Everything You Need to Know About Data Centers

MILESTONE

Strategic IT • Enabling Success

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Executive Summary

With more data being created today than at any other point in history, data centers have become critical components of our daily lives. We rely on them to keep track of all of the information we use at work, at home, and just about everywhere else. As a result, businesses that depend on data to function must stay on top of the data center options available to them. Choosing the right data center strategy for your business is one of the most important decisions an IT leader will make; and, in order to make an informed decision, IT leaders need to understand which types of data centers align with their unique business goals.

Why Do We Need Data Centers?

Within the last year or so, Mozilla started running a series of billboards in the Silicon Valley that read, “Food. Water. Shelter. Internet.” coupled with the tagline, “Mozilla protects our newest global resource.” While this message might seem somewhat facetious, Mozilla is onto something here; people have become highly dependent on technology, and the data it generates, to meet our needs—both basic and advanced. And much like we store water in reservoirs, all of the data generated has to be kept somewhere. That’s where data centers come in.

Image Source: The Mozilla Blog (CC BY-SA 3)

Humans have generated more data in the last two years than in the entire history of the human race, and we’re projected to reach 40 zettabytes within the next four years. To put that into perspective, 1 zettabyte is approximately 1,099,511,627,776 gigabytes. That means that by 2020, there will be 6,283 gigabytes of data per person on Earth .

This influx of data is called the Big Data Boom, and it’s affecting the way that people store and interact with data. Enterprises that rely on data to conduct business need to be able to turn massive amounts of complex data into actionable information, which is inspiring data centers to focus on increased latency and performance. Interestingly, the increase in data is expected to lead to a surprising decrease in the growth of data centers by 2017 , as more and more companies leave small centers behind and head for larger colocation (or shared) facilities.

A zettabyte (ZB) is a unit of measure for data.

Factors Affecting Data Centers

Security	Data center security is paramount, especially as an increasing number of businesses move toward shared data center locations (colocations). When making decisions about data centers, tech leaders must consider both physical and cyber security measures, and these decisions are based heavily on the kind of data being stored, processed, and recalled.
Flexibility	Technology changes quickly, so data centers are expected to be flexible. Tech leaders want to invest in data centers that are the right size for their businesses, but buying into a static data center will limit their options as their business scales.
Uptime	Due to improvements in efficiency and reliability, 56% of large companies chose to work with an MSP.[2] Proactive service alleviates quality issues involved with reactionary IT, and Service Level Agreements (SLAs) hold MSPs to a defined level of quality service.
Compliance	MSPs automate tedious, time-consuming, and repetitive tasks to streamline IT while reducing the time and money spent on maintenance. Automated tasks typically include aspects of daily system support and administration, such as monitoring, management, notification, reporting, and interoperability.
Service	If a tech leader chooses to work with a data center provider, service becomes a critical factor. While some colocation facilities provide customer service, including DCIMs and mobile considerations, many do not. Experience and expertise are valuable when looking for service providers to help you build, run, and maintain your data center, and employing a Managed Services Provider (MSP) to cover this gap is often a successful strategy.
Ongoing Maintenance	For a data center to function properly, tech leaders need to ensure that they have a plan to keep their data centers moving. From asset lifecycle management to ongoing operations, tech leaders need to determine whether they want to handle these services themselves or outsource them to an MSP.

What is a Data Center?

Data centers exist in many forms, but generally speaking a data center is a facility that houses a group of networked servers organizations use to store, process, or distribute data. Initially, data centers began as on-premise hardware that stored data within an organization's local network and was monitored by an in-house IT department. While these kinds of data centers still exist, more and more data centers are located off-site, often in shared locations known as colocations, or colos.

Several factors impact the design, functionality, and maintenance of a data center, and these factors can be divided into two primary categories: hard components and soft components.

Hard Components

All of the physical attributes of a data center can be classified as hard components. Many of a data center's hard components are in place to maintain an environment suitable for storing data and to address challenges related to building management. At a high level, hard components include IT equipment (i.e. servers), support infrastructure (i.e. generators), and the facility itself (i.e. the usable space in which other components are housed). More specific examples of hard components include:

- Physical Building
- Physical IT Equipment
- Critical Environmental Infrastructure (Power, Cooling Towers, Generators)
- Physical Security Measures
- Fire suppression systems
- Racks
- Cables
- Servers
- Networking Infrastructure
- Storage Array

Providing around-the-clock access to information makes data centers some of the most energy-consuming facilities in the world, which has pushed data centers to modernize and become more energy efficient. Many of the hard components above exist to maintain a stabilized environment within the data center. Without such environmental stability, the functionality of the data center suffers.

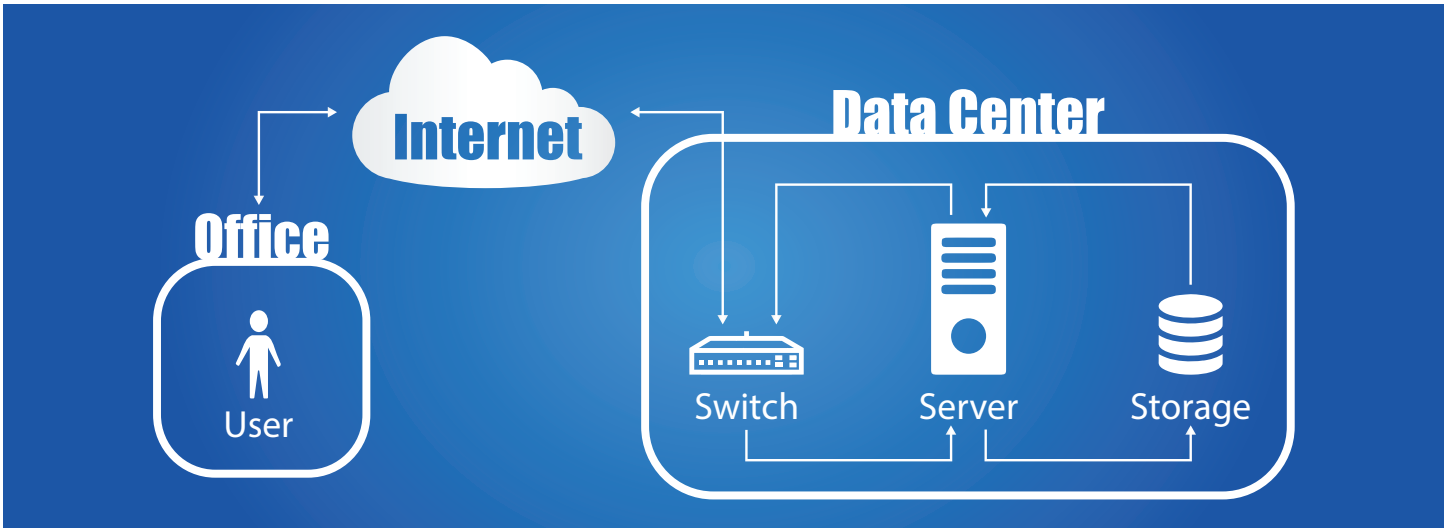
Soft Components

The logical and administrative aspects of a data center are known as soft components. While hard components are important, soft components are critical to a data center's success, as they relate to data security and availability.

Soft components address challenges related to:

- **Cyber-Security Measures**: Tech leaders need to keep their data centers safe from cyber threats, which can be a tricky task considering that different applications correspond to unique opportunities for attack. Firewalls, IDS/IDPs, VPN gateways, and other measures to prevent data breaches are critical.
- **General Connectivity**: Internet connectivity and connectivity between data centers are important, as businesses need to be able to move data into, out of, and between data centers on demand.
- **Latency** : Data centers are not always located next to the businesses they serve, and it takes time for data packets to travel from point A to point B (for example, from a data center to an office). That delay is called latency, and it can be a complicated issue to solve. Tech leaders must keep latency in mind when reviewing their data center options.
- **Industry Standard Certification and Compliance**: There are so many certifications and compliance standards for data centers that it can be difficult for a tech leader to keep everything straight. Data centers need to be ready for audits, which means keeping up to date with HIPAA, PCI DSS, SAS 70 (Type 1 and 2), SSAE 16, SOC 1, SOC 2, SOC 3, and more.
- **Disaster Recovery**: Downtime is a tech leader's worst nightmare. It is critical that data centers have disaster recovery plans in place, especially considering that companies lose an average of $5,600 per minute when a data center is down. Businesses need to be ready for anything that comes their way in a data center, from power outages and system failures to natural disasters, so it is important to define redundancy, cable plans, failover plans, action plans, and other workflows to ensure that hosted applications and users are as unaffected as possible.
- **Backups**: These days, it is common sense to back up your vacation photos to an external drive; it follows, then, that enterprises would backup critical information related to their operations and their customers. Tech leaders must have defined backup measures in place within their data centers to ensure that none of their mission-critical data is lost.
- **Virtualization** : According to Gartner, virtualization (the move toward virtual machines [VMs] versus traditional hard components) could account for upwards of 85% of server workloads by the end of 2016. While virtualization has a number of benefits—including reduced downtime—it also poses a number of questions about managing VMs, balancing networks, backups, and security.
- **Cloud Strategy**: An increasing number of tech leaders are looking for cloud options to augment or replace their current data centers. Cloud-based applications are driving movement, which is forcing many traditional data centers to consider Cloud and its implications.

How Do Data Centers Work?



It can be easy to think of a data center as a storage unit filled with computers, but that conception only begins to scratch the surface of what a data center truly is. That's because what a data center is is inherently tied to what a data center does. Put simply, a data center's job is to store, manage, and disseminate data.

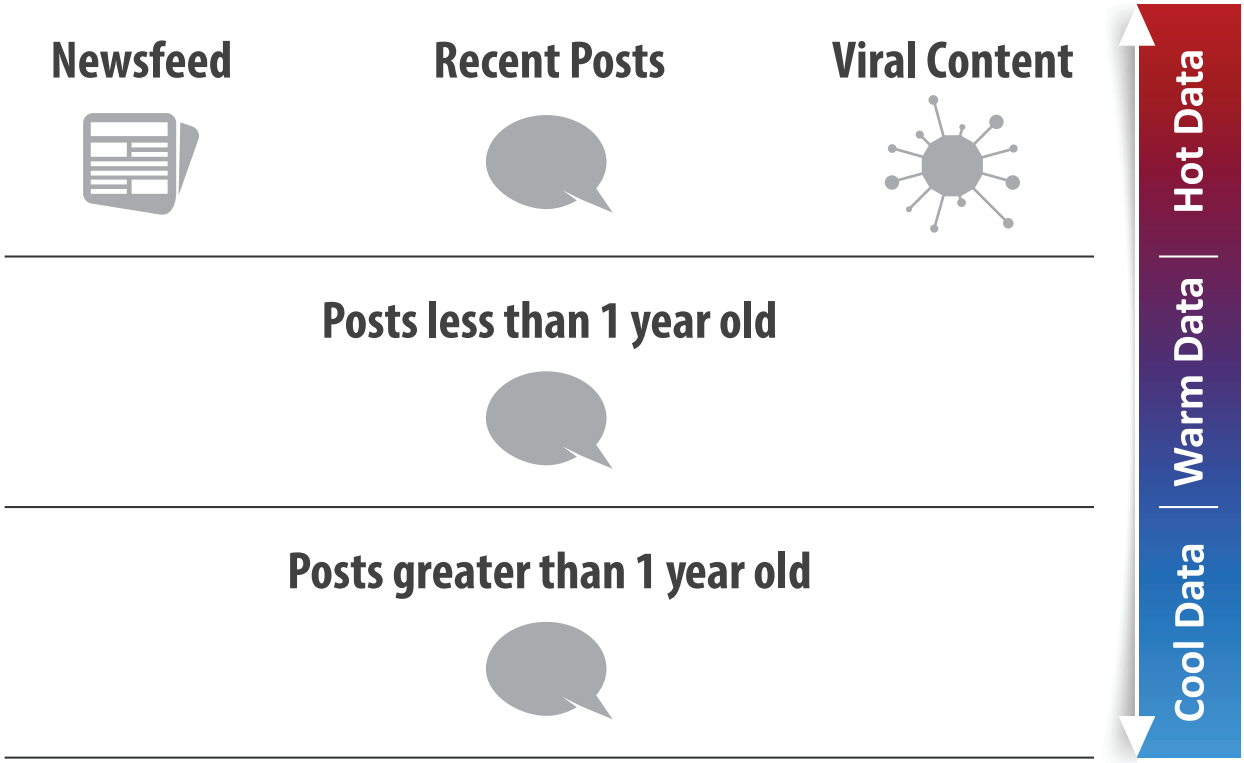
> **"It's important to note that, within a data center, not all information is treated equally..."**

A typical data center contains multiple rows of racks, with each rack holding multiple servers that are temperature regulated. These servers are connected to one another, as well as the outside world, through a series of routers and/or switches to facilitate smooth data transfers. While some servers are dedicated to running inter- and intranet services for the organization, others are dedicated to storage or are running applications and services that are internally and/or externally consumable.

While data centers serve different functions, the way that data gets into and out of a data center is roughly the same across the board. At a high level, an end user connected to the internet sends a data packet to the data center. In the simplest form, the data packet is typically a request from the user to a.) get data out of the data center, b.) put data into the data center, or c.) delete data from the data center. This packet is delivered to the data center through a switch, which talks to a server. The server then identifies the request as "get," "put," or "delete" and retrieves, deposits, or removes data from storage. If data is deposited or deleted, the user typically receives some kind of confirmation; if data is retrieved, the server sends the data back through the switch, which routes the data packet back to the user via the Internet.

It's important to note that, within a data center, not all information is treated equally. In fact, there are several basic tiers that data can fall into based on the type of information and the method of storage. Information in the top tier is new, time-critical, and/or commonly used and, is therefore stored on higher performance technology to make it more rapidly accessible. This is referred to as hot data. Data on lower tiers, also known as warm or cool data, is less frequently used and is stored on lower performance systems, which means that data retrieval has increased latency.

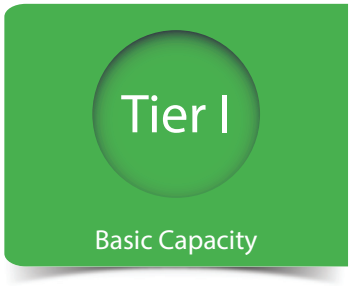
Here's a practical example. When you log onto your social media account, you send a data packet through the internet to a data center. The data center's switches communicates with the servers to send back the data that makes up your account. Things that happened recently show up at the top of your news feed, so that data is most likely coming from a tier containing hot data. If you decide to take a trip down memory lane and scroll through your old photos, you may notice that the photo's take longer to load; that's because your older photos are usually considered cool data, and they are probably stored in a cooler tier. Below is a visual representation of this example:



Types of Data Centers?

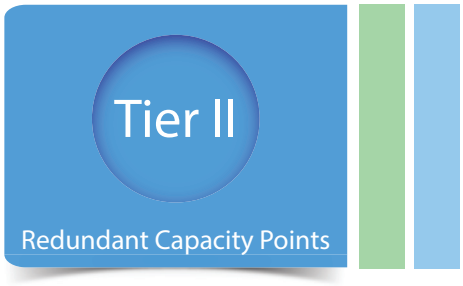
When tech leaders begin to consider all of the data center trends, along with the soft and hard components of a data center and the different levels of service available, choosing the data center that's right for them can seem like a daunting task.

According to the Uptime Institute , there are four tiers into which data centers can be classified depending on the performance of their infrastructure. The tiers are progressive, meaning that each tier also follows the requirements of all previous tiers. However, that does not mean that one tier is better than another—individual companies have different needs better suited to specific tiers. Tech leaders need to be aware of the level of infrastructure they need, or they risk spending too much or too little for infrastructure that doesn't support their goals.



A **Tier I** data center has a dedicated site infrastructure to support IT outside of a basic office. Tier I infrastructure includes:

- Dedicated space for IT assets
- An uninterruptable power supply
- Dedicated cooling equipment, 24/7
- An engine generator for power outages



In addition to Tier I components, **Tier II** centers contain:

- Redundant power and cooling components
- Increased protection against disruptions
- Minimal opportunities for proactive maintenance

In addition to Tier I and II components, **Tier III** centers do not require any shutdowns to perform maintenance. They include:

- A redundant delivery path for power and cooling
- The ability to shut down and maintain individual parts of the processing environment

In addition to Tier I, II, and III components, **Tier IV** centers include:

- Fault tolerance infrastructure
- Minimal (or no) effects associated with equipment failures or distribution path interruptions

No matter how many tiers of performance a data center has, it will fall into one of two main categories: Enterprise Data Centers or Hosting / IaaS Data Centers. Ultimately, tech leaders will choose from one of these categories depending on their specific needs.

Enterprise Data Centers

Enterprise data centers typically serve a high number of off-the-shelf and custom applications to a limited number of users behind a firewall. Using a mix of virtualized and non-virtualized servers, enterprise data centers must meet high standards in security and uptime.

At-a-Glance:	
Number of applications	High
Security	High
Cost vs. Value	Medium cost; High value
Workload scale	Medium
Multitenancy	Low
Traffic Orientation	Mixed
Degree of Virtualization	Medium but increasing
Example(s)	Walmart, Visa

Hosting or IaaS Data Centers

Hosted data centers are owned by third-party service providers and rented out to clients as a platform for storage and deployment. For this reason, they are sometimes known as IaaS data centers, offering different levels of Infrastructure as a Service and relying on virtualization to deliver data to multiple customers in different locations. Because hosted data centers are off-site, shared environments, security, and latency are high priorities.

At-a-Glance:	
Number of applications	Very High
Security	Low to Medium
Cost vs. Value	Medium cost; Varying value
Workload scale	Very High
Multitenancy	Very High
Traffic Orientation	Mixed
Degree of Virtualization	High
Example(s)	Amazon Web Services, Rackspace

Understanding Your Options

Choosing a data center strategy can be simple if you understand the difference between the offerings and how each could address your business goals. Traditionally, data centers are based on private, single-tenant models, and can be hosted and managed either on- or off-site. Cloud storage is an alternative to physical data center storage, but it can be structured as either a private or public instance and built in a single- or multi-tenant fashion. Nowadays, many companies employ a hybrid approach to their data center strategy, using a combination of both public and private options that fit their needs. We will discuss three (3) forms of data centers to help you decide which option is best for your business.

In-House Data Center

In-house data centers are typically private, single-tenant instances whose sole purposes are to store and provide a company's data internally to its stakeholders. Hosting your own data center means that you have greater control over the way your data is managed, which can increase your data security as long as you implement appropriate security practices. However, this can be a very costly option because building and maintaining all necessary resources requires a substantial capital investment. Once you determine your storage needs, you can determine the structure for building your data center. An added benefit of hosting your own data center is the ability to purchase and support only the resources needed to accommodate your data. A data center can range from a virtual instance stored on a devoted machine in the corner of your office to multiple servers located in a dedicated facility.

"Many companies employ a hybrid approach to their data center strategy, using a combination of both public and private options that fit their needs."

Some companies shy away from in-house data centers due to the increased costs associated with upkeep, maintenance, inventory management, and other services. Another major disadvantage of hosting an in-house data center is the amount of energy that it will consume. This variant is not energy efficient and may not be worth the cost or the potential stigma associated with non-green energy consumption in comparison to some of the other offerings. However, many companies have been focusing to reduce this enormous energy consumption by incorporating more efficient technologies and practices in efforts to reduce the environmental impact.

Colocation

A colocation data center is essentially a facility that offers rentable server space, as well as the power, bandwidth, maintenance, and security needed to support its customers' servers. This helps alleviate stress regarding costs and maintenance, letting companies focus on other key business concerns. There are several types of colocation data centers. These consist of retail, wholesale, and other hosting options. This variant can be beneficial to those who wish to store data needed for disaster recovery or those who may not have the resources to host an in-house data center.

Retail colocations are multi-tenant data centers, meaning they house more than one client. This setting attracts the attention of network, cloud, and IT service providers, offering more options and incentives to clients. They lease smaller amounts of space to companies for the storage of their company data. This solution is ideal for companies who do not need an excessive amount of rack space or who only need it for a short amount of time. It is also great for companies who do not have future plans for expansion, ones who have reached capacity at their current setup, or those who need to disperse their data to different geographies. This option is also perfect for companies who do not have the time or resources to manage and maintain their own data center.

"Ensure that you take into account the flexibility that you will require for your data center to evolve over the span of your business."

Wholesale colocations are similar to Retail, but the latter focuses on leasing large blocks of space that draw at least 300 kilowatts of power – this equates to 2,000 square feet or more. Space is rented out in the form of private suites or large cages. Management and maintenance of the data systems can be carried out by either the client or the provider. This is ideal for companies who wish to implement a full-scale data center without having to build or lease an entire facility, saving on capital expenditures and reducing excess energy consumption. However, it is up to the provider whether or not they will manage the mechanical and electrical systems on their client's behalf.

Other colocation options consist of the dedicated and shared hosting variants. In dedicated hosting, a client is able to lease an entire server without having to share resources with anyone else. This ensures that the right amount of resources is provided to your server the moment it demands it. In shared hosting, there are multiple servers utilizing a single system that allocates system resources based on demand. Using a shared hosting data center increases the power efficiency, thermal efficiency, and compute density of your data center equipment, eliminating the operational and maintenance costs associated with hosting your own data center.

Before entering into a contract or service level agreement (SLA) to have your data center hosted at a colocation, you should assess your current and future data storage needs. Some disadvantages to this offering include the distance and travel costs that arise when the need to manually touch any equipment occurs, as well as any long-term contracts which may prevent re-negotiation of rates when prices fall. Thus, it is important to ensure that your short- and long-term needs are reflected and addressed in the specific terms of agreement outlined in the SLA. Also, ensure that you take into account the flexibility that you will require for your data center to evolve over the span of your business.

Cloud Computing

Companies are increasingly switching from traditional data center options to a virtualized instance reachable via the Internet (the Cloud). Instead of spending a substantial amount of money on building and maintaining a physical data center, companies are turning to cloud computing as a cheaper alternative. The Cloud operates as an Internet-based network of servers that is able to host and process vast amounts of data for individual or multiple users to access at any given time. Unlike traditional data centers with direct network connections, the Cloud can be built as either a private or public architecture over the Internet, and it is available in a single- or multi-tenant fashion. Cloud-based data centers can serve similar workloads to traditional data centers, but they may pose different security and compliance challenges. Cloud often presents greater opportunities for scalability and self-service, providing a cost-effective solution.

Crash Course in Cloud

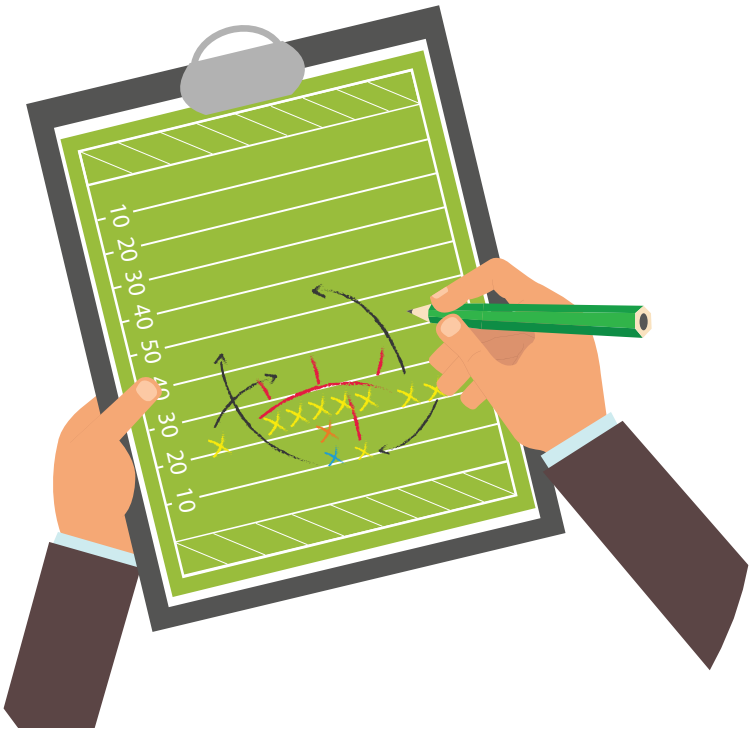
Cloud computing is a model for enabling the universal distribution and access of information, regardless of device or location. Here are a few cloud-computing basics:

- Cloud computing harnesses the power of a network of combined servers to store, process, and manage data.
- The term "**Cloud**" is used as a synonym for "Internet." In other words, "cloud computing" is simply computing done via the Internet.
- Local computers only need to be able to access and use a certain cloud interface through the Internet rather than storing and processing large data sets internally.
- Users can access data and applications stored in the Cloud on demand on their own devices, making it a major asset for the modern, remote workplace.
- Cloud computing allows for resources to adjust in response to high network traffic, creating an illusion of infinite computing ability. This is also known as **elasticity**.
- Most Clouds follow a pay-by-consumption model (meaning you only pay for what you use).
- Businesses using the Cloud are well positioned to scale up or down with fluctuations in demand without spending exorbitant amounts on infrastructure.

Which Strategy is Best For My Business?

Choosing the data center option that is best for your business depends on your current needs and future plans for data storage. For example, some businesses, such as hospitals and banks, must store highly sensitive data. For these companies, private data center strategies can help to meet compliance regulations and keep customer information secure. For other businesses, such as photo-sharing sites or social media outlets, expansion and operational cost may be more important than security, causing them to lean towards more public or combined solutions (i.e. some data in a wholesale center and some data stored in-house).

When choosing an option, you should start by addressing these needs and observing what other companies in your industry are doing. Refer to the following table for a quick reference highlighting the strengths of each data center option.



When choosing an option, you should start by addressing these needs and observing what other companies in your industry are doing. Refer to the following table for a quick reference highlighting the strengths of each data center option.

Business Need	Data Center Type
Future expansion or plenty of space	In-house, Wholesale Colocation, Cloud (General)
Physical or network security	In-house, Colocation (General), Private Cloud
Lower operational costs or increased efficiency	Colocation, Cloud (General)

In all cases, we recommend that you speak with a consultant to gain a better understanding of what options may be best for you and your organization.

How Do I Proceed?

With all of the data center options available, choosing the best solution for your company is a move that will save you money, reduce future storage concerns, and help you meet compliance regulations. If your company is set on managing and hosting its own data, then an in-house architecture will probably be the best strategy for you. However, if lower costs and provided benefits such as added security and maintenance appeal to you, then colocation services or the Cloud are the options you should look into. Ultimately, your business requirements related to compliance, security, and operations will inform your preferences when choosing a data center, so it is important to keep your business goals at the forefront of your decision making.

For any data center solution, you will need staff to implement and operate your IT hardware. This can be achieved through in-house full-time employees (FTEs), staffing agencies, or outsourcing to an MSP. While the specific route you choose may vary depending on your overall business goals, working with an MSP is a scalable solution that allows for predictable cost and reduced management responsibilities.

Staffing Option	Business Benefit
In-House FTEs	You will develop in-house skills related to data center management and operations
Staffing Agency	Great for one-time projects or services for a limited duration at a limited cost
Managed Services Provider	Excellent for routine, day-to-day projects as well as continual process improvement; employees come pre-trained and highly experienced

No matter what option you choose, a Managed Services Provider can help you build, manage, and operate your data center through implementation services, asset lifecycle management, and data center operations services. Other than the improved focus on operational needs, there are plenty of advantages to letting an MSP take care of your data center needs. Offloading core components to an MSP promotes the effective monitoring of your company's equipment, improved uptime metrics, and a reduction to your internal workload. This mitigates stress, allowing your organization to focus on its core competencies.

Implementation Services

An MSP can help you get your data center running or assist in relocation efforts through implementation services. Typically, these services include a full diagnostic of a business' existing data center ecosystem as well as a carefully coordinated project plan to get the data center off the ground.

Taking your data center from conceptual to concrete can be challenging, but MSPs can handle the installation and decommissioning of data center equipment, including cable management and rack diagramming. They can also validate, configure, and integrate hardware prior to deployment to ensure proper functionality and maximized uptime from the beginning.

Asset Lifecycle Management

One of the challenges in operating a data center is maintaining visibility into your assets. An MSP can provide end-to-end asset management from procurement to distribution and retirement, as well as pre-negotiated supplier contracts and defined standard operating procedures.

Because the hard components of your data center are so critical to success, Asset Lifecycle Management (ALM) is key. MSPs help you manage your data center's space and locations for standardized equipment, which helps you get the most out of your data center. They also provide dashboards for tracking consumption rates, asset lifecycle reports, and operational effectiveness, which ultimately helps lower transaction costs, meet inventory requirements, and drive operational efficiency.

Data Center Operations

An MSP provides maximum coverage for your data center, which allows you to be as productive as possible with the highest levels of uptime. In addition to hardware management, MSPs can provide operational level support for physical and logical layers within a data center. From break-fix and configurations for networks and servers to first-response troubleshooting, it is the MSP's responsibility to juggle all of the variables that can affect your data center from day to day.

The Milestone Difference

Like other MSPs, Milestone provides peace of mind for companies looking to build, manage, and operate data centers. However, we have the advantage of nearly two decades of experience with industry-leading enterprises. Our passionate professionals think about data centers holistically, and we build processes aligned with ITIL best practices to ensure quality IT across your data center. Our approach is built on:

- **Proactivity**: The best way to solve problems in your data center is to prevent them from happening. Proactive monitoring leads to increased uptime.
- **Expertise**: Over our 18 years of industry experience, we've worked with a variety of delivery models and partnered with many of the industry's biggest players.
- **Accessibility**: We offer 24/7/365 support because we understand that technology doesn't stick to a nine-to-five schedule. All of our support is provided onshore.
- **Process Engineering**: We engineer processes in addition to technology to ensure that people interact efficiently with infrastructure.
- **Clear Best Practices**: Milestone aligns with ITIL standards to ensure quality and create transparency.
- **Innovation**: Sometimes clients' problems do not fit into a predefined solution, and that's why Milestone employees think outside the box to provide innovative solutions.
- **People**: Milestone hires individuals who are passionate about technology and innovation, and our people go above and beyond to ensure that your IT is the best it can be.

With uptime and latency being critical factors for tech leaders, one of Milestone's key differentiators is our 24/7/365 accessibility. You need your data to be available 100% of the time, and you need an MSP who is, too. Contact Milestone to find out how we can be there for you.

About Milestone Technologies

At Milestone, we've been transforming IT since 1997, when President and CEO Prem Chand founded Milestone Technologies, Inc. Back then, Prem's goal was to solve a growing problem for Silicon Valley businesses: IT relocation. Nearly two decades later, we are growing as quickly as the high-tech industry, with more than 1,700 employees serving a substantial client base—currently over 200 companies in 18 countries. Today, Milestone's goal is to shape the way technology is delivered. Every solution we provide is driven by experienced people who are determined to understand your business goals and align your network to help you achieve them, ultimately streamlining your path to success.