Design Enterprise Data Center Infrastructure at Computer Center of Al-Jaderyia Baghdad-University Campus

Halah Hasan Mahmoud
Computer Center, University of Baghdad, Baghdad-Iraq.
E-mail: halah_altaha@yahoo.com.

Abstract

Cloud computing is an emerging computing paradigm. It aims to access and host's computing services and data over the internet. Access is achieved through web browser, and services are supplied by software running on a cloud platform. Cloud computing implementations can be characterized in two models: Service Models and Deployment Models. Cloud Computing resided in a large data center and is able to dynamically provide servers with the ability to address a wide range of needs. A data center (which is the heart of most companies) is a facility used to house computer systems and associated components, such as telecommunications and storage systems. This work presents a plan to design Enterprise Data Center infrastructure network at computer center that connects Colleges, Institutes and Centers within Baghdad University Campus and meets the requirements of modern data centers.

Keywords: Cloud Computing, Cloud Computing Models, Data Center, Data Center Layout

Introduction

With the advancement of the modern human society, basic essential services have been commonly provided such that everyone can easily obtain access to them. Today, utility services, such as water, electricity, gas, and telephony are deemed necessary for fulfilling daily life routines. These utility services are accessed so frequently that they need to be available whenever the consumer requires them at any time. Consumers are then able to pay service providers based on their usage of these utility services [1].

Cloud Computing [2] first came into concept back in the 1960′s when John McCarthy proposed that computers may someday be organized in a method that would involve it acting as a public utility. Telecommunication companies began offering Virtual Private Network services during the 90′s that were much lower in cost than their at the time offered point-to-point data circuits that provided their services. In 2007, major companies such as IBM, Google, Amazon and different school universities created a huge cloud computing research project which allowed many to see the prospects of cloud computing and the positive effects it could have on IT users and those who sell IT services. The launch of Google App Engine in 2008 was the entry of the first pure play technology company into the Cloud Computing market. Google a dominant Internet company entering into this market was clearly a major step towards wide spread adoption of cloud computing [3].

2009 saw Microsoft's entry into cloud computing with the launch of Windows Azure in November. Now, suddenly, there were major players jumping onto cloud computing from left, right and center. While 2010 saw the maximum number of companies entering this space, 2011 is expected to be even more eventful [4].

A) Definition of Cloud Computing

Cloud Computing is a modality for providing computer services via Internet, by incorporating ubiquitous access through a web browser for the execution of single-function applications, such as those available as office suites, and comprehensive enterprise line-of-business applications pieced together from components residing in varying Internet locations [5].

Cloud Computing is location-independent computing, whereby shared servers provide resources, software, and data to computers and other devices on demand, as with the electricity grid. Cloud computing is a natural evolution of the widespread adoption of virtualization, service-oriented architecture and utility computing [6].

B) Characteristics of Cloud Computing

National Institute of Standards and Technology [NIST] define Cloud computing as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. It also lists five essential characteristics of cloud computing [7]:-

- **On-Demand Self-Service:** A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.
- **Broad Network Access**: Capabilities are available over the network and accessed through standard mechanisms that promote use by client platforms (e.g., mobile, laptops).
- **Resource Pooling:** The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.
- **Rapid Elasticity:** Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities are unlimited and can be purchased in any quantity at any time.
- **Measured Service:** Cloud systems automatically control and optimize resource use by leveraging a metering capability appropriate to the type of service (e.g., storage, processing, and bandwidth). The provider and consumer can monitor, control, and report resource usage.

C) Cloud Computing Models

Cloud computing implementations [8] can be characterized in two orthogonal ways according to the definition of NIST: ***First*** by the capabilities they provide (***Service Models***) and ***Second*** by who can access their resources (***Deployment Models***).

Service Models

Based on capabilities, there are three types of cloud computing implementations:

Software as a Service, Platform as a Service and Infrastructure as a Service.

- **Software as a Service (SaaS)**
  SaaS focuses on providing users with business-specific capabilities hardware and software applications [8]. At the SaaS level, users do not have control or access to the underlying infrastructure being used to host the software. Salesforce's Customer Relationship Management software and Google Docs are popular examples of SaaS model [9].

- **Platform as a Service (PaaS)**
  This is where applications are developed using a set of programming languages and tools that are supported by the PaaS provider. PaaS provides users with a high level of abstraction that allows them to focus on developing their applications. Users do not have control or access to the underlying infrastructure being used to host their applications at the PaaS level. Google App Engine and Microsoft Azure are PaaS examples [9].

- **Infrastructure as a Service (IaaS)**
  The IaaS service model is the lowest service model in the technology stack, offering infrastructure resources as a service, such as raw data storage, processing power and network capacity. The consumer can the use IaaS based service offerings to deploy his own operating systems and applications, offering a wider variety of deployment possibilities for a consumer than the PaaS and SaaS models. The consumer has control over operating systems; storage, deployed applications, and possibly limited control of select networking components [10]. Amazon Web Services' EC2 and S3 are popular IaaS examples [9].

Fig.(1) provides an overview of abstractions of Cloud Service Models [11].

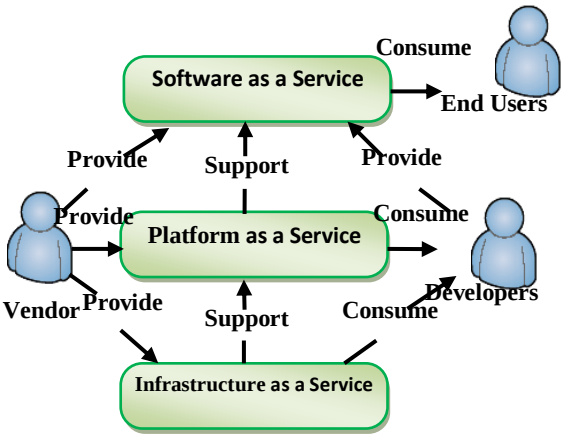

Fig.(1) Abstraction of Cloud Computing Service Models [11].

Deployment Models

Based on who can access their resources, there are four types of cloud computing implementations: ***Private, Public, Community,*** **and Hybrid.**

- **Private Cloud**

  Private (Internal) clouds run in service of a single organization, where resources are not shared by other entities. The physical infrastructure may be owned by and/or physically located in the organization's datacenters (on-premise) or that of a designated service provider (off-premise) with an extension of management and security control planes controlled by the organization or designated service provider respectively. Private users are considered as trusted by the organization, in which they are either employees, or have contractual agreements with the organization [10]. The St Andrews Cloud Computing Co-laboratory and Concur Technologies are example organizations that have private clouds [9].

- **Public Cloud**

  Public cloud (or External) is a cloud that can be used (for a fee) by the general public [9]. The infrastructure is located on the premises of the provider, who also owns and manages the cloud infrastructure. Public users are considered to be untrusted, which means they are not tied to the organization as employees and that the user has no contractual agreements with the provider [10]. Public clouds require significant investment and are usually owned by large corporations such as Microsoft, Google or Amazon [9].

- **Community Cloud**

  A Community (Federated) cloud may be established where several organizations have similar requirements and seek to share infrastructure so as to realize some of the benefits of cloud computing. With the costs spread over fewer users than a public cloud (but more than a single tenant). This option is more expensive but may offer a higher level of privacy, security and/or policy compliance [6]. Community clouds run in service of a community of organizations, having the same deployment characteristics as private clouds. Users are also considered as trusted by the organizations that are part of the community [10]. Examples of community cloud include Google's "Gov Cloud" [6].

- **Hybrid cloud**

  Hybrid clouds are a combination of public, private, and community clouds. They leverage the capabilities of each cloud deployment model. Each part of a hybrid cloud is connected to the other by a gateway, controlling the applications and data that flow from each part to the other. Where private and community clouds are managed, owned, and located on either organization or third party provider side per characteristic, hybrid clouds have these characteristics on both organization and third party provider side. Hybrid users' can be considered as trusted and untrusted. Untrusted users are prevented to access the resources of the private and community parts of the hybrid cloud [10].

Research Objective

In Information Technology, infrastructure is the physical hardware used to interconnect computers and users. Infrastructure includes the network equipment, servers, storage media, cables, wired and wireless media, antennae, routers, switches, and other devices that make up the transmission paths and devices at both ends. Infrastructure also includes the software used to store, manage, send, and receive the data and signals that are transmitted [12].

Now, cloud computing is starting to centralize IT infrastructure and computing power again. Another term for cloud is one or more cloud data centers [13]. 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 [6]. Often times, there are redundant or backup power supplies, redundant data communications connections, environmental controls, and security devices.

This research includes a plan to design Enterprise Data Center infrastructures network at Al-Jaderyia Baghdad University Campus that meets the requirements of modern data center. Design a data center, whether a new facility or retrofitting an existing one, is no simple task.

Therefore the proposed plan includes the following phases to design data center at Computer Center.

1. Construct Project of Data Center.
2. Select Building Site of Data Center.
3. Define Data Center Requirements.
4. Design Network Layout of Data Center.

Implementation

The demand for data centers has been a constant for many years. With the push for greater capacity, increased efficiency and higher levels of utilization, data centers have become more complex to design and bring on-line. Due to this, today's data center designer is often required to have knowledge in a mechanical, electrical and telecommunications systems areas not typically found in the same reference manuals or standards [14]. The data center provides the following practical requirements [12]:

- 24 × 7 network connectivity for equipment within the data center to devices outside the data center.
- A physically secure location for servers, storage, and network equipment.
- Necessary power to operate all equipment.
- An environment where the temperature and humidity are controlled to be within a narrow range.

A) Phases to design Data Center Project

First: Construct Project of Data Center.
Second: Select Building Site of Data Center.
Third: Define Data Center Requirements.
Fourth: Design Network Layout of Data Center.

First Phase: Construct Project of Data Center

A data center construction project should start with an understanding of the overall project cycle. The project cycle includes the following phases [15].

1. Planning Phase
2. Engineering Design Phase
3. Engineering Preparation Phase
4. Construction Phase
5. Commissioning Phase
6. Implementation Phase

Second Phase: Select Building Site of Data Center

The neighborhood where the data center will be located should be chosen carefully to get the best mix of ideal features. The site should be in a safe area that is not subject to any natural environmental dangers [16]. Natural disasters and weather [17] usually come to mind first when thinking about site selection. Many types of natural disasters exist to examine the effect on a data center and personnel working at the facility such as Climatic (Hurricane, Tornado, Drought, Ice-Storm), Geological (Earthquake, Volcanoes) and Hydrological (Tsunami, Flood). These factors exist only to take in to consideration when deciding on the optimal.

Third Phase: Define Data Center Requirements.

This Phase [12] includes ways to estimate the amount of hardware required within a server with a goal to satisfactorily meet forecasted loads. CPU and memory are the most important variables. Other factors such as adapter speed, network link speed, and server backplane frequency have a few alternatives. The capacity of planning for Servers is divided into three Stages [12]:

- Define the customer's requirements.
- Measure or estimate current resource utilization.
- Size of the new server.

Fourth Phase: Design Network Layout of Data Center

The network is the first component that should be thought of during the design of the data center. While the physical specifications of the data center are indeed important, without a network design, the remainder of the layout must be made prior to the understanding of the data requirements. Data communications networks have become an infrastructure resource for businesses, corporations, government agencies, and academic institutions.

Networks can consist of the two distinct components:

- Public Network.
- Core Network.
- Wide-Area -Networks (WANs).
- Data center.
- Remote Connections.

Case Study

This proposed plan selects Computer Center location of Baghdad University to design Data Center at Al-Jaderyia Campus.

Baghdad University Campus includes number of sites (Colleges, Institutes and Centers). This work connects sites (Buildings) together at Al-Jaderyia Campus.

Fig. (2) Shows the Layout of Data Center Network at Baghdad University Campus. ***Edraw Max*** software is used to Design Layout of this Network.

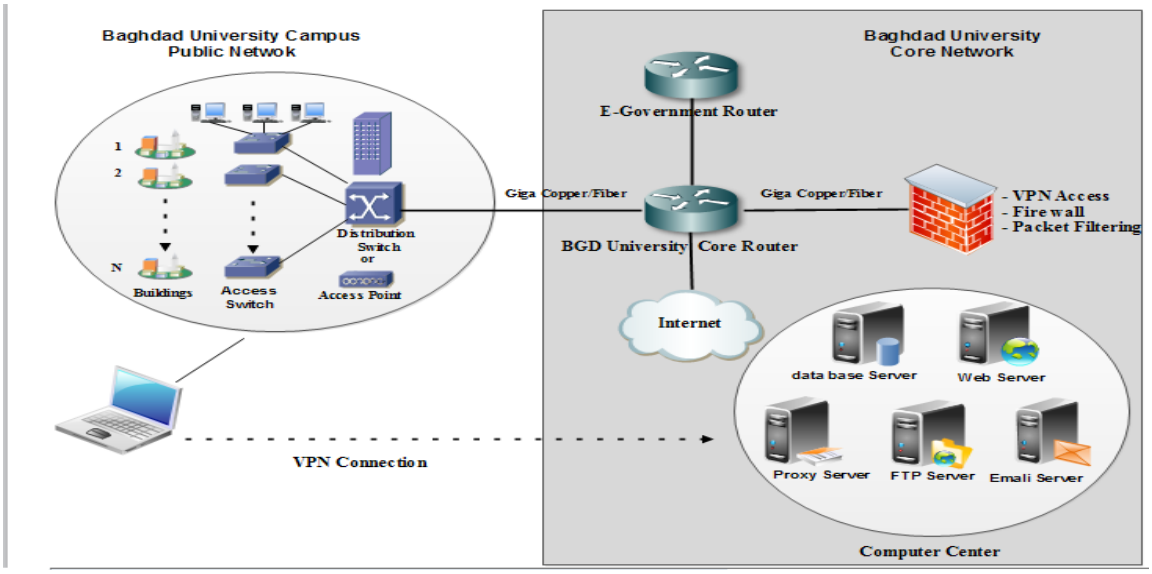

Fig. (2) Network Layout of Data Center Network at Baghdad University

To design data center shown in Fig.(2), the previous four phases described above is considered in this work.

1. Construct Project of Data Center.

A data center construction project should start with an understanding of the overall project cycle. Each phase is explains below [15].

- **Planning Phase**

  Projects must start with the planning and feasibility phase, sometimes termed the business requirements, programming requirements or needs analysis phase. This initial stage defines the overall scope, goals and budget for the project. The IT organization plays an important role in this phase because there must be a clear picture of the total power load, required availability.

- **Engineering Design Phase**

  The conceptual design and budget data gathered during the planning stage will guide the data center's design. The basic simple architectural drawings diagrams show staging areas, storage areas, elevated floor (equipment) areas, security points and so on. The goal is to establish the logical flow of both equipment and people. At this time an organization can easily make adjustments with a minimum impact on schedules or budgets. During this phase, mechanical, electrical, plumbing, security, fire protection, cabling and IT systems are detailed.

- **Engineering Preparation Phase**
  The next phase in a data center construction plan is focused primarily on the bidding process and the preparation of final construction documents and written specifications. These final plans correspond to the placement of electrical circuits and outlets, piping and valves, labeling and other items that construction workers will eventually build against.

- **Construction Phase**
  At this point, the building is assembled based on construction drawings and written specifications. Designers will normally oversee the construction and take steps to help implement it. While contractors should be responsible for handling routine municipal inspections, the organization itself should conduct periodic site inspections along with designers.

- **Commissioning Phase**
  As the construction phase nears completion, the focus should shift to the specialized practice of commissioning. This involves verifying the building's electrical, mechanical, cabling, security/fire and other infrastructure. Commissioning goes beyond cable testing to involve power and cooling system startup, fault and uninterruptable power supply (UPS) testing.

- **Implementation Phase**
  The final stage of a new data center project is the implementation or move-in phase, where actual IT systems are installed, tested and brought into service. This process is often accomplished as a series of pre-planned moves or new deployments. For example, one move may involve transferring email servers or migrating existing servers; another move may transfer archival storage to the new site.

After applied these phases, the following requirements have been obtained:-

1. **Budget**: According to the needs and requirements of this project, amount of money must be allocated by Baghdad University or ministry of Higher Education and Scientific Research to implement theses phases. This includes cost of infrastructure implement in this network (media, computer and network devices, cooling air…etc).
2. **Network Specifications**: it is specified according to the type of applications run in theses sites and number of users (which represents students, lecturers, stuff and employees in Al-Jaderyia Campus in this case study) using these applications

2. Select Building Site of Data Center

According to the conditions of selecting appropriate locations of data center described above , Computer Center location of Baghdad University is selected that meet theses conditions. The secure data center [16] should be constructed in a quiet area with low surface traffic, but at the same time it should have multiple access roads into the area. Other locations to avoid are banks (crime targets), parade routes (block access to facility), and chemical plants, sports arenas (anything that generates large amounts of street or foot traffic).

Baghdad University Campus includes number of Colleges, Institutes and Centers.

Let N1=No .of Colleges at Campus=8
Let N2=No .of Institutes at Campus=8
Let N3=No .of Centers at Campus=8

Thus

N =Total No. of Colleges, Institutes and Centers at Baghdad University Campus

=N1+N2+N3=8+4+8=20

This proposed work connects 20 Sites (Buildings) together at Al-Jaderyia Campus.

3. Define Data Center Requirements.

This Phase [12] includes ways to estimate the amount of hardware required within a server with a goal to satisfactorily meet forecasted loads. CPU and memory are the most important variables. Other factors such as adapter speed, network link speed, and server backplane frequency have a few alternatives. The capacity of planning for Servers is divided into three Stages [12]:

1. Define the Customer's Requirements

The first task is to evaluate the workload for the new environment. The second task is to understand what the user expects to be a satisfactory latency (or response time). It is important to collect enough information about the business needs, applications that will be

used, and type and amount of workload of batch jobs and acceptable response time.

* **CPU Requirements**
  When estimating CPU load, several assessments of intended load must be made such as large sorts are done in memory or on disk, Users do a lot of parsing and complex form navigation and Extent of mathematical manipulation on the rows and columns

* **Memory Requirements**
  Sizing memory is important. Adding generous amounts of memory is expensive, but it should not be undersized to cause swapping. Memory requirements include the maximum number of application users, I/O throughput, CPU for the application, Back-end database servers, Amount of shared images and Amount of sorting and SQL parsing.
  For application servers, memory is the most important factor determining the maximum number of concurrent users.

* **Disk Requirements**
  When estimating the number and size of required disks, a couple of factors must be considered: Spread the I/O across several spindles. This is easy with several, small-sized disks attached directly or via a SAN fabric to the server.
  For databases servers, table spaces, binaries, and redo logs must be kept on separate disks. One disk for each redo log is especially helpful for database archiving.

* **Maximum Latency Requirements**
  Latency is the time duration that a user has to wait for answers. Poor disk I/O rate is one common cause of high latency.
  For database servers, high latency is caused by large disk sorts, lack of indexes, poor indexing techniques, number of rollback segments, and size of redo log buffer.

- **Measure or Estimate Current Resource Utilization**

In this phase, we must estimate or measure CPU use for each computation or user. The resources used are measured by testing existing applications under current workload.

* **CPU Workload**
  CPU workload caused by a particular computation is measured by multiplying the amount of used CPU capacity and the amount of time the CPU is under load. CPUs are rated by various industry-standard units. A convenient standard is SPECfp2000 (CFP2000 in Seconds) units.
  Let V=No. of CPUs in server=2
  Let W= CPU Utilization (in %) =30
  Let X= CPU Capacity =1,500
  Let Y= CPU Duration Usage=20 Seconds
  Let Z= Total CPU Workload = V*W*X*Y
  =2*30*1,500*20 =18,00 Seconds.

* **Memory Consumption**
  The goal of sizing for memory is to minimize paging. Whereas it is possible to eliminate paging by buying enough memory, the value of sizing lies in recommending just enough memory and not over-prescribing. CPU, memory requirements fall into either a per-user category such as database servers, middleware clients, and timeshare systems or a system-wide category like Operating system memory requirement, Kernel requirements, System Library memory requirement, Application and database requirement, File system buffer memory requirement.

- **Size of the New Server**

Here, the estimates made in Stage 2 are extrapolated to calculate the CPU and memory needed to support requirements specified in Stage 1 such as the projected number of users.

* **CPU Estimates**
  Table (1) shows examples of CPU estimates for a predicted number of users and workload. The user needs, include the CPU estimate such as requirement for operating system, kernel processes and application processes, System response time requirements.

Let A=Projected Number of Users.
Let B= Projected Computations per Second.
Let C=Estimated CPU Workload per Computation.
Let D= Total CPU Usage =A*B*C

Table (1)
Examples of projected CPU Requirements for a Predicted Number of Users [12].

Computation Type	*A*	*B*	*C*	*D*
Application requests to data base instance	200	0.2	18	720
HTTP hits	400	5	3.24	6,480
Database reports	60	2	25	3,000
SQL queries	800	0.2	32	5,120
Total				15,320

Servers are arranged in server farms and is categorized according to its type, database, Web, E-mail, FTP, Proxy and so on. Each server farm consists of number of servers (e.g.50, 100) and this is determined according to the users' requirements mentioned above. Server farm is located at computer room of data center at computer center locations.

4. Fourth Phase: Design Network Layout of Data Center

The network is the first component that should be thought of during the design of the data center. While the physical specifications of the data center are indeed important, without a network design, the remainder of the layout must be made prior to the understanding of the data requirements. Data communications networks have become an infrastructure resource for businesses, corporations, government agencies, and academic institutions.

Networks can consist of the two distinct components:

- Public Network.
- Core Network.
  - Wide-Area -Networks (WANs).
  - Data center.
  - Remote Connections.

- **Public Network**

A Public (Campus) network is a building or group of buildings all connected into one enterprise network. Each Building consists of Local-Area Networks (LANs), which used to connect users by Access switch device.

In this research each building represents college, institute and center at University of Baghdad in Al-Jaderyia Campus, and users refer to Students, Lecturers, Employees and Stuff.

The primary focus of the proposed campus network is to provide the connection from the end users, into the data center network which reside in Core Network.

In large number of local area networks (LANs), there is need to aggregate traffic from a number of access switches into a distribution switch or Access Point. Distribution Switch is used to connect switches at all buildings in campus to Core Network. In computer networking, a Wireless Access Point (WAP) is a device that allows wireless devices to connect to a wired network using Wi-Fi, Bluetooth or related standards [18]. It can serve as the point of interconnection between the WLAN and a fixed wire network. Each access point can serve multiple users within a defined network area; as people move beyond the range of one access point, they are automatically handed over to the next one [19].

- **Core Network**

– Wide-Area -Networks (WANs).

Wide-Area Networks define communication traffic to be the transmission of information and data from public Network to Core Network.

WAN consists of the following components:-

∗ **Core Router**

A core router is a router designed to operate in the Internet backbone, or core [20]. It is a type of very powerful computer router used in large computer networks, fastest (capable of processing millions of packets every second), most powerful, and most expensive class of router available. It generally sits in the "center" of large networks and sends and receives packets to lower classes of routers [21]. In this work, a core router must be used to provide a "collapsed backbone" interconnecting the distribution tier switches or routers from multiple buildings of a campus, or Internet or E-Government Router. Core router is located at Central Library of Baghdad University.

∗ **E-Government Router**

E-Government is an important application of the internet and is used by authorities to encourage broad use of computers and to facilitate communication and interactions with

its institutions, citizens and businesses [22]. The E-Government router in this work connects Public Network to the E-Government Organizations to provide services of Iraqi Government to end users at Public Network when project of Iraqi Government is implemented in the future. Core router is located at Central Library of Baghdad University.

* **Media**

The physical media is the most important factor to consider when connecting buildings at distances that exceed a few kilometers (but still within a same Geography area). The speed and cost of the network infrastructure depend heavily on the media selection and must meet the requirements of emerging applications.

Gigabit Ethernet is used to connect components of network devices in this work and it is become more attractive in price and availability, making it a viable choice for situations where large bandwidth is demanded [23]. Gigabit Ethernet is a term describing various technologies for transmitting Ethernet frames at a rate of a gigabit per second, as defined by the IEEE 802.3 standard [24].

IEEE 802.3ab recent 'Gigabit over copper' standards have been adopted that make gigabit Ethernet as easy to use as 100Mbps Ethernet. Gigabit Ethernet can now utilize Cat5 or better twisted pair cabling and the same RJ-45 connectors that are used in 10/100Mbps networks. To achieve gigabit speeds, you must use Ethernet cable with all 8 wires (four pairs) present [25]. Copper-based Gigabit Ethernet holds additional advantages when considering the additional cost associated with rewiring for fiber technologies [23].

Optical fiber can be used as a medium for telecommunication and networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance communications, because light propagates through the fiber with little attenuation compared to electrical cables [26].

* **Fire wall**

The firewall protects all devices in Data Center by blocking unwanted vulnerability scans and attacks from users at public Network (outside the data center). Firewall may be Pc or Router. Firewalls fall into three broad categories (packet filters, Circuit Level Gateways and Application Level Gateways) [27]:

Packet Filters

Packet filtering firewalls work at the IP layer of TCP/IP model. They are usually part of a router. In a packet filtering firewall each packet is compared to a set of criteria before it is forwarded. Depending on the packet and the criteria, the firewall can drop the packet, forward it or send a message to the originator. Rules can include source and destination IP address, source and destination port number and protocol used. The advantage of it is their low cost and low impact on network performance.

Circuit Level Gateways

Network Address Translation (NAT) routers offer the advantages of packet filtering firewalls but can also hide the IP addresses of computers behind the firewall, and offer a level of circuit-based filtering. Circuit level gateways work at the TCP layer of TCP/IP. They monitor TCP handshaking between packets to determine whether a requested session is legitimate. Information passed to remote computer through a circuit level gateway appears to have originated from the gateway. This is useful for hiding information about protected networks. Circuit level gateways are relatively inexpensive and have the advantage of hiding information about the private network they protect. On the other hand, they do not filter individual packets. This type is used in the proposed work

Application Level Gateways

Application level gateways (proxies) are similar to circuit-level gateways except that they are application specific. They can filter packets at the application layer of the OSI model. Incoming or outgoing packets cannot access services for which there is no proxy. It can also be used to log user activity and logins. They offer a high level of security.

– **Data Center**

The goal of any data center (rooms or network of rooms within a building or occupy an entire building on its own) is to provide continuous availability of all network services at these Buildings (e.g. Access to Data Base - like Salary Systems, Personal System, and

electronic Library-, Browsing, E-mail and Others. The location of data center must be near to the public Network. The typical data center described as a larger space composed of smaller space includes the following ten rooms as described in Fig. (3) [28].

- Main Distribution Area (MDA)
- Horizontal Distribution Area (HDA)
- Storage Room
- Electrical/Mechanical Rooms (EMRs)
- Telecommunications Room (TR)
- Operations Center (OC)
- Entrance Room (ER)
- Equipment Distribution Areas (EDA)
- Computer Room
- Zone Distribution Area (ZDA)

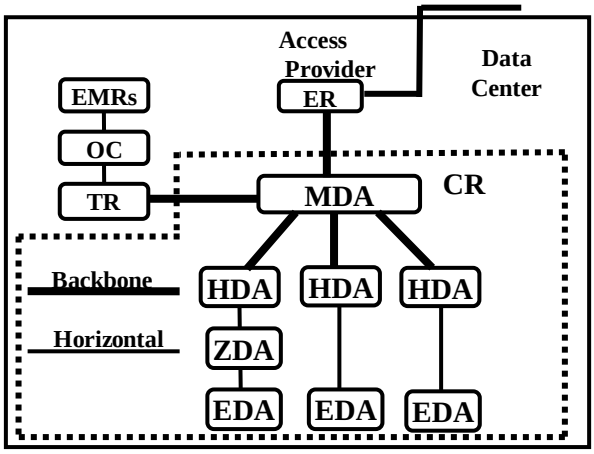

Fig. (3) Data Center Organization [28].

Computer room is a secure, environmentally-controlled space that houses data and telecommunications equipment and cabling. It is divided into distribution areas, which are the connection points for the structured cabling system. Racks/cabinets of equipment, server farms of applications are situated on a first floor of Computer Center Location.

– **Remote Connections**

Virtual Private Network (VPN) provides a secure channel between local computer and a computer at the remote location. The network user can access this from any part of the world provided internet connection and accessibility to the resources is available [29].VPN Connection allows College members to connect to data center services behind our network firewall from a remote location (Public Network).

Edraw Max software is used to Design Layout of the proposed Network. Edraw Max enables students, teachers and business professionals to reliably create and publish kinds of diagrams to represent any ideas. It's an all-in-one graphics software that makes it simple to create professional-looking flowcharts, organizational charts, network diagrams, business presentations, building plans, mind maps, fashion designs, UML diagrams, workflows, program structures, web design diagrams, electrical engineering diagrams, directional maps, database diagrams and more [30].

Conclusions and Recommendations

Cloud computing is a technology that uses the internet and central remote servers to maintain data and applications. A **data center** is a facility used to house computer systems and associated components, such as telecommunications and storage systems.

This work proposed the plan to design Enterprise Data Center infrastructure network at computer center that connects Colleges, Institutes and Centers within Baghdad University Campus and meets the requirements of modern data centers (*select* building, floors, determine user requirements and servers) and it is guidelines and best practice for peoples (designers) which hope to design small data center.

Data Center strategy recommendations arise directly out of the need for implement the following two factors especially in Iraq:

1- Security

Data centers contain the assets, applications, and data that are often targeted by electronic attacks. Endpoints such as data center servers are key objectives of malicious attacks and must be protected. The number of reported attacks, including those that affect data centers, continues to grow exponentially every year.

2- Cost

The process for determining a budget, deciding what parts of the data center will receive what portion of it, and putting together a center based on designated funds is one of negotiation, trade-offs, compromises, and creativity

References

[1] Rajkumar Buyya, Chee Shin Yeo, and Srikumar Venugopal , "**Market-Oriented Cloud Computing: Vision, Hype, and Reality for Delivering IT Services as Computing Utilities,** Aug 2008 , Grid Computing and Distributed Systems (GRIDS) Laboratory.
http://www.buyya.com/papers/hpcc2008_keynote_cloudcomputing.pdf

[2] **Cloud Computing: What is Cloud Computing, the History and Benefits**
http://zunaif.net/archives/164
www.Thefreeresource.com
Zunaif – Internet Technology Resources

[3] Kaushik Raghupathi ,"**5 Key Events in the history of Cloud Computing, Architectural Design Patterns & Best Practices"**, , 2011.
http://architects.dzone.com/news/5-key-events-history-cloud?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+zones%2Fdotnet+(.NET+Zone)

[4] Winston Churchill , CloudTweaks.com
http://www.cloudtweaks.com/2011/02/a-history-of-cloud-computing/#
"History is written by the victors.", British Prime Minister during WWII

[5] Harry Katzan, Jr , **Cloud Computing Economics: Democratization And Monetization Of Services** ,Savannah State University, USA, Page (1)
Journal of Business & Economics Research – June, 2009 Volume 7, Number 6
http://journals.cluteonline.com/index.php/JBER/article/view/2301

[6] Wikipedia, the free encyclopedia.htm, January 2011
http://en.wikipedia.org/wiki/Cloud_computing

[7] **IAnewsletter for information Cloud Computing: Silver Lining or Storm Ahead**? IAnewsletter Vol 13 No 2 Spring 2010 • page (11)
http://iac.dtic.mil/iatac/download/Vol13_No2.pdf

[8] Harrison D. Strowd, Grace A. Lewis , "T-**Check in System-of-Systems Technologies: Cloud Computing**" , September 2010, Page(2)
Research, Technology, and System Solutions (RTSS) Program
http://www.sei.cmu.edu/library/abstracts/reports/10tn009.cfm

[9] Ilango Sriram , Bristol Bristol, UK , Ali Khajeh-Hosseini , "**Research Agenda in Cloud Technologies"** page(3), Cloud Computing Co-laboratory School of Computer Science University of St Andrews St Andrews, UK

[10] Darrell M.West, "Saving Money through Cloud Computing", 2010.

[11] Alexandros Marinos, Gerard Briscoe, "**Community Cloud Computing"**
Conference paper, Page(2).
http://eprints.lse.ac.uk/26516/
LSE research online
London School of Economics and Political Science

[12] Kailash Jayaswal, Administering Data Centers:Servers, Storage, and Voice over IP Wiley Publishing, Inc. 2006
http://www.codebackpack.com/other__Administering-Data-Centers_ebook_9.html

[13] Dirk C. Aumueller, "**"IT-Compliance Analysis for Cloud Computin**g", Msc thesis , 16 August 2010 page (27), University of Applied Sciences Darmstadt Faculty of Computer Science
http://germany.emc.com/collateral/about/news/emc-publications/articles/it-compliance-analysis-for-cloud-computing-dirk-aumueller.pdf.

[14] **"Cisco Data Center Infrastructure 2.5 Design Guide**", Cisco Validated Design, March 9, 2010, Americas Headquarters, Cisco Systems, Inc.
http://www.cisco.com

[15] STEPHEN J. BIGELOW, "**Data center design and build out",**CHAPTER 4, page (5-6)
Data Center Facilities IT Handbook
http://upticon.com/whitepapers/Data_Center_Facilities_IT_Handbook.pdf

[16] Requirements for the Design of a Secure Data Center, SANS Institute InfoSec Reading Room, SANS Institute 2002, page

(1). As part of the Information Security Reading Room
http://www.sans.org/reading_room/whitepapers/recovery/requirements-design-secure-data-center_561
[17] John Rath , "DATA CENTER SIITE SELECTIION, Page (6)
Datacenterlinks.com
[18] Chris DiMinico,"**Data Center Design Considerations**", MC Communications
[19] Searchmobilecomputing.com.
[20] Wikipedia, the free encyclopedia
http://en.wikipedia.org/wiki/Core_router
[21] www.wisegeek.com site
http://www.wisegeek.com/ What Is a Core Router.htm
[22] AlShihi, Hafedh, "**Critical Factors in the Adoption and Diffusion of E-government Initiatives in Oman** ", Faculty of Business and Law -Victoria University, 2006.
http://eprints.vu.edu.au/483/

[23] Paul Gray, Anthony Betz, Performance Evaluation of Copper-based Gigabit Ethernet Interfaces, Department of Computer Science
University of Northern Iowa, page 1, Cedar Falls, IA 50614-0507
www.cns.uni.edu/~gray/gig-over-copper
[24]http://en.wikipedia.org/wiki/Gigabit_Ethernet
[25] HomeNetHelp: the home computer networking and Internet connection sharing resource site
http://www.homenethelp.com/web/explain/gigabit-ethernet.asp
[26] http://en.wikipedia.org/wiki/Optical_fiber
[27] esconsultants -Complete solutions site
http://www.iesconsultants.co.uk/connectivity/networks.html
[28] SYSTIMAX® Solutions Data Center Planning Guide
SYSTIMAX® Structured Connectivity Solutions, page (5-7)
http://docs.commscope.com/Public/Data_Center_Planning_Guide.pdf
or
http://rath-family.com/rc/DC_Site_Selection.pdf
[29] Lina AL-CHAAL, "Dynamic and Easily Manageable Approach for Secure IP VPN Environments, Phd thesis, 2005
[30] E draw max site
http://www.edrawsoft.com/EDrawMax.php

الخلاصة

تمثّل الحوسبة السحابية احدى نماذج الاحتساب الواضحة. تهدف الى الوصول الى البيانات واستضافة الخدمات المتوفرة على شبكة الانترنيت. تتم عملية الوصول الى هذه البيانات من خلال متصفح الانترنيت وتجهّز الخدمات من خلال برامج تعمل (تنفذ) عن طريق البرنامج الرئيس للسحابة. ت قسم تطبيقات الحوسبة السحابية الى نموذجين هما نماذج الخدمات ونماذج الانتشار. تقيم (تخزن) الحوسبة السحابية داخل مركز كبير للبيانات، والذي يحوي عدد كبير من الخوادم التي تقوم بتوفير مختلف الاحتياجات. يُستخدم مركز البيانات (الذي يعتبر بمثابة القلب لمعظم الشركات) لاستضافة انظمة الحاسوب ومكوناتها. مثل وحدات الاتصال وانظمة الخزن. ان الغرض من هذا العمل هو وضع خطة لتصميم البنى التحتية لمشروع مركز البيانات في مركز الحاسبة والذي يربط كليات ومعاهد ومراكز مجمع جامعة بغداد في الجادرية والمطابقة للتصاميم الحديثة لمراكز البيانات.