



As an IT leader, you know the importance of being able to meet your organization's increasing expectations for uptime, scalability and security. Your data center represents a critical piece of the solution. Done right, a data center gives your organization a competitive advantage with uninterrupted, problem-free operations and the flexibility to accommodate evolving business requirements and growth.

But not all data centers are created equal. This paper defines the five fundamental characteristics of a true **world-class data center (WCDC)**—one that offers your organization the highest attainable level of reliability, flexibility, scalability and security. A WCDC provides the best operational experience and highest confidence, with the lowest risk of problems that could compromise operations or data in even the most extreme circumstances.

“ A WCDC is designed to be ‘Business Mission Responsive’. For colocation this means it’s designed to accommodate a wide variety of customer-specific business requirements, and able to adapt to customer business strategy changes as well as growth over time.

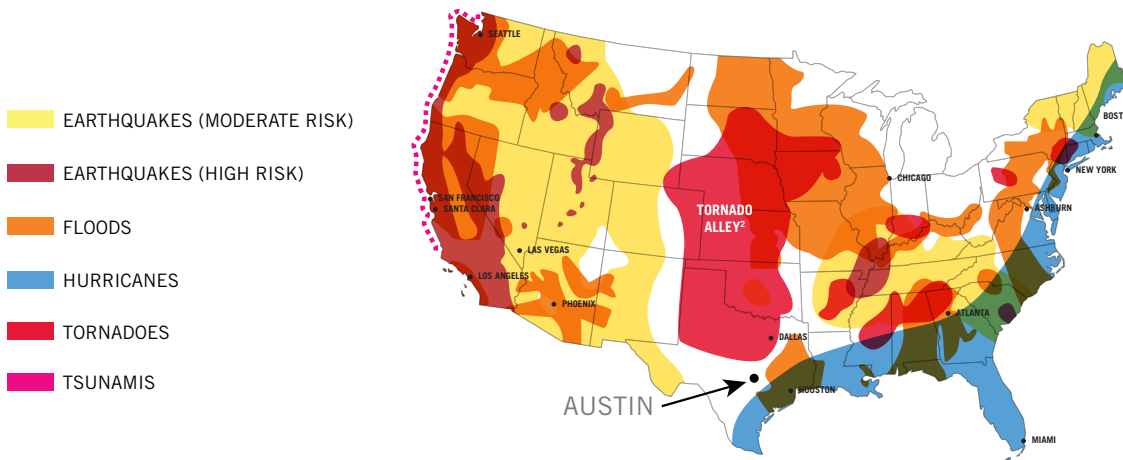
—MICHAEL MOSMAN, CTO, CCG FACILITIES INTEGRATION

THE FIVE PILLARS OF A WORLD-CLASS DATA CENTER:

1. A Purpose-Built Facility
2. Robust Utility and Facility Infrastructure
3. High Performance Computing Capable
4. Best-in-Class Equipment
5. The Human Factor

#1: A Purpose-Built Facility

Many data centers are retrofitted facilities—frequently old warehouses or other large, open buildings that have been converted into a data center. Such buildings cannot deliver the benefits and performance of a purpose-built WCDC.





RESILIENCE FROM DISASTERS

A data center should, of course, be located in an area with a low incidence of natural disasters, including strong winds, tornadoes, hurricanes, lightning strikes, flooding and earthquakes. More importantly, a data center should be constructed to withstand disasters, even if the chances are remote that they will occur.

Purpose-built data centers are designed to higher construction and performance specifications that make them capable of withstanding extreme weather conditions. For example, high winds from tornadoes or hurricanes present a serious risk to data centers. Many retrofitted buildings are constructed to withstand 90 mph winds, but in a tornado or hurricane winds can reach more than 200 mph. Protecting against winds of that speed requires a larger investment for higher-grade building materials and construction techniques, including:

- To provide adequate roof support and to harden against wind-blown projectiles, cinder block or concrete exterior walls should be at least 10" thick, instead of the more common 7" thickness.
- Instead of a flat concrete foundation, pier footings should secure the foundation deep into bedrock.
- To provide the necessary weight and strength to prevent lift, the roof should be made of 6" thick concrete, not metal or other fabricated 1" roof materials. In addition, minimal equipment should be attached on the roof, and there should not be any skylights.
- Exterior doors must be no taller than 7'.
- All structural components from the roof down to the below-ground piers should be welded together to create a rigid integrated structure.



Wide A WCDC is hardened to prevent wind-blown projectiles from penetrating any part of the building's shell. If allowed to penetrate, the wind could create very unstable wind pressure within the building, which can lead to catastrophic roof failure. You can achieve these higher design specifications in a purpose-built facility.

—MARK MERRYMAN, VP/PRINCIPAL, HAYNES WHALEY ASSOCIATES

STRUCTURAL SPECS	WORLD-CLASS DATA CENTER	RETRO-FITTED DATA CENTER
WALL THICKNESS	10"	7"
ROOF THICKNESS	6.5"	1"
WIND RATING	160 MPH	90 MPH
ROOF PENETRATIONS	VIRTUALLY NONE	EXCESSIVE - SKYLIGHTS, DRAINS, AC UNITS, ETC.
PVR (POTENTIAL VERTICAL RISE)	.75"	2"
WALLS	FACTORY PRODUCED	CONSTRUCTED ON SITE
DEPRESSED SLAB	3'	0
UNDERGROUND CONDUIT	EXTENSIVE	NONE

Comparison of WCDC design specifications to typical retrofitted facilities.



PROTECTING UTILITY AND MECHANICAL EQUIPMENT

In a WDC, all **electrical and mechanical assets** are situated where they are the most secure and easiest to maintain. This includes running electrical and telecom conduits underground where they are best protected, and placing generators and transformers indoors where they are protected from weather and can be serviced more efficiently. These options are often not available when retrofitting a building.



Housing the generator equipment inside the facility is a superior solution. It's more efficient and better protected from weather and intrusion. And it's much more accessible to maintenance staff.

—DOUG CLOUGH, REGIONAL OFFICE DIRECTOR, HOLDER CONSTRUCTION COMPANY

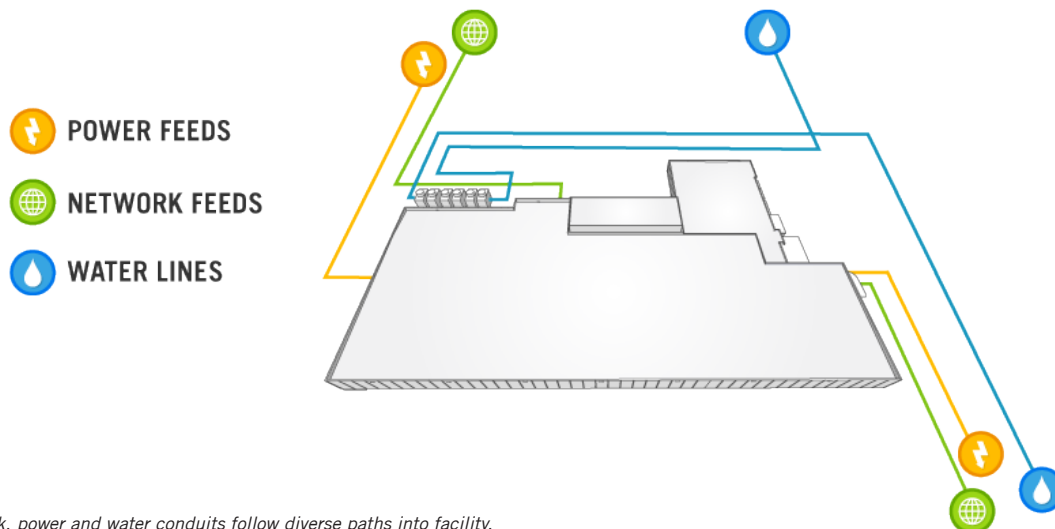
SPACE UTILIZATION

Finally, a WDC allows all space to be configured for maximum efficiency for customers and service technicians. By planning rooms around efficient rectangles from the outset, a WDC makes it more logical and convenient for customers and staff to navigate and use the data center. In contrast, when reconfigured for data center operations, retrofitted buildings often end up with poorly planned floor space and odd-shaped rooms.

#2: Robust Utility and Facility Infrastructure

Electricity, network connectivity and water are the lifeblood of a data center. In a WDC, all utilities are fully redundant and **no component or system has a single point of failure.**

The general strategies for protecting vital infrastructure are redundancy and diversity (physical separation). A WDC should have **dual electrical and water feeds from diverse locations and distribution sources.** This ensures that electrical and water supplies are available even if one source is interrupted due to either natural events or human errors. **Telecom entry points should also be diverse**, ideally on opposite sides of the building for the best security and protection.



Dual network, power and water conduits follow diverse paths into facility.



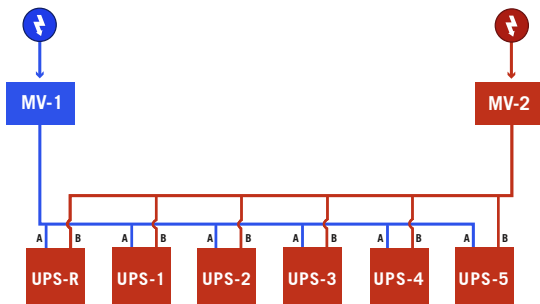
POWER

Multiple levels of redundancy are built into every level of a WDC's power infrastructure, from the substations to power distribution units. Redundancy starts with **dual power feeds supplied by separate substations**, with **each substation powered by independent power plants**. This provides the best alternative power source in case of a major power outage. Underground power feed lines provide added protection from accidental or natural breaks. The redundant power feeds should enter the property and the facility via diverse paths.

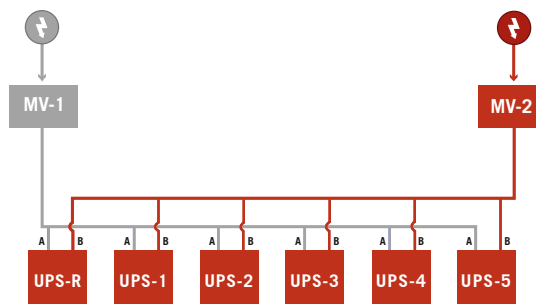
“Many data centers offer redundant power and water feeds. However, some data centers still create a single point of failure by having, for instance, dual power feeds that go to a single transformer, or utilizing non-diverse paths through the property. WDCs have redundant feeds into the buildings to minimize the chance that a disruption to one feed would affect the other.

—KELLY BELL, SENIOR ASSOCIATE, BURY+PARTNERS

Inside the facility, a WDC is optimally powered by both feeds sharing the load on separate power trains. Should one power source be disrupted, the entire system can quickly switch to power from the single source without any disruption or degradation to operations. Full redundancy also allows any part of the system to be taken offline for maintenance.



Dual power feeds with each half of facility powered off of alternate utility feed.



In case of severe power interruption from one source, load is quickly migrated to remaining active feed.

A WDC facility has:

- Transformers located inside the data center for improved serviceability and security.
- UPS rooms with two incoming power feeds that deliver true A/B power to servers.
- A UPS-protected maintenance bypass bus that enables maintenance of UPS systems without exposing equipment directly to utility power.
- All power distribution equipment located in service galleries to isolate maintenance activities from customers' equipment and improve power delivery to cabinets.

WATER

A continuous water supply for chilled water cooling is vital to a WDC. Like the other utilities, the dual water feeds should enter the property and connect to mechanical equipment through diverse paths. **Parallel water lines connect the cooling towers and chillers**, providing increased redundancy and concurrent maintainability.



NETWORK CONNECTIVITY

A WDC makes it easy for telecom carriers to connect to the facility. Carriers are provided access to **underground, concrete-encased duct banks** that enter the property and the building via diverse paths. These protected duct banks provide for ample growth of future network providers without the need to dig additional trenches. All of the telecom feeds are delivered to separate carrier rooms inside the facility for full redundancy.

It is important to have options when selecting a network carrier. A WDC is **carrier-neutral**, where customers can choose their preferred carrier from a long list. Data centers that offer at least 10 carrier options ensure that customers will get the best connectivity for their needs at the most competitive prices.

#3: High Performance Computing Capable

Managing heat is a primary challenge in every data center. High Performance Computing (HPC) environments produce significantly more heat due to the increased concentration of power to various locations across the floor. To support a wide mix of cabinet power densities, the cooling infrastructure must conserve energy, withstand load increases, and provide consistent, reliable high performance.

“ The cooling system of a WDC is designed for both reliability and efficiency in real-world conditions. It must operate at maximum efficiency at all load levels regardless of changing external conditions. Not all systems do that.

—ROY HUBBARD, SENIOR MARKETING MANAGER, JOHNSON CONTROLS

A WDC effectively manages HPC environments through a **chilled water-cooling system**. These systems circulate water to any location on the floor that requires cooling, while consuming significantly less electricity than conventional air-cooled systems. This design efficiently cools HPC environments because it supports higher return hot air temperatures and provides higher concentrations of cooling to locations with high-performance equipment.

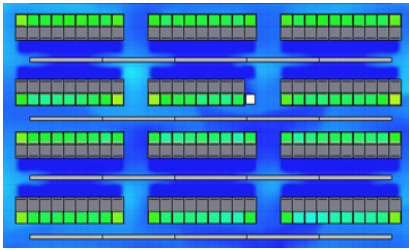


A chilled water cooling system more efficiently supports HPC environments



To remove heat, the key is to prevent hot and cold air from mixing, with the hot air efficiently removed from the immediate area. This starts with a **raised floor** that supports hot and cold aisle cabinet configurations. Cool air is directed under the raised floor to the front cabinet areas and tuned for each area's needs through the configuration of **perforated floor tiles or grates** on the cool air aisle.

The more difficult challenge is removing the hot air from the back hot air aisle of the cabinet area. WDCs have ceiling return air plenums to quickly segregate hot air and to support air management features such as cabinet chimneys and hot aisle containment partitions, which limit hot air from co-mingling with the white floor room air. For the highest density configurations, water-cooled in-cabinet heat exchangers are utilized.



Alternating "hot" and "cold" aisles minimizes unwanted mixing of hot air around the cabinets

Approximate power capacities for various HPC air management options:

- Standard cabinets. < 8kw
- Chimneys. < 25kw
- Hot/cold aisle containment < 30kw
- Rear door heat exchangers. < 60kw
- Chilled water to cabinet cooling > 60 kw

THE IMPORTANCE OF STRONG FLOORS

Modern IT cabinets weigh over 2,500 pounds across 8 square feet, or over 300 pounds per square foot. This requires extraordinarily strong floors, which are typically only found in purpose-built facilities. Consider that a typical parking garage load bearing capacity is only 40 pounds per square foot!

#4: Best-in-Class Equipment

Capital equipment—such as back-up power generators, switchgear, uninterruptible power supplies, chillers, fire suppression/detection systems, pumps and control systems—collectively represent one of the biggest investments in any data center. These assets are typically refreshed on a 10-year generational lifecycle. Some data centers purchase older generations of equipment to reduce investment costs. However, a WDC uses the newest generation of equipment because it is more reliable and more energy efficient. It is also easier to maintain, because newer systems are designed with increased component modularity and improved technician accessibility.

“ Previous generations of data centers were built with power and cooling sufficient for a fully loaded facility, which is inefficient both in CapEx and OpEx until the facility is actually fully loaded with servers. WDCs use a newer generation of modular equipment, so that the facility need only install and operate for required customer loads, with the ability to easily scale with additional modules as the load increases.

—ED SPEARS, TECHNICAL MARKETING MANAGER, EATON CORPORATION



The use of Best-in-Class equipment is extended to fire prevention/suppression systems as well. A WDC will have High-Sensitivity Smoke Detection (HSSD) system like VESDA. These types of systems actively sample the air to detect overheating components and tiny smoke particles before they have a chance to grow into a fire. The sensors within these systems provide early-warning fire detection many times more sensitive than conventional spot-type fire detectors, which enables facility personnel to address problems before they result in costly downtime or potential damage.



550 Ton York Chiller



Eaton Powerware® 9395 UPS

In the unlikely event a fire cannot be extinguished quickly, water should be the last resort because it is the fastest way to destroy the systems customers want protected. Instead, WDCs use state-of-the-art FM 200 gaseous fire suppressant systems. These are stored as a liquid and dispensed as a human-safe vapor that does not obscure vision or leave any residue. These systems can extinguish most fires in 10 seconds or less, stopping ordinary combustible, electrical and flammable liquid fires before they cause significant damage to valuable customer equipment. Extinguishing a fire this quickly results in less downtime and disruption of your business while providing an extra margin of human safety for both data center staff and on-site customers.



FM 200 Fire Suppression

Water sprinklers should only be triggered as a last line of defense. All data centers should employ dry pipe **multi-zone systems**, in which the water is pressurized far away from the spray nozzles in the main equipment rooms. These dry pipes fill with water and localized sprinklers discharge only in an extreme emergency.

Of course, the best way to manage fire risks is to prevent them from occurring. In a WDC, this begins with **staff that are on-site to continuously monitor early detection systems** — and are thoroughly trained to respond quickly and effectively using hand-held fire extinguishers if smoke, unusual heat or a fire is detected.



#5: The Human Factor

According to a report from the Uptime Institute, approximately 70 percent of data center downtime can be attributed to human error. One of the best ways to minimize human error is to have **experienced staff on-site 24/7/365**. This includes highly-skilled engineers who monitor mission-critical systems, facilities personnel to perform scheduled maintenance, and trained security provided by data center employees.

“A WCDC design will have a purpose-planned interior to accommodate multiple users—customers, security, staff, and technicians. Inherent familiarity is a fundamental objective of the design at the most basic level. Strong spatial and planning relationships between the major components create a simple ordering system to help people keep their bearings when traversing the building with consistency and order. Knowing that critical components are consistently placed from room to room throughout, the chances of mistakes are reduced. Human error plays less of a factor.

—GREG LACOUR, SENIOR ASSOCIATE NATIONAL MISSION CRITICAL PRACTICE AREA LEADER AT GENSLER

Furthermore, because a data center is an extension of your office facilities, it is important to have a **work environment that is productive, efficient, easily accessible and accommodating**. A WCDC provides:

- A flexible work environment in which floor space can be divided into private suites for complete customer privacy
- Optional dedicated offices, conference rooms and seats for longer-term needs
- Full media conference rooms
- Break rooms near the colocation floor
- Showers in main bathrooms for extended stays
- No ramps or stairs from the dock to raised floor areas
- Workstations with wired and wireless Internet access available
- A streamlined security check-in process
- Loading docks in front of the building for convenient loading and unloading
- Ample, well-lit and secure parking
- Close to hotels, an airport, public transportation, and restaurants



A work environment that is productive, efficient and accommodating.



DATA FOUNDRY

5 PILLARS OF A WORLD CLASS DATA CENTER

Finally, the best data centers are managed in adherence with rigorous processes and controls that govern all operations, maintenance, and emergency procedures for the facility. A WCDC will be **SSAE 16 Type II compliant**, having successfully completed a thorough independent audit of its control environment, risk assessment process, and information and communication systems. A successful audit completion demonstrates that a service organization has ample controls in place and a higher-level commitment to support its customers.

World-Class Data Centers: The Competitive Edge

The only constant in business is change. The demands placed on an IT organization—more uptime, greater flexibility, better security, faster growth and reduced risk—will only increase with time. Collocating services at a world-class data center empowers you with capabilities to meet the inevitable challenges you will face, while giving you an advantage over your competition and offering the best protection to meet unforeseen challenges.

Have you entrusted your mission-critical data and applications to a World-Class Data Center?
Compare your data center to a world-class facility by downloading the Data Foundry
Data Center Checklist on our resources page.

ABOUT DATA FOUNDRY

Data Foundry provides comprehensive wholesale and retail data center outsourcing, colocation, and disaster recovery services. The company provides its customers with secure premium facilities for servers and equipment, emergency workspace and carrier-neutral network accessibility, supported by experienced onsite technicians and customer support 24/7/365. The company supports more than 1,000 enterprise customers across a variety of industries including energy, healthcare and financial services. Founded in 1994, Data Foundry was the first Internet Service Provider in San Antonio and one of the first 50 Internet Service Providers in the United States. Today, Data Foundry operates data centers in Austin and Houston and owns private networks in Austin, Houston, San Antonio and Dallas. For more information, visit

ABOUT TEXAS 1 DATA CENTER

Opening its doors July 2011, Data Foundry's Texas 1 is a purpose-built, 130,000 SQ FT, carrier neutral data center located in Austin, Texas. Its unique infrastructure features independent and diverse power, water and network feeds without a single point of failure and is fully concurrently maintainable. Texas 1's 24 megawatt power system is fed from two independent substations. The chilled water system enables flexible cooling solutions ranging from single cabinet deployments up to high-density configurations. With over 17 network carriers available, Texas 1 is the most redundant, connected, and secure data center and disaster recovery solution available in Texas.

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