

Data center tiering

Tier I Data Center: Basic

A Tier I data center is susceptible to disruptions from both planned and unplanned activity. If it has UPS or generators, they are single-module systems and have many single points of failure.

The infrastructure should be completely shut down on an annual basis to perform preventive maintenance and repair work. Urgent situations may require more frequent shutdowns. Operation errors or spontaneous failures of site infrastructure components will cause a data center disruption.

Tier II Data Center: Redundant Components

Tier II facilities with redundant components are slightly less susceptible to disruptions from both planned and unplanned activity than a basic data center. They have UPS, and engine generators, but their capacity design is “Need plus One” (N+1), which has a single-threaded distribution path throughout.

Maintenance of the critical power path and other parts of the site infrastructure will require a processing shutdown.

Tier III Data Center: Concurrently Maintainable

Tier III level capability allows for any planned site infrastructure activity without disrupting the computer hardware operation in any way.

Planned activities include preventive and programmable maintenance, repair and replacement of components, addition or removal of capacity components, testing of components and systems, and more.

Sufficient capacity and distribution must be available to simultaneously carry the load on one path while performing maintenance or testing on the other path.

Unplanned activities such as errors in operation or spontaneous failures of facility infrastructure components may still cause a data center disruption.

Tier IV Data Center: Fault Tolerant

Tier IV provides site infrastructure capacity and capability to permit any planned activity without disruption to the critical load. Fault-tolerant functionality also provides the ability of the site infrastructure to sustain at least one worst-case unplanned failure or event with no critical load impact.

This requires simultaneously active distribution paths, typically in a System + System configuration.

Tier 3

The data center should be served by at least two access providers. Service should be provided from at least two different access provider central offices or points-of-presences.

Access provider cabling from their central offices or points-of-presences should be separated by at least 20 m (66 ft.) along their entire route for the routes to be considered diversely routed.

The data center should have two entrance rooms preferably at opposite ends of the data center but a minimum of 20 m (66 ft.) physical separation between the two rooms.

Do not share access provider provisioning equipment, fire protection zones, power distribution units, and air conditioning equipment between the two entrance rooms. The access provider provisioning equipment in each entrance room should be able to continue operating if the equipment in the other entrance room fails.

The data center should have redundant backbone pathways between the entrance rooms, MDA, intermediate distribution areas (IDAs), and HDAs.

Intra-data center LAN and SAN backbone cabling from switches to backbone switches should have redundant fiber or wire pairs within the overall star configuration. The redundant connections should be in diversely routed cable sheathes.

There should be a “hot” standby backup for all critical telecommunications equipment, access provider provisioning equipment, core layer production routers and core layer production LAN/SAN switches.

All cabling, cross-connects and patch cords should be documented using software systems or automated infrastructure management systems as described in the ANSI/TIA-606-B.

Some potential single points of failure of a tier 3 facility are:

- Any catastrophic event within the MDA may disrupt all telecommunications services to the data center; and any catastrophic event within a HDA may disrupt all services to the area it servers.

A tier 3 data center should have protection against most physical events, intentional or accidental, natural or manmade, which could cause the data center to fail.

All systems of a tier 3 facility should be provided with at least N+1 redundancy at the module, pathway, and system level, including the generator and UPS systems, the distribution system, and all distribution feeders.

The configuration of mechanical systems should be considered when designing the electrical system to ensure that N+1 redundancy is provided in the combined electrical-mechanical system.

This level of redundancy can be obtained by either furnishing two sources of power to each air conditioning unit or dividing the air conditioning equipment among multiple sources of power.

Feeders and distribution boards are dual path, whereby a failure of or maintenance to a cable or panel will not cause interruption of operations.

Enough redundancy should be provided to enable isolation of any item of mechanical or electrical equipment as required for essential maintenance without affecting the services being provided with cooling.

By employing a distributed redundant configuration, single points of failure are virtually eliminated from the utility service entrance down to the mechanical equipment, and down to the PDU or computer equipment.

To increase the availability of power to the critical load, the distribution system is configured in a distributed isolated redundant (dual path) topology. This topology requires the use of automatic static transfer switches (ASTS) placed either on the primary or secondary side of the PDU transformer.

Automatic static transfer switches (ASTS) requirements are for single cord load only.

For dual cord (or more) load design, affording continuous operation with only one cord energized, no automatic static transfer switches (ASTS) is used, provided the cords are fed from different UPS sources. The automatic static transfer switches (ASTS) will have a bypass circuit and a single output circuit breaker.

A central power and environmental monitoring and control system (PEMCS) should be provided to monitor all major electrical equipment such as main switchgears, generator systems, UPS systems, automatic static transfer switches (ASTS), power distribution units, automatic transfer switches, motor control centers, transient voltage surge suppression systems, and mechanical systems.

A separate programmable logic control system should be provided, programmed to manage the mechanical system, optimize efficiency, cycle usage of equipment and indicate an alarming condition.

The HVAC system of a Tier 3 facility includes multiple air conditioning units with the combined cooling capacity to maintain a critical space temperature and relative humidity at design conditions, with enough redundant units to allow failure of or service to one electrical switchboard.

If these air conditioning units are served by a water-side heat rejection system, such as a chilled water or condenser water system, the components of these systems are likewise sized to maintain design conditions, with one electrical switchboard removed from service.

This level of redundancy can be obtained by either furnishing two sources of power to each air conditioning unit or dividing the air conditioning equipment among multiple sources of power.

The piping system or systems are dual path, whereby a failure of or maintenance to a section of pipe will not cause interruption of the air conditioning system.

Redundant computer room air conditioning (CRAC) units should be served from separate panels to provide electrical redundancy.

All computer room air conditioners (CRAC) units should be backed up by generator power. Refrigeration equipment with N+1, N+2, 2N, or 2(N+1) redundancy should be dedicated to the data center.

Enough redundancy should be provided to enable isolation of any item of equipment as required for essential maintenance without affecting the services being provided with cooling.

Subject to the number of Precision Air Conditioners (PAC's) installed, and consideration of the maintainability and redundancy factors, cooling circuits to the Precision Air Conditioners (PAC's) should be sub-divided.

If chilled water or water-cooled systems are used, each data center dedicated sub-circuit should have independent pumps supplied from a central water ring circuit.

A water loop should be located at the perimeter of the data center and be in a sub floor trough to contain water leaks to the trough area.

Leak detection sensors should be installed in the trough. Consideration should be given to fully isolated and redundant chilled water loops.

Tier 4

Data center backbone cabling and distributor locations should be redundant.

Cabling between two spaces should follow physically separate routes, with common paths only inside the two end spaces.

Backbone cabling should be protected by routing through a conduit or by use of cables with interlocking armor.

There should be an automatic backup for all critical telecommunications equipment, access provider provisioning equipment, core layer production routers and core layer production LAN/SAN switches. Sessions/connections should switch automatically to the backup equipment.

The data center should have redundant MDAs preferably at opposite ends of the data center, but a minimum of 20 m (66 ft.) physical separation between the two spaces.

Do not share fire protection zones, power distribution units, and air conditioning equipment between the redundant MDAs. The redundant MDA is optional, if the computer room is a single

continuous space, as there is probably little to be gained by implementing two MDAs in this case.

The two MDAs should have separate pathways to each entrance room. There should also be a pathway between the MDAs.

The redundant routers and switches should be distributed between redundant distribution spaces (e.g. redundant MDAs, redundant pair of IDAs, or redundant pair of HDAs, or redundant pair of entrance rooms).

Each HDA should be provided with connectivity to two different IDAs or MDAs. Similarly, each IDA should be provided with connectivity to both MDAs.

Critical systems should have horizontal cabling to two HDAs. Some potential single points of failure of a tier 4 facility are at:

- The MDA (if the secondary distribution area is not implemented).
- The HDA and horizontal cabling (if redundant horizontal cabling is not installed).

A tier 4 data center must consider all potential physical events that could cause the data center to fail. A tier 4 data center must be provided with specific and in some cases redundant protections against such events.

Tier 4 data centers should consider the potential problems with natural disasters such as seismic events, floods, fire, hurricanes, and storms, as well as potential problems with terrorism and disgruntled employees.

Tier 4 data centers should have control over all aspects of their facility. Tier 4 facilities should be designed in a '2(N+1)' configuration in all modules, systems, and pathways.

All feeders and equipment should be capable of manual bypass for maintenance or in the event of failure. Any failure should automatically transfer power to critical load from a failed system to the alternate system without disruption of power to the critical electronic loads.

A battery monitoring system capable of individually monitoring the impedance or resistance of each cell and temperature of each battery jar and alarming on impending battery failure should be provided to ensure adequate battery operation.

The utility service entrances should be dedicated to the data center and isolated from all noncritical facilities. The building should have at least two utility feeders from different utility substations for redundancy.

The HVAC system of a tier 4 facility includes multiple air conditioning units with the combined cooling capacity to maintain a critical space temperature and relative humidity at design conditions, with sufficient redundant units to allow failure of or service to one electrical switchboard.

If these air conditioning units are served by a water-side heat rejection system, such as a chilled water or condenser water system, the components of these systems are likewise sized to maintain design conditions, with one electrical switchboard removed from service.

This level of redundancy can be obtained by either furnishing two sources of power to each air conditioning unit or dividing the air conditioning equipment among multiple sources of power.

The piping system or systems are dual path, whereby a failure of or maintenance to a section of pipe will not cause interruption of the air conditioning system.

Alternative source for water storage is to be considered when evaporative systems are in place for a tier 4 system.

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