



How to Design Physical Infrastructure for Distributed Computing

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INTRODUCTION

Distributed computing has become highly valuable thanks to its local compute, storage, and networking. However, each deployment comes with the same challenges of any standard IT data center deployment plus the additional unique challenges that come with placement in locations where the primary function is not to house IT equipment — like an industrial manufacturing floor.

To help you get started with distributed computing and understand how to overcome these unique challenges, we've divided these deployments into three categories ordered from the simplest environments to the most challenging:

- IT environments
- Commercial and office environments
- Industrial and harsh environments

In this eBook, we'll explore each environment, outline the dilemmas inherent to each, and provide tips for maintaining resiliency and reliability.

Distributed Computing in an IT Environment

An IT environment is defined as a dedicated, temperature-controlled location specifically designed to house IT equipment with restricted access so only a limited number of employees can access the equipment. Here are the key considerations to plan for with a distributed computing deployment in an IT environment:



Physical Security

Physical security should be at the top of the list of considerations for your distributed computing deployment. The more you control access to your equipment at all levels (perimeter, building, room, rack), the more you can reduce the possibility of a breach. For example, we recommend room access be limited to only personnel actively managing and responsible for the equipment in that room. Keep in mind that heightened physical security also means heightened cybersecurity.

IT Rack Enclosure(s)

In addition to controlled access to the room, we recommend choosing racks that can close and lock. There are a variety of options available to create a protective environment for your gear. Learn more about choosing IT racks in our white paper [How to Choose an IT Rack](#).

Environmental Separation

While IT environments typically provide the lowest risk placement for equipment, it is also vital to protect gear from [potential hazards like smoke or fire](#) with sensors to alert staff of impending danger. Water leaks are less likely, but if you live in an area prone to flooding, you may benefit from placing water sensors on your IT racks — especially if you use an active cooling system that can create condensation. A security camera is another good way to guard against environmental hazards.

Power Infrastructure

Uninterruptible power supplies (UPS) help maintain the resiliency of your distributed computing deployment, especially in locations where power outages or severe weather events regularly occur. Consider a UPS with a lithium-ion battery; they offer longer life expectancy and lower maintenance costs. Learn more about battery options in our white paper [Battery Technology for Single-Phase UPS Systems: VRLA vs. Li-ion](#).



Cooling Infrastructure

When it comes to protecting your equipment from overheating, there are many cooling options to choose from: conduction, passive ventilation, active ventilation, and dedicated cooling. To select the right option for your distributed computing deployment, you must understand the building's comfort cooling system and how it will impact your space. Some businesses run their comfort systems 24/7, while others turn them off at the end of the workday. Learn more about choosing the right kind of cooling for your IT environment in our white paper [Cooling Strategies for IT Wiring Closets and Small Rooms](#).

Remote Management

The ability to monitor the equipment remotely is another critical factor for maintaining uptime and resiliency. Breaches and equipment failures are always possible; devices sometimes need an unexpected reboot or maintenance. Many scenarios can arise that need immediate attention, but you may not have staff on premises trained to deal with the situation quickly. This is where remote management can have a significant impact on how smoothly your distributed computing deployments run. Learn more about managing local edge systems in our white paper [Essential Guidance on DCIM for Edge Computing Infrastructure](#).

Distributed Computing in a Commercial/Office Environment



A commercial/office environment is defined as a space not dedicated to housing IT equipment, offers a semi-controlled temperature and low levels of dust, and often lacks restricted access. Here are the key considerations to plan for with a distributed computing deployment in a commercial/office space environment:

Aesthetics

The aesthetics of IT equipment housing and placement are essential for businesses that want to exude professionalism, visual appeal, and a sense of organization. Many must maintain spaces that are attractive to both clients and personnel. A visible jumble of IT wires and cables, for example, does not fulfill that need. Fortunately, there are options available for rack enclosures designed to look more like furniture to blend in with the environment.

Noise Restriction

Offices with aesthetic considerations usually want to minimize noise generated by IT equipment, as well. For example, the average background noise in an office is about 50dBA, and the volume of a conversation is about 60dBA. The IT fans of 4-8 low form factor servers with average CPU loads can be around 65-68dBA, and cooling fans will add to this noise. If this is an issue in your space, look for equipment housing lined with acoustic material to dampen the sound.

Thermal Comfort

IT equipment can also generate a significant amount of heat, impacting people working around the equipment. Room size is a critical factor — small offices usually heat up much faster than larger areas. Some enclosures provide active ventilation, but their effectiveness depends on how tightly equipment is packed into the room. If active ventilation isn't enough, supplement cooling becomes necessary.

Space Constraints

In commercial/office environments, spaces are often maximized to serve their primary business function, with minimal space left over for support functions like IT equipment. For this reason, one small room may serve as a break room, office supply room, and IT room all at once. A wall-mount rack is often a good solution for multi-use areas. They save space and reduce the opportunity for human error or security breaches because the equipment isn't as reachable. Plus, the heat output is further away from work areas, so it has less impact on workers.

Physical Security

More physical security risks appear in commercial/office environments because the equipment is often in a shared space that is more easily accessible. In these spaces, rack enclosures should always be locked with access granted only to limited personnel. In addition, it is best to locate enclosures in an inconspicuous location with a security camera to record activity. Other options include adding dry contacts to the enclosure to alert you whenever the doors are opened and placing the equipment in a wall-mounted enclosure high up in a hard-to-reach area.



Distributed Computing in Industrial and Harsh Environments

An industrial or harsh environment is defined as an indoor or outdoor location with uncontrolled conditions like wide temperature ranges and humidity, high amounts of dust or other contaminants, and the potential for water leaks. These spaces also often lack restricted access. Here are the key considerations to plan for with a distributed computing deployment in an industrial or harsh environment:



Temperature/Humidity

When it comes to temperature and humidity, industrial or harsh environments require that you plan for extreme highs and/or lows as well as rapid changes. For example, an open warehouse space may expose equipment to changing seasons and frequently fluctuating weather patterns. A dedicated cooling system can help regulate temperature and humidity, and there are micro data center solutions that offer a self-contained air conditioner. These solutions are often referred to as 'ruggedized enclosures.' We'll discuss ruggedized solutions in more detail below.

Water/Leaks

Water main lines and overhead water pipes pose a significant risk to IT equipment. Fortunately, there are many options to help you protect your gear from water damage. Many enclosures (but not all) are classified under a rating system to help you choose the best option for your situation. For example, the [IEC standard 60529](#), or Ingress Protection (IP) code, classifies and rates the level of water protection offered from 0 (no protection) to 8 (protective for submersion). The [NEMA](#) rating is also often used in North America.

Particles/Dust

Industrial and harsh environments often contain dust and other contaminants that can reduce IT equipment reliability and life expectancy. Self-contained, sealed enclosure designs are available to protect equipment from these particles and, just like with water protection, [IEC standard 60529](#) rates these to help you choose. If you select an unsealed solution, an air filter can help, but it must be regularly cleaned/replaced to offer protection.

Vibration

High vibration levels can also reduce the longevity of IT equipment. This is a critical factor in areas where large industrial machinery is working alongside distributed computing gear. Here are a couple of ways to mitigate the impact of vibration:

- Place the enclosure on isolated spring mounts to reduce the transfer of vibrations through the floor.
- Use rubber vibration isolation pads to absorb noise and high-frequency shakes.



Collision

Collision risks appear in areas where forklifts or other machinery are mobilized near IT equipment. We recommend placing distributed computing gear as far away as possible from traffic areas and adding concrete bollards to protect the gear where it makes sense. Wall-mount racks can be helpful here, as long as they don't extend from the wall into traffic areas. Motion sensors and security cameras can also help deter collisions. Like the previously mentioned water and dust standards, there are also ratings to tell you what level of protection an enclosure offers against external impacts ([IEC 62262](#)). Learn more about IK (impact protection) ratings in our white paper [Physical Security in Mission Critical Facilities](#).

Nuisance Events

Nuisance Events are a catch-all category for a wide range of downtime-causing events that can happen in uncontrolled environments. For example, an animal chewing on wires, vandalism, or sudden adverse weather events. A few ways to cut down on these unforeseen challenges include selecting sites for IT equipment that minimize visibility of the gear and keep it out of reach of potential hazards, implementing proper security measures, and designing systems with protective liquid-tight or rigid conduits. A couple of rating standards that may come in handy are:

- EN 1627: European standard for burglar-resistant gear
- IEC 61439-5: international standard for anti-vandalism and resistance to shock, impact, torsion, and more



Corrosion

Factories using chemicals in their manufacturing processes often release gaseous contaminants, heightening corrosion risk for printed circuit boards, hard drives, and servers. Fresh air exposure also comes with added risk when the space is near saltwater or in high-humidity environments. Different enclosure materials offer different corrosive properties, and there are coatings and paints to add protection (see [ISO 12944](#)). Enclosures with thermal insulation, double-wall panels, casketing, and strong cable fittings to isolate the gear from the environment are also available.

Ruggedized IT to Mitigate Risk in Industrial and Harsh Environments

Military-grade IT equipment offers more temperature/humidity tolerance and heightened protection against water, dust, and vibration. Depending on the specs, these options often cost more than standard IT, mainly because the volumes sold are usually much lower and the suppliers offering these solutions tend to be at the higher end of the pricing and quality spectrum.

These solutions are often sealed without fans, which puts constraints on the amount of computing power. Ruggedized IT often works well for a single device but not for several. These enclosures usually need some basic maintenance but have an overall lifespan of at least ten years. You will pay the premium price each time you refresh equipment, but you'll also be able to amortize that premium over a longer period of time.



Partner with Distributed Computing Experts

The specific design requirements for distributed computing deployments are often highly dependent on their environment, in addition to the standard requirements that come with any data center deployment. As environments become riskier, solutions must become more effective and reliable. Before embarking on a new distributed computing project, classify your site(s) into one of these three categories and follow the tips provided to ensure risks are mitigated, and requirements are met. The right partner can make this process exponentially easier.

Schneider Electric's proven industry leadership, combined with our large community of IT partners, has resulted in collaborative technology that delivers connectivity, reliability, and accessibility through

simplified delivery and expert services. We can serve as your trusted partner, helping you reap all the benefits of on-premise edge micro data center solutions to the fullest. Our EcoStruxure Micro Data Center solutions offer a complete distributed IT infrastructure within a stand-alone, secure enclosure for protection of critical business applications, and includes power distribution, UPS, and environmental monitoring. It's fast to deploy, secure, standardized for reliability, and cost effective.

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APC by Schneider Electric

Boston One Campus
800 Federal Street
Andover, MA. 01810 USA
Phone: + 1 976 794 0600

www.apc.com

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