



# **GROUP ASSIGNMENT**

**TECHNOLOGY PARK MALAYSIA**

**CT109-3-2 - DCI**

**DATA CENTER INFRASTRUCTURE**

**NP2F1801IT**

**HAND OUT DATE:**

**HAND IN DATE:**

**WEIGHTAGE: 100%**

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## **INSTRUCTIONS TO CANDIDATES:**

- 1 Submit your assignment at the administrative counter**
- 2 Students are advised to underpin their answers with the use of References (cited using the Harvard Name System of Referencing)**
- 3 Late submission will be awarded zero (0) unless Extenuating Circumstances (EC) are upheld**
- 4 Cases of plagiarism will be penalized**
- 5 The assignment should be bound in an appropriate style (comb bound or stapled).**
- 6 Where the assignment should be submitted in both hardcopy and softcopy, the softcopy of the written assignment and source code (where appropriate) should be on a CD in an envelope / CD cover and attached to the hardcopy.**
- 7 You must obtain 50% overall to pass this module.**



## GROUP ASSIGNMENT

### DATA CENTER INFRASTRUCTURE

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WEIGHTAGE: 50%

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#### SUBMITTED BY:

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Sincerely,

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# 1. Introduction

In the world of Information Technology, data centers are highly demanding and increasing in numbers. The capacity of the data needs to be processed and flourished accordingly as per the constant increment and immense productivity of the data centers in the market. On the other hand, improving the profitability, eliminating the sources of error, constantly check and maintain the cost is also becoming the challenge to data center operators in order to prevent from failures and maintain efficiency (Systems, 2017).

A data center simply is a facility that centralizes an organization's internet technology operations and equipment and also manages and stores its data. Data centers are the most sensitive and important part to day to day works. But, with the increment in the number of data centers, the number of failures in the data is high too. The main reasons of such failure are passive planning of data center operation and human error. Therefore, to build a reliable and well functioned data center, quality planning and proper cabling needs to be prioritized as per the required. Data center can be differ from organization to organization as per the goal and necessity. We can find that data center are classified into internet facing and enterprise data centers. Cloud service providers uses different data center designs and focuses on satisfying customers in every possible way. On the other hand, a private organization which is focused on furnishing own business uses different database design and focuses on more centralizing data and maximizing privacy (Paloaltonetworks, 2019).

## 1.1 History of DCI

The concept of data center came in reality on 1960 A.D. The concept was to introduce and manage airlines reservations and to make the data available digitally to any agent at any place instantly. This idea was the main motive before creating data center. Earlier this planning, Electronic Numerical Integrator and Computer (ENIAC) was manufactured in order to stock artillery firing codes and was renamed as the first general-purpose electronic digital computer. After a while, Intel introduced a new processor in the market named as 4004 processor, the first general-purpose programmable process on the market dated on 1941 A.D. Similarly, Xerox Alto became the first desktop computer to utilize graphical User Interface and included a bit-mapped high resolution screen, higher internal memory storage and special software.

The “.com” surge resulted companies in craving of fast internet connection and restless operation in mid 1990s. With the evolution in technology, technology decision made in different ways which are applications based decisions and hardware decisions. Apple and VMware had invested in developing the server area in late 90s. Likewise, Amazon web services

started progression of suite of the cloud-based services in 2002. The services has included computation and human intelligence through “Amazon Mechanical Turk” and initiated providing IT infrastructure services to the business clients in the form of web services i.e. cloud computing. Surveys was conducted in the mid-2012. Results shows that 38 % of business were already consuming the cloud. Later that year, increase of 13% was found of using cloud computing in the business. Similarly, google invested a huge capital of \$7.35 billion to improve its internet frame during the year 2013. The expenditure lead to the huge growth in the global data center network of Google which was become as one of the biggest construction in the history of data center industry.

As time gradually changes, the innovation of the datacenters are gradually changing as per the requirement. Changes in consolidation, costing issue and cloud assistance can be seen in data centers. Similarly, pairing of datacenter and cloud computing has been merged resulting to make IT decisions on “call by call” basis on how resources are accessed, but the data centers themselves remains a completely unique entity (Siliconangle, 2019).

## 1.2 Importance of DCI

In the modern age of IT, data center has become an important entity to run, maintain and mobilize the IT world. Data center has been evolved as per the new business required. It has been adapting accordingly to provide best solution. Huge investment is required to modify hardware and software resulting in development in information technology infrastructure. Such development has provided a competitive advantage over generations. Data center has been very successful in various aspects in past years. Some of the aspects are costing and complexity. The importance of datacenters are described as follows:

- No infrastructure costs
- Security
- Bandwidth
- Uninterrupted Power Supply

### 1.2.1 No infrastructure Costs

There is no need for putting resources into infrastructure if there are already services of data center accessible. For the administration rendered the data center vendor charges their customer. All the essential extra hardware can be included solicitation and modified inside short interims. In the event that foundation costs increment irregularly when compared with all out costs, cautious capital on equipment can absolutely be a noteworthy cost saving element for most little and even real organizations.



### 1.2.2 Security

Protection and information security are one amongst the most fundamental highlights a customer would require in a Data Center. All physical access is controlled totally. Identities might be affirmed through biometrics and all exercises are video-logged. Entry to the premises is confined every customer is given a committed space the required security levels. This guarantees the security of customer information and look after protection.

### 1.2.3 Bandwidth

With the steady increment in online business, the rate for prerequisite of data transfer capacity increments fundamentally. Electronic requesting, item enrollment, online showcasing, video promotions, sound conferencing, video and sound joint effort are on the whole transmission capacity thorough applications. Dealing with every one of these administrations constantly, we can say data center are helpful and well-prepared system service

### 1.2.4 Uninterrupted Power Supply

Simply, no interruption in power supply means higher server uptime. The Data centers are built in such a way that the power supply system never goes down. Generally, in case of a general power outage, a battery bank will provide power till the fuel generators are kicked in, ensuring almost no interruption in power supply.

(slideshare, 2019)

## 1.3 Project Aim

The main aim of the project is to proposing a data center infrastructure suitable for Panadox Company.

### 1.4 Service offered by Tamanix Data Center

Tamanix Data Center is a service provider that has providing installation and technical support services for companies and network. It provides support to small medium enterprises to multinational companies. In addition, it assists facility to store data to respective data center as per the client requirement. It maintains security, proper bandwidth, and uninterrupted power and so on.

## 2. Problem Statement

Panadox is one of the leading health care companies in Malaysia that provides services to more than 10 million patients. It provides a Customer Relationship Management (CRM) platform but requires proper data base center to provide its data. It hasn't able to detect suitable good data center that facilitate proper security, compliance features and other necessary requirements.

## 3. Literature Review

Data Center being the home to computational power, storage and applications important to help as big business, a legitimate arranging of datacenter structure framework is basic, and execution, versatility, and adaptability should be painstakingly considered. Server farm foundation is integral to the IT design. Never the less, adaptability in speedy arrangement and backing amid new administrations is another significant part of server farm structure.

Investigating building computerization, the market for structure mechanization today powers over \$75 billion every year. There is dependably space to development, the computerization isn't simply connected exceptionally in creating district yet additionally in North America and Western Europe. The greater part of the structure robotiyzation controls supposedly is willful, as organizations intend to improve vitality effectiveness in their structure portfolios. These advances in structure computerization innovation are happening similarly as interest for more elevated amounts of vitality effectiveness is rising. Subsequently, it is normal that the market for structure robot frameworks to develop to \$146 billion out of 2021.

## 4. Design

### 4.1 Critical Building System

Tamanix can be better choice as a data center for Panadox, a healthcare which have to record the details of more than 10 million. Tamanix plans a building system with automation. The structure system has totally PC based control system that controls and screens the structure's electrical and mechanical gear in which lightning, power framework, ventilation, security frameworks like fire system are kept up. Tamanix offers a structure with 3d building perception and control.

The blend of vitality the board and building controls gives proprietors and tenants advantages past economic reserve funds, decreases in vitality as an asset just as discharges as a result. We, Tamanix Data Center facilitate on providing BMS system with usual functions such as power systems, illumination system, HVAC system, plumbing system, heat tracing, electric power control system and etc. (Automatedlogic, 2017).

Some of the function Tamanix facilities in BMS are enlisted below:

- Air Conditioning
- Temperature Control
- Power Monitoring System
- Live Data Monitoring

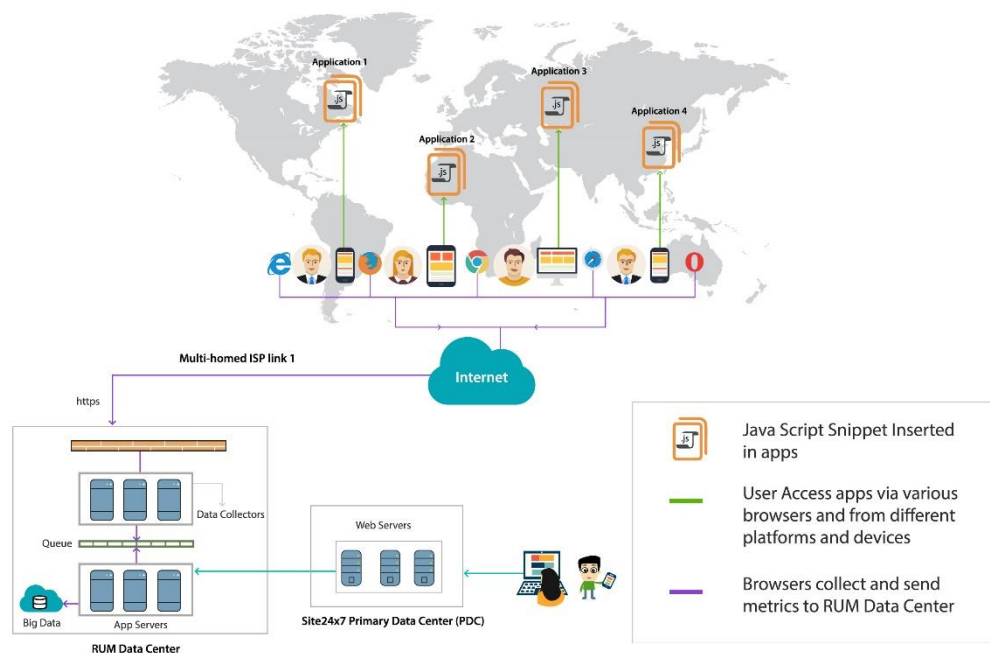
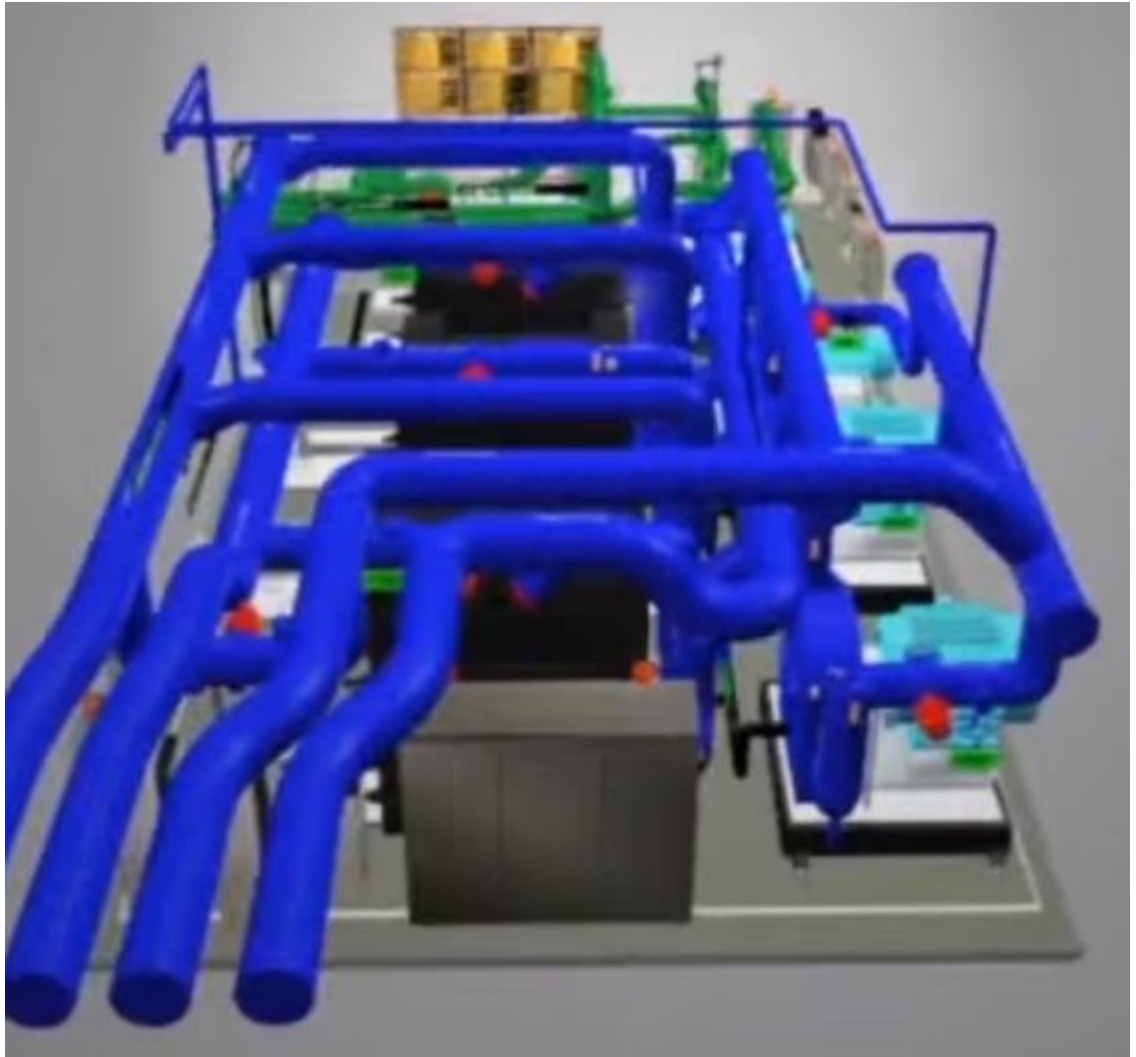


Figure 1 Working layout (Zoho Corp, 2019)

#### 4.1.1 Air Conditioning

Air conditioning is one of important features for the data centers. Air conditioning is required to provide easiness, comfortable and well-organized work environment. Staffs inside the data center might feel suffocated in case of lack of oxygen amount and need to be monitored. The level of oxygen should be maintained constant. So, in this section we place air chiller at the top of the building and the air will be distributed to every sections with the help of AHC.



*Figure 2 Chiller Plant Visualization*

#### 4.1.2 Live Data Monitoring

Real-time data monitoring (RTDM) is a process through which an administrator can review, evaluate and modify the addition, deletion, modification and use of data on software, a database or a system. It enables data administrators to review the overall processes and functions performed on the data in real time, or as it happens, through graphical charts and bars on a central interface/dashboard (Technopedia, 2019). Live Data Monitoring is one of another important in BMS. It assist us to have real time monitoring. With analyzing the data, concerned department can figure out the exact issues in the data base and solve it as soon as possible.

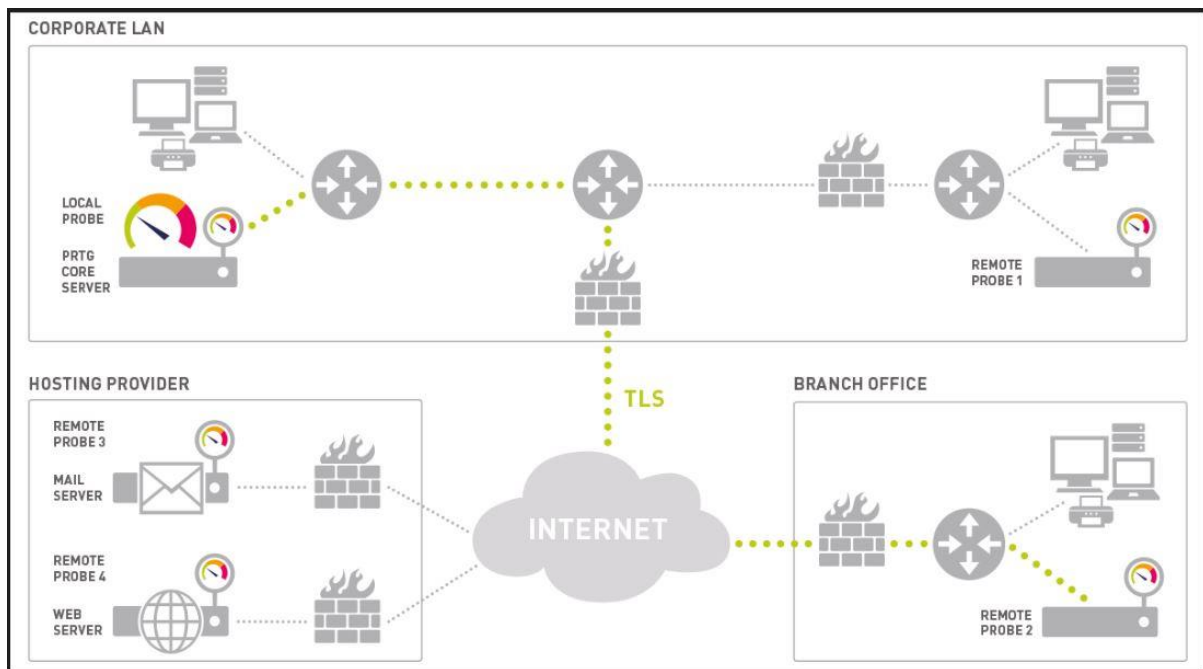
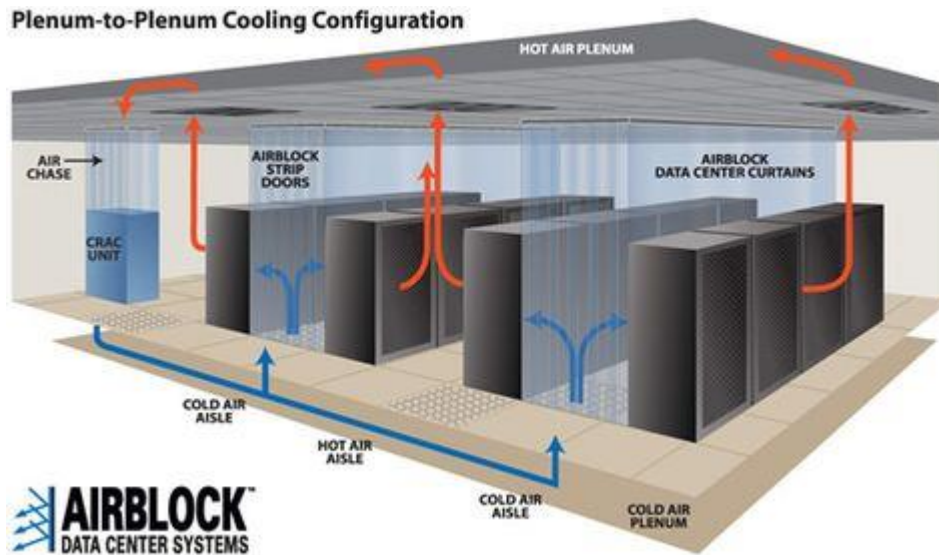


Figure 3 Live Monitoring System

#### 4.1.3 Temperature Control

Server Room is considered as the most dedicated and sensitive part of the data centers. Temperature inside the server room is very delicate. The temperature of the room is need to maintain of 18 degree Celsius. So, we have inserted air conditioner 2 feet below the ground. We have maintained the server room as shown in the picture.



*Figure 4 Air Conditioning module*

#### 4.1.4 Power Systems

Another significant and vital part is to keep up the principle control. The fundamental power originates from the AP power board and will be passed to the structure through UPS. The UPS assumes fundamental job as it ensures the servers are running fine regardless of whether the primary power is down. The UPS will have in any event 30mins of reinforcement. At the point when the fundamental power is down, the programmed turn on-off generator framework will come without hesitation.

## 4.2 Planning

Planning plays the vital role to have the success rate of any new project. Planning is considered one of the most essential part for project like data center design. Every one of the imperatives are portrayed on different pieces of proposition. So as to limit information duplication just the limitations are pointed beneath.

- Standards Based IT Infrastructure Design
- Thermal Management & Power
- Green Building Credits
- Disaster Recovery
- Latency
- Redundancy
- Global Deployment

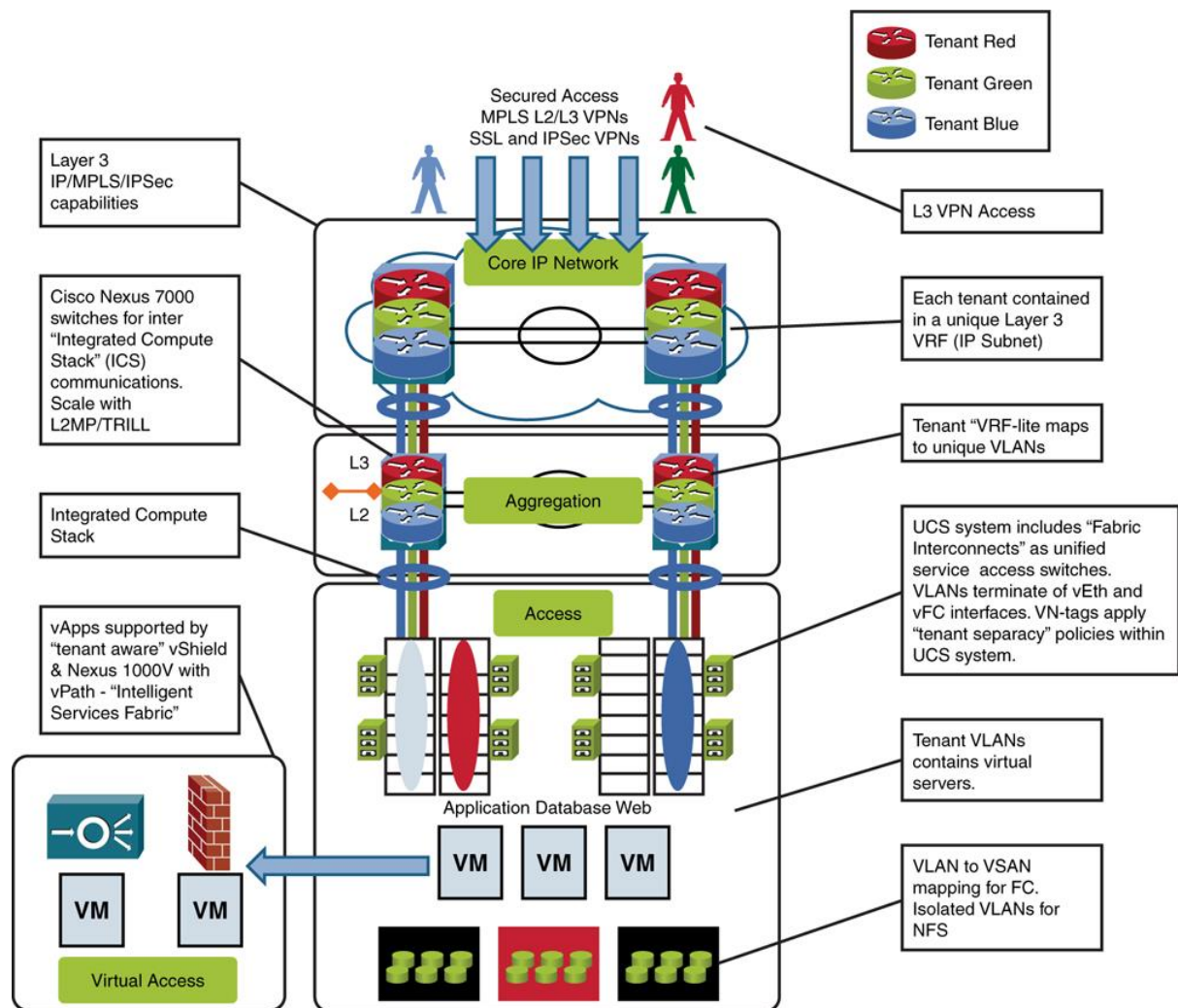


Figure 5 Integrated Design (CISCO, 2019)

## 4.3 Location

Data center planning is one of the important factor to be considered in order to build a new data center. For the foundation of completely excess and secure data center immense capital just as responsibility to progressing operational costs for help and upkeep is required. Some of the factors that are need to be considered are enlisted below:

- Weather and Natural Disasters
- Access to Power
- Proximity of workforce talent
- Real States

### 4.3.1 Weather and Natural Disasters

Weather and Natural Disasters can bring great destruction to the assets. As per the National Centers for environment information, “Around United States of America, eight weather and climate disasters events has been occurred resulting the loss of \$1 billion in 2014 A.D.” So, we need to analyze the weather pattern and choose the location according.

### 4.3.2 Access to Network

Power and Network are the powerhouse of data center. Without access to business power and additional or full access to reliable availability, data center cannot be performed. While a geographic territory may approach a dependable power grid, take over the area of the fundamental age control station(s), substations and feeds to where data center will be manufactured. For the simple guaranteeing of excess, the spot with various business power station ought to be picked. For the most dependable availability and ceaseless uptime, access to various level one system suppliers is basic (Incapsula, 2019).

### 4.3.3 Real Estate/Location Considerations

We need to consider following condition while choosing data center location.

- Does the tax revenue department of concerned location offer any tax incentives for choosing their area as this project is great benefit to the area?
- Is there provision of expansion of area if required?

Convenient, 75 percent of our clients are situated inside a two-hour drive to their data center. Being nearby gives us points of interest as recently expressed and it's a basic component that we think about when fabricating new server farms. Convenient likewise guarantees geographic assorted variety in unique areas, each at an okay of cataclysmic event. Besides, the majority of our data center are interconnected with a 10Gbps fiber ring and they have various fuel, system and power providers to guarantee excess, uptime and accessibility.



#### 4.4 Logical Design

Currently, Panadox data center is using Multi-Tier Design Model. It is the most common model used in the enterprise. Core, Aggregation and Access Layer are the layers of basic logical data center design. The Multi-Tier Model consists of 3 layers which are described below:

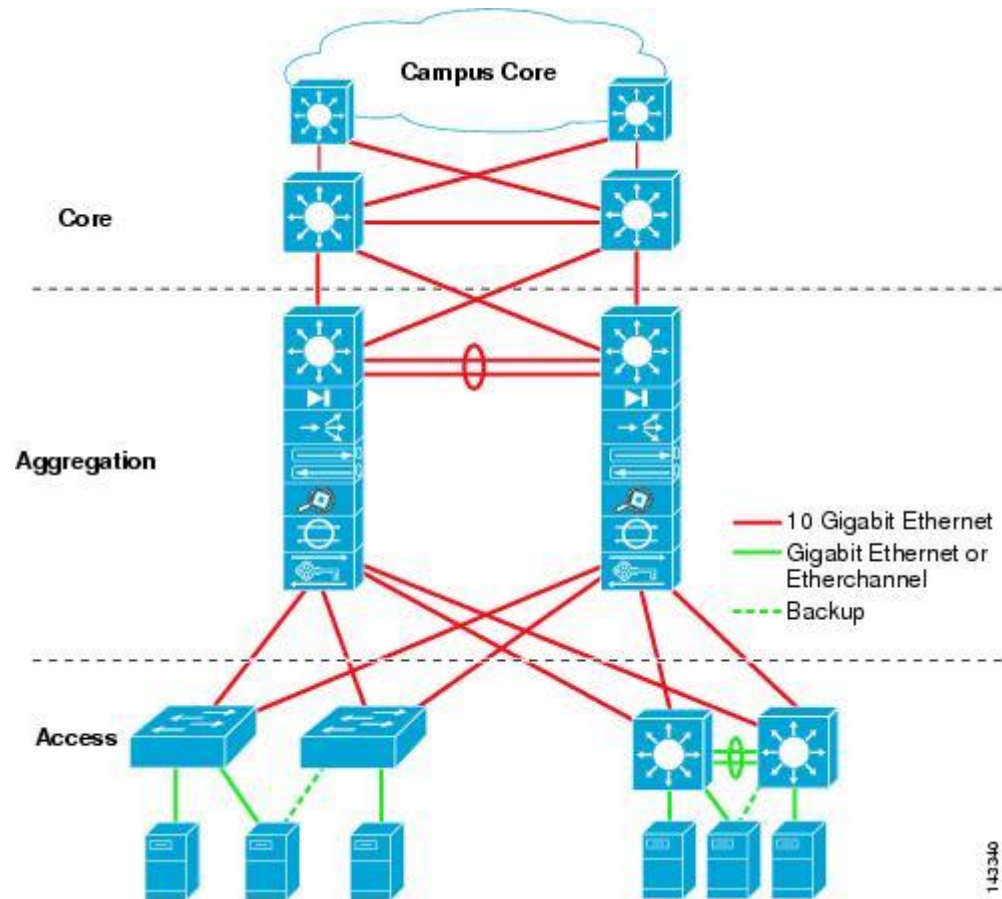


Figure 6 Multi-Tier Topology

##### 4.4.1 Core Layer

Core layer conveys the rapid parcel exchanging backplane for in-out progression of the server farm. It gives network to various collection modules and gives a versatile Layer 3 directed texture with no single purpose of disappointment. The center layer runs an inside directing convention, for example, OSPF or EIGRP, and burden adjusts traffic between the grounds center and collection layers utilizing Cisco Express Forwarding-based hashing calculations.

##### 4.4.2 Aggregation Layer

This layer gives significant capacities, for example, administration module incorporation, Layer 2 space definitions, traversing tree handling, and default entryway excess. Server-to-server multi-level traffic courses through the total layer and can utilize administrations, for example, firewall and server load adjusting, to streamline and verify applications. The littler symbols inside the accumulation layer switch to speak to the coordinated administration

modules. These modules give administrations, for example, content exchanging, firewall, SSL offload, interruption discovery, organize investigation, and the sky is the limit from there.

#### 4.4.2 Access Layer

The server parts comprise of 1RU servers, cutting edge servers with essential switches, sharp edge servers with go through cabling, bunched servers, and centralized computers with OSA connectors. The entrance layer arrangement comprises of particular switches, fixed setup 1 or 2RU switches, and necessary cutting edge server switches. Switches give both Layer 2 and Layer 3 topologies, satisfying the different server communicate space or authoritative prerequisites (CISCO, 2008).

#### 4.5 Business and Technical Goals

The main objective of each data center is to keep up and run the data center framework easily 24 hours and seven days. Already, specialty units used to have just a single way when new innovation are felt vital. Presently, there are unlimited choices. Data base business technique isn't made out of nowhere. For the fruitful undertaking, it requires arrangement of the business and innovation objectives, just as purchase in from a few territories.

Some of the steps that can be followed to design business strategy:

- To be clear on the aim for the data center policy.
- To know the current IT world.
- To know how IT world is developing.
- To be familiar with the current data center features.
- To find out the profit made on the data center.
- Progress the proposed scenarios.
- To know the current status of data center.
- To select the best strategy.
- IT as service provider.

## 5. Infrastructure issues and challenges

Most of the emerging technologies, data center infrastructure management DCIM has many doors, approaches and confusing proliferation of market definitions. Panadox is a large company, and the sites will get larger with time and work processes will get more complex. It will become ineffective at helping facility managers make informed decisions about additions, moves, consolidations and relocations. The data will be high with around 10 million clients in Panadox that at the beginning, solving questions like these will be a challenge on its own.

- How many servers will I need? Where will I locate them?
- How are they going to be physically connected to the power line and network patch panel?
- How much power will I need and what is the impact on my power chain?
- Do I have available power and network connection capacity?
- Is it possible to place these servers to these racks?

## 6. Maintenance

In the world of IT, data center cannot bear loss cost because of downtime. In current IT scene, personal time isn't only expensive as far as capital, it can likewise harm the organization's notoriety. Poor support is a standout amongst the in all probability reason for impromptu personal time. Following are the upkeep estimates that Tamanix contemplates in around one month, consistently.

### 6.1 Preventive Maintenance

Data Center staff ought to constantly examine frameworks and gear to guarantee they are in appropriate working request. This incorporates day by day investigations of generators, water temperature, fuel levels, and plenum weights, electrical and mechanical circulation system working parameters and other framework parameters and designs.

Precaution support is intended to "keep a bit of gear or segment working at its ideal dimension or an activity that draws out its lifecycle." This kind of upkeep can incorporate channel or oil changes, just as cleaning heat exchangers and electrical frameworks.

### 6.2 Continuous Maintenance

Office workers ought to likewise test explicit system to guarantee that they are working inside the right parameters. Procedures here can incorporate infrared, load testing and flop over Security alert testing.

### 6.3 Predictive Maintenance

This is a basic piece of the Data center system. Prescient upkeep use estimations and other information investigation to perceive any changes, patterns or anomalies that could point to a potential disappointment. Thusly, staff individuals can address these issues before they lead to a blackout.

### 6.4 Corrective Maintenance

At long last, staff individuals should use restorative support forms when it comes time for a framework or segment to be fixed or supplanted. Fixing a break or supplanting a heading or valve would fall under restorative upkeep. (Data Center Frontier, 2019)

## 7. Security

### 7.1 Physical Security

Physical security is a part of Building computerization system. Each room of the building has fire caution associated the smoke discovery sensors. With the exception of in server room each different rooms will have sprinkler framework. Since, sprinklers are not proper in server rooms as the likelihood of server harm will be high with the sprinklers. Along these lines, in server room fire douers will unique. So as to test the condition of gadgets the counterfeit flame drill will be directed in consistently. Flame extinguisher will be set in each 40-50 meters (Altus, 2018) Server room being the mind or spinal string of server farm, it can't be gotten to by everybody. Biometric security like iris filtering and unique finger impression sensors are embedded in the entryway of the server room and one must be approved before entering. Or then again it needs password and access card to enter (Cisco, 2019).

### 7.2 Logical Security

Following securities needs to considered to secure data in data center:

- Hardware and Software firewall protection
- Intrusion prevention (IDS/IPS) on core network
- Anti-malware and Anti-virus protection on all servers
- Anti-spam protection for all inbound & outbound emails
- SSL encryption provided for all common connectivity
- Encrypted storage used on email and data hosting servers
- VLAN segregation for added network security
- 24x7 monitoring of all servers and core network
- IP lock-down and VPN for remote management (boomhost, n.d.)

## 8. Limitation and Delimitation

Because of their location being outside of the buildings, some of the facilities modules are prone to being damaged from a variety of sources, including rain, wind, vandals, and animals and so on. Also, our facility modules aren't able to accommodate further data center expansion, as they have been built as limited, self-contained units and an enterprise. Seeking to add to its data center infrastructure would require buying more facility modules.

Moreover, the limited space inside may create some difficulties for maintenance personnel dropping in to do repairs. Our facility modules are built more to provide power and cooling for data centers, and not to provide a secret recreation room for data center staff.

## 9. Conclusion

Our team has worked hard to propose the system, as we had to put forward the datacenter infrastructure, necessary equipment and systems, and other operational requirements for Panadox. In fact, much of our theoretical knowledge was used to complete the assignment.

Next, we have also explained how to design the datacenter infrastructure, major factors to consider, and what components were required while designing the data center. A secured data center having a high level of security has thus been designed which can be easily accessed by the client. The proposed system also has a cost-efficient colocation. We have also focused on the issues and challenges concerned with the infrastructure in data center design, and our team has discussed about cooling capability, energy efficiency, along with technologies and techniques that promote green computing in the data center.

10. Gantt chart

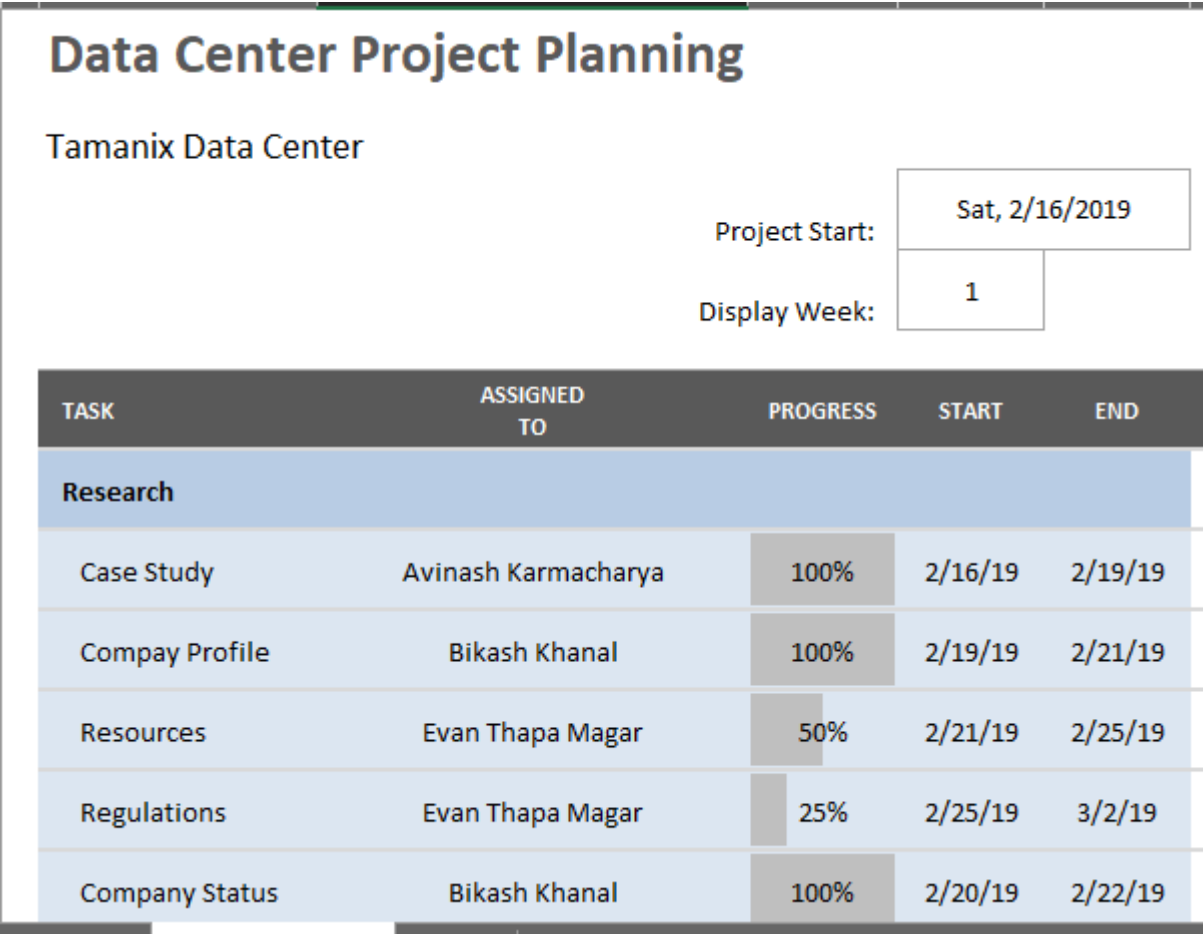


Figure 7 Workload 1

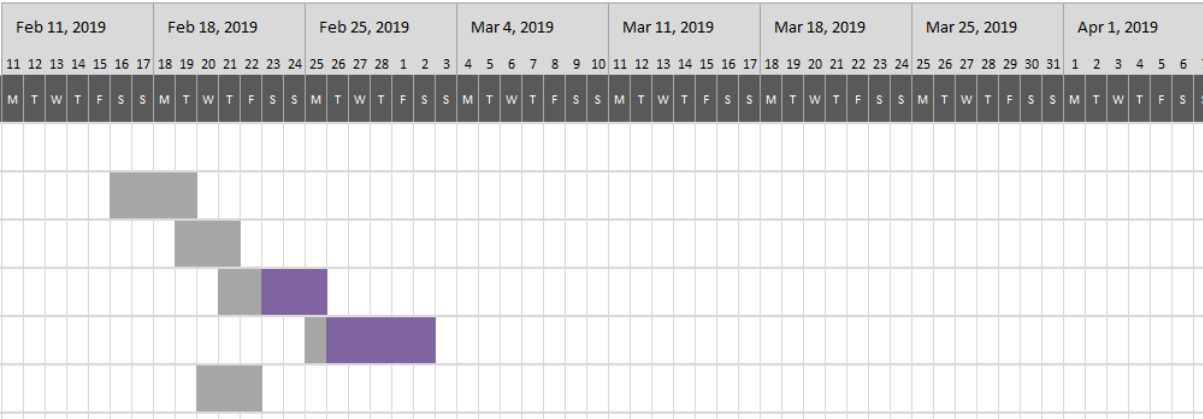


Figure 8 Workload 2



Plan and Analyse				
Stating Problem	Bikash Khanal	50%	2/21/19	2/25/19
Anlyzing problem	Avinash Karmacharya	50%	2/23/19	2/28/19
Finding aims	Evan Thapa Magar	75%	2/28/19	3/3/19
Feasibility Study	Bikash Khanal	60%	2/28/19	3/2/19
Regulatioary Study	Avinash Karmacharya	20%	2/28/19	3/3/19

Figure 9 Workload 3

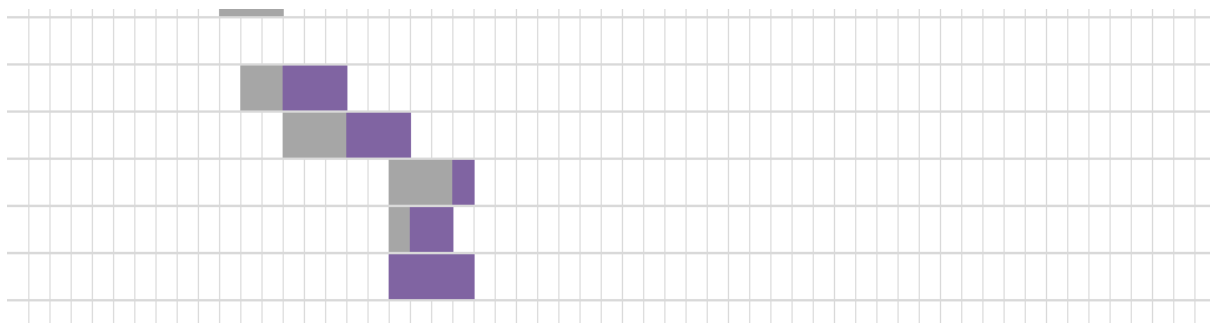


Figure 10 Workload 4

Implement				
Design	Evan Thapa Magar	100%	3/3/19	3/8/19
Locate	Bikash Khanal	98%	3/9/19	3/13/19
Document				
Creatinfg format	Avinash Karmacharya	40%	4/4/19	4/10/19
Contetnt	Evan Thapa Magar	90%	4/11/19	4/25/19
Error handling	Bikash Khanal	100%	4/24/19	4/27/19
Referencing	Evan Thapa Magar	45%	4/28/19	4/29/1029

Figure 11 Workload 5

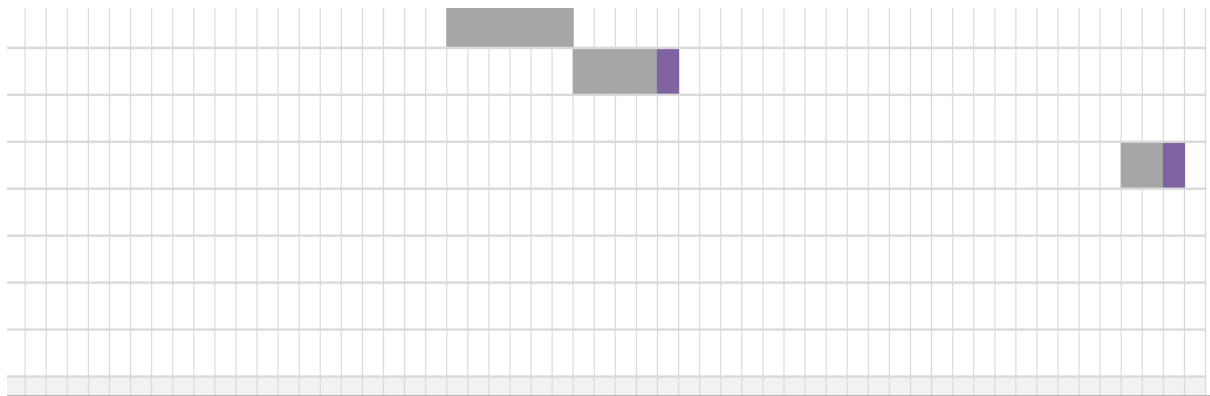


Figure 12 Workload 6

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## 12. Workload Matrix

<b><u>Name of Student and Roll number</u></b>	<b><u>Assigned Task</u></b>	<b><u>Total Contribution to project</u></b>	<b><u>Comments</u></b>
Bikash Khanal (NP000128)	-Documentation -Sentence structuring -Network Design -Critical Thinking -Research	33.33% out of 100%	I am happy to work in group. This project assisted me to extend my knowledge base of Computer Networking. Thanks to all the supporting hands.
Avinash Karmacharya (NP000127)	-Documentation -Figure collection -Research	33.33% out of 100%	Thanks to all my team members who supported to during all the process of projects. I am happy to be the part of this project.
Evan Thapa Magar (NP000130)	-Documentation -Security implementation -Research -Book collection	33.33% out of 100%	I thank to my other team members. I gained all lot of knowledge during this project completion time. It will help me in my future.

### 13. Marking Scheme

	Individual Components					Group Components					
	Discussion and justification	Report content (10)	Data Centre design (20)	Data Centre components (20)	Individual Total (60)	Presentation (20)	Documentation (5)	Workload Matrix (5)	Referencing (10)	Group Total (40)	Grand Total (100)
Evan Thapa Magar (NP000130)											
Bikash Khanal (NP00128)											
Avinash Karmarcharya NP(000127)											