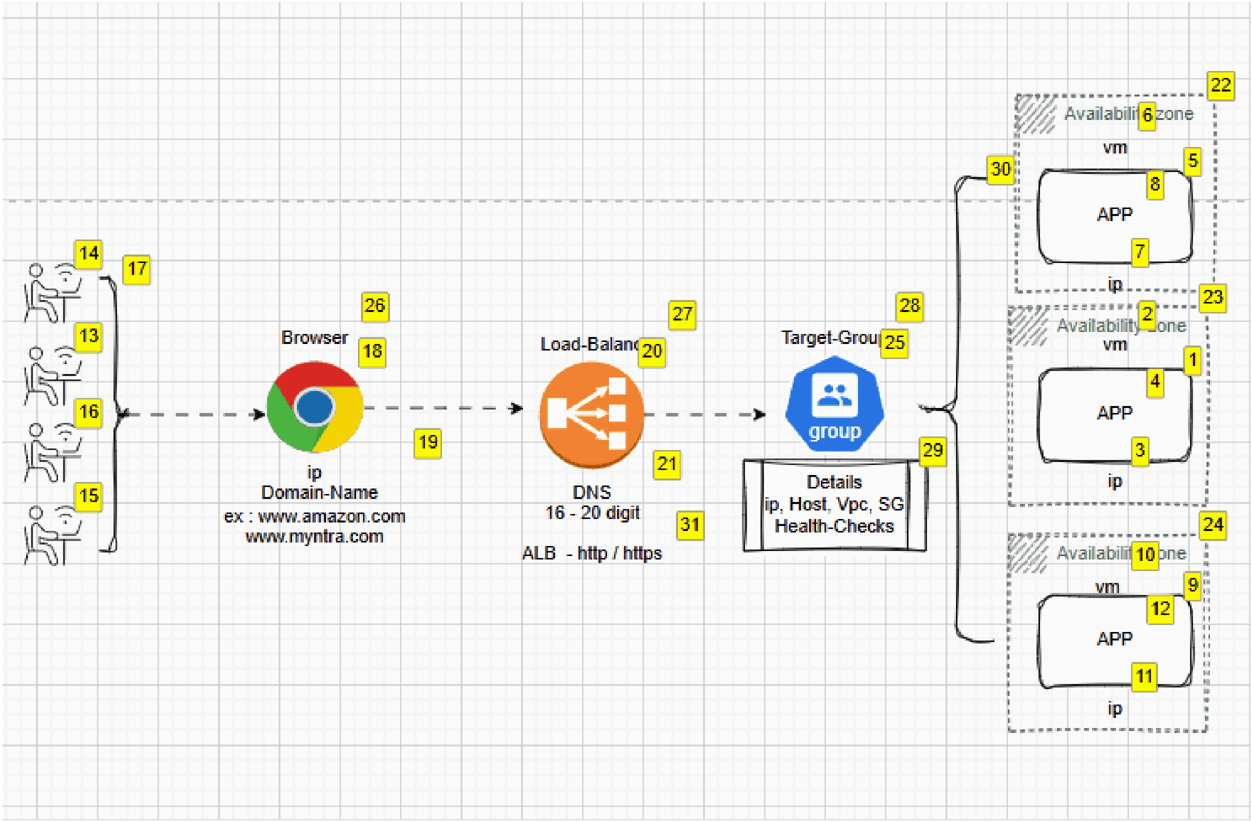

🌐 What is an Application Load Balancer (ALB)?

An **Application Load Balancer (ALB)** is a **Layer 7** (Application Layer) load balancer provided by AWS Elastic Load Balancing. It is designed to handle **HTTP and HTTPS** traffic and offers **advanced request routing**, including:

- **Content-based routing** (path, host, query string, headers)
- **WebSocket and HTTP/2** support
- **Container-based applications** (like with ECS or EKS)
- **Authentication** and **SSL termination**

🧱 Components of an Application Load Balancer

Here are all the **core components** of an ALB:

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1. Listeners

- A **listener** is a process that checks for connection requests.
- Each listener is configured with:
  - ○ **Protocol**: HTTP or HTTPS
  - ○ **Port**: Typically 80 (HTTP) or 443 (HTTPS)
- A listener **forwards requests to rules** for routing to target groups.

🔧 Example:

```
Listener on port 80 -> Forwards to rules
Listener on port 443 -> SSL termination + forwards to rules
```

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2. Listener Rules

- Listener rules determine **how incoming requests are routed**.
- Each rule consists of:
  - ○ **Conditions**: e.g., Host header, Path pattern (`/api/*`), HTTP headers, query string
  - ○ **Actions**: Forward to a target group, redirect, fixed response, or authenticate

🧠 Rule Example:

IF Host is api.example.com AND path is /v1/*
→ Forward to Target Group A

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3. Target Groups

- A **target group** is a logical group of targets (EC2 instances, IPs, Lambda functions, containers).
- You **attach health checks** and routing rules to a target group.
- A single ALB can route traffic to **multiple target groups** based on listener rules.

📦 Target Types:

- instance: Routes to EC2 instances
- ip: Routes to private IPs (good for on-premise or non-AWS targets)
- lambda: Routes to AWS Lambda functions
- alb: Routes to another ALB (chaining)

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4. Targets

- These are the **actual destinations** for incoming traffic.
- Can be:
  - EC2 instances
  - ECS containers

  - IP addresses
  - Lambda functions

Targets must be registered with a **target group**.

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5. Availability Zones (AZs)

- ALBs are **multi-AZ**, providing **high availability and fault tolerance**.
- You can choose one or more AZs when creating the ALB.
- AWS automatically distributes traffic across healthy targets in these zones (especially with **cross-zone load balancing** enabled).

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6. Health Checks

- ALB uses health checks to determine if a target is **healthy and available**.
- If a target fails health checks repeatedly, it is **removed from routing** until it recovers.

🧪 Configurable:

- Protocol (HTTP/HTTPS)
- Path (/health)
- Interval, timeout, and threshold

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7. Security Groups

- ALB uses **security groups** to control inbound/outbound traffic.
- Typical settings:
  - Allow inbound traffic on port 80/443
  - Restrict outbound access to known target IPs or ranges

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8. SSL Termination (HTTPS Listener)

- ALB can terminate SSL (HTTPS) traffic.
- You must:
  - Use an **SSL certificate** (from ACM or uploaded manually)
  - Configure **HTTPS listener**
- Offloads encryption from backend servers (performance benefit)

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9. WAF (Web Application Firewall) Integration

- ALB integrates with **AWS WAF** to protect web apps from:
  - SQL injection
  - Cross-site scripting (XSS)
  - Bot traffic
  - Rate limiting

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10. Access Logs

- ALB can log **detailed request information** to an S3 bucket:
  - Client IP
  - Target and response time
  - Status codes
  - User-agent

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11. Host-based and Path-based Routing

- ALB excels at advanced routing:
  - **Host-based**: api.example.com, shop.example.com
  - **Path-based**: /api/*, /admin/*

This enables **microservice** and **container-based architectures**.

✅ Summary of ALB Capabilities

Feature	ALB Support
Layer 7 routing (HTTP/HTTPS)	✅
Host- and path-based routing	✅
WebSocket & HTTP/2	✅
Container support (ECS, EKS)	✅

SSL termination	✅
AWS Lambda target support	✅
IP address target support	✅
Authentication via Cognito/OIDC	✅
WAF integration	✅

🏗️ Typical Use Case Architecture

Client → ALB (HTTPS Listener) → Listener Rule → Target Group → ECS Container or EC2
