

A Top-Down Approach

Chapter 5.1 ~ 5.4

5.1 Introduction

- Forwarding table
 - Flow table
1. Router output port forwarding
 2. drop packet
 3. Rewrite (2,3,4) - middle box

5.1 Introduction

- Drop packet

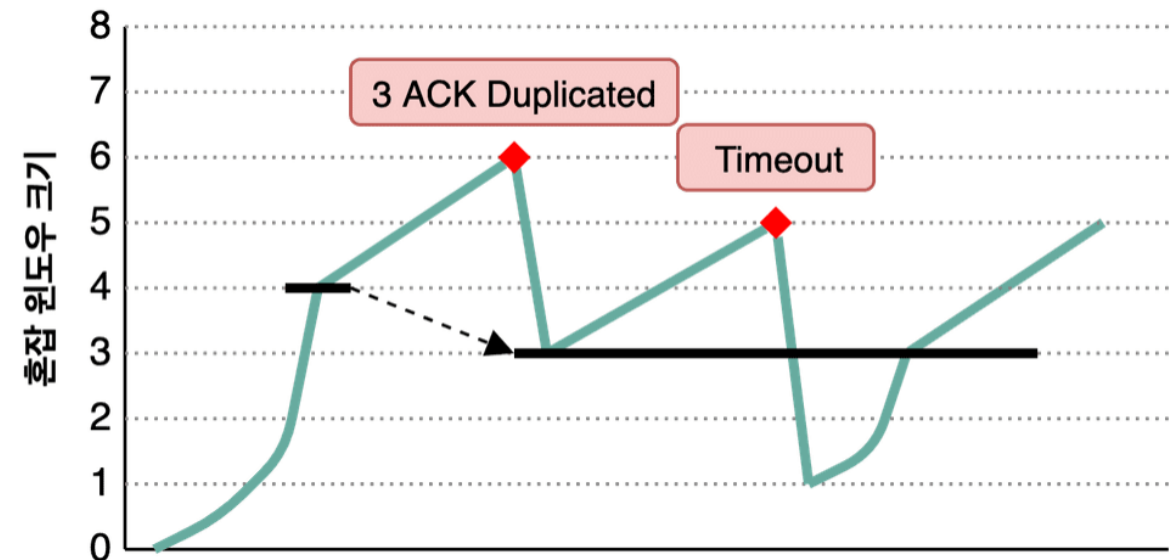
1. TTL

2. 혼잡 제어

3. 401 ERROR

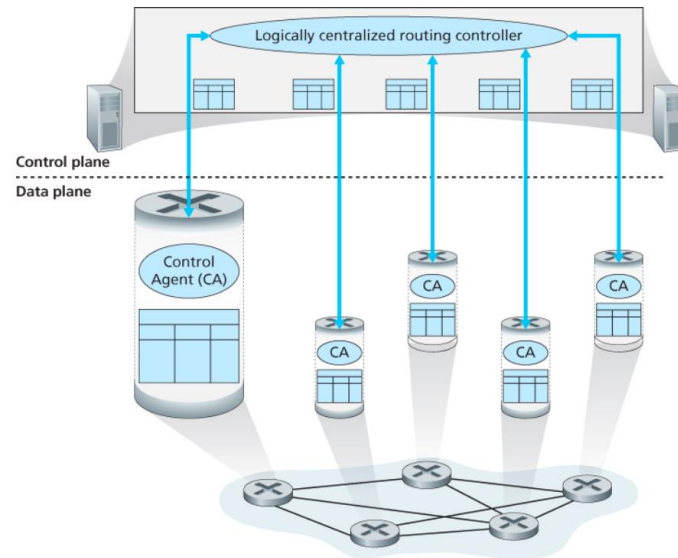
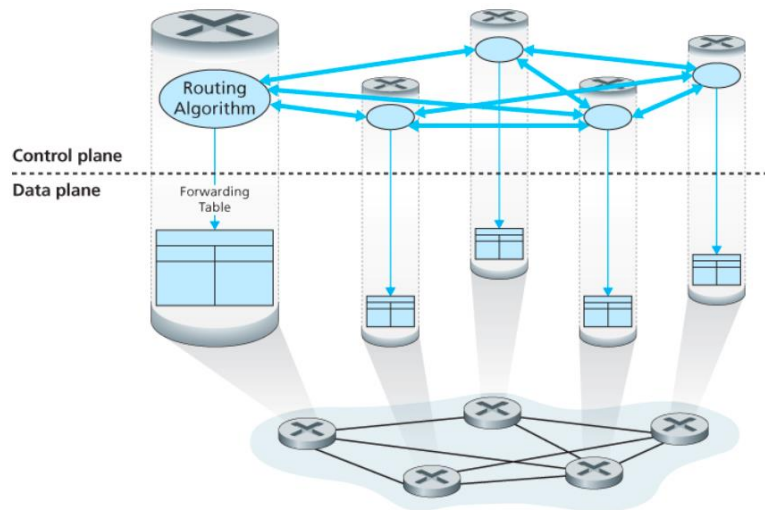
4-bit Version	4-bit Header Length	8-bit Type of Service (TOS)	16-bit Total Length (Bytes)	
16-bit Identification			3-bit Flags	13-bit Fragment Offset
8-bit Time to Live(TTL)		8-bit Protocol	16-bit Header Checksum	
32-bit Source IP Address				
32-bit Destination IP Address				
Options (if any)				
Payload				

20-by
head



5.1 Introduction

- Per-route control(라우터별 제어)
- Logically centralized control(논리적 중앙 집중형 제어)

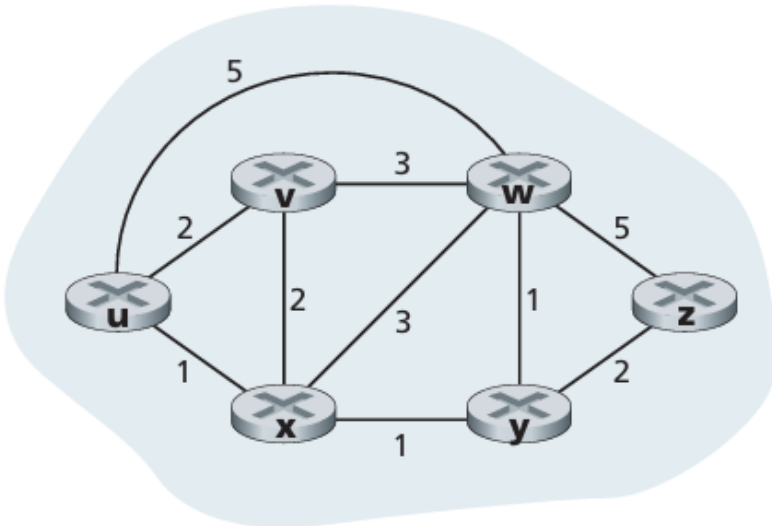


5.2 Routing Algorithms

centralized routing algorithm VS decentralized routing algorithm

static routing algorithm VS dynamic routing algorithm

load-sensitive algorithm VS load-insensitive algorithm



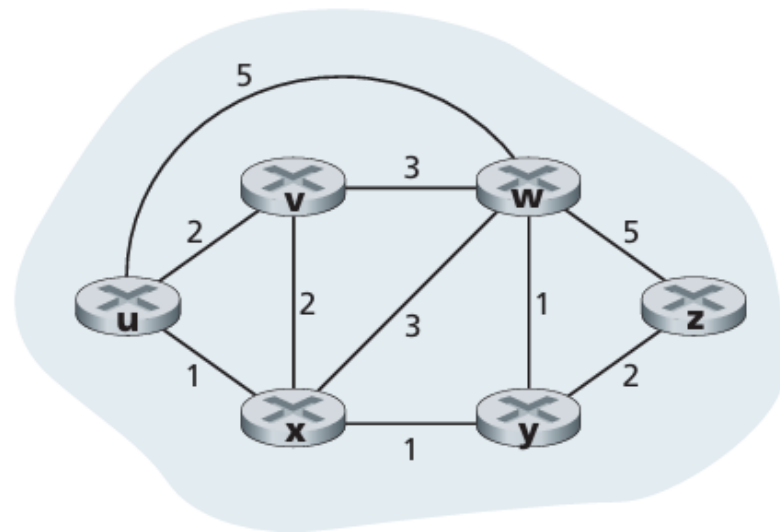
5.2 Routing Algorithms

centralized routing algorithm

- 다익스트라, OSPF

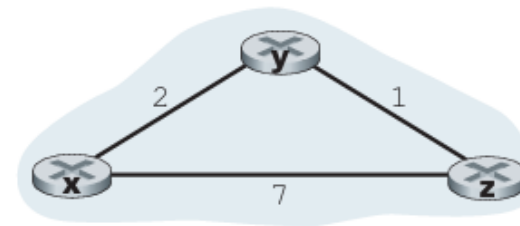
decentralized routing algorithm

- 거리 벡터, RIP
- 어느것이 성능이 좋을까? 가격은?



5.2 Routing Algorithms

- 거리 벡터 알고리즘(벨만 포드)
- 느린 다익스트라 $d_x(y) = \min_v \{ c(x, v) + d_v(y) \}$
- 간선 정보를 전부 알아야되지 않나?
- 물어본 정보를 사용한다
- 다른 간선간의 정보도 기억하나?
- 물어볼때 가져오나?



Node x table

		cost to		
		x	y	z
from	x	0	2	7
	y	∞	∞	∞
	z	∞	∞	∞

		cost to		
		x	y	z
from	x	0	2	3
	y	2	0	1
	z	7	1	0

		cost to		
		x	y	z
from	x	0	2	3
	y	2	0	1
	z	3	1	0

Node y table

		cost to		
		x	y	z
from	x	∞	∞	∞
	y	2	0	1
	z	∞	∞	∞

		cost to		
		x	y	z
from	x	0	2	7
	y	2	0	1
	z	7	1	0

		cost to		
		x	y	z
from	x	0	2	3
	y	2	0	1
	z	3	1	0

Node z table

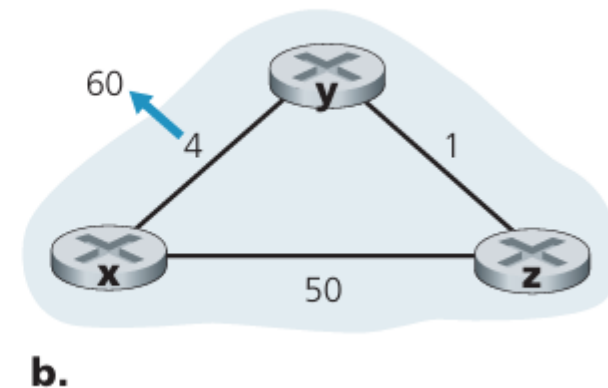
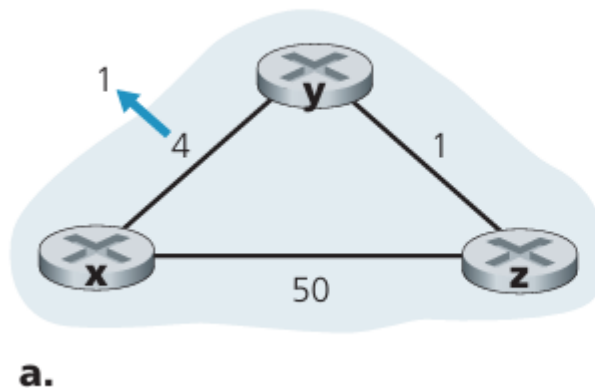
		cost to		
		x	y	z
from	x	∞	∞	∞
	y	∞	∞	∞
	z	7	1	0

		cost to		
		x	y	z
from	x	0	2	7
	y	2	0	1
	z	3	1	0

		cost to		
		x	y	z
from	x	0	2	3
	y	2	0	1
	z	3	1	0

5.2 Routing Algorithms

- 간선 정보가 바뀐다면...
- 변경된 거리벡터를 전파한다 (1)
- 변화가 없으면 전파하지 않는다 (2)
- 이웃한 노드에서 (1)-(2) 계속 실행

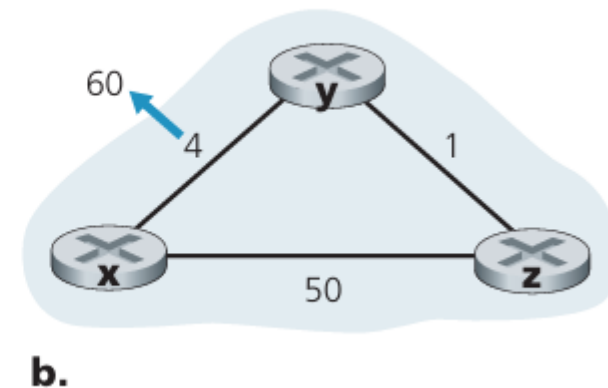
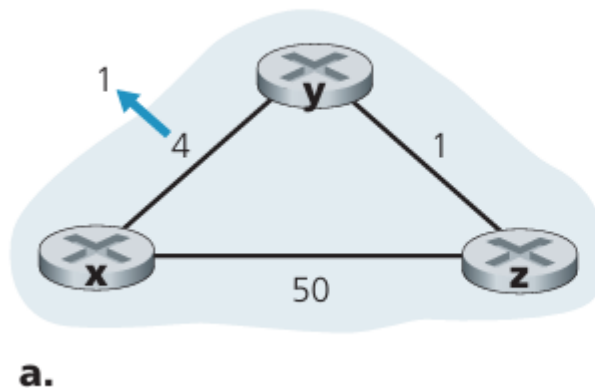


$$D_y(x) = \min \{ c(y,x) + D_x(x), c(y,z) + D_z(x) \} = \min \{ 60 + 0, 1 + 5 \} = 6$$

- 무한대 개수 문제

5.2 Routing Algorithms

- 간선 정보가 바뀐다면...
- 변경된 거리벡터를 전파한다 (1)
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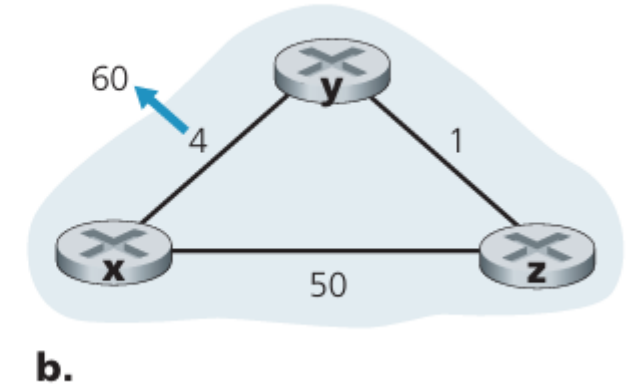
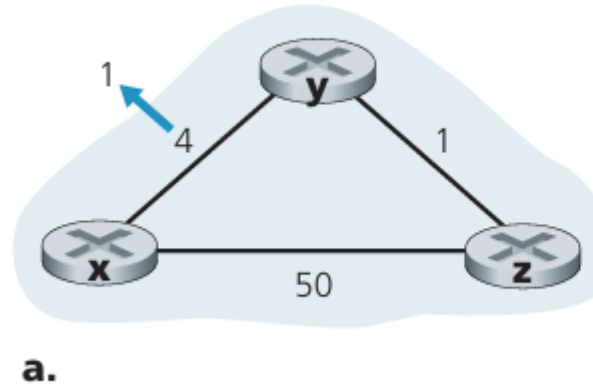


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- 무한대 개수 문제

5.2 Routing Algorithms

- 포이즌 리버스
- 나 무한대에요~~



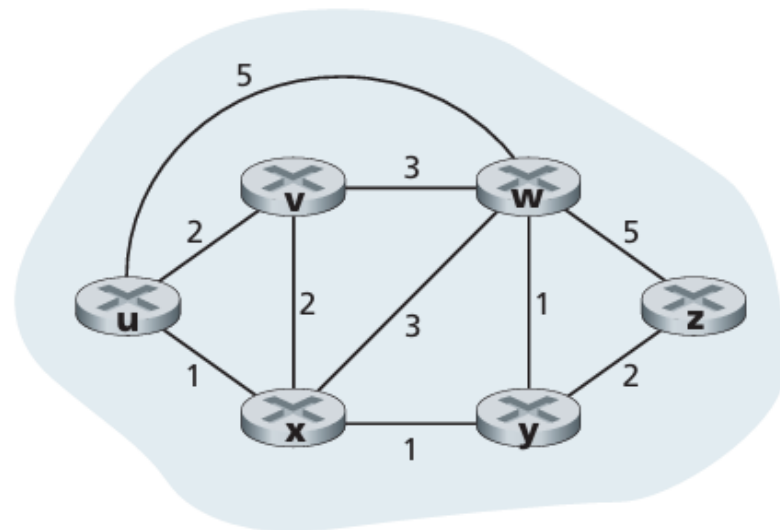
5.2 Routing Algorithms

static routing algorithm

- 직접 라우팅 정보를 관리, 가능한가?

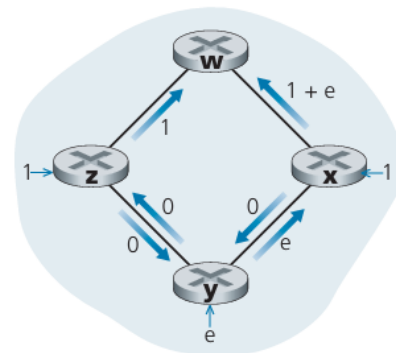
dynamic routing algorithm

- 비용을 시스템에게 말긴다
- 루프문제, 경로 진동

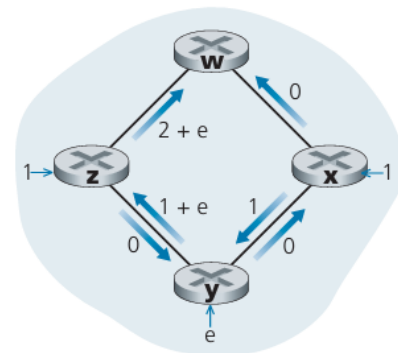


5.2 Routing Algorithms

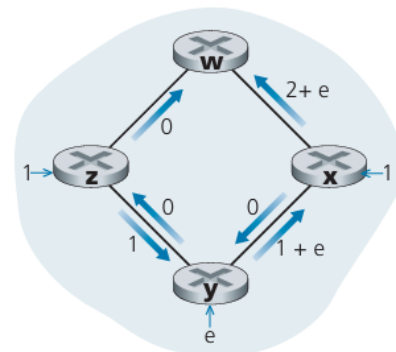
- 진동 문제
- 동시에 계산하지 못한다면?
- 네비게이션 고속도로, 시골
-



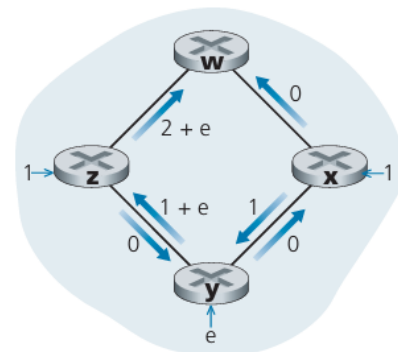
a. Initial routing



b. x, y detect better path to w, clockwise



c. x, y, z detect better path to w, counterclockwise



d. x, y, z, detect better path to w, clockwise

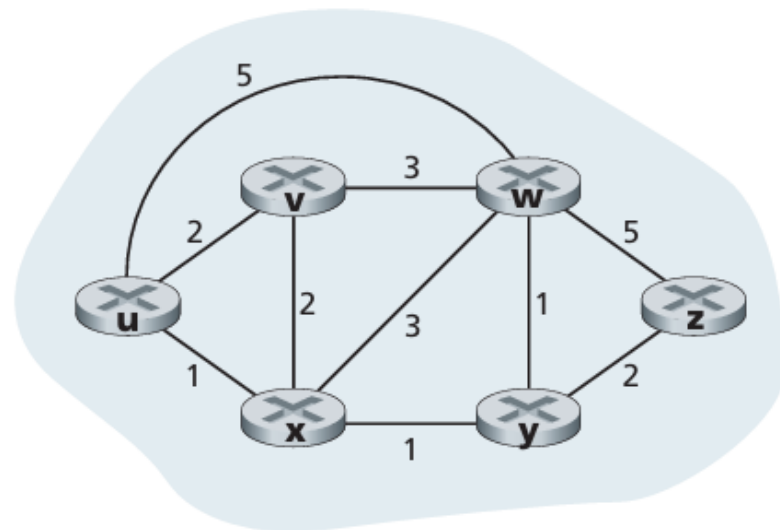
5.2 Routing Algorithms

load-sensitive algorithm

- 혼잡제어, ARPAnet

load-insensitive algorithm

- RIP OSPF BGP (Current)

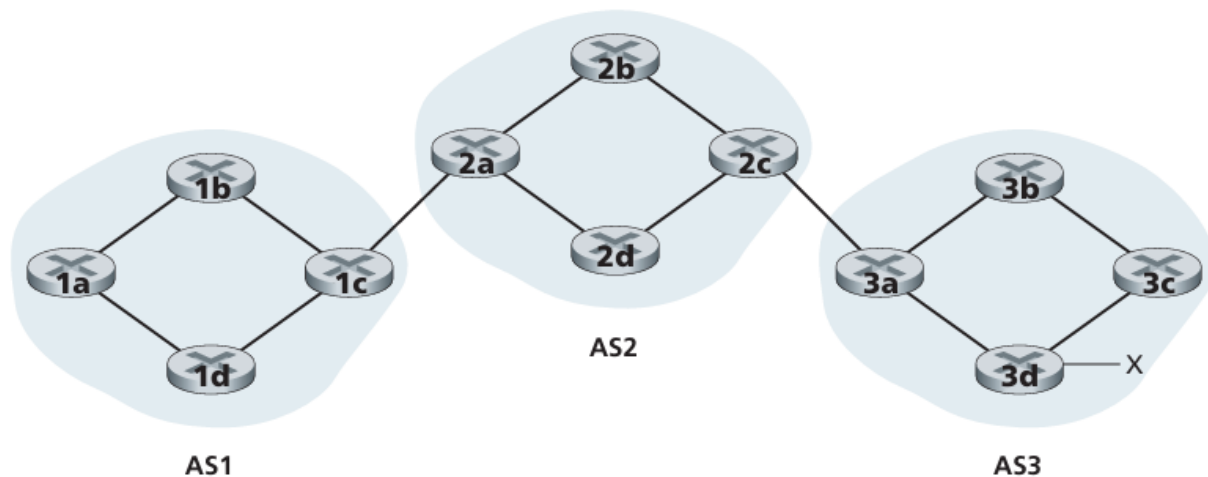


5.3 Intra-AS Routing in the Internet: OSPF

- ASs (autonomous system) ISP layer으로 생각해도 될까?
- OSPF (open shortest path first) 개방형 최단 경로 우선 프로토콜
- AS내의 다익스트라
- 중앙제어 or 분산제어

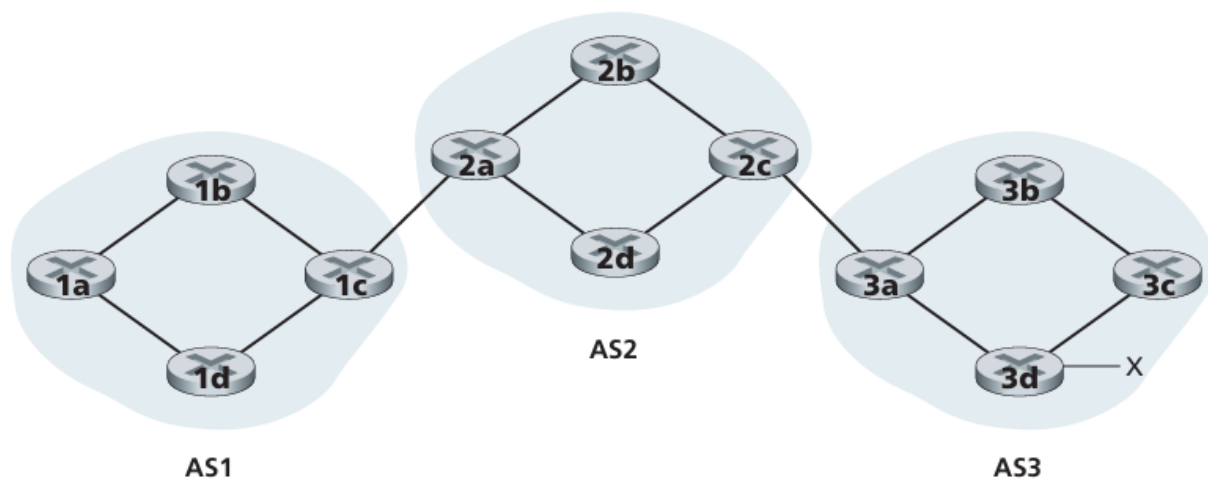
5.4 Routing Among the ISPs: BGP

- BGP (Border GateWay Protocol) 경계 게이트웨이 프로토콜
- As간의 라우팅
- CIDR, prefix
- Gateway router, Internal router



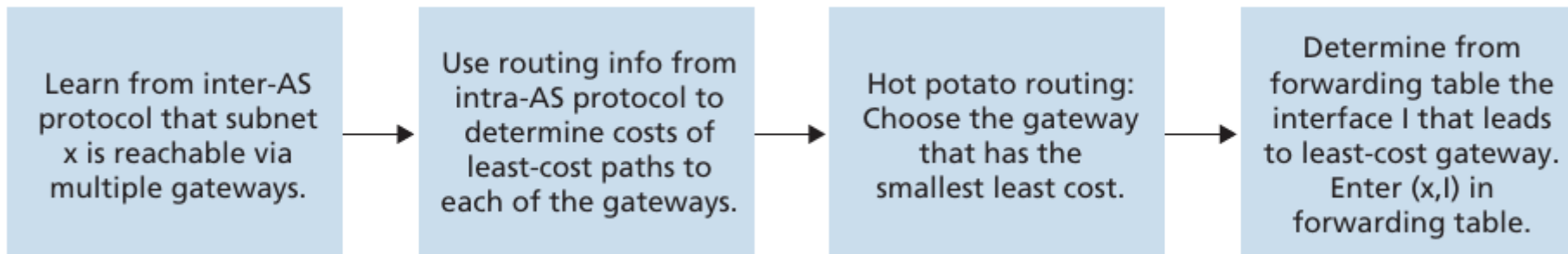
5.4 Routing Among the ISPs: BGP

- BGP Connection (TCP)
- External BGP, Internal BGP
- Internal BGP가 왜 필요하지?
- AS3 x -> AS2 AS3 x



5.4 Routing Among the ISPs: BGP

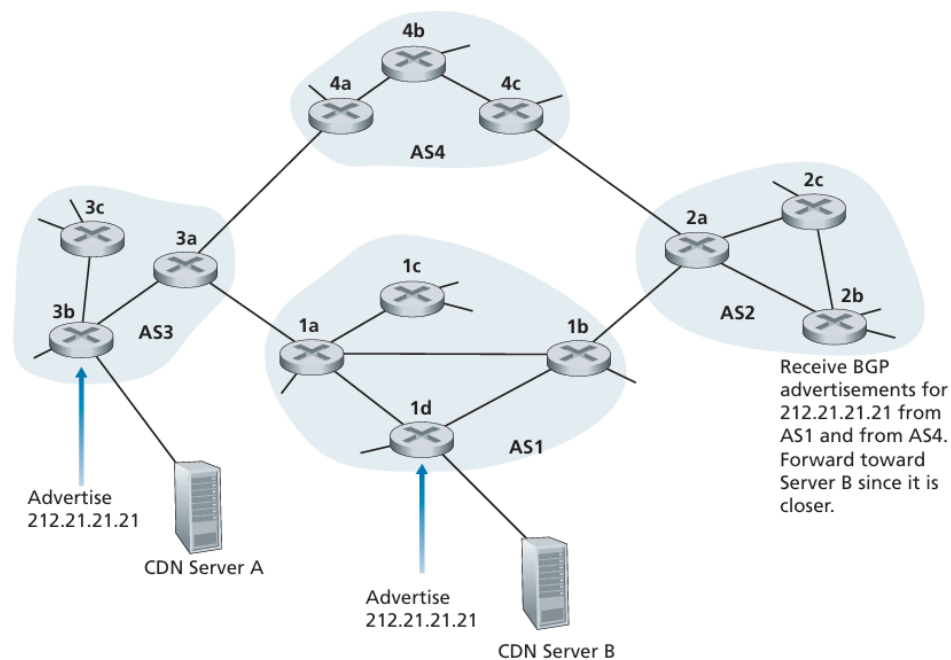
- AS-PATH
- NEXT-HOP
- Hot potato routing(local preference)



5.4 Routing Among the ISPs: BGP

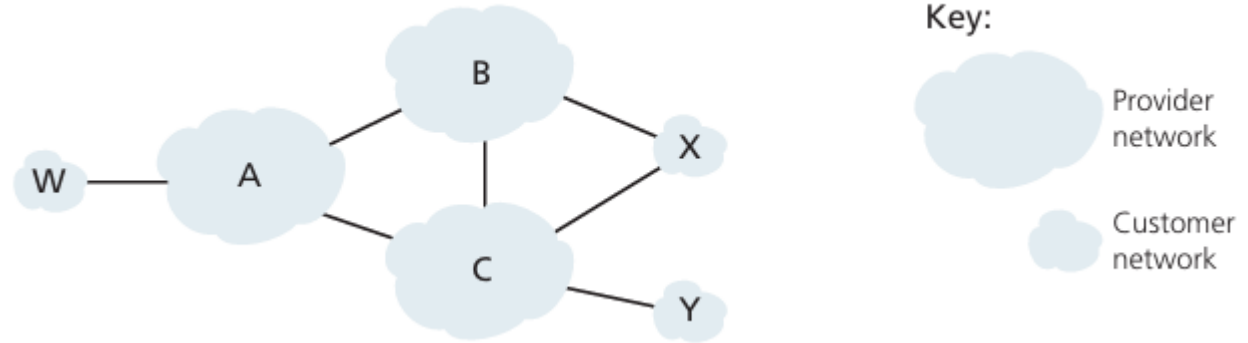
- Anycast
- CDN
- 같은 주소라는게...

종류	공인 IP의 범위	사설IP의 범위
A	1.0.0.0~9.255.255.255 11.0.0.0 ~ 126.255.255.255	10.0.0.0~10.255.255.255
B	128.0.0.0~172.15.255.255 172.32.0.0~191.255.255.255	172.16.0.0~172.31.255.255
C	192.0.0.0~192.167.255.255 192.169.0.0~223.255.255.255	192.168.0.0~192.168.255.255



5.4 Routing Among the ISPs: BGP

- AS 라우팅 정책
- W,X,Y: ISP
- A,B,C: backbone provider network
- X -> multi-homed access ISP
- A는 B,C에게 경로를 알리지 않는다?
- B는 C에게 WA를 알리지 않는다?



5.4 Routing Among the ISPs: BGP

- 1