Small Branch Office Network

Description:

This project aims to design a redundant and efficient campus network using Cisco Packet Tracer. The network will serve a small educational institution with multiple departments, each requiring access to shared resources like printers and the internet. The network will utilize a range of protocols, including RSTP, VLANs, HSRP, Layer 2 and Layer 3 EtherChannels, OSPF/EIGRP, DNS, DHCP, NAT and PAT, NTP, FTP, syslog, SNMP, SSH, LLDP. Cisco Packet Tracer has been employed to create the design of this network.

Network Topology:

The network uses a 3-tier architecture which increases scalability and improves performance.

The network consists of the following devices:

- 2 Cisco 2911 Routers
- 4 Cisco 3650 Layer 3 Switches
- 4 Cisco 2960 Layer 2 Switches
- 12 PCs
- 2 Printers
- 1 Server

Connections:

- R1:
  G0/0/0 <> Internet router G0/0/0
  G0/1 <> CSW-1 G1/0/1
  G0/2 <> CSW-2 G1/0/1
- CSW-1:
  G1/0/1 <> R1 G0/1
  G1/0/2 <> CSW-2 G1/0/2
  G1/0/3 <> CSW-3 G1/0/3
  G1/1/1 <> DSW-1 G1/1/1
  G1/1/2 <> DSW-2 G1/1/1
- DSW-1:
  G1/1/1 <> CSW-1 G1/1/1
  G1/1/2 <> CSW-2 G1/1/2
  G1/0/1 <> ASW-1 G0/1
  G1/0/2 <> ASW-2 G0/1
- CSW-2:
  G1/0/1 <> R1 G0/2
  G1/0/2 <> CSW-1 G1/0/2
  G1/0/3 <> CSW-2 G1/0/3
  G1/1/1 <> DSW-2 G1/1/2
  G1/1/2 <> DSW-1 G1/1/2
- DSW-2:
  G1/1/1 <> CSW-1 G1/1/2
  G1/1/2 <> CSW-2 G1/1/1
  G1/0/1 <> ASW-3 G0/1
  G1/0/2 <> ASW-4 G0/1

G1/0/3 <> ASW-3 G0/2
G1/0/4 <> ASW-4 G0/2
G1/0/5 <> DSW-2 G1/0/5
G1/0/6 <> DSW-2 G1/0/6

- ASW-1:
  F0/1 <> IT_Student_1
  F0/2 <> IT_Student_2
  F0/3 <> IT_Faculty
  F0/4 <> Server_1
- ASW-3:
  F0/1 <> Mech_Student_1
  F0/2 <> Mech_Student_2
  F0/3 <> Mech_Faculty
  F0/4 <> Printer_2

G1/0/3 <> ASW-1 G0/2
G1/0/4 <> ASW-2 G0/2
G1/0/5 <> DSW-1 G1/0/5
G1/0/6 <> DSW-1 G1/0/6

- ASW-2:
  F0/1 <> Elec_Student_1
  F0/2 <> Elec_Student_2
  F0/3 <> Elec_Faculty
  F0/4 <> Printer_1
- ASW-4:
  F0/1 <> Auto_Student_1
  F0/2 <> Auto_Student_2
  F0/3 <> Auto_Faculty

IP Addressing Plan:

Networks:

VLAN 10 (Faculty)	192.168.1.0/24
VLAN 20 (Students)	192.168.2.0/24
VLAN 30 (Management)	192.168.3.0/24

NOTE:

- ".1" addresses are VIP for HSRP (DG for the subnet), ".2" and ".3" addresses are for SVIs.
- Although the end devices have been physically separated based on the 4 departments (IT, Electrical , Mechanical, Automobile), they are configured to be in either of the 3 VLANs.

Connections:

R1 <> CSW1	192.168.0.0/30
R1 <> CSW2	192.168.0.4/30
R1 <> ISP	203.0.113.0/30

CSW1 <> DSW1	192.168.0.12/30
CSW1 <> DSW2	192.168.0.16/30

CSW2 <> DSW1	192.168.0.20/30
CSW2 <> DSW2	192.168.0.24/30

Loopbacks:

R1	192.168.0.28/32
CSW1	192.168.0.29/32
CSW2	192.168.0.30/32
DSW1	192.168.0.31/32
DSW2	192.168.0.32/32

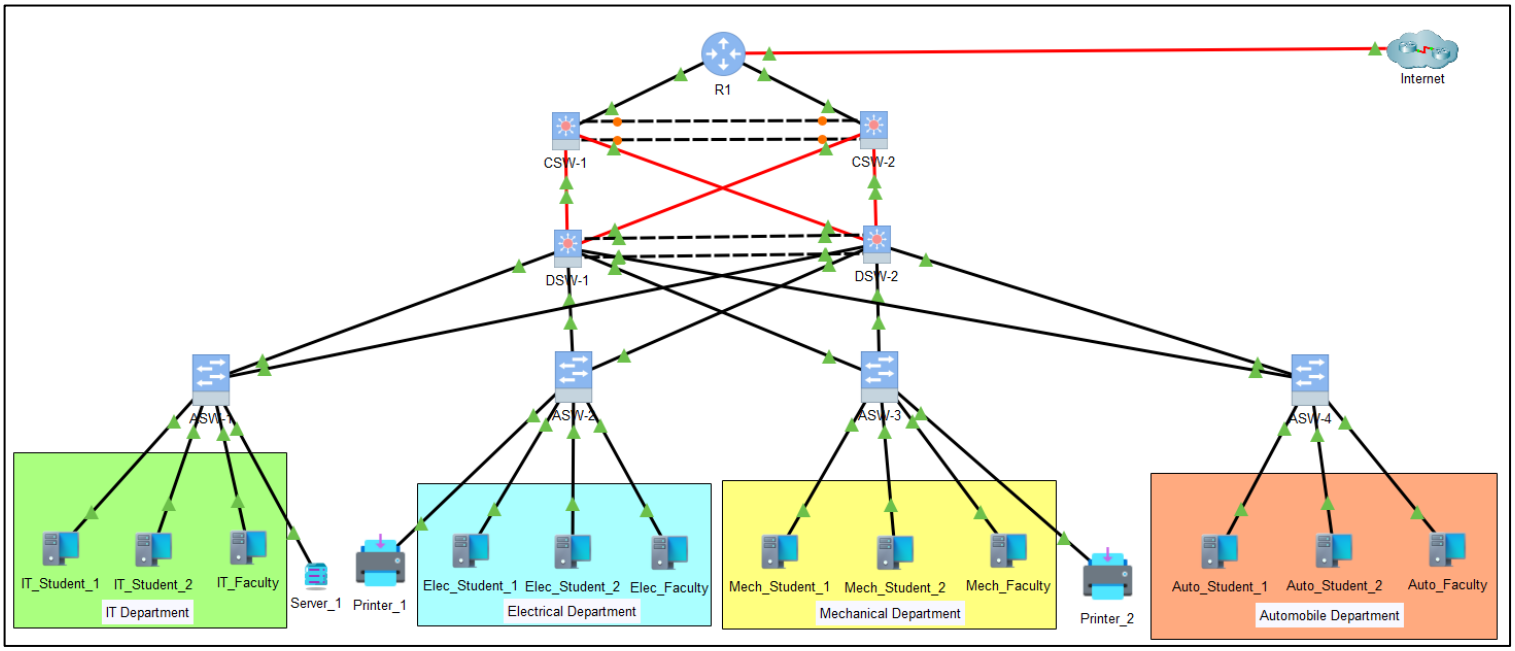
VLAN Interfaces:

ASW-1	192.168.3.4/24
ASW-2	192.168.3.5/24
ASW-1	192.168.3.6/24
ASW-2	192.168.3.7/24

Static IP Addresses:

SRV1	192.168.3.8/24

Topology Diagram:



Configuration:

Part 1:

1. Configure Hostnames for all devices.
2. Configure a Layer 2 EtherChannel b/w Distribution switches, which uses interfaces G1/0/5 and G1/0/6:
   - Disable DTP
   - Switchport mode is Trunk
   - Allowed VLANs: 10, 20, 30
   - Native VLAN: 1000
   - Channel Protocol: PAgP
   - Channel Mode: Desirable
3. Links b/w DSWs and ASWs are configured as trunks:
   - Disable DTP
   - Switchport mode is Trunk
   - Allowed VLANs: 10, 20, 30
   - Native VLAN: 1000
4. DSW-1 is configured as VTP server and other Access and Distribution switches as VTP clients:
   - Domain Name: Campus
   - VTP Version: 2
   - Configure VLAN names
5. Configure ASWs ports connecting to end devices:
   - Switchport mode is Access
   - Configure Access VLAN:
     - Faculty PCs – VLAN 10
     - Student PCs – VLAN 20
     - Servers and Printers – VLAN 30
   - Disable DTP
6. Disable all the unused interfaces.

Part 2:

1. Configure all the IP addresses based on the connections and IP addressing plan above.
2. Configure Loopbacks and SVIs (for DSWs). Configure VLAN interfaces and default gateway for ASWs.
   NOTE: Enable ip routing on L3 switches.

3. Manually configure IP addresses for Server_1 and IT_Faculty. (IT_Faculty is the only PC with SSH access to network devices)
4. Configure a Layer 3 EtherChannel b/w CSW1 <> CSW2:
   - Channel Protocol: LACP
   - Channel Mode: Active
   - Configure IP addresses on Port Channel Interfaces.
5. HSRP Configuration:

	VLAN 10 (Grp 1)	VLAN 20 (Grp 2)	VLAN 30 (Grp 3)
DSW-1	Standby	Standby	Active
DSW-2	Active	Active	Standby

   - Configure HSRP on the SVIs of DSWs.
   - For each subnet the ".1" address will be the Virtual IP.
   - Preempt active gateway and increase its priority to 105.

Part 3:

1. RSTP:
   - Spanning tree mode: Rapid PVST+
   - DSW-1: Priority 4096 for VLAN 30, Priority 8192 for VLAN 10 & 20
   - DSW-2: Priority 4096 for VLAN 10 & 20, Priority 8192 for VLAN 30
   - Ensure that the RSTP topology matches that of HSRP.
2. Configure PortFast and BPDU Guard on ASWs interfaces.

Part 4:

1. OSPF:
   - Configure OSPF on R1, CSWs and DSWs
   - Area 0, Process 1
   - Configure loopbacks as Router IDs.
   - Configure loopbacks and SVIs as Passive.
   - Enable OSPF on each interface.
2. Configure static routes on R1 to ISPs and redistribute them in OSPF.

Part 5:

1. DHCP:
   - R1 is configured as the DHCP server.
   - First 20 addresses if all subnets are reserved, so the start IP for all pools is from ".21"
   - DNS server for all subnets is Server 1 (192.168.3.8)

- Default router will be ".1" address of each subnet.
- Domain name: mycampus.com
- Configure DSWs as relay agents.

2. DNS:
   - Configure A records and CNAME records for the following, on Server 1:
     - google.com – www.google.com - 171.26.10.62/32
     - youtube.com – www.youtube.com – 153.16.120.10/32
   - Configure the above IP addresses as loopbacks on the router named "Internet"
3. NTP:
   - Configure loopback interface 100.100.100.100/32 on router named "Internet". This will be the NTP server for R1.
   - Configure R1 as NTP master of stratum 5.
   - Enable NTP authentication and configure 2 keys:
     - Key 1: mycampus1
     - Key 2: mycampus2
   - Configure R1 as NTP server for all network devices.
   - CSW1, DSW1, ASW1, ASW2 will use Key 1 and CSW2, DSW2, ASW3, ASW4 will use Key 2 for authentication.
4. FTP:
   - Server-1 will be the FTP server.
   - Configure FTP Username and Password on network devices and Server-1:
     - Username: mycampus
     - Password: mycampus1
5. SNMP:
   - Configure communities on all network devices:
     - Read-Only Community: mycampus1
     - Read-Write Community: mycampus2
   - Configure extended ACL 100 on CSWs, DSWs and R1 to allow SNMP traffic only from host "192.168.1.10"
6. Syslog:
   - Enable logging to server 192.168.3.8 (Server-1) on all network devices.
   - Enable synchronous logging
   - Logging buffer size: 8192
7. LLDP:
   - By default CDP is enabled for all interfaces on Cisco devices, so disable CDP on all network devices.

- Enable LLDP on all devices.
- Disable LLDP on interfaces connected to end devices and the interface on R1 that is connected to the ISP.

8. NAT(PAT):
   - Configure a standard ACL to permit the 192.168.0.0/16 network.
   - Configure PAT to translate to the WAN interface on R1.
9. Usernames and Passwords:
   - Login Username: admin & Secret: campusadmin1
   - Enable Secret: campusadmin2
   - Configure type 5 (md5) secret for ASWs & R1 and type 9 (scrypt) secret for CSWs & DSWs.
10. SSH:
    - SSH is enabled on all network devices.
    - Domain Name: mycampus.com
    - Generate SSH keys – Key length should be the maximum possible value.
    - Enable SSH version 2
    - On vty lines 0 to 4:
      - Only SSH connections should be allowed.
      - Enable logging synchronous.
      - Login authentication method is local.
      - Configure standard ACL to permit connections only from host 192.168.1.0/32.
    - On vty lines 5 to 15, disable both telnet and SSH connections.

Finally, verify all the configurations using the corresponding show commands.