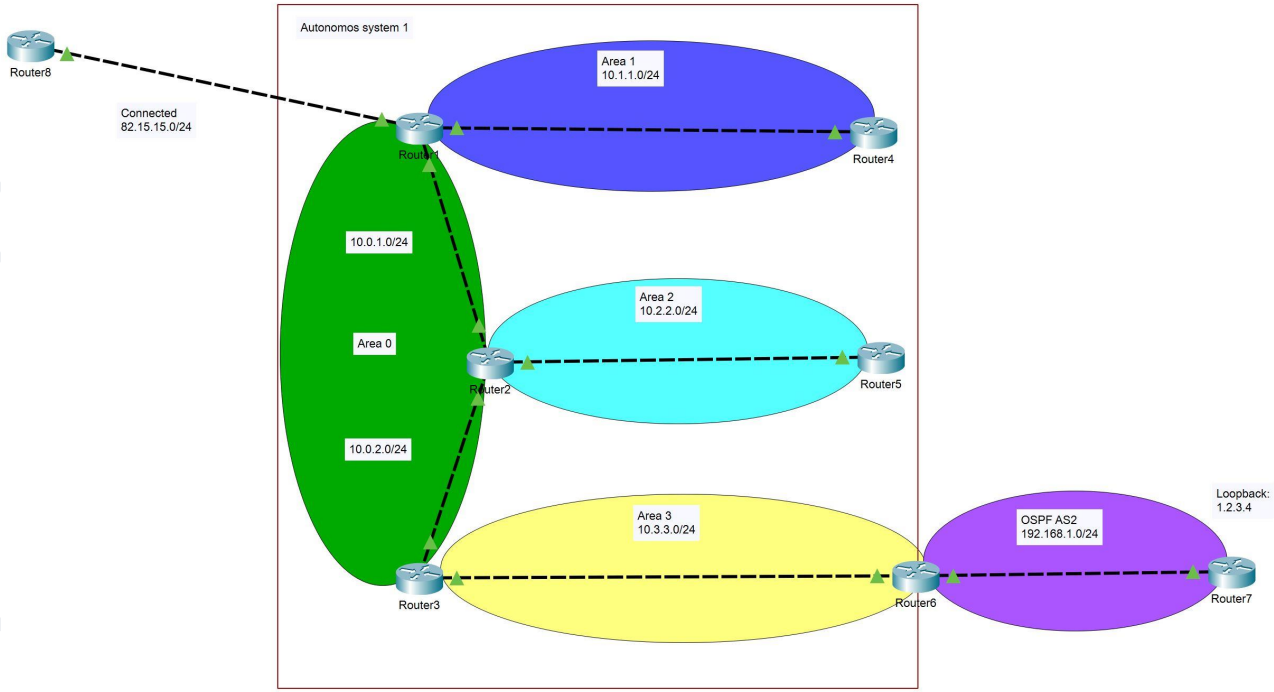
OSPF Advanced

Lecture 2



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Basic Concepts and Single Area OSPF

OSPF Advantages

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

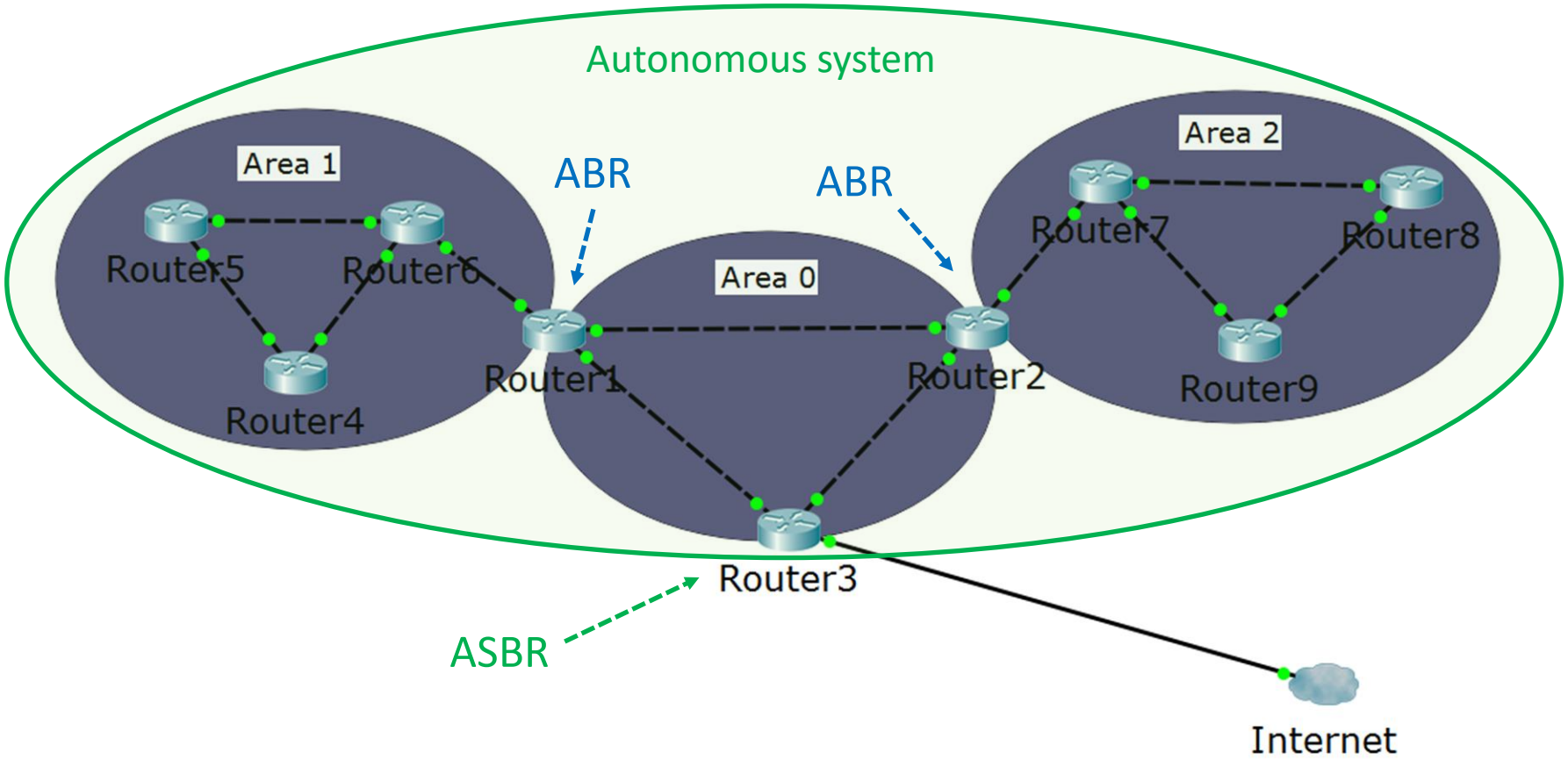
OSPF Disadvantages

- 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
- LSDB – Link state database
- Router ID
- Area
- ABR – Area border router
- Autonomous system
- ASBR – Autonomous system boundary router

OSPF Terms (2)



Area 0 = the backbone area

Router ID

- Router ID is required for OSPF but optional to configure
- If not specifically configured, the Router ID will be:
  - The highest IP address between the active physical interfaces
  - If there is a loopback interface configured with IP address, it will overwrite the above rule and will become the Router ID
  - If multiple loopback interfaces are configured, the highest IP address between them will become the Router ID
- Recommendation: manually configure the Router ID to one of the loopback IP addresses of the router

OSPF Hello Packet

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- Sent to the "all OSPF routers" multicast address: 224.0.0.5

Field	Must be the same?
Router ID	
Hello and dead intervals	Yes
Neighbors	
Area ID	Yes
Router priority	
DR IP Address	
BDR IP Address	
Authentication password	Yes
Stub area flag	Yes

Neighbor Relationships

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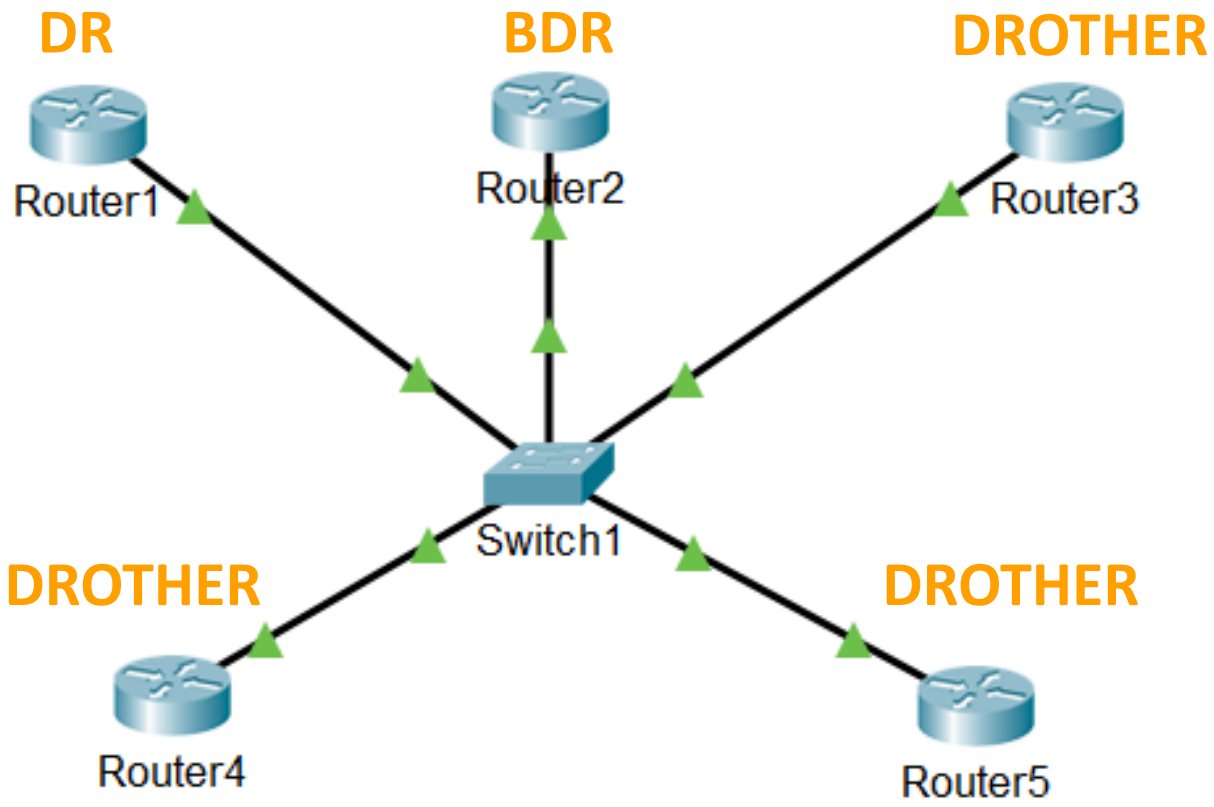
- If multiple routers are connected to a switch, OSPF uses designated router (DR) and backup designated router (BDR)
- This minimizes LSA traffic
- Other routers are referred to as DROTHER (DR other)
- The DR and the BDR ensure that all routers receive all the required updates
- DRs and BDRs are used in multi-access networks (where we can have more than two routers)
- DRs and BDRs will "listen" on 224.0.0.6 multicast address

Neighbor Relationships (2)

The **DR**, the **BDR** and the **DROTHER**s



DR/BDR Election Process

- DRs and BDRs are elected per physical segment (and not per area)
- The DR and BDR election process:
  - The first router that is active on the link becomes the DR and the second active becomes the BDR
  - Link/interface priority is used for the election of the DR and the BDR - highest priority is elected
  - If there is a tie, the highest router ID is elected
- Default priority is 1 (range is from 0 to 255)
- A priority of **0** prevents a router from becoming a DR or BDR

OSPF Cost

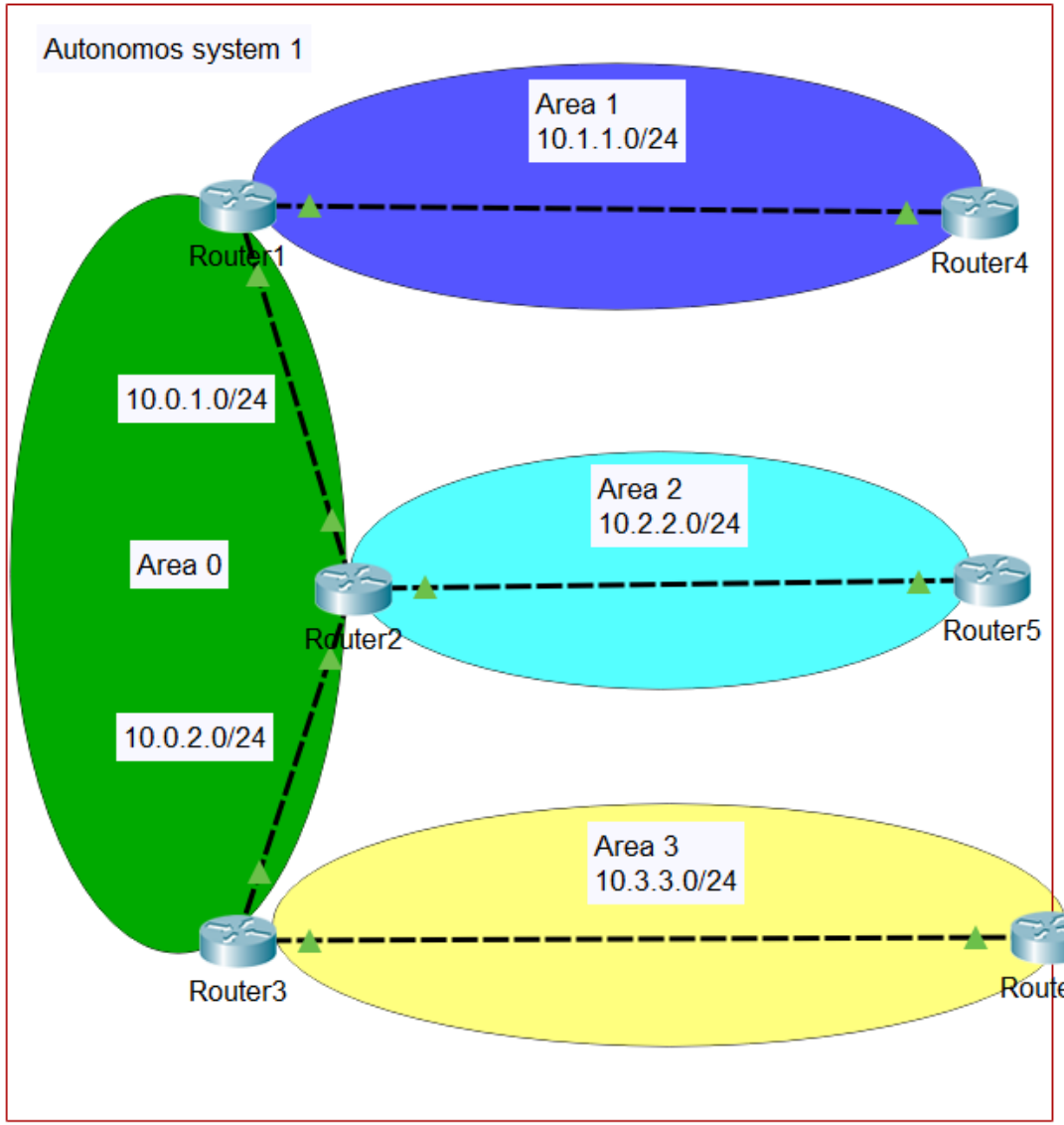
- Cost = 10^8 / bandwidth (10^8 is the reference bandwidth)
- 100 Mbps will have a cost of 1 (1Gbps will also have a cost of 1)
- Reference bandwidth can be changed. Default is 100(Mbps) ("auto-cost reference-bandwidth")
- You can also directly change the cost of an interface ("ip ospf cost X")

Multi Area OSPF

Why Multiple Areas?

- When the OSPF domain is segmented to areas:
  - Inter-area routes can be summarized
  - Router's LSDBs are not too big
  - The protocol is faster
  - Stability and control is increased

Multiple Areas Example

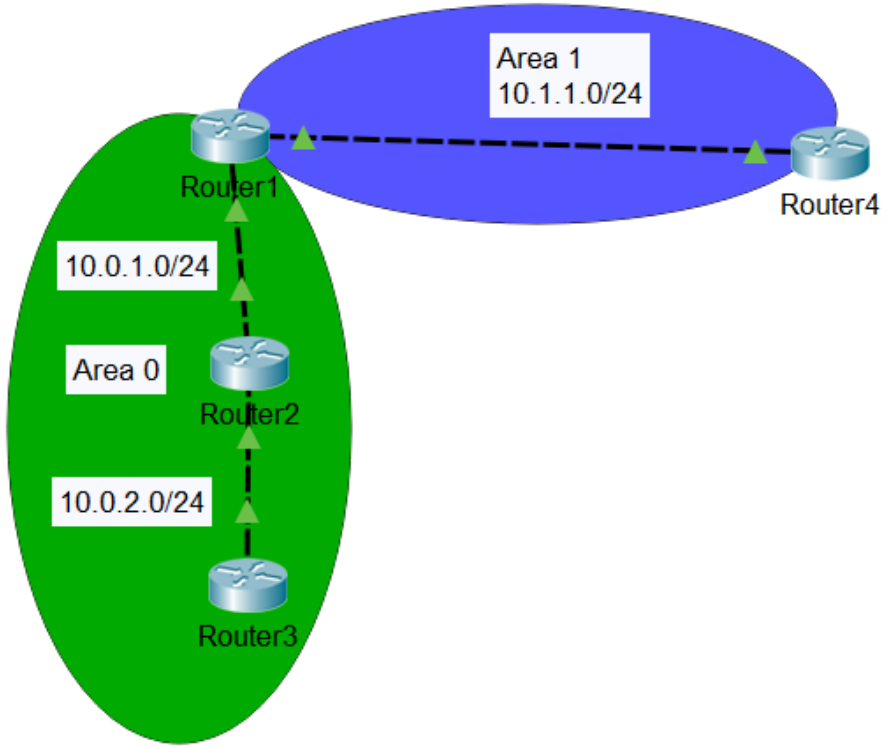


- All other areas connect to Area 0 (the backbone area)

- ABR routers in the example:
  - Router1
  - Router2
  - Router3

How to Configure an ABR

- There is no specific command to become an ABR
- When you configure a router in more than one area, it becomes ABR

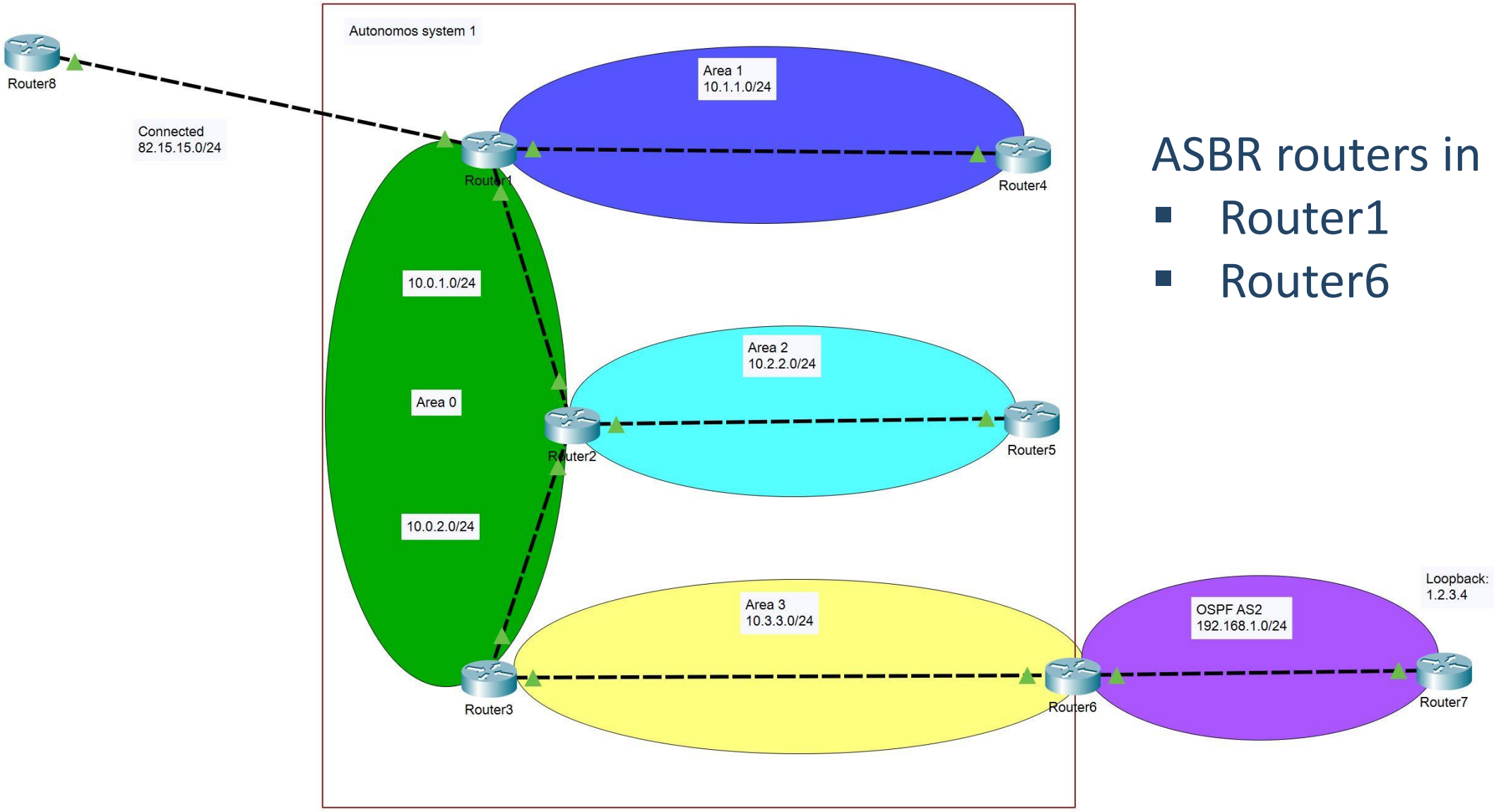


Router1:

```
router ospf 1
network 10.0.1.0 0.0.0.255 area 0
network 10.1.1.0 0.0.0.255 area 1
```

Connecting OSPF to External Networks

OSPF Autonomous System and External Networks



ASBR routers in the example:

- Router1
- Router6

Redistribute Between Protocols

- You need to import or redistribute routes to your AS
- Some options for redistribution:
  - **redistribute RIP**
  - **redistribute ospf [process_id]**
  - **redistribute static**
  - **redistribute connected**
  - Note: add the “subnets” word after the redistribute command to benefit from the classless routing

LSA and Area Types

OSPF LSA Types

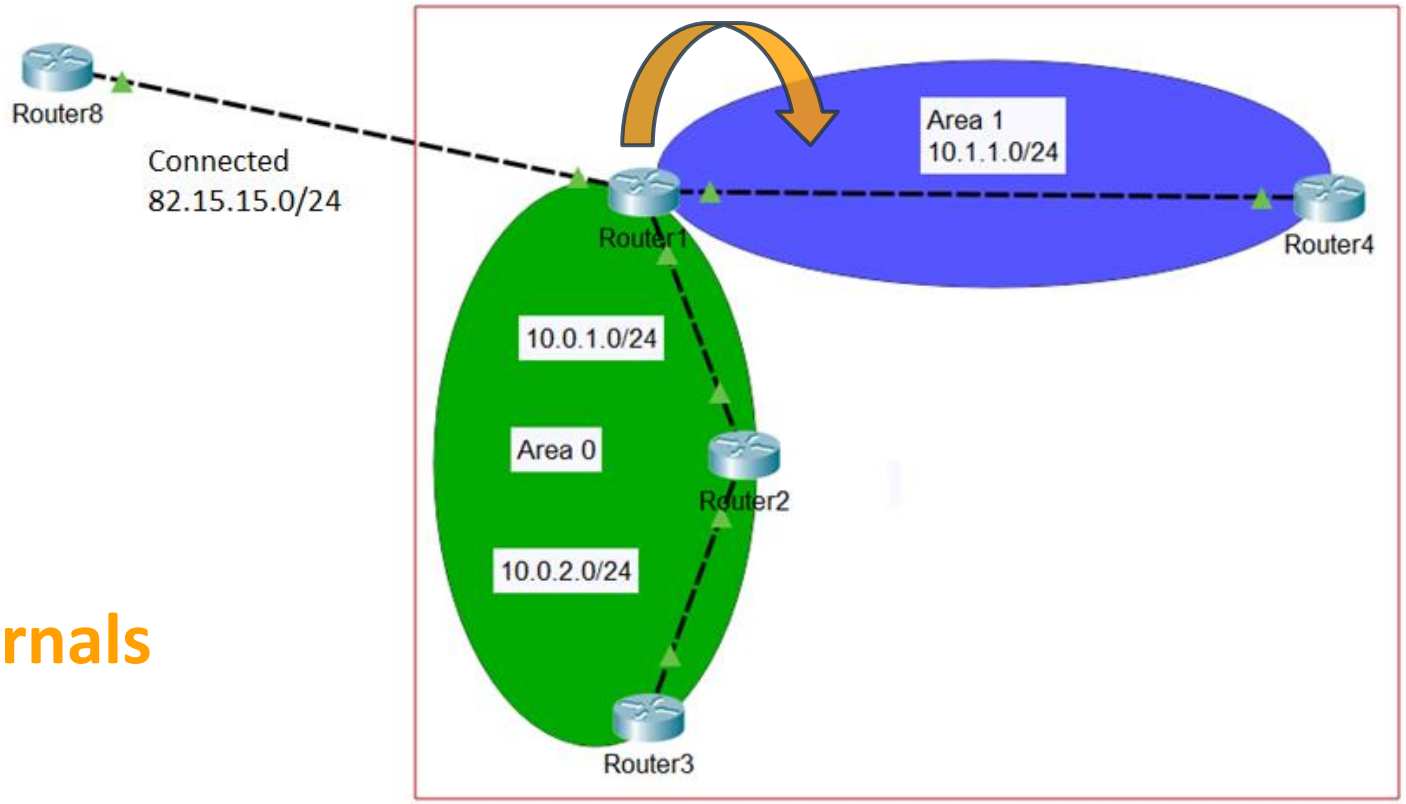
- LSA type 1: Router
- LSA type 2: Network
- LSA type 3: Summary
- LSA type 4: ASBR summary
- LSA type 5: ASBR external
- ~~LSA type 6: Multicast OSPF~~
- LSA type 7: Not-so-stubby area LSA

OSPF Area Types

- Standard area
- Stub area
- Totally stubby area
- Not-so-stubby area (NSSA) ☺

OSPF Stub Area

- Uses LSA types 1, 2, 3 + default route (for external networks)
- Blocks LSA types 4 and 5



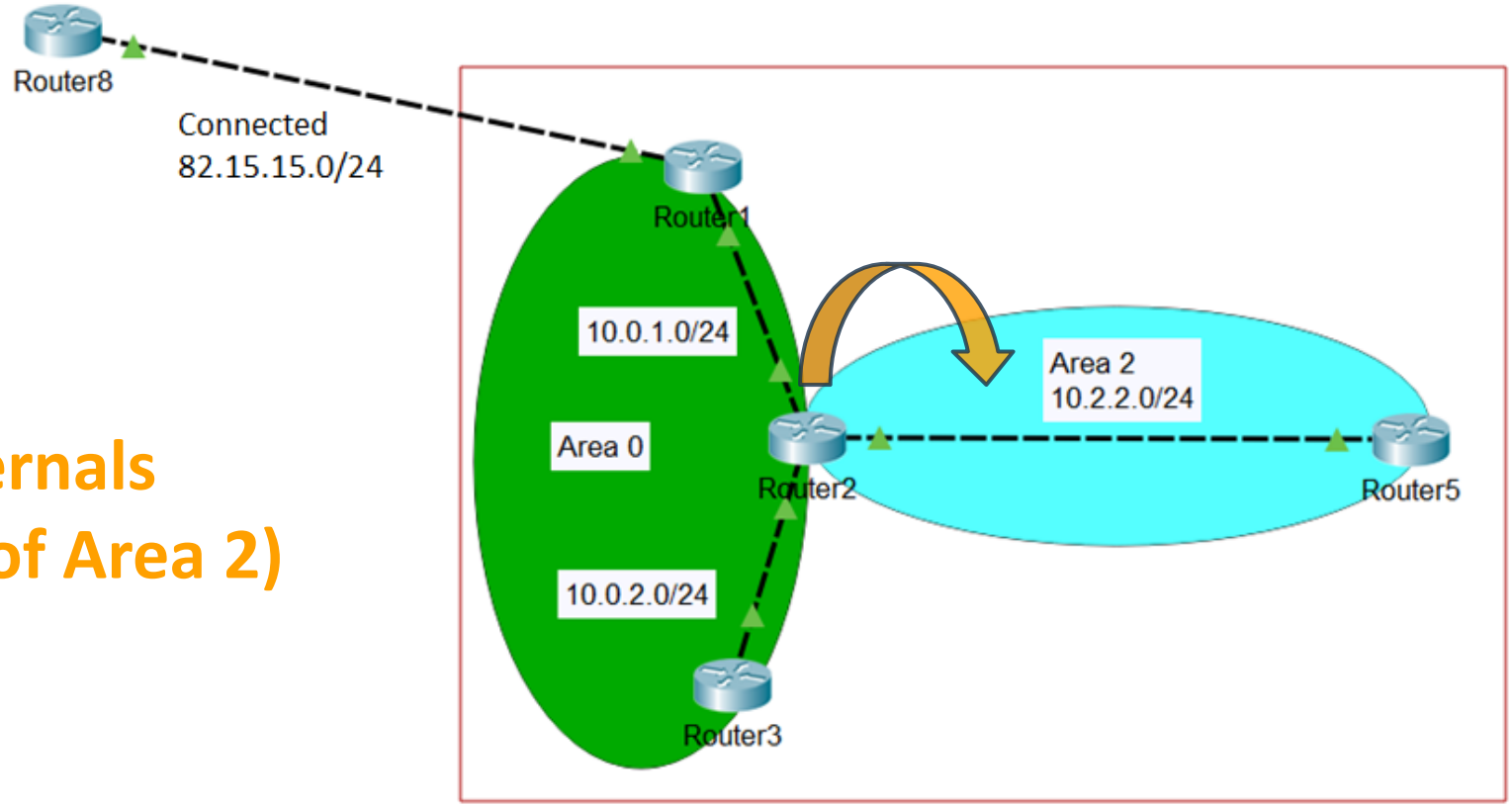
Area 1 is stub

Router1 injects:

- **Routes from area 0**
- **Default route to externals**

OSPF Totally Stubby Area

- Uses LSA types 1 and 2 + default route (for the other areas and external networks)
- Blocks LSA types 3, 4 and 5



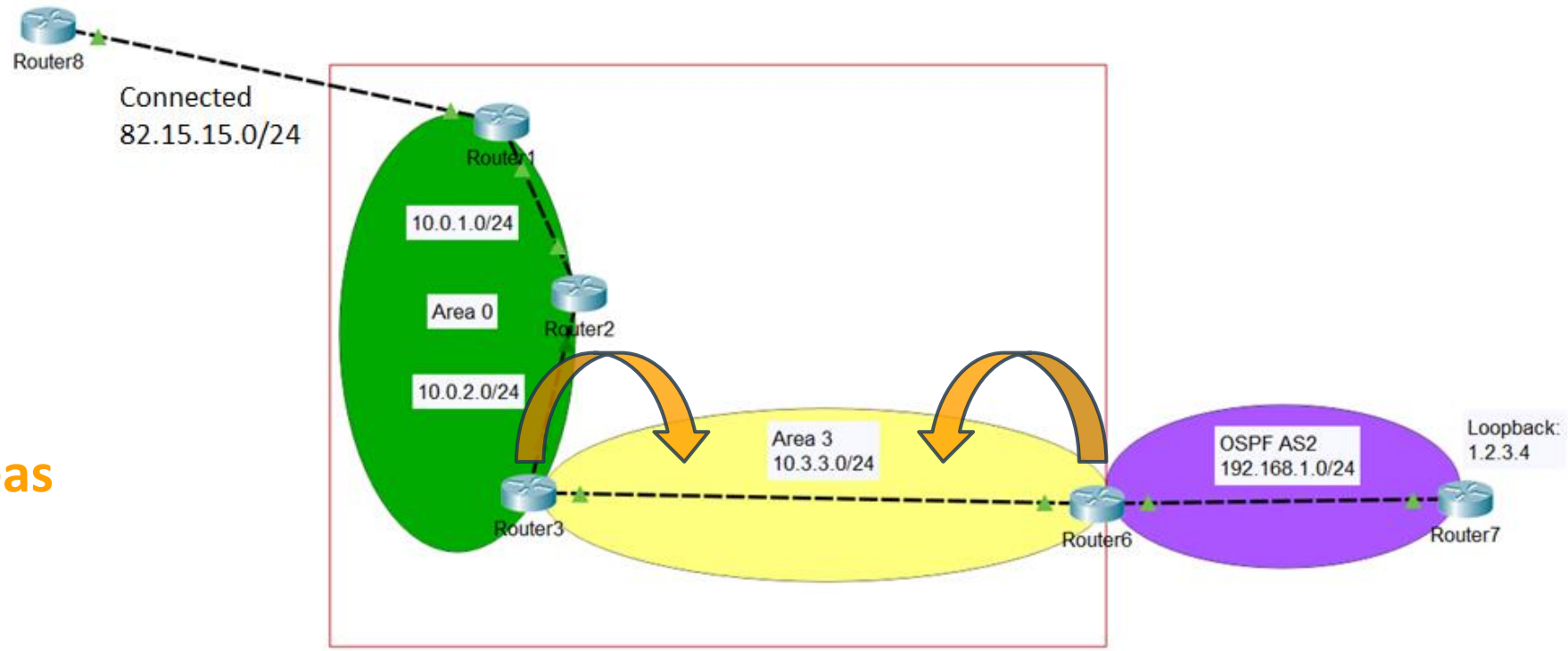
Area 2 is totally stubby

Router2 injects:

- **Default route to externals (everything outside of Area 2)**

OSPF Not-so-stubby Area (NSSA)

- Uses LSA types 1, 2, 3 and 7
- Blocks LSA types 4 and 5



Area 3 is NSSA

Router6 injects:

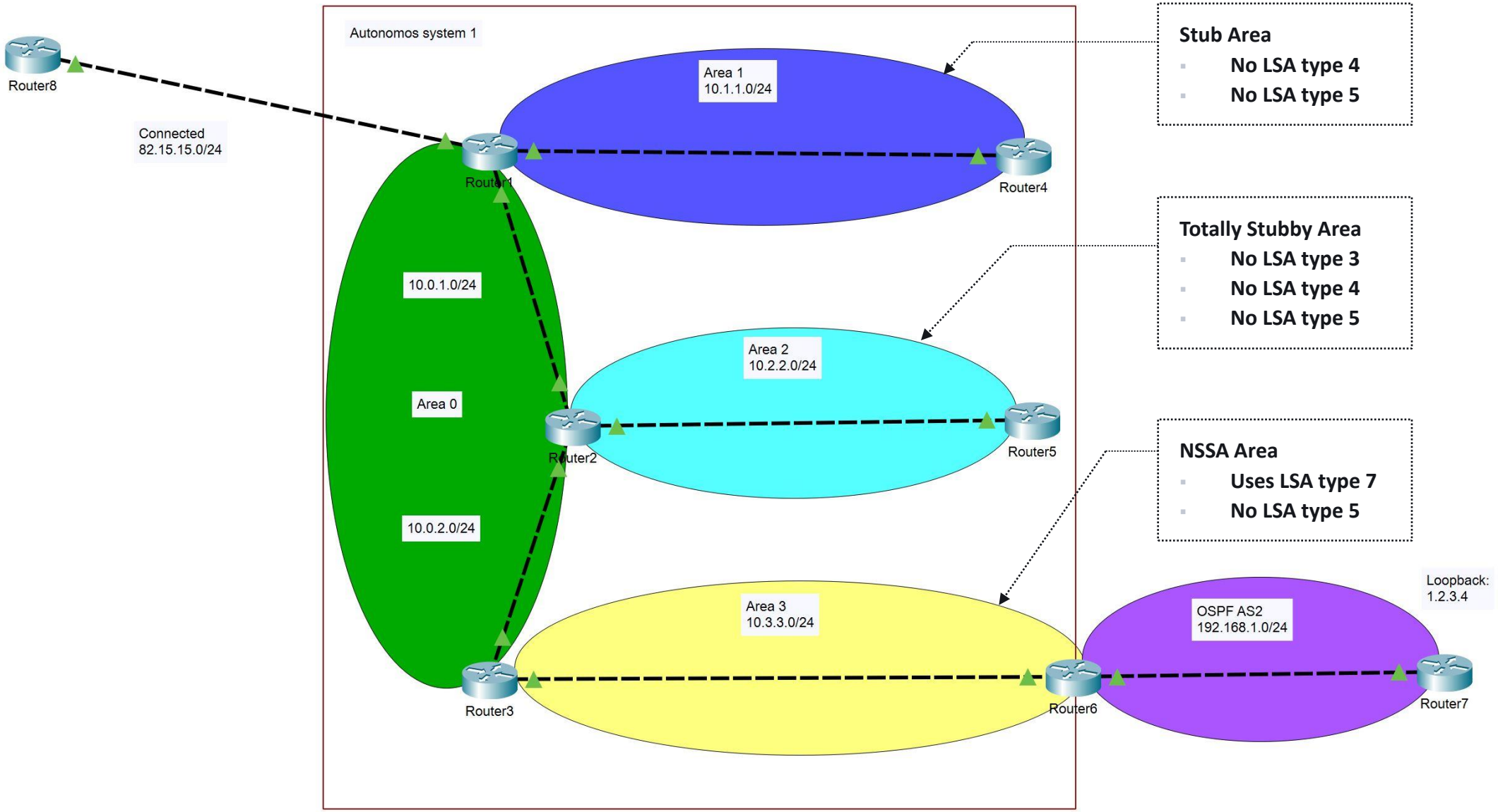
- **Routes in AS2**

Router3 injects:

- **Routes from other areas**

(Route to 82.15.15.0/24 not advertised)

Common Area Types and LSAs

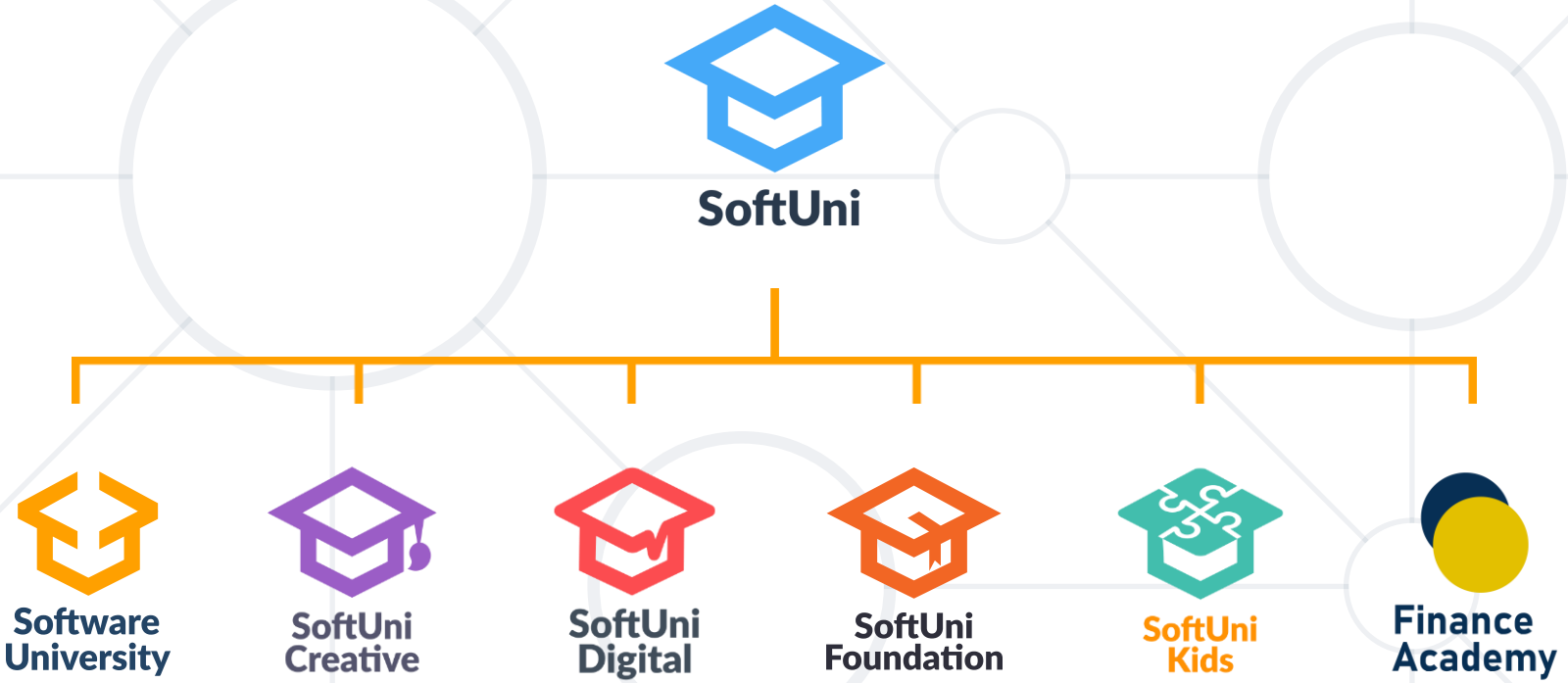


Demonstration

Summary

1. Basic concepts and single area OSPF
2. Multi area OSPF
3. Connecting OSPF to external networks
4. LSA and area types
5. Demonstration

Questions?



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