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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.

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 At that time, standards are reaffirmed, rescinded, or revised according to the submitted updates.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Documents superseded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*

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

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

- National Electrical Safety Code (NESC)

(IEEE C 2)

- Life Safety Code (NEC)

(NFPA 101)

- National Electrical Code (NEC)

(NFPA 70)

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

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

Other references are listed in annex G.

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

1 INTRODUCTION

1.1 Purpose

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

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

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

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

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

1.2 Specification of criteria

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

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

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

1.3 Metric equivalents of US customary units

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

1.4 Life of this Standard

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

1.5 Relationship of data center spaces to other building spaces

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

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

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

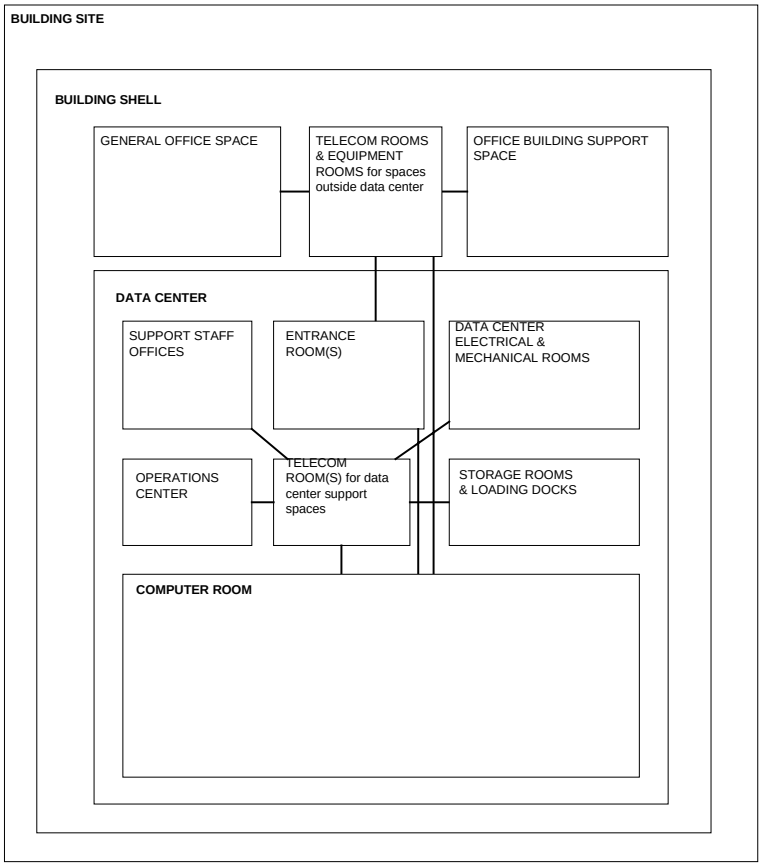

Figure 1: Relationship of component in a data center

1.6 Tiering

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

1.7 Consideration for professionals involvement

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

2 Scope

2.1 General

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

2.2 Normative references

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

- ANSI/TIA/EIA-568-B.1-2001, *Commercial Building Telecommunications Cabling Standard: Part 1: General Requirements*
- ANSI/TIA/EIA-568-B.2-2001, *Commercial Building Telecommunications Cabling Standard: Part 2: Balanced Twisted-Pair Cabling Components*
- ANSI/TIA/EIA-568.B.3-2000, *Optical Fiber Cabling Components Standard*
- ANSI/TIA/EIA-569-A-1998, *Commercial Building Standard for Telecommunications Pathways and Spaces*
- ANSI/TIA/EIA-606-A-2002, *Administration Standard for Commercial Telecommunications Infrastructure*
- ANSI/TIA/EIA-J-STD-607-2001, *Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications*
- ANSI/TIA/EIA-758-1999, *Customer-Owned Outside Plant Telecommunications Cabling Standard*

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.

cabling: A combination of all cables, jumpers, cords, and connecting hardware.

centralized cabling: A cabling configuration from the work area to a centralized cross-connect using pull through cables, an interconnect, or splice in the telecommunications room.

channel: The end-to-end transmission path between two points at which application-specific equipment is connected.

common equipment room (telecommunications): An enclosed space used for equipment and backbone interconnections for more than one tenant in a building or campus.

Computer room: An architectural space whose primary function is to accommodate data processing equipment.

conduit: (1) A raceway of circular cross-section. (2) A structure containing one or more ducts.

connecting hardware: A device providing mechanical cable terminations.

connector (plug), duplex; optical fiber: A remateable device that terminates two fibers and mates with a duplex receptacle.

consolidation point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

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

cross-connection: A connection scheme between cabling runs, subsystems, and equipment using patch cords or jumpers that attach to connecting hardware on each end.

Data center: a building or portion of a building whose primary function is to house a computer room and its support areas.

demarcation point: A point where the operational control or ownership changes.

distribution frame: A structure with terminations for connecting the cabling of a facility in such a manner that interconnection or cross-connections may be readily made.

(1) **main:** When the structure is located at the entrance facility or main cross-connect and serving the building or campus.

(2) **intermediate:** When the structure is located between the main cross-connect and the telecommunications room.

electromagnetic interference: Radiated or conducted electromagnetic energy that has an undesirable effect on electronic equipment or signal transmissions.

entrance room or space (telecommunications): A space in which the joining of inter or intra building telecommunications backbone facilities takes place.

equipment cable; cord: A cable or cable assembly used to connect telecommunications equipment to horizontal or backbone cabling.

equipment distribution area: the computer room space occupied by equipment racks or cabinets.

equipment room (telecommunications): An environmentally controlled centralized space for telecommunications equipment that usually houses a main or intermediate cross-connect.

fiber optic: See **optical fiber**.

ground: A conducting connection, whether intentional or accidental, between an electrical circuit (e.g., telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.

grounding conductor: A conductor used to connect the grounding electrode to the building's main grounding busbar.

horizontal cabling: 1) The cabling between and including the telecommunications outlet/connector and the horizontal cross-connect. 2) The cabling between and including the building automation system outlet or the first mechanical termination of the horizontal connection point and the horizontal cross-connect. 3) in a data center, horizontal cabling is the cabling from the horizontal cross-connect (in the main distribution area or horizontal distribution area) to the outlet in the equipment distribution area or zone distribution area.

horizontal cross-connect: A cross-connect of horizontal cabling to other cabling, e.g., horizontal, backbone, equipment.

Horizontal distribution area: a space in a computer room where a horizontal cross-connect is located.

identifier: An item of information that links a specific element of the telecommunications infrastructure with its corresponding record.

infrastructure (telecommunications): A collection of those telecommunications components, excluding equipment, that together provide the basic support for the distribution of all information within a building or campus.

interconnection: A connection scheme that employs connecting hardware for the direct connection of a cable to another cable without a patch cord or jumper.

intermediate cross-connect: A cross-connect between first level and second level backbone cabling.

intermediate distribution frame: See **distribution frame**.

intrabuilding telecommunications backbone: A pathway or cable facility for interconnecting telecommunications service entrance rooms, equipment rooms, or telecommunications rooms within a building. See building backbone.

jumper: An assembly of twisted-pairs without connectors, used to join telecommunications circuits/links at the cross-connect.

link: A transmission path between two points, not including terminal equipment, work area cables, and equipment cables.

main cross-connect: A cross-connect for first level backbone cables, entrance cables, and equipment cables.

Main distribution area: The space in a computer room where the main cross-connect is located**.**

main distribution frame: See **distribution frame**.

mechanical room: An enclosed space serving the needs of mechanical building systems.

media (telecommunications): Wire, cable, or conductors used for telecommunications.

mode: A path of light in an optical fiber.

modular jack: A female telecommunications connector that may be keyed or unkeyed and may have 6 or 8 contact positions, but not all the positions need be equipped with jack contacts.

multimode optical fiber: An optical fiber that carries many paths of light.

multipair cable: A cable having more than four pairs.

optical fiber: Any filament made of dielectric materials that guides light.

optical fiber cable: An assembly consisting of one or more optical fibers.

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

patch cord: A length of cable with a plug on one or both ends.

patch panel: A connecting hardware system that facilitates cable termination and cabling administration using patch cords.

pathway: A facility for the placement of telecommunications cable.

private branch exchange: A private telecommunications switching system.

pull box: A housing located in a pathway run used to facilitate the placing of wire or cables.

radio frequency interference: Electromagnetic interference within the frequency band for radio transmission.

screen: An element of a cable formed by a shield.

screened twisted-pair (ScTP): A balanced cable with an overall screen.

service provider: The operator of any service that furnishes telecommunications content (transmissions) delivered over access provider facilities.

sheath: See **cable sheath**.

shield: A metallic layer placed around a conductor or group of conductors.

singlemode optical fiber: An optical fiber that carries only one path of light.

splice: A joining of conductors, meant to be permanent.

star topology: A topology in which telecommunications cables are distributed from a central point.

telecommunications: Any transmission, emission, and reception of signs, signals, writings, images, and sounds, that is, information of any nature by cable, radio, optical, or other electromagnetic systems.

telecommunications entrance point: See **entrance point (telecommunications)**.

telecommunications entrance room or space: See **entrance room or space (telecommunications)**.

telecommunications equipment room: See **equipment room (telecommunications)**.

telecommunications infrastructure: See **infrastructure (telecommunications)**.

telecommunications media: See **media (telecommunications)**.

telecommunications room: An enclosed architectural space for housing telecommunications equipment, cable terminations, and cross-connect cabling.

telecommunications space: See **space (telecommunications)**.

topology: The physical or logical arrangement of a telecommunications system.

uninterruptible power supply: A buffer between utility power or other power source and a load that requires continuous precise power.

wire: An individually insulated solid or stranded metallic conductor.

wireless: The use of radiated electromagnetic energy (e.g., radio frequency and microwave signals, light) traveling through free space to convey information.

zone box: An enclosure used to house one or more of the following; a) a consolidation point, b) a horizontal connection point, c) building automation system outlets.

Zone distribution area: A space in a computer room where a zone outlet or a consolidation point is located

zone outlet: a connecting device in the zone distribution area terminating the horizontal cable enabling equipment cable connections to the equipment distribution area.

3.3 Acronyms and abbreviations

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

EDA	equipment distribution area
EF	entrance facility
EIA	Electronic Industries Alliance
EMI	electromagnetic interference
EMS	energy management system
ER	equipment room
FDDI	fiber distributed data interface
HC	horizontal cross-connect
HDA	horizontal distribution area
HVAC	heating, ventilation and air conditioning
IC	intermediate cross-connect
IDC	insulation displacement contact
LAN	local area network
MC	main cross-connect
MDA	main distribution area
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NEXT	near-end crosstalk
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
OC	optical carrier
PBX	private branch exchange
PCB	printed circuit board
PDU	power distribution unit
PVC	polyvinyl chloride
RFI	radio frequency interference
RH	relative humidity
SAN	storage area network
ScTP	screened twisted-pair
SDH	synchronous digital hierarchy
SONET	synchronous optical network
STM	synchronous transport model
TIA	Telecommunications Industry Association
TR	telecommunications room
UL	Underwriters Laboratories Inc
UPS	uninterruptible power supply
UTP	unshielded twisted-pair

WAN	wide area network
X	cross-connect
ZDA	zone distribution area

3.4 Units of measure

A	ampere
°C	degrees Celsius
°F	degrees Fahrenheit
ft	feet, foot
Gb/s	gigabit per second
Hz	hertz
in	inch
kb/s	kilobit per second
kHz	kilohertz
km	kilometer
kPa	kilopascal
kVA	kilovoltamp
lbf	pound-force
lx	lux
m	meter
Mb/s	megabit per second
MHz	megahertz
mm	millimeter
nm	nanometer
V	volt
µm	micrometer or micron