ISP Border Definition

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ISP goal (one ASN)

BGP Decision Process

Step	Attribute	Transit
1	Highest Local Preference value	Non-transit
2	Lowest AS Path length	Transit
3	Lowest Origin type	Transit
4	Lowest MED	Non-transit
5	eBGP learned over iBGP learned	Automatic
6	Lowest IGP cost to border router	Local configuration
7	Lowest router Id	Local configuration

Send traffic with maximum benefit.

BGP Decision Process

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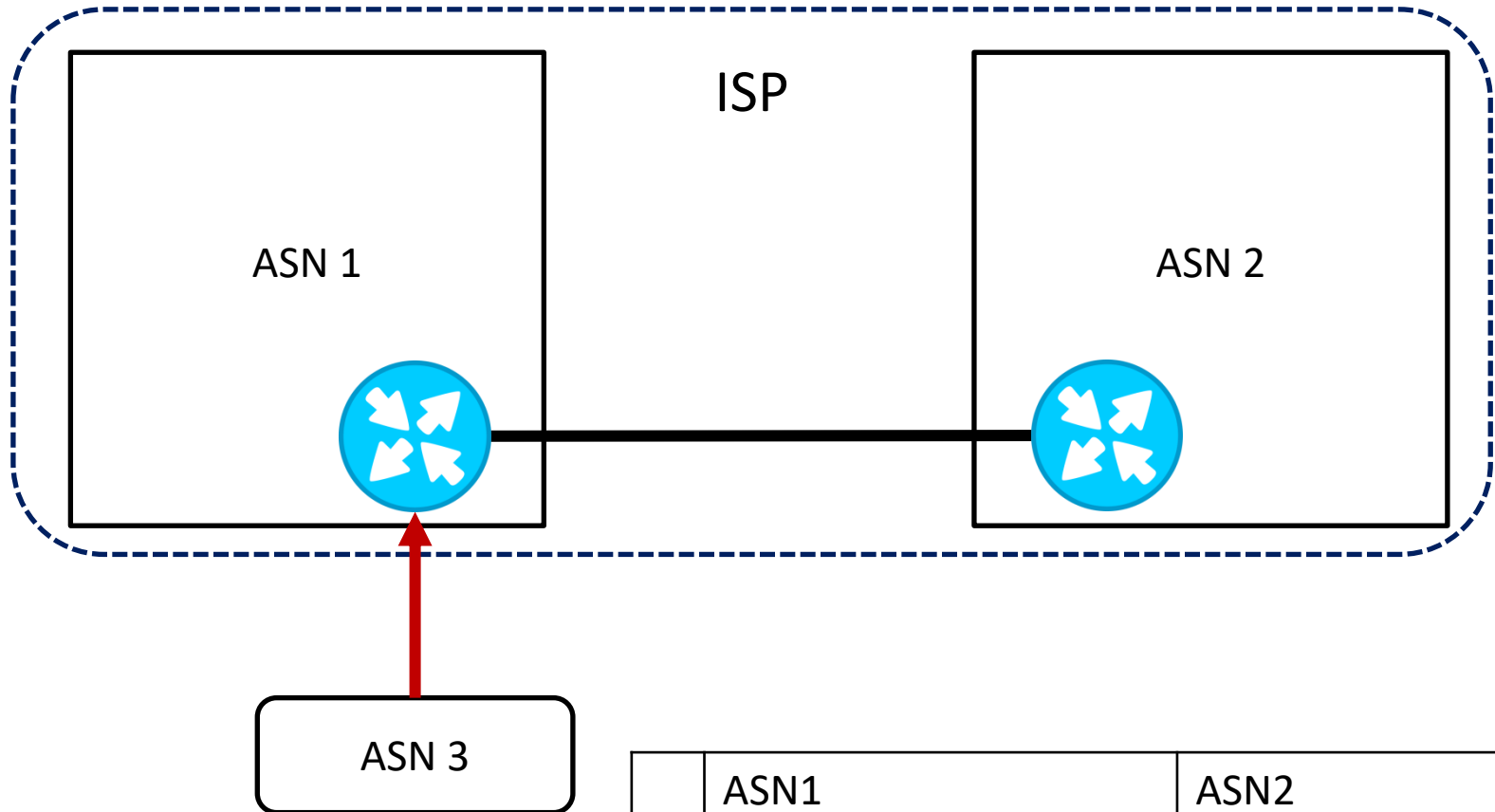Get rid of traffic as soon as possible!

ISP goal (multiple ASNs)

$$Profit(ASN_1 + ASN_2) > Profit(ASN_1) + Profit(ASN_2)$$
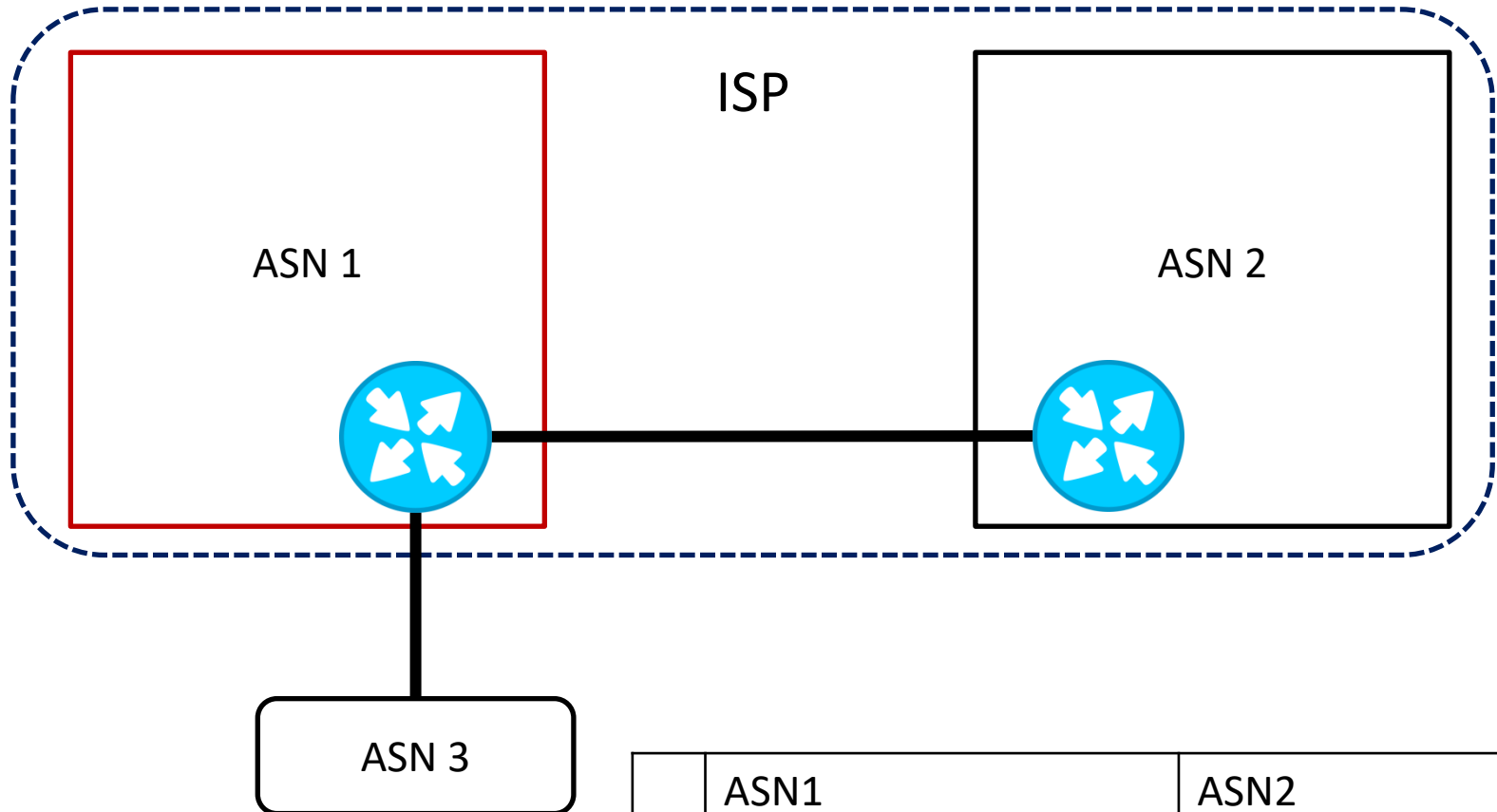
Multiple ASNs – One ISP
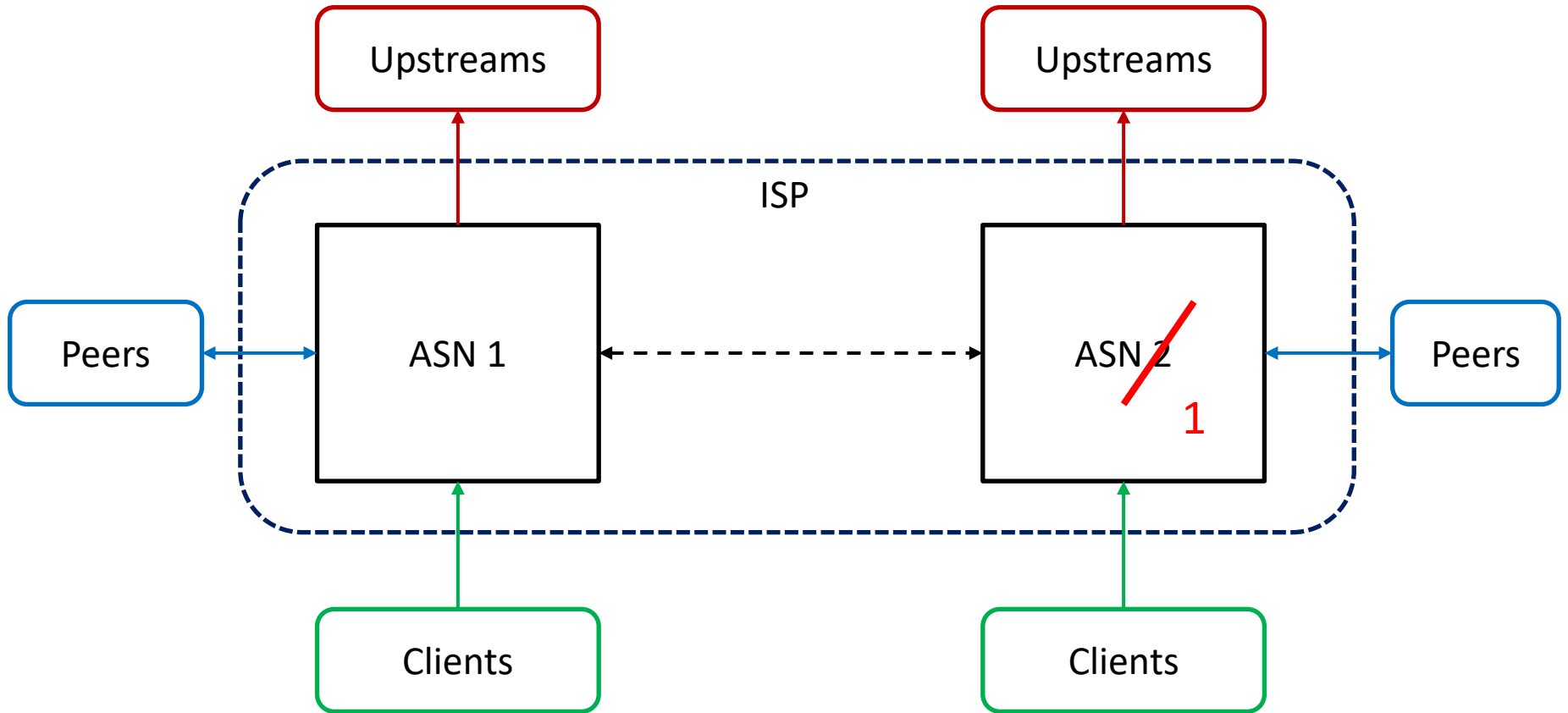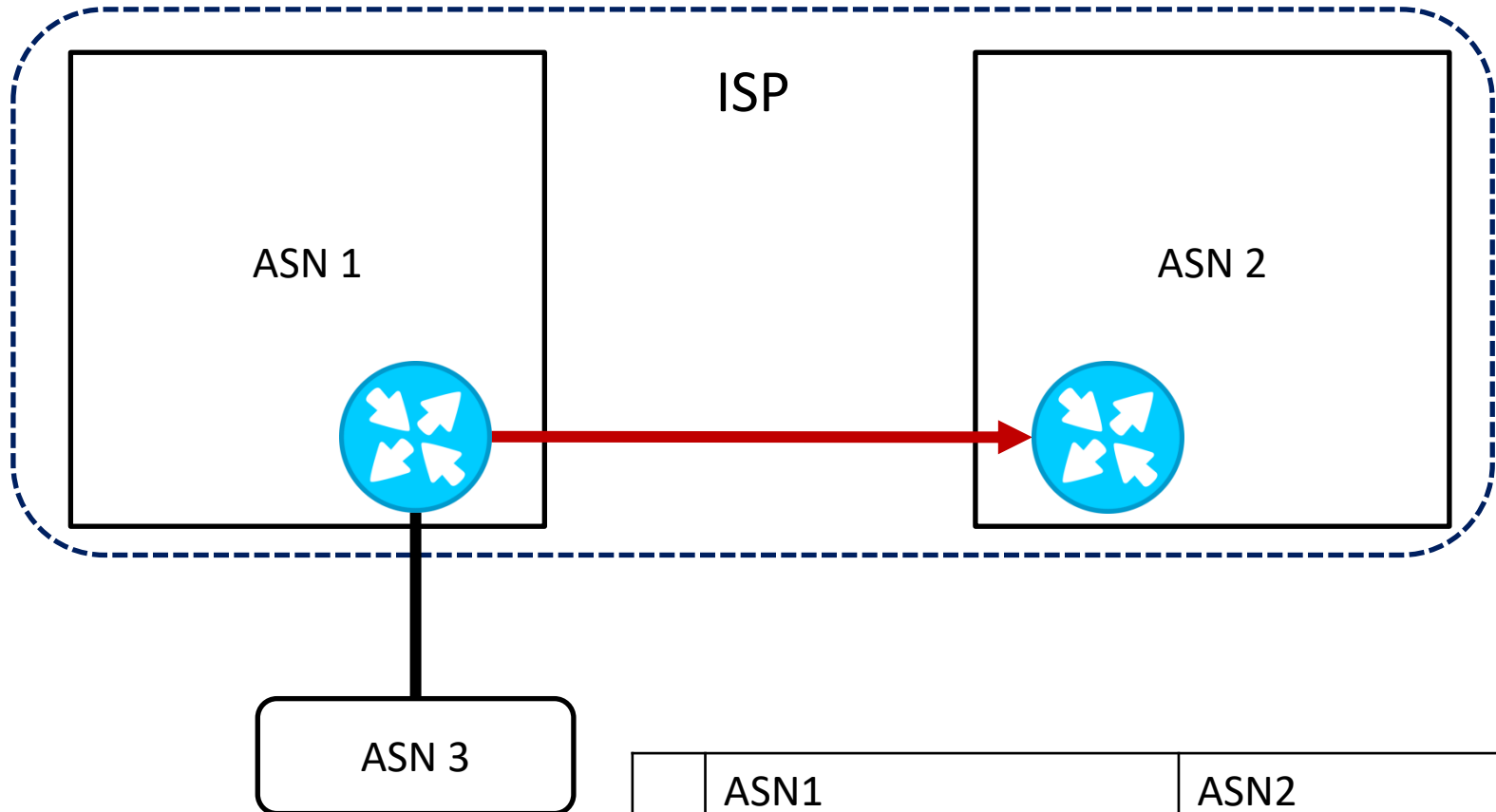

Not so fast…
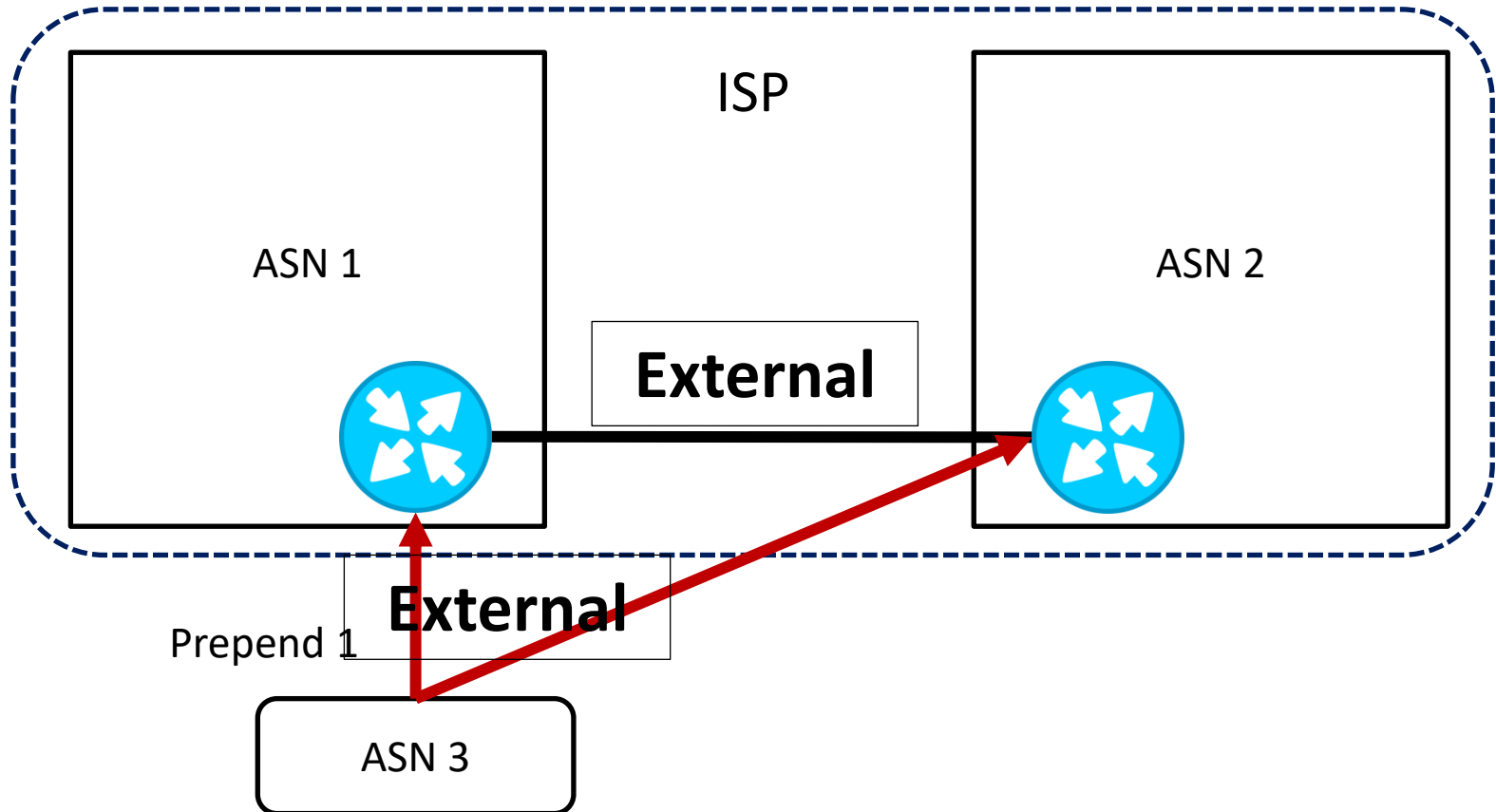
Pref Transmission

ISP

ASN 1

ASN 2

ASN 3

	ASN1	ASN2
a.	Assign pref	

Pref Transmission

ISP

ASN 1

ASN 2

ASN 3

	ASN1	ASN2
a.	Assign pref	
b.	Community -> pref	

Pref Transmission

ISP

ASN 1

ASN 2

ASN 3

	ASN1	ASN2
a.	Assign pref	
b.	Community -> pref	
c.		Community -> Pref

'Hot potato' routing

ISP

ASN 1

ASN 2

External

External

Prepend 1

ASN 3

	ASN 1	ASN 2
AS Path	3 3	3

'Hot potato' routing

ISP

ASN 1

ASN 2

External

Prepend 1

External

ASN 3

	ASN 1	ASN 2
AS Path	3 3	3

'Hot potato' routing

ISP

ASN 1

ASN 2

External

External

Prepend 1

ASN 3
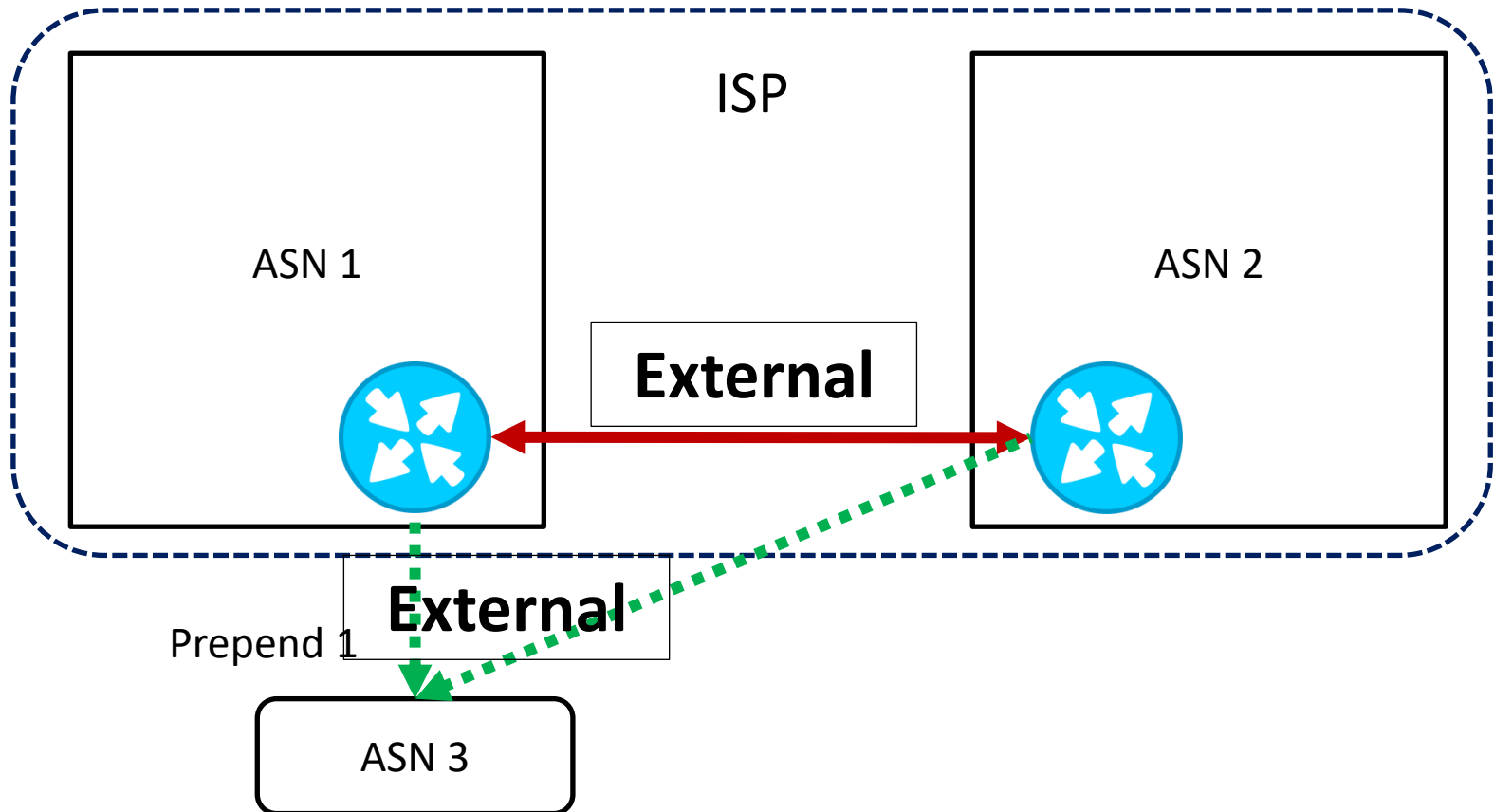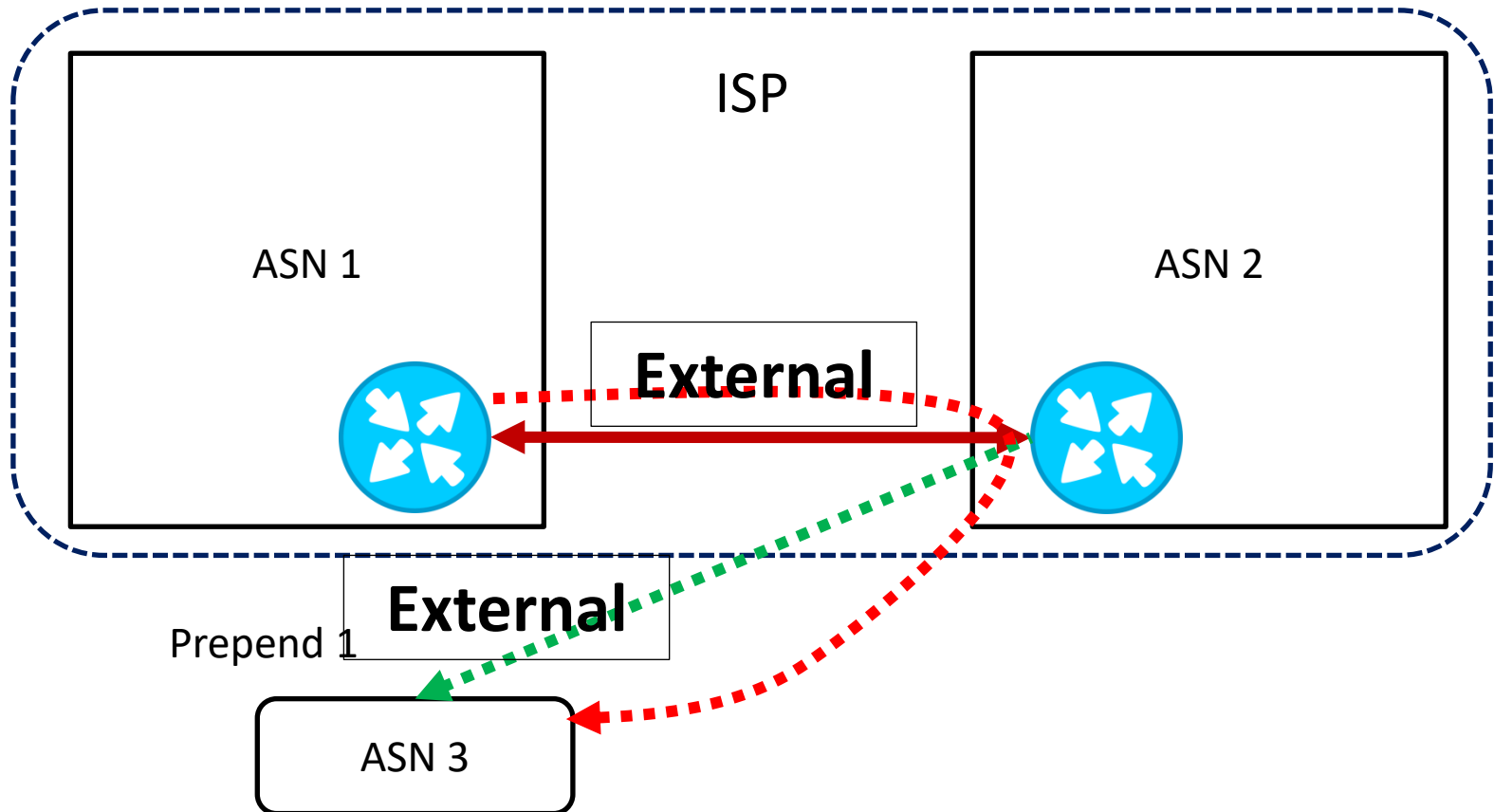
	ASN 1	ASN 2
AS Path	2 3	3

Securing 'Hot potato' routing

ISP

ASN 1

ASN 2

External

External

Prepend 1

ASN 3
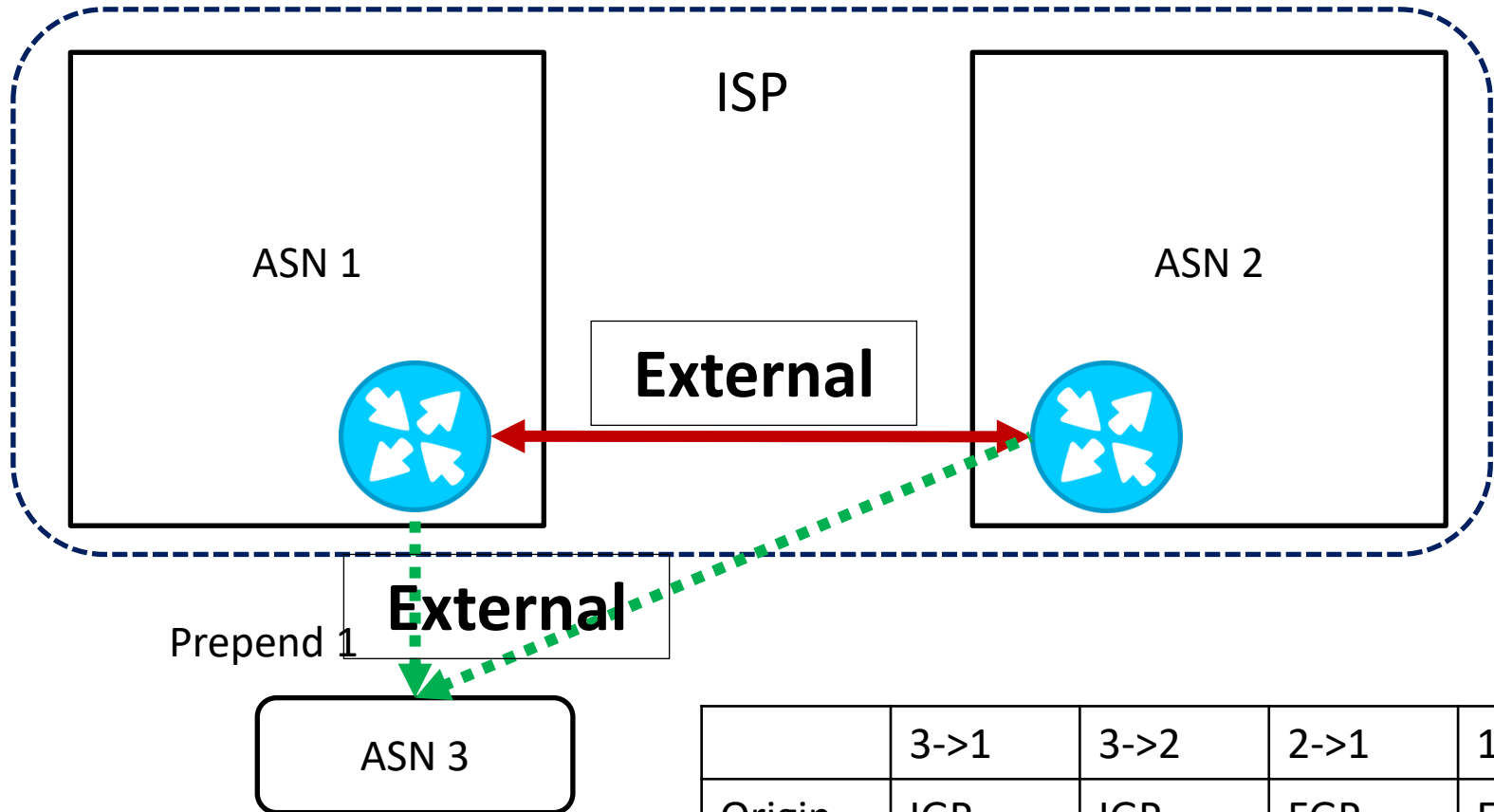
	3->1	3->2	2->1	1->2
Origin	IGP	IGP	EGP	EGP

	ASN 1	ASN 2
AS Path	3 3	3

Securing 'Hot potato' routing

ISP

External

ASN 1

ASN 2

Isolation

External

Prepend 1

ASN 3
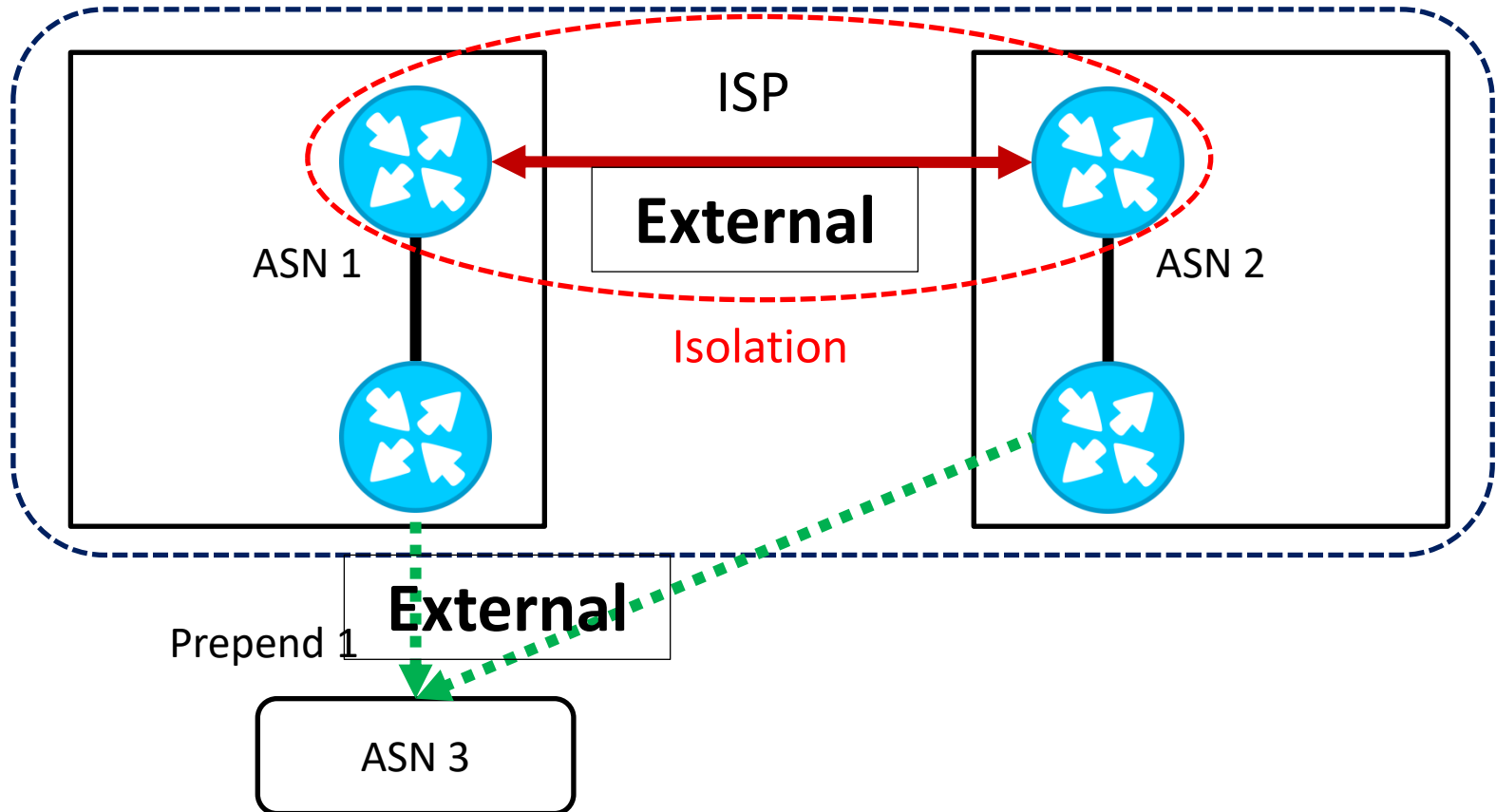
	ASN 1	ASN 2
AS Path	3 3	3

Path Length: Increased

ISP

ASN 1

ASN 2

Peer ASN 3

Customer ASN 4
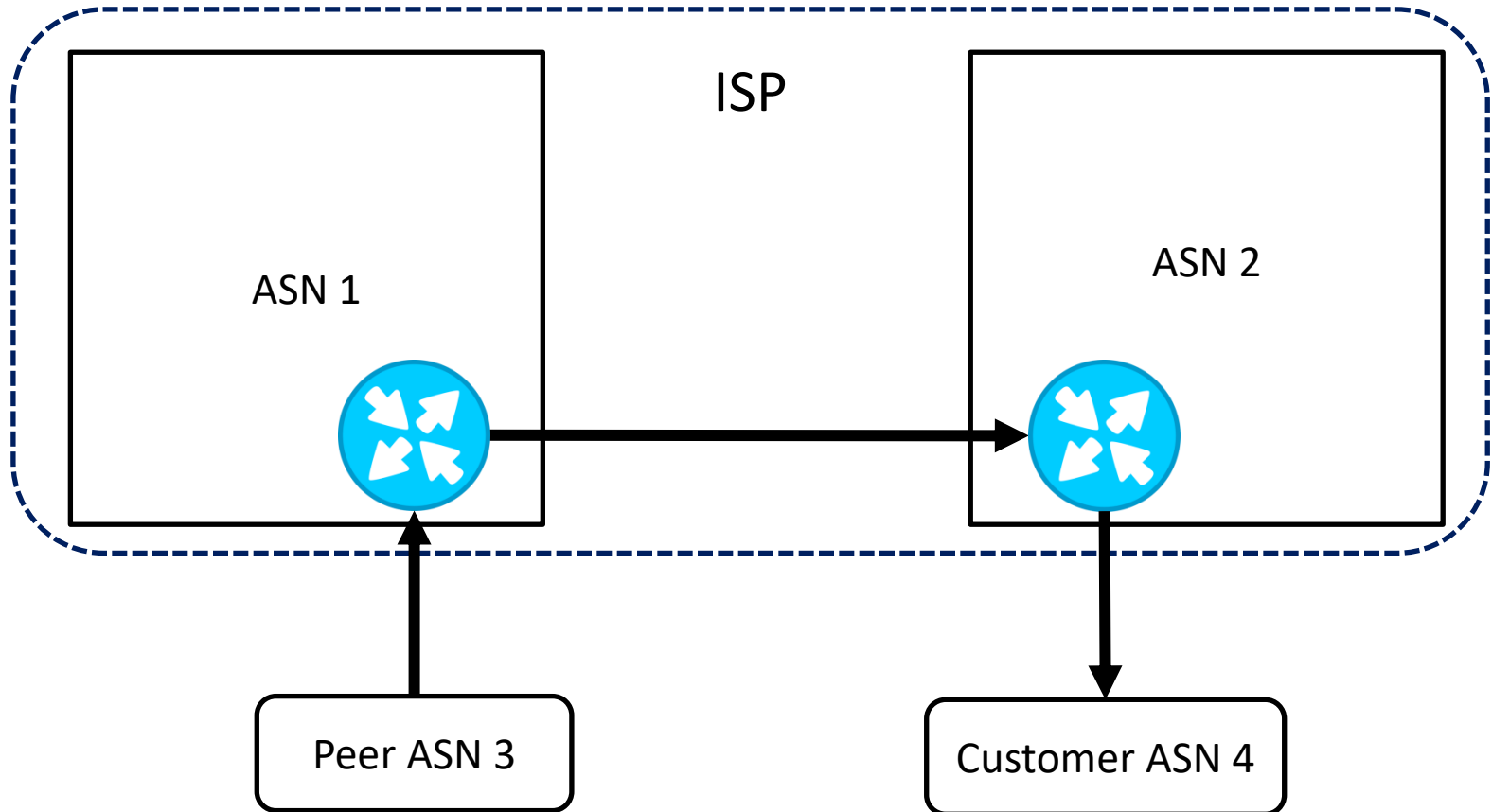
	ASN 1	ASN 2	ASN 4
AS Path	3	1 3	**2 1 3**

Path Length: Route Loops

ISP

ASN 1

ASN 2

no-prepend

Peer ASN 3

Customer ASN 4
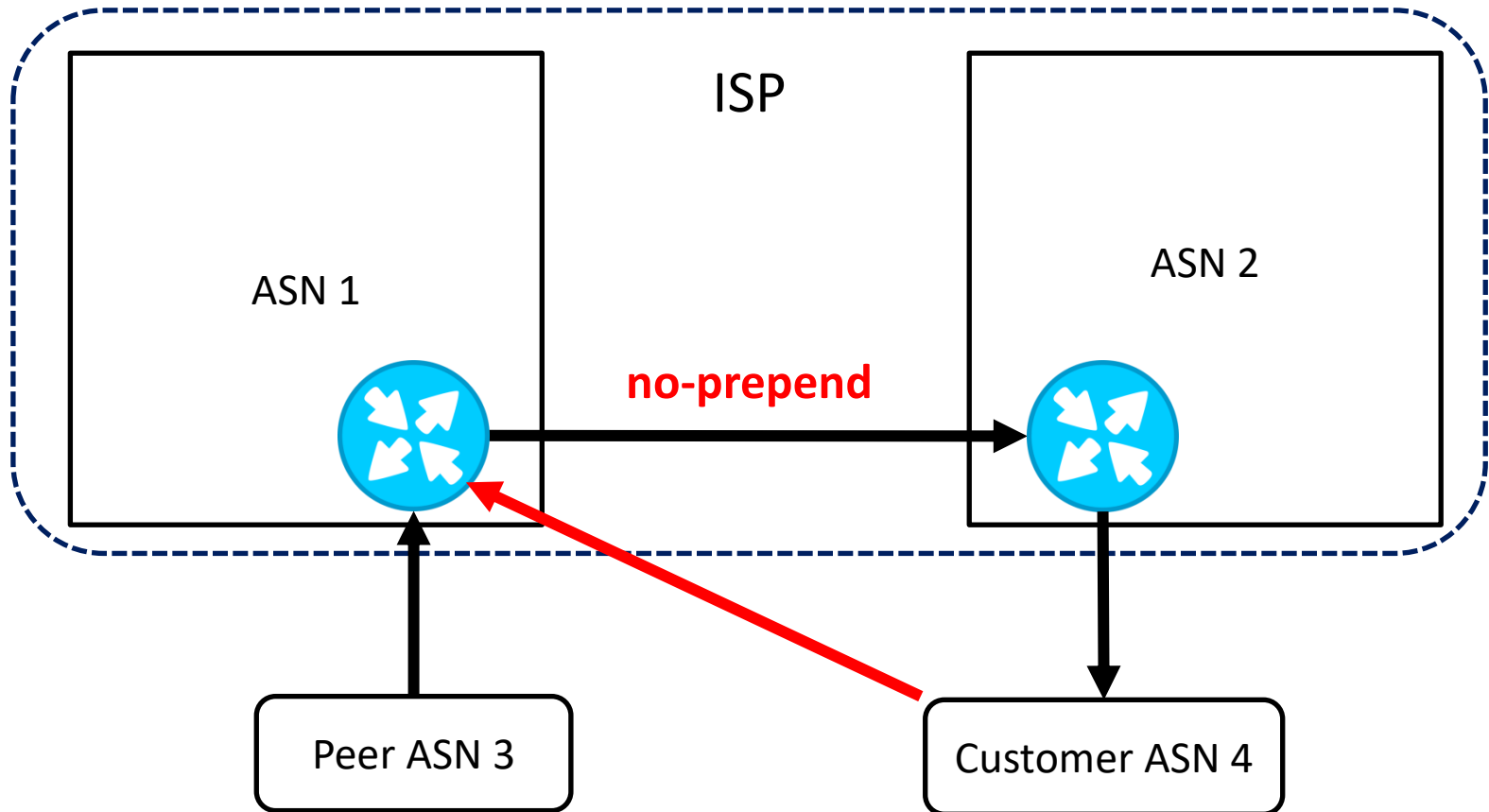
	ASN 1	ASN 2	ASN 4
AS Path	4 2 3	3	2 3

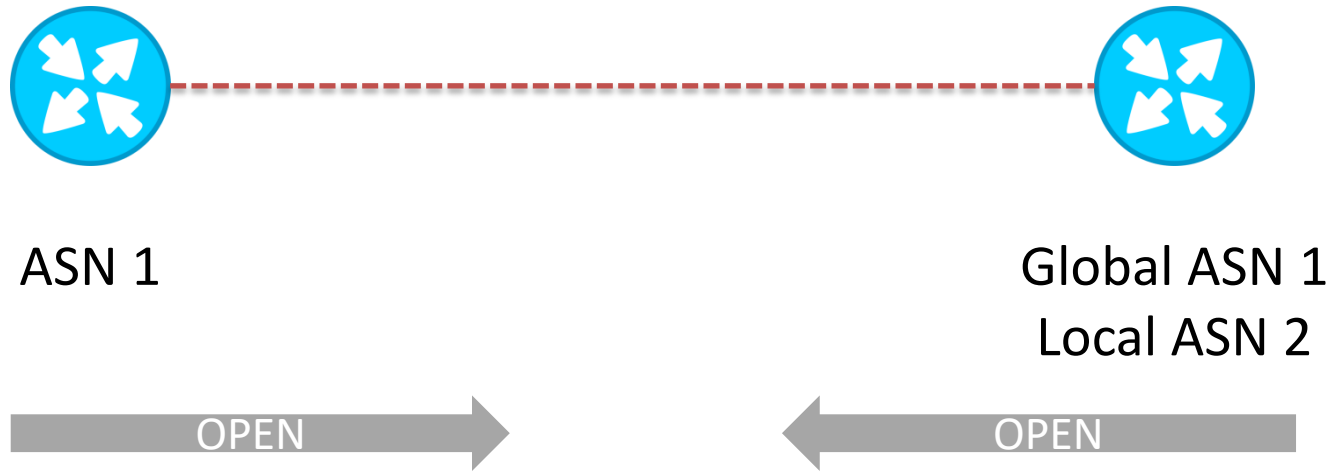# Multiple ASNs – One Network

Target	Plain BGP
Preference transmission	1. Synchronize Local Preference Values 2. Local-pref->Community->Local_pref
'Hot potato' routing	Origin modification / router isolation
Path length	**Increased / Loop Risk**
Route Leak prevention	Community synchronization

There is no simple way!

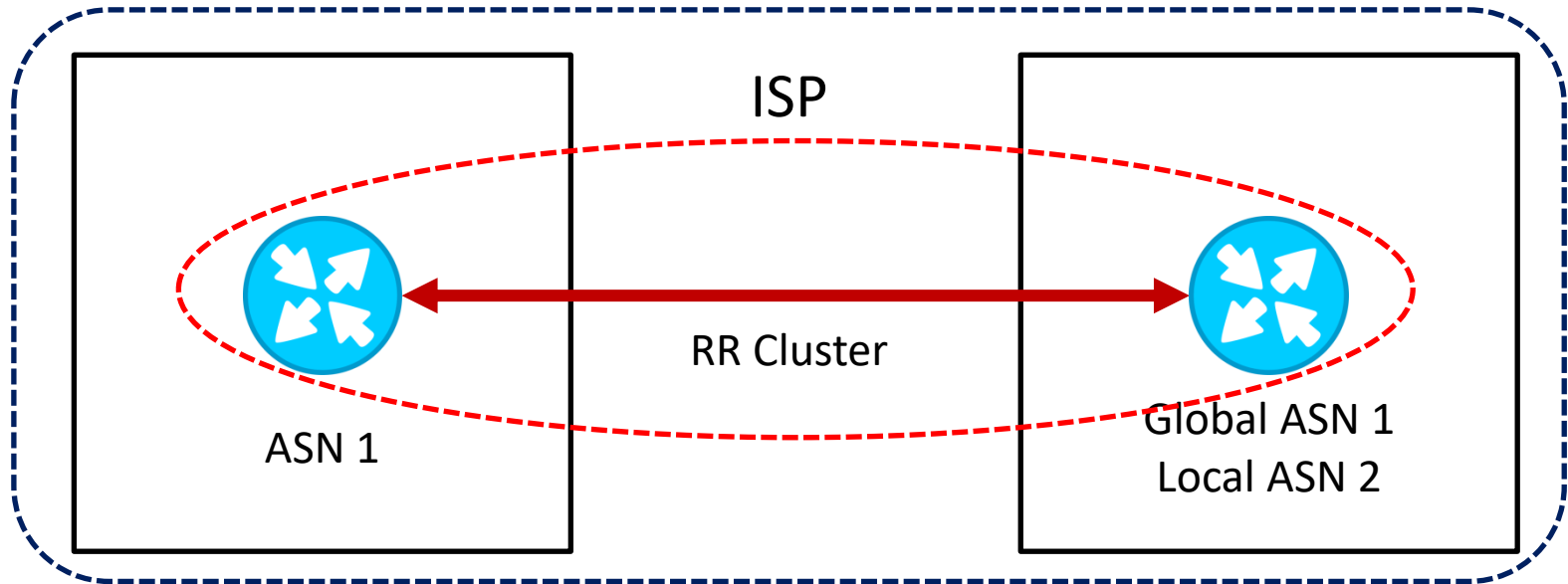# rfc7705: Autonomous System Migration Mechanisms

rfc7705: Local ASN capability

ASN 1

Global ASN 1
Local ASN 2

OPEN →

← OPEN

BGP session will be established if:
ASN in OPEN message = Local ASN OR
ASN in OPEN message = Global ASN

rfc7705: Migration ASN2 to ASN1

ISP

RR Cluster

ASN 1

Global ASN 1
Local ASN 2

1. Add Local AS capability to RR
2. Unite ALL RR in one cluster
3. Slow migration to ASN 1

rfc7705: Multiple ASNs – One Network

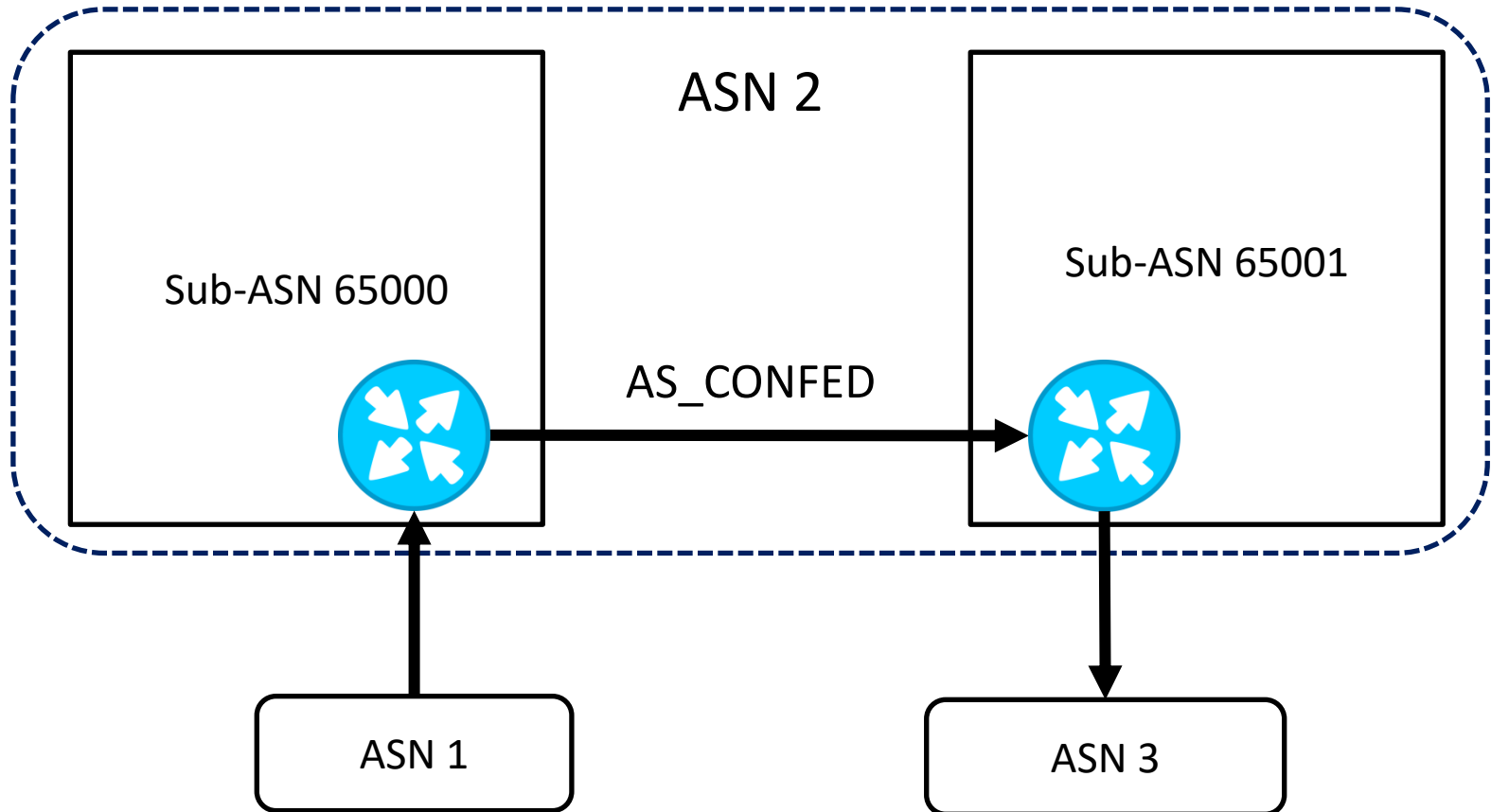| Target	rfc 7705
Preference transmission	1. Synchronize Local Preference Values 2. Unite all RR in cluster
'Hot potato' routing	**Built in**
Path length	**Partial increased / Loop Risk**
Route Leak prevention	Community synchronization

What if you have single RR in legacy AS?

What if you have more than two networks to migrate?

rfc5065: ASN Confederations

ASN 1

Sub-ASN 65000
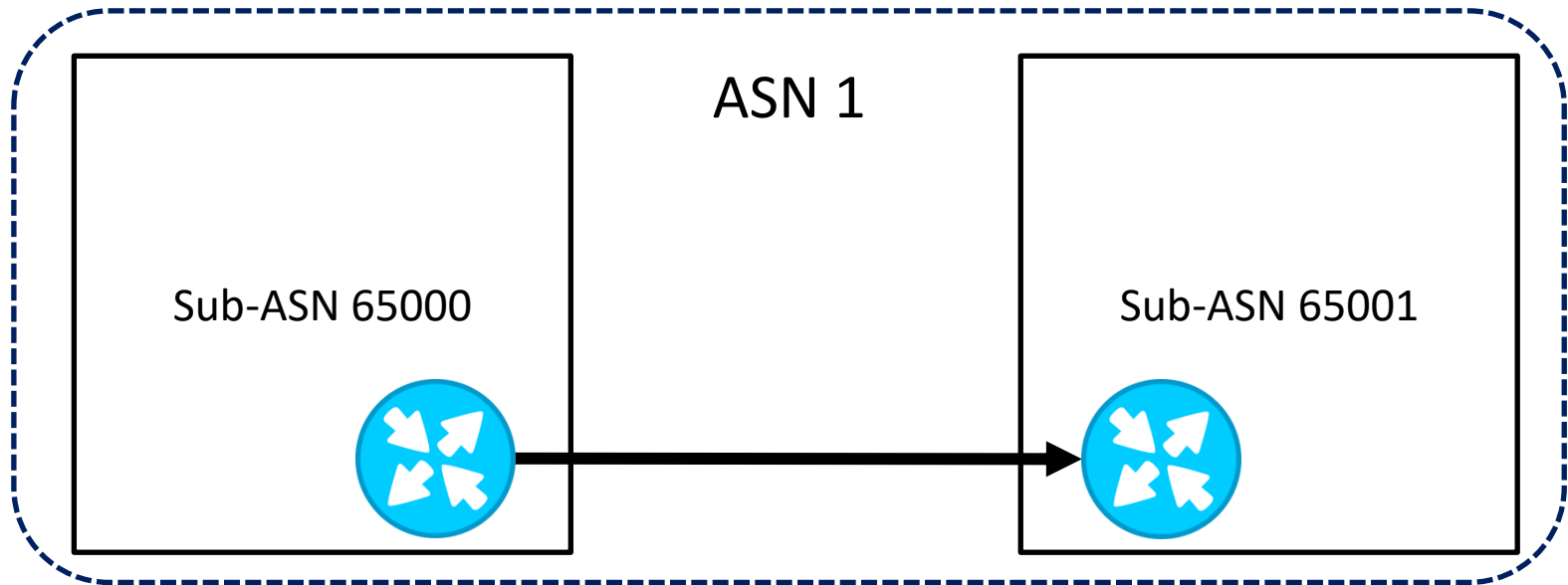
Sub-ASN 65001

A collection of autonomous systems represented and advertised as a single AS number to BGP speakers that are not members of the local BGP confederation.

rfc5065: Internal Routing

	ASN 1	ASN 65000	ASN 65001	ASN 3
AS Path	1	1	(65000) 1	2 1

rfc5065: Multiple sub-ASNs – One ASN

Target	rfc5065
Preference transmission	1. Synchronize Local Preference Values 2. Synchronize confederation list
'Hot potato' routing	**Built in**
Path length	**Not increased**
Route Leak prevention	Community synchronization

How to extend to multi-ASN level?

ISP Border Definition

BGP Session is Internal if:

Neighbor ASN = Local ASN	Plain BGP
Neighbor ASN = Global or Local ASN	rfc5065
Neighbor ASN in Confederations list	rfc7705

Next technical problem – next ad-hoc?

The Neighbor Roles

OPEN with
internal role

OPEN with
peer role

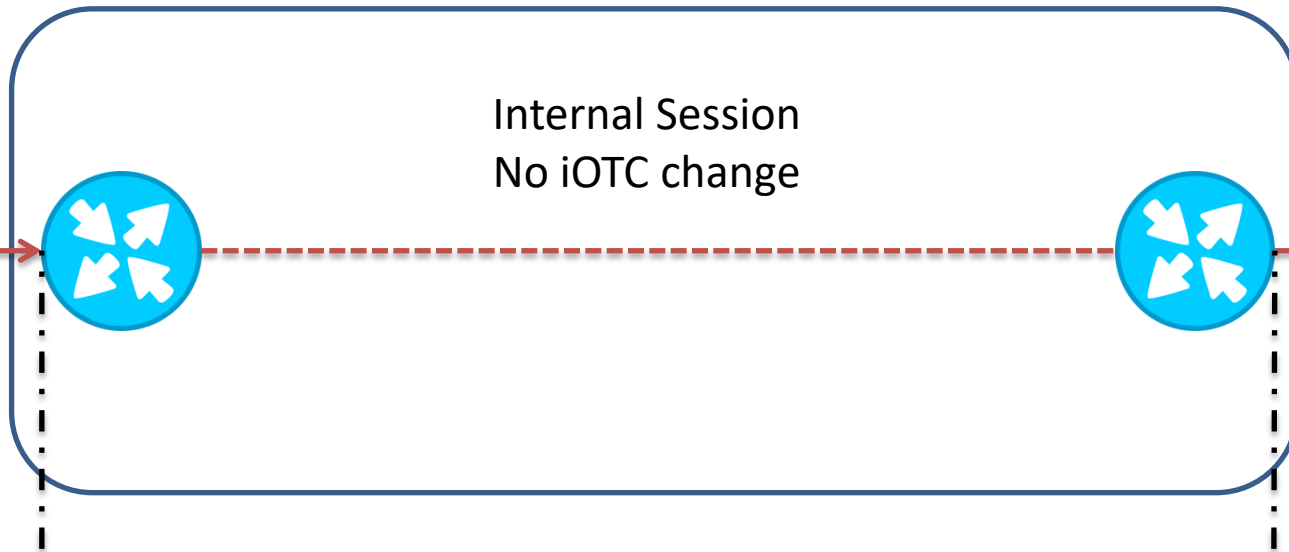Notification →

← Notification
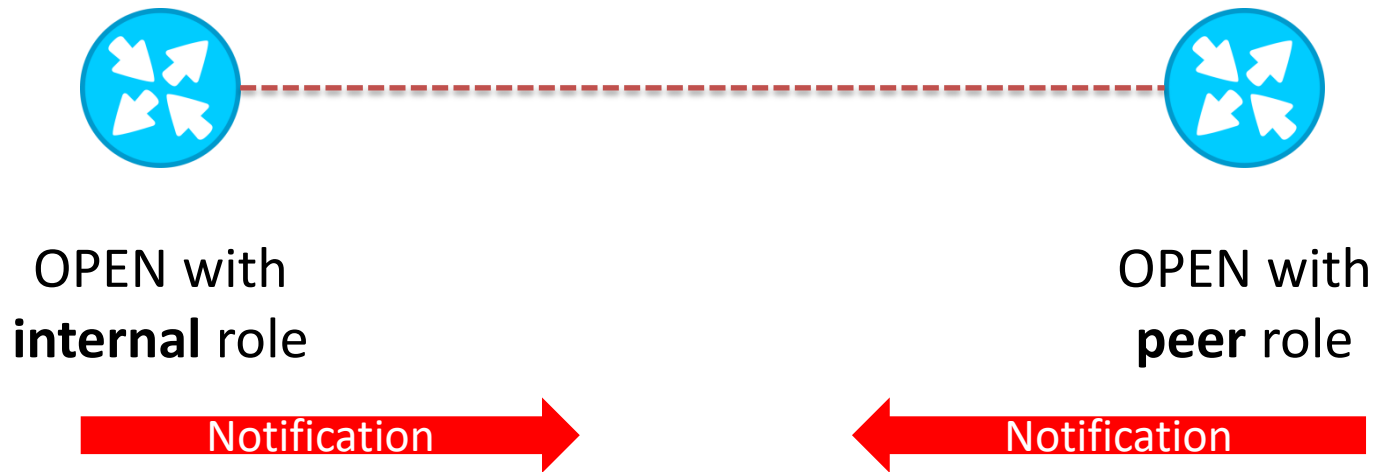
4 pairs of non-conflict roles:
1. Peer <---> Peer
2. Customer <---> Provider
3. Complex <---> Complex
4. **Internal <---> Internal**

Preventing Route Leaks

iOTC – internal Only To Customer attribute (zero size)

Internal Session
No iOTC change

Set iOTC if neighbor is
customer or peer

Filter routes if iOTC is set and
neighbor is customer or peer

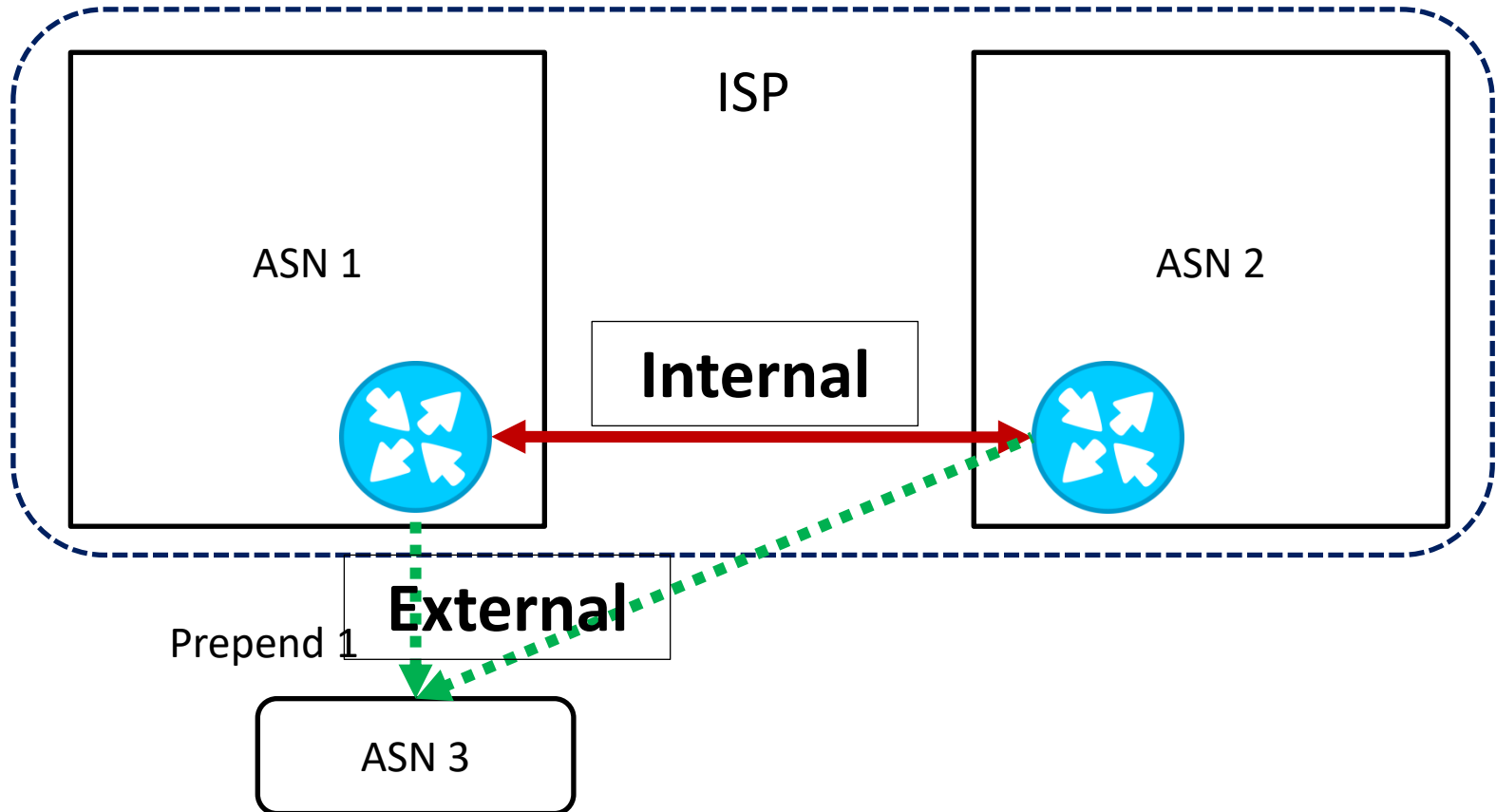If route was learned from a provider or peer it should not be
announced to another provider or peer

ISP Border Definition

OPEN with
Internal role

OPEN with
Internal role

OPEN →

← OPEN
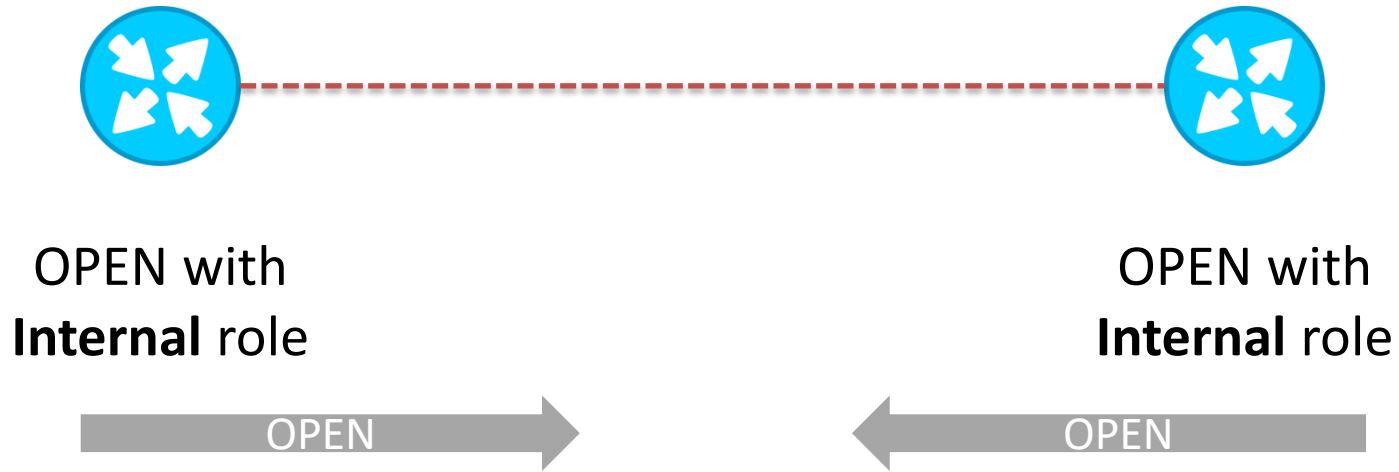
Enable transmission of local attributes through
If both sides are **Internal**

Securing 'Hot potato' routing

ISP

ASN 1

ASN 2

Internal

External

Prepend 1

ASN 3

	ASN 1	ASN 2
AS Path	3 3	3

Multiple ASNs – One Network

Target	BGP + roles
Preference transmission	1. Synchronize Local Preference Values 2. Synchronize roles
'Hot potato' routing	**Built in**
Path length	**Increased / Loop Risk**
Route Leak prevention	**Built in**

ISP Confederations

ASN 1

ISP

ASN 2
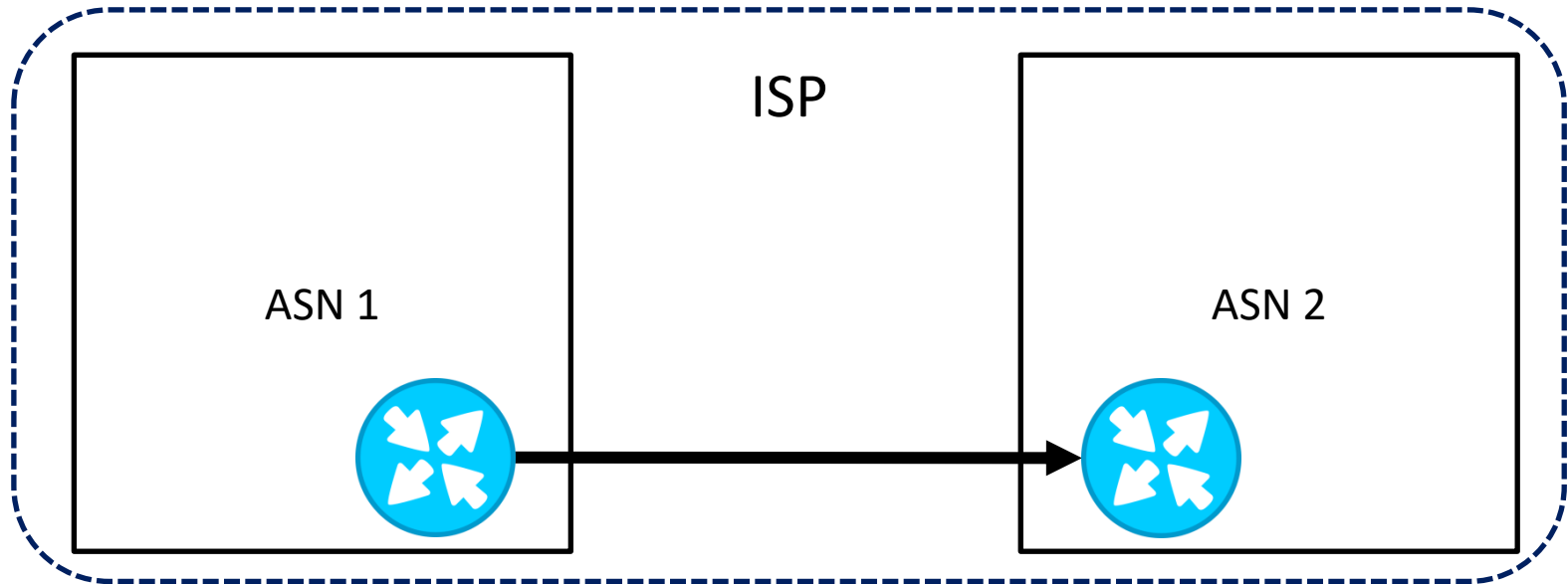
A collection of autonomous systems ~~represented and~~ advertised as a single AS number BGP speakers that are not members of the local BGP confederation.
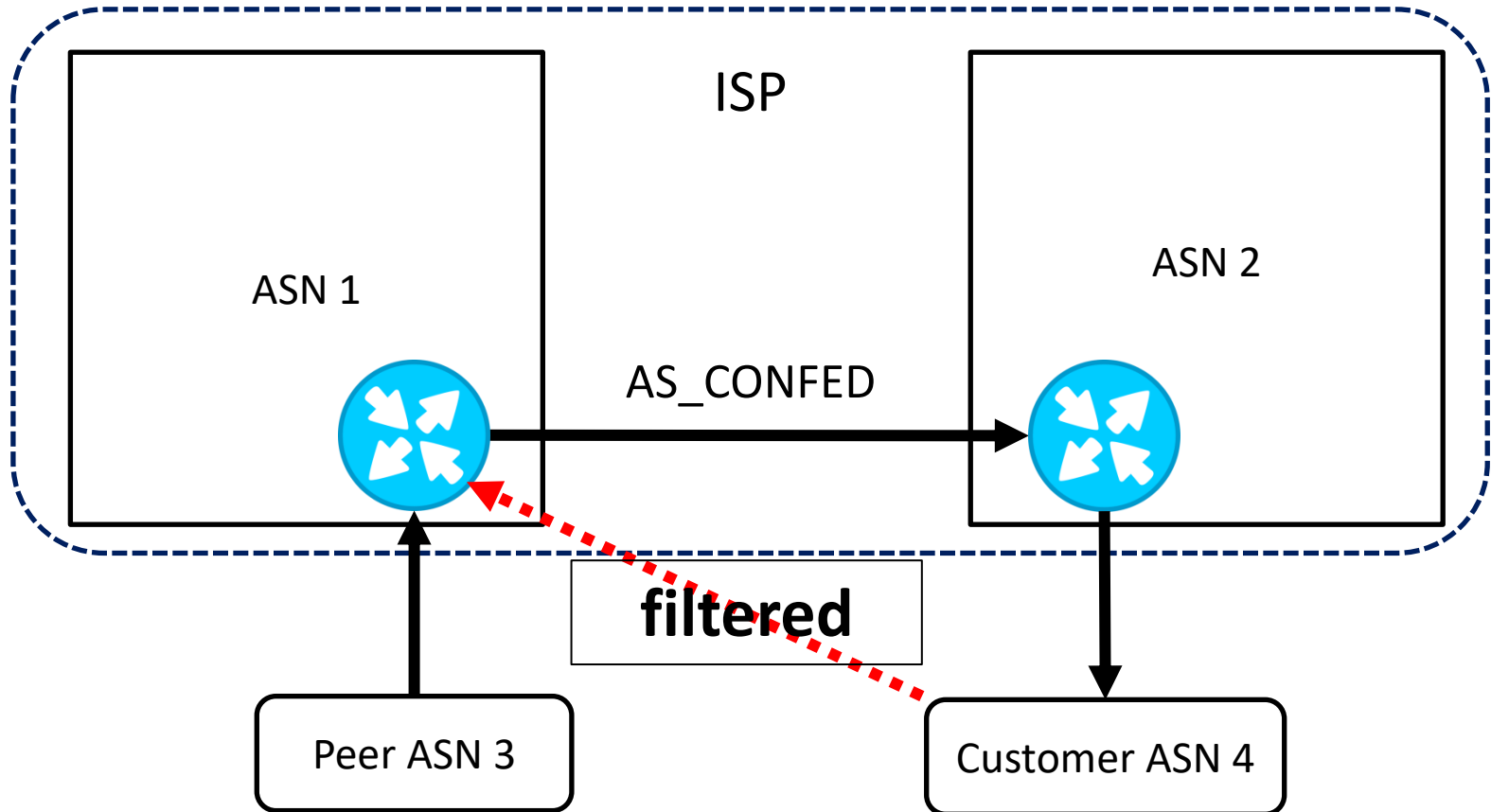
Loop Prevention

Internal Routing – likewise ASN confederation;

External Routing – filter routes with AS Path segments from confederation list;

These two rules guarantees loop free scenario!

Path Length

ISP

ASN 1

ASN 2

AS_CONFED

filtered

Peer ASN 3

Customer ASN 4

	ASN 1	ASN 2	ASN 4
AS Path	3	3 (1)	2 3

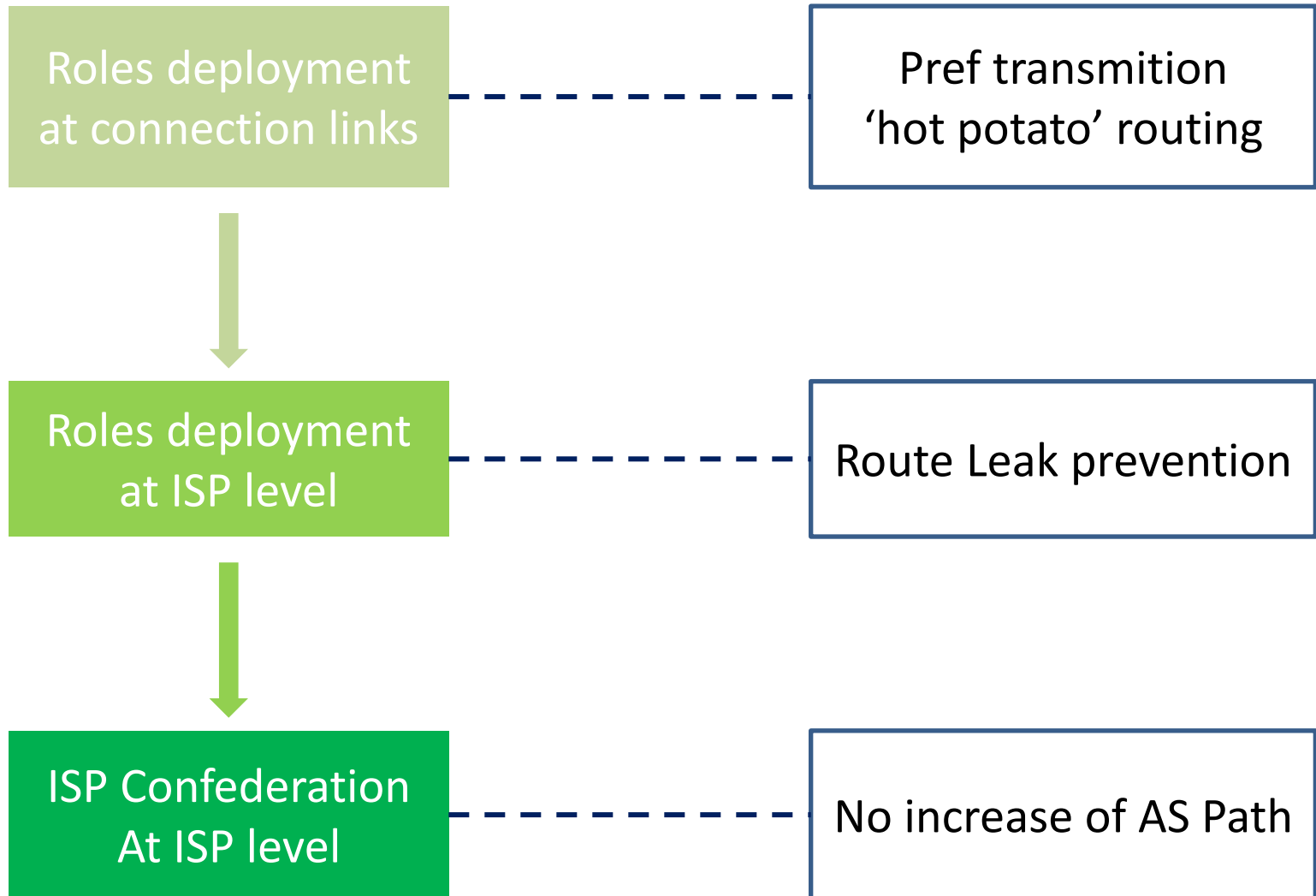# A Simple Config

```
protocol bgp IAMOPERATOR_1 {
    local as MY_AS1;
    neighbor X.X.X.X as MY_AS2;
    role internal;
    confederation MY_AS1, MY_AS2;
}
```

Multiple ASNs – One Network

Target	BGP + Roles + ISP Confederations
Preference transmission	1. Synchronize Local Preference Values 2. Synchronize roles 3. Synchronize Confederation List
'Hot potato' routing	**Built in**
Path length	**Not increased**
Route Leak prevention	**Built in**

There was no simple way!

Migration Process

Roles deployment at connection links - - - - Pref transmition 'hot potato' routing

↓

Roles deployment at ISP level - - - - Route Leak prevention

↓

ISP Confederation At ISP level - - - - No increase of AS Path

Summary

- ASN union vs ASN migration;
- Utilization with BGP confederations;
- Simplified configuration with no AS Path increase;
- Route Leak prevention;
- No affect on networks with single ASN.

Useful Links

- [Draft](), [description]() and [implementation]() of roles and route leak mitigation;
- [Description]() and [implementation]() of ASN union.