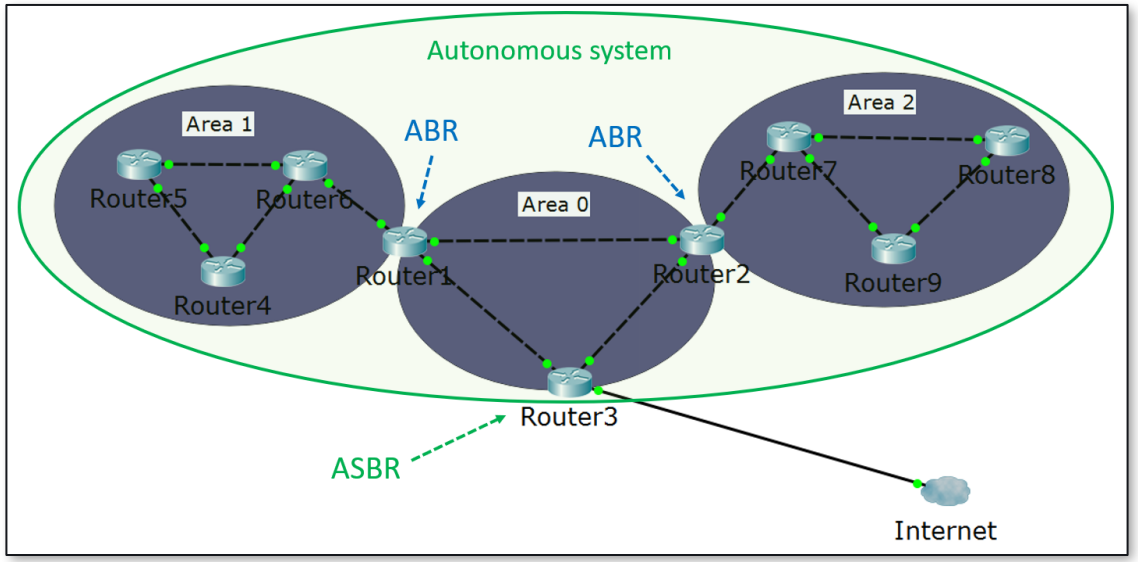
Dynamic routing with OSPF

Lecture 6



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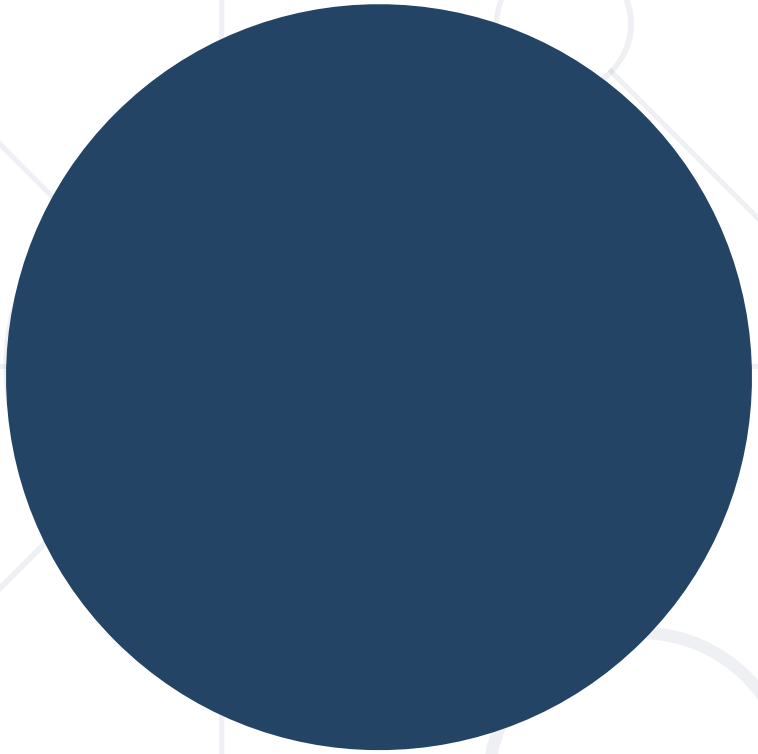


Introduction to dynamic routing

Static vs dynamic routing

- **Static routing**:
  - Routes to destination networks configured manually
  - Routing tables not updated if there is better route or lost network
  - Big administrative overhead, hard to manage
- **Dynamic routing**:
  - Routers dynamically exchange the networks they know about
  - Routing tables are created with the best routes to destinations
  - Routing tables dynamically create or remove entries

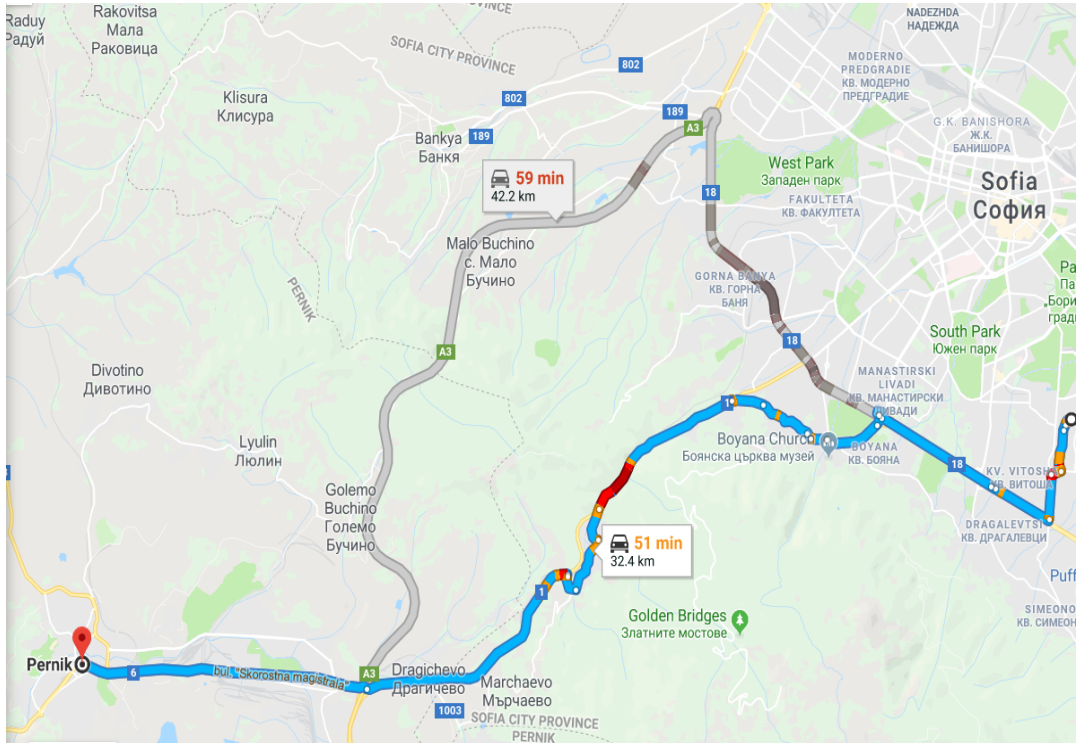
Distance-vector vs link-state protocols

- **Distance-vector protocols**
  - Designed for small networks
  - Not scalable
  - Examples: RIP, IGRP, BGP
- **Link-state protocols**
  - Designed for small, medium and large networks
  - Can scale
  - Examples: OSPF, IS-IS

Distance-vector vs link-state protocols (2)

- Distance-vector protocols

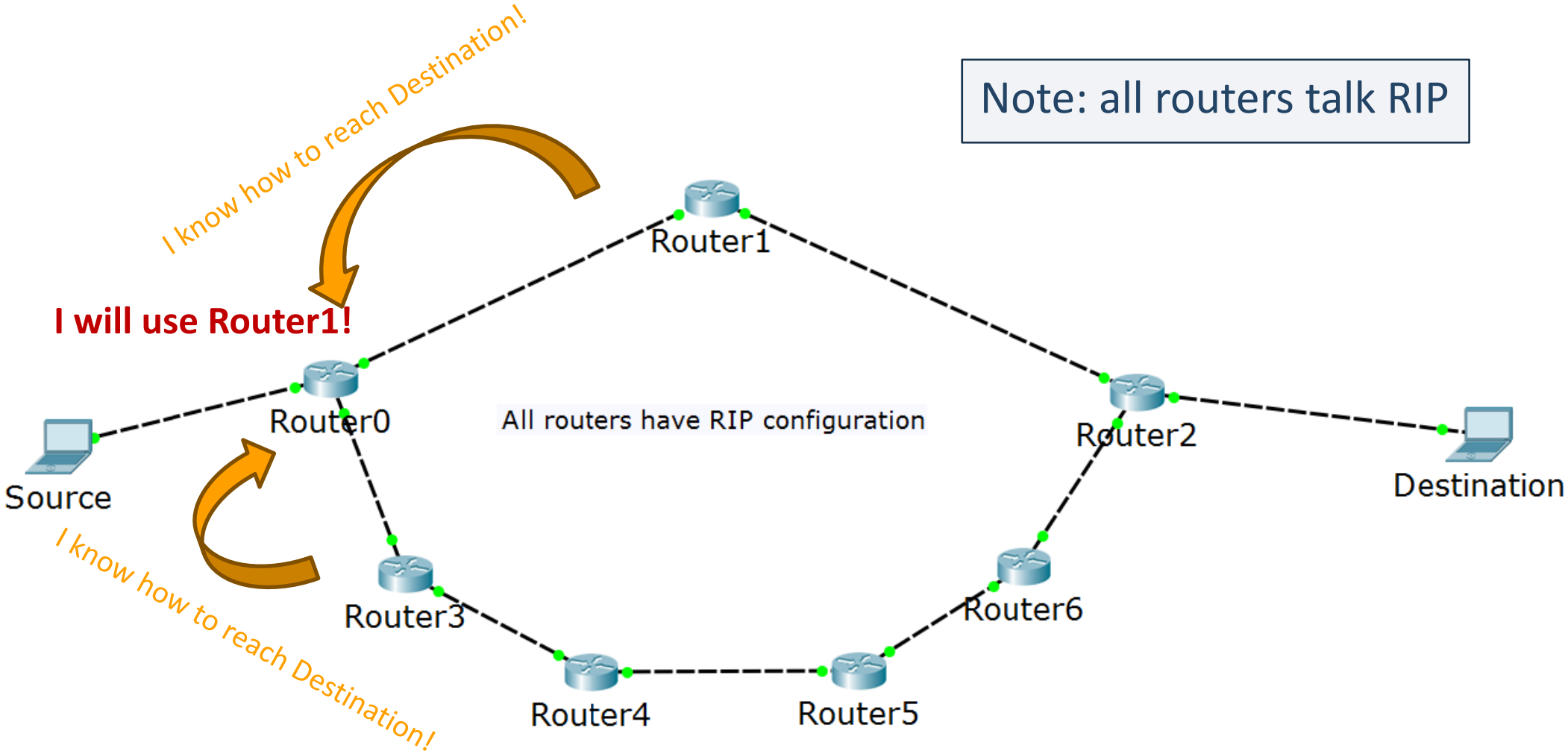
- Link-state protocols



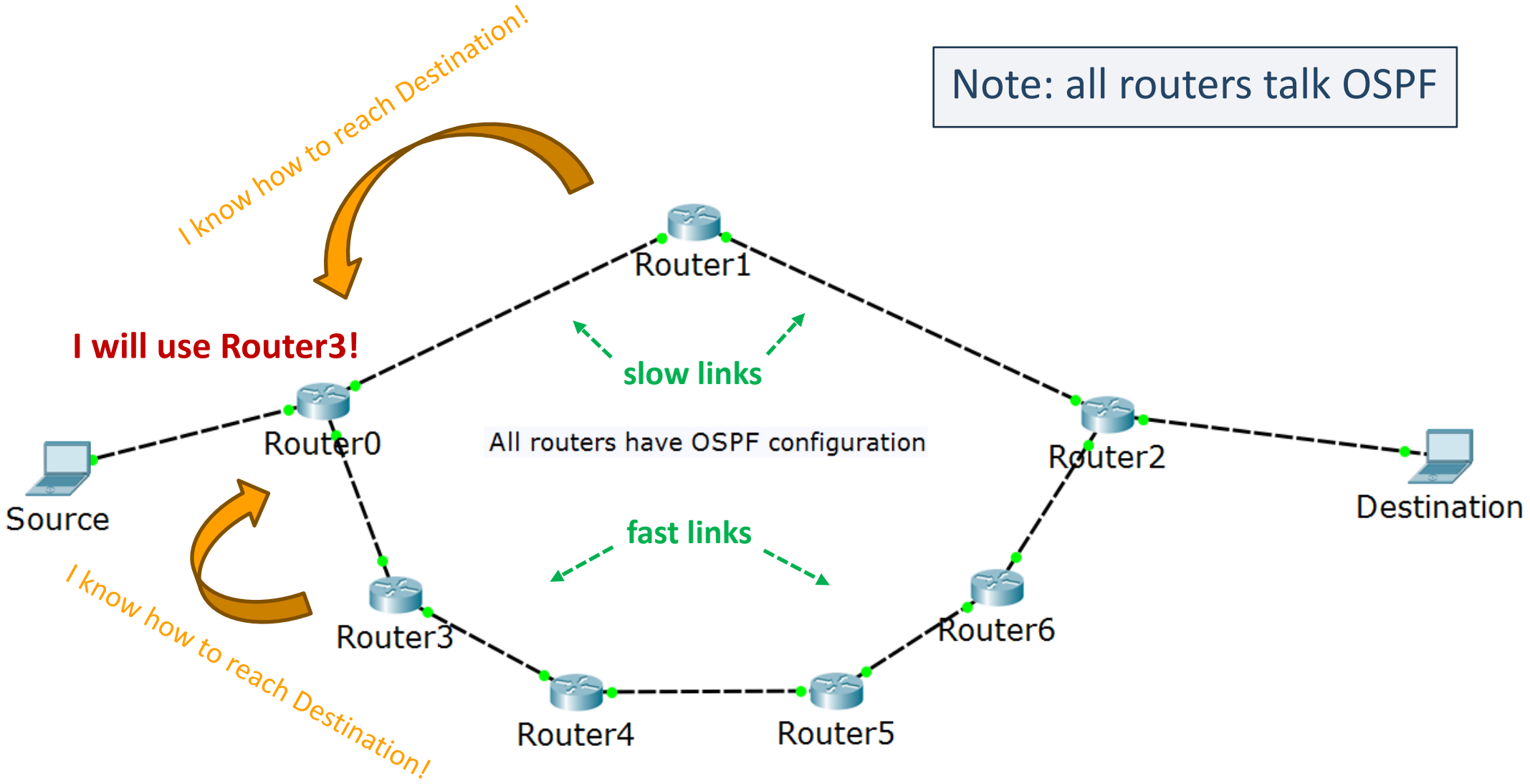
RIP vs OSPF

- RIP: Routing Information Protocol
  - Not efficient in the communication
    (uses broadcast, sends only periodic updates in v1)
  - Classful protocol (by default)
  - Uses hop count as a metric
- OSPF: Open Shortest Path First
  - Very efficient (uses multicast, sends triggered updates)
  - Classless protocol (but can summarize)
  - Uses cost as a metric

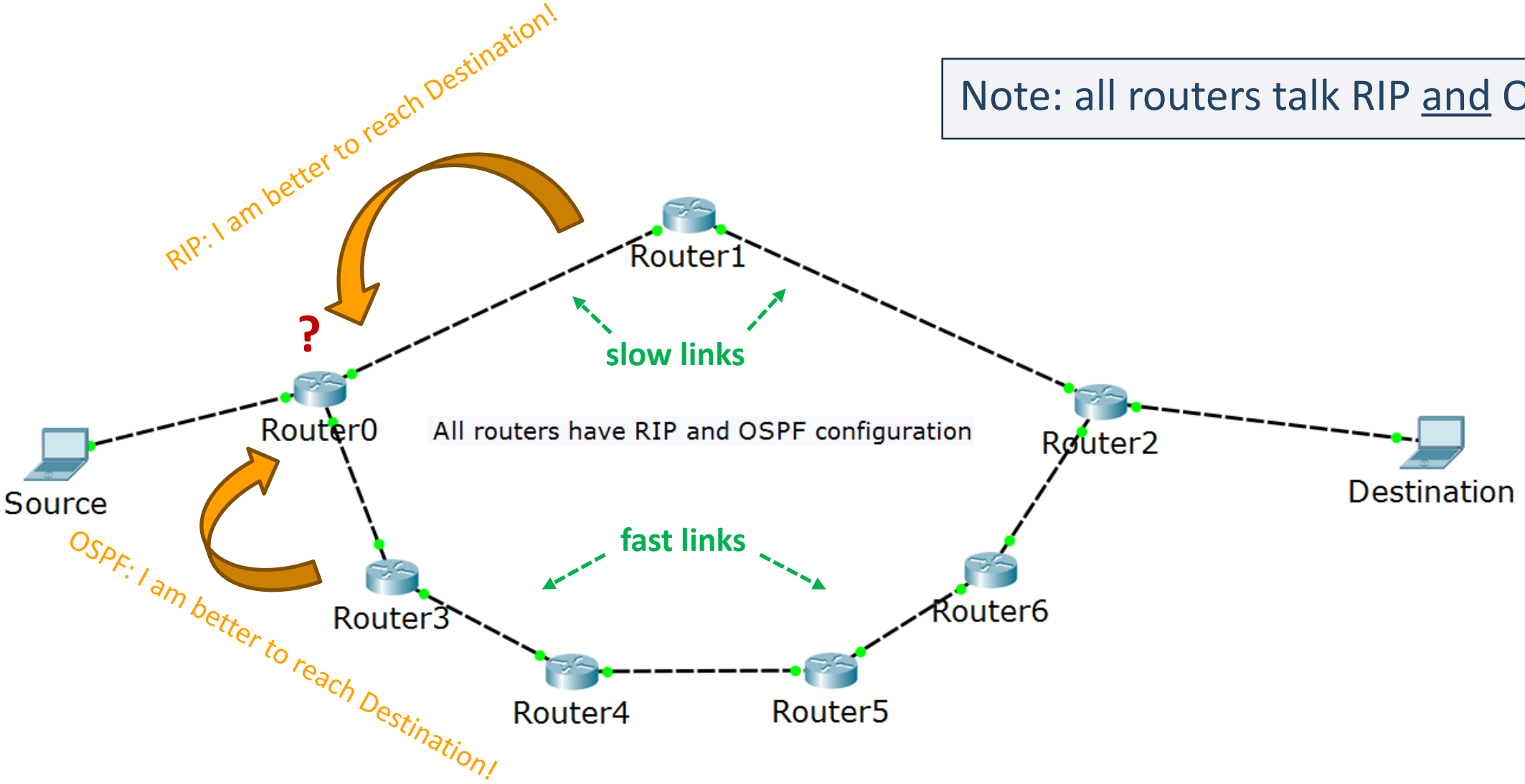
RIP Metric: hop count



OSPF Metric: cost



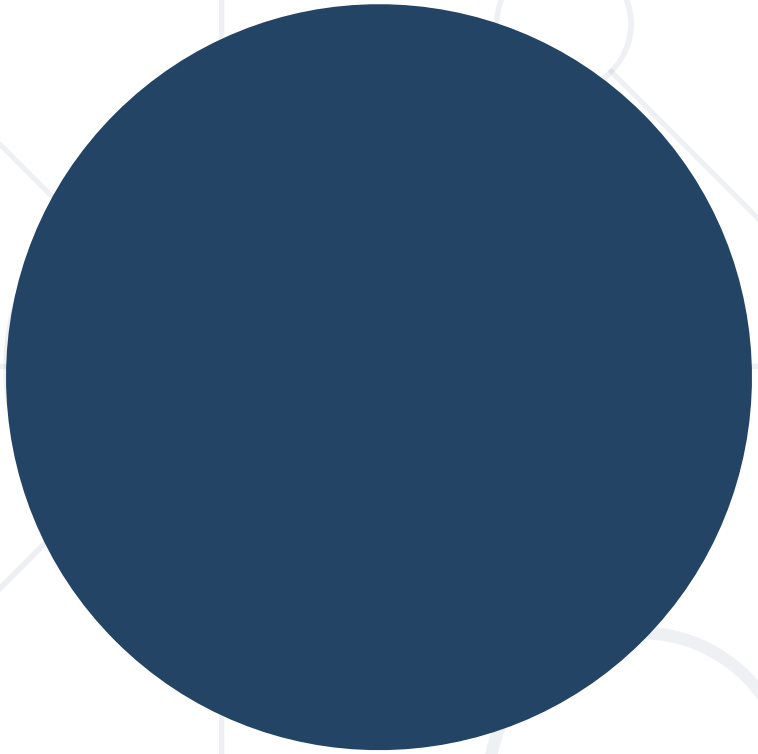
Multiple protocols in the same network



Note: all routers talk RIP and OSPF

Administrative distance

Route Source	Default Distance	Routing Table Entry
Connected interface	0	C
Static route out an interface	0	S
Static route to a next-hop address	1	S
EIGRP summary route	5	D
External BGP	20	B
Internal EIGRP	90	D
IGRP	100	I
OSPF	110	O
IS-IS	115	i
RIPv1, RIPv2	120	R
Exterior Gateway Protocol (EGP)	140	E
ODR	160	O
External EIGRP	170	D EX
Internal BGP	200	B
Unknown	255	



OSPF introduction

OSPF advantages

- Fast convergence with triggered updates
- Hierarchical structure (areas)
- VLSM support (classless protocol)
- Efficient communication with neighbors
- Uses intelligent metric (cost)
- Open standard

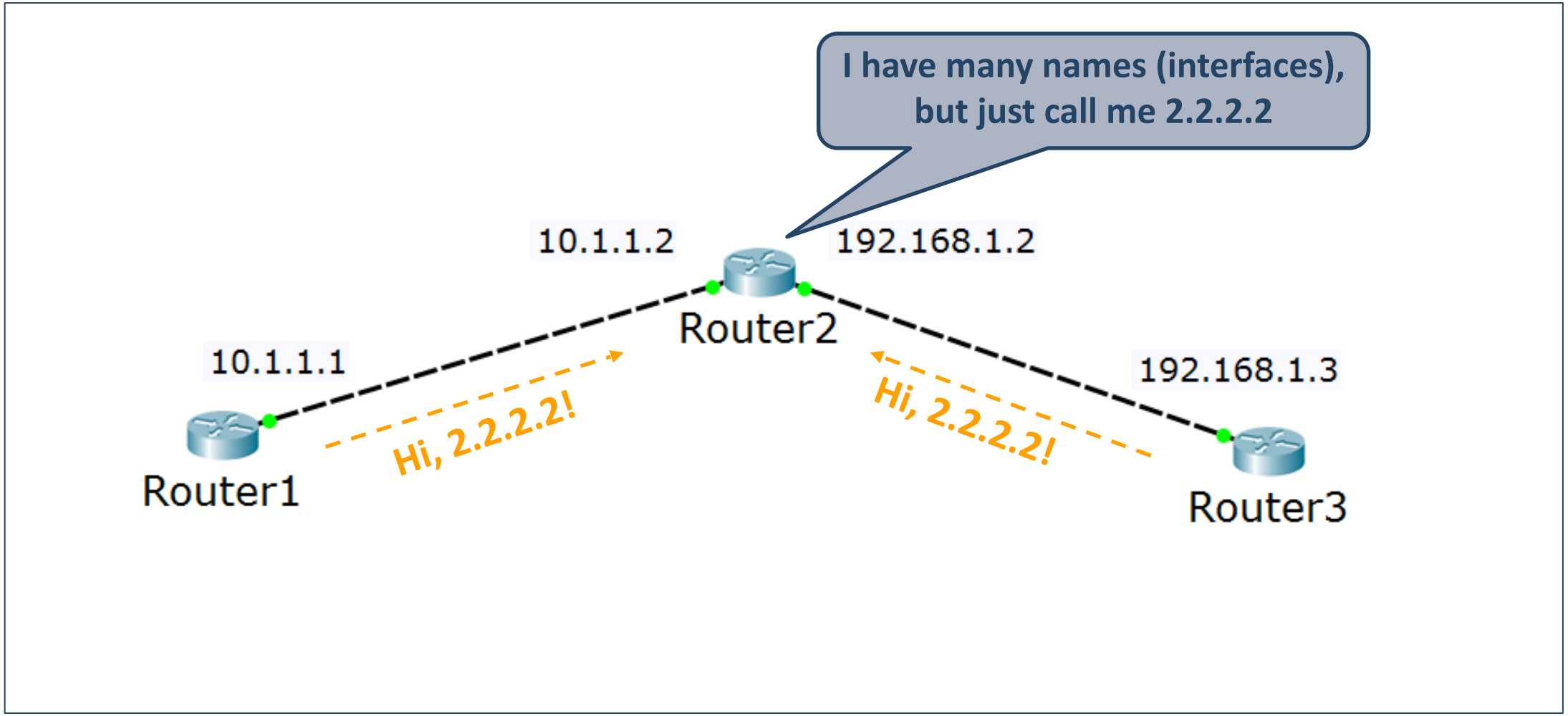
OSPF disadvantages

- Requires more RAM and CPU on the devices – maintains different tables (neighbor, topology, routing)
- Requires good and careful design when multiple areas are needed
- More complex to configure and troubleshoot

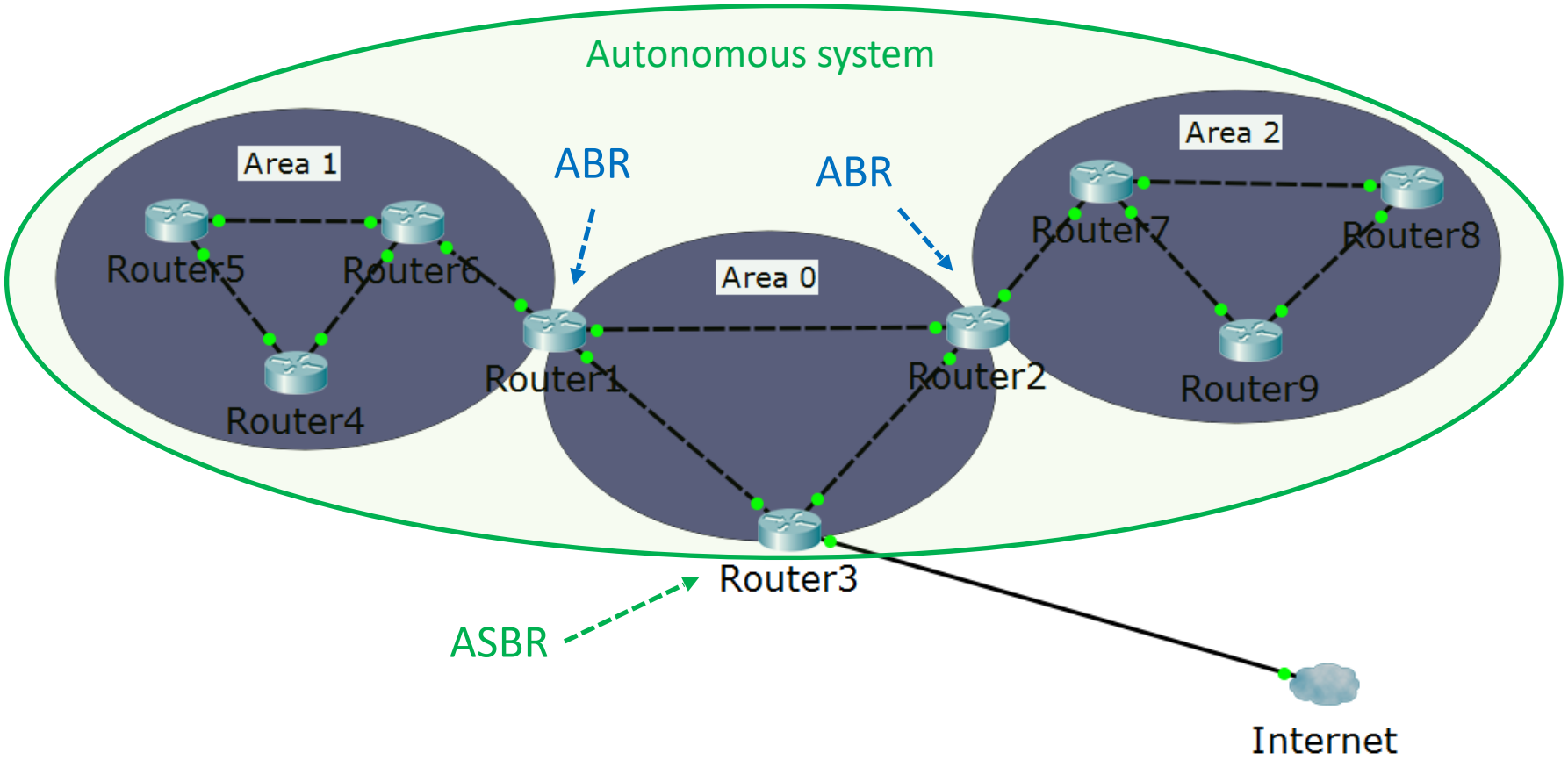
OSPF terms

- LSA – Link State Advertisement
- Router ID
- Area
- ABR – Area Border Router
- Autonomous system
- ASBR – Autonomous System Boundary Router

OSPF terms: router ID



OSPF terms (2)



Area 0 = the backbone area

Wildcard masks

- In the subnet masks, 1 means “do care” and 0 means “don’t care”
- Examples:
  - 192.168.1.0 255.255.255.0 -> refers to 192.168.1.0 network
  - Loopback address: 10.1.1.1 255.255.255.255 -> exact IP address
- In the wildcard masks, 0 means “do care” and 1 means “don’t care”
- Examples:
  - 192.168.1.0 0.0.0.255 -> refers to 192.168.1.0 network
  - Loopback address: 10.1.1.1 0.0.0.0 -> exact IP address

Process ID

- **router ospf *process-id***
- Has a local significance only – the numbers does not have to match between the routers
- Separates processes as they are different routing protocols
- It is rarely necessary to have more than 1 process on a router

The “network” command

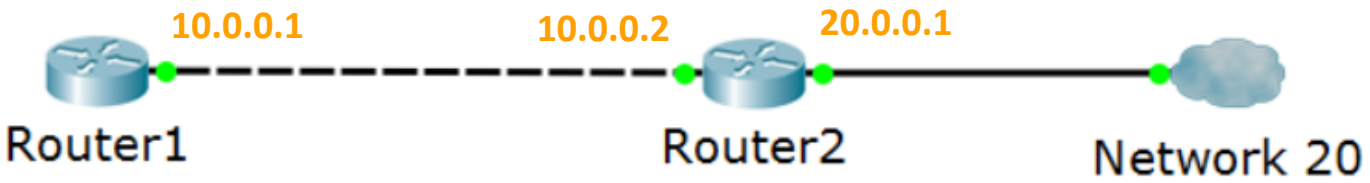
- The network A.B.C.D *Wildcard_Mask* command makes two things:
  - ➢It enables the interface (sends OSPF “Hello” messages)
  - ➢It advertises the network (“I know about network A.B.C.D”)

    to all OSPF enabled interfaces

The “network” command (2)

R1:
network 10.0.0.0 0.0.0.255

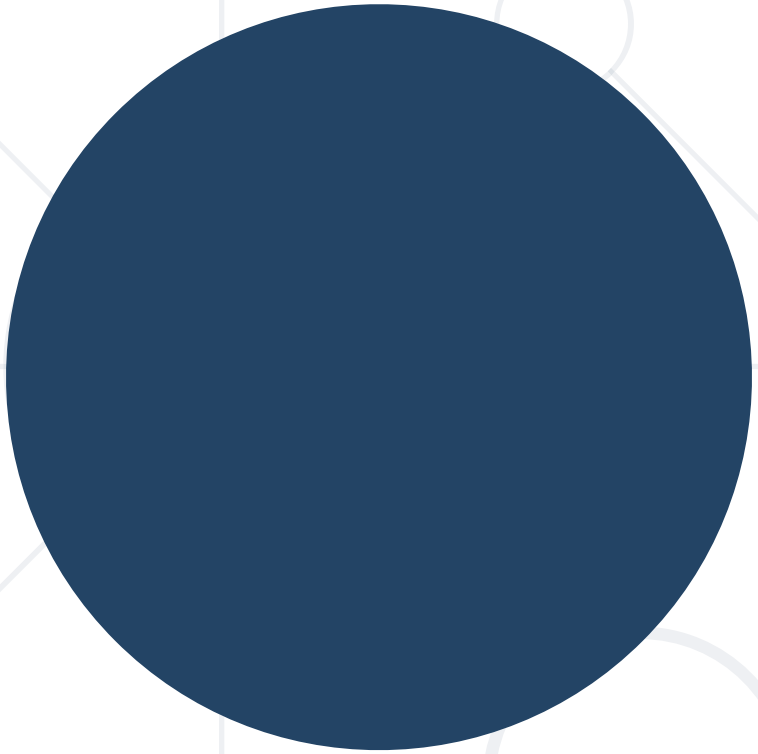
R2:
network 10.0.0.0 0.0.0.255
network 20.0.0.0 0.0.0.255



1. Hello!
2. I have network 10!

1. Hello!
2. I have network 10! …and 20!

1. Hello!
2. I have network 10 and 20!



Single area OSPF configuration

Single area OSPF configuration

- Minimum configuration:
  - **router ospf *process_id***
  - **router-id *number*** (optional)
  - **network A.B.C.D *wildcard_mask* area *number***
- Example:
  - **router ospf 1**
  - **router-id 1.1.1.1** (optional)
  - **network 192.168.1.0 0.0.0.255 area 0**
  - **network 10.0.0.0 0.0.0.255 area 0**

OSPF passive interface

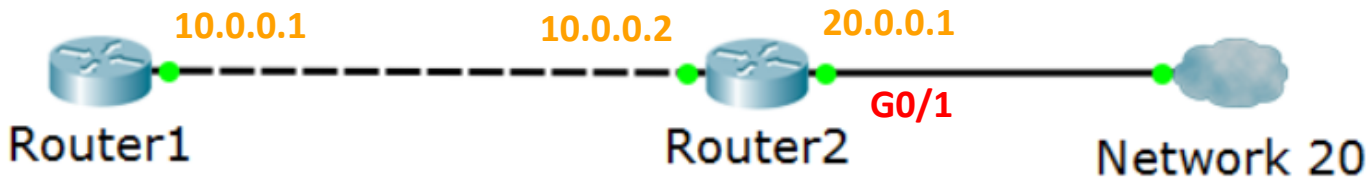
- The “network” command advertises the network AND sends hello messages out of the interface
- What if there is non-OSPF device on the other end of the link?
  - The Hello packets will be useless
  - Represents security issues
- One solution: use passive interfaces

OSPF passive interface (2)

R1:
network 10.0.0.0 0.0.0.255

R2:
network 10.0.0.0 0.0.0.255
network 20.0.0.0 0.0.0.255

passive-interface G0/1



1. Hello!
2. I have network 10!

1. Hello!
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1. Hello!
2. I have network 10 and 20!

Useful OSPF commands

- show ip ospf interface
- show ip ospf neighbor
- show run | begin ospf
- show ip route [ospf]

Tracing a route for a packet

- Some tips to check which path a packet will take in a multi-path L3 network:
  - show ip route – to check a router's routing table
  - tracert A.B.C.D (from Windows)
  - traceroute A.B.C.D (from Cisco, Linux, etc.)
  - *Use the Packet Tracer simulation mode

* not applicable in real networks

Summary

1. Introduction to dynamic routing
2. OSPF introduction
3. Single area OSPF configuration