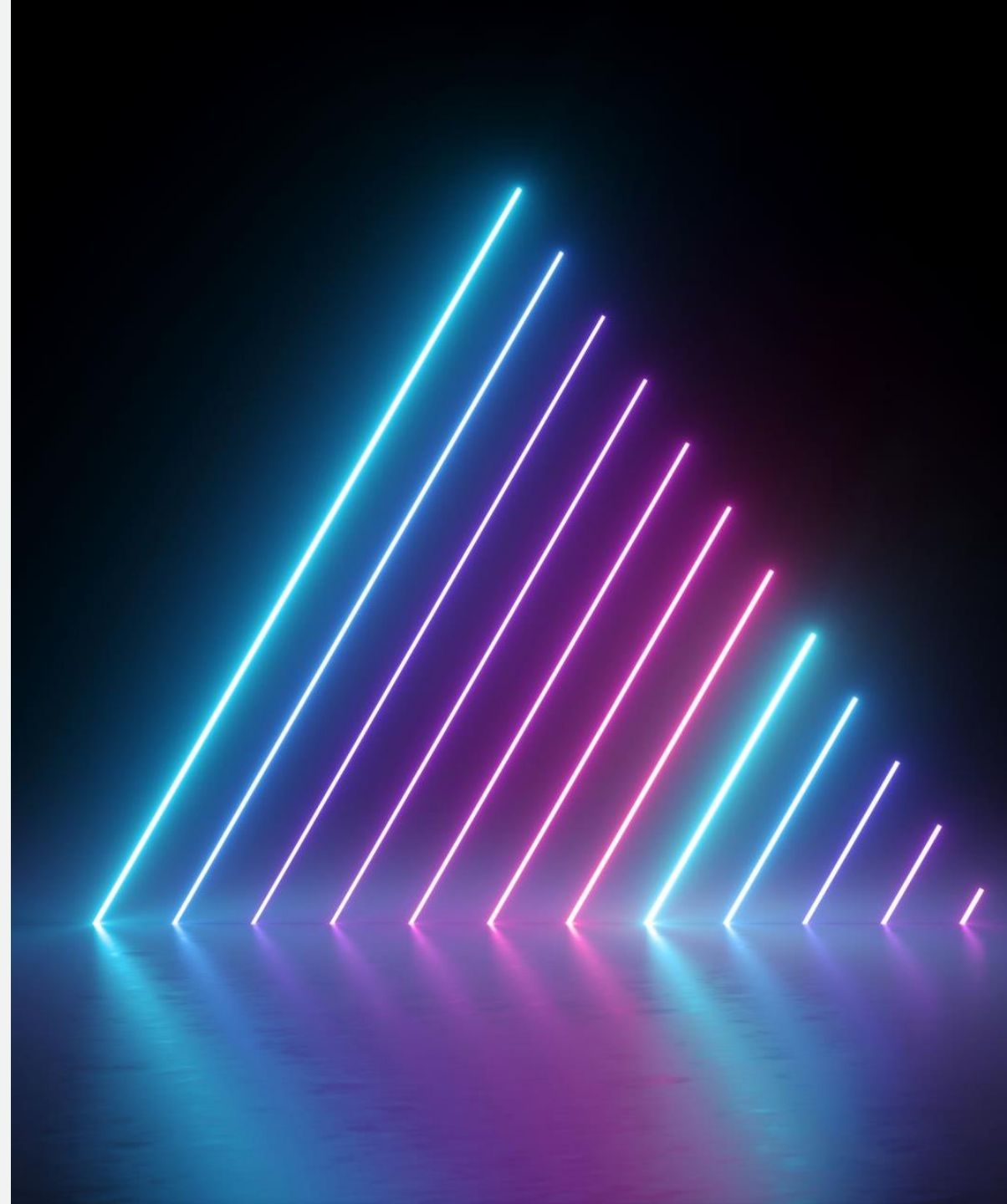




당신이 알아야 할 BGP 핵심 이야기

ChatGPT도 배우고 싶어하는 BGP

홀스홀리커



목차

-
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 2. BGP 프로토콜 동작
 3. ASN (Autonomous System Number)
 4. eBGP와 iBGP 비교
 5. iBGP issue
 6. BGP Attribute
 7. BGP 경로 선택 (Best Path Selection)
 8. Outbound Traffic 조정
 9. Inbound Traffic 조정
 10. Community 사용
 11. BGP Policy 적용
 12. BGP anycast
 13. BGP Hijacking
 14. BGP 보안
 15. Q&A
-

BGP란?

자율 시스템(AS) 간의 경로 정보를 교환하는 표준 외부 게이트웨이 프로토콜

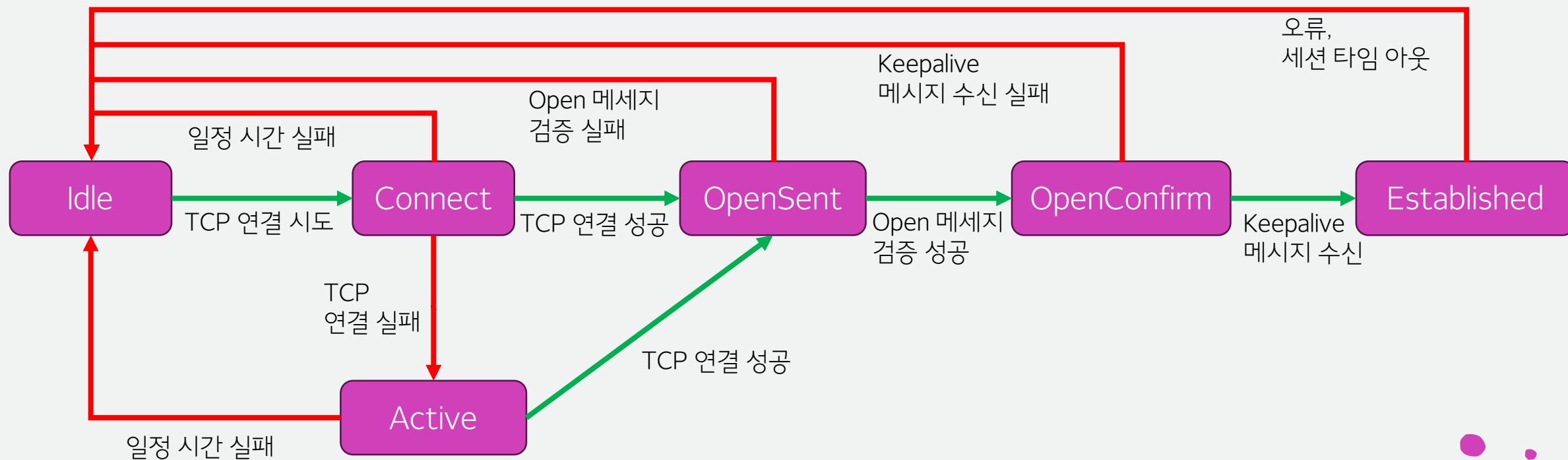
TCP Protocol (176)

Attribute (TLV Format)

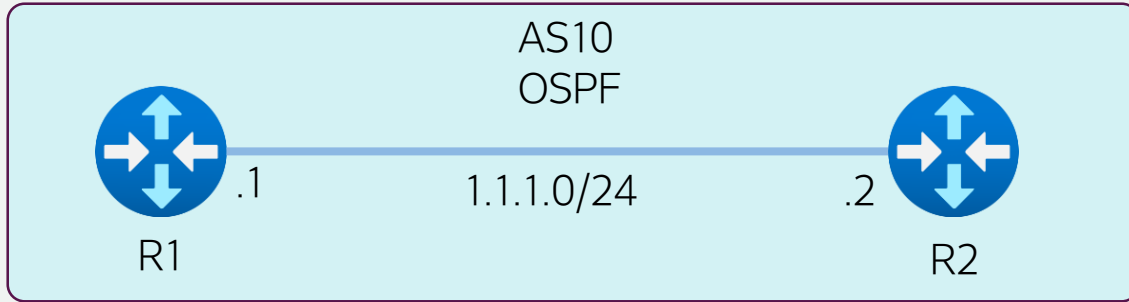
정책 기반 라우팅

Path Vector 방식

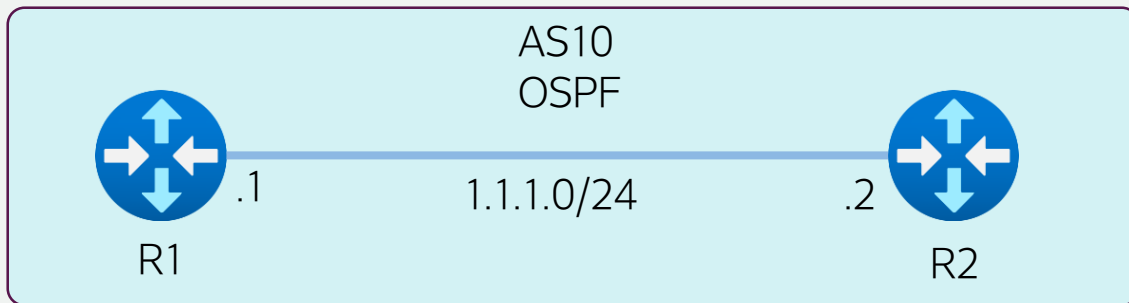
BGP 프로토콜 동작



BGP 프로토콜 동작



BGP 프로토콜 동작

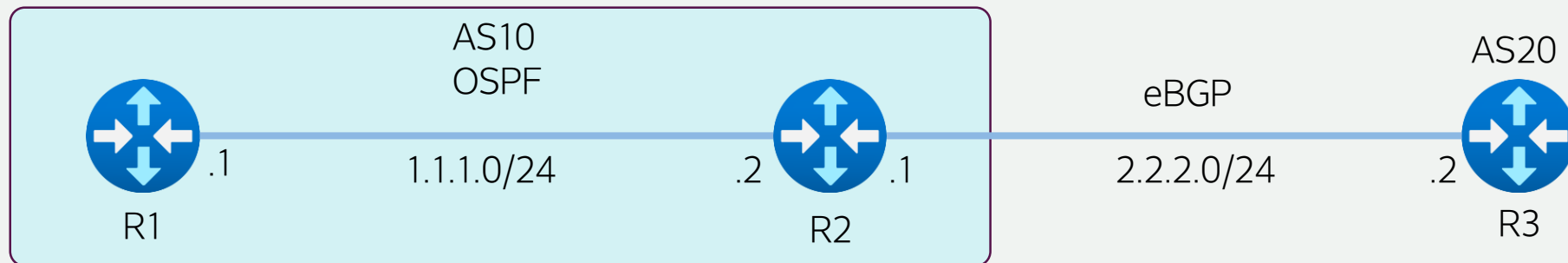


R2 장비

RIB (OSPF)		
10.0.0.0/24	1.1.1.1	
* 20.0.0.0/24	1.1.1.1	

RIB (routing table)		
S	10.0.0.0/24	1.1.1.1
O	20.0.0.0/24	1.1.1.1

BGP 프로토콜 동작



R2 장비

RIB (OSPF)		
	10.0.0.0/24	1.1.1.1
*	20.0.0.0/24	1.1.1.1

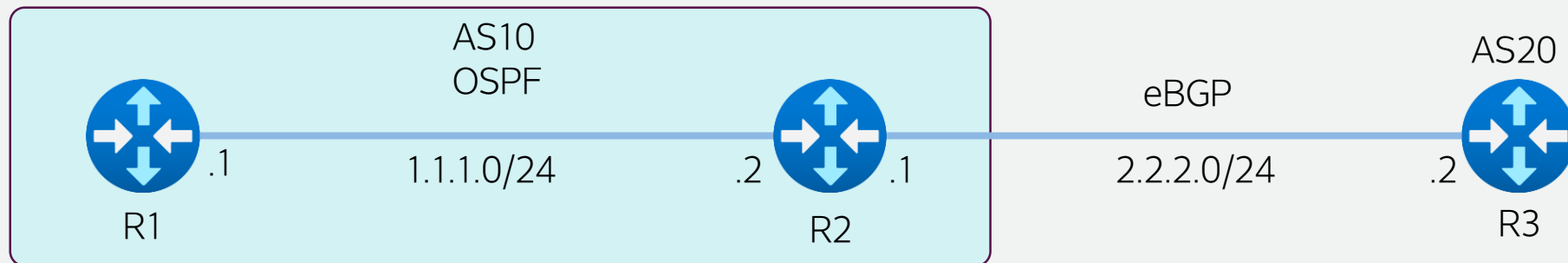
RIB (routing table)		
S	10.0.0.0/24	1.1.1.1
O	20.0.0.0/24	1.1.1.1

RIB (BGP)

R3 장비

RIB (BGP)

BGP 프로토콜 동작



R2 장비

RIB (OSPF)		
	10.0.0.0/24	1.1.1.1
*	20.0.0.0/24	1.1.1.1

RIB (routing table)		
S	10.0.0.0/24	1.1.1.1
O	20.0.0.0/24	1.1.1.1

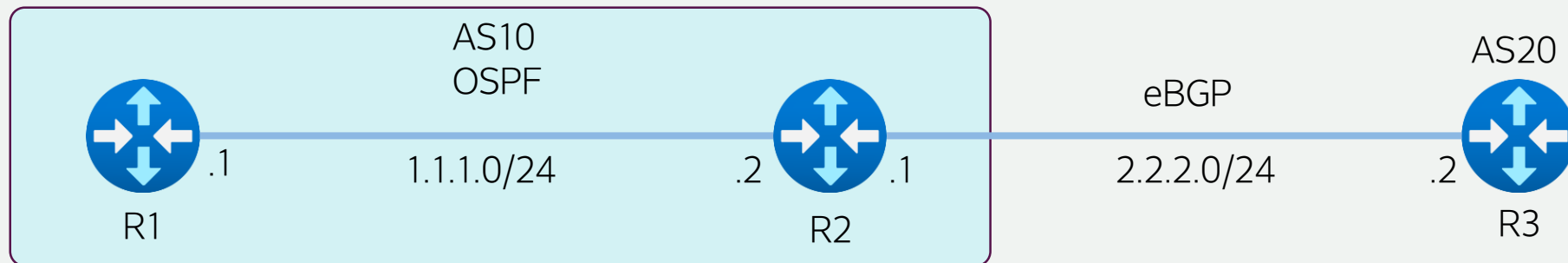
Network 명령어
network 10.0.0.0/24
network 20.0.0.0/24

RIB (BGP)		
	10.0.0.0/24	1.1.1.1
	20.0.0.0/24	1.1.1.1

R3 장비

RIB (BGP)		
	10.0.0.0/24	2.2.2.1
	20.0.0.0/24	2.2.2.1

BGP 프로토콜 동작



R2 장비

RIB (OSPF)		
	10.0.0.0/24	1.1.1.1
*	20.0.0.0/24	1.1.1.1

RIB (routing table)		
S	10.0.0.0/24	1.1.1.1
O	20.0.0.0/24	1.1.1.1

Redistribute OSPF

RIB (BGP)		
	20.0.0.0/24	1.1.1.1

R3 장비

RIB (BGP)		
	20.0.0.0/24	2.2.2.1

Autonomous System Number (ASN)

2Byte

- 0 ~ 65535
- 단일 숫자 형식 표기 : AS1, AS65000
- Private AS : 64512 ~ 65534

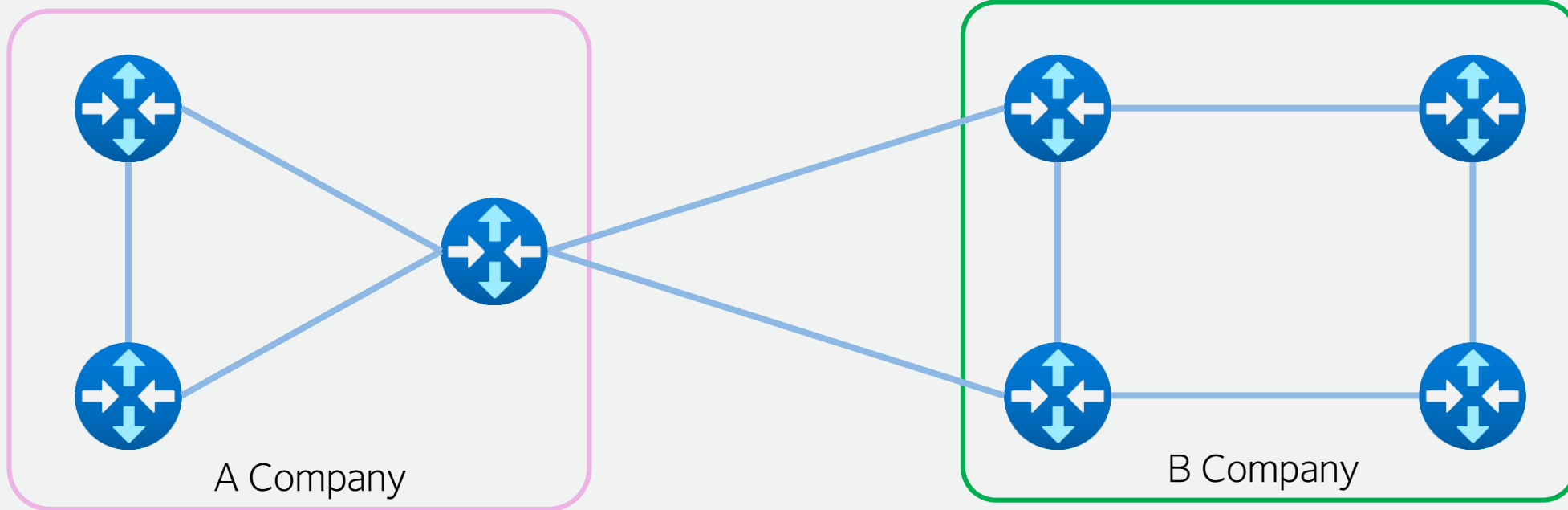
확장 4Byte

- 0 ~ 4,294,967,295
- 단일 숫자 / 점 형식 : AS1, AS222 / A1.0, A65535.65535
- Private AS : 4200000000 ~ 4294967294

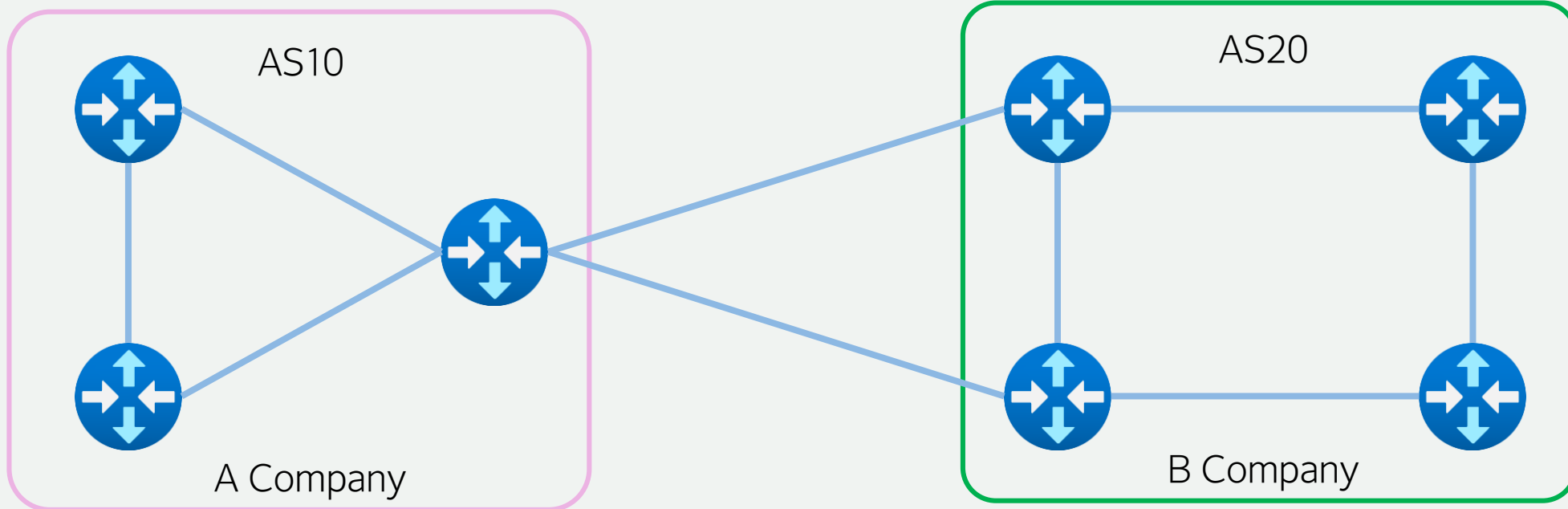
AS_TRANS

- 4Byte 번호를 2Byte로 변환할 때, 충돌을 피하기 위한 특수 AS번호
- AS23456 을 사용

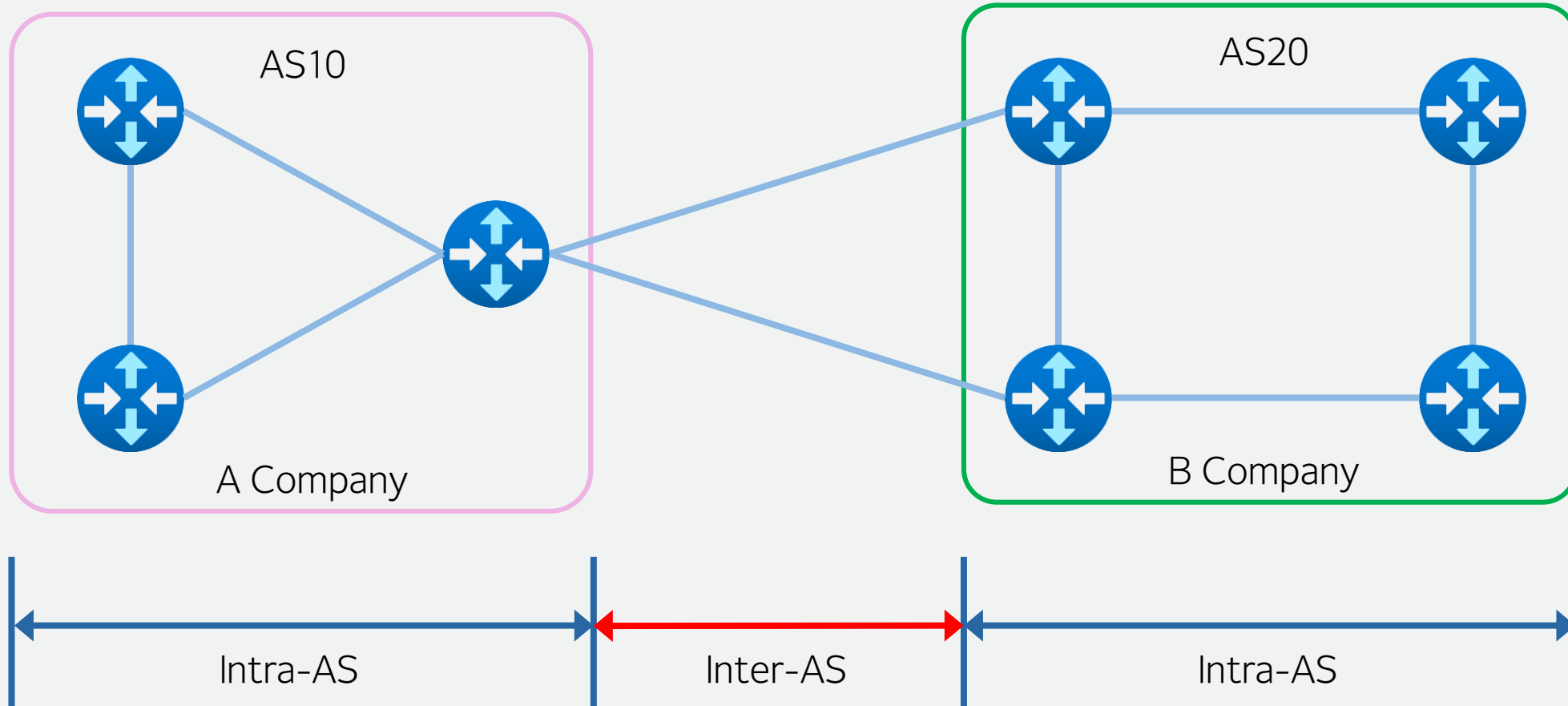
Autonomous System(AS)



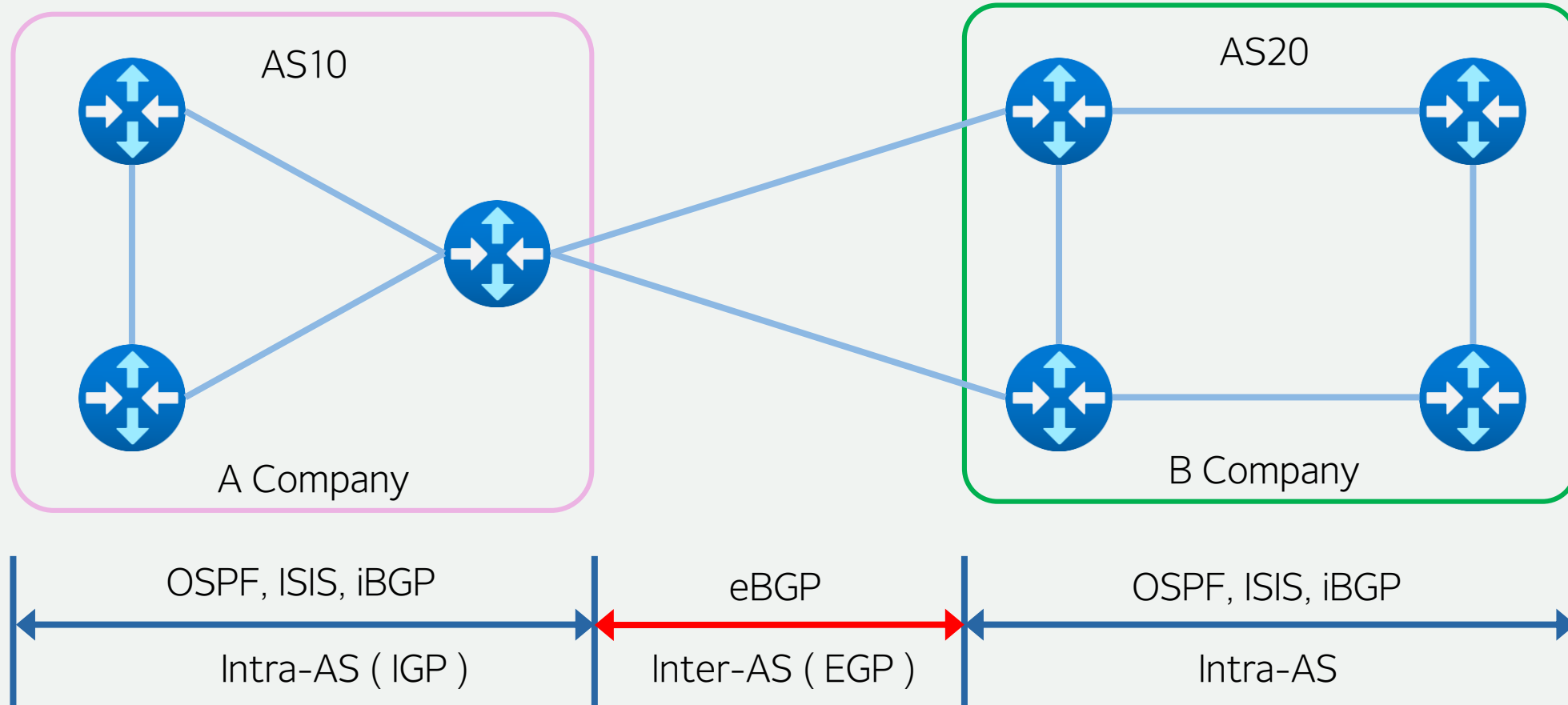
Autonomous System(AS)



Autonomous System(AS)



Autonomous System(AS)



eBGP와 iBGP 비교

	eBGP	iBGP
Scope	Different AS	Same AS
TTL	Default 1	Default 255
loop prevention	AS PATH	Split-horizon
next-hop	Change	Unchange
AS-PATH	Add	Not add
Local preference	Not sent	Sent
AD	20 (cisco)	200 (cisco)

iBGP issue

Synchronization

- iBGP로 광고 받은 네트워크는 IGP가 확인해 주어야 한다.

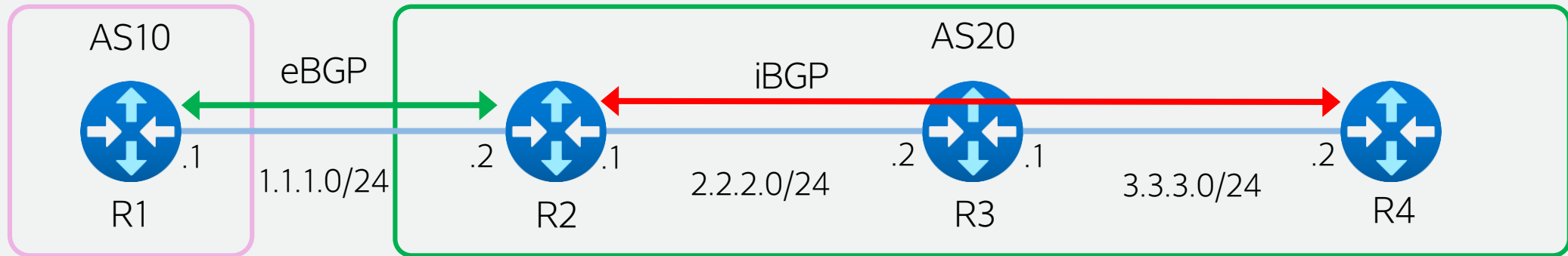
Next-hop

- BGP 장비 사이에 BGP가 동작하지 않는 장비가 있을 경우 블랙홀이 될 수 있다.

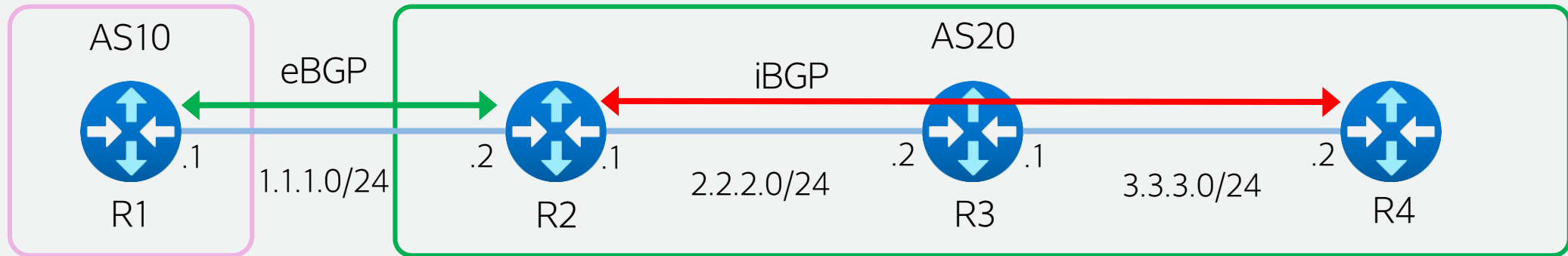
Split-horizon

- iBGP에서 광고 받은 정보는 iBGP로 전달하지 못한다.

iBGP issue - synchronization



iBGP issue - synchronization

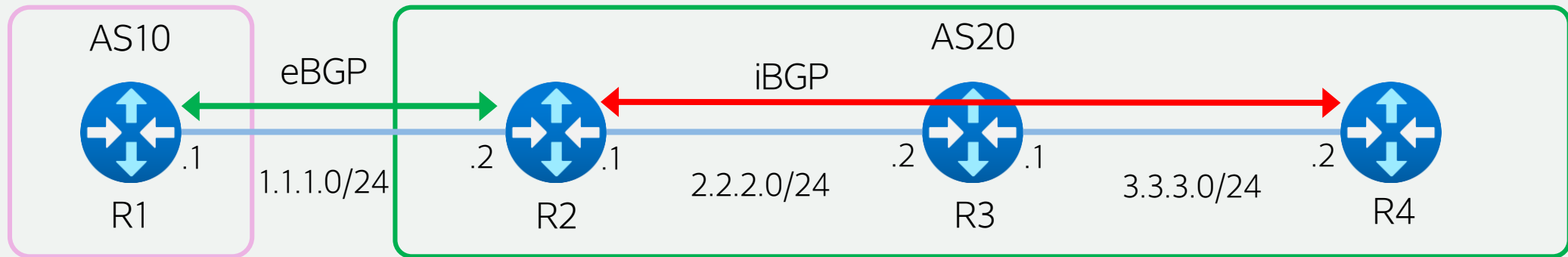


Network	Next-hop
3.3.3.0/24	2.2.2.2

Network	Next-hop
1.1.1.0/24	2.2.2.1

Network	Next-hop
1.1.1.0/24	3.3.3.1

iBGP issue - synchronization



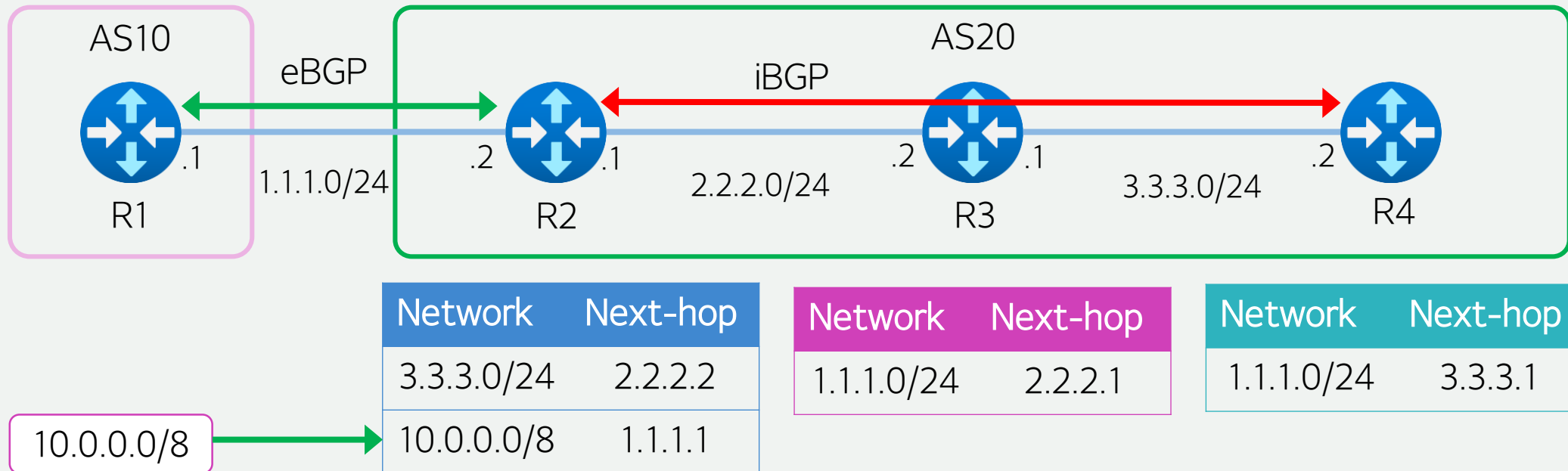
Network	Next-hop
3.3.3.0/24	2.2.2.2

Network	Next-hop
1.1.1.0/24	2.2.2.1

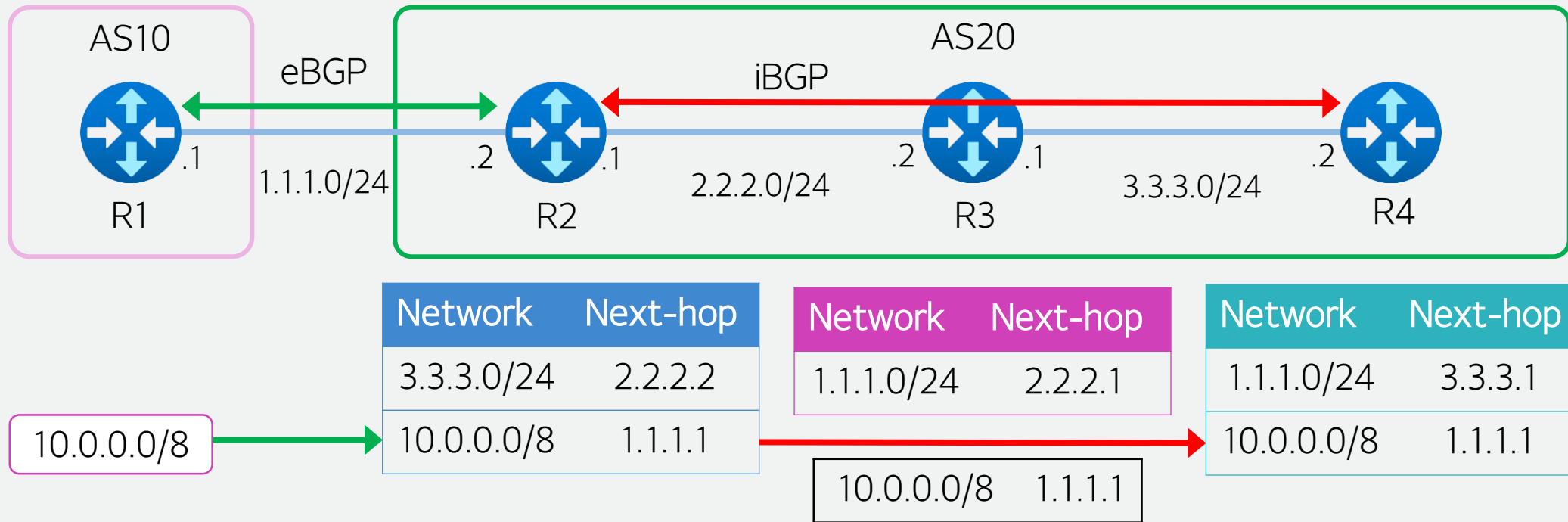
Network	Next-hop
1.1.1.0/24	3.3.3.1

10.0.0.0/8 →

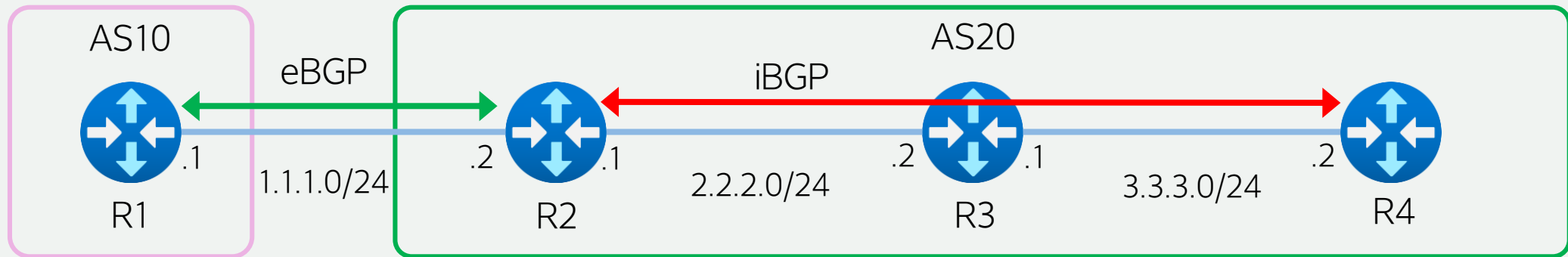
iBGP issue - synchronization



iBGP issue - synchronization



iBGP issue - synchronization



Network	Next-hop
3.3.3.0/24	2.2.2.2
10.0.0.0/8	1.1.1.1

Network	Next-hop
1.1.1.0/24	2.2.2.1

Network	Next-hop
1.1.1.0/24	3.3.3.1
10.0.0.0/8	1.1.1.1



Ping 10.0.0.1

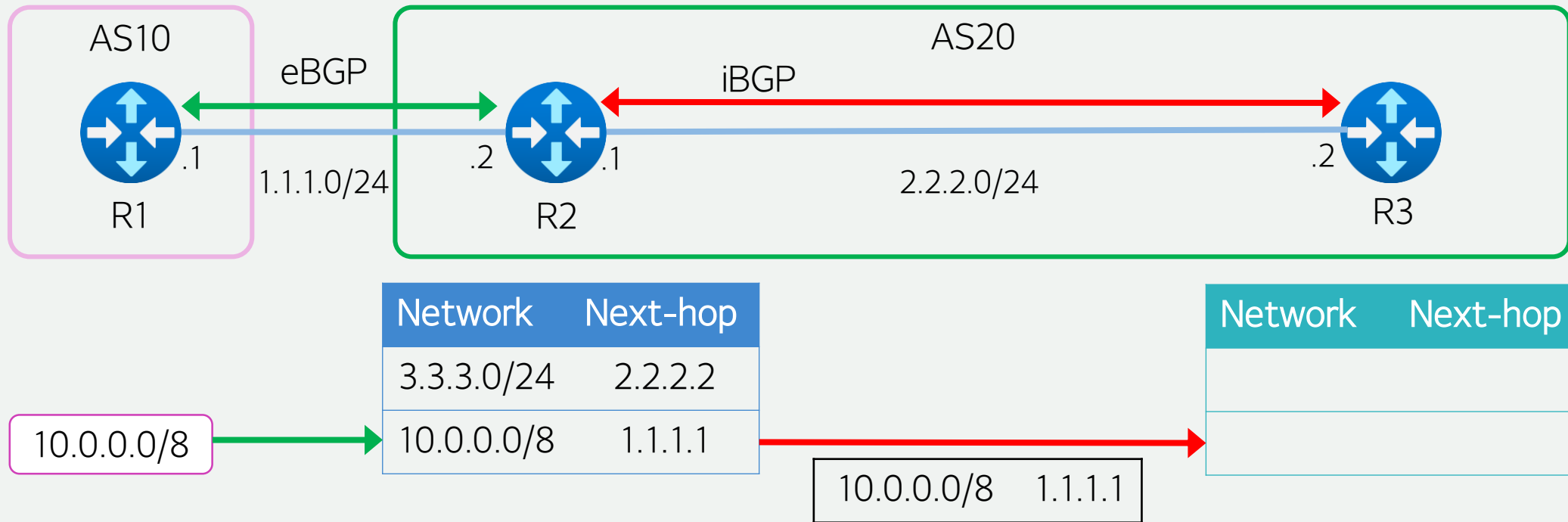
iBGP issue – synchronization

모든 장비에서 BGP가 동작할 경우 no synchronization을 입력

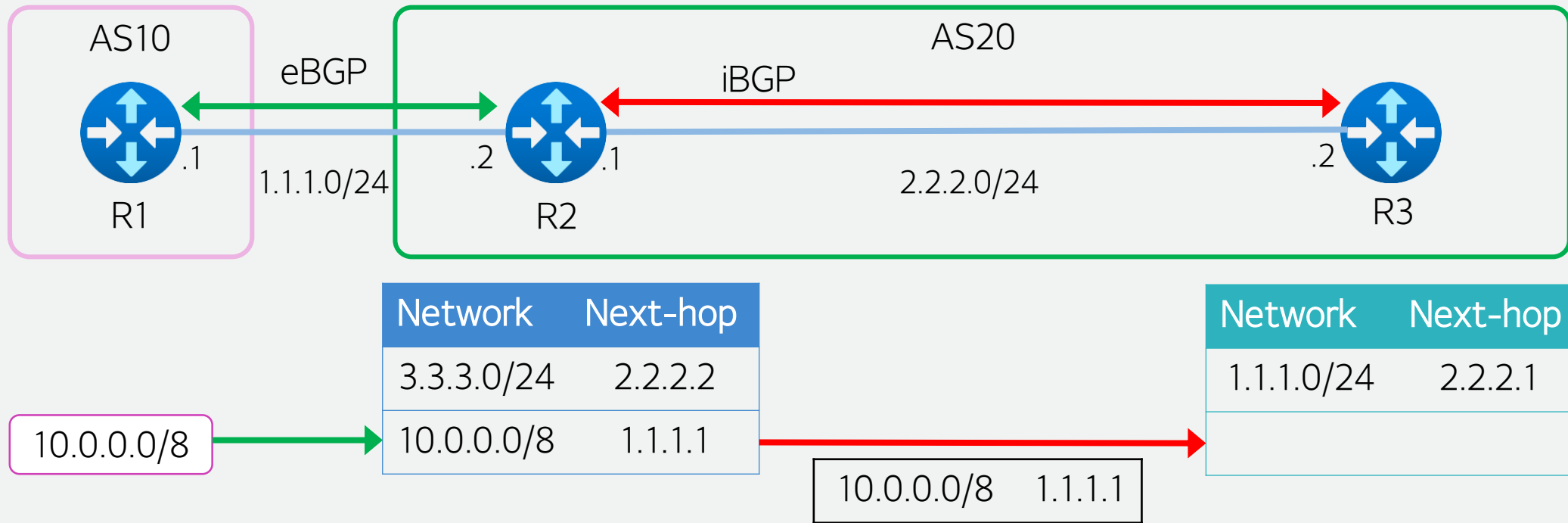
BGP 정보를 IGP에 재분배

Confederation 구성

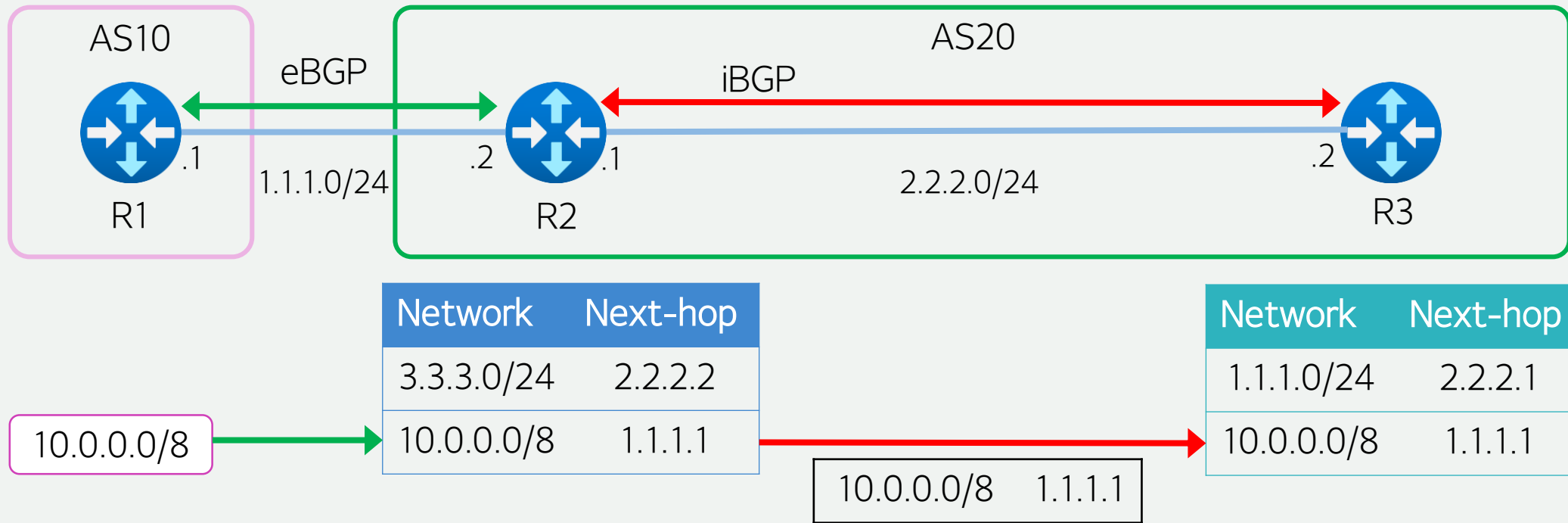
iBGP issue – Next-hop



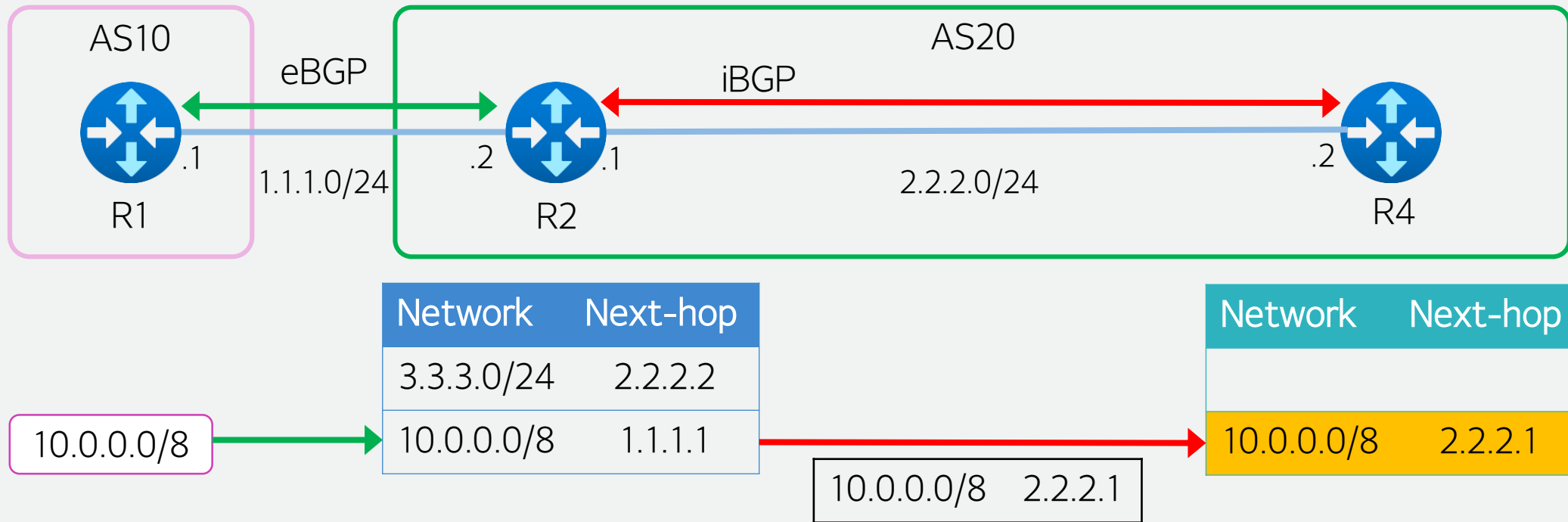
iBGP issue - Next-hop (IGP 재분배)



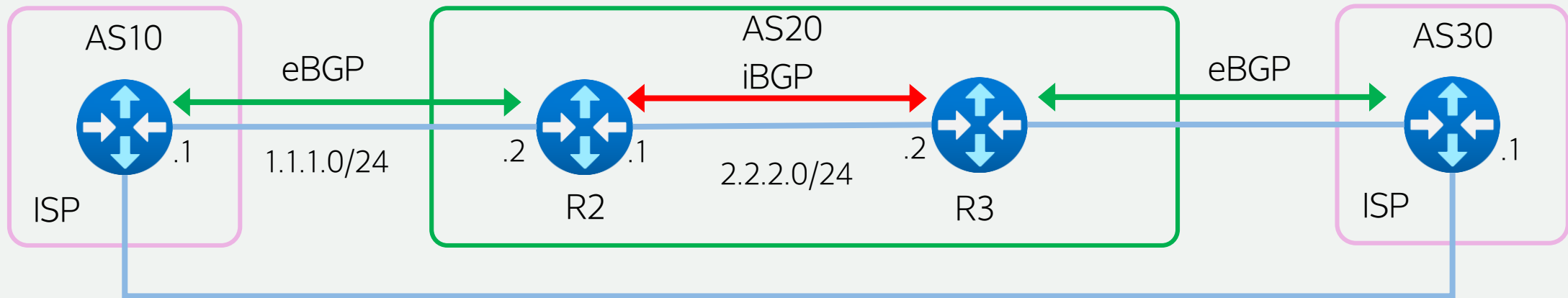
iBGP issue - Next-hop (IGP 재분배)



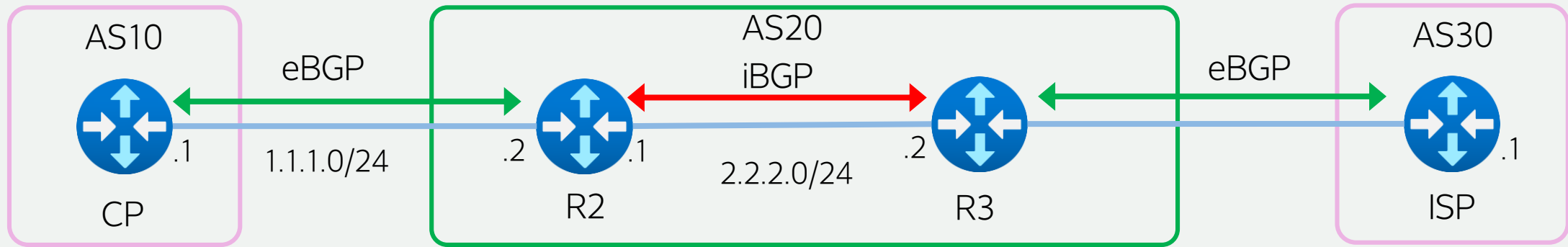
iBGP issue – Next-hop (Next-hop-self)



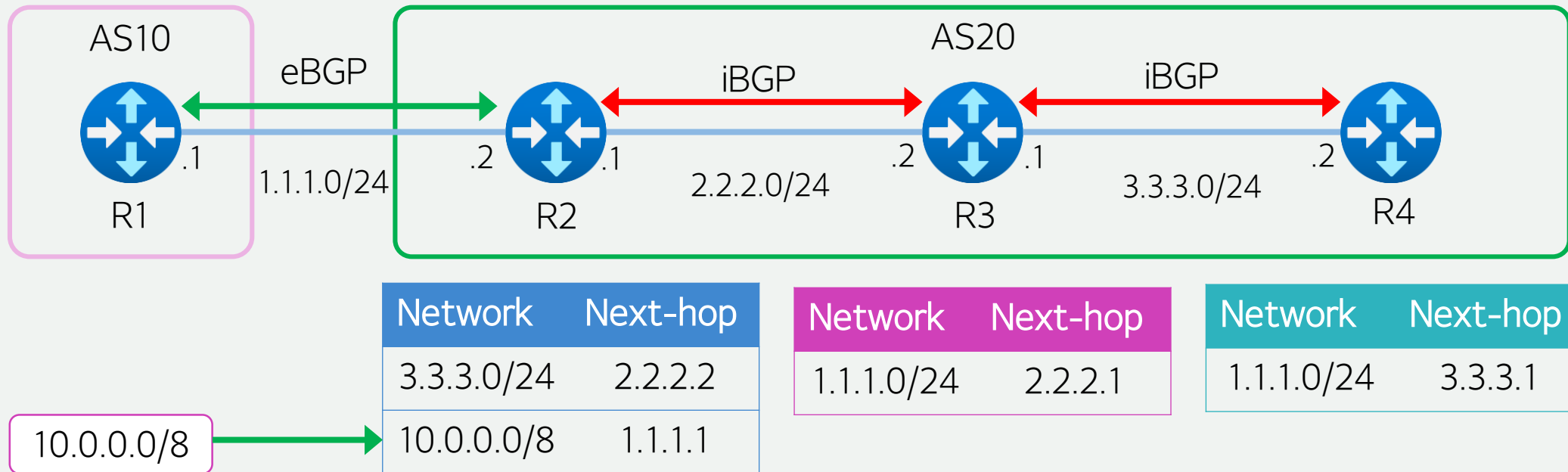
iBGP issue – Next-hop (Next-hop-self)



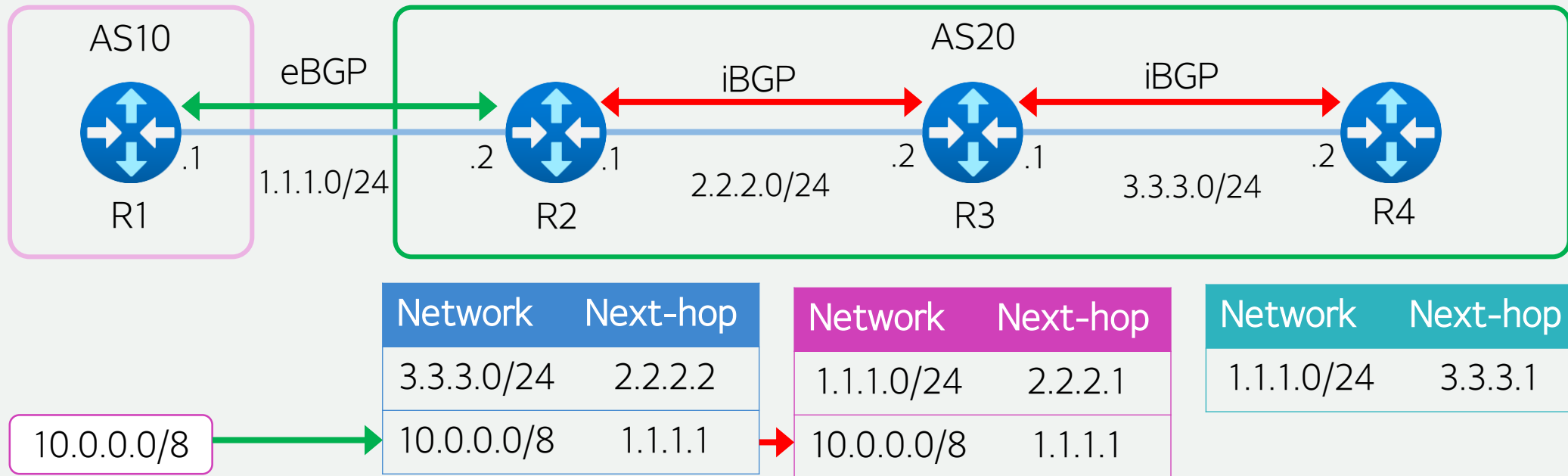
iBGP issue – Next-hop (Next-hop-self)



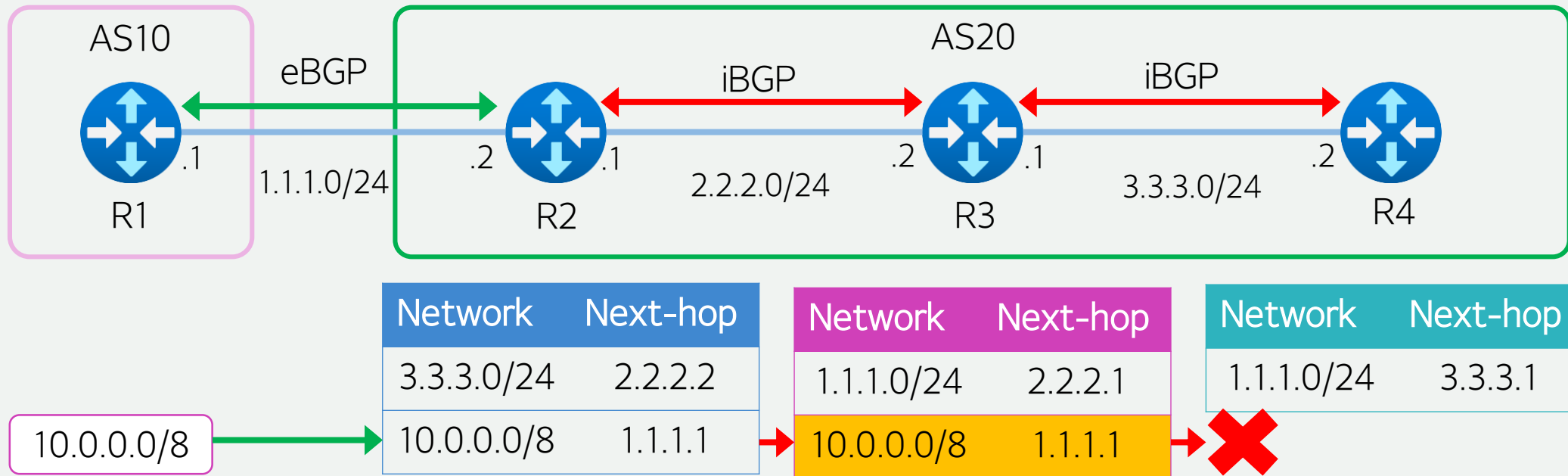
iBGP issue – split-horizon



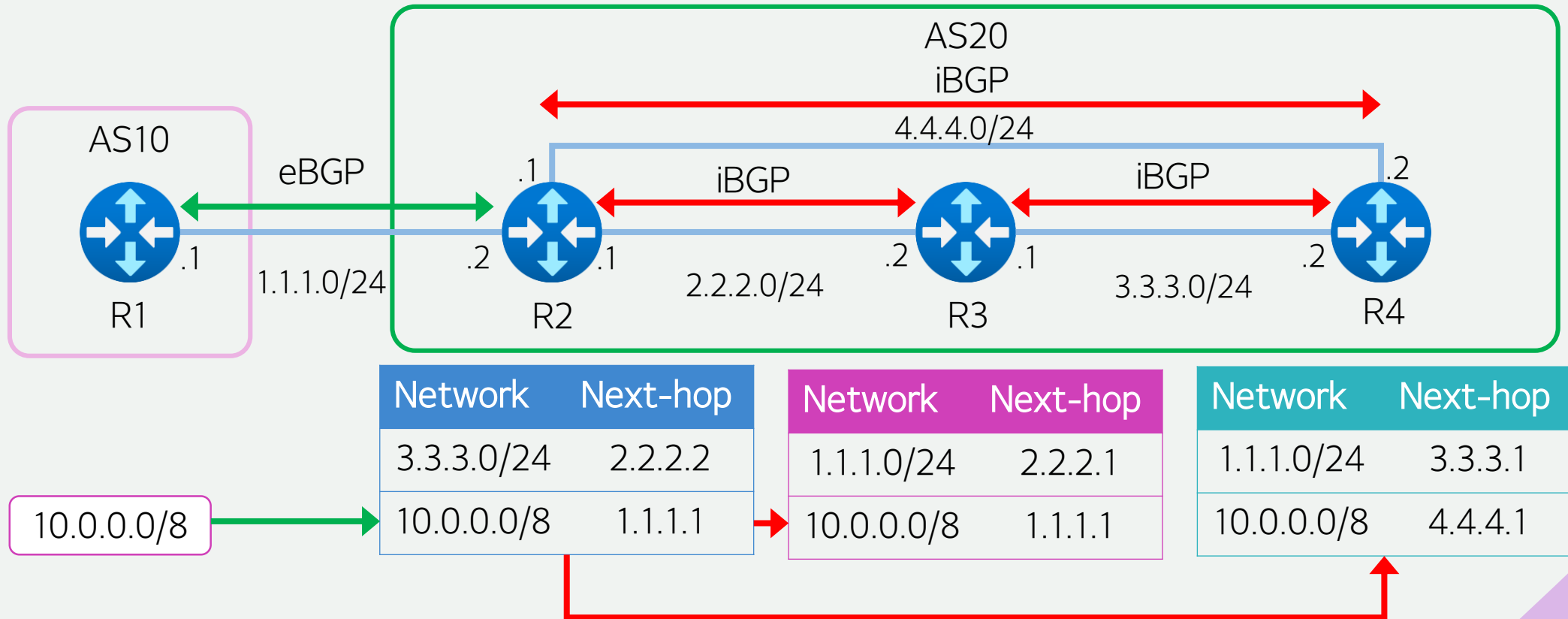
iBGP issue – split-horizon



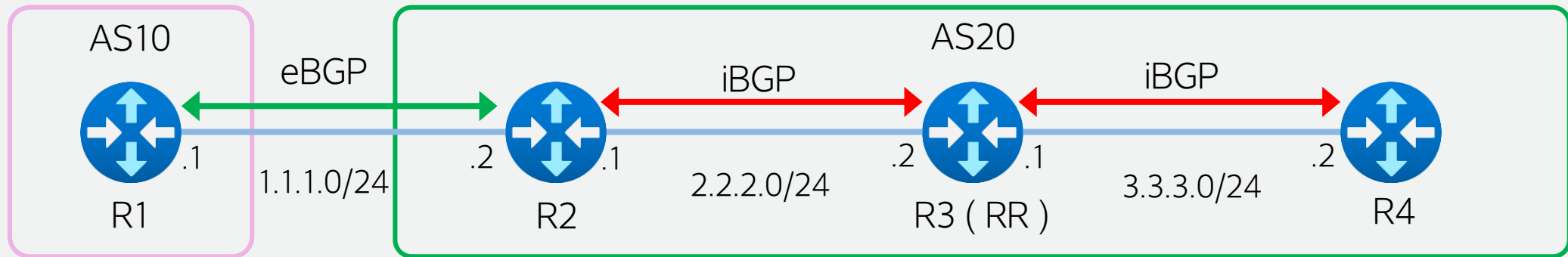
iBGP issue – split-horizon



iBGP issue – split-horizon (full mesh)

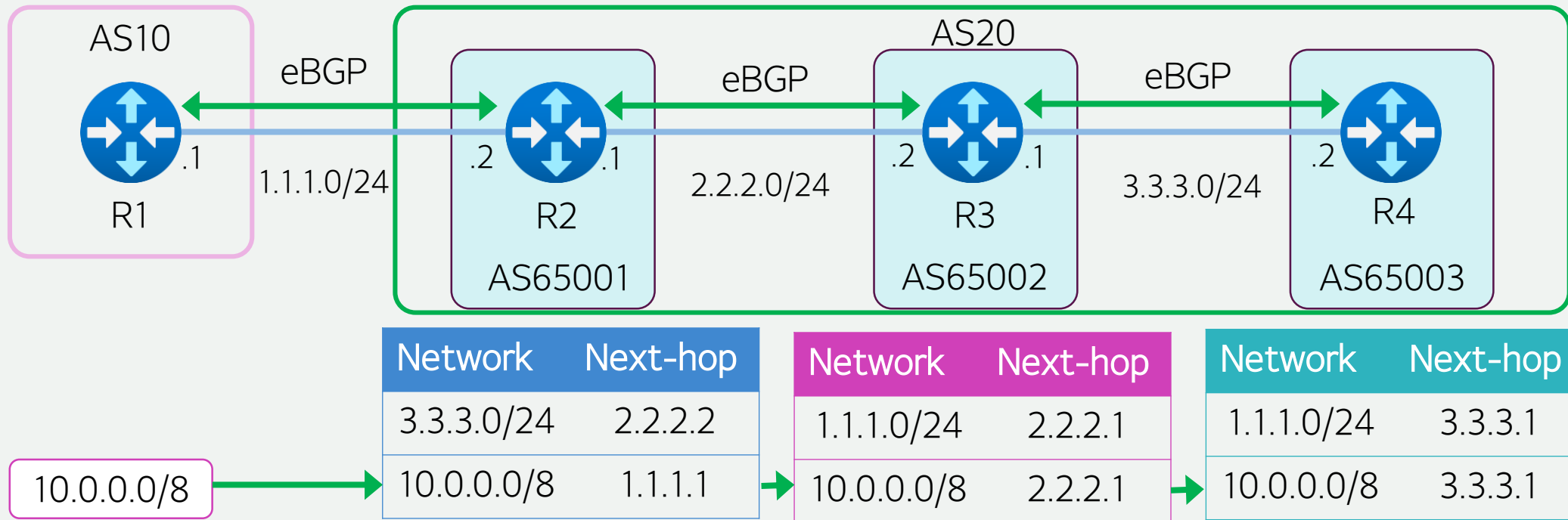


iBGP issue – split-horizon (Route Reflector)



Network	Next-hop	Network	Next-hop	Network	Next-hop
3.3.3.0/24	2.2.2.2	1.1.1.0/24	2.2.2.1	1.1.1.0/24	3.3.3.1
10.0.0.0/8	1.1.1.1	10.0.0.0/8	1.1.1.1	10.0.0.0/8	1.1.1.1

iBGP issue – split-horizon (Confederation)



BGP Attribute

Well-known : BGP Router가 지원해야 할 속성

- Mandatory : BGP Routing 정보에 반드시 포함
- Discretionary : BGP Routing 정보에 반드시 포함될 필요 없음

Optional : BGP Router가 지원 안 해도 되는 속성

- Transitive : 장비가 지원을 안 하면, Flag P 설정 후 피어에게 전달
- Non-transitive : 장비가 지원을 안 하면, 무시 및 전달 하지 않음

BGP Attribute – Mandatory

Origin : 경로 정보의 출처를 정의

- IGP (i) : network 명령어를 사용해서 BGP에 포함된 경로
- EGP (e) : EGP Protocol routing으로 BGP에 포함된 경로
- Incomplete (?) : IGP/EGP가 아닌 경로, 보통 Redistribute으로 BGP에 포함된 경로

AS-PATH : Network 대역까지 가는 경로 상의 ASN 정보들

Next-hop : Network 대역으로 가기 위한 IP Address

BGP Attribute – Discretionary

Local Preference : Outbound 경로를 조정하기 위한 값

- 높은 값이 우선순위
- 같은 AS안에서만 전파되고 다른 AS로는 전파되지 않음

Atomic Aggregate : 축약에 대한 정보 표시

- 축약으로 인해 원래 가지고 있던 AS Path가 없어졌을 수도 있음을 표시

BGP Attribute - Transitive

Aggregator : 축약 된 Network 정보

- 축약 된 AS 번호와 Router-id로 표시

Community : 특정 Network 정보들을 그룹화

- 숫자 (1 ~ 4,294,967,295) or ASN:NN (NN = community number)
- Well-known Community
 - no-advertise : 수신 받은 라우터가 다른 라우터에 전파하지 않음
 - no-export : 수신 받은 AS외에 다른 AS로 전파하지 않음
 - Local-AS : 특정 서브 AS외에 다른 AS로 전파하지 않음

BGP Attribute – Non-Transitive

MED : Inbound 경로를 조정하기 위한 값

- 낮은 값이 우선
- eBGP에서는 MED값 변경
 - iBGP에서 받은 MED값은 무시하고 전송하지 않음
 - 자신이 포함시킨 네트워크는 IGP의 metric값으로 전송
- route-map을 통해 MED값 조정 가능

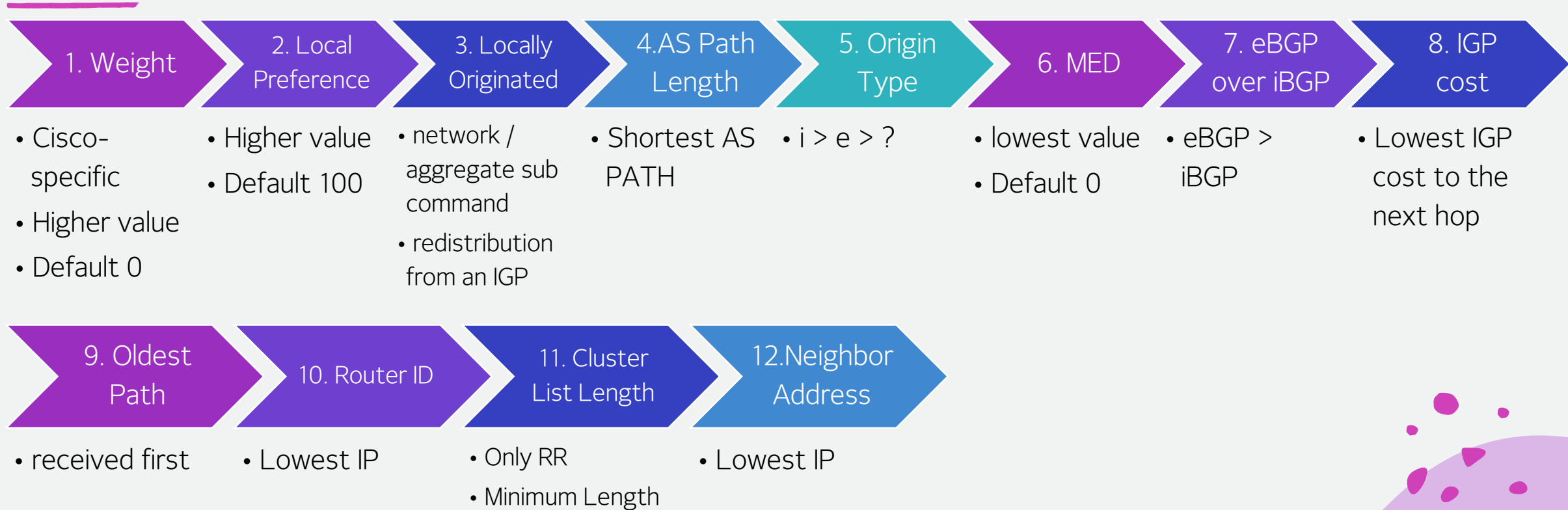
Originator ID : Network를 BGP에 전파한 라우터 ID

- 동일 Router Reflect Cluster에서 Routing loop를 방지하기 위한 값

Cluster List : Cluster ID를 모아둔 정보

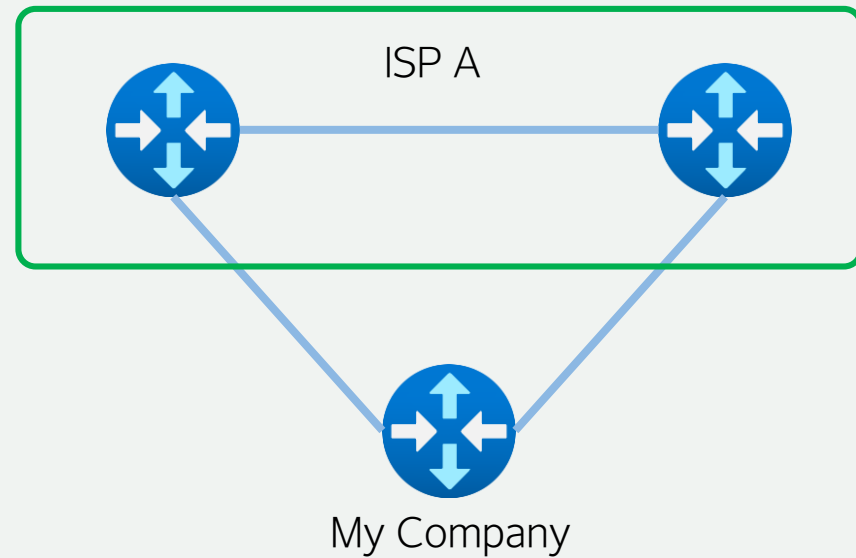
- 다수의 Router Reflect cluster에서 Routing loop를 방지하기 위한 값

BGP 경로 선택 (Best Path Selection)

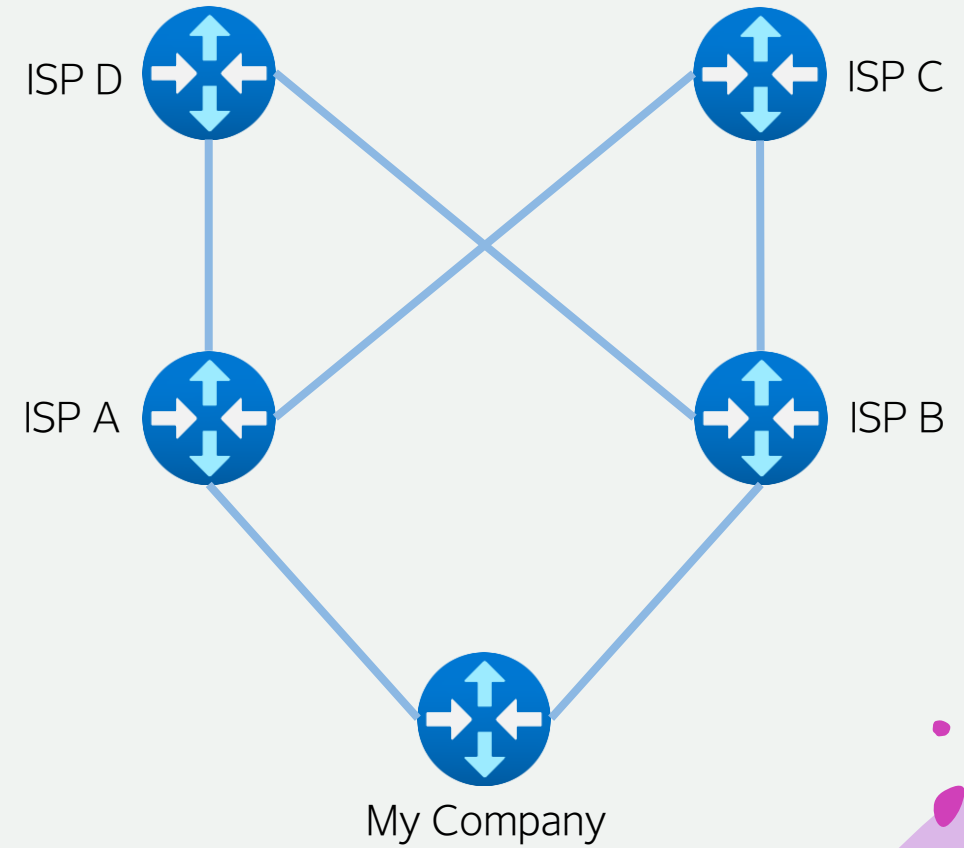


BGP 경로 선택 (Multipath)

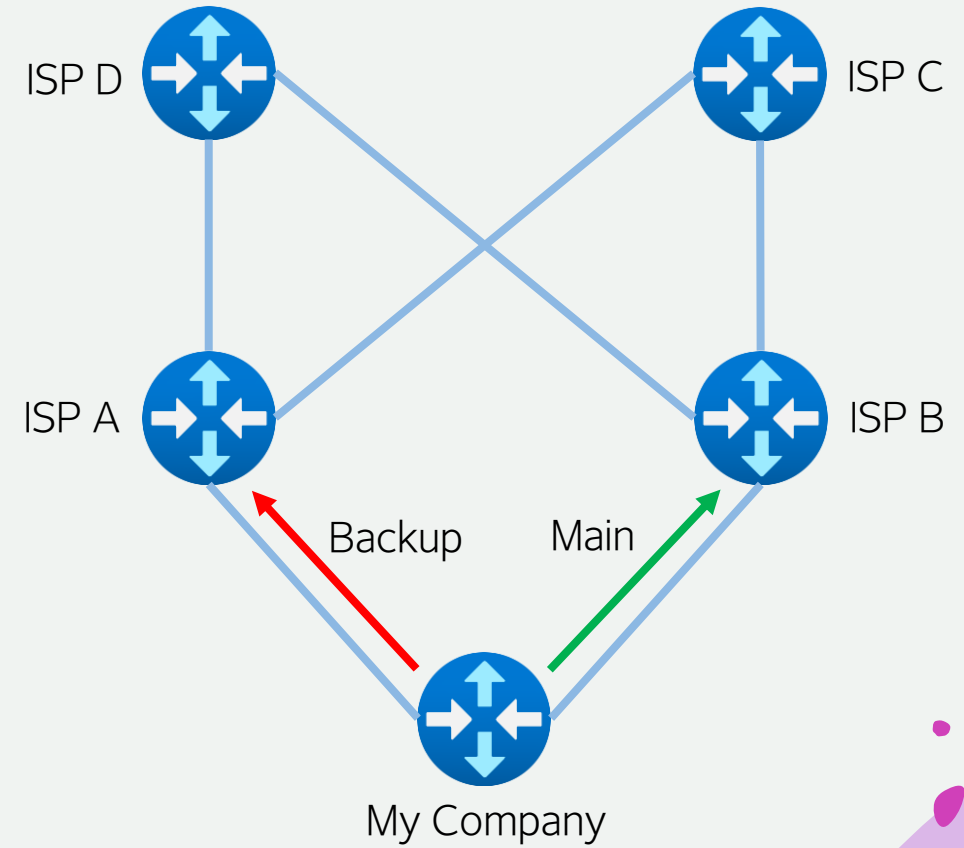
1. Weight 값이 동일
2. Local Preference 값이 동일
3. AS Path 길이가 동일
4. Origin Code가 동일
5. MED 값이 동일
6. eBGP / iBGP 동일
7. IGP Cost가 동일
8. Neighbor AS가 동일



Outbound Traffic 조정

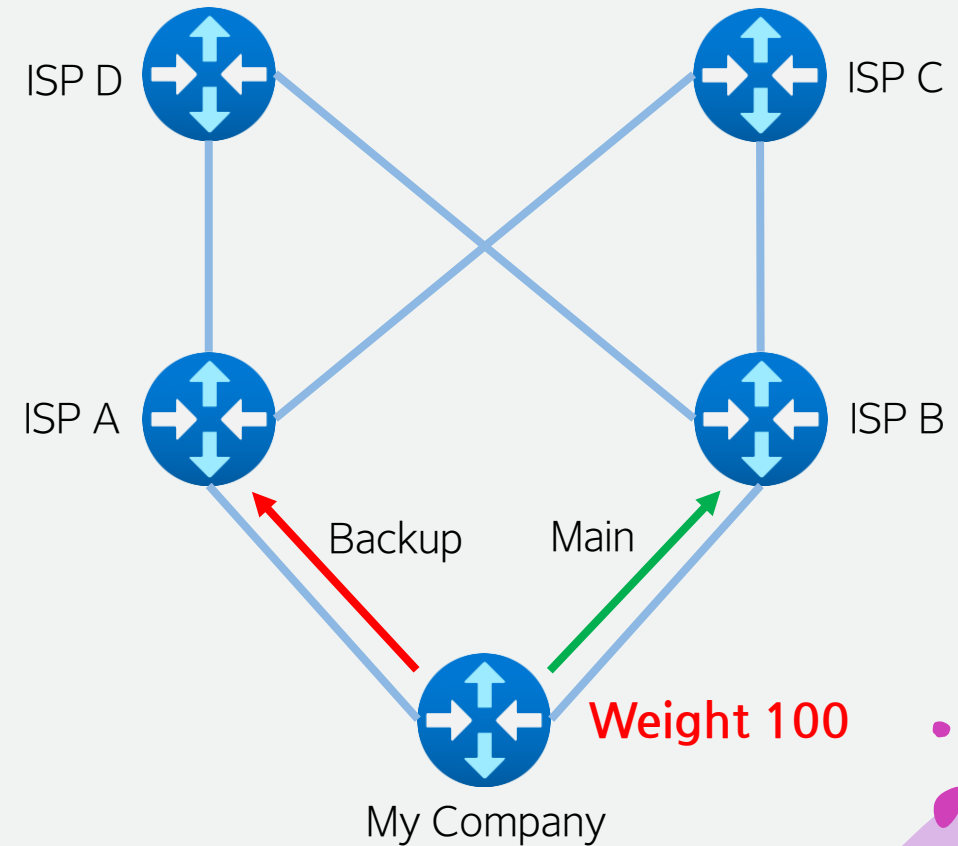


Outbound Traffic 조정



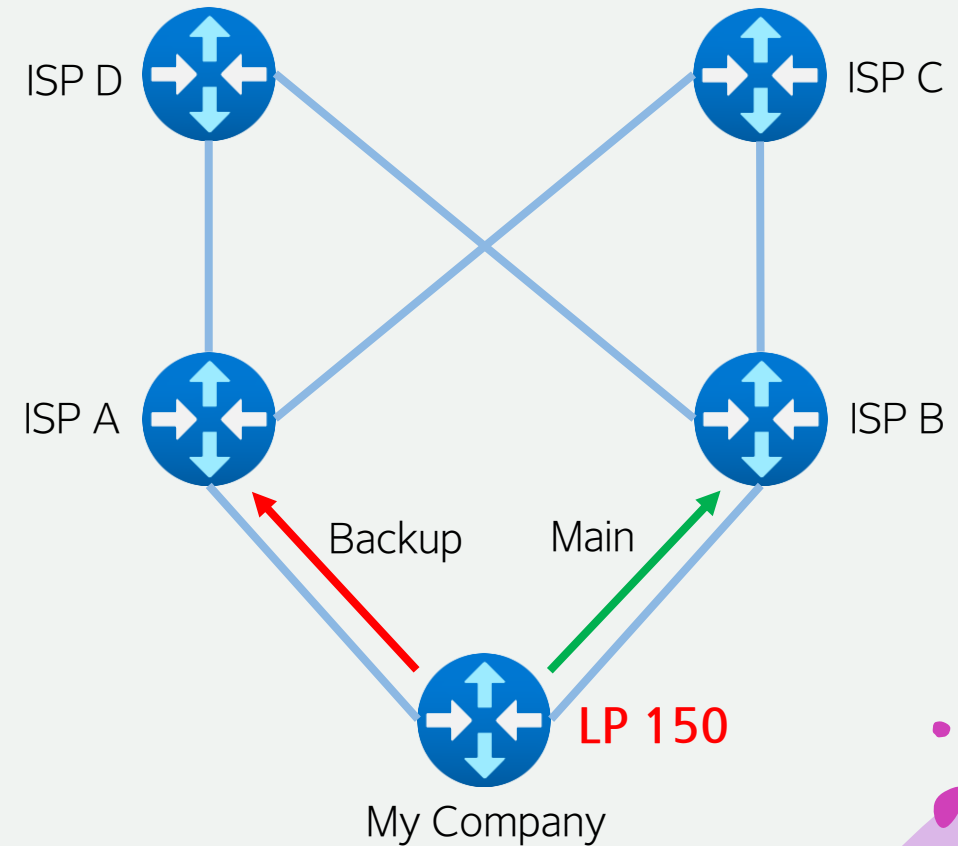
Outbound Traffic 조정

1. Weight (Cisco-specific)



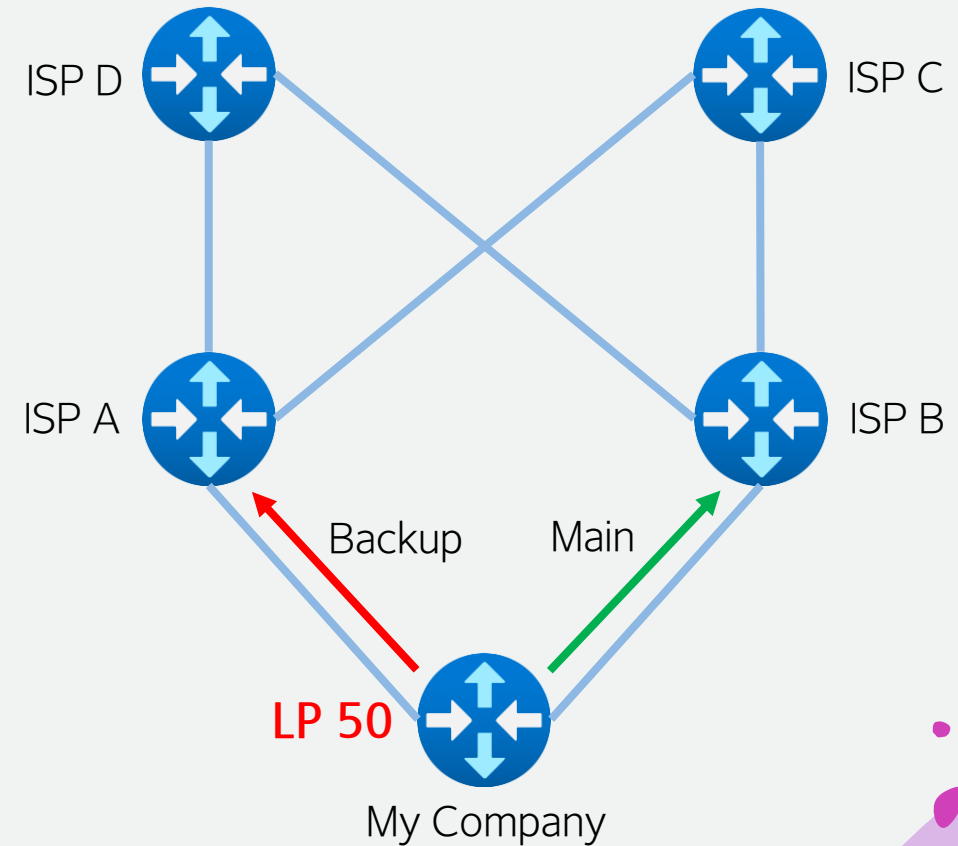
Outbound Traffic 조정

1. Weight (Cisco-specific)
2. Local Preference



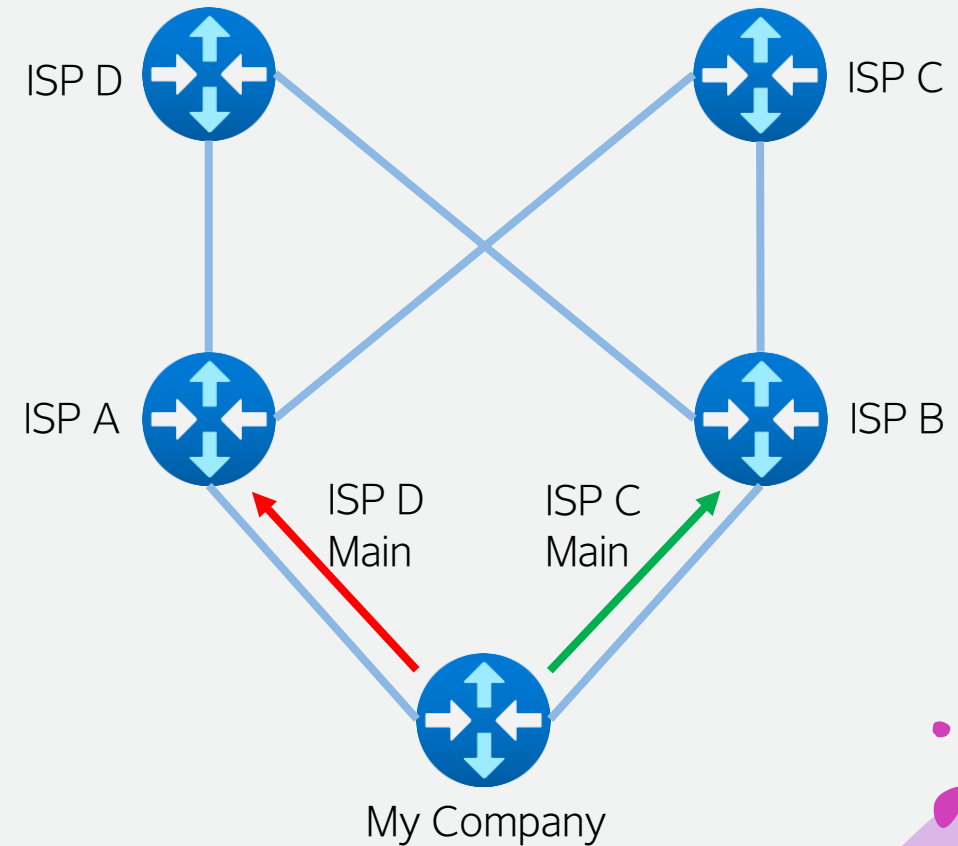
Outbound Traffic 조정

1. Weight (Cisco-specific)
2. Local Preference

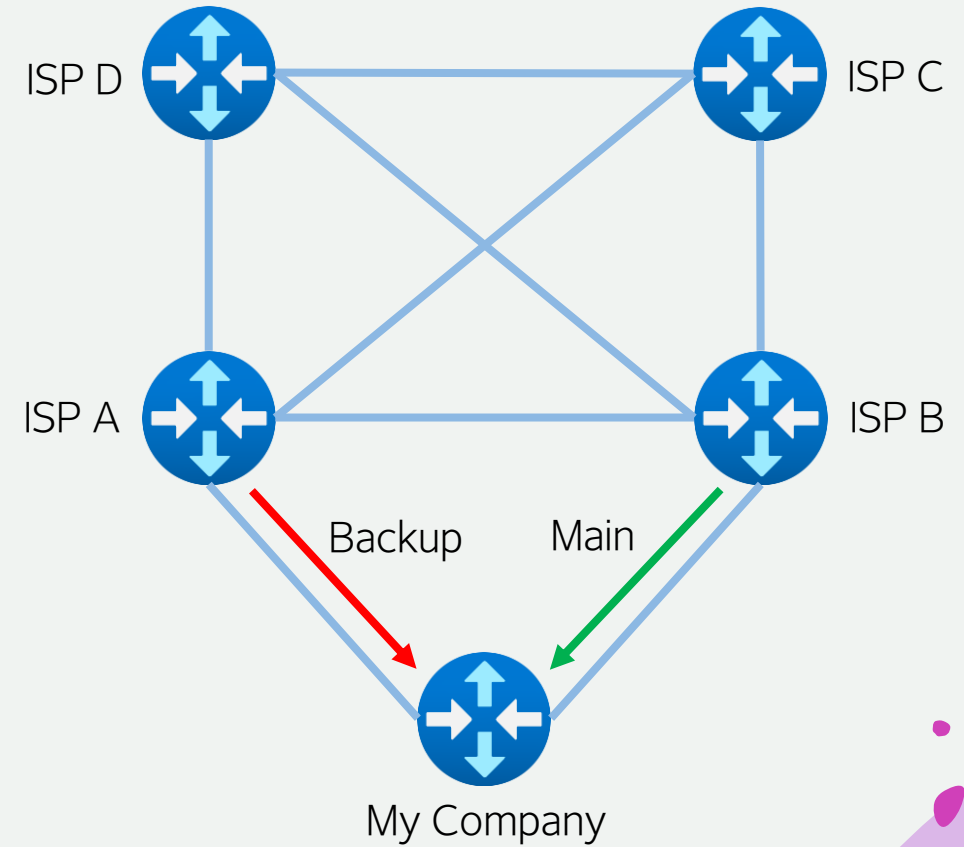


Outbound Traffic 조정

1. Weight (Cisco-specific)
2. Local Preference
3. AS-PATH (as regex)

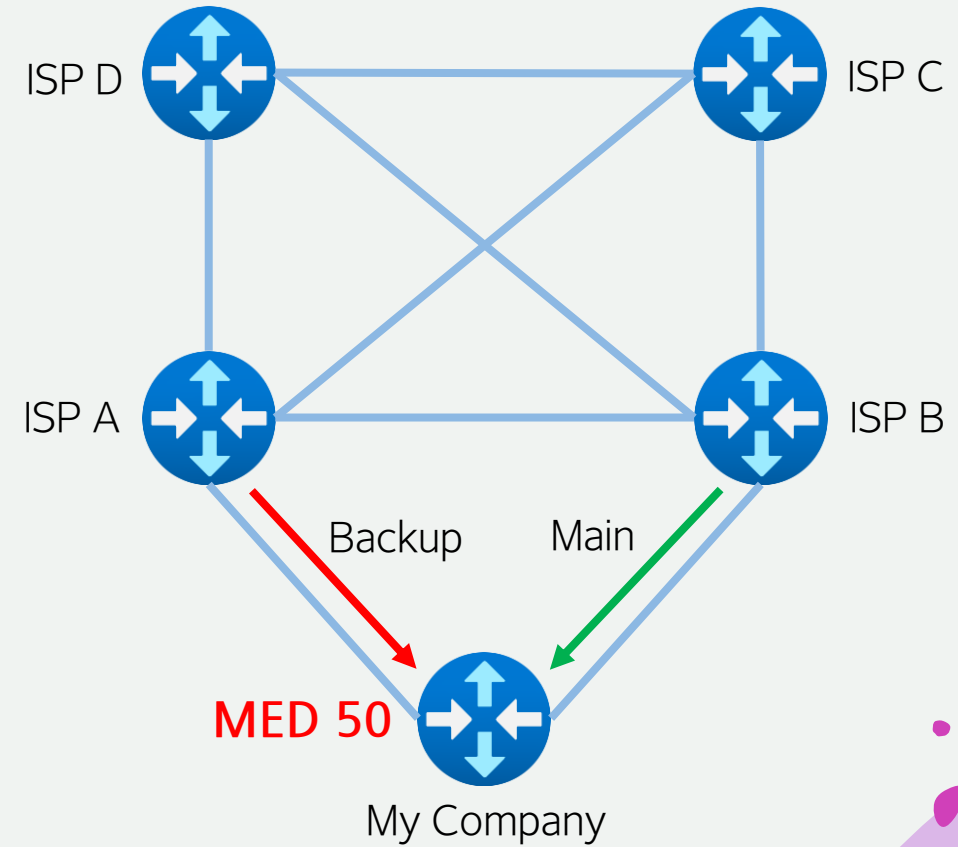


Inbound Traffic 조정



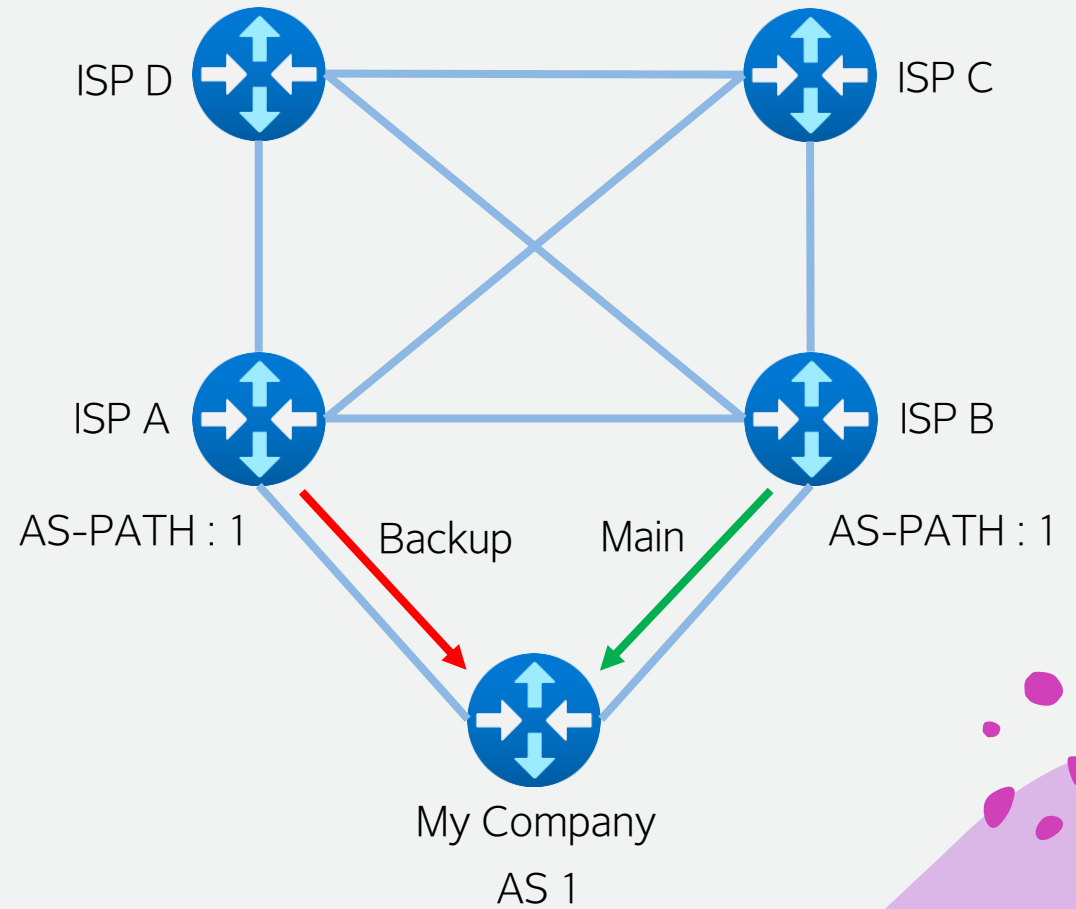
Inbound Traffic 조정

1. MED



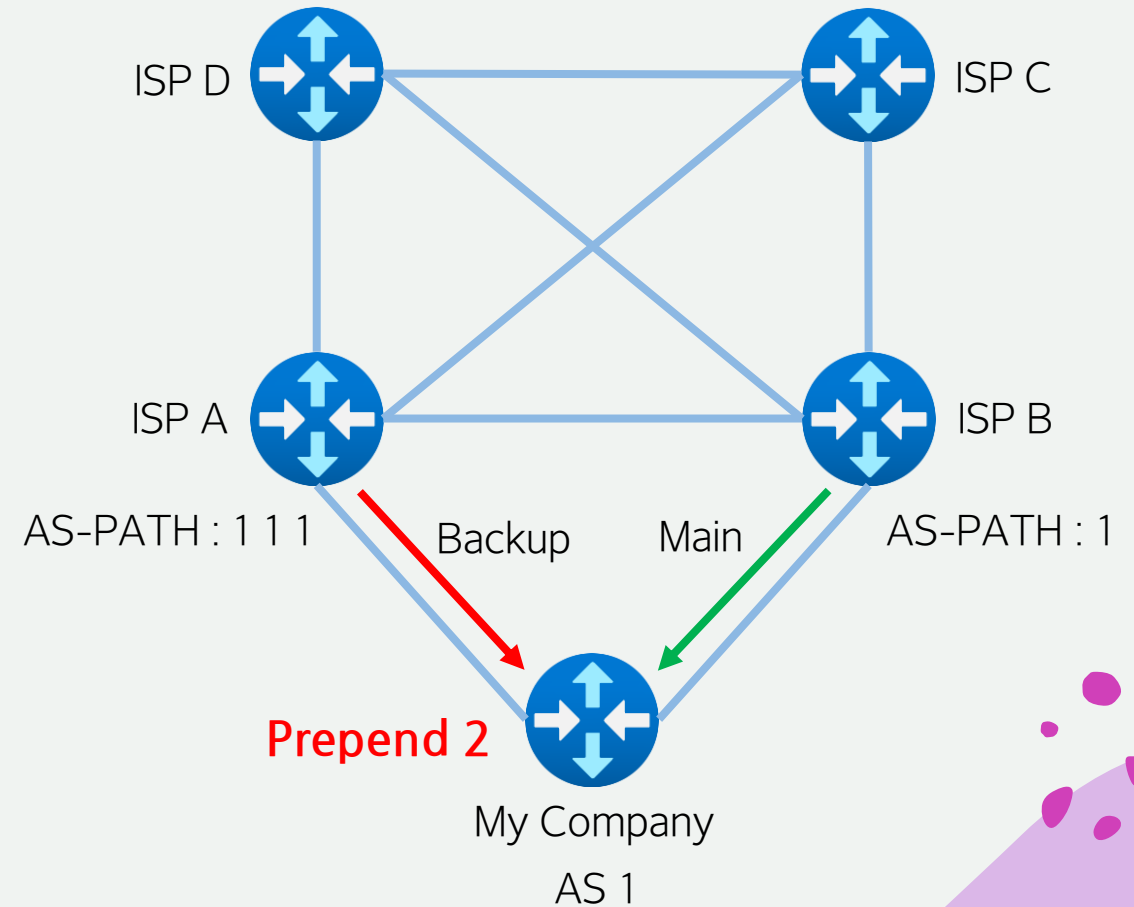
Inbound Traffic 조정

1. MED
2. AS PATH Prepending

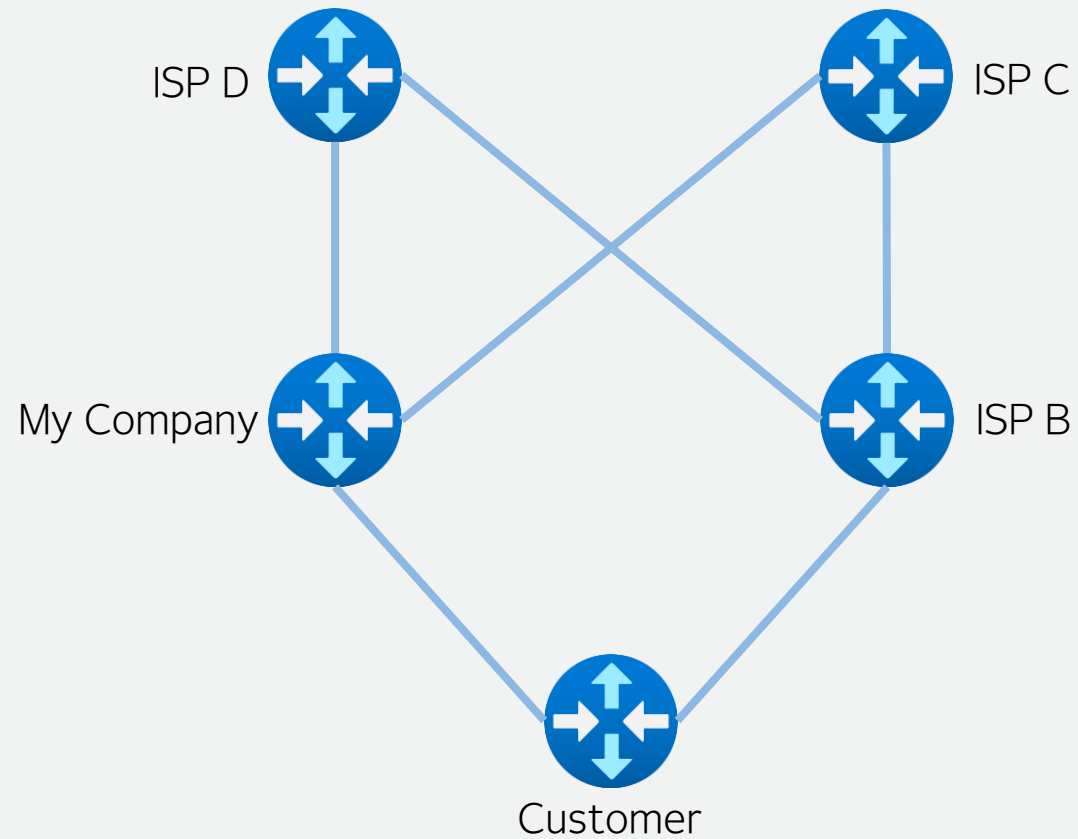


Inbound Traffic 조정

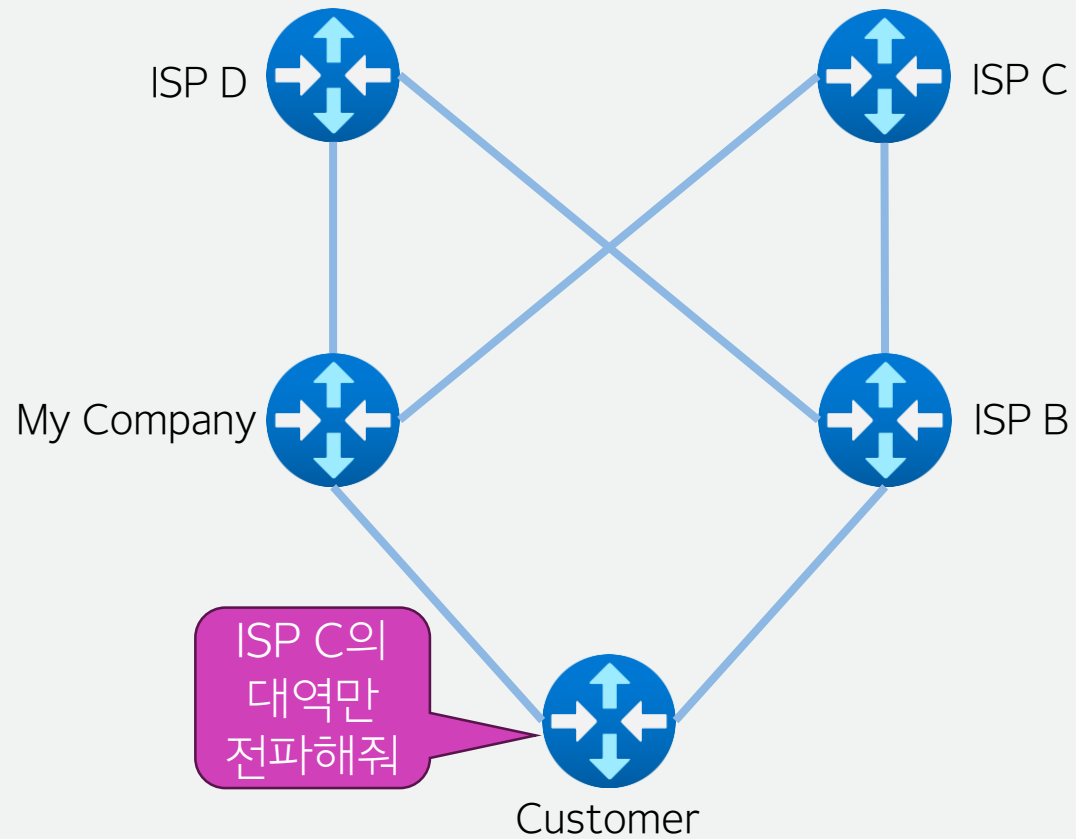
1. MED
2. AS PATH Prepending



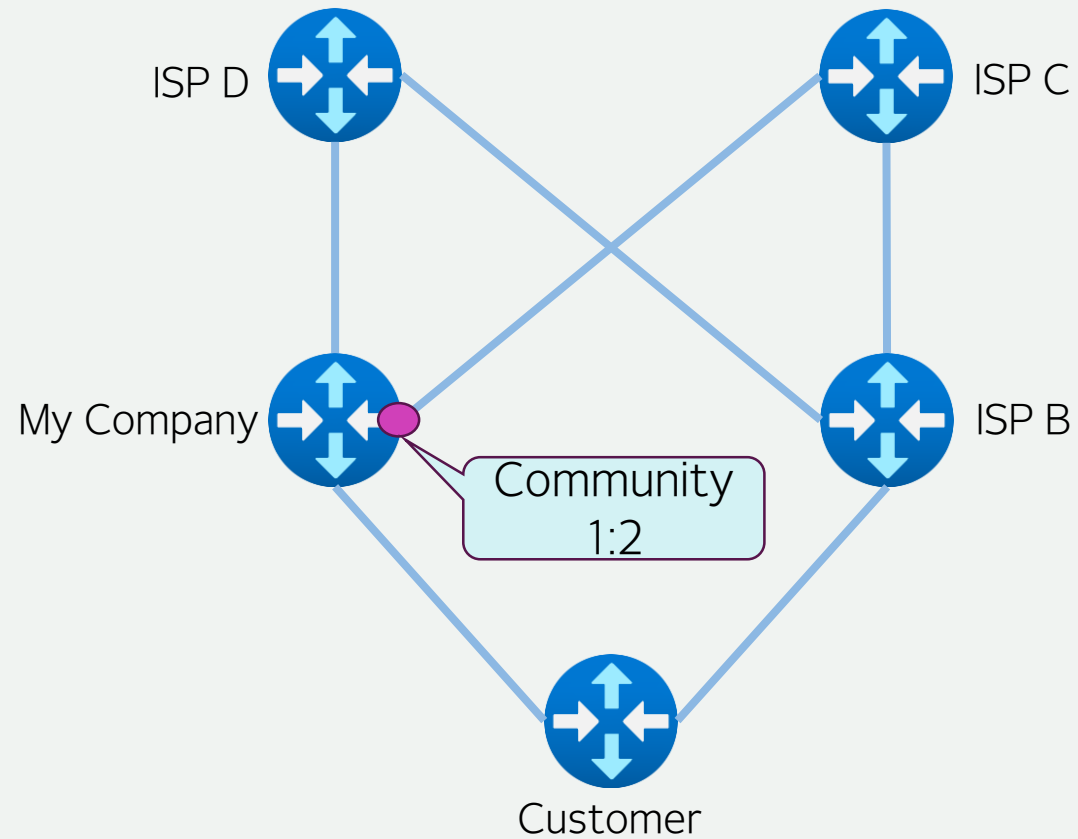
Community 사용



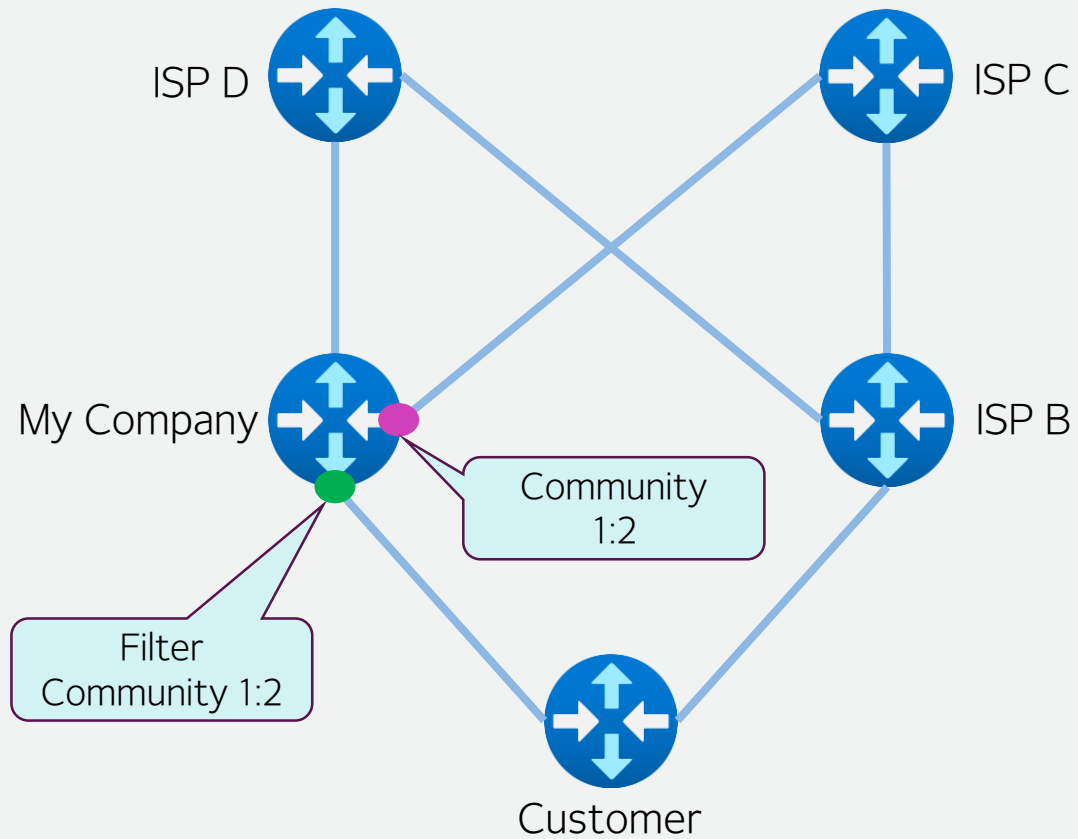
Community 사용



Community 사용



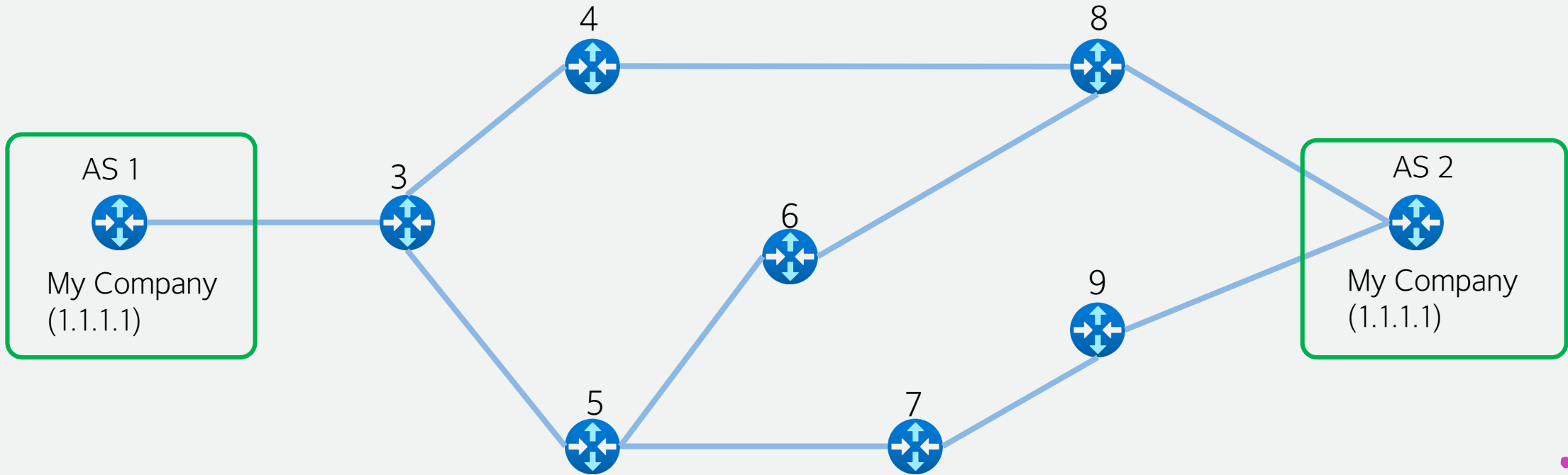
Community 사용



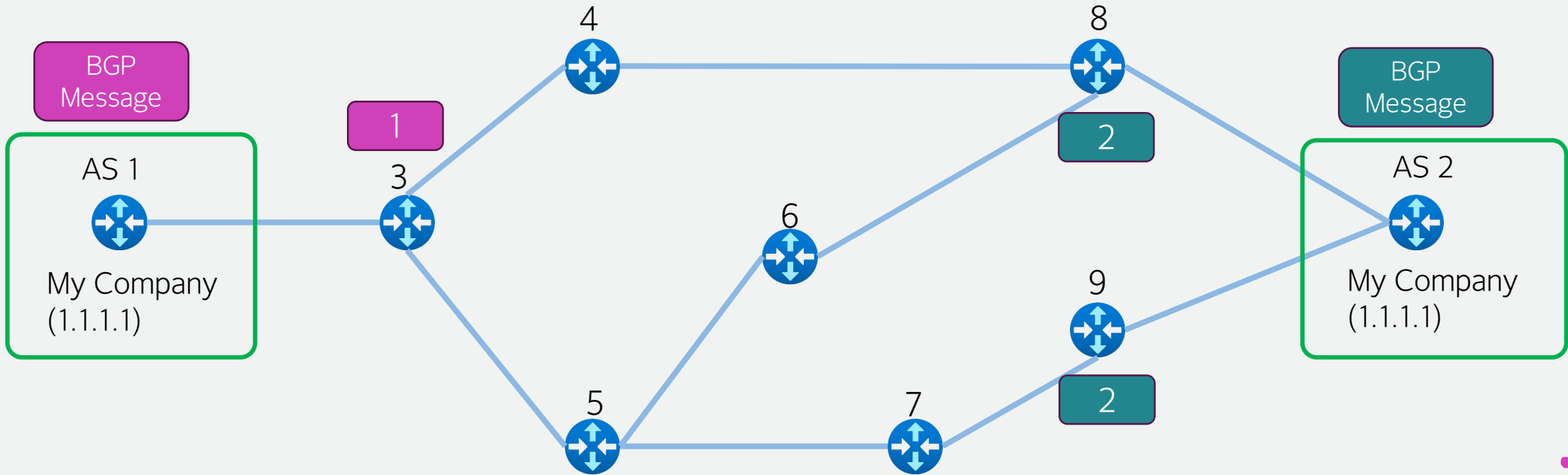
BGP Policy 적용

1. route-map을 사용
2. BGP Establish 이후 route-map 변경
 1. 자동으로 적용 되지 않음
3. 적용을 위해서는 clear 명령어 사용 (세션 재 연결)
 1. `clear ip bgp { * | neighbor ip address | peer-group }`
4. Soft Reconfiguration (세션 영향 없이 정책 적용)
 1. `clear ip bgp { * | neighbor ip address | peer-group } soft { in | out }`

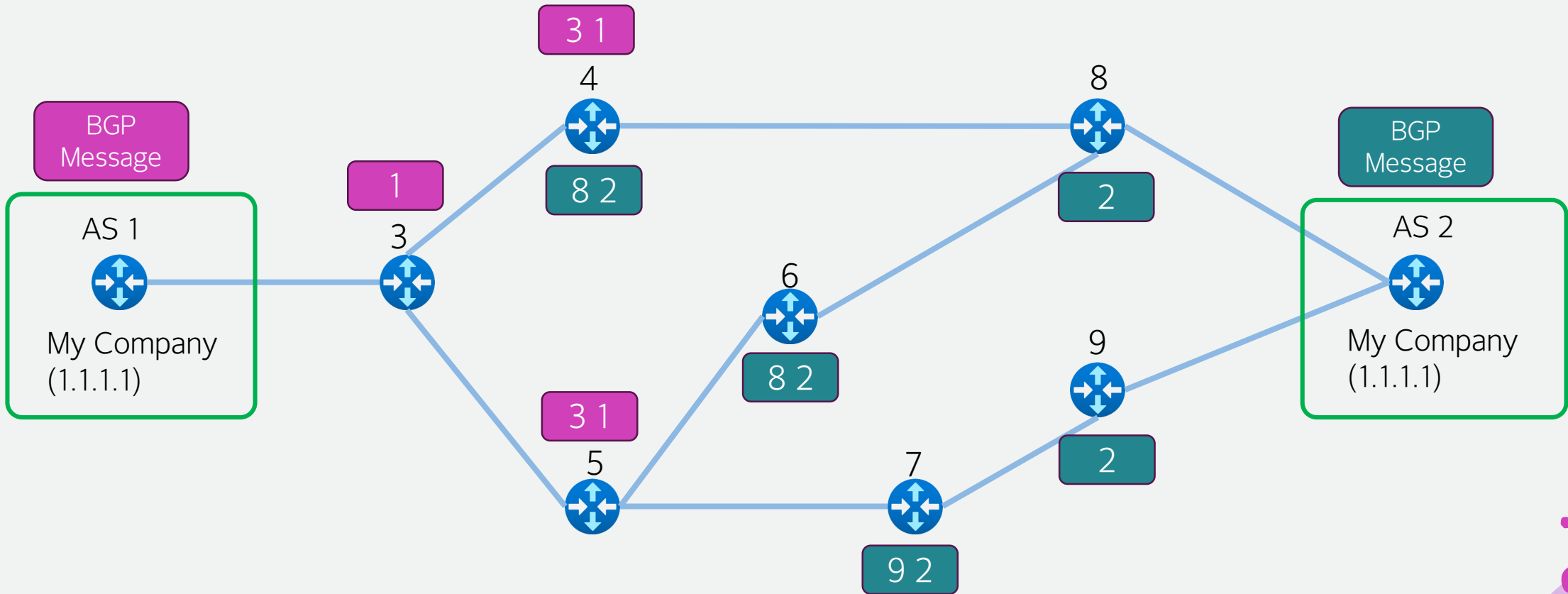
BGP Anycast



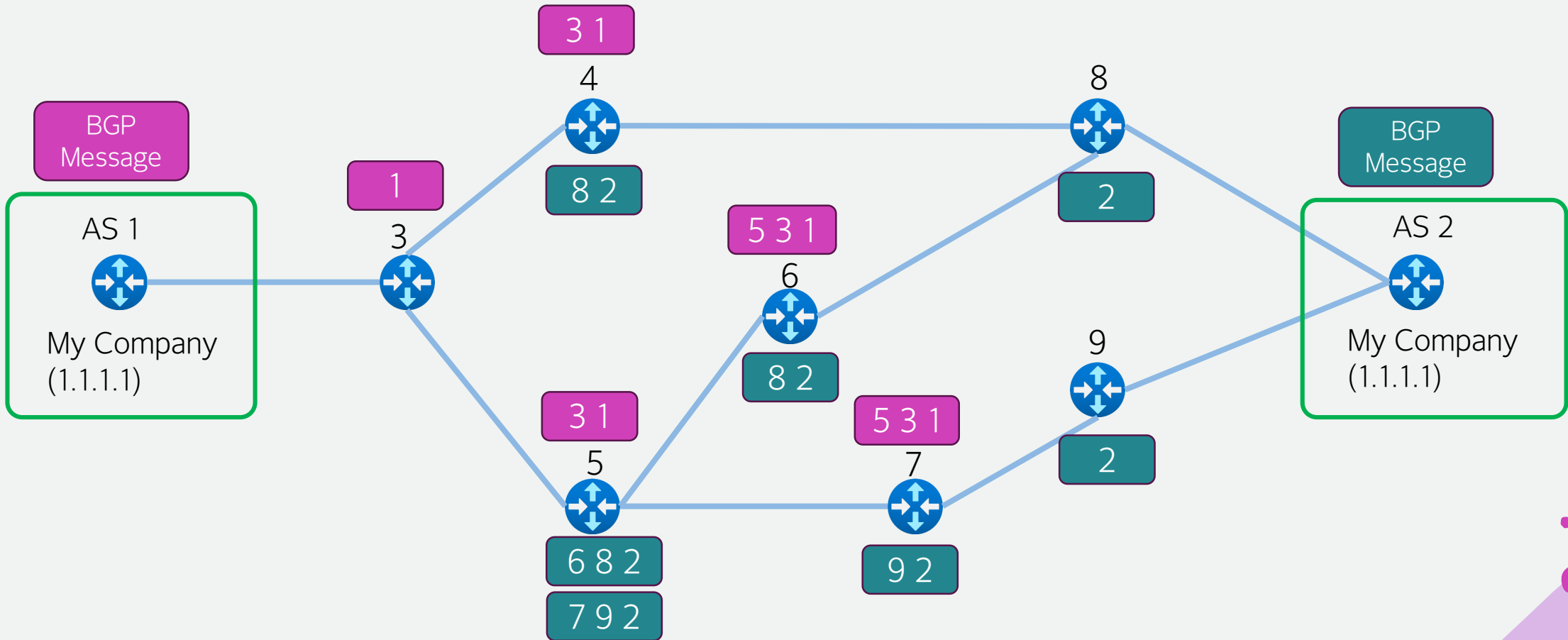
BGP Anycast



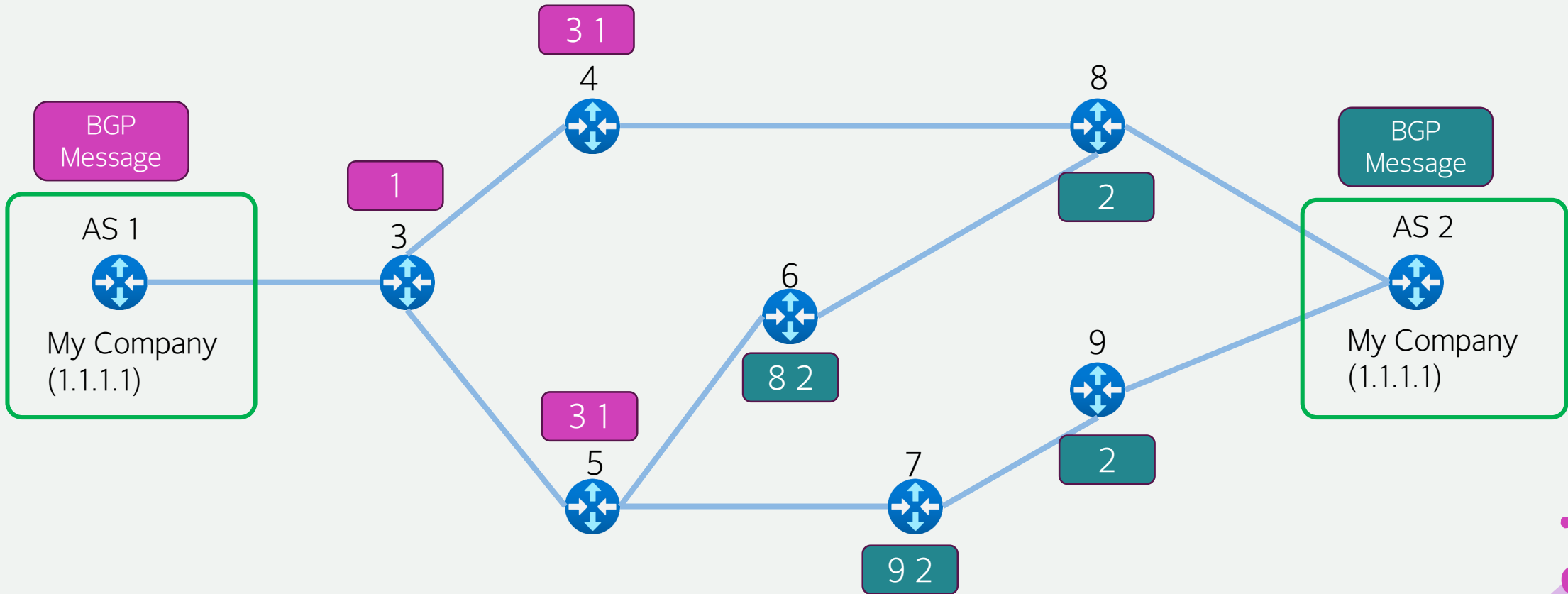
BGP Anycast



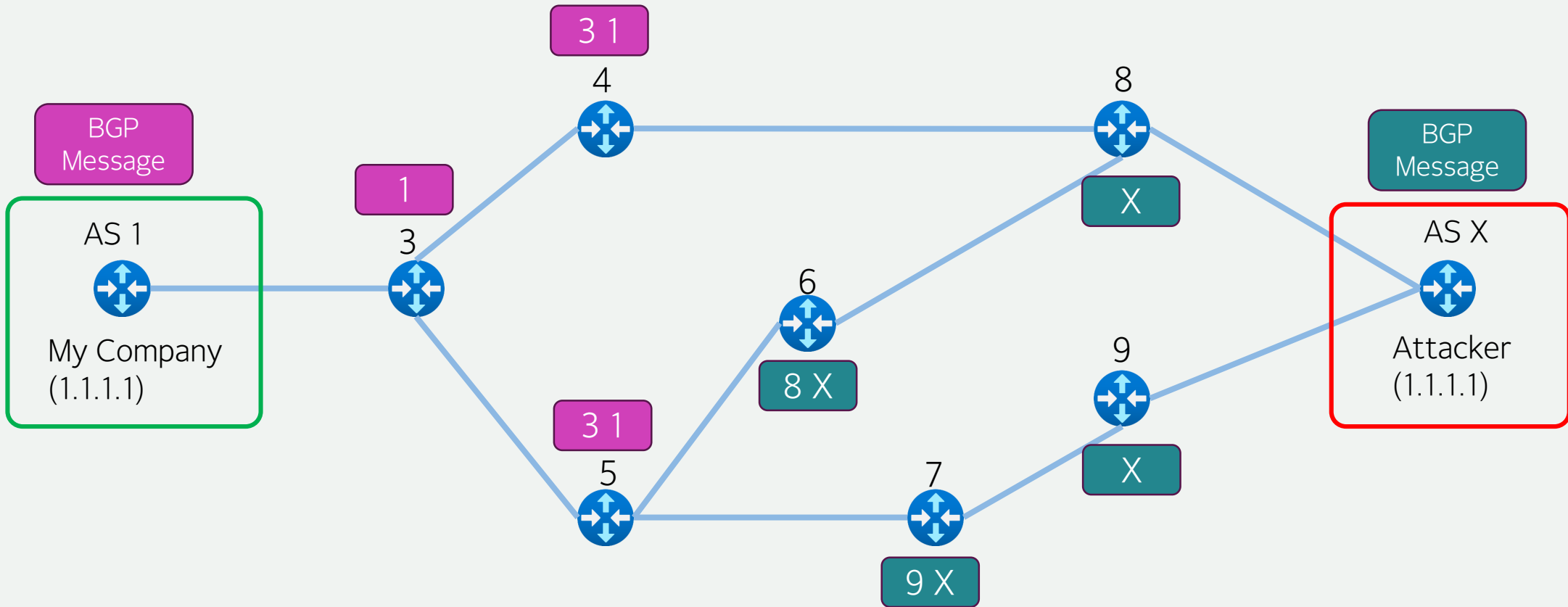
BGP Anycast



BGP Anycast

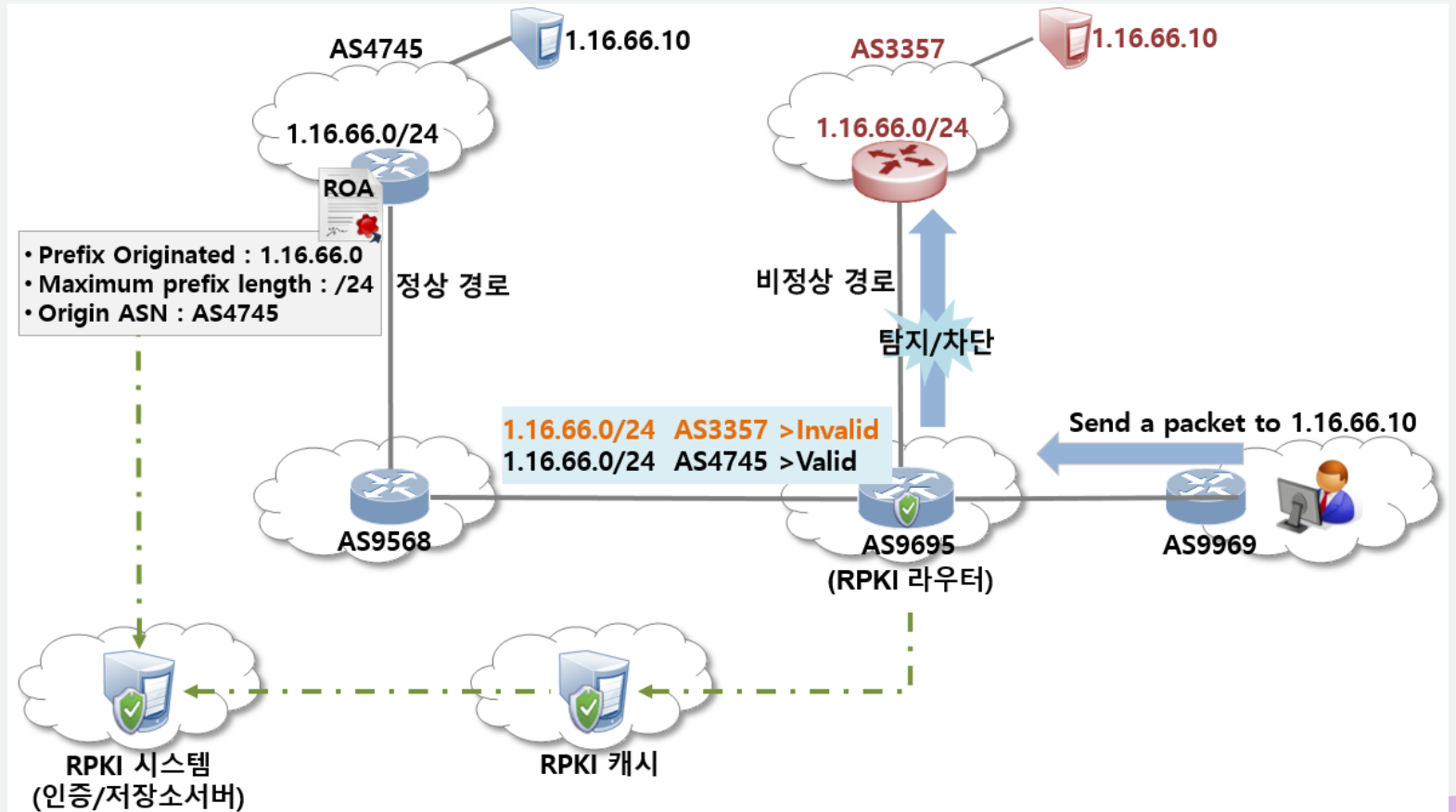


BGP Hijacking



BGP 보안

1. RADB
2. RPKI
(Resource Public Key Infrastructure)



출처 : <https://한국인터넷정보센터.한국/jsp/resources/rpki.jsp>

Q&A

