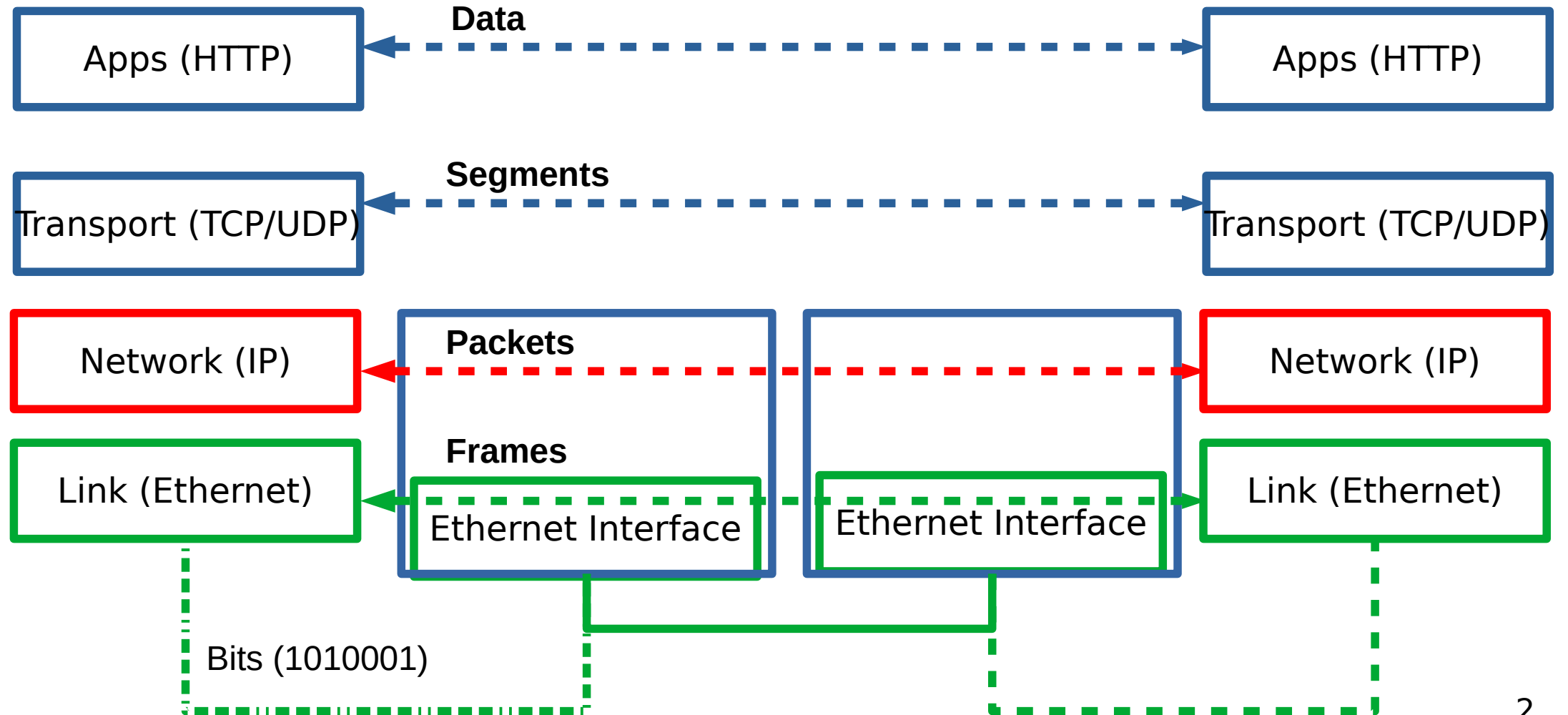# CSC4200/5200 – COMPUTER NETWORKING

Instructor: Susmit Shannigrahi

BGP - CONTINUED

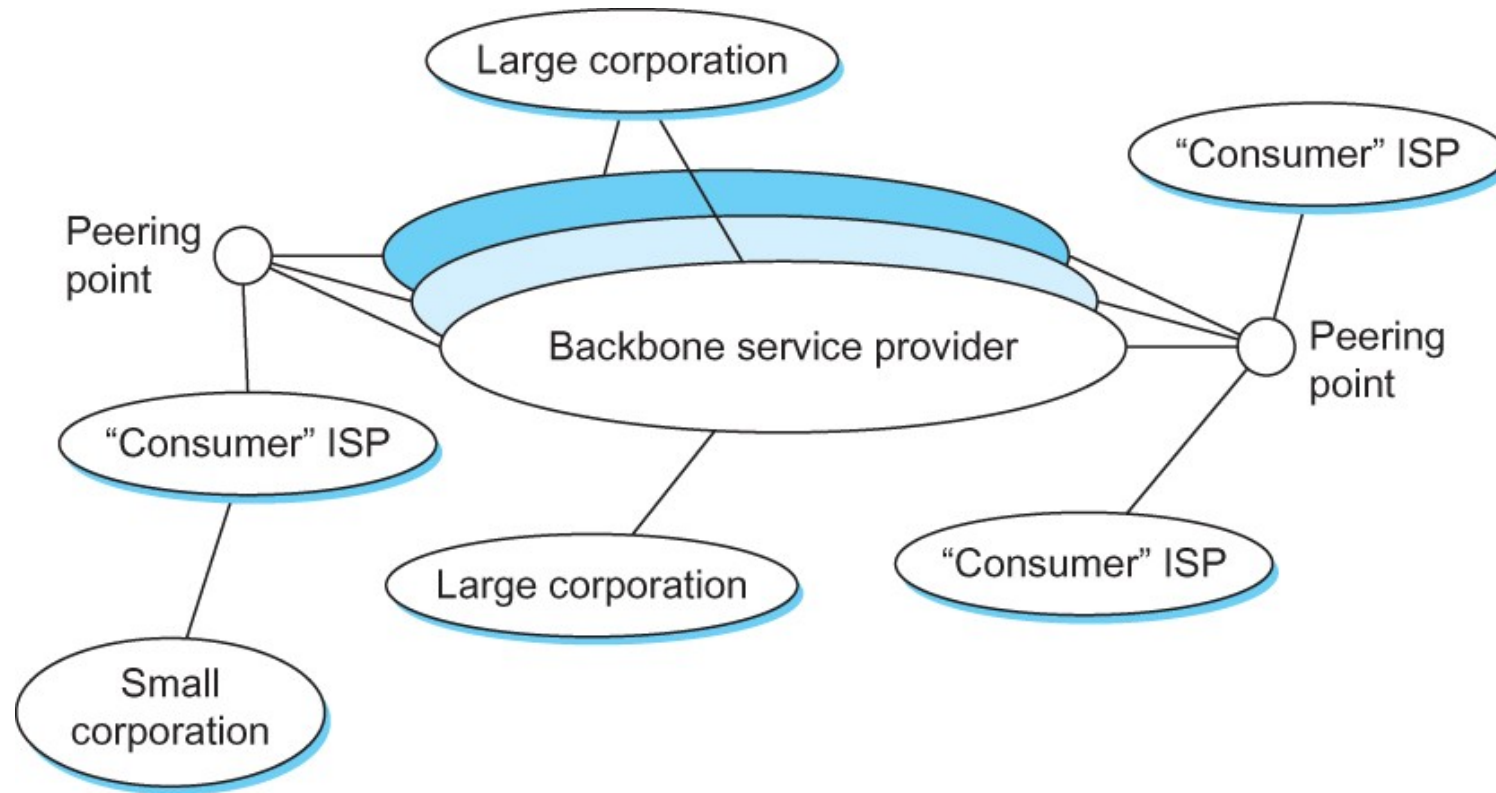**sshannigrahi@tntech.edu**

GTA: dereddick42@students.tntech.edu

Tennessee
TECH

| Apps (HTTP) | **Data** | Apps (HTTP) |

| Transport (TCP/UDP) | **Segments** | Transport (TCP/UDP) |

| Network (IP) | **Packets** | | | Network (IP) |

| Link (Ethernet) | **Frames** | Ethernet Interface | Ethernet Interface | Link (Ethernet) |

Bits (1010001)

So far…

- Routing
  How do we scale routing?

Internet now

Hierarchical routing - Policy

scale: with 600 million destinations:

- can't store all dest's in routing tables!
- routing table exchange would swamp links!
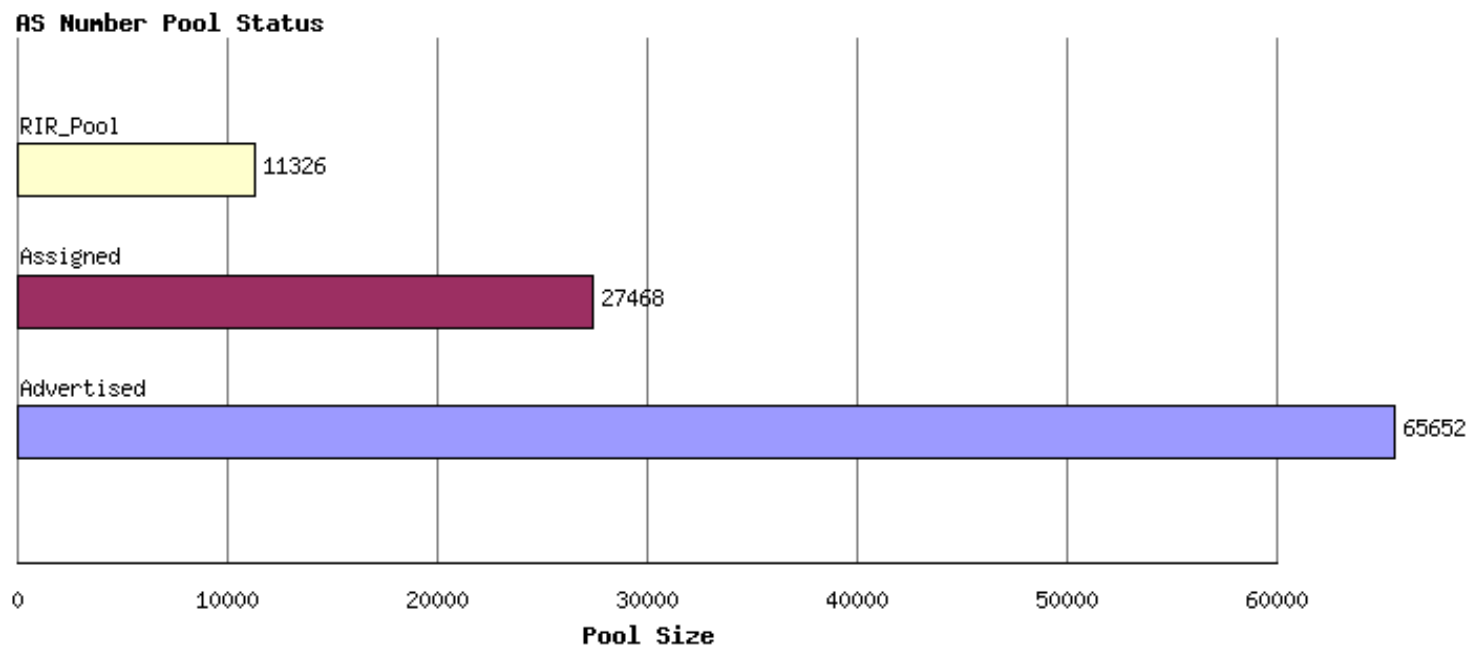
administrative autonomy

- internet = network of networks
- each network admin may want to control routing in its own network

Autonomous systems (ASes)

- AS
  - A set of routers under a single technical administration
  - Uses IGP within the AS to route packets
  - Uses BGP between Ases to route packets

- What happens inside an AS stays within that AS!
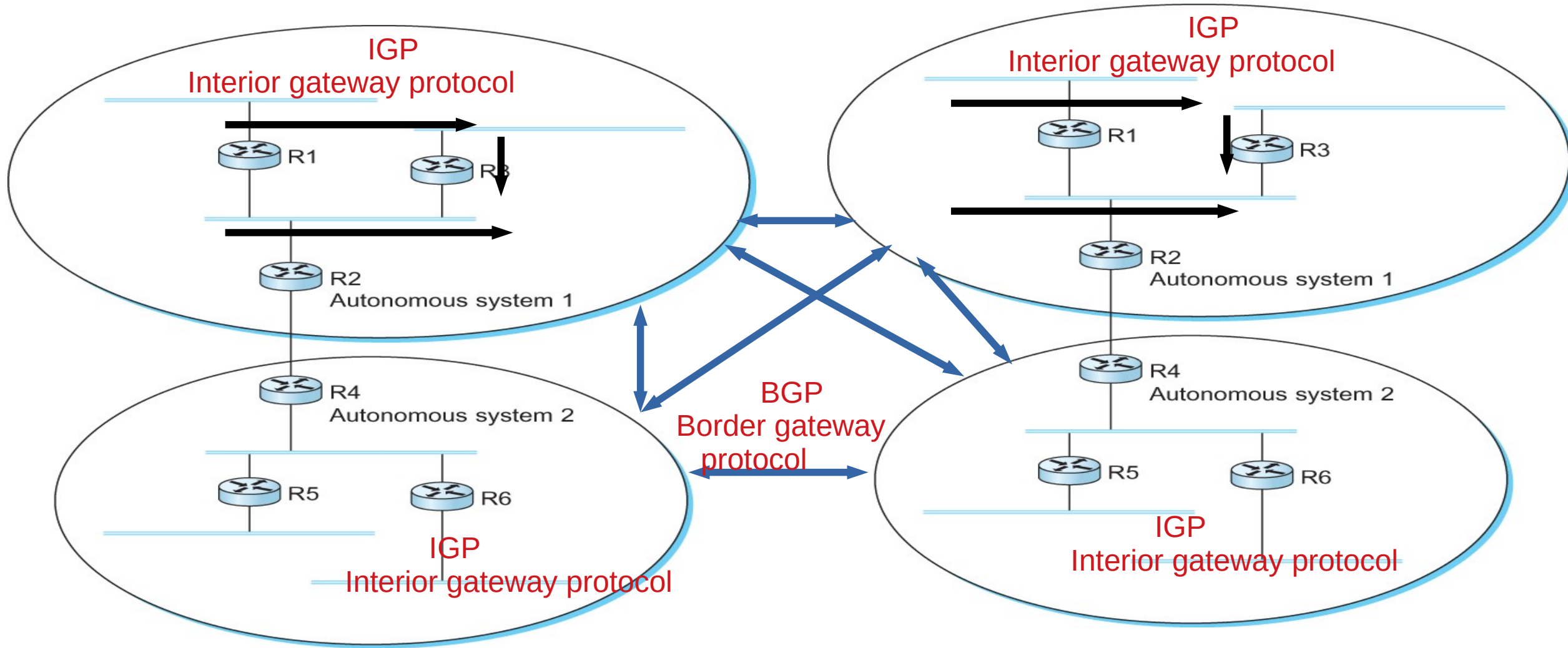 - That is, AS decides routing metrics internally

Status of ASNs

Status	AS Pool	16-bit	32-bit
IETF Reserved	95033874	1042	95032832
IANA Unallocated Pool	4199828976	0	4199828976
Allocated	104446	64494	39952
RIR Data			
AFRINIC	2302	1278	1024
APNIC	19093	8539	10554
ARIN	31567	25522	6045
RIPE NCC	39453	25729	13724
LACNIC	12031	3426	8605

AS Number Pool Status

RIR_Pool — 11326
Assigned — 27468
Advertised — 65652

Pool Size

http://www.potaroo.net/tools/asn32/

Interdomain Routing

A network with four autonomous systems

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BGP-4: Border Gateway Protocol

IGP
Interior gateway protocol

AS1000

R1

R3

AS1

R2
Autonomous system 1

AS2
Multihomed
AS

R3 Will **not** carry traffic between R2 and R1

AS5000
Transit AS

R4
Autonomous system 2

R5

R6

AS3

AS5000 Will carry traffic between AS1 and AS1000
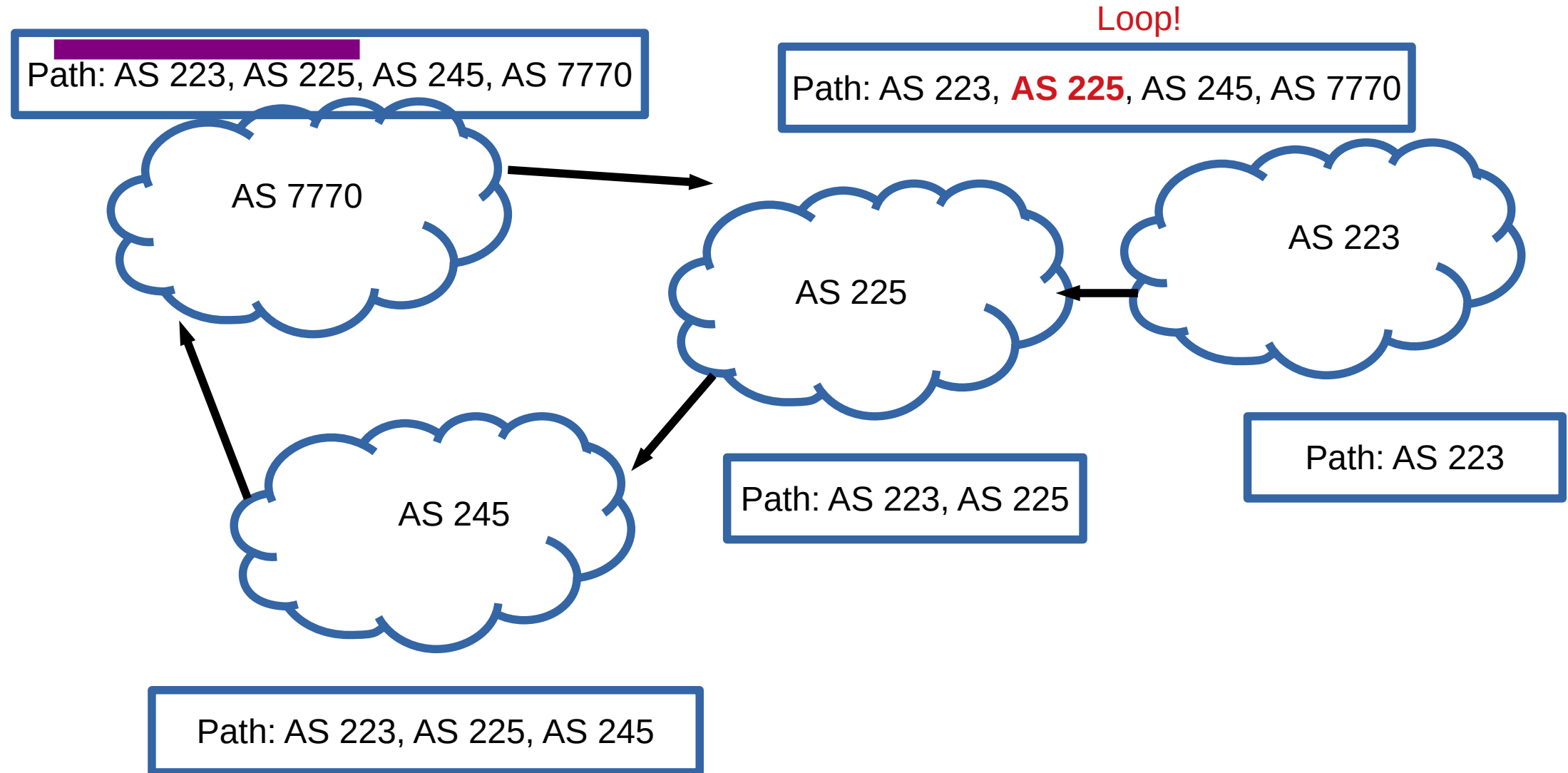
AS7
Stub AS

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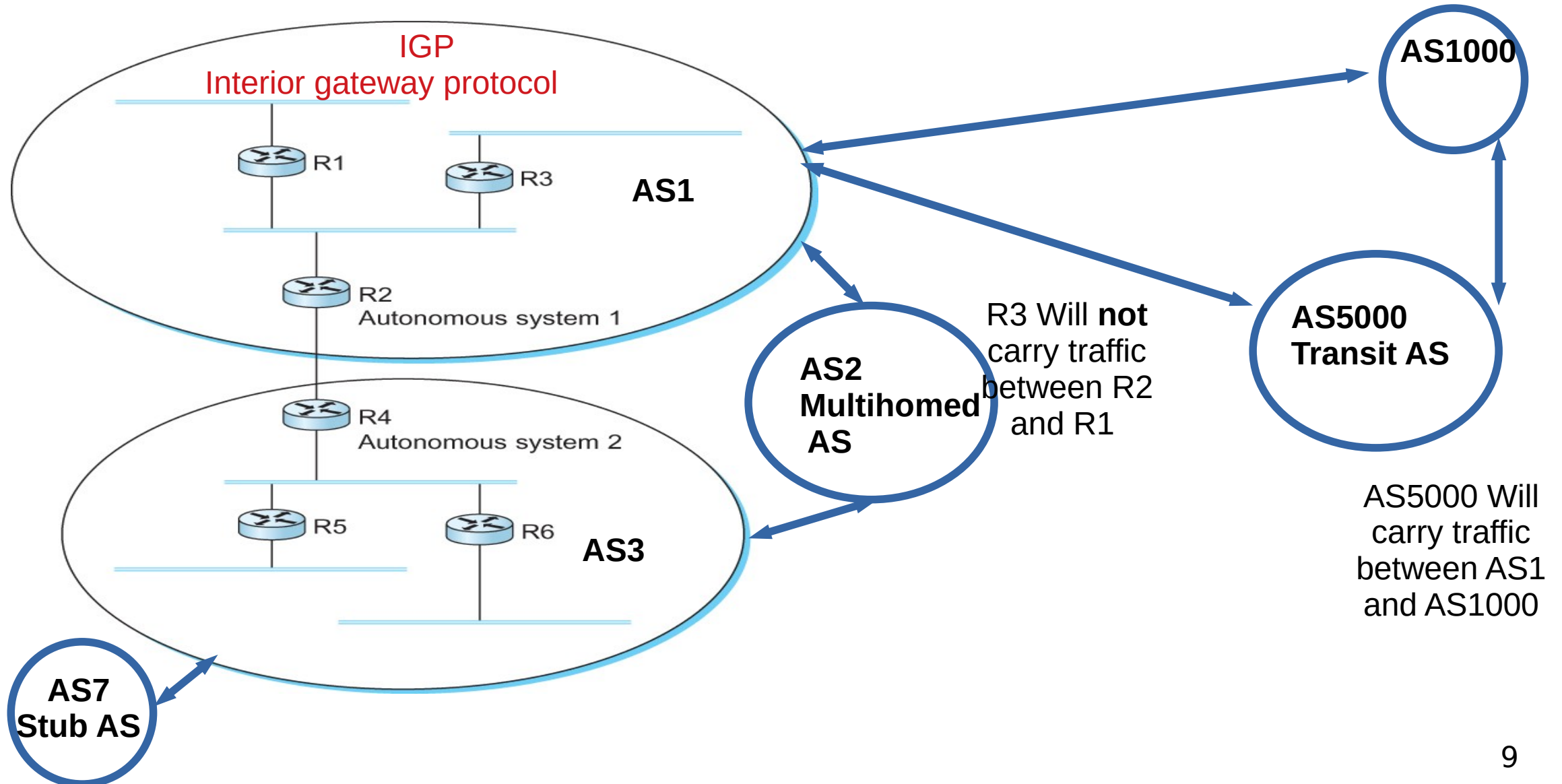
BGP - goals

- The goal of Inter-domain routing is to find **any path** to the intended destination that is **loop free**

  - **We are concerned with reachability than optimality**
  - Finding path anywhere close to optimal is considered to be a great achievement

- Why?

BGP: Path vector protocol

- Send the whole path with the routing update

- Loops are detected if an AS finds itself in the path
  - Reject if so
  - Accept otherwise

- Add self to the path and advertise to the neighbors

- Advantage: No loops, Local decision before advertising

BGP: Path vector protocol

Path: AS 223, AS 225, AS 245, AS 7770

Loop!

Path: AS 223, **AS 225**, AS 245, AS 7770

AS 7770

AS 225

AS 223

Path: AS 223, AS 225

Path: AS 223
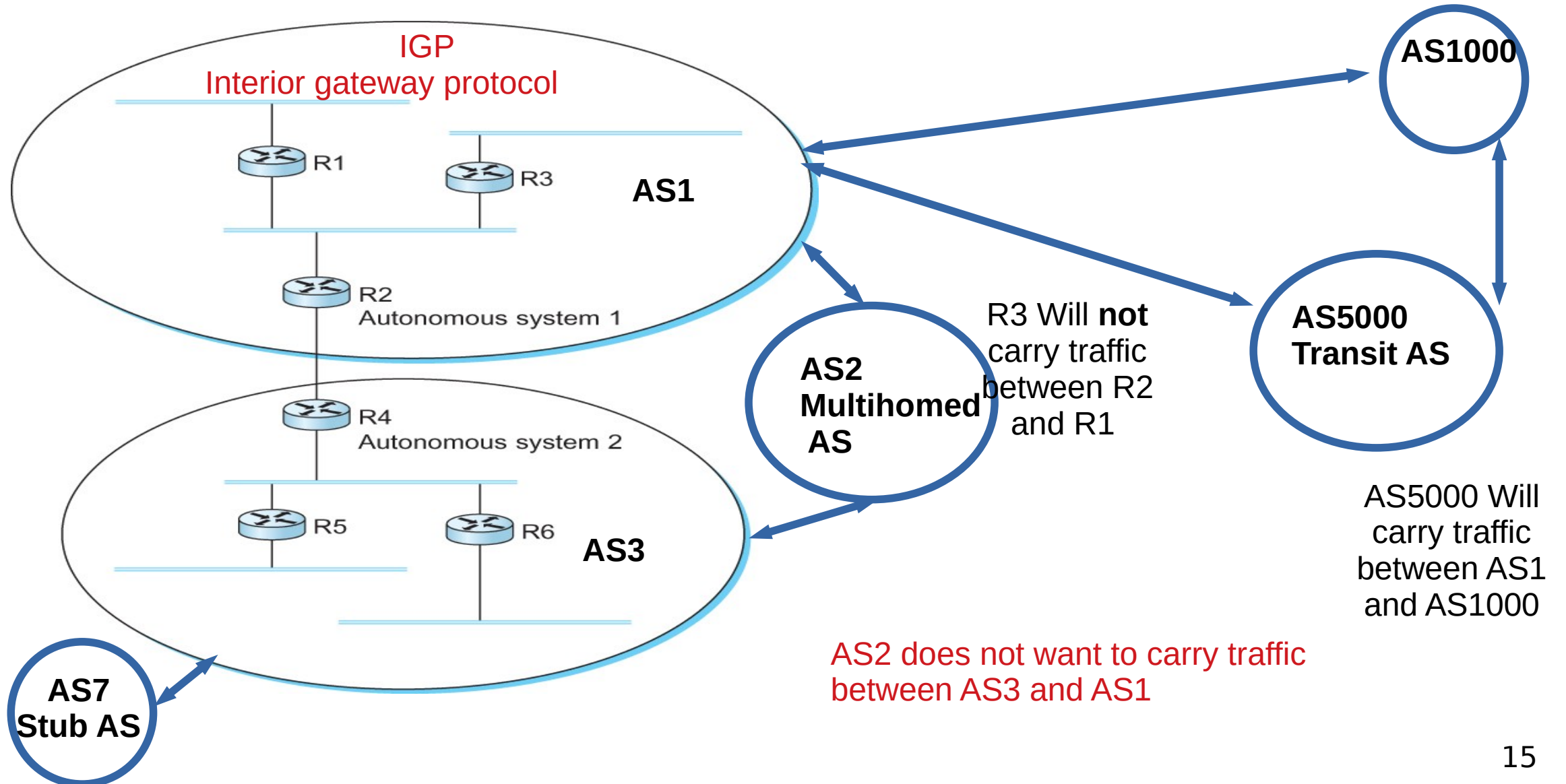
AS 245

Path: AS 223, AS 225, AS 245

BGP: Allows for policy

- Capable of enforcing various policies
  - AS2 → Don't use AS1 to get to AS3

- Not part of BGP – configuration information that controls propagation of paths

BGP: Hop by Hop model and control what you tell your neighbors

- You can only tell others what you are using
  - But you control what you say

- BGP advertises only to peers
  - Tell them what you are using
  - Hop-by-hop model

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What should AS2 (multihomed) tell AS3?

IGP
Interior gateway protocol

R1

R3

AS1

R2

Autonomous system 1

AS1000

AS5000
Transit AS

AS2
Multihomed
AS

R3 Will **not** carry traffic between R2 and R1

R4

Autonomous system 2

R5

R6

AS3

AS7
Stub AS

AS5000 Will carry traffic between AS1 and AS1000

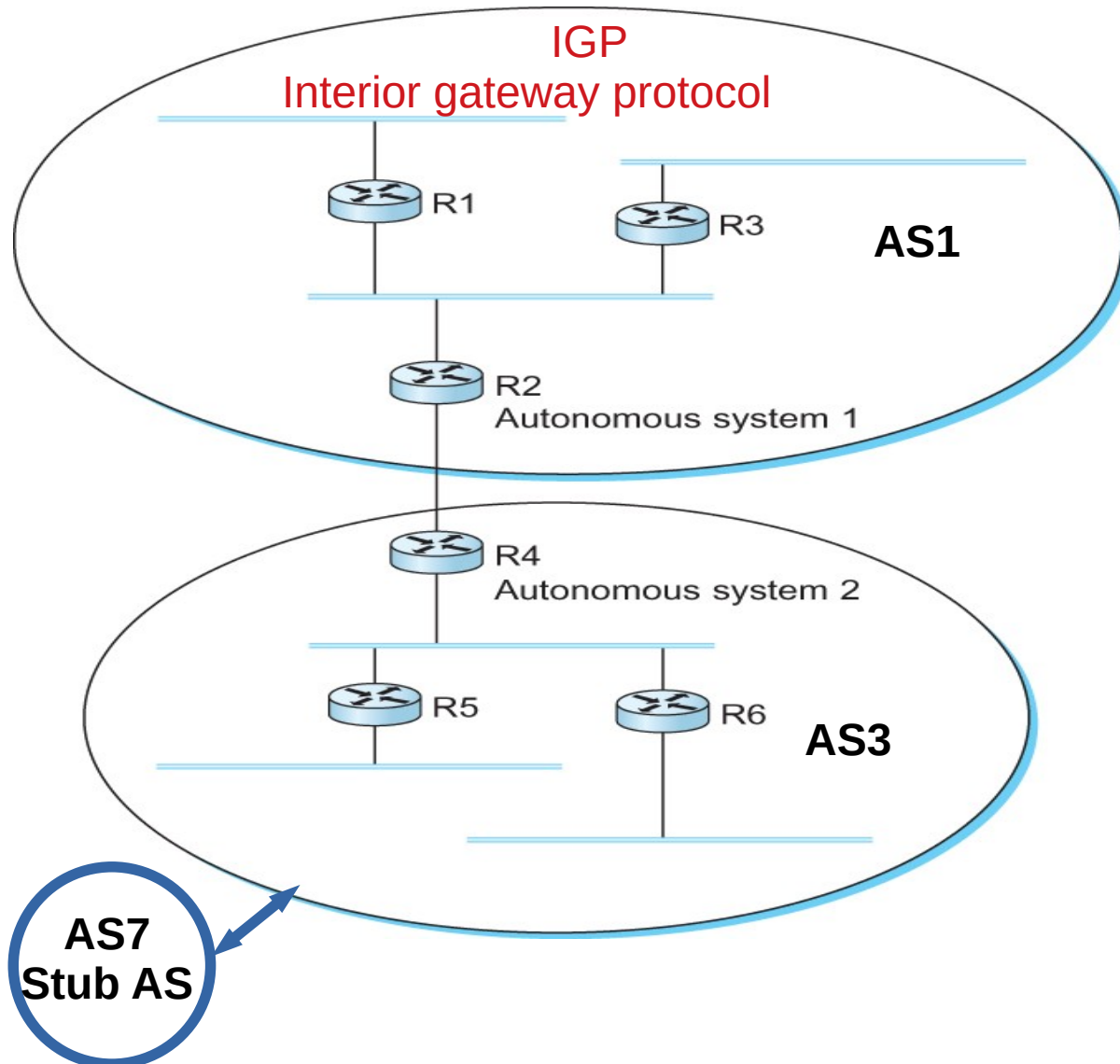AS2 does not want to carry traffic between AS3 and AS1

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Examples BGP Policies

- Multihomed AS100 does not want to act as a transit
  - Limit advertisement

- If someone pays AS100 – yes
  - Advertise only to those who are paying

- Prefer one path over the other
  - Play with the cost, artificially increase path length and so on ← more on this late

Examples BGP Policies

- Multihomed AS100 does not want to act as a transit
  - Limit advertisement

- If someone pays AS100 – yes
  - Advertise only to those who are paying

- Prefer one path over the other
  - Play with the cost, artificially increase path length and so on ← more on this late

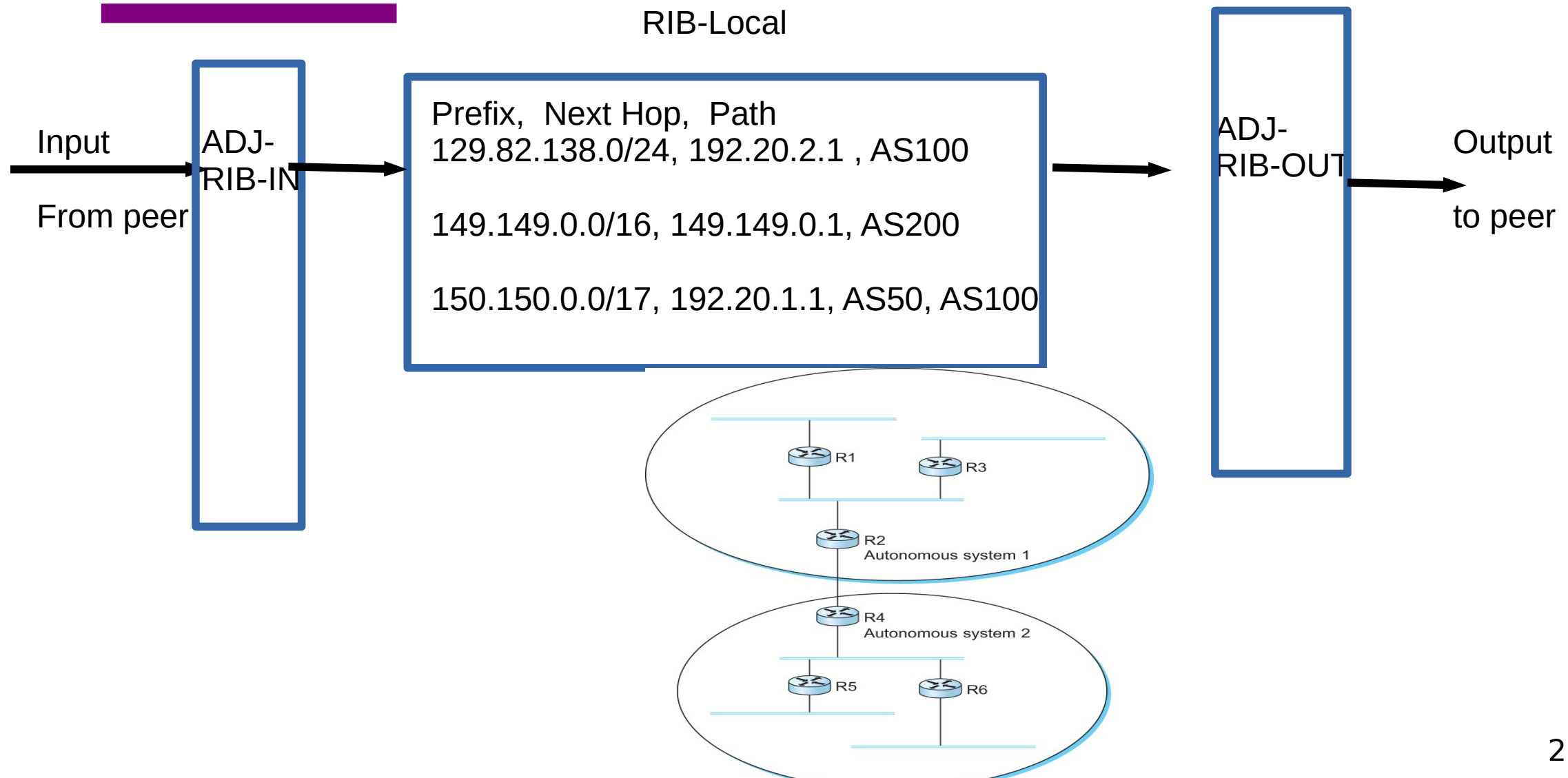# You don't need BGP for Stub ASes

IGP
Interior gateway protocol

R1
R3   **AS1**

R2
Autonomous system 1

R4
Autonomous system 2

R5   R6   **AS3**

**AS7
Stub AS**
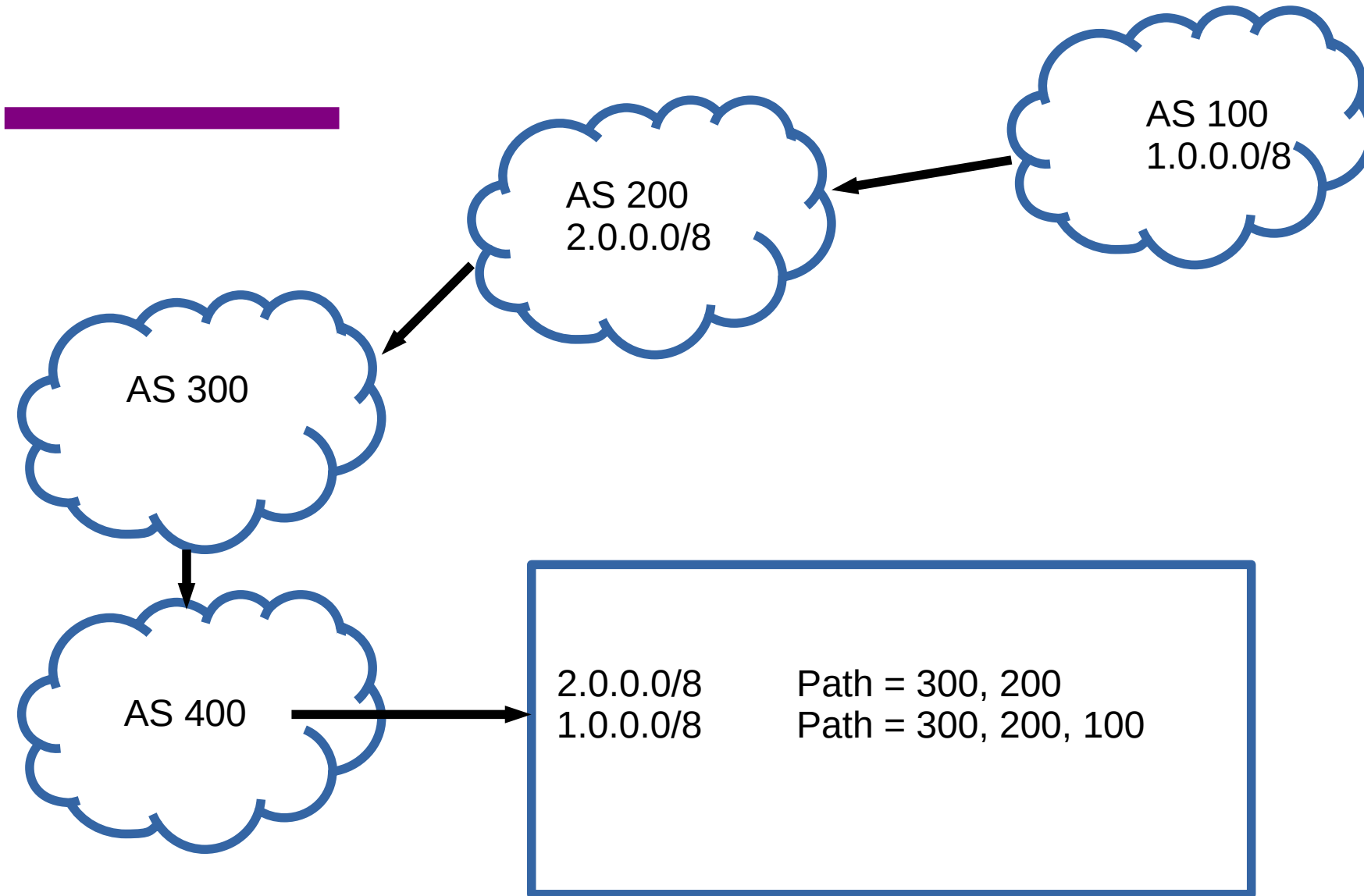
Default IP route should be sufficien[t]

BGP Messages

- Open – Open a TCP connection to a peer

- Update – Update route attributes or withdraw

- Notification – Error notification, close connection

- Keep alive – Periodic update to peers

Routing Information Bases (RIB)

Input

From peer

ADJ-
RIB-IN

RIB-Local

Prefix, Next Hop, Path
129.82.138.0/24, 192.20.2.1 , AS100

149.149.0.0/16, 149.149.0.1, AS200

150.150.0.0/17, 192.20.1.1, AS50, AS100

ADJ-
RIB-OUT

Output

to peer

R1   R3

R2
Autonomous system 1

R4
Autonomous system 2

R5   R6

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BGP Attributes - AS_PATH

AS 100
1.0.0.0/8

AS 200
2.0.0.0/8

AS 300

AS 400

2.0.0.0/8   Path = 300, 200
1.0.0.0/8   Path = 300, 200, 100

BGP Attributes – Next hop?

AS 100
1.0.0.0/8

AS 200
2.0.0.0/8

AS 300

3.0.0.0/8

IP router that does not speak BGP

Tells you where to send traffic -   Separate from BGP

AS200, 3.0.0.0/8   Path = 300, 200

BGP is a control protocol – IP forwards traffic
BGP tells you how to send IP traffic

AS 400

BGP Attributes – LOCAL-PREF

To AS400, PREF 100

AS 100
1.0.0.0/8

AS 200
2.0.0.0/8

AS 300

3.0.0.0/8

AS 400

To AS400, PREF 200

Provided by a BGP router to all other *internal* BGP routers

Tells you which way to send traffic

Lower preference wins!

BGP Attributes – LOCAL-PREF Example

AS 100
1.0.0.0/8

AS 200
2.0.0.0/8

a

b

4.0.0.0/8

4.0.0.0/8

c

d

AS 400
4.0.0.0/8
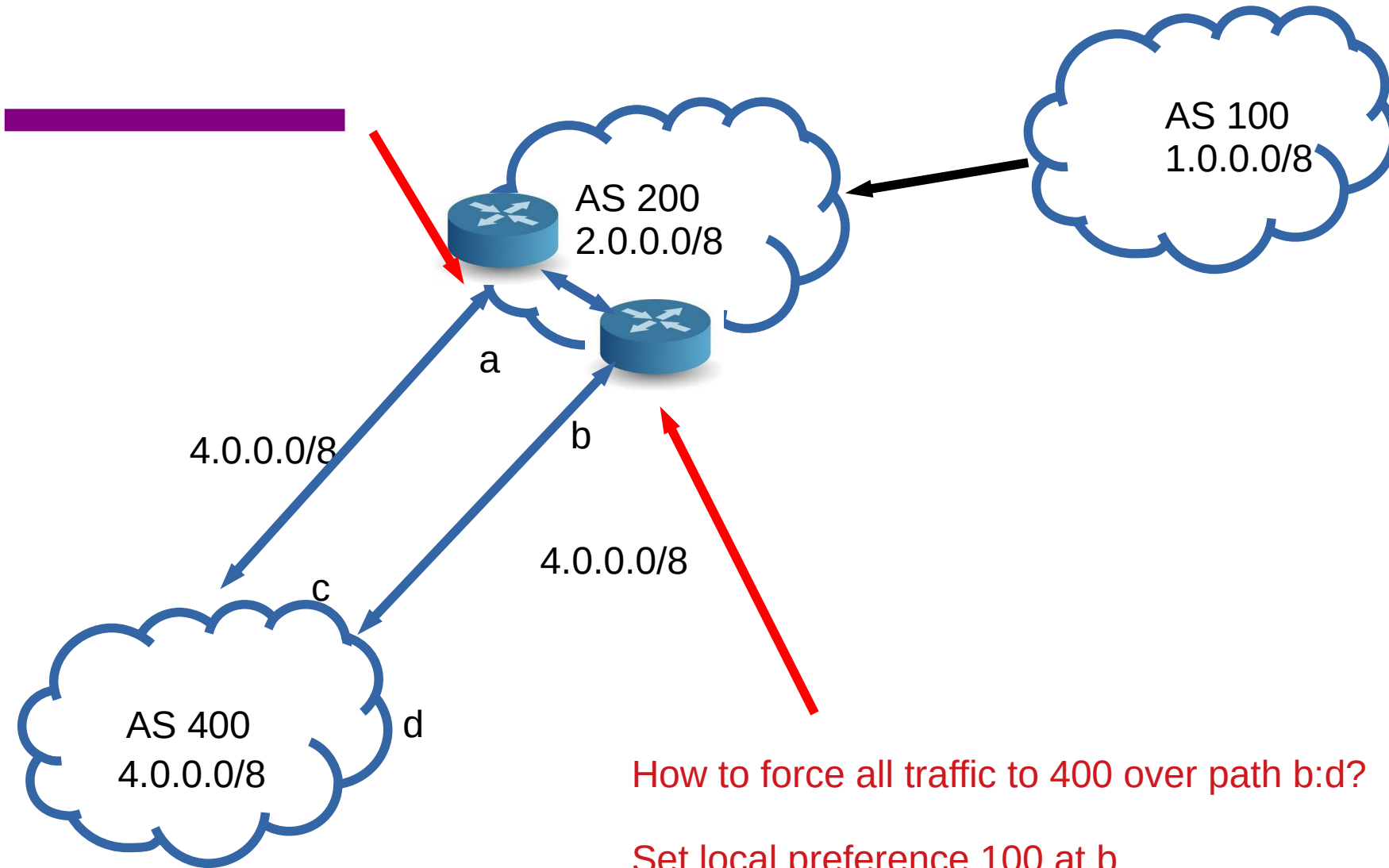
How to force all traffic to 400 over path b:d?

Set local preference 100 at b
Set local preference 200 at a

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