (e.g., radio frequency and microwave
 18 signals, light) traveling through free space to convey information.
- 19 **zone box:** An enclosure used to house one or more of the following; a) a consolidation point, b) a
 20 horizontal connection point, c) building automation system outlets.
- 21 **Zone distribution area:** A space in a computer room where a zone outlet or a consolidation point is
 22 located
- 23 **zone outlet:** a connecting device in the zone distribution area terminating the horizontal cable
 24 enabling equipment cable connections to the equipment distribution area.

25 **3.3 Acronyms and abbreviations**

26	AHJ	authority having jurisdiction
27	ANSI	American National Standards Institute
28	AWG	American Wire Gauge
29	BICSI	Building Industry Consulting Service International
30	BNC	bayonet Neil-Concelman or bayonet navel connector
31	CCTV	closed-circuit television
32	CEC	Canadian Electrical Code, Part I
33	CER	common equipment room
34	CPU	central processing unit
35	CSA	Canadian Standards Association International

1	EDA	equipment distribution area
2	EF	entrance facility
3	EIA	Electronic Industries Alliance
4	EMI	electromagnetic interference
5	EMS	energy management system
6	ER	equipment room
7	FDDI	fiber distributed data interface
8	HC	horizontal cross-connect
9	HDA	horizontal distribution area
10	HVAC	heating, ventilation and air conditioning
11	IC	intermediate cross-connect
12	IDC	insulation displacement contact
13	LAN	local area network
14	MC	main cross-connect
15	MDA	main distribution area
16	NEC	National Electrical Code
17	NEMA	National Electrical Manufacturers Association
18	NEXT	near-end crosstalk
19	NESC	National Electrical Safety Code
20	NFPA	National Fire Protection Association
21	OC	optical carrier
22	PBX	private branch exchange
23	PCB	printed circuit board
24	PDU	power distribution unit
25	PVC	polyvinyl chloride
26	RFI	radio frequency interference
27	RH	relative humidity
28	SAN	storage area network
29	ScTP	screened twisted-pair
30	SDH	synchronous digital hierarchy
31	SONET	synchronous optical network
32	STM	synchronous transport model
33	TIA	Telecommunications Industry Association
34	TR	telecommunications room
35	UL	Underwriters Laboratories Inc
36	UPS	uninterruptible power supply
37	UTP	unshielded twisted-pair

1	WAN	wide area network
2	X	cross-connect
3	ZDA	zone distribution area

4 **3.4 Units of measure**

5	A	ampere
6	°C	degrees Celsius
7	°F	degrees Fahrenheit
8	ft	feet, foot
9	Gb/s	gigabit per second
10	Hz	hertz
11	in	inch
12	kb/s	kilobit per second
13	kHz	kilohertz
14	km	kilometer
15	kPa	kilopascal
16	kVA	kilovoltamp
17	lbf	pound-force
18	lx	lux
19	m	meter
20	Mb/s	megabit per second
21	MHz	megahertz
22	mm	millimeter
23	nm	nanometer
24	V	volt
25	µm	micrometer or micron