Cisco Virtual Internship Program (VIP 2025)

Networking Industry Problem Statement – Final Report

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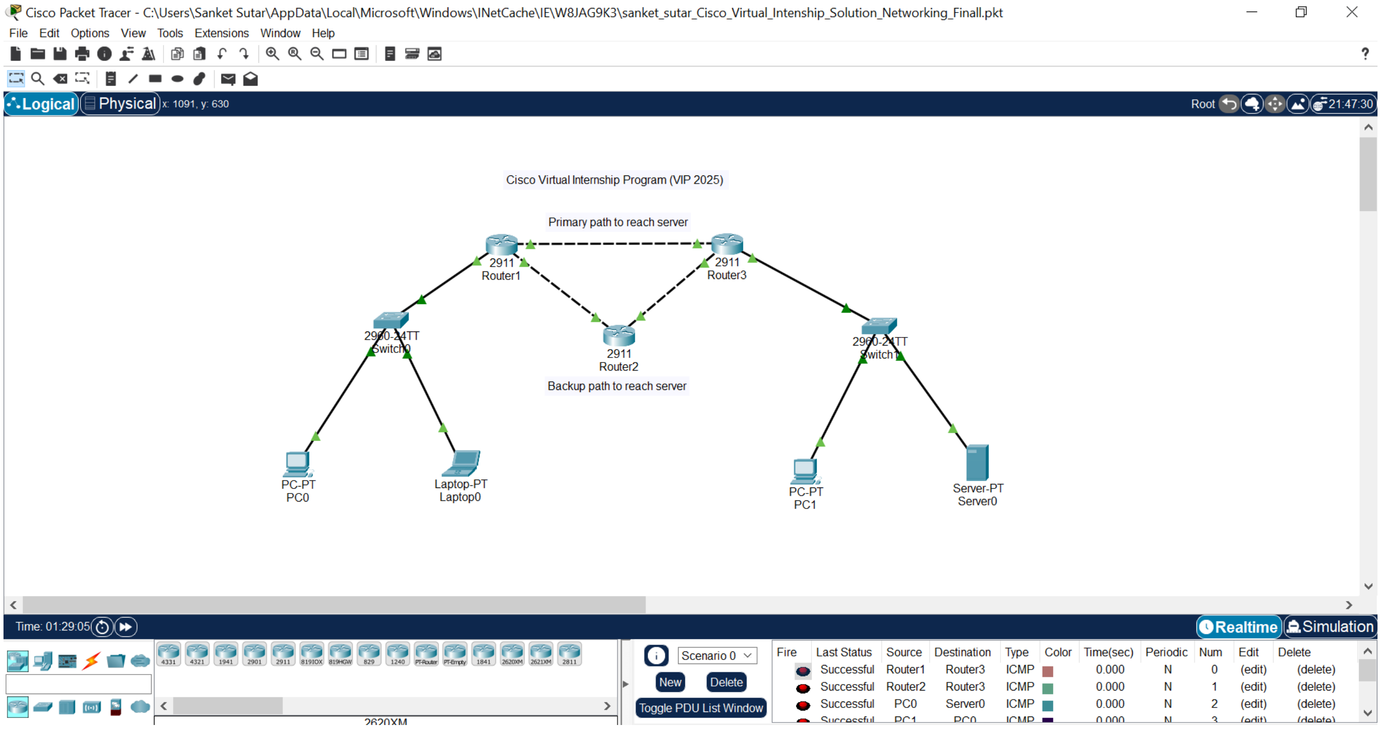
1. Problem Statement

The objective of this project is to design and implement a network topology using Cisco Packet Tracer. The topology must include two LANs connected via three routers with static routing. The configuration should also implement DHCP servers for automatic IP allocation, and failover paths should be available to ensure connectivity in case of a primary link failure.

2. Network Topology

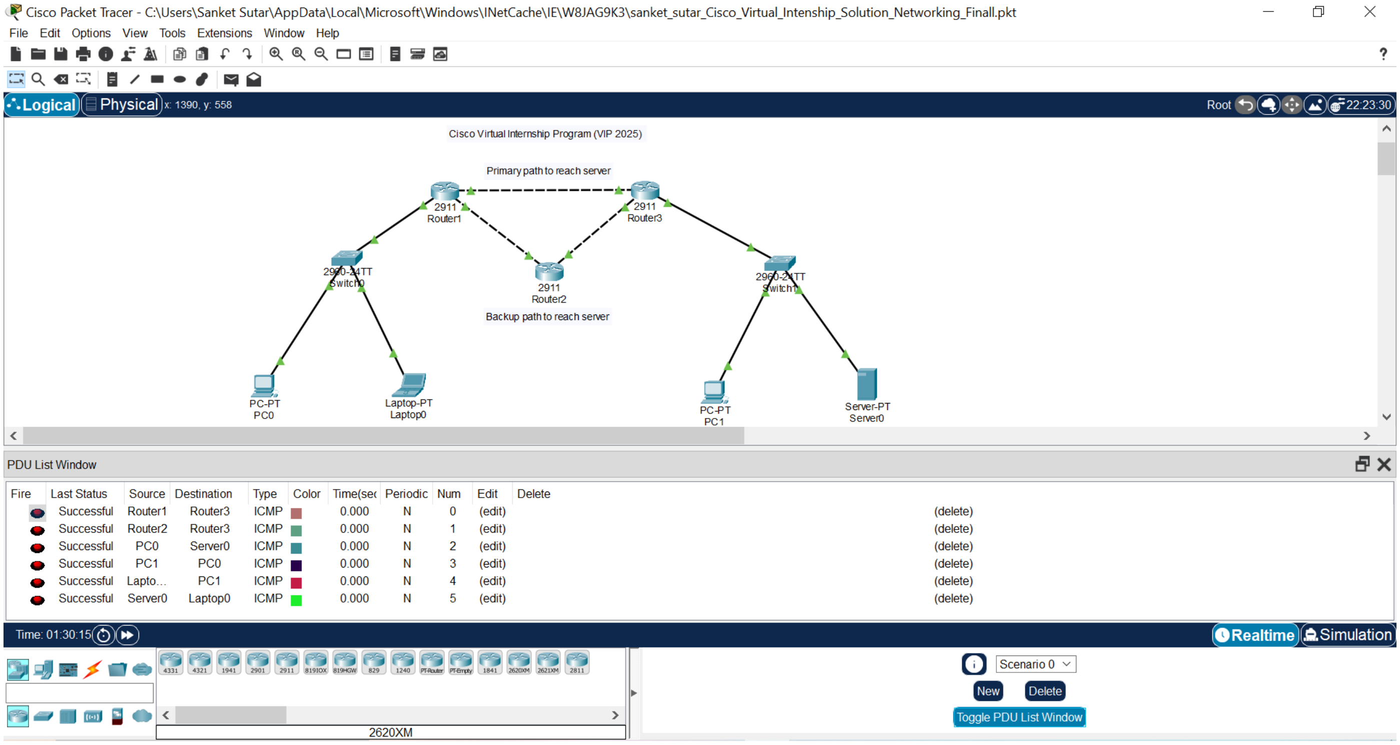
Devices Used

- Routers: R1, R2, R3 (Cisco 2911)
- Switches: 2
- End Devices: PC1 (LAN1), PC2 (LAN2)
- Connections: Serial/DCE-DTE and Copper Straight-Through



Cisco Packet Tracer - C:\Users\Sanket Sutar\AppData\Local\Microsoft\Windows\INetCache\IE\W8JAG9K3\sanket_sutar_Cisco_Virtual_Intenship_Solution_Networking_Finall.pkt
File Edit Options View Tools Extensions Window Help
Logical Physical x: 1091, y: 630
Root 21:47:30
Cisco Virtual Internship Program (VIP 2025)
Primary path to reach server
2911 Router1
2911 Router3
2960-24TT Switch0
2911 Router2
Backup path to reach server
2960-24TT Switch1
PC-PT PC0
Laptop-PT Laptop0
PC-PT PC1
Server-PT Server0
Time: 01:29:05
Realtime
Simulation
4331 4321 1941 2901 2911 819IOX 819HGW 829 1240 PT-Router PT-Empty 1841 2620XM 2621XM 2811
2620XM
Scenario 0
New
Delete
Toggle PDU List Window

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
●	Successful	Router1	Router3	ICMP	🟥	0.000	N	0	(edit)	(delete)
●	Successful	Router2	Router3	ICMP	🟩	0.000	N	1	(edit)	(delete)
●	Successful	PC0	Server0	ICMP	🟦	0.000	N	2	(edit)	(delete)
●	Successful	PC1	PC0	ICMP	■	0.000	N	3	(edit)	(delete)



Cisco Packet Tracer - C:\Users\Sanket Sutar\AppData\Local\Microsoft\Windows\INetCache\IE\W8JAG9K3\sanket_sutar_Cisco_Virtual_Intenship_Solution_Networking_Finall.pkt
File Edit Options View Tools Extensions Window Help
Logical Physical x: 1390, y: 558
Root 22:23:30
Cisco Virtual Internship Program (VIP 2025)
Primary path to reach server
2911 Router1
2911 Router3
2960-24TT Switch0
2911 Router2
Backup path to reach server
2960-24TT Switch1
PC-PT PC0
Laptop-PT Laptop0
PC-PT PC1
Server-PT Server0
PDU List Window
Time: 01:30:15
Realtime
Simulation
4331 4321 1941 2901 2911 819IOX 819HGW 829 1240 PT-Router PT-Empty 1841 2620XM 2621XM 2811
2620XM
Scenario 0
New
Delete
Toggle PDU List Window

Fire	Last Status	Source	Destination	Type	Color	Time(sec	Periodic	Num	Edit	Delete
●	Successful	Router1	Router3	ICMP	🟥	0.000	N	0	(edit)	(delete)
●	Successful	Router2	Router3	ICMP	🟩	0.000	N	1	(edit)	(delete)
●	Successful	PC0	Server0	ICMP	🟦	0.000	N	2	(edit)	(delete)
●	Successful	PC1	PC0	ICMP	■	0.000	N	3	(edit)	(delete)
●	Successful	Lapto...	PC1	ICMP	🟥	0.000	N	4	(edit)	(delete)
●	Successful	Server0	Laptop0	ICMP	🟩	0.000	N	5	(edit)	(delete)

3. IP Addressing Scheme

Device	Interface	IP Address	Subnet Mask	Purpose
R1	G0/0	192.168.10.1	255.255.255.0	LAN1 Gateway
R1	G0/1	10.0.13.1	255.255.255.252	R1–R3 link
R1	G0/2	10.0.12.1	255.255.255.252	R1–R2 link
R2	G0/0	10.0.12.2	255.255.255.252	R1–R2 link
R2	G0/1	10.0.23.1	255.255.255.252	R2–R3 link
R3	G0/0	192.168.20.1	255.255.255.0	LAN2 Gateway
R3	G0/1	10.0.13.2	255.255.255.252	R1–R3 link
R3	G0/2	10.0.23.2	255.255.255.252	R2–R3 link

4. Configuration Steps

Step 1: Assign IP addresses to all router interfaces(Router1)

```
 configure terminal
interface g0/0
 ip address 192.168.10.1 255.255.255.0
 no shutdown
interface g0/1
 ip address 10.0.13.1 255.255.255.252
 no shutdown
interface g0/2
 ip address 10.0.12.1 255.255.255.252
 no shutdown
```

Step 2: Configure DHCP On R1 (LAN1)

```
ip dhcp excluded-address 192.168.10.1
ip dhcp pool LAN1
 network 192.168.10.0 255.255.255.0
 default-router 192.168.10.1
 dns-server 8.8.8.8
```

On R3 (LAN2)

```
ip dhcp excluded-address 192.168.20.1
ip dhcp pool LAN2
 network 192.168.20.0 255.255.255.0
 default-router 192.168.20.1
 dns-server 8.8.8.8
```

Step 3: Configure Static Routes On R1:

```
ip route 192.168.20.0 255.255.255.0 10.0.13.2
ip route 192.168.20.0 255.255.255.0 10.0.12.2 10
```

On R3:

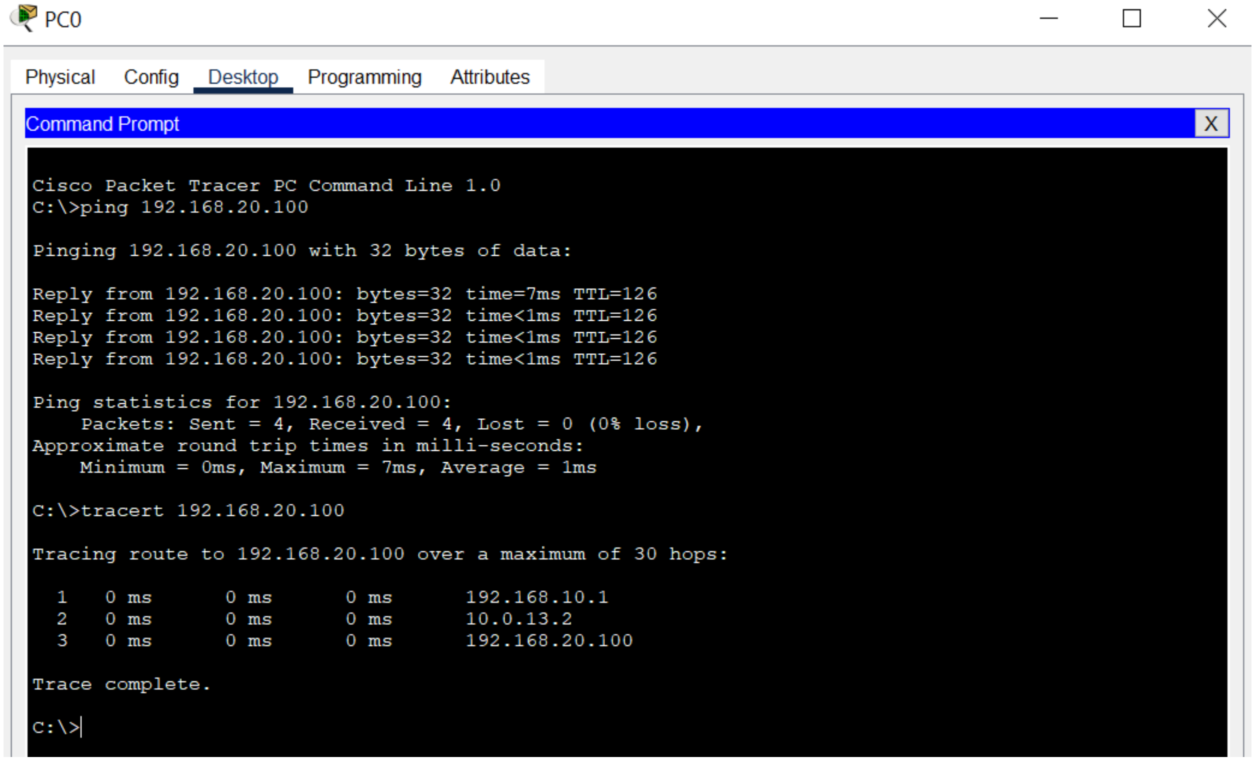
```
ip route 192.168.10.0 255.255.255.0 10.0.13.1
ip route 192.168.10.0 255.255.255.0 10.0.23.1 10
```

On R2:

```
ip route 192.168.10.0 255.255.255.0 10.0.12.1
ip route 192.168.20.0 255.255.255.0 10.0.23.2
```

(b) Ping Test

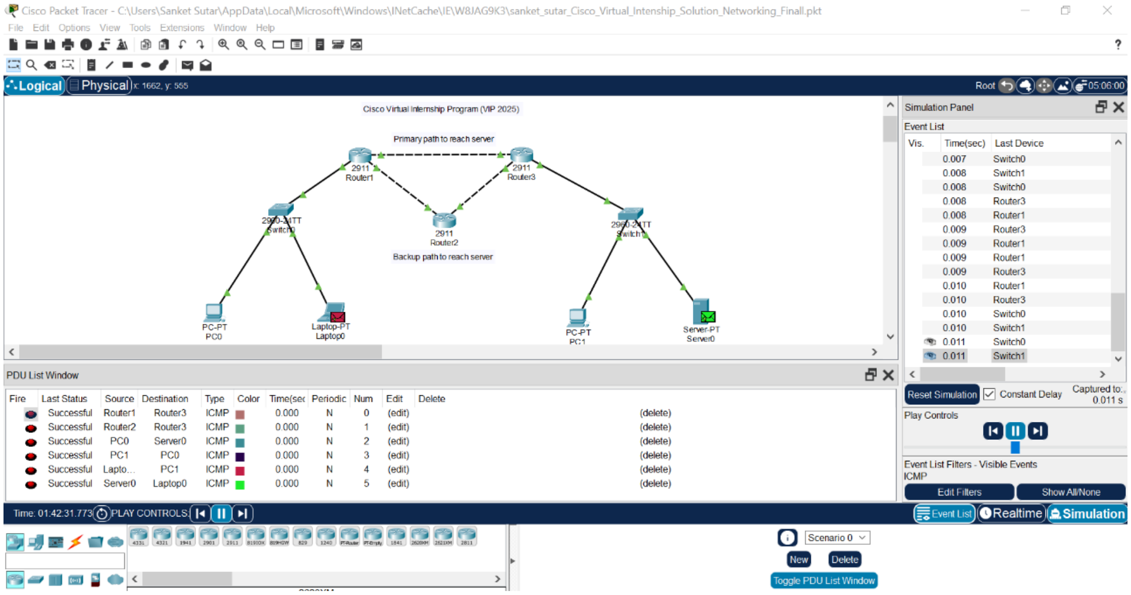
```
C:\> ping 192.168.20.100
Reply from 192.168.20.100: bytes=32 time<1ms TTL=128
```



```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.20.100

Pinging 192.168.20.100 with 32 bytes of data:

Reply from 192.168.20.100: bytes=32 time=7ms TTL=126
Reply from 192.168.20.100: bytes=32 time<1ms TTL=126
Reply from 192.168.20.100: bytes=32 time<1ms TTL=126
Reply from 192.168.20.100: bytes=32 time<1ms TTL=126

Ping statistics for 192.168.20.100:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 7ms, Average = 1ms

C:\>tracert 192.168.20.100

Tracing route to 192.168.20.100 over a maximum of 30 hops:

  1   0 ms      0 ms      0 ms      192.168.10.1
  2   0 ms      0 ms      0 ms      10.0.13.2
  3   0 ms      0 ms      0 ms      192.168.20.100

Trace complete.

C:\>
```

d) Failover Test

1. Shut down **R1–R3 link (G0/1 on R1 or R3)**
2. Run tracert again:


Cisco Packet Tracer - C:\Users\Sanket Sutar\AppData\Local\Microsoft\Windows\INetCache\IE\W8JAG9K3\sanket_sutar_Cisco_Virtual_Intenship_Solution_Networking_Finall.pkt

Vis.	Time(sec)	Last Device
	0.007	Switch0
	0.008	Switch1
	0.008	Switch0
	0.008	Router3
	0.008	Router1
	0.009	Router3
	0.009	Router1
	0.009	Router1
	0.009	Router3
	0.010	Router1
	0.010	Router3
	0.010	Switch0
	0.010	Switch1
👁	0.011	Switch0
👁	0.011	Switch1

Fire	Last Status	Source	Destination	Type	Color	Time(sec	Periodic	Num	Edit	Delete
●	Successful	Router1	Router3	ICMP	🟥	0.000	N	0	(edit)	(delete)
●	Successful	Router2	Router3	ICMP	🟩	0.000	N	1	(edit)	(delete)
●	Successful	PC0	Server0	ICMP	🟦	0.000	N	2	(edit)	(delete)
●	Successful	PC1	PC0	ICMP	🟪	0.000	N	3	(edit)	(delete)
●	Successful	Lapto...	PC1	ICMP	🟥	0.000	N	4	(edit)	(delete)
●	Successful	Server0	Laptop0	ICMP	🟩	0.000	N	5	(edit)	(delete)

Time: 01:42:31.773

# Cisco VIP Project - Auto Topology + Config Generator

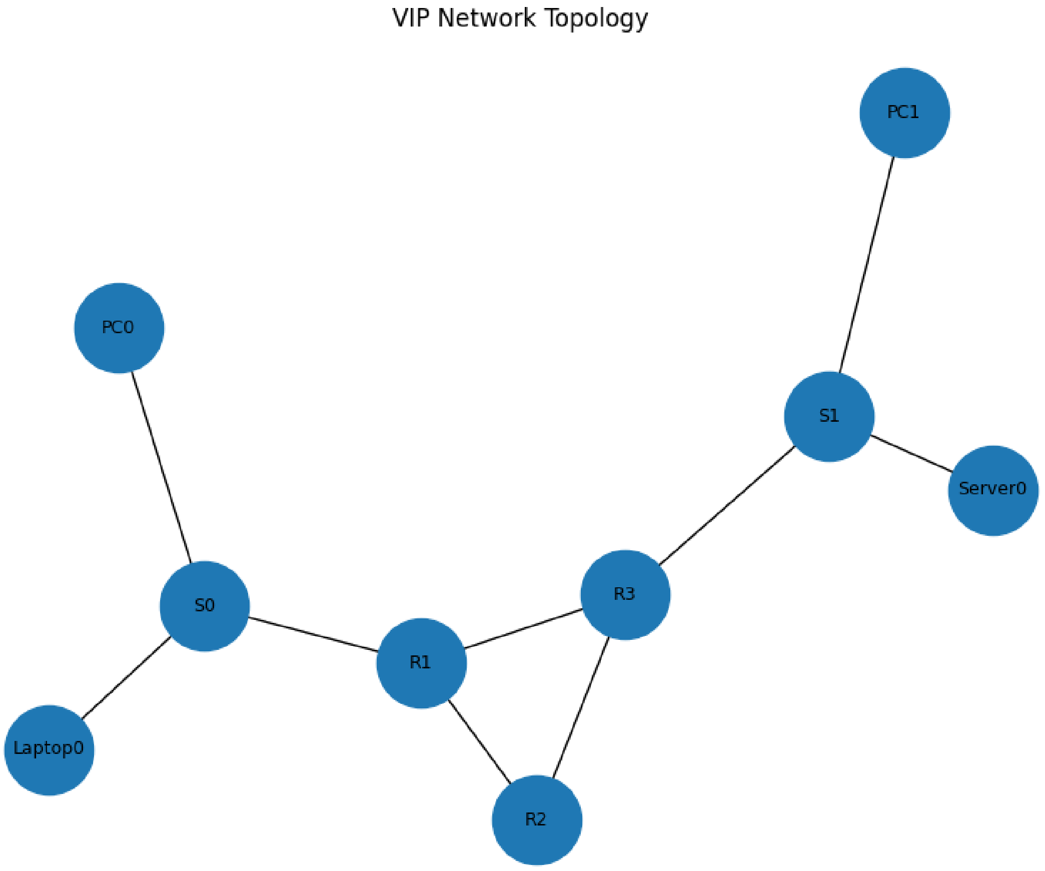
Google Colab link:-https://colab.research.google.com/drive/1MLFLSEfFl0oYZ9lW0p5Q-uIl0tgHKdw_?usp=sharing

```
import json, os, zipfile, textwrap
import networkx as nx
import matplotlib.pyplot as plt
from datetime import datetime
from IPython.display import FileLink, display

# ---------- Define Final Topology ----------
topology = {
    "project": "Cisco_VIP_Static_Routing_with_Backup",
    "addressing": {
        "LAN1": {"network": "192.168.10.0/24", "gateway": "192.168.10.1"},
        "LAN2": {"network": "192.168.20.0/24", "gateway": "192.168.20.1"},
        "R1_R2": {"network": "10.0.12.0/30", "R1": "10.0.12.1", "R2": "10.0.12.2"},
        "R1_R3": {"network": "10.0.13.0/30", "R1": "10.0.13.1", "R3": "10.0.13.2"},
        "R2_R3": {"network": "10.0.23.0/30", "R2": "10.0.23.1", "R3": "10.0.23.2"}
    },
    "devices": {
        "R1": {
            "type": "router",
            "interfaces": {
                "g0/0": {"ip": "192.168.10.1", "mask": "255.255.255.0"},
                "g0/1": {"ip": "10.0.12.1", "mask": "255.255.255.252"},
                "g0/2": {"ip": "10.0.13.1", "mask": "255.255.255.252"}
            },
            "routes": [
                {"dst": "192.168.20.0", "mask": "255.255.255.0", "nexthop": "10.0.13.2", "ad": 1},
                {"dst": "192.168.20.0", "mask": "255.255.255.0", "nexthop": "10.0.12.2", "ad": 10}
            ]
        },
"R2": {
  "type": "router",
  "interfaces": {
    "g0/0": {"ip": "10.0.12.2", "mask": "255.255.255.252"},
    "g0/1": {"ip": "10.0.23.1", "mask": "255.255.255.252"}
  },
  "routes": [
    {"dst": "192.168.10.0", "mask": "255.255.255.0", "nexthop": "10.0.12.1"},
    {"dst": "192.168.20.0", "mask": "255.255.255.0", "nexthop": "10.0.23.2"}
  ]
},
"R3": {
  "type": "router",
  "interfaces": {
    "g0/0": {"ip": "192.168.20.1", "mask": "255.255.255.0"},
    "g0/1": {"ip": "10.0.13.2", "mask": "255.255.255.252"},
    "g0/2": {"ip": "10.0.23.2", "mask": "255.255.255.252"}
  },
  "routes": [
    {"dst": "192.168.10.0", "mask": "255.255.255.0", "nexthop": "10.0.13.1"},
    {"dst": "192.168.10.0", "mask": "255.255.255.0", "nexthop": "10.0.23.1", "ad": 10}
  ],
  "dhcp": {
    "exclude": ["192.168.20.1"],
    "pool": {
      "name": "LAN2",
      "network": "192.168.20.0",
      "mask": "255.255.255.0",
      "default_router": "192.168.20.1",
      "dns": "8.8.8.8"
    }
  }
```

```
        },
        "S0": {"type": "switch"},
        "S1": {"type": "switch"},
        "PC0": {"type": "pc", "lan": "LAN1", "dhcp": True},
        "Laptop0": {"type": "laptop", "lan": "LAN1", "dhcp": True},
        "PC1": {"type": "pc", "lan": "LAN2", "dhcp": True},
        "Server0": {"type": "server", "ip": "192.168.20.100", "mask": "255.255.255.0", "gw": "192.168.20.1"}
    },
    "links": [
        ["R1:g0/1", "R2:g0/0"],
        ["R1:g0/2", "R3:g0/1"],
        ["R2:g0/1", "R3:g0/2"],
        ["R1:g0/0", "S0"], ["S0", "PC0"], ["S0", "Laptop0"],
        ["R3:g0/0", "S1"], ["S1", "PC1"], ["S1", "Server0"]
    ]
}

# ---------- Generate Configs ----------
def router_cfg(name, spec):
    lines = [f"hostname {name}"]
    for ifc, ipd in spec["interfaces"].items():
        lines += [f"interface {ifc}", f" ip address {ipd['ip']} {ipd['mask']}", " no shutdown", " exit"]
    if "dhcp" in spec:
        dhcp = spec["dhcp"]
        for e in dhcp["exclude"]:
            lines.append(f"ip dhcp excluded-address {e}")
        lines += [f"ip dhcp pool {dhcp['pool']['name']}",
                  f" network {dhcp['pool']['network']} {dhcp['pool']['mask']}",
                  f" default-router {dhcp['pool']['default_router']}",
                  f" dns-server {dhcp['pool']['dns']}", " exit"]
    for r in spec.get("routes", []):
        ad = f" {r['ad']}" if "ad" in r else ""
        lines.append(f"ip route {r['dst']} {r['mask']} {r['nexthop']}{ad}")
    lines.append("end")
    return "\n".join(lines)

os.makedirs("/content/configs", exist_ok=True)
for d, spec in topology["devices"].items():
    if spec["type"] == "router":
        with open(f"/content/configs/{d}.cfg", "w") as f:
            f.write(router_cfg(d, spec))

with open("/content/topology.json", "w") as f:
    json.dump(topology, f, indent=2)

# ---------- Draw Diagram ----------
G = nx.Graph()
for dev in topology["devices"].keys():
    G.add_node(dev)
for l in topology["links"]:
    G.add_edge(l[0].split(":")[0], l[1].split(":")[0])
plt.figure(figsize=(8,6))
nx.draw(G, with_labels=True, node_size=2000, font_size=9)
plt.title("VIP Network Topology")
plt.savefig("/content/topology.png")
plt.show()

# ---------- Zip Everything ----------
zip_path = f"/content/VIP_Project_{datetime.now().strftime('%Y%m%d_%H%M%S')}.zip"
with zipfile.ZipFile(zip_path, "w") as z:
    z.write("/content/topology.json", "topology.json")
    z.write("/content/topology.png", "topology.png")
    for f in os.listdir("/content/configs"):
        z.write(f"/content/configs/{f}", f"configs/{f}")
```

```
display(FileLink(zip_path, result_html_prefix="📥 Download: "))
```

Toplogy Image:-



Conclusion

- Both LANs successfully receive IP addresses dynamically through DHCP.
- Static routing enables communication between LAN1 and LAN2.
- Failover mechanism is successfully implemented — traffic shifts to the backup path when the primary link fails.
- The project demonstrates **end-to-end connectivity, DHCP automation, and redundancy** in a simple network topology.