

# ISM 6129 - Airport Slot Allocation

Hanchen Wang

Udayakumar Venkatesan

Likitha Shatdarsanam

Connor Tyrell

Annalee Watts

## 1 Introduction

This document presents a comprehensive analysis of the current airport slot allocation system at Level 3 Airport. Airport coordination is the management of airport capacity through rules outlined in the Worldwide Airport Slot Guidelines. This involves allocating limited capacity to airlines and operators at airports, serving as an interim solution until airport capacity can be expanded. The primary objective is to enhance the efficiency and fairness of slot distribution among airlines, ensuring optimal utilization of airport infrastructure and adherence to international aviation standards.

## 2 System Requirement Analysis

### 2.1 List of Business Activities

- Airlines submit requests for slots to the coordinator.
- The coordinator reviews these submissions to verify whether they are for new entrants, existing airlines, or historical slot requests.
- The coordinator evaluates the requests based on the airport's coordination parameters to determine feasibility.
- For historical slot requests, an analysis is conducted to confirm whether the airline has met the requirements for historic precedence (the 80/20 rule).
- If changes are requested to historical slots, the coordinator checks whether these changes are acceptable within the coordination parameters.
- The coordinator creates a slot pool, which may include slots returned from airlines or additional slots created through capacity optimization.
- The slot pool is divided evenly, with a portion set aside for new airlines and the rest for existing ones.
- If requests can't be accommodated, they are added to a waitlist.
- Upon successful matching of requests with available slots, the coordinator confirms the slots to the requesting airlines and communicates the results of the slot request process to the airlines.
- If unchanged historical slots are not allocated due to changes not being accepted, these slots are reallocated.
- Slots that fail to be allocated are managed accordingly, which may involve returning them to the slot pool for reallocation.
- Ongoing monitoring of how airlines utilize their allocated slots is conducted to ensure compliance with the "use it or lose it" principle.

- Throughout the slot allocation cycle, the coordinator may need to adjust, and updates based on operational needs, capacity changes, or regulatory requirements.
- The airport managing body regularly reports on the capacity of the airport, including runway availability, terminal capacity, air traffic control resources, and other operational constraints. Additionally, the managing body generates misuse reports to identify instances of slot misuse or non-compliance with slot allocation regulations.

### 3 Functional models

#### 3.1 Use case diagram

Refer to the appended use case diagram, which illustrates the interaction between the airlines and the slot coordinator. This diagram serves as a visual guide to the operational flow of requests and responses within the slot allocation system.

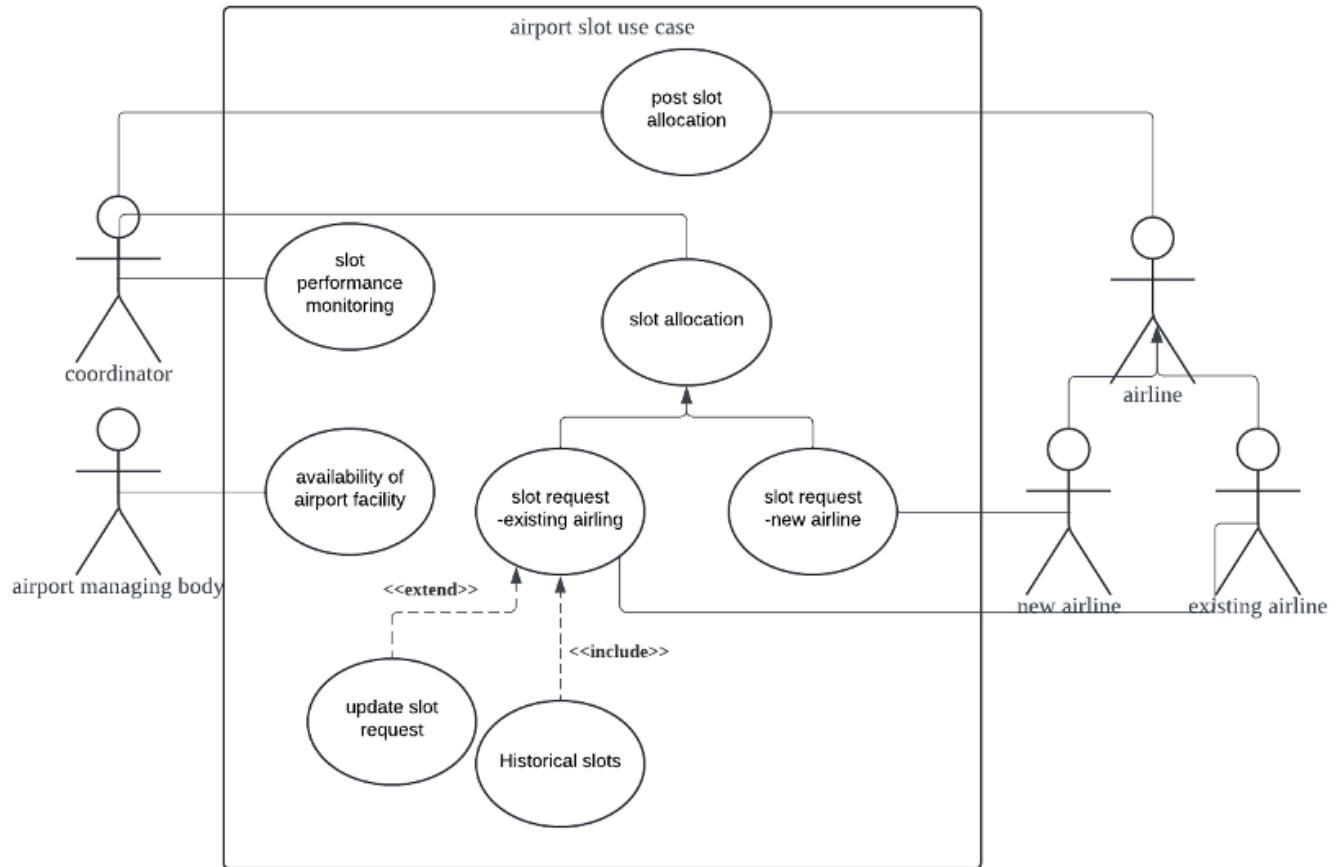


Figure 1: Use case diagram

## 3.2 Activity Diagram

The activity diagram offers a detailed view of the process flow from slot request submission to final allocation. It highlights critical decision points such as the evaluation of request feasibility and the reallocation of slots from the waitlist, providing stakeholders with insights into the procedural steps and decision-making criteria.

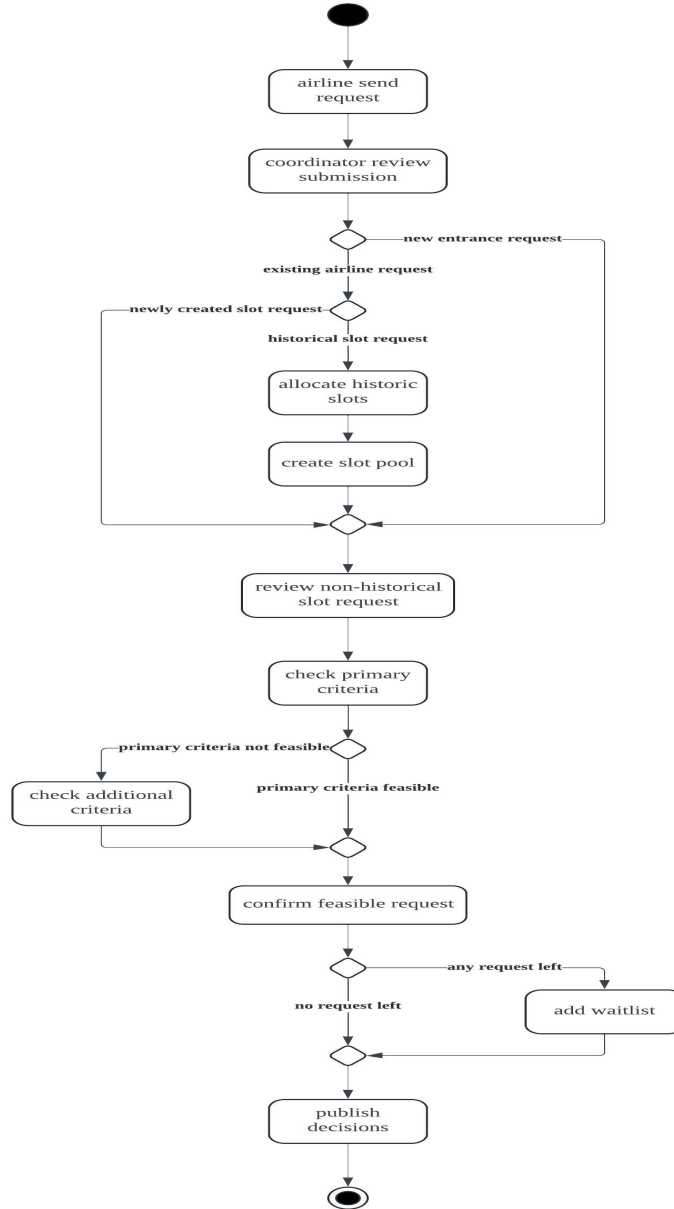


Figure 2: Activity diagram for airport slot allocation

## 4 Use Case Description

Attribute	Details
Use Case Name:	Allocate Airport Slots
Use Case ID:	UC001
Importance Level:	High
Use Case Type:	Detail, Essential
Primary Actor:	Slot Coordinator
Stakeholders and Interests:	<ul style="list-style-type: none"> <li>• Airlines: Want to obtain slots that allow them to operate flights according to their schedules.</li> <li>• Airport Authority: Aims to ensure an efficient and equitable slot allocation process.</li> <li>• Slot Coordinator: Responsible for overseeing the fair distribution of slots, adhering to regulatory requirements, and maintaining operational efficiency at the airport.</li> </ul>
Brief Description:	This use case outlines the process of allocating landing and take-off slots to airlines after they have submitted their requests. It involves the Slot Coordinator reviewing historical and new entrance requests, assessing them against predefined criteria, and making decisions to ensure optimal airport operation and fair access to slots.
Trigger:	The end of the slot request submission period.
Type:	External
Normal Flow of Events:	<ol style="list-style-type: none"> <li>1. The Slot Coordinator receives slot requests from airlines.</li> <li>2. The Slot Coordinator reviews the requests: <ol style="list-style-type: none"> <li>a) If the request is from an existing airline, proceed to subflow S1.</li> <li>b) If the request is from a new entrant, continue to step 3.</li> </ol> </li> <li>3. The Slot Coordinator reviews all non-historical slot requests.</li> <li>4. The Slot Coordinator evaluates each non-historical request against primary criteria: <ol style="list-style-type: none"> <li>a) If the primary criteria are met, the slot is allocated, and the process continues to step 5.</li> <li>b) If the primary criteria are not met, the Slot Coordinator performs subflow S2.</li> </ol> </li> <li>5. After slot allocations based on primary and additional criteria, the Slot Coordinator assesses any remaining unfulfilled requests: <ol style="list-style-type: none"> <li>a) If no requests are left, the Slot Coordinator publishes the allocation decisions.</li> <li>b) If unfulfilled requests remain, the Slot Coordinator initiates alternate flow A1.</li> </ol> </li> </ol>

Sub Flows:	<p><b>S1: Allocation of Historical Slots</b></p> <ol style="list-style-type: none"> <li>1. Review and validate historical usage for existing airlines.</li> <li>2. Allocate historical slots based on established guidelines.</li> <li>3. Create a slot pool from remaining unallocated slots for further allocation.</li> </ol> <p><b>S2: Evaluation of Additional Criteria</b></p> <ol style="list-style-type: none"> <li>1. Assess non-historical requests using additional criteria such as market demand, operational factors, and other strategic considerations.</li> <li>2. Confirm the allocation of slots based on the assessment outcome.</li> </ol>
Alternate Flows:	<p><b>A1: Waitlist Unfulfilled Slot Requests</b></p> <ol style="list-style-type: none"> <li>1. Place any remaining unfulfilled slot requests on the waitlist.</li> <li>2. Determine the priority of each waitlisted request based on predefined factors.</li> <li>3. Inform airlines of their waitlist status.</li> </ol>

## 5 Structural models

### 5.1 Class Diagram

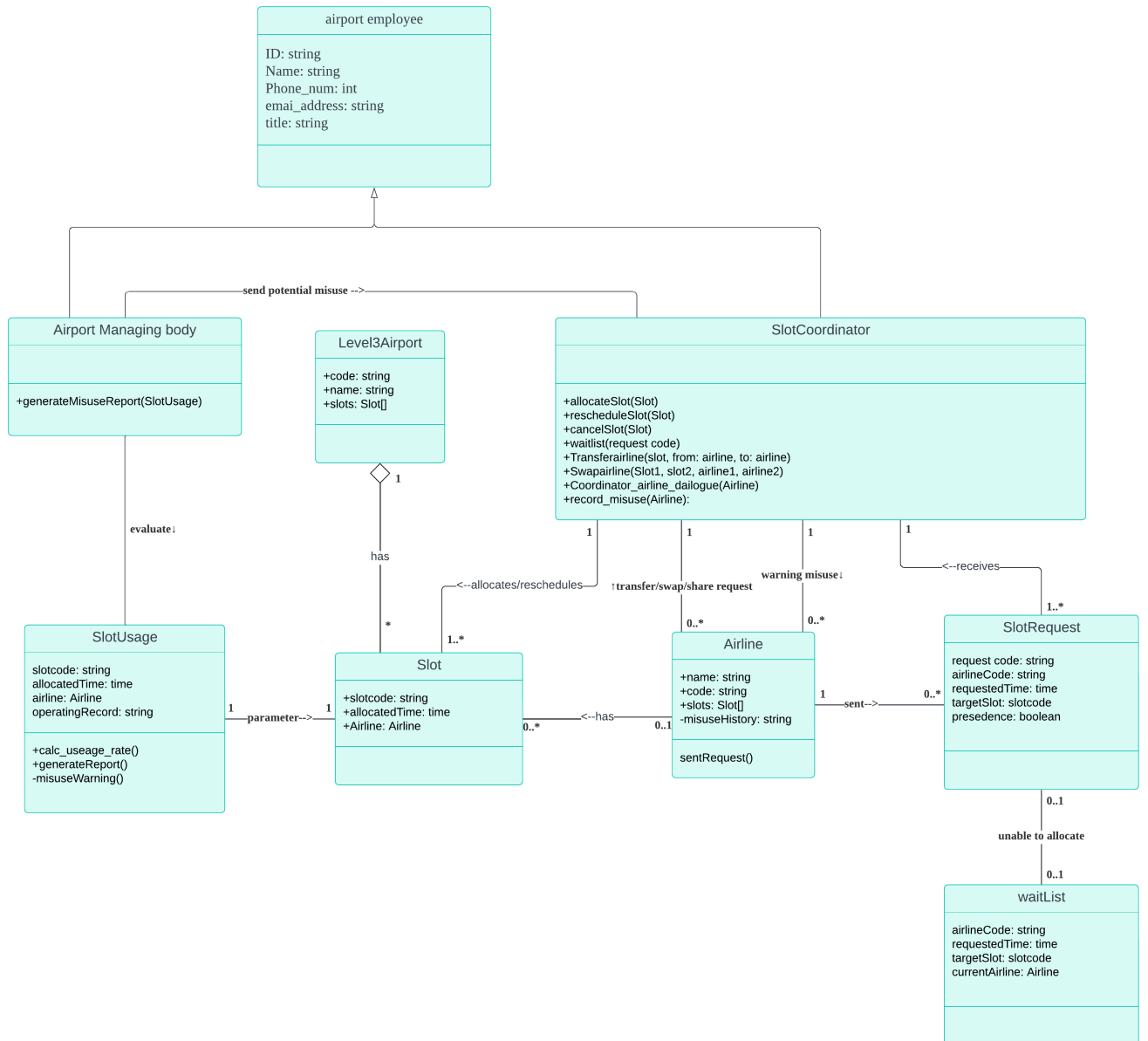


Figure 3: Class diagram

## 5.2 CRC Card

Front:

Class Name: SlotCoordinator

ID: 1

Type: Concrete, Domain

Description: Manages the processing of slot requests from airlines, including validating, prioritizing, and allocating slots, as well as handling reschedules, cancellations, and waitlisting.

Associated Use Cases: 3

Responsibilities

Validate and process incoming slot requests.

Apply prioritization rules to slot requests.

Allocate slots based on availability and priority

Communicate allocation decisions to airlines.

Handle rescheduling and cancellation of slots.

Manage the waitlist for slot requests.

Record and report any slot allocation misuse.

Transfer and swap airlines

Collaborators

SlotRequest

Slot

Airline

waitList

AirportManagingBody

Back:

Attributes:

ID (string)

name (string)

phone\_num (int)

email\_address (string)

Relationships:

Generalization (a-kind-of): Employee

Aggregation (has-parts):

Other Associations:

Airline

Slot, waitList

Figure 4: Class-responsibility-collaboration diagram

## 6 Behavioral models

### 6.1 Sequence diagram

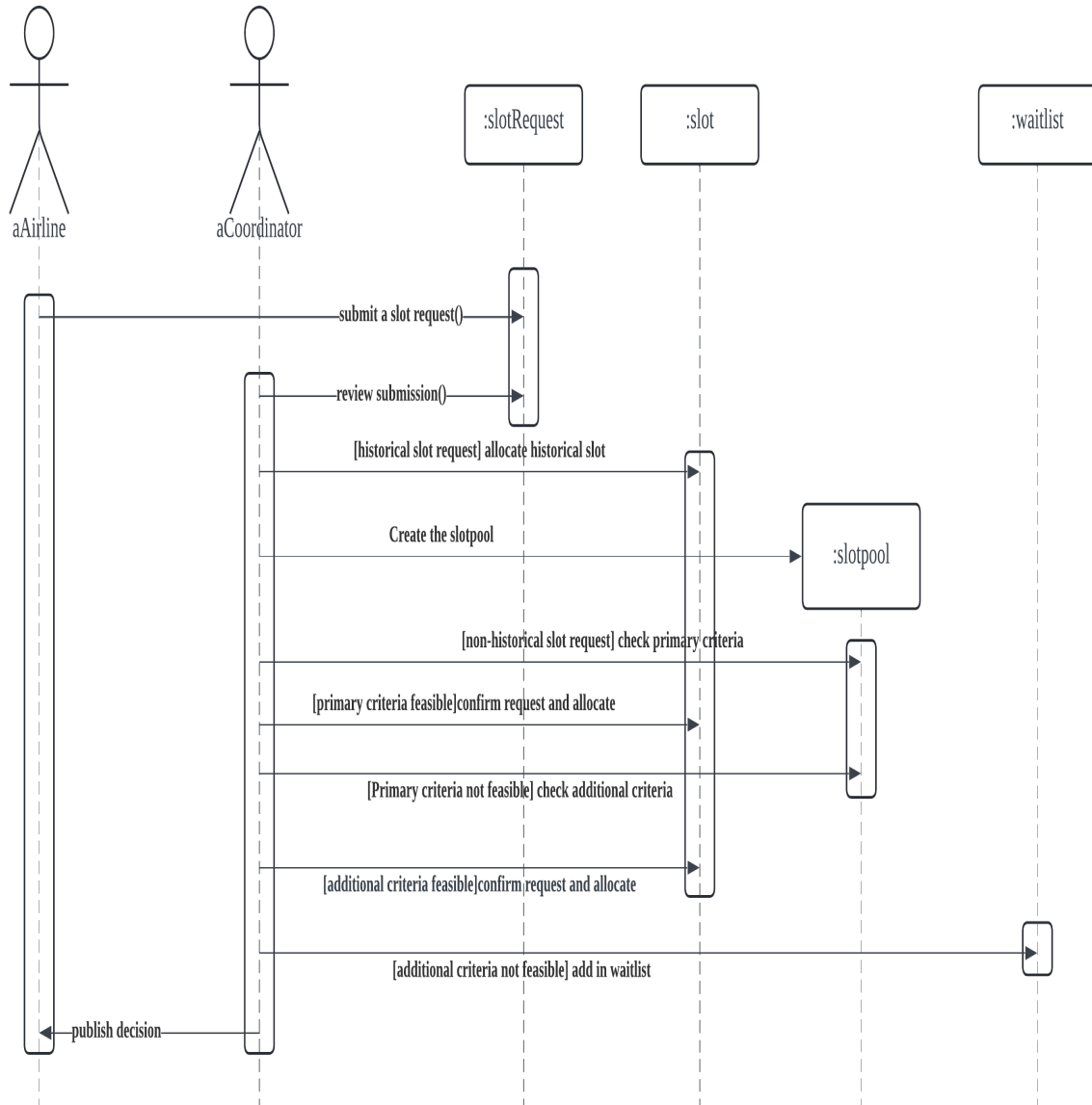


Figure 5: Slot allocation sequence diagram



## 6.2 Behavioral state machine

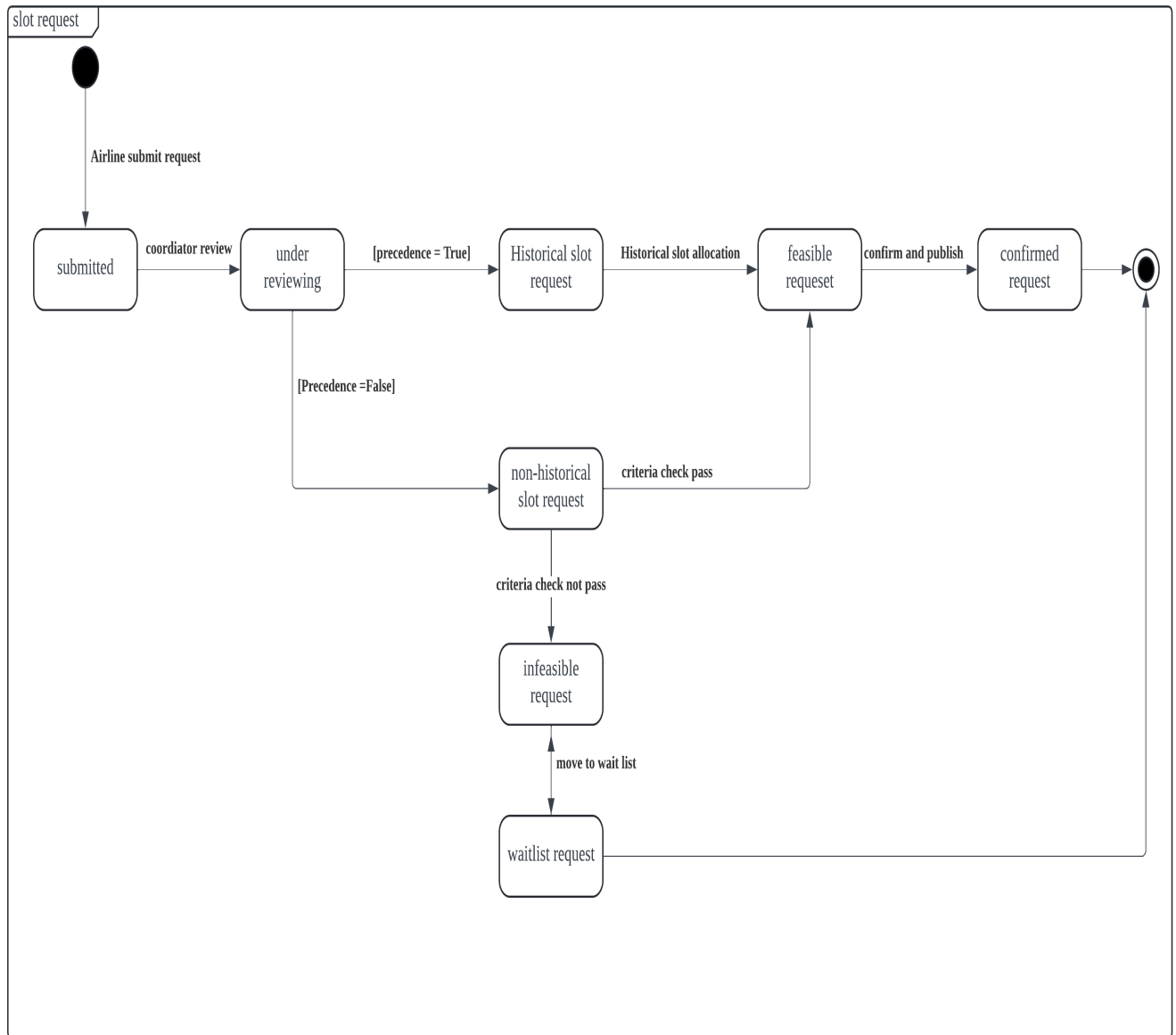


Figure 6: Slot request object behavioral state machine diagram