Uptime Institute®

Data Center Forum 2018

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Alexander Mironenko, Senior Consultant

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Tier Standard: Topology
Update

2018 *Tier Standard: Topology* Revisions

- An updated version of *Tier Standard: Topology* was publicly issued in
  January and adjusted in September 2018
  - No Fundamental Changes
  - Updates add experience from years of delivery
  - *Tier Standard: Topology* is intended to make data centers better

2018 *Tier Standard: Topology* Revisions

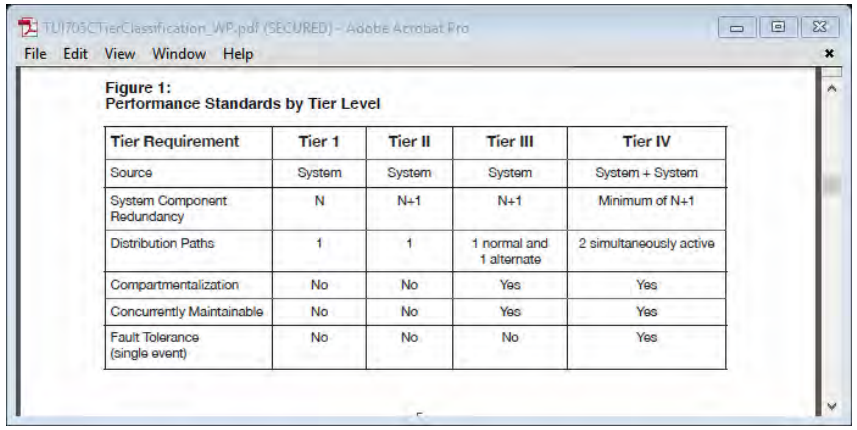

Figure 1:
Performance Standards by Tier Level

Tier Requirement	Tier 1	Tier II	Tier III	Tier IV
Source	System	System	System	System + System
System Component Redundancy	N	N+1	N+1	Minimum of N+1
Distribution Paths	1	1	1 normal and 1 alternate	2 simultaneously active
Compartmentalization	No	No	Yes	Yes
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance (single event)	No	No	No	Yes

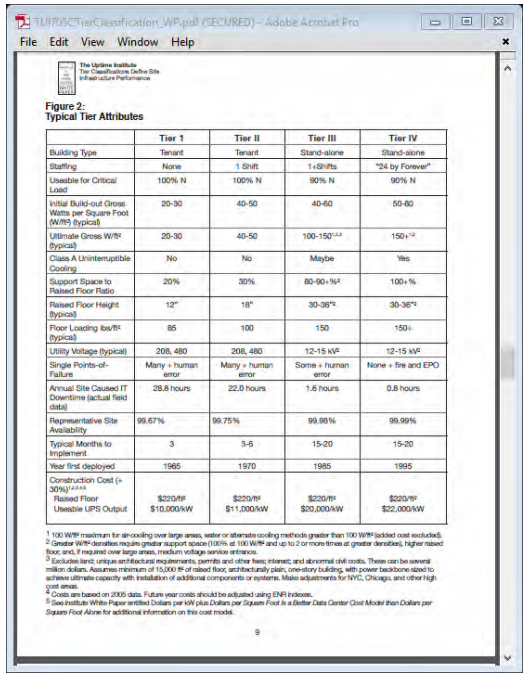

Figure 2:
Typical Tier Attributes

	Tier 1	Tier II	Tier III	Tier IV
Building Type	Tenant	Tenant	Stand-alone	Stand-alone
Staffing	None	1 Shift	1+Shifts	"24 by Forever"
Useable for Critical Load	100% N	100% N	90% N	90% N
Initial Build-out Gross Watts per Square Foot (W/ft²) (typical)	20-30	40-50	40-60	50-80
Ultimate Gross W/ft² (typical)	20-30	40-50	100-150[1,2,3]	150+[1,2]
Class A Uninterruptible Cooling	No	No	Maybe	Yes
Support Space to Raised Floor Ratio	20%	30%	80-90+%[3]	100+%
Raised Floor Height (typical)	12"	18"	30-36"[4]	30-36"[4]
Floor Loading lbs/ft² (typical)	85	100	150	150+
Utility Voltage (typical)	208, 480	208, 480	12-15 kV[5]	12-15 kV[5]
Single Points-of-Failure	Many + human error	Many + human error	Some + human error	None + fire and EPO
Annual Site Caused IT Downtime (actual field data)	28.8 hours	22.0 hours	1.6 hours	0.8 hours
Representative Site Availability	99.67%	99.75%	99.98%	99.99%
Typical Months to Implement	3	3-6	15-20	15-20
Year first deployed	1965	1970	1985	1995
Construction Cost (+ 30%)[1,2,3,4,5] Raised Floor Useable UPS Output	$220/ft² $10,000/kW	$220/ft² $11,000/kW	$220/ft² $20,000/kW	$220/ft² $22,000/kW

[1] 100 W/ft² maximum for air-cooling over large areas, water or alternate cooling methods greater than 100 W/ft² (added cost excluded).
[2] Greater W/ft² densities require greater support space (100% at 100 W/ft² and up to 2 or more times at greater densities), higher raised floor, and, if required over large areas, medium voltage service entrances.
[3] Excludes land; unique architectural requirements, permits and other fees; interest; and abnormal civil costs. These can be several million dollars. Assumes minimum of 15,000 ft² of raised floor, architecturally plain, one-story building, with power backbone sized to achieve ultimate capacity with installation of additional components or systems. Make adjustments for NYC, Chicago, and other high cost areas.
[4] Costs are based on 2005 data. Future year costs should be adjusted using ENR indexes.
[5] See Institute White Paper entitled *Dollars per kW plus Dollars per Square Foot is a Better Data Center Cost Model than Dollars per Square Foot Alone* for additional information on this cost model.

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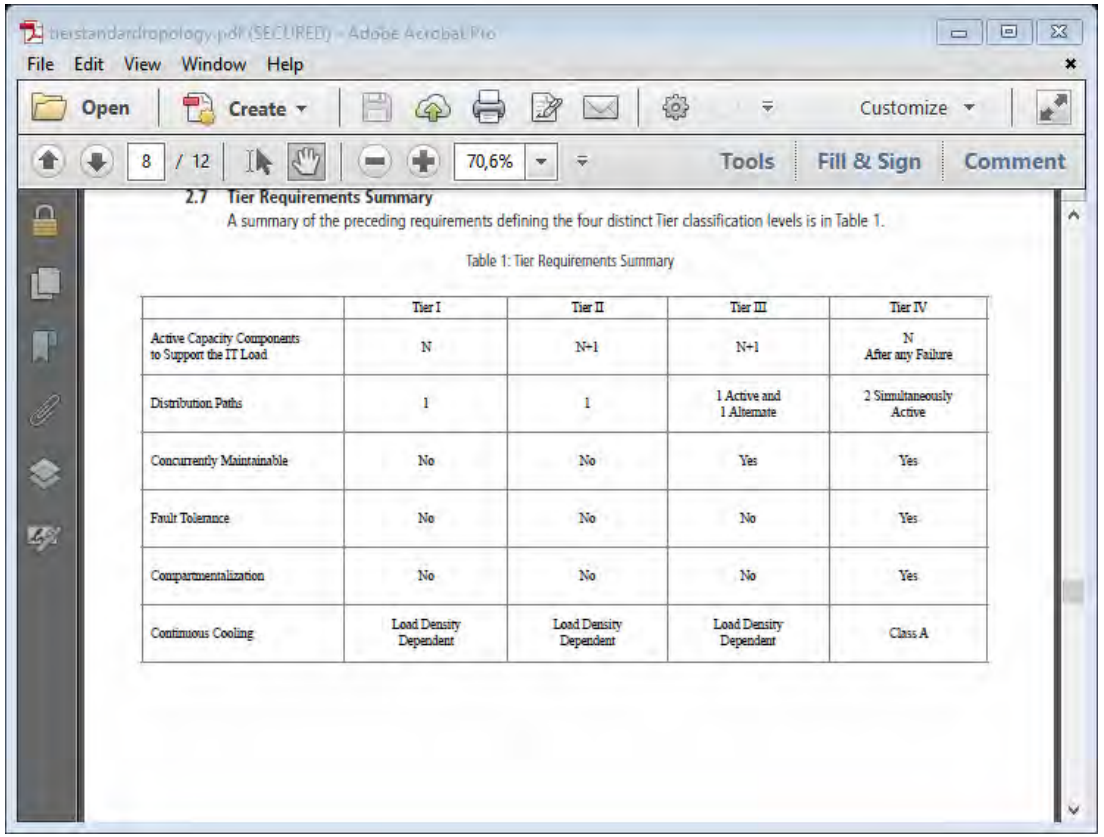
Not a Standard!
WP 2006



2.7 Tier Requirements Summary

A summary of the preceding requirements defining the four distinct Tier classification levels is in Table 1.

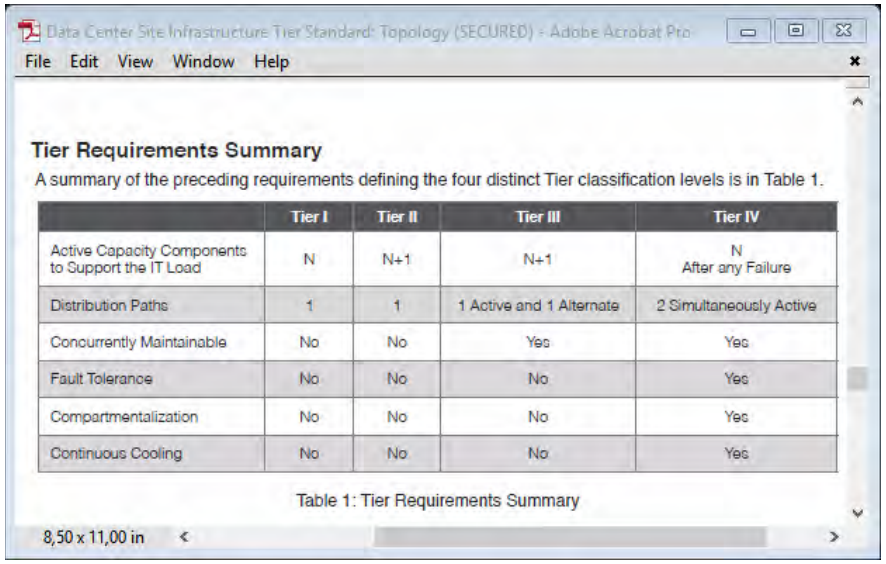
Table 1: Tier Requirements Summary

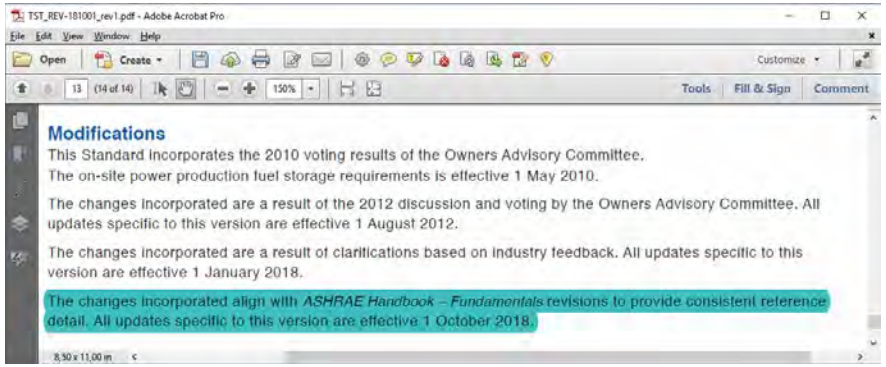
	Tier I	Tier II	Tier III	Tier IV
Active Capacity Components to Support the IT Load	N	N+1	N+1	N After any Failure
Distribution Paths	1	1	1 Active and 1 Alternate	2 Simultaneously Active
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continuous Cooling	Load Density Dependent	Load Density Dependent	Load Density Dependent	Class A

Tier Standard: Topology 2010

2018 *Tier Standard: Topology* Revisions

Tier Standard: Topology 2012





Tier Standard: Topology 2018

	Tier I	Tier II	Tier III	Tier IV
Minimum Capacity Components to Support the IT Load	N	N+1	N+1	N After any Failure
Distribution Paths - Electrical Power Backbone	1	1	1 Active and 1 Alternate	2 Simultaneously Active
Critical Power Distribution	1	1	2 Simultaneously Active	2 Simultaneously Active
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continuous Cooling	No	No	No	Yes

Table 1: Tier Requirements Summary —TS:T2018

2018 *Tier Standard: Topology* Revisions

- Site Power Updates
  - Typically thought of as primarily utility power backed up by diesel fueled engine generators
    - This was because engine generators are the predominant solution
  - Update refocuses on "On-site Power Production"
  - This is intended to remind the market that a Tier-rated facility can use other solutions as long as they meet Tier requirements
    - Engine Generators – Various fuels
    - Turbines
    - Fuel Cells
    - Renewables?

2018 *Tier Standard: Topology* Revisions

- Clarifications
  - Tier III – both uninterruptible power supply (UPS) sources (cords) for dual corded loads must be active/active
    - This has always been the requirement but it was not well stated in the past
  - All utility sources are treated the same, not just electrical power
    - The commentary previously focused so much on electrical power that some thought only electrical power needed to be backed up on site
    - All items that are not 100% on site and 100% under the control of the data center are utilities
      - No utilities can be used to satisfy capacity or redundancy requirements
  - Clarified that Tier IV requires detection of any single fault or failure
    - Regardless of the impact to the data center
  - Clarified that extreme ambient conditions not only consider the maximum but also the minimum
    - Mostly impacts the ability of equipment to actually operate at the n=20 years extreme minimum dry bulb temperature

2018 *Tier Standard: Topology* Revisions

- Continuous Cooling Update
  - Previously mentioned in the standard but no definition was included
    - Explained more in a technical paper and ATD
    - It is now fully defined in the *Tier Standard: Topology*
  - Never had a definition of a stable thermal environment
    - The definition of a stable thermal environment is based on ASHRAE standards
    - No more than a 5°C change in temperature in a 15-minute period or 20°C in an hour
  - Previously, the Continuous Cooling duration had to match the UPS ride through time
    - Duration is centered on mechanical system performance and design
    - Tier IV requires that a stable thermal environment be maintained at all times
    - The longest Continuous Cooling duration is the time between a utility power failure and the mechanical systems being online and supporting a stable thermal environment

2018 *Tier Standard: Topology* Revisions

- Telecommunication Conveyances
  - Telecommunication conveyances into the data center to the first point of demarcation are no longer a Tier requirement but a recommendation
  - This only impacted the number of conduits or trenches outside the building
  - However, once the building envelope is broken, Tier requirements do apply, such as
    the Tier IV requirement for Compartmentalization
  - Any room with active equipment still needs power and cooling at the appropriate
    Tier level
    - This may drive some telecommunication site plans to determine where the points are with active equipment

2018 *Tier Standard: Topology* Revisions

- Get a copy of the updated standard from the Uptime Institute web site
  - Familiarize yourself with the newest version
  - Ask any questions you may have

OS Updates – coming soon!

Reasons for Changes

- To adjust our product to growing operational trends and to address new methodologies in:
  - Staffing: Not staffing data centers 24 x 7
  - Maintenance: Making Housekeeping part of site policies
  - Training: Addressing not just initial training but ongoing training / vendor training
  - Planning, Coordination, and Management: Includes more behaviors on security and risks mitigation plans
  - Building Characteristics - security behaviors address building features only, less points for the overall category
  - Site Location Risks: Adding in social factors

Staffing Category

- Staffing: Not staffing data centers 24 x 7
  - Not an either/or behavior
  - Adding behaviors addressing Notification
  - Behavior added to address response time
  - Redundancy of equipment and automated responses
- Allows data centers that do not have 24 x 7 staffing to get credit for methods that reduce risk
- Still emphasizes that 24 x 7 staffed sites have the best risk mitigation

Questions?