# MikroTik Advanced Routing

## OSPF Introduction

MikroTik

# Agenda

- Dynamic Routing Fundamentals
- IGP Metrics
- OSPF neighborship
- Hello and exchange of LSUs
- Cost and SPF-Tree calculations
- OSPF Area

# Routers Learn IP routes from…

- Connected Routes
- Static Routes
- Routes learned from dynamic routing protocols

# Routing Protocol vs Routed Protocol & Routable Protocol

- ***Routing Protocol*** – A set of messages, rules, and algorithms used by routers for learning, exchanging of routes , e.g. RIP, OSPF, BGP

- ***Routed Protocol & Routable Protocol*** – Both the terms refer to the protocol that is used to define a packet structure and logical addressing, e.g. IPv4, IPv6

# Routing Protocol Functions

- Learn routing information about IP subnets from neighboring routers
- Advertise routing information about IP subnets to neighboring routers
- Pick best route if more than one route is available to the same subnet
- In case there is a change in topology, advertise its neighbors and let them know of the change

# IP Routing Protocols Classification

- ***IGP (Interior Gateway Protocol)*** – Protocol to be used inside an Autonomous System(AS)

- ***EGP(Exterior gateway Protocol)*** – Protocol to be used to inter-connect Autonomous Systems to one another

Autonomous System is a network under the Administrative control of a single organization

# IGP Routing Protocols Working

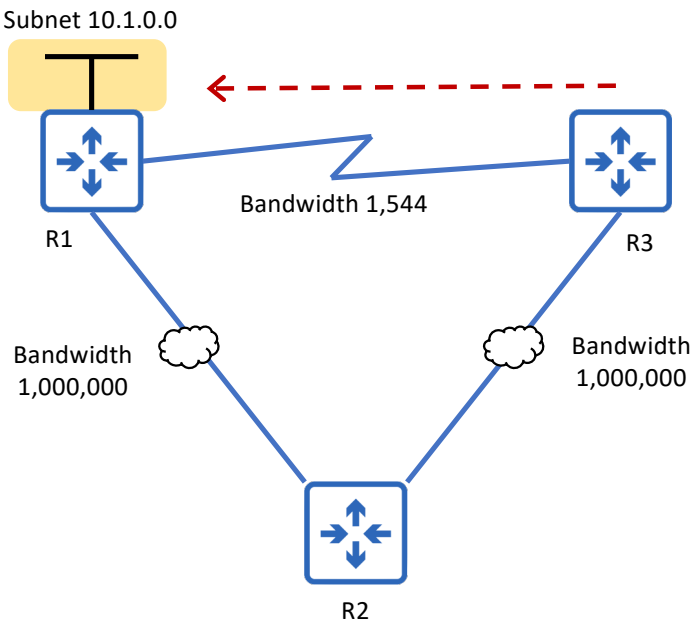
- ***Distance Vector*** – Routing decision takes place on the distance metrics received from the neighbors. Is susceptible to routing loops and has slow convergence.

- ***Link State*** – Routing decision are made on link state and link metrics which are advertised to the neighbor. The link metrics is the cost of the link and is directly proportionate to the bandwidth.

# Why is Metrics Important

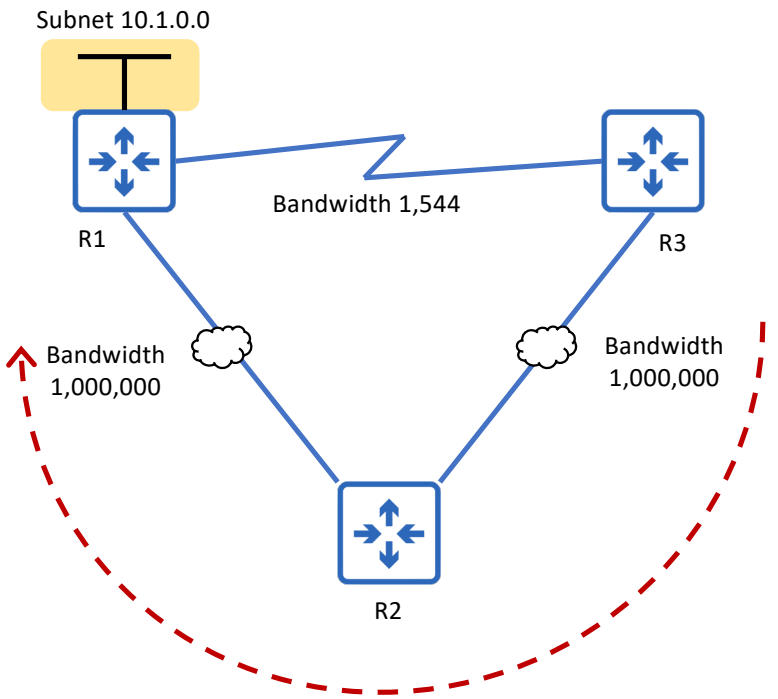
***Distance Vector***

RIP – Hop Count




***Link State***

OSPF – Cost



# OSPF

- Open Shortest Path First – Link State protocol
- Routers flood the network with LSAs to build their LSDB
- LSA - Link State Advertisement, router's local routing topology to all other local routers in the same OSPF area
- LSDB – Link State DataBase, is built and based on information that is found in LSAs. Same for routers within the area.

# How do Routers become neighbour

- Routers should be on same Data-Link Layer
- They must send OSPF messages and agree to become neighbors
- These messages include hello, topology changes etc
- Messages are delivered dynamically that means if at a later time a new router has to be introduced to the network, only the new router has to be configured and not the existing routers

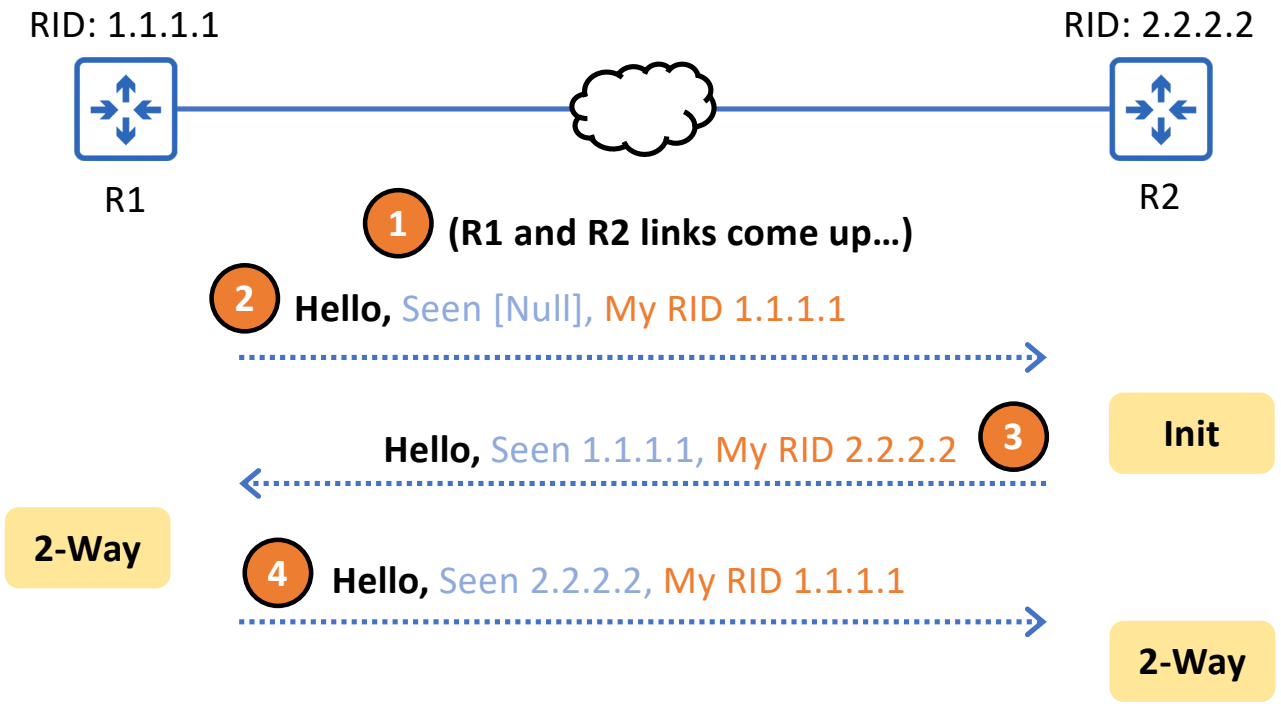
# Neighbours are identified by ROUTER-ID

- Result of the neighborship hello is routers learning each other's *name*, denoted by a 32-bit DDN(Dotted Decimal Number)
- By default, Router's Interface IPv4 address is picked up
- For Neighborship to establish the minimum configuration needed is *Setting up Instance(Router-Id* will be setup here), *area*, network/interface on which multicast hellos will be sent/received

# OSPF there is more…

- OSPF Hello message don’t use TCP/UDP header, OSPF has its own IP protocol type 89
- Hello Packets are sent on multicast address ***224.0.0.5***
- In turn OSPF routers listen on ***224.0.0.5*** multicast address to learn new neighbor

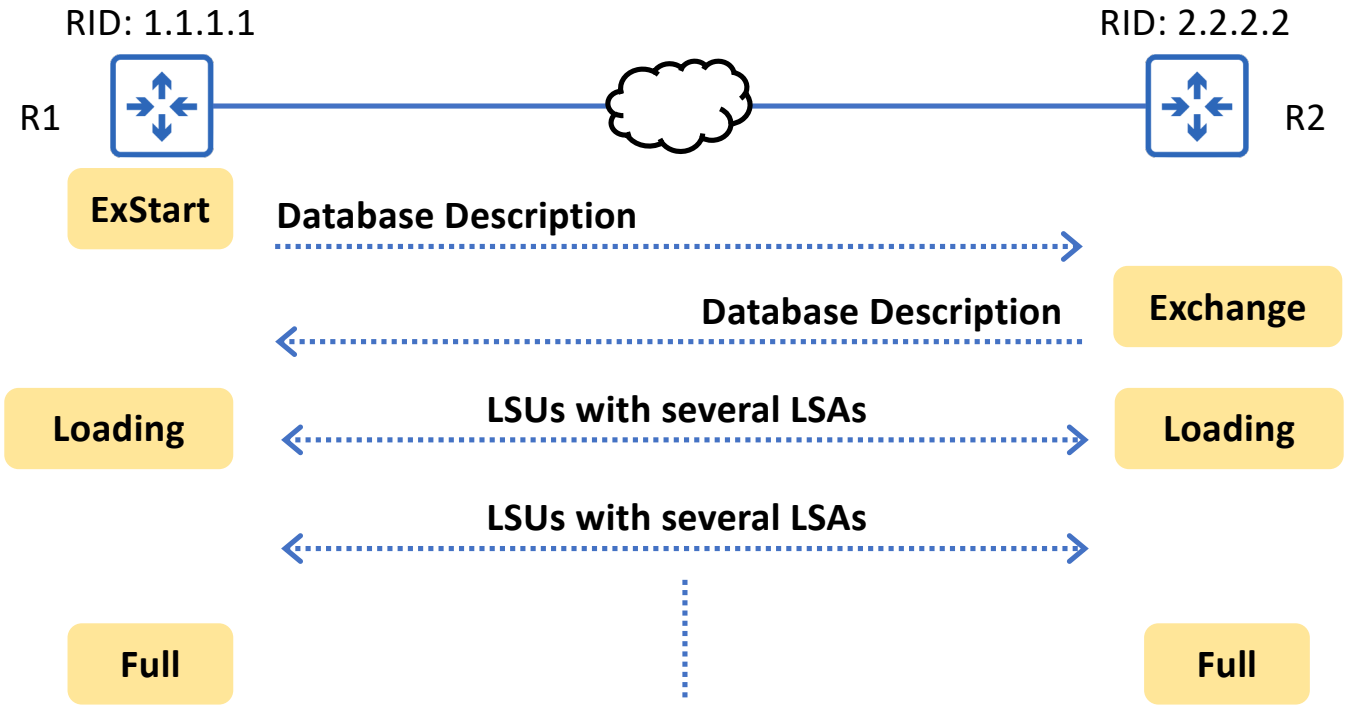
# OSPF Hello


RID: 1.1.1.1
RID: 2.2.2.2
R1
R2
1
(R1 and R2 links come up…)
2
Hello, Seen [Null], My RID 1.1.1.1
3
Hello, Seen 1.1.1.1, My RID 2.2.2.2
Init
2-Way
4
Hello, Seen 2.2.2.2, My RID 1.1.1.1
2-Way

# 2-Way state

- Router received a hello with Router's own ID listed as seen by neighbor
- Router has checked all parameters of the Hello received from the neighbor and finds it ok to be neighbor to the responding Router
- If both Router's reach 2-way State that means both Router's are ready to form neighborship and are ready to share their LSDB with each other

# Exchange between Neighbors




- LSU – Link-State Updates are packets that holds LSAs
- LSA – Link-State Advertisement are data-structures which sits inside LSDB
- LSDB – Link-State DataBase collection of structured information of LSAs

# Maintain Neighborship and LSDB

- ***Hello Interval*** – To maintain neighborship the routers will send Hello Packet to its neighbor, the interval is defined as hello interval. This is the same time frame that the router will wait for a ‘hello’ from its neighbor.

- ***Dead Interval*** – If the neighbor doesn’t respond to a ‘hello’ or is just silent for this period, the neighborship is broken(by default this is 4x the Hello Time)

- The router will flood any change in the network topology to its neighbor

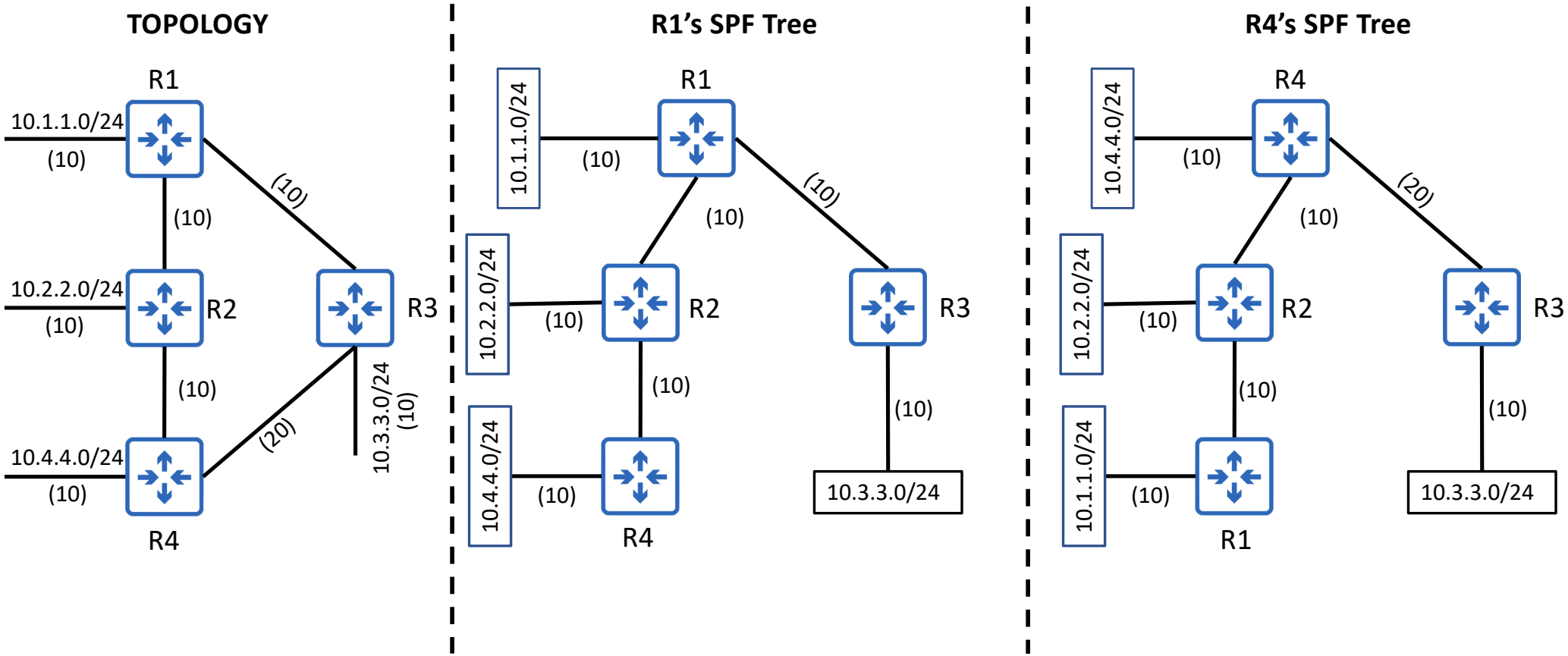
- The router will flood any unchanged LSAs as their lifetime is expiring(default: 30mins)

# More than 2 Routers on Ethernet Segment

- ***Designated Router(DR)***
- ***Backup Designated Router(BDR)***
- ***DROthers***
- ***DROthers*** communicate with DR ad BDR on 224.0.0.6 instead of 224.0.0.5
- DR and BDR send information to DROthers on 224.0.0.5

# Cost & SPF

- Each router considers itself as the root/top of the SPF tree
- SPF is calculated by sum of all the OSPF interface that the packet will transit thru to reach the destination



# OSPF Area

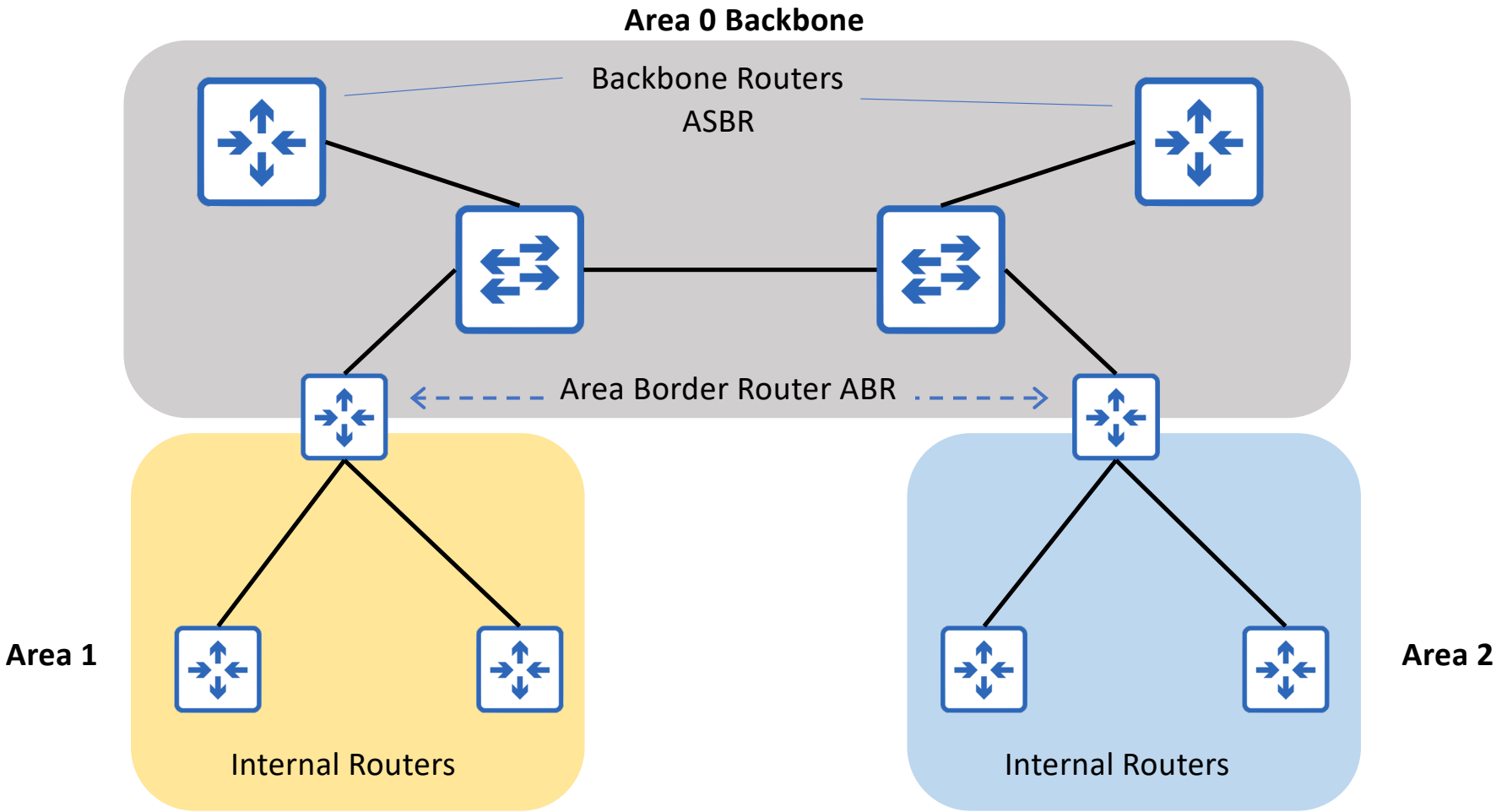
- OSPF network in a small environment does not need much thought and can be implemented on the fly, by adding all Routers to AREA 0
- But, in larger network, where there are many routers, this can create a problem
- SPF algorithm is CPU intensive, and the more Routers will affect the performance of the Routers in the network
- We can segment our network into smaller areas, general rule is to keep less than 50 routers in an area

- Note: Number of routers in an area is more dependent on the CPU power needed to process SPF tree.

# Area Rules

- Put all interfaces connected to the same subnet inside the same area.
- An area should be contiguous.
- Some routers may be internal to an area, with all interfaces assigned to that single area.
- Some routers may be Area Border Routers (ABR) because some interfaces connect to the backbone area, and some connect to non-backbone areas.
- All non-backbone areas must have a path to reach the backbone area (area 0) by having at least one ABR connected to both the backbone area and the non-backbone area.

# Area Rules


Area 0 Backbone
Backbone Routers
ASBR
Area Border Router ABR
Area 1
Internal Routers
Internal Routers
Area 2

# Q &. A

# Thank you for watching

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