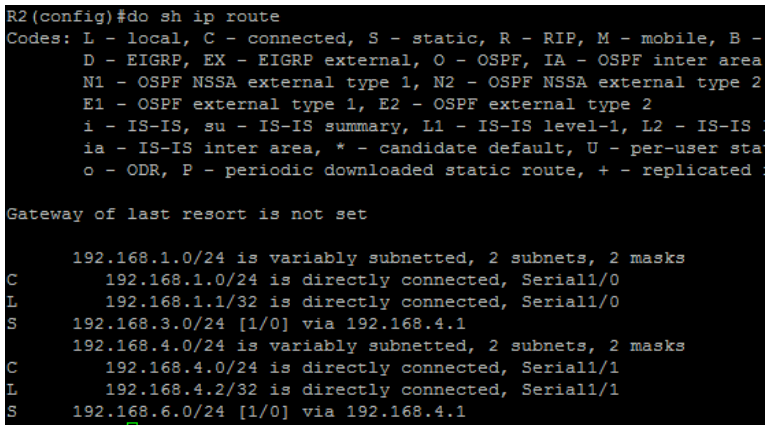
Lab 3

1. Static Routing
    a. static routes
        i. set up commserver and connections with serial cable
        ii. give ip address to interfaces on all routers
        iii. ip route [destination_network] [mask] [next-hop_address or exit_interface] [administrative_distance] [permanent]
            1. for example on R1
                a. ip route 192.168.4.0 255.255.255.0 192.168.1.1 (next hop)
            2. make msn.com and yahoo.com loopbacks
            3. 
```
R2(config)#do sh ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B -
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS
       ia - IS-IS inter area, * - candidate default, U - per-user sta
       o - ODR, P - periodic downloaded static route, + - replicated

Gateway of last resort is not set

      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, Serial1/0
L        192.168.1.1/32 is directly connected, Serial1/0
S     192.168.3.0/24 [1/0] via 192.168.4.1
      192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.4.0/24 is directly connected, Serial1/1
L        192.168.4.2/32 is directly connected, Serial1/1
S     192.168.6.0/24 [1/0] via 192.168.4.1
```
    b. extended ping
        i. en
        ii. ping
            1. destination ip

iii.

```
R1#ping
Protocol [ip]:
*Sep 16 22:02:15.853: %SYS-5-CONFIG_I: Configured from console by console
Target IP address: 20.20.20.20
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 20.20.20.20, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

c. Manipulate static routes

i. tracert <ip address> from vm to see echo request

ii. traceroute from routers

iii.

```
C:\Users\itplab>tracert 192.168.6.2

Tracing route to ITPLAB-PC [192.168.6.2]
over a maximum of 30 hops:

  1    <1 ms    <1 ms    <1 ms  biot-mgmt-gw.int.colorado.edu [192.168.5.1]
  2     1 ms     1 ms     1 ms  192.168.4.1
  3     2 ms     2 ms     2 ms  192.168.3.1
  4     3 ms     2 ms     2 ms  ITPLAB-PC [192.168.6.2]

Trace complete.
```

iv.

```
C:\Users\itplab>tracert 192.168.5.2

Tracing route to ITPLAB-PC [192.168.5.2]
over a maximum of 30 hops:

  1    <1 ms    <1 ms    <1 ms  192.168.6.1
  2     1 ms     1 ms     1 ms  192.168.2.1
  3     2 ms     2 ms     2 ms  192.168.1.1
  4     3 ms     2 ms     2 ms  ITPLAB-PC [192.168.5.2]

Trace complete.
```

v.

```
C:\Users\itplab>tracert 20.20.20.20

Tracing route to hub004470 [20.20.20.20]
over a maximum of 30 hops:

  1     1 ms    <1 ms    <1 ms  192.168.6.1
  2     1 ms     1 ms     1 ms  hub004470 [20.20.20.20]

Trace complete.
```

vi.

```
R4#traceroute
Protocol [ip]:
Target IP address: 192.168.6.2
Source address: 20.20.20.20
Numeric display [n]:
Timeout in seconds [3]:
Probe count [3]:
Minimum Time to Live [1]:
Maximum Time to Live [30]:
Port Number [33434]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Type escape sequence to abort.
Tracing the route to 192.168.6.2

  1 192.168.4.2 0 msec 0 msec 0 msec
  2 192.168.1.2 0 msec 0 msec 0 msec
  3 192.168.2.2 4 msec 0 msec 0 msec
  4 192.168.6.2 4 msec 0 msec 0 msec
```

2. RIPv2
    a. Enable RIP
        i. router rip
        ii. version 2
        iii. network 140.140.140.0
        iv. .....
        v. debug with ‘debug ip rip’
    b. document propagation

i.

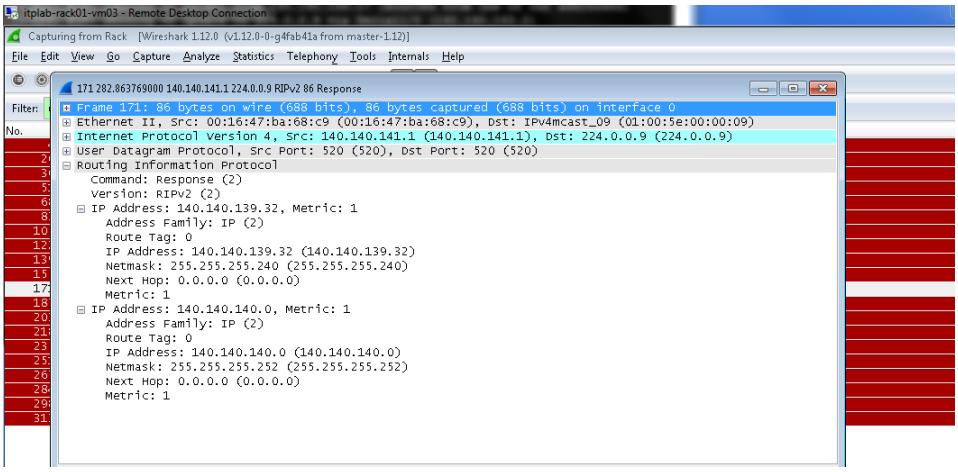
```
R1(config)#do sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     140.140.0.0/16 is variably subnetted, 7 subnets, 2 masks
R       140.140.140.4/30 [120/2] via 140.140.141.2, 00:00:10, FastEthernet2/0
C       140.140.140.0/30 is directly connected, Loopback2
C       140.140.141.0/30 is directly connected, FastEthernet2/0
R       140.140.142.0/30 [120/1] via 140.140.141.2, 00:00:10, FastEthernet2/0
R       140.140.143.0/30 [120/1] via 140.140.141.2, 00:00:10, FastEthernet2/0
R       140.140.139.16/30 [120/2] via 140.140.141.2, 00:00:10, FastEthernet2/0
C       140.140.139.32/28 is directly connected, Loopback1
```

    c. SNIFFER
        i. set up span on both two switch ports
            1. no monitor session 1

2. monitor session 1 source interface fa0/4 (monitored port)

3. monitor session 1 destination interface fa0/1 (monitoring port)

ii.



d. Document VLSM, auto-summarization, support, network reachability

i. VLSM is seen when the subnet masks /30 and /28 are used with 140.140.140.0 and 140.140.140.4. Variable length subnet masks help with using address space more efficiently.

ii. Auto-summarization is seen in the line 140.140.0.0/16. All the subnets can be summarized as belong to that network and subnet mask.

iii.

```
R1(config)#do sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     140.140.0.0/16 is variably subnetted, 8 subnets, 3 masks
R       140.140.0.0/16 [120/1] via 192.168.1.1, 00:00:01, Serial1/1
R       140.140.140.4/30 [120/2] via 140.140.141.2, 00:00:11, FastEthernet2/0
C       140.140.140.0/30 is directly connected, Loopback2
C       140.140.141.0/30 is directly connected, FastEthernet2/0
R       140.140.142.0/30 [120/1] via 140.140.141.2, 00:00:11, FastEthernet2/0
R       140.140.143.0/30 [120/1] via 140.140.141.2, 00:00:11, FastEthernet2/0
R       140.140.139.16/28 [120/2] via 140.140.141.2, 00:00:12, FastEthernet2/0
C       140.140.139.32/28 is directly connected, Loopback1
     192.168.1.0/24 is subnetted, 1 subnets
C       192.168.1.0 is directly connected, Serial1/1
```

e. Question?

i. No, you don't need static routes with RIPv2. It creates the routes for you and sends them to known networks.

f. Debug command rip

i. debug ip rip

ii. You can see RIP packets to being send to hosts telling them what subnets are available and how many hops it takes to get those subnets.

iii.

```
R3#debug ip rip
RIP protocol debugging is on
R3#
*Sep 17 01:02:24.751: RIP: sending v2 update to 224.0.0.9 via Loopback2 (140.140.140.5)
*Sep 17 01:02:24.751: RIP: build update entries
*Sep 17 01:02:24.751:   140.140.139.16/28 via 0.0.0.0, metric 1, tag 0
*Sep 17 01:02:24.751:   140.140.139.32/28 via 0.0.0.0, metric 3, tag 0
*Sep 17 01:02:24.751:   140.140.140.0/30 via 0.0.0.0, metric 3, tag 0
*Sep 17 01:02:24.751:   140.140.141.0/30 via 0.0.0.0, metric 2, tag 0
*Sep 17 01:02:24.751:   140.140.142.0/30 via 0.0.0.0, metric 2, tag 0
*Sep 17 01:02:24.751:   140.140.143.0/30 via 0.0.0.0, metric 1, tag 0
*Sep 17 01:02:24.751: RIP: ignored v2 packet from 140.140.140.5 (sourced from one of our addr
*Sep 17 01:02:28.531: RIP: received v2 update from 140.140.143.1 on Serial1/0
*Sep 17 01:02:28.531:      140.140.139.32/28 via 0.0.0.0 in 2 hops
*Sep 17 01:02:28.531:      140.140.140.0/30 via 0.0.0.0 in 2 hops
*Sep 17 01:02:28.531:      140.140.141.0/30 via 0.0.0.0 in 1 hops
*Sep 17 01:02:28.531:      140.140.142.0/30 via 0.0.0.0 in 1 hopsno debug ip rip
RIP protocol debugging is off
```

g. Add link between R1 and R3

i. add ip address to serial interfaces

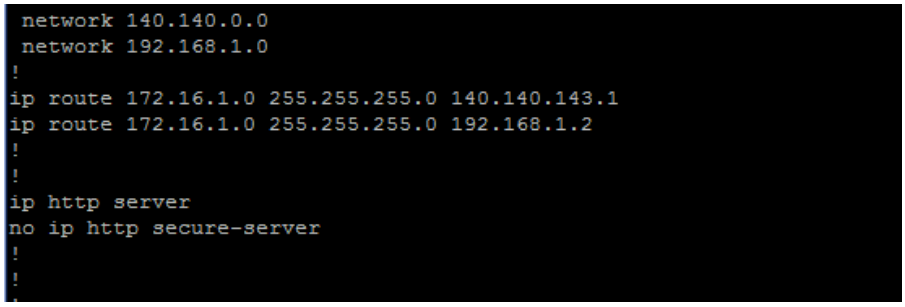
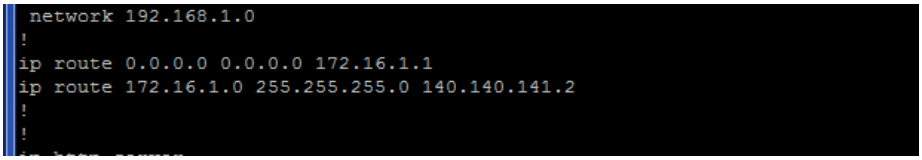
ii. add network to rip on r1 and r2

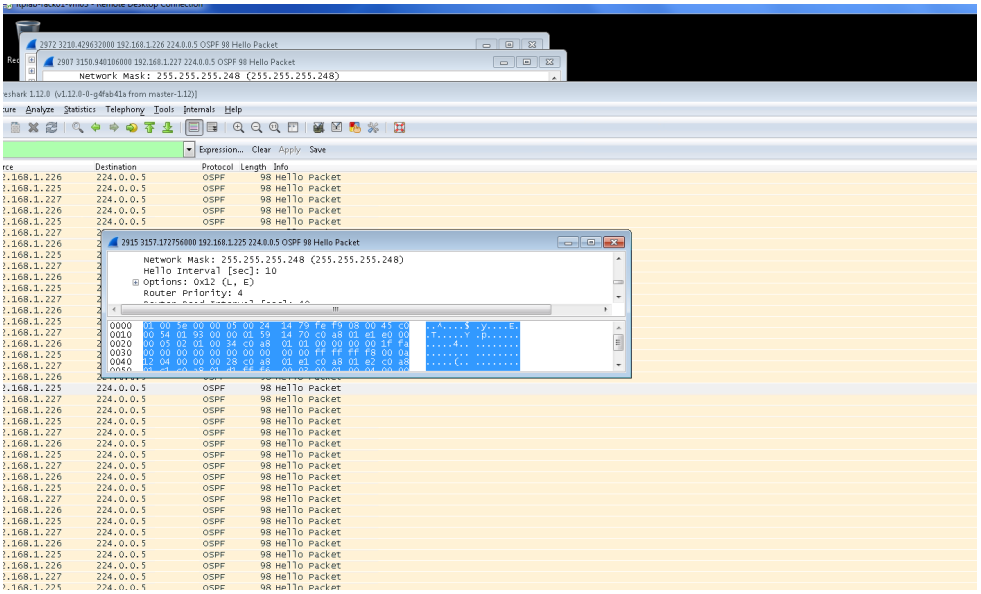
iii.

```
R1(config)#do sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     140.140.0.0/16 is variably subnetted, 8 subnets, 3 masks
R       140.140.0.0/16 [120/1] via 192.168.1.1, 00:00:01, Serial1/1
R       140.140.140.4/30 [120/2] via 140.140.141.2, 00:00:11, FastEthernet2/0
C       140.140.140.0/30 is directly connected, Loopback2
C       140.140.141.0/30 is directly connected, FastEthernet2/0
R       140.140.142.0/30 [120/1] via 140.140.141.2, 00:00:11, FastEthernet2/0
R       140.140.143.0/30 [120/1] via 140.140.141.2, 00:00:11, FastEthernet2/0
R       140.140.139.16/28 [120/2] via 140.140.141.2, 00:00:12, FastEthernet2/0
C       140.140.139.32/28 is directly connected, Loopback1
     192.168.1.0/24 is subnetted, 1 subnets
C       192.168.1.0 is directly connected, Serial1/1
```

iv. The fastest way from 139.16 to 139.32 networks is the path with the shortest amount of hops and the one that is directly connected. The new

link should be the fastest and shortest path. The routing table does not match this and neither do the rip packets.

3. Does not exist
4. Default Route
    a. 
    ```
     network 140.140.0.0
     network 192.168.1.0
    !
    ip route 172.16.1.0 255.255.255.0 140.140.143.1
    ip route 172.16.1.0 255.255.255.0 192.168.1.2
    !
    !
    ip http server
    no ip http secure-server
    !
    !
    ```
    b. add ip route 0.0.0.0 0.0.0.0 172.16.1.1 to R1 and R2 to create default gateways
    c. 
    ```
     network 192.168.1.0
    !
    ip route 0.0.0.0 0.0.0.0 172.16.1.1
    ip route 172.16.1.0 255.255.255.0 140.140.141.2
    !
    !
    ```
5. OSPF single area
    a. set up topology
    b. set up sniffer and ospf
        i. ospf stages
            1. down (no hellos received) -> attempt (send hellos) -> int (router has received hellos) -> 2-way (bi-directional communication established) -> Exstart (link state information exchange begins) -> exchange (database descriptor packets sent to neighbor) -> loading (link info is exchanged) -> full (routers fully adjacent)

2. 

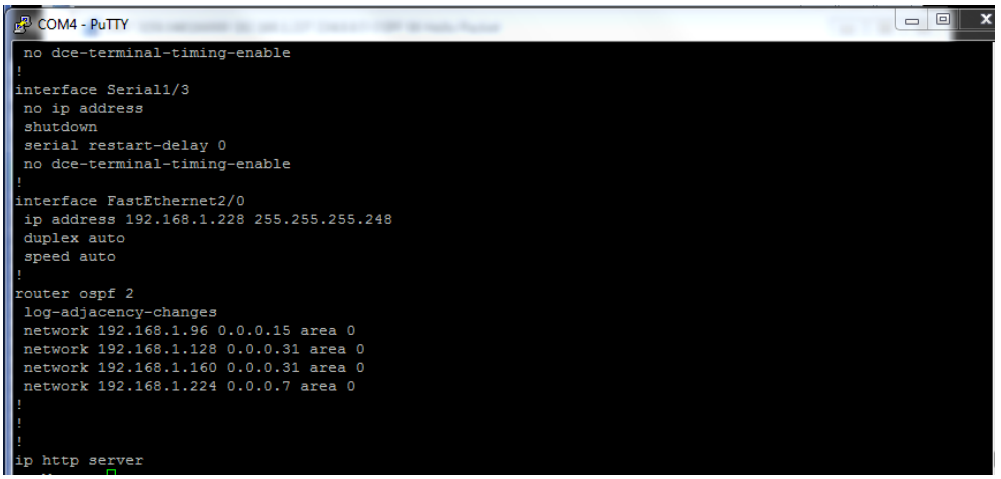
3. on all routers

    a. router ospf 2

    b. network _____ (complement of mask) area 0 (add all interfaces to network) (2^n -1)

    c. in fa2/0

    d. ip ospf priority 4 (priority of 0 means router won't take part)

4. 

ii. show ip ospf will tell you if the router is abr or asbr

iii. show adjacency

1.

```
R3#sh adjacency
Protocol Interface                 Address
IP       FastEthernet2/0           192.168.1.225(7)
IP       FastEthernet2/0           192.168.1.226(9)
IP       FastEthernet2/0           192.168.1.228(11)
R3#
```

iv. Route Entry?

1.

```
R3#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     192.168.1.0/24 is variably subnetted, 9 subnets, 4 masks
O       192.168.1.97/32 [110/2] via 192.168.1.228, 00:15:36, FastEthernet2/0
O       192.168.1.113/32 [110/2] via 192.168.1.226, 00:15:36, FastEthernet2/0
C       192.168.1.64/27 is directly connected, Loopback1
O       192.168.1.1/32 [110/2] via 192.168.1.225, 00:15:36, FastEthernet2/0
C       192.168.1.224/29 is directly connected, FastEthernet2/0
C       192.168.1.192/28 is directly connected, Loopback2
O       192.168.1.209/32 [110/2] via 192.168.1.226, 00:15:37, FastEthernet2/0
O       192.168.1.161/32 [110/2] via 192.168.1.228, 00:15:37, FastEthernet2/0
O       192.168.1.129/32 [110/2] via 192.168.1.228, 00:15:37, FastEthernet2/0
```

v. Commands

1. show ip ospf

a.

```
R3#sho ip ospf
 Routing Process "ospf 2" with ID 192.168.1.193
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 Supports Link-local Signaling (LLS)
 Supports area transit capability
 Initial SPF schedule delay 5000 msecs
 Minimum hold time between two consecutive SPFs 10000 msecs
 Maximum wait time between two consecutive SPFs 10000 msecs
 Incremental-SPF disabled
 Minimum LSA interval 5 secs
 Minimum LSA arrival 1000 msecs
 LSA group pacing timer 240 secs
 Interface flood pacing timer 33 msecs
 Retransmission pacing timer 66 msecs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 Number of areas transit capable is 0
 External flood list length 0
 IETF NSF helper support enabled
 Cisco NSF helper support enabled
    Area BACKBONE(0)
        Number of interfaces in this area is 3 (2 loopback)
        Area has no authentication
        SPF algorithm last executed 00:22:03.448 ago
        SPF algorithm executed 7 times
        Area ranges are
        Number of LSA 5. Checksum Sum 0x031476
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

2. show ip ospf database

a.

```
R3#show ip ospf database

            OSPF Router with ID (192.168.1.193) (Process ID 2)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
192.168.1.1     192.168.1.1     843         0x80000005 0x0048FA 2
192.168.1.161   192.168.1.161   1364        0x80000006 0x0098EA 4
192.168.1.193   192.168.1.193   920         0x80000004 0x00D46E 3
192.168.1.209   192.168.1.209   797         0x80000004 0x00B42F 3

                Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
192.168.1.225   192.168.1.1     1364        0x80000003 0x00A9F5
```

3. show ip ospf neighbor detail

a.

```
R3#show ip ospf neighbor detail
 Neighbor 192.168.1.1, interface address 192.168.1.225
    In the area 0 via interface FastEthernet2/0
    Neighbor priority is 4, State is FULL, 6 state changes
    DR is 192.168.1.225 BDR is 192.168.1.226
    Options is 0x52
    LLS Options is 0x1 (LR)
    Dead timer due in 00:00:35
    Neighbor is up for 00:48:31
    Index 1/1, retransmission queue length 0, number of retransmission 0
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
    Last retransmission scan length is 0, maximum is 0
    Last retransmission scan time is 0 msec, maximum is 0 msec
 Neighbor 192.168.1.161, interface address 192.168.1.228
    In the area 0 via interface FastEthernet2/0
    Neighbor priority is 1, State is 2WAY, 2 state changes
    DR is 192.168.1.225 BDR is 192.168.1.226
    Options is 0x12
    LLS Options is 0x1 (LR)
    Dead timer due in 00:00:31
    Neighbor is up for 00:23:08
    Index 0/0, retransmission queue length 0, number of retransmission 0
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
    Last retransmission scan length is 0, maximum is 0
    Last retransmission scan time is 0 msec, maximum is 0 msec
 Neighbor 192.168.1.209, interface address 192.168.1.226
    In the area 0 via interface FastEthernet2/0
    Neighbor priority is 3, State is FULL, 6 state changes
    DR is 192.168.1.225 BDR is 192.168.1.226
    Options is 0x52
    LLS Options is 0x1 (LR)
    Dead timer due in 00:00:39
    Neighbor is up for 00:47:33
    Index 2/2, retransmission queue length 0, number of retransmission 0
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
    Last retransmission scan length is 0, maximum is 0
    Last retransmission scan time is 0 msec, maximum is 0 msec
```

4. show ip protocols

a.

```
R3#sho ip protocols
Routing Protocol is "ospf 2"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.1.193
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.1.64 0.0.0.31 area 0
    192.168.1.192 0.0.0.15 area 0
    192.168.1.224 0.0.0.7 area 0
 Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.1.1          110      00:23:25
    192.168.1.209        110      00:23:25
    192.168.1.161        110      00:23:25
  Distance: (default is 110)
```

vi. debug ip ospf pkt/adj/hello explanation

1. pkt => packets sent from an interface
2. adj => nothing printed out
3. hello => send and recv hello packets

6. OSPF Multi Area
    a.
    b.
    c.

```
R3#sh ip ospf
 Routing Process "ospf 2" with ID 192.168.1.193
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 Supports Link-local Signaling (LLS)
 Supports area transit capability
 It is an area border router
 Initial SPF schedule delay 5000 msecs
 Minimum hold time between two consecutive SPFs 10000 msecs
 Maximum wait time between two consecutive SPFs 10000 msecs
 Incremental-SPF disabled
 Minimum LSA interval 5 secs
 Minimum LSA arrival 1000 msecs
 LSA group pacing timer 240 secs
 Interface flood pacing timer 33 msecs
 Retransmission pacing timer 66 msecs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 2. 2 normal 0 stub 0 nssa
 Number of areas transit capable is 0
 External flood list length 0
 IETF NSF helper support enabled
```

    d.

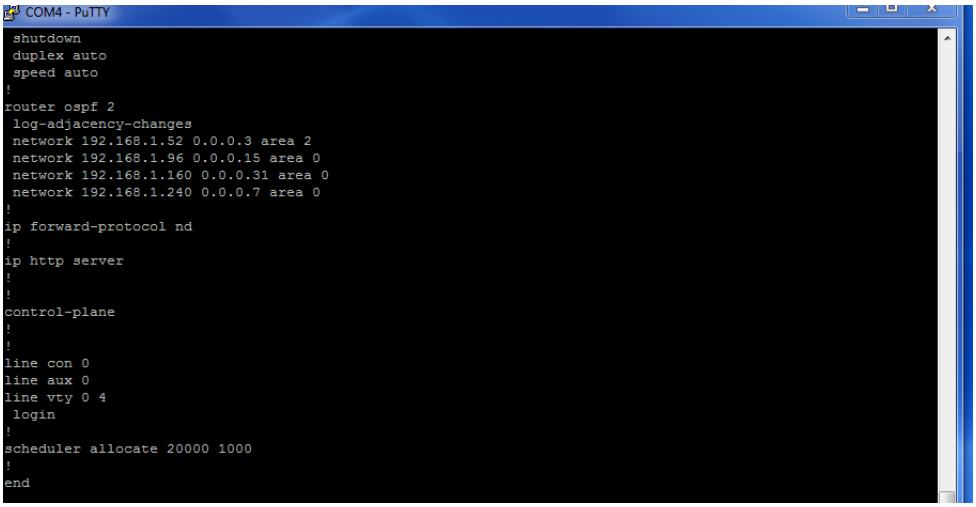
```
R2#ping 192.168.1.129

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.129, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
R2#traceroute
Protocol [ip]:
Target IP address: 192.168.1.129
Source address: 192.168.1.209
Numeric display [n]:
Timeout in seconds [3]:
Probe count [3]:
Minimum Time to Live [1]:
Maximum Time to Live [30]:
Port Number [33434]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Type escape sequence to abort.
Tracing the route to 192.168.1.129

  1 192.168.1.228 0 msec 0 msec 0 msec
  2 192.168.1.54 0 msec 0 msec *
```

    e. OSPF config
        i. R3

```
 serial restart-delay 0
 no dce-terminal-timing-enable
!
interface Serial1/3
 no ip address
 shutdown
 serial restart-delay 0
 no dce-terminal-timing-enable
!
interface FastEthernet2/0
 ip address 192.168.1.227 255.255.255.248
 ip ospf priority 0
 duplex auto
 speed auto
!
interface FastEthernet2/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
router ospf 2
 log-adjacency-changes
 network 192.168.1.88 0.0.0.3 area 1
 network 192.168.1.192 0.0.0.15 area 0
 network 192.168.1.224 0.0.0.7 area 0
!
!
```

1.

ii. R4



1.

iii. R5

```
!
router ospf 2
 log-adjacency-changes
 network 192.168.1.64 0.0.0.7 area 1
 network 192.168.1.72 0.0.0.7 area 1
 network 192.168.1.80 0.0.0.7 area 1
 network 192.168.1.88 0.0.0.3 area 1
!
ip forward-protocol nd
!
ip http server
!
!
control-plane
!
!
line con 0
line aux 0
```

1.

iv. R6

1.
```
 duplex auto
 speed auto
!
router ospf 2
 log-adjacency-changes
 network 192.168.1.52 0.0.0.3 area 2
 network 192.168.1.128 0.0.0.7 area 2
 network 192.168.1.136 0.0.0.7 area 2
 network 192.168.1.144 0.0.0.7 area 2
!
!
!
ip http server
no ip http secure-server
```

f.

g. questions

h.
```
Gateway of last resort is not set

      192.168.1.0/24 is variably subnetted, 18 subnets, 4 masks
O        192.168.1.1/32 [110/2] via 192.168.1.225, 01:42:11, FastEthernet2/0
O IA     192.168.1.52/30 [110/65] via 192.168.1.228, 00:26:53, FastEthernet2/0
O IA     192.168.1.65/32 [110/66] via 192.168.1.227, 00:33:54, FastEthernet2/0
O IA     192.168.1.73/32 [110/66] via 192.168.1.227, 00:33:54, FastEthernet2/0
O IA     192.168.1.81/32 [110/66] via 192.168.1.227, 00:33:55, FastEthernet2/0
O IA     192.168.1.88/30 [110/65] via 192.168.1.227, 00:38:43, FastEthernet2/0
O        192.168.1.97/32 [110/2] via 192.168.1.228, 00:54:10, FastEthernet2/0
C        192.168.1.112/28 is directly connected, Loopback2
L        192.168.1.113/32 is directly connected, Loopback2
O IA     192.168.1.129/32
           [110/66] via 192.168.1.228, 00:21:45, FastEthernet2/0
O IA     192.168.1.137/32
           [110/66] via 192.168.1.228, 00:21:45, FastEthernet2/0
O IA     192.168.1.145/32
           [110/66] via 192.168.1.228, 00:21:47, FastEthernet2/0
O        192.168.1.161/32 [110/2] via 192.168.1.228, 00:54:12, FastEthernet2/0
O        192.168.1.193/32 [110/2] via 192.168.1.227, 01:12:51, FastEthernet2/0
C        192.168.1.208/28 is directly connected, Loopback1
L        192.168.1.209/32 is directly connected, Loopback1
C        192.168.1.224/29 is directly connected, FastEthernet2/0
L        192.168.1.226/32 is directly connected, FastEthernet2/0
R2#
```

7. OSPF Virtual Link
    a. Split network E
        i. remove Network E from R4
        ii. add new routers and set up interfaces with ip addresses
        iii. start ospf on those routers and give networks and areas
    b. Virtual Links
        i. get router id’s of ospf process ‘show ip ospf database’
        ii. from router 7 to 3
            1. area 1 virtual-link 192.168.1.193 (router id on 3)
        iii. from router 3 to 7

1. area 1 virtual-link 192.168.1.161

iv. same thing for router 8 and 4

c. Area 0

d. Analyze

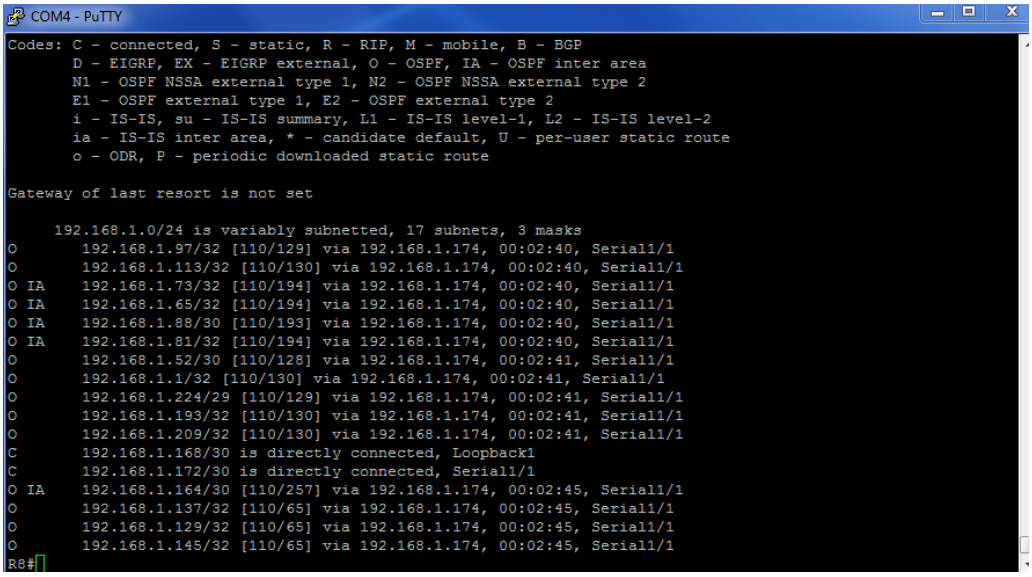
i.

```
8(config)#exit
8#sh
Sep 20 20:20:12.386: %OSPF-5-ADJCHG: Process 2, Nbr 192.168.1.161 on OSPF_VL0 from LOADING to FULL, Loading
Done
Sep 20 20:20:13.186: %SYS-5-CONFIG_I: Configured from console by console ip ospf neighbor detail
Neighbor 192.168.1.161, interface address 192.168.1.53
   In the area 0 via interface OSPF_VL0
   Neighbor priority is 0, State is FULL, 6 state changes
   DR is 0.0.0.0 BDR is 0.0.0.0
   Options is 0x72
   LLS Options is 0x1 (LR)
   Neighbor is up for 00:00:07
   Index 1/2, retransmission queue length 0, number of retransmission 0
   First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
   Last retransmission scan length is 0, maximum is 0
   Last retransmission scan time is 0 msec, maximum is 0 msec
Neighbor 192.168.1.145, interface address 192.168.1.174
   In the area 2 via interface Serial1/1
   Neighbor priority is 0, State is FULL, 6 state changes
   DR is 0.0.0.0 BDR is 0.0.0.0
   Options is 0x52
   LLS Options is 0x1 (LR)
   Dead timer due in 00:00:35
   Neighbor is up for 00:00:19
   Index 1/1, retransmission queue length 0, number of retransmission 0
   First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
   Last retransmission scan length is 0, maximum is 0
   Last retransmission scan time is 0 msec, maximum is 0 msec
8#
```

ii. From router 8 it shows that Area 0 is reached by OSPF_VL0 which means a virtual link.

e. Neighbor

i.

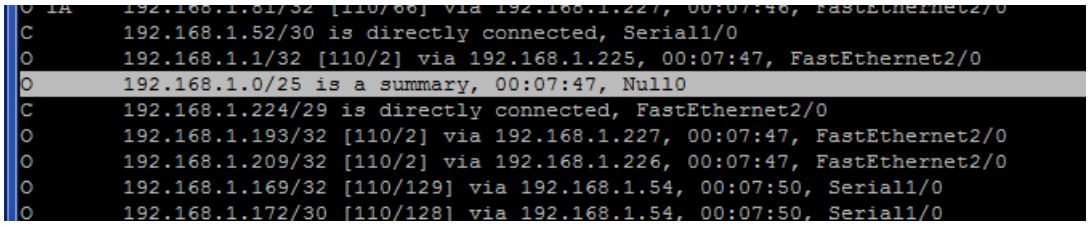


ii. It shows that the subnets from the entire network are all learned via the interface connected to the router between the the area 0's.

8. OSPF Route Summarization (Inter-Area) on ABR or ASBR

   a. area 2 range 192.168.1.0 255.255.255.128

b.



9. Study Questions

   a. Administrative distance is the way a router chooses which routing protocol and path to use to get to a certain point. It defines the reliability of the routing protocol.

   b. Metrics help a routing protocol choose the best path to a destination.

   c. Convergence time is a measure of how fast a group of routers come together and routing information propagates.

   d. Distance vector routing protocol determines a path to a network using hop count. Each node knows the cost of link to it's neighbors.

e. Problems with distance vector routing protocol are a possibility of a routing loop, a packet never reaches it's destinations, and count-to-infinity condition where the metric to a network is infinity.
f. A routing protocol is communication between routers while a routed protocol is way for data to be transmitted.
g. Routing protocols communicate routes to networks to other routers.
h. A routing protocol communicates with other routers.
i. Convergence means that routers have the same information about the network topology that they operate in.
j. A default route is a route taken when there are no other routes in a routing table to handle the address that you are trying to go to.
k. Load sharing is the balancing of who sends what information where. The workload of sending data is shared as much as possible.
l. Ripv2 uses multicast to send update packets while ripv1 uses broadcast.
m. Routers will have the letter R next to them.
n. It conveys with router has the routers to a summarized network.
o. Rip prevents loops by not advertising routes backwards and routes that fails are advertised with an infinity metric so other routers know not to use that route.
p. Ripv1 is classful. Ripv1 is a distance vector protocol. Rip does not support VLSM. Updates on with Ripv1 are sent as broadcasts.
q. Hierarchical routing decreases the complexity of network topologies. Flat routing is connecting all routers to each other.
r. Variable Length subnetting allows someone to allocate networks of different sizes, optimizing the use of the address space. Yes, ospf supports vlsm.

s. No, route summarizations does not automatically occur with OSPF.

t. A virtual link would be preferable to a physical link when the distance between areas are significant.

u. In OSPF, a loopback interfaces determines the BR and BDR.

v. You may seen an ABR, RI, BR, and ASBR, DR, BDR.