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SECTION 1: OSPF Setup

Overview: OSPF(Open Shortest Path First) has slowly replaced its predecessor (RIP) due to several advantages including flexibility and scalability. OSPF is a (link state routing protocol), which means that in order to determine best path, routers are sharing information about their nearest neighbor. The OSPF metric is based on interface bandwidth. The metric divides 100 Mbps by the interface bandwidth to calculate cost, then using Dijkstra's algorithm a shortest router path is created.

Initial Setup :
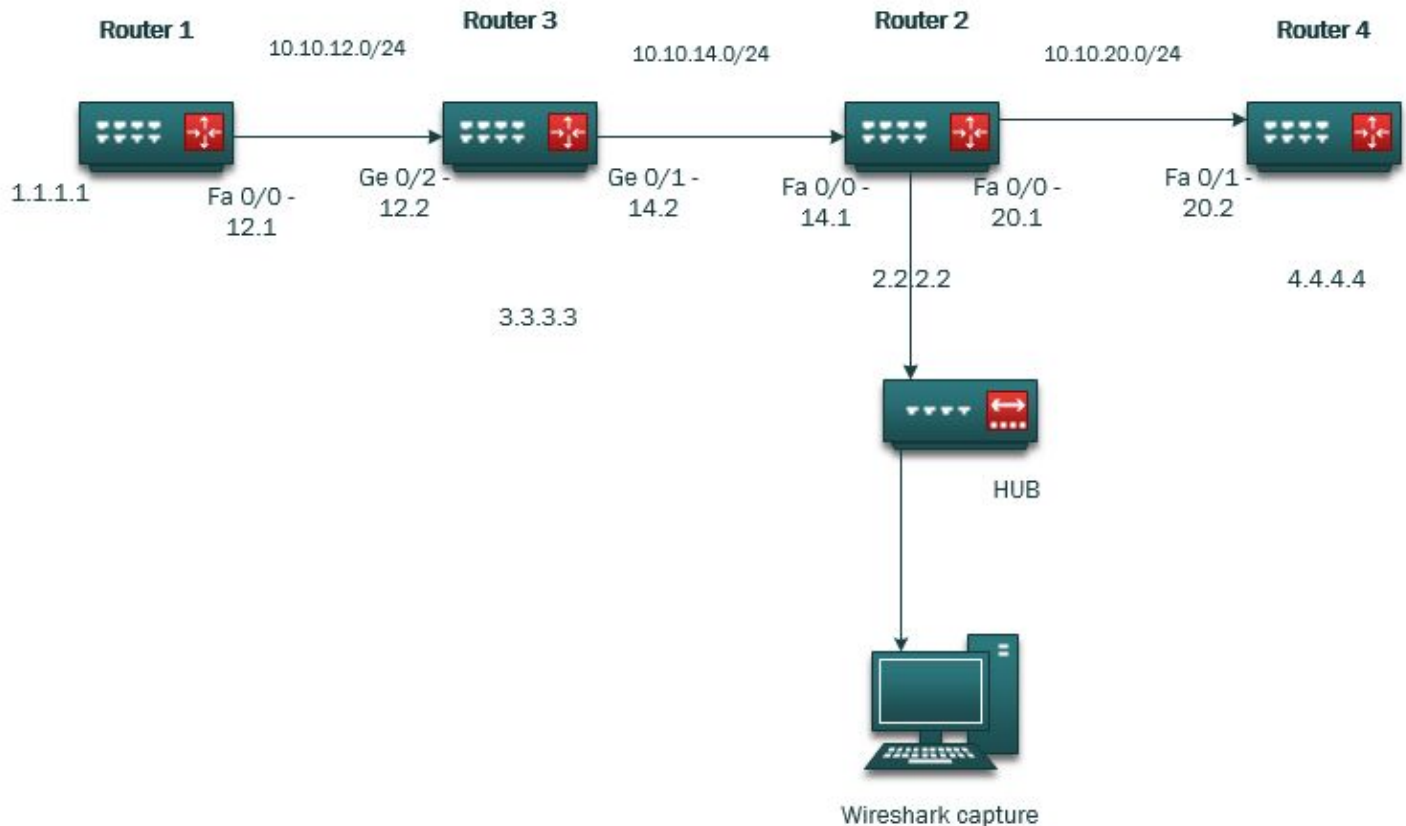
Steps for OSPF setup:

[configure OSPF on all 4 routers]

Step 1: Set Ip address for each router/port in above topology
Step 2: Enable OSPF on router → **Set router ospf 1** (global config command) NOTE: this process number is arbitrary. It does not have to be the same for each router in the area.
Step 3: Automatic selection of RID (configuring a loopback interface) → **interface loopback** *interface-number* | **ip address** *ip-address subnet-mask* NOTE: The RID is taken from the highest IP address assigned to a loopback interface.
Step 4: Define what networks will be advertised in OSPF → **network 10.10.12.1 0.255.255.255 area 0** The *address* can be the network address, subnet, or the address of a specific interface. This command also includes the wildcard mask and the area(area 0 is default).

[Steps to check the OSPF configurations]

Step 1: Show running config before authentication
Step 2: show ip ospf neighbor
Step 3: Show ip ospf protocols
Step 4: Show ip route

Configure OSPF on router 1

Show running config before authentication:

```
interface Loopback1
 ip address 2.2.2.2 255.255.255.255
!
interface FastEthernet0/0
 ip address 10.10.12.1 255.255.255.0
 duplex auto
 speed auto
!
```

```
router ospf 1
 log-adjacency-changes
 network 10.10.10.0 0.0.0.255 area 0
 network 10.10.12.0 0.0.0.255 area 0
!
```

show ip ospf neighbor:

```
Neighbor ID     Pri   State          Dead Time   Address       Interface
3.3.3.3          1    FULL/BDR       00:00:35    10.10.12.2    FastEthernet0/0
R-1#
```

Show ip ospf protocols:

```
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 2.2.2.2
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.10.10.0 0.0.0.255 area 0
    10.10.12.0 0.0.0.255 area 0
  Routing Information Sources:
    Gateway          Distance       Last Update
    4.4.4.4                110      00:15:09
    1.1.1.1                110      00:15:09
    2.2.2.2                110      00:15:09
```

Show ip route:

```
      2.0.0.0/32 is subnetted, 1 subnets
C        2.2.2.2 is directly connected, Loopback1
      10.0.0.0/24 is subnetted, 3 subnets
C        10.10.12.0 is directly connected, FastEthernet0/0
O        10.10.14.0 [110/2] via 10.10.12.2, 00:15:51, FastEthernet0/0
O        10.10.20.0 [110/3] via 10.10.12.2, 00:15:51, FastEthernet0/0
R-1#
```

Configure OSPF on router 2:

Show running config before authentication:

```
router ospf 1
 log-adjacency-changes
 network 10.10.14.0 0.0.0.255 area 0
 network 10.10.20.0 0.0.0.255 area 0
```

```
interface FastEthernet0/1
 ip address 10.10.20.1 255.255.255.0
 duplex auto
 speed auto
```

```
interface Loopback1
 ip address 1.1.1.1 255.255.255.255
!
interface FastEthernet0/0
 ip address 10.10.14.1 255.255.255.0
 duplex auto
 speed auto
```

Show ip ospf neighbor

```
Neighbor ID     Pri   State       Dead Time   Address       Interface
4.4.4.4           1   FULL/DR     00:00:35    10.10.20.2    FastEthernet0/1
3.3.3.3           1   FULL/BDR    00:00:33    10.10.14.2    FastEthernet0/0
R-2#
```

Show ip ospf protocols:

```
R-2#show ip protocols
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.1.1.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.10.14.0 0.0.0.255 area 0
    10.10.20.0 0.0.0.255 area 0
 Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway          Distance      Last Update
    2.2.2.2               110       00:11:01
    3.3.3.3               110       00:41:55
```

Show ip route:

```
     1.0.0.0/32 is subnetted, 1 subnets
C       1.1.1.1 is directly connected, Loopback1
     10.0.0.0/24 is subnetted, 3 subnets
O       10.10.12.0 [110/2] via 10.10.14.2, 00:12:20, FastEthernet0/0
C       10.10.14.0 is directly connected, FastEthernet0/0
C       10.10.20.0 is directly connected, FastEthernet0/1
R-2#
```

Configure OSPF on router 3:

Show running config before authentication

```
!
interface Loopback1
 ip address 3.3.3.3 255.255.255.255
```

```
interface GigabitEthernet0/1
 ip address 10.10.14.2 255.255.255.0
 duplex auto
 speed auto
!
interface GigabitEthernet0/2
 ip address 10.10.12.2 255.255.255.0
 duplex auto
 speed auto
!
router ospf 1
 network 10.10.12.0 0.0.0.255 area 0
 network 10.10.14.0 0.0.0.255 area 0
```

show ip ospf neighbor:

```
Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           1   FULL/DR         00:00:34    10.10.12.1      GigabitEthernet0/2
1.1.1.1           1   FULL/DR         00:00:31    10.10.14.1      GigabitEthernet0/1
R-3#
```

Show ip ospf protocols:

```
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 3.3.3.3
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.10.12.0 0.0.0.255 area 0
    10.10.14.0 0.0.0.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    4.4.4.4              110      00:10:12
    1.1.1.1              110      00:10:52
```

Show ip route:

```
      3.0.0.0/32 is subnetted, 1 subnets
C        3.3.3.3 is directly connected, Loopback1
      10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C        10.10.12.0/24 is directly connected, GigabitEthernet0/2
L        10.10.12.2/32 is directly connected, GigabitEthernet0/2
C        10.10.14.0/24 is directly connected, GigabitEthernet0/1
L        10.10.14.2/32 is directly connected, GigabitEthernet0/1
O        10.10.20.0/24 [110/2] via 10.10.14.1, 00:11:47, GigabitEthernet0/1
R-3#
```

Configure OSPF on router 4:

Show running config before authentication:

```
interface Loopback1
 ip address 2.2.2.2 255.255.255.255
!
interface FastEthernet0/0
 ip address 10.10.12.1 255.255.255.0
 duplex auto
 speed auto
!
```

show ip ospf neighbor:

```
R-4#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
1.1.1.1           1   FULL/BDR        00:00:33    10.10.20.1      FastEthernet0/1
R-4#
```

Show ip ospf protocols:

```
R-4#show ip protocols
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 4.4.4.4
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    10.10.20.0 0.0.0.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    3.3.3.3              110      00:27:16
    2.2.2.2              110      00:40:37
    1.1.1.1              110      00:18:55
    4.4.4.4              110      00:08:18
  Distance: (default is 110)
```
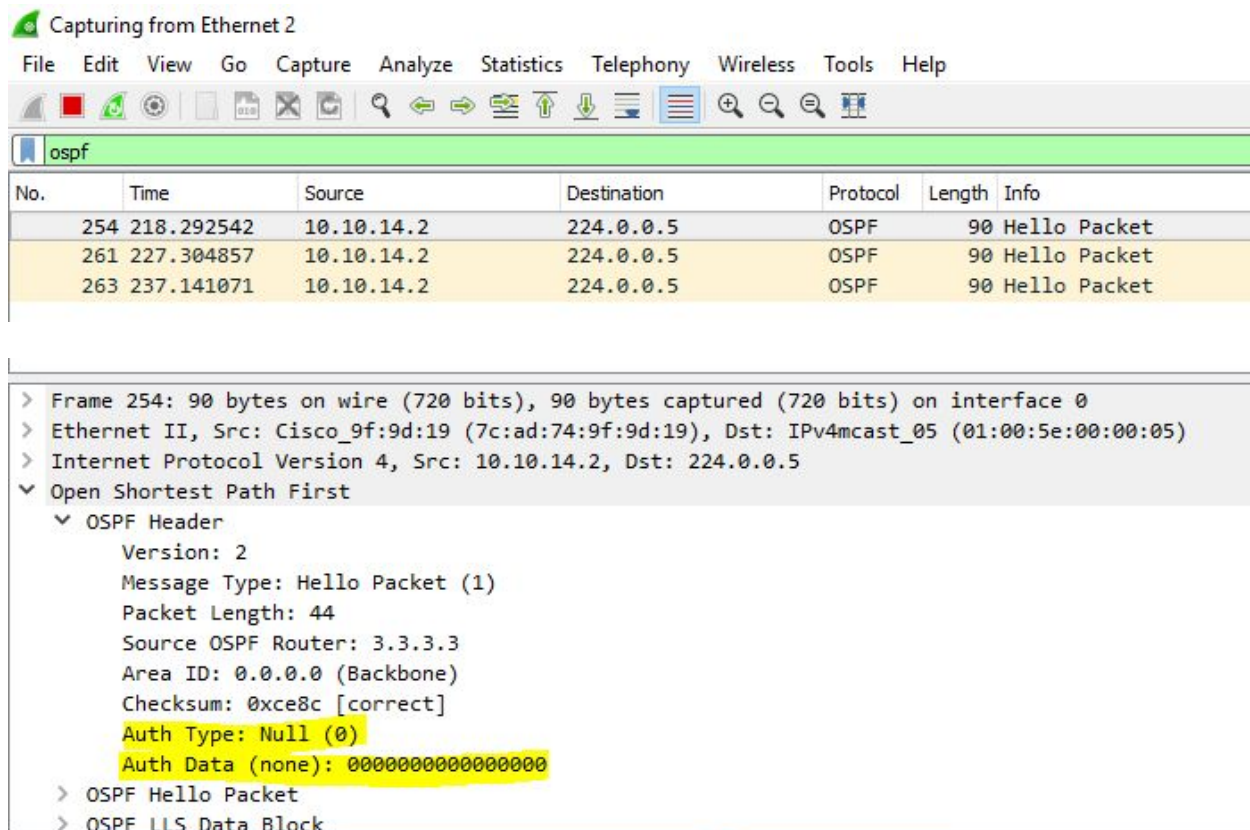
Show ip route:

```
      4.0.0.0/32 is subnetted, 1 subnets
C        4.4.4.4 is directly connected, Loopback1
      10.0.0.0/24 is subnetted, 1 subnets
C        10.10.20.0 is directly connected, FastEthernet0/1
```

Wireshark capture before authentication

Vulnerability: A man in the middle attack could be launched in order to create adjacencies in between routers to inject false routes or manipulate traffic in order to capture it. To ensure OSPF integrity and maintain safe packet traffic, adding a layer of authentication is helpful.

NOTE: **Null Authentication type & No authentication data**

SECTION 2: OSPF Authentication

Overview: To enable OSPF MD5 authentication, you need to define the encryption key. If you use authentication in an OSPF area, you must configure all of the routers in the area to support authentication. To ensure OSPF integrity and maintain safe packet traffic, adding a layer of MD5 authentication is helpful.

Enable MD5 authentication →

Step 1: Interface fastEthernet 0/0
Step 2: Ip ospf message-digest-key 1 md5 password
Step 3: Ip ospf authentication message-digest
or..
Step 1: Router ospf 1
Step 2: Area 0 authentication message-digest

Configure OSPF authentication on router 1:

Show running config after authentication:

```
interface Loopback1
 ip address 2.2.2.2 255.255.255.255
!
interface FastEthernet0/0
 ip address 10.10.12.1 255.255.255.0
 ip ospf message-digest-key 1 md5 nothing
 duplex auto
 speed auto
```

```
router ospf 1
 log-adjacency-changes
 area 0 authentication message-digest
 network 10.10.10.0 0.0.0.255 area 0
 network 10.10.12.0 0.0.0.255 area 0
```

Configure OSPF authentication on router 2:

Show running config after authentication:

```
interface Loopback1
 ip address 1.1.1.1 255.255.255.255
!
interface FastEthernet0/0
 ip address 10.10.14.1 255.255.255.0
 ip ospf message-digest-key 1 md5 nothing
 duplex auto
 speed auto
!
```

```
router ospf 1
 log-adjacency-changes
 area 0 authentication message-digest
 network 10.10.20.0 0.0.0.255 area 0
!
```

Configure OSPF authentication on router 3:

Show running config after authentication:

```
interface GigabitEthernet0/1
 ip address 10.10.14.2 255.255.255.0
 ip ospf message-digest-key 1 md5 nothing
 duplex auto
 speed auto
!
interface GigabitEthernet0/2
 ip address 10.10.12.2 255.255.255.0
 ip ospf message-digest-key 1 md5 nothing
 duplex auto
 speed auto
!
router ospf 1
 area 0 authentication message-digest
 network 10.10.12.0 0.0.0.255 area 0
 network 10.10.14.0 0.0.0.255 area 0
!
```

Configure OSPF authentication on router 4:

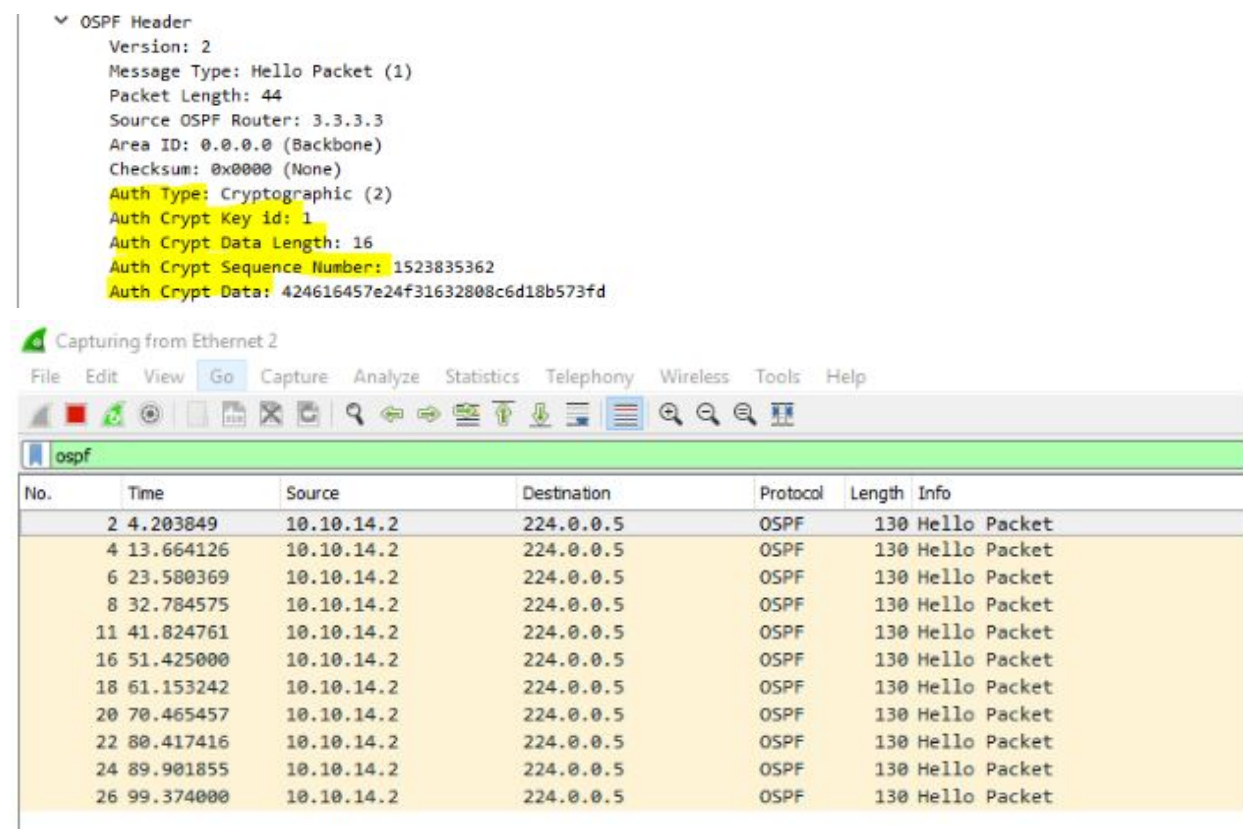**Show running config after authentication:**

```
!
interface Loopback1
 ip address 4.4.4.4 255.255.255.255
!
```

```
!
interface FastEthernet0/1
 ip address 10.10.20.2 255.255.255.0
 ip ospf message-digest-key 1 md5 nothing
 duplex auto
 speed auto
!
```

```
router ospf 1
 log-adjacency-changes
 area 0 authentication message-digest
 network 10.10.20.0 0.0.0.255 area 0
!
```

Wireshark capture after authentication

NOTE: Auth crypt (data | sequence | key) have now been assigned values {MD5: success }

```
∨ OSPF Header
      Version: 2
      Message Type: Hello Packet (1)
      Packet Length: 44
      Source OSPF Router: 3.3.3.3
      Area ID: 0.0.0.0 (Backbone)
      Checksum: 0x0000 (None)
      Auth Type: Cryptographic (2)
      Auth Crypt Key id: 1
      Auth Crypt Data Length: 16
      Auth Crypt Sequence Number: 1523835362
      Auth Crypt Data: 424616457e24f31632808c6d18b573fd
```

Capturing from Ethernet 2

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

ospf

No.	Time	Source	Destination	Protocol	Length	Info
2	4.203849	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
4	13.664126	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
6	23.580369	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
8	32.784575	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
11	41.824761	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
16	51.425000	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
18	61.153242	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
20	70.465457	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
22	80.417416	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
24	89.901855	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet
26	99.374000	10.10.14.2	224.0.0.5	OSPF	130	Hello Packet