**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**
**ISLAMIC UNIVERSITY OF TECHNOLOGY**
**A SUBSIDIARY ORGAN OF OIC**

# LAB REPORT 4

**CSE 4512: COMPUTER NETWORKING LAB**

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## 1. Lab Task

The objective of this laboratory assignment was to implement a hybrid network topology that integrates two different dynamic routing protocols, **RIPv2** and **OSPF**, and establishes communication between them using **Route Redistribution**.

**Specific Objectives:**

1. **Topology Design:** Construct a network with three distinct zones: Lab Alpha, Lab Beta, and the ICT Department (Core).
2. **Addressing:** Calculate subnets based on Student ID (**25**) following the formula: 192.168.(ID + n).0/24.
3. **Routing Implementation:**
    - Configure **RIPv2** for Lab Alpha.
    - Configure **OSPF (Area 0)** for Lab Beta.
    - Configure the Core Router to act as an Autonomous System Boundary Router (ASBR) to redistribute routes between RIP and OSPF.
4. **DHCP:** Implement DHCP services on routers for their respective LANs.

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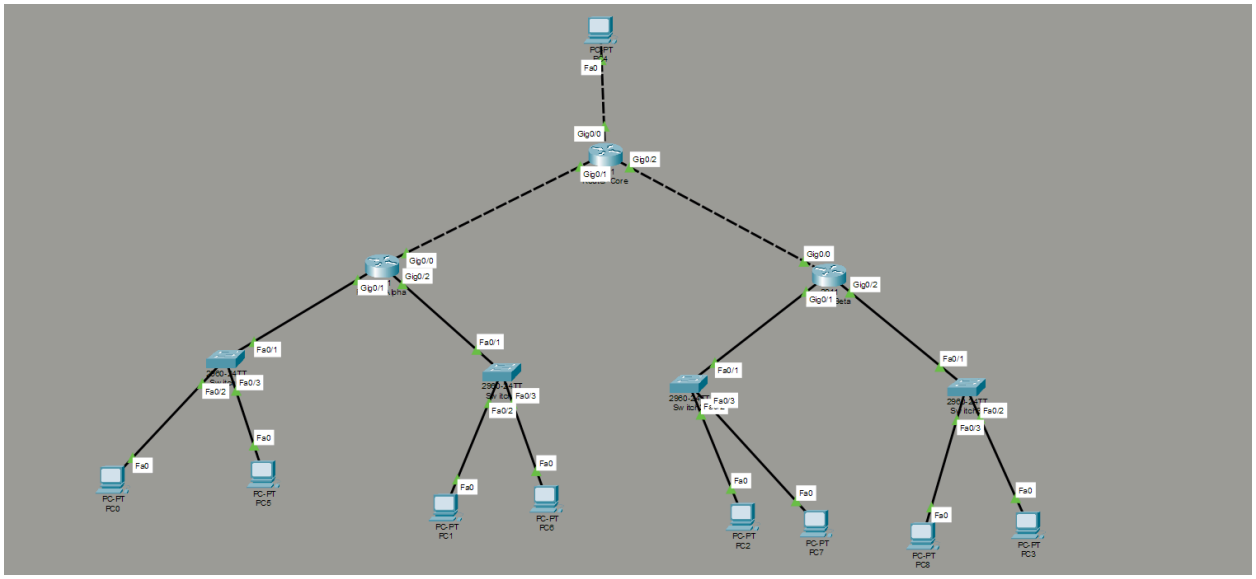
## 2. Final Network Topology



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## 3. Procedure

### Step 1: IP Addressing & Subnet Calculation

Based on Student ID **25**, the following address scheme was devised:

| Location | Network Address | Subnet Mask | Gateway IP | Protocol |
|---|---|---|---|---|
| **Lab Alpha (LAN 1)** | 192.168.25.0 | 255.255.255.0 | 192.168.25.1 | RIPv2 |
| **Lab Alpha (LAN 2)** | 192.168.26.0 | 255.255.255.0 | 192.168.26.1 | RIPv2 |
| **Lab Beta (LAN 3)** | 192.168.27.0 | 255.255.255.0 | 192.168.27.1 | OSPF |
| **Lab Beta (LAN 4)** | 192.168.28.0 | 255.255.255.0 | 192.168.28.1 | OSPF |
| **ICT Dept (Core)** | 192.168.29.0 | 255.255.255.0 | 192.168.29.1 | Both |

| | | | | |
|---|---|---|---|---|
| **WAN Link (Alpha-Core)** | 10.0.0.0 | 255.255.255.252 | .1 (Alpha) / .2 (Core) | - |
| **WAN Link (Beta-Core)** | 10.0.0.4 | 255.255.255.252 | .5 (Beta) / .6 (Core) | - |

### Step 2: Physical Connections

1. Three **Cisco 2911 Routers** were placed and renamed Router_Alpha, Router_Beta, and Router_Core.
2. LAN connections were established using Copper Straight-Through cables from Switches to Router ports G0/0 and G0/1.
3. WAN connections (Router-to-Router) were established using **Gigabit Ethernet** interfaces. **Copper Cross-Over cables** were used to connect Router_Alpha (G0/2) to Core_Router (G0/1) and Router_Beta (G0/2) to Core_Router (G0/2).

### Step 3: Device Configuration

A. Router Alpha Configuration (RIP Zone)
Interfaces were configured, and RIPv2 was enabled to advertise the local LANs and the WAN link.

```
Router_Alpha(config)# interface g0/0
Router_Alpha(config-if)# ip address 192.168.25.1 255.255.255.0
Router_Alpha(config-if)# no shutdown
! (Repeated for G0/1 and WAN G0/2)

! DHCP Configuration
Router_Alpha(config)# ip dhcp pool ALPHA_LAN_25
Router_Alpha(dhcp-config)# network 192.168.25.0 255.255.255.0
Router_Alpha(dhcp-config)# default-router 192.168.25.1

! RIP Routing
Router_Alpha(config)# router rip
Router_Alpha(config-router)# version 2
Router_Alpha(config-router)# no auto-summary
Router_Alpha(config-router)# network 192.168.25.0
Router_Alpha(config-router)# network 192.168.26.0
Router_Alpha(config-router)# network 10.0.0.0
```

B. Router Beta Configuration (OSPF Zone)

Interfaces were configured, and OSPF Process ID 1 was enabled for Area 0.

```
Router_Beta(config)# router ospf 1
Router_Beta(config-router)# network 192.168.27.0 0.0.0.255 area 0
Router_Beta(config-router)# network 192.168.28.0 0.0.0.255 area 0
Router_Beta(config-router)# network 10.0.0.4 0.0.0.3 area 0
```

C. Core Router Configuration (Redistribution)
The Core Router was configured to run both protocols and redistribute routes between them.

```
! RIP Configuration (Interface towards Alpha)
Router(config)# router rip
Router(config-router)# version 2
Router(config-router)# network 10.0.0.0
Router(config-router)# redistribute ospf 1 metric 5
Router(config-router)# redistribute connected metric 1

! OSPF Configuration (Interface towards Beta)
Router(config)# router ospf 1
Router(config-router)# network 10.0.0.4 0.0.0.3 area 0
Router(config-router)# redistribute rip subnets
Router(config-router)# redistribute connected subnets
```

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## 4. Observations & Results

**A. Routing Table Verification**
The routing table on Router_Beta was checked to ensure RIP routes from Alpha were successfully received via OSPF redistribution (marked as O E2).

```
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, E - EGP
       i - IS-IS, 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

     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C       10.0.0.0/30 is directly connected, GigabitEthernet0/0
L       10.0.0.1/32 is directly connected, GigabitEthernet0/0
R       10.0.0.4/30 [120/1] via 10.0.0.2, 00:00:10, GigabitEthernet0/0
     192.168.25.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.25.0/24 is directly connected, GigabitEthernet0/1
L       192.168.25.1/32 is directly connected, GigabitEthernet0/1
     192.168.26.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.26.0/24 is directly connected, GigabitEthernet0/2
L       192.168.26.1/32 is directly connected, GigabitEthernet0/2
R    192.168.27.0/24 [120/5] via 10.0.0.2, 00:00:10, GigabitEthernet0/0
R    192.168.28.0/24 [120/5] via 10.0.0.2, 00:00:10, GigabitEthernet0/0
 --More--
```

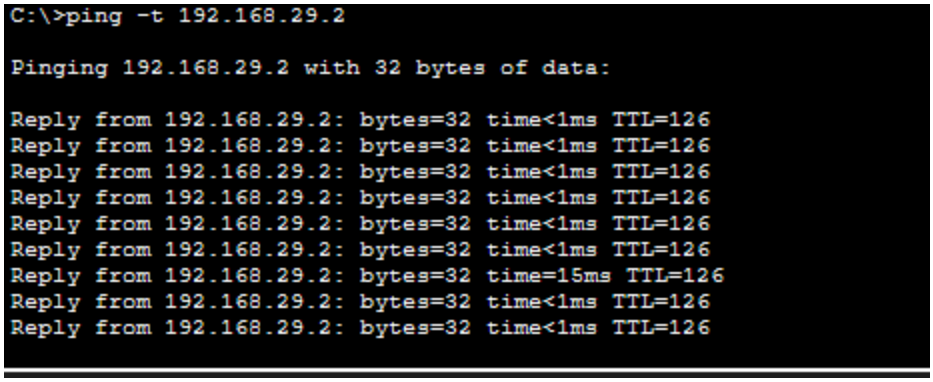
*Fig: Router Alpha routes*

```
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, E - EGP
       i - IS-IS, 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

     10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O E2    10.0.0.0/30 [110/20] via 10.0.0.6, 00:28:02, GigabitEthernet0/0
C       10.0.0.4/30 is directly connected, GigabitEthernet0/0
L       10.0.0.5/32 is directly connected, GigabitEthernet0/0
O E2 192.168.25.0/24 [110/20] via 10.0.0.6, 00:28:02, GigabitEthernet0/0
O E2 192.168.26.0/24 [110/20] via 10.0.0.6, 00:28:02, GigabitEthernet0/0
     192.168.27.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.27.0/24 is directly connected, GigabitEthernet0/1
L       192.168.27.1/32 is directly connected, GigabitEthernet0/1
     192.168.28.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.28.0/24 is directly connected, GigabitEthernet0/2
L       192.168.28.1/32 is directly connected, GigabitEthernet0/2
 --More--
```

*Fig: Router Beta routes*

**B. End-to-End Connectivity**

A ping test was performed from a PC in Lab Alpha (192.168.25.x) to a PC in Lab Beta (192.168.27.x) to verify full network reachability.

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## 5. Challenges Faced

1. **Cable Selection for Gigabit Links:** Initially, Copper Straight-Through cables were used for connecting the routers via Gigabit Ethernet ports, which resulted in link failure (Protocol Down). This was resolved by switching to **Copper Cross-Over cables**, which are required for connecting similar Layer 3 devices directly.
2. **Serial vs. Gigabit Interfaces:** The initial lab instructions implied the use of Serial DCE/DTE cables. However, modern Gigabit interfaces do not support DCE clocking. We adapted the topology to use high-speed Ethernet WAN links, removing the need for clock rate commands and simplifies the physical setup.
3. **Redistribution Syntax:** Determining the correct metric for redistributing OSPF into RIP was challenging. RIP requires a seed metric (hop count) to be manually defined (e.g., metric 5) because it cannot automatically translate OSPF's cost metric.