Exercise 04: E-Scooter Mobility Platform - AOM Solution

TU Clausthal | Institut für Software and Systems Engineering
Module: Requirements Engineering | **Task:** Agent-Oriented Modeling
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Part A: Agent Identification

The mobility platform consists of four distinct agents collaborating to deliver the ride-share service:

Agent Type	Assigned Role	Functional Scope
User (Human)	Service Consumer	Initiates all service requests; provides input for registration, selects vehicles, controls ride duration
Scooter Device (IoT)	Transport Asset	Executes physical operations: motor control, GPS broadcasting, battery monitoring, anti-theft lock
Platform Backend (Cloud)	Service Orchestrator	Coordinates all digital workflows: authentication, matching, pricing engine, transaction ledger
Payment Gateway (External)	Financial Mediator	Interfaces with banking networks; handles tokenization, fraud detection, settlement processing

Why Four Agents? Unlike simpler 3-agent models, separating the Payment Gateway as a distinct agent reflects real-world architecture where payment processing is delegated to specialized third-party services (e.g., Stripe, PayPal) rather than being embedded in the backend.

Part B: Goal Specification

B.1 Functional Goals

Code	Goal Name	Specification
FN-1	User Enrollment	Capture user profile data, validate driving eligibility, link verified payment instrument
FN-2	Asset Discovery	Display real-time map of available scooters within configurable radius (default: 500m)
FN-3	Session Initiation	Authenticate user proximity via Bluetooth/QR, release vehicle lock, start usage timer
FN-4	Session Termination	Accept end-ride signal, engage security lock, capture final GPS coordinates
FN-5	Fare Processing	Compute charges using distance algorithm, authorize payment, generate digital receipt

B.2 Quality Goals

Code	Goal Name	Specification
QL-1	Location Accuracy	GPS position updates every 5 seconds with ≤10m deviation tolerance
QL-2	Pricing Fairness	Distance-based model ensures users pay proportionally to actual resource consumption
QL-3	Transaction Security	All payment data encrypted (AES-256); PCI-DSS Level 1 compliance maintained

Part C: Pricing Algorithm

The platform implements a **zone-based distance pricing** model:

```
Fare = ActivationFee + Σ(ZoneDistance × ZoneRate)
```

Zone Type	Rate (€/km)	Description
Urban Core	€0.30	High-traffic city center areas
Suburban	€0.22	Residential and commercial districts
Peripheral	€0.18	Outskirts and industrial zones

Activation Fee: €0.50 (one-time per session)

Example: 2 km (Urban) + 1.5 km (Suburban) = €0.50 + (2×€0.30) + (1.5×€0.22) = **€1.43**

Part D: Behavioral Interface Model

The BIM defines state transitions across the complete user journey:

D.1 State Sequence

1. **Idle** → User opens application
2. **Browsing** → User views available scooters on map
3. **Claimed** → User reserves specific scooter (7-minute hold)
4. **Active** → User unlocks and rides scooter
5. **Concluding** → User signals ride end, lock engages
6. **Settling** → Fare calculated, payment processed
7. **Complete** → Receipt issued, session closed

D.2 Exception States

State	Condition	Resolution
ClaimExpired	7 minutes without unlock	Auto-release scooter, notify user
PaymentHold	Card authorization fails	Prompt alternate payment method (72h grace)
DeviceOffline	Scooter loses network connectivity	Cache ride data locally, sync when online

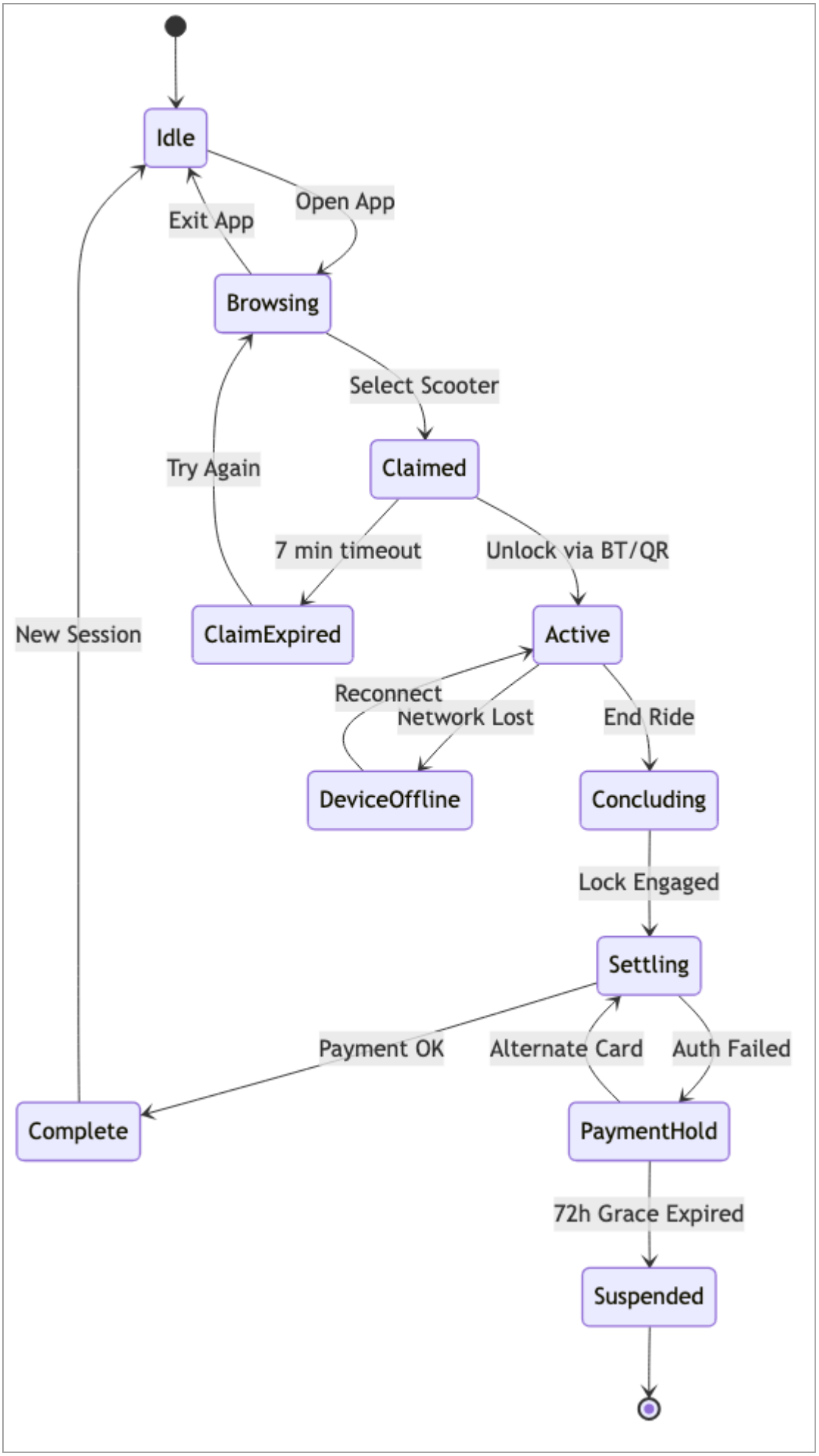

Figure 1: Behavioral Interface Model - Complete State Machine

Part E: Goal Hierarchy Model

The AOM goal model follows a three-level decomposition:

- **Root Goal:** Deliver Urban Micro-Mobility Service
- **Branch Goals (Level 2):**
  - BG-1: Onboard Users → FN-1, QL-3
  - BG-2: Facilitate Rides → FN-2, FN-3, FN-4, QL-1
  - BG-3: Process Transactions → FN-5, QL-2
- **Leaf Goals (Level 3):** 5 Functional + 3 Quality Goals

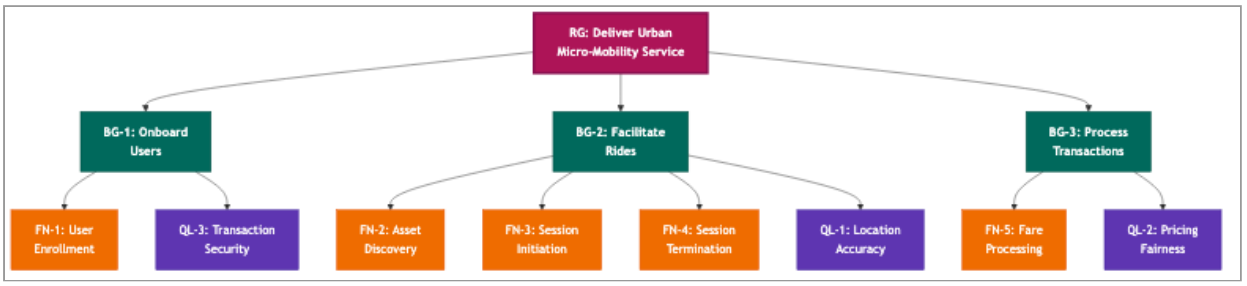

Figure 2: AOM Goal Hierarchy - Three-Level Structure