Lab Network Architecture

Lab ini bertujuan untuk menciptakan konektivitas yang handal dengan menerapkan solusi High Availability (HA) pada jaringan yang terdiri dari perangkat Fortigate, Cisco, dan Mikrotik. Dalam lab ini, dilakukan berbagai pengujian dan konfigurasi untuk memastikan bahwa koneksi internet tetap dapat terjaga meskipun beberapa perangkat seperti *Firewall, Switch, atau Router* mengalami gangguan atau mati.

Metode yang digunakan dalam lab ini :

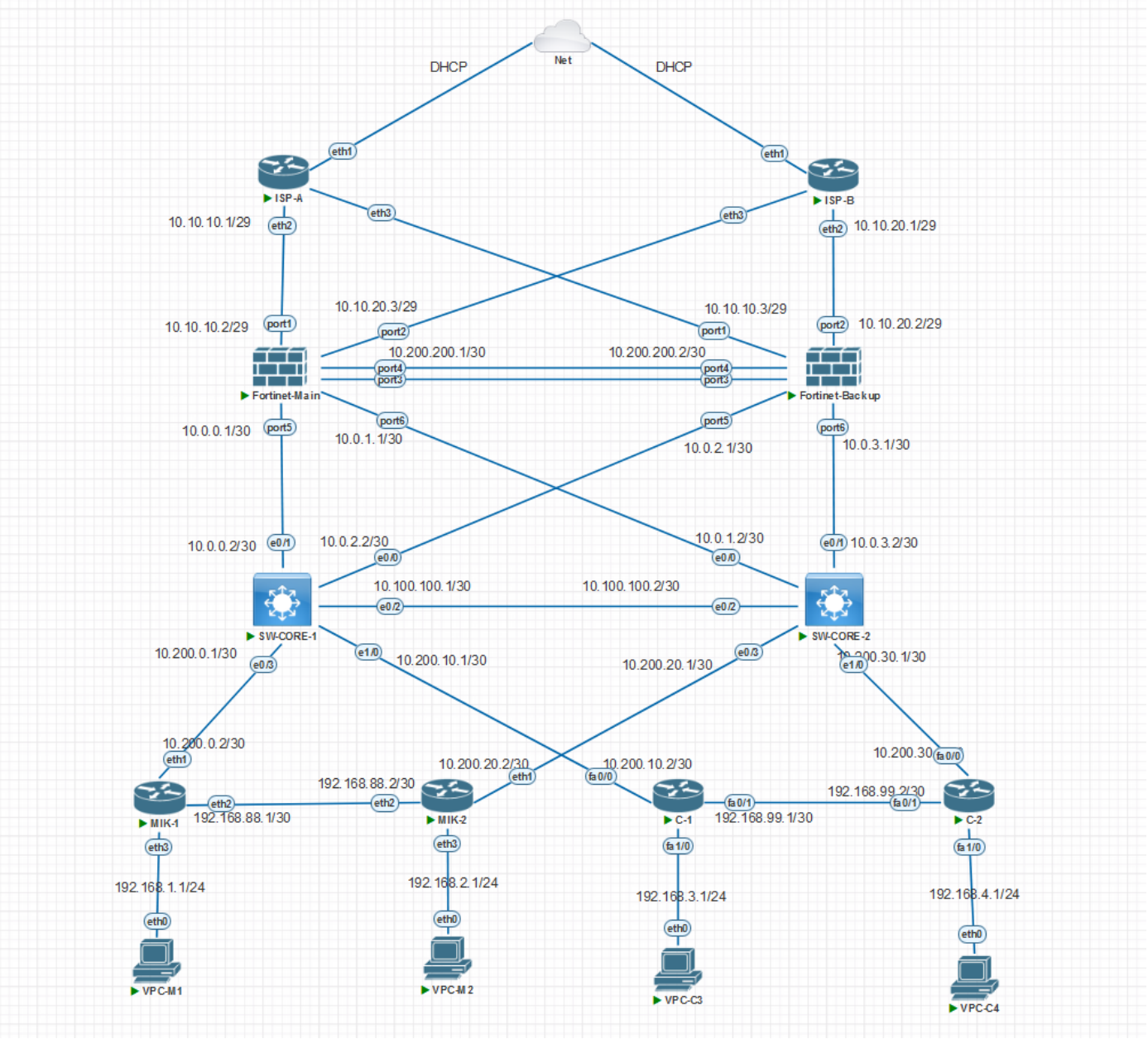
· *Routing Static: Digunakan untuk konfigurasi rute manual dan memastikan alur lalu lintas dapat diarahkan secara jelas ke tujuan meskipun ada perangkat yang down.*

· *Routing Dynamic OSPF: Menggunakan protokol OSPF untuk mendeteksi dan beradaptasi dengan perubahan topologi jaringan secara otomatis, memberikan redundansi dan pemulihan jalur secara dinamis.*

· *Link Aggregation (Etherchannel): Menggabungkan beberapa link fisik menjadi satu channel logis untuk meningkatkan bandwidth dan ketersediaan koneksi antar perangkat.*

Dengan implementasi metode-metode tersebut, lab ini berhasil menunjukkan cara memastikan jaringan tetap berjalan meskipun ada perangkat yang mengalami down, menjaga konektivitas pengguna ke internet tanpa gangguan

Topology Network Architecture



Keterangan

No	**Nama Devices**	**Manufacture**
1	ISP-A	MikroTik
2	ISP-B	MikroTik
3	FW-Main	FortiGate
4	FW-Backup	FortiGate
5	Mik-1	MikroTik

6	Mik-2	MikroTik
7	SW-Core-1	Cisco
8	SW-Core-2	Cisco
9	C-1	Cisco
10	C-2	Cisco

Konfigruasi

ISP-A

```
/interface bridge
add name=bridge1-forti
/interface bridge port
add bridge=bridge1-forti interface=ether2
add bridge=bridge1-forti interface=ether3
add bridge=bridge1-forti interface=ether4
/ip address
add address=10.10.10.1/29 interface=bridge1-forti network=10.10.10.0
/ip dhcp-client
add disabled=no interface=ether1
/ip dns
set allow-remote-requests=yes servers=8.8.8.8
/ip firewall nat
add action=masquerade chain=srcnat out-interface=ether1
/system identity
set name=ISP-A
```

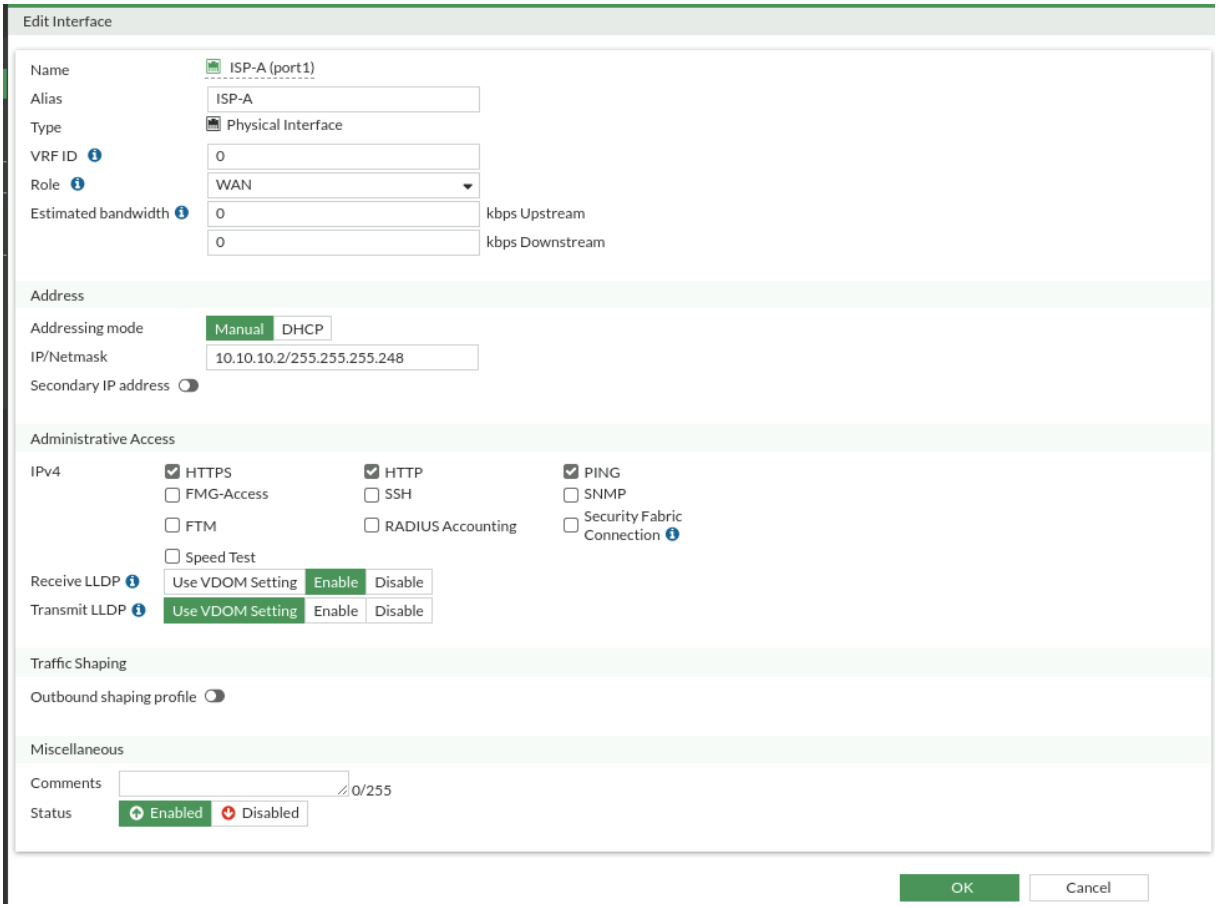
ISP-B

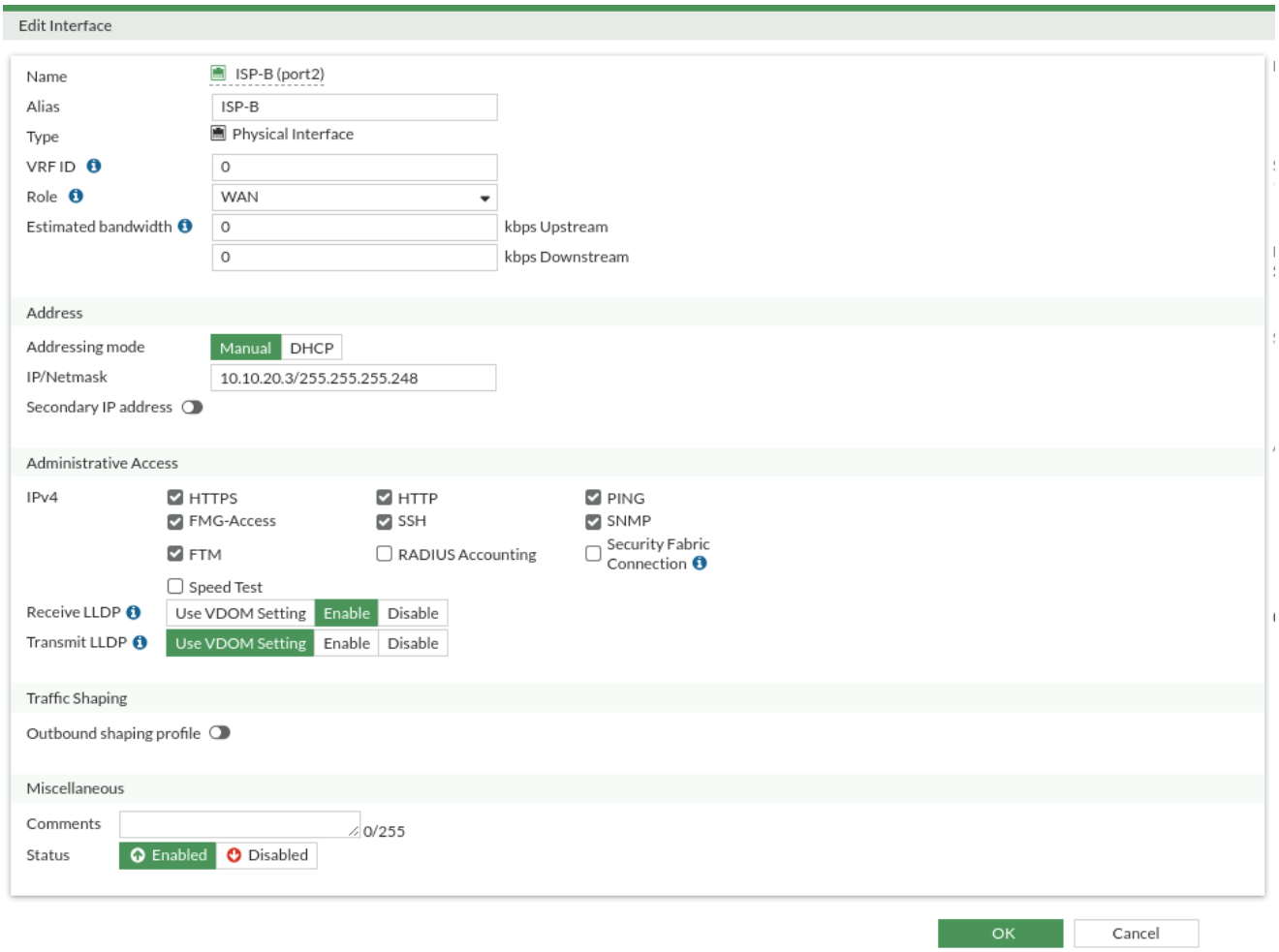
```
/interface bridge
add name=bridge1-forti
/interface bridge port
add bridge=bridge1-forti interface=ether2
add bridge=bridge1-forti interface=ether3
add bridge=bridge1-forti interface=ether4
/ip address
add address=10.10.20.1/29 interface=bridge1-forti network=10.10.20.0
/ip dhcp-client
add disabled=no interface=ether1
```

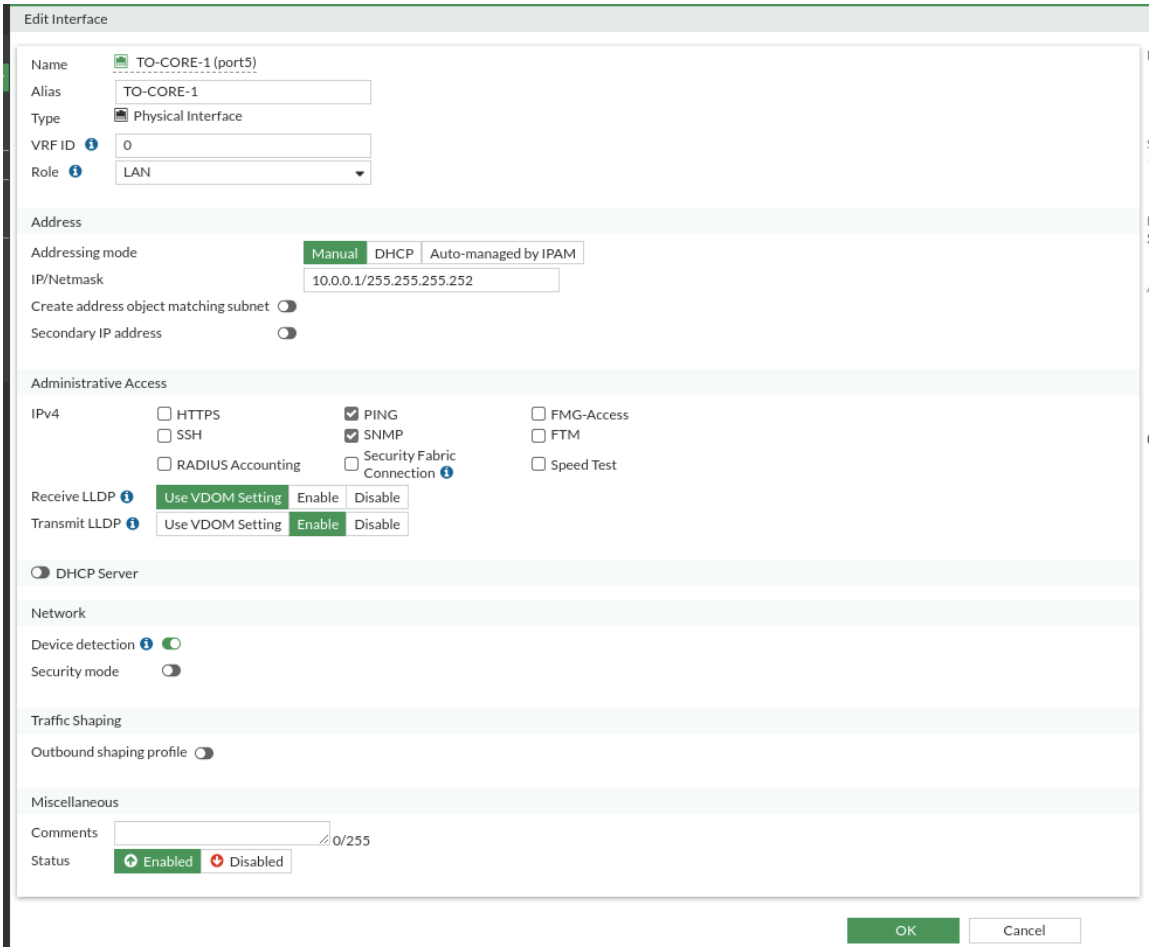
/ip dns
set allow-remote-requests=yes servers=8.8.8.8
/ip firewall nat
add action=masquerade chain=srcnat out-interface=ether1
/system identity
set name=ISB-B

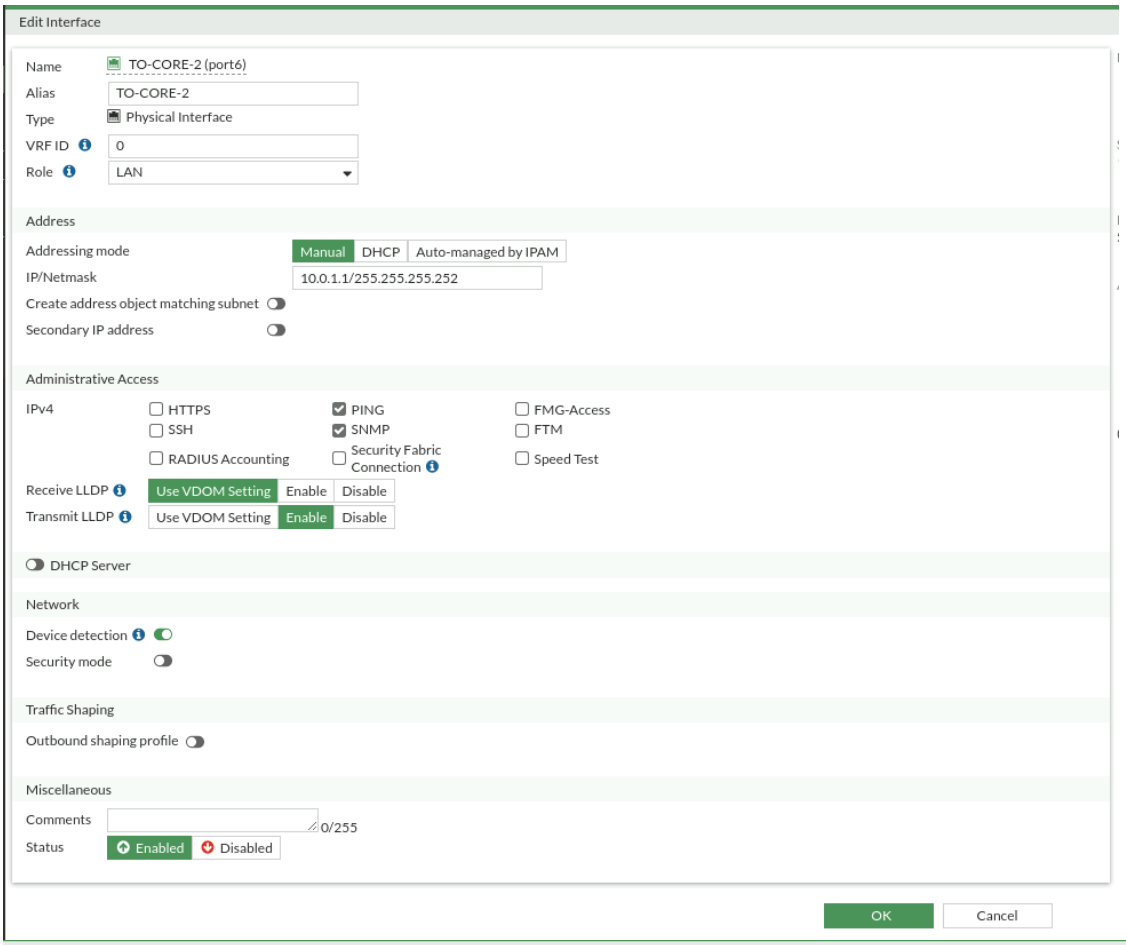
Config Forti-main :

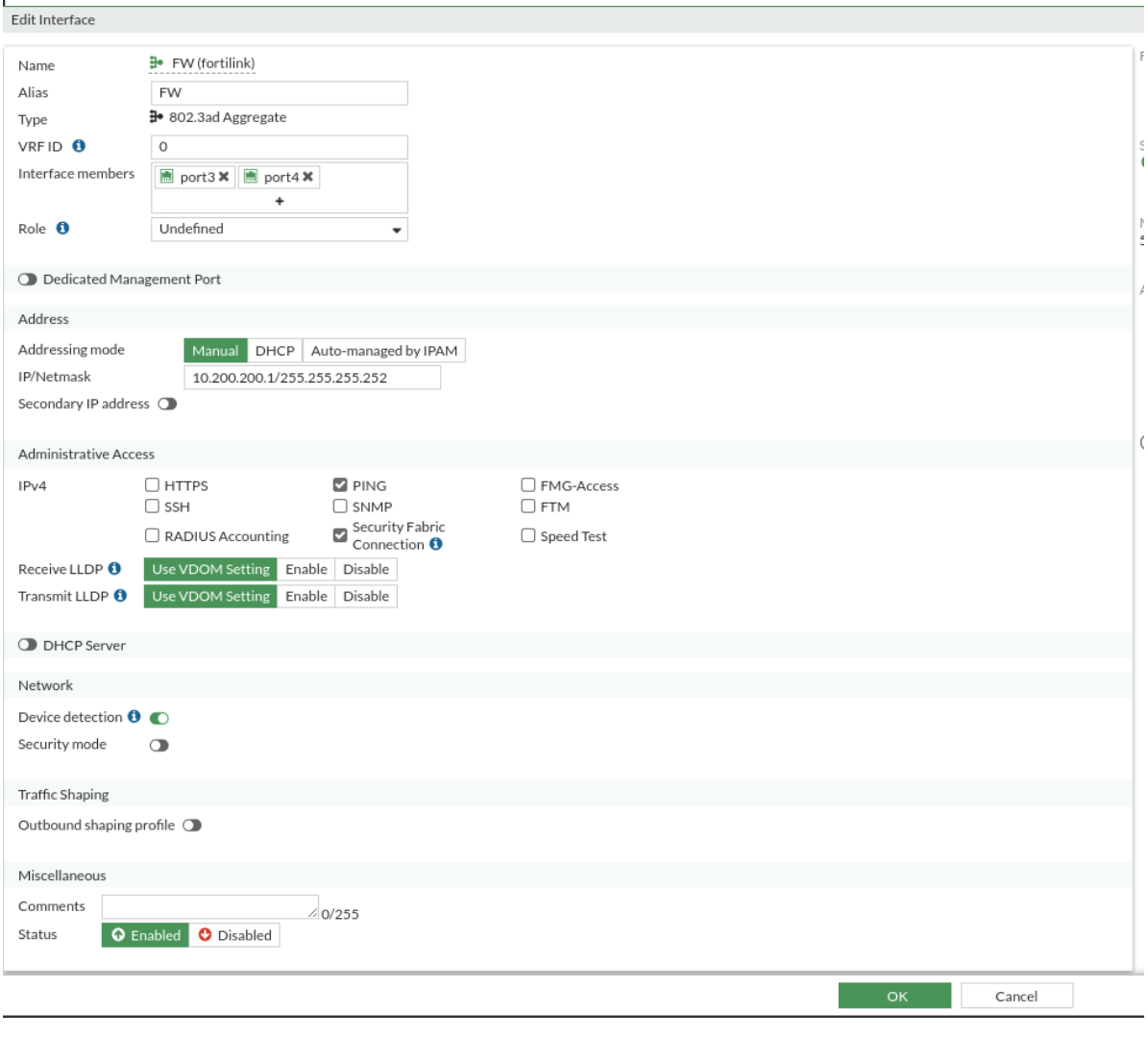
Interface



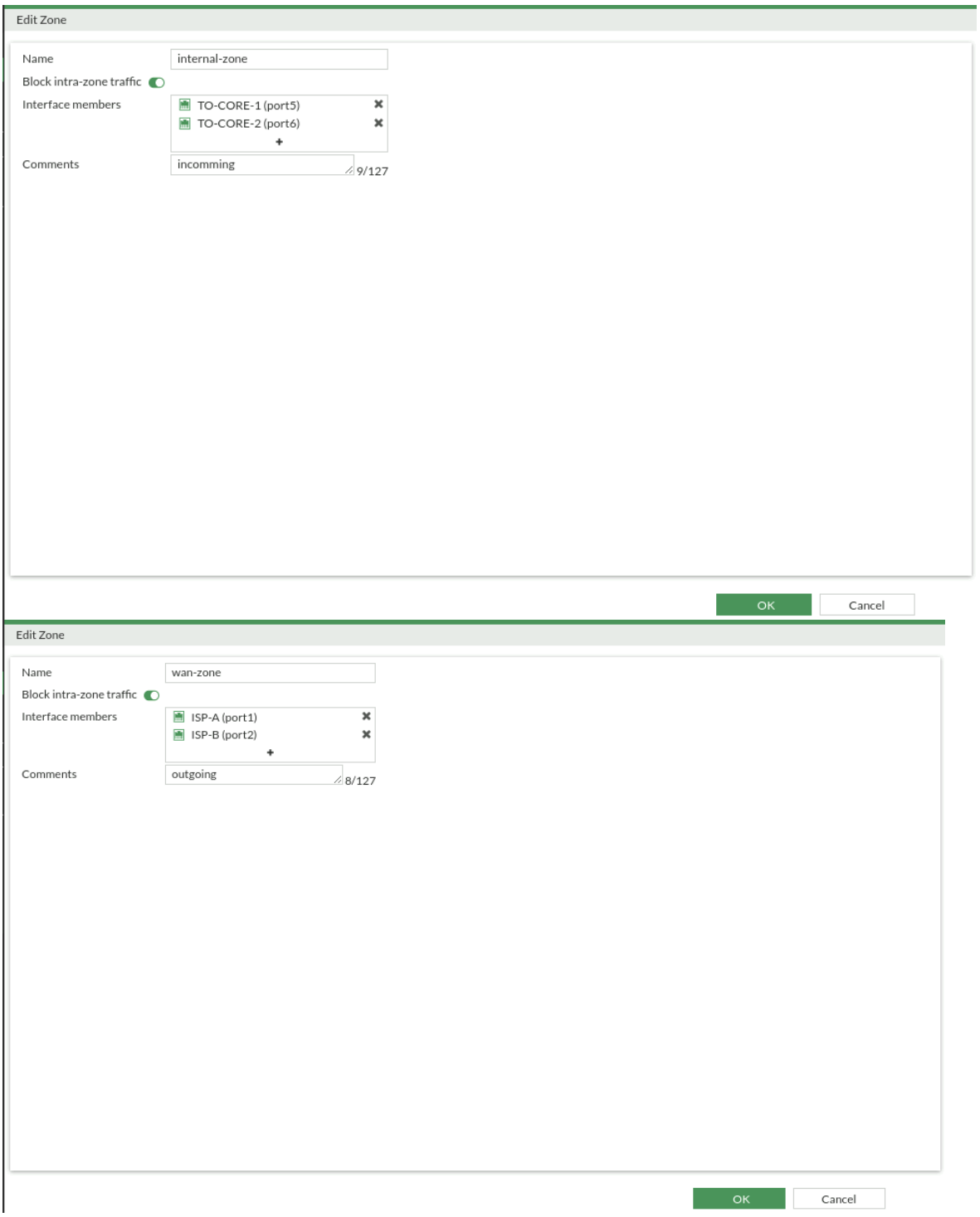

Edit Interface
Name
ISP-B (port2)
Alias
ISP-B
Type
Physical Interface
VRF ID
0
Role
WAN
Estimated bandwidth
0
kbps Upstream
0
kbps Downstream
Address
Addressing mode
Manual
DHCP
IP/Netmask
10.10.20.3/255.255.255.248
Secondary IP address
Administrative Access
IPv4
HTTPS
HTTP
PING
FMG-Access
SSH
SNMP
FTM
RADIUS Accounting
Security Fabric Connection
Speed Test
Receive LLDP
Use VDOM Setting
Enable
Disable
Transmit LLDP
Use VDOM Setting
Enable
Disable
Traffic Shaping
Outbound shaping profile
Miscellaneous
Comments
0/255
Status
Enabled
Disabled
OK
Cancel


Edit Interface
Name
TO-CORE-1 (port5)
Alias
TO-CORE-1
Type
Physical Interface
VRF ID
0
Role
LAN
Address
Addressing mode
Manual
DHCP
Auto-managed by IPAM
IP/Netmask
10.0.0.1/255.255.255.252
Create address object matching subnet
Secondary IP address
Administrative Access
IPv4
HTTPS
PING
FMG-Access
SSH
SNMP
FTM
RADIUS Accounting
Security Fabric Connection
Speed Test
Receive LLDP
Use VDOM Setting
Enable
Disable
Transmit LLDP
Use VDOM Setting
Enable
Disable
DHCP Server
Network
Device detection
Security mode
Traffic Shaping
Outbound shaping profile
Miscellaneous
Comments
0/255
Status
Enabled
Disabled
OK
Cancel

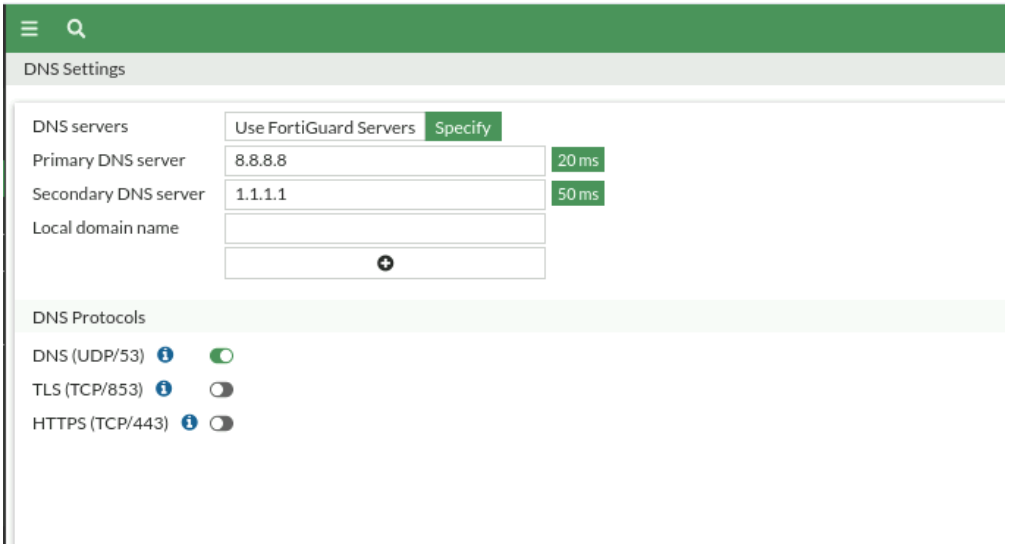

Edit Interface
Name
TO-CORE-2 (port6)
Alias
TO-CORE-2
Type
Physical Interface
VRF ID
0
Role
LAN
Address
Addressing mode
Manual
DHCP
Auto-managed by IPAM
IP/Netmask
10.0.1.1/255.255.255.252
Create address object matching subnet
Secondary IP address
Administrative Access
IPv4
HTTPS
PING
FMG-Access
SSH
SNMP
FTM
RADIUS Accounting
Security Fabric Connection
Speed Test
Receive LLDP
Use VDOM Setting
Enable
Disable
Transmit LLDP
Use VDOM Setting
Enable
Disable
DHCP Server
Network
Device detection
Security mode
Traffic Shaping
Outbound shaping profile
Miscellaneous
Comments
0/255
Status
Enabled
Disabled
OK
Cancel


Edit Interface
Name
FW (fortilink)
Alias
FW
Type
802.3ad Aggregate
VRF ID
0
Interface members
port3
port4
Role
Undefined
Dedicated Management Port
Address
Addressing mode
Manual
DHCP
Auto-managed by IPAM
IP/Netmask
10.200.200.1/255.255.255.252
Secondary IP address
Administrative Access
IPv4
HTTPS
PING
FMG-Access
SSH
SNMP
FTM
RADIUS Accounting
Security Fabric Connection
Speed Test
Receive LLDP
Use VDOM Setting
Enable
Disable
Transmit LLDP
Use VDOM Setting
Enable
Disable
DHCP Server
Network
Device detection
Security mode
Traffic Shaping
Outbound shaping profile
Miscellaneous
Comments
0/255
Status
Enabled
Disabled
OK
Cancel

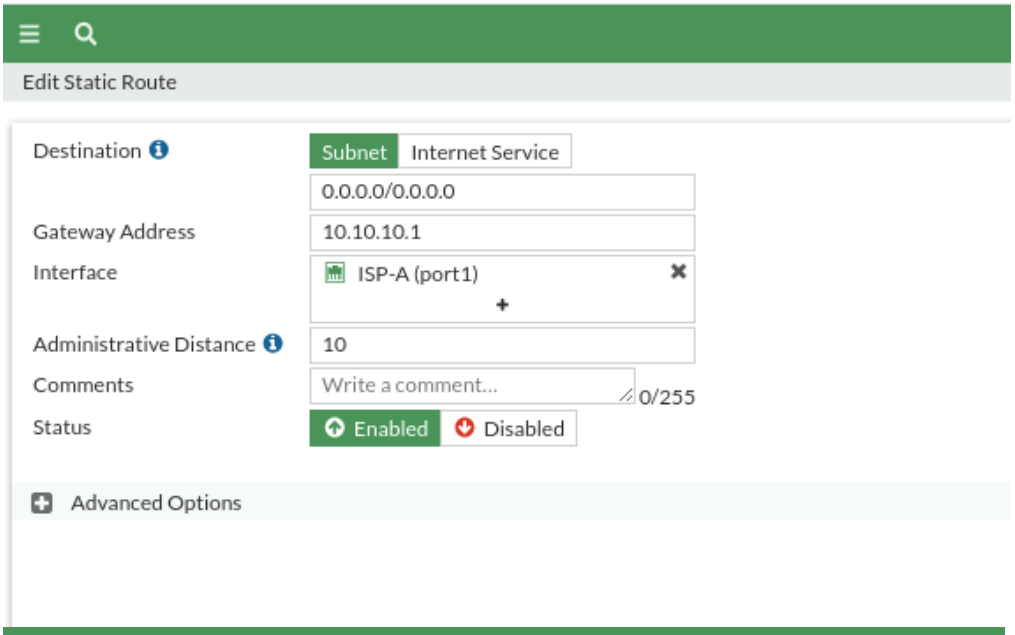
Zone Port

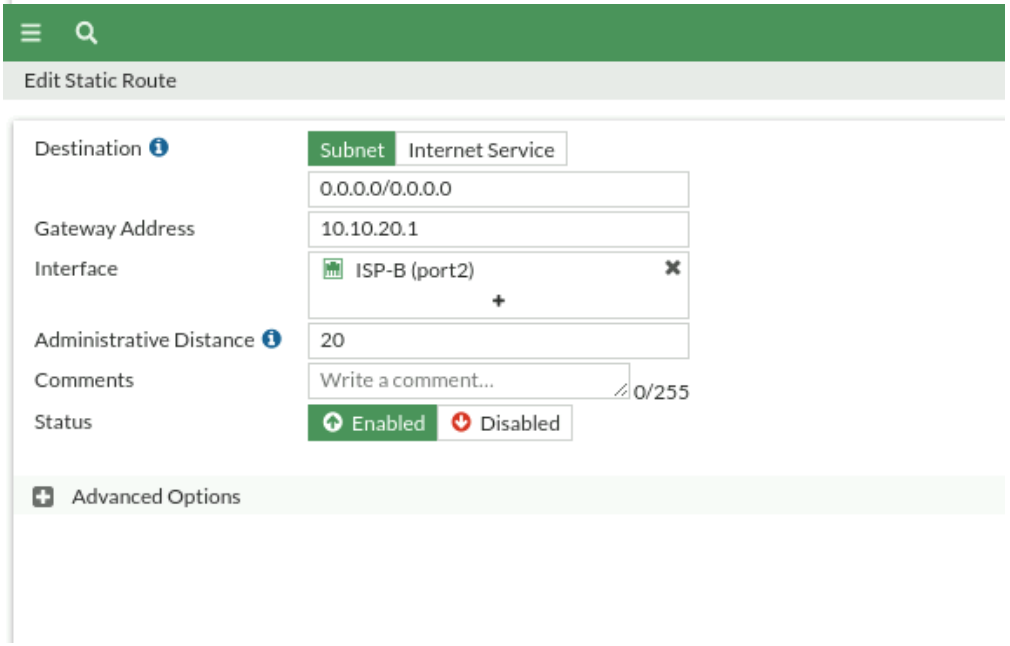

Edit Zone
Name
internal-zone
Block intra-zone traffic
Interface members
TO-CORE-1 (port5)
TO-CORE-2 (port6)
Comments
incomming
9/127
OK
Cancel
Edit Zone
Name
wan-zone
Block intra-zone traffic
Interface members
ISP-A (port1)
ISP-B (port2)
Comments
outgoing
8/127
OK
Cancel

DNS

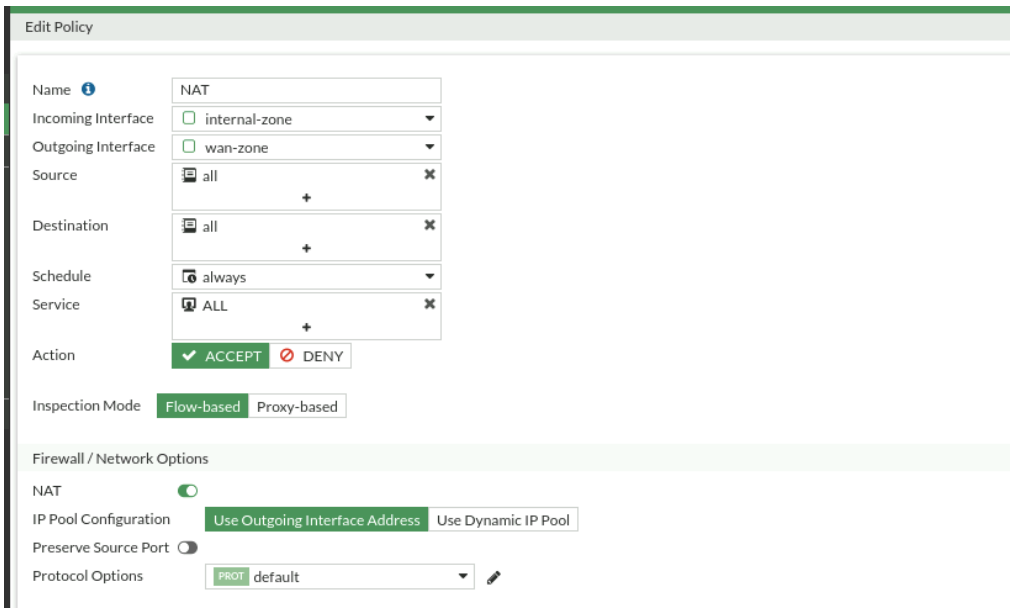


Routing to inet

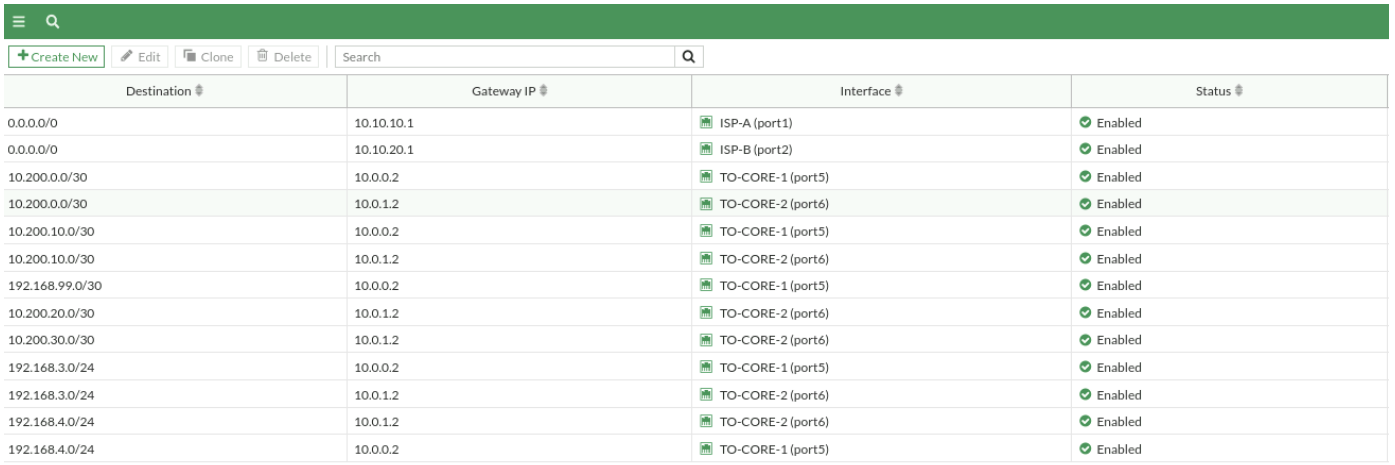




NAT



Static routing

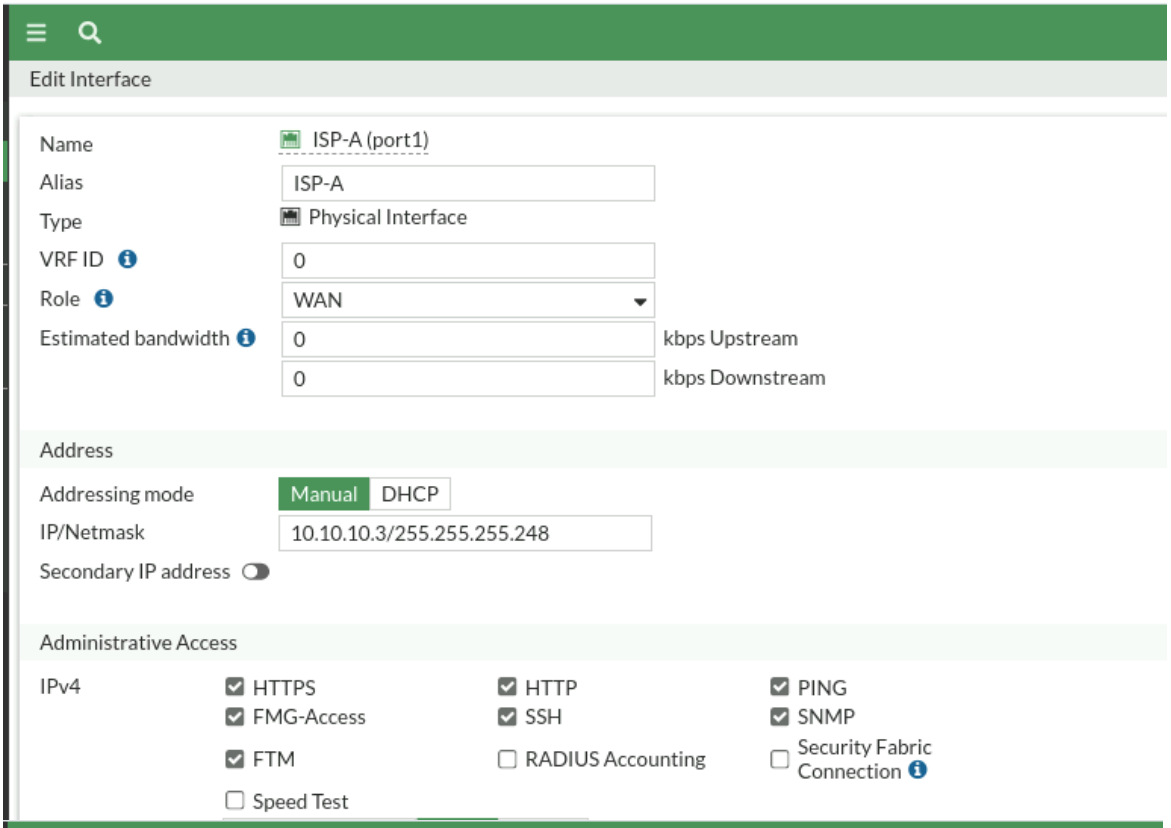


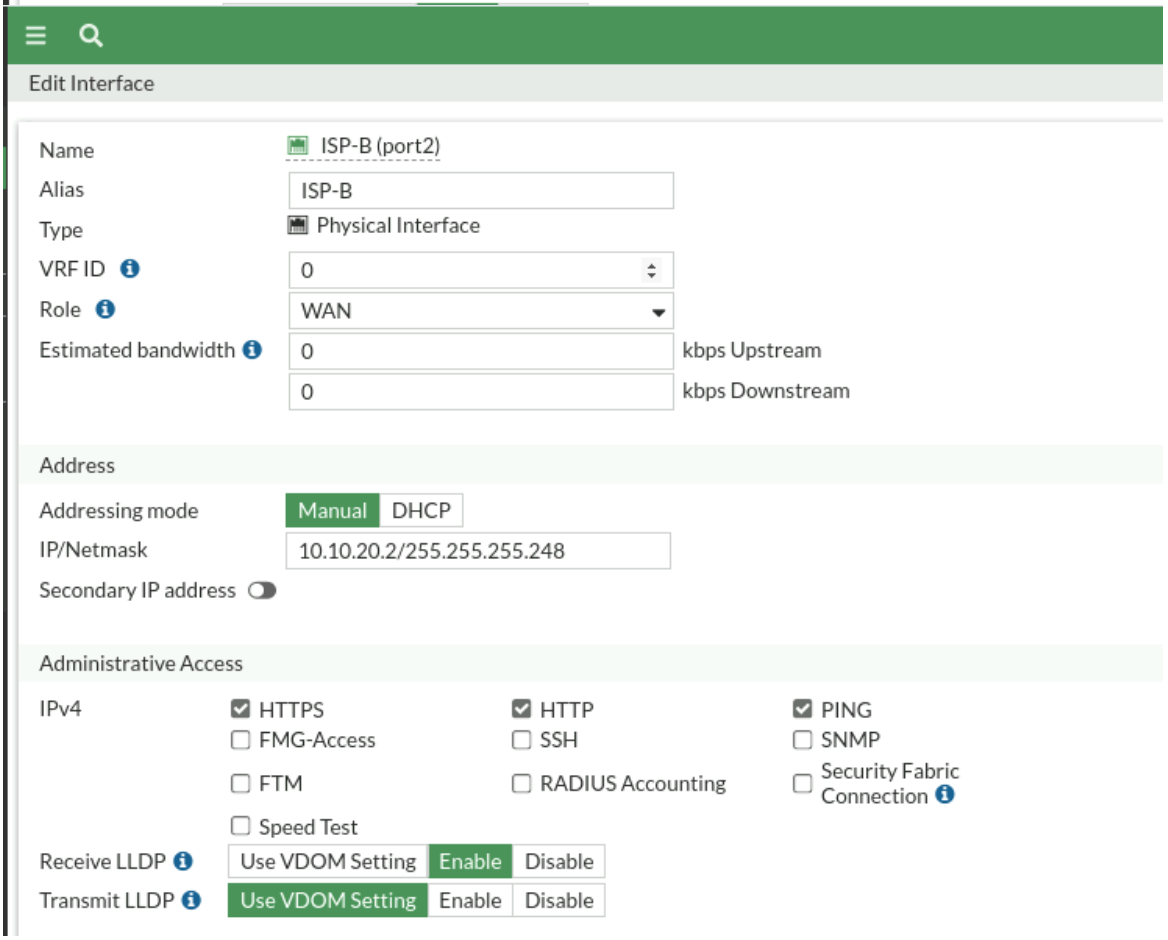
Create New | Edit | Clone | Delete | Search

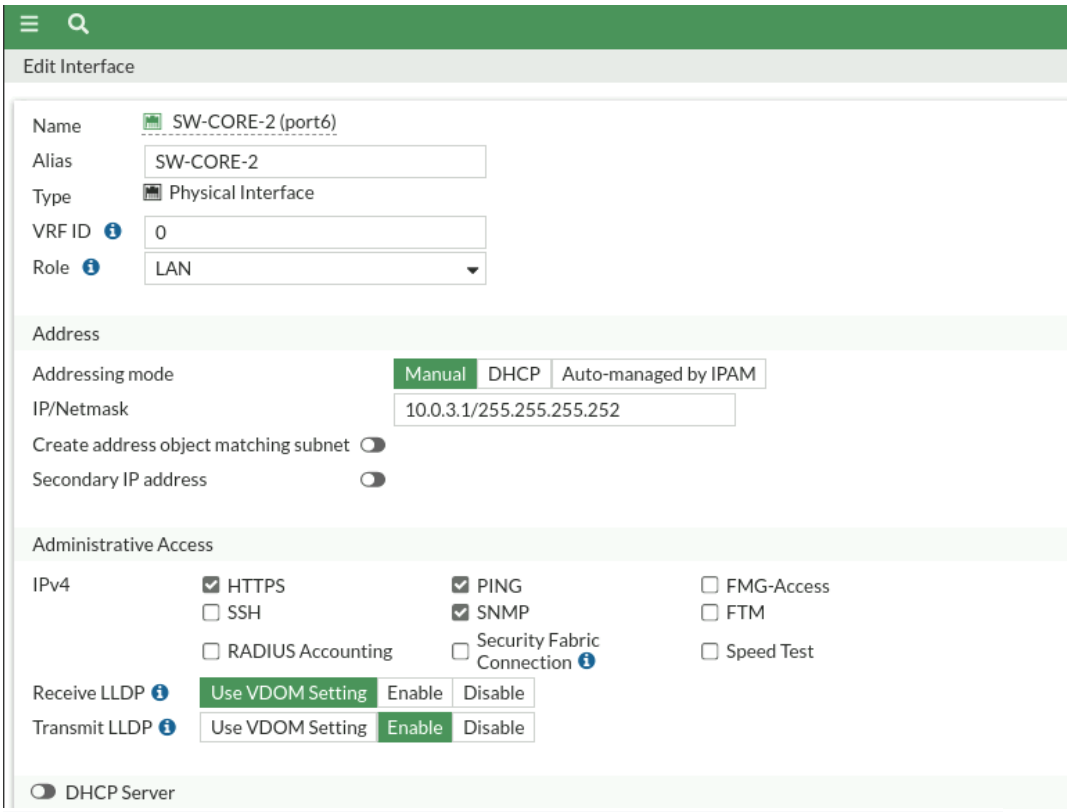
Destination	Gateway IP	Interface	Status
0.0.0.0/0	10.10.10.1	ISP-A (port1)	Enabled
0.0.0.0/0	10.10.20.1	ISP-B (port2)	Enabled
10.200.0.0/30	10.0.0.2	TO-CORE-1 (port5)	Enabled
10.200.0.0/30	10.0.1.2	TO-CORE-2 (port6)	Enabled
10.200.10.0/30	10.0.0.2	TO-CORE-1 (port5)	Enabled
10.200.10.0/30	10.0.1.2	TO-CORE-2 (port6)	Enabled
192.168.99.0/30	10.0.0.2	TO-CORE-1 (port5)	Enabled
10.200.20.0/30	10.0.1.2	TO-CORE-2 (port6)	Enabled
10.200.30.0/30	10.0.1.2	TO-CORE-2 (port6)	Enabled
192.168.3.0/24	10.0.0.2	TO-CORE-1 (port5)	Enabled
192.168.3.0/24	10.0.1.2	TO-CORE-2 (port6)	Enabled
192.168.4.0/24	10.0.1.2	TO-CORE-2 (port6)	Enabled
192.168.4.0/24	10.0.0.2	TO-CORE-1 (port5)	Enabled

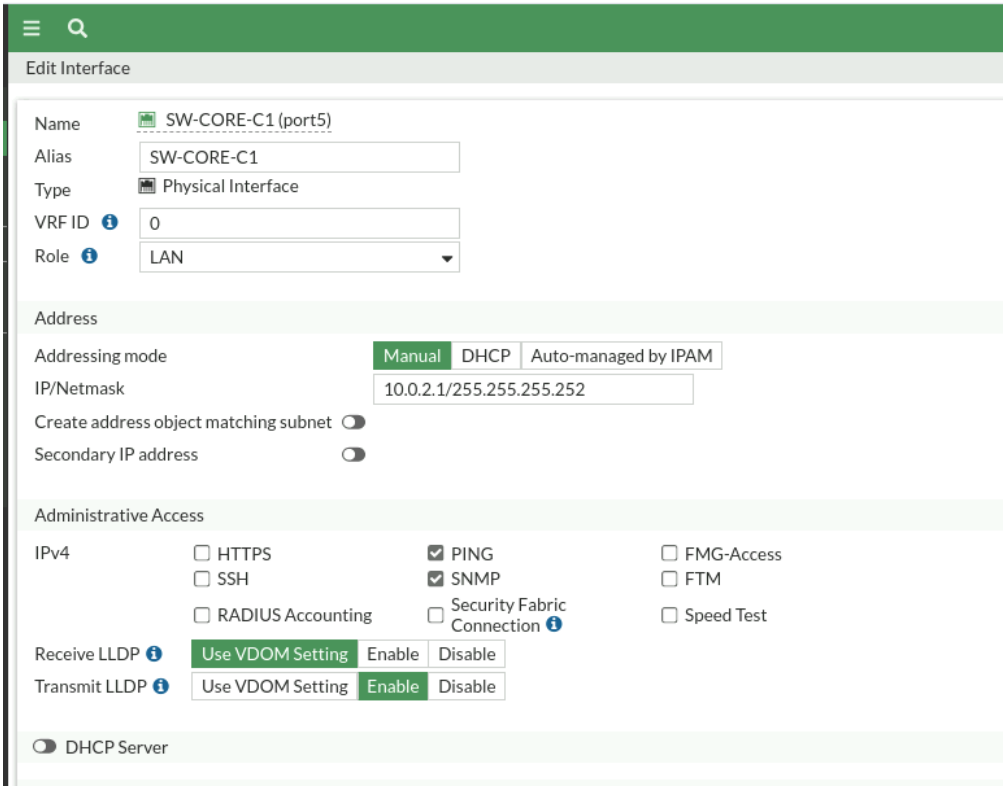
Config Forti-Backup

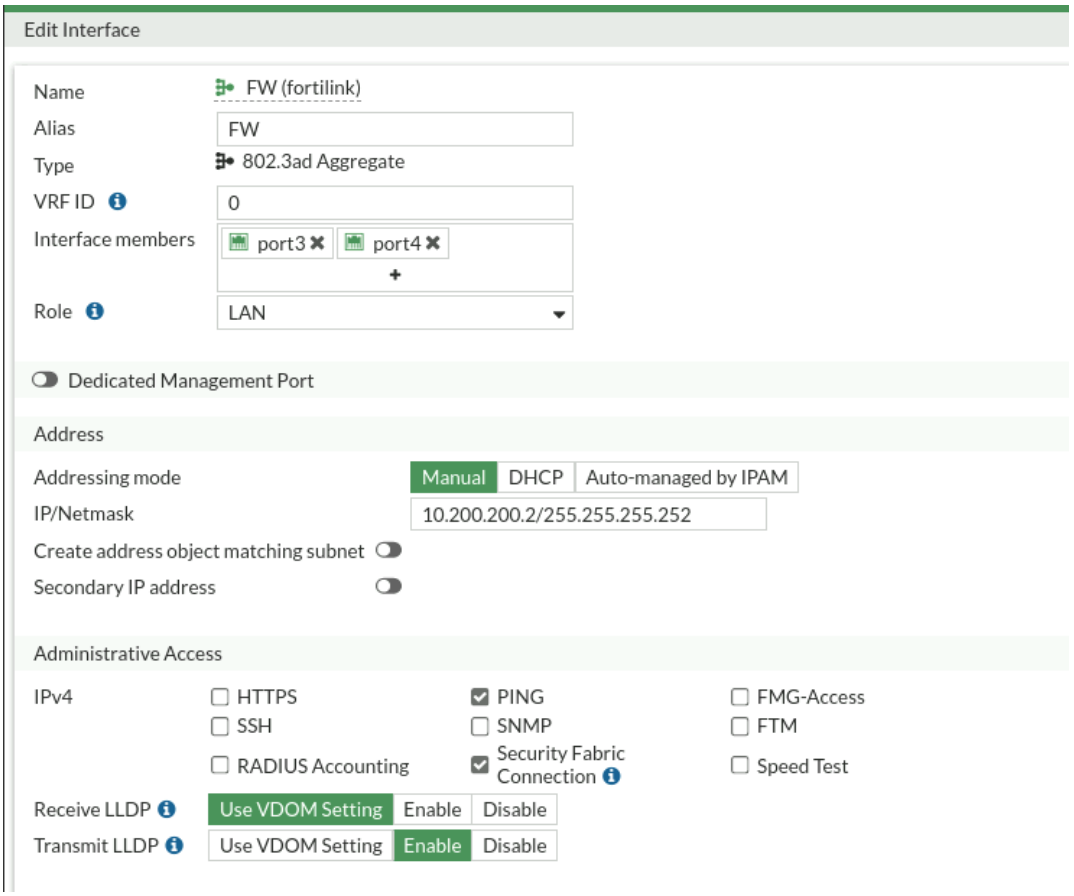
Interface

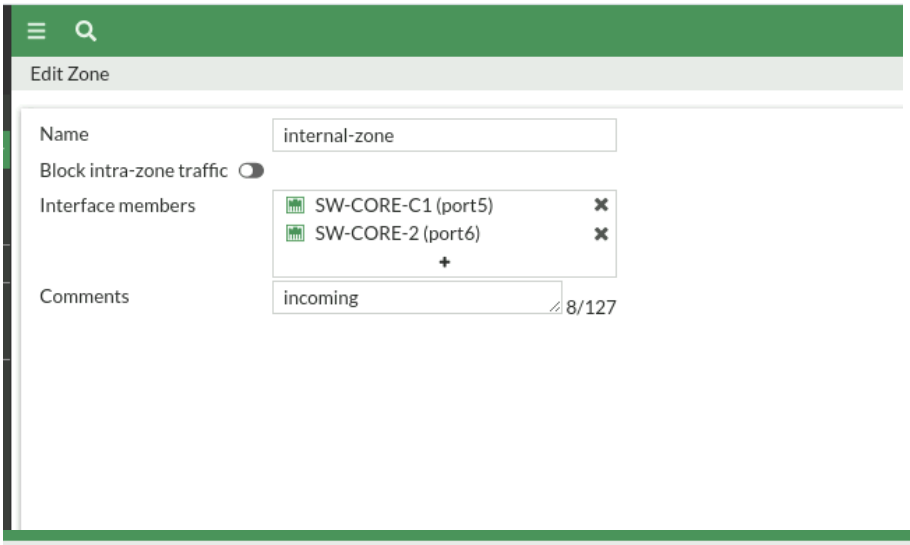

Edit Interface
Name
ISP-A (port1)
Alias
ISP-A
Type
Physical Interface
VRF ID
0
Role
WAN
Estimated bandwidth
0
kbps Upstream
0
kbps Downstream
Address
Addressing mode
Manual
DHCP
IP/Netmask
10.10.10.3/255.255.255.248
Secondary IP address
Administrative Access
IPv4
HTTPS
HTTP
PING
FMG-Access
SSH
SNMP
FTM
RADIUS Accounting
Security Fabric Connection
Speed Test

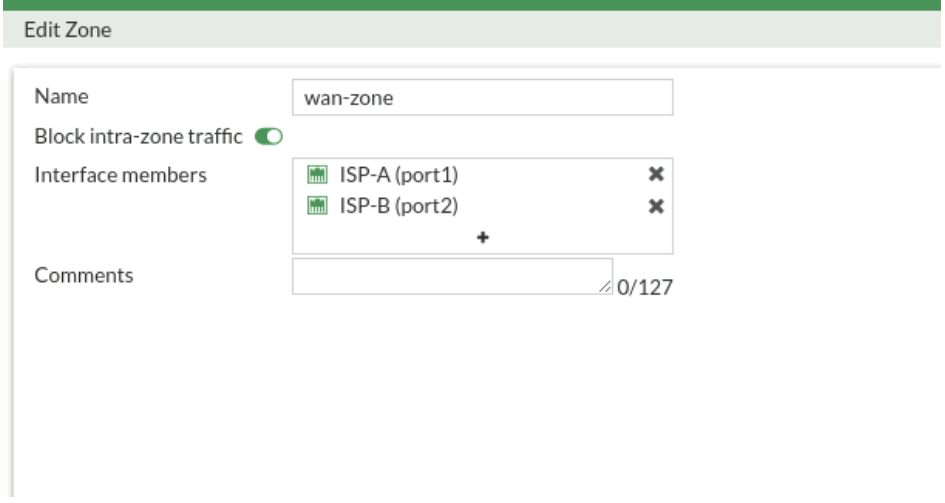

Edit Interface
Name
ISP-B (port2)
Alias
ISP-B
Type
Physical Interface
VRF ID
0
Role
WAN
Estimated bandwidth
0
kbps Upstream
0
kbps Downstream
Address
Addressing mode
Manual
DHCP
IP/Netmask
10.10.20.2/255.255.255.248
Secondary IP address
Administrative Access
IPv4
HTTPS
HTTP
PING
FMG-Access
SSH
SNMP
FTM
RADIUS Accounting
Security Fabric Connection
Speed Test
Receive LLDP
Use VDOM Setting
Enable
Disable
Transmit LLDP
Use VDOM Setting
Enable
Disable


Edit Interface
Name
SW-CORE-2 (port6)
Alias
SW-CORE-2
Type
Physical Interface
VRF ID
0
Role
LAN
Address
Addressing mode
Manual
DHCP
Auto-managed by IPAM
IP/Netmask
10.0.3.1/255.255.255.252
Create address object matching subnet
Secondary IP address
Administrative Access
IPv4
HTTPS
PING
FMG-Access
SSH
SNMP
FTM
RADIUS Accounting
Security Fabric Connection
Speed Test
Receive LLDP
Use VDOM Setting
Enable
Disable
Transmit LLDP
Use VDOM Setting
Enable
Disable
DHCP Server

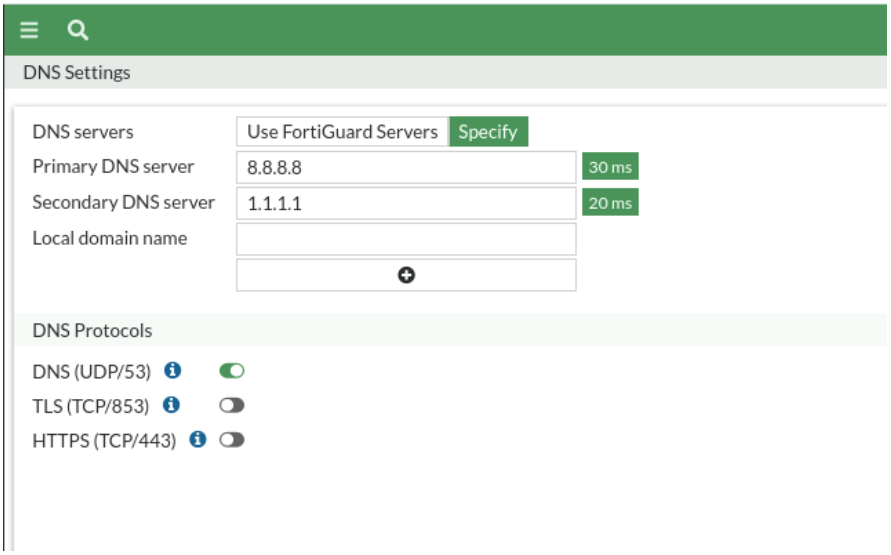

Edit Interface
Name
SW-CORE-C1 (port5)
Alias
SW-CORE-C1
Type
Physical Interface
VRF ID
0
Role
LAN
Address
Addressing mode
Manual
DHCP
Auto-managed by IPAM
IP/Netmask
10.0.2.1/255.255.255.252
Create address object matching subnet
Secondary IP address
Administrative Access
IPv4
HTTPS
PING
FMG-Access
SSH
SNMP
FTM
RADIUS Accounting
Security Fabric Connection
Speed Test
Receive LLDP
Use VDOM Setting
Enable
Disable
Transmit LLDP
Use VDOM Setting
Enable
Disable
DHCP Server


Edit Interface
Name
FW (fortilink)
Alias
FW
Type
802.3ad Aggregate
VRF ID
0
Interface members
port3
port4
Role
LAN
Dedicated Management Port
Address
Addressing mode
Manual
DHCP
Auto-managed by IPAM
IP/Netmask
10.200.200.2/255.255.255.252
Create address object matching subnet
Secondary IP address
Administrative Access
IPv4
HTTPS
PING
FMG-Access
SSH
SNMP
FTM
RADIUS Accounting
Security Fabric Connection
Speed Test
Receive LLDP
Use VDOM Setting
Enable
Disable
Transmit LLDP
Use VDOM Setting
Enable
Disable

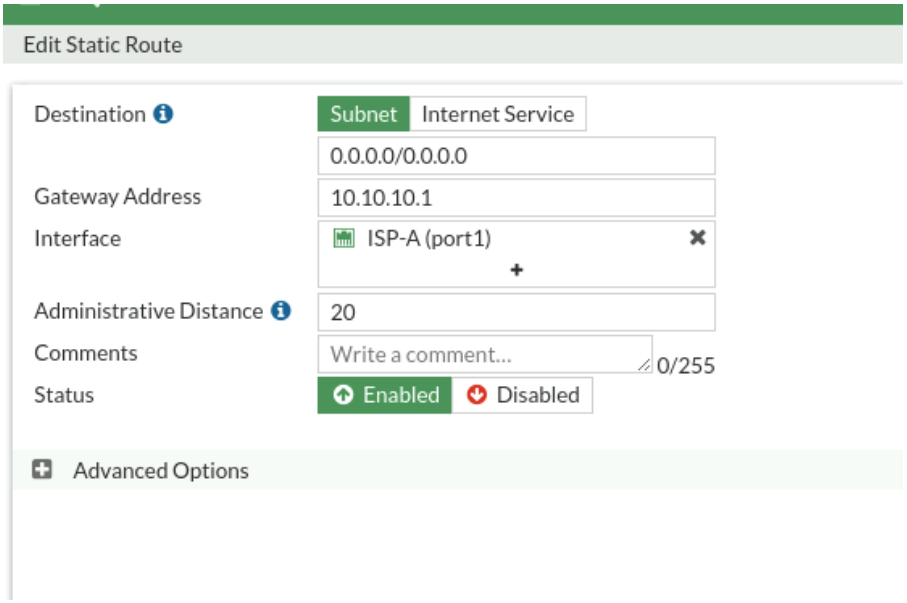

Edit Zone
Name
internal-zone
Block intra-zone traffic
Interface members
SW-CORE-C1 (port5)
SW-CORE-2 (port6)
Comments
incoming
8/127

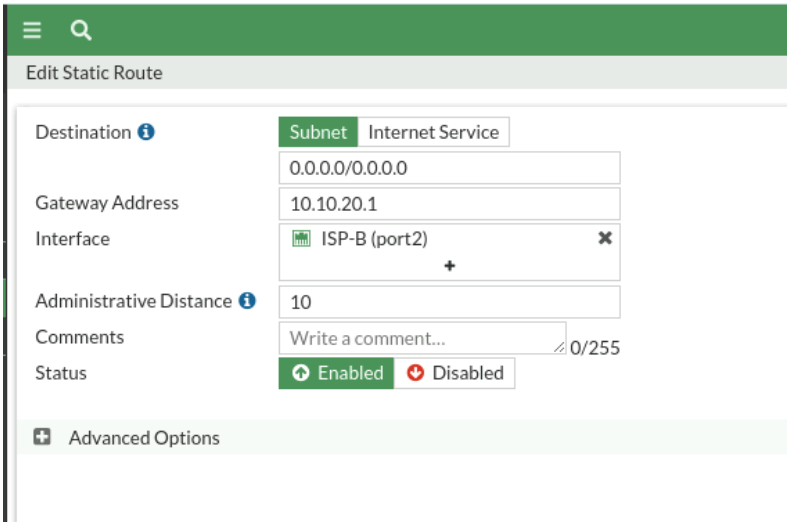

Edit Zone
Name
wan-zone
Block intra-zone traffic
Interface members
ISP-A (port1)
ISP-B (port2)
Comments
0/127

DNS

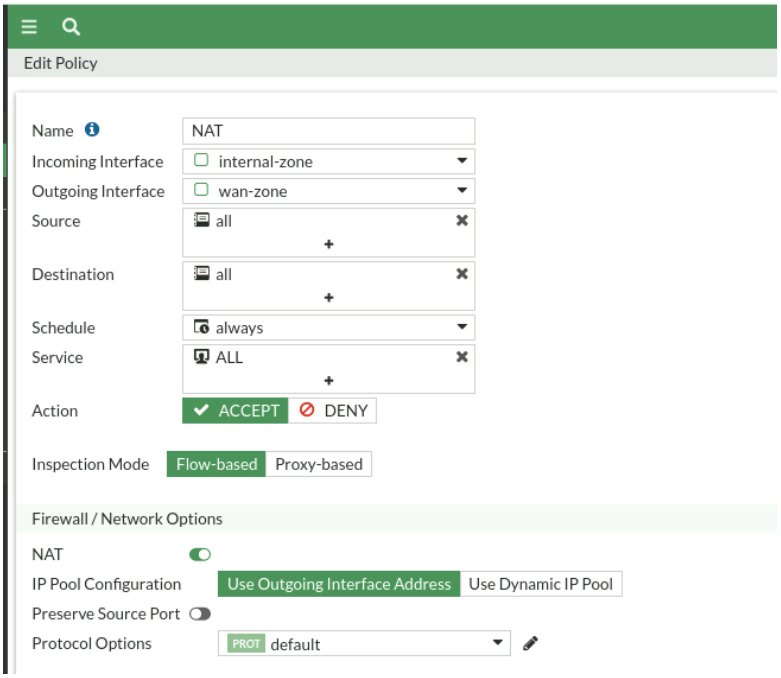


Routing to inet

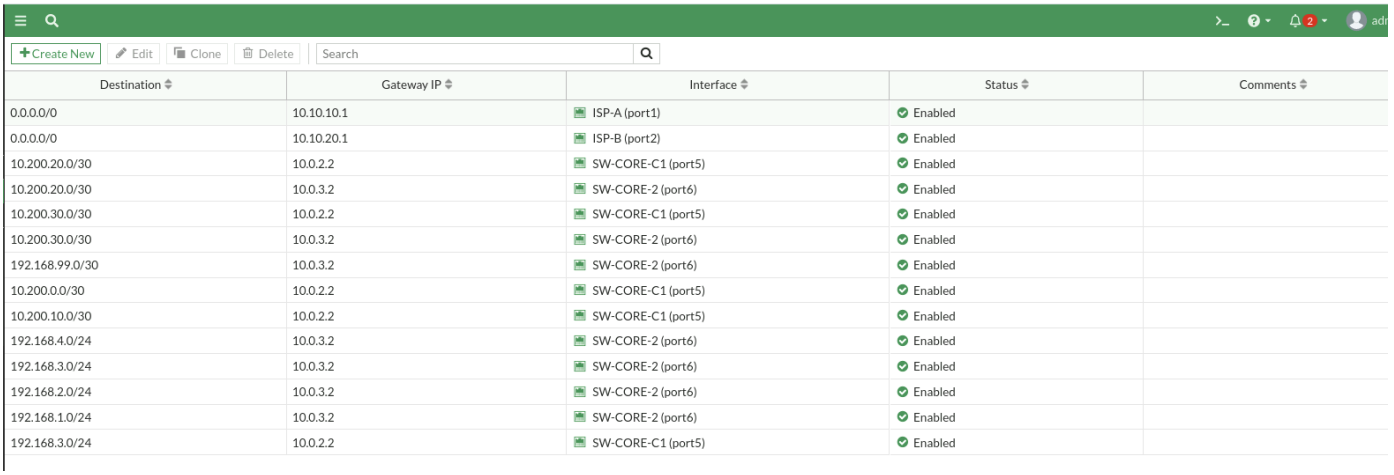




NAT



Static Routing



+Create New | Edit | Clone | Delete | Search

Destination	Gateway IP	Interface	Status	Comments
0.0.0.0/0	10.10.10.1	ISP-A (port1)	Enabled	
0.0.0.0/0	10.10.20.1	ISP-B (port2)	Enabled	
10.200.20.0/30	10.0.2.2	SW-CORE-C1 (port5)	Enabled	
10.200.20.0/30	10.0.3.2	SW-CORE-2 (port6)	Enabled	
10.200.30.0/30	10.0.2.2	SW-CORE-C1 (port5)	Enabled	
10.200.30.0/30	10.0.3.2	SW-CORE-2 (port6)	Enabled	
192.168.99.0/30	10.0.3.2	SW-CORE-2 (port6)	Enabled	
10.200.0.0/30	10.0.2.2	SW-CORE-C1 (port5)	Enabled	
10.200.10.0/30	10.0.2.2	SW-CORE-C1 (port5)	Enabled	
192.168.4.0/24	10.0.3.2	SW-CORE-2 (port6)	Enabled	
192.168.3.0/24	10.0.3.2	SW-CORE-2 (port6)	Enabled	
192.168.2.0/24	10.0.3.2	SW-CORE-2 (port6)	Enabled	
192.168.1.0/24	10.0.3.2	SW-CORE-2 (port6)	Enabled	
192.168.3.0/24	10.0.2.2	SW-CORE-C1 (port5)	Enabled	

SW-Core1 :

```
Switch>enable
Switch#configure terminal

Switch(config)#interface ethernet 0/0
Switch(config)#no switchport
Switch(config-if)#ip address 10.0.2.2 255.255.255.0
Switch(config-if)#no shutdown

Switch(config)#interface ethernet 0/1
Switch(config)#no switchport
Switch(config-if)#ip address 10.0.0.2 255.255.255.0
Switch(config-if)#no shutdown
```

```
Switch(config)#interface ethernet 0/2
Switch(config)#no switchport
Switch(config-if)#ip address 10.100.100.1 255.255.255.0
Switch(config-if)#no shutdown

Switch(config)#interface ethernet 0/3
Switch(config)#no switchport
Switch(config-if)#ip address 10.200.0.1 255.255.255.0
Switch(config-if)#no shutdown

Switch(config)#interface ethernet 1/0
Switch(config)#no switchport
Switch(config-if)#ip address 10.200.10.1 255.255.255.0
Switch(config-if)#no shutdown

Switch(config)#end
Switch#write memory

Switch(config)# ip routing

Switch(config)#ip route 0.0.0.0 0.0.0.0 10.0.0.1
Switch(config)#ip route 0.0.0.0 0.0.0.0 10.0.2.1 100

Switch(config)#router ospf 1
Switch(config-router)#router-id 1.1.1.1

Switch(config-router)#network 10.100.100.0 0.0.0.3 area 0
Switch(config-router)#network 10.200.0.0 0.0.0.3 area 0
Switch(config-router)#network 10.200.10.0 0.0.0.3 area 0

Switch#write memory
```

SW-Core2 :

```
Switch>enable
Switch#configure terminal

Switch(config)#interface Ethernet0/0
Switch(config)#no switchport
Switch(config-if)#ip address 10.0.1.2 255.255.255.252
Switch(config-if)#no shutdown

Switch(config)#interface Ethernet0/1
Switch(config)#no switchport
```

```
Switch(config-if)#ip address 10.0.3.2 255.255.255.252
Switch(config-if)#no shutdown

Switch(config)#interface Ethernet0/2
Switch(config)#no switchport
Switch(config-if)#ip address 10.100.100.2 255.255.255.252
Switch(config-if)#no shutdown

Switch(config)#interface Ethernet0/3
Switch(config)#no switchport
Switch(config-if)#ip address 10.200.20.1 255.255.255.252
Switch(config-if)#no shutdown

Switch(config)#interface Ethernet1/0
Switch(config)#no switchport
Switch(config-if)#ip address 10.200.30.1 255.255.255.252
Switch(config-if)#no shutdown

Switch(config)# ip routing

Switch(config)#ip route 0.0.0.0 0.0.0.0 10.0.3.1
Switch(config)#ip route 0.0.0.0 0.0.0.0 10.0.1.1 100

Switch(config)#router ospf 1
Switch(config-router)#router-id 2.2.2.2

Switch(config-router)#network 10.100.100.0 0.0.0.3 area 0
Switch(config-router)#network 10.200.0.0 0.0.0.3 area 0
Switch(config-router)#network 10.200.10.0 0.0.0.3 area 0

Switch#write memory
```

MIK-1

```
/ip pool
add name=dhcp_pool0 ranges=192.168.1.2-192.168.1.254
/ip dhcp-server
add address-pool=dhcp_pool0 disabled=no interface=ether3 name=dhcp1
/routing ospf instance
set [ find default=yes ] router-id=3.3.3.3
add disabled=yes name=ospf1 router-id=3.3.3.3
/ip address
add address=10.200.0.2/30 interface=ether1 network=10.200.0.0
add address=192.168.88.1/30 interface=ether2 network=192.168.88.0
```

```
add address=192.168.1.1/24 interface=ether3 network=192.168.1.0
/ip dhcp-client
add disabled=no interface=ether1
/ip dhcp-server network
add address=192.168.1.0/24 gateway=192.168.1.1
/ip dns
set allow-remote-requests=yes servers=8.8.8.8
/ip firewall nat
add action=masquerade chain=srcnat out-interface=ether1
add action=masquerade chain=srcnat out-interface=ether2
/routing ospf network
add area=backbone network=10.200.0.0/30
add area=backbone network=192.168.88.0/30
add area=backbone network=192.168.1.0/24
/system identity
set name=MIK-1
```

MIK-2

```
/ip pool
add name=dhcp_pool0 ranges=192.168.2.2-192.168.2.254
/ip dhcp-server
add address-pool=dhcp_pool0 disabled=no interface=ether3 name=dhcp1
/routing ospf instance
set [ find default=yes ] router-id=4.4.4.4
/ip address
add address=10.200.20.2/30 interface=ether1 network=10.200.20.0
add address=192.168.88.2/30 interface=ether2 network=192.168.88.0
add address=192.168.2.1/24 interface=ether3 network=192.168.2.0
/ip dhcp-client
add disabled=no interface=ether1
/ip dhcp-server network
add address=192.168.2.0/24 gateway=192.168.2.1
/ip dns
set allow-remote-requests=yes servers=8.8.8.8
/ip firewall nat
add action=masquerade chain=srcnat out-interface=ether1
add action=masquerade chain=srcnat out-interface=ether2
/routing ospf network
add area=backbone network=10.200.20.0/30
add area=backbone network=192.168.88.0/30
add area=backbone network=192.168.2.0/24
```

/system identity
set name=MIK-2

C1 :

Router>enable
Router#configure terminal
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 10.200.10.2 255.255.255.252
Router(config-if)#no shutdown
Router(config-if)#exit

Router(config)#interface FastEthernet0/1
Router(config-if)#ip address 192.168.99.1 255.255.255.252
Router(config-if)#no shutdown
Router(config-if)#exit

Router(config)#interface FastEthernet1/0
Router(config-if)#ip address 192.168.3.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#exit

Router(config)# ip dhcp pool LAN
Router(dhcp-config)# network 192.168.3.0 255.255.255.0
Router(dhcp-config)# default-router 192.168.3.1
Router(dhcp-config)# dns-server 8.8.8.8
Router(dhcp-config)# exit

Router>enable
Router#configure terminal

Router(config)#router ospf 1
Router(config-router)#router-id 5.5.5.5
Router(config-router)#log-adjacency-changes
Router(config-router)#network 10.200.10.0 0.0.0.3 area 0
Router(config-router)#network 192.168.3.0 0.0.0.255 area 0
Router(config-router)#network 192.168.99.0 0.0.0.3 area 0
Router(config-router)#exit

Router(config)#ip nat inside source route-map NAT1 interface FastEthernet0/0 overload
Router(config)#ip nat inside source route-map NAT2 interface FastEthernet0/1 overload

Router(config)#access-list 1 permit 192.168.3.0 0.0.0.255

```
Router(config)#route-map NAT1 permit 10
Router(config-route-map)#match ip address 1
Router(config-route-map)#match interface FastEthernet0/0
Router(config-route-map)#exit

Router(config)#route-map NAT2 permit 10
Router(config-route-map)#match ip address 1
Router(config-route-map)#match interface FastEthernet0/1
Router(config-route-map)#exit

Router(config)#exit
```

C2

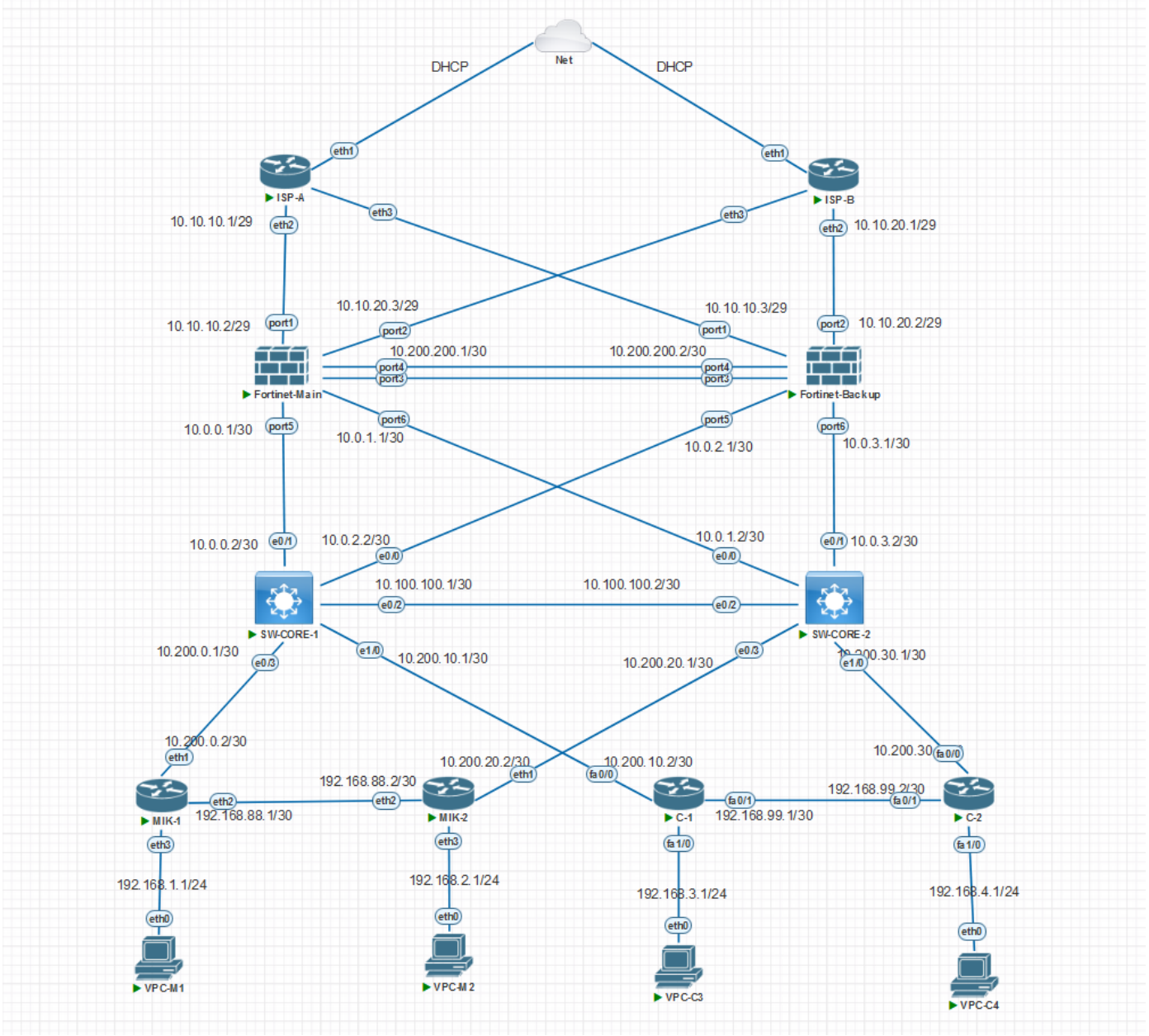
```
Router>enable
Router#configure terminal

Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 10.200.30.2 255.255.255.252
Router(config-if)#no shutdown

Router(config)#interface FastEthernet0/1
Router(config-if)#ip address 192.168.99.2 255.255.255.252
Router(config-if)#no shutdown

Router(config)#interface FastEthernet1/0
Router(config-if)#ip address 192.168.4.1 255.255.255.0
Router(config-if)#no shutdown

Router(config)#exit
Router#write memory

Router>enable
Router#configure terminal

Router(config)#ip dhcp pool LAN
Router(dhcp-config)#network 192.168.4.0 255.255.255.0
Router(dhcp-config)#default-router 192.168.4.1
Router(dhcp-config)#dns-server 8.8.8.8

Router(config)#exit
Router#write memory

Router>enable
Router#configure terminal
```

```
Router(config)#router ospf 1
Router(config-router)#router-id 6.6.6.6
Router(config-router)#log-adjacency-changes
Router(config-router)#network 10.200.30.0 0.0.0.3 area 0
Router(config-router)#network 192.168.4.0 0.0.0.255 area 0
Router(config-router)#network 192.168.99.0 0.0.0.3 area 0

Router(config)#ip nat inside source route-map NAT1 interface FastEthernet0/0 overload
Router(config)#ip nat inside source route-map NAT2 interface FastEthernet0/1 overload

Router(config)#access-list 1 permit 192.168.4.0 0.0.0.255

Router(config)#route-map NAT2 permit 10
Router(config-route-map)#match ip address 1
Router(config-route-map)#match interface FastEthernet0/0

Router(config)#route-map NAT1 permit 10
Router(config-route-map)#match ip address 1
Router(config-route-map)#match interface FastEthernet0/1

Router(config)#ip http server
Router(config)#no ip http secure-server

Router(config)#exit
Router#write memory
```

==========

PENGUJIAN :

Normal (semua ISP dalam keadaan hidup)



vpc-m1

trace 8.8.8.8 > mik-1 > sw-core-1 > forti-main > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   1.881 ms  2.634 ms  1.988 ms
 2   10.200.0.1   4.625 ms  3.097 ms  6.920 ms
 3   10.0.0.1   7.578 ms  4.779 ms  6.729 ms
 4   10.10.10.1   17.632 ms  6.811 ms  12.377 ms
 5   192.168.28.2   8.256 ms  8.791 ms  7.521 ms
^C 6
```

vpc-m2

trace 8.8.8.8 > mik-2 > sw-core-2 > forti-backup > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   2.206 ms  0.835 ms  0.761 ms
 2   10.200.20.1   2.108 ms  1.404 ms  6.969 ms
 3   10.0.3.1   5.136 ms  3.822 ms  9.135 ms
 4   10.10.20.1   8.630 ms  12.218 ms  3.654 ms
 5   192.168.28.2   6.639 ms  11.198 ms  9.756 ms
^C 6     *
```

vpc-c3

trace 8.8.8.8 > c-1 > sw-core-1 > forti-main > isp-A

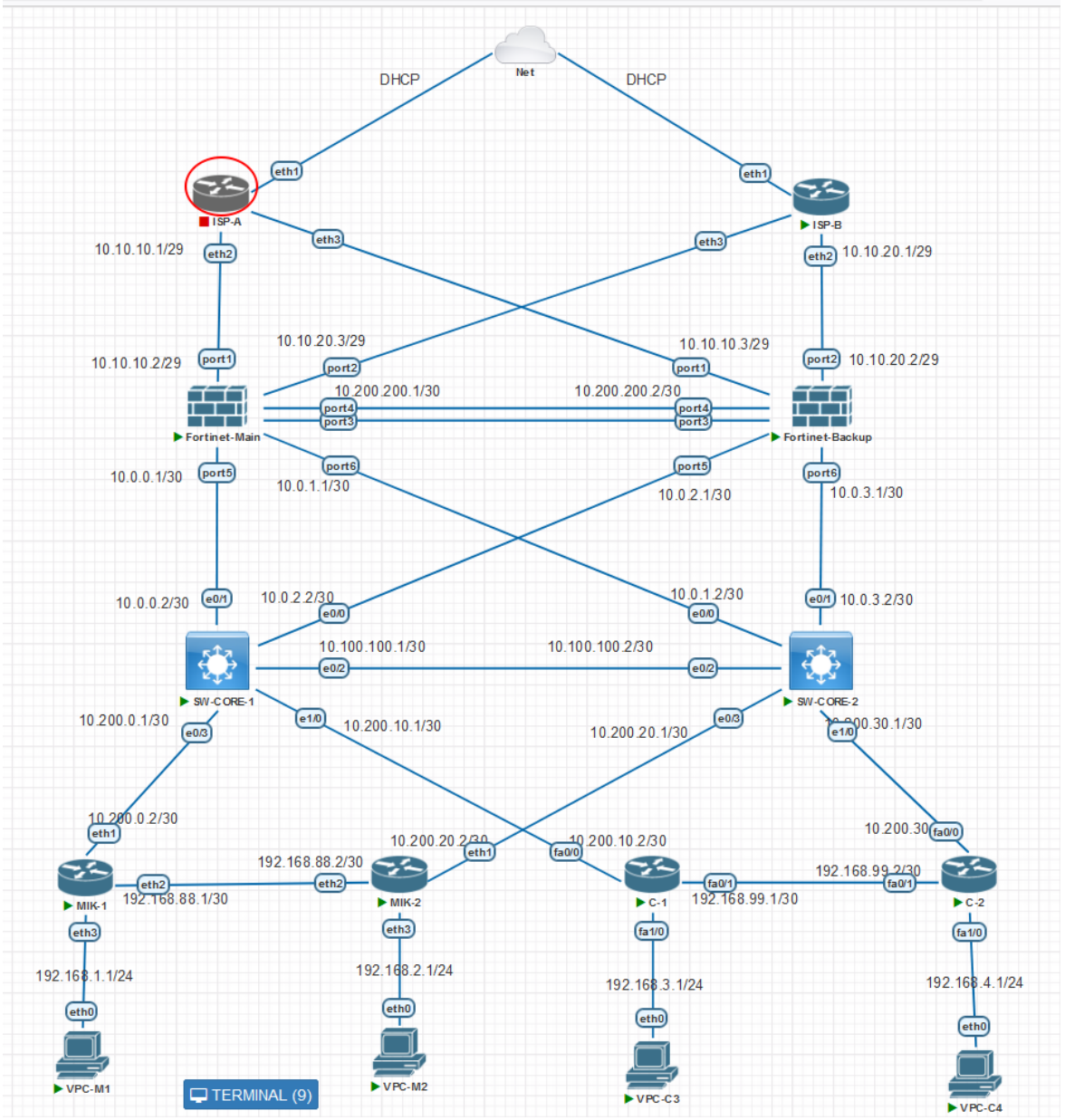
```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.3.1   10.967 ms  8.933 ms  10.160 ms
 2   10.200.10.1   20.144 ms  19.624 ms  19.329 ms
 3   10.0.0.1   21.336 ms  20.255 ms  20.846 ms
 4   10.10.10.1   30.684 ms  20.000 ms  20.783 ms
 5   192.168.28.2   41.502 ms  32.448 ms  20.446 ms
^C 6     *
```

vpc-c4

trace 8.8.8.8 > c-2 > sw-core-2 > forti-backup > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.4.1   14.669 ms  9.011 ms  13.281 ms
 2   10.200.30.1   21.703 ms  19.682 ms  20.055 ms
 3   10.0.3.1   30.922 ms  21.175 ms  19.855 ms
 4   10.10.20.1   20.274 ms  20.557 ms  20.833 ms
 5   192.168.28.2   20.772 ms  20.393 ms  20.875 ms
^C 6
```

ISP-A Down



vpc-m1

trace 8.8.8.8 > mik-1 > sw-core-1 > forti-main > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   2.085 ms  1.288 ms  1.432 ms
 2   10.200.0.1    5.091 ms  9.338 ms  5.075 ms
 3   10.0.0.1      3.690 ms  5.325 ms  11.637 ms
 4   10.10.20.1    10.967 ms  14.314 ms  6.680 ms
 5   192.168.28.2   8.009 ms  4.439 ms  12.255 ms
^C 6      *  *
```

vpc-m2

trace 8.8.8.8 > mik-2 > sw-core-2 > forti-backup > isp-B

(default route vpc-m2 melalui ISP-B. Jika ISP-A Down maka vpc-m2 tidak akan terpengaruh)

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   2.061 ms  1.737 ms  0.808 ms
 2   10.200.20.1   3.326 ms  2.510 ms  1.699 ms
 3   10.0.3.1   14.013 ms  3.896 ms  11.629 ms
 4   10.10.20.1   5.301 ms  14.306 ms  11.296 ms
 5   192.168.28.2   4.139 ms  7.127 ms  3.894 ms
^C 6
```

vpc-c3

trace 8.8.8.8 > c-1 > sw-core-1 > forti-main > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.3.1   9.871 ms  16.472 ms  3.441 ms
 2   10.200.10.1   20.508 ms  20.546 ms  22.108 ms
 3   10.0.0.1   19.599 ms  20.467 ms  19.377 ms
 4   10.10.20.1   20.640 ms  18.805 ms  20.452 ms
 5   192.168.28.2   20.431 ms  21.114 ms  19.848 ms
^C 6
```

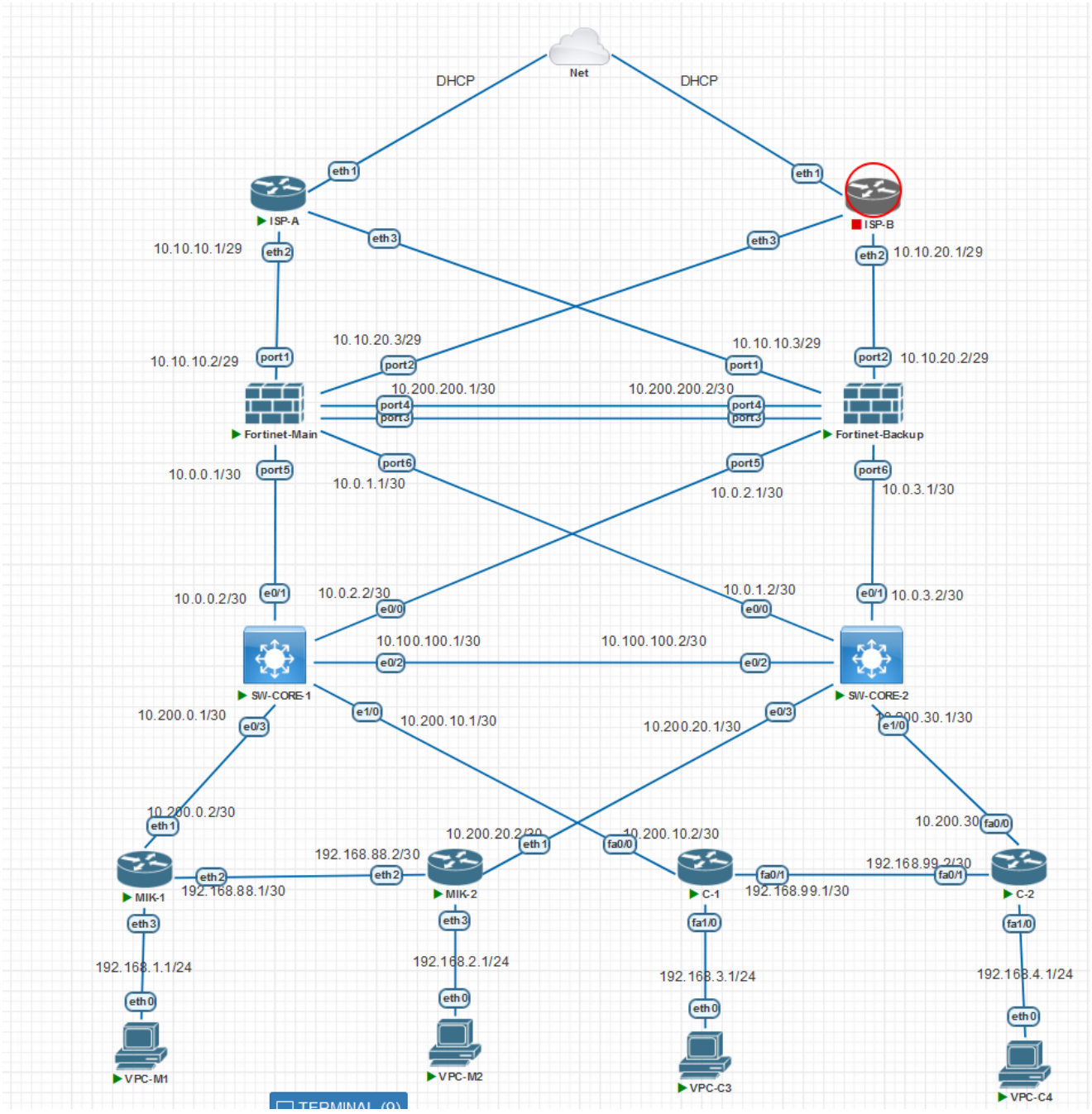
vpc-c4

trace 8.8.8.8 > c-2 > sw-core-2 > forti-backup > isp-B

(default route vpc-c4 melalui ISP-B. Jika ISP-A Down maka vpc-c4 tidak akan terpengaruh)

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.4.1   16.433 ms  3.663 ms  9.966 ms
 2   10.200.30.1   19.145 ms  20.178 ms  20.848 ms
 3   10.0.3.1   20.419 ms  20.007 ms  21.557 ms
 4   10.10.20.1   20.296 ms  20.649 ms  20.413 ms
 5   192.168.28.2   19.470 ms  20.470 ms  20.289 ms
^C 6      *  *
```

ISP-B Down



vpc-m1

trace 8.8.8.8 > mik-1 > sw-coer-1 > forti-main > isp-A

(default route vpc-m1 melalui ISP-1, Jika ISP-B down maka vpc-m1 tidak akan terpengaruh)

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   1.491 ms  2.121 ms  2.016 ms
 2   10.200.0.1    7.745 ms  14.484 ms  6.125 ms
 3   10.0.0.1    6.190 ms  5.116 ms  4.342 ms
 4   10.10.10.1    10.019 ms  16.215 ms  5.514 ms
 5   192.168.28.2    8.798 ms  11.549 ms  7.877 ms
 6      *  *  *
^C 7      *
```

vpc-m2

trace 8.8.8.8 > mik-2 > sw-core-2 > forti-backup > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   1.453 ms  0.860 ms  2.748 ms
 2   10.200.20.1   3.127 ms  5.458 ms  6.361 ms
 3   10.0.3.1   12.424 ms  7.347 ms  9.416 ms
 4   10.10.10.1   17.383 ms  17.488 ms  12.013 ms
 5   192.168.28.2   8.080 ms  10.174 ms  10.887 ms
^C 6     *
```

vpc-c3

trace 8.8.8.8 > c-1 >sw-core-1 > forti-main > isp-A

(default route vpc-c3 melalui ISP-1. Jika ISP-B Down maka VPC-C3 tidak akan terpengaruh)

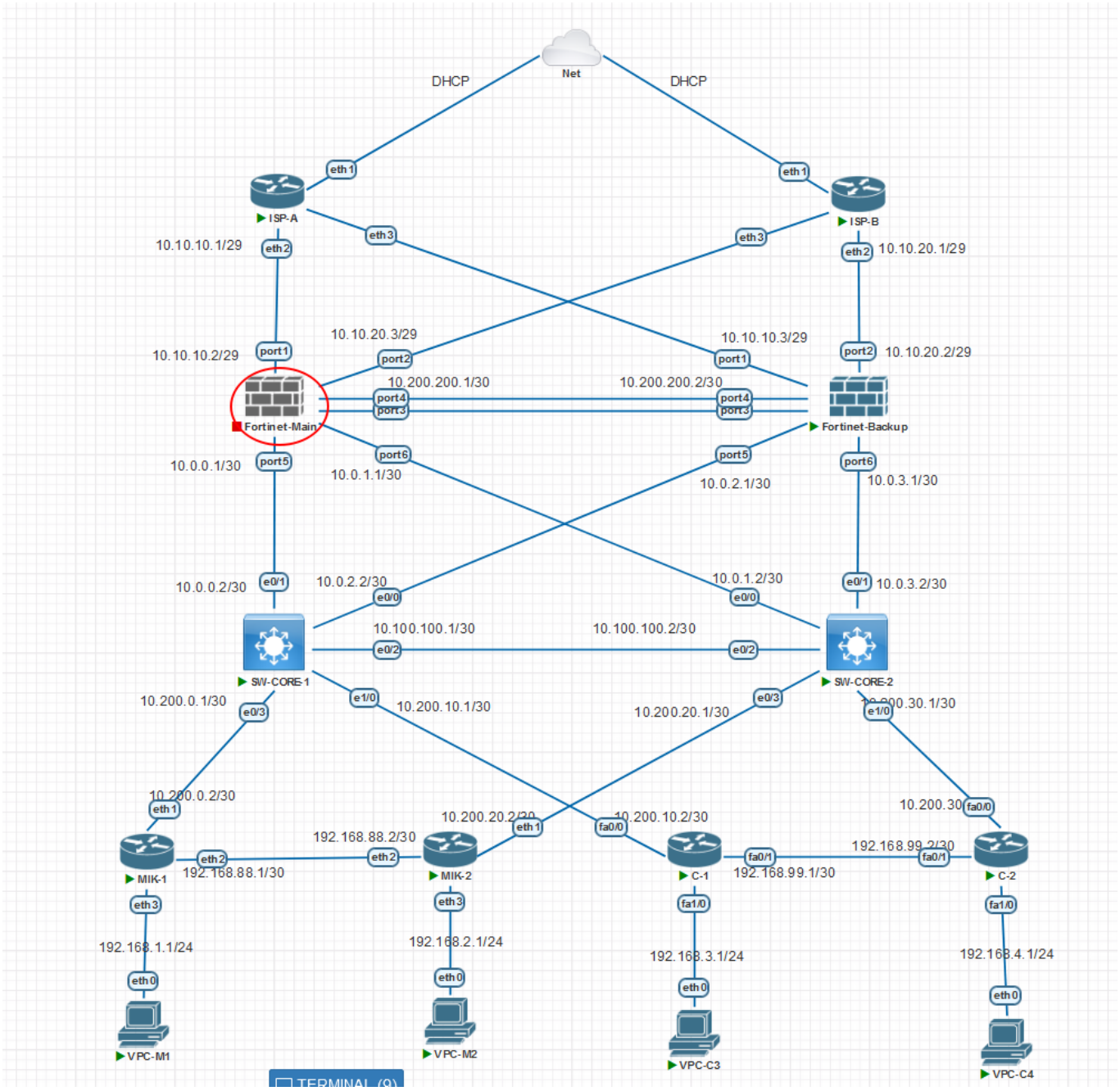
```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.3.1   9.585 ms  9.976 ms  8.714 ms
 2   10.200.10.1   22.586 ms  20.695 ms  20.086 ms
 3   10.0.0.1   20.400 ms  20.085 ms  20.002 ms
 4   10.10.10.1   19.942 ms  19.097 ms  19.535 ms
 5   192.168.28.2   43.426 ms  20.331 ms  21.440 ms
^C 6     *
```

vpc-c4

trace 8.8.8.8 > c-2 > sw-core-2 > forti-backup > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.4.1   9.447 ms  9.986 ms  10.061 ms
 2   10.200.30.1   20.667 ms  17.134 ms  20.467 ms
 3   10.0.3.1   20.094 ms  20.563 ms  19.714 ms
 4   10.10.10.1   19.881 ms  20.536 ms  19.487 ms
 5   192.168.28.2   19.359 ms  19.587 ms  19.341 ms
 6     *  *  *
^C 7
```

Forti-Main Down (link sw-core1 ke arah forti-main down)



vpc-m1

trace 8.8.8.8 > mik-1 > sw-core-1 > sw-core-2 > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   1.909 ms  1.510 ms  0.991 ms
 2   10.200.0.1   12.712 ms  4.209 ms  6.626 ms
 3   10.0.2.1   5.657 ms  9.230 ms  12.724 ms
 4   10.10.20.1   4.823 ms  10.945 ms  7.562 ms
 5   192.168.28.2   9.359 ms  12.413 ms  7.281 ms
^C 6      *  *
```

vpc-m2

trace 8.8.8.8 > mik-1 > sw-core-2 > forti-backup > isp-B

(akan tetap lewat ISP-2 krn default lewat ISP-2)

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   4.120 ms  4.809 ms  14.475 ms
 2   10.200.20.1   6.423 ms  2.378 ms  2.273 ms
 3   10.0.3.1   12.837 ms  2.940 ms  10.407 ms
 4   10.10.20.1   6.005 ms  9.081 ms  16.722 ms
 5   192.168.28.2   6.118 ms  17.708 ms  4.868 ms
^C 6      *
```

vpc-c3

trace 8.8.8.8 > c-1 > sw-core-1 > forti-backup > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.3.1   15.271 ms  10.025 ms  9.054 ms
 2   10.200.10.1   23.374 ms  20.911 ms  19.741 ms
 3   10.0.2.1   19.934 ms  21.082 ms  19.982 ms
 4   10.10.20.1   37.591 ms  20.096 ms  19.614 ms
 5   192.168.28.2   24.370 ms  20.736 ms  19.983 ms
^C 6      *
```

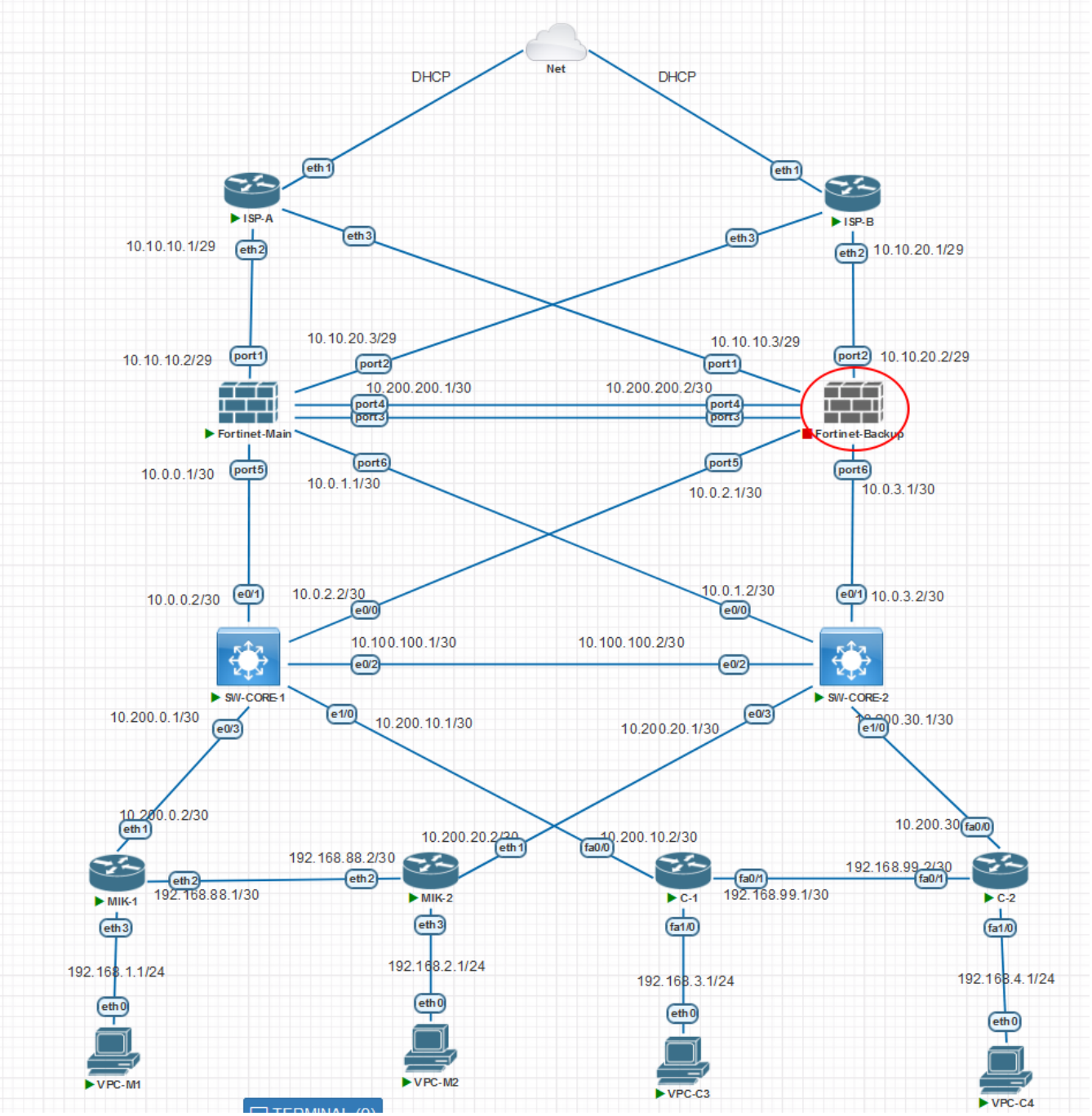
vpc-c4

trace 8.8.8.8 > c-2 > sw-core2 > forti-backup > isp-B

(akan tetap lewat ISP-2 krn default lewat ISP-2)

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.4.1   9.753 ms  10.460 ms  9.641 ms
 2   10.200.30.1   19.866 ms  19.764 ms  19.872 ms
 3   10.0.3.1   19.915 ms  20.000 ms  20.186 ms
 4   10.10.20.1   19.917 ms  19.310 ms  20.163 ms
 5   192.168.28.2   31.333 ms  19.389 ms  19.412 ms
^C 6
```

Forti-Backup Down (link sw-core2 ke arah forti-backup down)



vpc-m1

trace 8.8.8.8 > sw-core1 > forti-main > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   2.275 ms  1.286 ms  0.966 ms
 2   10.200.0.1    7.335 ms  11.586 ms  1.868 ms
 3   10.0.0.1    3.706 ms  9.201 ms  3.297 ms
 4   10.10.10.1    5.101 ms  9.501 ms  7.455 ms
 5   192.168.28.2    7.697 ms  9.978 ms  9.643 ms
^C 6      *
```

vpc-m2

trace 8.8.8.8 > sw-core2 > forti-main > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   1.148 ms  0.722 ms  0.866 ms
 2   10.200.20.1   4.872 ms  5.460 ms  2.416 ms
 3   10.0.1.1   5.509 ms  3.119 ms  8.256 ms
 4   10.10.10.1   8.330 ms  7.747 ms  4.611 ms
 5   192.168.28.2   5.567 ms  20.784 ms  5.382 ms
^C 6     *  *
```

vpc-c3

trace 8.8.8.8 > C-1 > C-2 > sw-core-2 > forti-main > isp-A

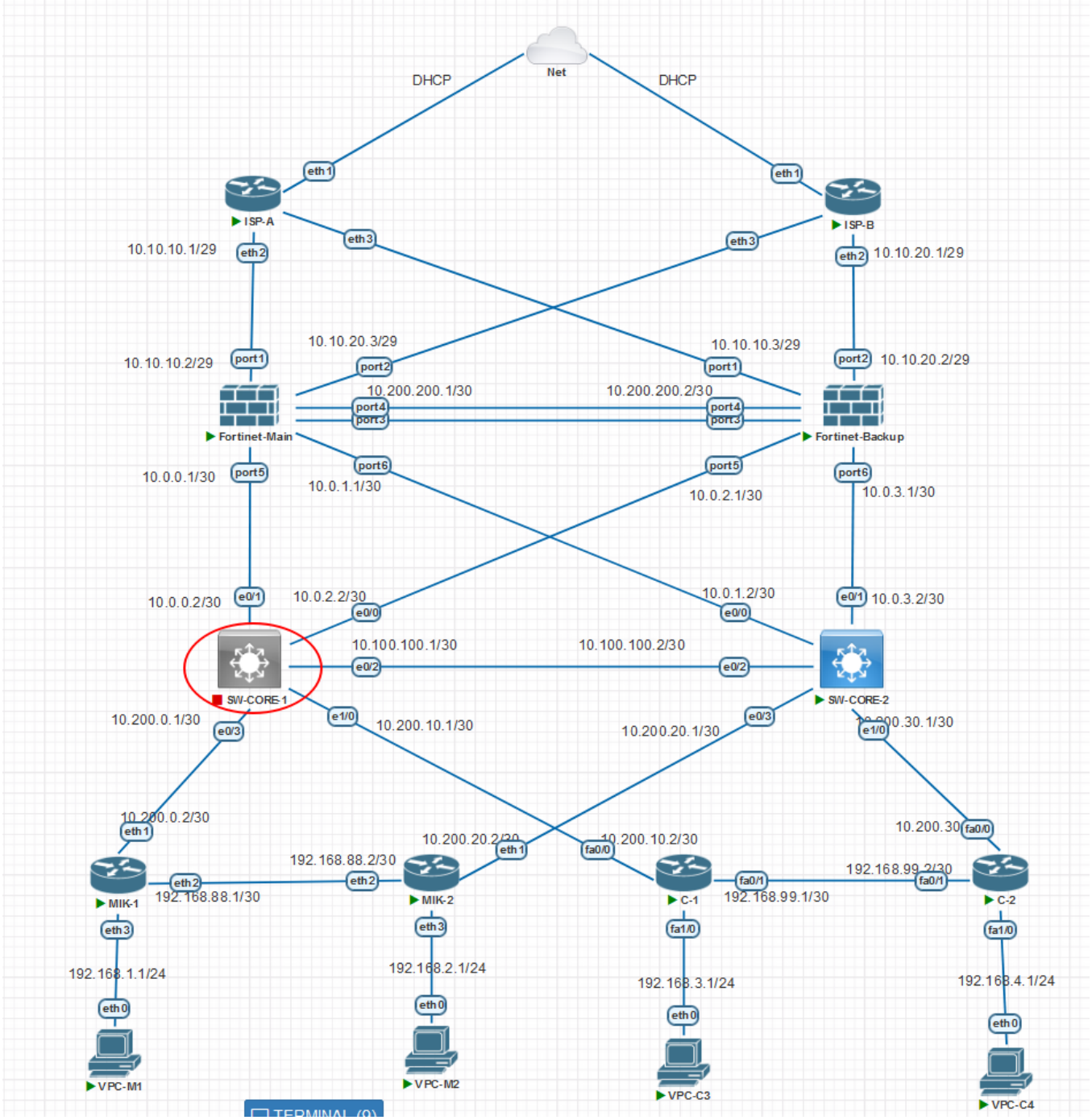
```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.3.1   8.145 ms  7.569 ms  9.282 ms
 2   192.168.99.2   21.030 ms  20.285 ms  20.487 ms
 3   10.200.30.1   29.525 ms  30.441 ms  30.578 ms
 4   10.0.1.1   29.708 ms  30.788 ms  30.593 ms
 5   10.10.10.1   52.104 ms  31.822 ms  30.869 ms
 6   192.168.28.2   30.334 ms  29.972 ms  30.250 ms
^C 7     *
```

vpc-c4

trace 8.8.8.8 > C-2 > sw-core-2 > forti-main > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.4.1   6.602 ms  8.773 ms  10.039 ms
 2   10.200.30.1   21.036 ms  19.442 ms  18.933 ms
 3   10.0.1.1   23.273 ms  19.911 ms  20.391 ms
 4   10.10.10.1   21.939 ms  20.546 ms  20.533 ms
 5   192.168.28.2   19.722 ms  20.261 ms  19.416 ms
^C 6     *
```

sw-core-1 down (link mik-1 ke arah sw-core1 down)



vpc-m1

trace 8.8.8.8 > mik-1 > mik-2 > sw-core-2 > forti-backup > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   1.035 ms  0.921 ms  0.729 ms
 2   192.168.88.2   7.470 ms  9.266 ms  10.287 ms
 3   10.200.20.1   5.017 ms  8.613 ms  4.470 ms
 4   10.0.3.1   19.535 ms  9.785 ms  7.549 ms
 5   10.10.20.1   8.127 ms  18.896 ms  12.689 ms
 6   192.168.28.2   11.755 ms  14.419 ms  6.573 ms
^C 7
```

vpc-m2

trace 8.8.8.8 > mik-2 > sw-core-2 > forti-backup > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   1.003 ms  0.782 ms  1.227 ms
 2   10.200.20.1   2.626 ms  1.434 ms  6.644 ms
 3   10.0.3.1   5.890 ms  4.037 ms  6.738 ms
 4   10.10.20.1   14.825 ms  8.402 ms  9.606 ms
 5   192.168.28.2   13.647 ms  17.329 ms  34.177 ms
^C 6      *
```

vpc-c3

trace 8.8.8.8 > C-1 > C-2 > sw-core-2> forti-backup > isp-B

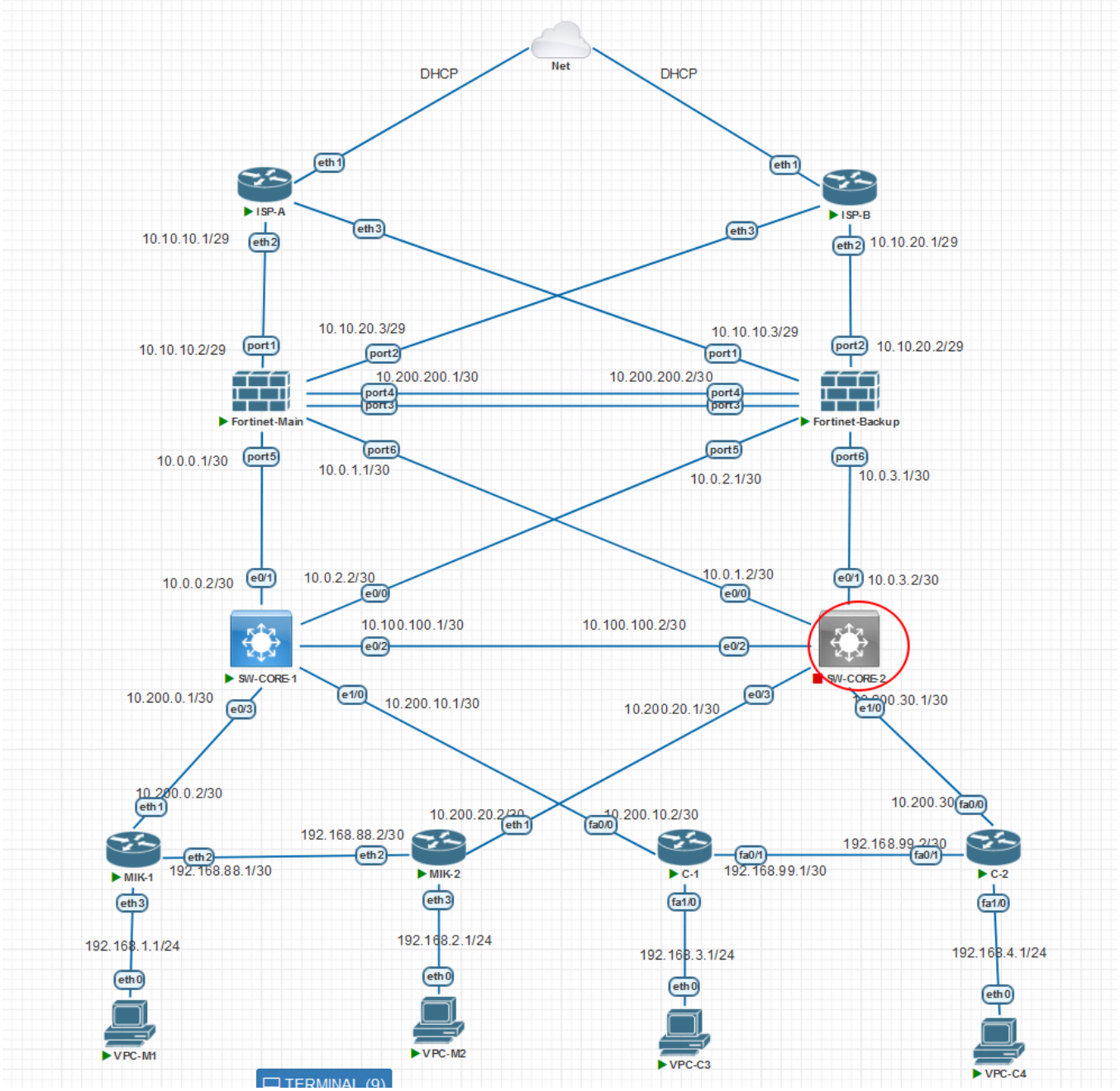
```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.3.1   10.859 ms  8.890 ms  10.649 ms
 2   192.168.99.2   18.904 ms  31.412 ms  31.531 ms
 3   10.200.30.1   30.339 ms  30.020 ms  26.044 ms
 4   10.0.3.1   31.016 ms  30.374 ms  30.381 ms
 5   10.10.20.1   42.487 ms  41.034 ms  51.642 ms
 6   192.168.28.2   29.907 ms  31.099 ms  30.287 ms
^C 7      *
```

vpc-c4

trace 8.8.8.8 > C-2 > sw-core-2 > forti-backup > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.4.1   9.621 ms  10.024 ms  8.396 ms
 2   10.200.30.1   20.460 ms  19.742 ms  20.951 ms
 3   10.0.3.1   19.394 ms  19.249 ms  21.436 ms
 4   10.10.20.1   62.965 ms  21.194 ms  19.813 ms
 5   192.168.28.2   14.862 ms  31.333 ms  31.410 ms
^C 6      *
```

sw-core-2 down



vpc-m1

trace 8.8.8.8 > mik-1 > sw-core-1 > forti-main > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   0.516 ms  3.758 ms  3.400 ms
 2   10.200.0.1    4.197 ms  1.694 ms  1.221 ms
 3   10.0.0.1     39.117 ms  8.645 ms  12.347 ms
 4   10.10.10.1    9.523 ms  14.080 ms  14.783 ms
 5   192.168.28.2   20.357 ms  6.553 ms  14.441 ms
^C 6      *
```

vpc-m2

trace 8.8.8.8 > mik-2 > mik-1 > sw-core-1 > forit-main > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   1.017 ms  0.610 ms  0.684 ms
 2   192.168.88.1   12.040 ms  4.666 ms  2.750 ms
 3   10.200.0.1   9.451 ms  7.510 ms  5.285 ms
 4   10.0.0.1   3.913 ms  4.297 ms  14.408 ms
 5   10.10.10.1   10.561 ms  9.379 ms  6.609 ms
 6   192.168.28.2   7.517 ms  10.380 ms  7.259 ms
^C 7     *
```

vpc-c3

trace 8.8.8.8 > C-1 > sw-core-1 > forti-main > isp-A

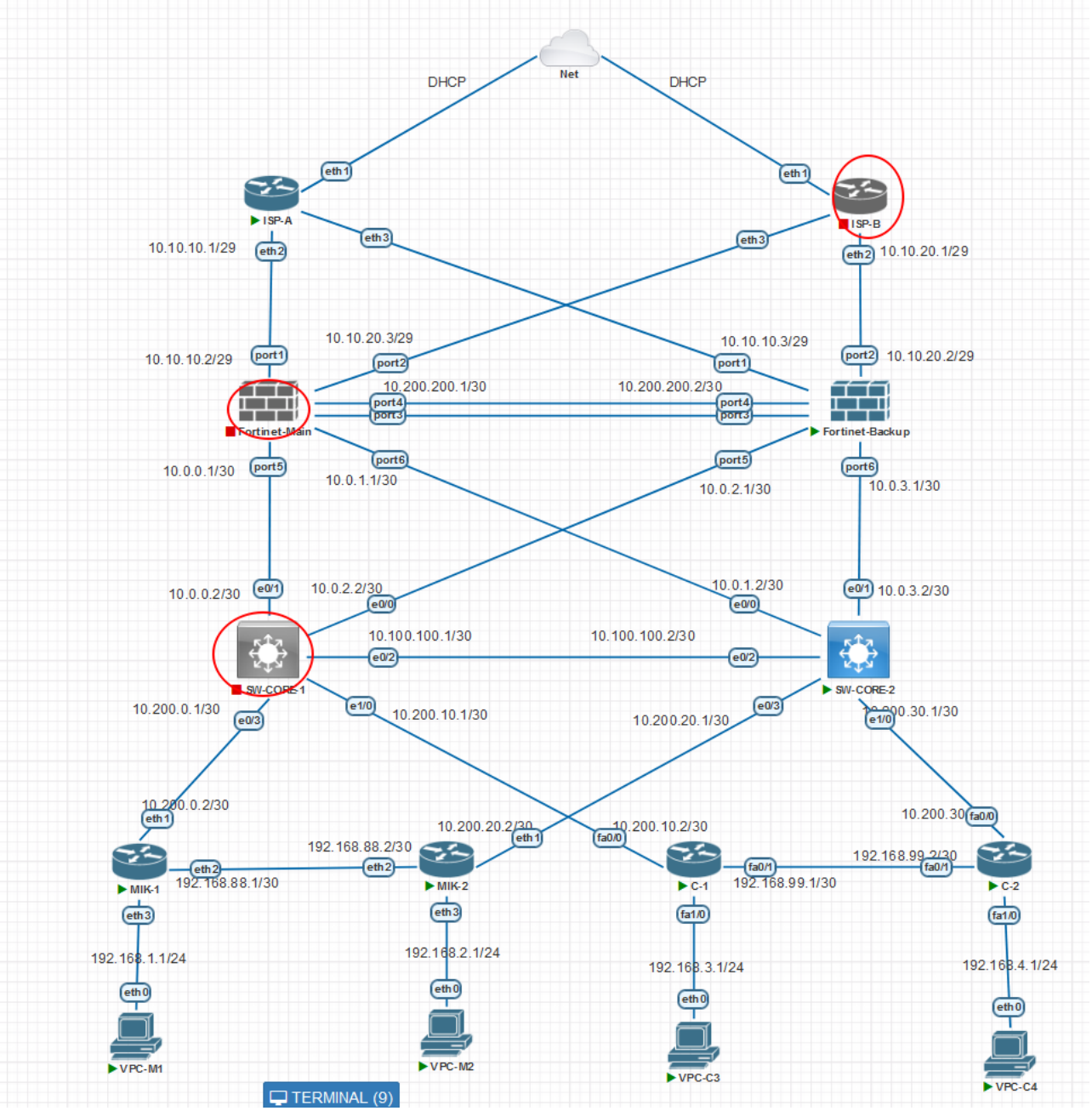
```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.3.1   9.050 ms  9.112 ms  8.970 ms
 2   10.200.10.1   22.893 ms  17.376 ms  20.053 ms
 3   10.0.0.1   20.692 ms  19.639 ms  20.721 ms
 4   10.10.10.1   30.557 ms  19.981 ms  20.186 ms
 5   192.168.28.2   20.887 ms  19.306 ms  21.326 ms
^C 6     *
```

vpc-4

trace 8.8.8.8 > C-2 > C-1> sw-core-2 > forti-main > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.4.1   3.511 ms  12.955 ms  5.728 ms
 2   192.168.99.1   26.258 ms  19.833 ms  19.412 ms
 3   10.200.10.1   40.753 ms  28.495 ms  38.777 ms
 4   10.0.0.1   39.691 ms  39.791 ms  41.534 ms
 5   10.10.10.1   39.838 ms  40.323 ms  30.301 ms
 6   192.168.28.2   30.041 ms  40.248 ms  30.302 ms
^C 7     *
```

sw-core-1 | forti-main | isp-b down



vpc-m1

trace 8.8.8.8 > Mik-1 > Mik-2 > sw-core-2 > forti-backup > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   0.961 ms  0.867 ms  0.787 ms
 2   192.168.88.2   3.390 ms  1.886 ms  3.207 ms
 3   10.200.20.1   4.159 ms  7.658 ms  8.080 ms
 4   10.0.3.1   5.857 ms  4.004 ms  12.597 ms
 5   10.10.10.1   8.014 ms  27.262 ms  8.326 ms
 6   192.168.28.2   11.504 ms  15.277 ms  10.663 ms
^C 7     *
```

vpc-m2

trace 8.8.8.8 > mik-2 > sw-core-2 > forti-backup > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   0.742 ms  1.003 ms  2.813 ms
 2   10.200.20.1   2.364 ms  6.639 ms  2.646 ms
 3   10.0.3.1   9.673 ms  5.037 ms  8.486 ms
 4   10.10.10.1   4.360 ms  4.025 ms  7.578 ms
 5   192.168.28.2   5.977 ms  12.608 ms  5.740 ms
^C 6
```

vpc-c3

trace 8.8.8.8 > c-1 > c-2 > sw-core-2 > forit-backup> isp-A

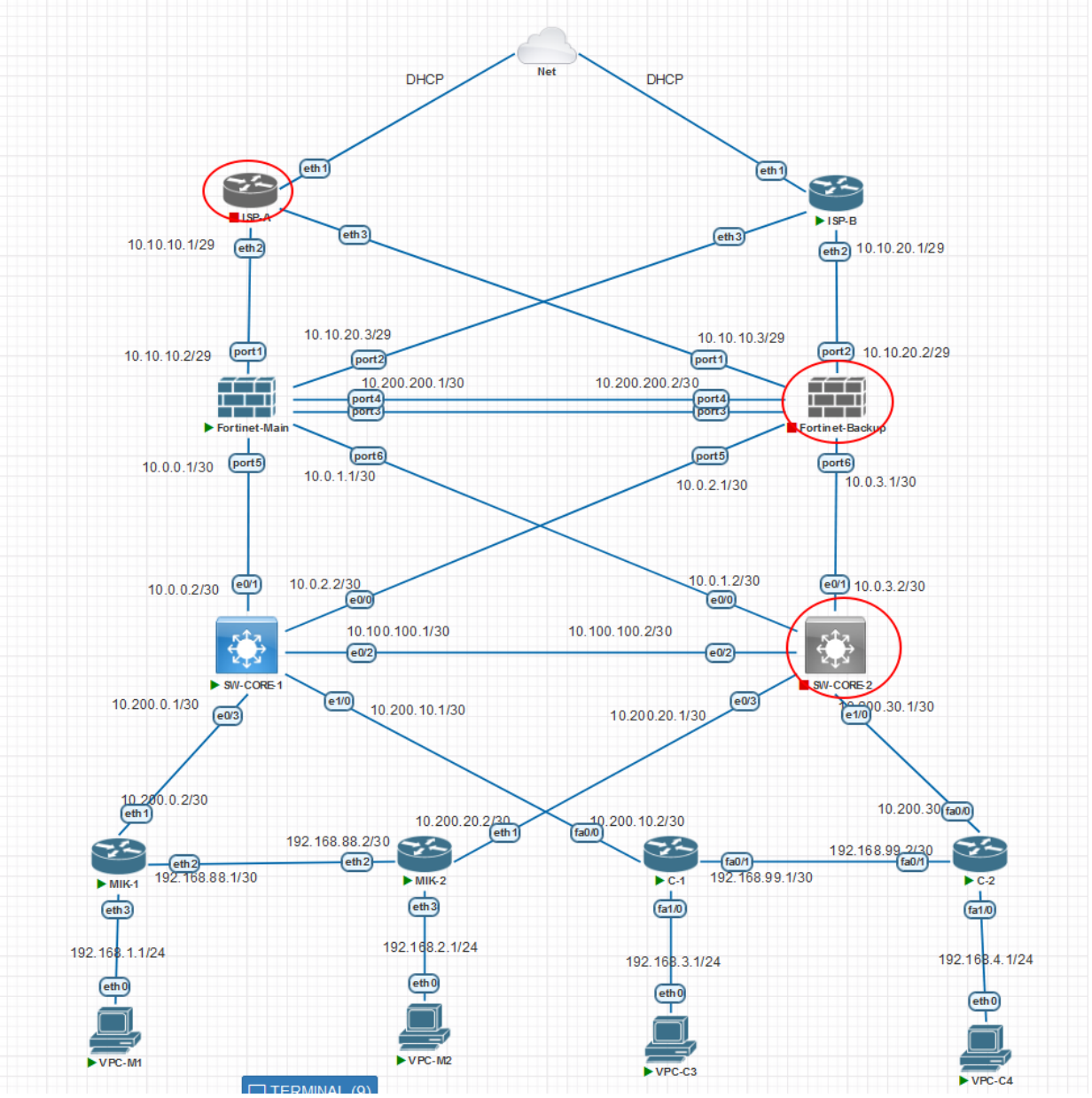
```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.3.1   9.275 ms  9.167 ms  9.478 ms
 2   192.168.99.2   20.412 ms  19.629 ms  20.144 ms
 3   10.200.30.1   31.402 ms  31.919 ms  31.316 ms
 4   10.0.3.1   30.979 ms  32.382 ms  29.890 ms
 5   10.10.10.1   31.035 ms  41.187 ms  30.758 ms
 6   192.168.28.2   44.003 ms  28.851 ms  33.224 ms
^C 7
```

vpc-c4

trace 8.8.8.8 > c-2 > sw-core-2 > forti-backup > isp-A

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.4.1   4.166 ms  10.245 ms  9.915 ms
 2   10.200.30.1   24.053 ms  19.174 ms  19.852 ms
 3   10.0.3.1   25.581 ms  20.811 ms  20.349 ms
 4   10.10.10.1   18.963 ms  13.892 ms  19.773 ms
 5   192.168.28.2   31.160 ms  20.400 ms  19.780 ms
^C 6
```

sw-core-2 | forti-backup | isp-a down



vpc-m1

trace 8.8.8.8 > mik-1 > sw-core-1 > forti-main > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.1.1   0.807 ms  1.196 ms  4.179 ms
 2   10.200.0.1    5.418 ms  5.004 ms  7.668 ms
 3   10.0.0.1     20.208 ms  11.842 ms  5.918 ms
 4   10.10.20.1    15.126 ms  50.551 ms  11.343 ms
 5   192.168.28.2   36.236 ms  26.230 ms  13.625 ms
^C 6      *  *
```

vpc-m2

trace 8.8.8.8 > mik-2 > mik-1 >sw-core-1 > forti-main > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.2.1   3.976 ms  1.787 ms  18.936 ms
 2   192.168.88.1   12.768 ms  27.575 ms  8.995 ms
 3   10.200.0.1   35.738 ms  25.244 ms  24.687 ms
 4   10.0.0.1   84.642 ms  30.560 ms  25.256 ms
 5   10.10.20.1   62.887 ms  49.525 ms  31.449 ms
 6   192.168.28.2   66.174 ms  30.209 ms  30.309 ms
^C 7
```

vpc-c3

trace 8.8.8.8 > c-1 > sw-core-1 > forti-main > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.3.1   3.475 ms  9.644 ms  9.932 ms
 2   10.200.10.1   19.691 ms  20.076 ms  20.441 ms
 3   10.0.0.1   29.020 ms  18.881 ms  22.153 ms
 4   10.10.20.1   36.905 ms  62.280 ms  30.153 ms
 5   192.168.28.2   32.848 ms  20.169 ms  53.220 ms
^C 6      *
```

vpc-c4

trace 8.8.8.8 > c-2 > c-1 > sw-core-1 > forti-main > isp-B

```
VPCS> trace 8.8.8.8
trace to 8.8.8.8, 8 hops max, press Ctrl+C to stop
 1   192.168.4.1   5.870 ms  10.078 ms  12.174 ms
 2   192.168.99.1   30.119 ms  23.268 ms  20.328 ms
 3   10.200.10.1   47.245 ms  52.153 ms  30.339 ms
 4   10.0.0.1   30.320 ms  42.131 ms  41.779 ms
 5   10.10.20.1   40.258 ms  30.409 ms  30.886 ms
 6   192.168.28.2   51.281 ms  40.291 ms  41.277 ms
^C 7
```

Dari hasil konfigurasi dan pengujian yang telah dilakukan, dapat disimpulkan bahwa tujuan High Availability pada jaringan yang telah dikonfigurasi telah tercapai dengan baik. Konfigurasi yang diterapkan diharapkan mampu meminimalkan downtime pada jaringan, sehingga memastikan ketersediaan koneksi yang stabil dan handal meskipun terjadi gangguan pada perangkat jaringan.

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