The evolution of Data Center standards and the ANSI/BICSI-002-2019

Yannis Katris, RCDD

BICSI Greece Day Event, 15.11.2019

Data Center standards and certifications

- Standards are important to guide data centre design and legitimately compare sites.
- The (main) reason for a Data Center: continuity of services, availability.
- The principles of design and management of Data Centers are the same wherever you are.
- Data Center certification against standards is a confused and unregulated space.

Data Center standards & related documents

Development of European Green Public Procurement Criteria for Data Centres

European Commission, JRC Technical Reports, *Version 1.0, October 2017*

- Open Standard for Datacenter Availability (OSDA); The Green Grid's No.71 White Paper
- The Green Grid Maturity Model (DCMM)
- ANSI/TIA-942-B
- Uptime Institute's Tier Classification System
- EN 50600 Series
- ISO/IEC 30134 series (aligned to the EN50600)
- ISO 14001 (environmental management system)
- ISO 50001 (operational energy management system)
- ETSI DCEM (Data Centre Energy Management)
- ITU Toolkit on Environmental Sustainability for the IT Sector (ESS)
- European Catalogue of IT Standards for Procurement
- US Energy STAR benchmarking of data centres
- EU Code of Conduct (CoC) for Energy Efficiency in Data Centres
- EU Code of Conduct for AC uninterruptible power systems (UPS)
- The Blue Angel energy efficient data centre operation
- EU Eco-Management and Audit Scheme (EMAS)
- Finnish sustainability rating system (TIKO) for data centres by Ministry of Transport and Communications
- EU Procurement guidance PrimeEnergyIT project
- EURECA project on data centres
- Green Public Procurement Criteria for Office Building Design, Construction and Management
- ANSI/ASHRAE Standard 90.4-2016
- BREEAM, LEED, ISO 14062, EN 15804, ...

Data Center standards & documents – most known

- ASHRAE - TC 9.9 2015 The environmental metrics
- Uptime Institute: Tier Standard – Topology
- ANSI/TIA-942-B-2017
- ANSI/BICSI 002-2019
- EN 50600
- ISO/IEC TS 22237
- ISO/IEC 11801-5:2017 [Generic Cabling – Data centers]
- CENELEC – EN 50173-5 [Generic Cabling – Data centers]

Additional standards applied to Data Centers

- ISO 9000 series: Quality System
- ISO 14000 series: Environmental management
- ISO 50000 series: Energy management
- ISO 27001: Information security
- PCI: Payment Card Industry Security Standard
- SOC, SAS70 & ISAE 3402 or SSAE16, FFIEC (USA): Assurance Controls
- AMS-IX: Amsterdam Internet Exchange - Data Centre Business Continuity Standard
- EN50600-2-6: Management and Operational Information

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Data Center design – coordination of trades

- IT Equipment and systems
- Electrical systems to and within the Data Center
- Ventilation, airflow, HVAC
- Fire minimization, detection, alarm and suppression
- Control, monitoring and reporting
- Security, access and CCTV
- Building management systems

Regulations and Standards: ***What is regulation?***

- Regulation is the way in which **public authorities** seek to **guide** or **control** behaviours.
- **Legislation** states what individuals and businesses must do, or must not do, and is usually backed by enforcement and the possibility of sanctions.
- Compliance with legislation is **mandatory**; it is accompanied by enforcement mechanisms and possible sanctions where requirements have been breached.

Source: ***CEN-CENELEC GUIDE 30****, European Guide on Standards and Regulation - Better regulation through the use of voluntary standards - Guidance for policy makers*

Regulations and Standards: ***What are Standards?***

- EN 45020:2006 Standardization and related activities: The term “standard” is defined as “a **document**, established by **consensus** and **approved by a recognized body**, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context”.
- An EN (European Standard) “carries with it the obligation to be implemented at national level by being given the status of a national standard …"

Source: CEN-CENELEC GUIDE 30, European Guide on Standards and Regulation - Better regulation through the use of voluntary standards - Guidance for policy makers

Regulations and Standards: ***What are Standards?***

- Standards are an **agreed** way of achieving a set objective.
- They may take a number of forms, including **specifications** for products, systems and services, **methods of testing**, **terminology and definitions**, information requirements, interfaces and processes.
- Standards are developed primarily to meet the **good practice** needs of industry, businesses and other interested parties and to encourage its take-up in the broader economy.

Source: CEN-CENELEC GUIDE 30, European Guide on Standards and Regulation - Better regulation through the use of voluntary standards - Guidance for policy makers

Regulations and Standards: ***What are Standards?***

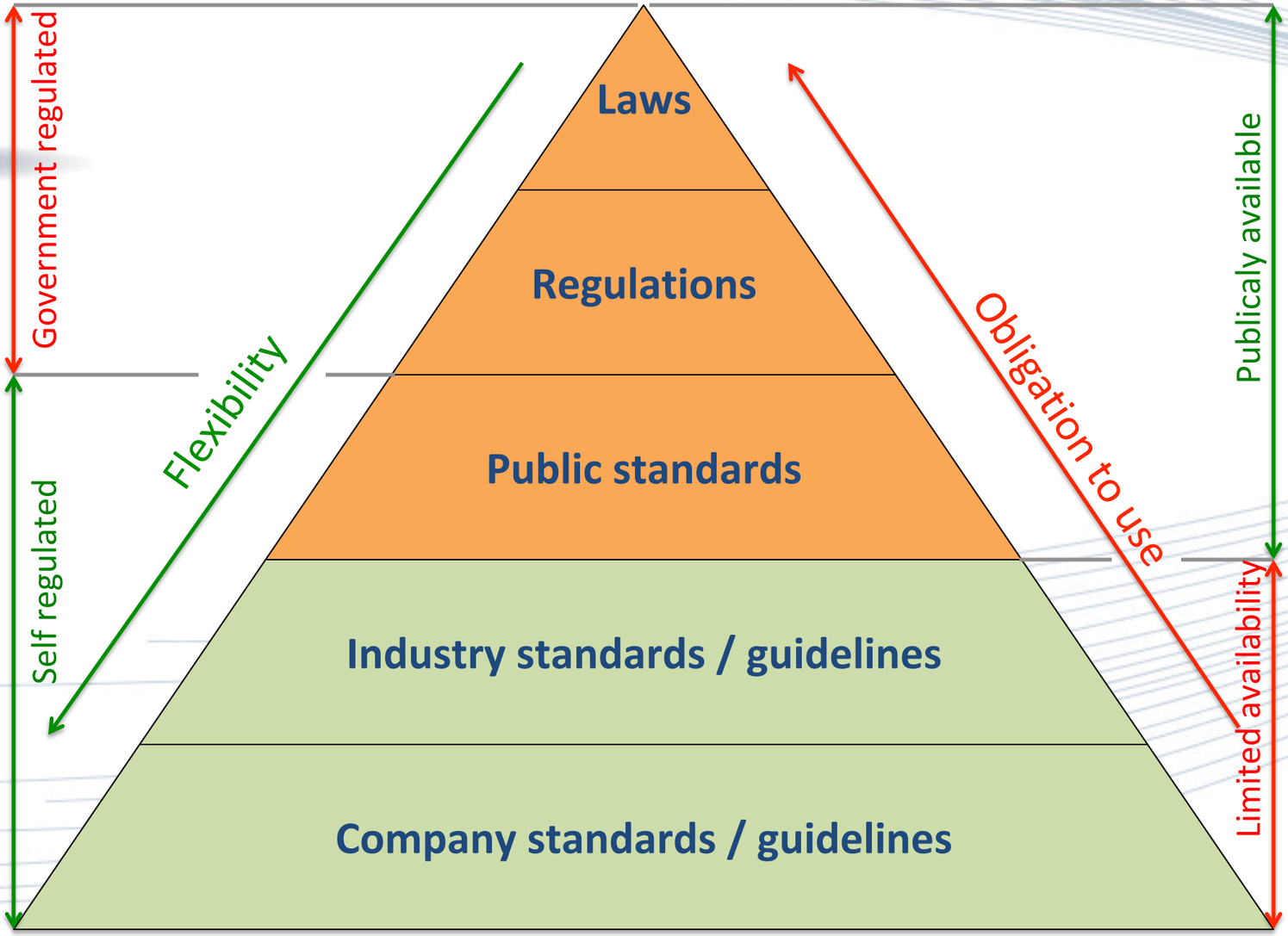
- Standards are **voluntary** in the sense that there is no obligation to comply with them, implement them or participate in their development; they are **tools for market players**.
- The primary objective of standardization is the definition of voluntary technical or quality specifications *(REGULATION (EU) No 1025/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2012 on European standardisation)*
- Making in legislation an indirect reference to a standard is strongly recommended by CEN and CENELEC; *(flexibility: Standards will be updated when required, responding to market needs and without necessitating changes to legislation)*

Source: CEN-CENELEC GUIDE 30, European Guide on Standards and Regulation - Better regulation through the use of voluntary standards - Guidance for policy makers

The differences between standards and legislation

Legislation (Technical Regulation)	Standards
Mandatory	Voluntary
Created by legislator	Developed by interested parties through private standardization organizations processes
Consultation depending on public authorities' policies	Full open and transparent public consultation
Decided by legislator	Based on consensus of interested parties
Revised when legislator decides	Considered for revision at least every 5 years

Laws, Regulations, Standard: positioning in the market and impact

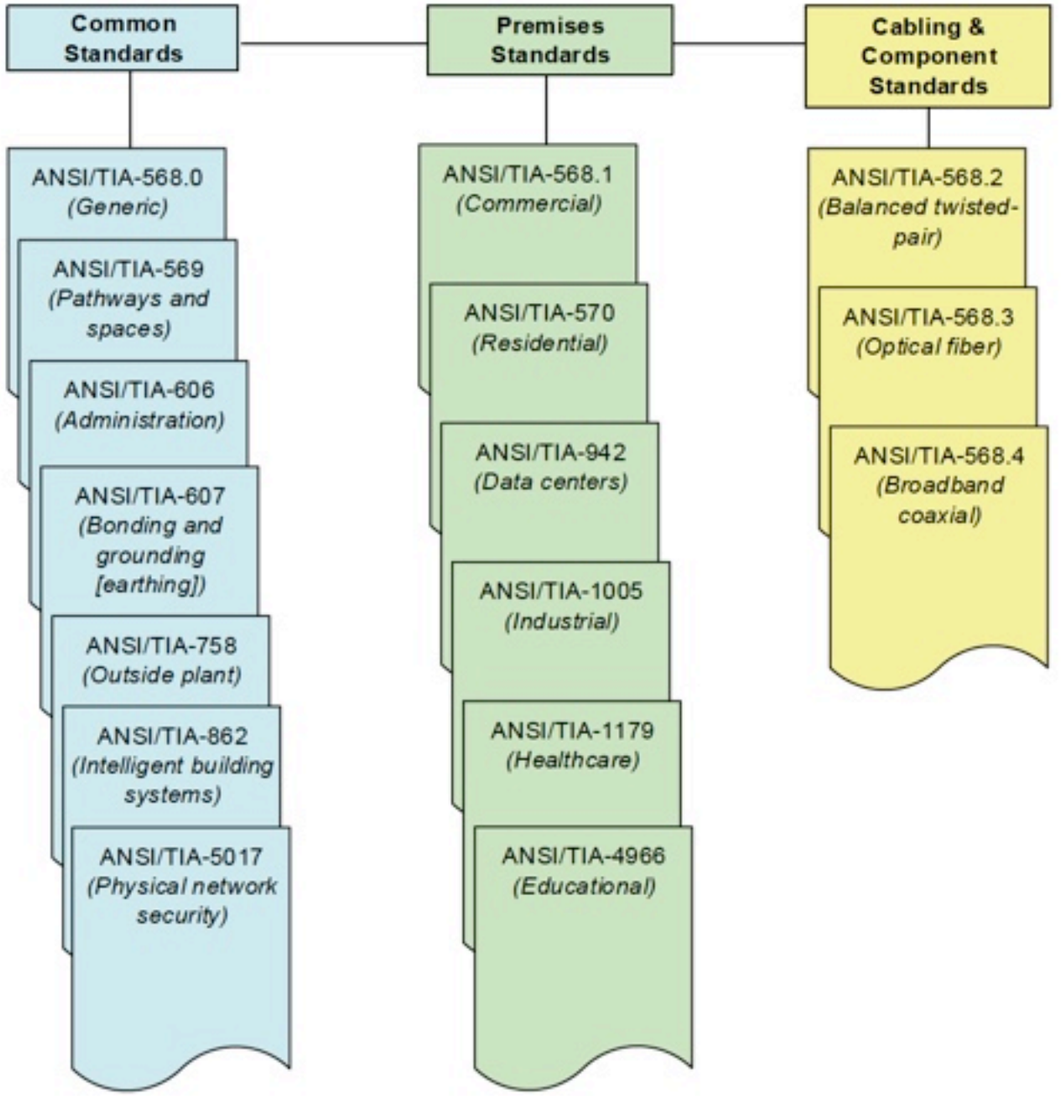


ANSI/TIA-942-B-2017

Telecommunications Infrastructure Standard for Data Centers

Yannis Katris, RCDD *Bucharest 3 July 2019*

ANSI/TIA-568 series standards



ANSI/TIA-942-B-2017 Sections

- Data Center Design overview
- Cabling system infrastructure
- Telecommunications spaces and related topologies
- Cabling systems
- Cabling pathways
- Data center redundancy (*Cabling)*
- Cabling installation requirements **(ANSI/TIA-568.0-D)**
- Cabling transmission performance requirements **(ANSI/TIA-568.0-D, -568.3-D, -568.4-D)**
- Cabling for intelligent building systems **(ANSI/TIA-862-B)**
- Cabling for wireless access points **(TIA TSB-162-A)**
- Cabling for DAS **(TIA TSB-5018)**
- Power delivery over balanced twisted-pair **(TIA TSB-184-A)**
- Grounding and bonding **(ANSI/TIA-607-C)**
- Firestopping **(ANSI/TIA-569-D)**
- Physical security **(ANSI/TIA-5017)**
- Administration **(ANSI/TIA-606-C) * Array connectivity & AIM Automated Infrastructure Management per the ANSI/TIA-5048**

*ANSI/TIA-942-B-2017 **Annexes** (informative)*

- Cabling design considerations
- Access provider information
- Coordination of equipment plans with other engineers
- Data Center space considerations
- Data Center site selection and building design considerations
- Data Center infrastructure rating
- Data Center design examples
- Cabling guidelines for Data Center fabrics

ANSI/TIA-942-B-2017 *Annex F Rating*

- Rated-1 Data Center: Basic
- Rated-2 Data Center: Redundant component
- Rated-3 Data Center: Concurrently maintenable
- Rated-4 Data Center: Fault tolerant

- A data center may have different ratings for different portions of its infrastructure (Telecommunications, Architectural, Electrical, Mechanical).
  - For example, a data center may be rated $\mathbf{T_2\,E_3\,A_1\,M_2}$

ANSI/TIA-942-B-2017 Annex F Rating

ANSI/TIA-PN-942-B

	1 (A_1)	2 (A_2)	3 (A_3)	4 (A_4)
Administrative offices				
Physically separate from other areas of data center	Not required	Yes	Yes	Yes
Fire separation from other areas of data center	Minimum Code requirements	Minimum Code requirements	Minimum Code requirements (not less than 1 hour)	Minimum Code requirements (not less than 2 hour)
Security office				
Physically separate from other areas of data center	Not required	Not required	Yes	Yes
Fire separation from other areas of data center	Minimum Code requirements	Minimum Code requirements	Minimum Code requirements (not less than 1 hour)	Minimum Code requirements (not less than 2 hour)
180-degree peepholes or CCTV on security equipment and monitoring rooms	Not required	Yes	Yes	Yes
Dedicated and hardened security equipment and monitoring rooms	Not required	Yes	Yes, solid core, reinforced or steel doors	Yes, solid core, reinforced or steel doors
Operations Center				
Operations Center physically separate from other areas of data center	Not required	Not required	Yes	Yes
Fire separation from other non-computer room areas of data center	Not required	Not required	1 hour	2 hour
Restrooms and break room areas				
Proximity to computer room and support areas	No requirement	No requirement	If immediately adjacent, provided with leak prevention barrier	Not immediately adjacent and provided with leak prevention barrier
Fire separation from computer room and support areas	Minimum Code requirements	Minimum Code requirements	Minimum Code requirements (not less than 1 hour)	Minimum Code requirements (not less than 2 hour)
UPS and Battery Rooms				
Aisle widths for maintenance, repair, or equipment removal	No requirement	Minimum Code requirements (not less than 1.2 m (4 ft) clear)	Minimum Code requirements (not less than 1.2 m (4 ft) clear)	Minimum Code requirements (not less than 1.2 m (4 ft) clear)
Fire separation from computer room and other areas of data center	Minimum Code requirements	Minimum Code requirements	Minimum Code requirements (not less than 1 hour)	Minimum Code requirements (not less than 2 hour)
Required Exit Corridors				
Fire separation from computer room and support areas	Minimum Code requirements	Minimum Code requirements	Minimum Code requirements (not less than 1 hour)	Minimum Code requirements (not less than 2 hour)
Width	Minimum Code requirements	Minimum Code requirements	Minimum Code requirements of 1.2 m (4 ft), whichever is greater	Minimum Code requirements of 1.2 m (4 ft), whichever is greater

*CENELEC **EN 50600** series* ***Information technology – Data centre facilities and infrastructures -***

- Overview:
  - **EN 50600-1: 2019 -** Part 1: General concepts
- Design:
  - **EN 50600-2-1: 2014 -** Part 2-1 : Building construction
  - **EN 50600-2-2: 2019** – Part 2-2: Power distribution
  - **EN 50600-2-3: 2019** – Part 2-3: Environmental control
  - **EN 50600-2-4: 2015** – Part 2-4: Telecommunications cabling infrastructure
  - **EN 50600-2-5: 2016** – Part 2-5: Security systems

*CENELEC **EN 50600** series* ***Information technology – Data centre facilities and infrastructures -***

- Operations and Management:
  - **EN 50600-3-1: 2016 -** Part 3-1 : Management and operational information
- KPIs
  - **EN 50600-4-1: 2016** – Part 4-1 : Overview of and general requirements for key performance indicators
  - **EN 50600-4-2: 2016** – Part 4-2: Power Usage Effectiveness
  - **EN 50600-4-3: 2016** – Part 4-3: Renewable energy factor

EN 50600 is written as a guideline.

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- Best practices
  - **CLC/TR 50600-99-1:2018:** Information technology - Data centre facilities and infrastructures - Part 99-1: **Recommended practices for energy management.**
  - **CLC/TR 50600-99-2:2018:** Information technology - Data centre facilities and infrastructures Part 99-2: **Recommended practices for environmental sustainability**
  - **CLC/TR 50600-99-3:2018:** Information technology - Data centre facilities and infrastructures Part 99-3: **Guidance to the application of EN 50600 series**

EN 50600 Availability Classes

- Apply to: Power supply & distribution, Environmental control, Telecommunications cabling

Class 1	Low availability. Design without redundancies based on a supply path
Class 2	Extended availability. Design with partial redundancies based on a supply path
Class 3	High availability. Design with redundant components based on two supply paths (but only one refrigeration supply path)
Class 4	Very high availability. Design with system redundancies based on two supply paths (but only one refrigeration supply path)

The protection **Zones** (1, 2, 3, 4) characterize data center spaces with respect to physical access protection, fire protection, defense against hazards from inside, defense against hazards from outside.
Energy efficiency **Levels** (1, 2, 3)

ISO/IEC 22237 series

- ISO/IEC TS 22237-1:2018 – Part 1: General concepts;
- ISO/IEC TS 22237-2:2018 – Part 2: Building construction;
- ISO/IEC TS 22237-3:2018 – Part 3: Power distribution;
- ISO/IEC TS 22237-4:2018 – Part 4: Environmental control;
- ISO/IEC TS 22237-5:2018 – Part 5: Telecommunications cabling infrastructure;
- ISO/IEC TS 22237-6:2018 – Part 6: Security systems;
- ISO/IEC TS 22237-7:2018 – Part 7: Management and operational information.

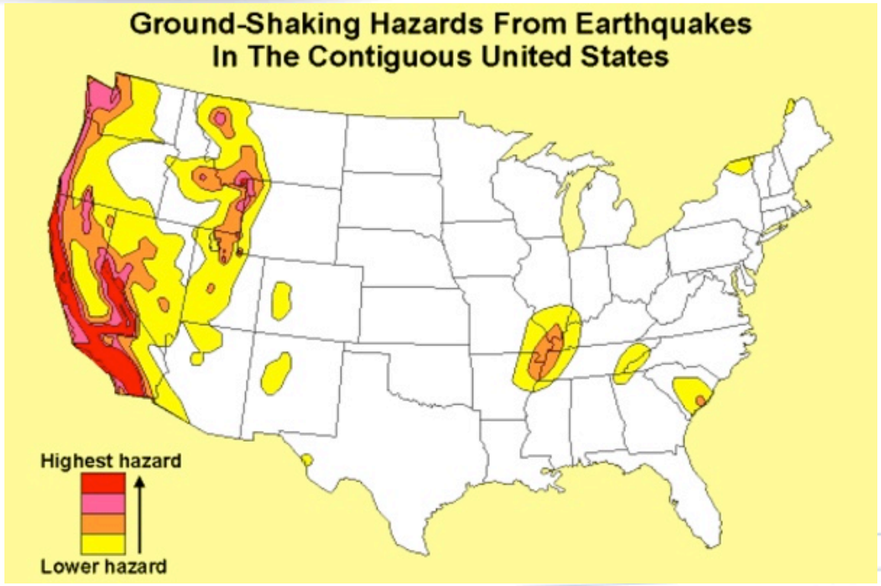
ANSI/BICSI 002-2019

Data Center Design and Implementation Best Practices

Yannis Katris, RCDD *Bucharest 3 July 2019*

- **1.2 Purpose**
  - **For:**
    - **Data Center owners and operators**
    - **Telecommunications and IT consultants and project managers**
    - **Telecommunications and IT technology installers**
      - **Users within IT** *… may use BICSI 002 in conjunction with the appropriate local telecommunications infrastructure standard (e.g., ANSI/TIA-942-B, AS/NZS 2834-1995 Computer Accommodation, CENELEC EN 50173 Series, ISO/IEC 24764) to design the telecommunications pathways, spaces, and cabling system for the data center…*
      - **Users within facilities group** *… as a guide…*
      - **Staff outside IT and facilities groups** (Physical security management, construction firms, Telecommunications consulting firms)

ANSI/BICSI 002-2019



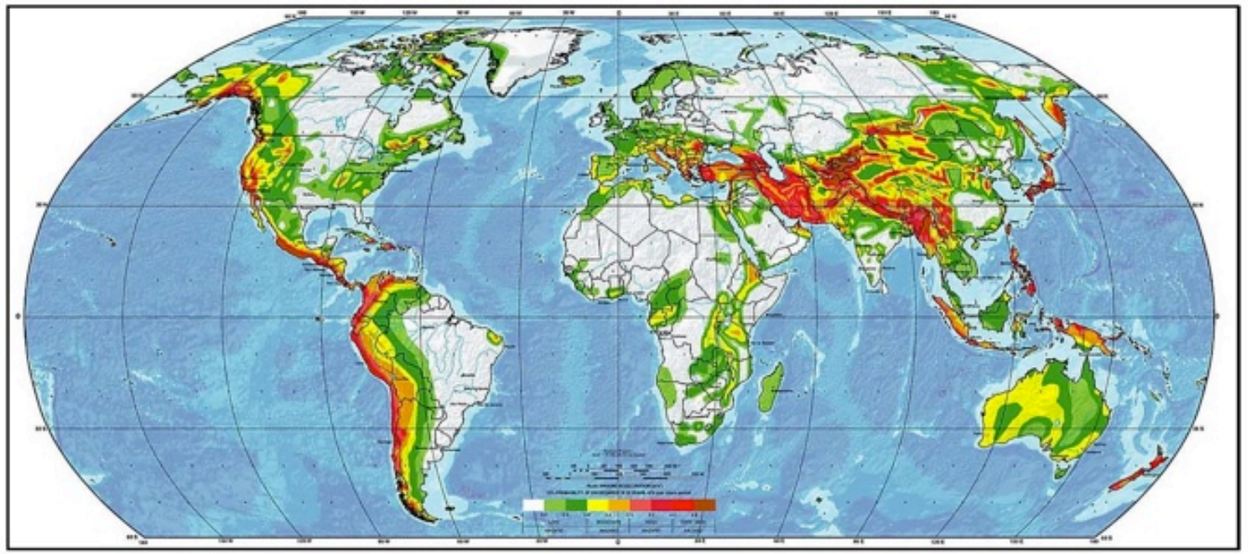


Figure 5-1
Example of a Global Seismic Hazard Map

ANSI/BICSI 002-2011

ANSI/BICSI 002-2019

ANSI/BICSI 002-2019 Sections

- Site selection
- Space planning
- Architectural
- Structural
- Electrical systems
- Mechanical systems
- Fire Protection
- Security

- Facility, ancillary and IP-enabled systems
- Telecommunications cabling infrastructure, pathways and spaces
- Information technology
- Commisioning
- Data Center maintenance

*ANSI/BICSI 002-2019 **Appendixes** (informative)*

- Design process
- Reliability and availability
- Alignment of Data Center services reliability with application and system architecture
- Data Center services outsourcing models
- Multi-Data Center Architecture
- Examples of testing documentation
- Design for energy efficiency
- Colocation technical planning
- Related documents

ANSI/BICSI 002-2019 Class Ratings

- The five Classes are:
  - **Class F0** - a single path data center that meets the minimum requirements of the standard, but doesn't meet the requirements of an F1 or higher level data center
  - **Class F1** - the single path data center
  - **Class F2** - the single path data center with redundant components
  - **Class F3** - the concurrently maintainable and operable data center
  - **Class F4** - the fault tolerant data center

ANSI/BICSI 002-2019

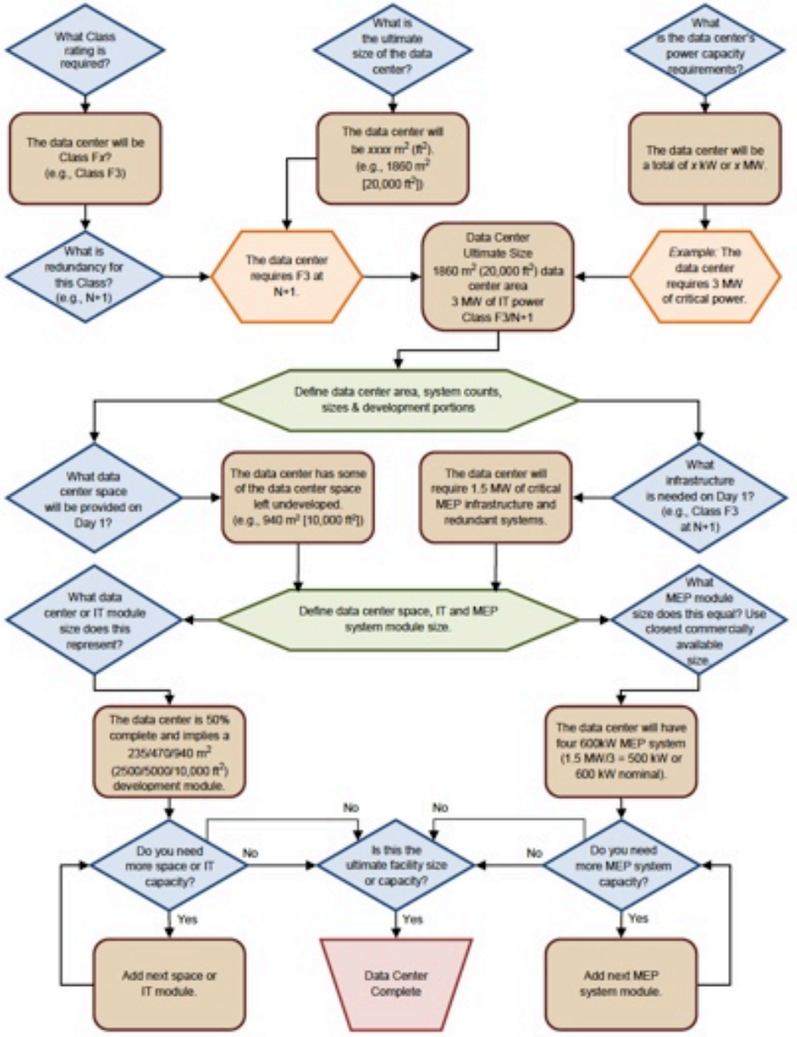


Figure 6-1
Example Module Size Decision Tree

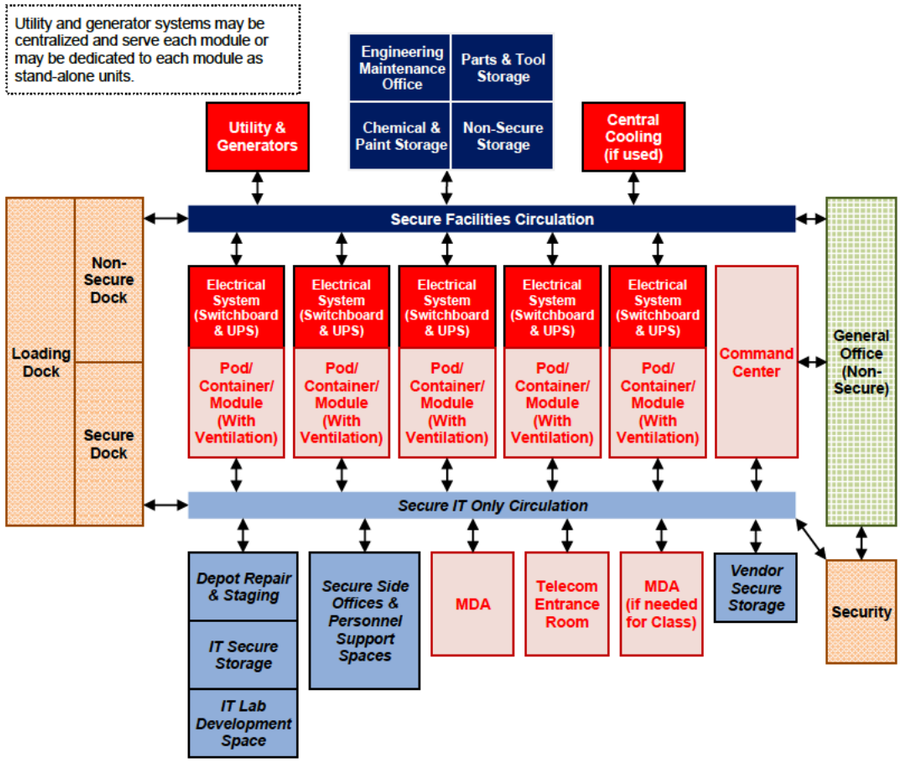


Figure 6-3
Space Adjacencies of Modular or Containerized Data Centers

ANSI/BICSI 002-2019

Table 9-17 Electrical Systems Availability Classes

System/Class	*Class F0*	*Class F1*	*Class F2*	*Class F3*	*Class F4*
9.1 (Electrical systems) Overview					
Common industry description	Single path data center that meets the minimum requirements of the standard, but doesn't meet the requirements of an F1 or higher	Single path	Single path with redundant components	Concurrently maintainable and operable	Fault tolerant
Number of power delivery paths to the critical load	One	One	One	Two, one active minimum with one passive/non-UPS power or one additional active	Two or more active
Redundant system components (e.g., UPS and generators)	No	No	Yes	Yes	Yes
Distinct UPS sources (e.g., A and B)	Optional/may not be present	Single or N	Single or N	Single or more, depending on the critical power topology	At least two resulting in a minimum of N + 2
System allows concurrent maintenance and operations	No	No	Within some systems with paralleled components, but not consistent throughout the electrical system.	Yes	Yes
System allows fault tolerance and self-healing failures?	No	No	No	Possible, depending on system configuration	Yes
Loss of redundancy during maintenance or failure?	Yes. Redundancy is zero, so load loss or systems interruption would be expected.	Yes. Redundancy is zero, so load loss or systems interruption would be expected.	Yes, for the power paths. Redundancy may exist in paralleled systems, and system topology may prevent load loss or interruption during routine maintenance or expected failures.	Yes, but the redundancy level reduced to N during maintenance or after a failure	No, but the redundancy level reduced to a level of >N during maintenance or after a failure.

ANSI/BICSI 002-2019 Classes, examples

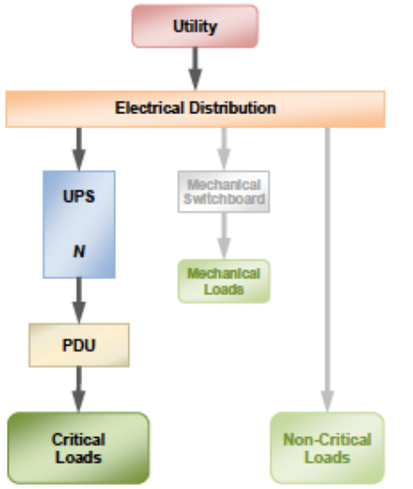


Figure 9-1
Class F0 Electrical Concept Diagram
(Configuration Without Backup/Alternate Power)

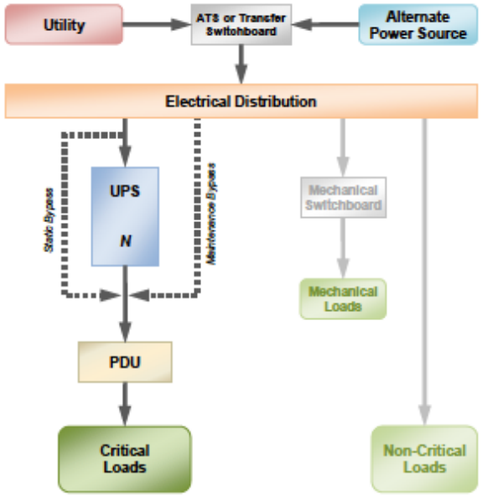


Figure 9-2
Class F1 Electrical Concept Diagram

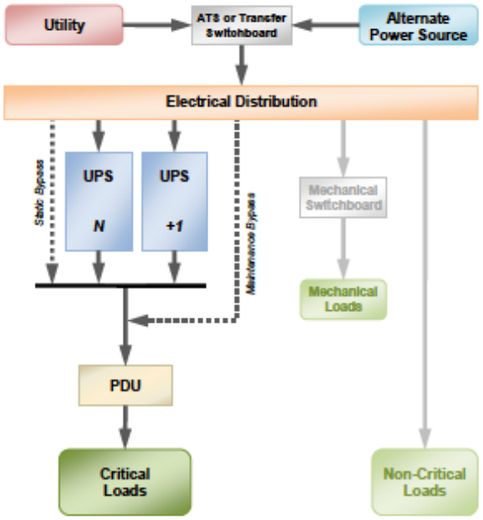


Figure 9-3
Class F2 Concept Diagram

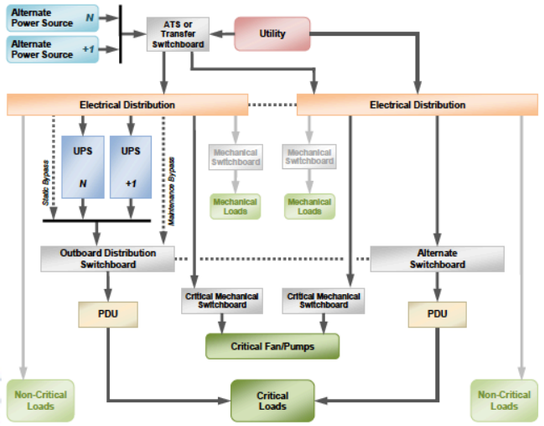


Figure 9-4
Class F3 Single Utility Source with Two Utility Inputs

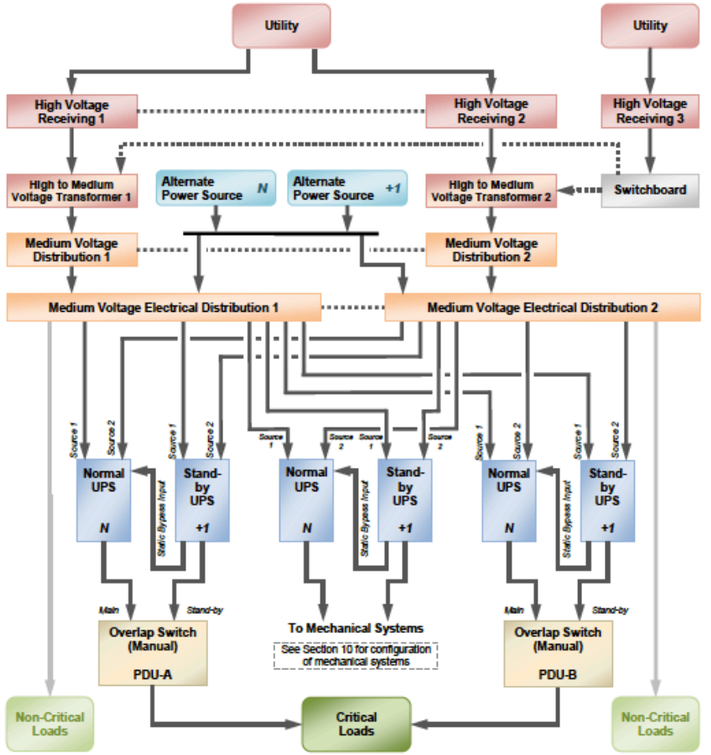


Figure 9-10
Class F4 2(N+1) Electrical Topology with Dual Utility Inputs

ANSI/BICSI 002-2019 - Classes, examples

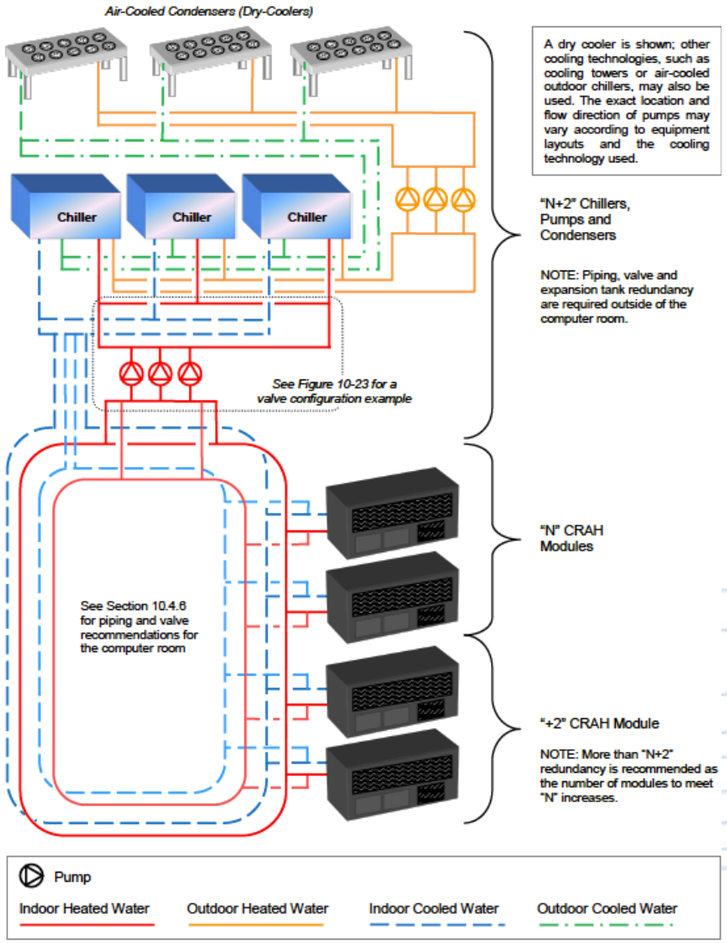
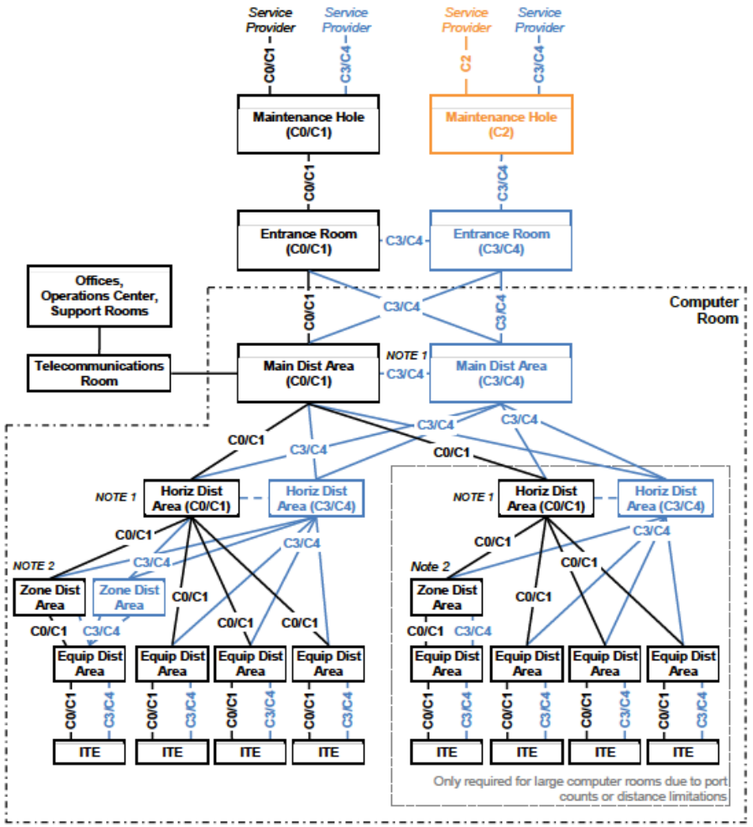


Figure 10-21
Class F4 Chiller System Example



NOTE 1: Physical separation between redundant MDA and HDA is required to minimize common modes of failure.
NOTE 2: Redundant ZDA's are an option, but not a requirement for C4.

Figure 14-4
Class C4 Concept Diagram

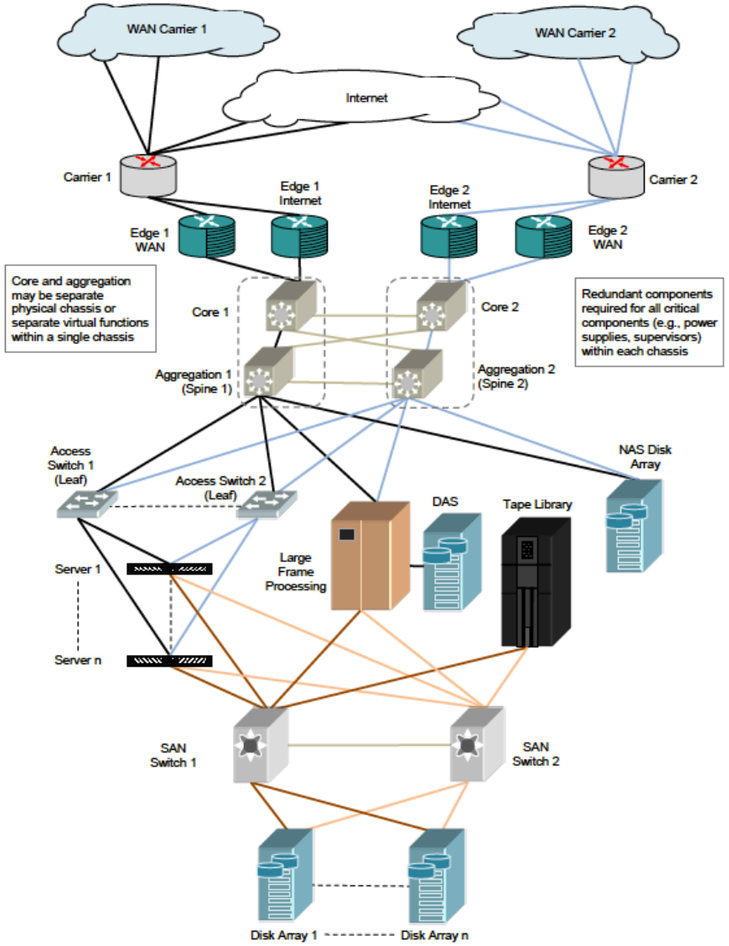
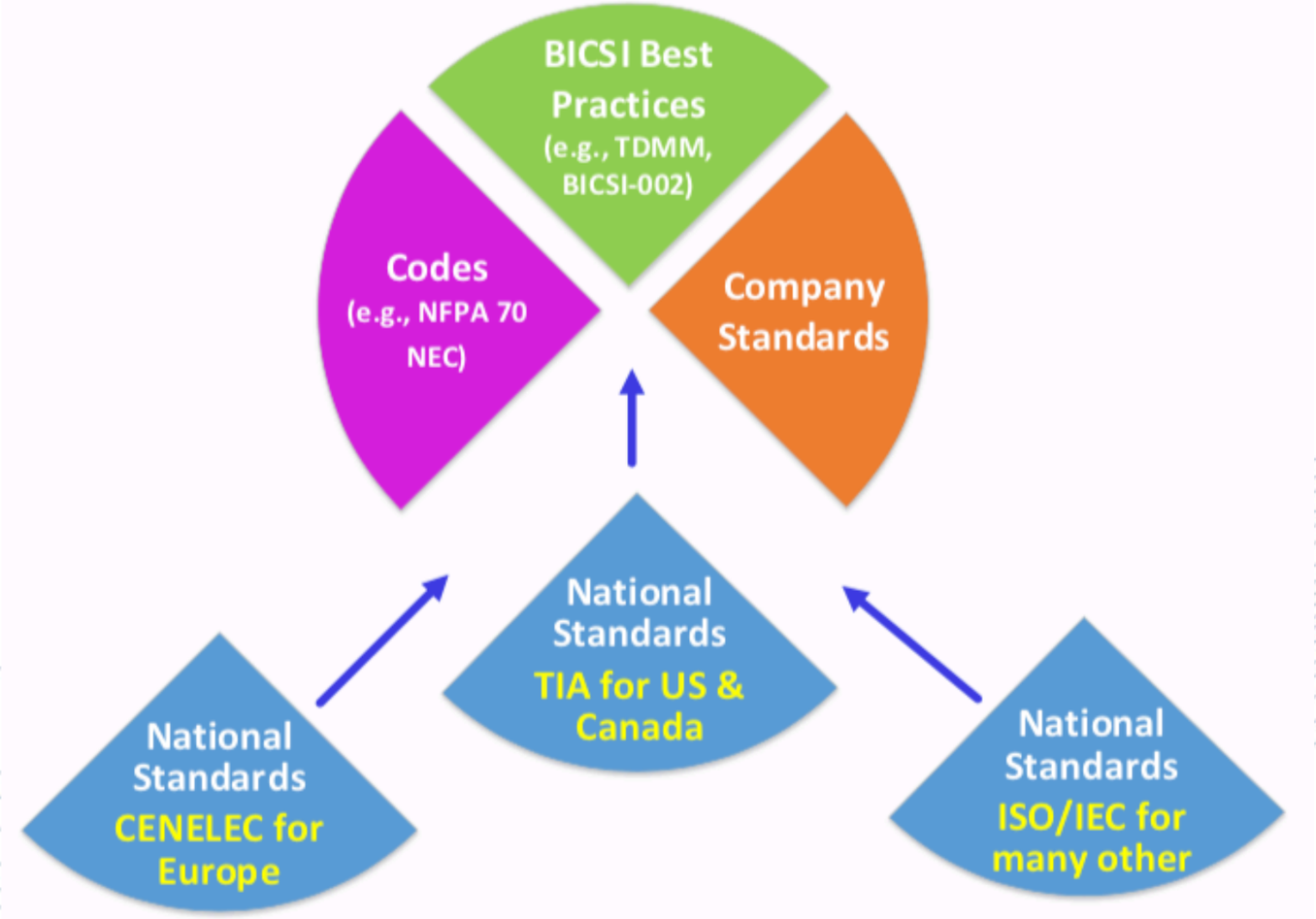


Figure 15-4
Class N4 Network Infrastructure

BICSI Standards and Manuals complement national standards



Source: What do DCDCs do? And how they relate to the ANSI/BICSI 002 standard? – Rui Takei, RCDD, DCDC

Data Center certification

- **Uptime Institute**
  - Tier Certification of Design Documents
  - Tier Certification of Constructed Facility
  - Tier Certification of Operational Sustainability
  - Aditional ratings: gold, silver, bronze

- Tier-Ready Program (2017 - for prefabricated and modular data centers)

Standards fall into three broad categories

- Components, assembly, applications and performance
- Implementation
- Validation, verification and audit.

- **TIA-942 Certification**
  - 7 August 2019: TIA Launches ANSI/TIA-942 **Accreditation Scheme** For Certification Of Data Centers, Selects Certac To Manage Program.
  - The new certification scheme will establish **conformity assessment bodies** (CABs) deemed competent to verify data center conformity with the standard.
  - tiaonline.org; TIA-942.org * Audit Services * Training for Consultants & Auditors (epi-ap.com)
    - Data Center Design Validation (DCDC)
    - Data Center Conformity Certification (DCCC)

- **EN 50600 Certification**
  - TUVIT
    - "EN 50600 is written as a guideline. If this guideline is complemented by a criteria catalogue which interprets the requirements of the EN 50600 standard then an evaluation and certification process can be put on top".
    - The certificates document that the data center complies with EN 50600,
      - has realized one of four availability classes,
      - has implemented at least the protection classes 1-3 and
      - demonstrates energy efficiency capabilities under one of three granularity levels.
  - CIS Austria

- **Certification to UL 3223**
  - UL 3223, Edition 1, February 16, 2018: **UL LLC Outline of Investigation for Data Center Certification**
  - The UL 3223 certification project team examines the following components:
    - Structure and architecture
    - Critical infrastructure (MEP) systems
    - Fire protection systems
    - Controls systems
    - Network and communications systems
    - Security systems
    - Commissioning

*Switch Introduces A New **Tier 5 Data Center Standard** To Compete with The Uptime Institute (June2017, cloudscene.com)*

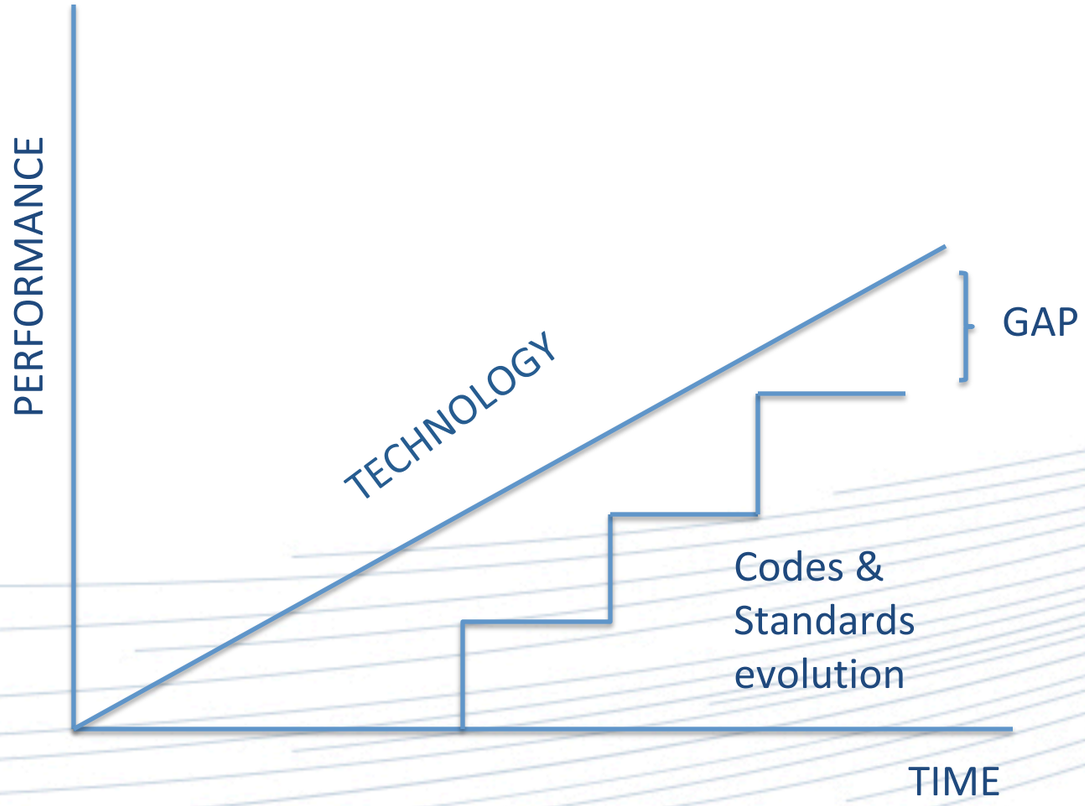
Uptime, TIA-942, BICSI 002, EN 50600: The general principle

- **Tier / Rating / Class**

1	**Enough** items for the system to function
2	Some **redundancy** in components
3	**Concurrent maintainability** (the ability to maintain any item of infrastructure without having to shut down the IT equipment).
4	**Automatic fault tolerance** (the system continues operating in the event of a failure without human intervention)

The general principles are similar, but the standards are not exactly the same.

Technology and Standards



Ερωτήσεις ;

Ευχαριστώ!

yannis.katris@telectrik.ro

TeleCTrik

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