Project Title:
Creating a Secure and Scalable VPN Service with AWS

Group Members:

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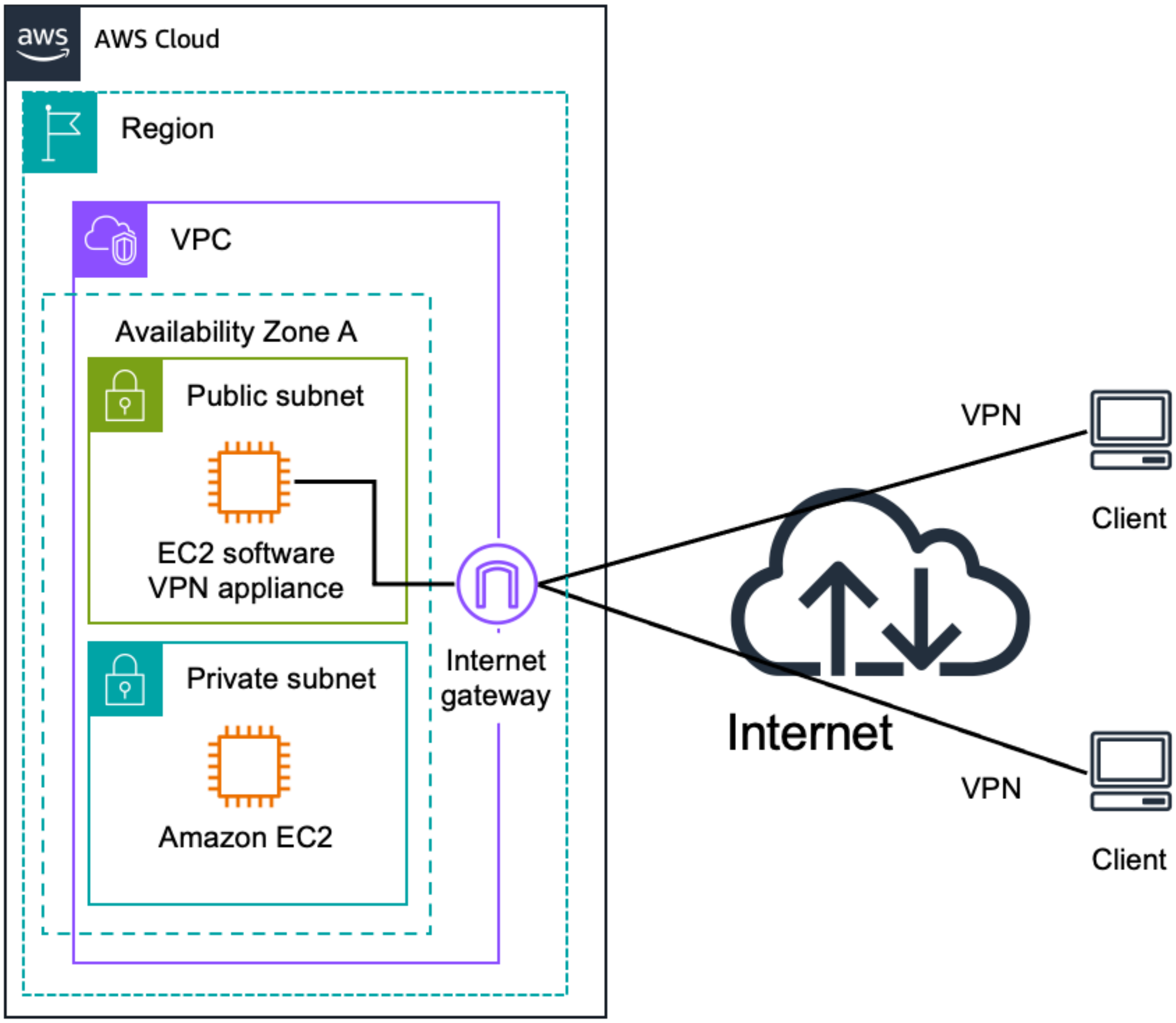

Implementation and Deployment

1. Setting Up the Network Infrastructure

- **Implementation:**
    - Created a **Virtual Private Cloud (VPC)** with a CIDR block of **10.0.0.0/16** to establish a secure, isolated environment.
    - Added **two public subnets (10.0.1.0/24 and 10.0.2.0/24)** in separate availability zones for high availability and fault tolerance.
    - Attached an **Internet Gateway (IGW)** to the VPC to allow outgoing internet traffic.
    - Configured **route tables** to direct all external traffic **(0.0.0.0/0)** through the IGW.

- **Challenge:** Ensuring redundancy and fault tolerance.
    - **Solution:** Used multiple availability zones to reduce the risk of downtime.

2. Deploying EC2 Instances

- **Implementation:**
    - Launched two **Amazon EC2 instances** using t3.medium type to balance performance and cost.
    - Installed **OpenVPN Access Server**, which simplifies VPN setup with a user-friendly web interface.
    - Assigned **Elastic IPs** to ensure consistent and static IP addresses for the VPN servers.

- **Challenge:** Balancing performance and cost.
    - **Solution:** Started with t3.medium instances for cost-effectiveness, with plans to upgrade if traffic demands grow.

3. Configuring Security

- **Implementation:**
    - Defined **Security Groups** to allow inbound traffic only on:
        - Port 1194 (UDP) for VPN connections.
        - Port 443 (TCP) for the OpenVPN web interface.
        - Port 51112 (TCP) for SSH access, restricted to trusted IPs only.
    - Generated encryption keys through OpenVPN's built-in tools to ensure secure client connections.
    - SSH port changed from 22 to 51112.
- **Challenge:** Preventing unauthorized access to the server.
- **Solution:**
    - Restricted SSH access to admin IPs only and periodically reviewed firewall rules.
    - SSH port changed from 22 to 51112.

4. Storing Logs

- **Implementation:**
    - Configured **CloudWatch Logs** to automatically collect and store connection logs from the VPN servers.
    - Enabled a 30-day log retention policy to reduce storage costs.
- **Challenge:** Managing the volume of logs.
    - **Solution:** Applied filters to log only necessary events and set up retention policies to delete old logs.

5. Adding Load Balancing and Scaling

- **Implementation:**
    - Deployed a **Network Load Balancer (NLB)** to distribute VPN traffic across the two EC2 instances.
        - Configured the NLB to handle UDP traffic on port 1194.
        - Set up health checks to ensure the NLB routes traffic only to healthy instances.
    - Configured an **Auto Scaling Group**:
        - **Scale Out:** Add an instance when CPU utilization exceeds 70% for 5 minutes.
        - **Scale In:** Remove an instance when CPU utilization falls below 30% for 5 minutes.
- **Challenge:** Managing scaling costs while ensuring performance.
    - **Solution:** Set conservative scaling limits (minimum of 1 instance, maximum of 3) to balance cost and performance.

Cloud Instance Cost Comparison Table

Provider	Instance Type	vCPUs	Memory (GiB)	Hourly Cost ($)	Monthly Cost	Key Features
AWS	t3.medium	2	4	0.0416	30.37	Great for occasional use; saves money when not always running.
Azure	B2s	2	4	0.05	36.5	Good for everyday tasks; handles extra work when needed.
Google Cloud	e2-medium	2	4	0.037	27.01	Affordable option for light to medium workloads.

6. Testing and Deployment

- **Implementation:**
  - Conducted connectivity tests by connecting to the VPN from laptops and smartphones to verify functionality.
  - Tested internet access and speed through the VPN to ensure reliability.
  - Created a backup by generating an AMI (Amazon Machine Image) of the EC2 instances to simplify recovery.
- **Challenge:** Simulating real-world traffic for testing.
  - **Solution:** Used simple speed tests and client devices to validate functionality.

Key Challenges and Simplified Solutions

Challenge	Solution
Single Point of Failure	Used multiple instances and a Network Load Balancer for redundancy.
Unpredictable Traffic Spikes	Configured Auto Scaling to dynamically add or remove instances as needed.
High Costs	Started with `t3.medium` instances and capped Auto Scaling to 3 instances.
Managing Logs	Used CloudWatch Logs with retention policies to minimize storage costs.
Balancing Security with Usability	Used Security Groups and restricted SSH access while simplifying user setup.