Huawei Network Administrator

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Corporate Campus Network Resilience Design(NetFusion TEAM)

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(1)

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1. Objective:

To design and simulate a fully functional, secure, and scalable network infrastructure connecting two buildings using Huawei eNSp

The objective is to ensure reliable communication between departments, provide high availability, enhance security using ACL and AAA, and implement essential enterprise services such as OSPF, DHCP, WLAN, VRRP, and STP.

Project Goals

• Ensure seamless connectivity between Building 1 and Building 2 through routers and OSPF dynamic routing.

• Provide high availability using VRRP between the core and backup switches to prevent network downtime.

• Enhance network security by implementing AAA for authentication and ACLs to control inter-department communication.

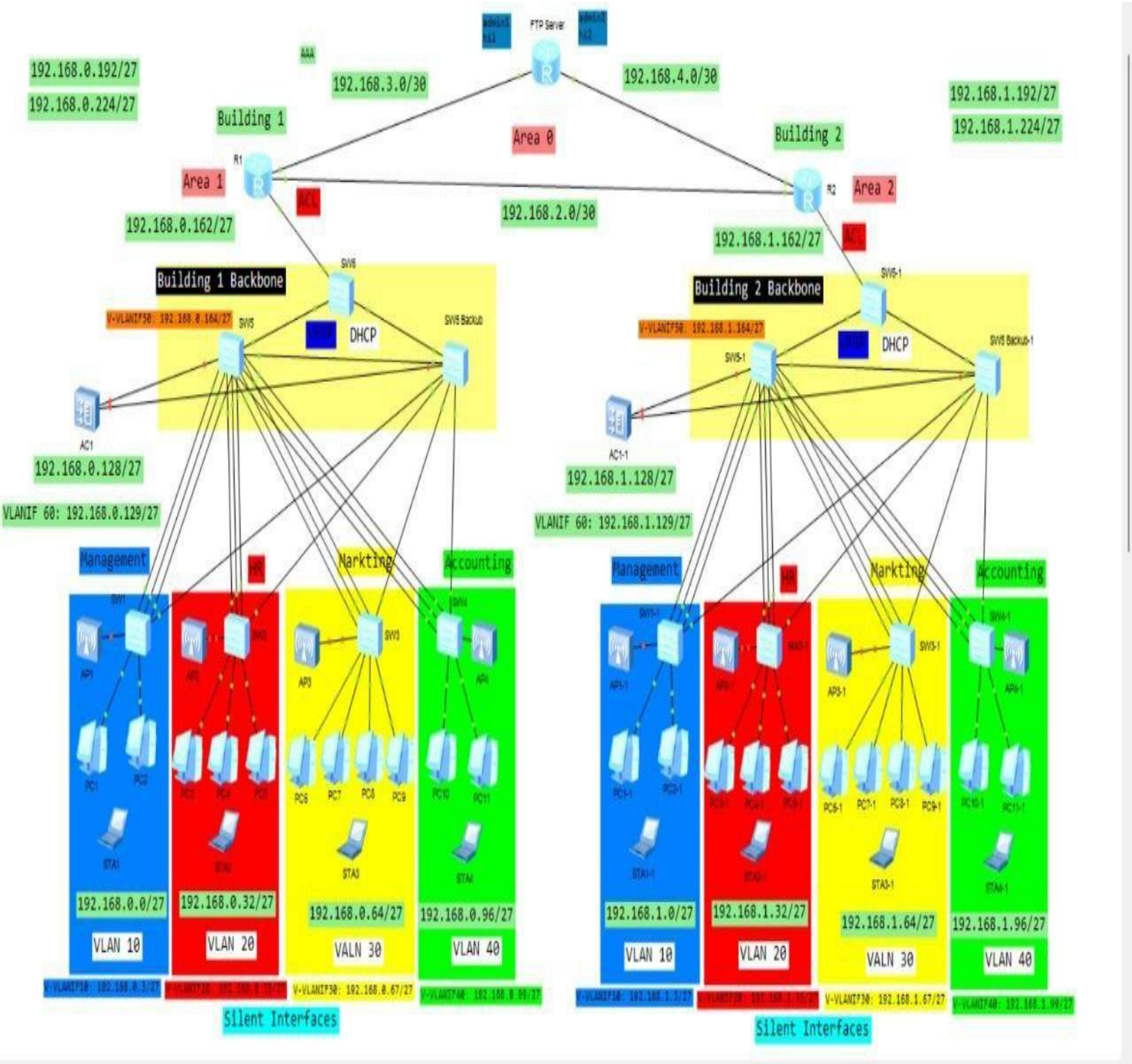
• Organize the network logically through VLAN segmentation for Management, Marketing, Accounting, HR, and other departments.

• Guarantee reliable IP assignment for all wired and wireless devices using DHCP pools per VLAN.

• Deploy wireless access for both buildings using WLAN, APs, and CAPWAP for centralized management.

• Prevent switching loops and maintain stable Layer 2 topology using STP.

• Improve link reliability and bandwidth using Eth-Trunk between the main switch and access switches.

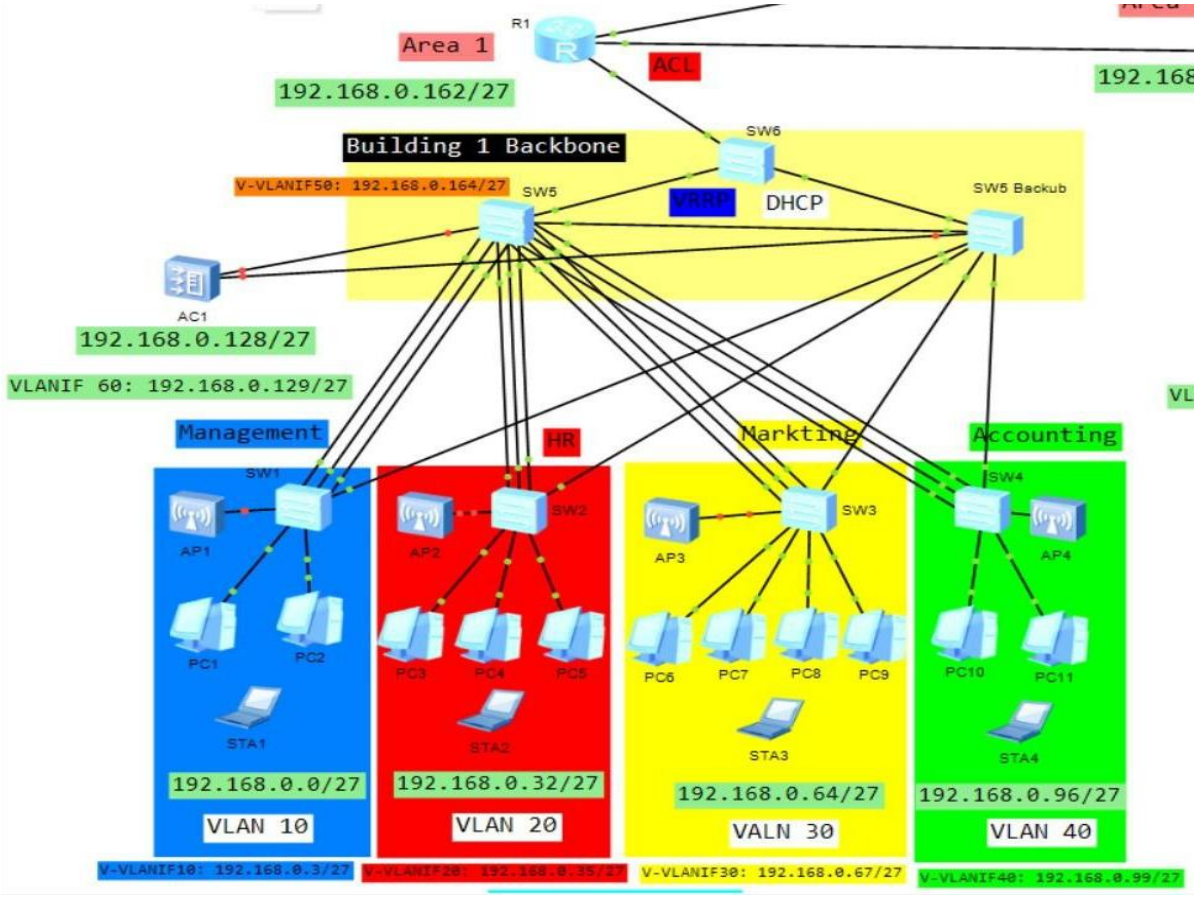

FTP Server
AAA
192.168.0.192/27
192.168.0.224/27
192.168.3.0/30
192.168.4.0/30
192.168.1.192/27
192.168.1.224/27
Building 1
Area 0
Building 2
R1
R2
Area 1
Area 2
ACL
192.168.2.0/30
192.168.0.162/27
192.168.1.162/27
Building 1 Backbone
Building 2 Backbone
SW6
SW5
SW5 Backup
SW5-1
SW5 Backup-1
V-VLANIF50: 192.168.0.164/27
V-VLANIF50: 192.168.1.164/27
DHCP
AC1
AC1-1
192.168.0.128/27
192.168.1.128/27
VLANIF 60: 192.168.0.129/27
VLANIF 60: 192.168.1.129/27
Management
HR
Marking
Accounting
SW1
SW2
SW3
SW4
AP1
AP2
AP3
AP4
PC1
PC2
PC3
PC4
PC5
PC6
PC7
PC8
PC9
PC10
PC11
STA1
STA2
STA3
STA4
192.168.0.0/27
192.168.0.32/27
192.168.0.64/27
192.168.0.96/27
VLAN 10
VLAN 20
VALN 30
VLAN 40
V-VLANIF30: 192.168.0.67/27
Silent Interfaces
SW1-1
SW2-1
SW3-1
SW4-1
AP1-1
AP2-1
AP3-1
AP4-1
PC1-1
PC2-1
PC3-1
PC4-1
PC5-1
PC6-1
PC7-1
PC8-1
PC9-1
PC10-1
PC11-1
STA1-1
STA2-1
STA3-1
STA4-1
192.168.1.0/27
192.168.1.32/27
192.168.1.64/27
192.168.1.96/27
VLAN 10
VLAN 20
VALN 30
VLAN 40
V-VLANIF30: 192.168.1.67/27
Silent Interfaces

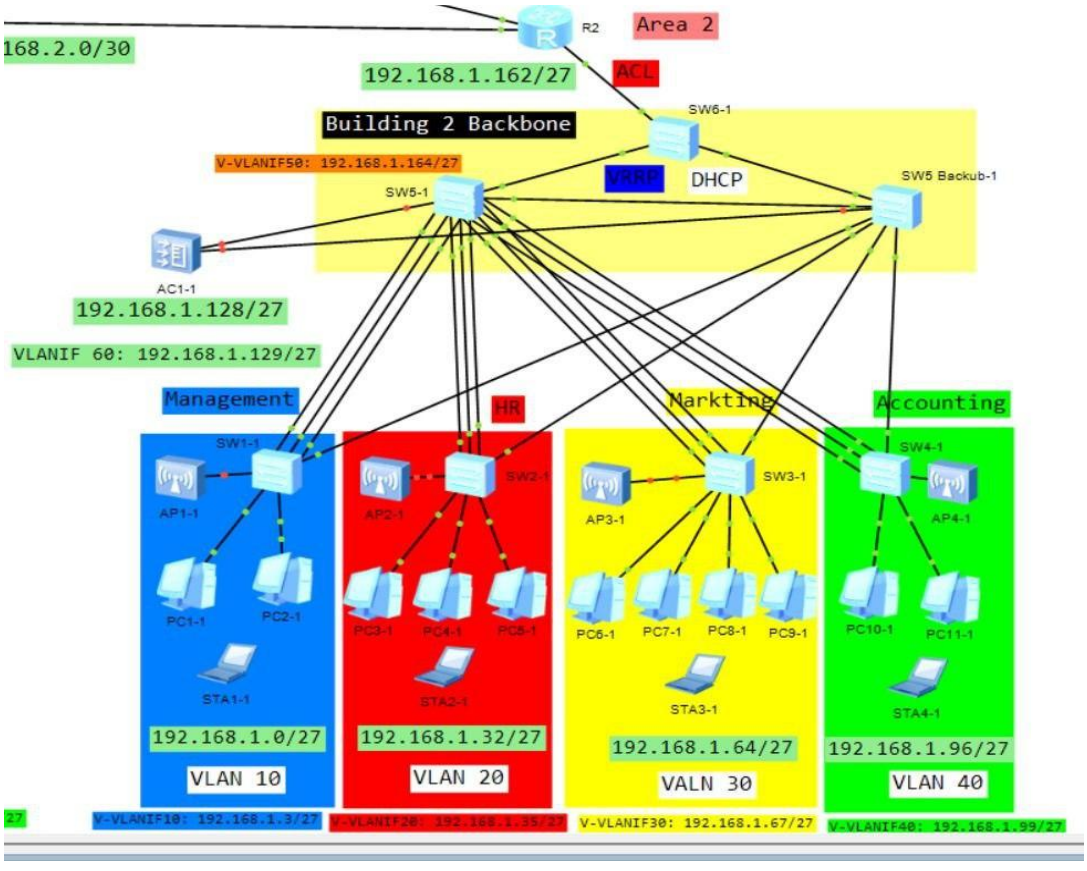
192.168.0.0/27	192.168.0.1	192.168.0.30	192.168.0.31	30	Management PCs, APs, switches, administrative devices
192.168.0.32/27	192.168.0.33	192.168.0.62	192.168.0.63	30	HR desktops, printers, laptops
192.168.0.64/27	192.168.0.65	192.168.0.94	192.168.0.95	30	Purpose: Marketing PCs and media devices
192.168.0.96/27	192.168.0.97	192.168.0.126	192.168.0.127	30	Accounting systems and financial devices
192.168.0.128/27	192.168.0.129	192.168.0.158	192.168.0.159	30	SVIs, VRRP virtual IPs, DHCP services
192.168.1.0/27	192.168.1.1	192.168.1.30	192.168.1.31	30	Management devices for Building 2
192.168.1.32/27	192.168.1.33	192.168.1.62	192.168.1.63	30	HR devices
192.168.1.64/27	192.168.1.65	192.168.1.94	192.168.1.95	30	Marketing systems
192.168.1.96/27	192.168.1.97	192.168.1.126	192.168.1.127	30	Accounting devices
192.168.1.128/27	192.168.1.129	192.168.1.158	192.168.1.159	30	SVIs, VRRP, DHCP functions
192.168.2.0/30	192.168.2.1	192.168.2.2	192.168.2.3	2	Router-to-router OSPF backbone link
192.168.3.0/30	192.168.3.1	192.168.3.2	192.168.3.3	2	Point-to-point connection to FTP Server
192.168.4.0/30	192.168.4.1	192.168.4.2	192.168.4.3	2	Secondery

Configuration Vlan and IP

The network is segmented into multiple VLANs to isolate traffic, enhance security, and improve overall performance across the two-building infrastructure. Each building uses the same VLAN structure to maintain consistency and simplify management.

Building 1	VLAN 10 – Management	192.168.0.0/27	192.168.0.1	192.168.0.30	192.168.0.31
Building 1	VLAN 20 – HR	192.168.0.32/27	192.168.0.33	192.168.0.62	192.168.0.63
Building 1	VLAN 30 – Marketing	192.168.0.64/27	192.168.0.65	192.168.0.94	192.168.0.95
Building 1	VLAN 40 – Accounting	192.168.0.96/27	192.168.0.97	192.168.0.126	192.168.0.126
Building 1	Infrastructure / VRRP / SVI	192.168.0.128/27	192.168.0.129	192.168.0.158	192.168.0.159
Building 1	Extra VLAN (Expansion)	192.168.0.160/27	192.168.0.161	192.168.0.190	192.168.0.191
Building 2	VLAN 10 – Management	192.168.1.0/27	192.168.1.1	192.168.1.30	192.168.1.31
Building 2	VLAN 20 – HR	192.168.1.32/27	192.168.1.33	192.168.1.62	192.168.1.63
Building 2	VLAN 30 – Marketing	192.168.1.64/27	192.168.1.65	192.168.1.94	192.168.1.95
Building 2	VLAN 40 – Accounting	192.168.1.96/27	192.168.1.97	192.168.1.126	192.168.1.127
Building 2	Infrastructure / VRRP	192.168.1.128/27	192.168.1.129	192.168.1.158	192.168.1.159
Building 2	Extra VLAN (Expansion)	192.168.1.160/27	192.168.1.161	192.168.1.190	192.168.1.191


R1
Area 1
ACL
192.168.0.162/27
192.168
Building 1 Backbone
SW6
V-VLANIF50: 192.168.0.164/27
SW5
VRRP
DHCP
SW5 Backub
AC1
192.168.0.128/27
VLANIF 60: 192.168.0.129/27
Management
HR
Markting
Accounting
SW1
SW2
SW3
SW4
AP1
AP2
AP3
AP4
PC1
PC2
PC3
PC4
PC5
PC6
PC7
PC8
PC9
PC10
PC11
STA1
STA2
STA3
STA4
192.168.0.0/27
VLAN 10
192.168.0.32/27
VLAN 20
192.168.0.64/27
VALN 30
192.168.0.96/27
VLAN 40
V-VLANIF10: 192.168.0.3/27
V-VLANIF20: 192.168.0.35/27
V-VLANIF30: 192.168.0.67/27
V-VLANIF40: 192.168.0.99/27


168.2.0/30
R2
Area 2
192.168.1.162/27
ACL
Building 2 Backbone
SW6-1
V-VLANIF50: 192.168.1.164/27
VRRP
DHCP
SW5-1
SW5 Backub-1
AC1-1
192.168.1.128/27
VLANIF 60: 192.168.1.129/27
Management
HR
Markting
Accounting
SW1-1
SW2-1
SW3-1
SW4-1
AP1-1
AP2-1
AP3-1
AP4-1
PC1-1
PC2-1
PC3-1
PC4-1
PC5-1
PC6-1
PC7-1
PC8-1
PC9-1
PC10-1
PC11-1
STA1-1
STA2-1
STA3-1
STA4-1
192.168.1.0/27
VLAN 10
192.168.1.32/27
VLAN 20
192.168.1.64/27
VALN 30
192.168.1.96/27
VLAN 40
V-VLANIF10: 192.168.1.3/27
V-VLANIF20: 192.168.1.35/27
V-VLANIF30: 192.168.1.67/27
V-VLANIF40: 192.168.1.99/27

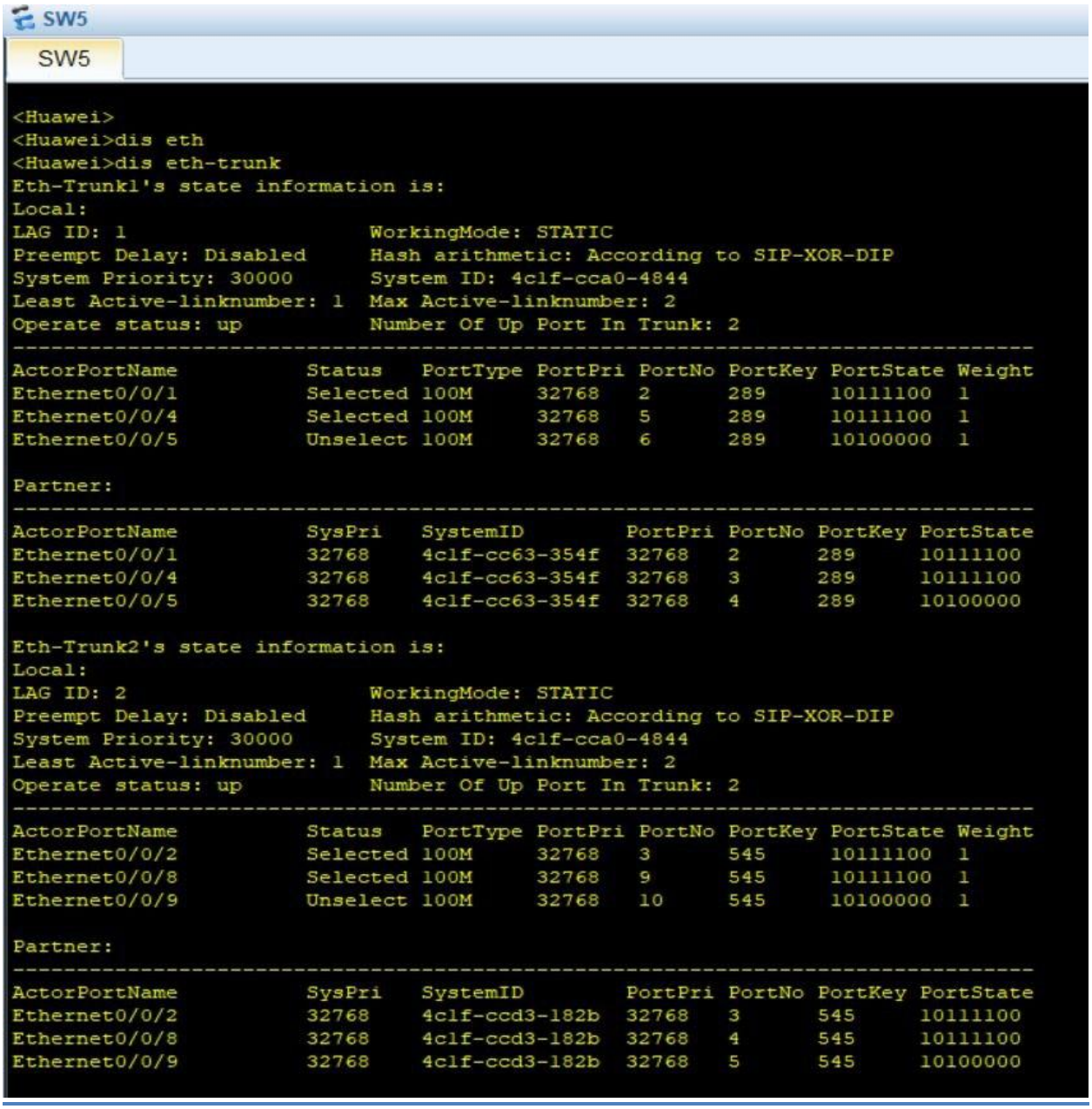
```
Vlanif40 current state : UP
Line protocol current state : UP
Last line protocol up time : 2025-11-29 19:32:24 UTC-08:00
Description:
Route Port,The Maximum Transmit Unit is 1500
Internet Address is 192.168.0.97/27
IP Sending Frames' Format is PKTFMT_ETHNT_2, Hardware address is 4c1f-cca0-4844
Current system time: 2025-11-29 19:53:06-08:00
    Input bandwidth utilization  : --
    Output bandwidth utilization : --

Vlanif50 current state : UP
Line protocol current state : UP
Last line protocol up time : 2025-11-29 19:32:24 UTC-08:00
Description:
Route Port,The Maximum Transmit Unit is 1500
Internet Address is 192.168.0.161/27
IP Sending Frames' Format is PKTFMT_ETHNT_2, Hardware address is 4c1f-cca0-4844
Current system time: 2025-11-29 19:53:08-08:00
    Input bandwidth utilization  : --
    Output bandwidth utilization : --
```

```
Vlanif10 current state : UP
Line protocol current state : UP
Last line protocol up time : 2025-11-29 19:32:24 UTC-08:00
Description:
Route Port,The Maximum Transmit Unit is 1500
Internet Address is 192.168.0.1/27
IP Sending Frames' Format is PKTFMT_ETHNT_2, Hardware address is 4c1f-cca0-4844
Current system time: 2025-11-29 19:53:02-08:00
    Input bandwidth utilization  : --
    Output bandwidth utilization : --

Vlanif20 current state : UP
Line protocol current state : UP
Last line protocol up time : 2025-11-29 19:32:24 UTC-08:00
Description:
Route Port,The Maximum Transmit Unit is 1500
Internet Address is 192.168.0.33/27
IP Sending Frames' Format is PKTFMT_ETHNT_2, Hardware address is 4c1f-cca0-4844
Current system time: 2025-11-29 19:53:02-08:00
    Input bandwidth utilization  : --
    Output bandwidth utilization : --

Vlanif30 current state : UP
Line protocol current state : UP
Last line protocol up time : 2025-11-29 19:32:24 UTC-08:00
Description:
Route Port,The Maximum Transmit Unit is 1500
Internet Address is 192.168.0.65/27
IP Sending Frames' Format is PKTFMT_ETHNT_2, Hardware address is 4c1f-cca0-4844
Current system time: 2025-11-29 19:53:06-08:00
    Input bandwidth utilization  : --
    Output bandwidth utilization : --
```

Link Aggregation(Eth-Trunk):

Link Aggregation, implemented using Eth-Trunk on Huawei devices, is a technique that combines multiple physical interfaces into a single logical link. In this project, Eth-Trunk was used to enhance both bandwidth and network reliability between the core switch and the access switches that connect to end devices in each department

OutPut



```
Eth-Trunk3's state information is:
Local:
LAG ID: 3                   WorkingMode: STATIC
Preempt Delay: Disabled     Hash arithmetic: According to SIP-XOR-DIP
System Priority: 30000      System ID: 4c1f-cca0-4844
Least Active-linknumber: 1  Max Active-linknumber: 2
Operate status: up          Number Of Up Port In Trunk: 2
--------------------------------------------------------------------------------
ActorPortName          Status   PortType PortPri PortNo PortKey PortState Weight
Ethernet0/0/3          Selected 100M     32768   4      801     10111100  1
Ethernet0/0/6          Selected 100M     32768   7      801     10111100  1
Ethernet0/0/7          Unselect 100M     32768   8      801     10100000  1

Partner:
--------------------------------------------------------------------------------
ActorPortName          SysPri   SystemID        PortPri PortNo PortKey PortState
Ethernet0/0/3          32768    4c1f-cce2-5d19  32768   2      801     10111100
Ethernet0/0/6          32768    4c1f-cce2-5d19  32768   3      801     10111100
Ethernet0/0/7          32768    4c1f-cce2-5d19  32768   4      801     10100000

Eth-Trunk4's state information is:
Local:
LAG ID: 4                   WorkingMode: STATIC
Preempt Delay: Disabled     Hash arithmetic: According to SIP-XOR-DIP
System Priority: 30000      System ID: 4c1f-cca0-4844
Least Active-linknumber: 1  Max Active-linknumber: 2
Operate status: up          Number Of Up Port In Trunk: 2
--------------------------------------------------------------------------------
ActorPortName          Status   PortType PortPri PortNo PortKey PortState Weight
Ethernet0/0/13         Selected 100M     32768   14     1057    10111100  1
Ethernet0/0/14         Selected 100M     32768   15     1057    10111100  1
Ethernet0/0/15         Unselect 100M     32768   16     1057    10100000  1

Partner:
--------------------------------------------------------------------------------
ActorPortName          SysPri   SystemID        PortPri PortNo PortKey PortState
Ethernet0/0/13         32768    4c1f-cc81-667a  32768   4      1057    10111100
Ethernet0/0/14         32768    4c1f-cc81-667a  32768   5      1057    10111100
Ethernet0/0/15         32768    4c1f-cc81-667a  32768   6      1057    10100000
```

STP(spanning-tree protocol)

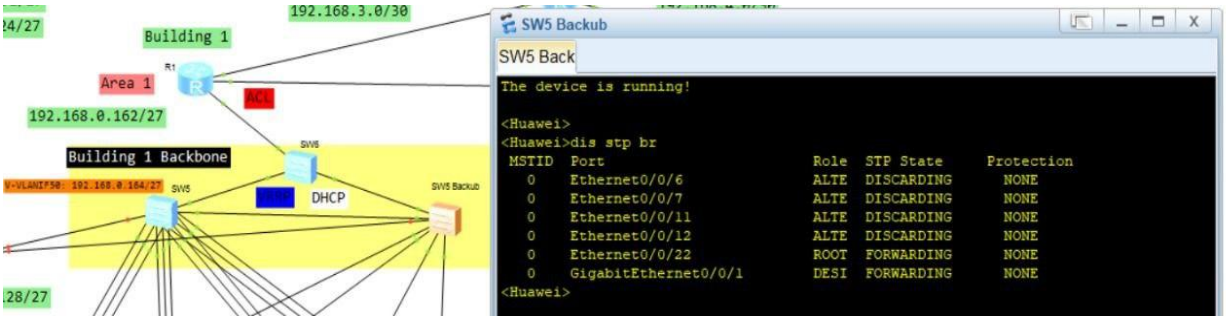
Spanning Tree Protocol (STP) is a Layer 2 protocol designed to prevent switching loops in networks that contain redundant physical paths. In this project, STP played a critical role in ensuring network stability and avoiding broadcast storms, which can occur when switches are connected using multiple links for redundancy.

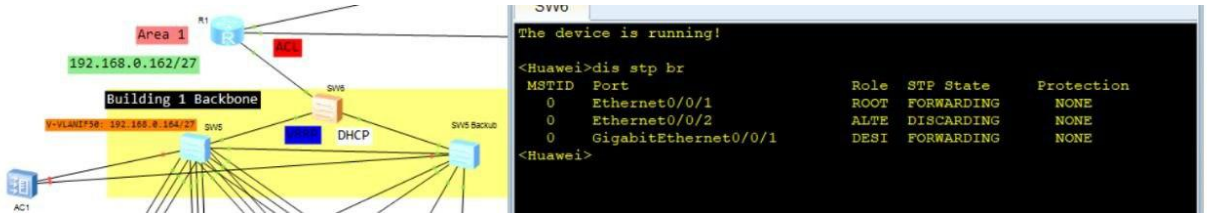
Because the network includes Core and Backup Switches, Eth-Trunk uplinks, and multiple interconnected access switches, the physical topology contains several potential loop paths. STP automatically detects these loops and places one or more redundant links into a *blocking* state, while still keeping them available as backups. This ensures that only

Within the project, STP ensured:

* Safe redundancy between core multiple inter-switch ence during link or failure

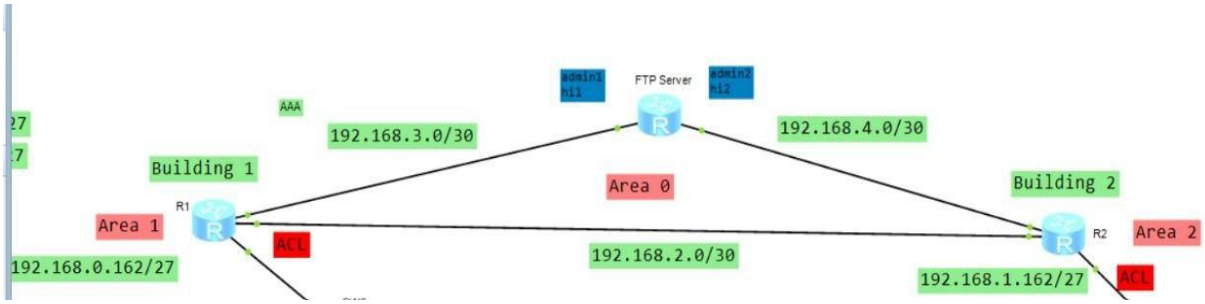
* Smooth coexistence with Eth-Trunk and VRRP failover processes.





OSPF (Open Shortest Path First):

OSPF is a link-state routing protocol used in IP networks to determine the best path for data. It divides the network into areas for efficient routing and uses the Dijkstra algorithm to calculate shortest paths. OSPF supports fast convergence, scalability, and VLSM (Variable Length Subnet Mask)

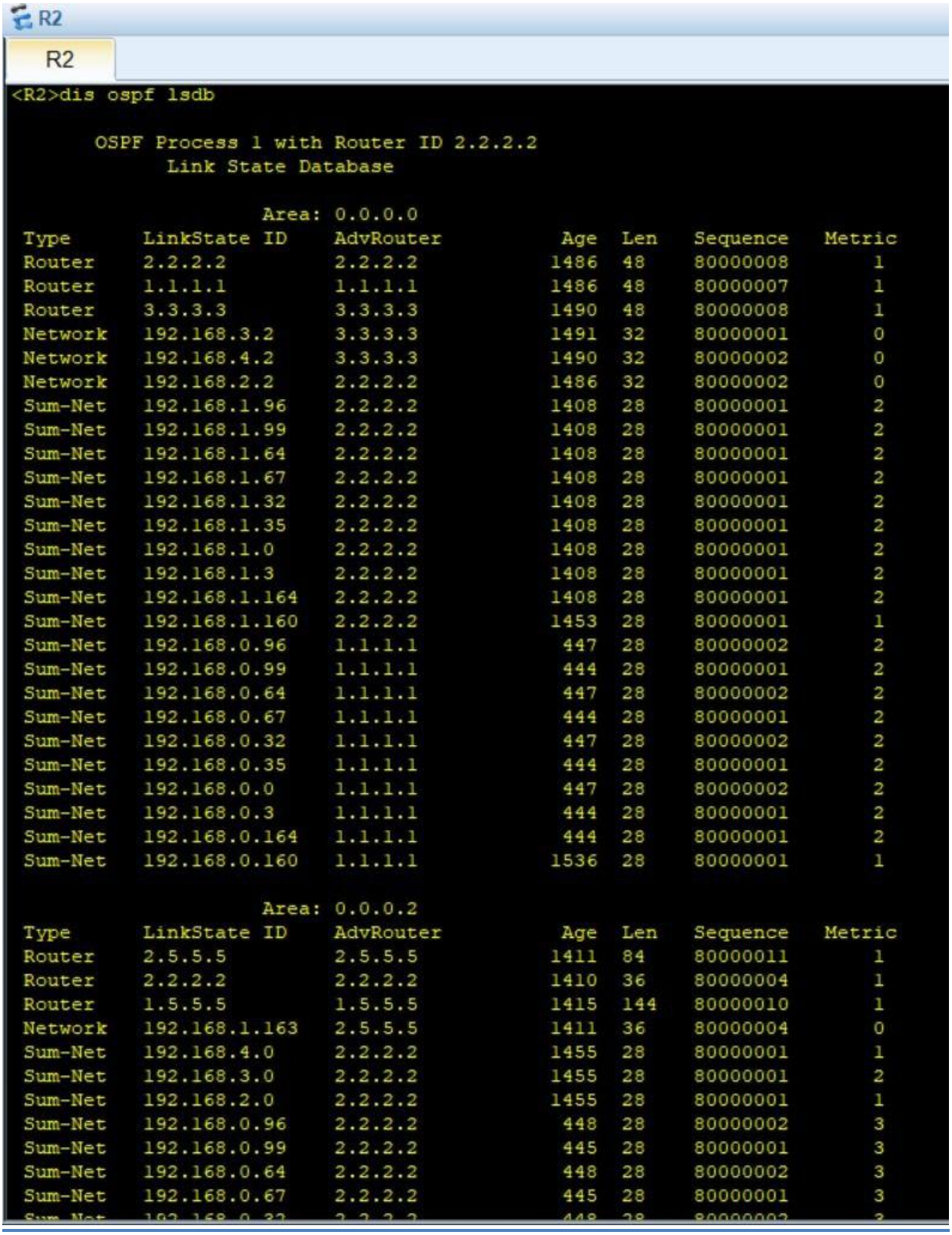


OutPut

SW5

SW5

```
    round-trip min/avg/max = 120/126/140 ms

<Huawei>
<Huawei>dis ospf lsdb

       OSPF Process 1 with Router ID 1.5.5.5
             Link State Database

                   Area: 0.0.0.1
 Type      LinkState ID    AdvRouter          Age  Len   Sequence   Metric
 Router    2.5.5.5         2.5.5.5            376  84    8000001F       1
 Router    1.5.5.5         1.5.5.5            375  144   80000010       1
 Router    1.1.1.1         1.1.1.1            377  36    8000000D       1
 Network   192.168.0.163   2.5.5.5            376  36    8000000A       0
 Sum-Net   192.168.4.0     1.1.1.1           1427  28    80000001       2
 Sum-Net   192.168.3.0     1.1.1.1           1470  28    80000001       1
 Sum-Net   192.168.2.0     1.1.1.1           1470  28    80000001       1
 Sum-Net   192.168.1.96    1.1.1.1           1345  28    80000001       3
 Sum-Net   192.168.1.99    1.1.1.1           1345  28    80000001       3
 Sum-Net   192.168.1.64    1.1.1.1           1345  28    80000001       3
 Sum-Net   192.168.1.67    1.1.1.1           1345  28    80000001       3
 Sum-Net   192.168.1.32    1.1.1.1           1345  28    80000001       3
 Sum-Net   192.168.1.35    1.1.1.1           1345  28    80000001       3
 Sum-Net   192.168.1.0     1.1.1.1           1345  28    80000001       3
 Sum-Net   192.168.1.3     1.1.1.1           1345  28    80000001       3
 Sum-Net   192.168.1.164   1.1.1.1           1345  28    80000001       3
 Sum-Net   192.168.1.160   1.1.1.1           1391  28    80000001       2


<Huawei>
```


R2
R2
<R2>dis ospf lsdb
OSPF Process 1 with Router ID 2.2.2.2
Link State Database
Area: 0.0.0.0
Type LinkState ID AdvRouter Age Len Sequence Metric
Router 2.2.2.2 2.2.2.2 1486 48 80000008 1
Router 1.1.1.1 1.1.1.1 1486 48 80000007 1
Router 3.3.3.3 3.3.3.3 1490 48 80000008 1
Network 192.168.3.2 3.3.3.3 1491 32 80000001 0
Network 192.168.4.2 3.3.3.3 1490 32 80000002 0
Network 192.168.2.2 2.2.2.2 1486 32 80000002 0
Sum-Net 192.168.1.96 2.2.2.2 1408 28 80000001 2
Sum-Net 192.168.1.99 2.2.2.2 1408 28 80000001 2
Sum-Net 192.168.1.64 2.2.2.2 1408 28 80000001 2
Sum-Net 192.168.1.67 2.2.2.2 1408 28 80000001 2
Sum-Net 192.168.1.32 2.2.2.2 1408 28 80000001 2
Sum-Net 192.168.1.35 2.2.2.2 1408 28 80000001 2
Sum-Net 192.168.1.0 2.2.2.2 1408 28 80000001 2
Sum-Net 192.168.1.3 2.2.2.2 1408 28 80000001 2
Sum-Net 192.168.1.164 2.2.2.2 1408 28 80000001 2
Sum-Net 192.168.1.160 2.2.2.2 1453 28 80000001 1
Sum-Net 192.168.0.96 1.1.1.1 447 28 80000002 2
Sum-Net 192.168.0.99 1.1.1.1 444 28 80000001 2
Sum-Net 192.168.0.64 1.1.1.1 447 28 80000002 2
Sum-Net 192.168.0.67 1.1.1.1 444 28 80000001 2
Sum-Net 192.168.0.32 1.1.1.1 447 28 80000002 2
Sum-Net 192.168.0.35 1.1.1.1 444 28 80000001 2
Sum-Net 192.168.0.0 1.1.1.1 447 28 80000002 2
Sum-Net 192.168.0.3 1.1.1.1 444 28 80000001 2
Sum-Net 192.168.0.164 1.1.1.1 444 28 80000001 2
Sum-Net 192.168.0.160 1.1.1.1 1536 28 80000001 1
Area: 0.0.0.2
Type LinkState ID AdvRouter Age Len Sequence Metric
Router 2.5.5.5 2.5.5.5 1411 84 80000011 1
Router 2.2.2.2 2.2.2.2 1410 36 80000004 1
Router 1.5.5.5 1.5.5.5 1415 144 80000010 1
Network 192.168.1.163 2.5.5.5 1411 36 80000004 0
Sum-Net 192.168.4.0 2.2.2.2 1455 28 80000001 1
Sum-Net 192.168.3.0 2.2.2.2 1455 28 80000001 2
Sum-Net 192.168.2.0 2.2.2.2 1455 28 80000001 1
Sum-Net 192.168.0.96 2.2.2.2 448 28 80000002 3
Sum-Net 192.168.0.99 2.2.2.2 445 28 80000001 3
Sum-Net 192.168.0.64 2.2.2.2 448 28 80000002 3
Sum-Net 192.168.0.67 2.2.2.2 445 28 80000001 3

FTP (File Transfer Protocol) and AAA ((Authentication, Authorization, Accounting):

*FTP is a standard network protocol used to transfer files between a client and a server over TCP/IP networks. It allows users to upload, download, and manage files on a remote system. FTP can operate in two modes:

Active mode: The server connects back to the client to establish the data transfer.

Passive mode: The client initiates both control and data connections, useful for bypassing firewalls.

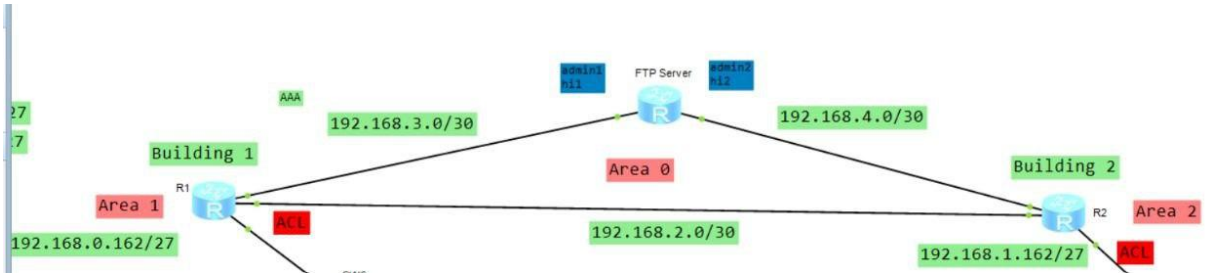
FTP can use authentication (username and password) for access control, though plain FTP is not secure; secure alternatives like FTPS or SFTP are recommended.

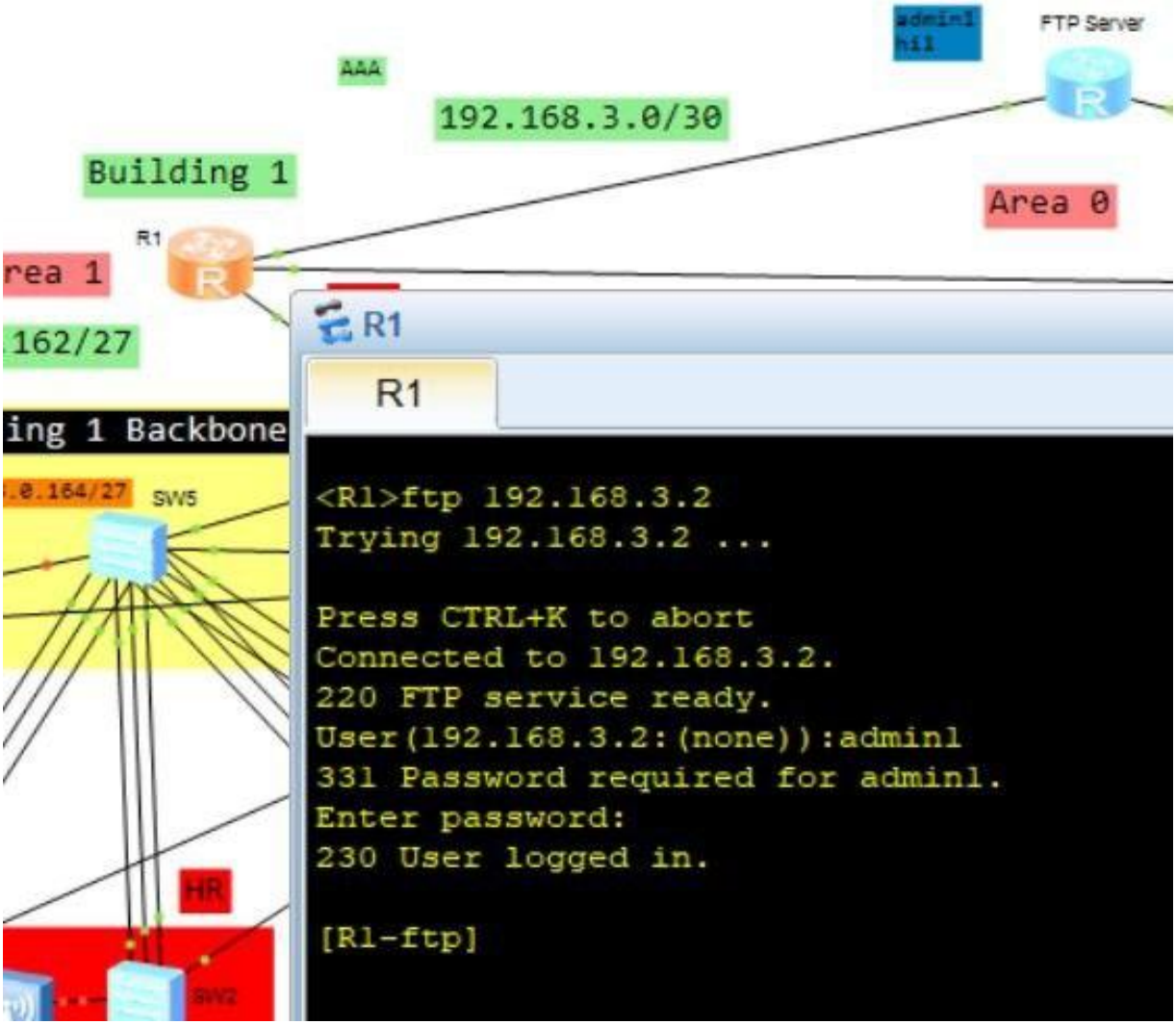
*AAA is a framework for controlling access to network devices and resources.

Authentication: Verifies user identity.

Authorization: Determines what resources or actions the user is allowed.

Accounting: Tracks user activity for auditing and reporting

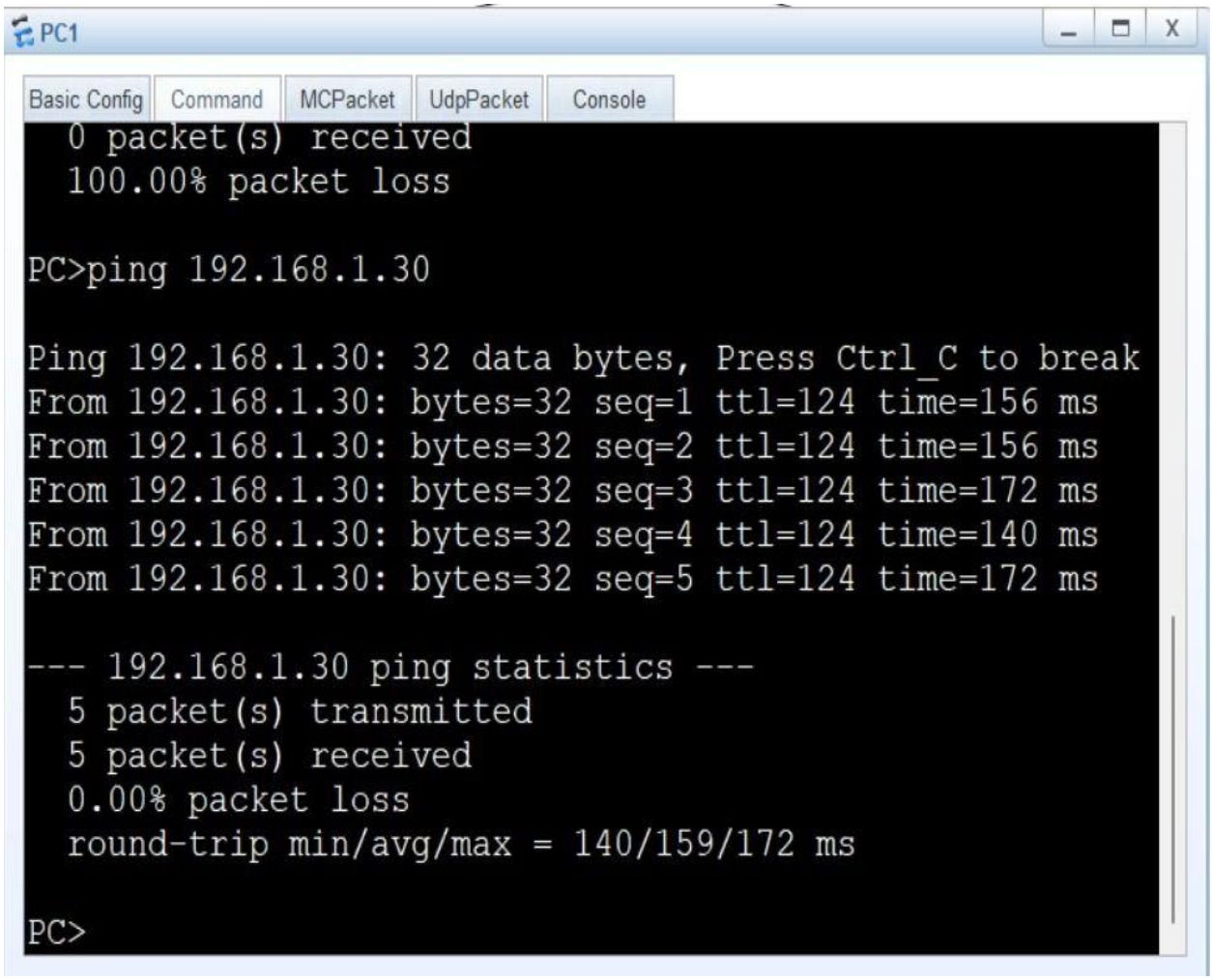



admin1
hi1
FTP Server
AAA
192.168.3.0/30
Building 1
Area 0
R1
rea 1
162/27
ing 1 Backbone
.0.164/27
SW5
HR
SW2
R1
R1
<R1>ftp 192.168.3.2
Trying 192.168.3.2 ...
Press CTRL+K to abort
Connected to 192.168.3.2.
220 FTP service ready.
User(192.168.3.2:(none)):admin1
331 Password required for admin1.
Enter password:
230 User logged in.
[R1-ftp]

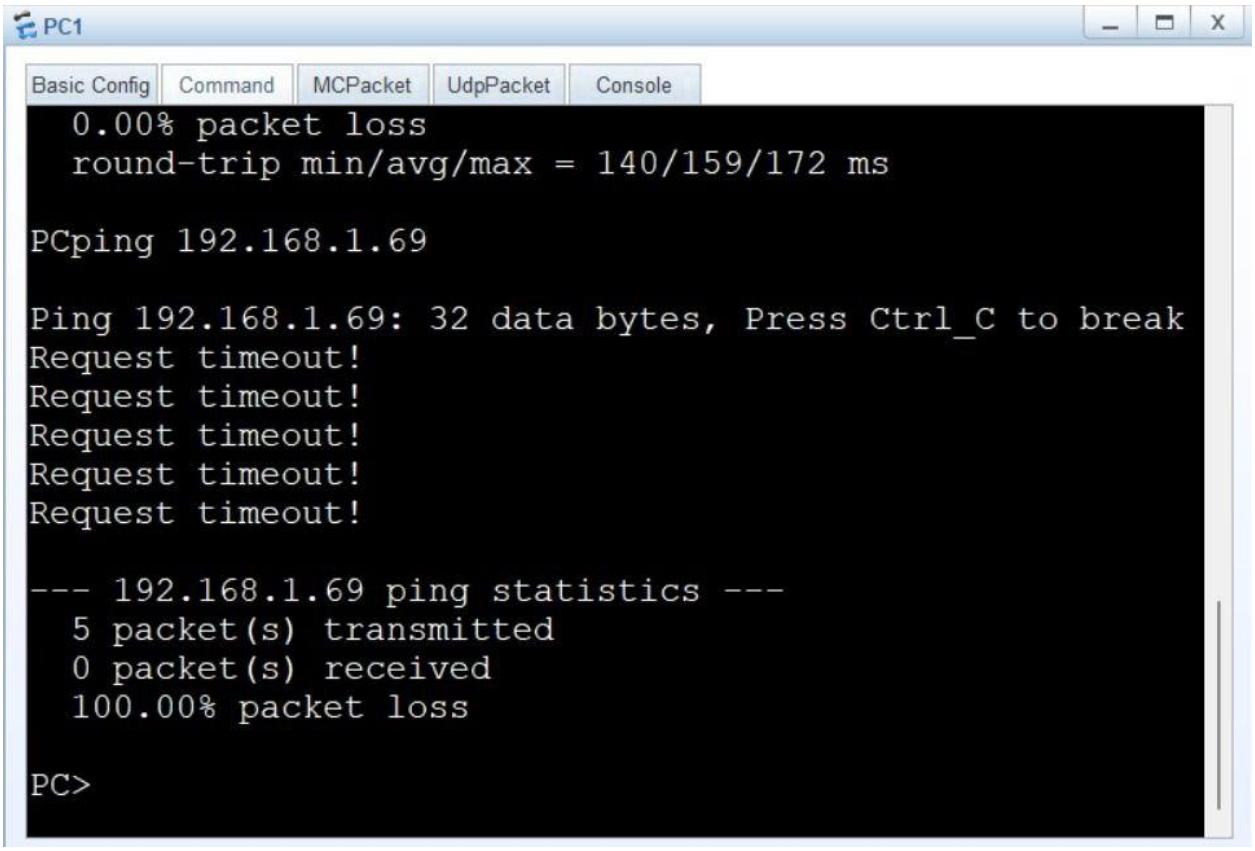
ACL (Access Control List):

An ACL is a set of rules applied to network traffic to permit or deny packets based on criteria like source/destination IP, protocol, or port. ACLs are used for security (firewall-like filtering), traffic management, and controlling network access.

OutPut



ACl: Manger ping to the other manager

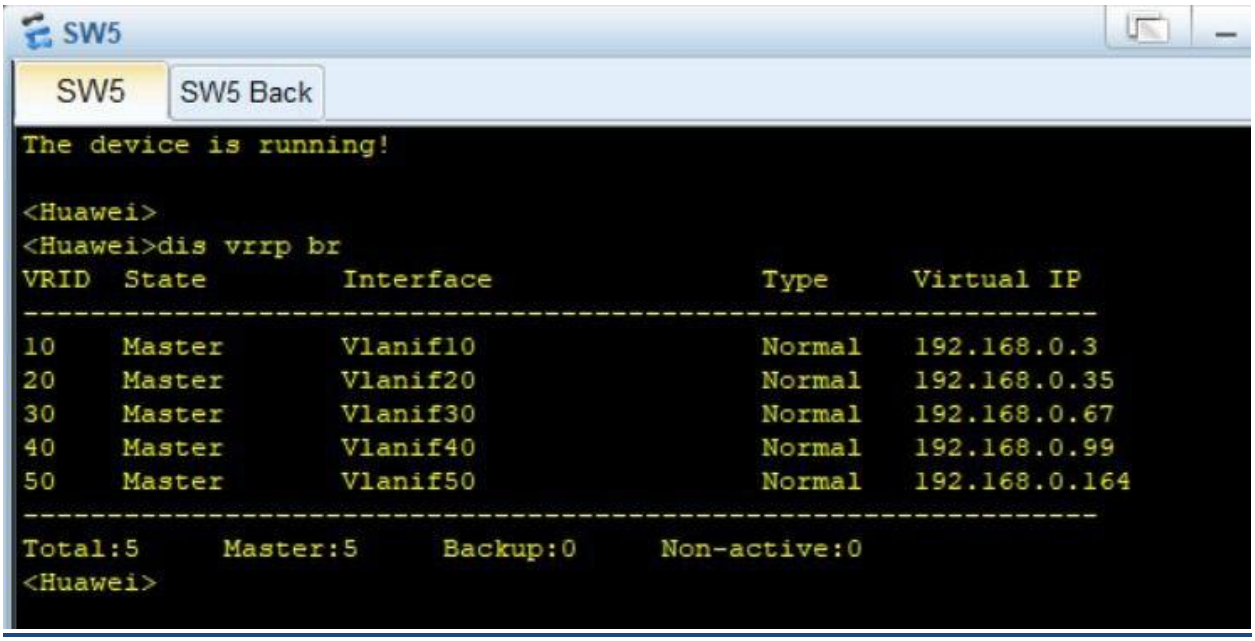


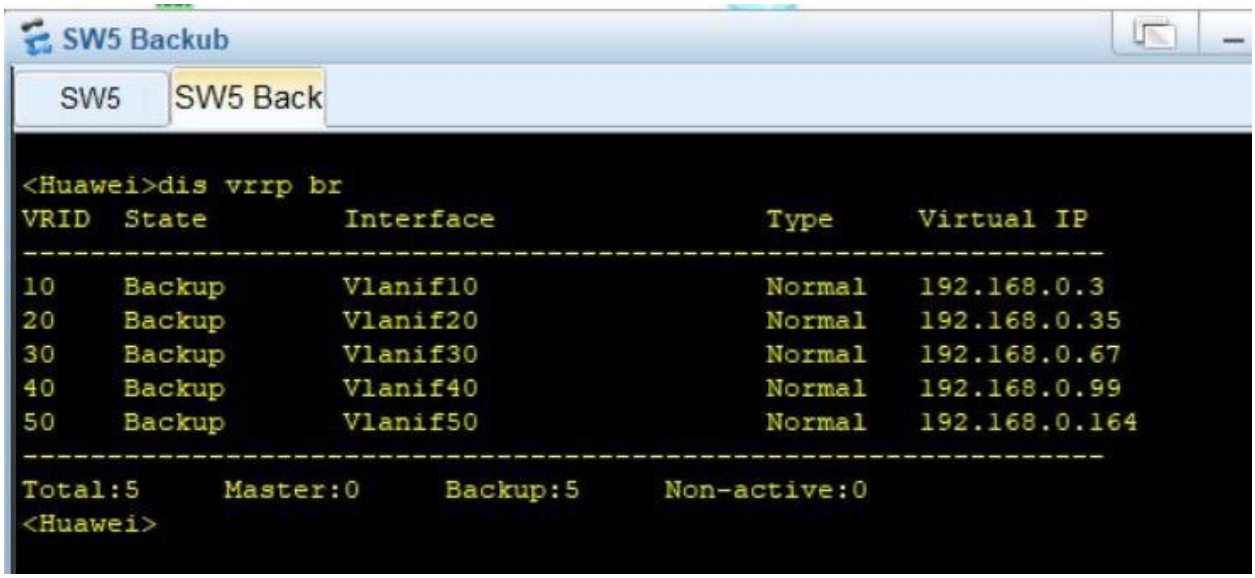
ACl: Manager ping to HR or Accounting or Marketing department

VRRP (Virtual Router Redundancy Protocol):

VRRP provides high availability by allowing multiple routers to work together, presenting a single virtual IP as the default gateway. One router is elected as the master to handle traffic, while others act as backups. If the master fails, a backup takes over automatically, ensuring minimal downtime.

.OutPut:





When the master switch fails to run..

DHCP (Dynamic Host Configuration Protocol):

DHCP is a network protocol that automatically assigns IP addresses and other network configuration parameters (like subnet mask, default gateway, and DNS servers) to devices on a network. This eliminates the need for manual IP configuration, reduces errors, and allows efficient IP address management.

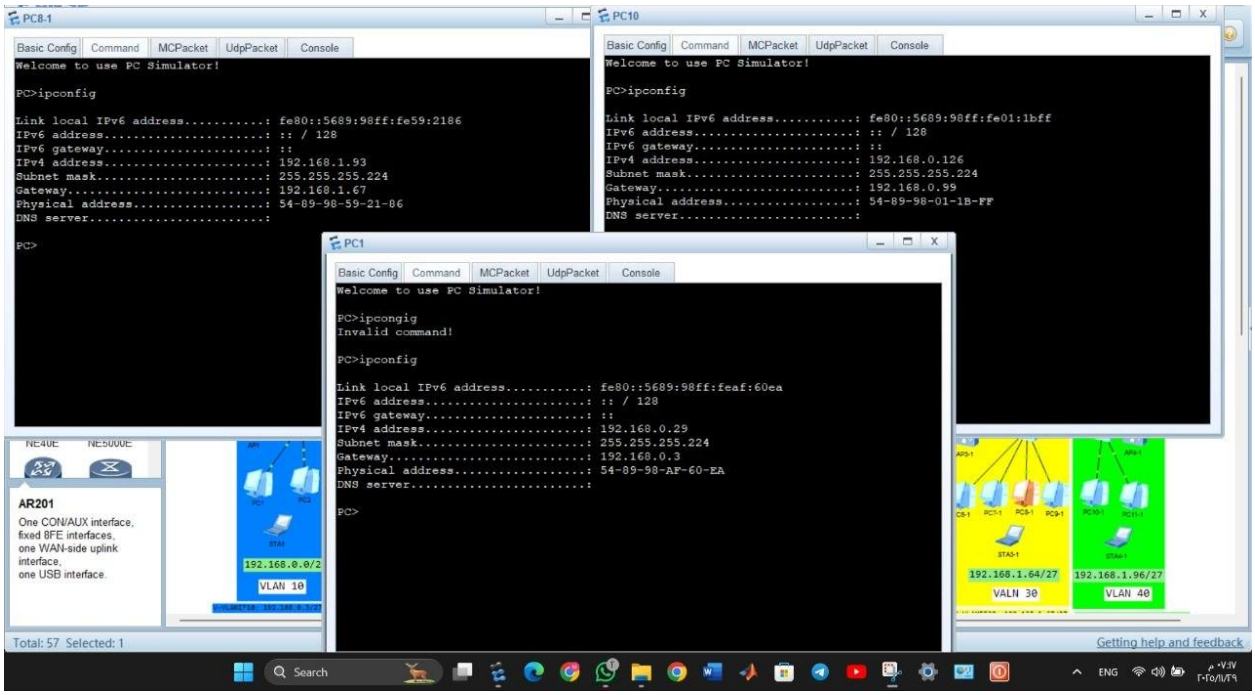
Key features:

*Dynamic allocation: Assigns temporary IP addresses from a pool

*Automatic allocation: Assigns a permanent IP to a device.

*Manual allocation: Admin assigns a fixed IP to a device but uses DHCP for other settings.

OutPut:



WLAN (Wireless Local Area Network):

WLAN is a network that allows devices to connect and communicate wirelessly within a limited area, such as an office, home, or campus. It uses Wi-Fi standards (like IEEE 802.11) to transmit data over radio waves, enabling mobility and reducing the need for physical cables. WLANs typically consist of access points (APs) that connect wireless devices to the wired network.