OSPF
(Open Shortest Path First)

By: *Shatrunjay Rawat*

IIIT, Hyderabad

OSPF Overview

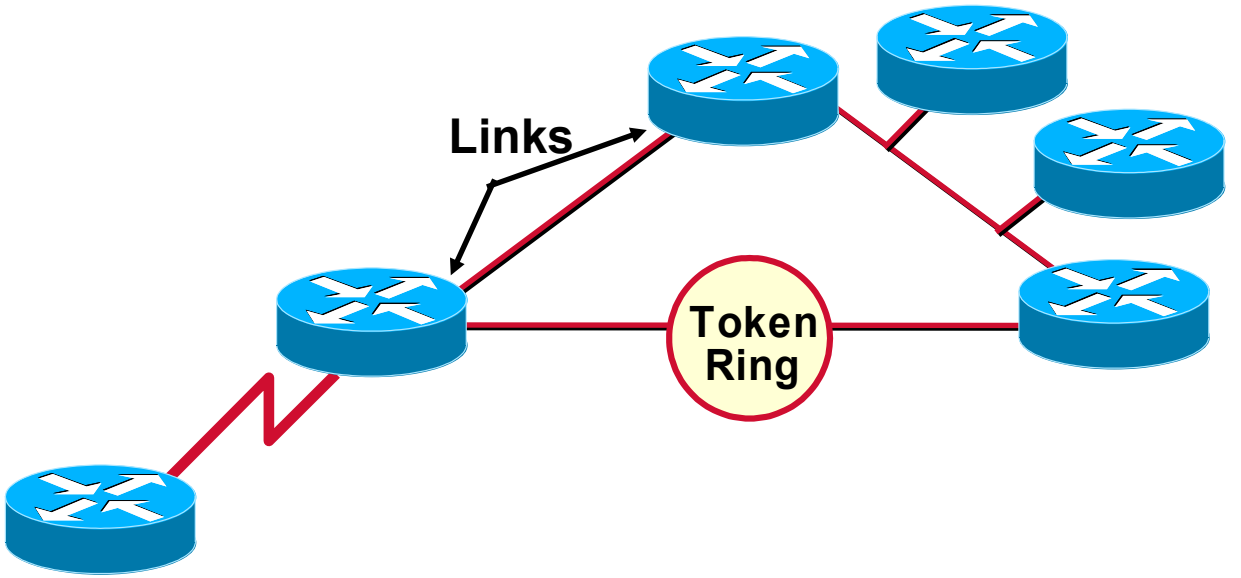
What Is OSPF?

- Stands for “Open Shortest Path first”.
- It is a “Link State” routing protocol, based on SPF/Dijkstra Algorithm
- Developed by IETF. It is “Open” and not proprietary of any vendor
- RFC 2328, Year 1990
- Interior Gateway Protocol (IGP)

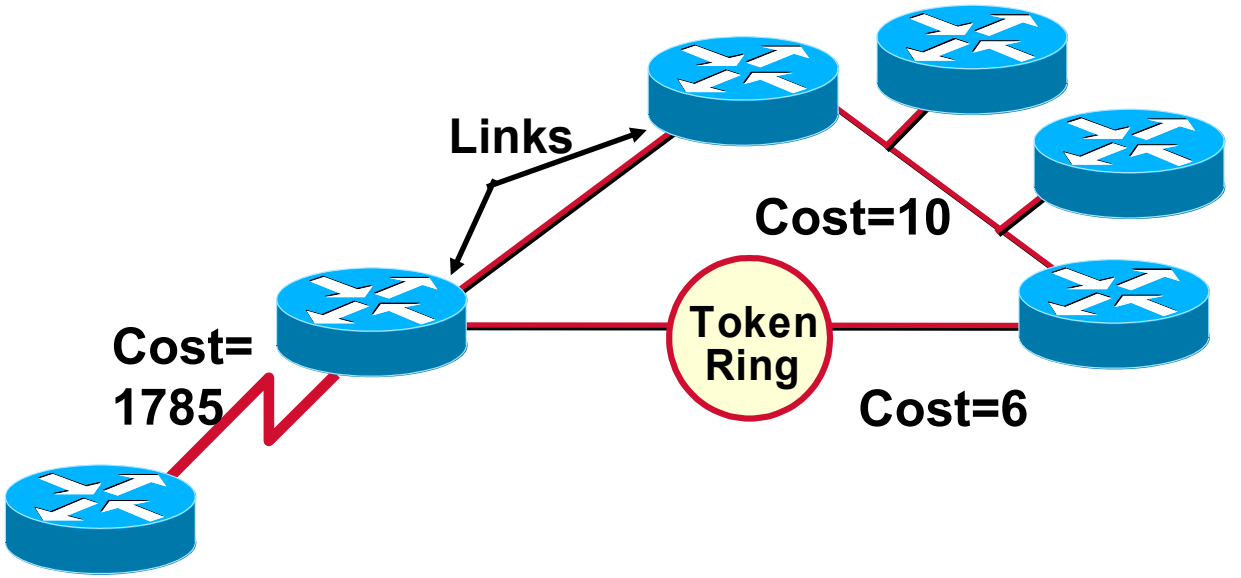
OSPF - features

- Has fast convergence
- Has no hop count limitation
- Processes updates efficiently
- Selects paths based on *cost* (bandwidth)
- Provides load balancing
- Support for hierarchical system

OSPF Terminology



OSPF Terminology



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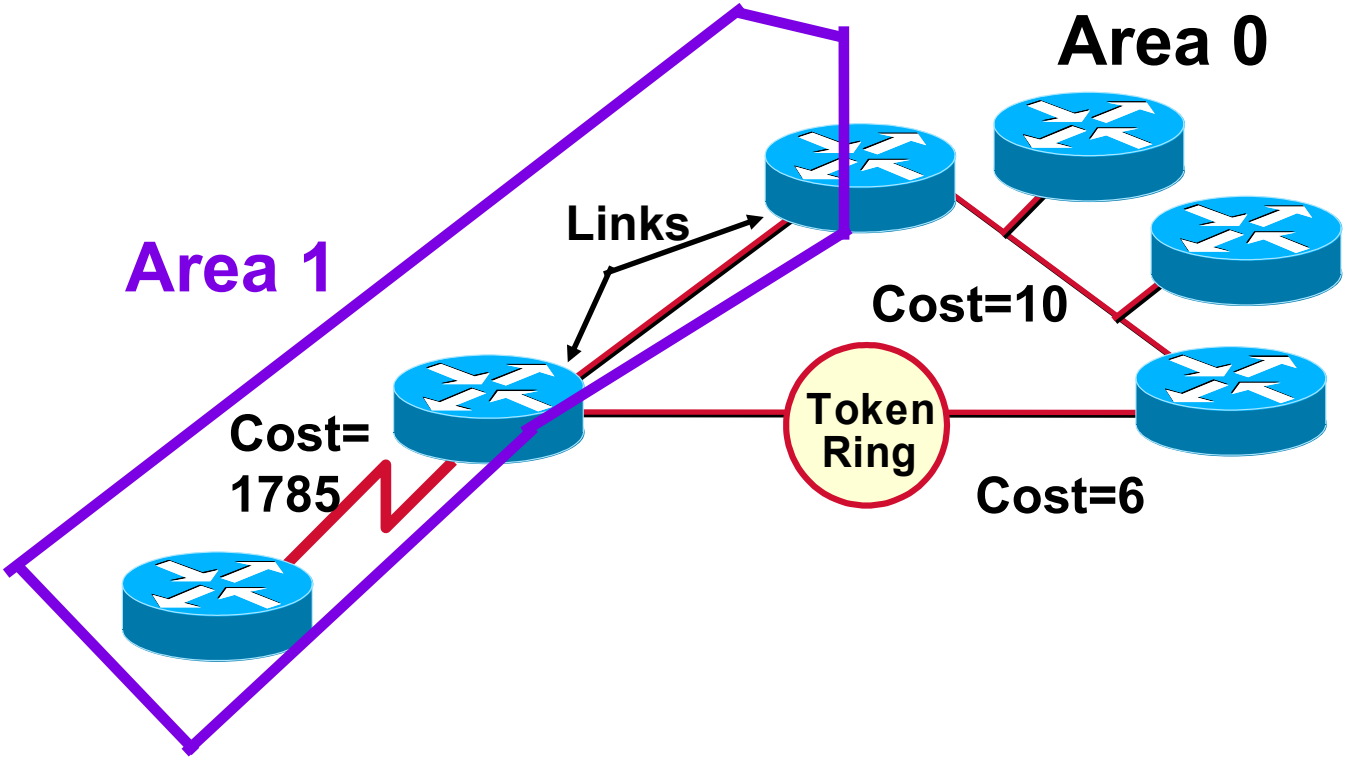

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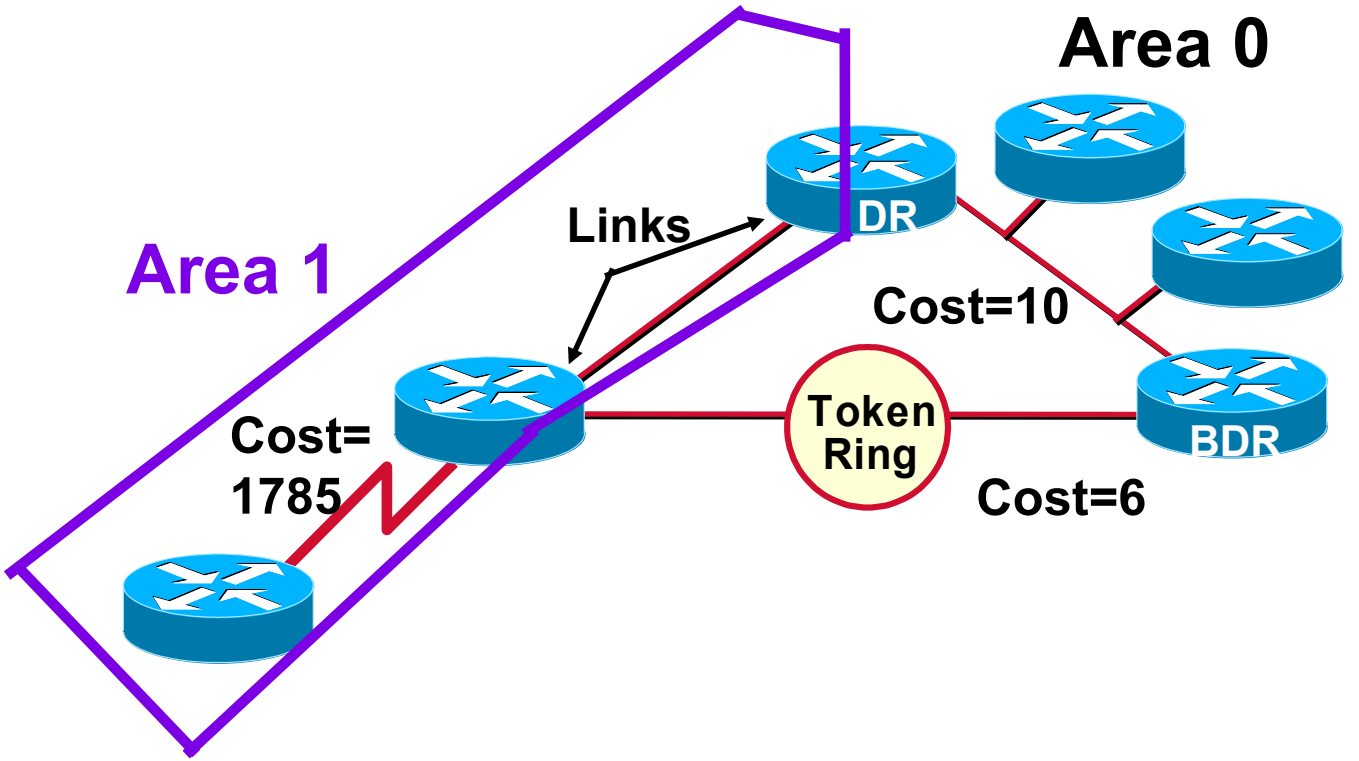

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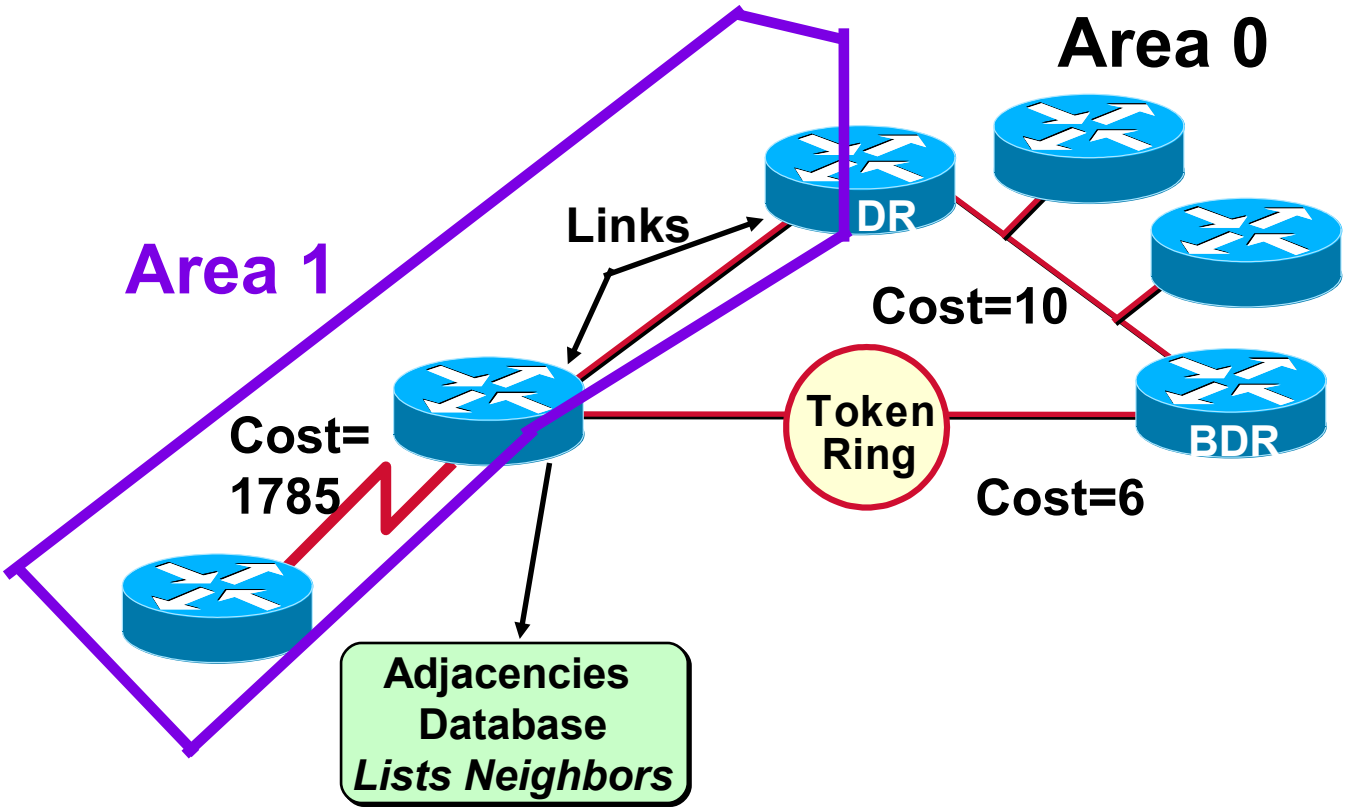
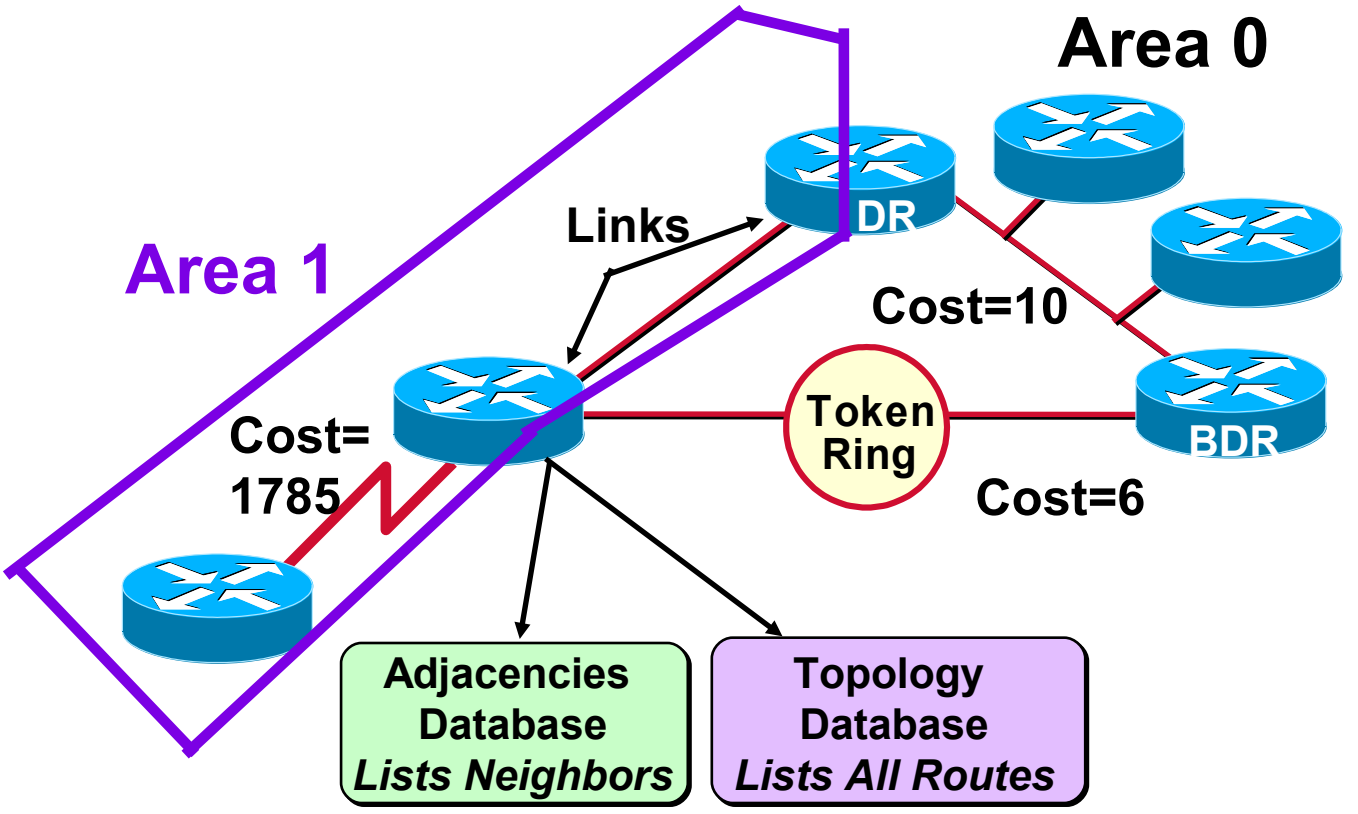


OSPF Terminology



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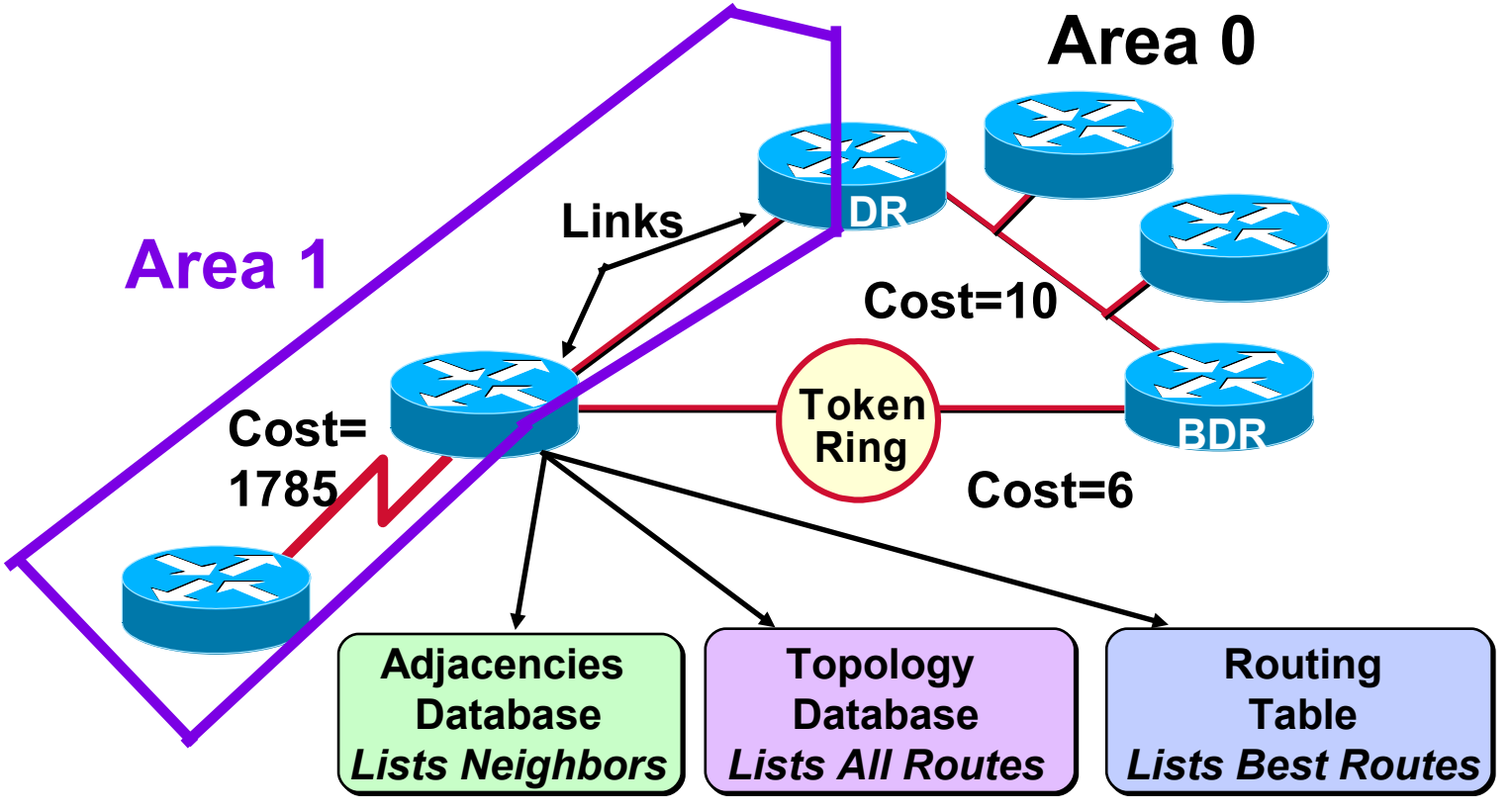
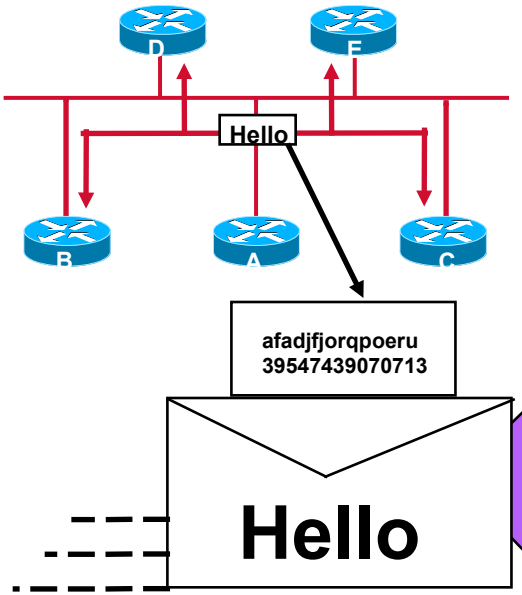


OSPF Operation within a Single Area

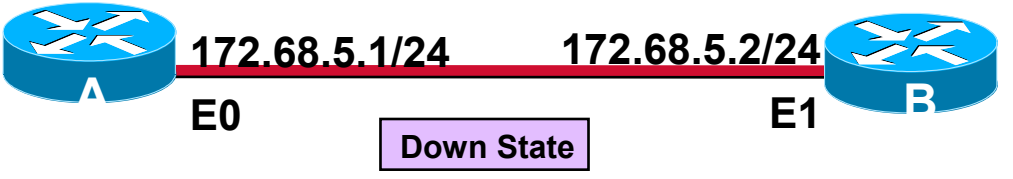
Establishing Adjacencies



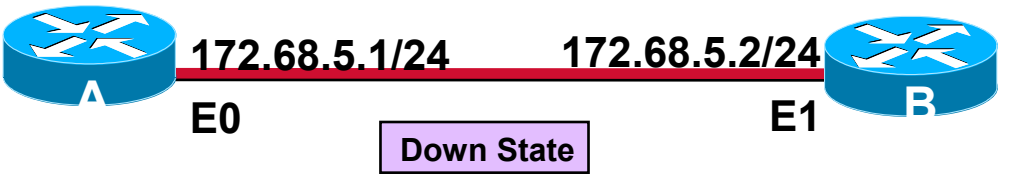
Router ID
Hello/Dead Intervals *
Neighbors
Area-ID *
Router Priority
DR IP Address
BDR IP Address
Authentication Password *

* **Entry must match on adjacent routers**

Establishing Adjacencies (cont.)



Establishing Adjacencies (cont.)

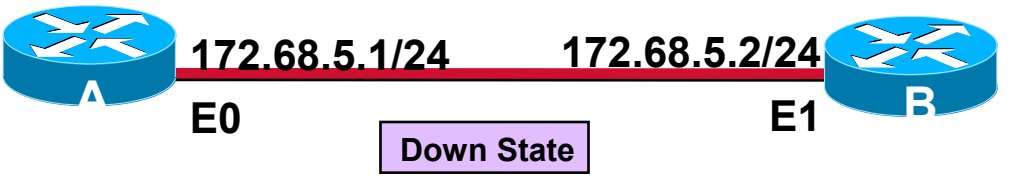


I am router ID 172.68.5.1 and I see no one.

Init State

Router B
Adjacencies Database
172.68.5.1/24, int E1

Establishing Adjacencies (cont.)



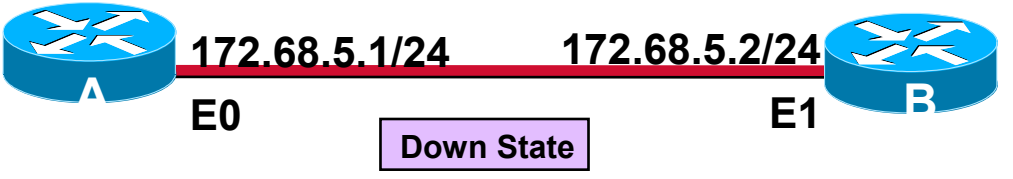
I am router ID 172.68.5.1 and I see no one.

Init State

Router B
Adjacencies Database
172.68.5.1/24, int E1

I am router ID 172.68.5.2, and I see 172.68.5.1

Establishing Adjacencies (cont.)



I am router ID 172.68.5.1 and I see no one.

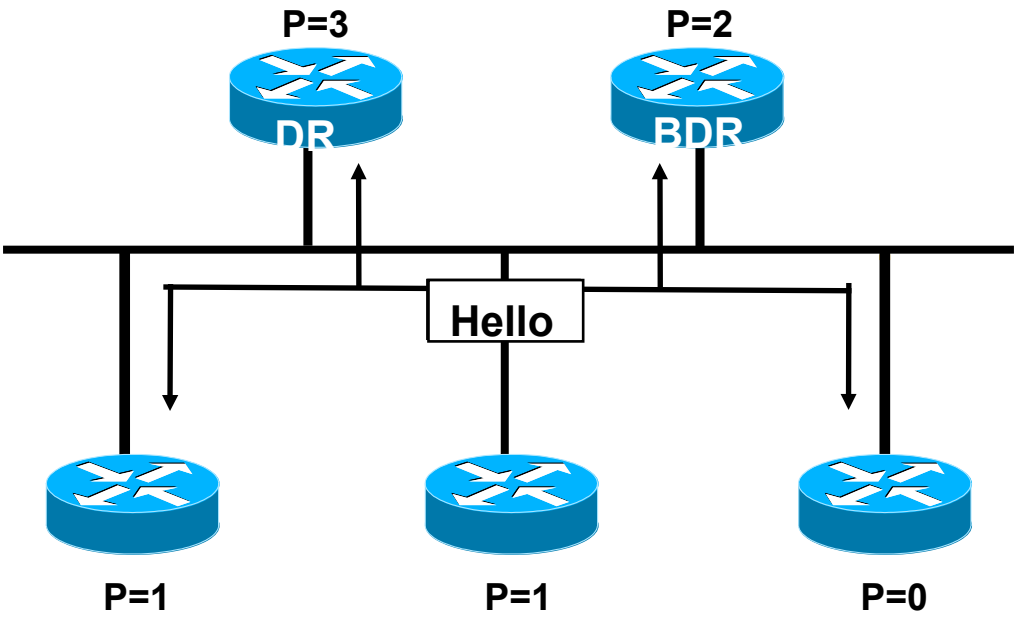
Init State

Router B
Adjacencies Database
172.68.5.1/24, int E1

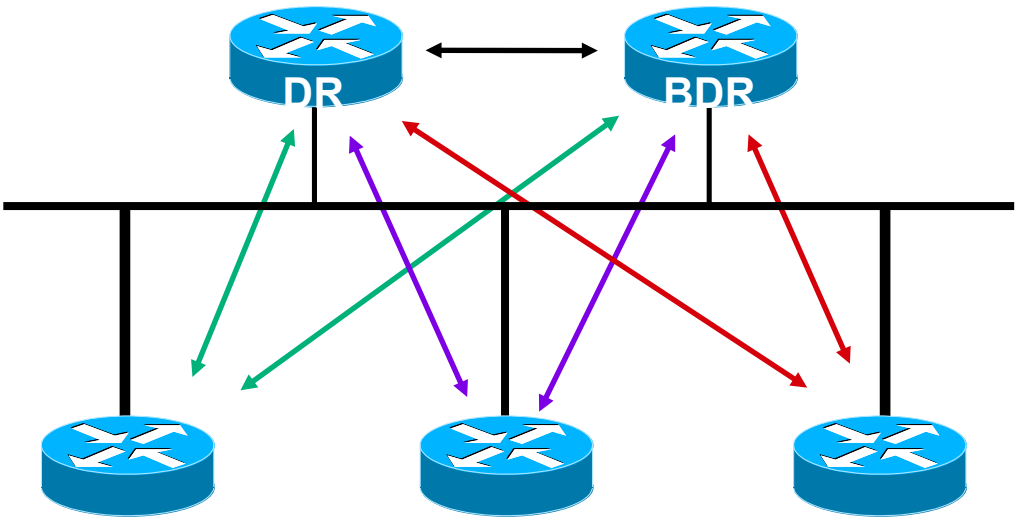
I am router ID 172.68.5.2, and I see 172.68.5.1

Router A
Adjacencies Database
172.68.5.2/24, int E0

Two-Way State



- Hello packets exchanged via IP multicast
- Router with highest OSPF priority elected

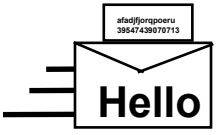


- **Hellos elect DR and BDR**
- **Each router forms adjacency with DR and BDR**

Discovering Routes

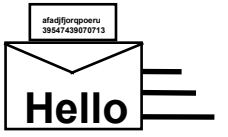
Discovering Routes

Exstart State



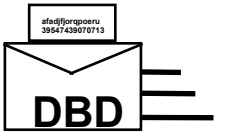
I will start exchange because I have router ID 172.68.5.1.

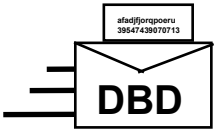
No, I will start exchange because I have a higher router ID.



Exchange State

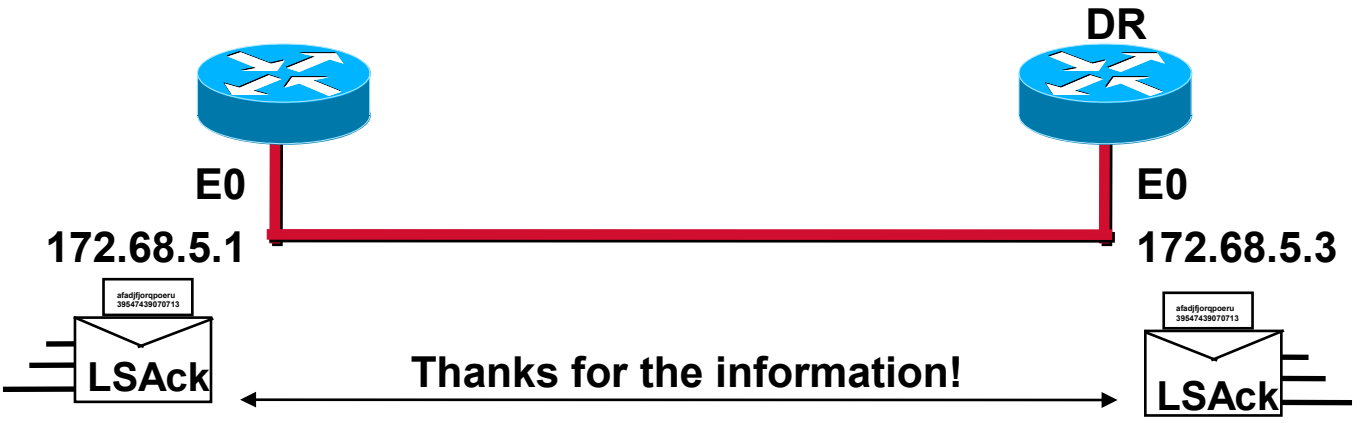
Here is a summary of my link-state database.



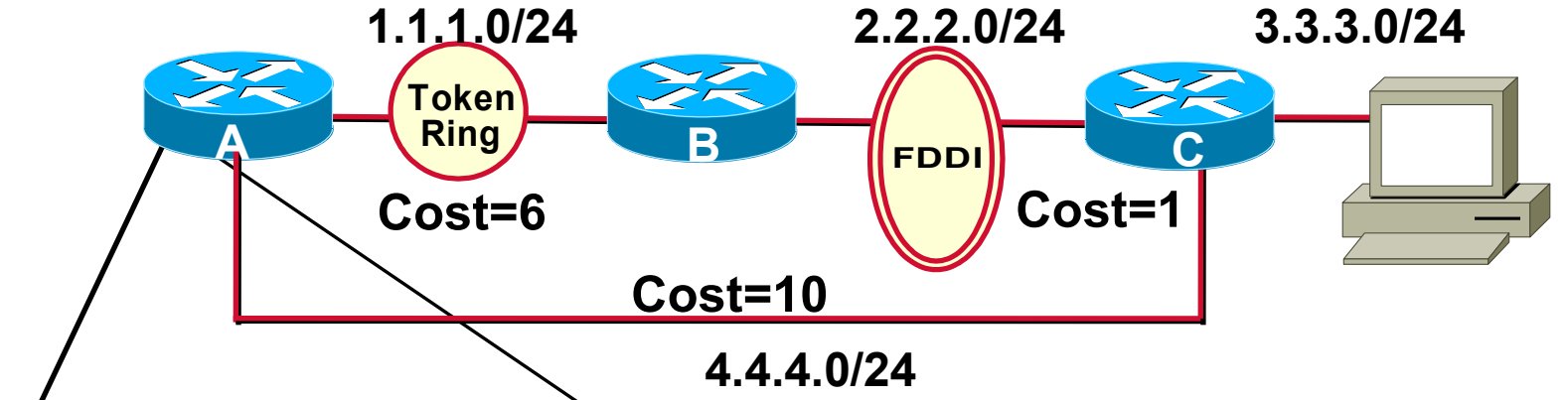


Here is a summary of my link-state database.

Discovering Routes (cont.)



Choosing Routes

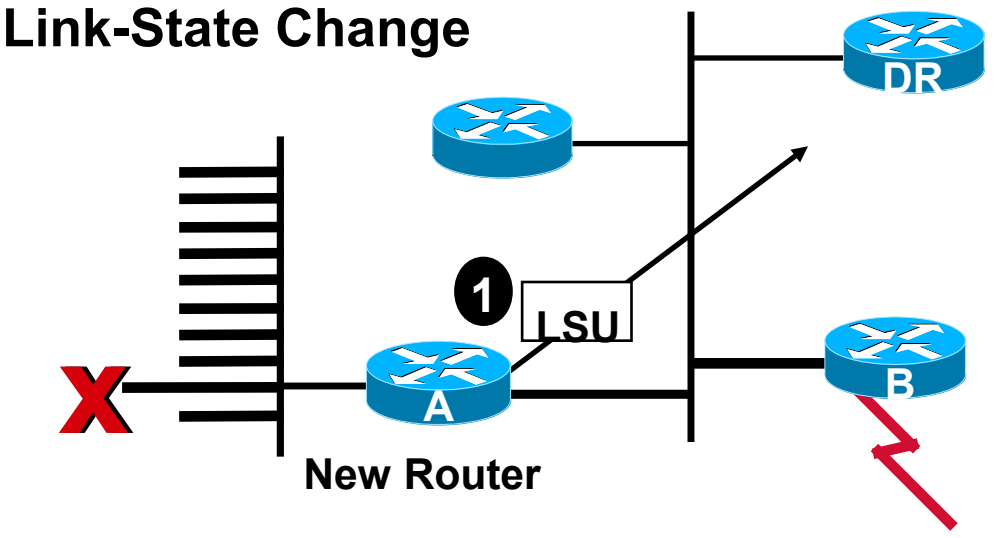


Routing Table

Net	Cost	Out Interface
2.2.2.0	6	TR0
3.3.3.0	7	TR0
3.3.3.0	10	E0

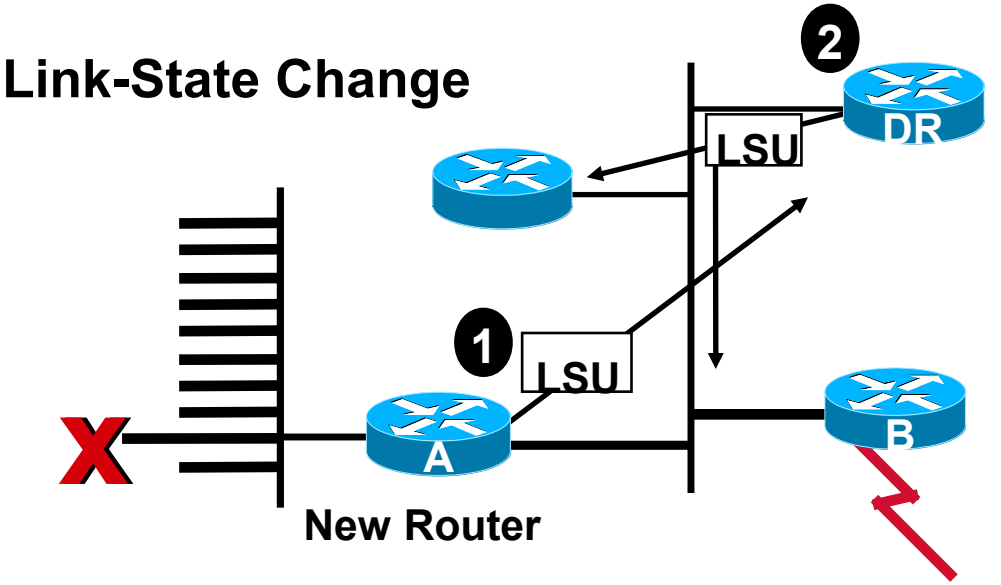
This is the best route to C.

Maintaining Routing Information

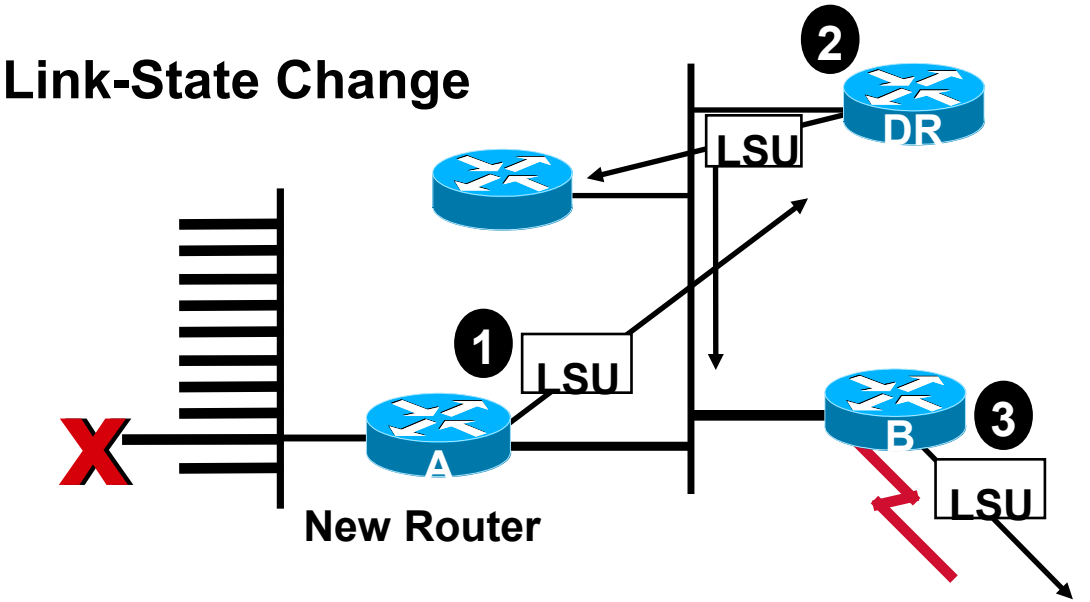


- New router tells all OSPF DRs on 224.0.0.6

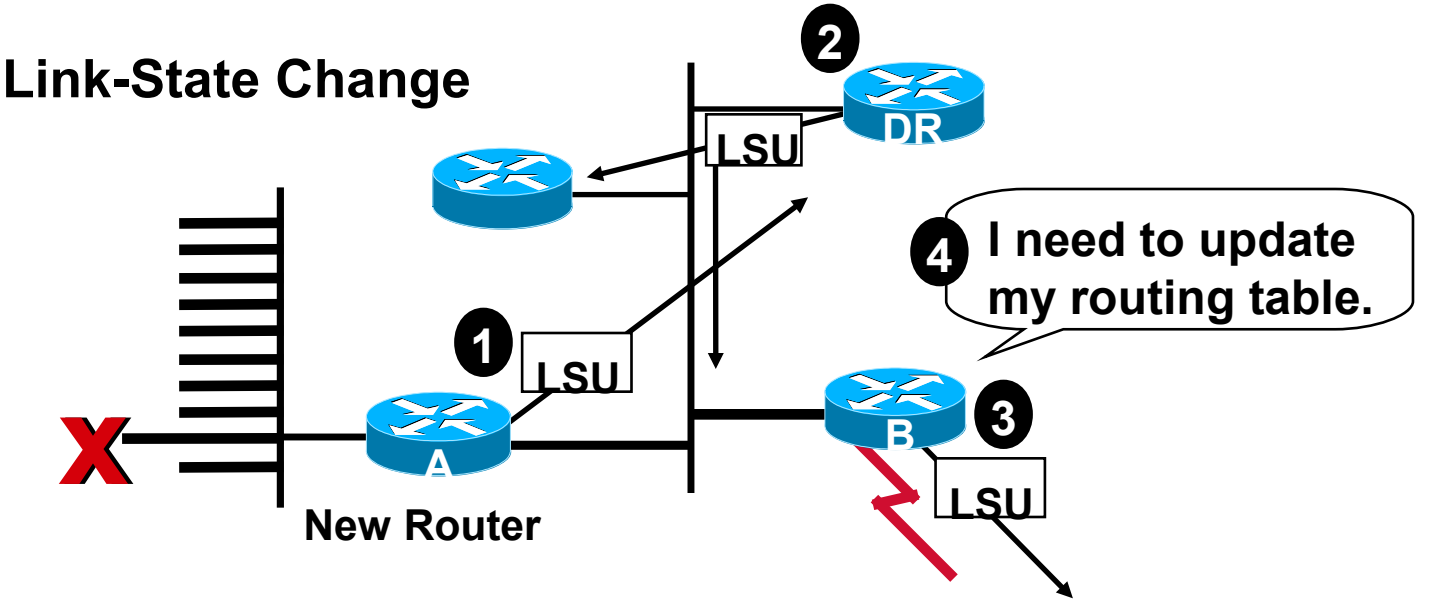
Maintaining Routing Information



- New router tells all OSPF DRs on 224.0.0.6
- DR tells others on 224.0.0.5



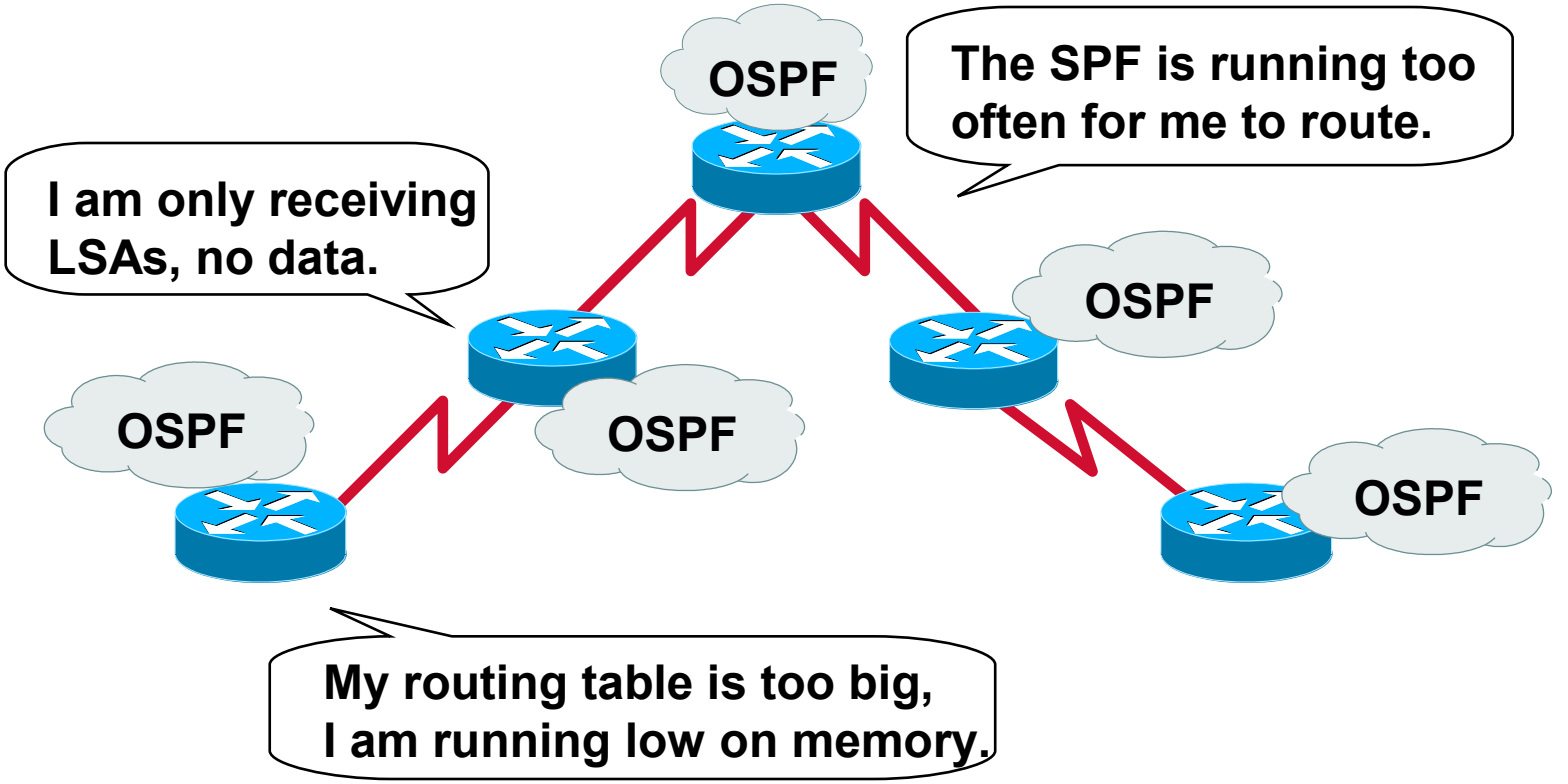
- New router tells all OSPF DRs on 224.0.0.6
- DR tells others on 224.0.0.5



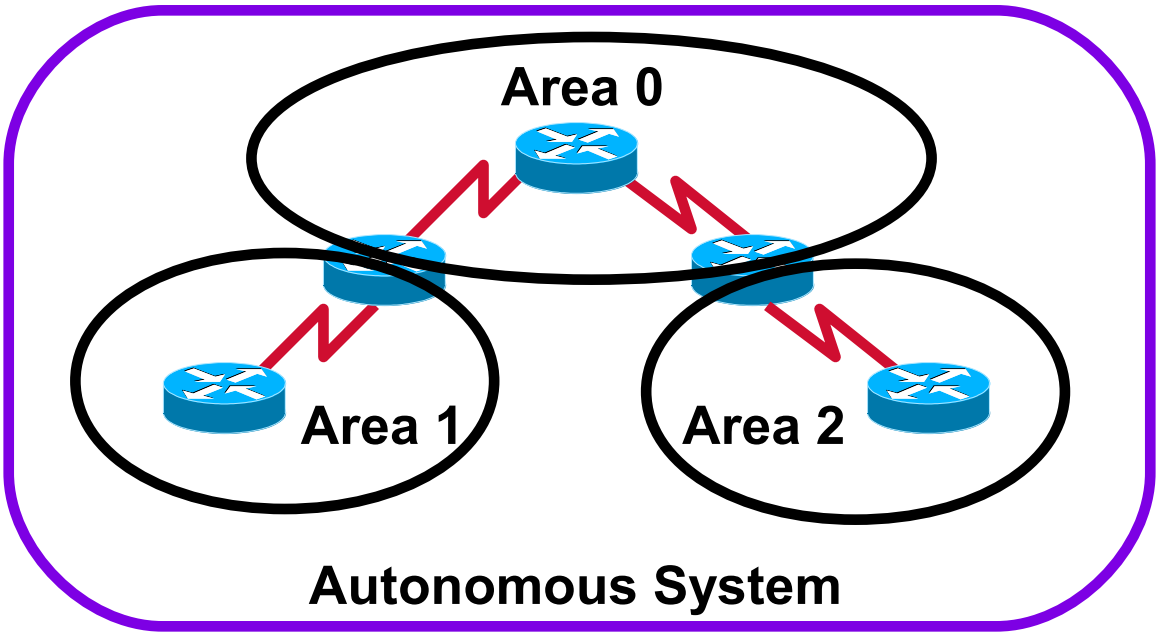
- New router tells all OSPF DRs on 224.0.0.6
- DR tells others on 224.0.0.5

Interconnecting Multiple OSPF Areas

Issues with Maintaining a Large OSPF Network



Dividing Large Networks in Multiple Areas



- Consists of areas and autonomous systems
- Minimizes routing update traffic

OSPF Multi area Components

Areas

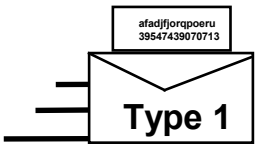
Area 0
I am a backbone.

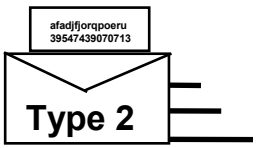
Area 1
I am standard.

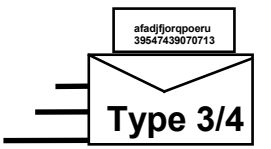
Area 2
I am a stub.

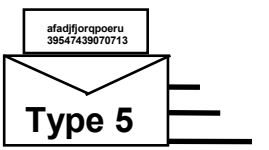
Routers

LSAs

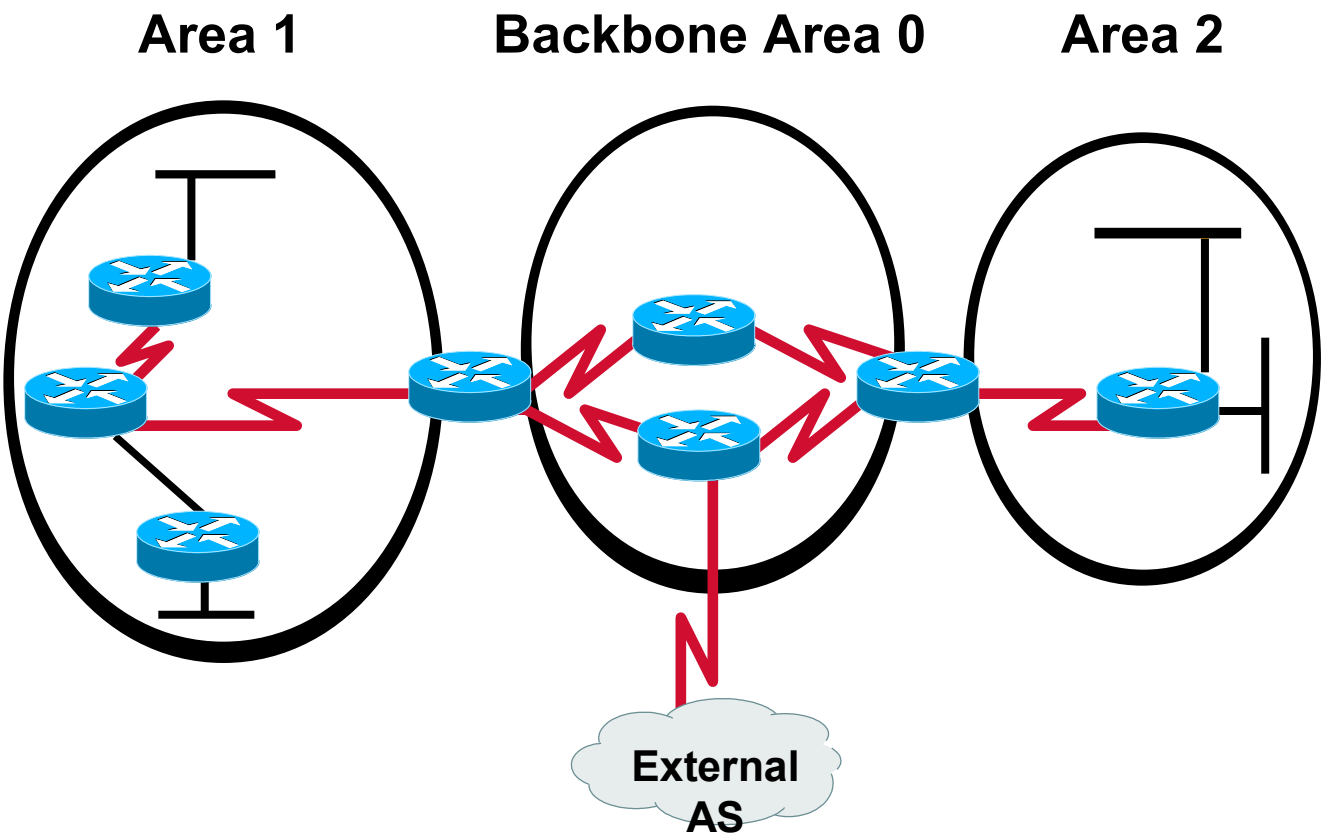








Types of OSPF Routers



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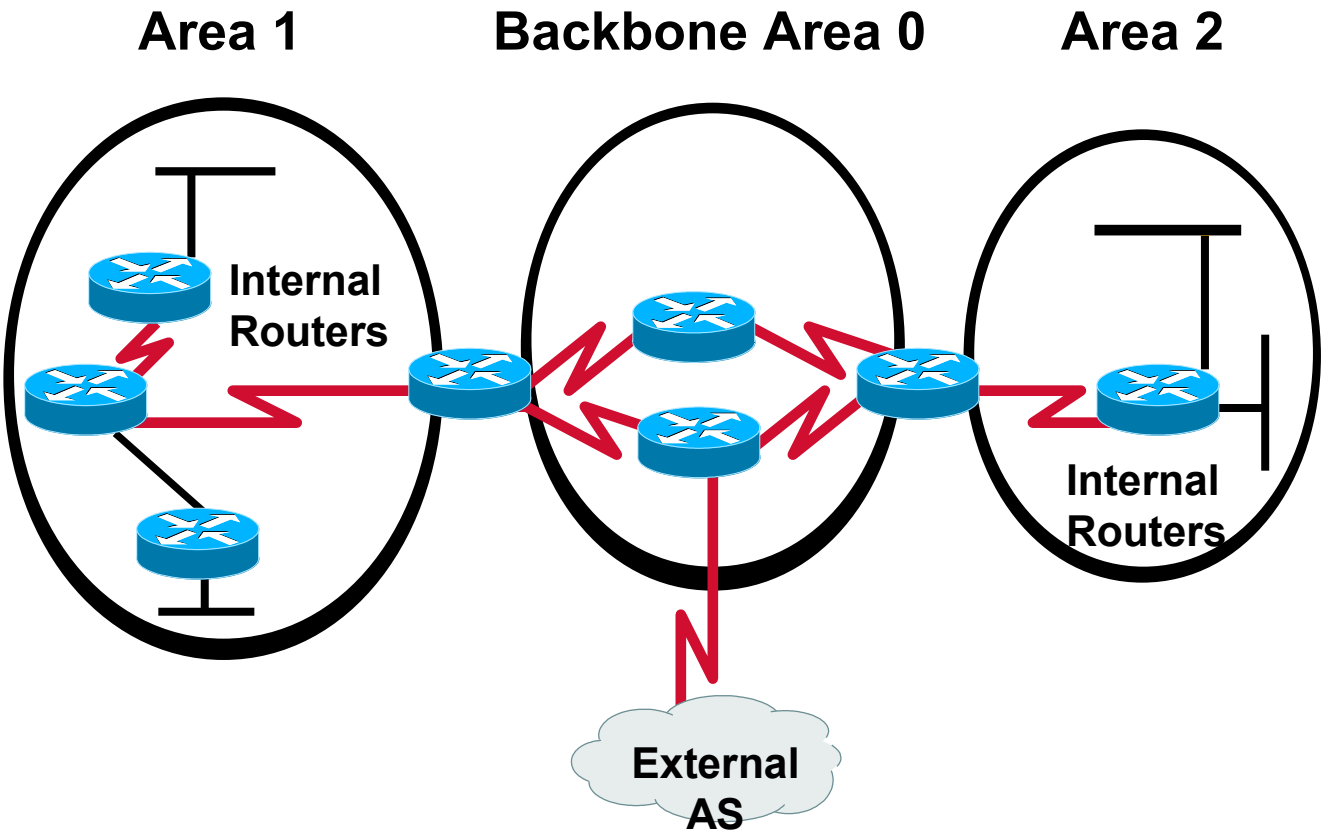

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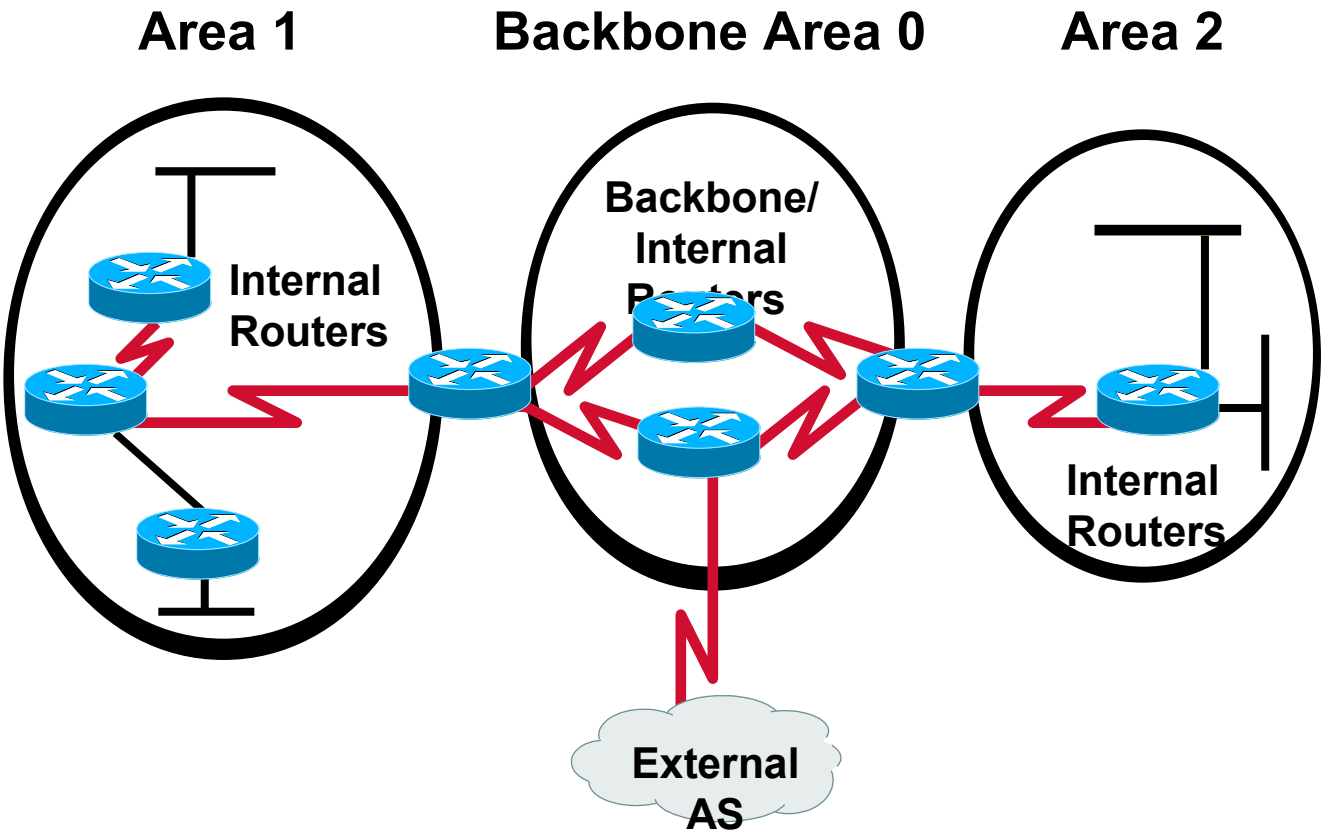

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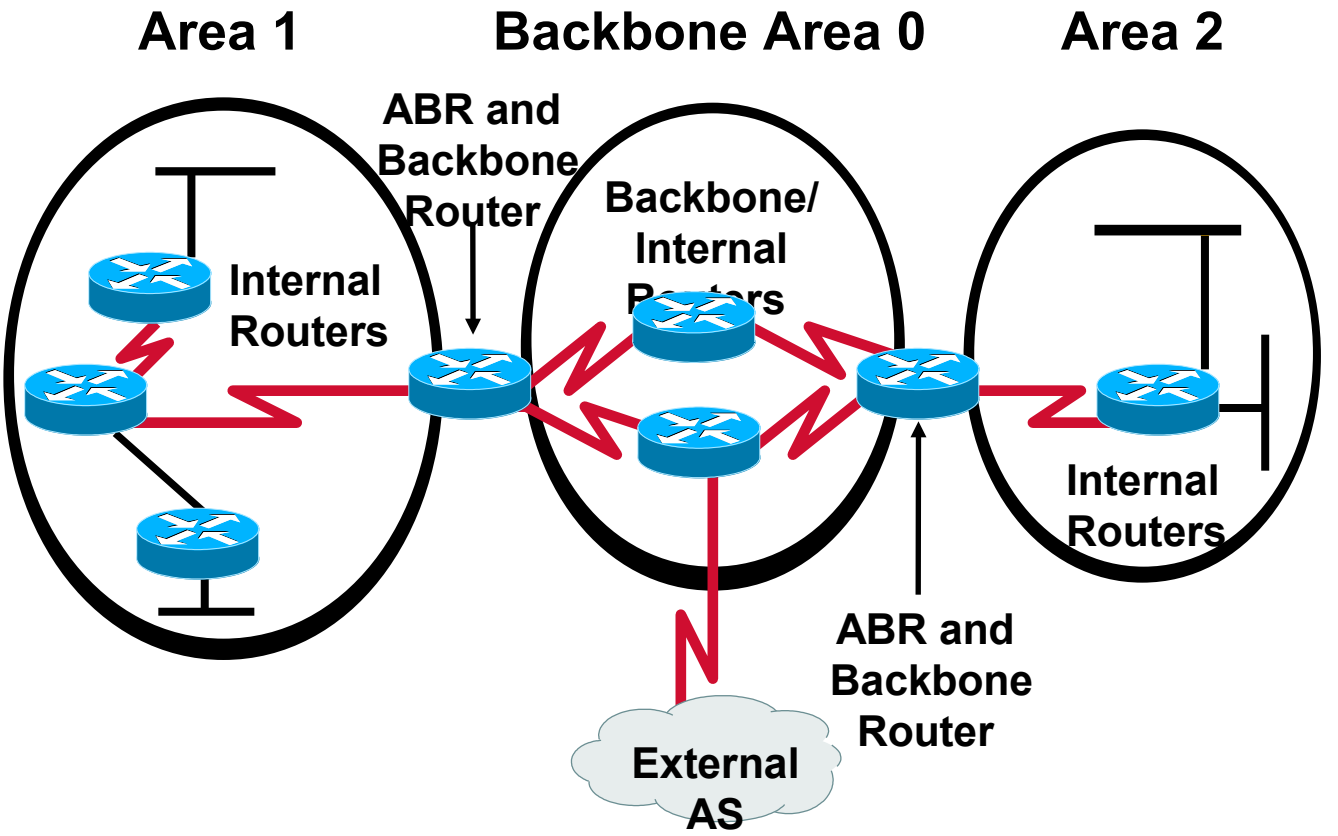

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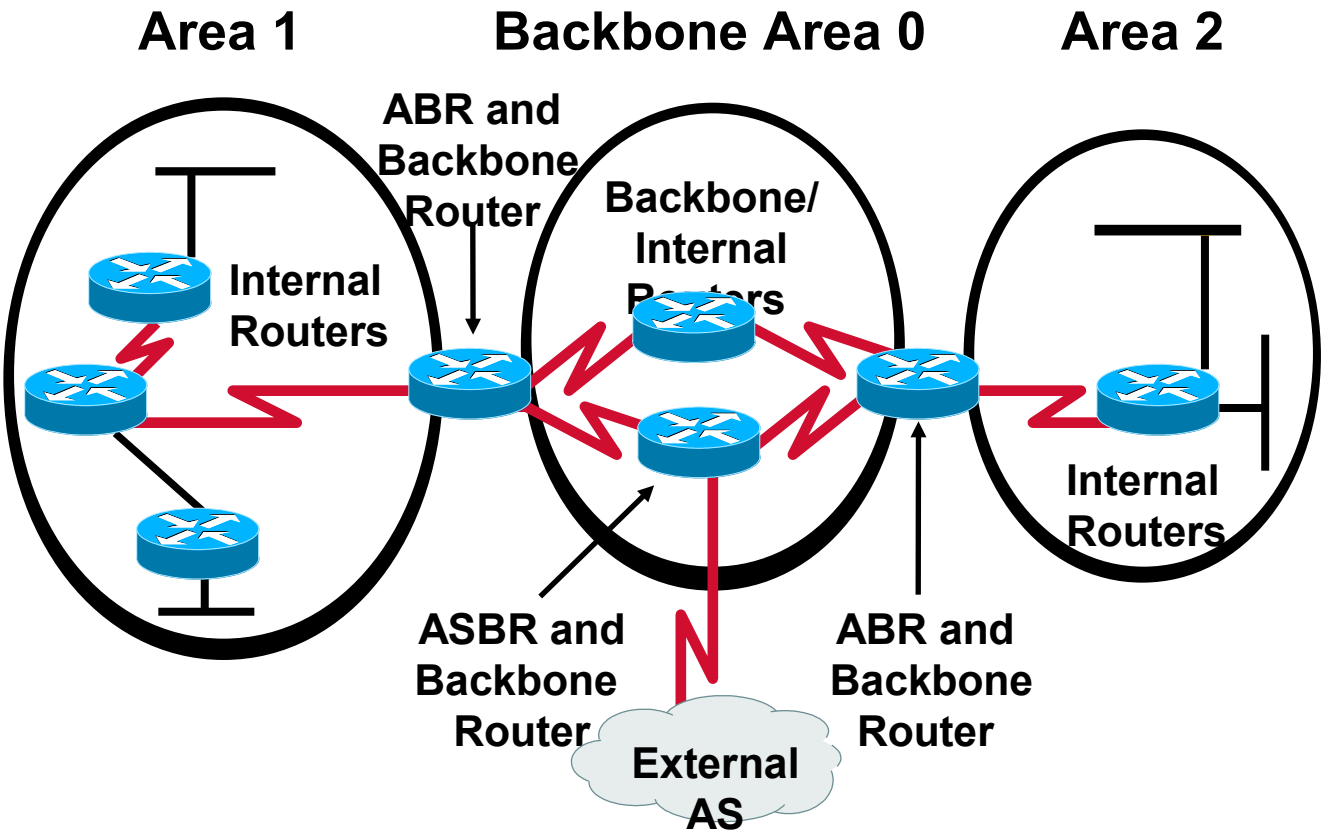
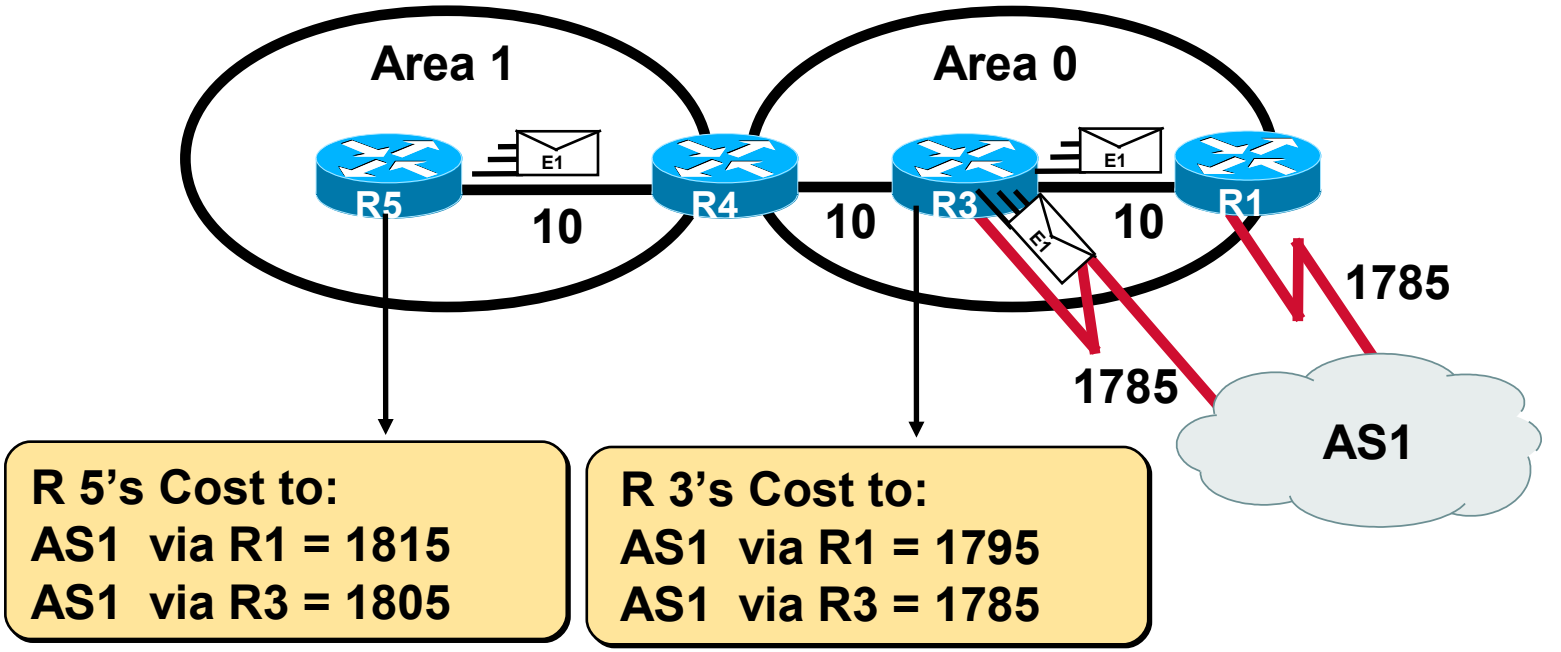
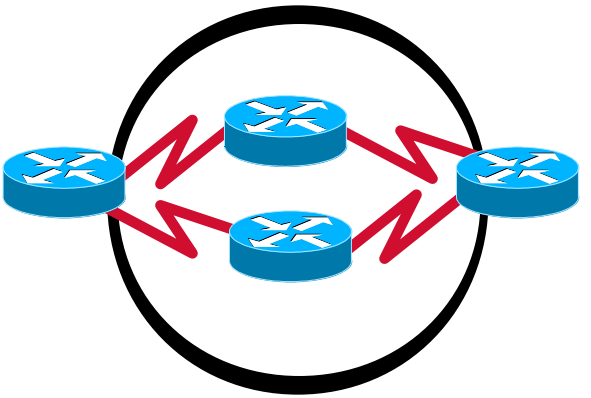


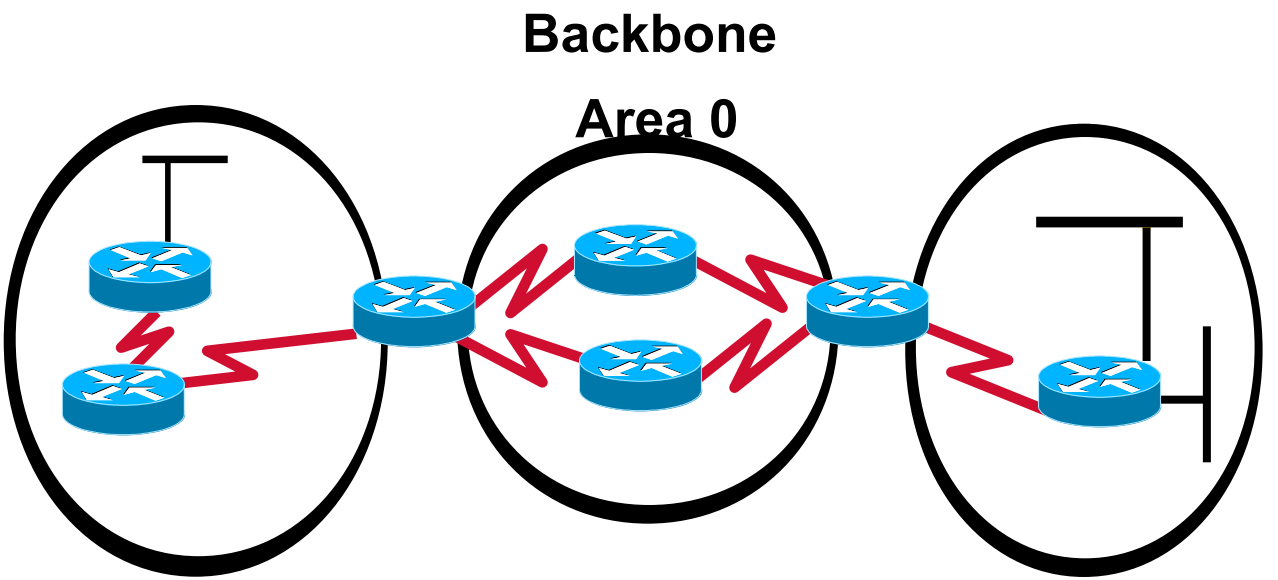
Calculating Costs for Summary and AS External Routes



Types of Areas

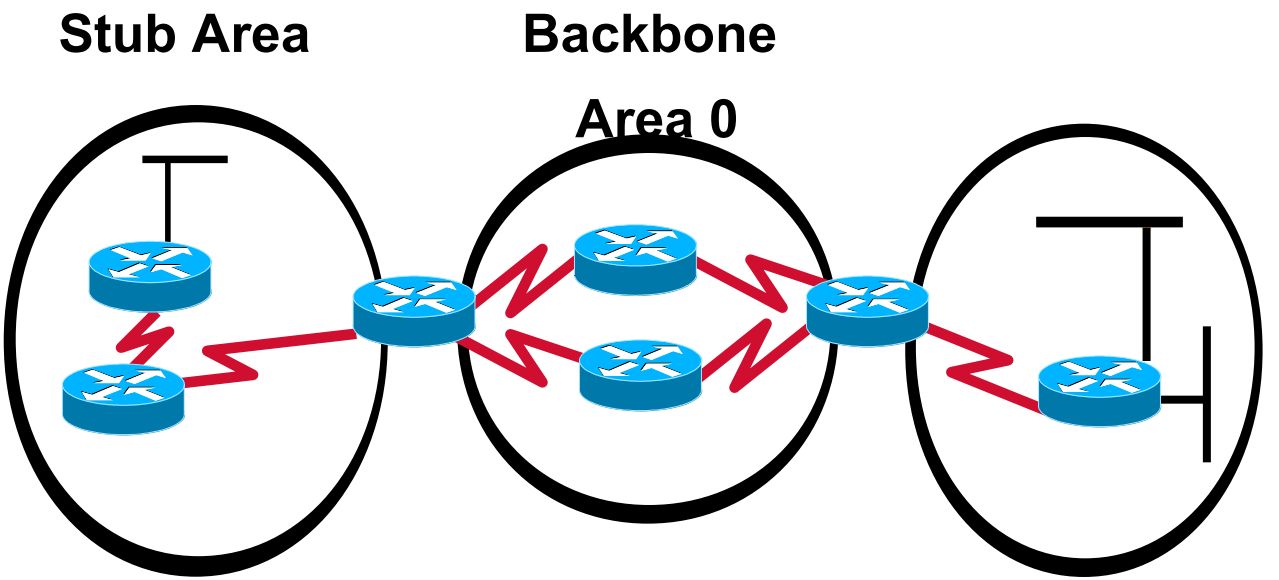


Types of Areas



Interconnects areas; accepts all LSAs.

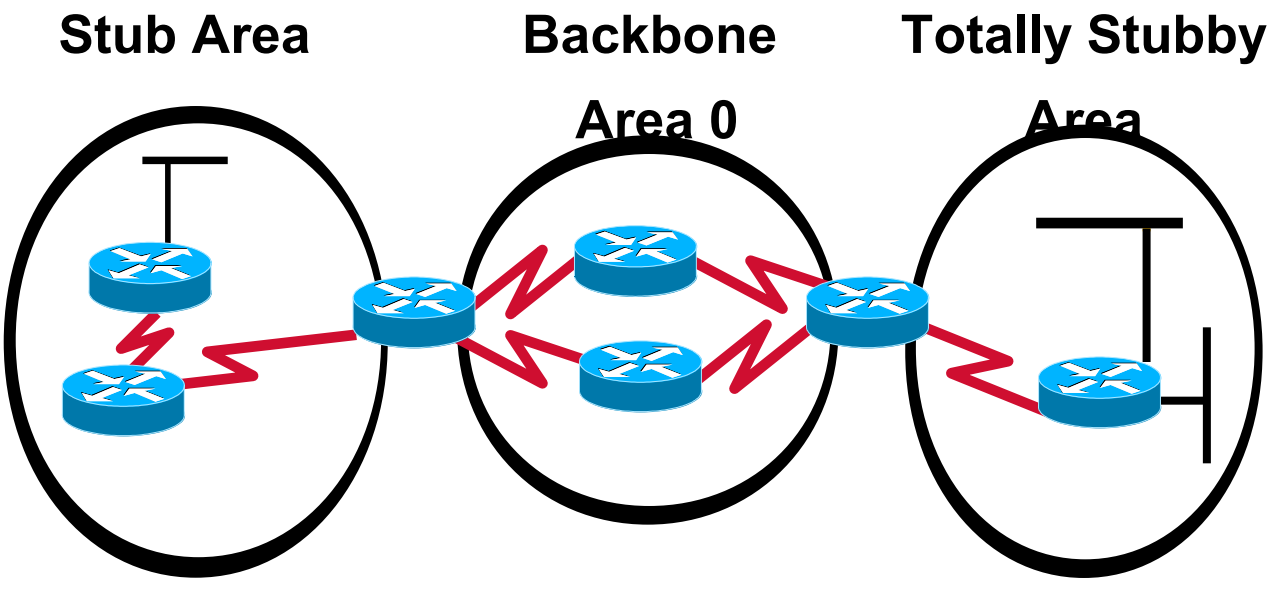
Types of Areas



Does not accept external LSAs.

Interconnects areas; accepts all LSAs.

Types of Areas



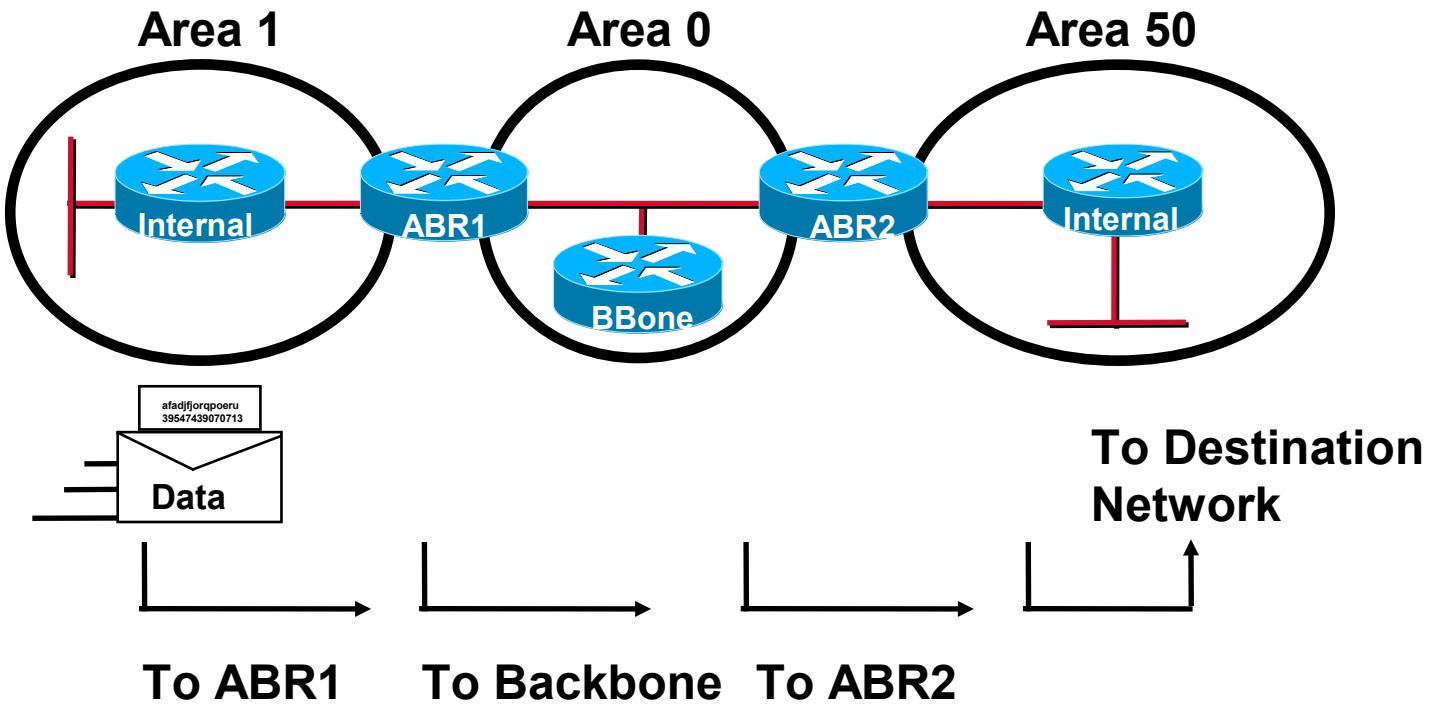
Does not accept external LSAs.

Interconnects areas; accepts all LSAs.

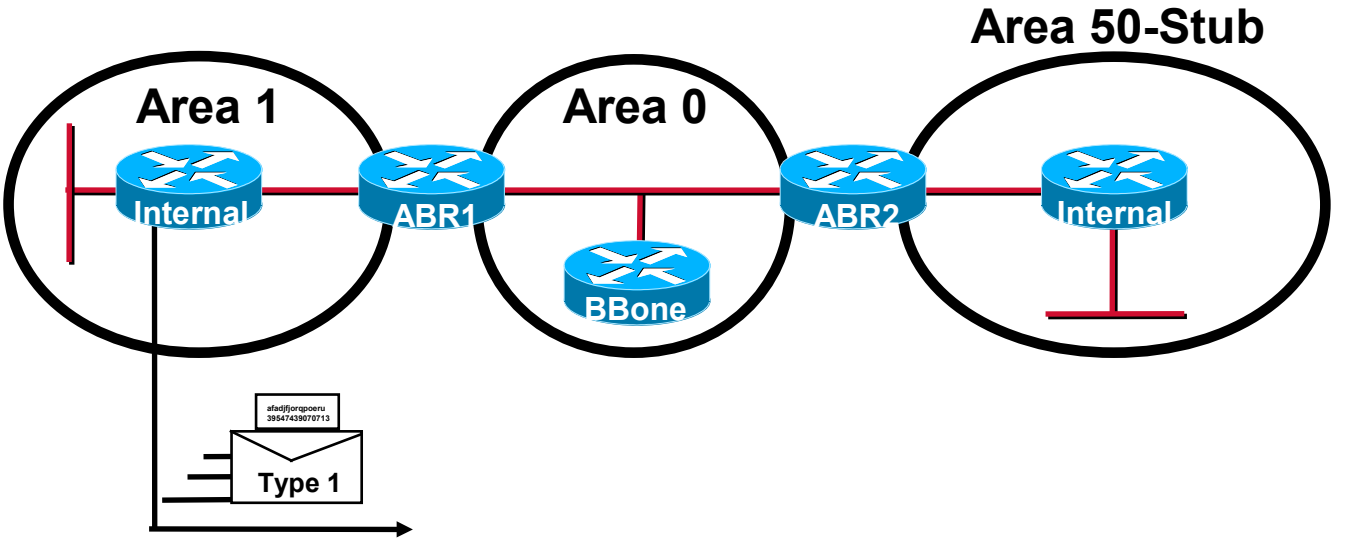
Does not accept external or summary LSAs.

OSPF Operation across Multiple Areas

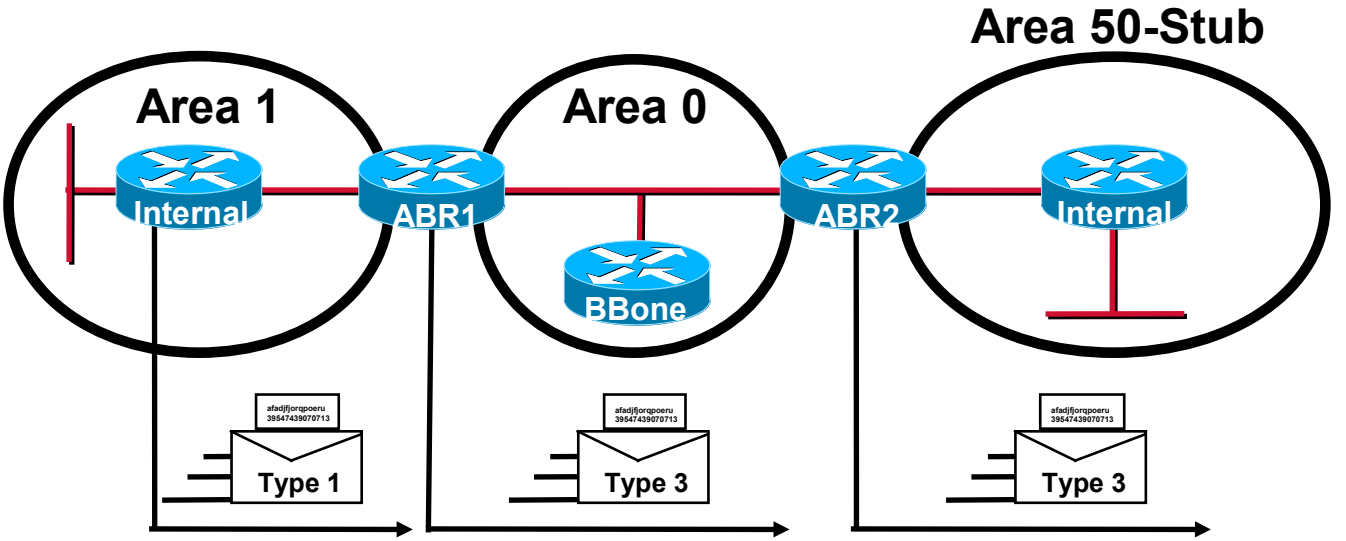
Forwarding Packets in a Multi area Network



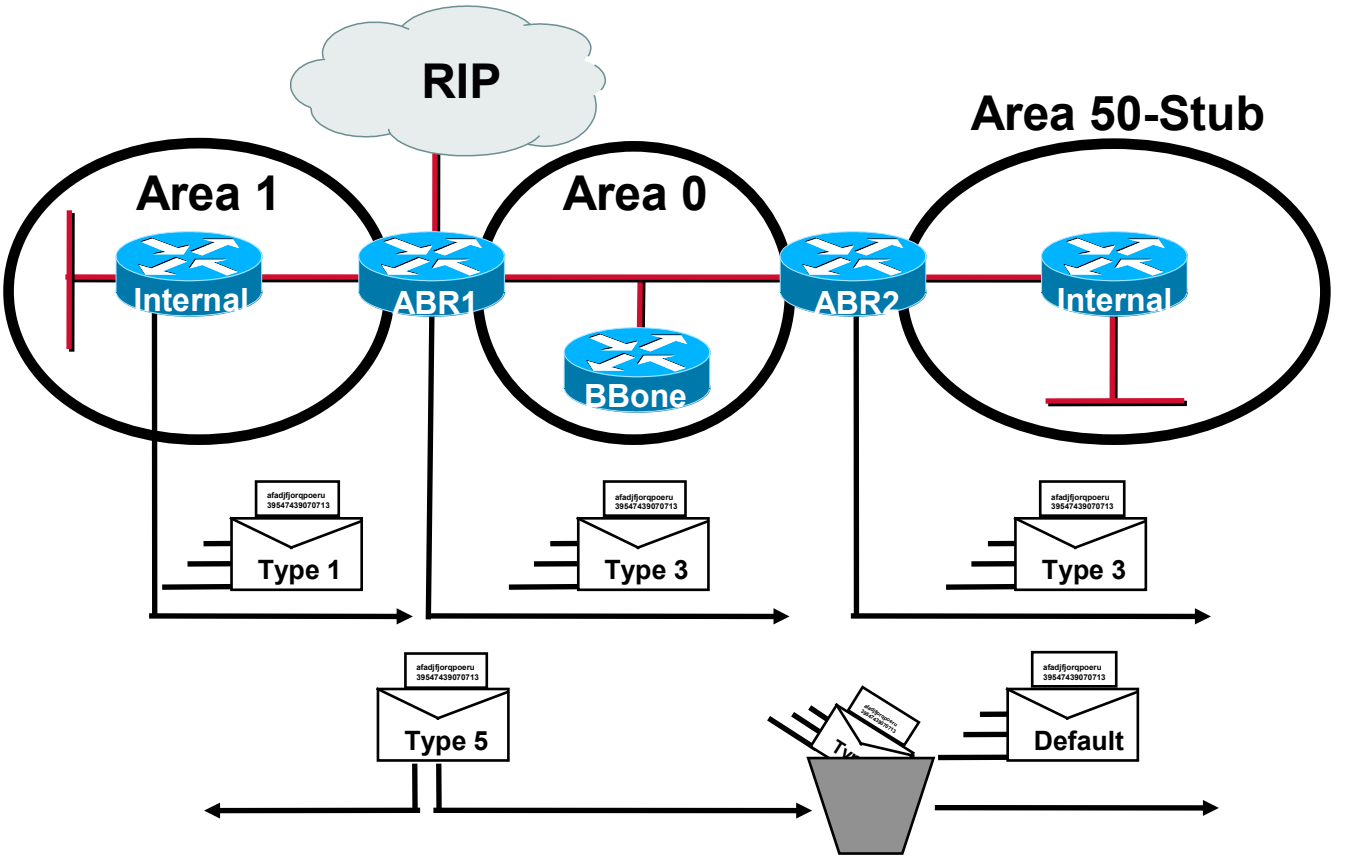
Flooding LSUs to Multiple Areas



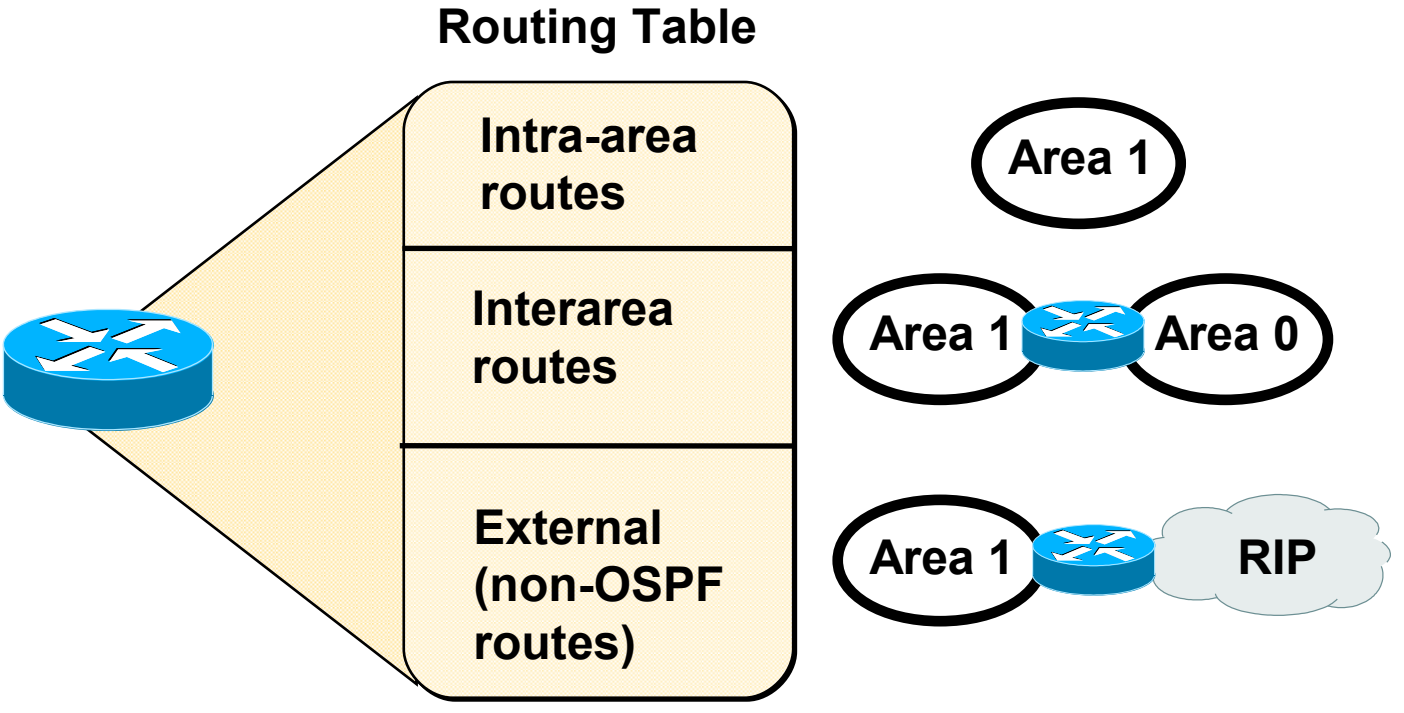
Flooding LSUs to Multiple Areas



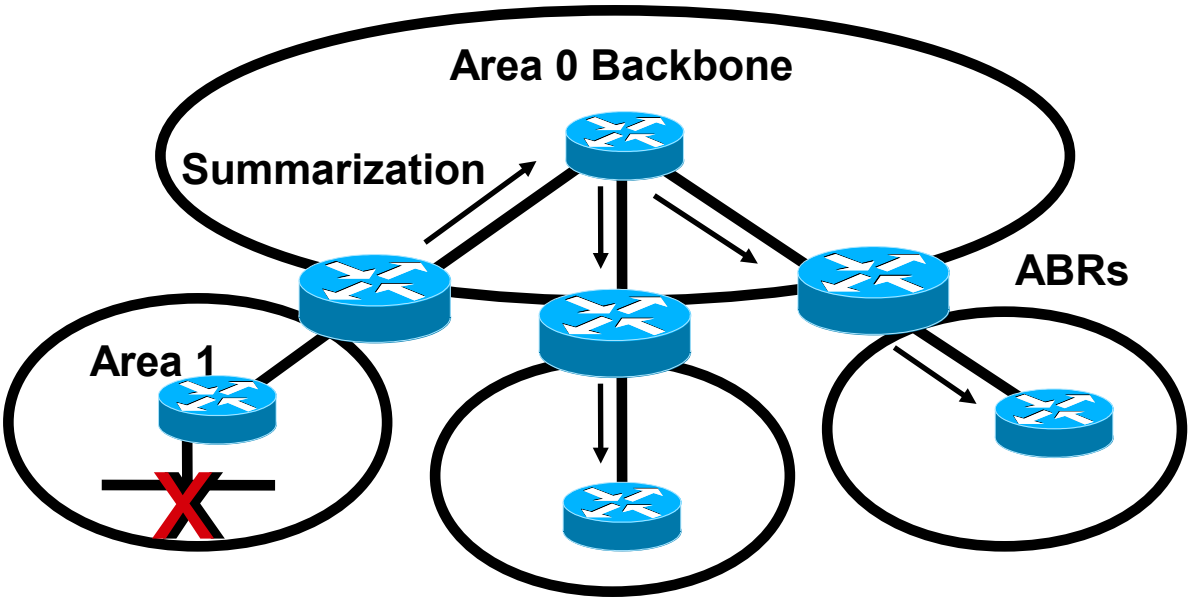
Flooding LSUs to Multiple Areas



Flooding LSUs to Multiple Areas (cont.)

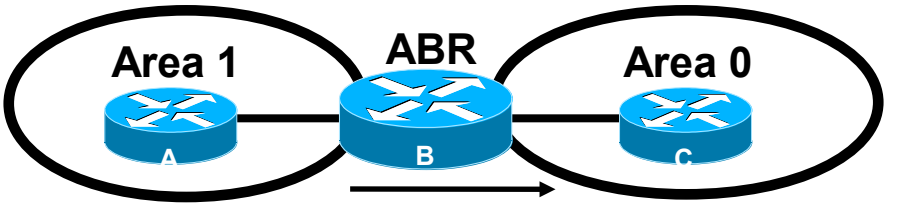


Route Summarisation



- Minimizes number of routing table entries
- Localizes impact of a topology change

Route Summarisation



Summarization

Routing Table for B

O 131.108.8.0	255.255.252.0
O 131.108.12.0	255.255.252.0
O 131.108.16.0	255.255.252.0
O 131.108.20.0	255.255.252.0
O 131.108.24.0	255.255.252.0
O 131.108.28.0	255.255.252.0

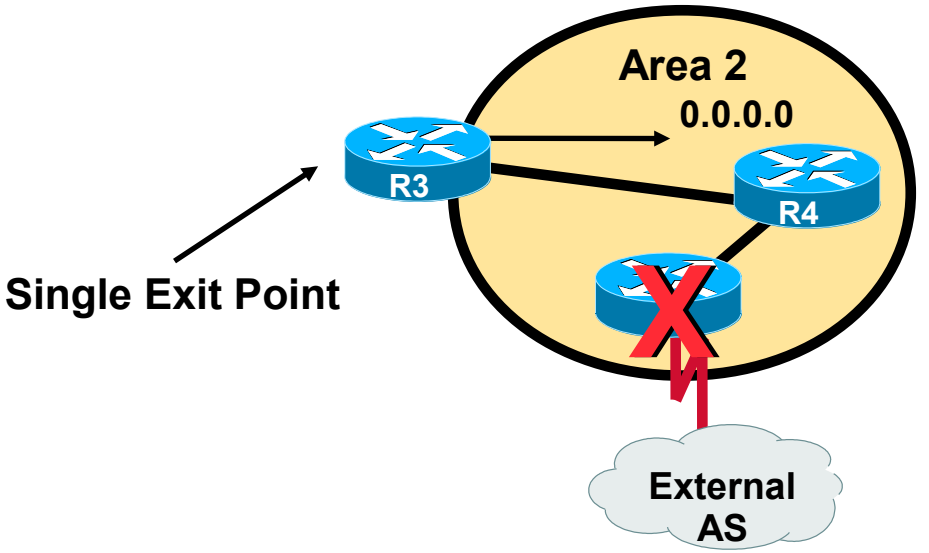
LSAs sent to Router C

IA 131.108.8.0 255.255.248.0

IA 131.108.16.0 255.255.240.0

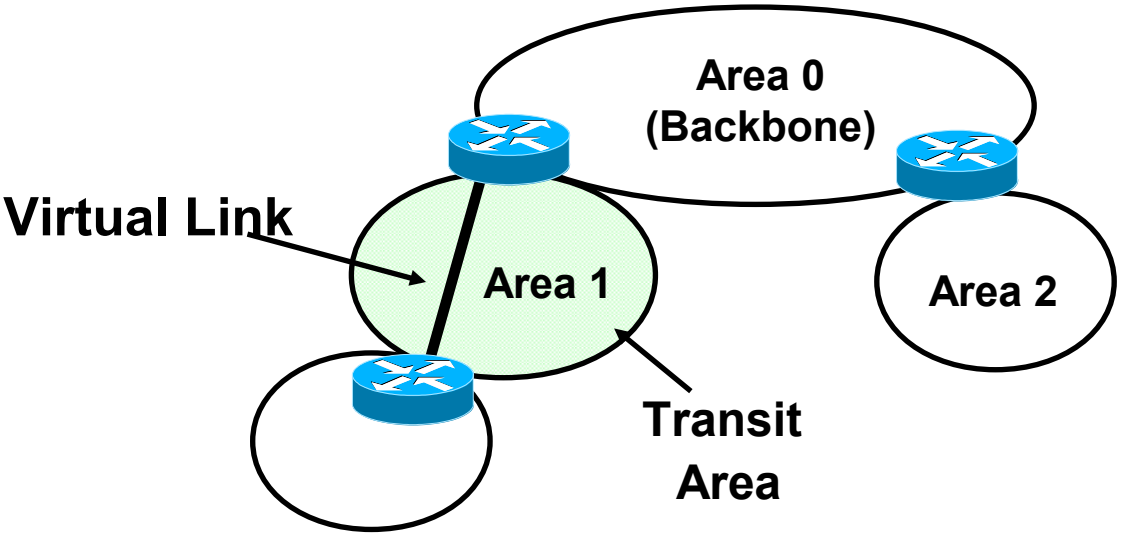
- Inter area (IA) summary link carries mask
- One entry can represent several subnets

Some Restrictions



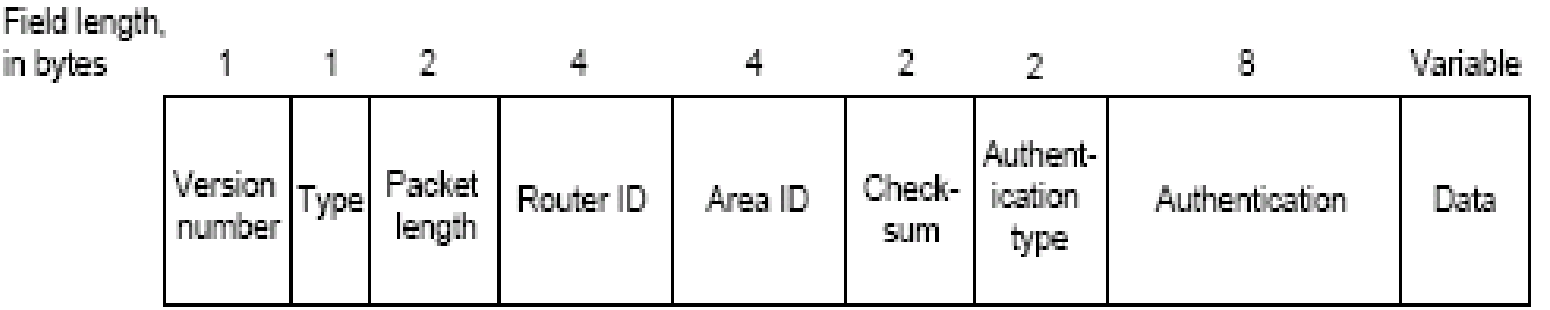
- Typically single exit point into area, if multiple exit points, sub optimal paths may be selected
- An ASBR cannot be internal to stub

Virtual Links



- Backbone center of communication
- Virtual links provide path to backbone
- Avoid configuring virtual links if possible

OSPF Packet Format



Summary

- OSPF is a scalable, standards-based link-state routing protocol
- OSPF benefits include:
  - No hop count limit
  - Mulitcasts routing updates
  - Faster convergence
  - Better path selection