



Router Virtualization

Future Internet Summer Camp 2008
2008.8.28

유 성 훈



Xen Network Type

- **Bridging Mode**
 - by MAC address at the link layer.
- **Routing Mode**
 - by IP address at the network layer.
- **NAT (Network Address Translation) Mode**
 - gateway remaps a guest's IP and port to the driver domain's port at the network layer.

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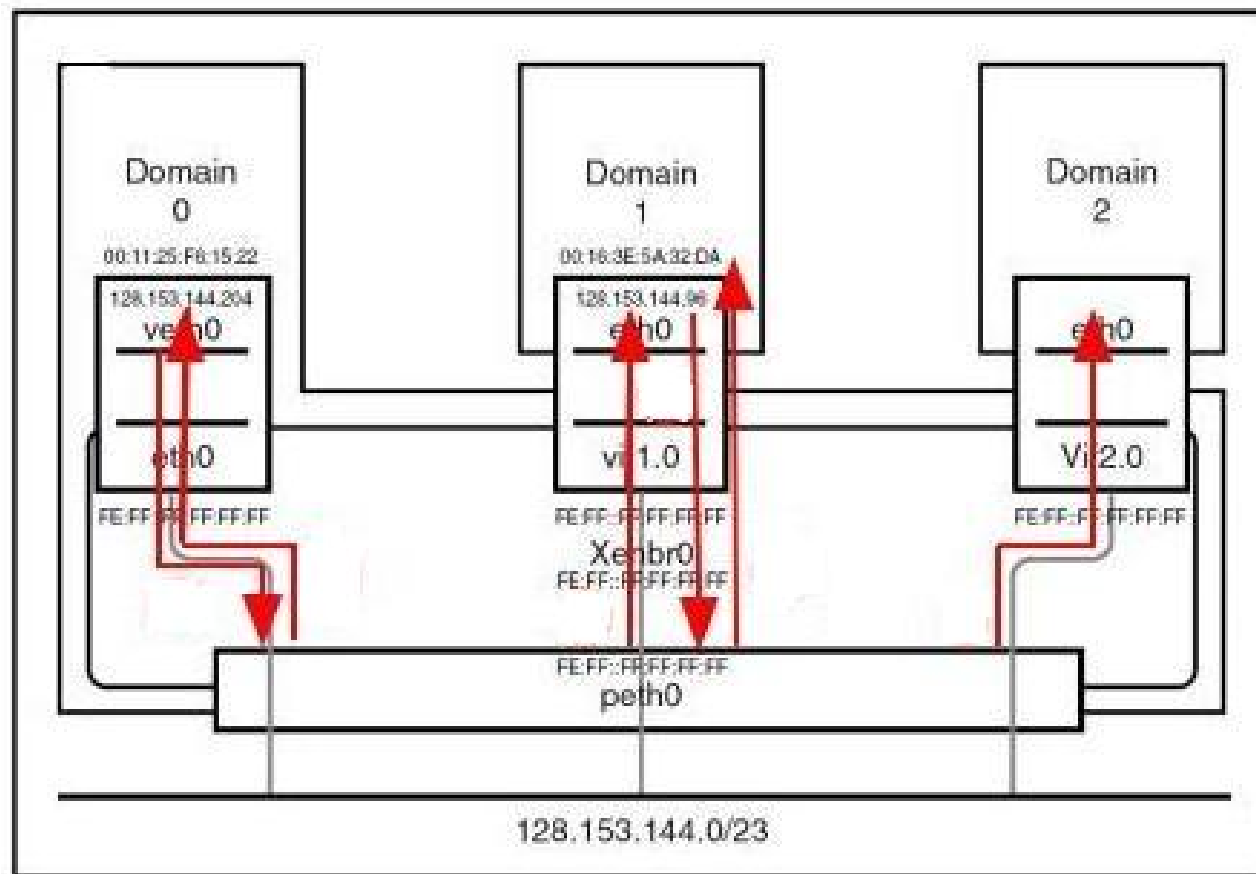
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Xen Network Type

■ Bridging Mode



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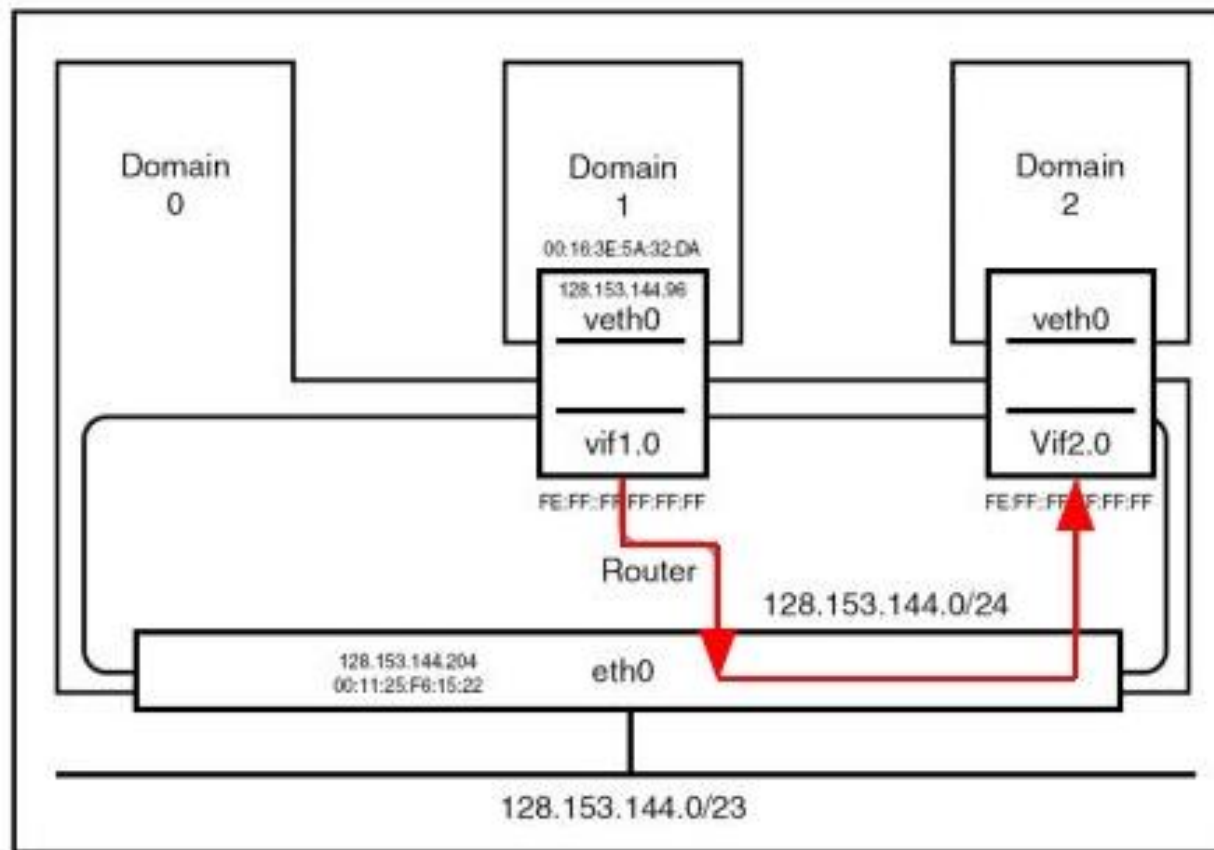
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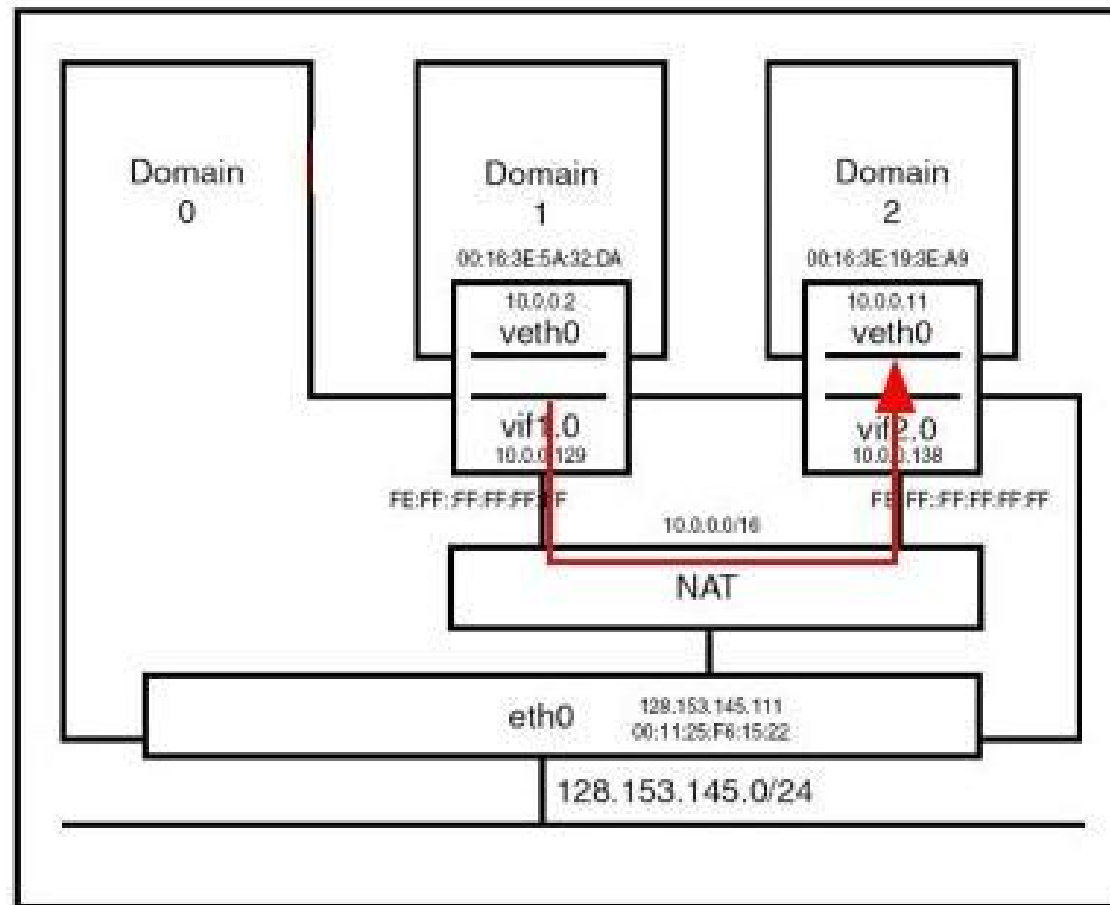
Xen Network Type

■ Routing Mode

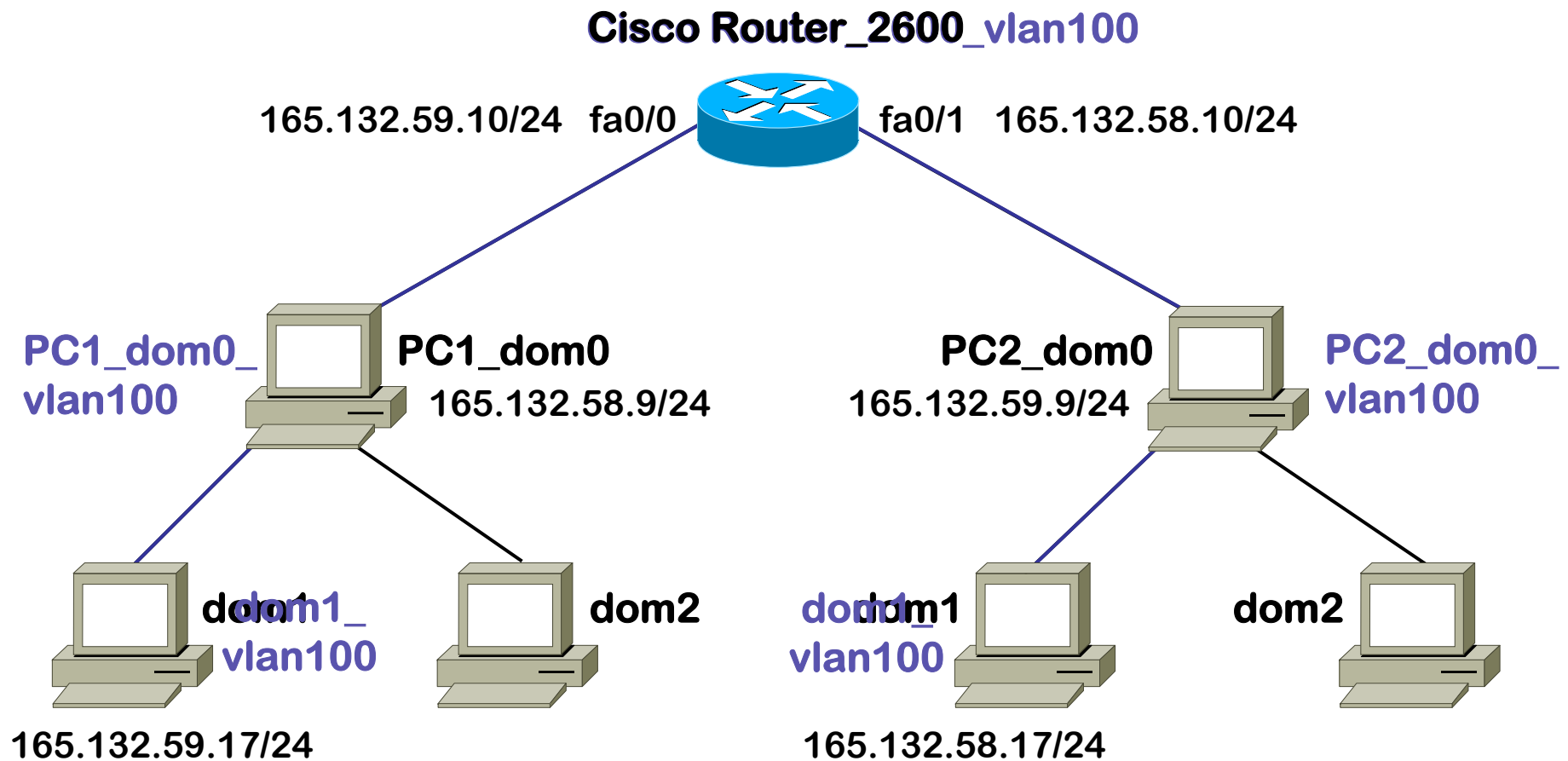


Xen Network Type

- NAT Mode



■ Topology



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Separated Vlan Network by Xen

■ Result

- PC1의 dom_1으로부터 PC2의 dom1으로 ICMP Ping Test

No. .	Time	Source	Destination	Protocol	Info
1	0.000000	165.132.58.17	165.132.59.17	ICMP	Echo (ping) request
2	0.000031	165.132.59.17	165.132.58.17	ICMP	Echo (ping) reply
3	0.898825	165.132.58.17	165.132.59.17	ICMP	Echo (ping) request
4	0.898905	165.132.59.17	165.132.58.17	ICMP	Echo (ping) reply
5	1.898865	165.132.58.17	165.132.59.17	ICMP	Echo (ping) request
6	1.898944	165.132.59.17	165.132.58.17	ICMP	Echo (ping) reply
7	2.898897	165.132.58.17	165.132.59.17	ICMP	Echo (ping) request
8	2.899006	165.132.59.17	165.132.58.17	ICMP	Echo (ping) reply
9	3.510035	Cisco_67:31:60	Cisco_67:31:60	LOOP	Reply
10	3.898944	165.132.58.17	165.132.59.17	ICMP	Echo (ping) request
11	3.899018	165.132.59.17	165.132.58.17	ICMP	Echo (ping) reply
12	4.067411	Cisco_67:31:60	CDP/VTP	CDP	Cisco Discovery Protocol


```

> Frame 1 (102 bytes on wire, 102 bytes captured)
> Ethernet II, Src: Cisco_67:31:60 (00:0f:34:67:31:60), Dst: 00:16:3e:18:e5:ed (00:16:3e:18:e5:ed)
> 802.1Q Virtual LAN
> Internet Protocol, Src: 165.132.58.17 (165.132.58.17), Dst: 165.132.59.17 (165.132.59.17)
> Internet Control Message Protocol

```

PC1_dom1과 PC2_dom1이 802.1Q vlan tag가 붙어서 정상적으로 통신됨

➡ Xen위에서 vlan을 이용하여 각각 독립된 망 구성 가능

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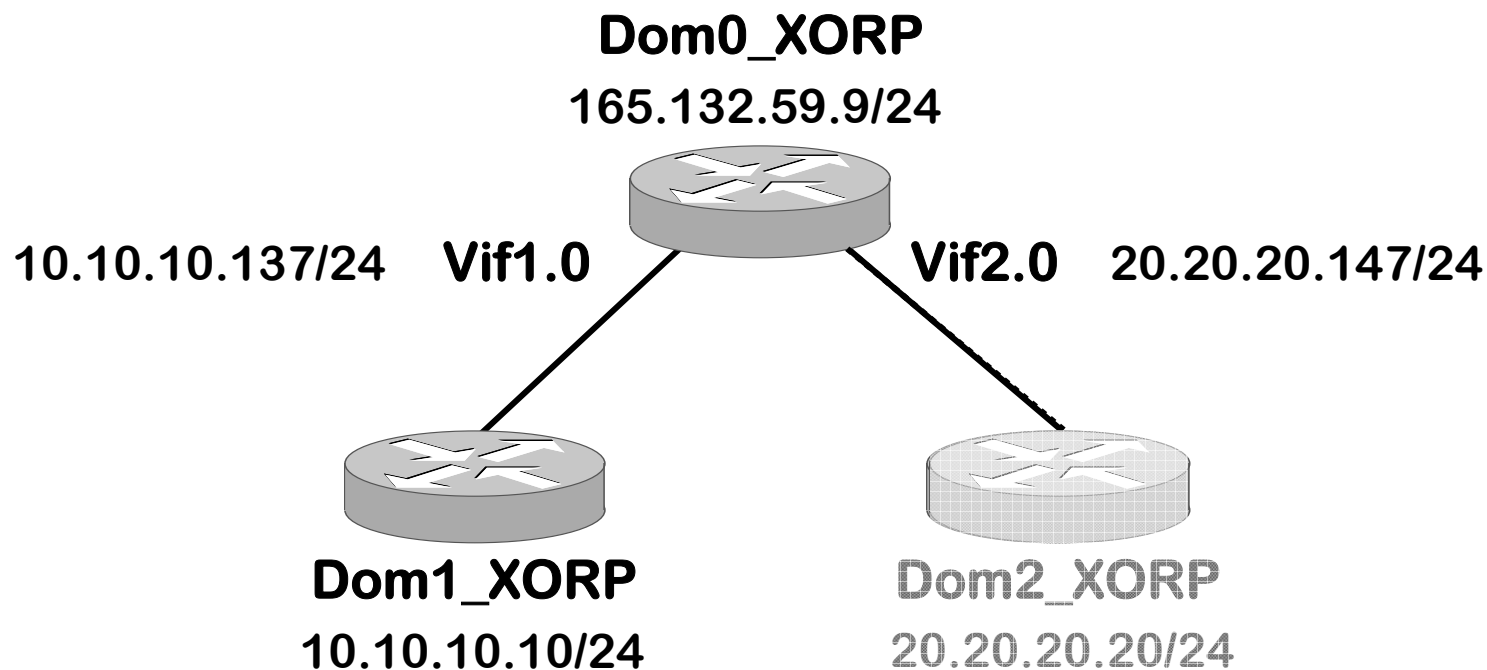
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Networking by XORP

- XORP의 routing 기능 확인



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Networking by XORP

■ dom1에서 dom2로의 Ping Test

```
[root@localhost rtrmgr]# ./xorpsh
Welcome to XORP on localhost.localdomain
root@localhost.localdomain> ping 20.20.20.20
PING 20.20.20.20 (20.20.20.20) 56(84) bytes of data:
64 bytes from 20.20.20.20: icmp_seq=1 ttl=63 time=0.354 ms
64 bytes from 20.20.20.20: icmp_seq=2 ttl=63 time=0.140 ms
64 bytes from 20.20.20.20: icmp_seq=3 ttl=63 time=0.138 ms

Command Interrupted!

root@localhost.localdomain> ping 20.20.20.20
PING 20.20.20.20 (20.20.20.20) 56(84) bytes of data:
From 10.10.10.137 icmp_seq=1 Destination Net Unreachable
From 10.10.10.137 icmp_seq=2 Destination Net Unreachable
From 10.10.10.137 icmp_seq=3 Destination Net Unreachable
From 10.10.10.137 icmp_seq=4 Destination Net Unreachable

Command Interrupted!

root@localhost.localdomain> ping 165.132.59.9
PING 165.132.59.9 (165.132.59.9) 56(84) bytes of data:
64 bytes from 165.132.59.9: icmp_seq=1 ttl=64 time=0.100 ms
64 bytes from 165.132.59.9: icmp_seq=2 ttl=64 time=0.087 ms
64 bytes from 165.132.59.9: icmp_seq=3 ttl=64 time=0.079 ms
64 bytes from 165.132.59.9: icmp_seq=4 ttl=64 time=0.084 ms

Command Interrupted!
```

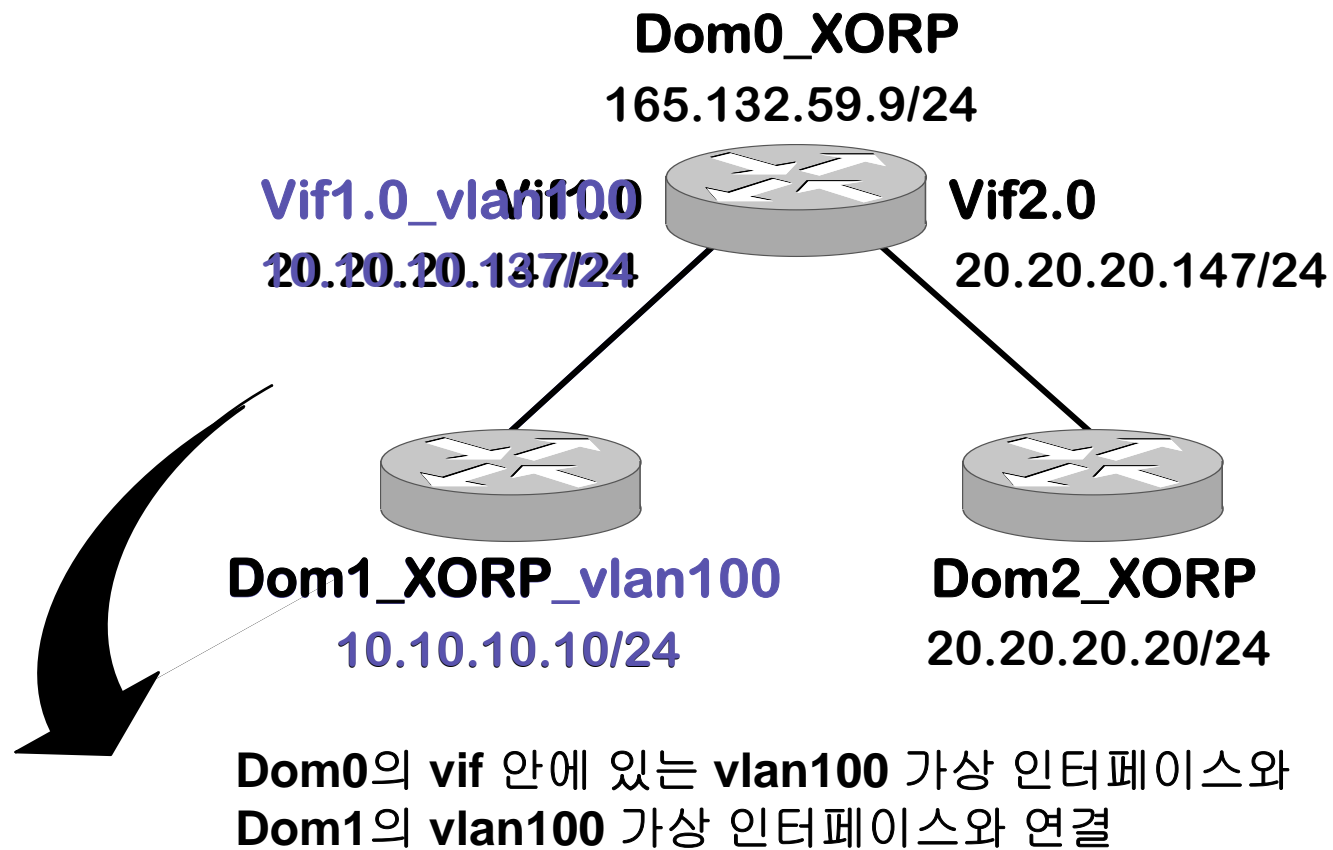
XORP를 이용하여
vif2.0 link down 후

Dom2는 도달 불가

Eth0은 도달 가능

Vlan Configure by XORP

■ Topology



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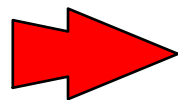
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Vlan Configure by XORP

- dom1 에서 dom2로의 Ping Test

No. .	Time	Source	Destination	Protocol	Info
1	0.000000	10.10.100.10	10.10.10.137	ICMP	Echo (ping) request
2	0.000042	10.10.10.137	10.10.100.10	ICMP	Echo (ping) reply
3	0.999658	10.10.100.10	10.10.10.137	ICMP	Echo (ping) request
4	0.999698	10.10.10.137	10.10.100.10	ICMP	Echo (ping) reply
5	1.999716	10.10.100.10	10.10.10.137	ICMP	Echo (ping) request
6	1.999760	10.10.10.137	10.10.100.10	ICMP	Echo (ping) reply
7	2.999782	10.10.100.10	10.10.10.137	ICMP	Echo (ping) request
8	2.999824	10.10.10.137	10.10.100.10	ICMP	Echo (ping) reply

b Frame 1 (102 bytes on wire, 102 bytes captured)	
b Ethernet II, Src: 00:16:3e:27:e5:44 (00:16:3e:27:e5:44), Dst: fe:ff:ff:ff:ff:ff (fe:ff:ff:ff:ff:ff)	
802.1Q Virtual LAN	
000.	= Priority: 0
...0	= CFI: 0
.... 0000 0110 0100	= 10: 100
Type: IP (0x0800)	
b Internet Protocol, Src: 10.10.100.10 (10.10.100.10), Dst: 10.10.10.137 (10.10.10.137)	
b Internet Control Message Protocol	



802.1Q Protocol..... Vlan 구성

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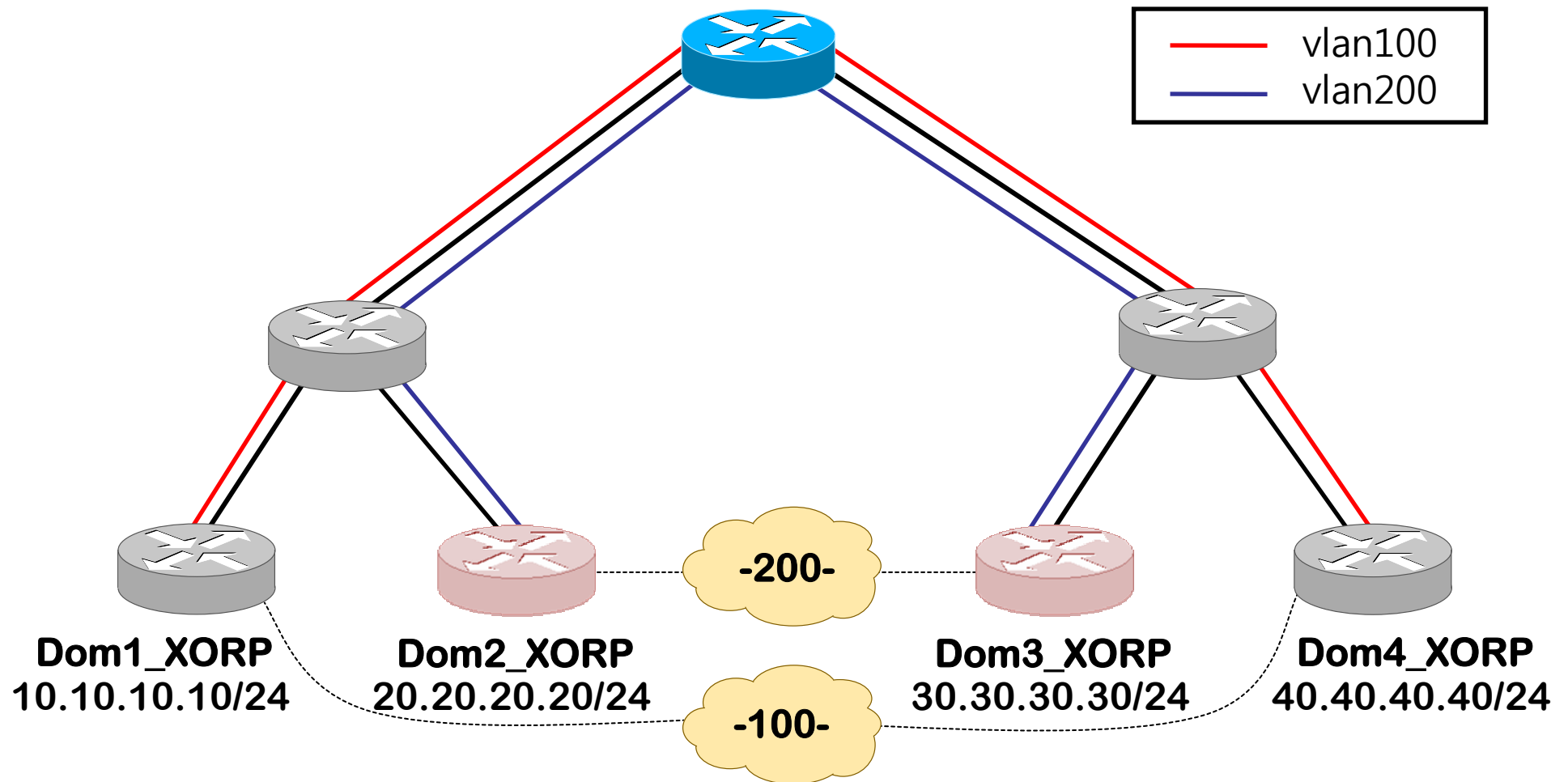
Vlan Configure by XORP

■ Result

- XORP 상에서 구성한 config 및 동작이 Xen의 physical layer에도 반영됨.
- XORP의 console에서 protocol encapsulation (e.g. 802.1q VLAN) 구성 시 Xen의 가상 인터페이스에 반영됨.
- 여러 개의 가상 라우터를 만든 후 각각의 가상인터페이스를 VLAN으로 분류하여 가상 네트워크 구성 가능.

Vlan Configure by XORP

■ Vlan Physical Topology



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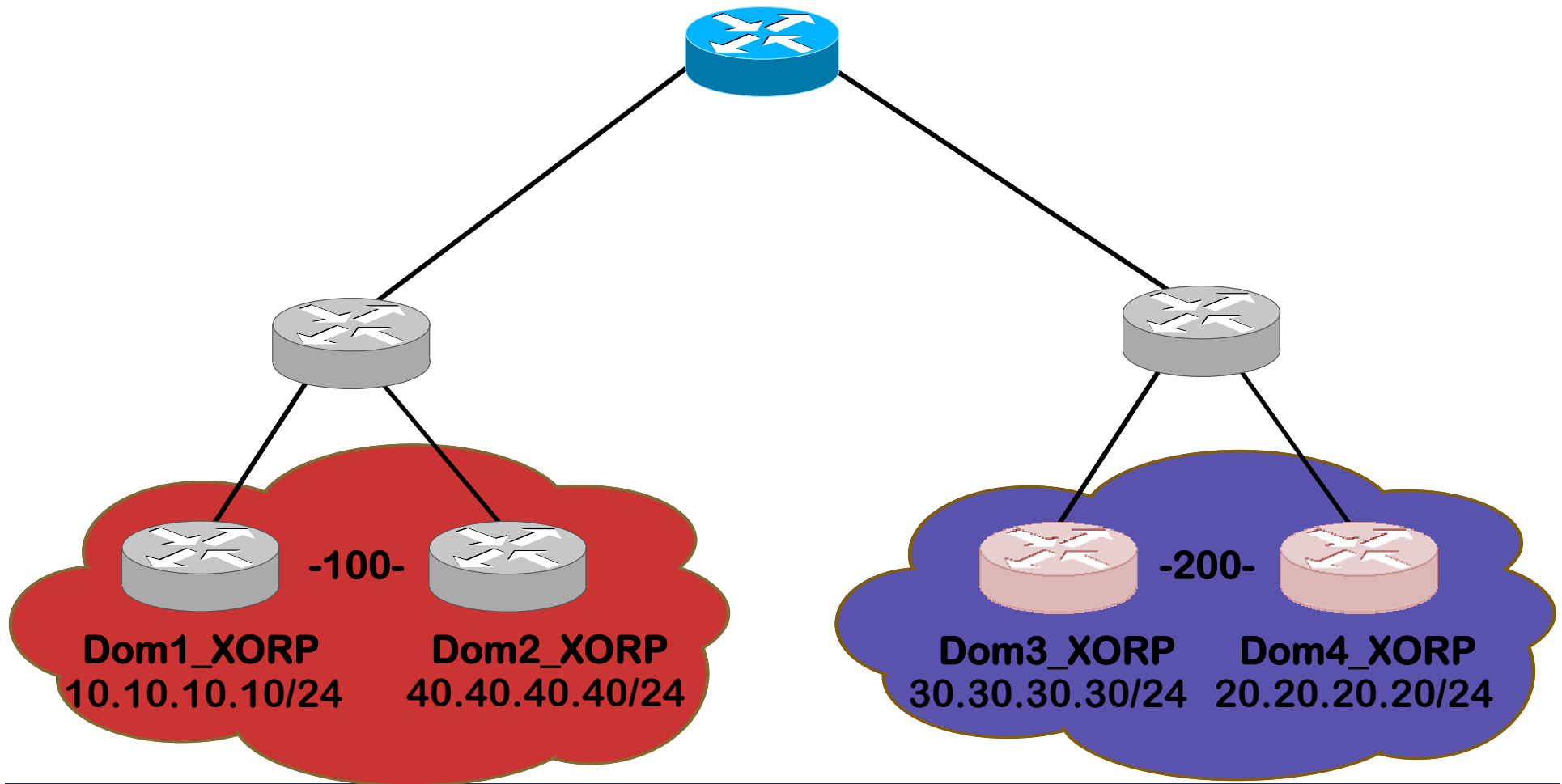
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Vlan Configure by XORP

■ Vlan Logical Topology



Conclusion

- **Xen**을 이용하여 **Virtual machine** 생성.
- **Virtual machine**에 **XORP** 라우터를 올려 가상 라우터 망 구성.
- 가상 라우터 망에서 **Vlan**을 이용하여 각각 독립된 망 구성.
- **Physical**하게는 멀리 떨어져 있는 라우터를 **logical**하게는 같은 망에 있는 것처럼 구성.