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Understanding Data Centers and Cloud Computing

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Introduction

Competitive business environments are putting pressure on IT managers to accomplish more each year with reduced budgets. With the need for flexibility, competitive edge, and faster time to market, IT organizations must find new solutions that are more efficient and more cost-effective than their past or current solutions.

The original data center started as a private server room hosted within the organization's facility containing many individual servers running single applications. In the early days of data centers, most organizations were responsible for maintaining the servers and software, and required a number of personnel resources to manage the servers as well as the facility.

While some larger organizations continue to manage internal data center, many business managers are able to increase service levels, cover more users, and lower response times by outsourcing their out-dated server farms to third-party data centers and cloud computing providers. These third-party data center providers are better equipped to maintain and update server equipment.

This white paper will define data centers and explore cloud networking.

What Is a Data Center?

A data center (sometimes called a server farm) is a centralized repository for the storage, management, and dissemination of data and information. Typically, a data center is a facility used to house computer systems and associated components, such as telecommunications and storage systems. Often times, there

are redundant or backup power supplies, redundant data communications connections, environmental controls, and security devices.

In April 2005, the Telecommunications Industry Association (TIA) produced specification TIA-942: Telecommunications Infrastructure for Data Center. This was the first standard to specifically address data center infrastructure. This standard encompasses all parts of data center design, including cabling, facility, network design, and data center tiers (see sidebar).

One key benefit to the data center is that physical hard drive storage resources are aggregated into storage pools, from which "logical storage" is created. The heterogeneous nature of most storage systems allows many different vendors' storage hardware to be added to the system with little or no noticeable effect (except for the additional storage space). These logical storage spaces can be reached from many different computer systems that share the same pool of storage space. One of the biggest benefits to storage virtualization – other than the obvious ones such as centralized backups and the need for fewer hard drives overall – is the fact that the data can be replicated or migrated to another location transparently to the server using the logical storage point.

One of the not so glamorous or "hi-tech" benefits of the data center is the consolidation of all of the facility resources such as HVAC, electrical, network connections, wiring, hardware, software, and personal. Many corporations have multiple server rooms with duplicated services across their entire organization, all of which are running on duplicated hardware and software platforms. In an attempt to reduce duplication and wasted expense, many corporations are consolidating their server rooms into private data centers, reducing the duplication of hardware, software, and facilities needed to operate their business.

Cloud Computing

Leveraging third-party computing capability over the network is a good way to cut costs, increase scale, and improve agility. The concept of cloud computing involves a data center somewhere in the world, or even multiple data centers scattered around the world. This is a paradigm shift from the historical client-server architecture where the network users owned, maintained, and operated their own network infrastructure, server rooms, data servers, and applications.

Typical cloud computing providers deliver common business applications online that are accessed from web browsers, while the software and data are stored on the servers or SAN devices. These applications are broadly divided into the following categories: Software as a Service (SaaS), Utility Computing, Web Services, Platform as a Service (PaaS), Managed Service Providers (MSP), Service Commerce, and Internet Integration.

These data centers are hosting the servers and applications the clients use to operate their business.

This structure reduces capital expenditures, since by renting from a third-party provider to provide the services on a per-use fee the business only pays for the resources used.

Some Cloud providers employ a utility computing model, meaning they bill clients like a utility such as an electrical company. Others bill on a subscription basis. In either case, the customer gains the security of a service level agreement (SLA) as well as the saved expense of hiring an IT staff to maintain a local server farm.

There are many resources available in a data center and in the cloud that a client can purchase or rent, such as processing time, network bandwidth, disk storage, and memory. The users of the cloud do not need to know where the data center is, or have any expertise on how to operate or maintain the resources in the cloud. Clients only need to know how to connect to the resources and how to use the applications needed to perform their jobs.

With cloud-based computing, the applications run on servers in the data center, not the local laptop or desktop computer the user is operating. The user's computer provides a window into the application, but does not actually run the application; in other words, it runs a user interface. This procedure reduces the need for big processing power and memory on the end user's computer and centralizes it in the data center.

Key benefits of cloud computing:

- **Flexibility** – There is the ability to update hardware and software quickly to adhere to customer demands and updates in technology.
- **Savings** – There is a reduction of capital expenditures and IT personnel.
- **Location & Hardware Independence** – Users can access application from a web browser connected anywhere on the internet.
- **Multi-tenancy** – Resources and cost are shared among many users, allowing overall cost reduction.
- **Reliability** – Many cloud providers replicate their server environments in multiply data centers around the globe, which accounts for business continuity and disaster recovery.

Cabling Design - Structured cabling system for data centers using standardized architecture and media

- Copper and fiber cabling performances
- Connectors, cables, distribution hardware
- Cabling distancez
- Space management

Facility Design

- Data center sizing
- Power distribution methodologies
- Pathways and spaces
- HVAC, security, operations, and administration

Network Design

- Support of legacy systems
- Enable rapid deployment of new and emerging technologies.

Data Center Tiers

- Tier 1 – Basic Data Center
  - 99.671% Availability
  - No redundancy
  - Single path for power and cooling distribution
  - May or may not have a raised floor, UPS, or generator
  - Annual downtime 28.8 hours
- Tier 2 – Redundant Components
  - 99.741% Availability
  - Redundant components
  - Single path for power and cooling distribution
  - Includes raised floors, UPS, and generators
  - Annual downtime 22.0 hours
- Tier 3 – Concurrently Maintainable
  - 99.982% Availability
  - Single path for power and cooling distribution
  - Redundant components
  - Includes raised floors, UPS and generators
  - Annual downtime 1.6 hours
- Tier 4 – Fault Tolerant
  - 99.999% Availability
  - Multiple active power and cooling distributions paths
  - Includes raised floors, UPS and generator
  - Multiple active distribution path

TIA-942 Contents

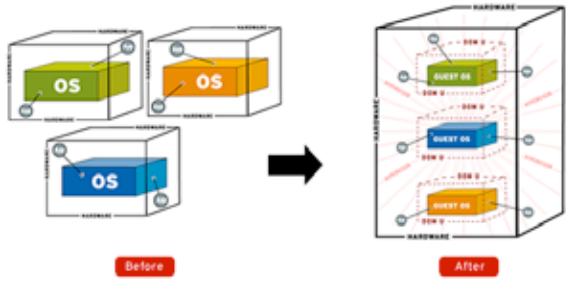
- **Scalability** – Multiply resources load balance peak load capacity and utilization across multiply hardware platforms in different locations
- **Security** – Centralization of sensitive data improves security by removing data from the users' computers. Cloud providers also have the staff resources to maintain all the latest security features to help protect data.
- **Maintenance** – Centralized applications are much easier to maintain than their distributed counter parts. All updates and changes are made in one centralized server instead of on each user's computer.

The term *Cloud Computing* was inspired by the cloud symbol that is often used to represent the Internet in flow charts and diagrams.

Virtualization

One of the main cost-saving, hardware-reducing, and energy-saving techniques used by cloud providers is virtualization. Virtualization is done with software-based computers that share the underlying physical machine resources among different virtual machines (VMs).

With OS virtualization each VM can use a different operating system (OS), and each OS is isolated from the others. Many companies use VMs to consolidate servers, enabling different services to run in separate VMs on the same physical machine. VMs allow time-sharing of a single computer among several single-tasking operating systems. Utilizing VMs requires the guest operating systems to use memory virtualization to share the memory of the one physical host.



Memory Virtualization removes volatile random access memory (RAM) resources from individual systems, and aggregates those resources into a virtualized memory pool available to any computer in the cluster. Memory virtualization leverages large amount of memory which improves overall performance, system utilization, and increased efficiency. Allowing applications on multiple servers to share data without replication also reduces the total amount of memory needed.

Summary

A data center is a facility used to house computers, telecommunications, and storage systems. Most data centers have redundant power systems and data communications connections, as well as proper environmental and security to protect the equipment and the clients' data. By renting these data center resources, clients can reduce their cost of operation and need for technical staff, and increase the amount of time and energy expended on their core business.

Many services are offered at data centers, such as cloud computing. For all practical purposes the use of cloud computing centralizes the clients' server hardware and applications, reducing the need to maintain a server

room, equipment, and staffing of their own. The use of cloud computing also has many other benefits, including increased productivity, since users can access their applications from anywhere on the internet.

The data center reduces the need for hardware by "time sharing" clients on the same hardware platform with the use of virtualization. By reducing the number of servers, the data center reduces its need for power and HVAC, again reducing the cost of doing business, and also doing its share to save the planet.

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About the Author

Paul Stryer, CCSI, CCNA is a Global Knowledge contract instructor who provides consulting service though his company LMLP, LLC. As an engineer at Cisco Systems Inc. for over 10 years, Paul was exposed to many different disciplines within the Technical Assistance Center (TAC). Using his Microsoft, Banyan Vines, and Novell certifications, Paul began with Layer 2 TAC and escalated his career into the Advanced Services Multiservice TAC. As one of the founding members of the Selsius (CallManager) TAC Paul has worked with CallManger 2.1 to the current Unified Communications Manager 7.0 and all versions and technologies in between. Paul has continued his experience in the voice and data communications arena as a network integrator and contract instructor outside of Cisco Systems.

Paul has led many teams to develop and teach classes for Cisco Systems, such as Cisco IP Telephony version 1.0 (CIPT) and Wholesale Voice and Dial (SS7 to VoIP interconnect technology SC2200/PGW2200). During his tenure with Cisco Systems Paul assisted with developing and teaching classes on BGP, OSPF, and Wireless Technologies.

Resources

Cisco Data Center Technologies – http://www.cisco.com/en/US/netsol/ns949/index.html

Wikipedia – http://en.wikipedia.org/wiki/Virtualization

IEEE – http://ieee802.org/3/hssg/public/nov06/diminico_01_1106.pdf

Telecommunications Industry Association (TIA-942) – http://tiaonline.org/