Belden

# Maximize Data Center efficiency: optimize space without oversizing

White Paper

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## Introduction

Is your equipment consuming valuable space that could be better managed? Are you cooling and maintaining equipment you're not using? Efficient space utilization in a data center is crucial.

Undersizing and underutilizing space may require future expansion or new facilities. Oversizing and overutilizing space unnecessarily increases capital and operating costs.

According to Forsythe Data Center Solutions, the average data center is 18 years old. How can you ensure your data center meets current workload management needs and adapts to future applications and business requirements?

Design your infrastructure for flexibility and scalability to optimize space and resource utilization. This approach improves sustainability and controls energy and operating costs. Even in data centers that seem to be running out of space, you can recapture, repurpose and reallocate square footage.

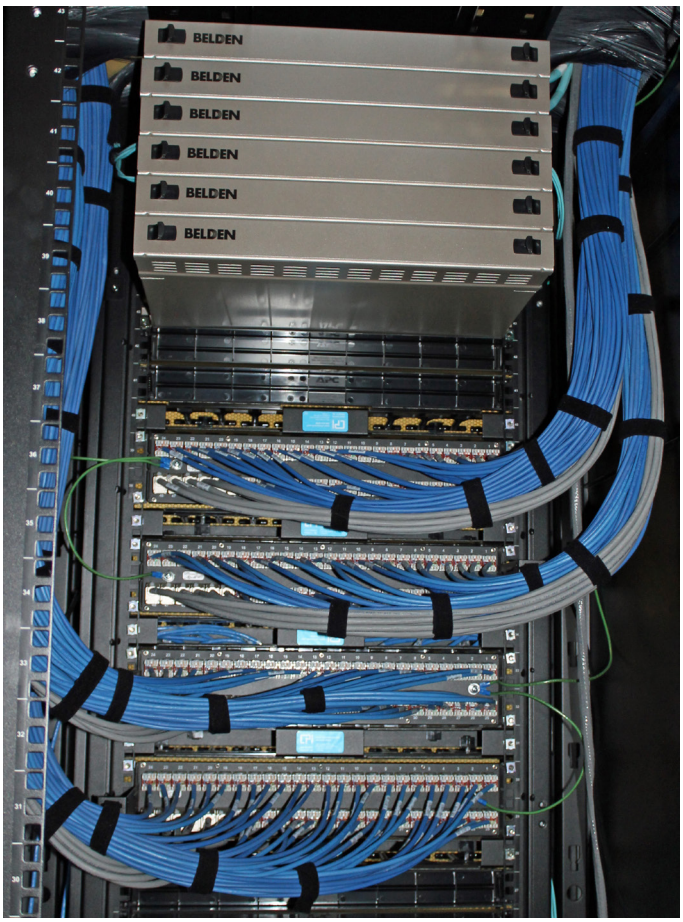
To make the most of your data center space without oversizing, there are three components to consider:

- Cabling and cable management
- Racks and cabinets
- Utilities (power and cooling)

Here are 11 ways you can make the most of data center space without oversizing.

### 1. Use vertical space

Vertical growth allows more equipment to occupy the same square footage in your data center.



Make use of currently unused space outside the rack with zero U solutions that maximize rack units (RUs) for equipment. This approach is particularly valuable in high-density environments where optimizing rack capacity and maintaining organized cable routing are critical.

Mount connectivity in other areas, such as on ladder racks above cabinets, to provide vertical rack space. Patching above the rack or cabinet is another efficient way to use above-the-rack space.

Consider zero U vertical patching to accommodate fiber or copper connectivity in data center cabinets without taking up valuable rack space. These patch panels mount vertically inside the cabinet along equipment mounting rails. This approach not only maximizes rack space and keeps energy and space usage in check, but also reduces the number of racks you need to purchase.

While cross-connects can be placed in a rack, a wall-mount cross-connect takes advantage of free real estate. This allows you to install passive connectivity on the wall, potentially reducing the number of racks required.

In addition to saving valuable rack and floor space, wall-mount cross-connects offer another benefit: When networking equipment is upgraded every three to five years, changes in form factor and density occur. Replicating all equipment ports on a wall-mount system ensures a smooth transition and avoids forklift upgrades to cabling infrastructure.

### 2. Invest in smaller-diameter, rightsized cables and patch cords

Even if cable congestion isn't an issue now, smaller-diameter cables can prevent future problems. As density increases, equipment footprints may shrink, but the number of cables in your cabinets will rise.

Cables with small outside diameters (ODs) save space by allowing more cables in a pathway without needing larger, more expensive ladder racks and cable trays. Smaller-diameter cables also free up rack space for more equipment instead of dedicating it to cable management.

Additionally, smaller-diameter cables improve cabinet airflow, reducing cooling needs and ensuring an optimal environment for peak performance. Their compact size allows air to move around them easily.

Ensure cables are the right length without excessive slack. Excess slack can clog pathways, add weight, reduce airflow and require additional storage space. Proper cord routing, such as using angled panels, can help improve space utilization by organizing cords more efficiently.

### 3. Ensure adequate cable pathways and management

Pathways are often overlooked. Coordinating them with power, airflow and other resources like liquid cooling can reduce interference and optimize access and utilization.

When selecting cable management solutions, consider options that:

- Support cable density
- Provide ample room for future cable additions
- Allow sufficient airflow around cables
- Accommodate both copper and fiber

Cabinet design also influences cable management. Depending on the depth, power distribution units (PDUs) can be placed on one side, while cables can be organized on the other.

Belden's Customer Innovation Center (CIC) can assist in designing your data center infrastructure to optimize cable management.

### 4. Implement high-density and mixed-media solutions

Today's high-density solutions enable more computing power in a smaller space. High-density connectivity and mixed-media options (supporting both copper and fiber) optimize space while accommodating large port densities.

High-density connectivity solutions offer the flexibility and scalability needed to support demand increases. Additional connectivity can be added as needed without requiring data center managers to know exact port numbers or connector types.

For example, high-density patch panels can double the port density in 1 rack unit (RU) of space. This allows for density increases and technology changes without replacing existing infrastructure. High-density solutions reduce the need for cabinets and power distribution units (PDUs). They involve smaller fire detection and suppression systems and utilize shorter telecommunications runs and electrical power feeders. This approach saves space and reduces operating costs.

Mixed-media panels that manage both fiber and copper save space and simplify transitions between the two.

As fiber optic cable becomes more prevalent due to increasing speeds and bandwidth requirements, transitioning from media-specific to mixed-media connectivity allows for a smoother transition. This approach lets you adapt at a pace that suits your data center.

Combining fiber and copper in a single panel eliminates the need for separate panels, resulting in automatic space savings.

### 5. Maximize racking efficiency

Racks occupy significant square footage. Optimizing the space they offer enhances space utilization. The more connectivity you fit into a space, the less square footage is needed. This results in reduced energy usage and more available space for other purposes.

Some data centers run cabinets at only 40% capacity, leading to inefficiency and nearly double the expenditure on cabinets.


Fully populated racks maximize existing space without increasing costs, saving money by avoiding unnecessary rack purchases. This also eliminates the need for blanking panels to cover empty rack unit (RU) space.

Non-traditional connectivity, such as zero U solutions, can further maximize rack potential by moving high-density connectivity options out of the rack. These options can be placed along equipment mounting rails.

To maximize efficiency, it's crucial to utilize the space within each rack effectively. Underutilized or poorly managed racks prevent you from getting the most out of available resources.

Avoid using single-use or single-purpose racks, including those branded for specific equipment, as they often remain partially loaded and waste space. They also lack the flexibility to accommodate changes. Instead, opt for build-to-suit modular and component-based racking systems that can manage multiple brands and applications. These systems can be easily reconfigured as needs evolve.

### 6. Try a centralized distribution system

For space-saving, a centralized distribution system using a cross-connect scenario is often the best choice. This approach brings all cables to a single location for maintenance, patching and servicing. It effectively separates infrastructure topology from network topology.

Imagine how much more productive staff could be without constantly moving around for routine maintenance!

A centralized distribution system allows network components to have permanent equipment cables remain terminated on the backs of panels. Equipment is then connected with patch cords or jumpers at the cross-connect. In contrast, direct cabling requires more cables and thus more space.

However, centralized distribution isn't always optimal. For example, a 5G edge data center might benefit more from a purpose-built distribution system. It's essential to understand your environment and its specific requirements.

### 7. Consider hyperconverged solutions

Hyperconverged infrastructure solutions can save rack space by "de-siloing" infrastructure.

They allow you to place compute, network and storage in the same cabinet instead of separate ones. This setup saves floor space. Centralizing these components significantly reduces the physical space needed for infrastructure.

Gartner projects that by 2025, 75% of enterprises will have adopted hyperconverged infrastructure. This reflects the growing trend towards more integrated and efficient infrastructure.

Connecting hyperconverged solutions to a fabric network like leaf-spine architecture reduces latency for east-west traffic. This traffic moves from server to server within the hyperconverged solution.

This means data doesn't need to return to a main distribution area, go through a cross-connect, out to storage and back to the server before reaching its destination. Instead, data moves directly from the main distribution area to horizontal distribution and then to equipment distribution.

Hyperconverged solutions also enhance and streamline cable management. Cables run within a row or between two cabinets, rather than across multiple cabinets and rows.

### 8. Place workloads in the right space

Each workload has an optimal location that impacts business processes and the customer experience. Determine where your data center's workload belongs to ensure optimal functionality and service delivery.

Instead of choosing between cloud adoption or traditional data center infrastructure, place workloads where they best meet business demands. Combining cloud and edge solutions with traditional infrastructure ensures workloads are in the right place at the right time, requiring space only for the workload in that area.

Consider retail environments during the holiday rush. Data transfer increases significantly in October, November and December, requiring network elasticity to grow during these months and shrink in January. The cloud can accommodate this, but only for applications that need to expand and contract over time, saving money and space.

Education environments also benefit from better workload management. Specific applications are used during certain parts of the year when students are on campus, requiring network elasticity. These applications aren't needed during summer months, long breaks or hands-on learning outside the classroom.

**The key takeaway:** Applications needing elasticity are great candidates for the cloud.

Data and applications needing proximity to users are suited for edge solutions.

Workloads involving significant compute power and frequent ingress/egress of information (north-south movement) are best managed in your core data center.

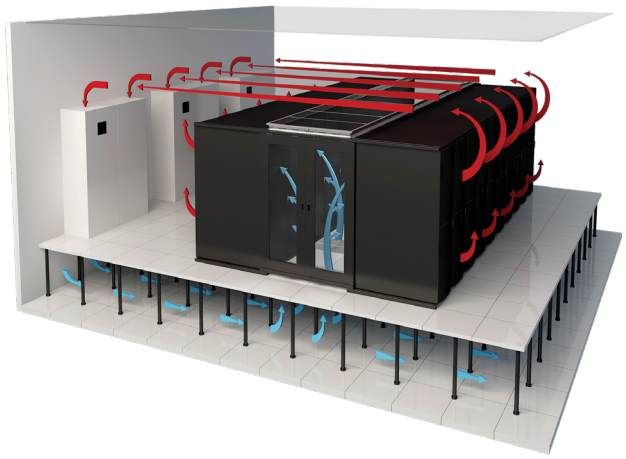
### 9. Implement air-handling solutions suitable for your environment

There is no one-size-fits-all solution for air-handling in a data center. The primary goal is to manage hotspots.

Depending on your space, this could involve CRAC (Computer Room Air Conditioning) or CRAH (Computer Room Air Handler) units, chimney containment and doors. It might also include hot-/cold-aisle containment or a combination of these options.

Equipment placement and power usage also influence the type of air-handling solution you choose. For example, a cabinet running at 5 kW next to one running at 20 kW will be affected by the heat from the higher-powered cabinet.

There is no definitive "right" or "wrong" way to address this issue. Options include implementing hot-/cold-aisle containment or separating the cabinets for better airflow. The best solution depends on your environment, available space and overall data center management.



Remember, to optimize cooling resources, systems must operate at optimal efficiency (above "low" or "idle"). By right-sizing your utilities and ensuring equipment runs at around 80% of maximum load, you can reduce the total space needed for air-handling equipment.

### 10. Increase cabinet power density

Providing more computing power at a lower cost per square foot supports higher density per rack or the same amount of IT equipment with fewer cabinets. This approach reduces occupied floor space. Fewer cabinets also mean less cabling, fewer power distribution units (PDUs) and less equipment to manage.

Using 3-phase power in your data center optimizes space by allowing utilities to deliver more power over smaller, less expensive wires. This is more efficient compared to single-phase power systems. It enables carrying more load by combining three alternating currents that vary by 120 degrees in phase, preventing the power from dropping to zero. Additionally, 3-phase power reduces the number of cables and PDUs within a cabinet, freeing up space for other devices and improving airflow.

### 11. Utilize Data Center Infrastructure Management (DCIM)

A Data Center Infrastructure Management (DCIM) solution helps manage power, cooling, capacity, loads, pathways and spaces. This ensures efficient use of space and resources.

By collecting real-time data, DCIM monitors, measures and manages data center utilization and energy consumption. It integrates facilities and assets with network management software and applications, providing a comprehensive view of data center performance trends and potential capacity issues.

DCIM also forecasts the impact of proposed data center projects on space, power, cooling and networks. It offers a holistic view of infrastructure, going beyond simple connections to provide deeper insights. While patching information is important, immediate problem investigation can diminish Return on Investment (ROI).

### Adapt, change and connect for maximum efficiency

Your data center approach should evolve with your needs and new realities. Data centers are never "done." One-size-fits-all designs no longer work. Instead, flexibility is key to maximizing space. Growing in place and making the best use of existing square footage helps you expand data center output without adding more infrastructure to manage.

Better space utilization reduces the likelihood of needing to expand your data center or build new space in the future.

Belden can help you design, upgrade and maintain a data center to maximize existing space.

Our space-saving solutions include:

- Data center products that maximize space to efficiently maintain and scale your business
- High-density solutions that provide better space optimization and allow for additional bandwidth
- Standard product family footprints to ensure everything fits together and reduces required rack unit (RU) space
- Space-efficient product innovation that ensures superior performance while decreasing necessary product space

To learn more about Belden data centers, visit www.belden.com/markets/data-centers.

# Connect to what's possible.

White Paper

# About Belden

Belden Inc. delivers complete connection solutions that unlock untold possibilities for our customers, their customers and the world. We advance ideas and technologies that enable a safer, smarter and more prosperous future. Throughout our 120+ year history we have evolved as a company, but our purpose remains – making connections. By connecting people, information and ideas, we make it possible. We are headquartered in St. Louis and have manufacturing capabilities in North America, Europe, Asia and Africa.

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