DATA CENTER DESIGN

Best Practices

Mechartés

SIMULATION EXPERTS

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Introduction

A data center is a physical location where businesses keep their mission-critical programs and data. The design of a data center is built on a network of processing and storage resources that allows the delivery of shared applications and data.

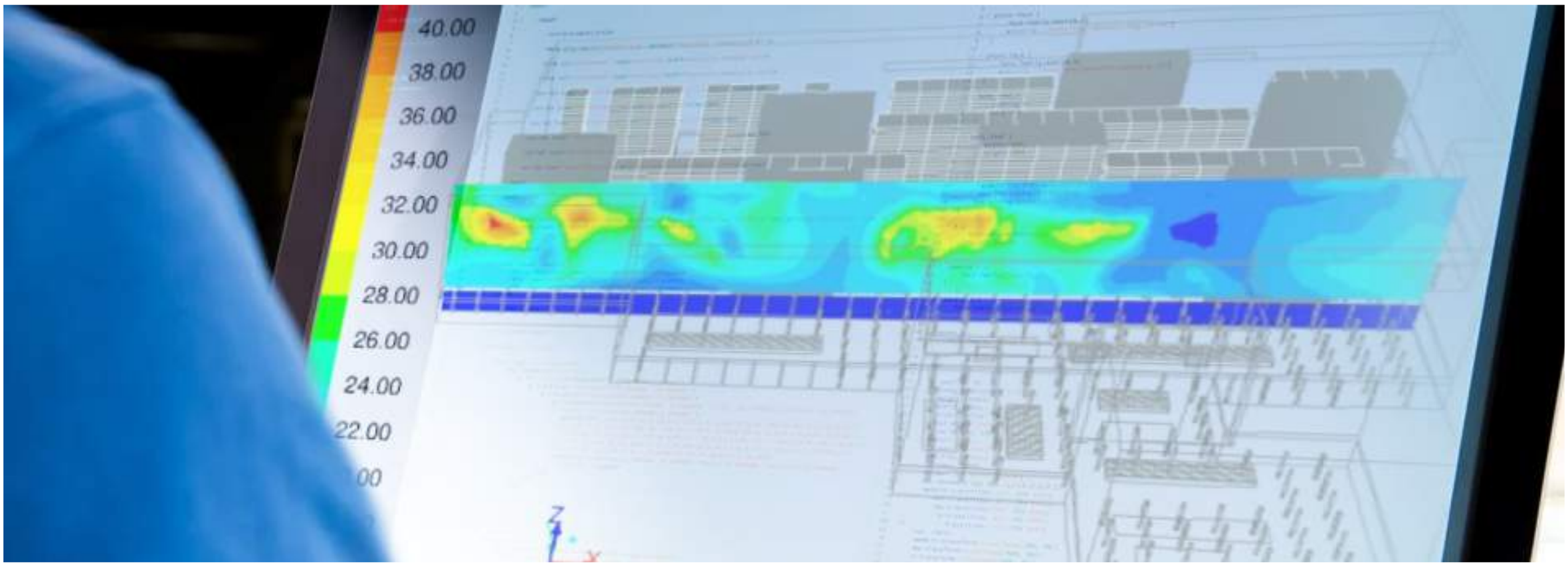
Routers, switches, firewalls, storage systems, servers, and application-delivery controllers are the most critical components of data center design.

The size of data centers can range from small rooms, single floors to a 100-acre facility, depending on the nature of its function and requirements.

But not all data centers are built equally. Consequently, not all can provide the same level of support and expertise when the need arises. This makes proper planning an essential step in designing a reliable data center and can be scaled.

Introduction

To build a thriving data center, you must explore the various aspects of data center design and its essential components. Trained professionals for decades have collaborated to guide future data center owners.



Mechartes is one such company with over 50 skilled engineers and simulation experts who work on data center's pre-design and design stages. They have helped several clients globally in the past 16 years by analyzing existing environmental and structural conditions to curate the best-fitted data center designs and techniques for their clients.

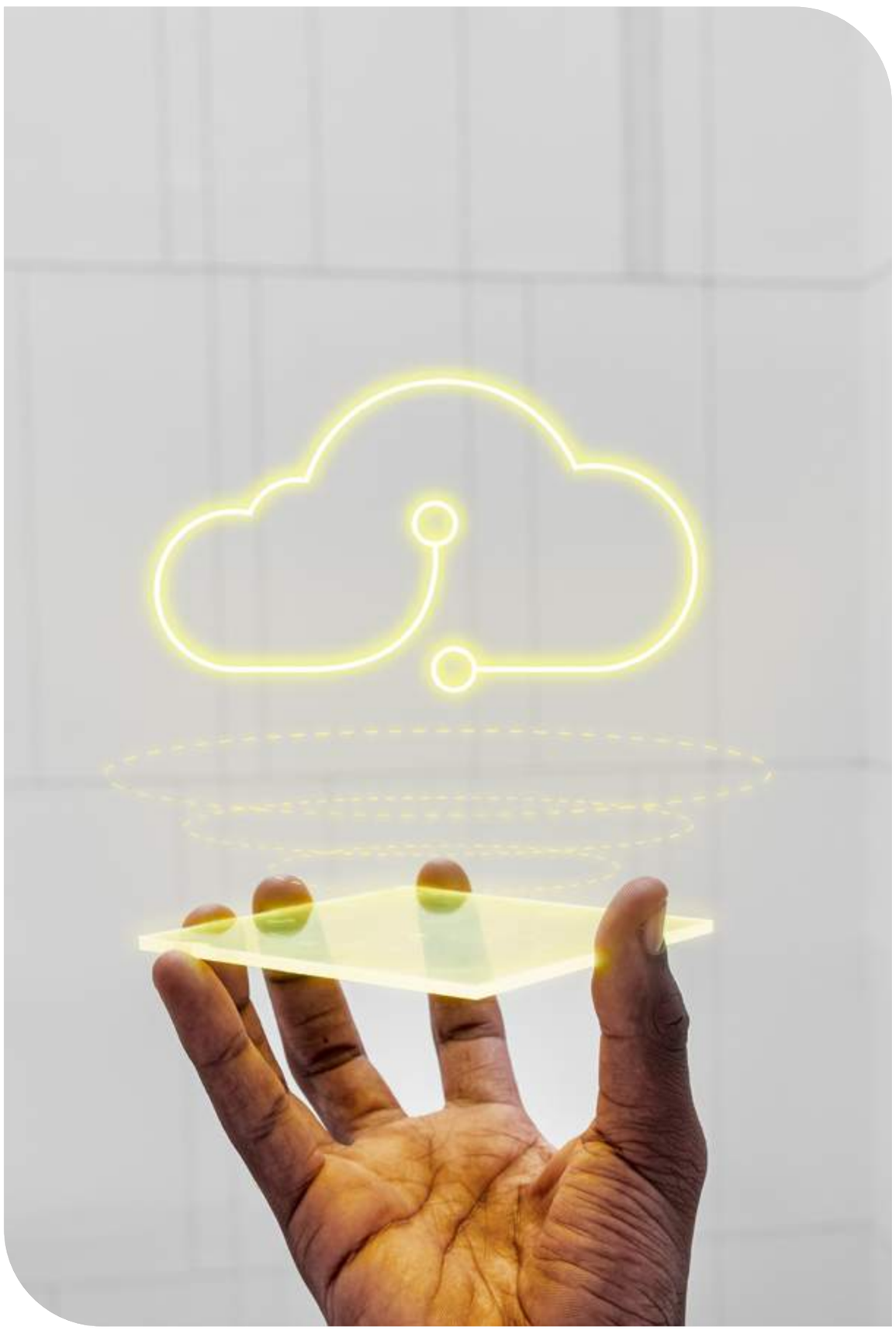
This ebook unfolds a holistic picture based on decades of gathered data of the ideal data center and shares and advices on how to handle the ever-increasing problems encountered by administrators both today and in the future.

Introduction

Market: The Data Center Services Market was valued at USD 48 billion in 2020 and is expected to reach approx. USD 100+ billion by 2026, at a CAGR of 13.5% over the forecast period 2021 - 2026. Business leaders are facing an influx of data, and thus, they are under pressure to manage all business-critical data, along with the constant need to outpace their competitors.

The emerging cloud technology in data centers is one of the key factors driving the demand for data center systems and technology, thereby, fueling the market growth.

Digitization has imparted certain crucial changes in the ways of data consumption in the past decade, especially in India. As millions of web users keep piling every year, the average data consumption by a user, which stood at 10 GB/month in 2018, reached 13.4 GB/month until 2020 and is expected to see a drastic rise of 21 exabytes/month until 2025.

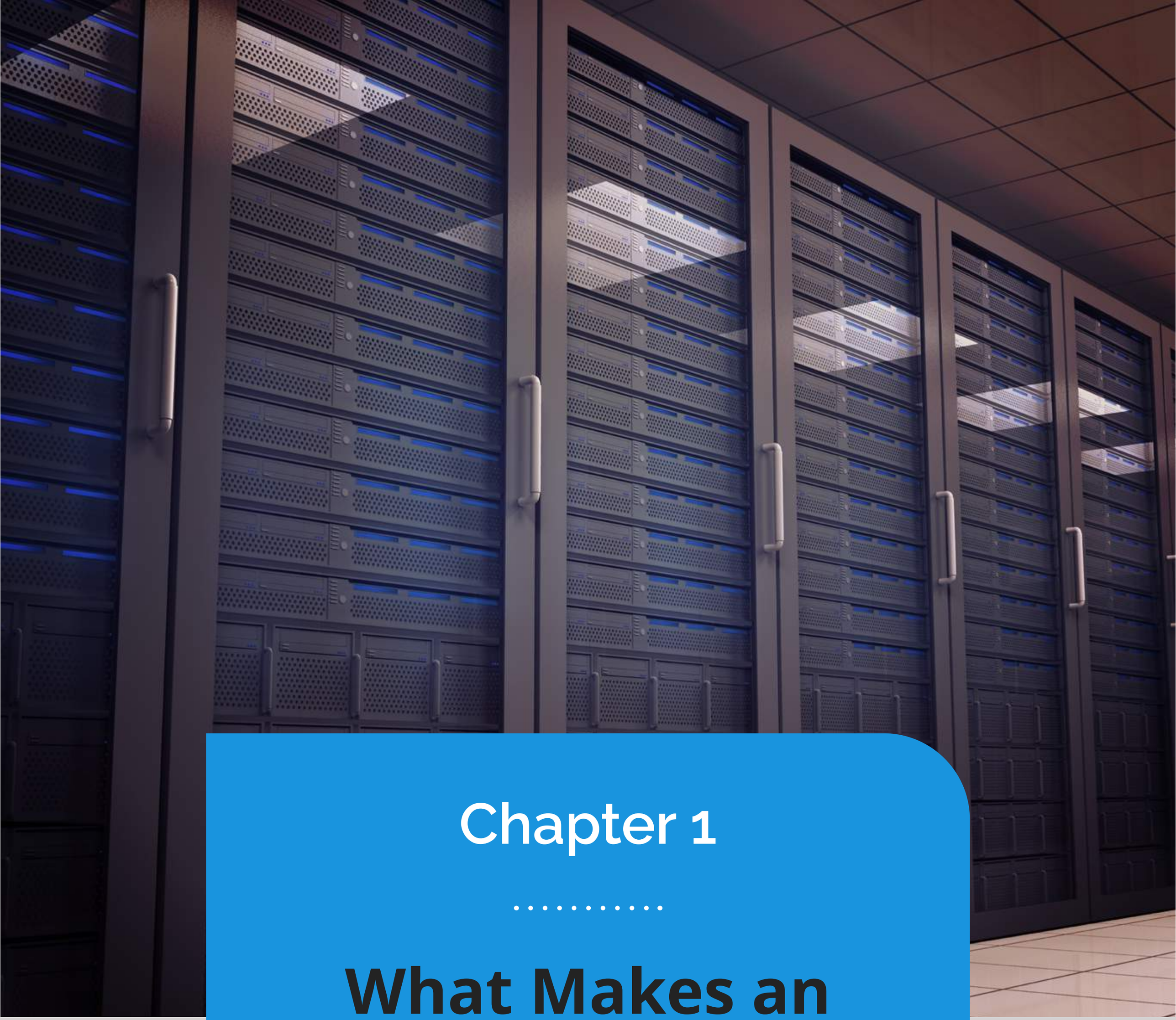


Introduction

The increase in demand for online retail / e-commerce, work from home due to COVID-19 pandemic has acted as a catalyst for the data center industry. Organizations across industries are accelerating their digital transformations and looking toward technology to help them adapt to a new normal where disruption could be around every corner. Customers want more personalized data center, services & solutions.

In North America being the most advanced region, data center services are in demand. However, at the same time, Asia-Pacific is also growing because of the presence of two big giants of data consumption: India and China.

On the flip side, concerns relating to data privacy is a major concern nowadays, which is acting as a limitation for this market to grow. As the data are not being hosted locally in many countries, there are high chances of leakage of data.



Chapter 1

What Makes an Ideal Data Center: Understanding Industry Standards

1 What Makes an Ideal Data Center: Understanding Industry Standards

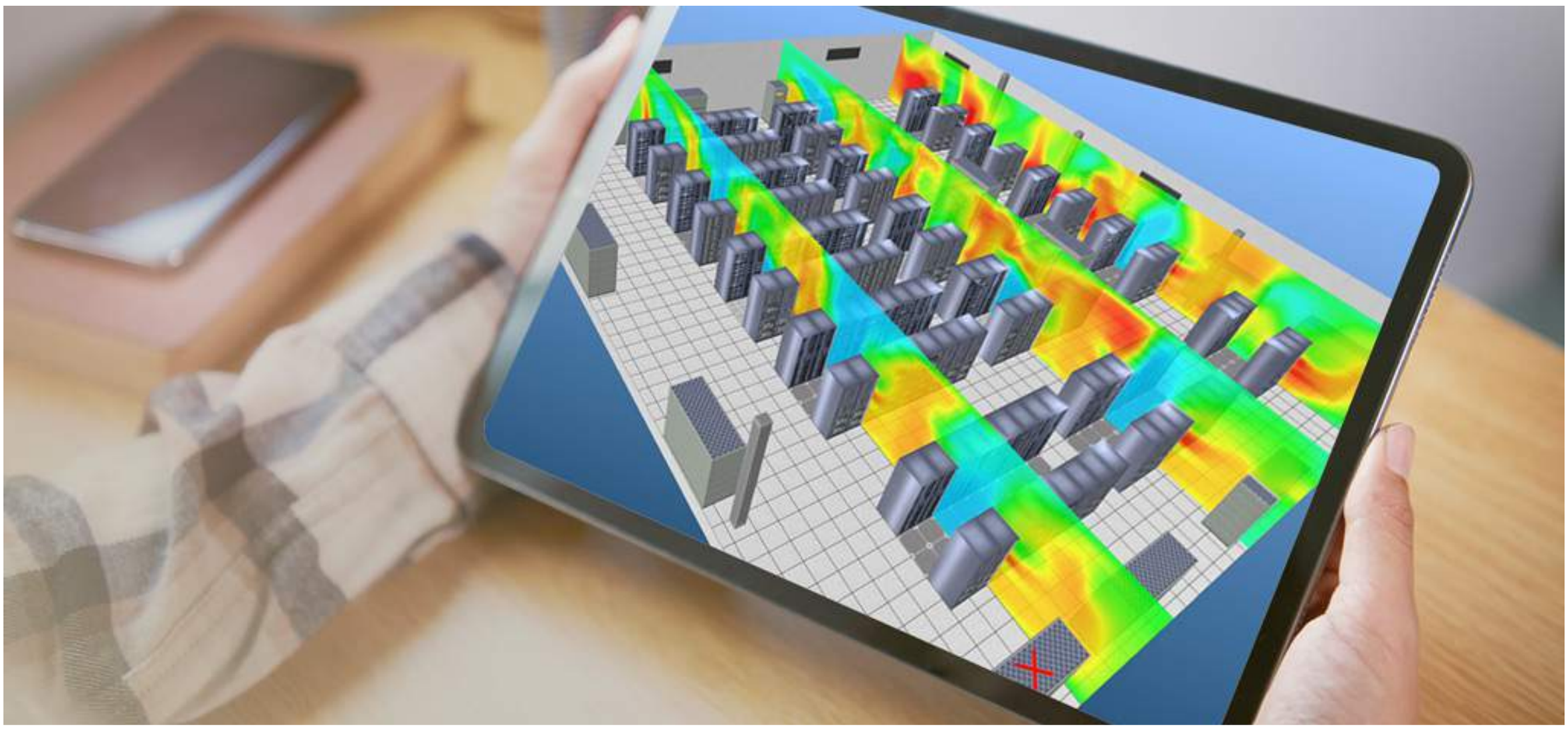
Challenges: Numerous companies already have data centers since long, and many of them do not intend to replace/upgrade their facilities completely with more power efficient or a green data center.

As every data center is critical in business operation, IT equipment functions 24*7, generating a lot of heat. The heat generated is enough to pose serious threats to data centers. Higher electricity expense due to increasing energy consumption is not the only issue.

If cooling is inadequate, the equipment can overheat. Hotspot can also develop somewhere inside the facility. These problems are the main culprit for data center downtime. Here, the challenge of optimized solutions with the operating equipment and solutions of existing data centers is a serious subject, and companies have concerns regarding the budget and compatible modern solutions. They desire to have efficient solutions, so that they can achieve higher profitability, prevent downtime and lower their operational expenses.

1 What Makes an Ideal Data Center: Understanding Industry Standards

However, many companies wish to add/replace certain components like servers, racks, AC Units, Heat Exchanger Unit to make use of their existing data centers. As power and heat loads rise, efficient cooling is becoming more challenging. Developing an airflow improvement plan is difficult as it is not perceptible to the eyes. One way to address this challenge is the use of Computational Fluid Dynamics (CFD) Analysis.



Hence, many vendors are tackling this challenge and providing components, such as less power consuming servers, better cooling, and power infrastructure, which can be modified as per the existing data center structure and deployed easily. Moreover, if the price of electricity continues to grow, the ROI can be obtained much earlier.

1 What Makes an Ideal Data Center: Understanding Industry Standards

Important Data Center Standards to consider

Following codes and standards for your data center design is essential for life safety and energy efficiency purposes. However, these standards can vary depending on your company's requirements. The best way to go about it is to frame the missions and goals for your data center, pick codes and standards and work towards following them.

There is a range of standards of the various aspects of a data center design like the facility's conceptual design, space planning, building construction, physical security, mechanical, electrical, and plumbing infrastructure, and fire protection.

Standards also differ between countries. If you have facilities across the globe, it is best to follow internationally accepted codes. If your facilities are limited to a single country, following national codes is sufficient.

Some of the important standards and codes followed by a significant number of data centers globally are listed below:

1 What Makes an Ideal Data Center: Understanding Industry Standards

ASHRAE Guidelines

ANSI/ASHRAE Standard 90.4-2019, Energy Standard for Data Centers, establishes the minimum energy-efficiency requirements for the design and operation of data centers, with special consideration to their unique load requirements compared to other buildings. Standard 90.4 applies to data centers with a conditioned floor area greater than 20 W/ft2 and IT equipment loads greater than 10 kW and contains specific requirements for mechanical and electrical systems installed in new data centers or in data center additions/alterations that require new mechanical or electrical systems.

> "The updated standard enables operators and designers to use the latest and most effective equipment and techniques to achieve energy efficiency in data centers, while avoiding potential reliability issues."

Two AHRAE standards to be considered are:

1. Standard 90.4-2019 — Energy Standard for Data Centers (ANSI Approved)

2. Standard 127-2012 — Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners (ANSI Approved)

1 What Makes an Ideal Data Center: Understanding Industry Standards

A robust data center meets the existing requirements of users efficiently, without delays or downtime. But, as data keeps accumulating, data center designs must be capable of supporting expansions, upgrades, and additions.

Many data centers fail or slowly disintegrate because they neglect to consider sustainable and realistic data center designs and practices that are the present and future goals of the company. This usually results in a loss or unnecessary capital investments and a waste of time.

CFD analysis is one such technology which offers a quick and cost-effective method of evaluating new designs or alterations to existing designs before they are implemented in accordance with ASHRAE data center standards. To know more about CFD analysis benefits, methodology and software you need to contact specialized CFD consultant like Mechartes who can precisely guide and help you make the best decisions on Data Center Design Best Practices.

1 What Makes an Ideal Data Center: Understanding Industry Standards

Tier Classification by Uptime Institute

Uptime Institute came up with Tier Classification, predominantly followed as an essential data center standard globally for the past 25 years.

The Tier Certification ratings issued by Uptime Institute help ascertain performance requirements for a data center and budget finances accordingly. The classification does not imply that a specific class is superior to the other. Instead, it simply defines the data center's criteria and performance with respect to the business's operational requirements.

Data centers can incorporate several solutions to meet performance needs and compliance regulations as these Tiers are flexible and progressive. In addition, the Tier Certification gives worldwide accountability for excellence and does not imply that the data center has any weak areas.

1 What Makes an Ideal Data Center: Understanding Industry Standards

Refer to the following table for a brief overview of the Tier Classification.

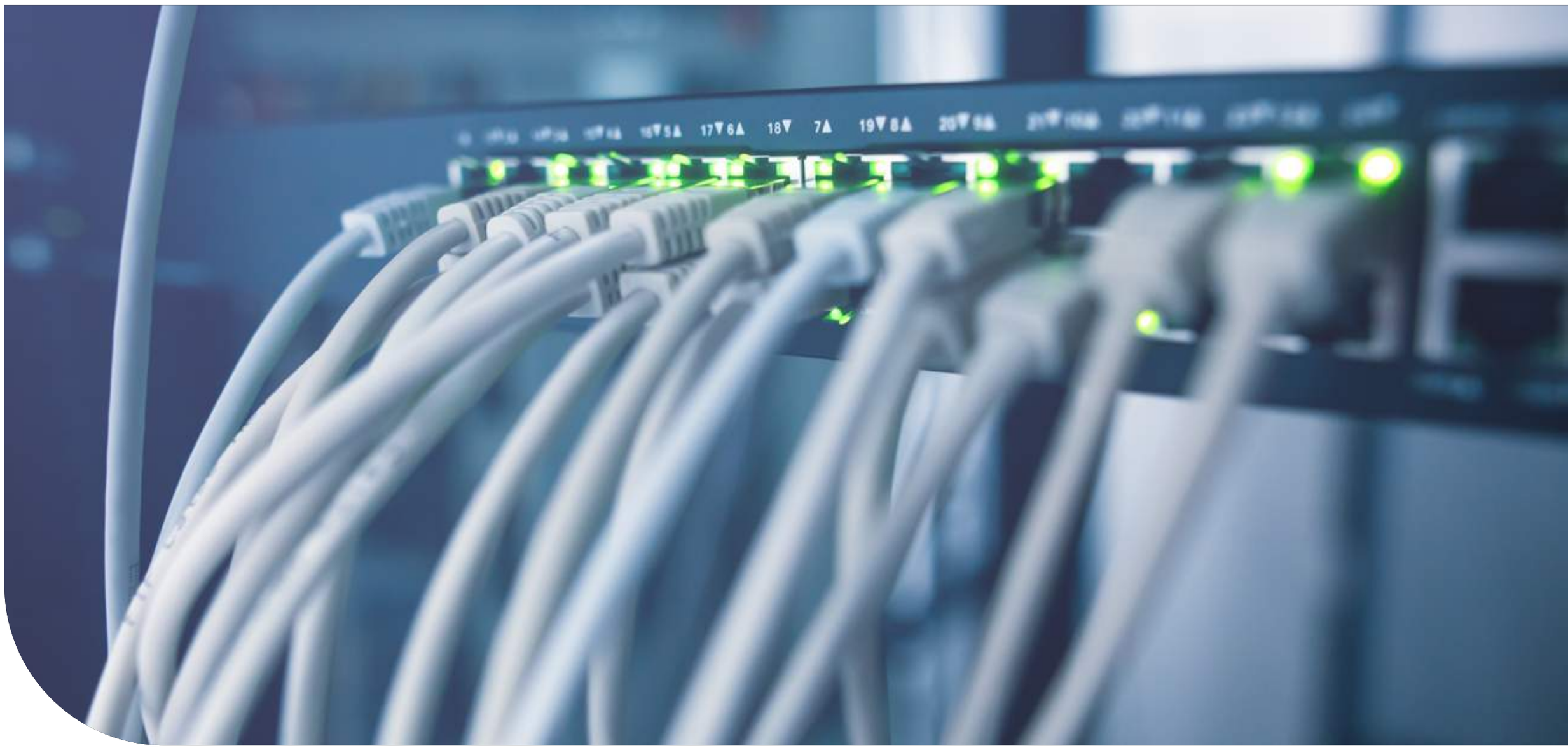
Tier rating	Tier 1	Tier 2	Tier 3	Tier 4
Active Capacity Components	N	N+2	N+1	N after failure
Distribution Paths	1	1	1 Active + 1 Alternate	2 Active
Concurrently Maintainable	No	No	Yes	Yes
Fault-Tolerant	No	No	No	Yes
Compart-mentalization	No	No	No	Yes

1 What Makes an Ideal Data Center: Understanding Industry Standards

Cabling Standards by TIA 942

Proper cabling standards present efficient designs, easy installation, and good performance of the network. Telecommunications Industry Associations (TIA) came up with TIA 942 Telecommunications Infrastructure Standards for Data Centers in April 2005 which addresses the standards for data center designers in the building development process. It covers 4 main areas:

- Site space and layout
- Cabling Infrastructure
- Tiered reliability
- Environmental considerations



1 What Makes an Ideal Data Center: Understanding Industry Standards

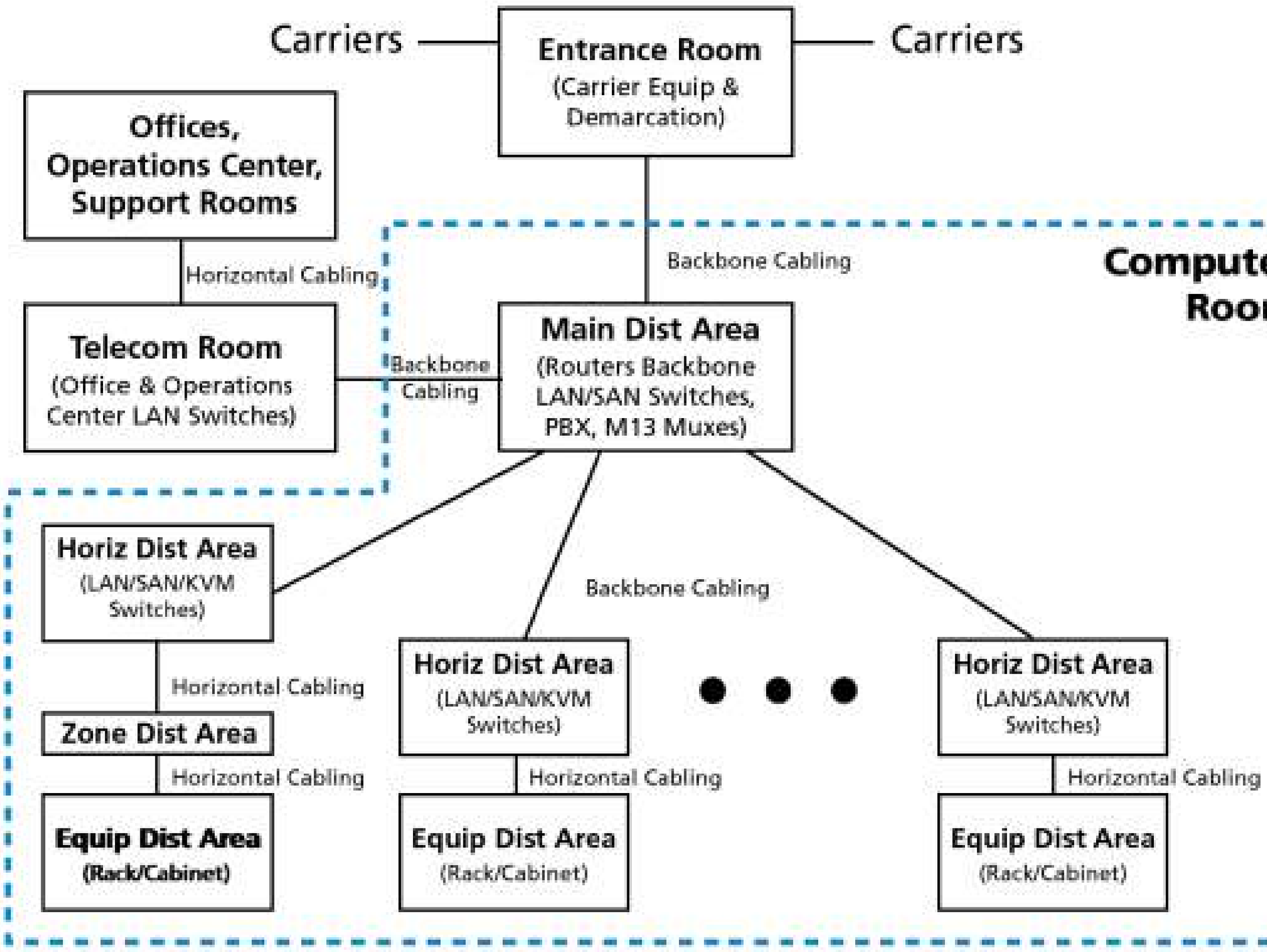


Figure 1. TIA-942 Compliant Data Center Showing Key Functional Area

Apart from other standards mentioned by TIA 942, it prescribes a good framework for cabling standards built on existing TIA 568 and 569 standards. TIA 942 provides a generic, permanent telecommunications cabling system and provides specifications for the following cabling media:

1 What Makes an Ideal Data Center: Understanding Industry Standards

- Standard single-mode fiber
- 62.5 and 50µm multimode fiber
- Laser optimized 50µm multimode fiber (recommended)
- 75-ohm coaxial cable (recommended for E-1, E-3, and T-3 Circuits)
- 4-Pair Category 6 UTP and ScTP cabling (Cat 6* recommended)

TIA 942 extends the TIA 606A Administration Standard to data centers which prescribe a labeling scheme for all racks, cabinets, patch panels, patch cords and cables.

1 What Makes an Ideal Data Center: Understanding Industry Standards

EN 50600 Standards

EN 50600 provides specifications for data center planning, construction, and operation. It covers all data center operational criteria standards like construction, power supply, cooling conditions, cabling systems, and security.

EN 50600 was created by the European standardization organization CENELEC and is applied to new data centers. These standards help data center owners enjoy benefits such as these:

- Transnational and operational Standards for data center owners.
- Helps data center owners plan, operate, and expand their facilities in a future-proof manner with a sophisticated and modular approach.
- Helps with certification in the tendering process and provides security.
- Establishes and improves the quality of internal project management.

1 What Makes an Ideal Data Center: Understanding Industry Standards

Since 2012, EN 50600 has released 10 parts & subsections covering various aspects:

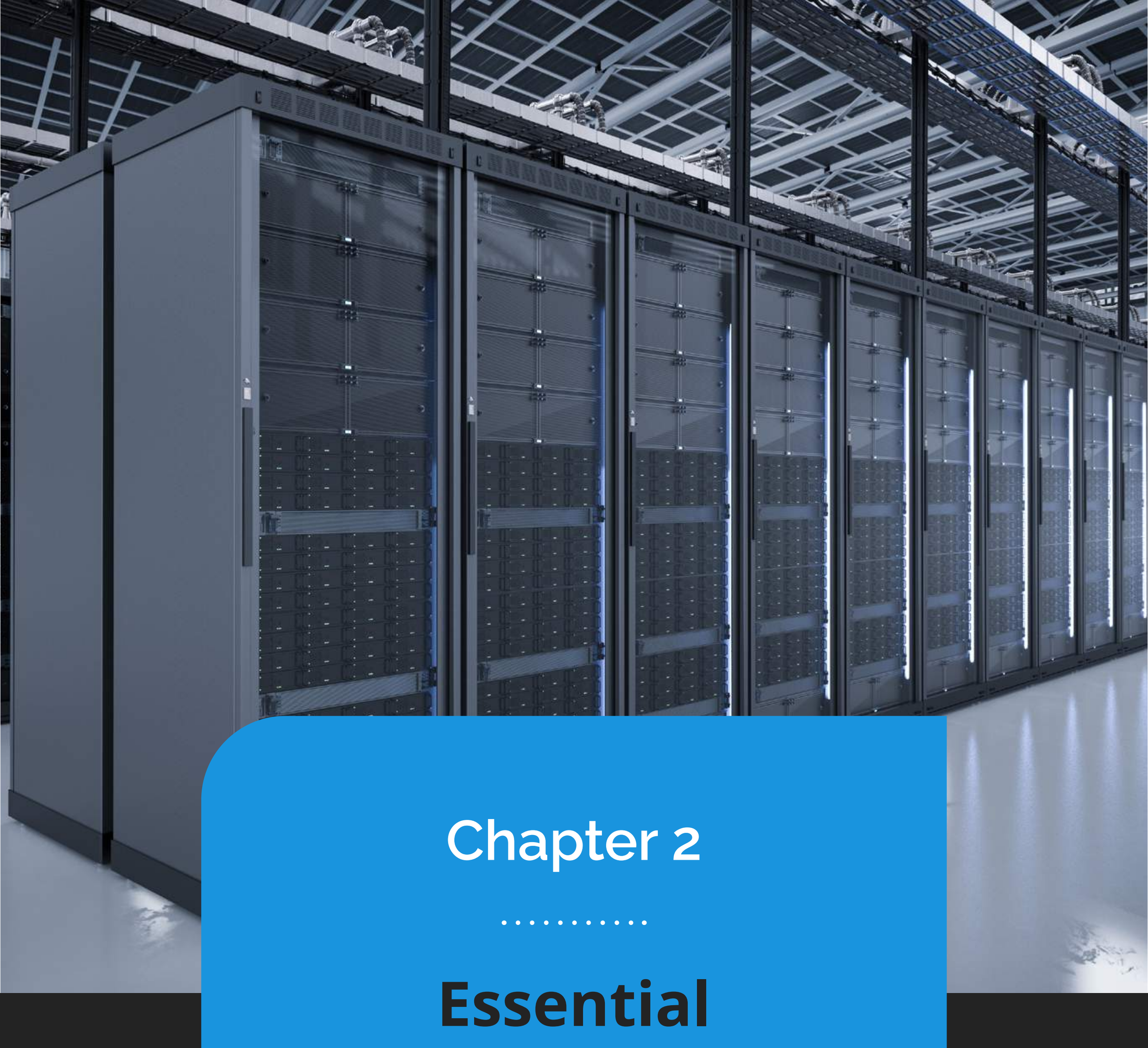
No.	Parts & Subsections	Aspects covered
1	EN 50600-1	General aspects for design and specifications
2	EN 50600-2-1	Building construction
3	EN 50600-2-2	Power distribution
4	EN 50600-2-3	Environmental control
5	EN 50600-2-4	Telecommunications cabling infrastructure
6	EN 50600-2-5	Security systems
7	EN 50600-3-1	Management and operational information
8	EN 50600-4-1	Overview of and general requirements for key performance indicators
9	EN 50600-4-2	Power Usage Effectiveness
10	EN 50600-4-3	Renewable Energy Factor

1 What Makes an Ideal Data Center: Understanding Industry Standards

Other Regulatory and Operational Standards

Operational and regulatory standards are highly subjective to the nature of your business and the demands for your data center. There are several standards you can choose from and these are a few:

- HIPPA (Health Insurance Portability and Accountability Act)
- SOX (Sarbanes Oxley) 2002
- SAS 70 Type I or II
- GLBA (Gramm-Leach Bliley Act)
- New York State Energy Conservation Construction Code
- Green certifications and ratings, such as LEED, Green Globes, PUE, and Energy Star ratings.
- ISO 9000 - Quality System
- ISO 14000 - Environmental Management System
- ISO 27001 - Information Security
- AMS-IX – Amsterdam Internet Exchange - Data Centre Business Continuity Standard
- SOC, SAS70 & ISAE 3402 or SSAE16, FFIEC (USA) - Assurance Controls



Chapter 2

Essential Data Center Components

2 Essential Data Center Components

Whether you are planning to design a new data center or remodeling an existing one, you must choose the essential components and specifications of a data center with utmost care as they determine overall performance, delivery, and ability to accommodate growth.

Servers, Racks, and Network Connectivity Infrastructure

The performance of a data center is rated based on its latency and redundancy. The data is hosted and stored in servers running 24/7, which occupy the most space and power in a data center.

Cables of several unique configurations connect the servers arranged in racks, fitting the needs of the data center and the user.

The arrangement of servers and racks determines airflow within the data center, and efficient use of floor space helps during expansion. Cabin solutions are also chosen to make management and organization easier by eliminating clutter and providing better airflow within the building.

2 Essential Data Center Components

Security Measures and Monitoring Structures

Data centers house several valuable components, from the data itself, whether hosted or stored, to the hardware components like servers, which don't come cheap. Therefore, security measures and monitoring the facility are necessary to safeguard everything within the facility.

Safety measures can begin with high-rise walls, heavy personnel screening, security cameras, biometric scanners and end with armed men at every floor to monitor the activities and keep the valuables safe.

Some giant tech parks have their own Fire Department to enjoy quick responses to any disaster at the facility and hire skilled security personnel experienced in the armed forces to tackle situations on the ground.

Softwares and applications like Intelligent Monitoring Systems keep track of activity and tasks performed within the facility and provide an overview of the data center building, especially in colocation data centers where tenants can gain visibility and control over the power and security of the data center.

2 Essential Data Center Components

Power and Cooling Systems

When systems run continuously, they heat up, wearing out of hardware components or becoming a severe fire hazard. HVAC techniques cool these components and equipment that consume about **35% of the data center's energy** to prevent such dangers. The IT equipment alone consumes **50% of the power**, depending on the data center redundancy.

Power and cooling, are hence, the most significant investments in a data center design. Planning power and cooling solutions wisely while keeping future goals in focus can prevent potentially huge losses.

Apart from the main power, data center components also utilize UPS and backup generators to maintain redundancy depending on tier classification.

A calculative choice of essential components for a data center, based on present needs that also align with the business's future goals, is a vital step to securing a robust data center design that is flawless and futuristic.

Chapter 3

Designing a New Data Center or Upgrading an Existing Design

3 Designing a New Data Center or Upgrading an Existing Design

Data Centers are highly subjective to change as the demand for data hosting and storage will only increase. However, given the constant rise of data traffic and the necessity to provide high-bandwidth, low-latency connections, there has been a flurry of effort among standards groups to specify faster speeds.

It's critical to stay current with new advancements to guarantee that the cabling infrastructure can sustain these more incredible speeds with little downtime.

Almost **70% of components** in a data center are either replaced or upgraded in **10 years**.

Therefore, data center designs must accommodate such changes with reduced time and expenditure as much as possible.

Designing a data center depends more specifically on building a new or upgrading and maximizing an existing data center. This is the first decision you need to make. Then, follow the pointers below to get the most out of your organization's data and network infrastructures.

3 Designing a New Data Center or Upgrading an Existing Design

New Data Center Design

It might be overwhelming to make decisions for a new data center design. However, as these decisions can make or break your investments and your business goals, so consider these key elements to make these decisions more easily:

Adopt Modular Solutions

Designs that are flexible and scalable are much needed for today's in-demand data centers. For example, structures like raised floors, alternative cabinets, wider racks to fit high-density servers, etc., can aid airflow and optimize space and enable future expansions.

With simple infrastructure, strategic arrangement of aisles, and adopting flexible and easily manageable cabling solutions, much can be achieved.

3 Designing a New Data Center or Upgrading an Existing Design

Consider Going Green

Although the installation costs of sustainable energy solutions are considerably higher, they will benefit in the long run. You can draw green energy for power and the cooling of data centers from renewable natural resources like solar, wind, tidal, geothermal, and hydroelectric energy. These solutions with proper maintenance and operation can save billions for data centers planning for the long haul.

Since you can't manage what you can't measure, tracking your data center's energy usage to gauge its efficiency is essential. For instance, you can utilize a metric called PUE (Power Usage Effectiveness) to cut down on non-computing energy use, such as cooling and power distribution in their high-profile data centers.

It's critical to measure PUE often to get the most out of it. Tech giants even sample at least once every second. However, it's much more critical to collect energy statistics throughout the year, as seasonal weather fluctuations significantly impact PUE.

3 Designing a New Data Center or Upgrading an Existing Design

Strategize Initial Investments

When calculating Capital Expenditure (CapEx), take into account the costs for Operation and Maintenance Expenses (OpEx) along with Energy Costs. Segregate budget for expansion plans as well.

Any data center design would first be drafted after carefully analyzing its users' needs and requirements. Then, as a best practice, predict the future needs and allocate funds for growth and periodic upgrades to avoid unnecessary expenses or a shortage of funds in the future.

Pay Attention to Quality Software

Even if the hardware is not as sophisticated, software offering flexibility and optimizing operations and management of data centers can significantly benefit and enhance the facility's performance.

3 Designing a New Data Center or Upgrading an Existing Design

Software solutions for a data center cannot be neglected, irrespective of the size of the facility. Solutions like Data Center Infrastructure Management Solutions (DCIM), Building Management System (BMS), IT System Management (ITSM), and virtualization management systems like VMWare and Nutanix can help employees perform their tasks efficiently and maintain the overall performance of the facility.

This software holds and records all tasks performed within the facility and makes task allocation, reporting, analyses, and visualization of processes more straightforward.

3 Designing a New Data Center or Upgrading an Existing Design

Upgrading an Existing Data Center

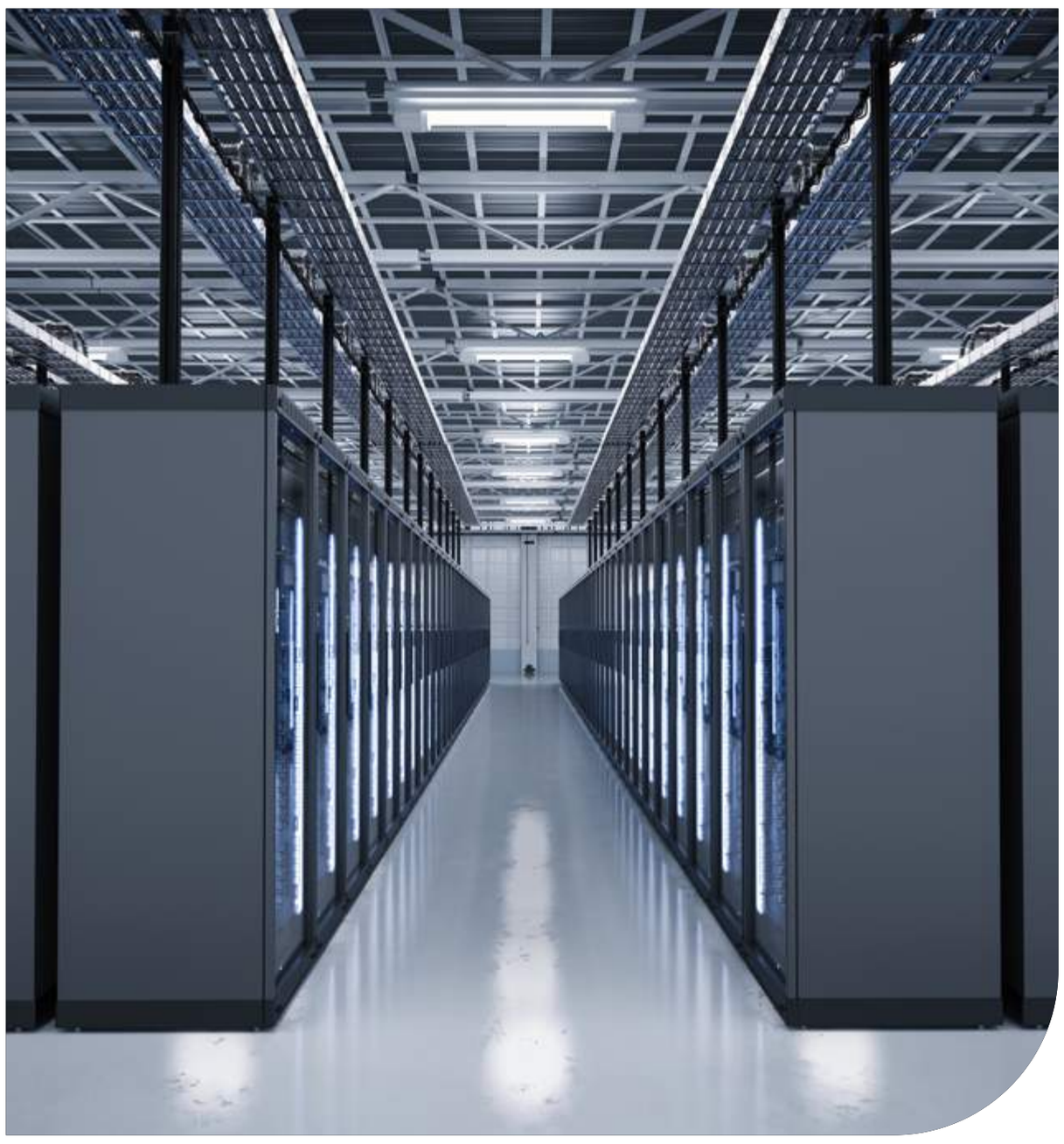
Upgrading or expanding an existing data center is a situation you will ultimately face. This can be as challenging as building a new one. One slight misstep can spiral down the facility's expenses and time and eventually lead to design failure.

These are some key elements to consider for upgrading an existing data center that focuses on futuristic innovations rather than day-to-day operations:

Build Reliable and Modular Solutions

Upgrading data center components with those that deliver more uptime and availability can boost ROI and help recoup incurred losses if any.

Using cabling solutions that cater to multiple configurations and support copper and fiber media can aid easy integration for upgrading.

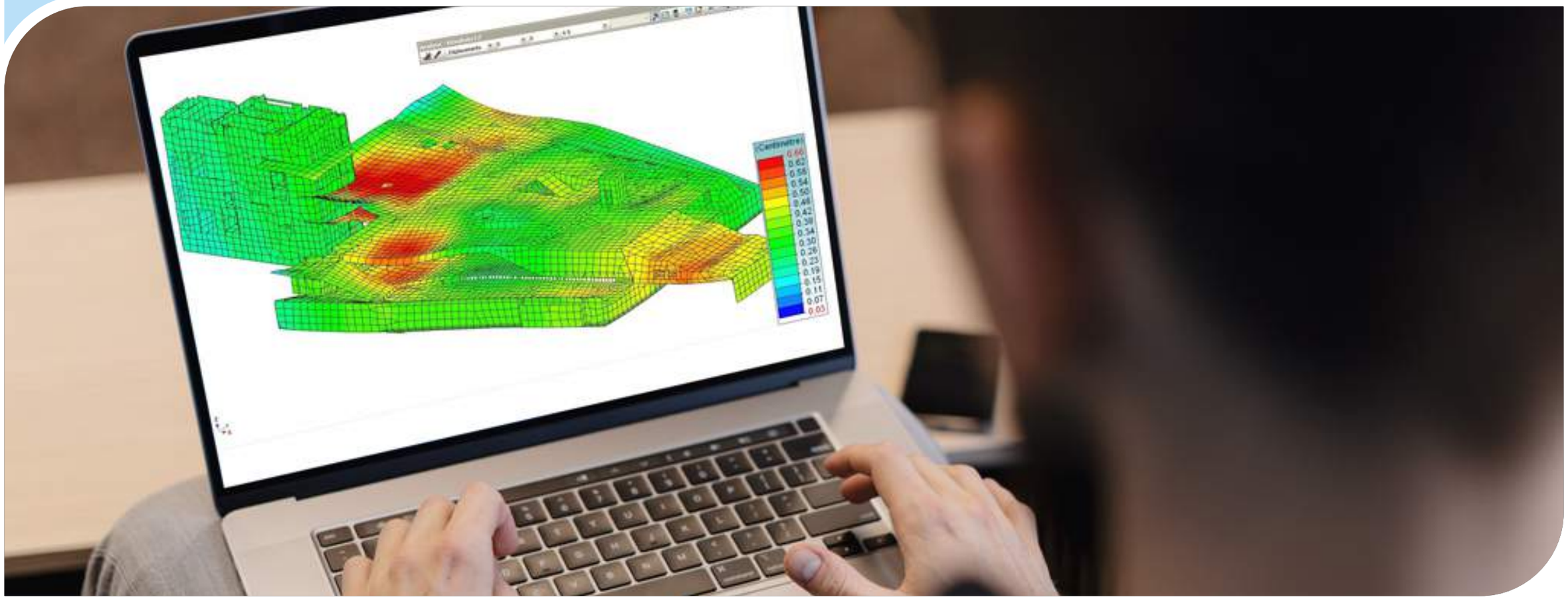


3 Designing a New Data Center or Upgrading an Existing Design

Analyze Airflow for Cooling Solutions

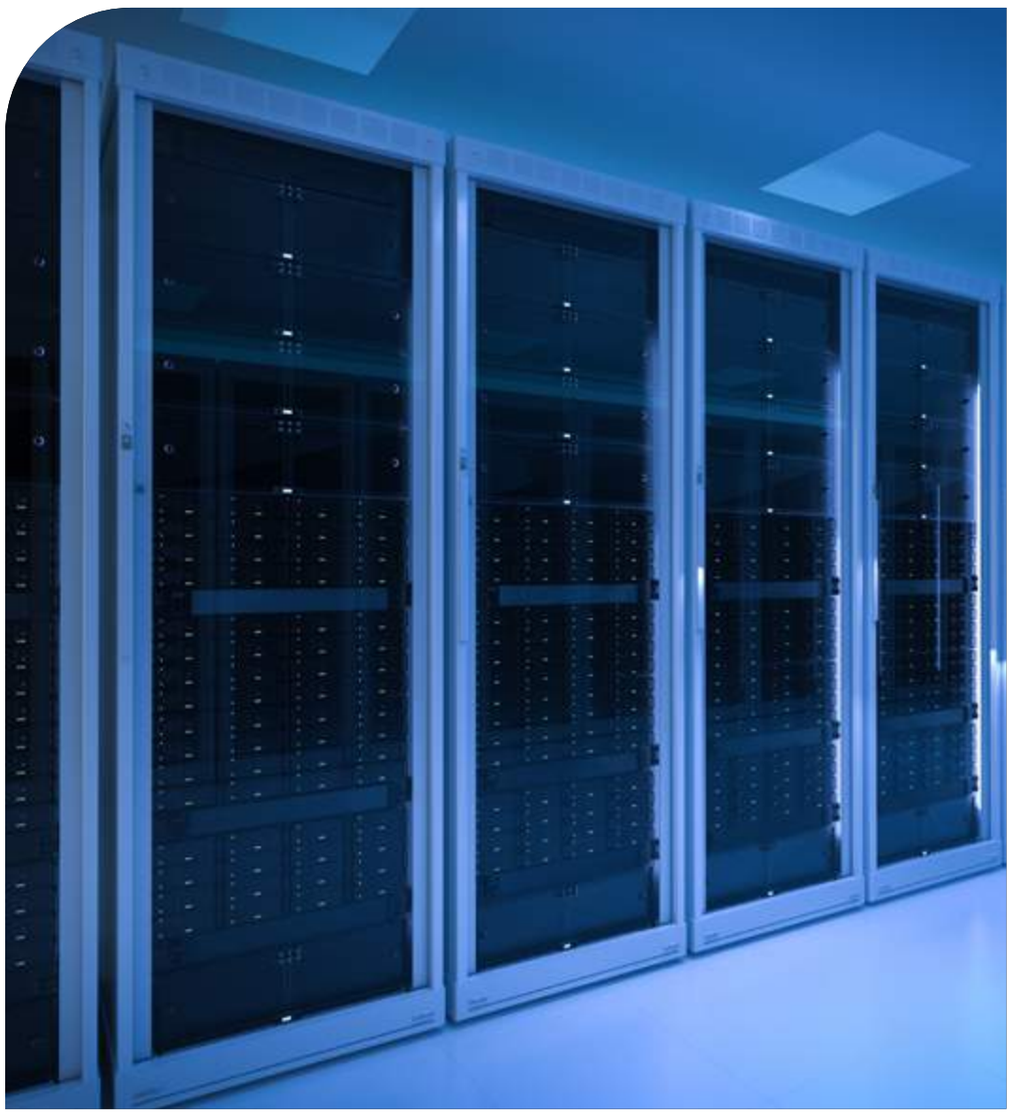
Cooling solutions must be drafted to be as efficient as possible and this is one of the fundamentals of data center best practices. When adding new components to a data center facility, the heat generated will also increase proportionately.

Before implementing the cooling solution, analyze existing conditions within the facility with the help of specialized simulation experts like **Mechartes**.



CFD and FEA simulations can help determine the airflow and deduce the cooling solutions that are adequate for the facility. This prevents unwanted cooling components from drawing excessive power, taking up space, and unnecessary expenses.

3 Designing a New Data Center or Upgrading an Existing Design



Install Backup Power Options

With new additions, backup power and UPS are required to prevent downtime in an outage depending on tier classifications.

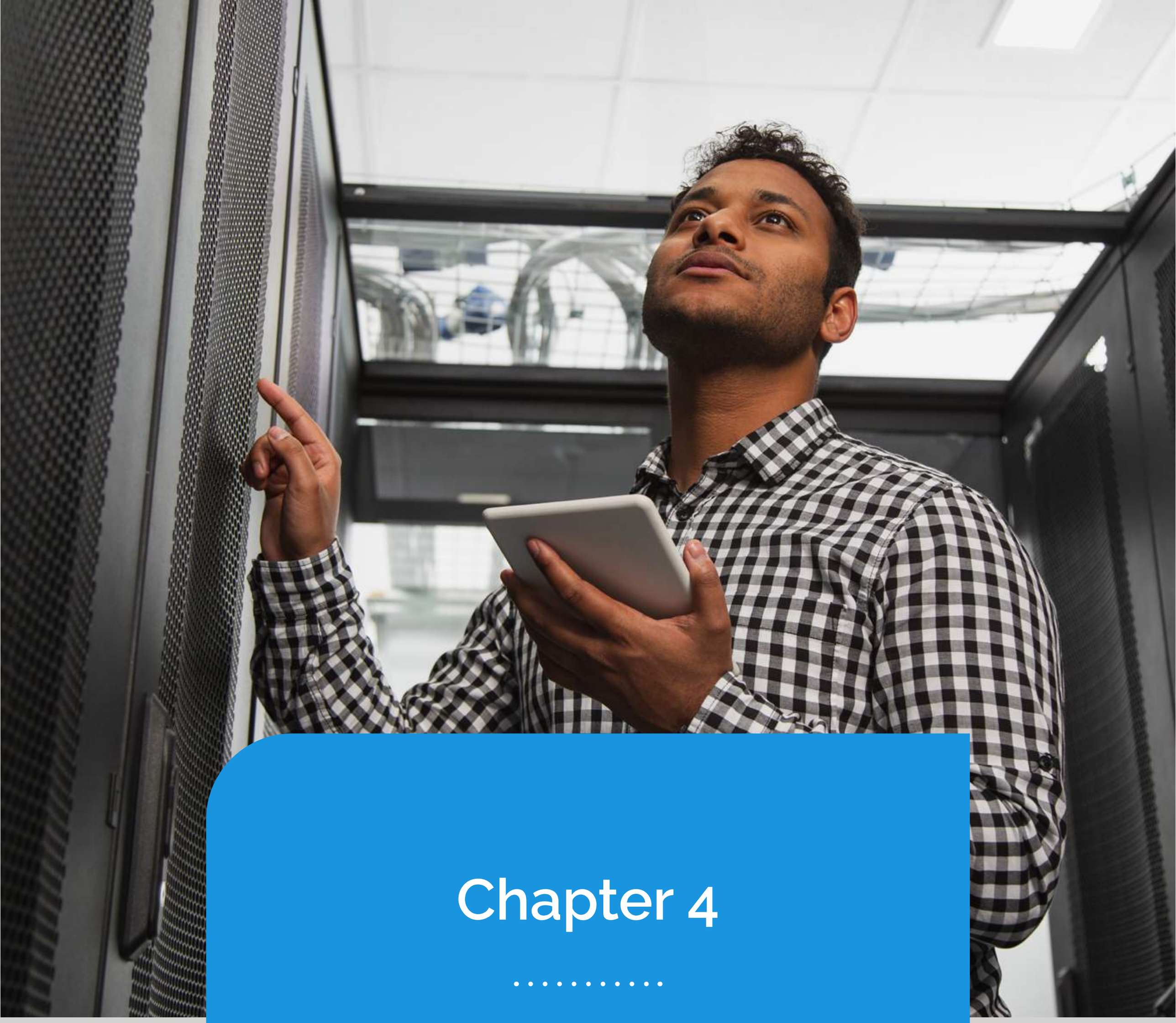
New Backup systems or establishing solid connections between new server racks and existing systems can keep the data center components up and running continuously and deliver without disturbances.

Convenient and Efficient Cabling

Cabling solutions play a very vital role in data center designs. However, improper maintenance and management of cables cause much clutter, which hinders airflow and complicates maintenance. Using color-coded lines and cable organizers can help solve these issues.

Additionally, integrating new components becomes easier when cabling solutions are built to add new elements to the data center.

Irrespective of whether you are planning for a new data center or remodeling an existing one, data center design practices can help improve your infrastructure and maximize performance.



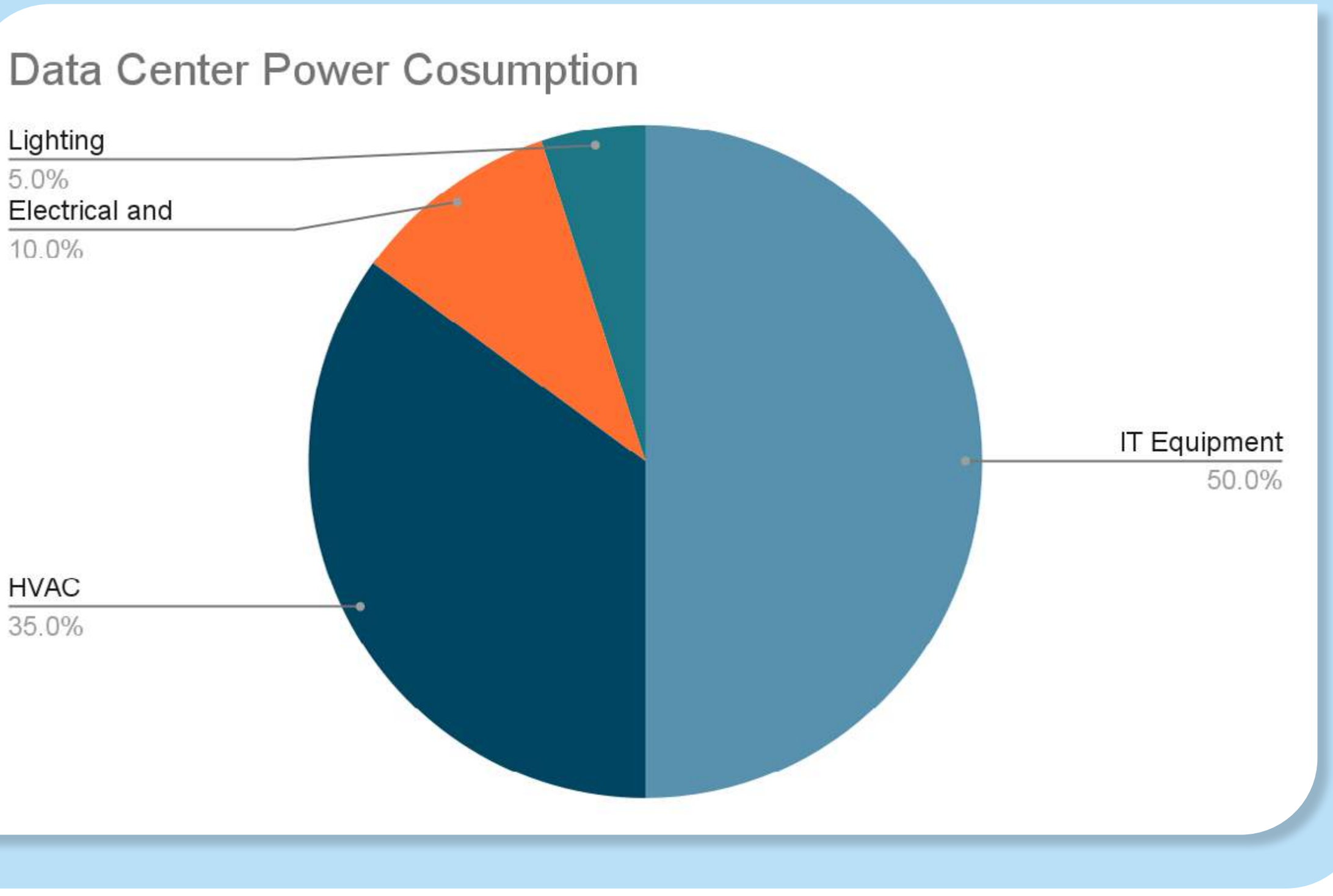
Chapter 4

Data Center Design Best Practices

4 Data Center Design Best Practices

Some of the data center design best practices can never go wrong and have worked for data center giants like Switch and Google. You can adopt these practices for smaller facilities too. Take a look at the data center design best practices that can change the outlook of your business.

Power and Redundancy



4 Data Center Design Best Practices

One of the significant expenses for a data center is the energy costs for running the components day in and day out. The following factors can help reduce the load in this crucial area.

Servers

Servers and other IT equipment draw 50% energy from the power source. The amount of energy consumed by a server depends on the power of the server. A powerful server consumes more energy.

Be careful not to overestimate your needs while choosing the server configurations. If a primary server is sufficient for your business, prefer that. It can save a lot of energy and capital. Essential components do not require sophisticated maintenance and skilled experts for operations too.

If the future calls for a server upgrade, you can opt for cable solutions and cabinets to accommodate such upgrades.

4 Data Center Design Best Practices

HVAC Equipment

Extensive heat generation is one of the cons of running data center components continuously. This heat, in turn, damages the hardware of the components, leading to its wear and tear or other hazards. To prevent such events, Data Centers use HVAC Solutions to maintain the optimum temperature within their facility.

(Factors determining the type of HVAC Solutions and the different types of HVAC solutions are discussed further below)

Emergency Power

Data Centers usually draw their main power from the electricity grid and use in-house transformers to convert it into AC or DC as required. This is then split among the various components and supplied via a network of cables.

Based on the redundancy requirements and the Tier classification of the data center, other backup generators or UPS units are used for separate components within the data center to prevent systems from going offline.

4 Data Center Design Best Practices

In case of an outage, the UPS units keep the systems running for about 20 minutes until the backup generators, which usually run on diesel, launch. The capacity of backup generators varies based on the size and requirements of the data center.

In tier 3 datacenters, UPS and Backup generators are connected with multiple paths for power and cooling to keep systems online, and In Tier 4, however, redundancy is applied to every component. This is an enterprise-class data center and may seem to be an overkill for smaller data centers.

So choose the redundancy, i.e., N, N+1, 2N, or 2N+1, based on your requirements while keeping future expansion provisions.

4 Data Center Design Best Practices

Sustainability and Efficiency

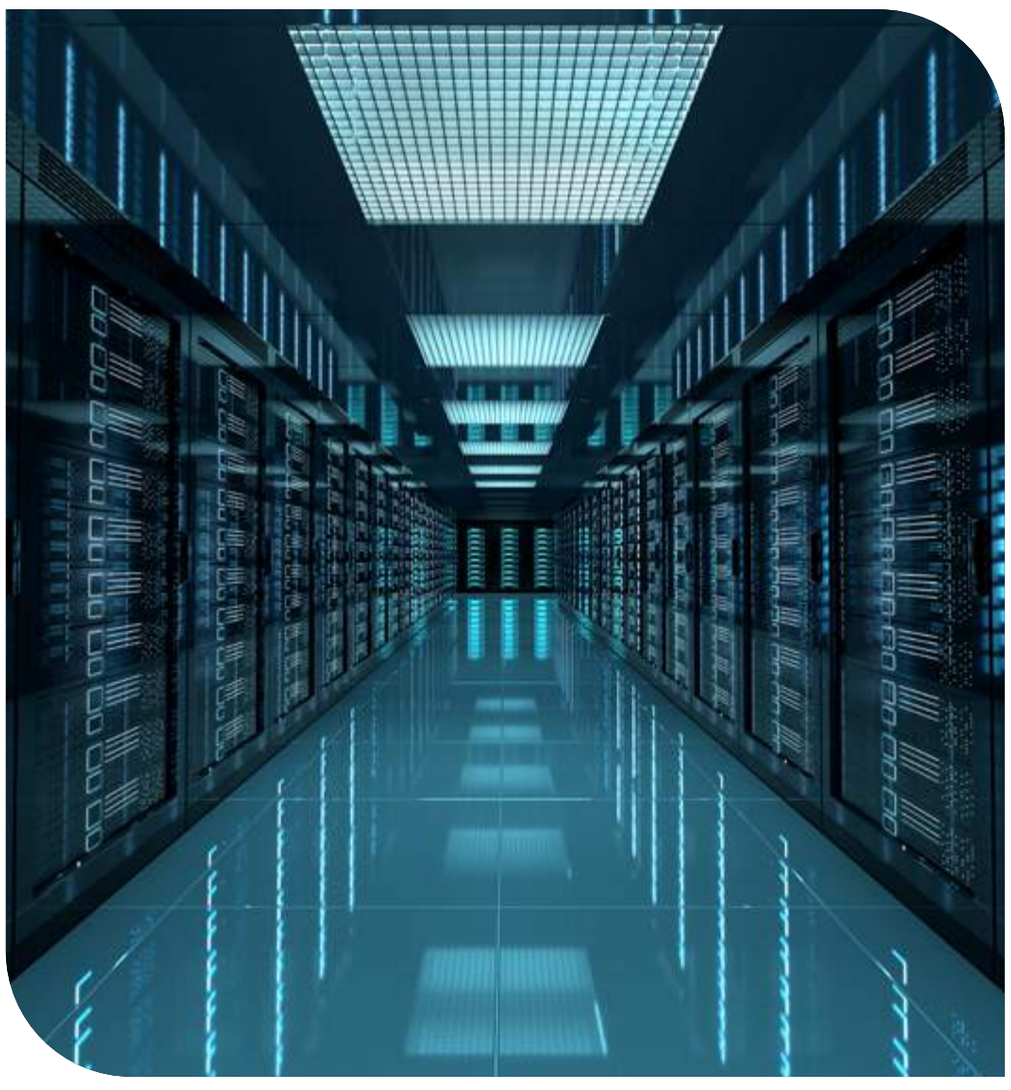
Wherever possible, implement sustainable solutions. Although the initial installation costs may seem like a lot, they have proven to save a fortune in the long haul.

Data centers are highly in demand due to the increased use of cloud-based solutions, data hosting and storage, and the need for uninterrupted connectivity. More and more establishments are built every day to meet this growing demand. Unfortunately, this significantly increases the amount of energy consumption.

Sustainable solutions for power and cooling minimize the impact on the environment, incredibly balancing the massive energy consumed by data centers globally and the environment's depleting resources.

Sustainable products are given ISO 14001 Certified for Manufacturers. In addition, Power Usage Effectiveness (PUE) and Leadership in Energy and Effectiveness Certification (LEED) ratings are other parameters for measuring energy efficiencies.

PUE rating greater than 3.0 indicates inefficiency, and 1.0 means high efficiency in converting energy.



4 Data Center Design Best Practices

Physical Space and Organization

This is the most vital aspect when designing a data center. Proper planning of space and organization of physical components will help optimize airflow, server performance and make expansion and growth more manageable.

Floor Space

Overestimating floorspace for a data center will pay off during expansion. Although this estimation is impossible in upgrading an existing data center design, optimizing floor space in new data center designs is essential.

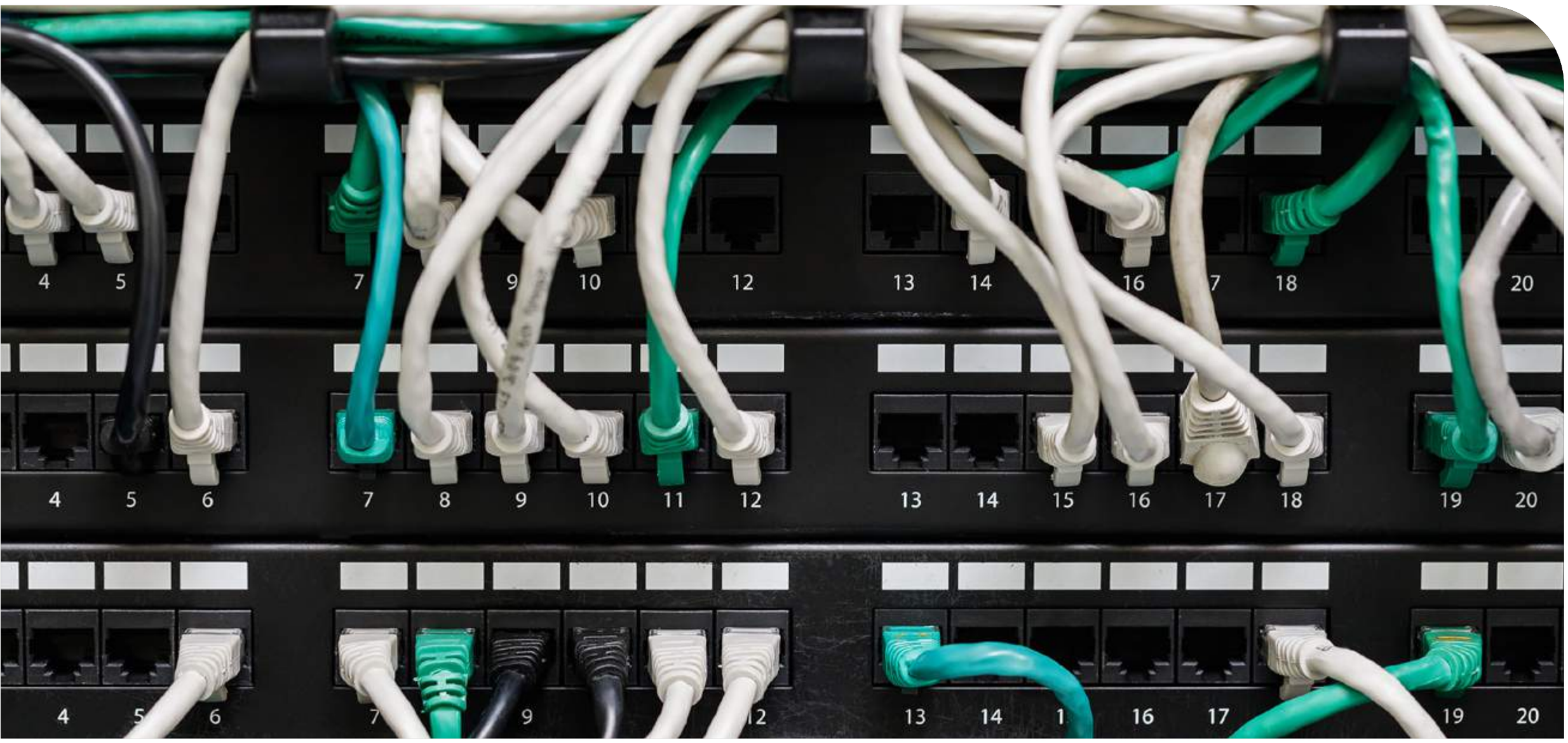
Some data centers allocate more than five floors for future expansions. Unfortunately, businesses that fail to optimize floor space will be left with no other option but to build an entirely new facility to accommodate their growing needs, which will cost way more than the former solution.

4 Data Center Design Best Practices

Cabinets and Racks

Implementing filler panels not only aids airflow but also allows for adding new panels during the time of expansion.

Also, cabinets and racks designed to be more comprehensive and taller are great for physical space optimization.



Cable Selection

Selecting cables that are smaller in diameter and meet performance requirements without latency is suggested. Cables are a small detail yet play a significant role in data center infrastructure design.

4 Data Center Design Best Practices

Cooling Technology

To prevent high temperatures in data center buildings, cooling technology is used to prevent damage to equipment and provide optimal conditions for the overall operation and performance of the data center.

Cooling Equipment

Some of the factors that determine the type of HVAC solution to be implemented in a facility are:

- Location of the facility
- Energy costs and regulations in the selected location
- Proximity to water bodies if liquid cooling is used/required
- Airflow and conditions inside the building
- Airflow and environmental conditions outside the building
- Size of the data center
- Types of equipment used inside the datacenter
- Structure of the building and its impact on conditions within the data center

4 Data Center Design Best Practices

Based on factors like these, the type of HVAC solution for a data center is determined. Some of the standard HVAC solutions are as follows:

Traditional Air Conditioning units: Industrial air conditioners consume more energy but produce and circulate chilled air to keep data centers at optimum temperatures.

Water Cooling units: Wet cooling methods are more efficient than most methods. Most data centers are built near large water bodies when adopting this technique.

Outdoor Air Circulation: Regions with considerably lower outdoor temperatures can circulate outside air into the site to moderate indoor temperatures.

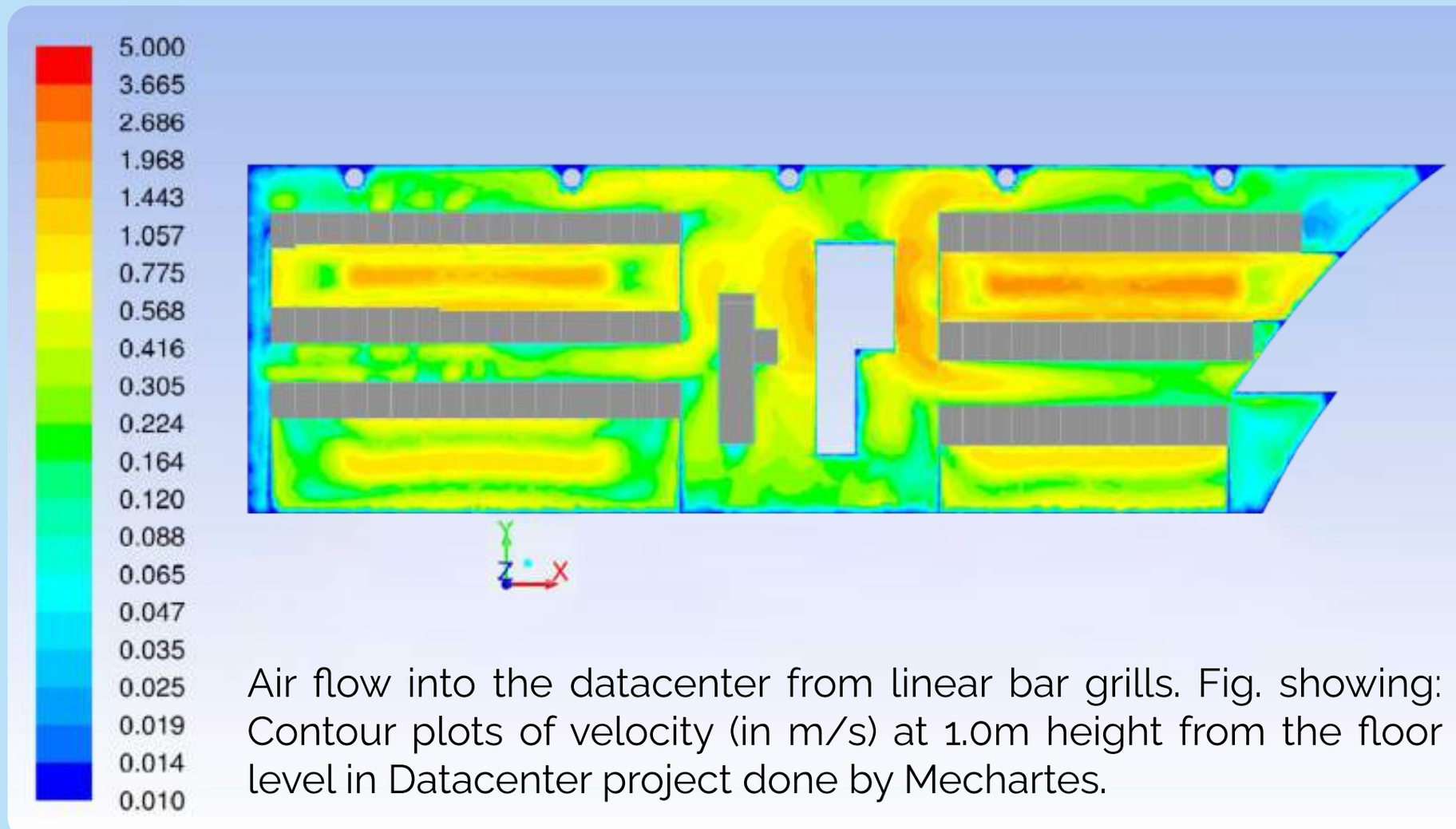
Localized Cooling Units: Cooling units are placed in “warm rows.” When planned efficiently, air need not be transported using ducts. It also allows precision cooling of the IT equipment.

4 Data Center Design Best Practices

Airflow Design and Efficiency

Air is the main carrier of heat and moisture in data centers. It is challenging but important to optimize the flow paths of both cold supply air and hot return to minimize mixing of these two streams as well as reduce any short-circuiting of cold air back to the air-conditioning systems.

Several factors affect airflow distribution and cooling performance of a data center. Physical measurements and experimental testing are not only time and labor intensive but sometimes impossible. In such a situation, computational fluid dynamics (CFD) simulations provide a feasible alternative for testing various design layouts and configurations in a relatively short time.



Air flow into the datacenter from linear bar grills. Fig. showing: Contour plots of velocity (in m/s) at 1.0m height from the floor level in Datacenter project done by Mechartes.

4 Data Center Design Best Practices

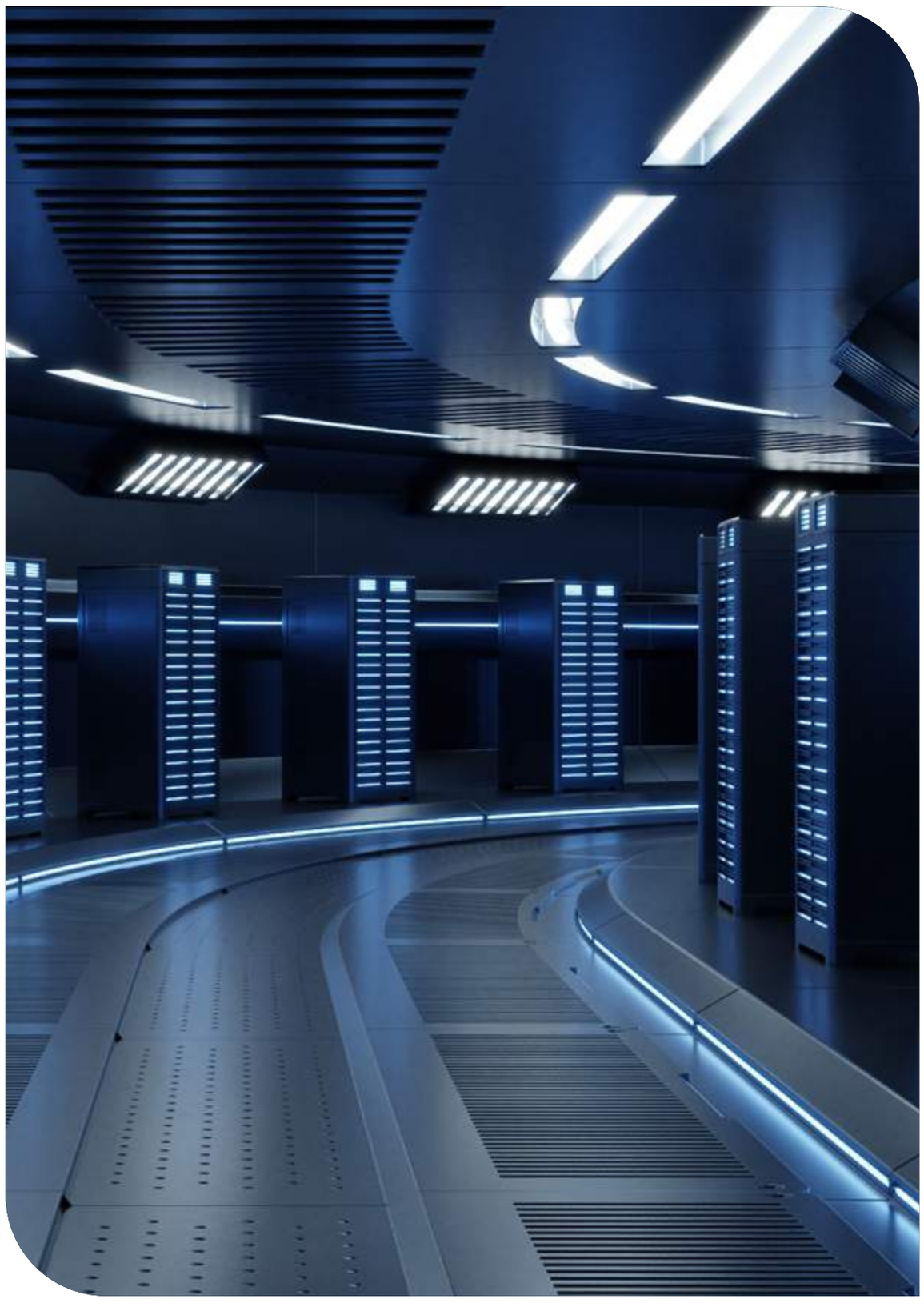
As mentioned earlier, the conditions inside and outside the facility determine the choice of HVAC solution.

Furthermore, structural adaptations such as the following can enhance HVAC performances.

Hot aisle/cold aisle designs: The rack-fronts face the air conditioner output ducts called cold aisles. The opposite sides of the racks face the air conditioner return ducts and are considerably hotter.

Filler panels: Some negative space is left between server panels in a row to allow airflow. This space can also be utilized in the future for additional paneling.

Raised floors: The servers are placed at a height from the bottom to allow airflow through the bottom.



4 Data Center Design Best Practices

Physical barriers between hot and cold aisles: The temperatures do not interfere, thereby regulating optimum temperatures by placing physical barriers between the hot and cold galleries.

Minimalist cabling solutions with reduced clutter: Reducing cable clutter allows better airflow within the racks and panels and does not hinder cooling efficiencies.

These implementations can enhance airflow within the building and help optimize the temperature in the data center with reduced stress on the HVAC solutions. These also save energy consumed by HVAC equipment, thereby reducing energy costs.

4 Data Center Design Best Practices

Security

Every facility associated with valuable assets -- in this case, data -- requires protection and restriction from intruders and unauthorized access.

Physical Security

Physical security layers like higher boundary walls, fencing, CCTV coverage, floors operated by skilled and trained security personnel, etc., are necessary to protect and restrict the server rooms and other components from unauthorized persons.

Other measures like biometric scanners can help to keep track of anybody who has access to the facility. Restricting access primarily ensures the safety of the data. However, it also helps to prevent or trace unnecessary or unauthorized actions performed by employees or intruders.

4 Data Center Design Best Practices

Network Protection

To prevent unauthorized breaches to systems, station a highly-skilled cybersecurity team to monitor activities on the network and detect any suspicious intrusions.

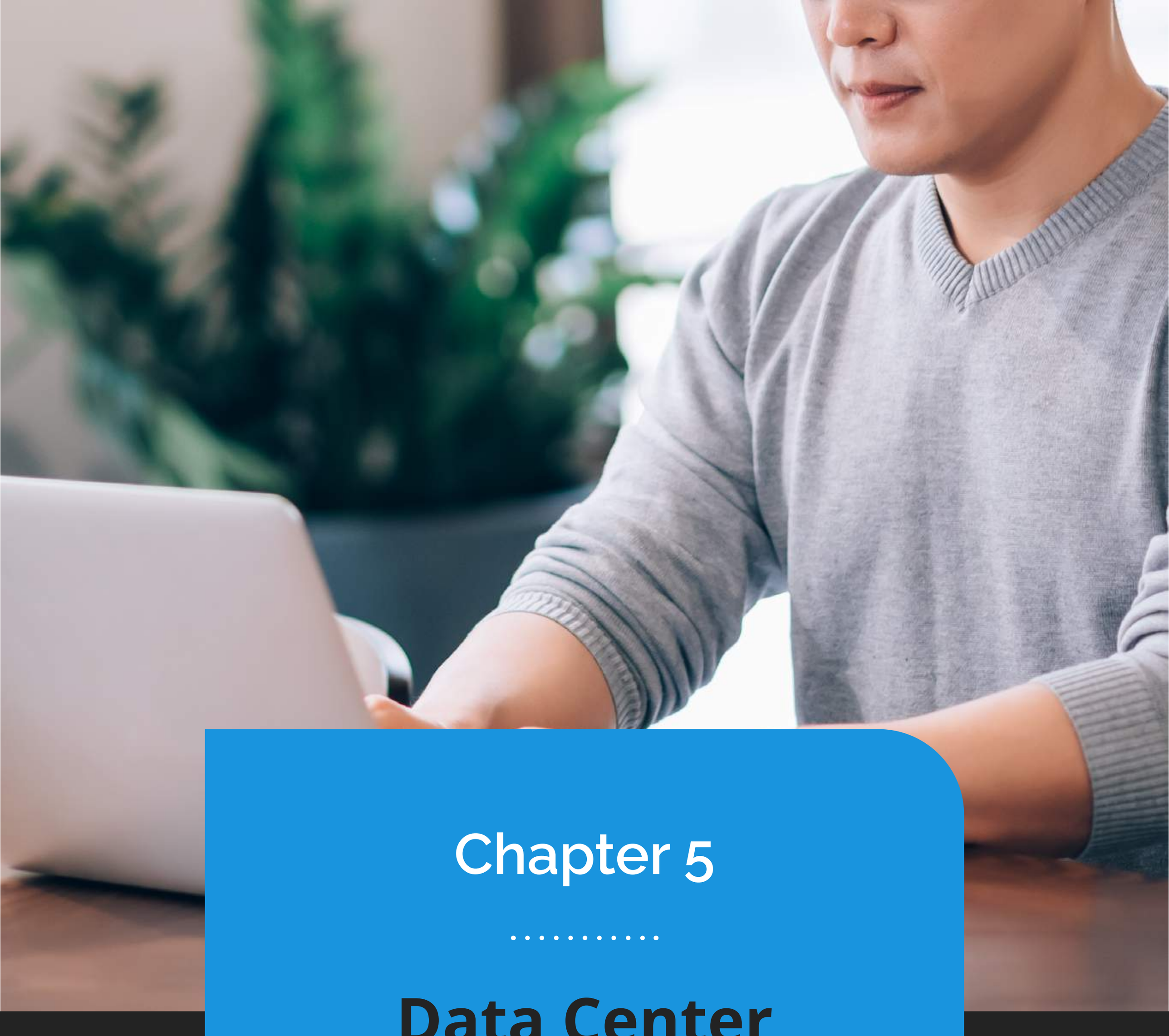
Install protective measures like firewall, IDSs, and ACLs to safeguard the network and data within the facility.

Backup and Disaster Management

In case of natural or man-made disasters, ensure that the facility and the components within the building and the staff are safe.

In locations prone to earthquakes or floods, pay attention to structural integrity in case of unfortunate events. Plan in advance for any such risks to ensure the safety of the components and the employees working in the facility.

Most tech parks hold in-house fire departments for quick responses and to avoid causing inconveniences to the public if the facility is located inside well-populated demography.



Chapter 5

Data Center Design Services by Mechartes

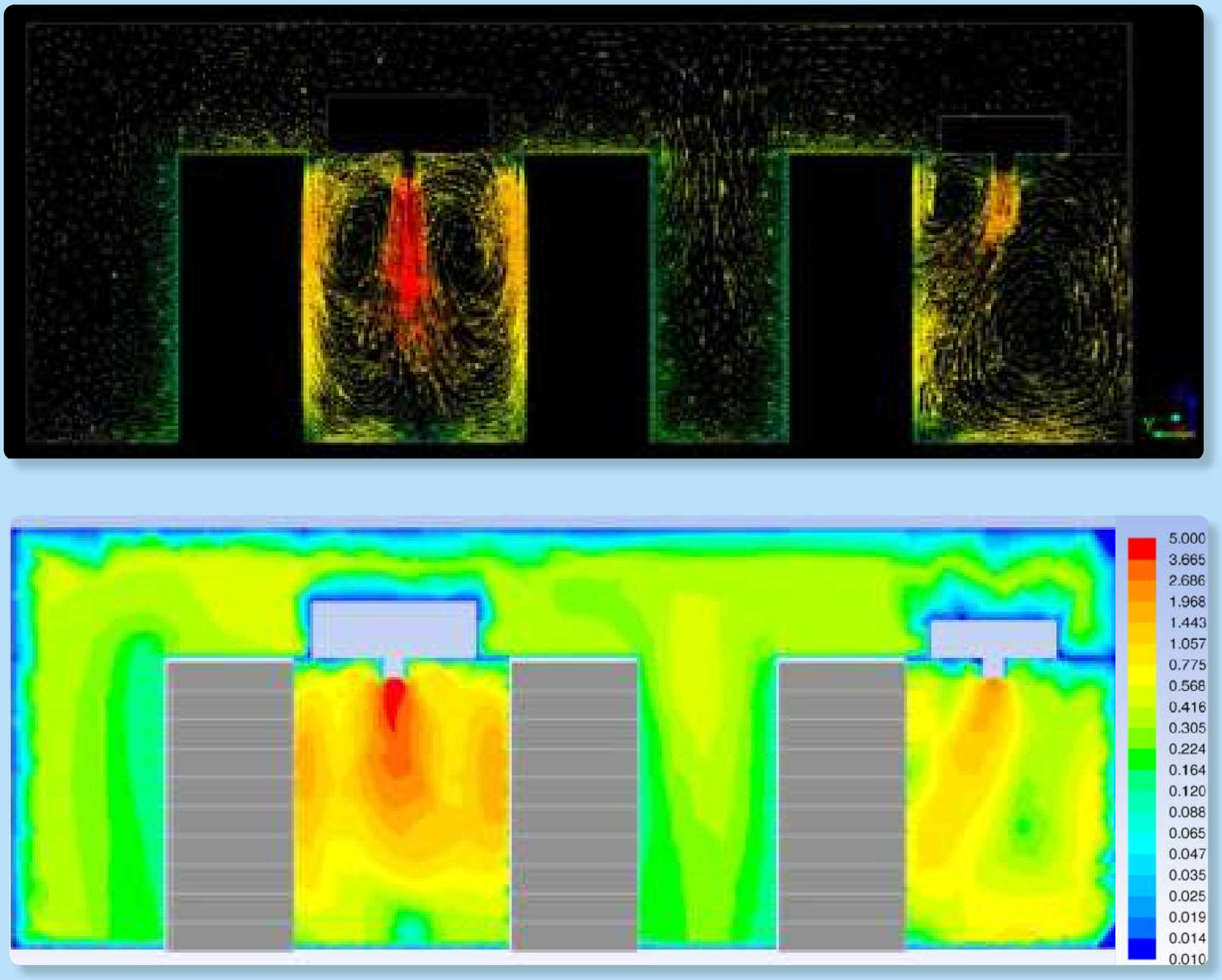
5 Data Center Design Services by Mechartes

Mechartes offers data center design validation services and provides advanced engineering using analysis tools like CFD simulations.

CFD is used in a variety of fields, including the data center design, specifically in thermal and flow profiles management. The next step after 3D CAD design is simulation, and CFD is one of it. CFD software has 3D objects that are usually found inside the data center. These include complete design of a DC like ventilation design layout, cooling units, racks, and perforated floor tiles and setting of boundary conditions before running the simulation. Through CFD analysis, identification of Thermal Hot spots – a critical part of a DC management and one of the major cause of an equipment failure, can be predicted and avoided.

5 Data Center Design Services by Mechartes

Fig. showing Contour & Vector plots of velocity (in m/s) in X-plane-4 in a Datacenter project done by Mechartes.



5 Data Center Design Services by Mechartes

The CFD's ability to predict at design stage can help Owners/Project Managers/Design Engineers in designing the right layout. The proposed design can be reviewed by modeling the data center. As a result, concerned parties can see thermal management problems that may arise once the data center is up and running. Some of these are hot aisle/cold aisle flow, hot air recirculation, mixing of hot air and cold air, relative humidity etc.

Thus, CFD saves time and money for possible rectifications, as problems are discovered before construction. Another benefit is preventing the huge downtime costs for issues during the operation.

CFD is also used to understand the effectiveness of cooling, optimization of air flow, humidity and reduce excessive cooling with varying IT layouts and reduce power consumption, be it for water cooled chillers, heat exchangers, thermal energy storage tanks (TES) etc.

However, it should be noted that in CFD, the smaller the computational domain, the more accurate the result. For bigger data centers, dividing the space into smaller parcels is recommended. This aims to achieve an accurate result.

5 Data Center Design Services by Mechartes

This insight helps determine the best cooling solutions for specific facilities that save energy and costs.

The CFD simulations are used in analysis like:

- Computer Room Air Conditioner (CRAC) failure analysis
- Testing different rack layouts and loads
- Optimize telecommunications pathways, air conditioning equipment, equipment enclosures, air return, air vents, and ventilated tiles.
- Chiller Yard/ Generator Yard Study
- Hot and Cold Aisle Arrangement
- TES and Buffer Tank Design
- Generator and DRUPS Rooms
- Piping Stress Analysis and Support Design
- Seismic Analysis

You can find more case studies and other resources here.

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That was...

Data Center Design Best Practices

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