• OSPF – Open Shortest Path Protocol

•Link state protocol; Interior Gateway Protocol (IGP)

• **RFC 2328 - OSPF Version 2**

• On initialization or topology change in routing information, a router will generate a link-state advertisement, which represents the collection of all link-states on that router.

• Link State algorithm:
 -- 1. Construct "Network topological database" by flooding (multicast)
 -- 2. After the database of each router is completed, each router will calculate it's own Shortest Path Tree to all destinations using Dijkstra algorithm. And then the destinations, the associated cost and the next hop to reach those destinations will form the IP routing table.
 -- 3. For any changes, the change are communicated via link-state packets, and the Dijkstra algorithm is recalculated to find the shortest path.

1.With OSPF, there is no 15 hop count limitation.

2.OSPF uses IP multicast to send link-state updates.

3.OSPF has better convergence than RIP.

4.OSPF allows for better load balancing.

5. OSPF allows for a logical definition of networks where routers can be divided into areas, which limits the explosion of link state updates over the whole network.

6.OSPF allow use more routing authentication.

7.OSPF allow external routes injected into an AS.

OSPF Area

- An area topology is invisible outside of that area

- A router with multiple interfaces can participate in multiple areas

- Each area is identified by a 32 bit Area ID and consist of a collection of network segments and interconnected by routers. Backbone: **Area 0.0.0.0**

- The Area ID is **NOT** an IP address, although it looks like one

- Each area has it's own Link-State Database consisting of Router and Network LSAs describing how areas routers and network segments are interconnected.
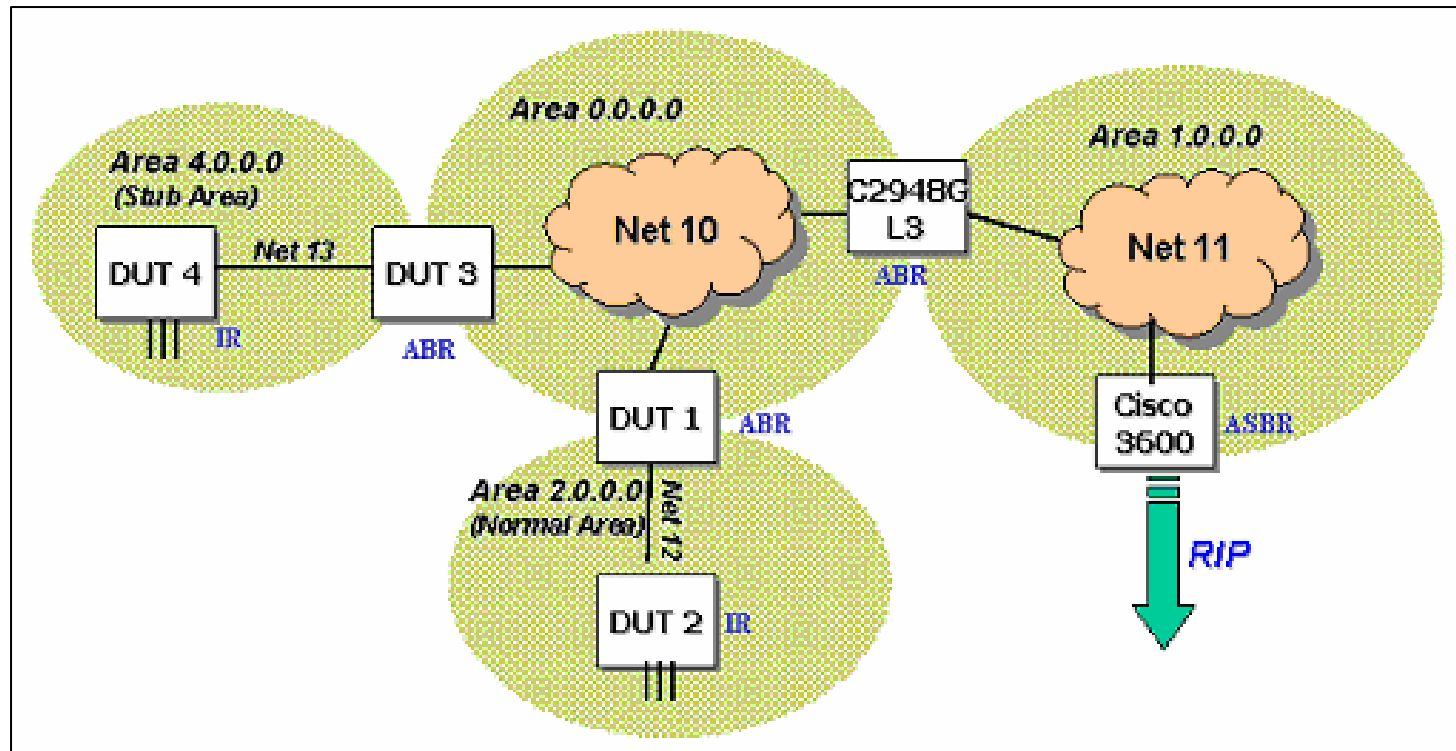
Routers that have connections to more than one area are called Border Routers (BR). The Border Routers have the responsibility of distributing necessary routing information and changes between areas.

IR: A router that has all of its interfaces in the same area is called an Internal Router

ABR: A router that has interfaces in multiple areas is called a Area Border Router.

ASBR: Routers that act as gateways to other networks (possibly using other routing protocols) are called Autonomous System Border Routers (ASBRs)

Types of OSPF Routers

Area 0.0.0.0

Area 4.0.0.0
(Stub Area)

Area 1.0.0.0

Net 13

DUT 4

DUT 3

Net 10

C2948G
L3

Net 11

IR

ABR

ABR

DUT 1

ABR

Cisco
3600

ASBR

Area 2.0.0.0
(Normal Area)

Net 12

DUT 2 IR

RIP

- **Exchange of Routing Information**

  –Each router periodically sends out a description of its connections to its neighbors

  –Routers are neighbors if they are directly connected via a common network.

  –A router sends the LSA to each of its neighbors. The LSA includes a listing of all interfaces and configured "cost" of each link and each configured cost-TOS pairing

- **Routing Area**

  –The LSA is flooded throughout the router's domain. The router's domain may be entire AS or limited area within the AS

  –Areas are configured by assigning an area_ID for each router interface. If the area_ID is identical for all ports on a router, then the router is contained in single area

- **Link-State Database**

  –Each router in the domain maintain an identical, synchronized copy of a database composed of this link-state information

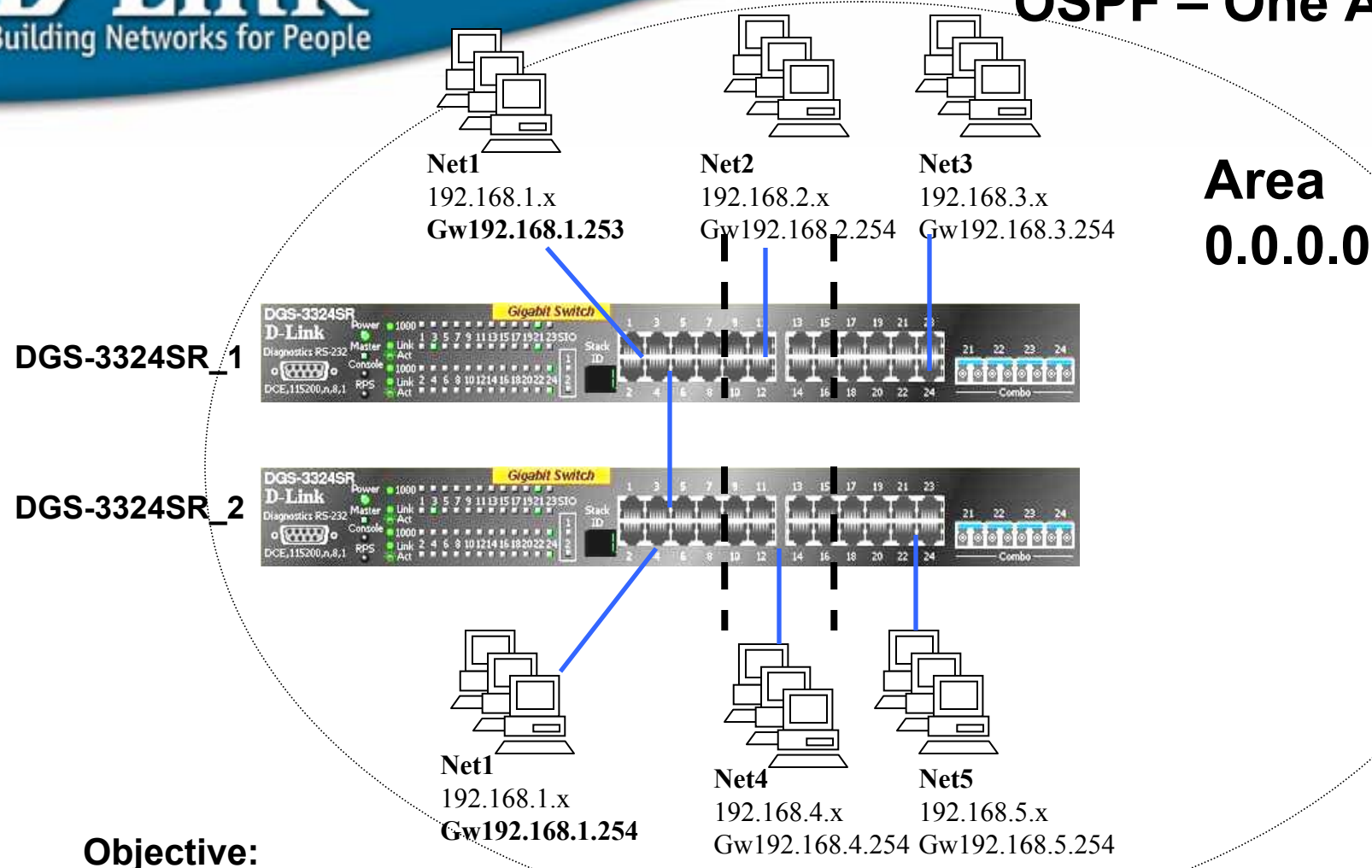 –Router belonging to multiple areas maintain a separate Link_state database for each area

- **Shortest Path Tree**

  –Each Router runs an algorithm on the database used to create a shortest path tree.

  –The shortest path tree contains the shortest path to every router and every network that other routers can reach. The router performing the calculation places itself at the root of each tree.

- **Routing Table**

  –The resulting shortest path trees determine total cost to the destination network and next hop router. The shortest path trees are used as the basis of creating the routing table.

Net1
192.168.1.x
Gw192.168.1.253

Net2
192.168.2.x
Gw192.168.2.254

Net3
192.168.3.x
Gw192.168.3.254

Area 0.0.0.0

DGS-3324SR_1

DGS-3324SR_2

Net1
192.168.1.x
Gw192.168.1.254

Net4
192.168.4.x
Gw192.168.4.254

Net5
192.168.5.x
Gw192.168.5.254

Objective:

1. **DGS-3324SR_1 can learn the networks (i.e, Net4 and Net5) at DGS-3324SR_2.**

2. **DGS-3324SR_2 can learn the networks (i.e, Net2 and Net3) at DGS-3324SR_1.**

AT DGS-3324SR_1(TOP)

1. **Configure VLAN and IP interfaces for net1, Net2, and Net3, as in previous example.**
2. **Enable OSPF, and enable the associated Interface or enable all.**
    enable ospf
    config ospf ipif net1 state enabled
Or   config ospf all state enabled
(other OSPF settings are by default)

AT DGS-3324SR_2 (Bottom)

1. **Configure VLAN and IP interfaces for net1, Net4, and Net5, referring to previous example.**
2. **Enable OSPF, and enable the associated Interface or enable all.**
    enable ospf
    config ospf ipif net1 state enabled
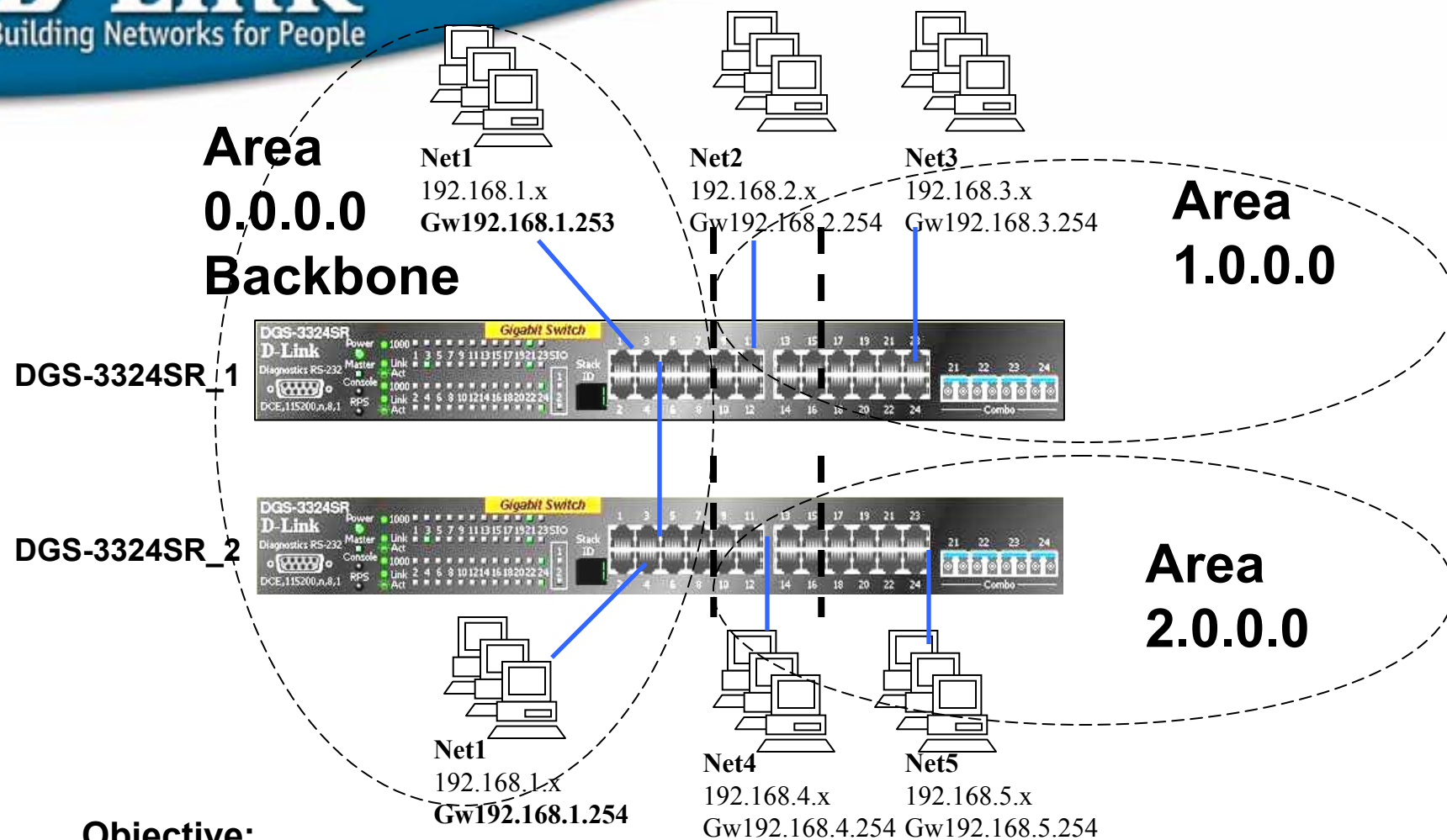Or   config ospf all state enabled
(Other OSPF settings are by default)

TEST:

1. **At top, "show iproute" to check whether Net4 and Net5 are learned by OSPF**
2. **At bottom, "show iproute" to check whether Net2 and Net3 are learned by OSPF.**
3. **Ping test to networks at remote switch.**

OSPF – Three Areas 1/3

Objective:

1. **DGS-3324SR_1 can learn the networks (i.e, Net4 and Net5) at DGS-3324SR_2.**

2. **DGS-3324SR_2 can learn the networks (i.e, Net2 and Net3) at DGS-3324SR_1.**

PROCEDURE:

AT DGS-3324SR_1(TOP)
1. **Configure VLAN and IP interfaces for net1, Net2, and Net3, as in previous example.**
2. **Enable OSPF, and enable the associated Interface or enable all.**
   enable ospf
   config ospf all state enabled
3. **Create new Area (1.0.0.0) and enable the associated Interface**
   create ospf area 1.0.0.0 type normal
   config ospf ipif net2 area 1.0.0.0 state enabled
   config ospf ipif net3 area 1.0.0.0 state enabled
4. **Check setting**
   show ospf

AT DGS-3324SR_2 (Bottom)

- **Configure VLAN and IP interfaces for net1, Net4, and Net5, referring to previous example.**
- **Enable OSPF, and enable the associated Interface or enable all.**
  enable ospf
  config ospf all state enabled
3. **Create new Area (2.0.0.0) and enable the associated Interface**
  create ospf area 2.0.0.0 type normal
  config ospf ipif net4 area 2.0.0.0 state enabled
  config ospf ipif net5 area 2.0.0.0 state enabled
4. **Check setting**
  show ospf

TEST:
1. **At top, "show iproute" to check whether Net4 and Net5 are learned by OSPF**
2. **At bottom, "show iproute" to check whether Net2 and Net3 are learned by OSPF.**
3. **Ping test to networks at remote switch.**