2.8 VLAN Table

Each Department has a unique VLAN to divide the departments/sub departments and to reduce traffic on each link on the network. For the easy reference we have assigned the same VLAN ID to the DHCP pool of every department.

Description	**VLAN ID**
Reception & Customer Area	100
Administration	101
Accounting	102
Sales	103
Finance	104
H.R.	105
Marketing	106
Research and Development	107
Production	108
Engineering	109
IT (Operations & Maintenance).	110
IP Cameras	111
IP Printers	112
Other Devices (Servers, APs, WLCs)	113
Additional Subnet for Device Testing	114
Employee Wireless Network	200
Guest Wireless Network	201

2.9 IP Address Table

Reserved IP Block: 172.16.0.0/16

Wired Network

VLAN	Subnet	Description	IPs
100	172.16.8.224/28	Reception & Customer Area	10
101	172.16.5.0/25	Administration	70
102	172.16.6.128/26	Accounting	60
103	172.16.8.128/26	Sales	35
104	172.16.6.192/26	Finance	50
105	172.16.5.128/25	H.R.	70
106	172.16.6.0/25	Marketing	70
107	172.16.7.0/26	Research and Development	50
108	172.16.7.192/26	Production	40
109	172.16.8.0/26	Engineering	40
110	172.16.7.64/26	IT (Operations & Maintenance).	50
111	172.16.8.64/26	IP Cameras	37
112	172.16.8.192/27	IP Printers	16
113	172.16.4.128/25	Other Devices (Servers, APs, WLCs)	80
114	172.16.7.128/26	Additional Subnet for Device Testing	50
-	172.16.8.240/30	Firewall & SWC-FG-1 Switch	2
-	172.16.8.244/30	Firewall & SWC-FG-2 Switch	2
-	172.16.8.248/30	Ether Channel between SWC-FG-1 & 2	2
			658

Wireless Network

VLAN	Subnet	Description	Clients
200	172.16.0.0/22	Employee Network	670
201	172.16.4.0/25	Guest Network	100
			770

Total IP Addresses = Wireless Network + Wired Network
= 770 + 658
= **1428**

2.10 Switch Port Calculation Table

Access Layer Switches Port Calculation

Floor	Req. Port Count	24 Port Switch	48 Port Switch	Allocated Port Count	Extra Port Count
G	10	1	0	24	14
1	145	1	3	168	23
2	190	1	4	216	26
3	80	0	2	96	16
4	70	0	2	96	26
5	50	1	1	72	22

Collapsed Core Layer Switches Port Calculation

Floor	Req. Port Count	24 Port Switch	48 Port Switch	Allocated Port Count	Extra Port Count
G	72	0	2	96	24

24 Port Switches = 4
48 Port Switches = 12

2.11 Port Assignment Table

Switch Labeling Code

SWX – FY – Z

SW - Switch
F - Floor
X - If X replaced with C: Core Layer Switch
If X replaced with A: Access Layer Switch

Y - Floor Number
Z - Switch Number

Floor Number	Switch Name	Switch Label
G	Cisco WS-C3850-48T	SWC-FG-1
	Cisco WS-C3850-48T	SWC-FG-2
	Cisco WS - C2960L-24PS-LL	SWA-FG-1
1	Cisco WS - C2960L-24PS-LL	SWA-F1-1
	Cisco WS - C2960L-48PS-LL	SWA-F1-2
	Cisco WS - C2960L-48PS-LL	SWA-F1-3
	Cisco WS - C2960L-48PS-LL	SWA-F1-4
2	Cisco WS - C2960L-24PS-LL	SWA-F2-1
	Cisco WS - C2960L-48PS-LL	SWA-F2-2
	Cisco WS - C2960L-48PS-LL	SWA-F2-3
	Cisco WS - C2960L-48PS-LL	SWA-F2-4
	Cisco WS - C2960L-48PS-LL	SWA-F2-5
3	Cisco WS - C2960L-48PS-LL	SWA-F3-1
	Cisco WS - C2960L-48PS-LL	SWA-F3-2
4	Cisco WS - C2960L-48PS-LL	SWA-F4-1
	Cisco WS - C2960L-48PS-LL	SWA-F4-2
5	Cisco WS - C2960L-24PS-LL	SWA-F5-1
	Cisco WS - C2960L-48PS-LL	SWA-F5-2

Port Assignment Table

Primary Core Switch (Cisco WS-C3850-48T) (Code: **SWC-FG-1**)

Description	**Source Port (**SWC-FG-1**)**	**Destination Port**	**Destination Device**
Ether-Channel 1 (Between the Core)	GigabitEthernet 1/0/1	GigabitEthernet 1/0/1	SWC-FG-2
	GigabitEthernet 1/0/2	GigabitEthernet 1/0/2	SWC-FG-2
Core to Firewall	GigabitEthernet 1/0/3	GigabitEthernet 0/1	Sophos XG 550
Ether-Channel 2	GigabitEthernet 1/0/4	GigabitEthernet 0/1	SWA-FG-1
	GigabitEthernet 1/0/5	GigabitEthernet 0/2	
Ether-Channel 3	GigabitEthernet 1/0/6	GigabitEthernet 0/1	SWA-F1-1
	GigabitEthernet 1/0/7	GigabitEthernet 0/2	
Ether-Channel 4	GigabitEthernet 1/0/8	GigabitEthernet 0/1	SWA-F1-2
	GigabitEthernet 1/0/9	GigabitEthernet 0/2	
Ether-Channel 5	GigabitEthernet 1/0/10	GigabitEthernet 0/1	SWA-F1-3
	GigabitEthernet 1/0/11	GigabitEthernet 0/2	
Ether-Channel 6	GigabitEthernet 1/0/12	GigabitEthernet 0/1	SWA-F1-4
	GigabitEthernet 1/0/13	GigabitEthernet 0/2	
Ether-Channel 7	GigabitEthernet 1/0/14	GigabitEthernet 0/1	SWA-F2-1
	GigabitEthernet 1/0/15	GigabitEthernet 0/2	
Ether-Channel 8	GigabitEthernet 1/0/16	GigabitEthernet 0/1	SWA-F2-2
	GigabitEthernet 1/0/17	GigabitEthernet 0/2	
Ether-Channel 9	GigabitEthernet 1/0/18	GigabitEthernet 0/1	SWA-F2-3
	GigabitEthernet 1/0/19	GigabitEthernet 0/2	

Description	**Source Port (**SWC-FG-1**)**	**Destination Port**	**Destination Device**
Ether-Channel 10	GigabitEthernet 1/0/20	GigabitEthernet 0/1	SWA-F2-4
	GigabitEthernet 1/0/21	GigabitEthernet 0/2	
Ether-Channel 11	GigabitEthernet 1/0/22	GigabitEthernet 0/1	SWA-F2-5
	GigabitEthernet 1/0/23	GigabitEthernet 0/2	
Ether-Channel 12	GigabitEthernet 1/0/24	GigabitEthernet 0/1	SWA-F3-1
	GigabitEthernet 1/0/25	GigabitEthernet 0/2	
Ether-Channel 13	GigabitEthernet 1/0/26	GigabitEthernet 0/1	SWA-F3-2
	GigabitEthernet 1/0/27	GigabitEthernet 0/2	
Ether-Channel 14	GigabitEthernet 1/0/28	GigabitEthernet 0/1	SWA-F4-1
	GigabitEthernet 1/0/29	GigabitEthernet 0/2	
Ether-Channel 15	GigabitEthernet 1/0/30	GigabitEthernet 0/1	SWA-F4-2
	GigabitEthernet 1/0/31	GigabitEthernet 0/2	
Ether-Channel 16	GigabitEthernet 1/0/32	GigabitEthernet 0/1	SWA-F5-1
	GigabitEthernet 1/0/33	GigabitEthernet 0/2	
Ether-Channel 17	GigabitEthernet 1/0/34	GigabitEthernet 0/1	SWA-F5-2
	GigabitEthernet 1/0/35	GigabitEthernet 0/2	

Secondary Core Switch (Cisco WS-C3850-48T) (Code: **SWC-FG-2**)

Description	**Source Port (**SWC-FG-2**)**	**Destination Port**	**Destination Device**
Ether-Channel 1 (Between the Core)	GigabitEthernet 1/0/1	GigabitEthernet 1/0/1	SWC-FG-2
	GigabitEthernet 1/0/2	GigabitEthernet 1/0/2	SWC-FG-2
Core to Firewall	GigabitEthernet 1/0/3	GigabitEthernet 0/1	Sophos XG 550
Ether-Channel 2	GigabitEthernet 1/0/4	GigabitEthernet 0/3	SWA-FG-1
	GigabitEthernet 1/0/5	GigabitEthernet 0/4	
Ether-Channel 3	GigabitEthernet 1/0/6	GigabitEthernet 0/3	SWA-F1-1
	GigabitEthernet 1/0/7	GigabitEthernet 0/4	
Ether-Channel 4	GigabitEthernet 1/0/8	GigabitEthernet 0/3	SWA-F1-2
	GigabitEthernet 1/0/9	GigabitEthernet 0/4	
Ether-Channel 5	GigabitEthernet 1/0/10	GigabitEthernet 0/3	SWA-F1-3
	GigabitEthernet 1/0/11	GigabitEthernet 0/4	
Ether-Channel 6	GigabitEthernet 1/0/12	GigabitEthernet 0/3	SWA-F1-4
	GigabitEthernet 1/0/13	GigabitEthernet 0/4	
Ether-Channel 7	GigabitEthernet 1/0/14	GigabitEthernet 0/3	SWA-F2-1
	GigabitEthernet 1/0/15	GigabitEthernet 0/4	
Ether-Channel 8	GigabitEthernet 1/0/16	GigabitEthernet 0/3	SWA-F2-2
	GigabitEthernet 1/0/17	GigabitEthernet 0/4	
Ether-Channel 9	GigabitEthernet 1/0/18	GigabitEthernet 0/3	SWA-F2-3
	GigabitEthernet 1/0/19	GigabitEthernet 0/4	

Description	**Source Port (**SWC-FG-2**)**	**Destination Port**	**Destination Device**
Ether-Channel 10	GigabitEthernet 1/0/20	GigabitEthernet 0/3	SWA-F2-4
	GigabitEthernet 1/0/21	GigabitEthernet 0/4	
Ether-Channel 11	GigabitEthernet 1/0/22	GigabitEthernet 0/3	SWA-F2-5
	GigabitEthernet 1/0/23	GigabitEthernet 0/4	
Ether-Channel 12	GigabitEthernet 1/0/24	GigabitEthernet 0/3	SWA-F3-1
	GigabitEthernet 1/0/25	GigabitEthernet 0/4	
Ether-Channel 13	GigabitEthernet 1/0/26	GigabitEthernet 0/3	SWA-F3-2
	GigabitEthernet 1/0/27	GigabitEthernet 0/4	
Ether-Channel 14	GigabitEthernet 1/0/28	GigabitEthernet 0/3	SWA-F4-1
	GigabitEthernet 1/0/29	GigabitEthernet 0/4	
Ether-Channel 15	GigabitEthernet 1/0/30	GigabitEthernet 0/3	SWA-F4-2
	GigabitEthernet 1/0/31	GigabitEthernet 0/4	
Ether-Channel 16	GigabitEthernet 1/0/32	GigabitEthernet 0/3	SWA-F5-1
	GigabitEthernet 1/0/33	GigabitEthernet 0/4	
Ether-Channel 17	GigabitEthernet 1/0/34	GigabitEthernet 0/3	SWA-F5-2
	GigabitEthernet 1/0/35	GigabitEthernet 0/4	

2.12 Protocols Used in the Network

Protocol	Description
DHCP	Dynamic Host Configuration Protocol (DHCP) is a network protocol that enables a server to automatically assign an IP address to a computer from a defined range of numbers.
FTP	The File Transfer Protocol is a standard network protocol used for the transfer of computer files between a client and server on a computer network. FileZilla is a free software, cross-platform FTP application, consisting of FileZilla Client and FileZilla Server.
DNS	A DNS server is a type of name server that manages, maintains and processes Internet domain names and their associated records
RSTP	Rapid Spanning Tree Protocol (RSTP) is a network protocol that ensures a loop-free topology for Ethernet networks. Nowadays it is a popular solution to implement redundant networks.
SNMP	Simple Network Management Protocol is an Internet Standard protocol for collecting and organizing information about managed devices on IP networks.
HSRP	Hot Standby Router Protocol is a Cisco proprietary redundancy protocol for establishing a fault-tolerant default gateway.
NTP	The Network Time Protocol is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks.
VTP	VLAN Trunking Protocol is a Cisco proprietary protocol that propagates the definition of Virtual Local Area Networks on the whole local area network.
PAgP	Port Aggregation Protocol (PAgP) is a Cisco Systems proprietary networking protocol, which is used for the automated, logical aggregation of Ethernet switch ports, known as an EtherChannel
CAPWAP	The Control And Provisioning of Wireless Access Points protocol is a standard, interoperable networking protocol that enables a central wireless LAN Access Controller to manage a collection of Wireless Termination Points, more commonly known as wireless access points.

2.13 ISP Connections

For this company, We're going to buy Primary ISP as Sri Lanka Telecom and Secondary as Dialog. In case of primary ISP fails then quickly up the secondary connection without any failure. We are going to implement following fiber lines for the ISP connections.

- 100 Mbps fiber connection (From SLT Connection).
- 100 Mbps fiber connection (From Dialog Connection).

2.14 Bandwidth Calculation

We have assumed the following bandwidth limits for the users categorized.

• Light users - 512 kbps (Guest Users in waiting area)
• Moderate users - 1 Mbps (Normal Employees)
• Heavy users - 2 Mbps (Company Managers)

Floor	Department	Wired Users	Usage	Peak Bandwidth
Ground	Reception & Customer Area	10	512 kbps	5 Mbps
1	Accounting	60	1 Mbps	60 Mbps
	Sales	35	1 Mbps	35 Mbps
	Finance	50	1 Mbps	50 Mbps
2	Human Resource	70	1 Mbps	70 Mbps
	Marketing	70	1 Mbps	70 Mbps
	Research and Development	50	1 Mbps	50 Mbps
3	Engineering	40	1 Mbps	40 Mbps
	Production	40	1 Mbps	40 Mbps
4	Administration	70	2 Mbps	140 Mbps
5	IT (Operations &Maintenance).	50	2 Mbps	100 Mbps

Total Peak Bandwidth is 660 Mbps. We can assume that all users are not using internet simultaneously at full speed. Therefore, the normal bandwidth is lower than that peak value.

Connection Cost per Month

ISP	Package	Total Monthly Usage	Cost per Month
SLT	100 Mbps Fiber Line	1700 GB	Rs. 33000.00
Dialog	100 Mbps Fiber Line		
Total Cost			

2.15 Limit Bandwidth in Switch Ports

There are a number of reasons for limiting bandwidth on a Ethernet port. In above bandwidth calculation table, we divide users into three main categories and limit their bandwidth.

If a host connected to switch port via CAT6 cable, the switch port can reach 1Gbps or It's max speed. Then the other users in the company network unable to access the internet using the specified speed in above table.

In this case, we should limit the switch port bandwidth to the speed limits specified in above table.