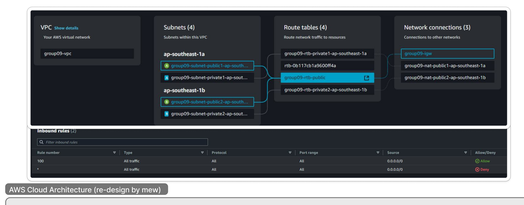

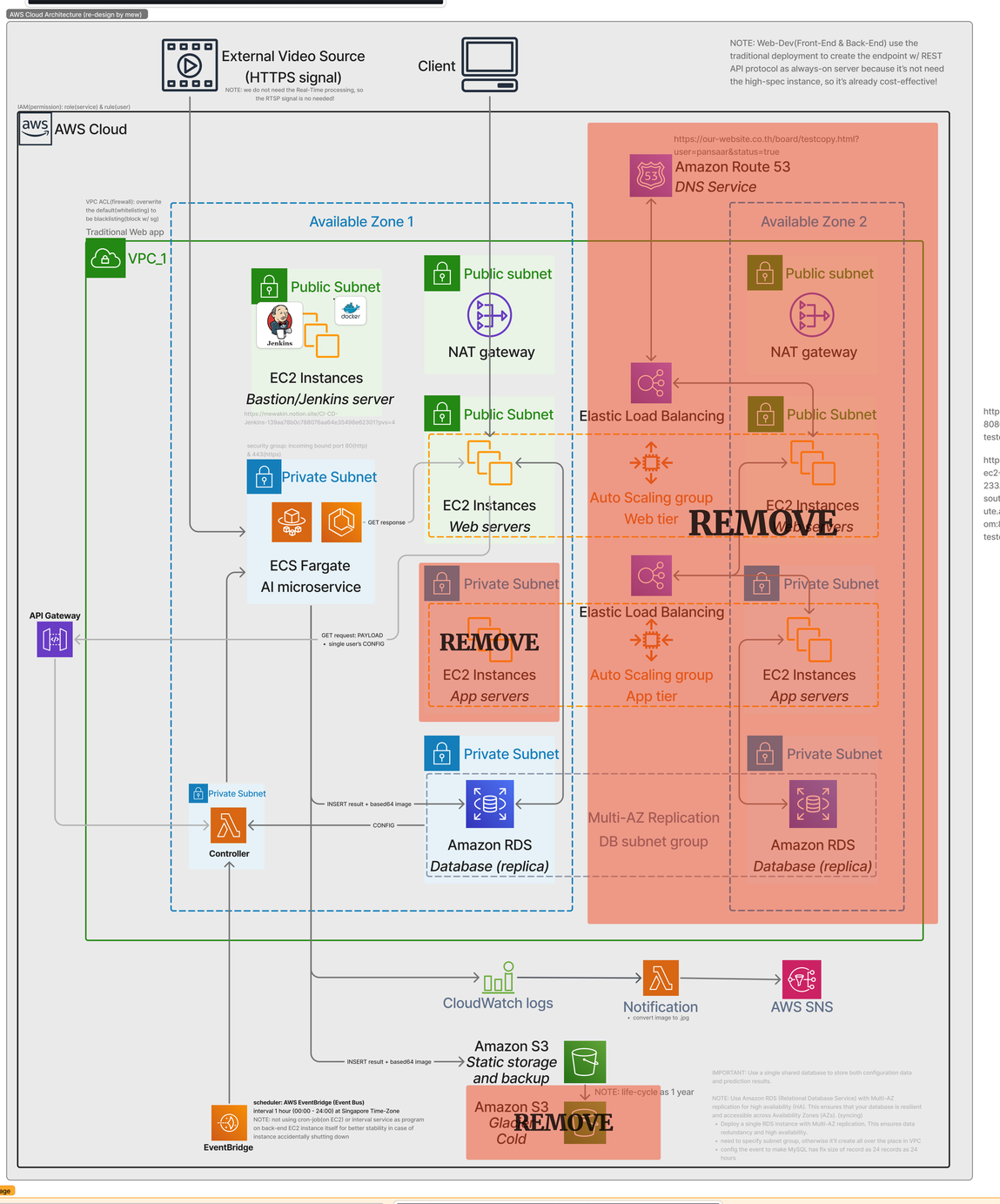

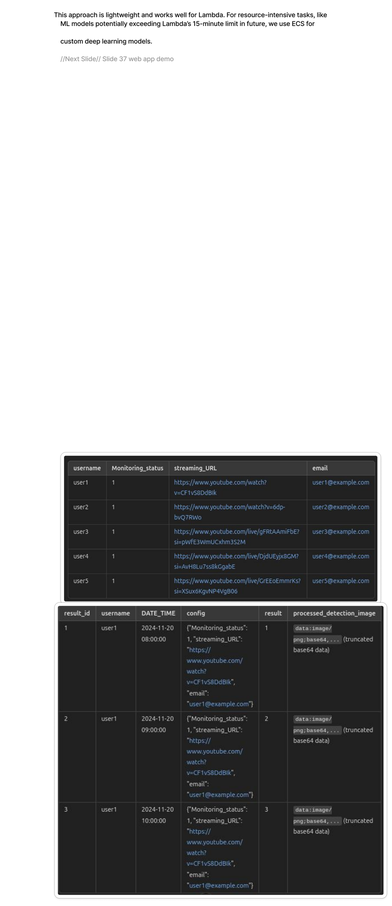

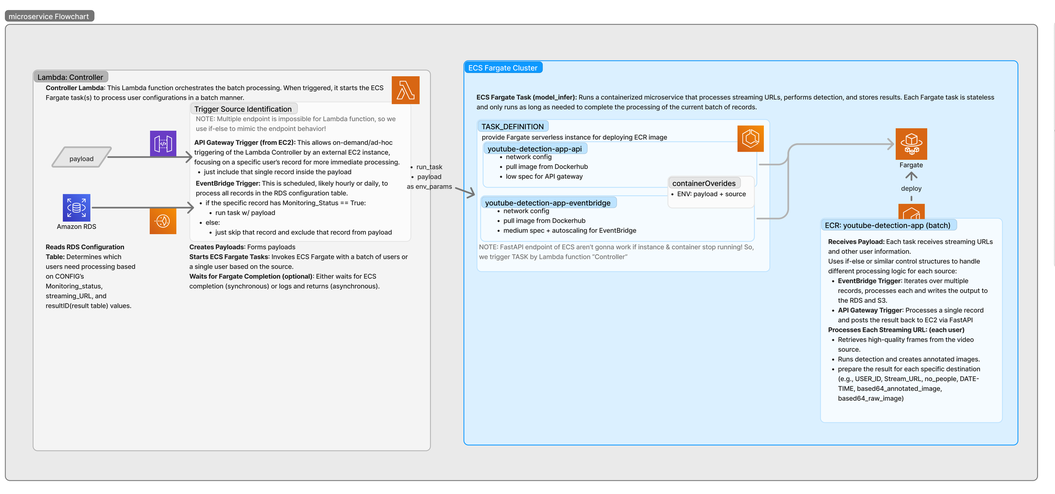

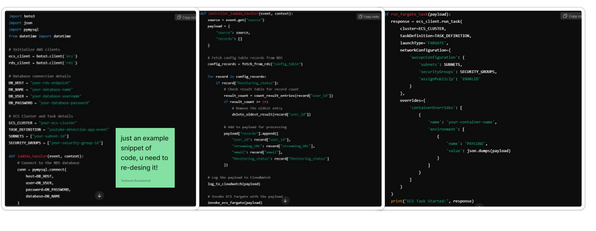

Workflow for Controller Lambda

Purpose: The Controller Lambda orchestrates batch processing by triggering ECS Fargate based on two types of events: scheduled (EventBridge) and on-demand (API Gateway). It prepares the payload based on configurations in the RDS config table and logs details to CloudWatch.

1. Trigger Source Identification

- **EventBridge Trigger**:
  - This is scheduled to run hourly or daily, processing all users in the RDS configuration table who have `Monitoring_status == True`.
- **API Gateway Trigger**:
  - This trigger occurs from an ad-hoc call to Lambda by an external EC2 instance. It handles a specific user configuration for immediate processing.

2. Read RDS Config Table

- Fetch all records from the RDS config table.
- The table includes fields:
  - `user_id`: Unique identifier for the user.
  - `Monitoring_status`: Boolean (True/False) indicating if monitoring is active.
  - `streaming_URL`: URL of the video stream for analysis.
  - `email`: User's email for potential notifications.

3. Process Records Based on Monitoring Status

- **For each record in the RDS config table**:
  - If `Monitoring_status == True`:
    - Check the number of entries in the RDS result table for that specific `user_id`.
    - If `user_id` **has 24 or more entries**:
      - Remove the oldest entry based on the `DATE-TIME` field to bring the count down to 23. This step ensures the table can accept a new entry after ECS Fargate completes processing, maintaining a max of 24 records.
    - If `user_id` **has fewer than 24 entries**:
      - No deletion is required, and the row is directly included in the payload.
    - **Add the record to the payload** to be sent to ECS Fargate.
  - If `Monitoring_status == False`:
    - Skip this record (do not include it in the payload).

4. Log the Payload

- Write the constructed payload to CloudWatch logs for debugging and tracking purposes.
- Include details such as the trigger source (EventBridge or API Gateway) and user-specific configurations.

Workflow for ECS Fargate

Purpose: ECS Fargate is responsible for processing video streams for each user, running detection on each frame, and storing results in the RDS result table and S3 for long-term storage. The Fargate task is stateless and runs only as long as required to process the batch of records.

1. Receive Payload

- ECS Fargate receives the payload from Controller Lambda. The payload includes:
  - `source`: To identify if it was triggered by EventBridge or API Gateway.
  - `records`: List of user configurations to process. Each record has:
    - `user_id`: The identifier for each user.
    - `streaming_URL`: The video URL for streaming analysis.
    - `email`: User's email address for potential notifications.
    - `Monitoring_status`: Boolean to confirm active monitoring (should always be True at this stage).

2. Process Each User's Streaming URL

- **For each record in** `records`:
  - Retrieve high-quality frames from the `streaming_URL`.
  - Calculate frame quality and select the best frame.
  - Run detection to count people in the frame and annotate the image.

3. Prepare and Store Results

- Prepare the result data, including:
  - `DATE-TIME`: Current timestamp for the processed result.
  - `config`: Snapshot of the user's config used in this processing cycle.
  - `result`: The detected count of people or other metrics.
  - `processed_detection_image`: Base64-encoded image or S3 URL if saved separately.
- **Store results based on** `source`:
  - If `source == EventBridge`:
    - Insert the result into the RDS result table for historical tracking.
    - Append a new row to the corresponding user's CSV file in S3.
  - If `source == API Gateway`:
    - Use FastAPI to send the result back to the specific EC2 instance that requested it.

4. Optional: Trigger Notification Lambda

- If a specific threshold (e.g., more than 15 people) is detected, invoke the Notification Lambda.
- Notification Lambda:
  - Converts the image to a JPEG (if necessary) and sends an SNS notification (email) to the user.

Flowchart for Notification Lambda

The **Notification Lambda** function is triggered if the ECS Fargate processing detects an anomaly, such as the foot traffic exceeding a threshold (e.g., more than 15 people). Here's the step-by-step flow for the Notification Lambda:

1. **Receive Input from ECS Fargate**:
   - The ECS Fargate task sends a payload to the Notification Lambda whenever an anomaly is detected. This payload includes:
     - `user_id`
     - `DATE-TIME`
     - `people_count`
     - `processed_detection_image` (in base64 or a URL reference)
     - `email`
2. **Check Anomaly Condition**:
   - If `people_count` **exceeds the threshold (e.g., 15)**:
     - **Convert Image to** `.jpg` **Format** (if necessary).
     - **Prepare Notification Email**:
       - Attach the `.jpg` image.
       - Include relevant details (`DATE-TIME`, `people_count`, etc.).
     - **Send Email** to the user's email address provided in the payload.
     - Log the notification event and details for tracking purposes.
   - **Else**:
     - No action required. Log that no anomaly was detected.

```
Notification triggered for user_id: user_1 due to high foot traffic
```