ANSI/BICSI 004-2018

Information Communication Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities

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PREFACE

Revision History

December 4, 2012 First publication of this standard, titled BICSI 004-2012, *Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities*

April 12, 2013 Published as an American National Standard, with the designation of ANSI/BICSI 004-2012

April 25, 2018 Revision of ANSI/BICSI 004-2012, retitled and published as ANSI/BICSI 004-2018, *Information Communication Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities*

Major revisions include:

- Expansion of Section 5, *Regulatory Bodies and Regulations*
- Expansion of content for communication and ICT infrastructure
- Expansion of content for wireless systems
- Addition of passive optical networks
- Expansion of content for architectural aspects of healthcare facilities
- Addition of content for telemedicine and communication suites
- Content revision for notification and intercom systems
- Addition of content for emergency medical services radio, sound and acoustical systems, sound masking, and digital signage and wayfinding
- Addition of Appendix B, *Network Security*
- Addition of Appendix C, *Network Design Principles*

Minor revisions include:

- Restructure of former Sections 1-8 with relevant content relocated into the new structure
- Added content for electrical power
- Added content for security control frameworks
- Minor revisions of healthcare systems
- Revision of real time location systems
- Other content updates and editorial corrections

Document Format (Usability Features)

This standard has the following usability features as aids to the user:

- Additions and changes, other than those for editorial purposes, are indicated with a vertical rule within the left page margin.
- Deletion of one or more paragraphs within unrevised content is indicated with a bullet (•).

Translation Notice

This standard may have one or more translations available for the convenience of its readers. As translated text may contain inconsistencies when compared to the original text, if differences between the translation and the published English version exist, the English text shall be used as the official and authoritative version.

1 Introduction

1.1 General

Today's healthcare facilities are encountering many issues because of:

- Rapid changes in medical technologies
- Rapid changes in information technologies
- An aging nursing workforce and patient demographics

Industry initiatives are also a key factor in the need to upgrade or replace the built electronic infrastructure, such as:

- Electronic health records
- Patient portable (personal) health records
- Electronic security
- Clinical and information technology convergence

Today's modern hospital's technology infrastructure supports the following:

- Medical procedures and clinical processes
- Business and enterprise operations
- Building and facilities requirements

A hospital's main function is to treat the injured, sick and infirmed and its infrastructure must be capable of supporting that mission.

This standard is intended primarily for, but not limited to, healthcare facilities, such as:

- Hospitals
- Skilled nursing facilities (nursing homes)
- Rehabilitation centers
- Psychiatric facilities
- Ambulatory clinics and surgical centers
- Outpatient clinics
- Acute care facilities

1.2 Purpose

This standard is written for use in the design and implementation of information technology systems used within healthcare facilities. This standard provides a reference of common technology and design practices and is not intended to be used by architects and engineers as their sole reference or as a step-by-step design guide. This standard may also be used to determine design requirements in conjunction with the system owner, occupant, or safety and security consultant.

1.3 Categories of Criteria

Two categories of criteria are specified: mandatory and advisory.

- 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 building system infrastructure in all its contemplated applications.

Mandatory requirements are designated by the word *shall*; advisory recommendations are designated by the words *should*, *may*, or *desirable*, which are used interchangeably in this standard. When possible, recommendations and requirements were separated to aid in clarity.

2 Scope

This standard provides requirements and recommendations for best practices for the design and implementation of information communication technology systems infrastructure for healthcare institutions and facilities.

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3 Required Standards and Documents

The following standards and documents contain provisions that constitute requirements listed within this standard. Unless otherwise indicated, all standards and documents listed are the latest published version prior to the initial publication of this standard. Parties to agreement based on this standard are encouraged to investigate the possibility of applying a more recent version as applicable.

Where equivalent local codes and standards exist, requirements from these local specifications shall apply. Where reference is made to a requirement that exceeds minimum code requirements, the specification requirement shall take precedence over any apparent conflict with applicable codes.

BICSI

- ANSI/BICSI 002, *Data Center Design and Implementation Best Practices*
- ANSI/BICSI 005, *Electronic Safety and Security (ESS) System Design and Implementation Best Practices*
- ANSI/BICSI 006, *Distributed Antenna System (DAS) Design and Implementation Best Practices*
- ANSI/BICSI 007, *Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises*
- ANSI/BICSI 008, *Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices*

European Committee for Electrotechnical Standardization (CENELEC)

- EN 50173-1, *Information technology—Generic cabling systems—Part 1: General requirements*

International Organization for Standardization (ISO)

- ISO/IEC 11801-1, *Generic cabling for customer premises – Part 1: General requirements*
- ISO/IEC 11801-6, *Generic cabling for customer premises – Part 6: Distributed building services*
- ISO/IEC 14763-2, *Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation*

National Fire Protection Association (NFPA)

- NFPA 70®, *National Electrical Code®*
- NFPA 99, *Health Care Facilities Code*

Telecommunication Industry Association (TIA)

- ANSI/TIA-526-7-A, *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 edition 2: Fibre-Optic Communications Subsystem Test Procedures – Part 4-2: Installed Cable Plant – Single-Mode Attenuation and Optical Return Loss Measurement*
- ANSI/TIA-526-14-C, *Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 612 80-4-1 Edition 2, Fibre-Optic Communications Subsystem Test Procedure – Part 4-1: Installed Cable Plant – Multimode Attenuation Measurement*
- ANSI/TIA-568.2-D, *Balanced Twisted-Pair Telecommunications Cabling and Components Standard*
- ANSI/TIA-568.3-D, *Optical Fiber Cabling and Components Standard*
- ANSI/TIA-569-D, *Telecommunications Pathways and Spaces*
- ANSI/TIA-758-B, *Customer-Owned Outside Plant Telecommunications Cabling Standard*
- ANSI/TIA-862-B, *Structured Cabling Infrastructure Standard for Intelligent Building Systems*
- ANSI/TIA-1152-A, *Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling*
- ANSI/TIA-1179-A, *Healthcare Facility Telecommunications Infrastructure Standard*

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4 Definitions, Acronyms, Abbreviations, and Units of Measurement

4.1 Definitions

For the purposes of this document, the following terms and definitions apply. Some terms and definitions may also be represented by an acronym as listed in Section 4.2

annunciator — An electrical signaling device used to indicate the sources of calls or alarms on a switchboard or control panel (e.g., as used in hotels or offices).

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

backbone cabling — See backbone.

critical power — A subsystem of the emergency system that supplies energy to task illumination, special power circuits, and selected receptacles serving areas and functions related to patient care and that is connected to alternate power sources by one or more transfer switches during the interruption of the normal power source.

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

distributed antenna system — A system that transmits or relays radio frequency signals (e.g., signals from cellular/personal communications system telephones, text pagers, wireless local area networks) within buildings, structures, tunnels, or other areas where wireless services cannot be otherwise provided.

equipment room (telecommunications) — An environmentally controlled centralized space for telecommunications and data processing equipment with supporting communications connectivity infrastructure.

horizontal cabling — (1) The cabling between and including the telecommunications outlet and 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) Within 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., backbone cabling, active equipment).

internet protocol — The Open Systems Interconnection Reference Model Layer 3 (Network layer) protocol most commonly used for internetworking. Required for communications over the Internet.

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

panel — An electrical device consisting of an enclosure, box or surface that may contain switches, dials, displays or meters for controlling or monitoring other electrical devices.

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

pathway (telecommunications)	A facility for the placement of telecommunications cable.
proprietary	A characteristic of a technique, technology, or device which is owned and controlled by a company or other party and is thereby only usable or adaptable as allowed by that party and not deemed to achieve interoperability.
redundancy	The provision of secondary components or other elements that either become operational or allow continuous operation so that failure of a specified primary component does not result in mission failure.
space (telecommunications)	An area whose primary function is to house the installation and termination of telecommunications equipment and cable (e.g., equipment room, telecommunications room, entrance facility).
telecommunications	Any transmission, emission, and reception of information (e.g., signs, signals, writings, images, sounds) by cable, radio, optical, or other electromagnetic systems.
telecommunications outlet	An assembly of which consists of a faceplate, body, housing, or supporting bracket, and one or more receptacles or jacks of a telecommunication connector. Telecommunications outlets are typically located to provide ease connection for communication and data equipment (e.g., computer, phone).
telecommunications room	A telecommunications space that differs from equipment rooms and entrance facilities in that this space is generally considered a floor-serving or tenant-serving (as opposed to building- or campus-serving) space that provides a connection point between backbone and horizontal cabling.
termination	The physical connection of a conductor or fiber to connecting hardware.
topology	The physical or logical arrangement of a system.
uninterruptible power supply	A system that provides a continuous supply of power to a load, utilizing stored energy when the normal source of energy is not available or is of unacceptable quality. A UPS will provide power until the stored energy of the system has been depleted, or when the acceptable quality of either an alternative source of power (e.g., generator) or the normal source of power becomes available.
zone cabling	A design methodology that utilizes a connection point centrally located within areas with higher densities of telecommunications outlets and devices being served.

4.2 Acronyms and Abbreviations

Abbreviations and acronyms, other than in common usage, are defined as follows:

ADA	American Disabilities Act
AHJ	authority having jurisdiction
AV	audio visual
AWG	American wire gauge
BAS	building automation system
BMS	building management system
CATV	community access television
CCTV	closed circuit television
CfC	condition for coverage
CIA	confidentiality, integrity, and availability
CoP	condition of participation
CR	computerized radiology
CT	computed tomography
DAS	distributed antenna system
DR	digital radiology
EF	entrance facility
EHR	electronic health record
ESS	electronic safety and security
HIPAA	Health Insurance Portability and Accountability Act
HVAC	heating ventilation and air conditioning
ICT	information communication technology
ICU	intensive care unit
IP	internet protocol

IV	intravenous
LAN	local area network
LED	light emitting diode
MRI	magnetic resonance imaging
NM	nuclear medicine
OR	(medical) operating room
PACS	picture archival and communications systems
PET	positive emission tomography
PoE	power over Ethernet
RF	radio frequency
RFID	radio frequency identification
RT	radiation therapy
RTLS	real time locating system
TO	telecommunication outlet
TCP/IP	transmission control protocol/internet protocol
TR	telecommunications room
UPS	uninterruptible power supply
US	ultrasound
UTP	unshielded balanced twisted-pair
VGA	video graphics array
VoIP	voice over internet protocol
WLAN	wireless local area network
XA	x-ray angiography

4.3 Units of Measurement

The units of measurement used in this standard are metric. Approximate conversions from metric to U.S. customary units are provided in parentheses; e.g., 100 millimeters (4 inches).

Units of measurement used in this standard are defined below:

bit	binary digit
C	Celsius
cfm	cubic foot per minute
dBm	decibel milliwatt
F	Fahrenheit
ft	foot; feet
ft^2	square foot
Gb/s	gigabit per second
Hz	hertz
in	inch
m	meter
m^2	square meter
m^3/min	cubic meter per minute
Mb	megabit
MB	megabyte
Mb/s	megabit per second
MHz	megahertz
mil	1/1000 of an inch
mm	millimeter
V	volt
V_{AC}	volt alternating current
V_{DC}	volt direct current

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5 Regulatory Bodies and Regulations

5.1 Authorities Having Jurisdiction (AHJ's)

Several regulating bodies may have authority over the installation and maintenance of information technology system devices, infrastructure, spaces, etc. As such all designs, installation and maintenance of information technology system equipment shall be completed in such a manner as to meet the appropriate AHJ standard for the facility or program. The facility licensing and provider type identifies the acceptance requirements for the AHJ which could include and may not be limited to: Government Agencies (i.e. Ministry of Health or Centers for Medicare & Medicaid Services, or Department of Health by State), and Accrediting Organizations (i.e. Joint Commission). The AHJ considers collectively Healthcare Facilities codes (i.e. NFPA 99), National Electrical Codes, state and local building codes, and Healthcare Facility Guidelines to form acceptance requirements.

5.1.1 Centers for Medicare & Medicaid Services (CMS)

Many Healthcare facilities depend on receiving monetary payments from government programs. In the United States, Healthcare organizations that receive payment from Medicare or Medicaid programs must be certified as complying with the federal Conditions of Participation (CoPs), and Conditions for Coverage (CfCs). The CMS is the agency within the United States Department of Health and Human Services that administers the Medicare program and works with state governments to administer Medicaid, the State Children's Health Insurance Program (SCHIP), and health insurance portability standards. CMS responsibilities include stipulating compliance with quality standards in long-term care facilities through its survey and certification process, and maintaining clinical laboratory quality standards under the Clinical Laboratory Improvement Amendments. CMS ensures that the standards of any Accrediting Organizations recognized by CMS through a process called "deeming" meet or exceed the Medicare standards set forth in the CoPs & CfCs.

5.1.2 Department Of Health, Ministry Of Health

Each State has the responsibility for certifying healthcare facilities CMS compliance or noncompliance in that state. A State Department of Health Survey Agency evaluates and certifies each participating healthcare facility for compliance with state laws, CoPs & CfCs requirements and then certifies it as a provider institution. Be aware states conduct standard surveys and complete them on consecutive workdays, whenever possible. The State's certification for a facility is subject to CMS' approval. The CMS regional office determines a facility's eligibility to participate in the Medicare program based on the State's certification of compliance and a facility's compliance with civil rights requirements; however, "Certification of compliance" means that a facility's compliance with Federal participation requirements is ascertained. In addition to certifying a facility's compliance or noncompliance, the State recommends appropriate enforcement actions to the State Medicaid agency for Medicaid and to the regional office for Medicare. A hospital accredited by a CMS-approved accreditation program may substitute accreditation under that program for survey by the State Survey Agency. Healthcare facility new construction or renovation plans and specifications often need approval by the state Department of Health prior to construction.

5.1.3 Accrediting Organizations

In the United States if a national accrediting organization, such as the Joint Commission, has and enforces standards that meet the federal CoPs, CMS may grant the accrediting organization "deeming" authority and "deem" each health care facility accredited by that organization as meeting the Medicare and Medicaid certification requirements. The health care facility would have "deemed status" and would not be subject to the Medicare survey and certification process because it has already been surveyed by the Accrediting Organization. Accreditation is voluntary and seeking deemed status through accreditation is an option, not a requirement. Healthcare facilities seeking CMS approval may choose to be surveyed either by an accrediting body, such as Joint Commission, DNV Healthcare, a subsidiary of Det Norske Veritas (DNV), The Healthcare Facilities Accreditation Program (HFAP), or by state surveyors on behalf of CMS.

Joint Commission is the United States oldest and largest standards-setting and accrediting body in healthcare with deeming authority from the Centers for Medicare & Medicaid Services (CMS). Joint Commission Accreditation is recognized within the United States as a symbol of quality which indicates that an organization meets Joint Commission performance standards. Surveyors assess hospital's compliance with the Medicare CoP for all services, areas and locations covered by the hospital's provider agreement under its CMS Certification Number (CCN). The Joint Commission publishes its own accreditation standards.

In the limited context of this standard, the Accrediting Organization is a unique AHJ within the United States which has authority over the installation and maintenance of information technology system devices, infrastructure, spaces, etc. As such, all designs, installation and maintenance of information technology system equipment shall be completed in such a manner as to meet the appropriate accrediting organization's standard for the facility or program.

5.2 Patient Information Privacy

5.2.1 Health Insurance Portability and Accountability Act (HIPAA)

The American Health Insurance Portability and Accountability Act of 1996 (HIPAA) is a set of rules to be followed by health plans, doctors, hospitals and other health care providers. HIPAA took effect on April 14, 2003. In the health care and medical profession, the great challenge that HIPAA has created is the assurance that all patient account handling, billing, and medical records are HIPAA compliant.

The goals and objectives of this legislation are to reduce industry inefficiencies, reduce paperwork, make it easier to detect and prosecute fraud and abuse, and enable workers of all professions to change jobs, even if they (or family members) had pre-existing medical conditions.

Compliance with the Health Insurance Portability and Accountability Act (HIPAA) is more complex than simply using products that claim to be "HIPAA-compliant." HIPAA compliance entails an organized set of secure, monitored, and documented practices within and between covered entities. Though products cannot ensure compliance, some products may contain elements or features that allow them to be operated in a HIPAA-compliant way.

Some provisions of the HIPAA involve patient hospital interaction. For example, patients must be able access their record and correct errors and must be informed of how their personal information will be used. Other provisions involve confidentiality of patient information and documentation of privacy procedures. It is these provisions that have led to regulation-specific software updates, specialist consulting, and in some cases complete overhauls of medical billing and records systems.

5.3 Disability Access

5.3.1 Americans with Disabilities Act (ADA)

Within the United Sates, the Americans with Disabilities Act provides requirements for the access and use of public accommodations and telecommunications by those with disabilities. As such, designers of healthcare facilities in the United States need to ensure that all systems under their purview meet these requirements. Designers for facilities outside of jurisdiction of the United States should check with the applicable national and local AHJ(s) to ensure that all relevant regulations concerning disability access are met.

5.3.2 Disability Discrimination Act [Australia]

The Federal Disability Discrimination Act 1992 (DDA) provides protection for everyone in Australia against discrimination based on disability. The DDA makes it against the law to discriminate against someone if they have a disability in different area of life, including:

- Access to premises used by the public.
- Provision of goods, services and facilities.
- Administration of Commonwealth Government laws and programs

Access considerations include:

- All areas within places used by the public should be accessible to people with a disability.
- Facilities should be accessible (e.g., wheelchair-accessible toilets, lift buttons within reach, tactile and audible lift signals for people with vision impairments)
- Required information is available and accessible by all users of the premises.

5.4 Other Organizations

The following organizations provide additional information concerning regulatory requirements that may be encountered:

- Academy of Architecture for Health (AAH)
- American Hospital Association (AHA)
- American Institute of Architects (AIA)
- American Society for Healthcare Engineering (ASHE)
- California Office of Statewide Healthcare Planning and Development (OSHPD)
- Centers for Disease Control (CDC)
- Centers for Medicare & Medicaid Services (CMS)
- Department of Health and Human Services (HHS)
- Health Information Management Systems Society (HIMSS)
- National Fire Protection Administration (NFPA)