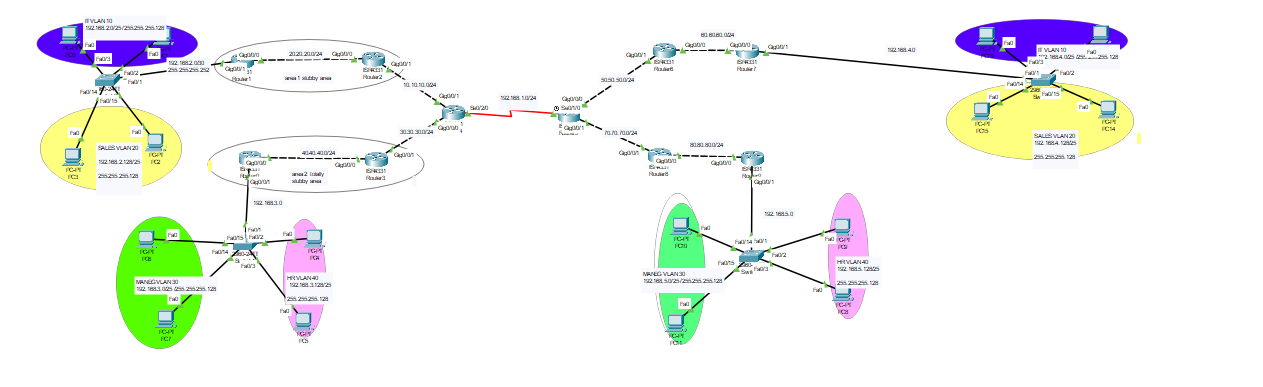
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**Problem Statement**

A medium-sized company aims to establish a scalable network that connects internal Brunch departments with an external Brunch**(each branch have HR,IT,Sales and Management departments)** . The network design includes multiple routing protocols (OSPF and EIGRP) across separate domains that must communicate via BGP. The current lab infrastructure lacks:

1. Protocol compatibility: No mechanism for communication between OSPF and EIGRP.
2. Inefficient scalability: Static routes cannot handle future growth.
3. Lack of dynamic route exchange between internal and external segments.
4. Weak security for routers
5. Network Segmentation and Broadcast Domain Reduction
6. Manually assigning IP addresses is time-consuming and error-prone.

To address these issues, a multi-protocol, BGP-enabled network design is required that ensures reliable, redundant, and dynamic connectivity across routing domains.

**Solution**

The proposed solution involves the construction of an internal and external network using 10 routers and 2 switches. The network integrates:

1. **OSPF**: Configured in a multi-area design (Backbone, Stubby, and Totally Stubby).
2. **EIGRP**: Deployed in a separate routing domain.
3. **BGP**: Used to connect and enable communication between OSPF and EIGRP domains via an ISP router.
4. **ASBR**: Autonomous System Boundary Routers (R4 and R5) for route redistribution.
5. **Basic Security**: All routers secured with passwords, encryption, and message banners.
6. **VLAN**: VLANs divide a physical network into logical segments, improving **security** and **traffic management** and reduce broadcast domains
7. **Inter VLAN**
8. **DHCP** : automatically assigns IP addresses, subnet masks, gateways, and DNS servers to devices

**Network Topology**

The network is divided as follows:

* **OSPF Domain (internal brunch)**:
  + R4: Backbone (Area 0)
  + R1,R2: Stubby Area (Area 1)
  + R0,R3: Totally Stubby Area (Area 2)
  + R4: ASBR connected to the ISP
  + SW0,SW1: Access switch for internal VLAN devices
* **EIGRP Domain (External brunch)**:
  + R6–R9: Peer routers in EIGRP AS 1
  + R5: ASBR connected to the ISP
  + SW2,SW3: Access switch for internal VLAN devices
* **ISP Router (R-ISP)**:
  + Connects R4 and R5 via external BGP (eBGP)
  + Mediates route exchange between AS100 and AS200

**IP Addressing Scheme**

|  |  |  |
| --- | --- | --- |
| Device | interface | ip |
| R1 | G0/0/0 | 20.20.20.2/24 |
| R1 | G0/0/1.10 | 192.168.2.1/25 |
| R1 | G0/0/1.20 | 192.168.2.129/25 |
| R2 | G0/0/0 | 20.20.20.1/24 |
| R2 | G0/0/1 | 10.10.10.2/24 |
| R0 | G0/0/0 | 40.40.40.2/24 |
| R0 | G0/0/1.30 | 192.168.3.1/25 |
| R0 | G0/0/1.40 | 192.168.3.129/25 |
| R3 | G0/0/0 | 40.40.40.1/24 |
| R3 | G0/0/1 | 30.30.30.2/24 |
| R4 | S0/2/0 | 192.168.1.1/24 |
| R4 | G0/0/0 | 30.30.30.1/24 |
| R4 | G0/0/1 | 10.10.10.1/24 |
| R5 | S0/1/0 | 192.168.1.2/24 |
| R5 | G0/0/0 | 50.50.50.1/24 |
| R5 | G0/0/1 | 70.70.70.1/24 |
| R6 | G0/0/0 | 60.60.60.1/24 |
| R6 | G0/0/1 | 50.50.50.2/24 |
| R7 | G0/0/0 | 60.60.60.2/24 |
| R7 | G0/0/1.10 | 192.168.4.1/25 |
| R7 | G0/0/1.20 | 192.168.4.129/25 |
| R8 | G0/0/1 | 70.70.70.2/24 |
| R8 | G0/0/0 | 80.80.80.1/24 |
| R9 | G0/0/0 | 80.80.80.2/24 |
| R9 | G0/0/1.30 | 192.168.5.1/25 |
| R9 | G0/0/1.40 | 192.168.5.129/25 |

**VLANS**

|  |  |  |  |
| --- | --- | --- | --- |
| **Network** | **VLAN** | **IP Range** | **Default router** |
| Ospf(internal) | 10(IT) | 192.168.2.0/25 | R1 |
| Ospf(internal) | 20(Sales) | 192.168.2.128/25 | R1 |
| Ospf(internal) | 30(Management) | 192.168.3.0/25 | R0 |
| Ospf(internal) | 40(HR) | 192.168.3.128/25 | R0 |
| EIGRP(external) | 10(IT) | 192.168.4.0/25 | R7 |
| EIGRP(external) | 20(Sales) | 192.168.4.128/25 | R7 |
| EIGRP(external) | 30(Management) | 192.168.5.0/25 | R9 |
| EIGRP(external) | 40(HR) | 192.168.5.128/25 | R9 |

**Explanatory Tables**

**Routing Configuration Table**

| **Router** | **Protocol** | **Area/AS** | **Role** |
| --- | --- | --- | --- |
| R1 | OSPF | Area 1 | Stub |
| R2 | OSPF | Area 1 | Stub |
| R3 | OSPF | Area 2 | Totally Stubby |
| R0 | OSPF | Area 2 | Totally Stubby |
| R4 | OSPF/BGP | ASBR | Redistribution |
| R5 | EIGRP/BGP | ASBR | Redistribution |
| R6–R9 | EIGRP | AS 1 | Internal Routing |

**BGP Peering Links (eBGP)**

| **Link** | **AS Pair** | **Description** |
| --- | --- | --- |
| R4 ↔ R5 | 100 ↔ 200 | OSPF Domain to EIGRP Domain by BGP |

**Routing Details**

**OSPF Configuration (R1–R4)**

* R1–R4 use router ospf 1 with specific area types.
* R4 redistributes BGP into OSPF

**EIGRP Configuration (R5–R9)**

* R5–R9 use router eigrp 1
* R5 redistributes BGP into eigrp

**BGP Configuration**

* R4 (AS 100)
* R5 (AS 200)

**Expected Outcomes**

1. **Dynamic Routing**: Seamless route exchange between internal domains and ISP.
2. **Protocol Interoperability**: Proper redistribution between OSPF and EIGRP.
3. **Redundancy**: BGP ensures connectivity between domains via the ISP.
4. **Modular Design**: Scalable structure for future growth.

**Test Cases**

**🔹 Test Case 1: OSPF Internal Routing**

* **Objective:** Ensure OSPF routes are propagated correctly within the internal branch.
* **Steps:**
  1. Run show ip route ospf on R1, R2, R3, and R0.
  2. Ping from a device in VLAN 10 (IT) to a device in VLAN 40 (HR)
* **Expected Result:**  
  OSPF routes are visible in the routing table, and ping succeeds.

**🔹 Test Case 2: EIGRP Internal Routing**

* **Objective:** Validate EIGRP route exchange among external routers.
* **Steps:**
  1. Run show ip route eigrp on R6–R9.
  2. Ping from VLAN 10 to VLAN 40
* **Expected Result:**  
  EIGRP routes are established, and inter-router communication succeeds.

**🔹 Test Case 3: BGP Peering and Route Exchange**

* **Objective:** Verify external BGP (eBGP) peering and redistribution between domains.
* **Steps:**
  1. On R4 and R5, run show ip bgp summary to confirm peering.
  2. On R4, verify EIGRP routes are visible after redistribution.
  3. On R5, verify OSPF routes are visible.
* **Expected Result:**  
  BGP session is established and both domains share routes correctly.

**🔹 Test Case 4: Inter-VLAN Communication**

* **Objective:** Ensure devices in different VLANs can communicate using Inter-VLAN routing.
* **Steps:**
  1. From a PC in VLAN 10 (IT), ping a PC in VLAN 20 (Sales).
  2. Repeat for other VLAN combinations (e.g., VLAN 30 ↔ VLAN 40).
* **Expected Result:**  
  Successful pings between different VLANs confirm routing is functional.

**🔹 Test Case 5: DHCP IP Assignment**

* **Objective:** Check if devices receive IPs automatically.
* **Steps:**
  1. Connect a PC to a switch port in VLAN 10.
  2. Set PC to obtain IP automatically.
* **Expected Result:**  
  The PC receives a correct IP address, subnet mask, gateway, and DNS via DHCP.

**🔹 Test Case 6: Security Verification**

* **Objective:** Ensure router security features are active.
* **Steps:**
  1. Try to access router console or telnet without login.
  2. Check for banner messages and encrypted passwords.
* **Expected Result:**  
  Unauthorized access is blocked, banners appear, and passwords are secure.

**Implementation Notes**

* **Simulation Tools**: Cisco Packet Tracer
* **Testing**:
  + Verify BGP neighbor relationships.
  + Test connectivity between OSPF and EIGRP devices.
* **Monitoring**:
  + Use show ip route, show ip protocols, and show ip bgp summary.