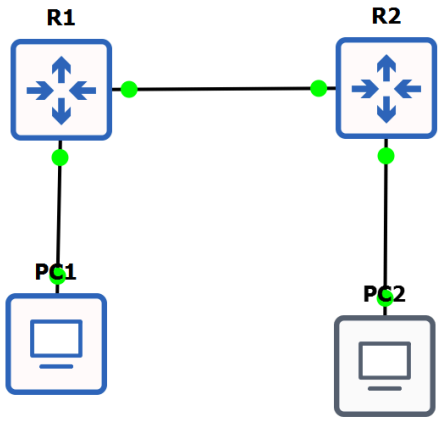
PART A – Conceptual Grounding

1. Static Routing – Understanding Control

Static routing is when we explicitly define the route through which data packets are to travel from one router to another.
Consider the below given network:



If we try to ping PC2 from PC1, the ping request is sent to R1, but R1 only knows two members in this network - R2 and PC1. It doesn't know if PC2 exist in this network. Therefore it simply drops the request and the packet transfer won't happen. We need to tell the router R1 to move the request to R2. From there R2 knows where PC2 is and will thereafter send the request to PC2. This is the whole idea behind routing
Manually defining a route is explicitly mentioning the path data packets should travel from one node/pc.
Static routes are more predictable than dynamic routing because we manually defines the exact path data packets should travel and this path isn't likely to change. Therefore, we can easily predict through which path a data packet will travel. But this very feature is a disadvantage since adaptability according to real-time network changes isn't possible here. Also manual routing has poor scalability due to predefined paths.
In real world scenarios manual routing can be used for small networks where the number of PCs and routers are less, such as home or small office networks.

2. Dynamic Routing – Letting Routers Learn

In dynamic routing there are no predefined data paths. Various algorithms are used to define the current best path for data packet transfer. Many protocols are used to determine the best path and some among them are RIP, EIGRP, and OSPF.
When routers use dynamic routing they no longer use manually configured paths. They enter into a continuous conversation with other routers and establish connections and learn about other remote networks of neighbouring routers.
Dynamic routing is of great use nowadays since modern networks are often large and constantly changing. Therefore manually defining paths to each router is impractical and inefficient. In the present world where constant connectivity is the priority, dynamic routing allows routers to adapt automatically to changes.
Dynamic routing solves many drawbacks of Static routing, it allows easy scalability and flexibility. Also dynamic routing can be easily used in large networks.Dynamic routing enables routers to learn, adapt, and respond to network changes automatically, solving scalability, reliability, and maintenance problems that static routing cannot handle.

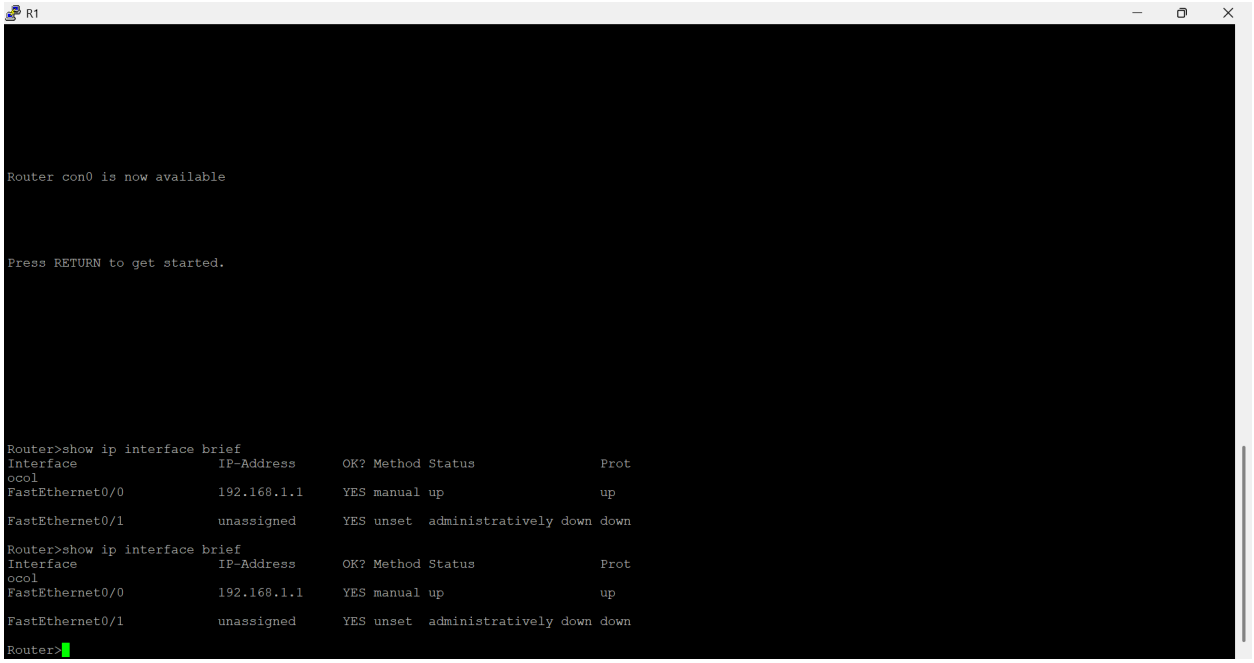
3. Static vs Dynamic – A Thought Comparison

Comparing static and dynamic routing approaches there are significant differences between the two.
Considering scalability Dynamic routing has got an upperhand than static routing.Dynamic routing offers high scalability.Dynamic protocols, however, use automated discovery and algorithms (like OSPF or BGP) to learn the entire network topology and adapt without human intervention, making them the only feasible solution for large enterprises or the entire internet.
Dynamic routing offers more failure recovery. If in static routing a path fails. The network admin has to manually define another path. But in dynamic routing if one path breaks a new alternate path is automatically discovered. Therefore dynamic routing offers better fault tolerance.
When thinking about human effort static routing comes first because in static routing each route has to be manually assigned by the administrator. But Dynamic routing paths are automatically defined by communication between adjacent routers using some protocols.

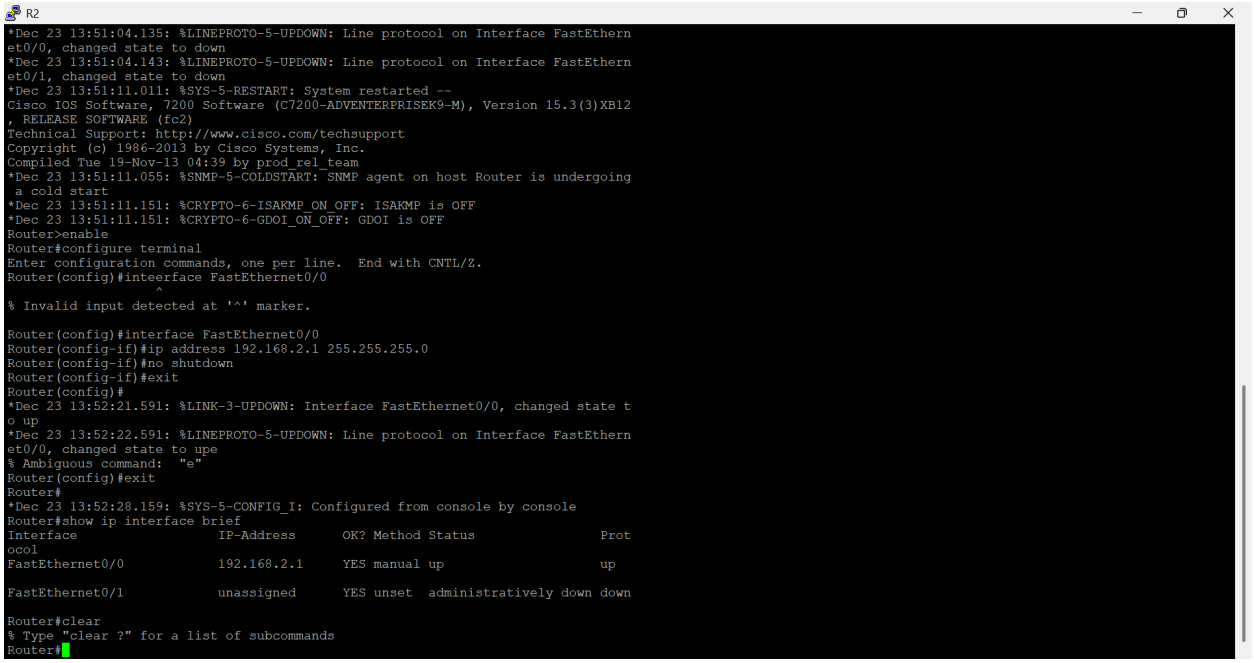
PART B – Static Routing Lab

1.Assign IP addresses to:

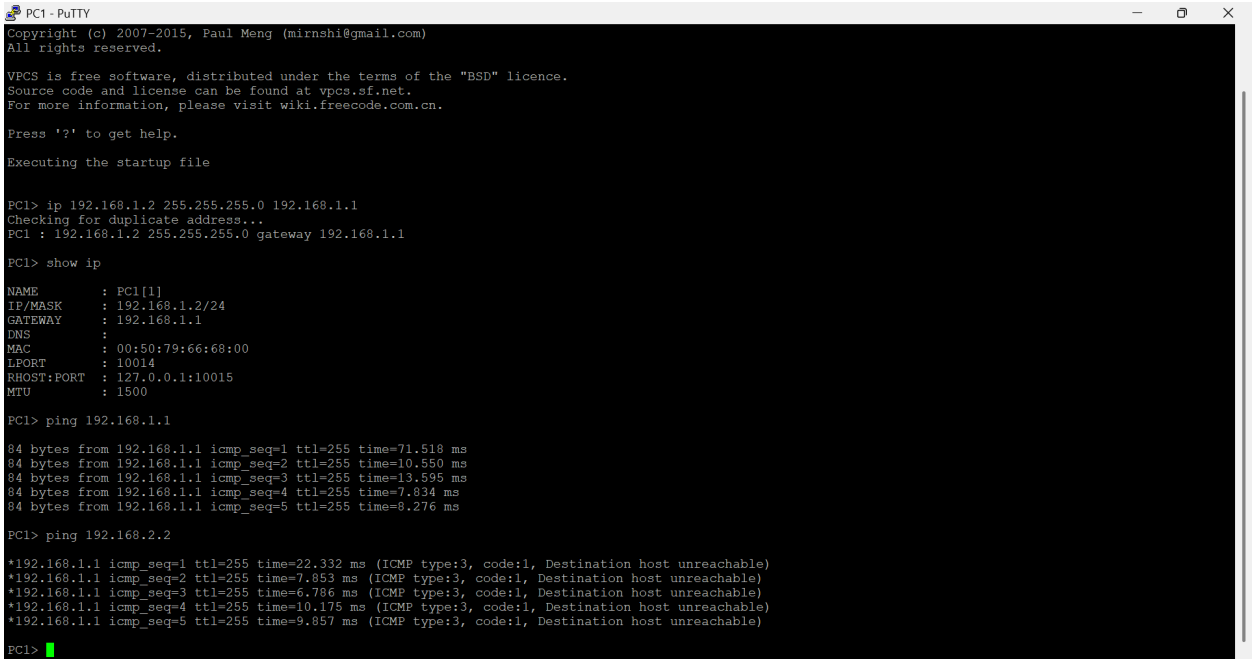
R1



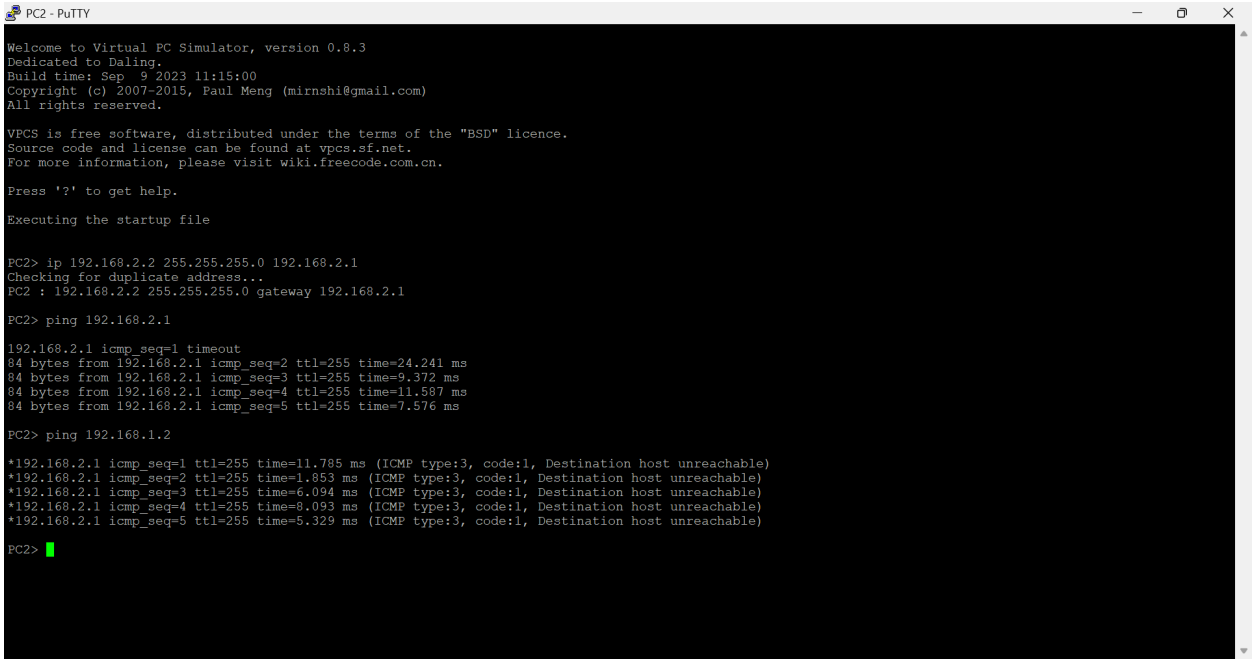
R2



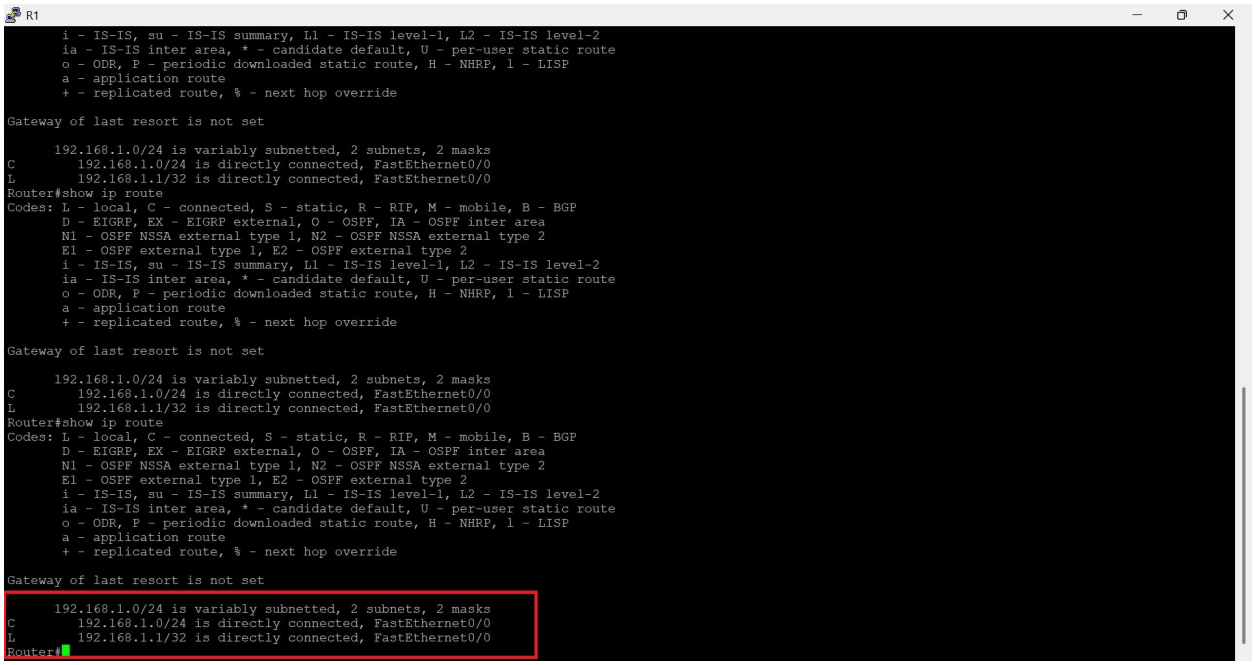
PC1 pinging gateway and PC2



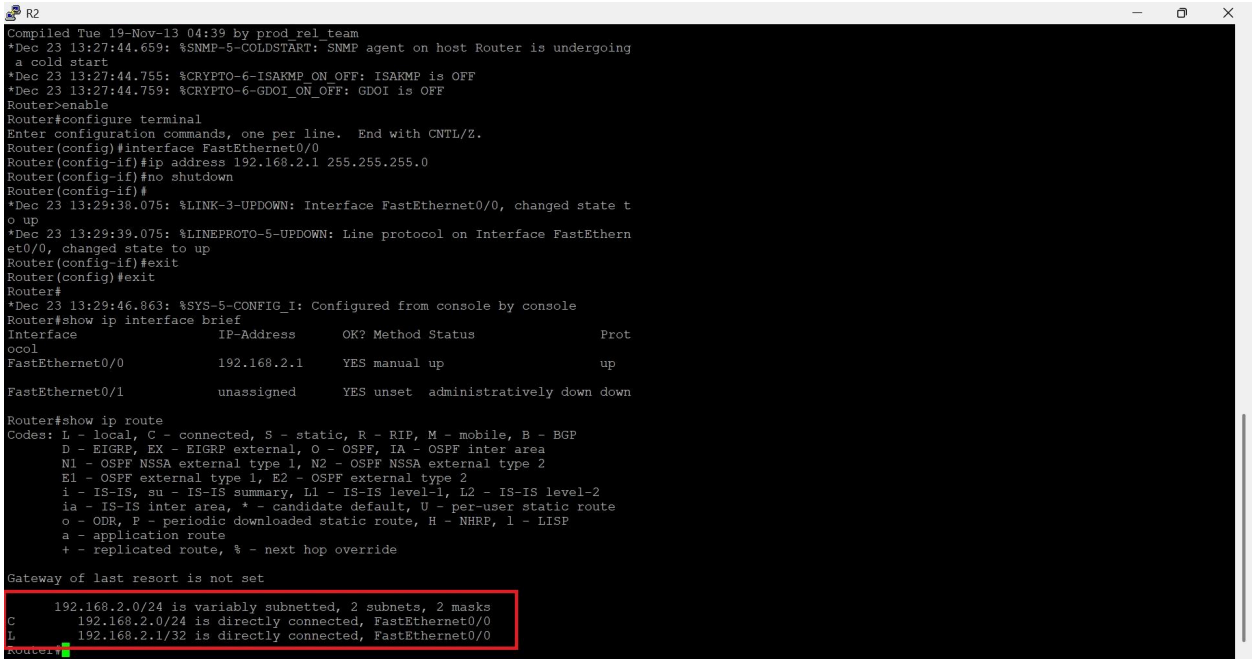
PC2 pinging gateway and PC1



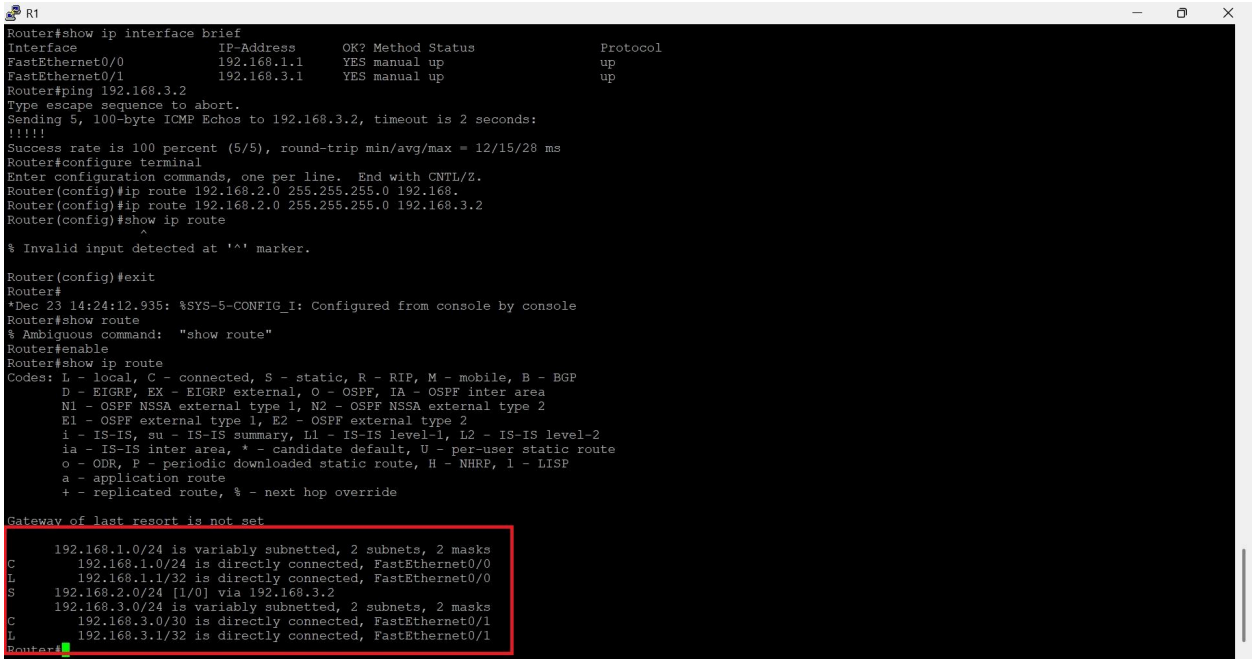
Routing table before static routes - Router 1



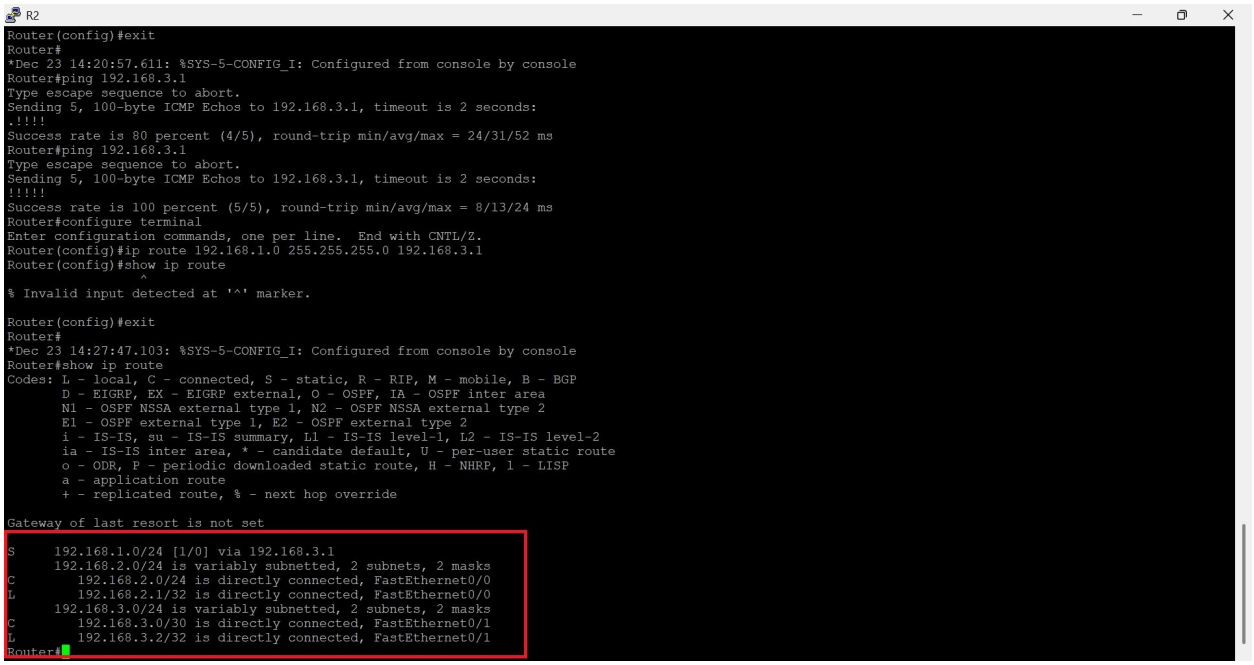
Routing table before static routes - Router 2



Routing table after static routes - Router 1

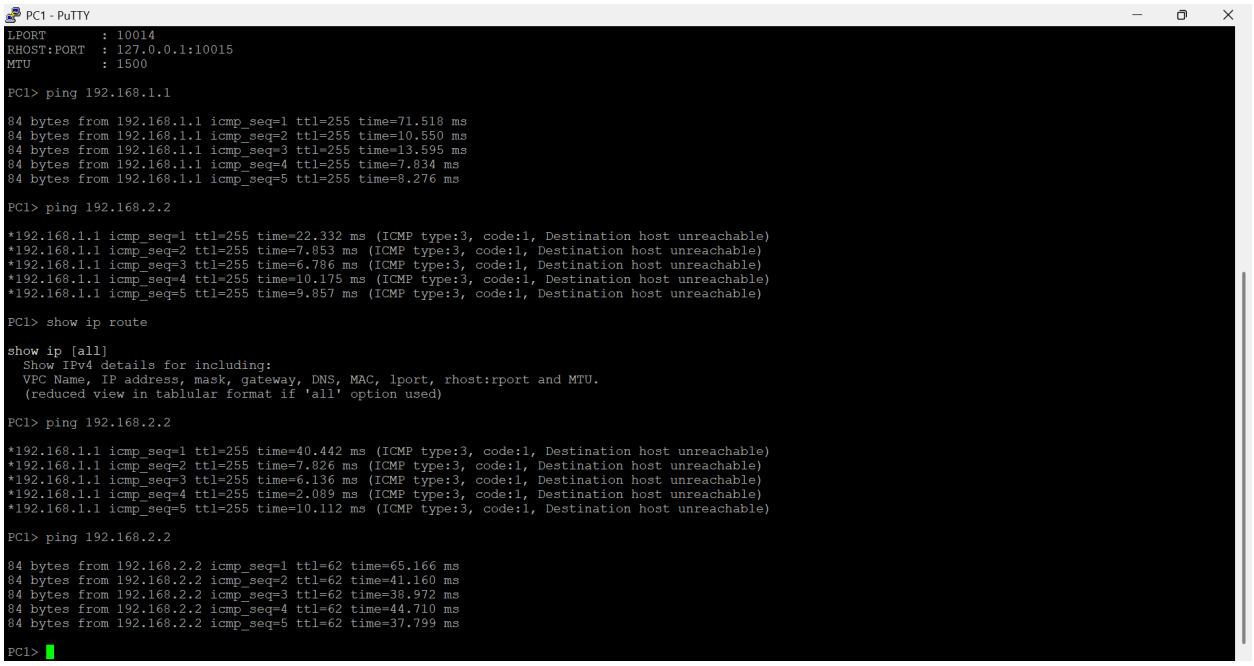


Routing table after static routes - Router 2

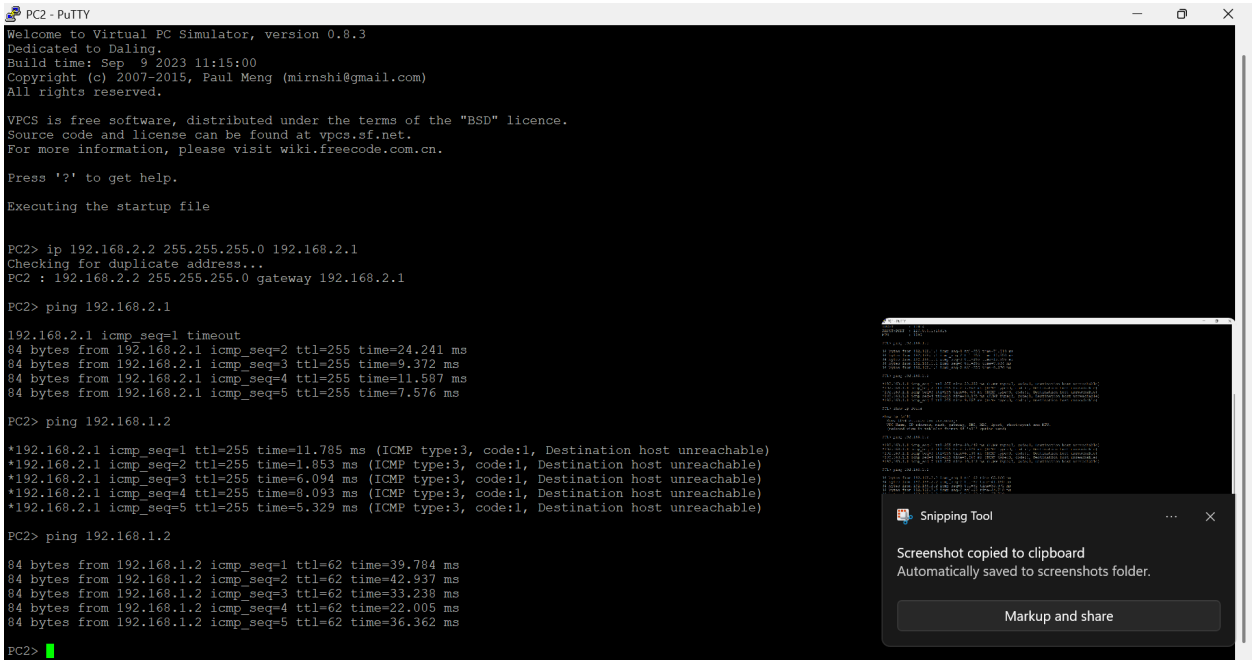


Verify end-to-end connectivity.

Pinging pc2 from pc1



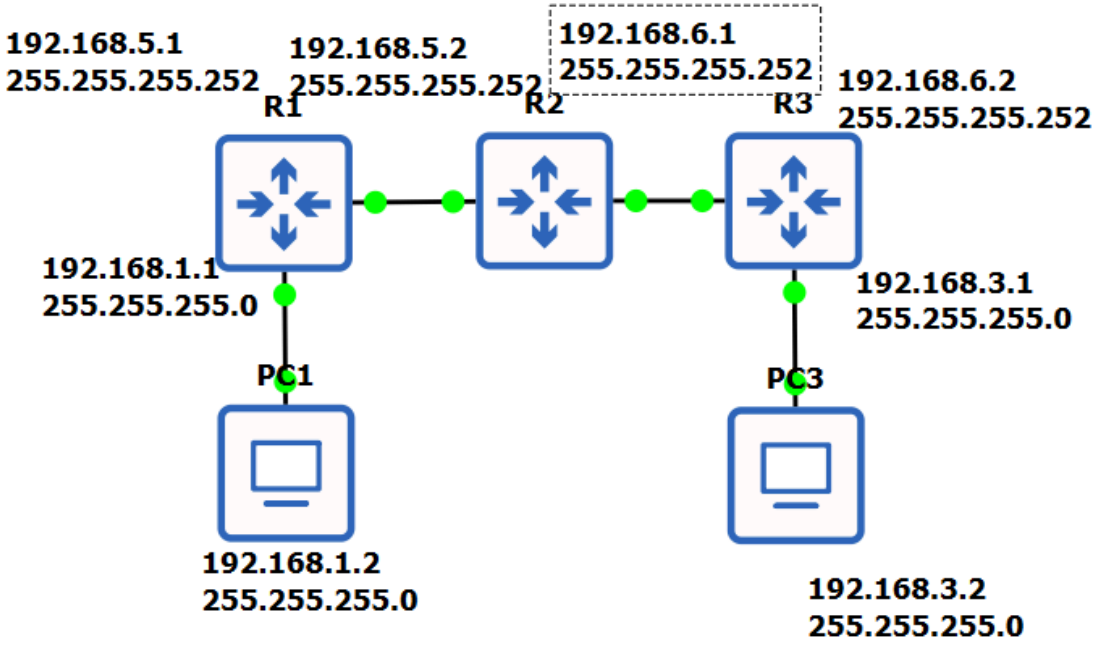
Pinging pc1 from pc2



- **What happens if you remove a static route**

If we remove static routing the PC1 cannot ping and connect to PC2 and vice versa. Both PCs cannot connect to each other since the r1 and r2 doesn’t know if pc1 and pc2 are connected to r1 and r2 respectively.

PART C – Dynamic Routing Lab



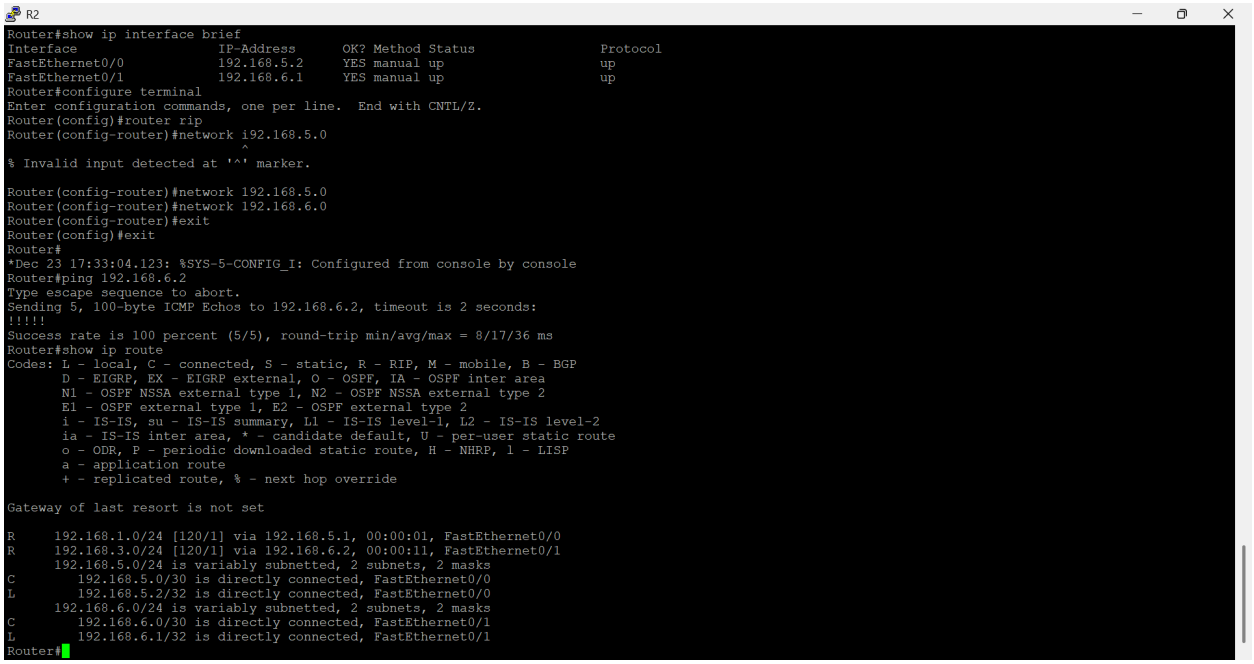
Routing tables

Router 1

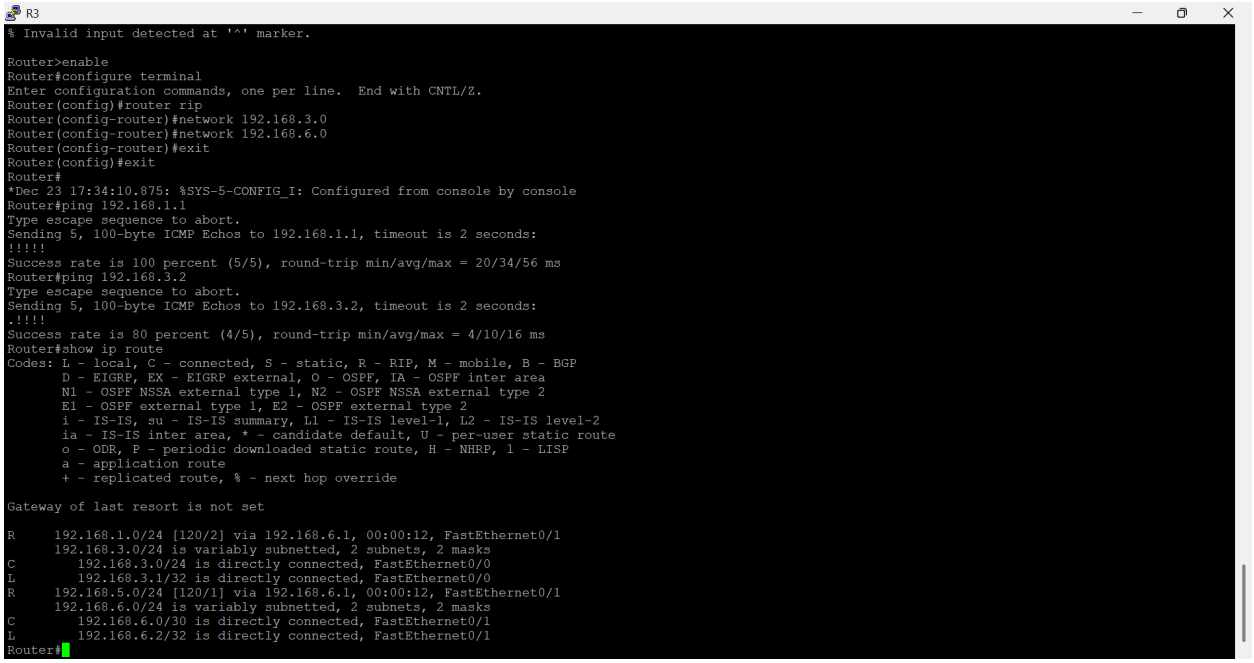
R1

```
Router>configure terminal
          ^
% Invalid input detected at '^' marker.

Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 192.168.1.0
Router(config-router)#network 192.168.5.0
Router(config-router)#exit
Router(config)#exit
Router#
*Dec 23 17:31:45.751: %SYS-5-CONFIG_I: Configured from console by console
Router#ping 192.168.5.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.5.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/21/32 ms
Router#show ip route
Codes: L - local, 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, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

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, FastEthernet0/0
L        192.168.1.1/32 is directly connected, FastEthernet0/0
R     192.168.3.0/24 [120/2] via 192.168.5.2, 00:00:25, FastEthernet0/1
      192.168.5.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.5.0/30 is directly connected, FastEthernet0/1
L        192.168.5.1/32 is directly connected, FastEthernet0/1
R     192.168.6.0/24 [120/1] via 192.168.5.2, 00:00:25, FastEthernet0/1
Router#
```

Router 2

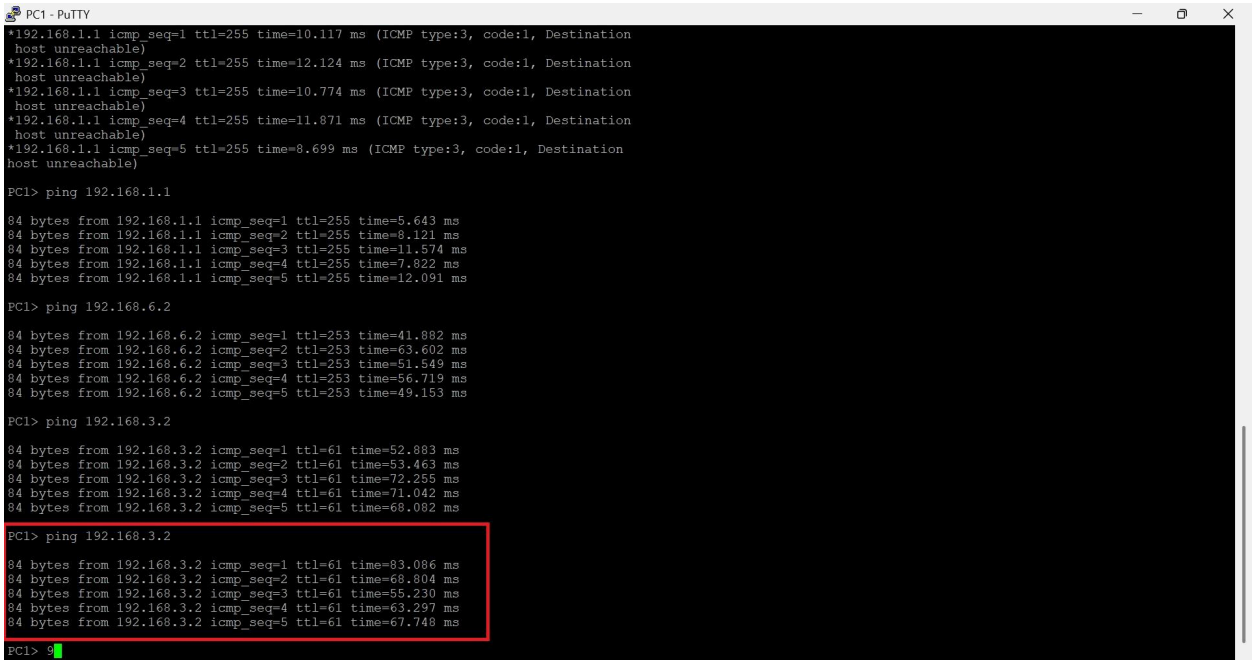


Router 3

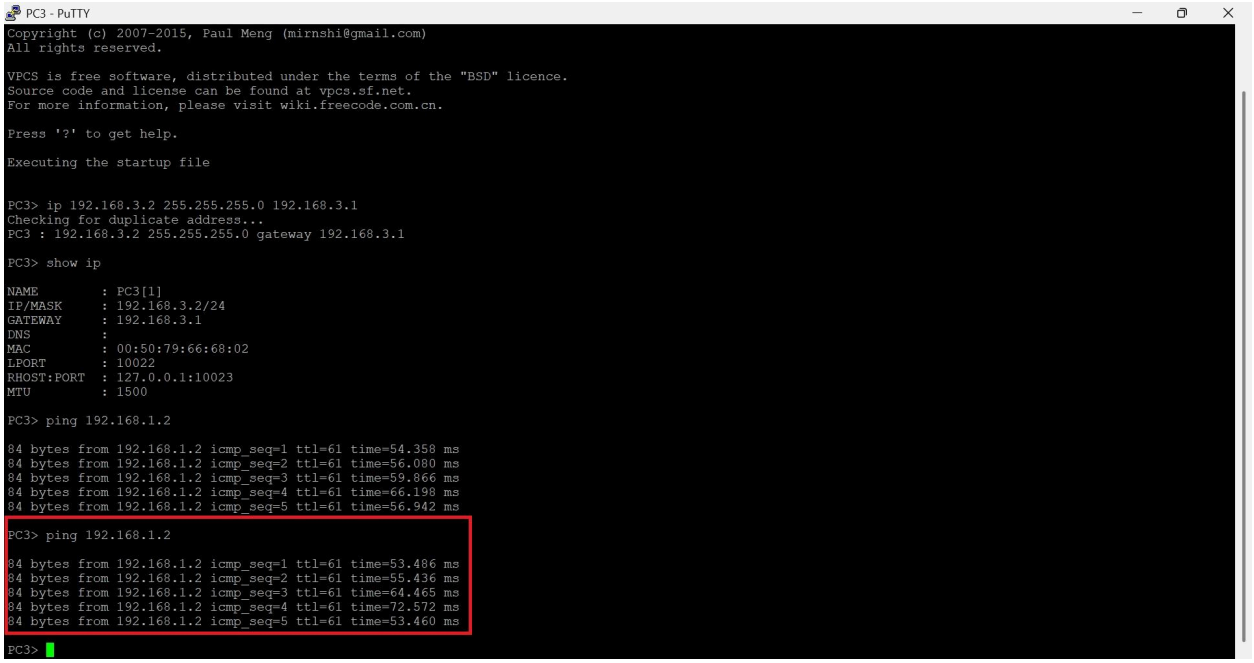


Can End hosts reach remote networks? - Ping Test

Pinging PC3 from PC1

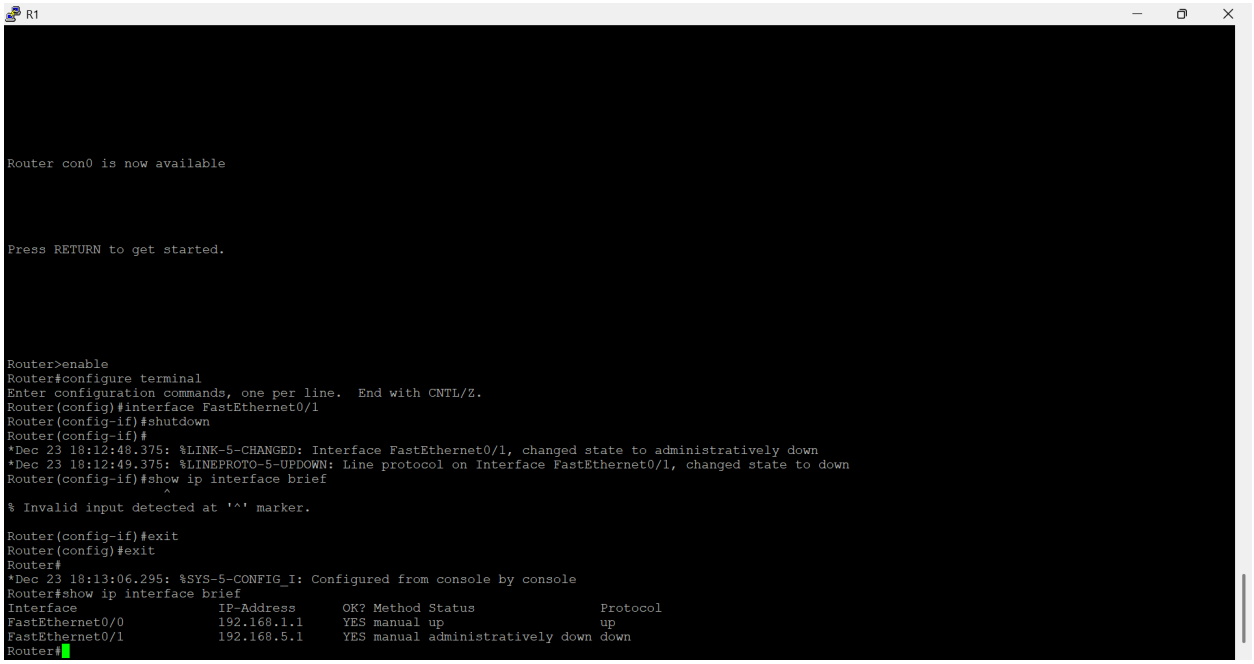


Pinging PC1 from PC3

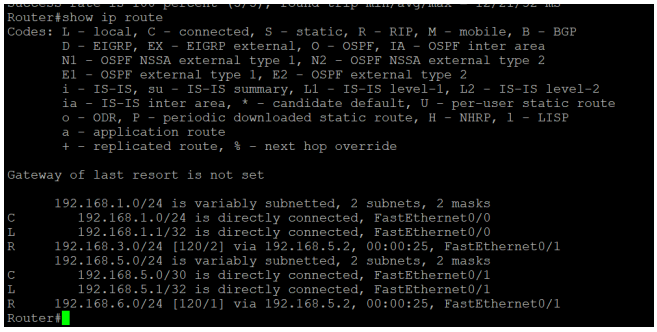


Failure Observation

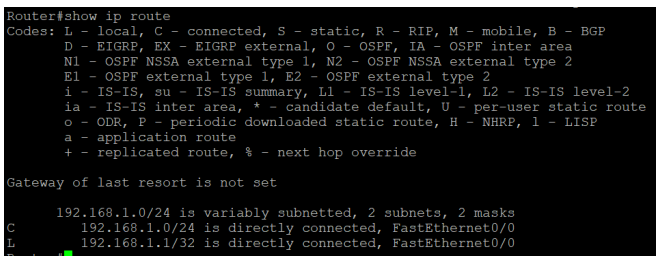
Shutting down FastEthernet0/1 interface of Router1



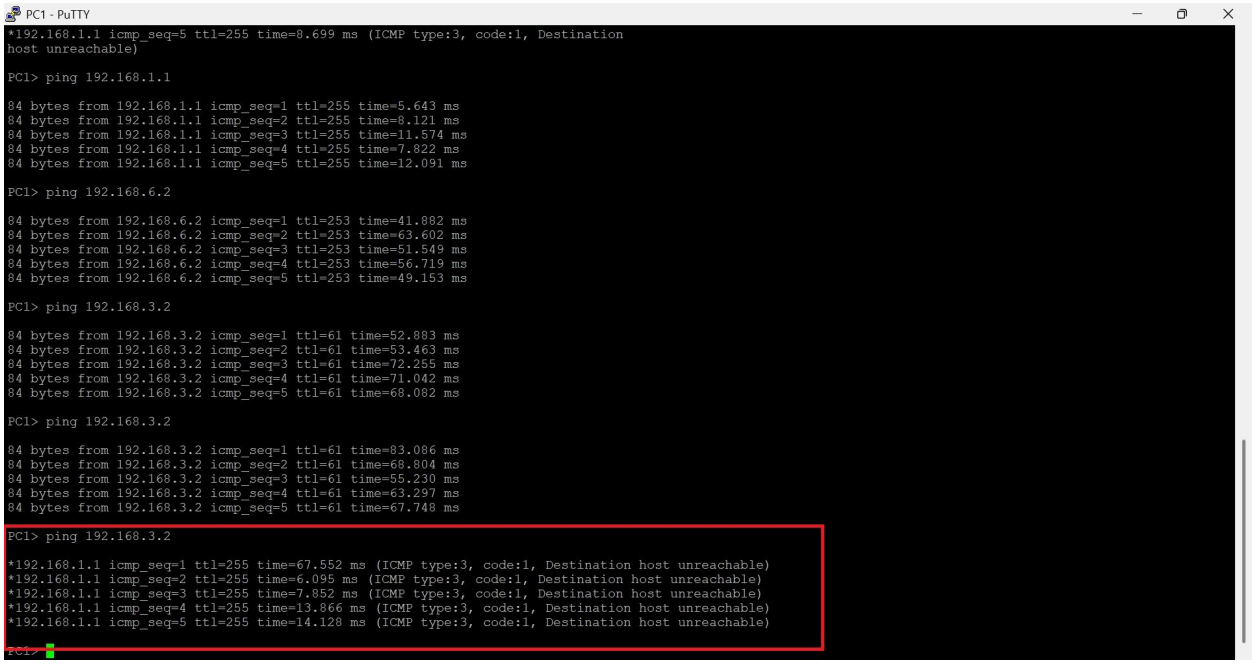
Routing table of R1 before shutdown-



Routing table of R1 after shutdown-

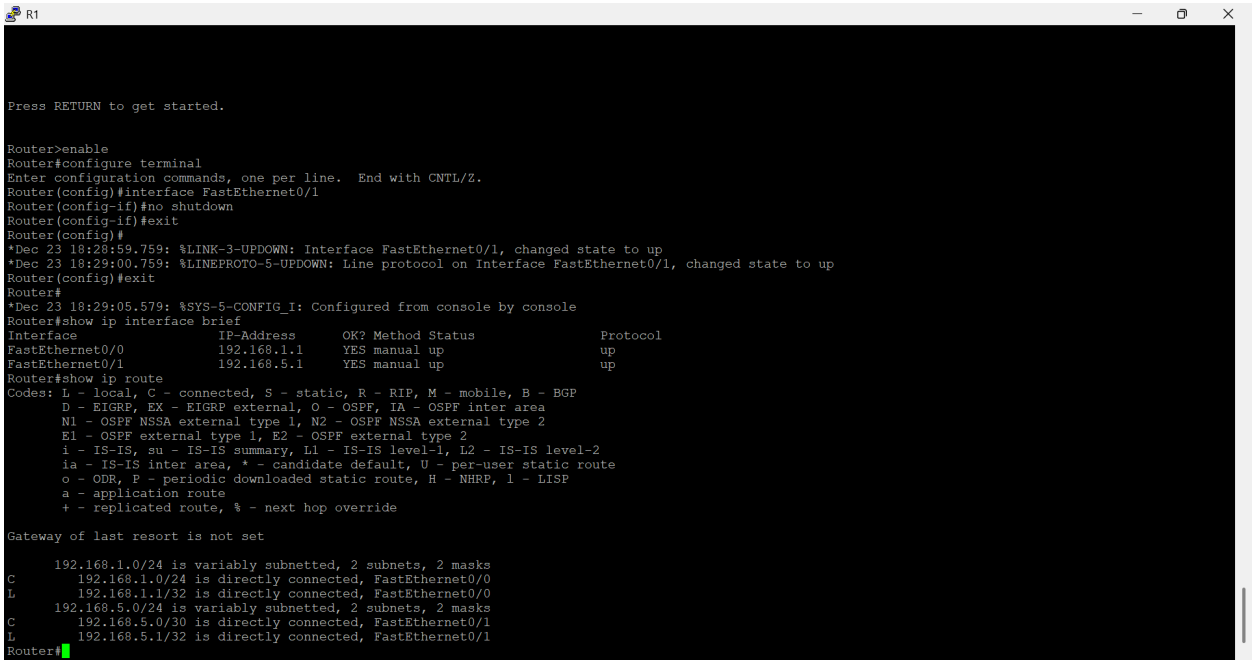


Ping Test after shutdown



It fails because there exist no alternate path to reach pc3.

Routing table after interface brought up again.



When the interface is brought back,we don’t have to manually create the route. Dynamic routing automatically connects back and the ping test will be successful.

PART D – Static vs Dynamic in Practice

When static routing was used, the routing tables felt very rigid and fixed. Every route had to be entered manually by the administrator, and the router simply followed those instructions without questioning whether the path was still usable. Even when the network changed, the routing table remained the same unless a human intervened. This made the router feel more like a machine following orders rather than an intelligent system that understands the network around it.

In contrast, dynamic routing felt much more responsive and adaptable. The routing tables were built automatically through communication between routers. Routes appeared on their own when the network was stable and disappeared when a link went down. Watching the routing table change after a failure made it clear that the routers were actively aware of the network state. This automatic learning and updating gave dynamic routing a sense of being alive and self-adjusting.

When a link failed, the difference between the two approaches became very clear. In static routing, nothing changed in the routing table, even though the path was broken. The router continued sending packets toward the failed link, which caused communication to stop completely. With dynamic routing, the routers detected the failure, removed the unreachable routes, and updated their tables accordingly. When the link was restored, the routes came back automatically without any manual setup.

Static routing is still useful in real life when the network is small and predictable. For example, in a small office or home network with only one or two routers and a single internet connection, static routing is simple, stable, and easy to manage. There is no need for complex routing protocols when the network rarely changes.

Dynamic routing, however, becomes essential in large and complex networks. In enterprise networks, data centers, or internet service provider (ISP) backbones, there are many routers and multiple possible paths for data to travel. Links may fail, traffic may need to be rerouted, and the network must remain available at all times. In such environments, manual route configuration is impractical, and dynamic routing is necessary to ensure reliability and growth.

Overall, this practical exercise clearly showed that static routing provides control and simplicity, while dynamic routing offers flexibility, intelligence, and resilience. Dynamic routing's ability to automatically respond to changes makes it the preferred choice for modern networks.

"What routing really means after this lab"

After completing this lab, routing is no longer just about forwarding packets from one network to another. It becomes clear that routing involves decision-making and adaptability within a network. Routers are not passive devices; they constantly assess network information to determine the best path for data to travel.

This lab showed that routing is closely tied to network awareness. With static routing, routers follow predefined instructions without question. In contrast, dynamic routing allows them to learn, share information, and respond to changes. Observing routing tables update automatically during link failures demonstrates how routers keep communication going even in unstable conditions.

Ultimately, routing means keeping networks connected despite change. It enables communication to withstand failures, scale across multiple devices, and work reliably in real-world settings. This lab changed routing from a theoretical idea into a practical process that evolves as the network changes.