

CCNA : Ethernet

, 가 ...^^;;

가

Ethernet, Token Ring, FDDI

Ethernet

Ethernet

. Ethernet

Ethernet

~~

Ethernet **CSMA/CD**(Carrier Sense Multiple Access with Collision Detect)

??

Ethernet

data

data

?

1.

. (*Carrier Sense*)



data

(*Multiple Access*)

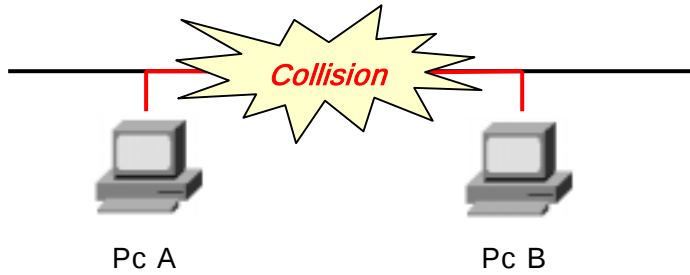
2. data

data



PC A가 가 . data ..

3. ?? A B가 ?? data



A, B 가 data . ?
data data .. data data

4. (Re Transmit)



B 가 .. CSMA/CD
가 가 .

가 2 ?



가 4 . data ?
가 ??? ... 가 2
Collision ?? .. ?? 가 100 , 200

?? , . Collision .

. Collision ..

, Collision

Collision Domain() . Collision Domain

?? , .. Collision Domain

Bridge 가 Switch 가 .(~)

Backoff Algorithm

Backoff Algorithm

Never
가

^^;;; Backoff Algorithm

.. @.@??

가

+-+;;

?? ^^ -.-;;;

?? ^^;;

가 .. Ethernet Network CSMA/CD Collision Domain

.. Collision

?? .. CSMA/CD

. Collision . ^^??

Ethernet IEEE 802.3 . IEEE 가(-

. -a) ;; LAN ;;

Token Ring IEEE 802.5 . ^^

(operation) . Ethernet 가

operation . **Half-Duplex** **Full-Duplex**가 ..

Half-Duplex Transmit() Receive() 가 .

가 .

Full-Duplex . 가 ..

..

—.—;; ^^;;

가 ..

^^;(;;)

가 . TP(Twisted Pair), Coaxial Cable, Optical Fiber

.. ??

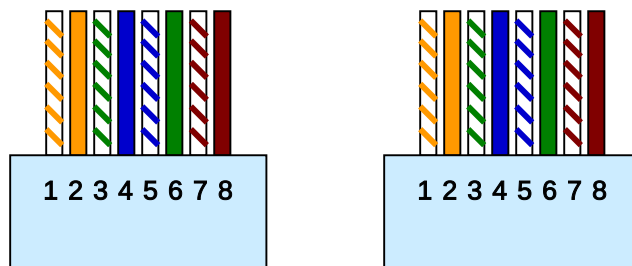
, TP UTP(Unshield Twisted Pair) .

UTP . UTP

Straight-through, Crossover, Rolled .

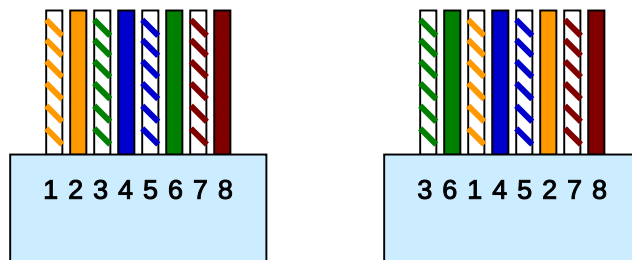
~

1. Straight-through Cable



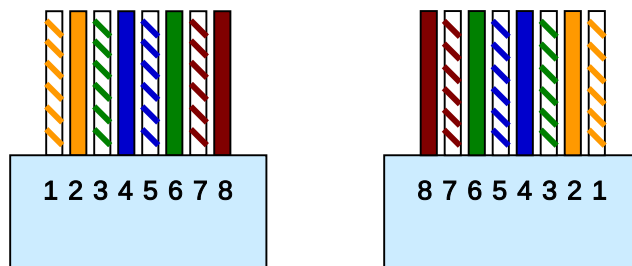
.. @_@??
 Straight-through (Direct)
 ??
 . 가
 - - - - -
 ' ,
 PC-Hub, Pc-Switch, Router-Hub, Router-Switch
 Crossover

2. Crossover Cable



Straight-through ??
 1 3 2 6
 Straight Cable
 ?
 data가
 ...
 ()
 Rolled Cable
 . PC-PC, Hub-Hub, Switch-Switch
 10BaseT 100BaseTx
 ^^, 가
 ^^;; 8가
 ^^;)

3. Rolled Cable



, Rolled Cable . ^^?
PC Router Console .

			Cable Type	Pair
10Base5	802.3	500m	Thick coaxial	
10Base2	802.3	185m	Thin coaxial	
10BaseT	802.3	100m	Cat 3,4,5(UTP)	2
100BaseTx	802.3u	100m	Cat 5(UTP)	2

가 @.@;;

. 10BaseT

10 (Mbps), Base (Baseband),

Baseband(), Broadband() 가 가 .
UTP Category

Cat 3 10BaseT, 5 100BaseTx

Pair 가 2

.. ^^

^^

;;;

OSI 7 Layer(OSI 7)

. 7

??

...

가 —a ;;

^^;;

^^

—.—;;;

CCNA : OSI 7 Layer

? ... 2
 ^^::;
 , ^^ 가 ...^^::;
 OSI 7 Layer (OSI 7)
 100% 가 . ~
 OSI(Open System Interconnection Standardization) ISO(International Organization for Standardization) OSI ..
 —a (--::)
 가 가 .. 가 가 ..
 .. OSI ? 가
 Guideline OSI .. 가 OSI
 . 640-607 OSI
 , () 가 4-5
 ^^:: (—::)
 OSI 7 Layer... 7 Layer가 ~ ~
 π_π::

가 , 7

Application Layer	7
Presentation Layer	6
Session Layer	5
Transport Layer	4
Network Layer	3
Data Link Layer	2
Physical Layer	1

(“) OSI 7 Layer . 7 1
^::;
7 CCNA
1~4 . data ^;
~

1. Application Layer (7)

가 . 가
?? Applicaton Layer .
HTTP, FTP, WWW, Telnet, SMTP, POP .

2. Presentation Layer (6)

Data Format() . Data (Compression),
 (Encryption) .
 Data . JPEG, TIFF, GIF(),
 MPEG, QUICKTIME(), MIDI(), RTF, ASCII, EBCDIC()
 .

3. Session Layer (5)

(Establishment), (Manage and Control), (Terminate)
 Application Data
 가 Application Data ..
 OS(Operating System)

4. Transport Layer (4)

Data Data가
 가
 TCP, UDP가 TCP (Connection
 oriented Protocol) UDP (Connectionless Protocol)
 TCP 가 UDP

5. Network Layer (3)

가 Data 가 가
 Router가 Router
 ..??(
 —;;)
 가 Transport Layer
 ^^^;(TCP)
 IP, IPX, ICMP, ARP

6. Data Link Layer (2)

.. Data Link Layer Data , Error
 Notification(), Flow Control() Data
 가 Data Link Transport Layer
 Bridge, Switch 가 ,
 HDLC, PPP, Frame-Relay, FDDI, ATM Data Link 가
 SubLayer MAC LLC

MAC(Media Access Control)

Data

Device

LLC

.

7. Physical Layer (1)

Data

. Data

Data

. **Hub, Repeater, Cable**

..

...

^^::
;;

..—; OSI

Wan

가

...

^^::
;;

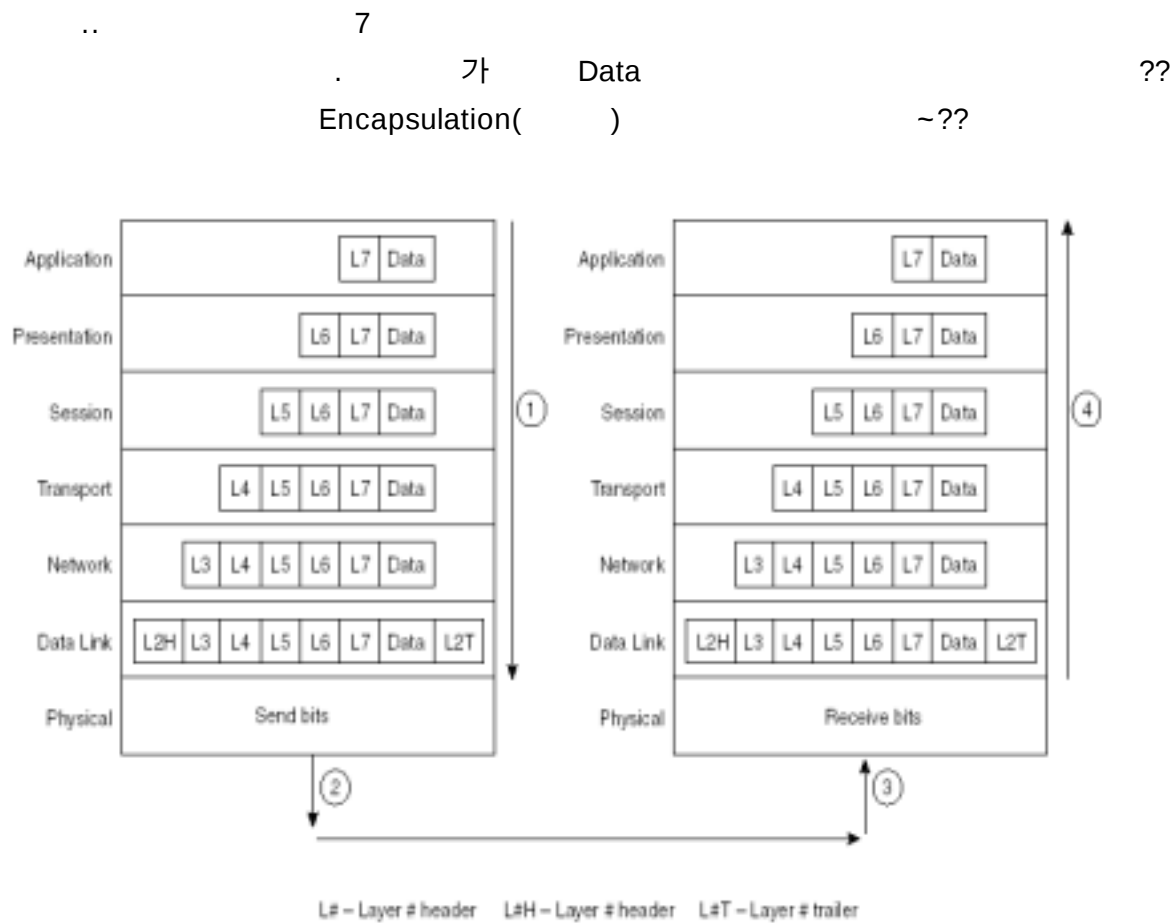
. 가

..

가

^^::
;;

^^::
;;



Data 가 가 ... ^^;;

Data가 7 1 .. Data 1

Data가 1 가 Data Header가

Data Header가 가 Encapsulation Data Link

Trailer .. ?? 1 Data

PC 1 7 Header가

Data가

가 .. 가 Data 7 Data

???

Application, Presentation, Session Data

Transport 'Segment', Network 'Packet', Data Link

'Frame', Physical 'Bit'

Data . PDU(Protocol Data Unit)
 . PDU Data 가 가 가
 .. Data Link
 가 가 Data Frame ..
 , 3 PDU ?? , Packet . ^^?
 , 4 PDU ?? , Segment ..

Encapsulation

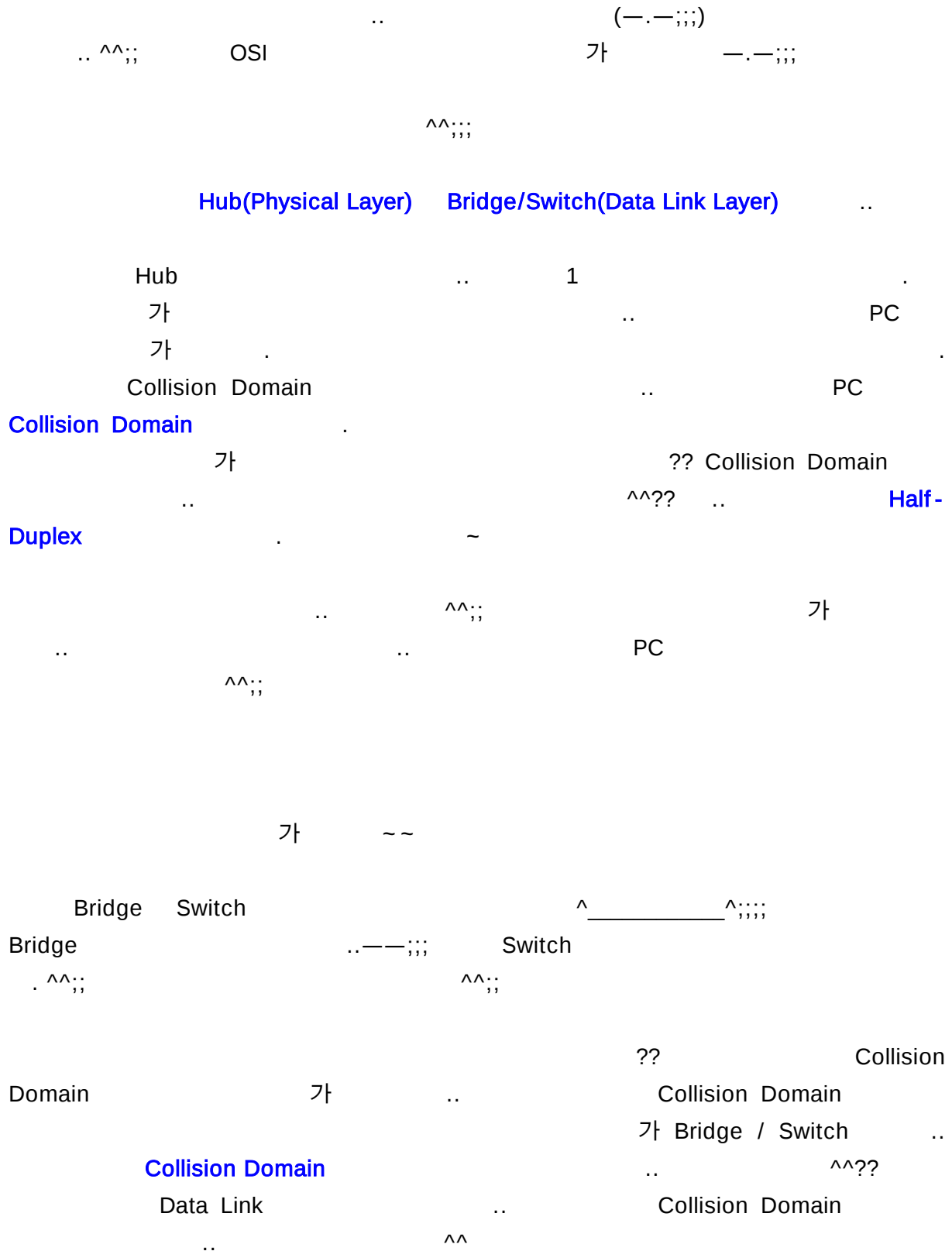
Layer	PDU
Application, Presentation, Session	Data
Transport	Segment
Network	Packet
Data Link	Frame
Physical	Bit

Data Link Trailer가
 FCS(Frame Check Sequence) CRC(Cyclical Redundancy Check) 가
 .. .

OSI 7

^^...
 ,
 OSI 가
 ^^...
 - _____ - ^^^^^

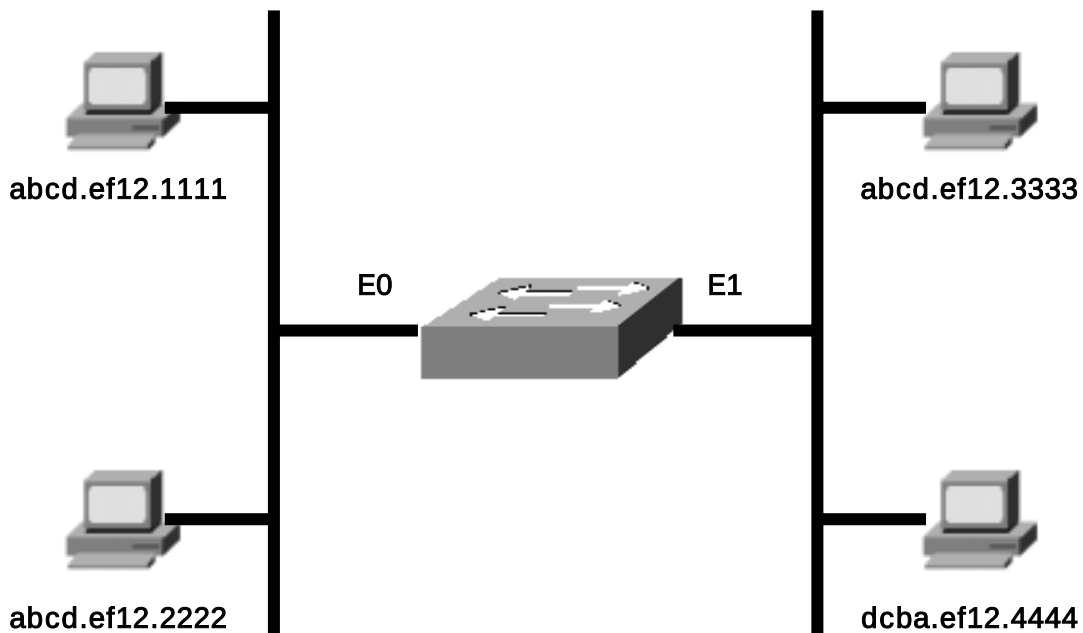
CCNA : Hub, Bridge/Switch



가 가 ..
Unitcast, Broadcast, Multicast .. (^^)

Unicast 가 . 1 1
Broadcast Data
Data가 Broadcast ..
Data
Data
Data
PC
Data ..
Netcom CCNA Data ..
Multicast
^^;;

Collision Domain ^^;



, 가 Switch가 ^^;; 가
Collision Domain .. E0 PC가
E1 PC
!!! ~??

Switch **MAC(Media Access Control) Address** MAC Table

(**MAC Address** 2 . LAN

NIC(Network Interface Card) . PC abcd.ef12.1111

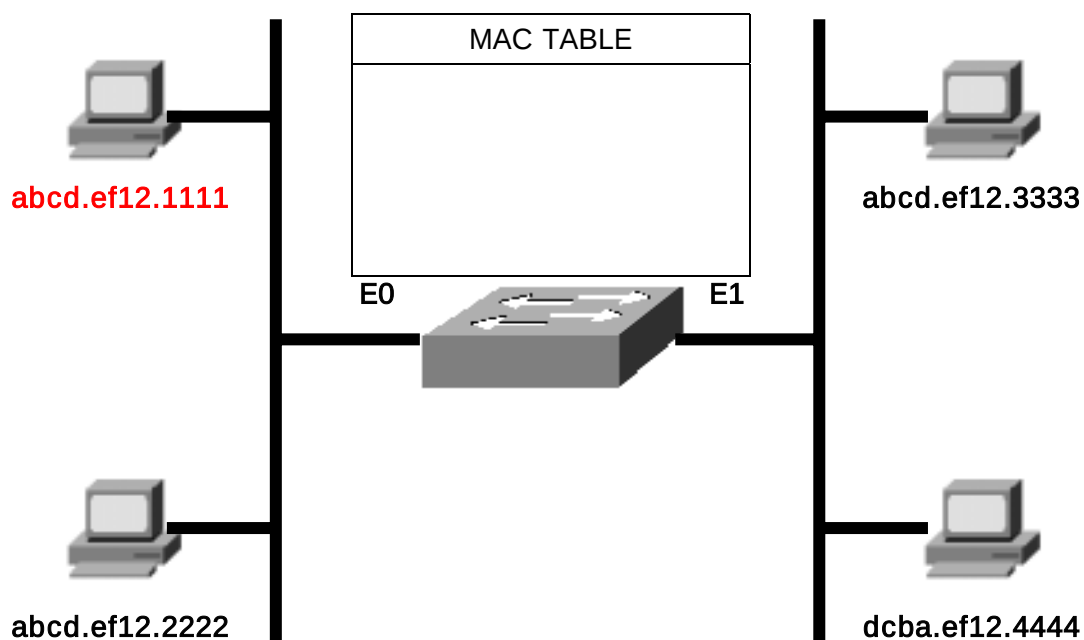
가 . MAC Address 16 12 . 48bit 가

16 6 6

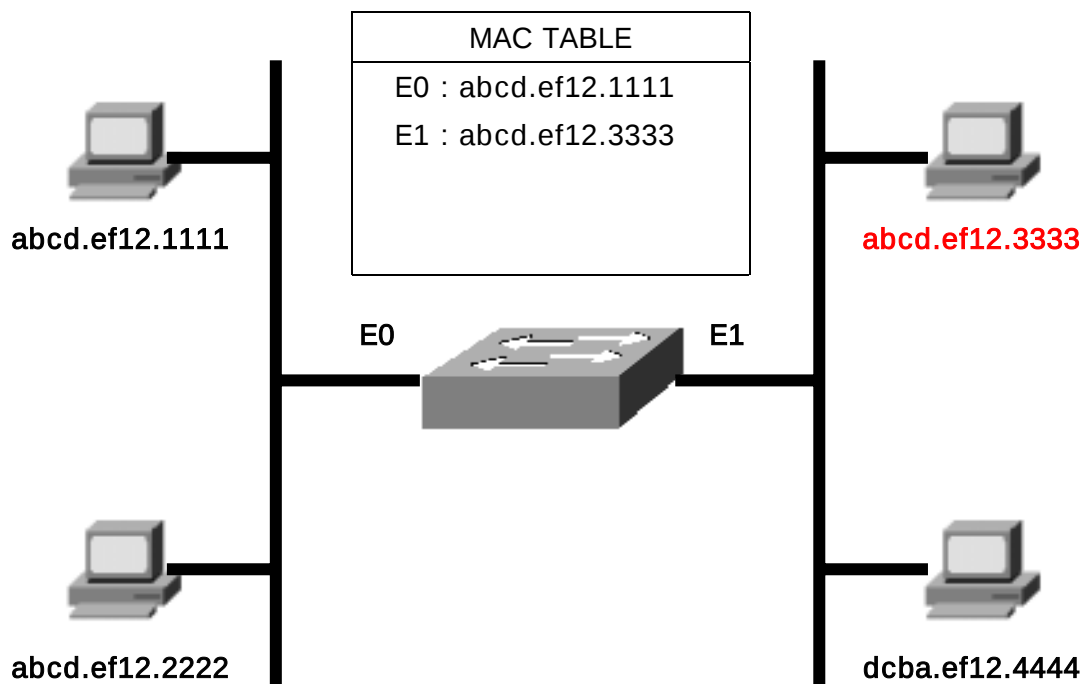
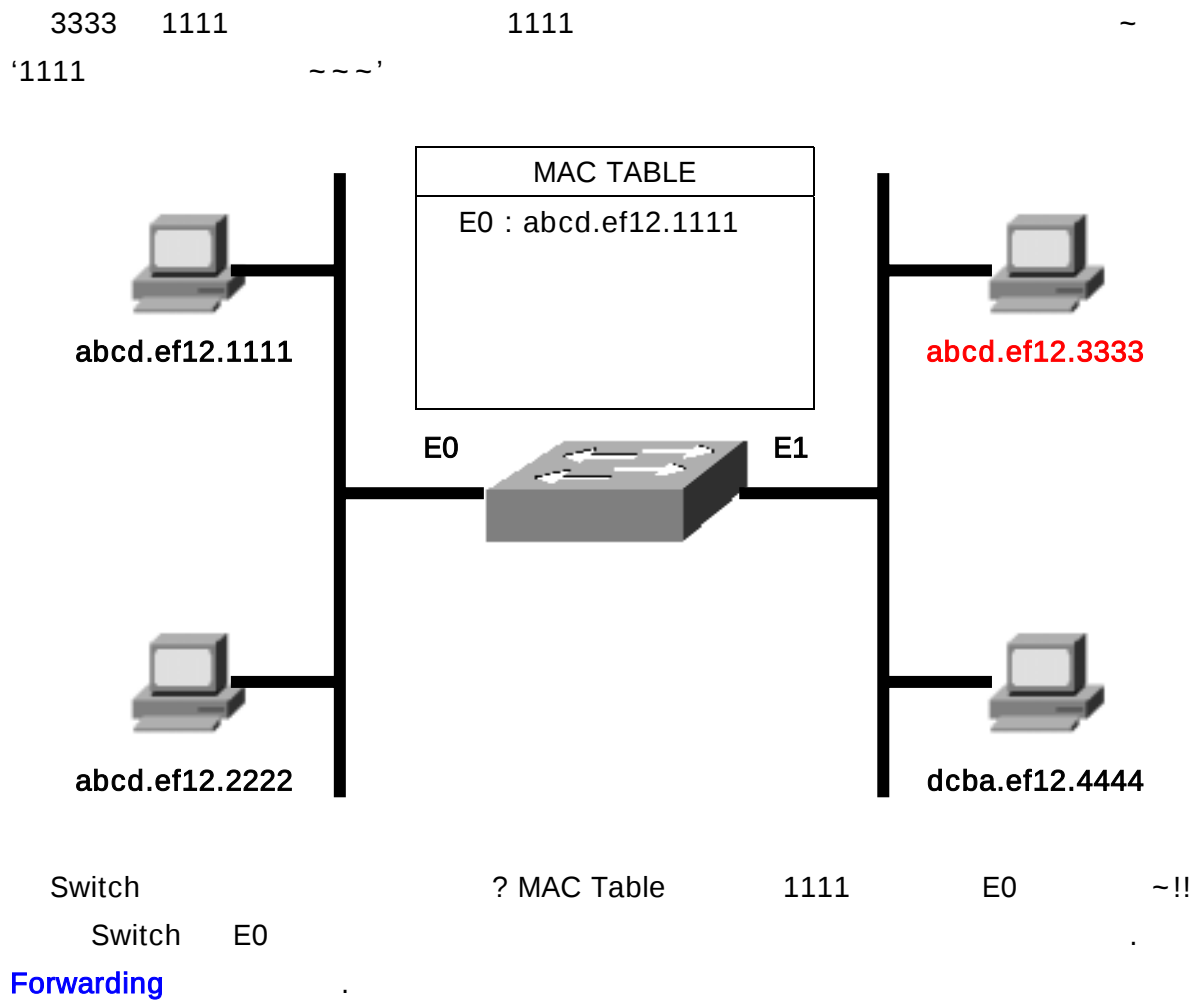
NIC 4 3 가 ..

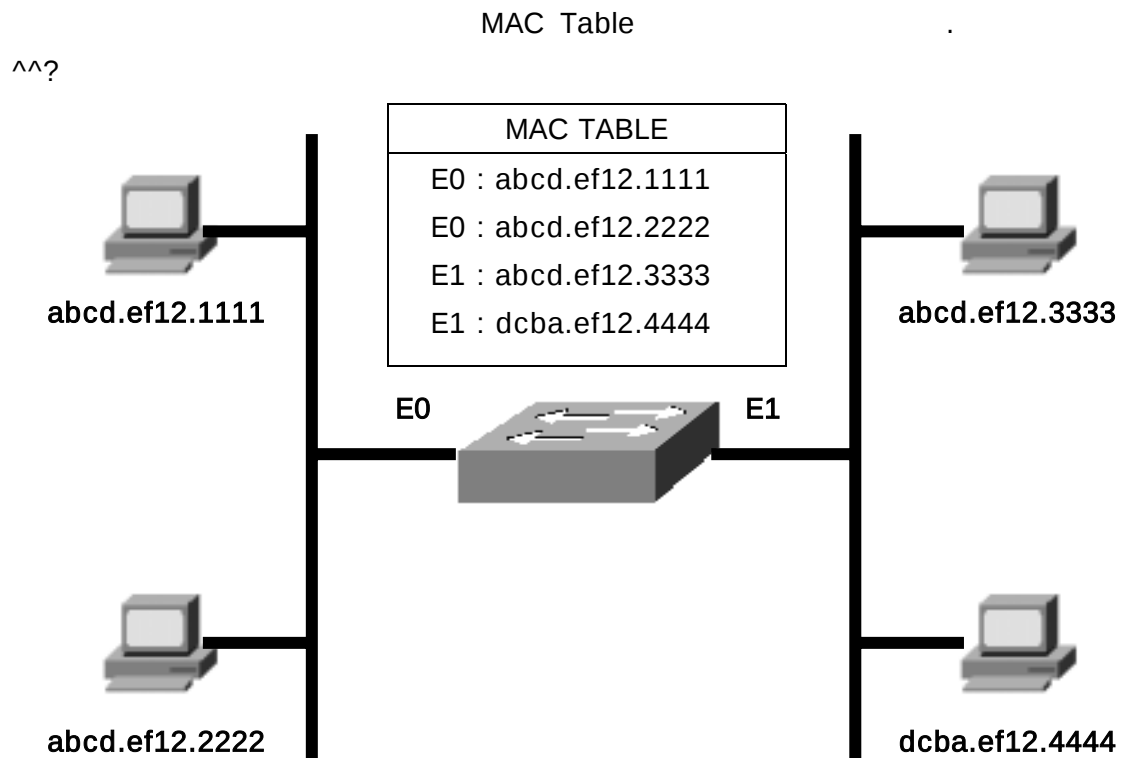
^^??)

.. MAC Table



1111 3333 . ?
 1111 .. '3333 ~ ~ ?'
 Table .. Switch MAC Table .
 가
 Flooding . Switch 1111
 E0 .. Table .
 Learning . (Learning 가
 E0 ^^)





Switch Table

1111 2222

1111 2222

가 가

Switch

Filtering

^^?

^^

가

^^

^^

?? ^^;;

~
Switch 가 . 가 ^^?

* **Learning** : Switch가 Source Address() Table ..

* **Flooding** : Table Broadcast가
. Flooding ?? ..
..

* **Forwarding** : 가
. Forwarding .

* **Filtering** : 가
가 ??
Filtering . Collision Domain ??
.. Filtering

* **Aging** : MAC Table Forwarding/Filtering .
Table 가
. Aging .

^^?

Switch 가 . **Switch** 가
Collision Domain . 24 Switch Collision Domain 24
. Switch Broadcast 가 Flooding
. Broadcast **Broadcast Domain** .
Switch Collision Domain Broadcast Domain .
Broadcast Domain 3 (Network Layer) 가
..

Collision Domain 가 Broadcast Domain
 가 . Broadcast 가 PC 가
 Broadcast ??
 가 Broadcast Domain 가 .. @.@;; Broadcast
 PC . 가 ^^?;
 ^^;;
 가 .. Collision Domain Broadcast Domain Segment
 .. Segment.. ^^?? ... 4 PDU
 ^^;; Network Segment ^^?? ..
 , , ^^
 ^^a;;; Bridge Switch ^^???

...

.. Bridge Software Switch
 Hardware .. Switch가 .. Switch 가
 Bridge .. Switch
 . MAC Address Broadcast
 . Switch Full-
 Duplex . Hub Hub Only Half-Duplex
 Switch Half-Duplex .

가 ^ _____ ^;;;;;

2가 .. 가 ^^??

Bridge/Switch Multicast Broadcast Forwarding .
 Broadcast FFFF.FFFF.FFFF (^^;;;
 FF-FF-FF-FF-FF-FF, ^^;;;
 Multicast 6 가 01-00-5E . '2 Bridge/Switch
 Multicast or Broadcast , 3 Router가
 , ^^??;
 .. ~ ~ ^^

Switch가 Frame(2 PDU .. ^^;; Switching Mode ..
 가 Mode 가 . 가 ^^?)

* Store - and - Forward

* Cut - Through

* Fragment - Free (Modified Cut - through)

Store - and - Forward Frame Data
 . Frame 가
 . Frame Latency(data
) 가 .

Cut - Through . 가
 . Store - and - Forward
 Frame .

Fragment - Free 64byte . Frame
 가 가 64byte . Store - and - Forward
 Cut - Through .

Bridge Store - and - Forward ..

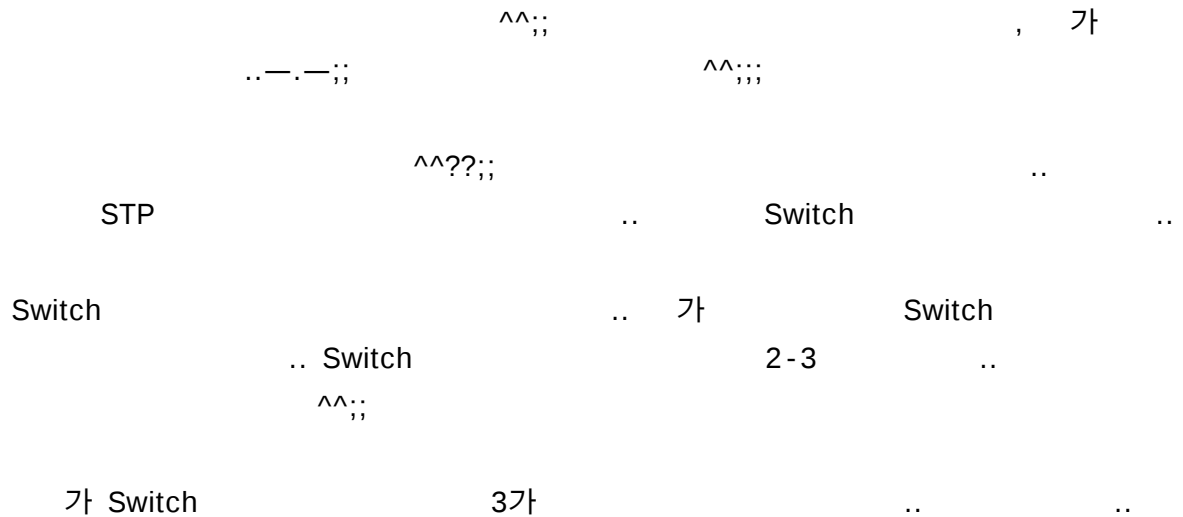
Hub, Bridge/Switch . ^^?

Loop STP(Spanning Tree Protocol)
 ... 가 @_@;;;

^^

~~ ^_^//

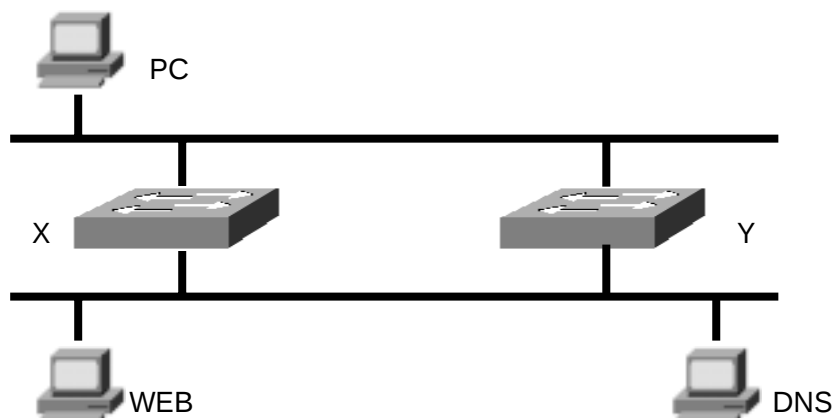
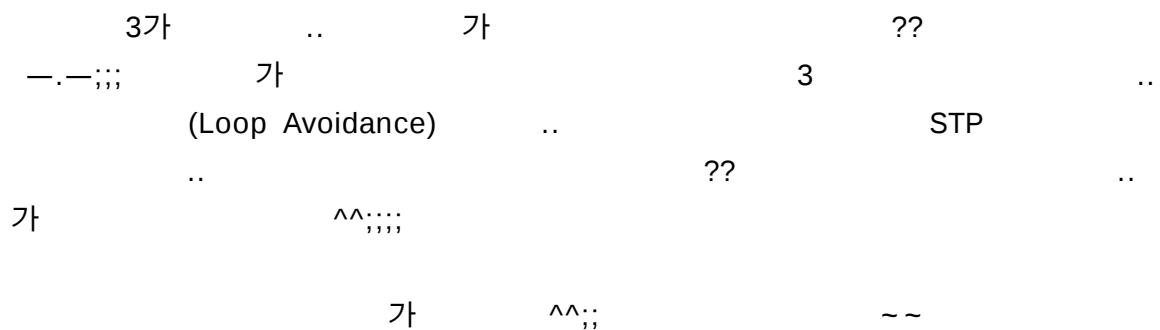
CCNA : STP(Spanning Tree Protocol)



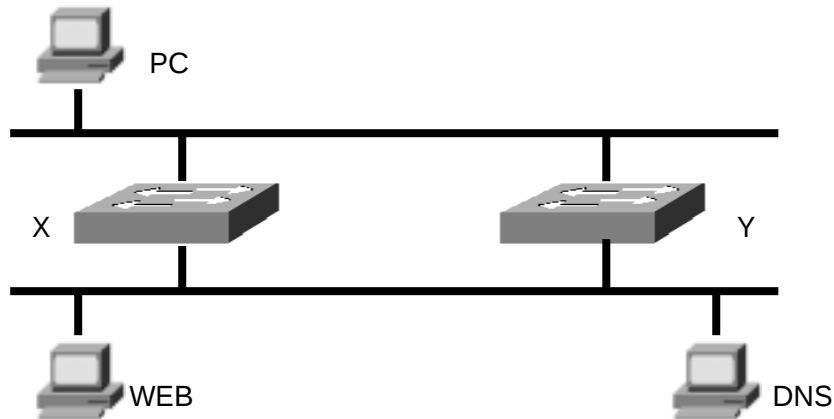
* Learning

* Forwarding/Filtering

* Loop Avoidance



가 2 가 Loop PC가 DNS WEB



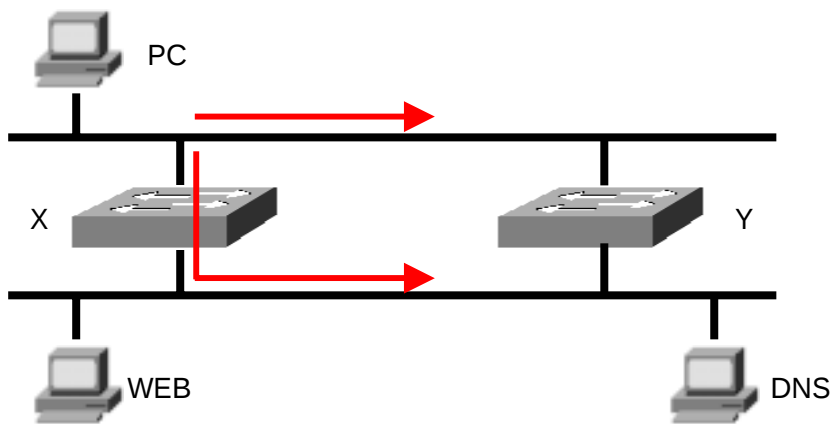
가 A Collision Domain Broadcast Domain

Loop STP Loop PC, WEB, DNS DNS(Domain Name Server) ARP(Address Resolution Protocol, IP) MAC DNS IP MAC PC DNS IP (DNS) PC IP (^^) 98 winipcfg

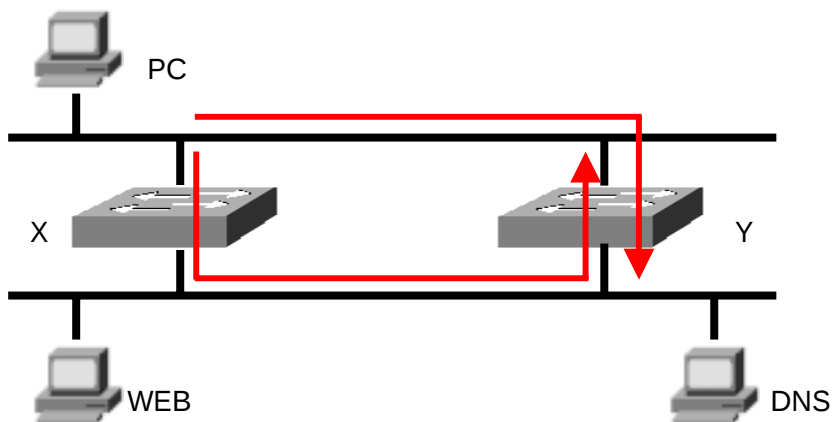
CCNA

Cisco Certified Network Associate

Broadcast DNS MAC PC .. PC
DNS WEB IP .. DNS PC WEB
IP ...
..?? .. WEB IP ARP
?? Broadcast .. WEB 가 ^^^; Broadcast
WEB MAC PC PC WEB
.. Loop ^^??
PC WEB Broadcast가 ??
Broadcast.. ??

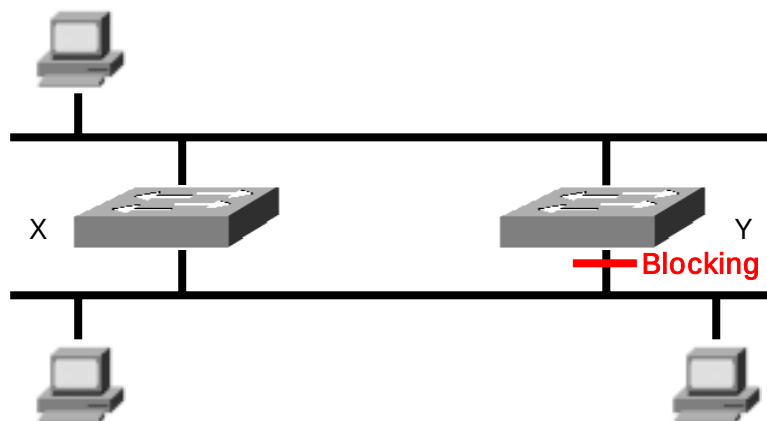


PC가 Broadcast .. Switch Broadcast, Multicast Flooding
?? X가 Broadcast Flooding .. Y Flooding ??
Switch ^^^;



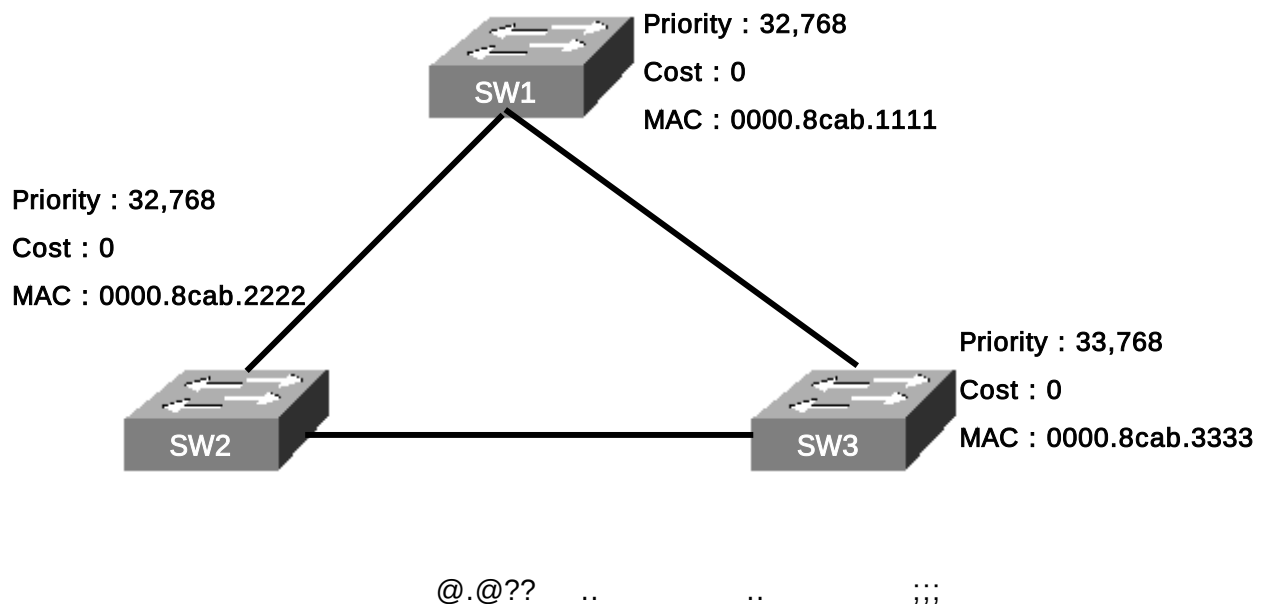
.. .. 가 ^^??

가 가
 ^^?? Off
 가-.-;; 가..-.-; ..
 -.-?? ..
 ;;; ...
 ^^;;

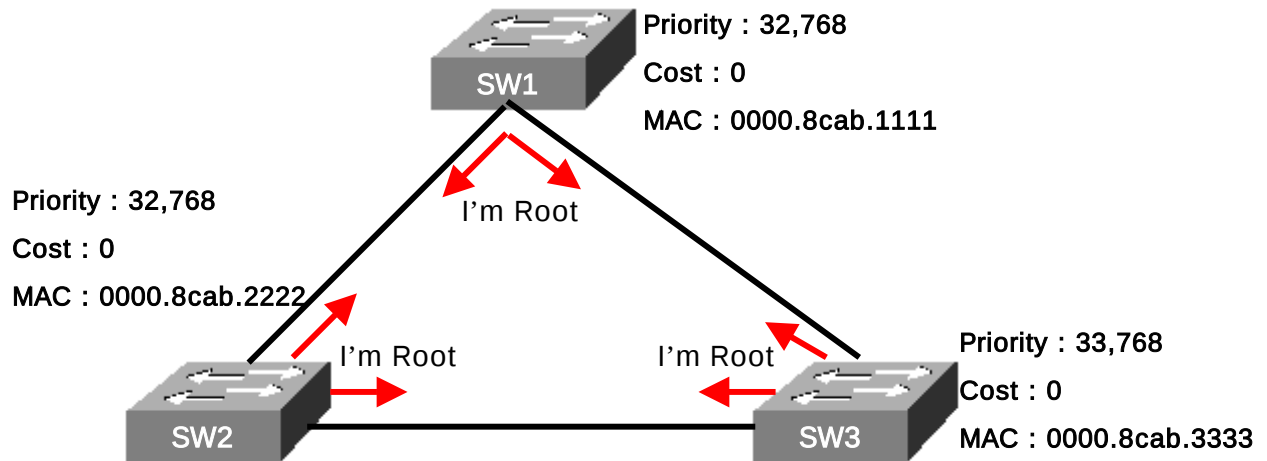


Y 가 Blocking() ..
 Forwarding() 가 ?? ..
 .. Traffic ~ ~!!..
 -.-;; STP Forwarding Blocking ..
 .. Blocking ??

Show me the Picture!!

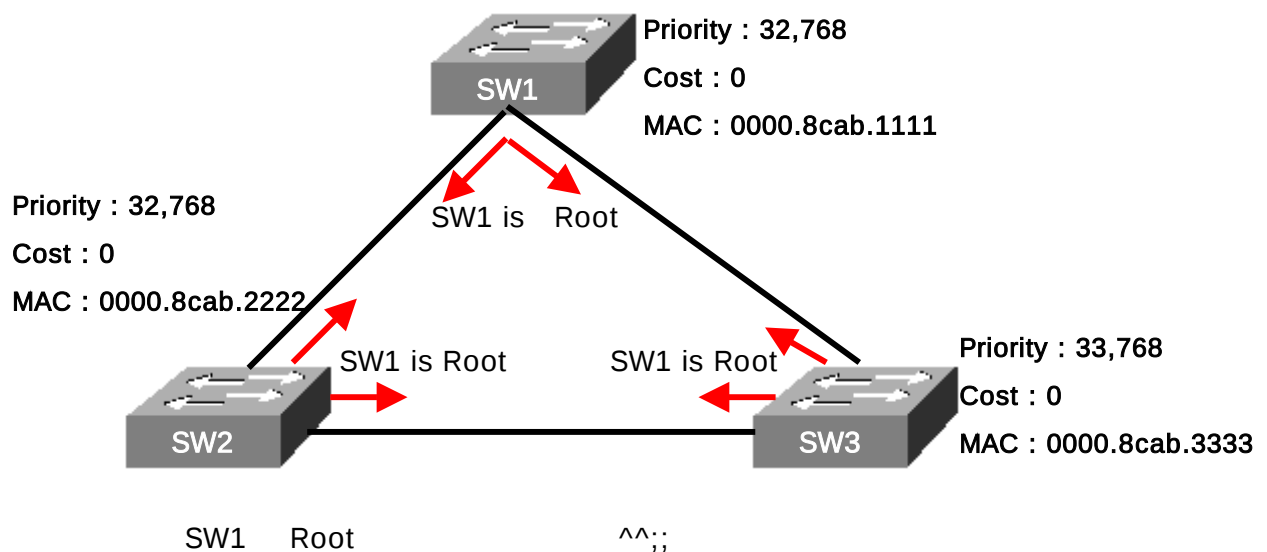


.. STP 가.. BPDU(Bridge Protocol Data Unit)
 .. Priority MAC ..
 가 .. Root Bridge
 Root Bridge .. ' 가 Root Bridge ~~!!!!'

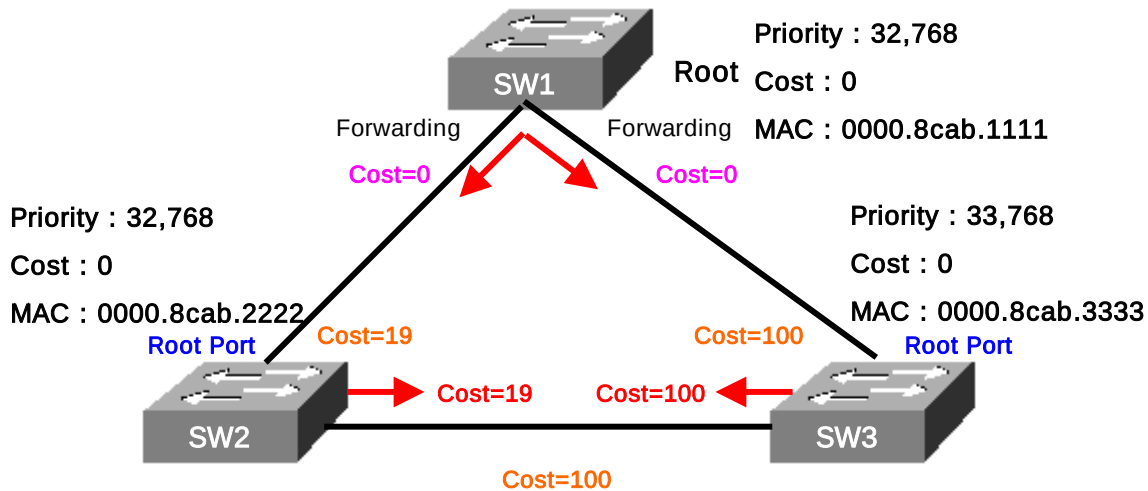


가 Root ?
 Root Bridge가 .. Root Bridge ..
 .. Priority .. Root Bridge
 .. SW3 .. MAC ..
 Root Bridge가 .. Root Bridge ~-??

~~ !! SW1 Root Bridge가 .. BPDU

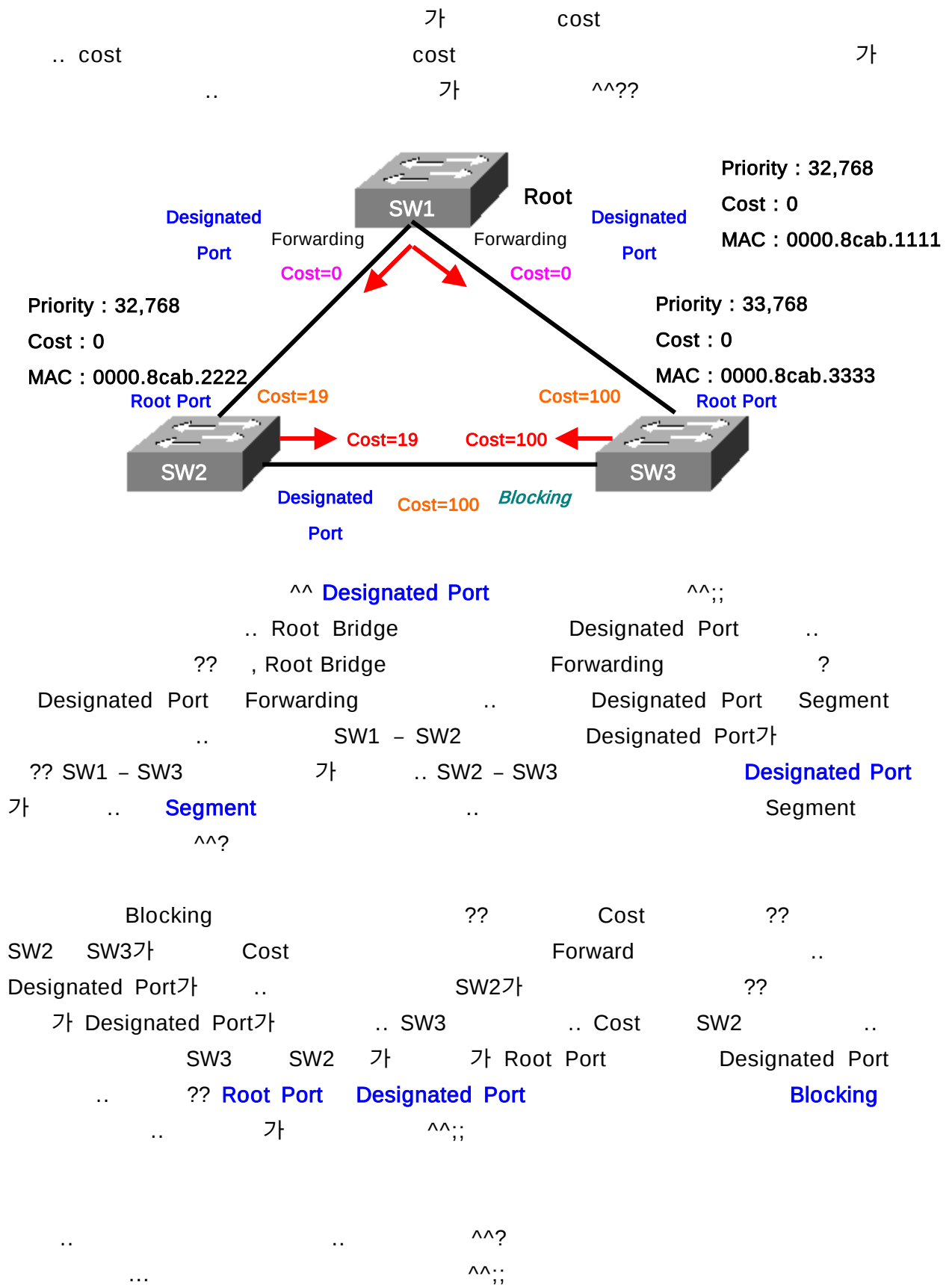


Root Bridge가
 .. Root Bridge가
 Nonroot Bridge
 Forwarding ..
 Nonroot Bridge
 Blocking ?? Root Bridge



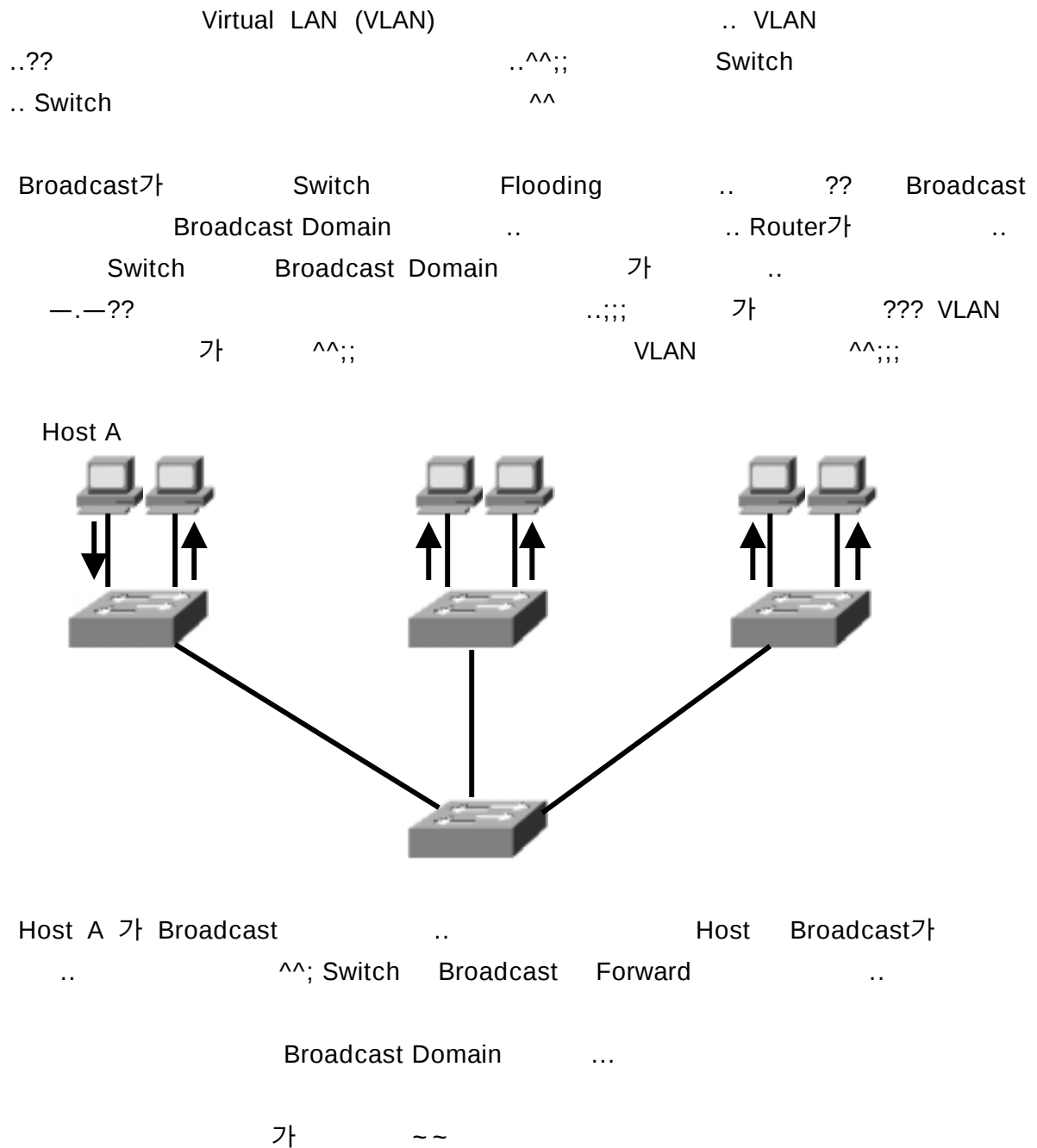
Root Port .. Nonroot Bridge Root 가
 cost Port Root Port .. Forwarding ..
 Nonroot Bridge Root Port 가 .. Cost
 ?? Cost ..
 .. SW2가 SW3 SW2 SW1 cost (0) Line cost
 (19) SW3 .. cost 19 + 0 = 19 ..
 ?? SW3 (19) Line cost (100) 119 ..
 SW3가 SW2 cost 100 SW2가 200 ..
 cost
 Blocking ... cost ..
 Cost .. ^^

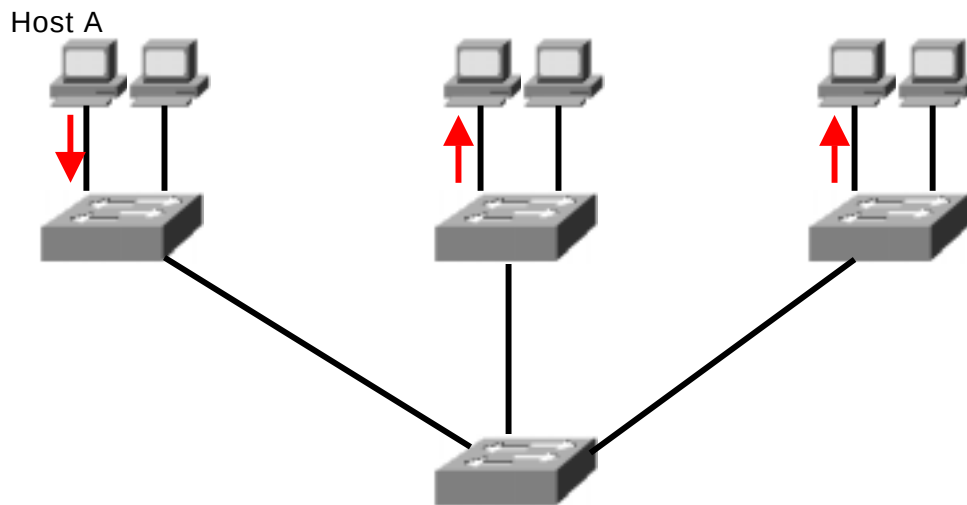
Speed	New IEEE Cost	Original IEEE Cost
10Gbps	2	1
1Gbps	4	1
100Mbps	19	10
10Mbps	100	100



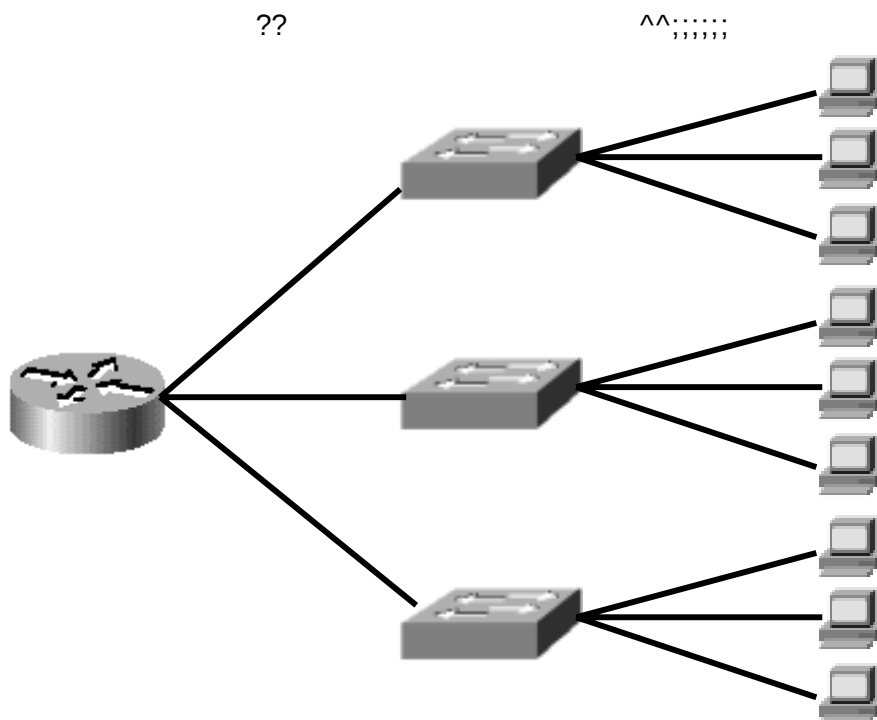
.. 가 (가
 .. —;);
 Loop가 ..
 ..Redundant path(..) Loop가
 .. STP(IEEE 802.1d) ..
 , Root Bridge .. BID(Bridge ID)
 BID = Priority + MAC .. ^^;; ^^
 , Nonroot Bridge Root Port Designated Port, Blocking ..
 Cost ... ^_^^;;
 cost ? 가
 .. ?? 가 ???
 Blocking ?? BID ..
 .. SW3 SW2 가 가 Blocking ??
 가 ^^:.....
 ^_^^;; .. on
Blocking 가 .. data ..
Listening 가 .. 가 BPDU .. data
 loop가 .. ()
 .. **Learning** 가 .. BPDU .. MAC
 MAC Table .. data ..
Forwarding 가 .. Forwarding 가 data ..
 .. **Blocking → Listening → Learning → Forwarding** .. ^^
 .. ↓
 ▲ Hello Time = BPDU .. 2 ..
 ▲ Max Age = BPDU 20 가
 .. Max Age ..
 ▲ Forward Delay = 가 Listening / Learning (15)
 .
 STP .. ^^ VLAN ~
 ^^

CCNA : VLAN(Virtual LAN)





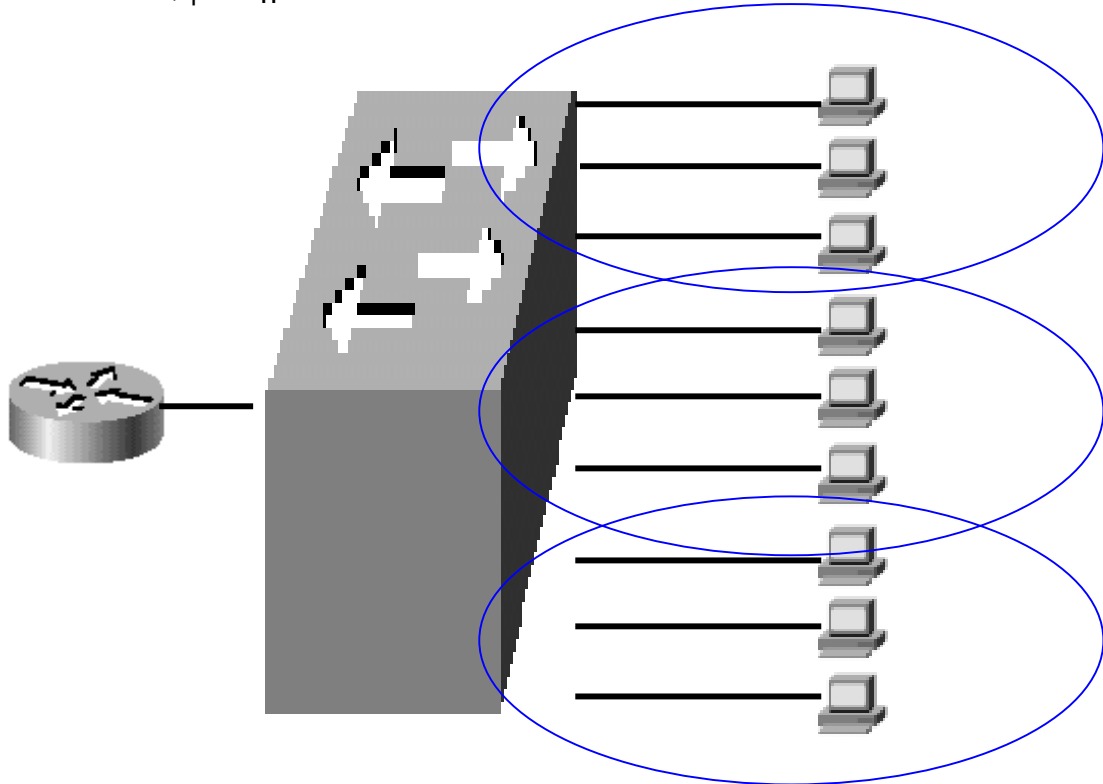
.. Host A가 Broadcast Host Broadcast
 .. ?? 가 가 ..
 Broadcast Host가 .. VLAN ..
 Broadcast Domain .. ??



.. 가
 가 Broadcast Domain .. 3 ..
 Broadcast Domain ..

3 Broadcast Broadcast Domain

가



가 .. @.@;; ?? VLAN

Broadcast Domain

.. VLAN 가

.. ^^;

VLAN 가 ..(—:;:;:;)

.. 가 ..

^^... VLAN

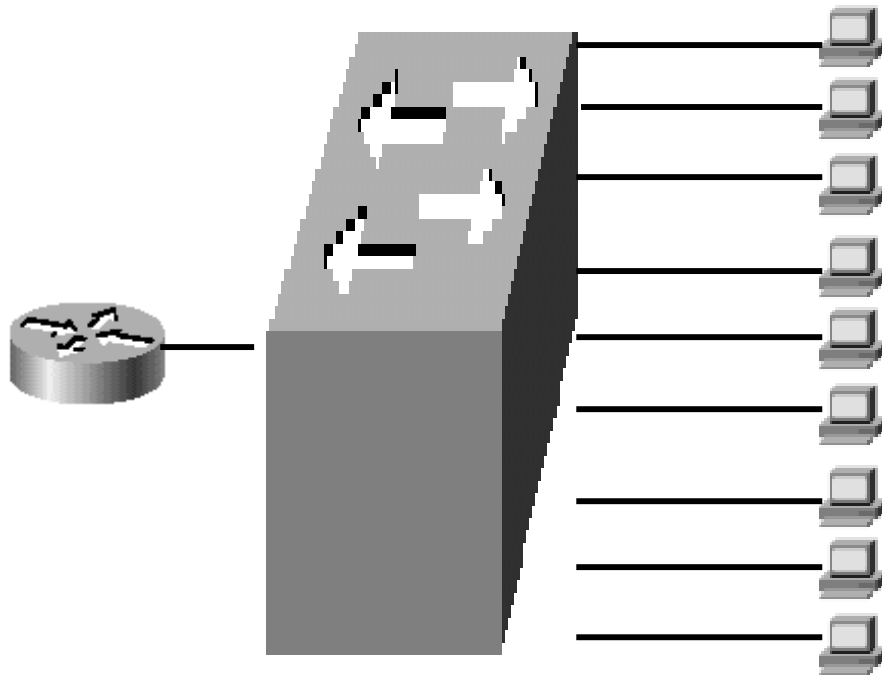
...^^... ..

VLAN ..

(Security)

, Segment

(Flexibility)



VLAN

가

PC 가

VLAN

??

Segment
Domain
Segment

.. Collision, Broadcast

.. VLAN Broadcast Domain

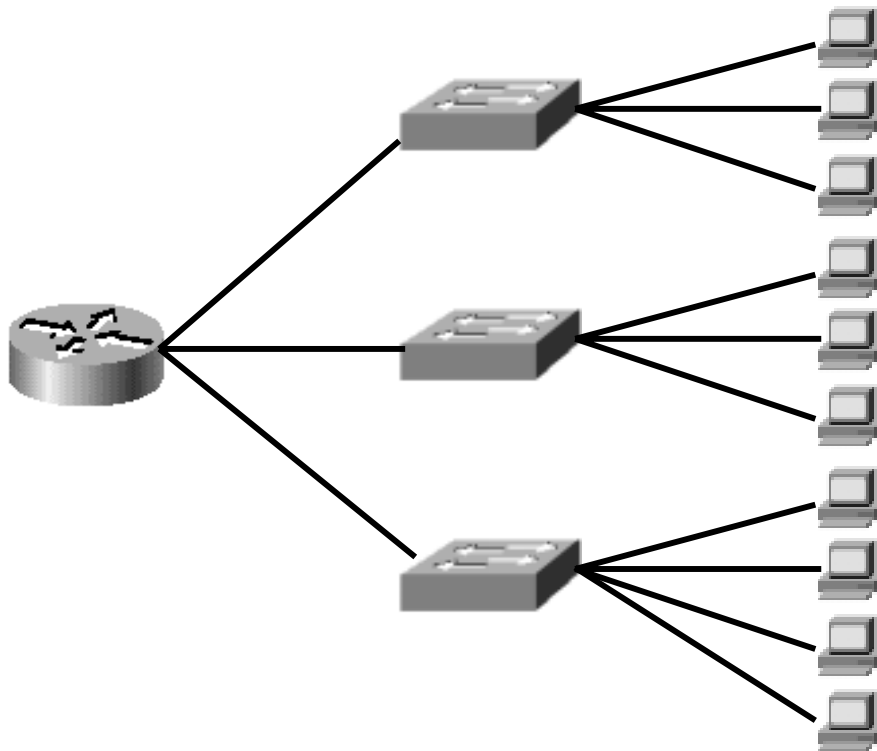
..

1 , 2 , 3
1 가 가 ..
??

..

..

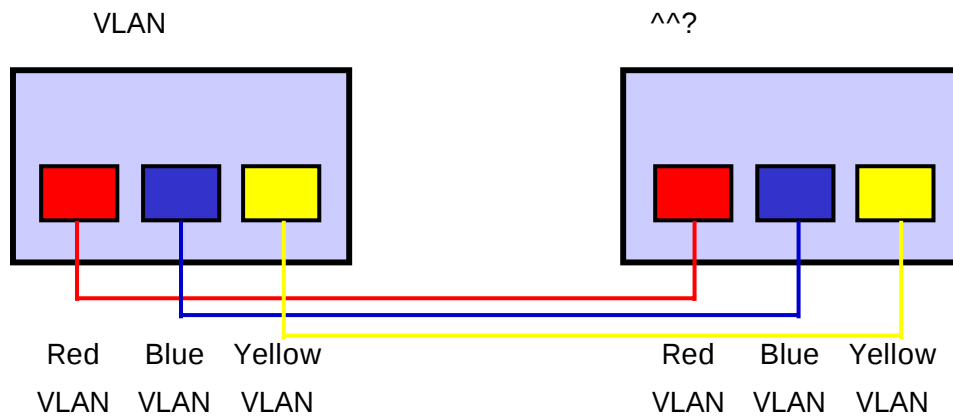
..^^



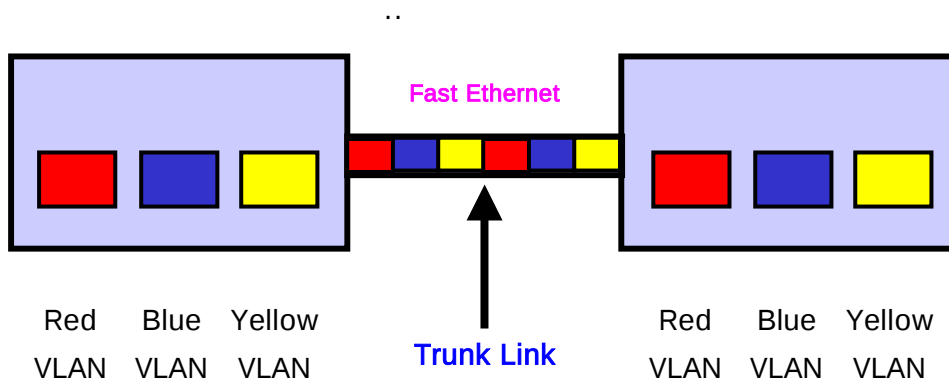
1 ..
1 ..
가 ..
VLAN 3 ..
.. (... 가
^^)
VLAN ^^?
^^;; VLAN .. 가 가 ..
Static VLAN Dynamic VLAN ..

Static VLAN 가 VLAN ID ..
1~4 1 VLAN, 5~8 2 VLAN ..
PC 1~4 PC 1 VLAN 5~8
2 VLAN .. ??

Dynamic VLAN MAC Address, Protocol
.. Cisco VLAN Management Policy Server (VMPS)
MAC dynamic VLAN ..



.. 3 VLAN ..() VLAN
 가 ??
 VLAN 20 20 ??
 VLAN VLAN ..



Trunk link .. Trunk VLAN Traffic
 .. VLAN Traffic
 .. Traffic
 ..^^
 * access-link .. PC access-link
 ..
 * .. VLAN ..
 ^^

..

VLAN 가

..

Trunk Link ..^^; VLAN Traffic

가 가 ..

Frame tagging .. Frame tagging Frame

VLAN tag ..

가 Frame ' 1 VLAN 1 가'

1 .. Frame Trunk Link

' ! 1 VLAN .. 가

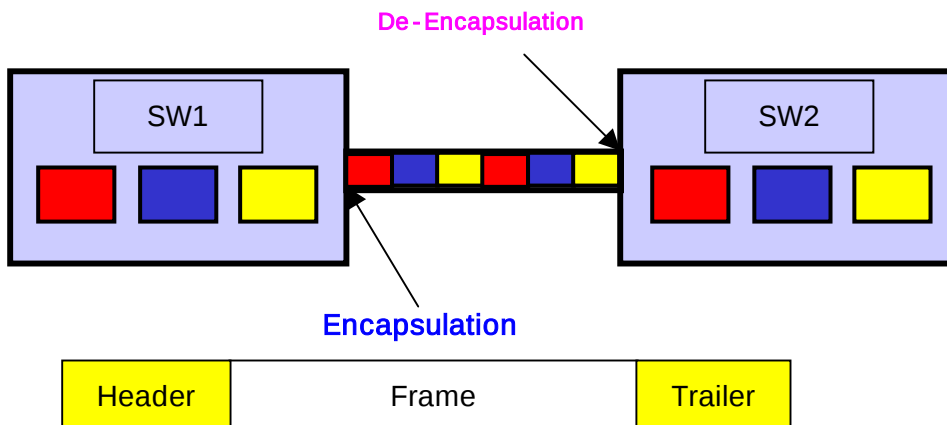
' 1 VLAN Frame .. ??

tagging ?? ISL(Inter-Switch Link) Protocol IEEE IEEE 802.1Q()가 .. Cisco

ISL Cisco

IEEE 802.1Q .. ISL Protocol tagging frame

header trailer ..encapsulation ^^;;



Header VLAN ID 가 Frame VLAN

.. ??? SW1 SW2 Frame ..

VLAN Frame SW2 .. SW1 Frame

Trunk Line Frame Header, trailer .. header

VLAN 가 .. SW2 header

trailer Frame VLAN

Frame ..

802.1Q ISL Frame 가 Frame
 VLAN .. CCNA ISL Protocol ..
 (—;) 802.1Q 'tagging
 , .. ^^;;

가 가 가 ..
 .. Yellow VLAN
 VLAN ..
 VLAN 가 ?? ?? .. ???

VLAN Broadcast Domain .. Broadcast
 Domain .. 가 ..^^;;
 Broadcast Domain ??
 Broadcast Domain ..
 , Broadcast Domain
 .. ^^?

.. ??(^^)
 가 ?? 가 A B
 C,D,E,F,G?? ..
 ?? ...

= Broadcast Domain

가 ..^^

^^ Trunk Line
 .. 3 1
 ..

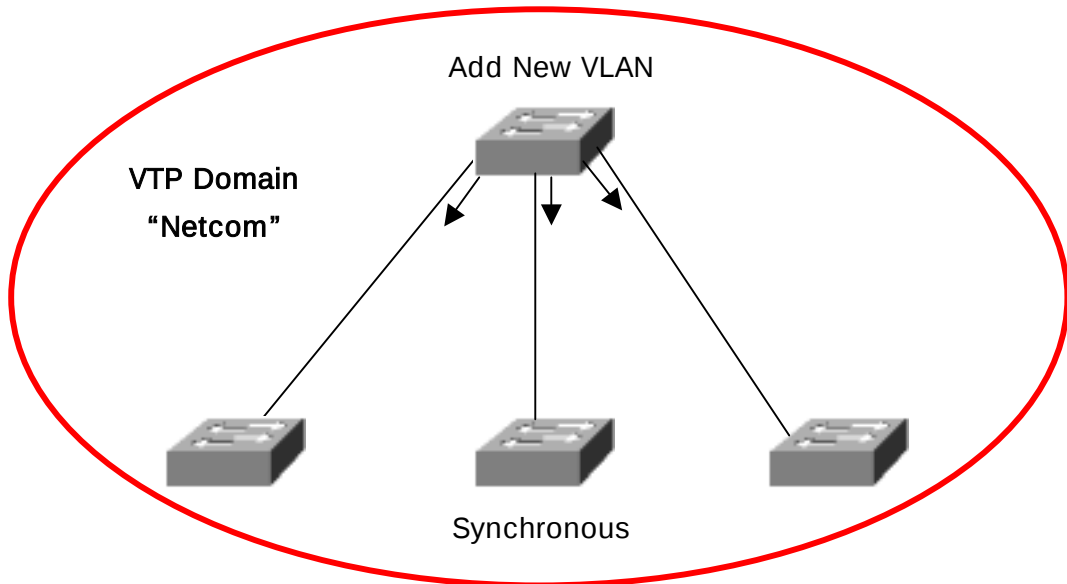
Trunk Line ^^;;

... VLAN
VTP(VLAN Trunk Protocol)

Trunk Trunk Line
 VLAN

VTP 2 가 VLAN , ,
 .. VTP Domain VTP
 .. VLAN Domain

.. ..



.. VLAN 가 .. VTP advertisement(VTP , 5
 VLAN 가 ..) Domain 가
 .. Netcom Domain VTP 가
 ' .. VLAN 가가 ,
 가 Synchronous(, equal
 ^^;;)
 ..
 VTP Mode ^^;;

VTP 3가지 Mode가 . Server, Client, Transparent
 3가지 ..

Server VLAN VTP Domain .
 NVRAM ..

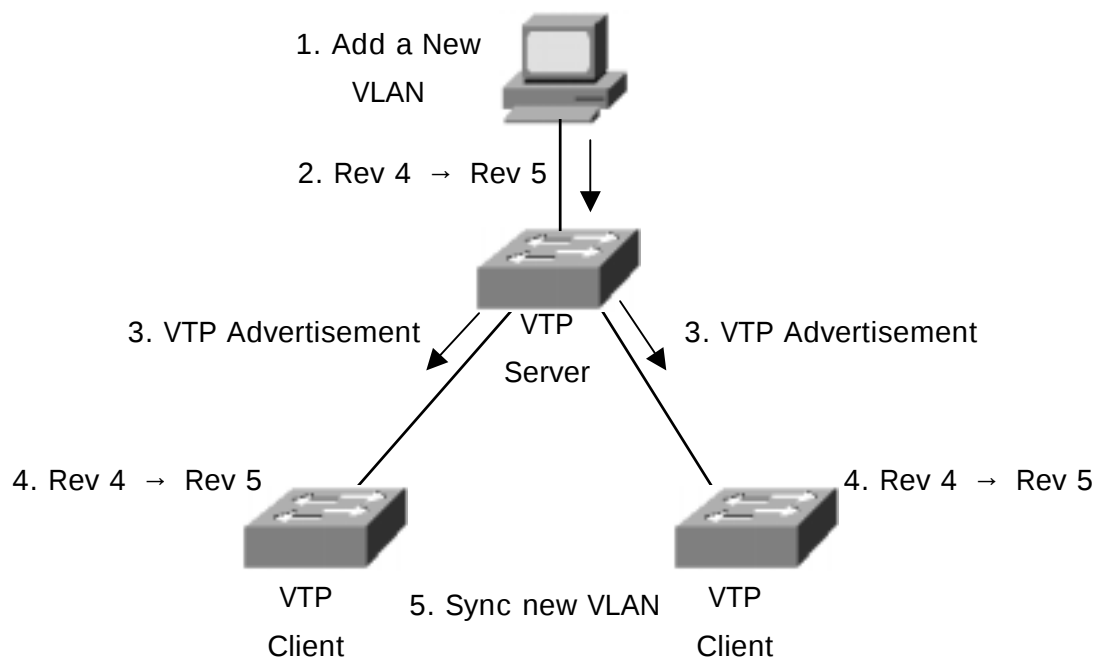
Client VLAN ..
 Client Server VTP
 ...

Transparent () VLAN , , .. VTP
 Domain .. , .. Server
 Mode VTP ..

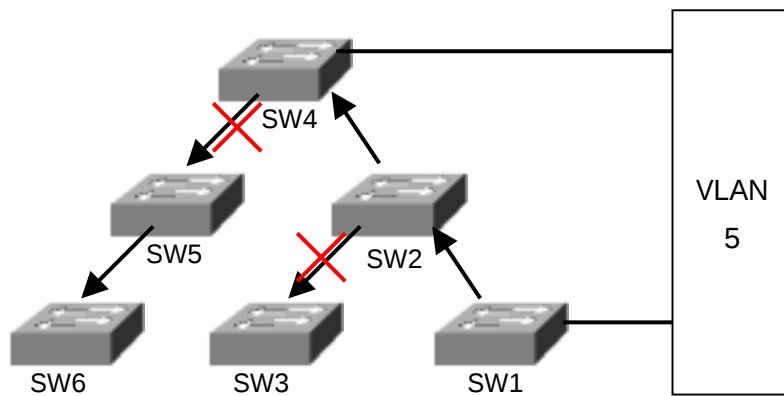
^^..
 ,;

	Server	Client	Transparent
VTP	Yes	No	No
VLAN	Yes	Yes	No
VTP	Yes	Yes	Yes
VLAN (NVRAM)	Yes	No	Yes
VLAN , ,	Yes	No	Yes

..? ?? ..
 .. 가
 .. — . — ; ; ; ;



VTP (Configuration Revision Number) .. VTP 가 VLAN 1 가 .. 가 .. 가가 .. VTP 가 Revision Number 4 5 .. VTP ?? Client 5 VLAN 가 Domain .. ^^;;



^^^; VTP Pruning(가) ..
 .. VLAN5 가 SW1 SW4 ..
 .. ISL VTP
 VLAN SW1 VLAN5 SW4
 VLAN5 .. ??
 SW 2,3,4,5,6 .. SW 3,5,6 VLAN5
 ?? VLAN5 가 ~ (SW2 VLAN5
 SW4 ^^a ^^)

Pruning

.. Bandwidth(,)가
 ^^^;

, VLAN .. ^^
 VTP ..T.T
 가..-.-a;;

^^ ~

2	249	
2	124	 1
2	62	 0
2	31	 0
2	15	 1
2	7	 1
2	3	 1
	1	 1

$$249(10) = 11111001(2)$$

$$249 \quad 2$$

가

$$2 \quad 가 \quad ..$$

??

$$249 \quad 10$$

10	249	
10	24	 9
	2	 4

?

$$249 \quad 10$$

$$249가 \quad ..$$

10

?? ..

?

$$.. 2 * 10^2 + 4 * 10^1 + 9 * 10^0 = 249..$$

..

$$249(10) = 11111001(2) \quad ..$$

$$11111001 = 1 * 2^7 + 1 * 2^6 + 1 * 2^5 + 1 * 2^4 + 1 * 2^3 + 0 * 2^2 + 0 * 2^1 + 1 * 2^0$$

$$= 128 + 64 + 32 + 16 + 1 = 249 \quad .. \quad 10 \quad ^^$$

$$^^??$$

.. 2 10
 2 10
 ..

.. 10 2 2
 .. 2 (-1)

$$11111001 = 1 * 2^7 + 1 * 2^6 + 1 * 2^5 + 1 * 2^4 + 1 * 2^3 + 0 * 2^2 + 0 * 2^1 + 1 * 2^0$$

$$= 128 + 64 + 32 + 16 + 0 + 0 + 1 = 249$$

0 0 0 ..
 —.—;; 1 가 ?? 1 * = ..
 ..—;; ??

2 0 2 4

2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1024	512	256	128	64	32	16	8	4	2	1

1	1	1	1	1	0	0	1	←	11111001
128	64	32	16	8	4	2	1	←	2^{x-1} (x=1)
128	64	32	16	8	0	0	1	←	1

2^{x-1} 1

IP

가

128 64 32 16 8 4 2 1

1

^^;;

10

..

2

^^;;

^^

10101001 (2) →

00111001 (2) →

11111111 (2) →

?? ..

...;

가

.. Logical AND

..

..

1 AND 1 = 1

1 AND 0 = 0

0 AND 1 = 0

0 AND 0 = 0

Logical AND

.. 1

1

0 ..

Logical AND

..

^^? ..

~

1	0	1	0	0	0	1	1
1	1	1	1	1	0	0	0

.. Logical AND

??

1

1

0

^^?

1	0	1	0	0	0	1	1
1	1	1	1	1	0	0	0
1	0	1	0	0	0	0	0

.. 163

248 ??

Logical AND

가 ??

160

.. AND

^^??

^^?

,

Logical AND

..

IP Address

Subnet

..

..

Subnet

가

...;

,

^^;;

CCNA : IP Address and Subnet

^^?
 ..^^;; .. IP
 .. MAC
 .. IP
 ^^;;
 가 ^^;;
 IP 가 ..
 .. 가
 .. 가
 .. 가
 .. 가
 .. IP
 .. IP ?? IP 2 32
 .. ?? 172.16.35.22
 .. 172.16.35.22 ??
 172.16.35.22 → 1010110000001000000010001100010110 .. @_@; ; ; ; ; ; ; ; ; ;
 -_-??? @.@? 가 IP
 ??? , ---;;
 8 .. ??
 가 ^^;;

10101100	.	00010000	.	00100011	.	00010110
172	.	16	.	35	.	22

 .. ^^ 1bit .. 8
 8 Octet .. , IP 4 Octet
 ..
 ^^;;

IP .. **Network Part**()
Host Part() ..

Broadcast Domain .. Broadcast Domain
 ^^;;
 .. ^^?
 ?? , ..
 Broadcast Domain .. ^^;;
 ..

PC ^^;;
 .. 30 PC가 .. PC
 IP ??
 ^^ ?? ,
 .. IP 가
 ^^;; , IP
 .. ??

.. 172.16.35.22 가 가
 ?? —.—a?
 ^^;;
 IP 172.16 35.22 ...
 .. ——;; ^^?
 ——;; ——;; ^^;;

.. 가 172.16.35.22 가 가
 .. **IP** **Class** ..

Class **A, B, C, D, E** ..

^^
 ^^;;

Class ?? IP
 .. ^^;; 가
 IP 가 Class
 ... ^^;;

Class A

Network	Host	Host	Host
---------	------	------	------

Octet 0 (0NNNNNNN, 1~126, 127)

Class B

Network	Network	Host	Host
---------	---------	------	------

Octet 10 (10NNNNNN, 128~191)

Class C

Network	Network	Network	Host
---------	---------	---------	------

Octet 110 (110NNNNN, 192 ~ 223)

Class D Multicast
 Octet 1110 (1110NNNN, 224 ~ 239)

Class E Research

Class A,B,C,D,E .. D Multicast, E Research
 .. 가 A,B,C ...

Class A Octet bit가 0 .. Octet
 Octet .. Class A Octet
 1~126 .. IP 가
 Class A 가 ..

Class B Octet bit가 10 .. Octet
 Octet .. Class B Octet
 128~191 .. IP 가 Class B
 .. 가 172.16.35.22 Class B Class
 B Octet 172.16 35.
 22 .. ^^?

Class C 110 Octet 192~223
 .. ^^;; Class D ^^

IP Class 가

..

IP 가 ..

Part	Network		Host	
------	---------	--	------	--

Maximum	255	255	255	255
---------	-----	-----	-----	-----

Binary	11111111	11111111	11111111	11111111
	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1

Example	172	16	35	22
---------	-----	----	----	----

Binary	10101100	00010000	00100011	00010110
	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1	128 64 32 16 8 4 2 1

1 10 ^? Octet
8 Octet 255 .. 11111111(2) = 255(10)
.. 0.0.0.0 ~ 255.255.255.255 ..

.. , ~
Class A 1.0.0.1 ~ 126.255.255.254 ..(127 loopback
..) 126 .. 2 24
가 1600 가 .. -.-;;
bit가 0 1 .. ?? ..
Class A

Class A	Network	00000000	00000000	00000000
---------	---------	----------	----------	----------

Class A	Network	11111111	11111111	11111111
---------	---------	----------	----------	----------

.. bit가 0
..
bit가 1 Broadcast ..
.. Class A
?? .. $2^{24} - 2 = 16,777,214$ 가 ..

Class B 10 octet 가
 $2^{14} = 16,384$ 가 .. 128.0. 191.255
 .. 가 16,382
 ... $2^{16} - 2 = 65,534$ 가 ..

Class C 110 octet 가
 $2^{21} = 2,097,152$ 192.0.0 223.255.255
 .. 2,097,150 가 가
 .. 가 $2^8 - 2 = 254$ 가 ..

, 가 $2^N - 2$, (N bit) ..

172.16.0.0 가 IP ??
 0 172.16.0.1 가
 가 .. 가 ?? .. 172.16.255.254 가 ..
 1 ..

?? 192.168.1.0 가

???

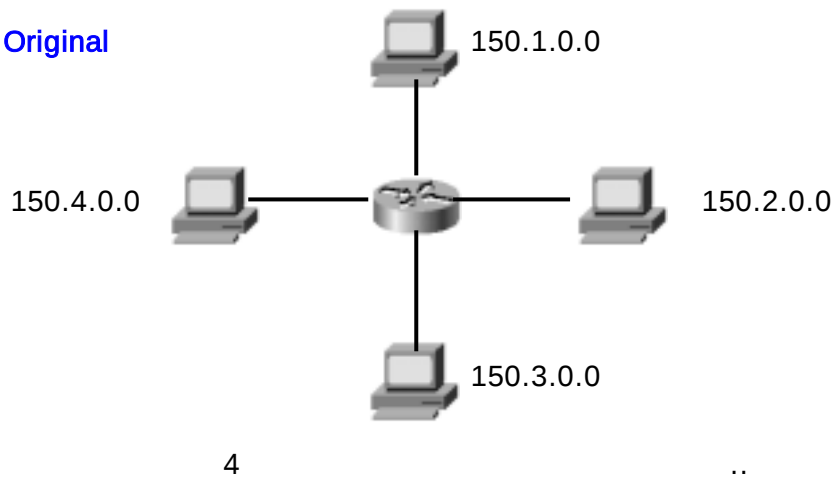
가 192.168.1.1 .. 192.168.1.254
 .. ?? .. ^^?
 0 ?? .. 192.168.1.0
 .. 1 192.168.1.255
 가 !!!!

Network Address	192	168	1	00000000
First Available Address	192	168	1	00000001
⋮				
Last Available Address	192	168	1	11111110
Broadcast Address	192	168	1	11111111

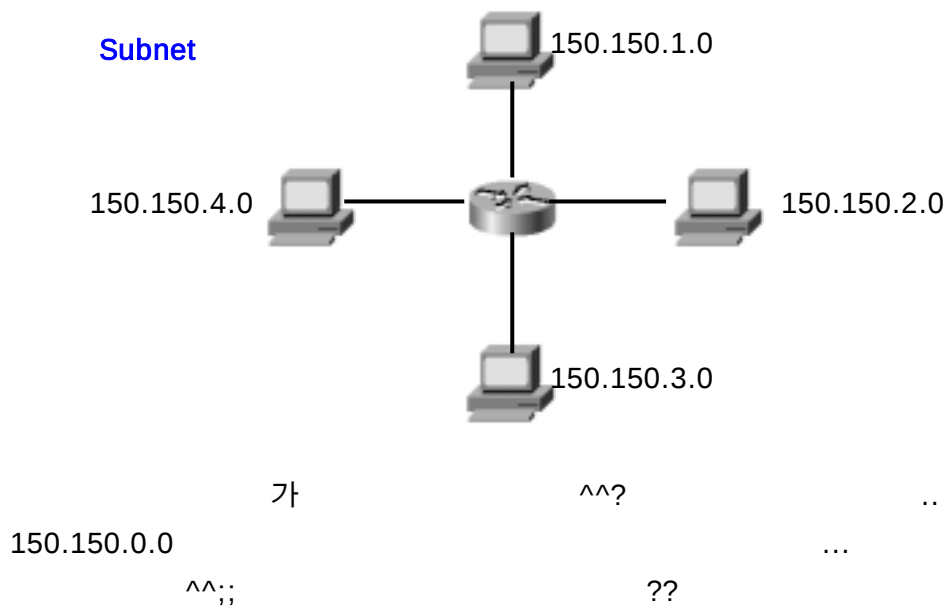
.. ^^? ^^?

Subnet
가 Subnet
.. Class B 150.150.0.0
.. 65,000
(Broadcast Domain) 65,000 가 ?? Broadcast
Domain ?? ...
?? PC 200.200.200.0
.. PC가 25 .. 가 254 25
.. 230 IP가 ?? 가 ..
IP ..

Original



Subnet



Logical AND

..

192	168	10	4
11000000	10101000	00001010	00000100
255	255	255	0
11111111	11111111	11111111	00000000
11000000	10101000	00001010	00000000

192.168.10.4 Class C .. 255.255.255.0 .. IP
 () Logical AND ..
 192.168.10.0 가 ()..
 ?? .. 1 192.168.10.4
 IP 192.168.10.0 가 ..
 가 ??

Logical AND 255 = 가
 (example : 192 Logical AND 255 = 192) Logical AND 0 = 0 ..

가 .. 150.150.1.0 150.150.2.0
 가 가 가
 255.255.255.0 .. 150.150.1.0
 150.150.2.0 ???
 가 ..
 150.150.1.0 150.150.2.0
 .. 150.150.0.0
 가 .. Feel ^^??
 ..
 ^^

PC 가 .. 200.200.200.0
 .. PC 25 가 .. 200.200.200.1 ~
 200.200.200.254 IP .. 0 1
 .. , ..
 .. 00, 01, 10, 11 .. 00, 11
 ??

가 01,10 ..
 3 000, 001, 010, 011, 100, 101, 110, 111 .. 000, 111
 가 6 가 .. 25 PC
 ()가 ?? 2 4 16 2 5 32
 가 !!

.. .. 255.255.255.0 .. 8
 가 25 PC ..
 5 .. ^^

Default	11111111	11111111	11111111	00000000
Subnetting	11111111	11111111	11111111	111 00000

가 5 0
 1 ..
 255.255.255.224가 .. 가 200.200.200.0(Mask 255.255.255.224)
 IP .. 2 5 2 30
 .. 25 5 가 ..
 200 가 가 PC
 ^^;; IP ^^
 .. 200.200.200.40 200.200.200.70
 가 .. 255.255.255.224
 ..

11001000 (200)	11001000 (200)	11001000 (200)	00101000 (40)
11111111 (255)	11111111 (255)	11111111 (255)	11100000 (224)
11001000 (200)	11001000 (200)	11001000 (200)	00100000 (32)
11001000 (200)	11001000 (200)	11001000 (200)	01000110 (70)
11111111 (255)	11111111 (255)	11111111 (255)	11100000 (224)
11001000 (200)	11001000 (200)	11001000 (200)	01000000 (64)

가 ^^ 200.200.200.40 200.200.200.32
 200.200.200.70 200.200.200.64 .. ^^ ^^

Class C

??

Octet

255.255.255

^^;; Class C

10000000 = 128	/25	Not Valid (	0	1	)
11000000 = 192	/26	Valid Subnet = 2	Valid Host Per Subnet = 62		
11100000 = 224	/27	Valid Subnet = 6	Valid Host Per Subnet = 30		
11110000 = 240	/28	Valid Subnet = 14	Valid Host Per Subnet = 14		
11111000 = 248	/29	Valid Subnet = 30	Valid Host Per Subnet = 6		
11111100 = 252	/30	Valid Subnet = 62	Valid Host Per Subnet = 2		
11111110 = 254	/31	Not Valid (	0	1	)

.. 가 $2^N - 2$ (N ,) ..

/25, /26 Prefix
 .. / 1 ..
 /25 1 25 가 ..
 /28 255.255.255.240 ... ??

^^

.. 가
 ..

Question > 200.200.200.0

.. 26

.. 5 가 ..

???

^
 ^

.. ?? ..

200.200.200.0 .. 26

.. 가 26 가

5bit가 .. PC PC 25 5bit ..

.. 248 11111000 255.255.255.248

.. 3bit 가 1

255.255.255.248 가 6 가

..

?? 150.150.0.0 Class B ..

.. 458 가 가

.. ??

150.150.0.0 / 23 , 255.255.254.0 .. 2

9 512 9bit .. 가

.. ^^;;

.. 200.200.200.0

가 255.255.255.224 ..

?? 3bit 8

.. ..

200	200	200	00000000 (0)
200	200	200	00000001 (1)
↓			
200	200	200	00011110 (30)
200	200	200	00011111 (31)

200.200.200.0 ~ 200.200.200.31 .. 200.200.200.0

200.200.200.31 가 ...

?? .. 0

.. 1 200.200.200.224

200	200	200	00100000 (32)
200	200	200	00100001 (33)
↓			
200	200	200	00111110 (62)
200	200	200	00111111 (63)

.. 001 ..

200.200.200.32 ~ 200.200.200.63 .. 200.200.200.32

200.200.200.63 .. 200.200.200.33

200.200.200.0/27 가 IP 가 .. ??

200.200.200.0 / 27 Subnet

Network Address	First Available	Last Available	Broadcast Address
200.200.200.0	200.200.200.1	200.200.200.30	200.200.200.31
200.200.200.32	200.200.200.33	200.200.200.62	200.200.200.63
200.200.200.64	200.200.200.65	200.200.200.94	200.200.200.95
200.200.200.96	200.200.200.97	200.200.200.126	200.200.200.127
200.200.200.128	200.200.200.129	200.200.200.158	200.200.200.159
200.200.200.160	200.200.200.161	200.200.200.190	200.200.200.191
200.200.200.192	200.200.200.193	200.200.200.222	200.200.200.223
200.200.200.224	200.200.200.225	200.200.200.254	200.200.200.255

200.200.200.0 / 27

??

Tip ^^

bit .. 5bit가

.. 2 N ..(N bit) 2

5 = 32 .. 0 .. 0 가 2^N .

0 + 32 = 32.. ~ 2^N .

64가 .. !! 2^N

가 .. 1

가 ..^^ 1 가

가 ^^ 1 가

.. ^^??

.. 192.168.1.0 / 26

, 가

..

6 .. 64 ...!! .. 64 bit .. / 26 6bit가 2
가

Network Address	First Available	Last Available	Broadcast Address
192.168.1.0			
192.168.1.64			
192.168.1.128			
192.168.1.192			

1

가

..

Network Address	First Available	Last Available	Broadcast Address
192.168.1.0			192.168.1.63
192.168.1.64			192.168.1.127
192.168.1.128			192.168.1.191
192.168.1.192			192.168.1.255

가

~

1

가

1

가

가

~

Network Address	First Available	Last Available	Broadcast Address
192.168.1.0	192.168.1.1	192.168.1.62	192.168.1.63
192.168.1.64	192.168.1.65	192.168.1.126	192.168.1.127
192.168.1.128	192.168.1.129	192.168.1.190	192.168.1.191
192.168.1.192	192.168.1.193	192.168.1.254	192.168.1.255

^^?? Class B

가

..

가

..

가

..

^^? 가
 .. 127.0.0.0 가 ..
 LoopBack ..
 .. 가 가
 Ping Ping .. Ping
 127.0.0.1 .. Ping
 가 .. 가
 TCP/IP 가 가 ..
 NAT(Network Address Translation)

10.0.0.0 ~ 10.255.255.255

172.16.0.0 ~ 172.31.255.255

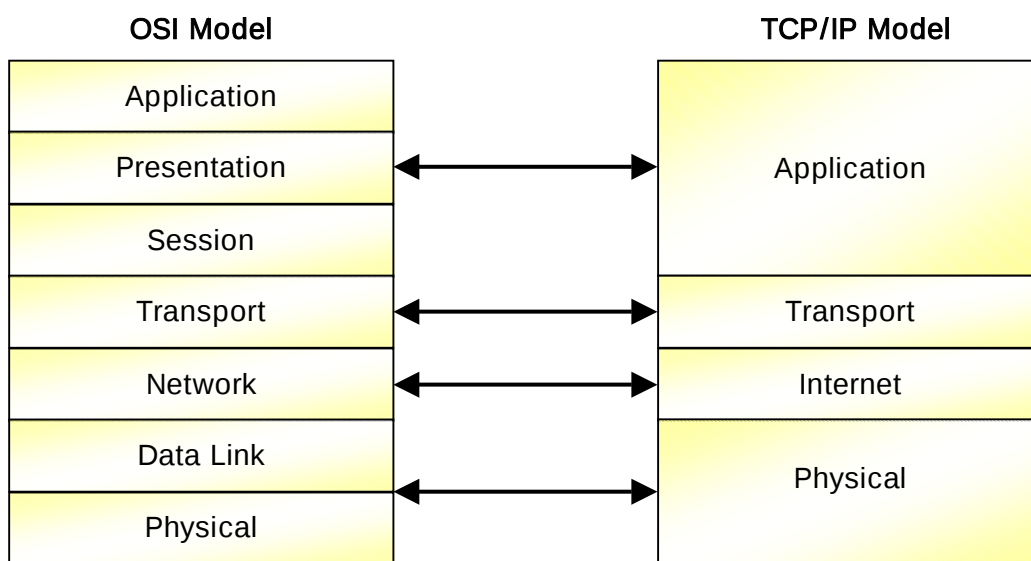
192.168.0.0 ~ 192.168.255.255

..
 ..
 .. A,B,C 가
 192.168.10.10 IP .. 가
 가
 ^^
 IP ... 가 ^^
 ^^
 ~ ~ ~ ^^

CCNA : TCP/IP

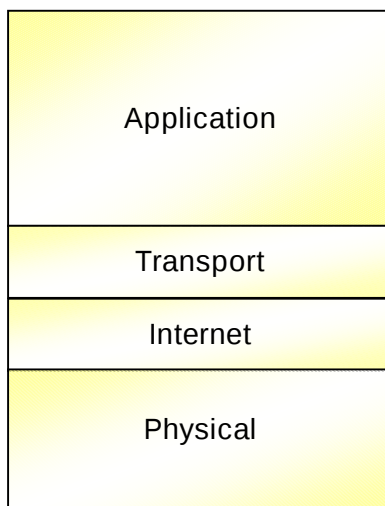
IP .. IP (??) (??).. TCP(Transmission Control Protocol)
 .. Transport Layer Network Layer
 .. TCP/IP 가
 .. TCP/IP

TCP/IP Model OSI Model

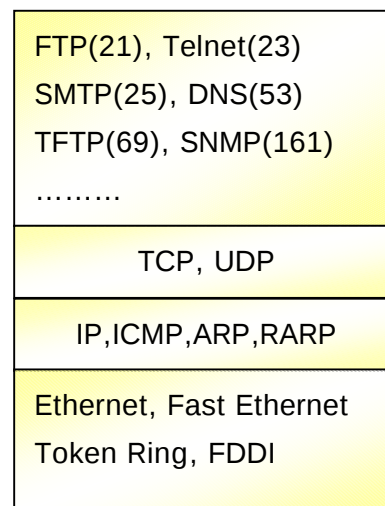


TCP/IP

TCP/IP Model



()



Application

..

File Transfer : TFTP, FTP, NFS

E-mail : SMTP

Remote login : Telnet

Network Management : SNMP

Name Management : DNS

..

가

..

가

..

A

TCP

가 80

.. 80

WWW가

^^;;

가

1024

well-known

1024

..

TCP/IP

..

TCP(Transmission Control Protocol)

UDP(User Datagram Protocol)

..

가

data

..

TCP : (Connection oriented protocol)

data가

..

data

..

2

(reliable)

..

100%

가

가

..

UDP

^^;; UDP

^^

UDP : (Connectionless Protocol)

data

.. data가

..

가

data

.. TCP

..UDP

Application

..

TCP

UDP

TCP

가

.. ..

Go~

TCP Header Format

() bit

Source Port(16)			Destination Port(16)		
Sequence Number (32)					
Acknowledgment Number (32)					
Header Length(4)	Reserved(6)	Code Bits(6)	Windows(16)		
Checksum(16)			Urgent(16)		
Options (0 or 32 If Any)					

UDP Header Format

() bit

Source Port(16)	Destination Port(16)
Length (16)	Checksum (16)
Data (If Any)	

TCP가 .. Never
 ---;; ...;
 TCP 가 ..

Multiplexing ()

Error Recovery (Reliability) ()

Flow Control using Windowing ()

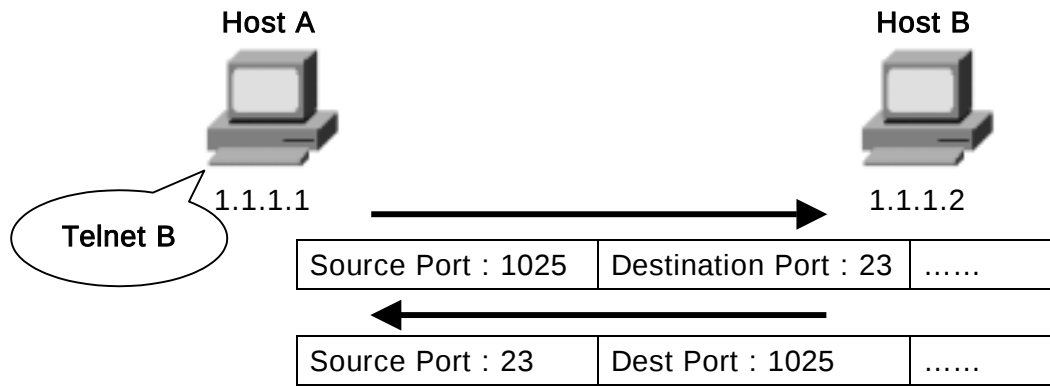
Connection Establishment and Termination ()

Data transfer ()

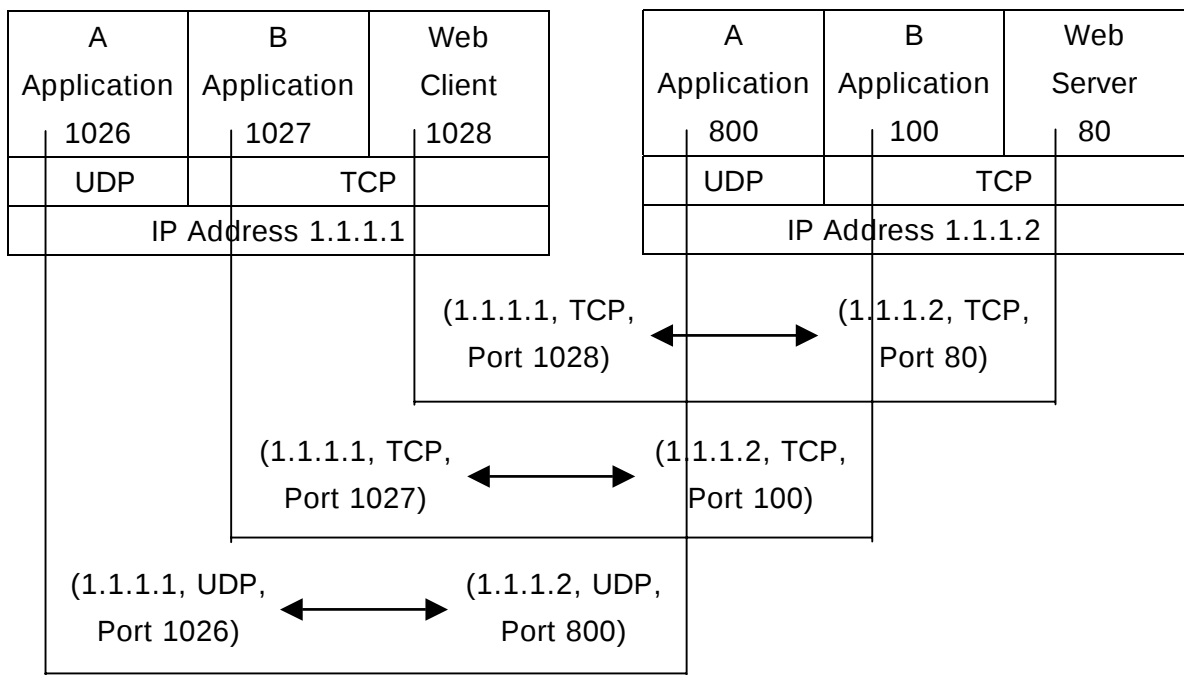
^^;; ..

Multiplexing

.. Multi 가 가 가 .. Multiplexing
 가 ?? socket socket IP , Transport
 Protocol(TCP, UDP), Port Number ..



A가 B .. Well-Known
 23 (Telnet) TCP .. B ' .. A가 Application
 , Source
 .. ??
 Multiplexing ..

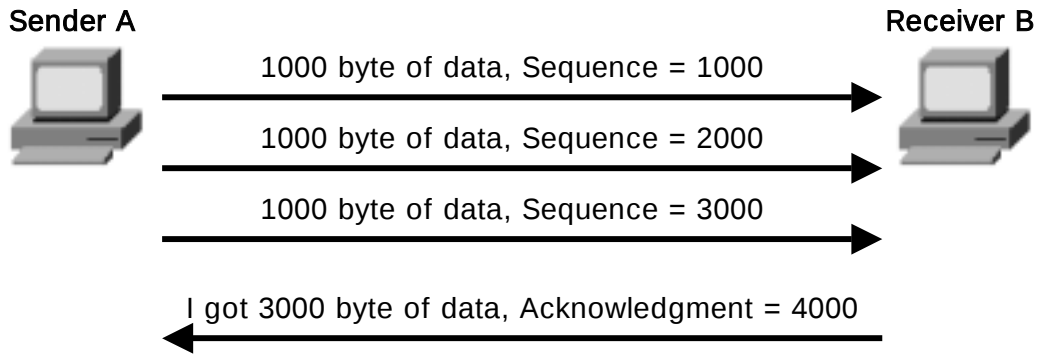


.. A B가 가 가 .. TCP
 data가 가 data가 Application
 .. ??
 ^^

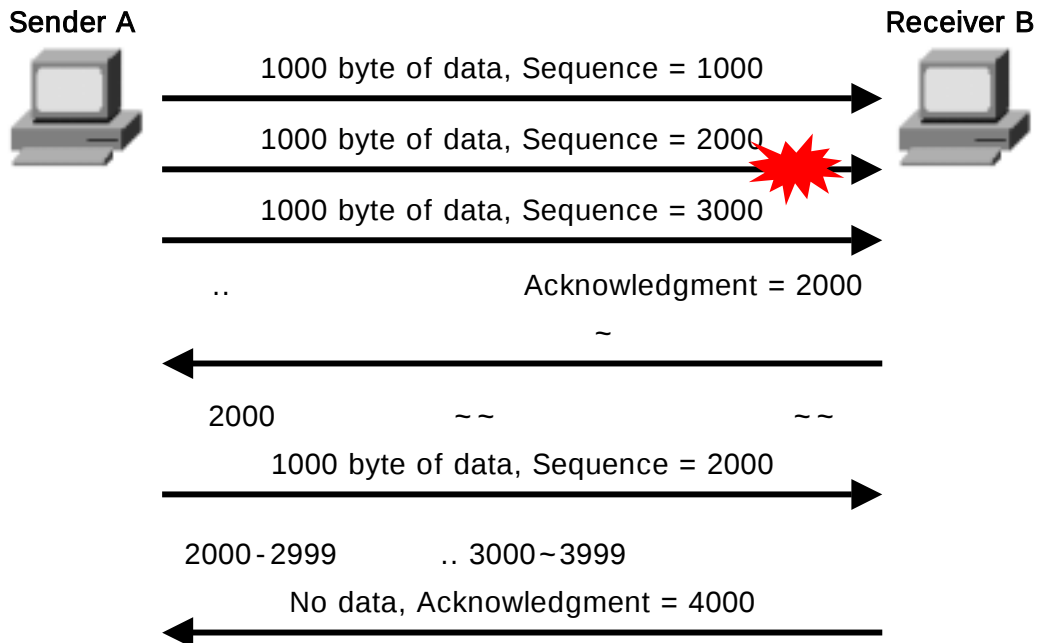
Error Recovery(Reliability)

.. TCP reliable ..

TCP Header Sequence Number
Acknowledgment Number .. 가 ^^



A가 B 3000 byte ? B가 3000byte
A ' 3000 byte ~ 4000 ~ ~ ' ..
A ' 가 가 .. 4000 ~ ~ ' ..
^^;; 가 .. 가 ??

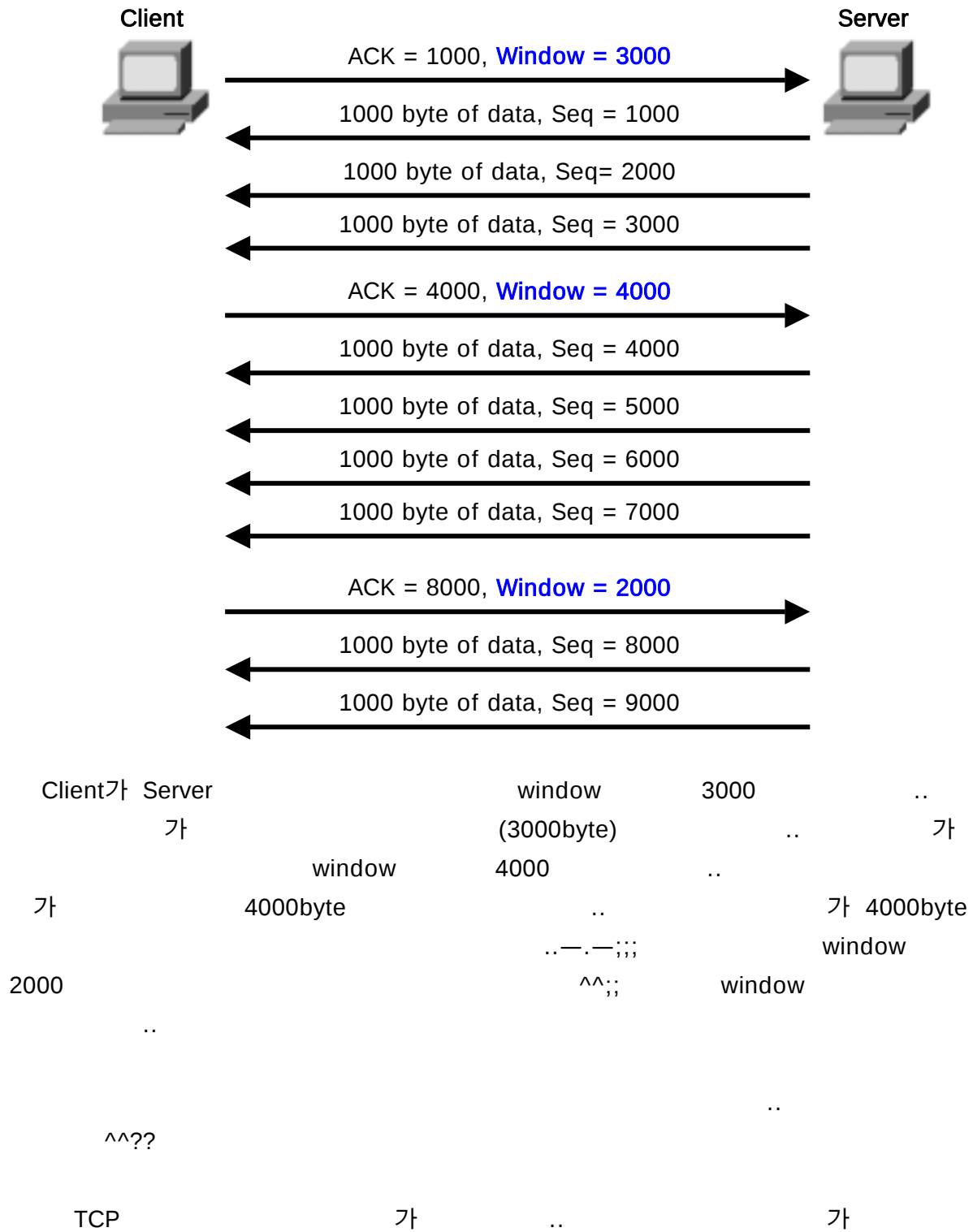


A가 B 2000-2999 가 가 .. B A
2000 .. A 2000 B
2000 .. 3000 .. 4000 A
4000 ... Ok??

Flow Control using Windowing

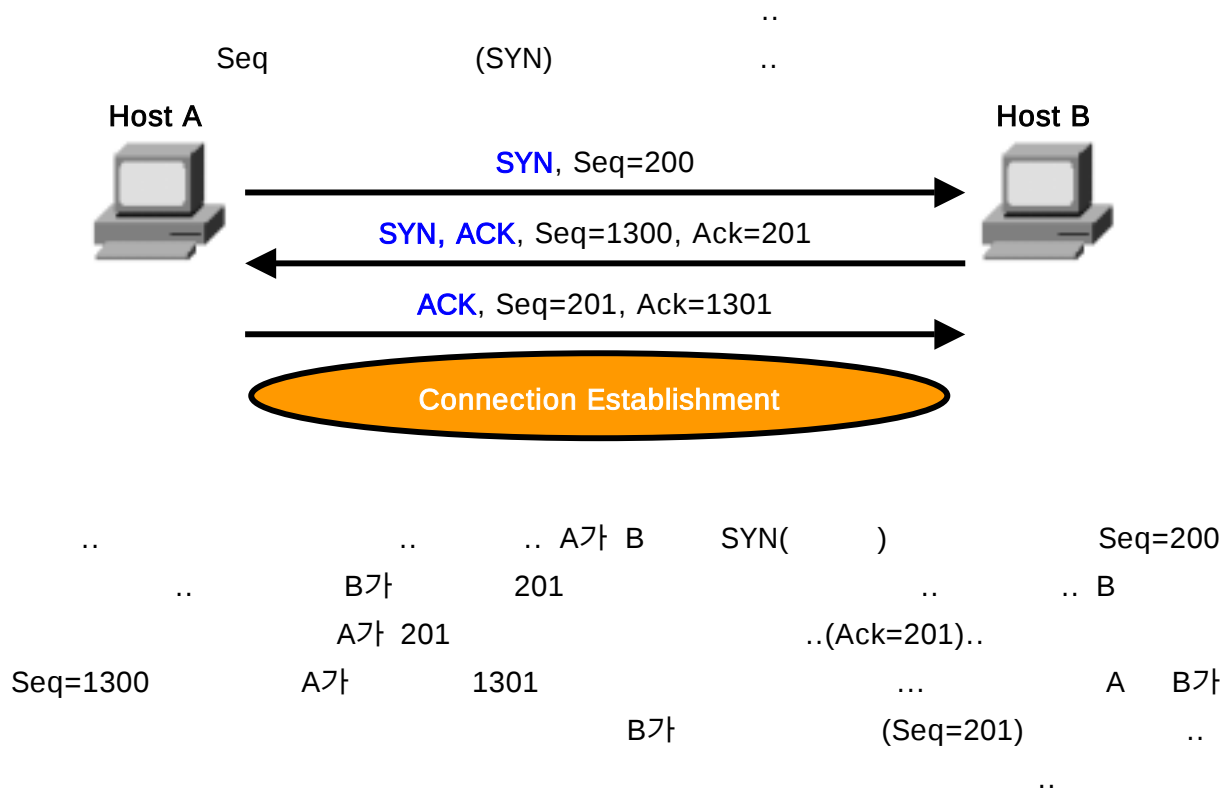
.. windowing

..



Connection Establishment and Termination

.. TCP



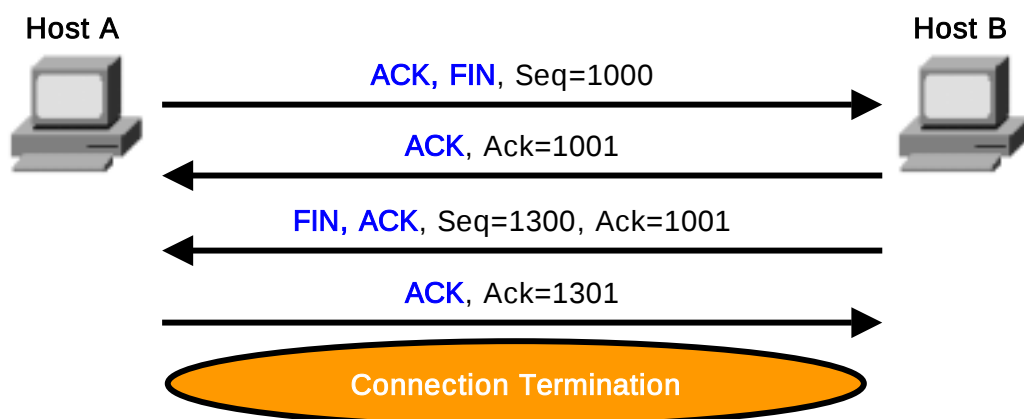
Three way handshake (3

)

..

4

..



A가 B FIN . B Seq Ack(1001) ..
 A FIN .. A B Ack(1301) 가

.. TCP

^^

Data transfer		..	.. TCP
..	^^	..	..
A B가	A가	..1000byte	B 가
seq	가 1000, 3000, 2000	..	B 1000
3000	2000 A		2000
..	가	..	
TCP	가	.. TCP	
4	UDP	..	..
TCP		UDP	
Connection oriented		Connectionless	
Multiplexing		Multiplexing	
Flow Control with windowing			
Reliable Transfer			
..	TCP	^^;;	
Network	ARP, RARP, ICMP		..
	^^		

ARP(Address Resolution Protocol)

^^? .. IP

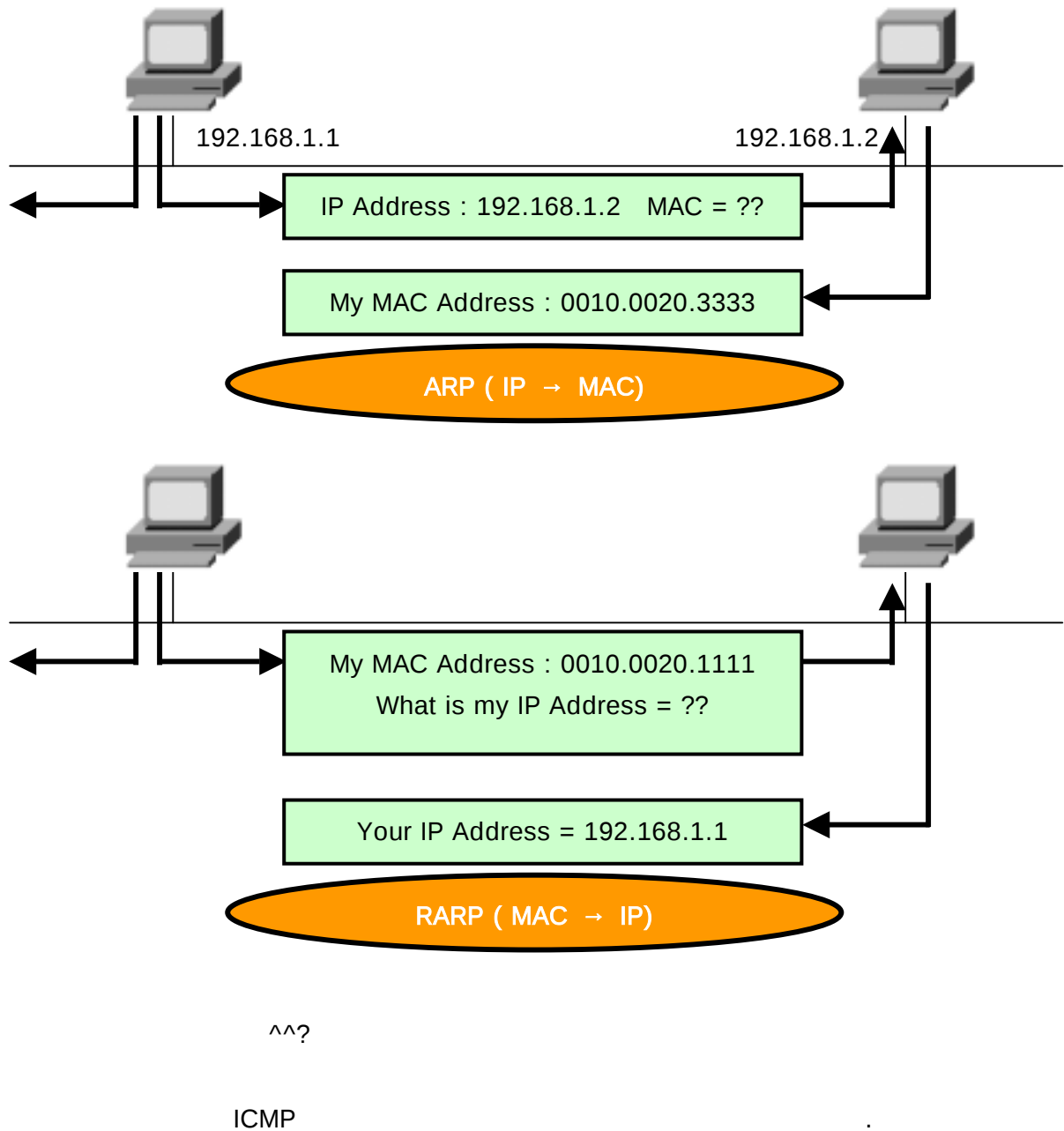
MAC

^^;; RARP(Reverse Address Resolution Protocol)

MAC

IP

..



ICMP(Internet Control Message Protocol)

TCP/IP

.. ICMP Message

..

.. 가 ??

Echo

Echo Request Echo Reply 가

.. ping

.. 가 echo request

echo reply

..

가

..^^

Destination Unreachable

가

..

packet

..

가

가

??

가

..

가..

가

가

..

Time Exceeded

ICMP

packet

..

가

.. IP header

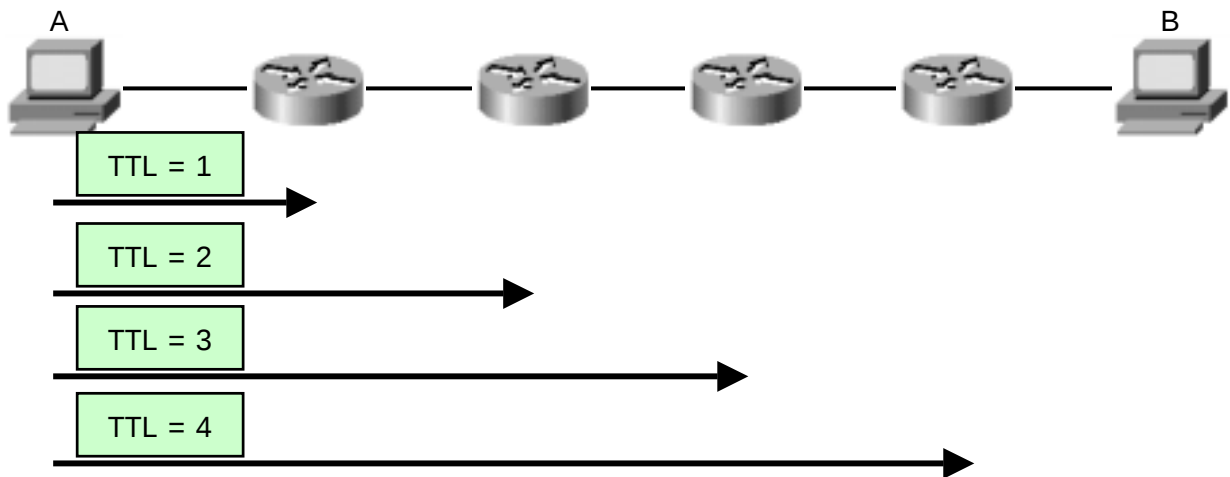
TTL(Time to Live)

가

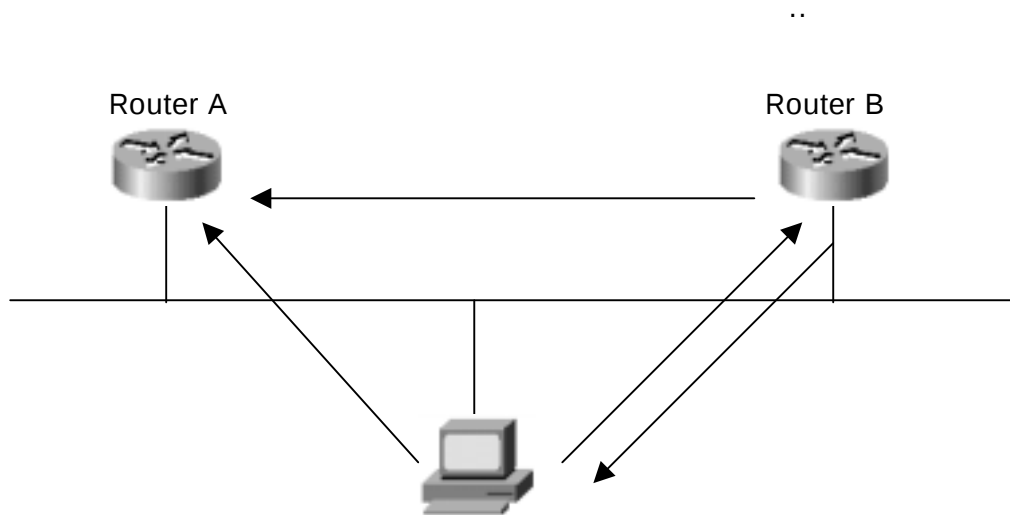
..

0

..



Redirect Message가 .. (Default Gateway) 가(



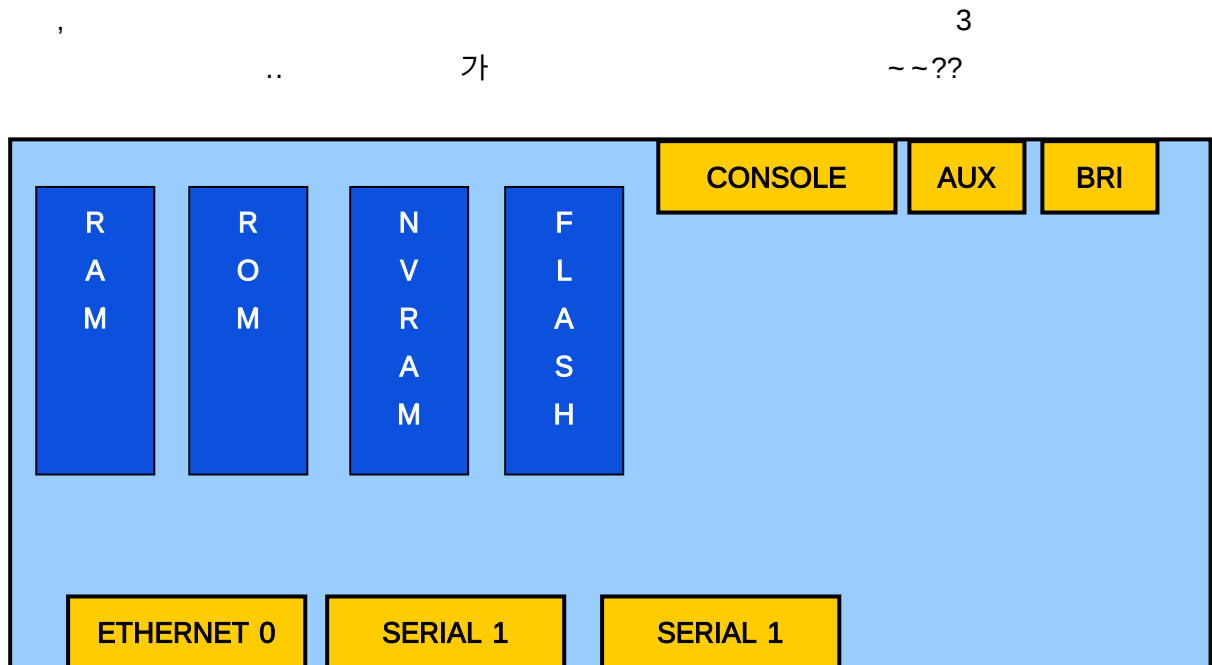
PC (1.1.1.0)) B .. PC가 .. B가 1.1.1.0 .. B PC Redirect Message A .. '1.1.1.0 PC 1.1.1.0 ..^^

.. 4 TCP, UDP 3 ICMP, ARP, RARP .. 가 .. ^^;; 가 @_@;; ^^

CCNA : Router

(Router)

Route + r, ,
data가
3 (Network)



(?) —;;

.. ..

..

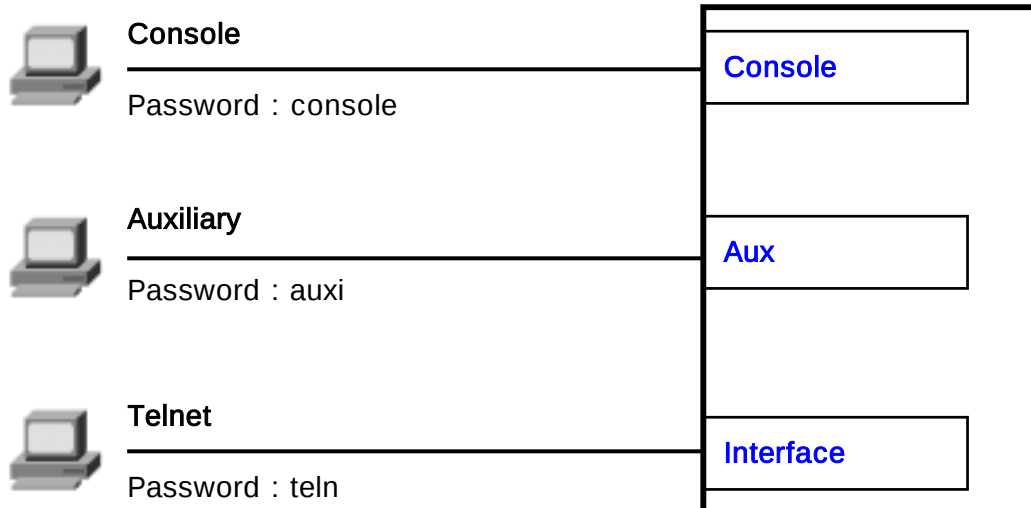
~

IOS(Internetworking Operating System)

CLI(Command Line Interface)

.. GUI .. DOS ^^;;

가 가 ..



Console Console PC

..

Console 가 ..

Aux ..

Telnet (Interface) IP

..

Telnet 가 ?? Auxiliary

가 ..

Console

.. 가 ^^;;

Console	Auxiliary	Telnet
line console 0	line aux 0	line vty 0 4
login	login	login
password console	password auxi	password teln

..^^

User exec Mode

.. User mode .. Router> 가
 .. '>' 가 User mode ..

..

enable

Privileged exec Mode(Enable Mode)

가 .. Privileged Mode
 가 Router# 가 .. '#' 가 Privileged Mode ..
 User Mode 가 'disable' ..
 Router> enable Router> en
 ?? , .. ,

가

가 ab —;; abceee abffff
 가 ab .. 가 ?? abceee
 abceee abc abceee
 .. --;;

Privileged Mode config terminal

Global Configuration Mode

..'conf t' .. ^^;;
 Router(config)# .. Global Configuration Mode
 .. Privileged Mode
 —. —;;

..

..

가

.. ^^;;

^^??

Press Return to get started.

..

Router> **en**

User Mode ^^ '>' Privileged Mode 가 . en 가 ~

Router# **conf t**

Privileged Mode .. Global Configuration Mode ~~ config terminal ^^

Router(config)# **hostname** Netcom

.. Global Mode .. hostname .. enter

Netcom(config)# **enable password** netcom

Netcom ^^;; enable password User Mode Privileged
Mode password ..
Privileged Mode netcom ~ ~

Netcom(config)# **line con 0**

line console 0 .. console configuration mode 가

Netcom(config-line)# **login**

console mode login
..

Netcom(config-line)# **password** console

가 'console' ~ ~!! .. ~

Netcom(config-line)# **exit**

exit 가 ...

Netcom(config)# **line aux 0**

.. Global Mode .. Auxiliary !!

Netcom(config-line)# **login**

Netcom(config-line)# **password** auxi

```
Netcom(config-line)# line vty 0 4
```

```
^^? Line vty 0 4
```

```
telnet
```

```
~
```

```
Netcom(config-line)# login
```

```
Netcom(config-line)# password teln
```

```
..
```

```
..^^
```

```
~~?
```

```
..
```

```
^^..
```

```
;;
```

```
Netcom(config-line)# ^z
```

```
Ctrl + z
```

```
Privileged Mode
```

```
.. exit
```

```
^^??
```

```
^^
```

```
Netcom# copy running-config startup-config
```

```
copy running-config startup-config
```

```
running-config ,
```

```
NVRAM
```

```
..
```

```
^^..
```

```
;;
```

```
^^
```

```
..
```

```
가
```

```
^^..
```

```
..
```

```
.. enable password enable secret 가 .. enable
password ^^? 가 show running-config
```

```
.. Privileged Mode
```

```
password .. enable password
```

```
enable secret
```

```
가
```

```
..
```

```
가
```

```
enable secret
```

```
^^..
```

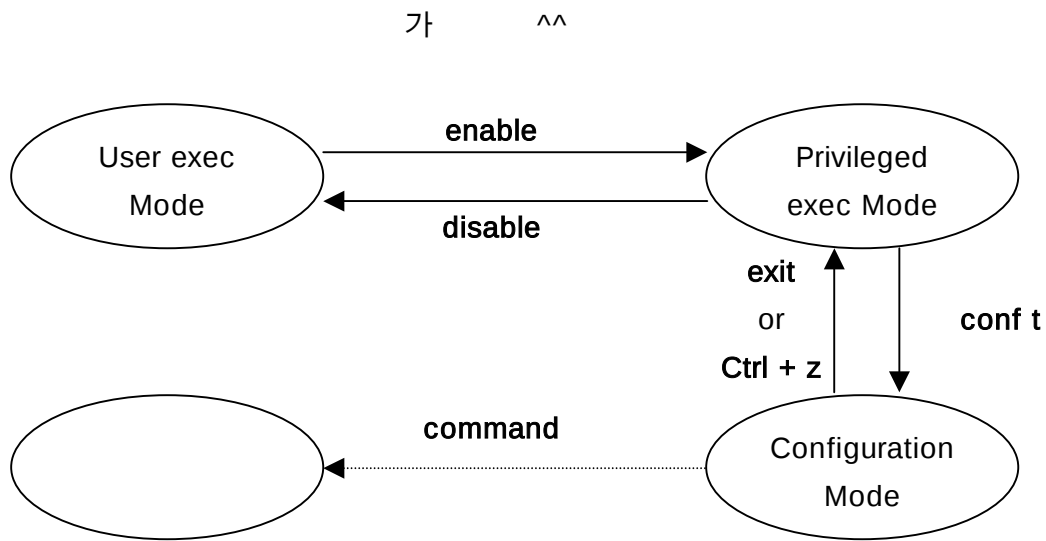
```
enable secret
```

```
Privileged Mode
```

```
가
```

```
^^..
```

```
;;
```



4가 가 .. **RAM**(Random Access Memory),
ROM(Read Only Memory), **NVRAM**(NonVolatile RAM), **Flash** 4가 ..

, **RAM** .. RAM .. 가 Off
 .. **IOS**가 .

, **ROM** .. ROM . ROM
 IOS가 ... 가 IOS
 가 가 IOS

..

, **NVRAM** .. NVRAM ..

..

, **Flash Memory** **IOS** 가 ..

——;;;

RAM NVRAM ..

RAM IOS , (Routing Table)

.. Routing Table ..

, 가 RAM

.. RAM Off

..

RAM Privileged Mode 'show running-config'

..??

, Off ??

NVRAM .. 가 IOS

IOS Flash Memory , NVRAM ...

NVRAM P Mode 'show startup-config'

..

, , IP ,

가 ..

Flash Memory IOS .. 가 IOS

.. IOS ?? TFTP(Trivial File

Transfer Protocol) IOS ..

, copy running-config startup-config

?? RAM ..

NVRAM .. ^^

june# sh run

```
RAM .. show running-config ^^ hostname june
^^;
```

$$\dots \left(\begin{array}{c} \wedge \wedge \end{array} \right)$$

```
hostname june
```

$$\dots (\quad \wedge \wedge)$$

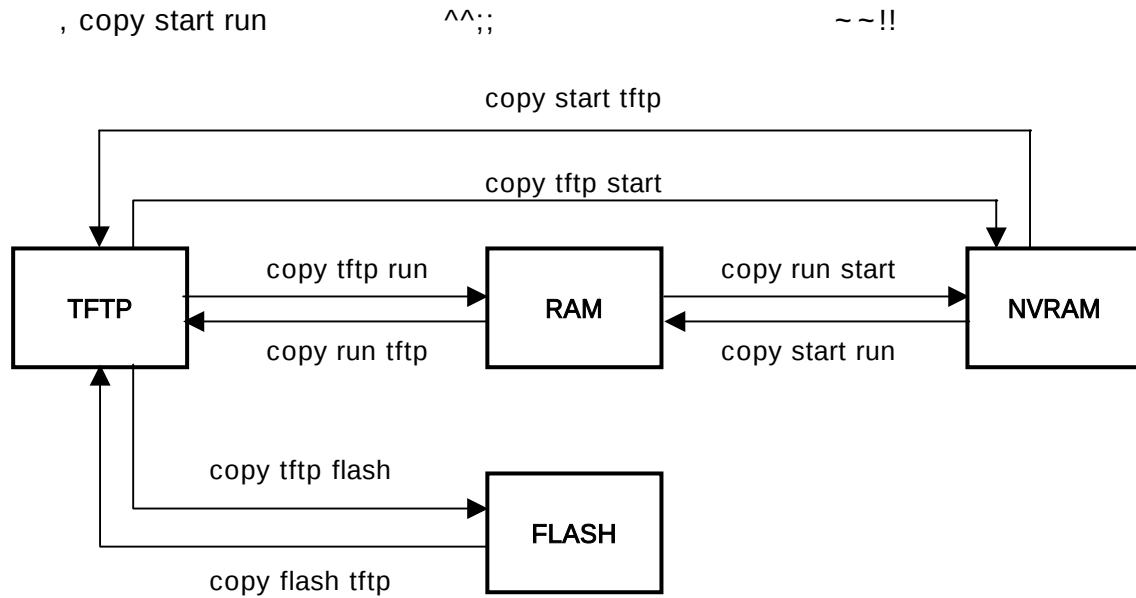
```

,                               hostname                .. hostname
june    ..    RAM              ^^

```

june# sh start
NVRAM .. show startup - config ^^;
...(^^)
hostname june
...(^^)
, NVRAM hostname june !!
june# conf t
june(config)# hostname netcom
Global Configuration Mode 가 hostname netcom !!!
netcom(config)# exit
netcom# sh run
hostname Privileged Mode sh run .. ??
...(^^)
hostname netcom
...(^^)
Hostname ^^ RAM ??
netcom# sh start
^^?
...(^^)
hostname june
...(^^)
!!! ?? RAM NVRAM ..
hostname june ..^^;;
netcom# copy run start
copy running - config startup - config ^^ RAM NVRAM
..
netcom# sh start
...
...(^^)
hostname netcom
...(^^)
.. RAM ^^;; , RAM
NVRAM ..^^;;

copy tftp flash
 .. TFTP
 !! NVRAM
 IOS
 Flash memory
 .. copy (from) (to)
 RAM
 IOS
 ???



copy
 ^^?

..^^

ROM Flash .. Booting
 가 가 ^^a??

^^!!

CCNA : Router

```

??                                ^^;;
^^;; ,                            ??
..
ROM, Flash                        ..
^^;; ROM                          Flash ..
                                ^^;;
                                ;; Flash   IOS .. 가
IOS load .. Flash
가      ^^; show      Flash
.. show flash

```

Router# **show flash**

System flash directory:

File	Length	Name/status
1	7567500	study.c4500-d-mz.120-5.bin

[7567564 bytes used, 820114 available, 8387678 total]
 8192K bytes of processor board System flash (Read ONLY)

```

                                ^^;; show version
                                IOS .. show version
ROM ..^^
TFTP IOS Flash copy tftp flash
.. TFTP IP , , Flash
가, IOS ..
^^
? ^^;;

```

Router# copy tftp flash		
System flash directory:		
File	Length	Name/status
1	7567500	study.c4500-d-mz.120-2.bin
[7567564 bytes used, 820114 available, 8387678 total]		
8192K bytes of processor board System flash (Read ONLY)		
Address or name of remote host [255.255.255.255]? 1.1.1.1		
Remote host,	TFTP	가 ..
TFTP	IP	1.1.1.1 ..
Source file name? study.c4500-d-mz.120-5.bin		
.. ..		
Destination file name [study.c4500-d-mz.120-5.bin]?		
IOS .. []		
.. [] .. ^^		
Erase flash device before writing? [confirm]		
Flash	.. Flash	
..	^^... ,,,	

Flash .. ^^...
,,,

^^...
,,,

, ROM ~ ~ ~

ROM 가 code ..

Flash IOS .. 가

가 가 IOS ..

, ?? **Setup Mode** .. 가

..

가 가 .. Square bracket '[']' default

.. .. ^^?

, NVRAM 가 .. Privileged Mode **setup**

..

Booting

.. 4가

~!!

.. ..

, POST(Power-On Self Test)

..

..

, ROM

bootstrap code

.. bootstrap code

ROM

code

..

, IOS

load

..

Flash

,

TFTP,

ROM

load

..

,

load

...

Reboot

.. POST

가

가

..

IOS

load

OS

3가

가

..

..

가

-_-;;

3가

.

Full-featured IOS(

OS), Limited - function IOS(

가 OS), ROMMON(

or Low-level debugging

)

OS	Full	Limited	ROMMON
	Flash, TFTP Server	ROM	ROM
	IOS	가	ROM Monitor
	..	IP	ROMMON
	..^^	.. TFTP	. Low-level
		IOS	debugging(
		^^;;	...;)
		RXBOOT Mode	
	.		..

^^? , OS

3가

가

OS

?? OS

2

가

..

register

boot system

..

, register .. **config-register**
 Global Configuration Command .. Global Configuration Command
 Router(config)# ..
 register OS ..

Router# show version		
show version	register	..
..		
Cisco Internetwork Operating System Software		
...()		
Configuration register is 0x2102		
Register	0x2102	!!

show version register ..
 default value **0x2102** .. 0x 16 .. ,
 16 2102 .. 가 ^^

2				1				0				2			
0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0

16 2 .. 0xA 10 ?? , 10
 .. ?? 1010 ^^;; ()가 **boot**
field .. 0 **ROMMON** , 1 **RXBOOT** , 2~F
Full IOS .. OS가
 .. ^^?

, boot system .. Global Configuration Mode
 .. Router(config)# **boot system (ROM / flash / tftp)** ..

가 ~

Boot Field	Boot System Command	
0x0	Ignore Command	ROMMON load
		boot system ROMMON load ..
0x1	Ignore Command	RXBOOT load
		boot system RXBOOT load ..
0x2 - 0xF	No boot command	boot 가 Flash, TFTP, ROM load ..
0x2 - 0xF	boot system ROM	ROM IOS load ...
0x2 - 0xF	boot system flash	Flash memory 가 load ..
0x2 - 0xF	boot system flash <i>filename</i>	Flash memory <i>filename</i> 가 load . ^^;;
0x2 - 0xF	boot system tftp <i>filename</i> 1.1.1.1	1.1.1.1 TFTP <i>filename</i> 가 load ..
0x2 - 0xF	Multiple Command	boot system , load .. 가 boot , .. ^^

?? ..

..—.—a;;

—;; Password Recovery(

)

?..

..(

^^.....)

2500

..

(???).....

□ □

□ □

.. ^^?

?	가	.
Command ?	Command	parameter
	..	
com?	'com'	..
Command parm?	Command	parameter parm
	parameter	..
command parm<Tab>	<tab>	CLI가
	.. sh run	sh run<tab>
	sh running-config	..
	^^?	
Command parm1 ?	Command	parameter
	parameter	..

• •

Command	
↑ or Ctrl-p	.. .
↓ or Ctrl-n	p .. .
← or Ctrl-b	
→ or Ctrl-f	b .. .
Ctrl-a	..
Ctrl-e	..
Esc-b	..
Esc-f	..

^^??

clock

 $\wedge \wedge$

가

..

..

..

Router# **clock**

Translating "CLOCK"

% Unknown command or computer name, or unable to find computer address

.. klok 가 ..^^

Router# **cl?**

clear clock

cl (??) cl? .. cl
 ^^ clear clock ^^;;Router# **clock**

% Incomplete command.

clock ..
 가 ^^;;Router# **clock ?**

set set the time and date

clock
parameter ^^;; clock set 가
 ^^;; clock clo<tab> clock 가
 ..Router# **clock set**

% Incomplete command.

clock set ^^

Router# **<Ctrl-p>clock set ?**

hh:mm:ss Current Time

<Ctrl-p> ^^? Ctrl-p
clock set 가 .. ? parameter
 ^^;;
 ^^??

```

가      ..      가 가      ..      show history
      ..      10      .. 10
terminal history size x      x      ( 256 )
..
erase      .. erase      ^^ erase startup-config
  NVRAM      ..
      ??      가 ?
..      enable secret abcd123      Privileged Mode
abcd123      ..
      ??      no enable secret abcd123
..      no      가      ..      가 no      가
      ..
..      ..      ^^;;
Interface      , CDP, debug      ..
Router      ^^

```

CCNA : Router

가 ??

..^^;;

Interface

CDP(Cisco Discover Protocol), Debug

..

Routing Protocol

^^..;;

Interface

Interface

Ethernet Interface

Serial Interface

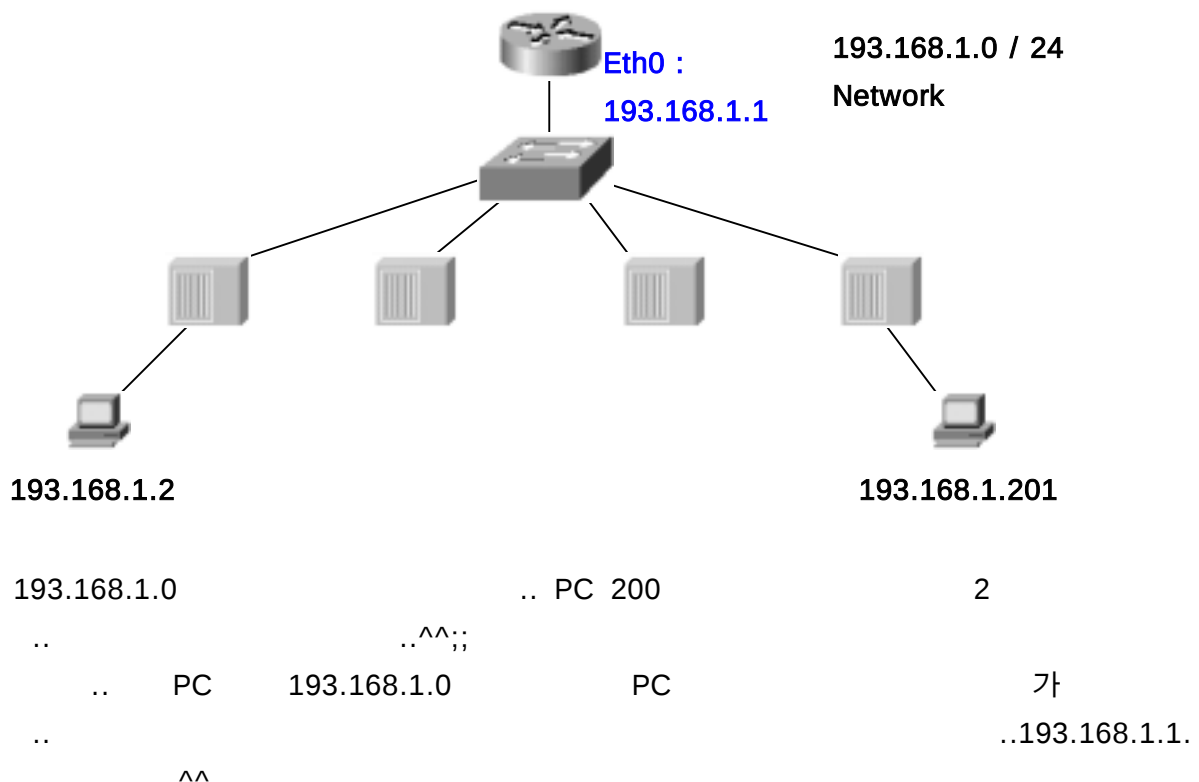
250 PC PC 193.168.1.0 / 24 가

Ethernet Interface

Ethernet Interface

Gateway

Gateway



??

..

Router> en

Router# conf t

Router(config)# interface ethernet0

interface Ethernet0 . Ethernet0 Interface .. int e0

..

Router(config-if)# ip address 193.168.1.1 255.255.255.0

ip address [ip address] [subnet mask] .. Prompt (config-if)

.. if=interface.. Ethernet0 Interface 193.168.1.1 IP

.. PC ??

..

Router(config-if)# no shutdown

00:00:08: %LINK-3-UPDOWN: Interface Ethernet0, changed state to up

00:00:09: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0, changed state to up

No shutdown.. ..

Router(config-if)# ^z

Router# copy run start

^^

IP

no shutdown

?

??

shutdown

..

가

IP

.. no shutdown

가

.. show

interface

가

.. show interface

..

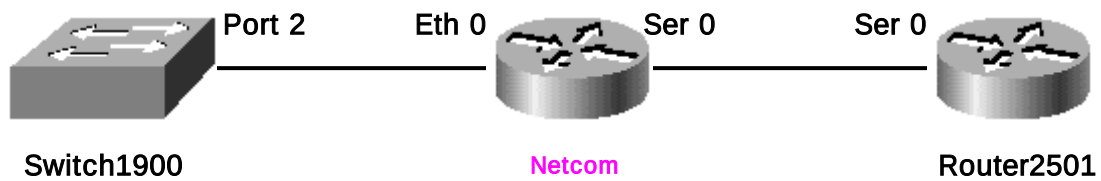
.. Ethernet 0

show interface Ethernet 0

가

..

~~



.. Netcom .. cdp
??

Netcom# **show cdp**

Global CDP information

Sending CDP packets every 60 seconds

Sending a holdtime value of 180 seconds

cdp .. 60 CDP packet ..^^ holdtime
180 .. holdtime 180 CDP packet
.. 가
Off ^^
Global Command cdp [timer/holdtime] value
.. Global Mode가
? show cdp neighbor ..

Netcom# **show cdp neighbor**

Capability Codes: R – Router, T – Trans Bridge, B – Source Route Bridge,

S – Switch, H – Host, I – IGMP, r – Repeater

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
Switch1900	Eth 0	238	T S	1900	2
Router2501	Ser 0	138	R	2500	Ser 0

Netcom show cdp neighbor Netcom
가 .. Router2501 가 10 가
Netcom ..
가 가 .. ~

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
Switch1900	Eth 0	238	T S	1900	2
Router2501	Ser 0	138	R	2500	Ser 0

```

.. Device ID      Hostname      .. Local Interface
Netcom            Router2501   Netcom            Serial0
Holdtime          ^^?          Router2501        138
CDP Packet        18          CDP Packet        ^^?
Capability        .. 2501   Router, 1900      Trans Bridge Switch
Platform          ^^;; Platform      .. Router2501   Cisco Router 2500
Port ID           Local Interface      .. Netcom       CDP Packet
Netcom            가      .. Switch      2      , Router2501   Serial0

```

show cdp neighbor detail

```
Netcom# sh cdp nei de
```

```
Device ID : Switch1900
```

```
Entry address(es):
```

```
IP address : 0.0.0.0
```

```
Platform: cisco 1900, Capabilities: Trans-Bridge Switch
```

```
Interface: Ethernet0, Port ID (outgoing port) : 2
```

```
Holdtime : 166 sec
```

```
Version :
```

```
V9.00
```

Device ID : Router2501
Entry address(es):
IP address : 172.16.10.2
Platform: cisco 2500, Capabilities: Router
Interface: Serial0, Port ID (outgoing port) : Serial0
Holdtime : 150 sec
Version :
Cisco Internetwork Operating System Software
.....()

```

      ^.^?.....
      ,,,,,,
show cdp entry *
..

cdp          enable          ... cdp          no cdp run
..
      ^.^?          ^.^a;; Global Mode          ^.^
..

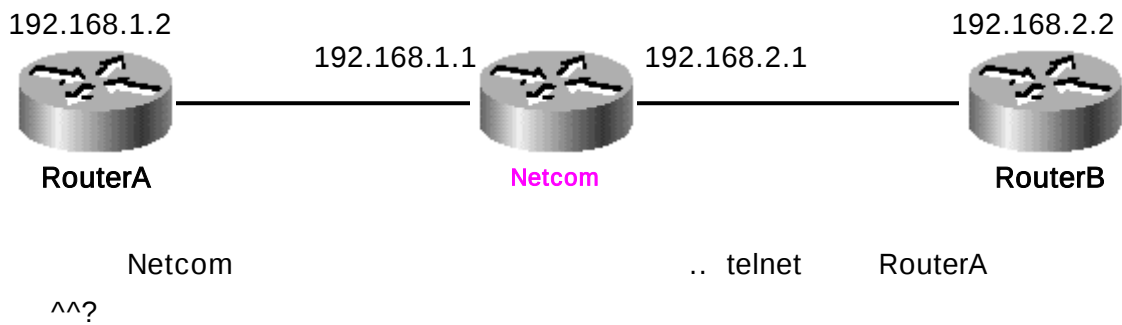
      cdp          Interface          가
((config-if) ← ^.^ ) no cdp enable          ..          cdp
enable          ^^

..          Telnet          .. Routing Protocol          가
..—.—;;

..          Telnet          가          가
..          ^^ telnet IP address          ^^
..          ..^^;;

```

Go~ Next Page~!



```
Netcom# telnet 192.168.1.2
```

```
Trying 192.168.1.2 ... Open
```

```
Password required, but none set
```

```
[Connection to 192.168.1.2 closed by foreign host]
```

```
Netcom#
```

```
@.@???
```

```
?? 가
```

```
password
```

```
Telnet
```

```
?? RouterA
```

```
..
```

```
-_-;;
```

```
가
```

```
가
```

```
가
```

```
Netcom# 192.168.1.2
```

```
telnet
```

```
IP
```

```
..
```

```
Trying 192.168.1.2 ... Open
```

```
User Access Verification
```

```
Password:
```

```
RouterA>
```

```
RouterA
```

```
가
```

```
^^
```

RouterA> **enable**

% No password set

RouterA>

@.@;;; Privileged Mode 가 password가

.. enable password enable secret

..

, Multiple Device telnet ?

Netcom# **telnet 192.168.1.2**

Trying 192.168.1.2 ... Open

User Acces Verification

Password:

RouterA> **[Ctrl+Shift+6, then x]**

RouterA .. Ctrl,Shift,6 x ??

Netcom#

!! Netcom @_@

Netcom RouterA ..
Netcom ..

Netcom# **telnet 192.168.2.2**

Trying 192.168.2.2 ... Open

User Acces Verification

Password:

RouterB> **[Ctrl+Shift+6, then x]**

RouterB .. Ctrl+Shift+6, then x Netcom 가 ..

Netcom#

RouterA, RouterB 2 가 ??
Netcom ..

??

Netcom# **show session**

Conn	Host	Address	Byte	Idle	Conn Name
1	192.168.1.2	192.168.1.2	0	0	192.168.1.2
* 2	192.168.2.2	192.168.2.2	0	0	192.168.2.2

^.^:: * telnet session ..
 telnet 가 ?? resume ..
 .. RouterB 가 ..
 resume .. resume 1 RouterA .. resume 2
 RouterB .. ^.^? B 가 ??

Netcom# **Enter twice or resume 2**

RouterB>

.. RouterB .. ??
 가 가 .. telnet (Netcom Router
 ..) **disconnect** (RouterB>)
exit ..

RouterB> **exit**

[Connection to 192.168.2.2 closed by foreign host]

Netcom# **disconnect 1**

Closing Connection to 192.168.1.2 [confirm]

Netcom# **sho sess**

Conn	Host	Address	Byte	Idle	Conn Name
exit	RouterB		Netcom#		..
disconnect (number)		RouterA			.. show session

^^

IP .. —.—;; hostname

... ..
 .. ↓ ~

```

ip host . ip host name tcp_port_number ip_address
. Tcp port 23 .. 가 telnet 23
.. ^^

```

```
Netcom# conf t
```

```
Netcom(config)# ip host RouterA 192.168.1.2
```

```
Netcom(config)# ip host RouterB 192.168.2.2
```

```
Netcom(config)# ^z
```

```

ip host RouterA 192.168.1.2 RouterB 192.168.2.2 ..
^^ host table

```

```
show hosts ..
```

```
Netcom# show hosts
```

Host	Flags	Age	Type	Address(es)
RouterA	(perm, OK)	0	IP	192.168.1.2
RouterB	(perm, OK)	0	IP	192.168.2.2

```
Netcom#
```

```

.. DNS
.. perm 가 DNS
perm temp .. DNS RouterA
DNS ..
^^?

```

```
Netcom# telnet RouterA or RouterA
```

```

telnet .. ^^? telnet
..

```

```
Trying RouterA (192.168.1.2)... Open
```

```
User Access Verification
```

```
Password:
```

```
RouterA>
```

```
^^?? ..
```

```
, Debug ..
```

```

..                               telnet                               .. @.@;;;                               ..—.—.;;

IOS      가      message                               ..      Syslog
Message      ..                               .. debug
가      ..      powerful                               .. debug
      IOS가      가      ..
      syslog      ^^ debug
가      IOS      .. debug                               no
debug all or undebg all      .. debug      가
      ^^;; debug      ..
      ..      ~

debug      syslog message      console
..      가 telnet      .. telnet
      terminal monitor      ..

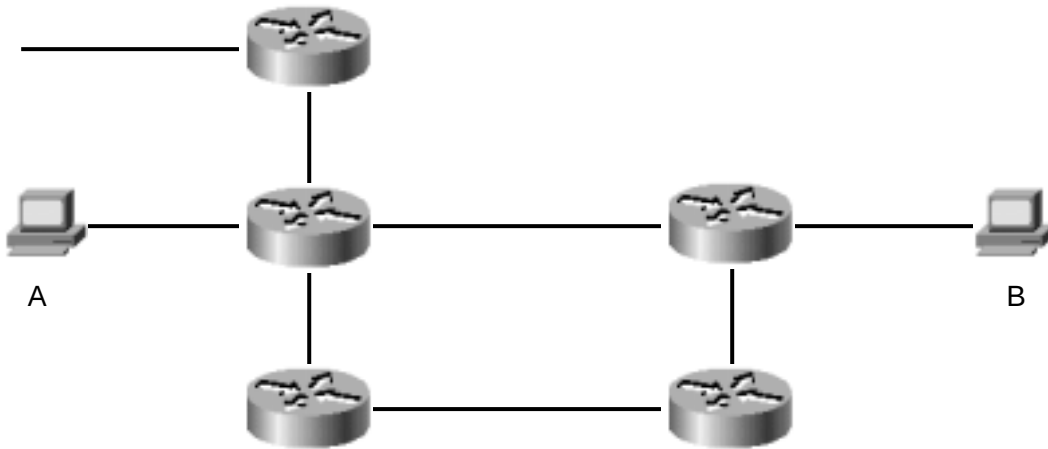
      logging buffered      RAM      ..
      show logging      ..

no logging console      console
..

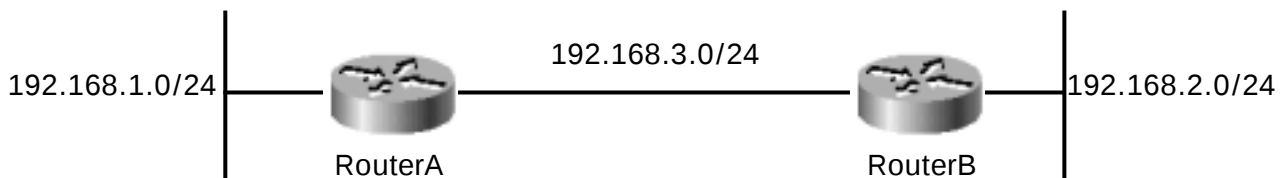
...      ..      ..

      ~ ~

```

A가 B .. Distance Vector Protocol
 .. 1,2,3 .. ?? 3
 ?? Vector, ^^;; 1 2
 Distance, 가 ?? 1 ~..
 data 1 B .. Distance Vector ^^?
 , ?? , Distance Vector
 Protocol (direct)
 .. ' xxx 가 ~ ~' ..
 Routing table ..
 가 ..

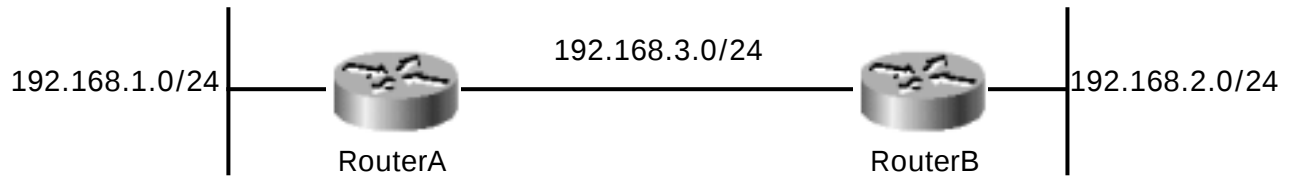


Routing Table		
E0	192.168.1.0	0
S0	192.168.3.0	0

Routing Table		
E0	192.168.2.0	0
S0	192.168.3.0	0

.. Routing Table .. ^^;;
 direct Table ~
 hop count .. hop count 가
 .. direct 0 ^^

가
Distance Vector ^^ ^^)
..(direct ??

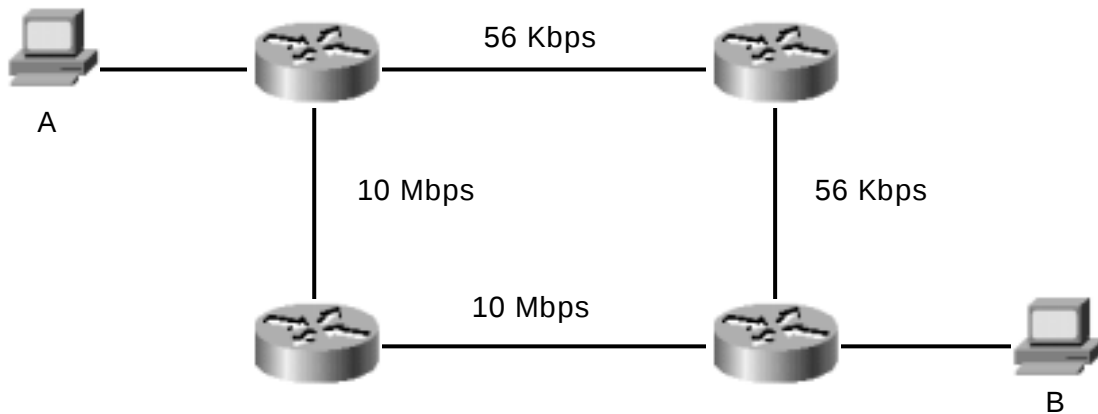


Routing Table		
E0	192.168.1.0	0
S0	192.168.3.0	0
S0	192.168.2.0	1

Routing Table		
E0	192.168.2.0	0
S0	192.168.3.0	0
S0	192.168.1.0	1

가
Interface 가
192.168.2.0 가
Serial0 가 가 .. ?? RouterA

.. Routing Table Update ^^;;
.. , RouterA
1



Distance Vector Protocol 가 RIP IGRP 가
.. RIP Hop Count .. -.-;;

A가 B 가 hop count가
.. .. 10Mbps ;;
RIP ..

IGRP Bandwidth, Delay, Load, Reliability, MTU

..

Bandwidth	,	..	56Kbps
10Mbps가	^^		
Delay		..	
Load		..	
Reliability		..	
MTU	Maximum Transmission Unit..	..	

IGRP Bandwidth Delay 가
 .. 10Mbps ..
 RIP ^^

, RIP IGRP가 Protocol
 ?? RIP IGRP가 IGRP
 ?? Administrative Distance()
 .. 가 ..

Route Type	Default Distance
Connected	0
Static	1
EIGRP	90
IGRP	100
OSPF	110
RIP	120

RIP IGRP IGRP ?? , 가
 RIP IGRP IGRP ..
 (IGRP) (RIP)
 ..^^;; ^^.....
 ;;;

..

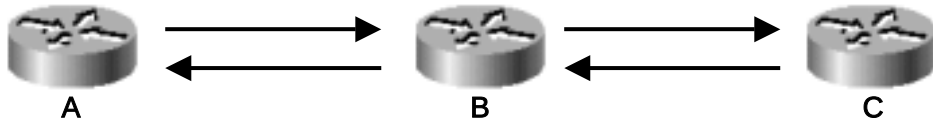
Distance Vector Protocol

Routing Loop가

.. @.@;;

@.@?? , Distance Vector

..



direct

.. B A

C

.. hop count 1 가

^^;;

C가 A

?? .. A가 B

B가

C

C A

가

..

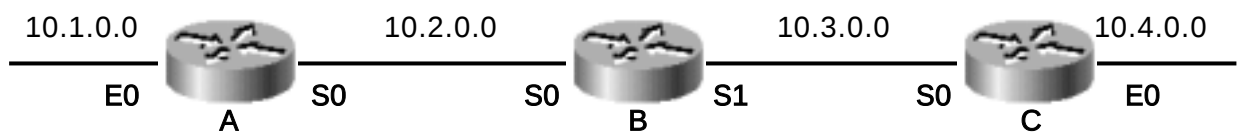
가

??

,

가

..



Routing Table		
E0	10.1.0.0	0
S0	10.2.0.0	0
S0	10.3.0.0	1
S0	10.4.0.0	2

Routing Table		
S0	10.2.0.0	0
S1	10.3.0.0	0
S1	10.4.0.0	1
S0	10.1.0.0	1

Routing Table		
E0	10.4.0.0	0
S0	10.3.0.0	0
S0	10.2.0.0	1
S0	10.1.0.0	2

..

..

??

..

(convergence)

..

RIP IGRP

..

가

가

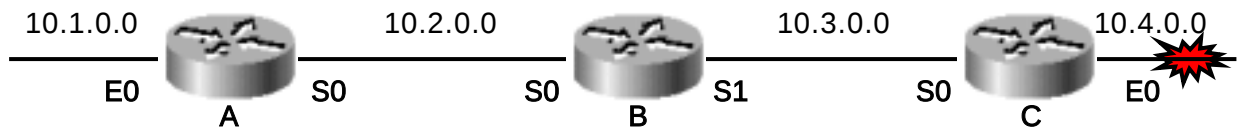
.. .. C

10.4.0.0 가 가

가

..

??



Routing Table		
E0	10.1.0.0	0
S0	10.2.0.0	0
S0	10.3.0.0	1
S0	10.4.0.0	2

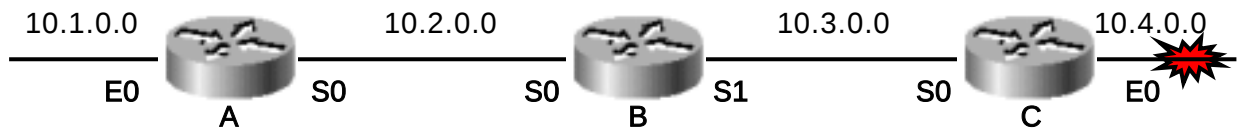
Routing Table		
S0	10.2.0.0	0
S1	10.3.0.0	0
S1	10.4.0.0	1
S0	10.1.0.0	1

Routing Table		
E0	10.4.0.0	Down
S0	10.3.0.0	0
S0	10.2.0.0	1
S0	10.1.0.0	2

10.4.0.0 .. C 10.4.0.0 가
 ?? E0 ..
 A B 10.4.0.0 가 @.@;; C가
 10.4.0.0 가 B
 .. 가 .. B가
 C .. 가 .. 'S1 : 10.4.0.0 : 1' ,
 C 10.4.0.0 가 B
 ..

hop count 1 가

@.@;;

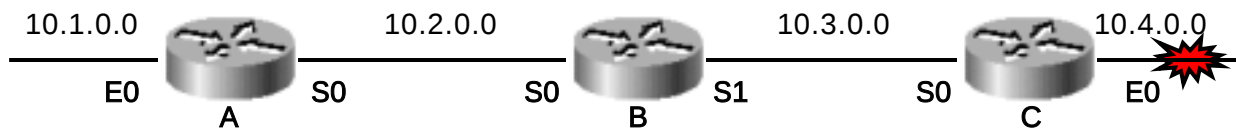


Routing Table		
E0	10.1.0.0	0
S0	10.2.0.0	0
S0	10.3.0.0	1
S0	10.4.0.0	2

Routing Table		
S0	10.2.0.0	0
S1	10.3.0.0	0
S1	10.4.0.0	1
S0	10.1.0.0	1

Routing Table		
S0	10.4.0.0	2
S0	10.3.0.0	0
S0	10.2.0.0	1
S0	10.1.0.0	2

@.@;; 10.4.0.0 C E0
 C 10.4.0.0 가 S0 B
 .. -_..... , C가
 B .. B S1 S1
 ('2') +1 3
 ?? B가 A 가
 .. 3 + 1 = 4



Routing Table		
E0	10.1.0.0	0
S0	10.2.0.0	0
S0	10.3.0.0	1
S0	10.4.0.0	4

Routing Table		
S0	10.2.0.0	0
S1	10.3.0.0	0
S1	10.4.0.0	3
S0	10.1.0.0	1

Routing Table		
S0	10.4.0.0	2
S0	10.3.0.0	0
S0	10.2.0.0	1
S0	10.1.0.0	2

..

@.@;;

C B가

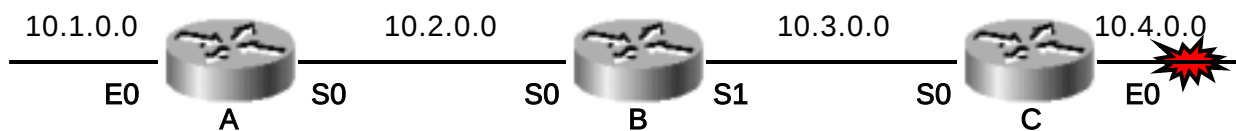
4 , B C가

4

5 , A B가

6

..



Routing Table		
E0	10.1.0.0	0
S0	10.2.0.0	0
S0	10.3.0.0	1
S0	10.4.0.0	6

Routing Table		
S0	10.2.0.0	0
S1	10.3.0.0	0
S1	10.4.0.0	5
S0	10.1.0.0	1

Routing Table		
S0	10.4.0.0	4
S0	10.3.0.0	0
S0	10.2.0.0	1
S0	10.1.0.0	2

.. 10.4.0.0

.. @.@;; , Distance Vector Protocol

가

가

..

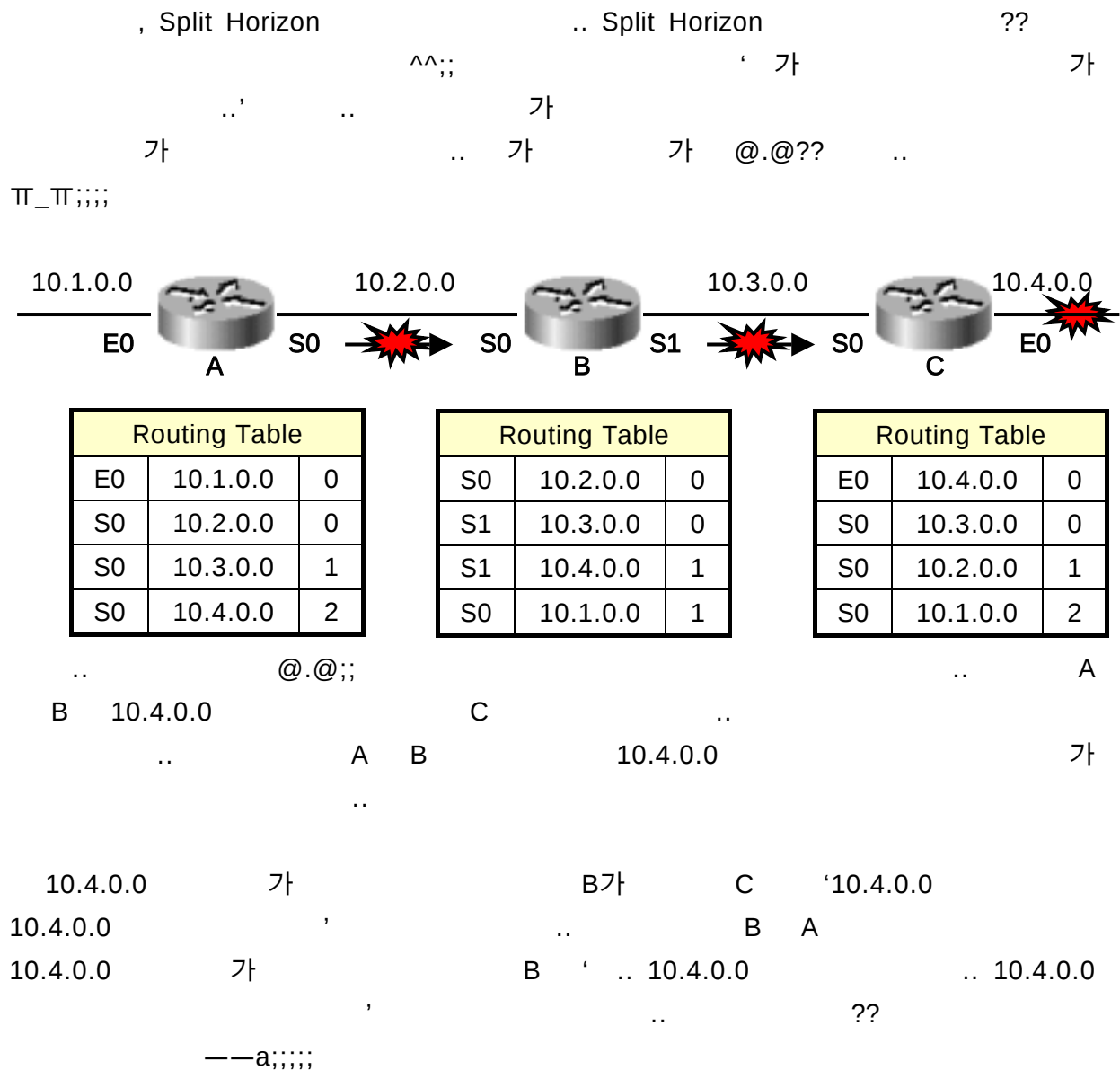
, 가 STP

..

~~

Loop Avoidance : Maximum Hop Count

.. RIP hop count
 15 가 unreachable
 .. , RIP
 가 16 가 ..
 hop count가 16
 ..

Loop Avoidance : Split Horizon

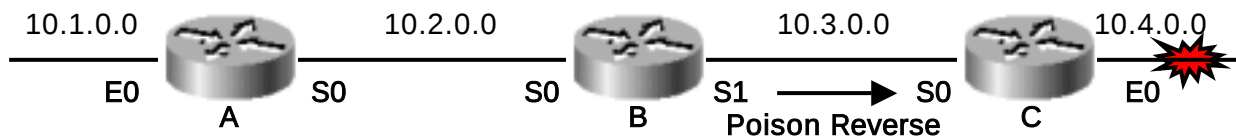
Loop Avoidance : Route Poisoning

, Route Poisoning .. Route Poison 가 ..
가 .. —;;

Route Poisoning

Metric

..



Routing Table		
E0	10.1.0.0	0
S0	10.2.0.0	0
S0	10.3.0.0	1
S0	10.4.0.0	2

Routing Table		
S0	10.2.0.0	0
S1	10.3.0.0	0
S1	10.4.0.0	possibly Down
S0	10.1.0.0	1

Routing Table		
E0	10.4.0.0	Infinity
S0	10.3.0.0	0
S0	10.2.0.0	1
S0	10.1.0.0	2

10.4.0.0

C Metric

..

B C

‘ .. 10.4.0.0

..’

..

C

Poison Reverse

.. Poison

..

route poisoning

..

Loop Avoidance : Holddown Timer

, Holddown timer ..

—??;; Holddown timer

timer

..

.. —;; Holddown Timer

..

가

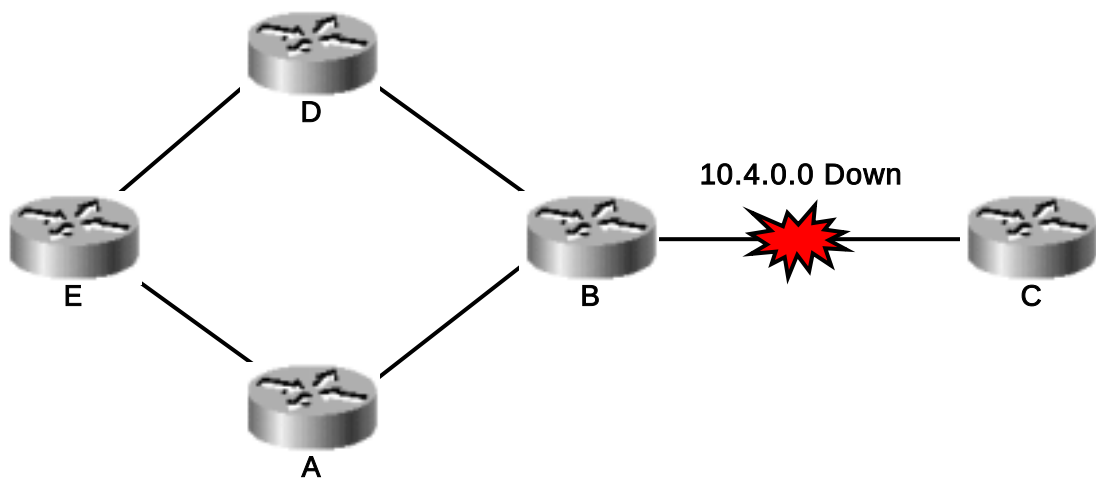
가

가

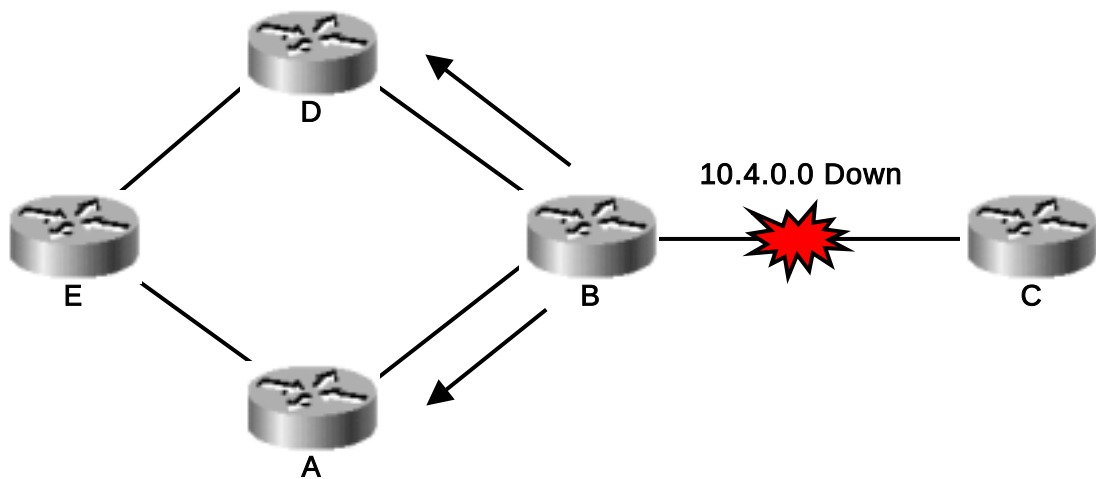
..

Holddown Timer

~



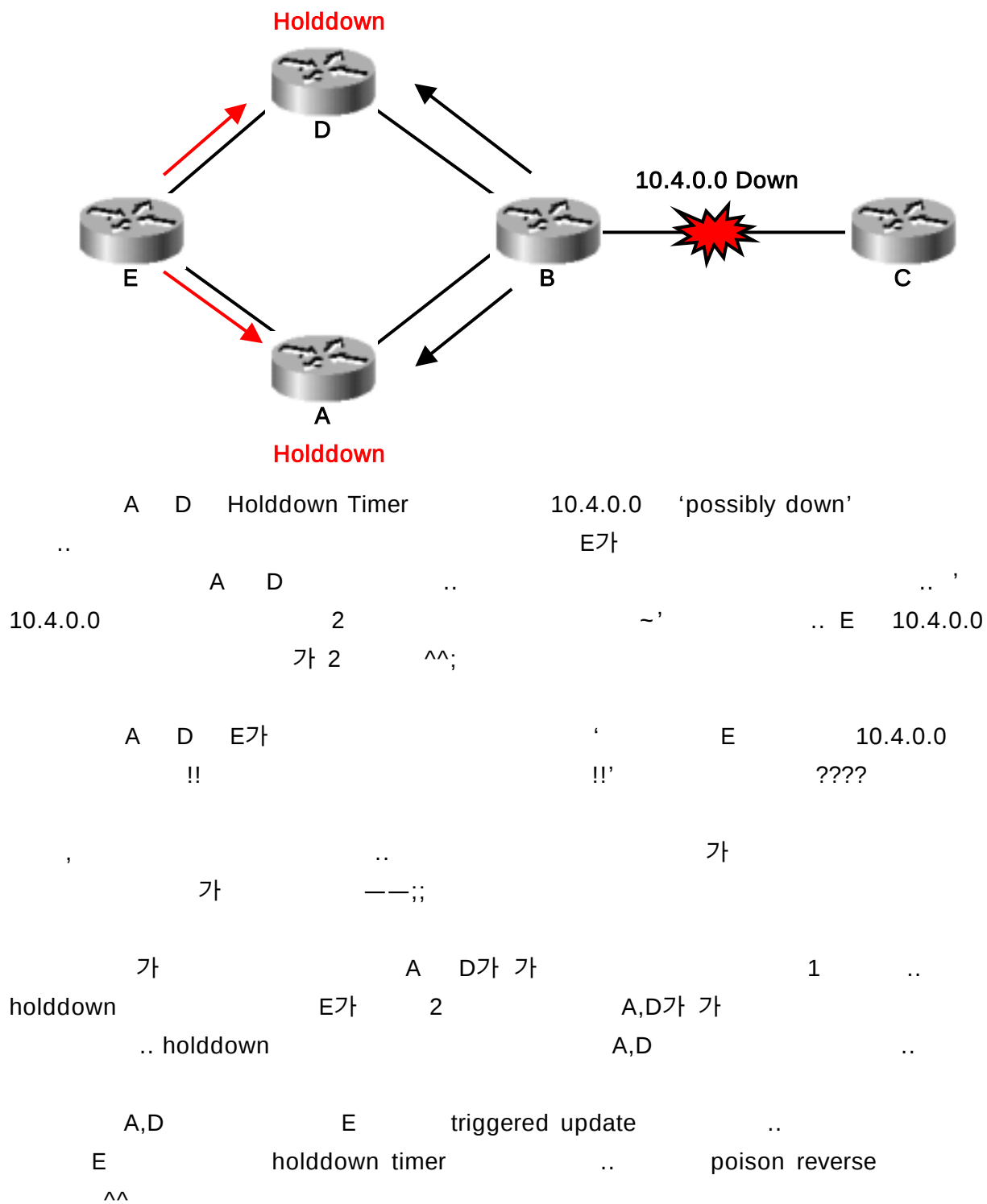
.. 가 10.4.0.0 .. 가 ..

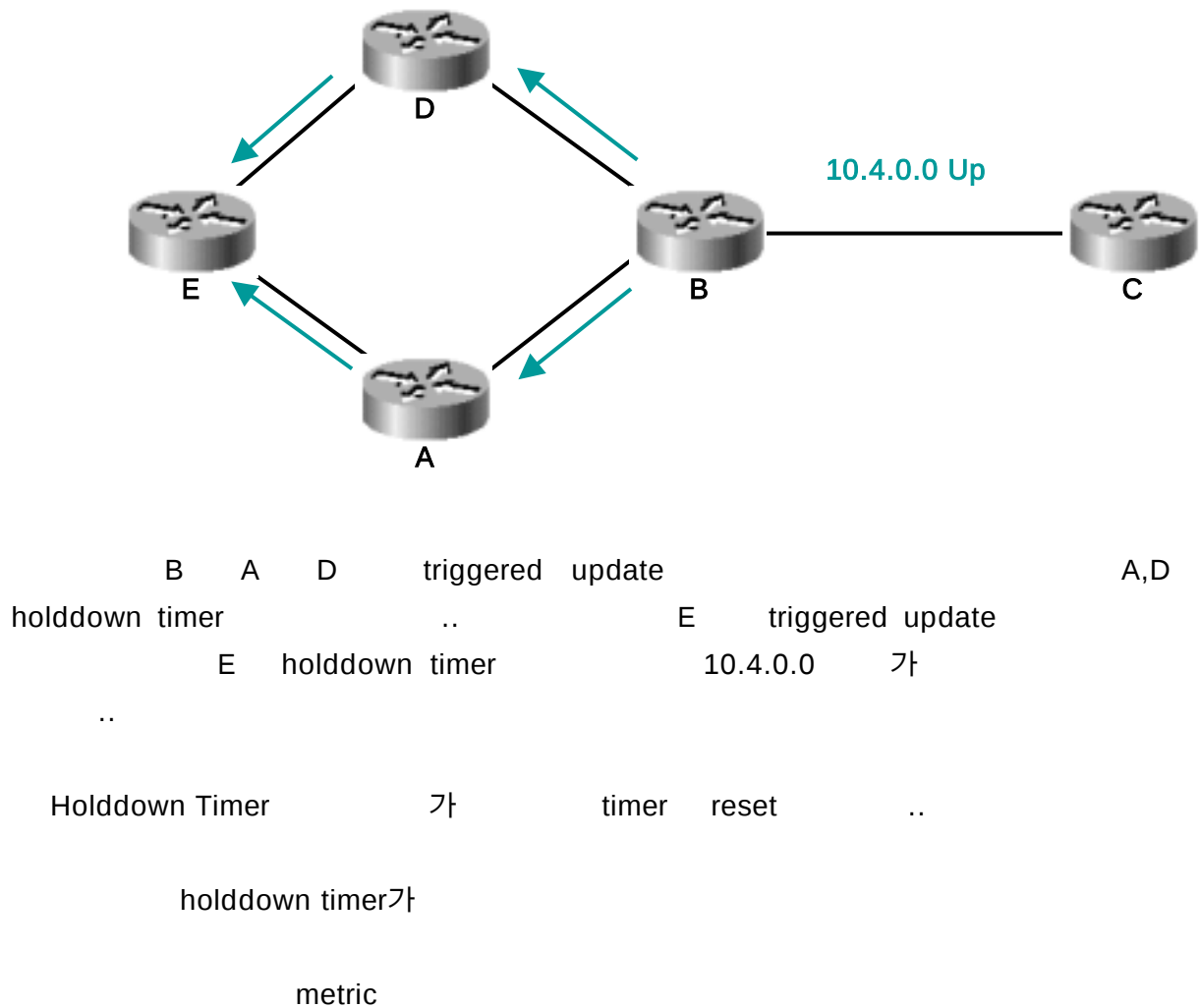
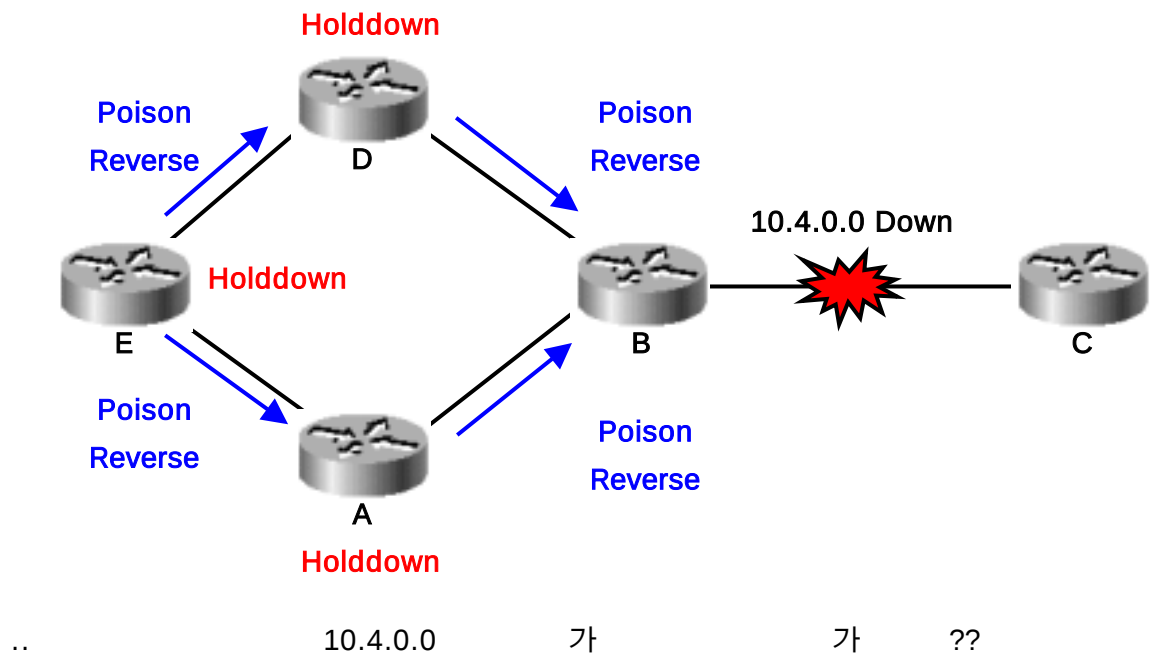


가 B 10.4.0.0 route poison
Triggered update ..

?? (B Triggered Update A, D ??
poison reverse .. holddown timer
??

—??;





flush time

routing table

가

..

.. ^^?::
 ;;

..

^^::
;;

~ ~

CCNA : RIP and IGRP

2003

가 ^^?

가 ..

^^;;

Distance Vector Protocol RIP IGRP ..

~~

Static Routing

가

.. Static

routing

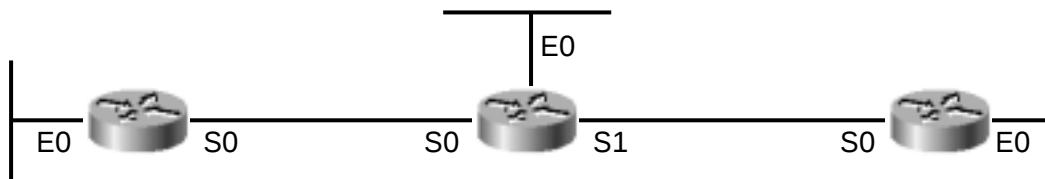
.. ,

가

..

..

Router(config)# **ip route** [*destination_network*] [*mask*] [*next-hop address or exit interface*] [*administrative_distance*] [*pernament*]



Clock rate 64000

A

B

C

E0 : 10.1.1.1

E0 : 10.1.3.1

E0 : 10.1.2.1

S0 : 172.16.10.1

S0 : 172.16.10.2

S0 : 172.16.20.2

S1 : 172.16.20.1

가 clock rate 64000

가 ..

DSU CSU

clock

..

가

clock rate

DCE(Data Communication Equipment)

.. Router(DTE) – CSU(DCE) – CSU(DCE) – Router(DTE)

CSU가 Router(DTE) – Router(DCE)

.. Cisco Router

DTE(Date Terminal Equipment)

clock rate

DCE

..

–

^^;;

clock rate 64000 64000bps = 64Kb

..

.. 가

DTE

DCE

DCE

가 clock rate

~

Serial Interface clock rate 64000

show ip route

Routing table

A# show ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

C 10.1.1.0/24 is directly connected, Ethernet0

C 172.16.10.0/24 is directly connected, Serial0

A#

A	show ip route	..	A	10.1.1.0/24
	172.16.10.0/24	가 ??		가
Ethernet0	Serial0	C	..	
C - connected	..	..	Static	
Routing	??			

A(config)# ip route 10.1.2.0 255.255.255.0 172.16.10.2

A(config)# ip route 10.1.3.0 255.255.255.0 172.16.10.2

A(config)# ip route 172.16.20.0 255.255.255.0 172.16.10.2

A(config)# ^z

A# show ip route

```
ip route 10.1.2.0 255.255.255.0 172.16.10.2 , 10.1.2.0/24 가
172.16.10.2(IP Address of Next hop Router ) ..
^^;;
```

```
A# show ip route
```

```
(... ..)
```

```
C 10.1.1.0/24 is directly connected, Ethernet0
```

```
C 172.16.10.0/24 is directly connected, Serial0
```

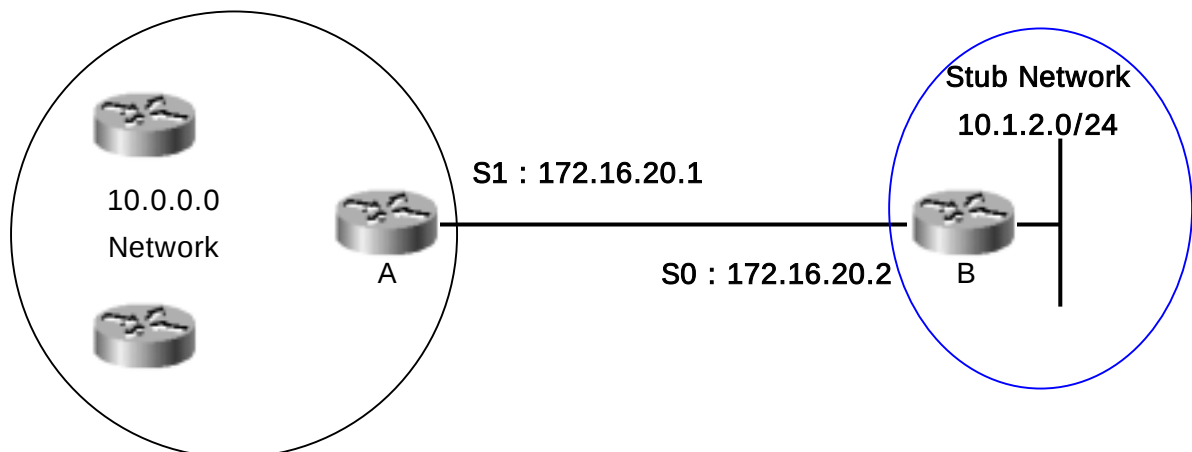
```
S 10.1.2.0/24 [1/0] via 172.16.10.2
```

```
S 10.1.3.0/24 [1/0] via 172.16.10.2
```

```
S 172.16.20.0/24 [1/0] via 172.16.10.2
```

```
A#
```

```
, ip route A show ip route
3 가 가 ~ S static
.. S 10.1.2.0/24 [1/0] via 172.16.10.2 10.1.2.0/24 가
172.16.10.2 ^^;; [1/0] 1 Distance
..
```



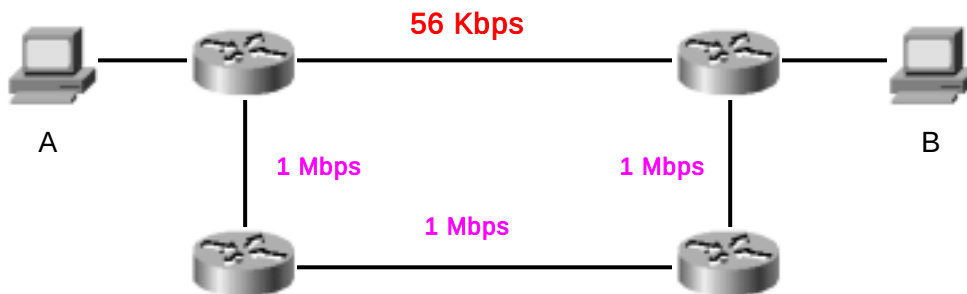
```
, A가 B .. 10.1.2.0 가
ip route 10.1.2.0 255.255.255.0 172.16.20.2 ??
B .. B가
A ?? , A가 100
가 .. Static Routing ?? , 100 —.—;;
```

가 (B Stub Network
 .. Static Routing ..
 B ip route 0.0.0.0 0.0.0.0 172.16.20.1 ..
 172.16.20.1 .. B
Default Routing .. Static Default ~ ~
 .. Dynamic Routing RIP IGRP ..

RIP(Routing Information Protocol)

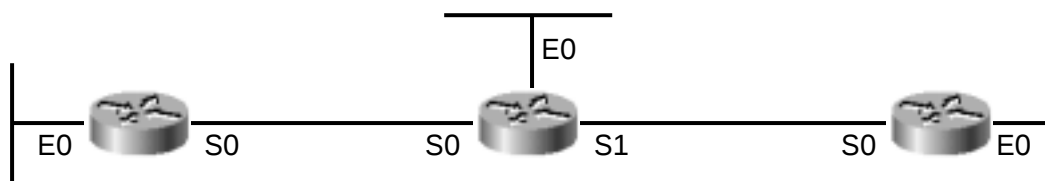
hop count

.. RIP



가 RIP 가 .. A가 B
 .. 가 2 가 ..
 .. hop count가 1 3 RIP 1
 .. @.@;; RIP hop count가 15 .. RIP
 ..
 ^^;;

RIP router network
 ~ ~



Clock rate 64000

A

E0 : 10.1.1.1
S0 : 172.16.10.1

B

E0 : 10.1.3.1
S0 : 172.16.10.2
S1 : 172.16.20.1

C

E0 : 10.1.2.1
S0 : 172.16.20.2

^^ A RIP

ip route

~~

A(config)# router rip

router rip : Routing Protocol RIP

..

A(config-router)# network 10.0.0.0

A(config-router)# network 172.16.0.0

network 가 . RIP

..

10.0.0.0 172.16.0.0

RIP

..

가

..

A(config-router)# ^z

A#

network

.. ?? , 가 ?? A 10.1.1.0/24

172.16.10.0/24

network 10.0.0.0 172.16.0.0

?? RIP network

classful address

..

Class A,B,C

.. 10.1.1.0

Class A

A

10.0.0.0

172.16.10.0

Class B

172.16.0.0

.. Default SubnetMask

..^^

A# show ip route

(... ...)

C 10.1.1.0/24 is directly connected, Ethernet0

C 172.16.10.0/24 is directly connected, Serial0

R 10.1.3.0/24 [120/1] via 172.16.10.2, 00:01:25, Serial0

R 172.16.20.0/24 [120/1] via 172.16.10.2, 00:02:40, Serial0

R 10.1.2.0/24 [120/2] via 172.16.10.2, 00:05:14, Serial0

A#

```

          R          .. RIP          .. [120/1]
120 Distance      1 Metric      ..      hop count가      ..
          가 update
가

```

A# show ip protocols

Routing Protocol is "rip"

Sending updates every 30 seconds, next due in 12 seconds

Invalid after 180 seconds, hold down 180, flushed after 240

Outgoing update filter list for all interfaces is

Incoming update filter list for all interfaces is

Redistributing: rip

Default version control: send version1, receive any version

Interface	Send	Recv	Key-Chain
Serial0	1	1 2	
Ethernet0	1	1 2	

Routing for Networks:

10.0.0.0

172.16.0.0

Routing Information Sources:

172.16.10.2	120	00:00:03
-------------	-----	----------

Distance: (default is 120)

show ip protocols

```

..                               30          17          가
(Sending updates every 30 seconds, next due in 12 seconds) 180          update
..(Invalid after 180 seconds)

Holddown timer    180          240 가
(flushed after 240)          ..

```

Default version control: send version1, receive any version

Interface	Send	Recv	Key-Chain
Serial0	1	1 2	

```

version1          .. RIP    1,2 가
RIP version1     ..      2    ^^;;

```

A# **debug ip rip**

RIP Protocol debugging is on

RIP: *received* v1 update from 172.16.10.2 on Serial0

10.1.3.0 in 1 hops

172.16.20.0 in 1 hops

10.1.2.0 in 2 hops

RIP: *sending* update to 255.255.255.255 via Serial0 (172.16.10.1)

subnet 10.1.1.1 metric 1

RIP: *sending* update to 255.255.255.255 via Ethernet0 (10.1.1.1)

subnet 172.16.10.0 metric 1

subnet 10.1.3.0 metric 2

subnet 172.16.20.0 metric 2

subnet 10.1.2.0 metric 3

A# **undebug all**

debug ip rip

^^;

.. debug

?? 172.16.10.2

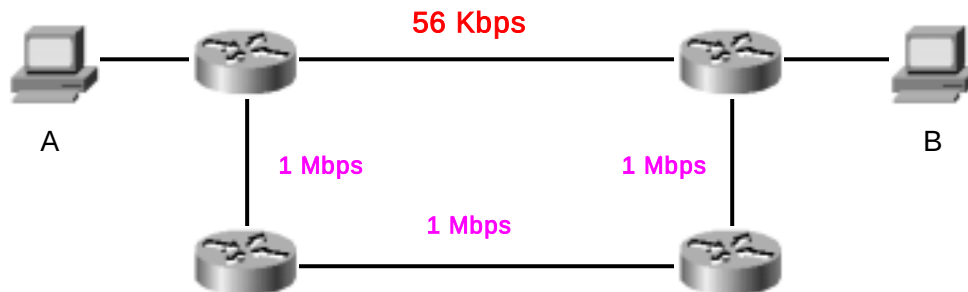
Broadcast

^^?

가

^^;;

IGRP(Interior Gateway Routing Protocol) metric 가
 .. Bandwidth Delay 가
 ..



RIP ^^ RIP IGRP
 .. hop count Bandwidth Delay
 ^^ IGRP

RIP IGRP .. IGRP

Router(config)# **router igrp AS-number** AS-Number ..
 IGRP 가 ..
 IGRP 가 4 가 가 4 AS-
 number가

network 가 RIP ..
 ^ ^.....
 11111111111111111111

, RIP IGRP ..

	RIP	IGRP
Update Timer	30	90
Metric	Hop Count(Max 15)	Bandwidth, Delay – Default Reliability, Load, MTU
Hold - Down Timer	180	280
Flush	240	630
Load Balancing	Default 4, Maximum 6	Default 4, Maximum 6
Triggered update	Yes	Yes
Mask sent update	RIP - 1 : No RIP - 2 : Yes	No

Load Balancing

4 가

4

...

4

6

..

가

^^;;;

OSPF EIGRP

.. ICND

-_-;;;

가

^^;; OSPF EIGRP

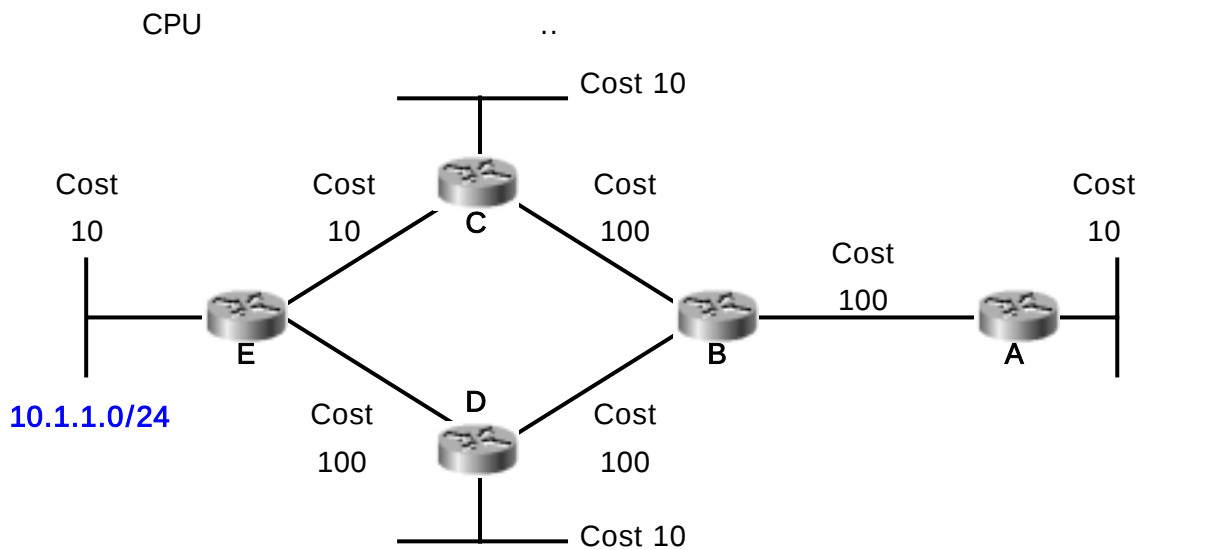
;;;

~ ~

^^

CCNA : Link State and Balanced Hybrid Protocol

가 가 ..
 ^^;; 가 @.@@; ,
 Link State/Balanced Hybrid Routing Protocol .. ICND
 Link State Hybrid ..
 -_-;; Link-
 state ~
 Link-state Distance Vector .. 가
 가 .. 가 ...
 Distance Vector ..
 .. 가 ..
 Link-state 가 ..
 .. Link-state



Distance Vector metric 3 10.1.1.0/24 B A 10.1.1.0
 cost .. Link-state metric ..
 A가 10.1.1.0/24 .. C 가 D 가
 가 .. C 220 cost D 310 cost ..
 B Routing
 Table B .. B 가 C
 Routing Table C ..
 10.1.1.0/24 B .

Link-state Protocol Algorithm 가

Shortest Path First(SPF) algorithm ..

..

;; Link-state

.. SPF

algorithm ..

Link-state Protocol .

.. 가 가

topology SPF algorithm

..

.. 가 Link-

state ..

가 topology database

..OSPF가 **LSU(Link-State Updates)**

LSA(Link-State Advertisements) .. LSA

, cost (metric), .. OSPF

Reliable Protocol TCP

.. LSU packet 가 .. OSPF

LSA ..

OSPF가 ^^

-
1. neighbor table .

 2. reliable protocol topology (LSA)

 3. topology database ..

 4. SPF algorithm database
(가) ..

 5. 가 .

Link-state protocol Distance vector protocol

Link-state neighbor table, topology database, routing table

가 SPF algorithm

.

Link-state Distance vector ..

Link-state 가 small packet ..

Distance vector가 .. OSPF

small packet 'Hello packet' .. Hello packet

packet 가 ..



가
Hello packet
.. OSPF가
Hello packet
dead interval .. Ethernet Interface
hello interval 10 , dead interval 40 가 . dead interval
hello packet packet topology
base down . hello packet
SPF algorithm .

Link-state Distance vector loop 가

.. Link-state loop 가

..

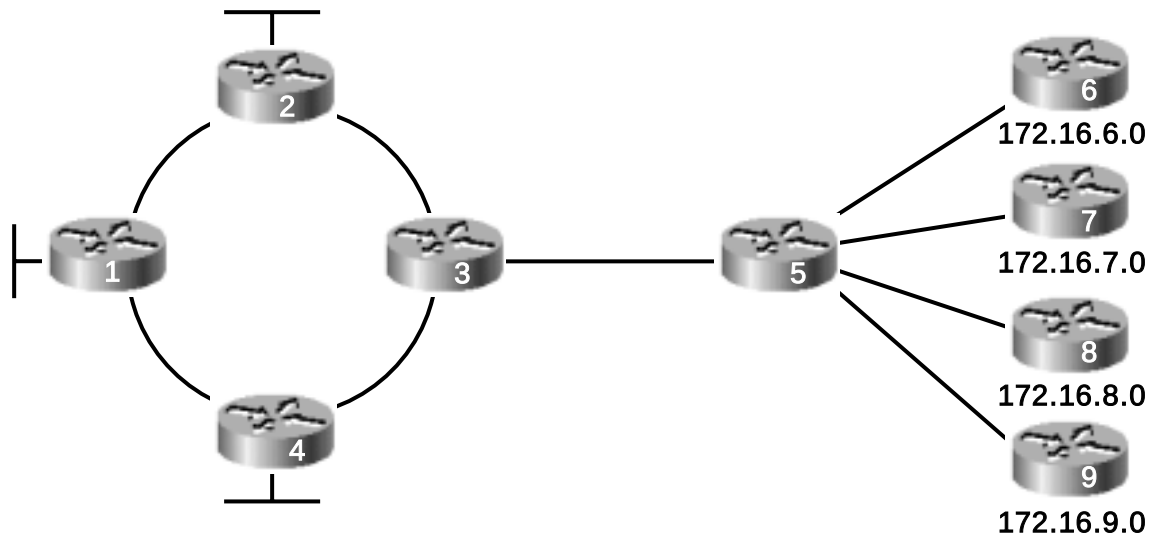
A 가 B

.

가

Distance vector protocol loop
 Link-state loop ..
 가 5 loop
 .. 가 ..???

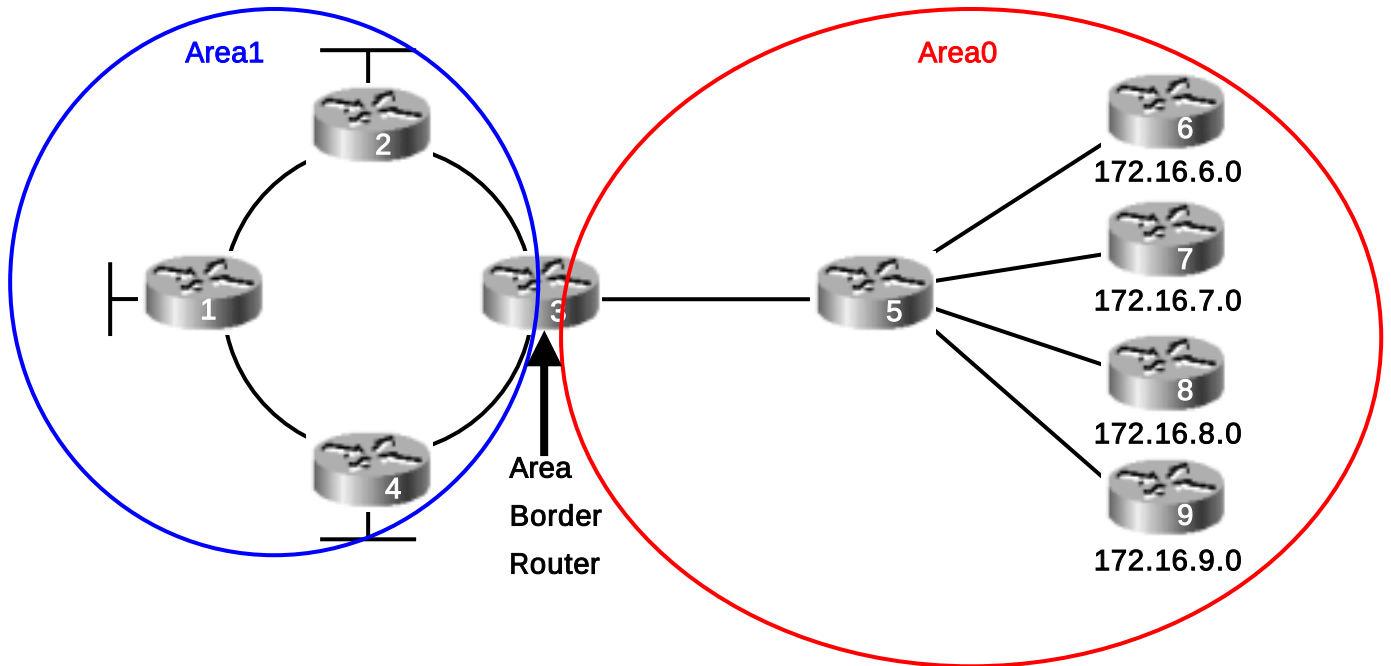
^^??;



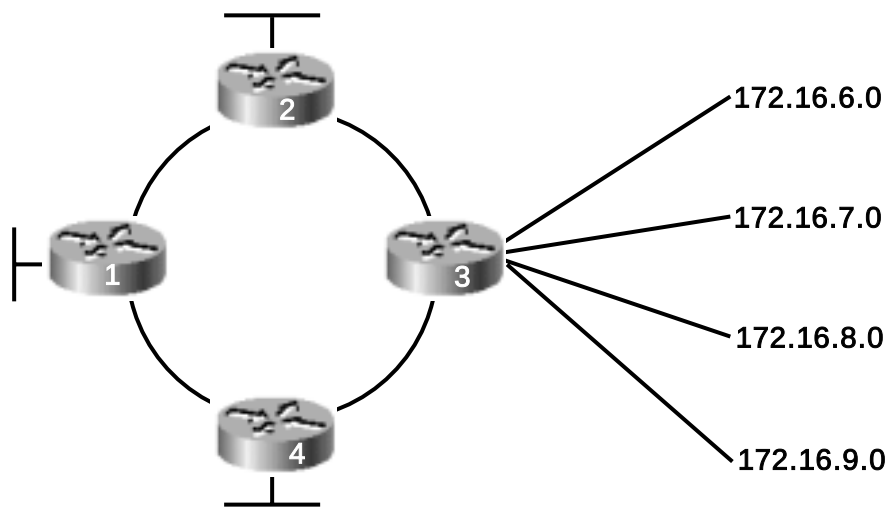
가 ^^a;; OSPF ..
 OSPF .. 가 1000
 .. 1000 .. OSPF
 SPF .. 가

○	topology database	..
○	topology database	SPF database
○	..	SPF
○	..	

OSPF Area



.. Area Single Area .. Area
 ABR(Area Border Router)
 ^^?

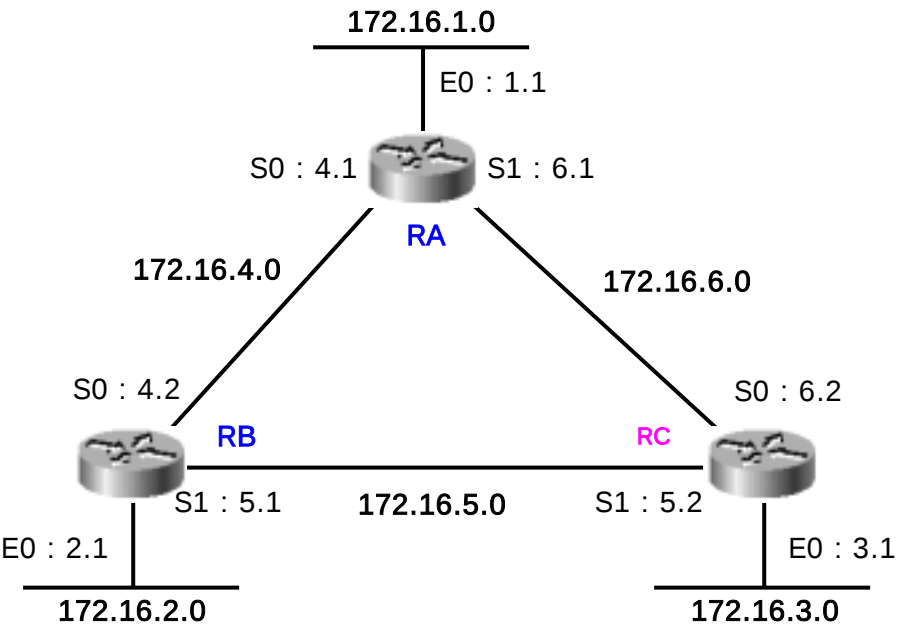


Area1 1,2,4가 .. Single Area
 Area0 Area1
 Area1 가 .. ABR Area0 Area1
 SPF topology database ..
 Area0 가 Area1 SPF 가 ?
 3 ABR OSPF SPF .. ABR
 ^^;;

Link-state Distance Vector

Link-state	Distance Vector
	Split Horizon, Holddown
CPU	
OSPF	RIP
	IGRP -

가 ~



.. @.@ @.@;;;
172.16.0.0/24 . OSPF -_-;;
Router(config)# router ospf process-id network
.. network wildcard-mask
process id 가 .. 1,10,100
..
^^; OSPF process-id
.. CCNP BSCI(Routing) ..;

```

network          network ip address wildcard-mask area area-number
.. wildcard-mask subnet-mask .. 0
1 .. RA OSPF

```

```
RA(config)# router ospf 100
```

```
RA(config-router)# network 172.16.0.0 0.0.255.255 area 0
```

```

.. RB, RC ^^^;
area 172.16.0.0 ..
wildcard-mask ..
.. 0 .. 172.16
ospf ..

```

```
RA(config)# router ospf 100
```

```
RA(config-router)# network 172.16.1.1 0.0.0.0 area 0
```

```
RA(config-router)# network 172.16.4.1 0.0.0.0 area 0
```

```
RA(config-router)# network 172.16.6.1 0.0.0.0 area 0
```

```

OSPF 가 . Wildcard
-mask가 0.0.0.0 .
가 ^^;
??

```

```
RA# show ip route
```

```

172.16.0.0/24 is subnetted, 6 subnets
C    172.16.1.0/24 is directly connected, Ethernet0
C    172.16.4.0/24 is directly connected, Serial0
C    172.16.6.0/24 is directly connected, Serial1
O    172.16.2.0/24 [110/65] via 172.16.4.2, 00:00:46, Serial0
O    172.16.5.0/24 [110/65] via 172.16.6.2, 00:00:45, Serial1
O    172.16.3.0/24 [110/65] via 172.16.6.2, 00:00:33, Serial1

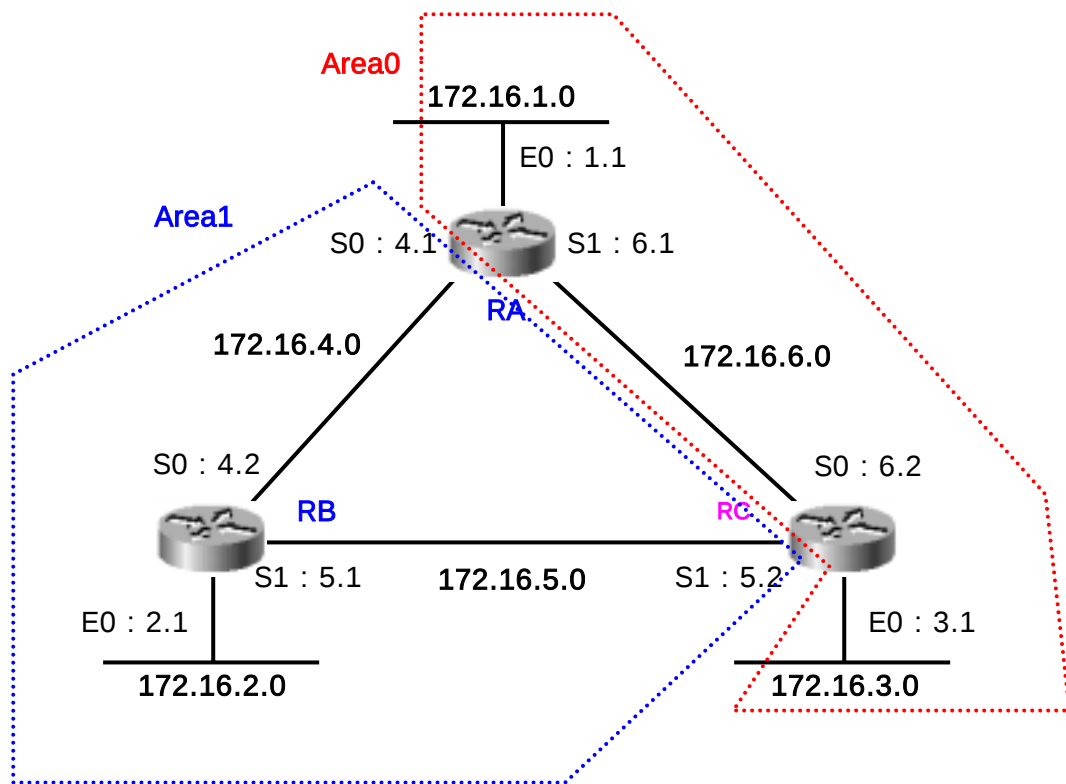
```

O OSPF .. [110/65] 110 distance
65 metric ..

O 172.16.2.0/24 [110/65] via 172.16.4.2, 00:00:46, Serial0

172.16.2.0 Serial0 RB 172.16.4.2
.. ^^?

Single - area ?? Multiple -
area



Area0 Area1 .. RA RC ?? ,
Area ABR ..

— . — ;

```
RA(config)# router ospf 1
```

```
RA(config-router)# network 172.16.1.1 0.0.0.0 area 0
```

```
RA(config-router)# network 172.16.4.1 0.0.0.0 area 1
```

```
RA(config-router)# network 172.16.6.1 0.0.0.0 area 0
```

RA는 area 0에 속하고, RB는 area 1에 속한다. 따라서 RA와 RB는 OSPF ABR가 된다. ABR는 area 0과 area 1의 경계 라우터이다.

```
RB(config)# router ospf 1
```

```
RB(config-router)# network 172.16.0.0 0.0.255.255 area 1
```

RB는 area 1에 속한다. RB는 area 0과 area 1의 경계 라우터이다.

```
RB# show ip route
```

```
172.16.0.0/24 is subnetted, 6 subnets
```

```
C    172.16.2.0/24 is directly connected, Ethernet0
```

```
C    172.16.4.0/24 is directly connected, Serial0
```

```
C    172.16.5.0/24 is directly connected, Serial1
```

```
IA   172.16.3.0/24 [110/65] via 172.16.5.2, 00:00:46, Serial1
```

```
IA   172.16.1.0/24 [110/65] via 172.16.4.1, 00:00:45, Serial0
```

```
IA   172.16.6.0/24 [110/65] via 172.16.4.1, 00:00:33, Serial0
```

RB는 area 1에 속하고, RA는 area 0에 속한다. 따라서 RB와 RA는 OSPF inter area가 된다. ABR는 area 0과 area 1의 경계 라우터이다.

```
show ip route ospf
```

```
OSPF
```

```
topology database
```

```
, , 가 , neighbor table
```

```
Router ID(RID) ..
```

```

RA RID 172.16.6.1
loopback
interface NP
router-id

show ip ospf interface

```

RA# show ip ospf interface

Serial0 is up, line protocol is up

Internet Address 172.16.4.1/24, Area 1

Process ID 1, Router ID 172.16.6.1 Network Type BROADCAST, Cost : 64

Transmit Delay is 1 sec, State DR, Priority 1

Designated Router (ID) 172.16.6.1, Interface address 172.16.4.1

Backup designated router (ID) 1.1.1.2, Interface address 172.16.4.1

Timer Intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5

Hello due in 00:00:02

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 172.16.5.1

Suppress hello for 0 neighbor(s)

Serial1 is up, line protocol is up

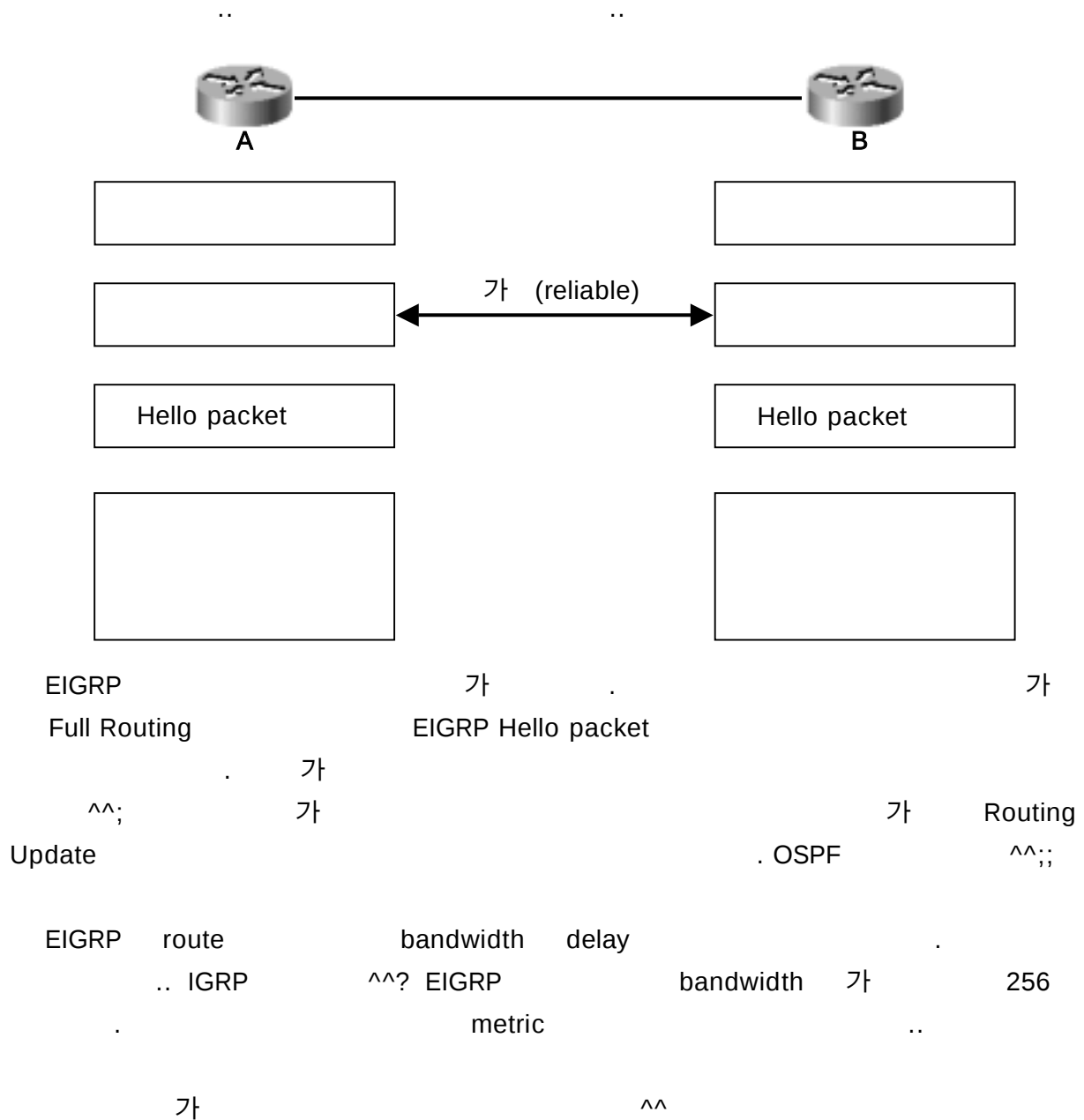
```

.. Serial0 Area1
.. RID 172.16.6.1 OSPF Hello, Dead Interval
RID 172.16.5.1 .. OSPF Cost metric
ip ospf cost x
bandwidth cost
10^8 / bandwidth bandwidth kbps
bandwidth 1544 10^8 / 1,544,000 = 64 Cost
64

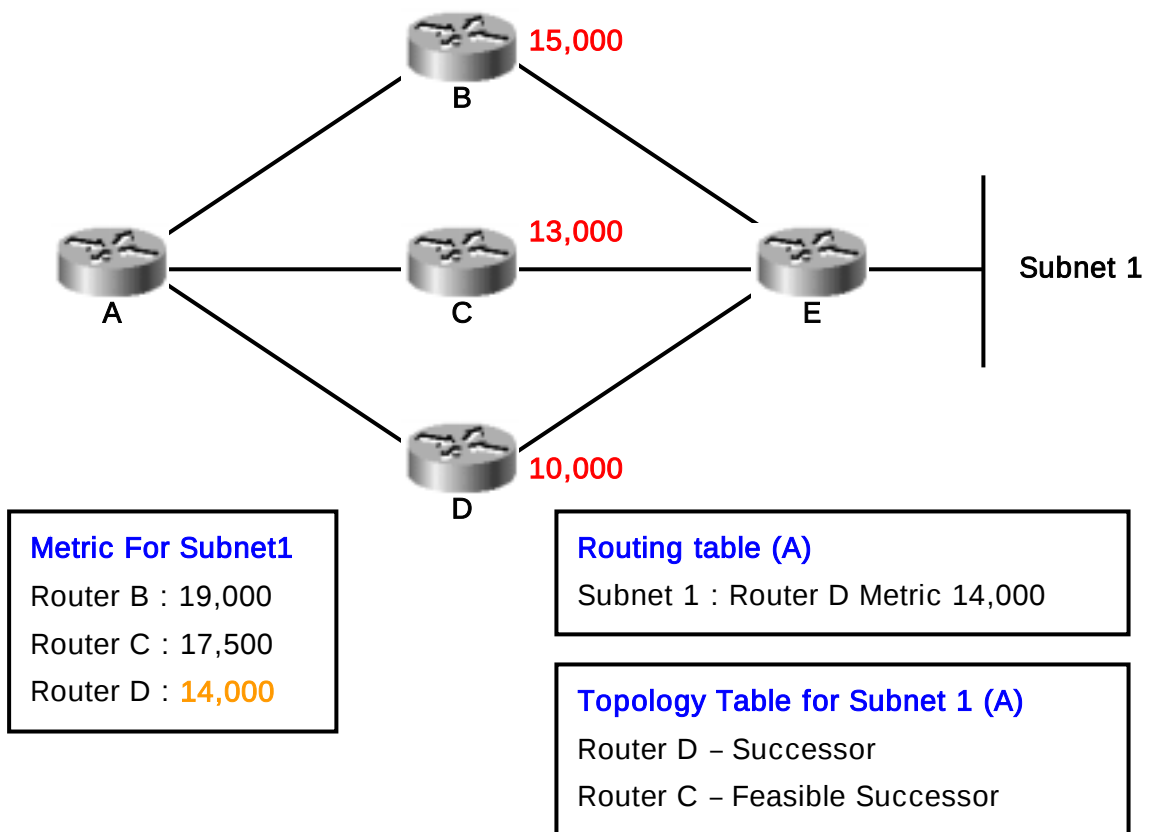
OSPF .. CCNP BSCI
..

```

Balanced Hybrid Routing Protocol			EIGRP		
Distance	Vector	RIP, IGRP	Link-state	OSPF	IS-IS
Balanced Hybrid	EIGRP		EIGRP	Distance vector	Link-state



Dynamic routing protocol . EIGRP topology
 .. 가 가 가
 (best route) routing table . backup route
 topology database 가 best route 가 backup
 route .. 가 .
 ~ ~



가 ^^?
 Subnet 1 metric .. A Subnet 1 가
 가 D
 routing table . EIGRP best route Successor Successor
 가 Feasible Successor Feasible Successor D가
 Successor C가 Feasible Successor ^^;
 Successor가 가 A가 가
 D 14,000 . Feasible Successor 가
 metric (14,000) .. C 13,000
 가 Feasible Successor가 . B 15,000
 가 A가 14,000 ?? Feasible Successor
 가 .

Successor가 EIGRP 가 D 가 route 가 C Feasible
 routing table 가 DUAL

Link-state EIGRP
 overhead

EIGRP가 OSPF
 route redistribution

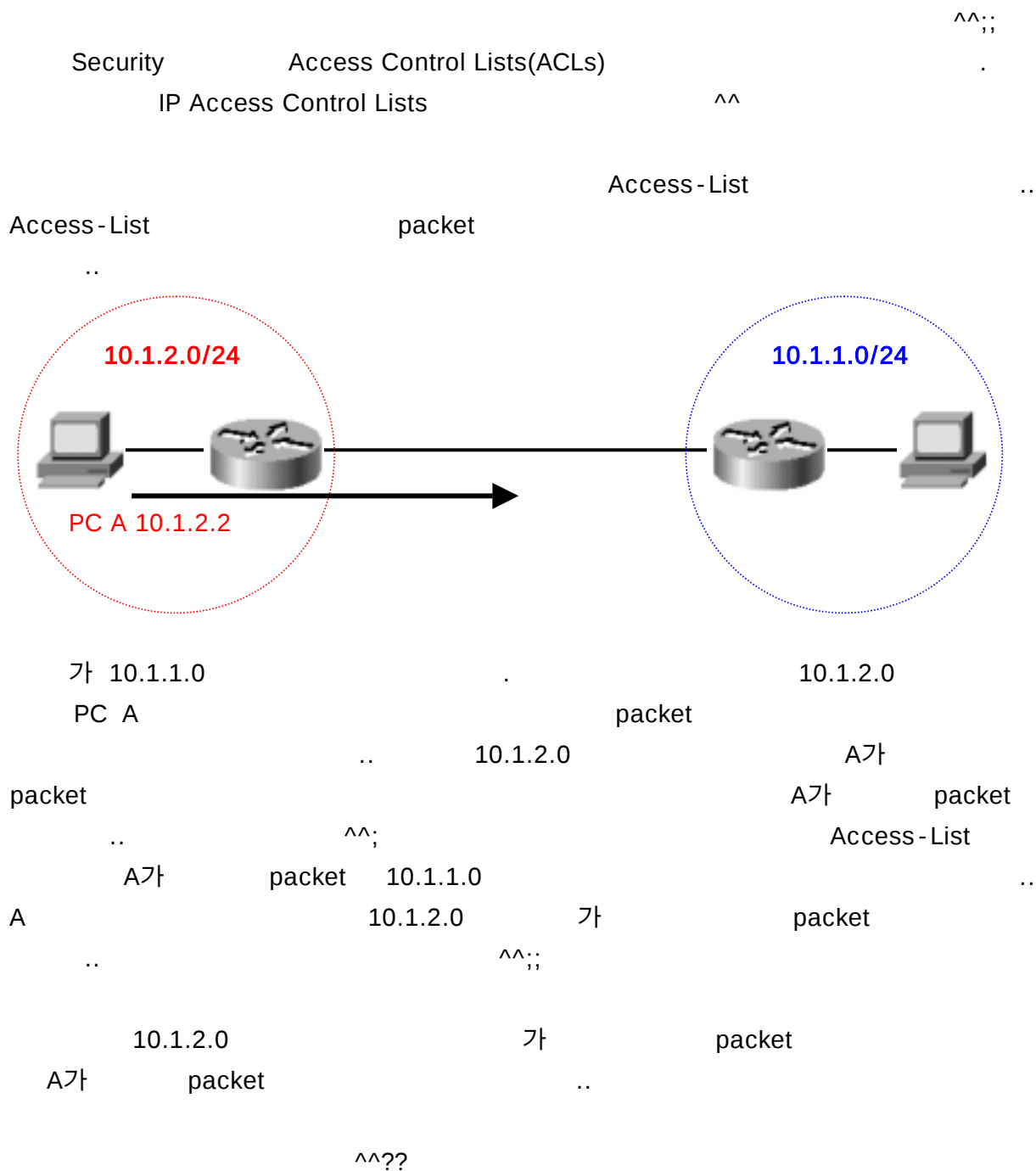
EIGRP IGRP .. IGRP EIGRP .. IGRP
 가 AS-number

CCNP BSCI

List WAN Protocol .. Access-

Access-List ~ ~ ^

CCNA : Access Control Lists



Access Lists **Standard Access Lists** **Extended Access Lists**

가 Inbound Access Lists(ACLs) Outbound

Access Lists(ACLs) ..

Standard Access Lists : IP . / /
IP 가/ .

Extended Access Lists : ,
, 가 .. Standard ..^^;;

Access Lists ACLs ^^ packet
..
ACLs
packet ..
packet ..

1. ACLs packet .

2. .

3. .

4. packet .

~ ~ ~

Standar Access-list ..

Router(config)# **access-list** *access-list-number* {**permit|deny**} source-address
[wildcard mask]

..

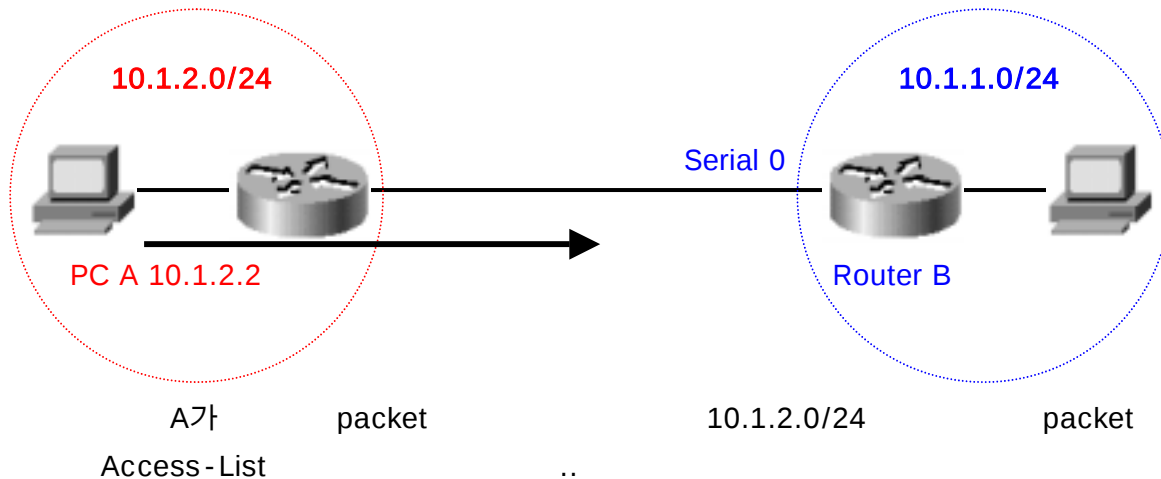
access-list-number **Standard가 1~99, Extended가 100~199** .

wildcard mask ^^??

.. Subnetmask

^^;;

^^;;



```
RouterB(config)# access-list 1 deny 10.1.2.2 0.0.0.0
```

. 가 10.1.2.2 packet deny() ^^;; wildcard
mask bit가 0 ..

```
RouterB(config)# access-list 1 permit 10.1.2.0 0.0.0.255
```

10.1.2.0 packet permit() ^^;;

.. 10.1.2.4 packet .. Router B
ACLs .. ^^;;

10.1.2.2가 deny .. packet
10.1.2.4 .. 10.1.2.4

^^ packet permit ^^;;

PC A가 packet deny permit ??

.. permit ACLs

access-list 1 deny 10.1.2.2 0.0.0.0 ?? ,

packet deny .. @.@;;

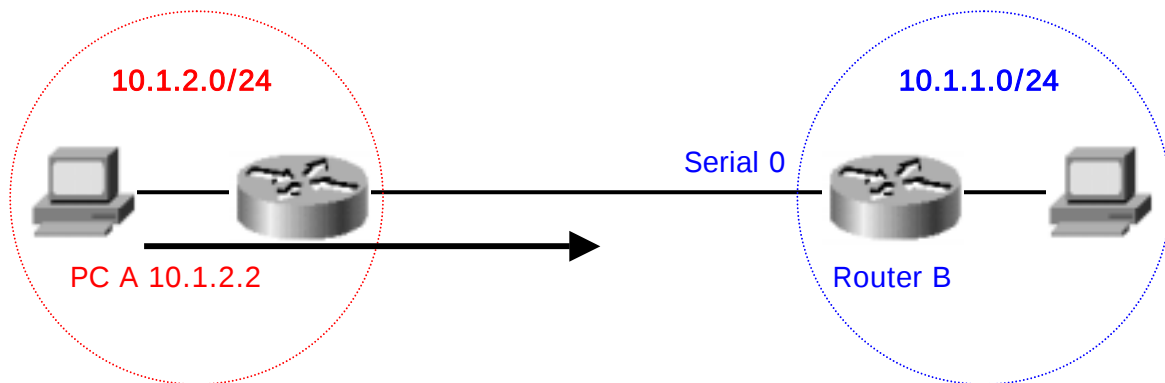
ACLs deny all .. packet

.. 가 ACLs permit

.. ^^??

permit ^^

^^;;



```
RouterB(config)# access-list 1 permit 10.1.2.0 0.0.0.255
```

```
RouterB(config)# access-list 1 deny 10.1.2.2 0.0.0.0
```

.. ACLs !!! ACLs

. A가 packet ..

, ?? A가 packet permit

.. ACLs 가 ACLs 가 ACLs

packet ... ACLs

A가 packet permit ??

```
RouterB(config)# access-list 1 permit 10.1.2.2 0.0.0.0
```

IP address		Mask	Wildcard mask	Hosts
10.1.2.2	0.0.0.0	10.1.2.2가	??	packet
0.0.0.0		가	??	host 10.1.2.2
..	0.0.0.0 255.255.255.255	가	??	가
..	any	..		

```
RouterB(config)# access-list 1 permit 10.1.2.0 0.0.0.255
```

```
RouterB(config)# access-list 1 deny 10.1.2.2 0.0.0.0
```

```
RouterB(config)# access-list 1 permit 10.1.2.0 0.0.0.255
```

```
RouterB(config)# access-list 1 deny host 10.1.2.2
```

.. ^^?

```
RouterB(config)# access-list 1 permit host 10.1.2.2
```

```
RouterB(config)# access-list 1 deny 10.1.2.0 0.0.0.255
```

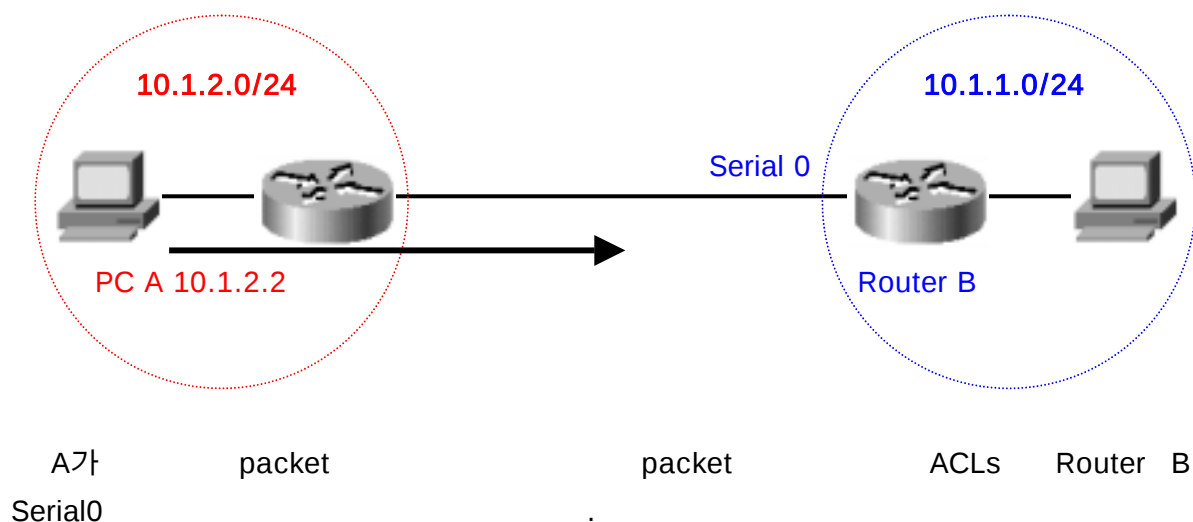
```
RouterB(config)# access-list 1 permit any
```

10.1.1.0/24 10.1.2.0/24 가 가 ..
 ACLs ?? . PC A가 packet 10.1.2.0/24
 packet .. packet
 .. host any ^^??

, ACLs ?? ??
 ?? , ACLs ..
 .. access group ..
 access-group

```
Router(config-if)# {protocol} access-group access-list-number {in|out}  

{in|out}    out
```



```
RouterB(config)# access-list 1 deny host 10.1.2.2
```

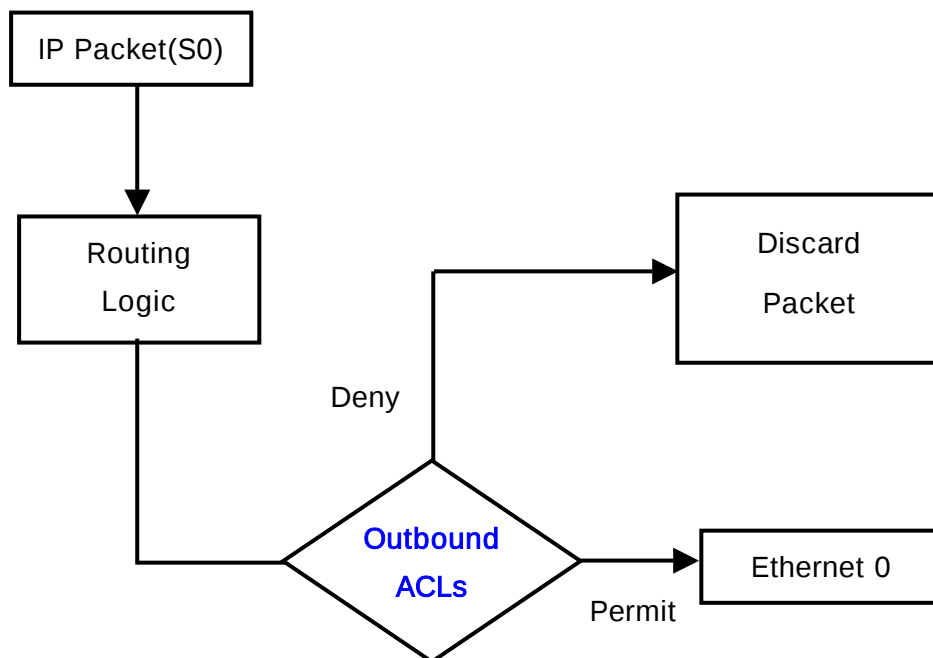
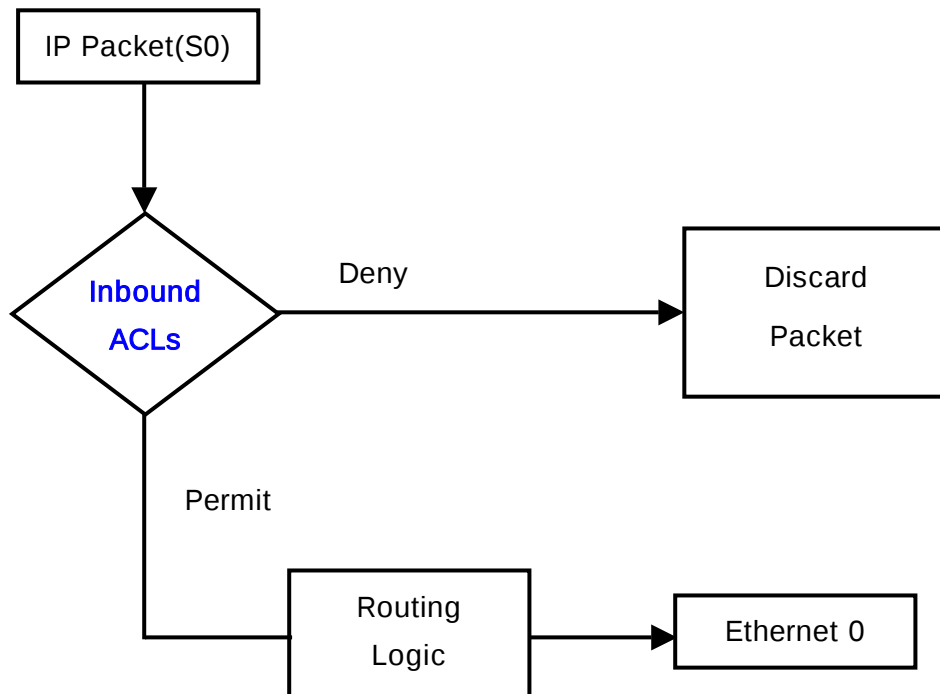
```
RouterB(config)# access-list 1 permit 10.1.2.0 0.0.0.255
```

```
RouterB(config)# int s0
```

```
RouterB(config-if)# ip access-group 1 in
```

Global configuration mode ACLs 가
 access-group .. in / out 가 ..

in|out ACLs가



Inbound/Outbound Filter ..
 inbound outbound interface 가 ACLs ..Outbound
 Routing Logic ACLs .. in out
 overhead .. Routing Logic

^^;;

, , ACLs가 ..
 ACLs가 ..
 ?? IP ACLs .
 IP IPX ACLs ..
 Are You Understand ???

IP wildcard mask , ,
 ACLs ..

, ACLs Physical Interface(,)
 Virtual Interface ?? 가
 .. vty(virtual terminal lines) ^^;; Telnet ^^? Virtual
 port 0~4 가 telnet
line vty 0 4 .. ACLs .
 .. ^^

```
Router(config)# access-list 2 permit 192.168.1.0 0.0.0.255
```

```
Router(config)# line vty 0 4
```

```
Router(config-line)# access-class 2 in
```

```
access-group access-class .. Protocol ^^;;
```

```
line vty #number number ..
```

^^?? Extended ACLs ^^

Extended ACLs Standard ACLs

.. ..

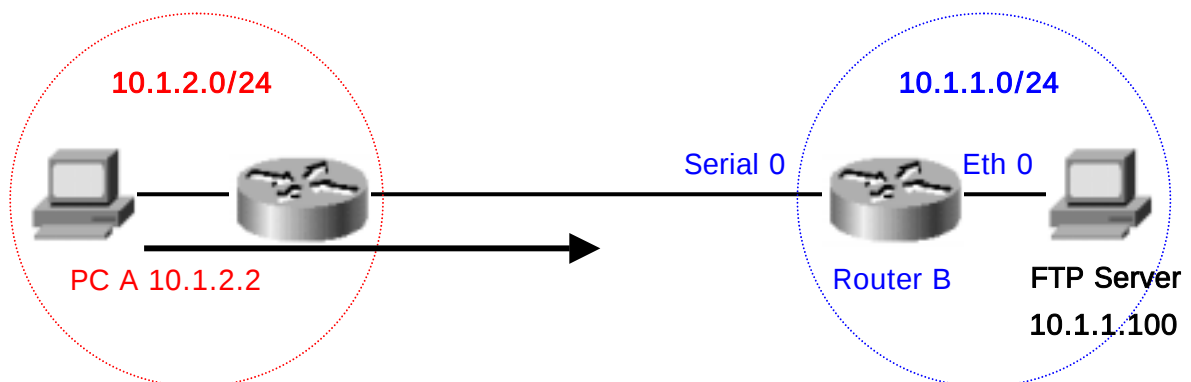
^^

Router(config)# **access-list** *ACLs-number* {**permit**|**deny**} protocol
source-address source-wildcard[operator port]
destination-address destination-wildcard[operation port] [established] [log]

^^?????....., ^^;;

ACLs-number 100~199 .. permit/deny ..
protocol, / /
...

[operation port] lt(less than), gt(greater than), eq(equal to), neq(not equal to)
가 ..



ACLs B FTP Server 가 ;; Extended
ACLs .. A 10.1.2.0/24 FTP

RouterB(config)# **access-list 100 deny tcp host 10.1.2.2 host 10.1.1.100 eq 21**

RouterB(config)# **access-list 100 permit tcp 10.1.2.0 0.0.0.255 host 10.1.1.100 eq 21**

RouterB(config)# **int e0**

RouterB(config-if)# **ip access-group 100 out**

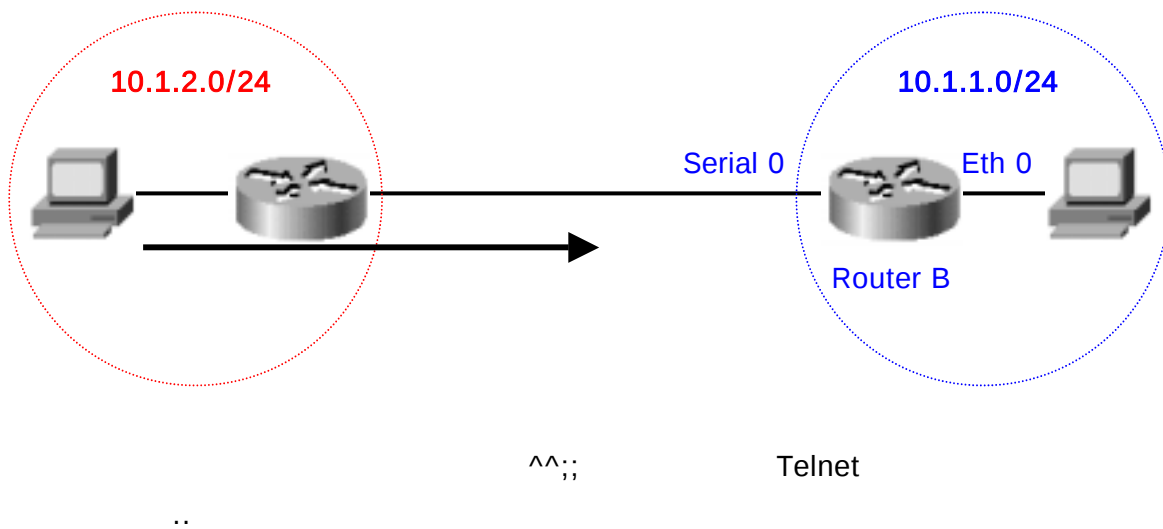
Standard ^^? Standard 가 ACLs
Extended 가 ^^;;
^^;;

```
RouterB(config)# access-list 100 deny tcp host 10.1.2.2 host 10.1.1.100 eq 21
```

→ 10.1.2.2(PC A) packet 10.1.1.100(FTP Server) 21 port(FTP well-known port) packet deny .. ?

```
RouterB(config)# access-list 100 permit tcp 10.1.2.0 0.0.0.255 host 10.1.1.100 eq 21
```

→ 10.1.2.0 packet permit .. Extended ACLs 가 100 ..^^;;



```
RouterB(config)# access-list 101 deny tcp 10.1.2.0 0.0.0.255 10.1.1.0 0.0.0.255 eq 23
```

```
RouterB(config)# access-list 101 permit ip any any
```

```
RouterB(config)# int e0
```

```
RouterB(config-if)# ip access-group 101 out
```

.. (^^)

→ 101 : Extended ACLs Number

→ deny :

→ tcp : IP Packet TCP . Telnet

..

→

→ eq 23 : Telnet well-known port ^^

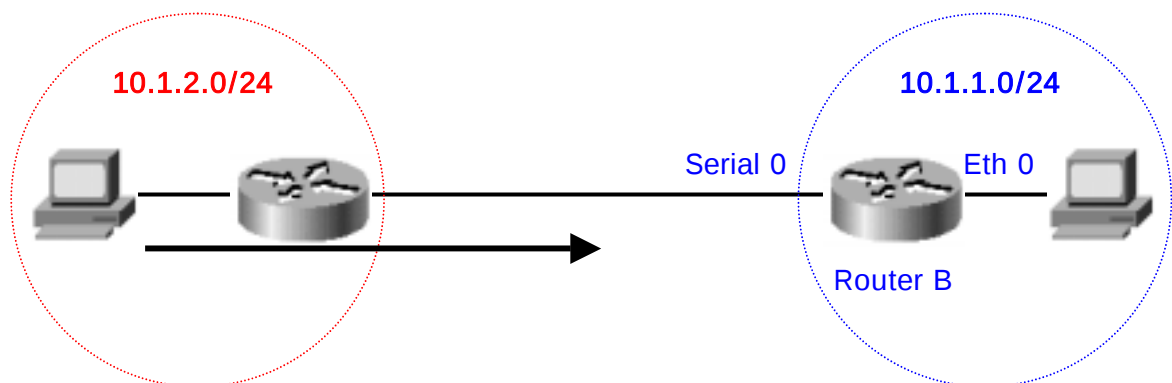
- ip : IP 가 ..
- any : .. ^^?;;

Extended가 Standard 가

ACLs access-lists ..
 .. Named IP Access Lists ..
 ..

```
Router(config)# ip access-list { standard | extended } name
Router(config {sta- | ext- }nacl)# {permit|deny} [condition]
Router(config-if)# ip access-group name {in | out}
```

Named ACLs ^^;;



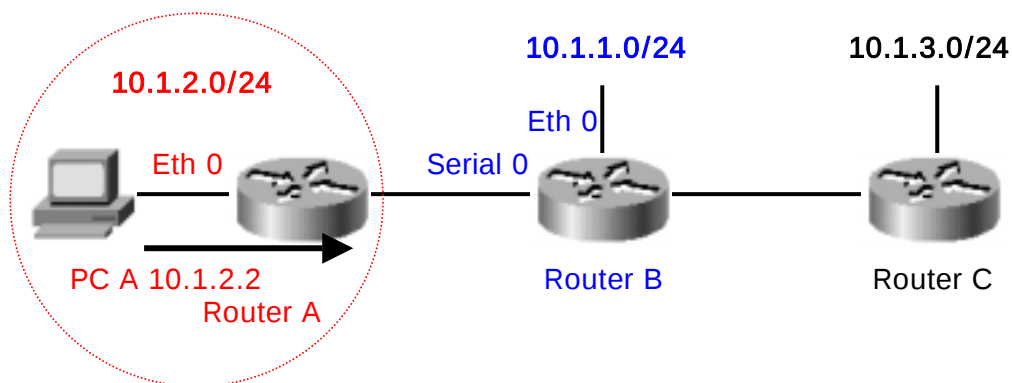
^^;;

```
RouterB(config)# ip access-list extended netcom
RouterB(config ext-nacl)# deny tcp 10.1.2.0 0.0.0.255 10.1.1.0 0.0.0.255 eq 23
RouterB(config ext-nacl)# permit ip any any
RouterB(config ext-nacl)# int e0
RouterB(config-if)# ip access-group netcom out
```

.. ^^;;

Named ACLs	Standard/Extended	List	Sta/Ext
99/100	Named		
	Sta/Ext	List	
Named	가/	가	가

ACLs ..



가	..	$\pi_{\pi};;$	ACLs	A가	packet
10.1.1.0/24		..	Standard	ACLs	A
Ethernet 0	가	..			

```
access-list 1 deny host 10.1.2.2
```

ACLs	..	Eth0	??
10.1.1.0/24	가	host A가 packet	.. 가
??	~	10.1.3.0/24	packet 가 ..

10.1.3.0/24 가 packet
Extended 가 .. ACLs
packet
^^::

Standard ACLs 가 Extended 가

.. Sta

가 가 packet

.. Extended 가

packet

~

ACLs

^^;;

```
Router# show ip int e0
```

```
... ..
```

```
Outgoing access list is not set
```

```
Inbound access list is 1
```

```
... ..
```

```
Router#
```

```
Show ip interface e0
```

ACLs

```
. Ethernet 0
```

```
Inbound 1 ACLs가
```

^^;;

```
Router# show access-lists
```

```
Standard IP access-list 1
```

```
Permit 10.1.2.2
```

```
Permit 10.1.2.3
```

```
Extended IP access list 100
```

```
Permit tcp host 172.16.1.3 any eq telnet
```

```
Permit tcp host 172.16.1.4 any eq ftp
```

```
Router#
```

```
show access-lists
```

ACLs

.. ip

```
ACLs show ip access-lists
```

```
show access-lists number
```

ACLs

..

```
Router# show {protocol} access-lists {ACLs-number | name}
```

```
..
```

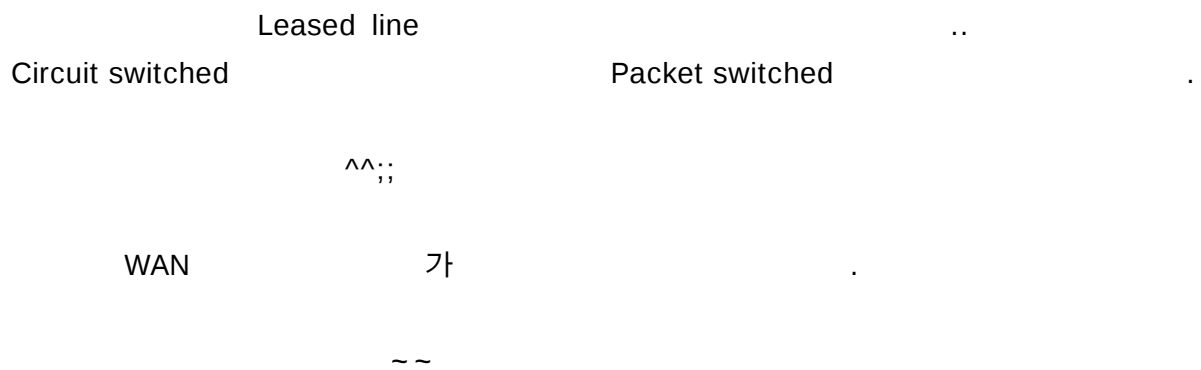
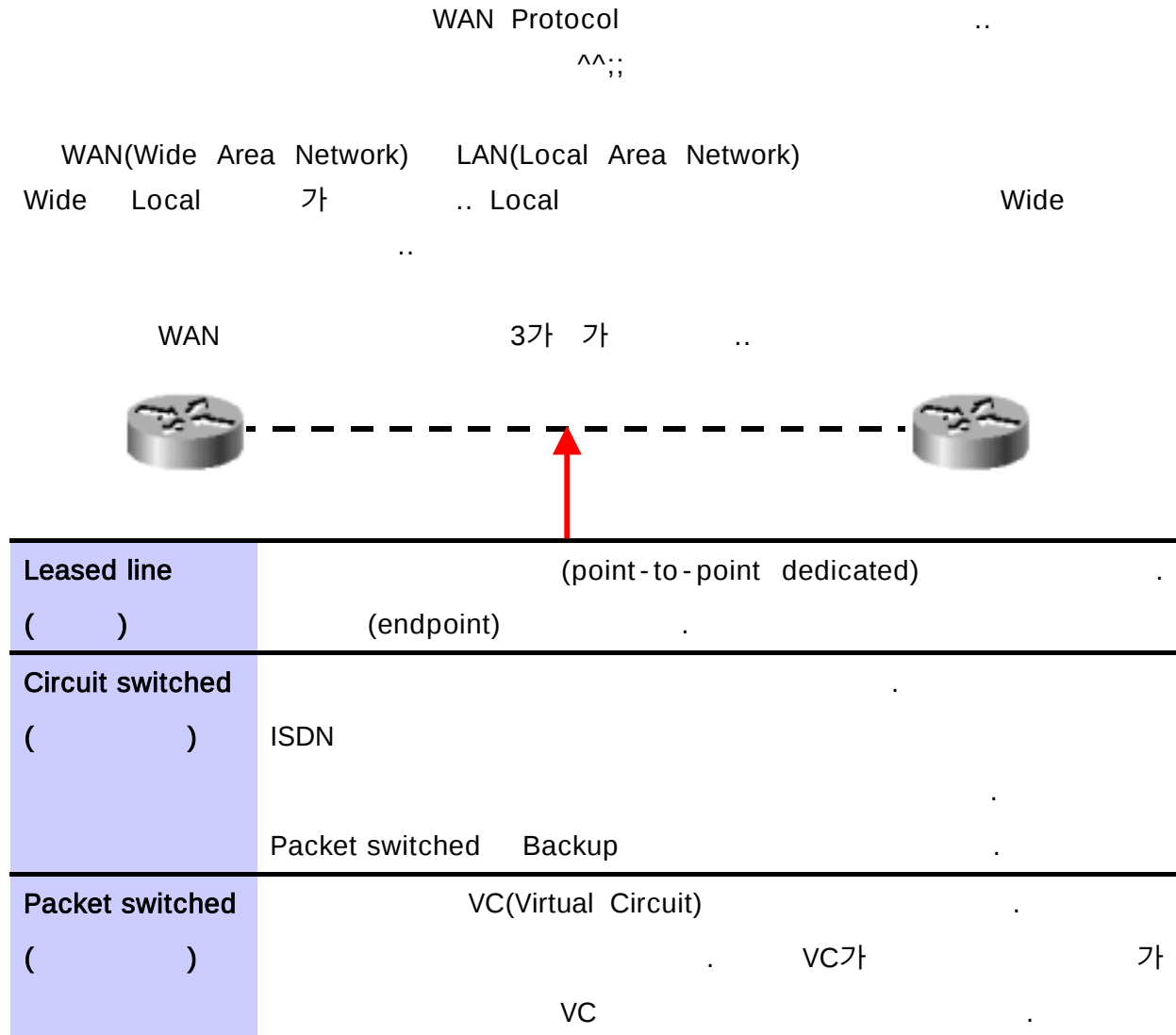
```
.. ACLs
```

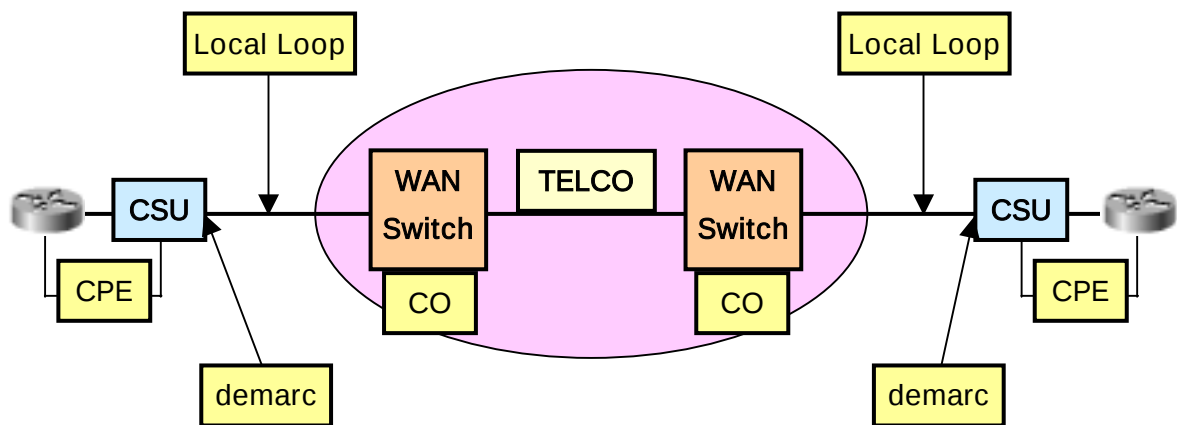
```
..
```

WAN

```
~~
```

CCNA : WAN(Leased Line)





가 ^^?;;

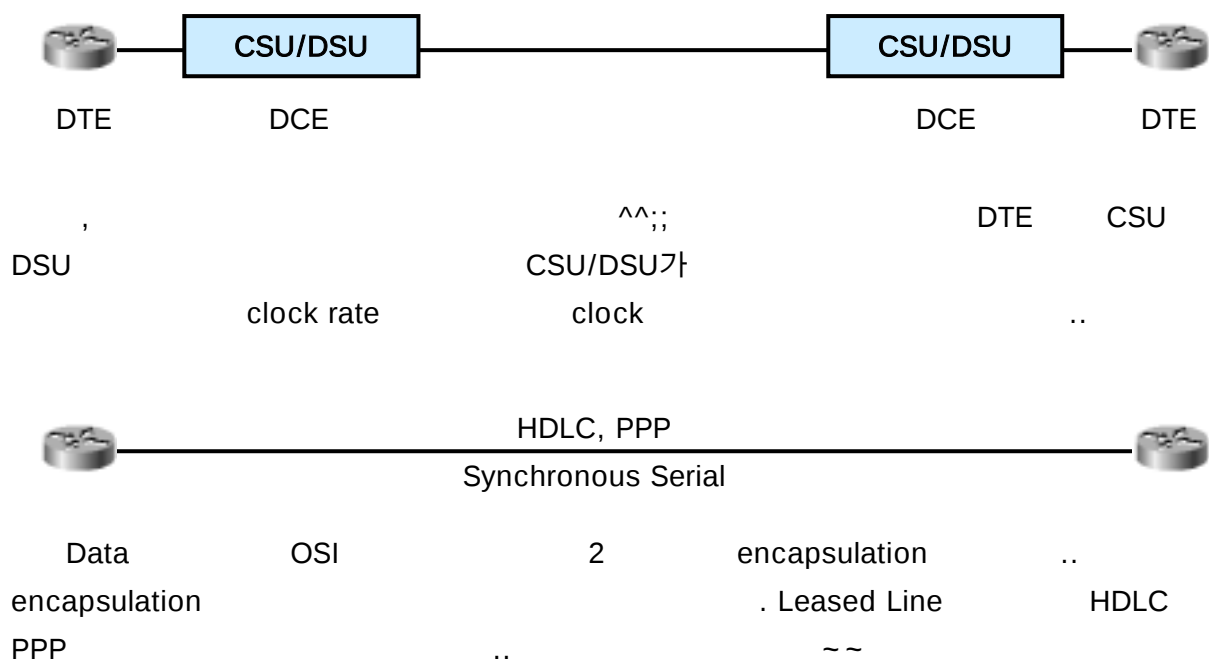
CPE(Customer premise equipment) : 가 가 .

가 가 가 가 .

Demarc(Demarcation) : CPE local loop 가

Local loop : demarc WAN CO(Central Office)

CO(Central office) switch : WAN



HDLC(Cisco High-Level Data Link Control):

- HDLC Cisco HDLC
- Cisco HDLC
-
-

PPP(Point-to-Point Protocol): , PC

HDLC · IP, IPX

PAP(Password Authentication Protocol) **CHAP(Challenge Handshake Authentication Protocol)**

·

HDLC .. HDLC

· HDLC 가

가

·

Router(config-if)# **encapsulation hdlc** · PPPRouter(config-if)# **encapsulation ppp** ^^; ^^;

HDLC

PPP

·

PPP .. PPP Protocol

·

PPP Protocol Stack ..

Network	Upper-Layer Protocol (ex: IP, IPX, AppleTalk)
Datalink	Network Control Protocol(NCP)
	Link Control Protocol(LCP)
	High-Level Data Link Control Protocol(HDLC)
Physical	EIA/TIA-232-C, V.24, V.35, and ISDN

Physical Layer

Network Control Protocol

3

. NCP 3

Link Control Protocol

PPP Control Protocol

3

. IP IPCP(Internet Protocol Control Protocol) , IPX

IPXCP(Internetwork Packet Exchange Control Protocol) . NCP

PPP

LCP

3

Control Protocol

IPX, AppleTalk, IP가 PPP

3

Control Protocol

가

. IP가

IPCP

^^ CDP

Control

Protocol

CDPCP

LCP가

?

PPP			
Authentication	PPP		
()	. PAP(Password Authentication Protocol)	CHAP(Challenge Handshake Authentication Protocol)	.
Compression	PPP	가	
()	가	.	
Error Detection	Quality	Magic Number	가
()	, loop가		
Multilink	IOS 11.1	PPP	가
()	.		

LCP

Error Detection Authentication

..

^^...

Error Detection Looped link Detection PPP . Looped link
 Detecton magic number looped link
 magic number 가 . PPP LCP
 .. 가 magic number가
 loop가 down 가 .

Error Detection Link Quality Monitoring (LQM)

가

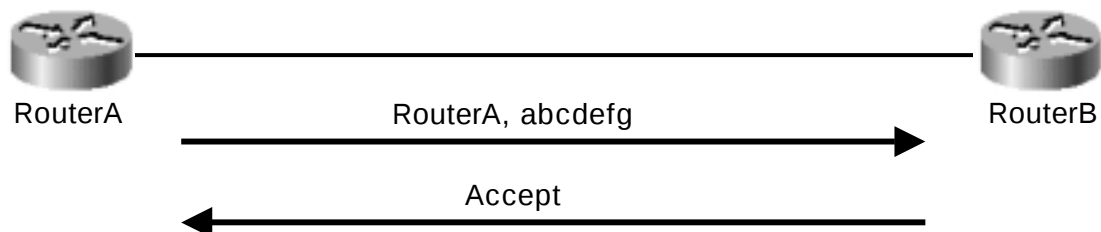
가

Authentication

PAP CHAP

.. PAP

PAP 2



hostname RouterA	hostname RouterB
username RouterB password abcdefg	username RouterA password abcdefg
interface serial0	interface serial0
ip address 192.168.1.1	ip address 192.168.1.2
encapsulation ppp	encapsulation ppp
ppp authentication pap	ppp authentication pap

, A username RouterB B RouterA ..
 .. pap .. pap

```
Router(config)# username name password password
```

```

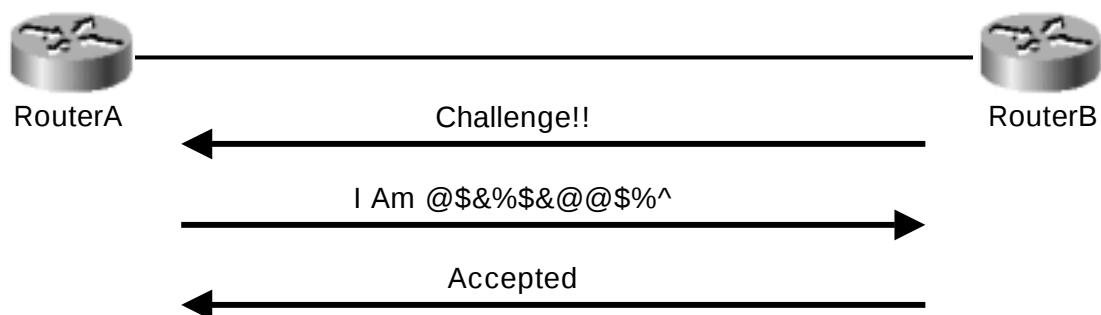
username      password      Global Configuration Mode      .. username
               . ppp                      interface mode              ..

```

```
Router(config-if)# ppp authentication {chap | pap | pap chap | chap pap}
```

(chap pap or pap chap)

CHAP 3 MD5 .. CHAP



pap ppp authentication chap

hostname RouterA	hostname RouterB
username RouterB password abcdefg	username RouterA password abcdefg
interface serial0	interface serial0
ip address 192.168.1.1	ip address 192.168.1.2
encapsulation ppp	encapsulation ppp
ppp authentication chap	ppp authentication chap

$$\wedge \wedge ? ? \cdot \cdot$$

PPP

..



RouterA

PPP Session Establishment

1. Link Establishment Phase
2. Optional Authentication Phase
3. Network Layer Protocol Phase



RouterB

Link Establishment	LCP	PPP	.	packet	(
	,	,	)	.	
Authentication	가				
	PPP	CHAP	..	가	.
Network Layer Protocol				PPP	
	.				

3가

..

~~ show interface s0

encapsulation

RouterA# show interface s0

Serial0 is up, line protocol is up

Hardware is HD64570

Internet address is 10.1.1.1/24

MTU 1500 bytes, BW 1544 Kbit DLY 20000 usec, rely 255/255, load 1/255

Encapsulation PPP, loopback not set, keepalive set(10 sec)

LCP : Open

Open : IPCP, CDPCP

...()...

Encapsulation PPP

LCP : Open..

..

Open : IPCP, CDPCP NCP

IP CDP Control Protocol

```

Authentication      CHAP                                debug ppp
authentication      ..                                ^^;;

```

```
RouterA# debug ppp authentication
```

```
... ..
```

```
4d20h: Se0 CHAP: O CHALLENGE id 2 len 28 from "left"
```

```
4d20h: Se0 CHAP: I CHALLENGE id 3 len 28 from "right"
```

```
4d20h: Se0 CHAP: O RESPONSE id 3 len 28 from "left"
```

```
4d20h: Se0 CHAP: I RESPONSE id 2 len 28 from "right"
```

```
4d20h: Se0 CHAP: O SUCCESS id 2 len 4
```

```
4d20h: Se0 CHAP: I SUCCESS id 3 len 4
```

```
...( )...
```

```
CHALLENGE, RESPONSE, SUCCESS 3
```

```
^^;;
```

```
.. 가 WAN
```

```
^^;;
```

```
~~
```

CCNA : WAN(ISDN / DDR)

D-2!! ISDN(Integrated Service Digital Network)

가 ..;; 3 ..7 가—a;; 가 28.8

56K 2 (1M 5 ..

;;) ISDN ..

가 -_-;;; 1M 2 30

..π_π;;

xDSL ISDN

.. CCNA ^^;; VDSL

..π_π(——;;;)

ISDN ITU-T , OSI 1~3 ..

ISDN .. ,

.. Call Setup()

.. (28.8 or 56Kbps) 64Kbps Bearer(B)

..

ISDN ..^^

ISDN 가 가 .. **BRI(Basic Rate Interface)** **PRI(Primary Rate Interface)**

가 . BRI PRI B Channel . B

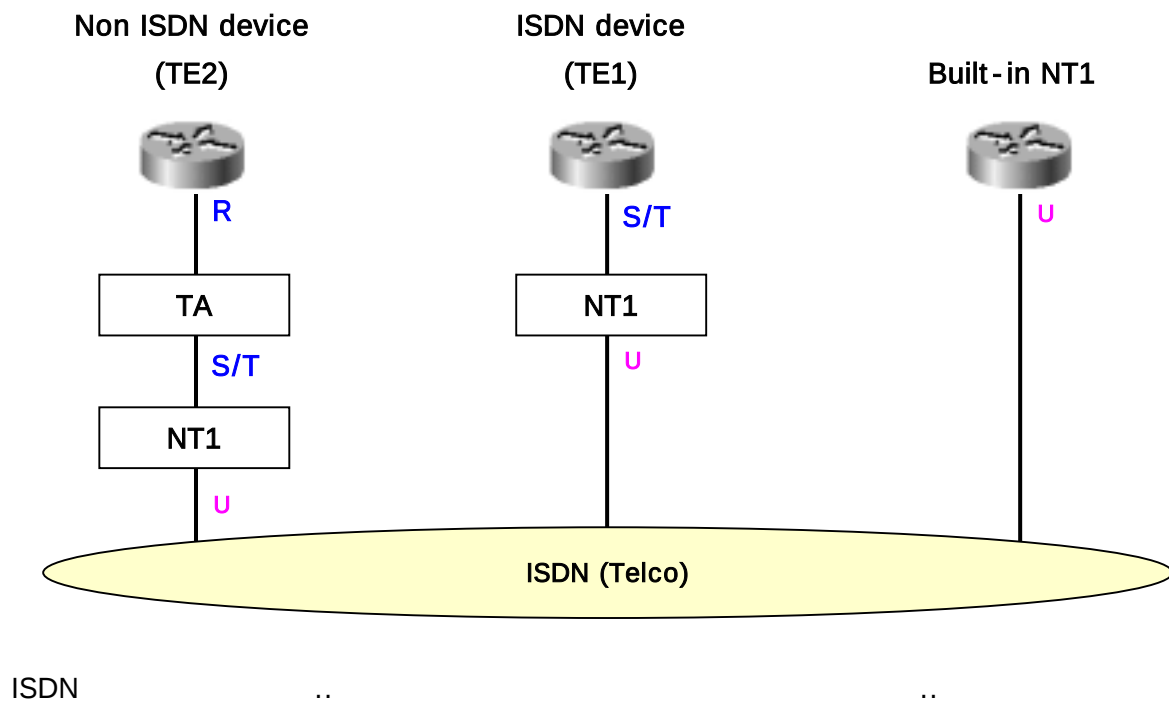
64Kbps . D Channel ISDN

signaling (call setup) .

	Bearer Channel (B)	Signaling Channel (D)	
BRI	2	1 (16 kbps)	2B + D
PRI(T1)	23	1 (16 kbps)	23B + D
PRI(E1)	30	1 (16 kbps)	30B + D

BRI . BRI ISDN

.. .. ;;;



ISDN Terminals

TE1 (Terminal Equipment 1)

ISDN .. BRI 가 .. NT1
S/T .

TE2 (Terminal Equipment 2)

ISDN .. TA ISDN
. TA R .. , PC
.

NT1 (Network Termination 1)

ISDN Physical Layer
.. ISDN U .

NT2 (Network Termination 2)

가 가 .
..

TA (Terminal Adapter)

TE2가 ISDN . NT1
ISDN .

ISDN Reference Point()

ISDN

..

R	TE2	TA	.
S/T	TE1	NT1	..
U	NT1	ISDN	.

ISDN Protocol

ISDN Protocol ITU-T .. Series Protocol

E-Series	Telephone Network	ISDN	.
I-Series	ISDN	concept, aspect, service	.
Q-Series	Switching	signaling	. ISDN Trouble
	shooting	. Signaling	.
	Q.921	LAPD(Link Access Procedure on the D channel)	ISDN data-
	link process	Q.931	Network

ISDN Switch Types

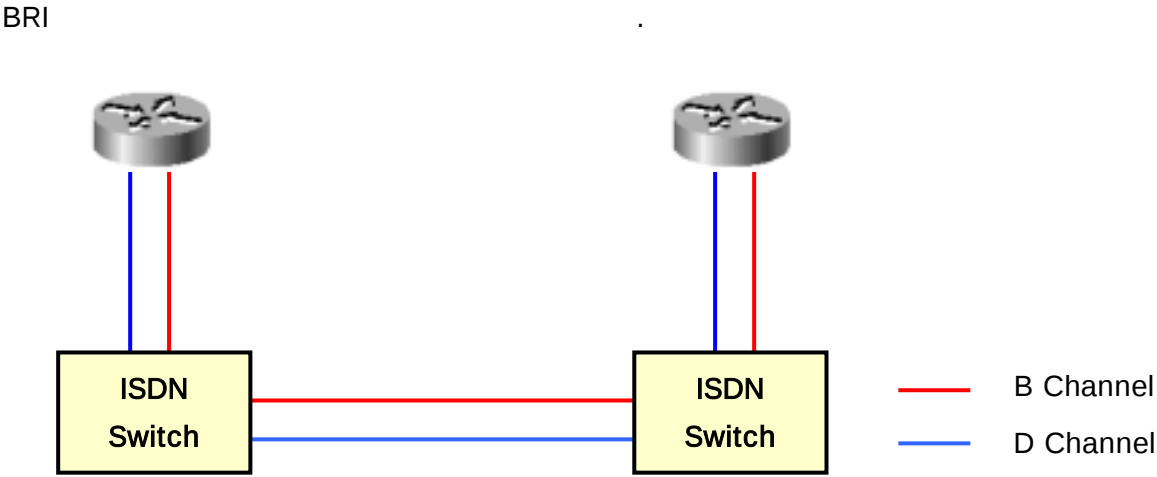
ISDN

.

Switch Type	Keyword
AT&T basic -rate switches	basic -5ess
Nortel DMS-100 basic rate switch	basic -dms100
National ISDN-1 switch	basic -ni1
AT&T 4ESS (ISDN PRI only)	primary -4ess
AT&T 5ESS (ISDN PRI only)	primary -5ess
Nortel DMS-100 (ISDN PRI only)	primary -dms100
Keyword	switch-type .. 가
	basic -ni1

ISDN BRI (Basic Rate Interface)는 2개의 B 채널 (64Kbps)과 1개의 D 채널 (16Kbps)로 구성됩니다. 총 대역폭은 144Kbps입니다. B 채널은 음성 또는 데이터 전송을 위한 채널이며, D 채널은 제어 신호를 전송하는 채널입니다. D 채널은 2B+D 구조에서 2개의 B 채널보다 낮은 대역폭을 가지며, 일반적으로 16Kbps입니다. D 채널은 SS7 신호를 전송하는 채널이며, 이는 전화 교환망에서 사용되는 신호입니다. D 채널은 2B+D 구조에서 2개의 B 채널보다 낮은 대역폭을 가지며, 일반적으로 16Kbps입니다. D 채널은 SS7 신호를 전송하는 채널이며, 이는 전화 교환망에서 사용되는 신호입니다.

ISDN은 SPIDs(Service Profile Identifiers)를 사용하여 서비스 프로파일을 식별합니다. SPIDs는 ISDN 스위치가 특정 서비스 프로파일을 식별하는 데 사용됩니다. SPIDs는 ISDN 스위치가 특정 서비스 프로파일을 식별하는 데 사용됩니다.



1.	Local Switch	
2.	Switch	Remote Switch
3.	Remote Switch	Remote
4.	B Channel	ent-to-end()

Router ISDN BRI ~ ~ Go Next Page!!

```
Router# conf t
```

```
Router(config)# isdn switch-type basic-ni
```

```
Router(config)# int bri0
```

```
Router(config-if)# encap ppp
```

```
Router(config-if)# isdn spid1 086506610100 8650661
```

```
Router(config-if)# isdn spid2 086506620100 8650662
```

```

Router  bri                                .. isdn switch-type      Global
Mode    Interface Mode                    가      .. Global
        isdn switch-type                Interface Mode
        switch-type                      .                ^^?

isdn spid1/spid2      ISDN                SPID                ..
isdn spid1 spid-number [ldn]                .. spid-number  ISDN
                                ldn                .

DDR                                가                                ISDN
.. (DDR                )

```

```
Router(config)# isdn switch-type basic-ni
```

```
Router(config)# isdn dialer map ip address name name connection number
```

```
Router(config-if)# ip address address mask
```

```
Isdn switch-type                ^^ isdn dialer map
```

```

                                DDR (Dial-on-Demand Routing)      ..
3가                                ISDN
. ^^;;

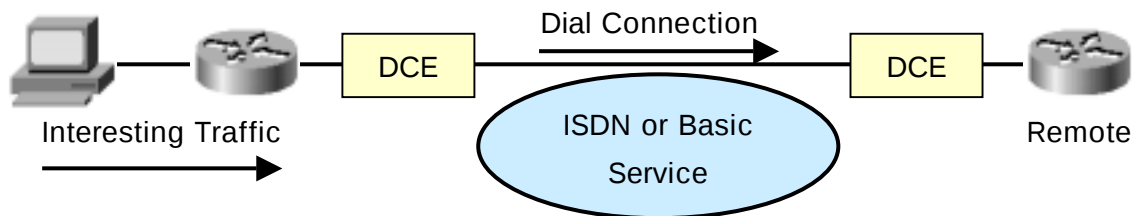
,                                ~ ~ DDR      가      ~ ^^;

```

DDR(Dial-on-Demand Routing)

.. Dial-on-Demand , 가
 Routing .. VOD(Video-on-Demand)
 .. TV TV
 VOD ?? DDR
 가 ^^;

DDR 가 ISDN dial-up
 . DDR interesting traffic() access-list가
 . DDR POTS(Plain Old Telephone Service)
 ISDN .
 WAN , DDR WAN . DDR
 ^^



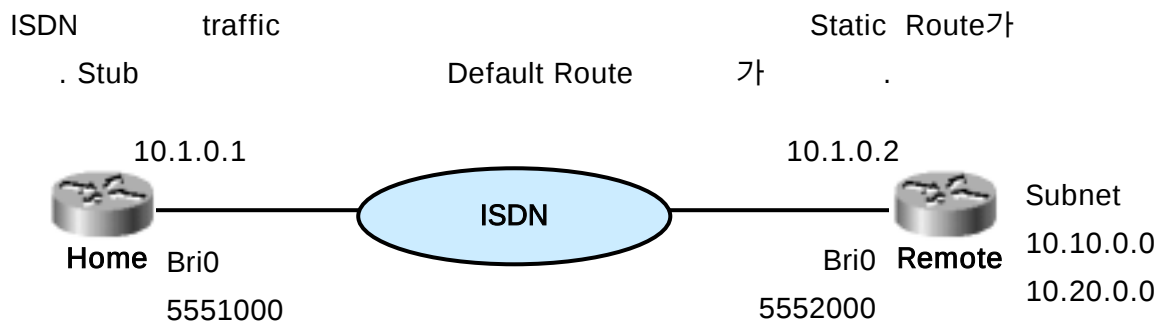
1. 가 dial-up .
2. Interesting Packet DDR .
3. dialer .
4. Traffic .
5. interesting traffic idle-timeout .

DDR

3

1. Static Route()
 → .
2. Interesting Traffic
 → Traffic .
3. dialer
 →

1.



```
Home(config)# ip route 10.10.0.0 255.255.0.0 10.1.0.2
```

```
Home(config)# ip route 10.20.0.0 255.255.0.0 10.1.0.2
```

```
Static Route .. ^^;
```

2. Interesting Traffic

Interesting Traffic dialer-list Global Command

^^;

```
Router(config)# dialer-list dialer-group protocol protocol-name {permit | deny | list access-list-number}
```

→ dialer-group : dialer-list

.

→ protocol-name : . Ip, ipx, appletalk

→ permit|deny : Interesting Traffic ^^

→ list : list access-list dialer . list 1

access-list 가 1 ..

^^..
;

```
Home(config)# dialer-list 1 protocol ip list 101
```

```
dialer-group 1 . ip protocol 101 access-list
. ^^?
```

```
Home(config)# access-list 101 permit tcp any any eq telnet
```

```
Home(config)# access-list 101 permit tcp any any eq ftp
```

```
101 access-list .. ^^;
```

3. dialer

```
Static route Interesting Traffic .. dialer
.
```

```
Step1. Interface .
```

```
Step2. Interface .
```

```
Home(config-if)# ip address ip-address mask
```

```
Step3. Encapsulation type . PPP
```

```
Home(config-if)# encapsulation ppp
```

```
Authentication
```

```
Home(config-if)# ppp authentication chap
```

```
Step4. Interesting Traffic Interface .
```

```
Home(config-if)# dialer-group group-number
```

```
group-number 1 10 . dialer-list group-number
```

```
Step5. dial number .
```

```
Home(config-if)# dialer string dial-number or
```

```
Home(config-if)# dialer map protocol next-hop-address [name hostname]
```

```
[speed 56 | 64] [broadcast] dialer-string
```

Router(config-if)# **dialer map** protocol next-hop-address [**name** hostname]
[**speed 56 | 64**] [**broadcast**] dialer-string

→ name hostname : . PPP ID
ISDN .

→ speed 56 | 64 : ISDN kbps 가 .
64 .

→ broadcast : Broadcast Multicast forwarding . (Interesting Traffic
)

→ dialer-string : Remote .
가 .

Router(config-if)# **dialer load-threshold** number [either | inbound | outbound]

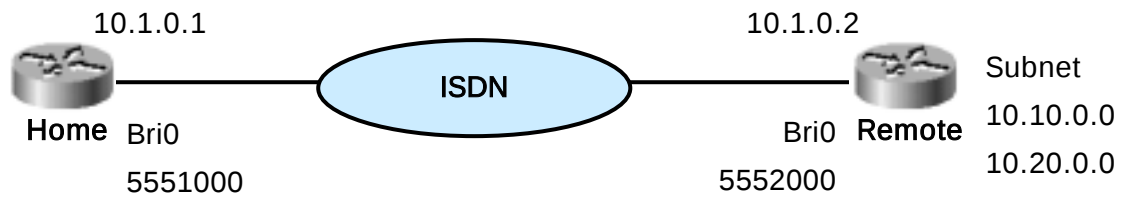
BRI Interface B . Number
1 - 255 .. 255 B 100%
B . Inbound/outbound/either
가 traffic .. outbound .

Router(config-if)# **dialer load-threshold 125 either**

inbound traffic outbound traffic 45%
B .. OK^^?;;

Router(config-if)# **dialer idle-timeout** number

dialer idle-timeout interesting traffic number
() .. 120 .
, 가 ~
^^ 가 ^^



Home Bri0 Interface ISDN
 .. ^^;;

```
Home(config)# username Remote password cisco
```

```
Home(config)# ip route 10.10.0.0 255.255.0.0 10.1.0.2
```

```
Home(config)# ip route 10.20.0.0 255.255.0.0 10.1.0.2
```

```
Home(config)# dialer-list 1 protocol ip list 101
```

```
Home(config)# access-list 101 permit tcp any any eq telnet
```

```
Home(config)# access-list 101 permit tcp any any eq ftp
```

```
Router(config)# isdn switch-type basic-ni
```

```
Home(config)# interface bri0
```

```
Home(config-if)# ip address 10.1.0.1 255.255.255.0
```

```
Home(config-if)# no shutdown
```

```
Home(config-if)# encapsulation ppp
```

```
Home(config-if)# ppp authentication chap
```

```
Home(config-if)# isdn spid1 086506610100 5551000
```

```
Home(config-if)# isdn spid2 086506620100 5551200
```

```
Home(config-if)# dialer load-threshold 128 either
```

```
Home(config-if)# dialer idle-timeout 180
```

```
Home(config-if)# dialer map ip 10.1.0.2 name Remote 5552000
```

```
Home(config-if)# dialer-group 1
```

.. ^^;; !!
 Frame Relay ^^;;

CCNA : WAN(Frame Relay)

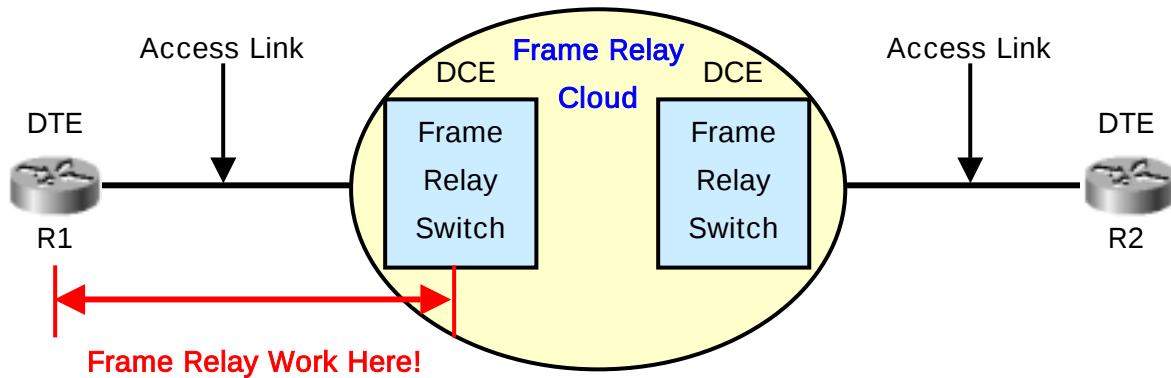
Frame Relay .. CCNA WAN

Frame Relay Packet Switched Service PDN(Public Data Network)

ITU-T ANSI . Frame Relay

link 가 . OSI 1,2

^^;;



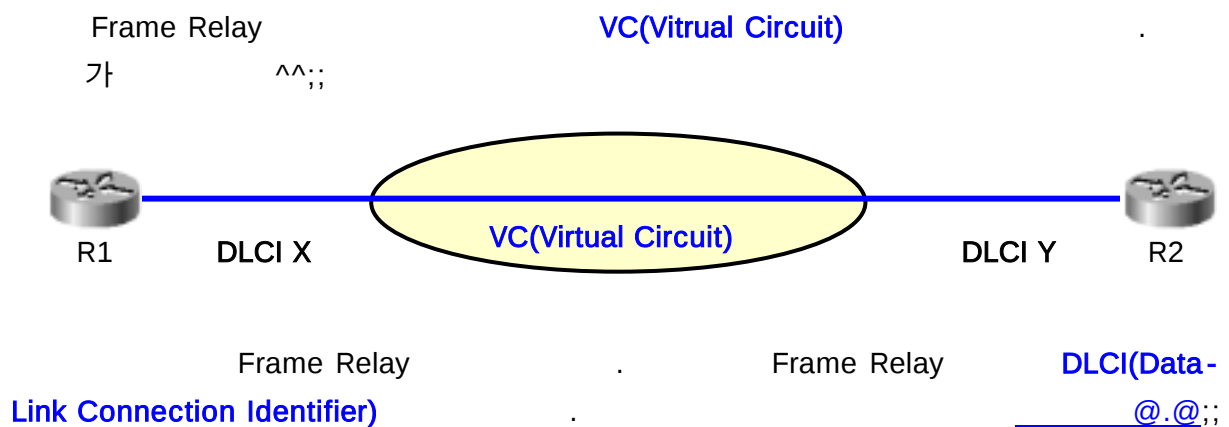
^^?;;

Frame Relay

Frame Relay Cloud

Frame Relay

가



VC(Virtual Circuit)	.. PVC/SVC가		
PVC(Permanent Virtual Circuit)	가 ..		
SVC(Switched Virtual Circuit)	.		
Access Link	DTE	DCE	.
DLCI (Data-link Connection Identifier)	Frame Relay . Frame Relay PVC DLCI . DLCI local 가 local Frame Relay		
CIR(Committed Information Rate)	(bps)	가	가
LMI(Local Management Interface)	DTE	DCE	.
	PVC, SVC	,	.
IARP(Inverse Address Resolution Protocol)	DLCI . 가 VC		
NBMA(Nonbroadcast Multiaccess)	Broadcast	가	가
	Broadcast	.	Frame Relay

^^?;;

.. (

PVC

^^;;

VC

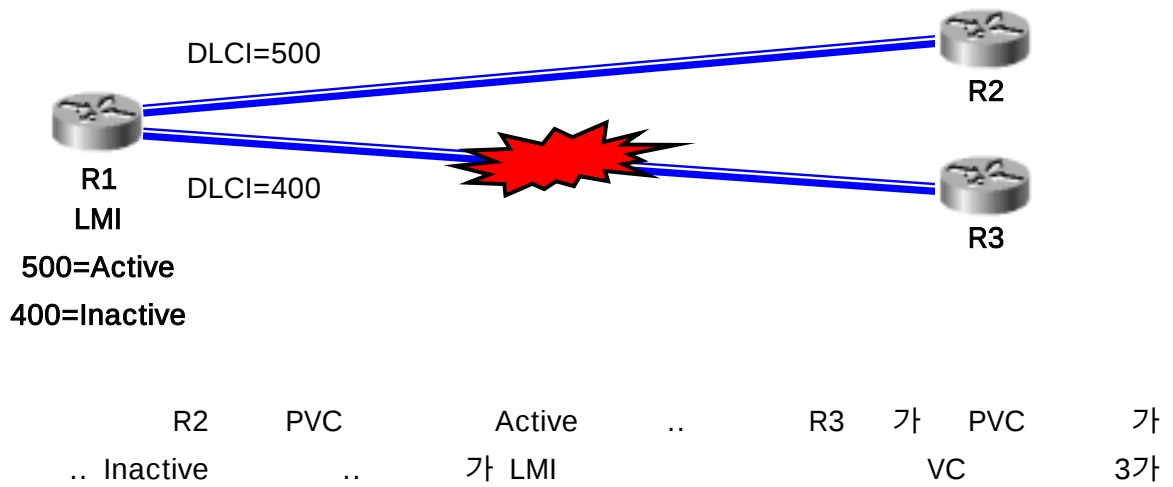
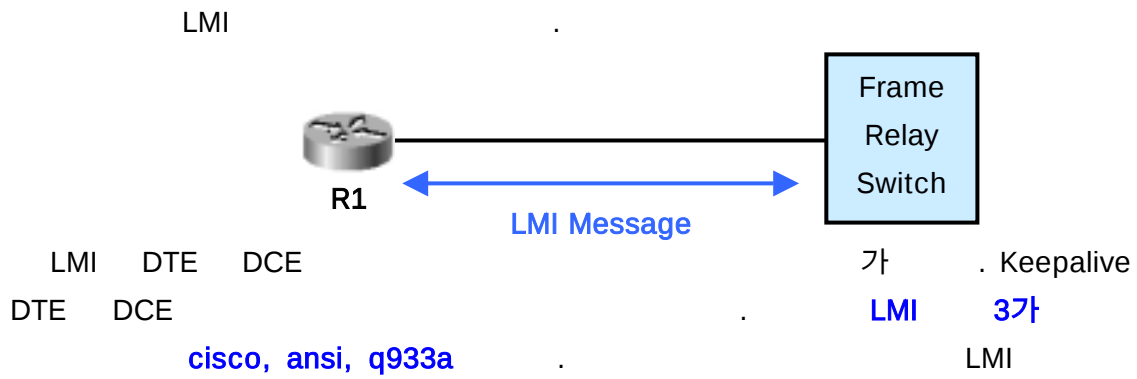
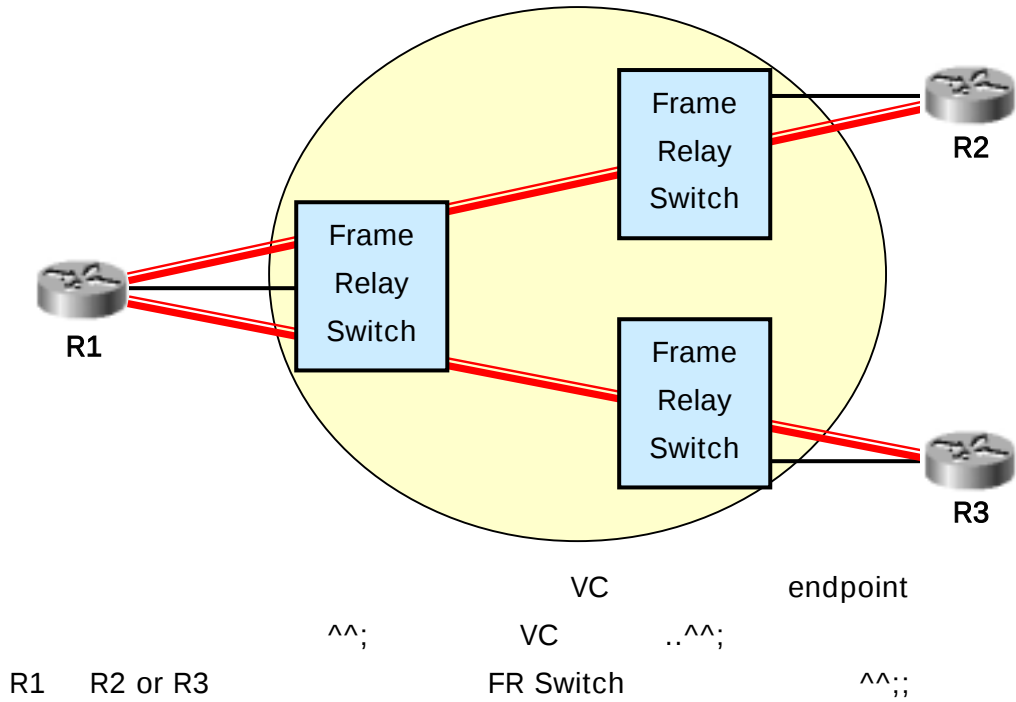
PVC

^^;.....)

VC ^^;; VC Frame Relay DTE
 . point-to-point

^^;; Virtual!!

^^??



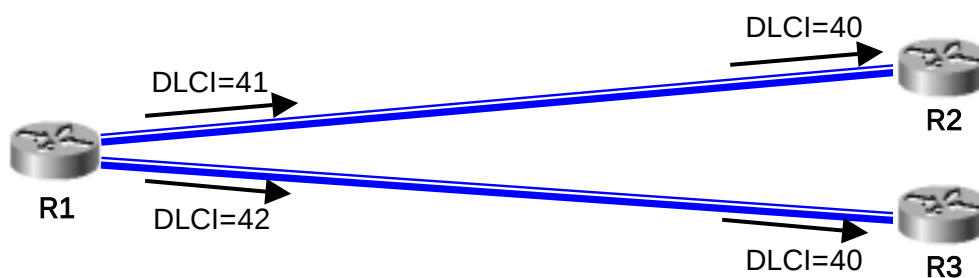
Active	가			
Inactive	FR Switch	FR Switch		
Delete	FR Switch	LMI	가	.
	FR Switch	가	가	.

가 .. (DTE) FR
 Switch(DCE) Access link DTE VC
 PVC Frame Relay PVC
 DLCI access-link LMI
 LMI type DLCI
 ^^;; DLCI ??

DLCI VC
 FR Switch DLCI Remote Site
 Frame Relay ^^; DLCI 2
 가 2 Encapsulation Source/Destination
 가 가가 Frame Relay DLCI field 가

Frame Relay DLCI DLCI 가 local access-link
 Local addressing()
 ^^;;
 가
 ?

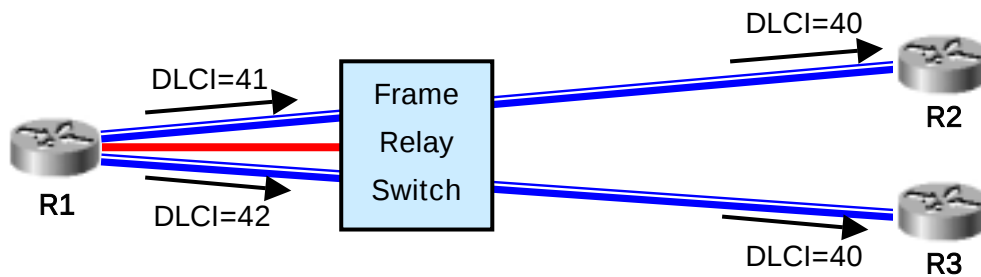
@.@;,,, 가 DLCI access-
 link access-link DLCI 가
 ^^;; ^^?;;



link PVC access-link DLCI 40 access-link

access-link access-link VC DLCI access-link

.. ,



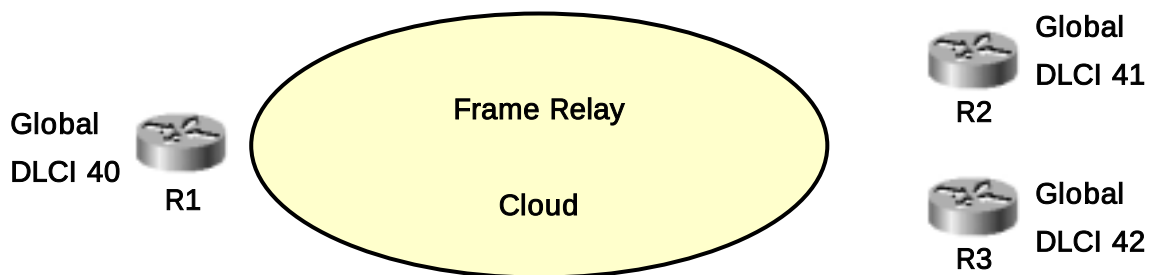
Switch R1 PVC access-link .. local 가 ^^; R1
 DLCI 가 R2,R3
 ..^^;;)

Global Addressing

^^;; local addressing

..

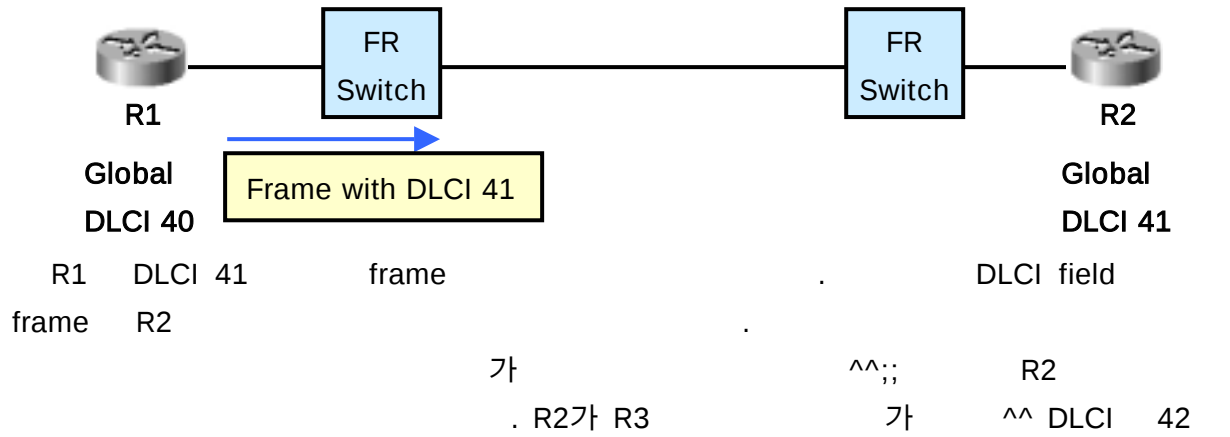
가



R1 R2 frame DLCI 41 . R2 DLCI가 41 ^^;;
 가 R3 frame 42 .
 . DLCI MAC 가

, frame ..^^;; R1 R2

..^^



Global addressing

MAC

local Switch가 DLCI Number

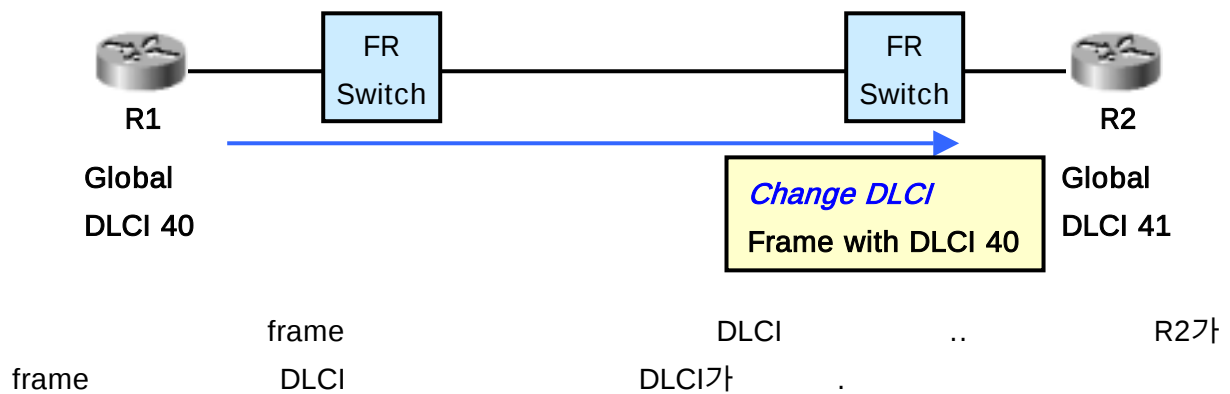
Frame Relay Header

DLCI field가 .. MAC / 가 !!

DLCI

frame

..^^



Header	global DLCI	DLCI field
DLCI field		
global DLCI		

^^??

Frame Sent by Router	With DLCI Field	Is Delivered to Router	With DLCI Field
R1	41	R2	40
R1	42	R3	40
R2	40	R1	41
R3	40	R1	42

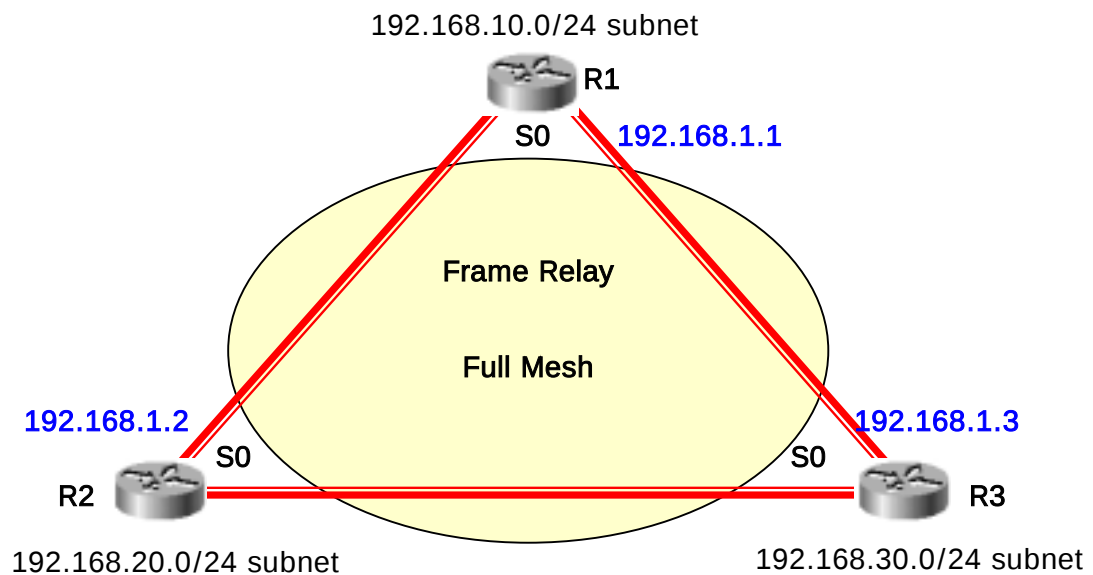
R1 R2,R3 DLCI field .. ^^;;

Frame Relay packet (3) . Cisco Frame
Relay 3가 Frame Relay .

VC

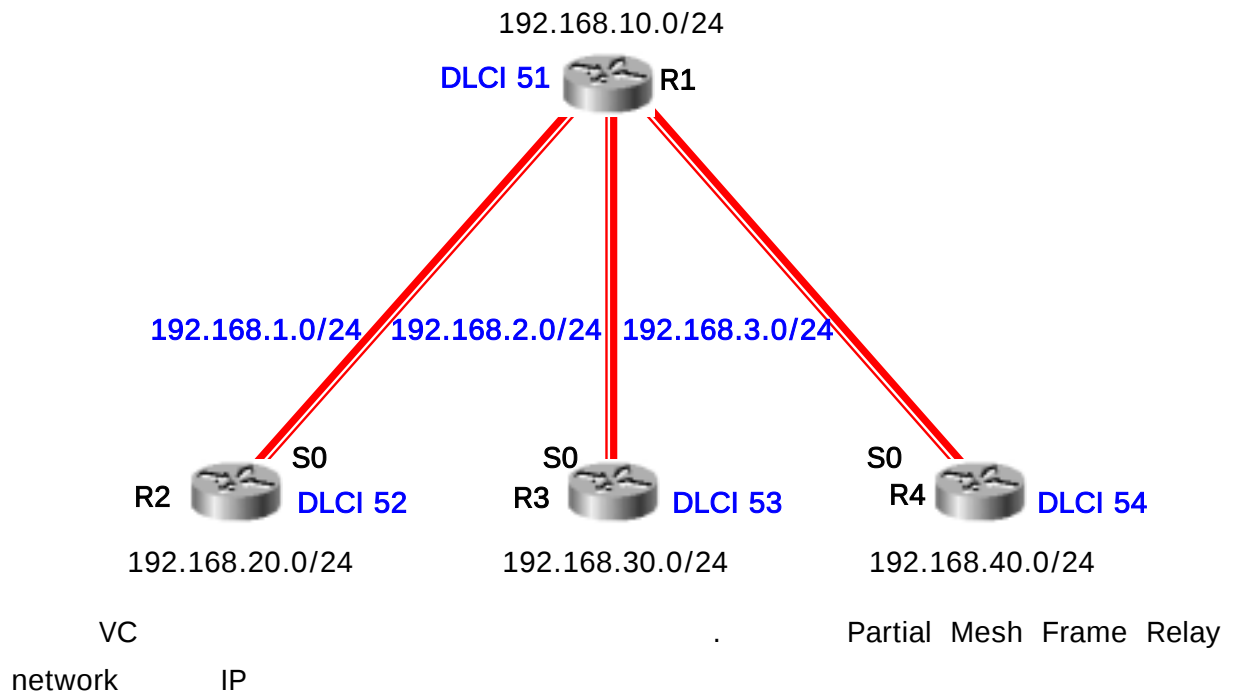
^^

1. Full Mesh with IP Addresses



Frame Relay Network IP 가 ..

2. Partial Mesh with IP Addresses



IP Addresses with Point-to-Point Subinterfaces

Router	Subnet	IP Address
R1	192.168.1.0	192.168.1.1
R2	192.168.1.0	192.168.1.2
R1	192.168.2.0	192.168.2.1
R3	192.168.2.0	192.168.2.2
R1	192.168.3.0	192.168.3.1
R4	192.168.3.0	192.168.3.2

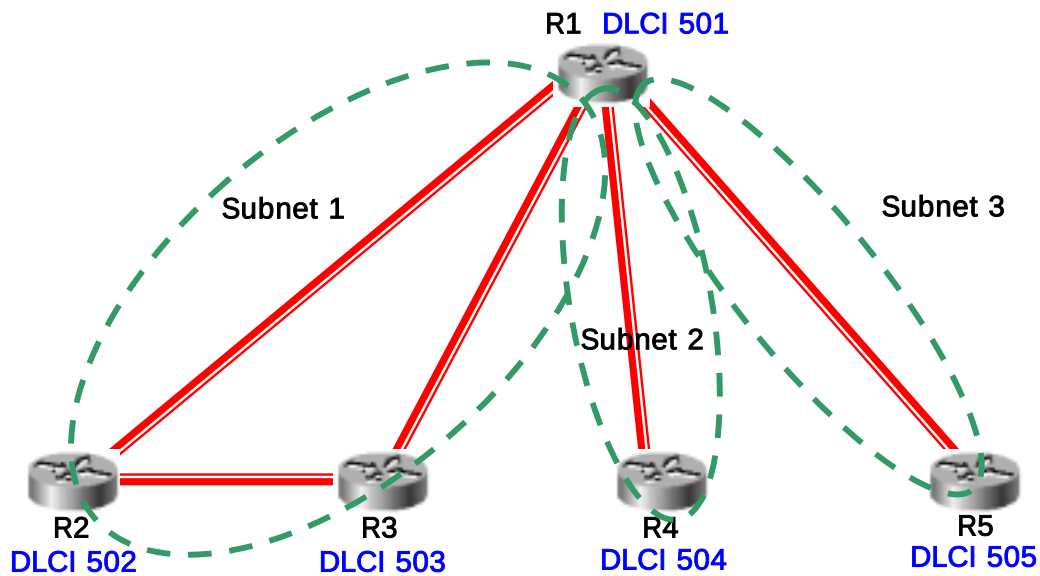
IOS VC R1 가

.. 3 !! Cisco

subinterface

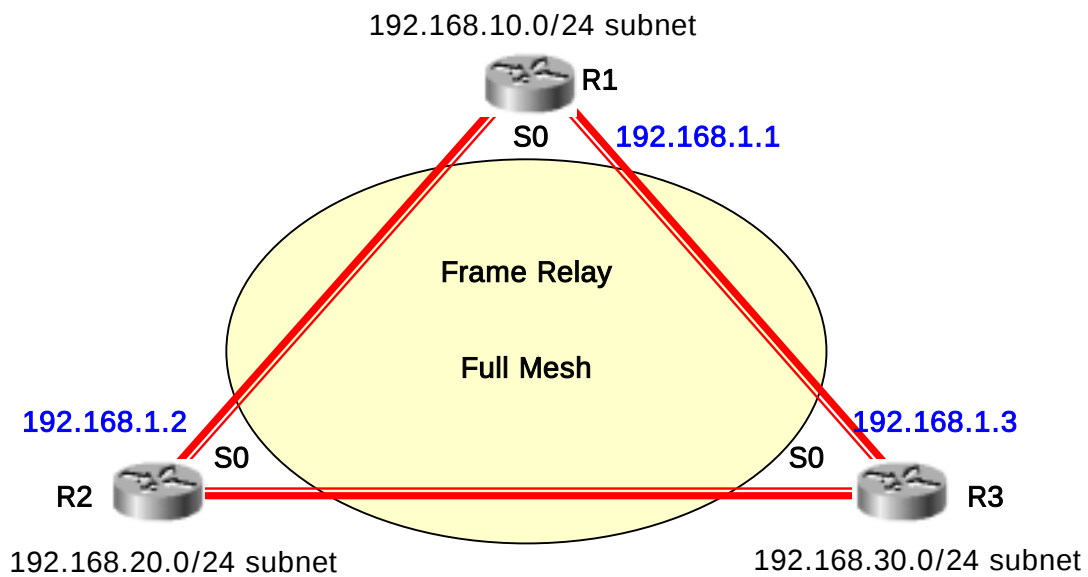
^^

3. Hybrid of Full and Partial Mesh



Router	Subnet	IP Address	Subinterface Type
R1	192.168.1.0/24	192.168.1.1	Multipoint
R2	192.168.1.0/24	192.168.1.2	Multipoint
R3	192.168.1.0/24	192.168.1.3	Multipoint
R1	192.168.2.0/24	192.168.2.1	Point-to-point
R4	192.168.2.0/24	192.168.2.2	Point-to-point
R1	192.168.3.0/24	192.168.3.1	Point-to-point
R5	192.168.3.0/24	192.168.3.2	Point-to-point

Frame Relay



R1

R1(config)# int s0

R1(config-if)# encapsulation frame-relay

R1(config-if)# ip address 192.168.1.1 255.255.255.0

R1(config-if)# int e0

R1(config-if)# ip address 192.168.10.1 255.255.255.0

R1(config-if)# exit

R1(config)# router igrp 1

R1(config-router)# network 192.168.1.0

R1(config-router)# network 192.168.10.0

가 frame-relay .. R2, R3 가 IP
 . ^^? IOS

→ LMI type ..(cisco, ansi, q933a 가 ^^)

→ Encapsulation type cisco가 .. cisco, ietf 가 가 .

→ LMI status PVC DLCI

→ Inverse ARP가 enable .

```

^ ^;;   가   ^ ^;;

encapsulation frame-relay          HDLC          frame-
relay          . frame-relay  encapsulation type      cisco
ietf   가   가   . ietf          .

          frame-relay   가

          ^ ^;          ^ ^

∴ R3   가   VC   ietf encapsulation type   .
∴ R1   LMI type   ansi가   .

```

R1

```

interface serial0
  encapsulation frame-relay
  frame-relay lmi-type ansi
  frame-relay interface-dlci 53 ietf
  ip address 192.168.1.1 255.255.255.0

```

R3

```

interface serial0
  encapsulation frame-relay ietf
  ip address 192.168.1.3 255.255.255.0

```

```

frame-relay lmi-type {cisco|ansi|q933a}
lmi type          . (Interface Mode)

```

```

frame-relay interface-dlci dlci {ietf|cisco}
          frame-relay          DLCI number          .

```

```

          frame-relay encapsulation type
          VC          .          PVC
encapsulation type          .

```

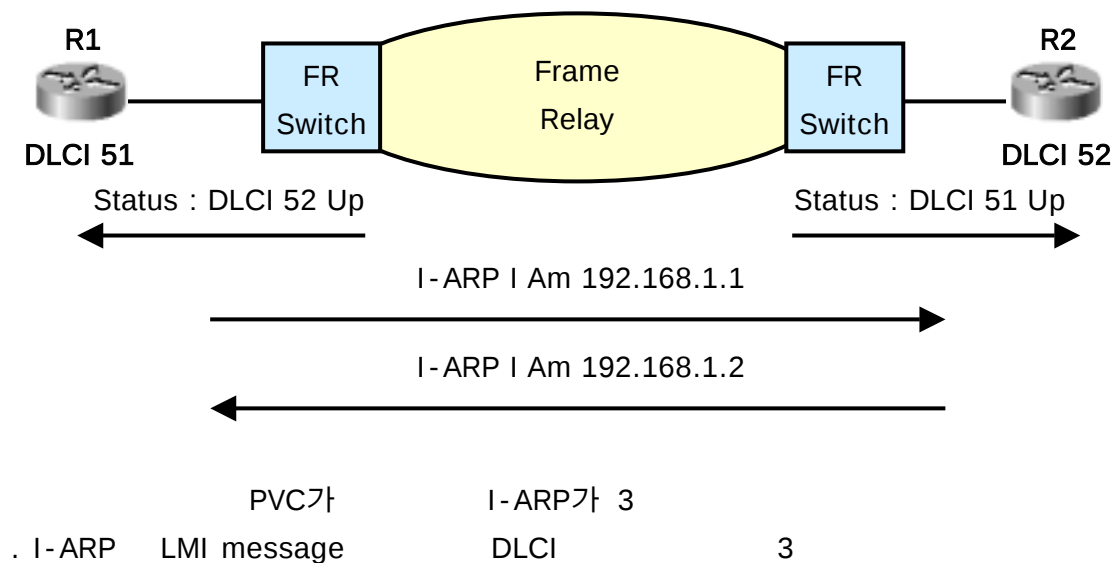
Address Mapping

(^^;:)

Frame Relay "mapping" 3 2
 ^^;(;;;) 가 ^^;
 ARP(Address Resolution Protocol, IP Address → MAC Address) Layer3-to-Layer2 mapping

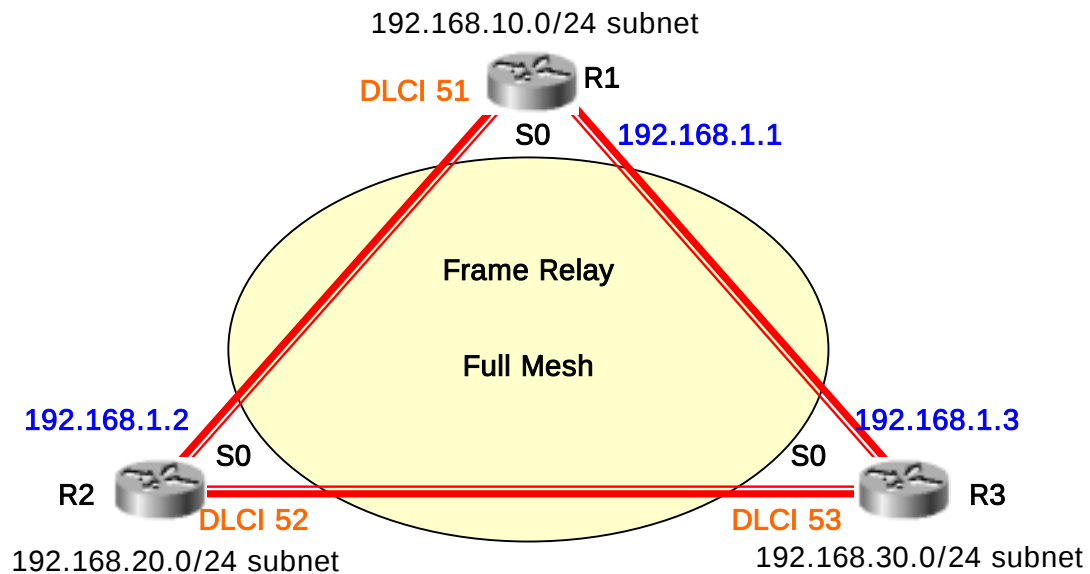
가 IP MAC ARP MAC
 가 Frame Relay IP DLCI
 mapping . Frame Relay DLCI
 ^^; Frame Relay

Frame Relay I-ARP(Inverse ARP) I-
 ARP IP DLCI mapping
 frame-relay map ARP



..^^;

1. Full Mesh with IP Addresses



```
R1(config)# int s0
```

```
R1(config-if)# encapsulation frame-relay
```

```
R1(config-if)# ip address 192.168.1.1 255.255.255.0
```

```
R1(config-if)# no shut
```

^^;; I-ARP

mapping

```
R1(config-if)# no frame-relay inverse-arp
```

```
R1(config-if)# frame-relay map ip 192.168.1.2 52 broadcast
```

```
R1(config-if)# frame-relay map ip 192.168.1.3 53 broadcast
```

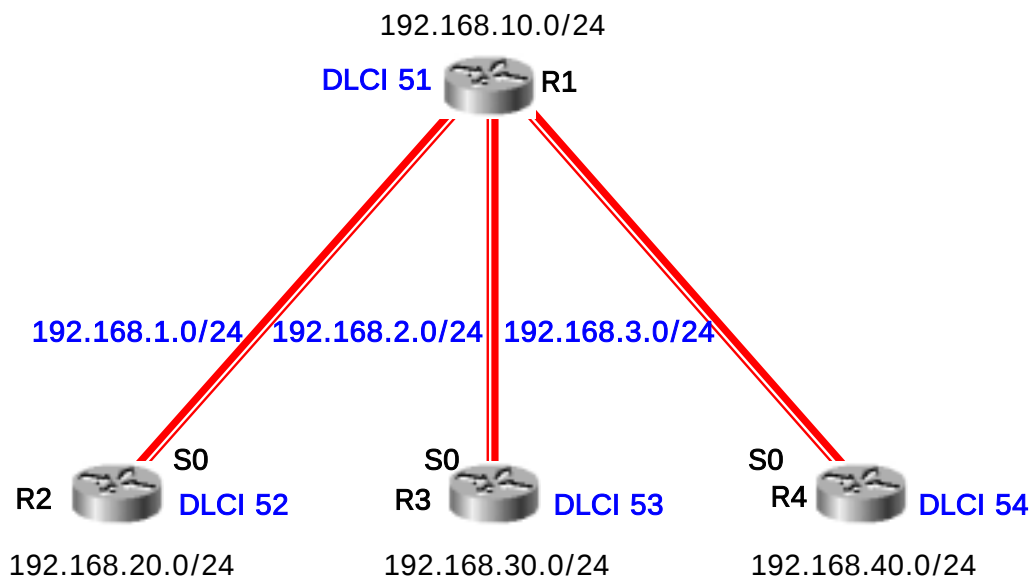
frame-relay map {protocol protocol-address dlci} [**broadcast**] [ietf|cisco]

frame-relay map . Protocol Protocol
 . **broadcast** Frame-relay broadcast forwarding .

R2, R3 가 ^^

Encapsulation type cisco LMI autosense .. ^^

2. Partial Mesh with IP Addresses



```
R1(config)# int s0
```

```
R1(config-if)# encapsulation frame-relay
```

```
R1(config-if)# interface serial 0.1 point-to-point
```

```
R1(config-subif)# ip address 192.168.1.1 255.255.255.0
```

```
R1(config-subif)# frame-relay interface-dlci 52
```

```
R1(config-fr-dlci)# interface serial 0.2 point-to-point
```

```
R1(config-subif)# ip address 192.168.2.1 255.255.255.0
```

```
R1(config-subif)# frame-relay interface-dlci 53
```

```
R1(config-fr-dlci)# interface serial 0.3 point-to-point
```

```
R1(config-subif)# ip address 192.168.3.1 255.255.255.0
```

```
R1(config-subif)# frame-relay interface-dlci 54
```

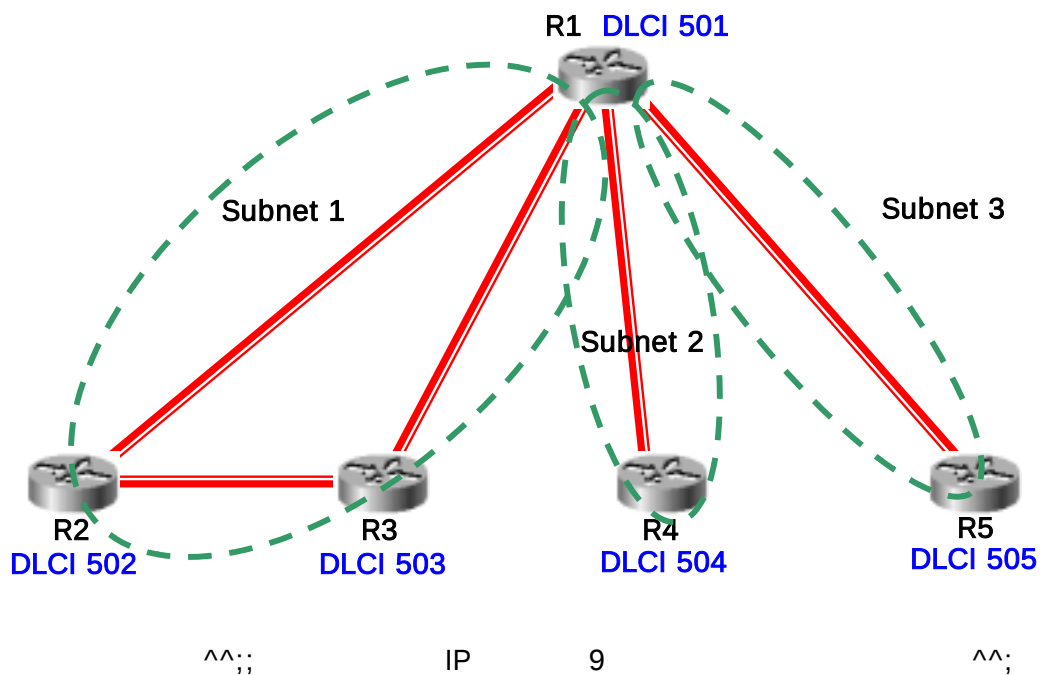
```
R1
subinterface          . Interface serial number.sub [point-to-point] [multipoint]
                        . Serial0 Inteface      subinterface    0.1 0.2 0.3
                        ^^ point-to-point          multipoint
가
```

가 . IP 가 . IP
 . point-to-point
 DLCI . frame-relay interface-dlci .

```
R2(config)# int s0
R2(config-if)# encapsulation frame-relay
R2(config-if)# int s0.1 point-to-point
R2(config-subif)# ip address 192.168.1.2 255.255.255.0
R2(config-subif)# frame-relay interface-dlci 51
```

R2 . ^^^; R3, R4 가 .

3. Hybrid of Full and Partial Mesh



R1	192.168.1.0/24	192.168.1.1	Multipoint
R2	192.168.1.0/24	192.168.1.2	Multipoint
R3	192.168.1.0/24	192.168.1.3	Multipoint

R1 ↔ R4, R1 ↔ R5 point-to-point ..
 Multipoint ..^^^;

```
R1(config)# int s0
```

```
R1(config-if)# encapsulation frame-relay
```

```
R1(config-if)# int s0.1 multipoint
```

```
R1(config-subif)# ip address 192.168.1.1 255.255.255.0
```

```
R1(config-subif)# frame-relay interface-dlci 502
```

```
R1(config-subif)# frame-relay interface-dlci 503
```

```
R2(config)# int s0
```

```
R2(config-if)# encapsulation frame-relay
```

```
R2(config-if)# int s0.1 multipoint
```

```
R2(config-subif)# ip address 192.168.1.2 255.255.255.0
```

```
R2(config-subif)# frame-relay interface-dlci 501
```

```
R2(config-subif)# frame-relay interface-dlci 503
```

```
R3(config)# int s0
```

```
R3(config-if)# encapsulation frame-relay
```

```
R3(config-if)# int s0.1 multipoint
```

```
R3(config-subif)# ip address 192.168.1.3 255.255.255.0
```

```
R3(config-subif)# frame-relay interface-dlci 501
```

```
R3(config-subif)# frame-relay interface-dlci 502
```

point-to-point

PVC

multipoint

^^;
;

frame-relay interface-dlci

.. ^^;
;

Frame-relay

..

show frame-relay lmi		
LMI	.	
show frame-relay pvc		
DLCI, PVC	.	
show frame-relay map		
Frame-relay DLCI-to-IP	mapping	.

, ^^:: CCNA 가 ^^::

가 . ^^

^^::
,,