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| **Your organization** |
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**Scope of work**Design a network infrastructure based on the available material list and the  
current --------------------- service requirements. Then deploy, test and  
commission the network infrastructure accordingly.  
**Background**---------------- has built G+2 and basement building. Each floor has different  
rooms to be used for office purpose. For propose infrastructure deployment, the  
building can be sectioned in to two taking the lobby as point of reference. For  
this document purpose, the direction reference is when a person stands in front of  
the lobby. So we sectioned the building as left and right based on this reference.  
**Requirement**There are nearly 96 network nodes per floor except first floor and these nodes are  
equally distributed to left and right side of the building. Meaning each side of the  
building requires 48 switch ports. But first floor has more network nodes than the  
rest which requires more switch port. Considering the available network  
resources even if first floor has more port density, it is decided to configure the  
first 96 ports and the rest will be considered during expansion.

**Available Material List**

|  |  |  |  |
| --- | --- | --- | --- |
| No | Name of Network Device | Qty | Number & Type of ports |
| 1 | Cisco 3750 Stackable Switch | 2 | 12 SPF |
| 2 | Cisco 2960 switch | 16 | 24 Electrical ports and 2 combo uplink ports |

**Network Design Consideration**Our design incorporated client’s service requirements, available resources and  
network infrastructure best practices.  
**Proposed network Architecture**Legend  
STACK

**Description of the network  
In relation to performance and Availability**Performance and availability are basically based on three major factors: The Equipment, Number of  
Redundant devices and links, network Topology and Configuration.  
***The Equipment***The hardware and the software architecture of a network node really affect the performance and  
availability of network. Some performance issues may not occur at low load but will eventually  
create a significant issue when traffic grows. **The network nodes (Cisco 3750 and 2960  
Switches) used for this network are world class and field proven and their behaviors are  
believed to be stable even at higher traffic loads**. Furthermore, since every device has a  
position in network where it works with its full capacity, we placed each at the appropriate  
location. If that was not the case, the overall performance of the device will be degraded. **That  
is why placed Cisco 3750 at Core layer and 2960 at Access layer.  
Number of Redundant devices and links**It is unwise to provide link redundancy for every single device in network as it will result in network  
complexity and higher cost. That is why we only consider link redundancy between Access to Core  
Switches and also we only considered device level redundancy at Core switch by deploying Cisco  
Stacking techology. So the proposed network topology appropriately considers failover for network  
outage. For example in the above architecture, if one of the links to the Core switch fails, another  
redundant link is available. And also if one of the Core Switch fails, the other will take care of the  
service

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**In terms of Configuration**Device configuration plays a major role in network performance and availability. No matter how wonderful  
devices we deploy in network and no matter how many redundant devices and links we considered,  
unless we apply proper configuration, we may face a huge performance and network outage issue. The  
links and devices added for redundancy may create loops and broadcast storm. Loops and broadcast  
storm are the most common problems in any network. **We, as network solution provider, have  
qualified professionals for network configuration for devices in the network.** With Proper network  
configuration, we will make use of the redundant network scenario for best resource utilization.  
If we take one of the access switch connection, it is easy to observe network loops due to the  
redundancy considered.

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CS-SW-1 CS-SW-2  
STACK  
Ground Floor  
LEFT Right  
BS-AS-SW-L-01 BS-AS-SW-R-01  
BS-AS-SW-L-01 BS-AS-SW-R-02  
To  
prevent the expected loop, we first of all will deploy stacking at core switch so that the two switches will act as one  
virtual switch. Furthermore, we will implement inter-chassis ether-channel technology. Moreover we will  
implement Spanning Tree Protocol (STP) to finally avoid any loop. Though STP surely prevent loops by blocking  
one of the physical interface which resulted in resource wastage. To fully use all the available resources, we will  
enable Per-VLAN STP for load sharing.

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**Redundancy**two core switches are deployed and the Core switches will be configured for Router redundancy protocol  
like VRRP (Virtual Router Redundancy Protocol) or HSRP (Hot Standby Redundancy Protocol) so  
computers in network will keep their default gateway in case one of the core switches fails and the other  
takes care of the service.  
Cisco Core switches are designed to support layer 3 routing like: Static, OSPF, EIGRP IS-IS and BGP. But  
as per our understanding there is no device currently which requires dynamic routing protocol so we will  
static and inter-vlan routing in this network deployment.  
Finally, the entire switch used for this network support vlan, we have the required expertise to define  
and implement vlans with different scenarios basically depending on the requirement. The  
requirements are the basis for the different valn configuration.  
If for example a need arises not have a communication between two ports in the same broadcast  
domain, we recommend PVLAN implementation.  
PVLANs provide layer 2 isolation between ports within the same broadcast domain. There are three  
types of PVLAN ports:  
**Promiscuous**— A promiscuous port can communicate with all interfaces, including the isolated and  
community ports within a PVLAN.  
**Isolated**— An isolated port has complete Layer 2 separation from the other ports within the same  
PVLAN, but not from the promiscuous ports. PVLANs block all traffic to isolated ports except traffic

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from promiscuous ports. Traffic from isolated port is forwarded only to promiscuous ports.  
**Community**— Community ports communicate among themselves and with their promiscuous ports.  
These interfaces are separated at Layer 2 from all other interfaces in other communities or isolated  
ports within their PVLAN.

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In this scenario, the devices in the isolated VLAN ("101") have a restriction from communication at Layer  
2 with one another. However, the devices can connect to the Internet. In addition, port "Gig 3/26" on the  
4006 has the promiscuous designation. This optional configuration allows a device on GigabitEthernet  
3/26 to connect to all devices in the isolated VLAN. This configuration also allows, for example, the  
backup of the data from all the PVLAN host devices to an administration workstation. Other uses for  
promiscuous ports include connection to an external router, Local Director, network management device,  
and other devices.

**VLAN Trucking Protocol (VTP)**This is a Cisco Proprietary protocol to manage vlan addition and deletion. Based on the requirement,  
we can implement VPT on this Cisco environment.  
**In relation to Security**As discussed above, we follow a layered security solution to protect critical network resources that reside  
on the network. If one layer fails, the next layer will stop the attack and/or limit the damages that can  
occur. To achieve this layered approach, in addition to the existing firewalls if any, we will make use of the  
hierarchical Network topology and implement different security polices at each layer of the topology.  
For example we can at least implement port Security at Cisco 2960 switch to prevent unauthorized  
access to the network. In addition, Cisco IOS has rich flexibilities to provide network level security.  
Besides we will deploy the most secured network management remote technique, SSH, rather than  
using unsecured telnet.  
**In relation to Network Management**As described above, network nodes selected for the deployment of this Campus LAN are manageable  
from Center or direct connection. In addition, we can make use of SNMP Protocol for advanced  
standalone network management tools. Currently there a lot open or proprietary network management  
tools available on the market. HP Open view is an open tool but Cisco Works is a proprietary for Cisco  
devices. But we believe that these advanced Network management tools are not under the scope of this  
bid.  
So we are planning to implement simple and cost efficient Central NMS for the new Campus. From  
this NMS center, it is possible to manage all network nodes via SSH or telent.

**Implementation  
Naming Convention**We used the following naming conventions and all Naming will be written in capital  
letter  
**Device Naming  
XX-YY-SW-D-AA  
XX= Shortened for floor,**⇨**Basement= BS**⇨**Ground=GD**⇨**First =FR**⇨**Second= SD  
YY=Shortened to refer to Switch role in the network**⇨**Access Switch= AS, Core SW =CS  
SW= Shortened to Device type**⇨**SW= Refers to Switch  
D= Refers to device’s location**⇨**L= Refers Left side of the floor**⇨**R= refers to Right side of the floor  
AA= Refers to switch number per rack example 01, 02…  
Interface Description**LINK-TO-“REMOTE-DEVOCE-NAME\_”REMOTE-DEVICE-PORT  
CONNECTED TO LOCAL DEVCE”  
**Cable labeling**“LOCAL DEVICE NAME”\_”LOCAL-PORT”-“REMOTE DEVICE NAME”\_”REMOTE  
PORT”

**Physical Deployment**⮚Core Switch will be placed at Datacenter Rack. We recommend if the two  
switches are placed at different racks and each will be supplied from different  
power source ensure most availability.  
⮚Access switches are mounted on racks prepared at each respective floor  
**Floor Rack Layout**Floor Patch Panel -02  
Floor Acess Swiitch  
Floor Access Swotch-02  
Floor Patch Panel-01  
Floor Access Swotch-01  
FLOOR RACK LAYOUT  
Link TO Access Switch -01  
Link to Core Switch 01  
Link to Core Switch 02  
**Switch port allocation  
Core Switch Port Allocation**

|  |  |  |
| --- | --- | --- |
| Core Switch Port | Reserved For | Port Role |
| CS -SW-1\_G0/1 | BS-AS-SW-L-01\_G0/0/1 | Trunk |
| CS -SW-1\_G0/2 | BS-AS-SW-R-01\_G0/0/1 | Trunk |

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|  |  |  |
| --- | --- | --- |
| CS -SW-1\_G0/3 | GD-AS-SW-L-01\_0/0/1 | Trunk |
| CS -SW-1\_G0/4 | GD-AS-SW-R-01\_G0/0/1 | Trunk |
| CS -SW-1\_G0/5 | FR-AS-SW-L-01\_G0/0/1 | Trunk |
| CS -SW-1\_G0/6 | FR-AS-SW-R-01\_G0/0/1 | Trunk |
| CS -SW-1\_G0/7 | SD-AS-SW-L-01\_G0/0/1 | Trunk |
| CS -SW-1\_G0/8 | SD-AS-SW-R-01\_G0/0/1 | Trunk |
| CS -SW-1\_G0/9 | Reserved for Server Farm Switch |  |
| CS -SW-1\_G0/10 | Reserved for Server Farm Switch |  |
| CS -SW-1\_G0/11 | Reserved Uplink connection |  |
| CS -SW-1\_G0/12 | Reserved Uplink connection |  |

|  |  |  |
| --- | --- | --- |
| Core Switch Port | Reserved For | Remark |
| CS -SW-02\_G0/1 | BS-AS-SW-L-01\_G0/0/2 | Trunk |
| CS -SW-02\_G0/2 | BS-AS-SW-R-01\_G0/0/2 | Trunk |
| CS -SW-02\_G0/3 | GD-AS-SW-L-01\_G0/0/2 | Trunk |
| CS -SW-02\_G0/4 | GD-AS-SW-R-01\_G0/0/2 | Trunk |
| CS -SW-02\_G0/5 | FR-AS-SW-L-01\_G0/0/2 | Trunk |
| CS -SW-02\_G0/6 | FR-AS-SW-R-01\_G0/0/2 | Trunk |
| CS -SW-02\_G0/7 | SD-AS-SW-L-01\_G0/0/2 | Trunk |
| CS -SW-02\_G0/8 | SD-AS-SW-R-01\_G0/0/2 | Trunk |

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|  |  |
| --- | --- |
| CS -SW-02\_G0/9 | Reserved for Server Farm Switch |
| CS -SW-02\_G0/10 | Reserved for Server Farm Switch |
| CS -SW-02\_G0/11 | Reserved for Uplink connection |
| CS -SW-02\_G0/12 | Reserved for Uplink connection |

**Access Switch 01 Port Allocation**

|  |  |  |
| --- | --- | --- |
| Access Switch port | Reserved for | Remark |
| G0/0-G0/22 | Users PC | Access |
| G0/23 | Access Point or Camera | Access |
| G0/24 | AS-SW-01 & 02 connection | Trunk |
| G0/0/1 | Reserved for future connection to Core switch | Trunk |
| G0/0/2 | Trunk |  |

**Access Switch 02 Port Allocation**

|  |  |  |
| --- | --- | --- |
| Access Switch port | Reserved for | Remark |
| G0/0-G0/22 | Users PC | Access |
| G0/23 | Access Point or Camera | Access |
| G0/24 | AS-SW-01 & 02 connection | Trunk |
| G0/0/1 | Reserved for future connection to Core switch | Trunk |
| G0/0/2 | Trunk |  |

**VLAN Design**Based on the current requirement from ---------------- IT Section requirement, each side of  
a floor will belong to a single VLAN. This means, it is required to have nearly eight user VLANs.  
For suture, it is wise to consider voice, CCTV and WiFi VLANs.

|  |  |
| --- | --- |
| VLAN ID | Usage |
| 10 | Basement Floor Left |
| 20 | Basement Floor Right |
| 30 | Ground Floor Left |
| 40 | Ground Floor Right |
| 50 | First Floor Left |

|  |  |
| --- | --- |
| 60 | First Floor Right |
| 70 | Second Floor Left |
| 80 | Second Floor Right |
| 90 | Wifi Network |
| 100 | IP Telephony/Voice Network |
| 110 | CCTV Camera |
| 500 | Network Management |

**IP Address Plan**Because there are limited numbers of users per floor, we designed IP addresses as efficient as  
possible.  
Total number of users per floor is nearly 96 which means /25 blocks IP address is sufficient but  
considering future expansion we allocated /24 block per floor

|  |  |  |
| --- | --- | --- |
| VLAN ID | Usage | Address block |
| 10 | Basement Floor Left | 10.0.10.0/24 |
| 20 | Basement Floor Right | 10.0.20.0/24 |
| 30 | Ground Floor Left | 10.0.30.0/24 |
| 40 | Ground Floor Right | 10.0.40.0/24 |
| 50 | First Floor Left | 10.0.50.0/24 |
| 60 | First Floor Right | 10.0.60.0/24 |
| 70 | Second Floor Left | 10.0.70.0/24 |
| 80 | Second Floor Right | 10.0.80.0/24 |
| 90 | Wifi Network | 10.0.90.0/24 |
| 100 | IP Telephony/Voice Network | 10.0.100.0/24 |
| 110 | CCTV Camera | 10.0.110.0/24 |
| 1 | Network Management | 10.0.0.0/24 |

**IP Address Allocation**

|  |  |  |  |
| --- | --- | --- | --- |
| VLAN ID | Usage | Block | Allocation |
| Gateway | CS-01 | CS-02 | DHCP/ Host Address |
| 10 | Basement Floor Left | 10.0.10.0/24 | 10.0.10.1 | 10.0.10.2 | 10.0.10.3 | 10.0.10.4-254/24 |
| 20 | Basement Floor Right | 10.0.20.0/24 | 10.0.20.1 | 10.0.20.2 | 10.0.20.3 | 10.0.20.4-254/24 |
| 30 | Ground Floor Left | 10.0.30.0/24 | 10.0.30.1 | 10.0.30.2 | 10.0.30.3 | 10.0.30.4-254/24 |
| 40 | Ground Floor Right | 10.0.40.0/24 | 10.0.40.1 | 10.0.40.2 | 10.0.40.3 | 10.0.40.4-254/24 |
| 50 | First Floor Left | 10.0.50.0/24 | 10.0.50.1 | 10.0.50.2 | 10.0.50.3 | 10.0.50.4-254/24 |
| 60 | First Floor Right | 10.0.60.0/24 | 10.0.60.1 | 10.0.60.2 | 10.0.60.3 | 10.0.60.4-254/24 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 70 | Second Floor Left | 10.0.70.0/24 | 10.0.70.1 | 10.0.70.2 | 10.0.70.3 | 10.0.70.4-254/24 |
| 80 | Second Floor Right | 10.0.80.0/24 | 10.0.80.1 | 10.0.80.2 | 10.0.80.3 | 10.0.90.4-254/24 |
| 90 | Wifi Network | 10.0.90.0/24 | 10.0.90.1 | 10.0.90.2 | 10.0.90.3 | 10.0.10.4-254/24 |
| 100 | IP Telephony/Voice Network | 10.0.100.0/24 | 10.0.100.1 | 10.0.100.2 | 10.0.100.3 | 10.0.100.4-254/24 |
| 110 | CCTV Camera | 10.0.110.0/24 | 10.0.110.1 | 10.0.110.2 | 10.0.110.3 | 10.0.110.4-254/24 |
| 1 | Network Management | 10.0.0.0/24 | 10.0.0.1 | 10.0.0.2 | 10.0.0.3 | 10.0.0.4-254/24 |
|  |  |  |  |  |  |  |

**Network Gateway Design**The default gate of every host in network will be the vrrp address which the floating address.  
VRRP will be enabled between the two Core Switches with an update interval of 3 seconds. To  
optimally use the network resources, VRRP mastership will be divided equally in the available  
network segments. The table below summarizes the VRRP implementation plan

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| VLAN ID | Usage | Block | Allocation | VRRP Mastership |
| Gateway | CS-01 | CS-02 | DHCP/ Host Address |  |
| 10 | Basement Floor Left | 10.0.10.0/24 | 10.0.10.1 | 10.0.10.2 | 10.0.10.3 | 10.0.10.4-254/24 | CS-SW-01 |
| 20 | Basement Floor Right | 10.0.20.0/24 | 10.0.20.1 | 10.0.20.2 | 10.0.20.3 | 10.0.20.4-254/24 | CS-SW-02 |
| 30 | Ground Floor Left | 10.0.30.0/24 | 10.0.30.1 | 10.0.30.2 | 10.0.30.3 | 10.0.30.4-254/24 | CS-SW-01 |
| 40 | Ground Floor Right | 10.0.40.0/24 | 10.0.40.1 | 10.0.40.2 | 10.0.40.3 | 10.0.40.4-254/24 | CS-SW-02 |
| 50 | First Floor Left | 10.0.50.0/24 | 10.0.50.1 | 10.0.50.2 | 10.0.50.3 | 10.0.50.4-254/24 | CS-SW-01 |
| 60 | First Floor Right | 10.0.60.0/24 | 10.0.60.1 | 10.0.60.2 | 10.0.60.3 | 10.0.60.4-254/24 | CS-SW-02 |
| 70 | Second Floor Left | 10.0.70.0/24 | 10.0.70.1 | 10.0.70.2 | 10.0.70.3 | 10.0.70.4-254/24 | CS-SW-01 |
| 80 | Second Floor Right | 10.0.80.0/24 | 10.0.80.1 | 10.0.80.2 | 10.0.80.3 | 10.0.90.4-254/24 | CS-SW-02 |
| 90 | Wifi Network | 10.0.90.0/24 | 10.0.90.1 | 10.0.90.2 | 10.0.90.3 | 10.0.10.4-254/24 | CS-SW-01 |
| 100 | IP Telephony/Voice Network | 10.0.100.0/24 | 10.0.100.1 | 10.0.100.2 | 10.0.100.3 | 10.0.100.4-254/24 | CS-SW-02 |
| 110 | CCTV Camera | 10.0.110.0/24 | 10.0.110.1 | 10.0.110.2 | 10.0.110.3 | 10.0.110.4-254/24 | CS-SW-01 |
| 500 | Network Management | 10.0.0.0/24 | 10.0.0.1 | 10.0.0.2 | 10.0.0.3 | 10.0.0.4-254/24 | CS-SW-02 |

**DHCP Design**In this network, the Core switch will work as DHCP server. To avoid any network outage because  
a failure in DHCP service, we will enable DHCP on both switch. But enabling DHCP on both  
devices will cause IP address duplication in different hosts. So we will make optimized DHCP  
configuration and ensure that address duplication will not occur.  
**Routing Design**with the network we have now, there is no need service to enable dynamic routing function. So we only  
use inter-vlan and static routing.  
**Network Management Design**SSHv2 will be enabled on all network devices with default username and password cisco. But the  
customer is expected to change it immediately after project handover.  
Device Management IP Address

|  |  |  |
| --- | --- | --- |
| VLAN ID | Usage | Block |
| Gateway |  |  |
| 500 | CS-01 | 10.0.0.2 | 10.0.0.1 |
| 500 | CS-02 | 10.0.0.3 | 10.0.0.1 |
| 500 | BS-AS-SW-L-01 | 10.0.0.4 | 10.0.0.1 |
| 500 | BS-AS-SW-L-02 | 10.0.0.5 | 10.0.0.1 |
| 500 | BS-AS-SW-R-01 | 10.0.0.6 | 10.0.0.1 |
| 500 | BS-AS-SW-R-02 | 10.0.0.7 | 10.0.0.1 |
| 500 | GD-AS-SW-L-01 | 10.0.0.8 | 10.0.0.1 |
| 500 | GD-AS-SW-L-02 | 10.0.0.9 | 10.0.0.1 |
| 500 | GD-AS-SW-R-01 | 10.0.0.10 | 10.0.0.1 |
| 500 | GD-AS-SW-R-02 | 10.0.0.11 | 10.0.0.1 |
| 500 | FR-AS-SW-L-01 | 10.0.0.12 | 10.0.0.1 |
| 500 | FR-AS-SW-L-02 | 10.0.0.13 | 10.0.0.1 |
| 500 | FR-AS-SW-R-01 | 10.0.0.14 | 10.0.0.1 |
| 500 | FR-AS-SW-R-02 | 10.0.0.15 | 10.0.0.1 |
| 500 | SD-AS-SW-L-01 | 10.0.0.16 | 10.0.0.1 |
| 500 | SD-AS-SW-L-02 | 10.0.0.17 | 10.0.0.1 |
| 500 | SD-AS-SW-R-01 | 10.0.0.18 | 10.0.0.1 |
| 500 | SD-AS-SW-R-02 | 10.0.0.19 | 10.0.0.1 |