Huawei Network Administrator

Group Name:
R3_DEPI3_ONL3_ISS5_S2 Huawei Network Administrator

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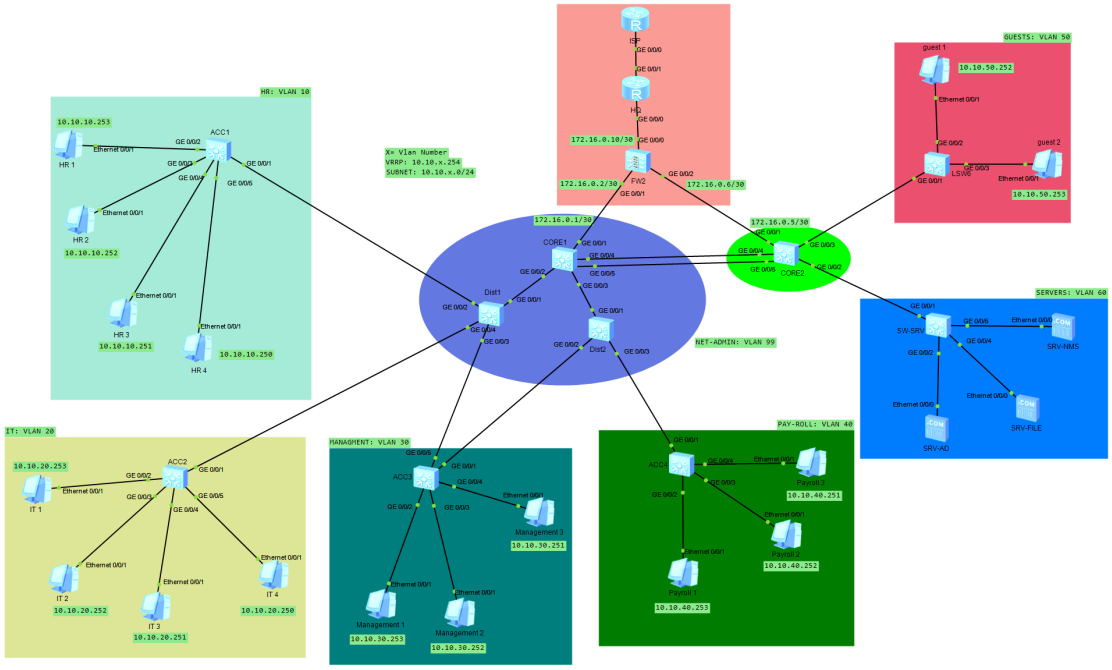
1. Network Overview & Design

1.1 Project Objective

- Multi-department enterprise network
- Segmented using VLANs
- Redundant core switches
- Central firewall
- HQ router with WAN connectivity
- Internet simulation via ISP
- OSPF dynamic routing
- VRRP gateway redundancy
- NAT for internet access

1.2 Logical & Physical Topology

- Core1 & Core2
- Distribution switches
- Departments
- FW2
- HQ
- ISP



1.3 Devices Used

- Core Switch 1: Huawei S5700
- Core Switch 2: Huawei S5700
- Firewall: Huawei USG5500
- HQ Router: AR Router
- ISP Router: AR Router
- End hosts (PCs)

2. Technologies and Configurations

VLAN	Purpose	Gateway (VRRP)	Gateway (VRRP)
10	HR	10.10.10.254	10.10.10.0/24
20	IT	10.10.20.254	10.10.20.0/24
30	Management	10.10.30.254	10.10.30.0/24
40	Pay-Roll	10.10.40.254	10.10.40.0/24
50	Guests	10.10.50.254	10.10.50.0/24
60	Servers	10.10.60.254	10.10.60.0/24
99	Inter-Core	10.10.99.0/24	-
200	Firewall	172.16.0.0/30	-

2.2 STP (Spanning Tree Protocol)

- STP enabled on access switches
- Core1 as root bridge (priority 4096)
- Core2 as secondary root (priority 8192)

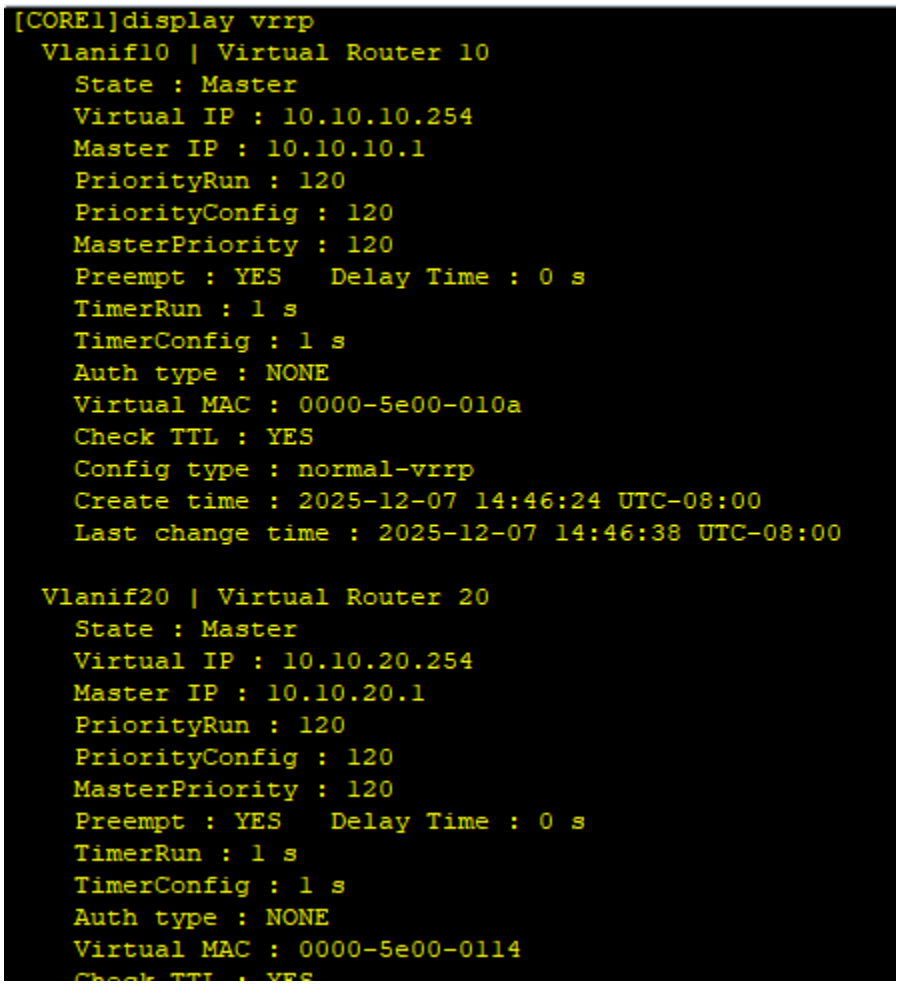
```
[CORE1]display stp
-------[CIST Global Info][Mode MSTP]-------
CIST Bridge          :4096 .4c1f-ccaa-3649
Config Times         :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
Active Times         :Hello 2s MaxAge 20s FwDly 15s MaxHop 20
CIST Root/ERPC       :4096 .4c1f-ccaa-3649 / 0
CIST RegRoot/IRPC    :4096 .4c1f-ccaa-3649 / 0
CIST RootPortId      :0.0
BPDU-Protection      :Disabled
TC or TCN received   :6
TC count per hello   :0
STP Converge Mode    :Normal
Time since last TC   :0 days 0h:2m:32s
Number of TC         :6
Last TC occurred     :GigabitEthernet0/0/3
----[Port2(GigabitEthernet0/0/1)][FORWARDING]----
 Port Protocol        :Enabled
 Port Role            :Designated Port
 Port Priority        :128
 Port Cost(Dot1T )    :Config=auto / Active=20000
 Designated Bridge/Port    :4096.4c1f-ccaa-3649 / 128.2
 Port Edged           :Config=disabled / Active=disabled
 Point-to-point       :Config=auto / Active=true
 Transit Limit        :147 packets/hello-time
 Protection Type      :None
 Port STP Mode        :MSTP
 Port Protocol Type   :Config=auto / Active=dot1s
 BPDU Encapsulation   :Config=stp / Active=stp
 PortTimes            :Hello 2s MaxAge 20s FwDly 15s RemHop 20
 TC or TCN send       :3
```

```
[CORE1]display stp brief
 MSTID  Port                        Role  STP State     Protection
   0    GigabitEthernet0/0/1        DESI  FORWARDING      NONE
   0    GigabitEthernet0/0/2        DESI  FORWARDING      NONE
   0    GigabitEthernet0/0/3        DESI  FORWARDING      NONE
   0    Eth-Trunk1                  DESI  FORWARDING      NONE
   1    GigabitEthernet0/0/1        DESI  FORWARDING      NONE
   1    GigabitEthernet0/0/2        DESI  FORWARDING      NONE
   1    GigabitEthernet0/0/3        DESI  FORWARDING      NONE
   1    Eth-Trunk1                  DESI  FORWARDING      NONE
[CORE1]
```

2.3 VRRP – Gateway Redundancy

For VLANs 10/20/30/40/50/60:

- Core1 = VRRP master (higher priority)
- Core2 = VRRP backup



2.4 OSPF (Dynamic Routing)

- OSPF area 0
- Core1 + Core2 advertise VLANs
- FW2 does *not* use OSPF to HQ (static routing instead)

```
[CORE1]display ospf peer

       OSPF Process 1 with Router ID 1.1.1.1
             Neighbors

 Area 0.0.0.0 interface 10.10.10.1(Vlanif10)'s neighbors
 Router ID: 2.2.2.2          Address: 10.10.10.2
   State: Full  Mode:Nbr is  Master  Priority: 1
   DR: 10.10.10.2  BDR: 10.10.10.1  MTU: 0
   Dead timer due in 32  sec
   Retrans timer interval: 5
   Neighbor is up for 00:46:26
   Authentication Sequence: [ 0 ]

             Neighbors

 Area 0.0.0.0 interface 10.10.20.1(Vlanif20)'s neighbors
 Router ID: 2.2.2.2          Address: 10.10.20.2
   State: Full  Mode:Nbr is  Master  Priority: 1
   DR: 10.10.20.2  BDR: 10.10.20.1  MTU: 0
   Dead timer due in 39  sec
   Retrans timer interval: 5
   Neighbor is up for 00:46:27
   Authentication Sequence: [ 0 ]

             Neighbors
```

```
[CORE1]display ospf lsdb

       OSPF Process 1 with Router ID 1.1.1.1
             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          1065  108   8000000E       1
 Router    1.1.1.1         1.1.1.1          1072  204   8000000C       1
 Network   10.10.30.2      2.2.2.2          1076  32    80000002       0
 Network   10.10.40.2      2.2.2.2          1070  32    80000003       0
 Network   10.10.60.2      2.2.2.2          1075  32    80000002       0
 Network   10.10.20.2      2.2.2.2          1077  32    80000002       0
 Network   10.10.99.2      2.2.2.2          1075  32    80000002       0
 Network   10.10.50.2      2.2.2.2          1076  32    80000002       0
 Network   10.10.10.2      2.2.2.2          1076  32    80000002       0


             AS External Database
 Type      LinkState ID    AdvRouter         Age  Len   Sequence   Metric
 External  0.0.0.0         1.1.1.1          1116  36    80000002       1
```

```
[CORE1]display ospf routing

      OSPF Process 1 with Router ID 1.1.1.1
            Routing Tables

 Routing for Network
 Destination        Cost  Type       NextHop         AdvRouter       Area
 10.10.10.0/24      1     Transit    10.10.10.1      1.1.1.1         0.0.0.0
 10.10.10.254/32    1     Stub       10.10.10.254    1.1.1.1         0.0.0.0
 10.10.20.0/24      1     Transit    10.10.20.1      1.1.1.1         0.0.0.0
 10.10.20.254/32    1     Stub       10.10.20.254    1.1.1.1         0.0.0.0
 10.10.30.0/24      1     Transit    10.10.30.1      1.1.1.1         0.0.0.0
 10.10.30.254/32    1     Stub       10.10.30.254    1.1.1.1         0.0.0.0
 10.10.40.0/24      1     Transit    10.10.40.1      1.1.1.1         0.0.0.0
 10.10.40.254/32    1     Stub       10.10.40.254    1.1.1.1         0.0.0.0
 10.10.50.0/24      1     Transit    10.10.50.1      1.1.1.1         0.0.0.0
 10.10.50.254/32    1     Stub       10.10.50.254    1.1.1.1         0.0.0.0
 10.10.60.0/24      1     Transit    10.10.60.1      1.1.1.1         0.0.0.0
 10.10.60.254/32    1     Stub       10.10.60.254    1.1.1.1         0.0.0.0
 10.10.99.0/24      1     Transit    10.10.99.1      1.1.1.1         0.0.0.0
 10.10.99.254/32    1     Stub       10.10.99.254    1.1.1.1         0.0.0.0
 172.16.0.0/30      1     Stub       172.16.0.1      1.1.1.1         0.0.0.0

 Total Nets: 15
 Intra Area: 15  Inter Area: 0  ASE: 0  NSSA: 0
```

2.5 DHCP Server (on Core1)

Configured DHCP pools for all VLANs:

- 10
- 20
- 30
- 40
- 50
- 60

```
[CORE1]display dhcp server statistics
 DHCP Server Statistics:

 Client Request          : 35
  Dhcp Discover          : 19
  Dhcp Request           : 16
  Dhcp Decline           : 0
  Dhcp Release           : 0
  Dhcp Inform            : 0
 Server Reply            : 35
  Dhcp Offer             : 19
  Dhcp Ack               : 16
  Dhcp Nak               : 0
 Bad Messages            : 0
```

2.6 Firewall (FW2)

- **Interfaces**
- **Zones**
- **Policies**
- **Static routes**
- **Management access**
- **Default route**

Interfaces

- **`GE0/0/1`→ Core1 (trust)**
  IP: `172.16.0.2/30`
- **`GE0/0/0` → HQ router (untrust)**
  IP: `172.16.1.1/30`

```
<FW2>display interface GigabitEthernet0/0/0
15:48:18  2025/12/07
GigabitEthernet0/0/0 current state : UP
Line protocol current state : UP
GigabitEthernet0/0/0 current firewall zone : untrust
Description : Huawei, SRG Series, GigabitEthernet0/0/0 Interface, Route Port
The Maximum Transmit Unit is 1500 bytes, Hold timer is 10(sec)
Internet Address is 172.16.1.1/30
IP Sending Frames' Format is PKTFMT_ETHNT_2, Hardware address is 0000-0028-ab00
QoS max-bandwidth : 1000000 Kbps
Output queue : (Urgent queue : Size/Length/Discards)  0/50/0
Output queue : (Frag queue : Size/Length/Discards)  0/1000/0
Output queue : (Protocol queue : Size/Length/Discards) 0/1000/0
Output queue : (FIFO queue : Size/Length/Discards)  0/256/0
```

```
<FW2>display interface GigabitEthernet0/0/1
15:48:39  2025/12/07
GigabitEthernet0/0/1 current state : UP
Line protocol current state : UP
GigabitEthernet0/0/1 current firewall zone : trust
Description : Huawei, SRG Series, GigabitEthernet0/0/1 Interface, Route Port
The Maximum Transmit Unit is 1500 bytes, Hold timer is 10(sec)
Internet Address is 172.16.0.2/30
IP Sending Frames' Format is PKTFMT_ETHNT_2, Hardware address is 0000-0028-ab01
QoS max-bandwidth : 1000000 Kbps
Output queue : (Urgent queue : Size/Length/Discards)  0/50/0
Output queue : (Frag queue : Size/Length/Discards)  0/1000/0
Output queue : (Protocol queue : Size/Length/Discards) 0/1000/0
Output queue : (FIFO queue : Size/Length/Discards)  0/256/0
```

```
<FW2>display interface brief
15:48:52  2025/12/07
PHY: Physical
*down: administratively down
^down: standby down
(s): spoofing
InUti/OutUti: input utility/output utility
Interface                   PHY    Protocol InUti OutUti   inErrors  outErrors
GigabitEthernet0/0/0        up     up          0%     0%          0          0
GigabitEthernet0/0/1        up     up          0%     0%          0          0
GigabitEthernet0/0/2        up     down        0%     0%          0          0
GigabitEthernet0/0/3        down   down        0%     0%          0          0
GigabitEthernet0/0/4        down   down        0%     0%          0          0
GigabitEthernet0/0/5        down   down        0%     0%          0          0
GigabitEthernet0/0/6        down   down        0%     0%          0          0
GigabitEthernet0/0/7        down   down        0%     0%          0          0
GigabitEthernet0/0/8        down   down        0%     0%          0          0
NULL0                       up     up(s)       0%     0%          0          0
```

```
<FW2>display zone
15:49:18  2025/12/07
local
 priority is 100
#
trust
 priority is 85
 interface of the zone is (2):
    GigabitEthernet0/0/1
    GigabitEthernet0/0/2
#
untrust
 priority is 5
 interface of the zone is (1):
    GigabitEthernet0/0/0
#
dmz
 priority is 50
 interface of the zone is (0):
#
```

```
<FW2>display ip routing-table
15:49:51  2025/12/07
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
      Destinations : 8  Routes : 8

Destination/Mask    Proto  Pre  Cost      Flags NextHop         Interface

        0.0.0.0/0   Static 60   0           RD  172.16.1.2      GigabitEthernet0/
0/0
      10.10.0.0/16  Static 60   0           RD  172.16.0.1      GigabitEthernet0/
0/1
      127.0.0.0/8   Direct 0    0           D   127.0.0.1       InLoopBack0
      127.0.0.1/32  Direct 0    0           D   127.0.0.1       InLoopBack0
     172.16.0.0/30  Direct 0    0           D   172.16.0.2      GigabitEthernet0/
0/1
     172.16.0.2/32  Direct 0    0           D   127.0.0.1       InLoopBack0
     172.16.1.0/30  Direct 0    0           D   172.16.1.1      GigabitEthernet0/
0/0
     172.16.1.1/32  Direct 0    0           D   127.0.0.1       InLoopBack0
```

2.7 HQ Router (WAN Edge Router)

```
<HQ-Router>display ip interface brief
*down: administratively down
^down: standby
(l): loopback
(s): spoofing
The number of interface that is UP in Physical is 3
The number of interface that is DOWN in Physical is 1
The number of interface that is UP in Protocol is 3
The number of interface that is DOWN in Protocol is 1

Interface                         IP Address/Mask      Physical   Protocol
GigabitEthernet0/0/0              172.16.1.2/30        up         up
GigabitEthernet0/0/1              203.0.113.10/30      up         up
GigabitEthernet0/0/2              unassigned           down       down
NULL0                             unassigned           up         up(s)
```

```
<HQ-Router>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 12        Routes : 12

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

        0.0.0.0/0   Static  60   0           RD   203.0.113.9     GigabitEthernet
0/0/1
      10.10.0.0/16  Static  60   0           RD   172.16.1.1      GigabitEthernet
0/0/0
      127.0.0.0/8   Direct  0    0           D    127.0.0.1       InLoopBack0
      127.0.0.1/32  Direct  0    0           D    127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D    127.0.0.1       InLoopBack0
     172.16.1.0/30  Direct  0    0           D    172.16.1.2      GigabitEthernet
0/0/0
     172.16.1.2/32  Direct  0    0           D    127.0.0.1       GigabitEthernet
0/0/0
     172.16.1.3/32  Direct  0    0           D    127.0.0.1       GigabitEthernet
0/0/0
    203.0.113.8/30  Direct  0    0           D    203.0.113.10    GigabitEthernet
0/0/1
   203.0.113.10/32  Direct  0    0           D    127.0.0.1       GigabitEthernet
0/0/1
   203.0.113.11/32  Direct  0    0           D    127.0.0.1       GigabitEthernet
0/0/1
255.255.255.255/32  Direct  0    0           D    127.0.0.1       InLoopBack0
```

```
<HQ-Router>display nat outbound
 NAT Outbound Information:
 ------------------------------------------------------------------------------
 Interface                       Acl     Address-group/IP/Interface      Type
 ------------------------------------------------------------------------------
 GigabitEthernet0/0/1          2000                    203.0.113.10    easyip
 ------------------------------------------------------------------------------
  Total : 1
```

2.8 ISP Router (Internet)

```
<ISP-Router>display ip interface brief
*down: administratively down
^down: standby
(l): loopback
(s): spoofing
The number of interface that is UP in Physical is 3
The number of interface that is DOWN in Physical is 2
The number of interface that is UP in Protocol is 3
The number of interface that is DOWN in Protocol is 2

Interface                         IP Address/Mask      Physical   Protocol
GigabitEthernet0/0/0              203.0.113.9/30       up         up
GigabitEthernet0/0/1              unassigned           down       down
GigabitEthernet0/0/2              unassigned           down       down
LoopBack0                         8.8.8.8/32           up         up(s)
NULL0                             unassigned           up         up(s)
```

```
<ISP-Router>display ip routing-table
Route Flags: R - relay, D - download to fib
------------------------------------------------------------------------------
Routing Tables: Public
         Destinations : 10       Routes : 10

Destination/Mask    Proto   Pre  Cost      Flags NextHop         Interface

        0.0.0.0/0   Static  60   0           D   0.0.0.0         NULL0
        8.8.8.8/32  Direct  0    0           D   127.0.0.1       LoopBack0
      10.10.0.0/16  Static  60   0          RD   203.0.113.10    GigabitEthernet
0/0/0
      127.0.0.0/8   Direct  0    0           D   127.0.0.1       InLoopBack0
      127.0.0.1/32  Direct  0    0           D   127.0.0.1       InLoopBack0
127.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
    203.0.113.8/30  Direct  0    0           D   203.0.113.9     GigabitEthernet
0/0/0
    203.0.113.9/32  Direct  0    0           D   127.0.0.1       GigabitEthernet
0/0/0
   203.0.113.11/32  Direct  0    0           D   127.0.0.1       GigabitEthernet
0/0/0
255.255.255.255/32  Direct  0    0           D   127.0.0.1       InLoopBack0
```

```
<ISP-Router>display ip interface LoopBack0
LoopBack0 current state : UP
Line protocol current state : UP (spoofing)
The Maximum Transmit Unit : 1500 bytes
input packets : 0, bytes : 0, multicasts : 0
output packets : 0, bytes : 0, multicasts : 0
Directed-broadcast packets:
 received packets:            0, sent packets:
 forwarded packets:           0, dropped packets:
Internet Address is 8.8.8.8/32
Broadcast address : 8.8.8.8
TTL being 1 packet number:          0
TTL invalid packet number:          0
ICMP packet input number:           0
  Echo reply:                       0
  Unreachable:                      0
  Source quench:                    0
  Routing redirect:                 0
  Echo request:                     0
  Router advert:                    0
  Router solicit:                   0
  Time exceed:                      0
  IP header bad:                    0
  Timestamp request:                0
  Timestamp reply:                  0
  Information request:              0
```

3. Testing AND Verification

3.1 Core Switch 1 (CORE1)

Test Inter-VLAN Gateway Reachability

```
<CORE1>ping 10.10.10.254
  PING 10.10.10.254: 56  data bytes, press CTRL_C to break
    Reply from 10.10.10.254: bytes=56 Sequence=1 ttl=255 time=190 ms
    Reply from 10.10.10.254: bytes=56 Sequence=2 ttl=255 time=20 ms
    Reply from 10.10.10.254: bytes=56 Sequence=3 ttl=255 time=20 ms
    Reply from 10.10.10.254: bytes=56 Sequence=4 ttl=255 time=30 ms
    Reply from 10.10.10.254: bytes=56 Sequence=5 ttl=255 time=1 ms

  --- 10.10.10.254 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 1/52/190 ms

<CORE1>ping 10.10.20.254
  PING 10.10.20.254: 56  data bytes, press CTRL_C to break
    Reply from 10.10.20.254: bytes=56 Sequence=1 ttl=255 time=10 ms
    Reply from 10.10.20.254: bytes=56 Sequence=2 ttl=255 time=1 ms
    Reply from 10.10.20.254: bytes=56 Sequence=3 ttl=255 time=10 ms
    Reply from 10.10.20.254: bytes=56 Sequence=4 ttl=255 time=1 ms
    Reply from 10.10.20.254: bytes=56 Sequence=5 ttl=255 time=20 ms

  --- 10.10.20.254 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 1/8/20 ms
```

Test Connectivity to Firewall (FW2)

```
<CORE1>ping 172.16.0.2
  PING 172.16.0.2: 56  data bytes, press CTRL_C to break
    Reply from 172.16.0.2: bytes=56 Sequence=1 ttl=255 time=80 ms
    Reply from 172.16.0.2: bytes=56 Sequence=2 ttl=255 time=60 ms
    Reply from 172.16.0.2: bytes=56 Sequence=3 ttl=255 time=110 ms
    Reply from 172.16.0.2: bytes=56 Sequence=4 ttl=255 time=60 ms
    Reply from 172.16.0.2: bytes=56 Sequence=5 ttl=255 time=100 ms

  --- 172.16.0.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 60/82/110 ms
```

3.2 Core Switch 2 (CORE2)

Test Inter-VLAN Gateway Reachability

```
<CORE2>ping 10.10.10.254
  PING 10.10.10.254: 56  data bytes, press CTRL_C to break
    Reply from 10.10.10.254: bytes=56 Sequence=1 ttl=255 time=50 ms
    Reply from 10.10.10.254: bytes=56 Sequence=2 ttl=255 time=40 ms
    Reply from 10.10.10.254: bytes=56 Sequence=3 ttl=255 time=50 ms
    Reply from 10.10.10.254: bytes=56 Sequence=4 ttl=255 time=30 ms
    Reply from 10.10.10.254: bytes=56 Sequence=5 ttl=255 time=50 ms

  --- 10.10.10.254 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 30/44/50 ms

<CORE2>ping 10.10.99.1
  PING 10.10.99.1: 56  data bytes, press CTRL_C to break
    Reply from 10.10.99.1: bytes=56 Sequence=1 ttl=255 time=50 ms
    Reply from 10.10.99.1: bytes=56 Sequence=2 ttl=255 time=30 ms
    Reply from 10.10.99.1: bytes=56 Sequence=3 ttl=255 time=10 ms
    Reply from 10.10.99.1: bytes=56 Sequence=4 ttl=255 time=10 ms
    Reply from 10.10.99.1: bytes=56 Sequence=5 ttl=255 time=50 ms

  --- 10.10.99.1 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 10/30/50 ms
```

Test Connectivity to Firewall (FW2)

```
<CORE2>ping 172.16.0.2
  PING 172.16.0.2: 56  data bytes, press CTRL_C to break
    Reply from 172.16.0.2: bytes=56 Sequence=1 ttl=254 time=110 ms
    Reply from 172.16.0.2: bytes=56 Sequence=2 ttl=254 time=60 ms
    Reply from 172.16.0.2: bytes=56 Sequence=3 ttl=254 time=60 ms
    Reply from 172.16.0.2: bytes=56 Sequence=4 ttl=254 time=80 ms
    Reply from 172.16.0.2: bytes=56 Sequence=5 ttl=254 time=90 ms

  --- 172.16.0.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 60/80/110 ms
```

3.3 Firewall (FW2)

Test Connectivity to Core & HQ

```
<FW2>ping 172.16.0.1
16:05:40  2025/12/07
  PING 172.16.0.1: 56  data bytes, press CTRL_C to break
    Reply from 172.16.0.1: bytes=56 Sequence=1 ttl=255 time=450 ms
    Reply from 172.16.0.1: bytes=56 Sequence=2 ttl=255 time=440 ms
    Reply from 172.16.0.1: bytes=56 Sequence=3 ttl=255 time=50 ms
    Reply from 172.16.0.1: bytes=56 Sequence=4 ttl=255 time=450 ms
    Reply from 172.16.0.1: bytes=56 Sequence=5 ttl=255 time=60 ms

  --- 172.16.0.1 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 50/290/450 ms

<FW2>ping 172.16.1.2
16:05:48  2025/12/07
  PING 172.16.1.2: 56  data bytes, press CTRL_C to break
    Reply from 172.16.1.2: bytes=56 Sequence=1 ttl=255 time=80 ms
    Reply from 172.16.1.2: bytes=56 Sequence=2 ttl=255 time=200 ms
    Reply from 172.16.1.2: bytes=56 Sequence=3 ttl=255 time=60 ms
    Reply from 172.16.1.2: bytes=56 Sequence=4 ttl=255 time=240 ms
    Reply from 172.16.1.2: bytes=56 Sequence=5 ttl=255 time=110 ms

  --- 172.16.1.2 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 60/138/240 ms
```

Test Inter-VLAN Gateway Reachability

```
<FW2>ping 10.10.10.254
16:06:19  2025/12/07
  PING 10.10.10.254: 56  data bytes, press CTRL_C to break
    Reply from 10.10.10.254: bytes=56 Sequence=1 ttl=255 time=80 ms
    Reply from 10.10.10.254: bytes=56 Sequence=2 ttl=255 time=120 ms
    Reply from 10.10.10.254: bytes=56 Sequence=3 ttl=255 time=80 ms
    Reply from 10.10.10.254: bytes=56 Sequence=4 ttl=255 time=100 ms
    Reply from 10.10.10.254: bytes=56 Sequence=5 ttl=255 time=60 ms

  --- 10.10.10.254 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 60/88/120 ms

<FW2>ping 10.10.60.254
16:06:24  2025/12/07
  PING 10.10.60.254: 56  data bytes, press CTRL_C to break
    Reply from 10.10.60.254: bytes=56 Sequence=1 ttl=255 time=110 ms
    Reply from 10.10.60.254: bytes=56 Sequence=2 ttl=255 time=60 ms
    Reply from 10.10.60.254: bytes=56 Sequence=3 ttl=255 time=100 ms
    Reply from 10.10.60.254: bytes=56 Sequence=4 ttl=255 time=80 ms
    Reply from 10.10.60.254: bytes=56 Sequence=5 ttl=255 time=110 ms

  --- 10.10.60.254 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 60/92/110 ms
```

3.4 HQ Router

Test Connectivity to FW2

```
<HQ-Router>ping 172.16.1.1
  PING 172.16.1.1: 56  data bytes, press CTRL_C to break
    Reply from 172.16.1.1: bytes=56 Sequence=1 ttl=255 time=180 ms
    Reply from 172.16.1.1: bytes=56 Sequence=2 ttl=255 time=40 ms
    Reply from 172.16.1.1: bytes=56 Sequence=3 ttl=255 time=170 ms
    Reply from 172.16.1.1: bytes=56 Sequence=4 ttl=255 time=50 ms
    Reply from 172.16.1.1: bytes=56 Sequence=5 ttl=255 time=100 ms

  --- 172.16.1.1 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 40/108/180 ms
```

Test Connectivity to ISP

```
<HQ-Router>ping 203.0.113.9
  PING 203.0.113.9: 56  data bytes, press CTRL_C to break
    Reply from 203.0.113.9: bytes=56 Sequence=1 ttl=255 time=40 ms
    Reply from 203.0.113.9: bytes=56 Sequence=2 ttl=255 time=20 ms
    Reply from 203.0.113.9: bytes=56 Sequence=3 ttl=255 time=30 ms
    Reply from 203.0.113.9: bytes=56 Sequence=4 ttl=255 time=20 ms
    Reply from 203.0.113.9: bytes=56 Sequence=5 ttl=255 time=30 ms

  --- 203.0.113.9 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 20/28/40 ms
```

Test LAN Reachability

```
<HQ-Router>ping 10.10.20.254
  PING 10.10.20.254: 56  data bytes, press CTRL_C to break
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out

  --- 10.10.20.254 ping statistics ---
    5 packet(s) transmitted
    0 packet(s) received
    100.00% packet loss

<HQ-Router>ping 10.10.10.254
  PING 10.10.10.254: 56  data bytes, press CTRL_C to break
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out

  --- 10.10.10.254 ping statistics ---
    5 packet(s) transmitted
    0 packet(s) received
    100.00% packet loss
```

Successfully failed to ping inner devices which is a good sign of safety and means that the firewall works

3.5 ISP Router

Test Connectivity to HQ

```
<ISP-Router>ping 203.0.113.10
  PING 203.0.113.10: 56  data bytes, press CTRL_C to break
    Reply from 203.0.113.10: bytes=56 Sequence=1 ttl=255 time=40 ms
    Reply from 203.0.113.10: bytes=56 Sequence=2 ttl=255 time=20 ms
    Reply from 203.0.113.10: bytes=56 Sequence=3 ttl=255 time=40 ms
    Reply from 203.0.113.10: bytes=56 Sequence=4 ttl=255 time=10 ms
    Reply from 203.0.113.10: bytes=56 Sequence=5 ttl=255 time=20 ms

  --- 203.0.113.10 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 10/26/40 ms
```

Test LAN Reachability

```
<ISP-Router>ping 10.10.10.254
  PING 10.10.10.254: 56  data bytes, press CTRL_C to break
    Request time out
    Request time out
    Request time out
    Request time out
    Request time out

  --- 10.10.10.254 ping statistics ---
    5 packet(s) transmitted
    0 packet(s) received
    100.00% packet loss
```

Internet Simulation

```
<ISP-Router>ping 8.8.8.8
  PING 8.8.8.8: 56  data bytes, press CTRL_C to break
    Reply from 8.8.8.8: bytes=56 Sequence=1 ttl=255 time=1 ms
    Reply from 8.8.8.8: bytes=56 Sequence=2 ttl=255 time=1 ms
    Reply from 8.8.8.8: bytes=56 Sequence=3 ttl=255 time=1 ms
    Reply from 8.8.8.8: bytes=56 Sequence=4 ttl=255 time=1 ms
    Reply from 8.8.8.8: bytes=56 Sequence=5 ttl=255 time=1 ms

  --- 8.8.8.8 ping statistics ---
    5 packet(s) transmitted
    5 packet(s) received
    0.00% packet loss
    round-trip min/avg/max = 1/1/1 ms
```

3.6 PC

Testing: From Vlan 10 → 60 / 30 → 50 / 20 → 40

10 → 60 & Internet

```
Ping 10.10.60.10: 32 data bytes, Press Ctrl_C to break
From 10.10.60.10: bytes=32 seq=1 ttl=254 time=235 ms
From 10.10.60.10: bytes=32 seq=2 ttl=254 time=93 ms
From 10.10.60.10: bytes=32 seq=3 ttl=254 time=125 ms
From 10.10.60.10: bytes=32 seq=4 ttl=254 time=94 ms
From 10.10.60.10: bytes=32 seq=5 ttl=254 time=110 ms

--- 10.10.60.10 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 93/131/235 ms

PC>ping 8.8.8.8

Ping 8.8.8.8: 32 data bytes, Press Ctrl_C to break
From 8.8.8.8: bytes=32 seq=1 ttl=252 time=94 ms
From 8.8.8.8: bytes=32 seq=2 ttl=252 time=109 ms
From 8.8.8.8: bytes=32 seq=3 ttl=252 time=94 ms
From 8.8.8.8: bytes=32 seq=4 ttl=252 time=94 ms
From 8.8.8.8: bytes=32 seq=5 ttl=252 time=109 ms

--- 8.8.8.8 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 94/100/109 ms
```

30 → 50 & Internet

```
PC>ping 10.10.50.252

Ping 10.10.50.252: 32 data bytes, Press Ctrl_C to break
From 10.10.50.252: bytes=32 seq=1 ttl=127 time=141 ms
From 10.10.50.252: bytes=32 seq=2 ttl=127 time=140 ms
From 10.10.50.252: bytes=32 seq=3 ttl=127 time=125 ms
From 10.10.50.252: bytes=32 seq=4 ttl=127 time=125 ms
From 10.10.50.252: bytes=32 seq=5 ttl=127 time=141 ms

--- 10.10.50.252 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 125/134/141 ms

PC>ping 8.8.8.8

Ping 8.8.8.8: 32 data bytes, Press Ctrl_C to break
From 8.8.8.8: bytes=32 seq=1 ttl=252 time=109 ms
From 8.8.8.8: bytes=32 seq=2 ttl=252 time=125 ms
From 8.8.8.8: bytes=32 seq=3 ttl=252 time=94 ms
From 8.8.8.8: bytes=32 seq=4 ttl=252 time=109 ms
From 8.8.8.8: bytes=32 seq=5 ttl=252 time=94 ms

--- 8.8.8.8 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 94/106/125 ms
```

20 → 40 & Internet

```
PC>ping 10.10.40.253

Ping 10.10.40.253: 32 data bytes, Press Ctrl_C to break
From 10.10.40.253: bytes=32 seq=1 ttl=127 time=125 ms
From 10.10.40.253: bytes=32 seq=2 ttl=127 time=110 ms
From 10.10.40.253: bytes=32 seq=3 ttl=127 time=125 ms
From 10.10.40.253: bytes=32 seq=4 ttl=127 time=125 ms
From 10.10.40.253: bytes=32 seq=5 ttl=127 time=109 ms

--- 10.10.40.253 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 109/118/125 ms

PC>ping 8.8.8.8

Ping 8.8.8.8: 32 data bytes, Press Ctrl_C to break
From 8.8.8.8: bytes=32 seq=1 ttl=252 time=94 ms
From 8.8.8.8: bytes=32 seq=2 ttl=252 time=125 ms
From 8.8.8.8: bytes=32 seq=3 ttl=252 time=109 ms
From 8.8.8.8: bytes=32 seq=4 ttl=252 time=93 ms
From 8.8.8.8: bytes=32 seq=5 ttl=252 time=94 ms

--- 8.8.8.8 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 93/103/125 ms
```

Test Default Gateway

```
PC>ping 10.10.10.254

Ping 10.10.10.254: 32 data bytes, Press Ctrl_C to break
From 10.10.10.254: bytes=32 seq=1 ttl=255 time=63 ms
From 10.10.10.254: bytes=32 seq=2 ttl=255 time=62 ms
From 10.10.10.254: bytes=32 seq=3 ttl=255 time=63 ms
From 10.10.10.254: bytes=32 seq=4 ttl=255 time=46 ms
From 10.10.10.254: bytes=32 seq=5 ttl=255 time=63 ms

--- 10.10.10.254 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 46/59/63 ms
```

Test Firewall Connectivity

```
PC>ping 172.16.0.2

Ping 172.16.0.2: 32 data bytes, Press Ctrl_C to break
From 172.16.0.2: bytes=32 seq=1 ttl=254 time=344 ms
From 172.16.0.2: bytes=32 seq=2 ttl=254 time=78 ms
From 172.16.0.2: bytes=32 seq=3 ttl=254 time=93 ms
From 172.16.0.2: bytes=32 seq=4 ttl=254 time=110 ms
From 172.16.0.2: bytes=32 seq=5 ttl=254 time=328 ms

--- 172.16.0.2 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 78/190/344 ms
```

Test HQ Router Connectivity

```
PC>ping 172.16.1.2

Ping 172.16.1.2: 32 data bytes, Press Ctrl_C to break
From 172.16.1.2: bytes=32 seq=1 ttl=253 time=125 ms
From 172.16.1.2: bytes=32 seq=2 ttl=253 time=94 ms
From 172.16.1.2: bytes=32 seq=3 ttl=253 time=109 ms
From 172.16.1.2: bytes=32 seq=4 ttl=253 time=109 ms
From 172.16.1.2: bytes=32 seq=5 ttl=253 time=79 ms

--- 172.16.1.2 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 79/103/125 ms
```

Test ISP Connectivity

```
PC>ping 203.0.113.9

Ping 203.0.113.9: 32 data bytes, Press Ctrl_C to break
From 203.0.113.9: bytes=32 seq=1 ttl=252 time=110 ms
From 203.0.113.9: bytes=32 seq=2 ttl=252 time=109 ms
From 203.0.113.9: bytes=32 seq=3 ttl=252 time=78 ms
From 203.0.113.9: bytes=32 seq=4 ttl=252 time=109 ms
From 203.0.113.9: bytes=32 seq=5 ttl=252 time=94 ms

--- 203.0.113.9 ping statistics ---
  5 packet(s) transmitted
  5 packet(s) received
  0.00% packet loss
  round-trip min/avg/max = 78/100/110 ms
```

4. Global IP Addressing Plan

Device	Interface	IP Address	Subnet	Purpose
ISP Router	G0/0/0	203.0.113.9	/30	Link to HQ

ISP Router	Loopback0	8.8.8.8	/32	Simulated Internet
HQ Router	G0/0/1	203.0.113.10	/30	Link to ISP
HQ Router	G0/0/0	172.16.1.2	/30	Link to FW2
FW2	GE0/0/0	172.16.1.1	/30	Link to HQ
FW2	GE0/0/1	172.16.1.2	/30	Link to Core1

Routed VLAN Interfaces (Core1)

VLAN	Vlanif IP	Subnet	Role
10	10.10.10.1	/24	VRRP member
20	10.10.20.1	/24	VRRP member
30	10.10.30.1	/24	VRRP member
40	10.10.40.1	/24	VRRP member
50	10.10.50.1	/24	VRRP member
60	10.10.60.1	/24	Services/Servers
99	10.10.99.1	/24	Inter-core link
200	172.16.0.1	/30	To FW2

VRRP Virtual Gateways (shared across Core1 & Core2)

VLAN	Virtual Gateway
10	10.10.10.254

20	10.10.20.254
30	10.10.30.254
40	10.10.40.254
50	10.10.50.254
60	10.10.60.254

COMPLETE IP TABLE

Device	Interface	IP Address	Subnet	Purpose
ISP Router	G0/0/0	203.0.113.9	/30	To HQ
ISP	Loopback0	8.8.8.8	/32	Internet
HQ Router	G0/0/1	203.0.113.10	/30	To ISP
HQ	G0/0/0	172.16.1.2	/30	To FW2
FW2 (Firewall)	GE0/0/0	172.16.1.1	/30	To HQ

FW2	**GE0/0/2**	**172.16.0.2**	**/30**	**To Core1**
Core1	**Vlan200**	**172.16.0.1**	**/30**	**To FW2**
Core1	**Vlan99**	**10.10.99.1**	**/24**	**Inter-core**
Core1	**Vlan10**	**10.10.10.1**	**/24**	**HR**
Core1	**Vlan20**	**10.10.20.1**	**/24**	**Sales**
Core1	**Vlan30**	**10.10.30.1**	**/24**	**R&D**
Core1	**Vlan40**	**10.10.40.1**	**/24**	**Finance**
Core1	**Vlan50**	**10.10.50.1**	**/24**	**Management**
Core1	**Vlan60**	**10.10.60.1**	**/24**	**Services**
Core2	**Vlan99**	**10.10.99.2**	**/24**	**Inter-core**
Core2	**Vlan10**	**10.10.10.2**	**/24**	**HR**
Core2	**Vlan20**	**10.10.20.2**	**/24**	**Sales**
Core2	**Vlan30**	**10.10.30.2**	**/24**	**R&D**

Core2	**Vlan40**	**10.10.40.2**	**/24**	**Finance**
Core2	**Vlan50**	**10.10.50.2**	**/24**	**Management**
Core2	**Vlan60**	**10.10.60.2**	**/24**	**Services**
PC (VLAN10)	**NIC**	**10.10.10.253~250**	**/24**	**DHCP**
PC (VLAN20)	**NIC**	**10.10.20.253~250**	**/24**	**DHCP**
PC (VLAN30)	**NIC**	**10.10.30.250~251**	**/24**	**DHCP**
PC (VLAN40)	**NIC**	**10.10.40.253~251**	**/24**	**DHCP**
PC (VLAN50)	**NIC**	**10.10.50.253-252**	**/24**	**DHCP**