Scooter Ride-Hailing System

The system provides micro-mobility services consisting of different components: Scooter(S), Scooter Backend (SB), Scooter Mobile Application (SMA) and the Rider(R).

The description below provides a general overview of a scooter ride-hailing system, and thus, is not an exhaustive explanation of the system component interaction. You are allowed to assume the existence of lower-level components not explicitly mentioned in the case but are vital to any working software system.

Scooter(S)

The scooter component of the system is used to fulfil commutes. The scooter chassis (external hardware) houses its wheels, lights, batteries, cables, and connectors. Inside of its chassis, the scooter contains various perception (i.e sensing, positioning, actuating), network, and application (i.e storage) assets. Below are the important assets classified by their information processing functions.

<table>
<thead>
<tr>
<th>Information processing function</th>
<th>Description</th>
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<tbody>
<tr>
<td>Capturing information</td>
<td>• Global positioning system (GPS) module to get geolocation and time information from global navigation satellite systems (GNSS).</td>
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<td>• Scooter control interface is a hardware interface allowing direct connection to the scooter controller.</td>
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### Transmitting information
- Bluetooth driver to communicate with external systems.
- 3G/4G network card to communicate with external systems including the scooter backend (SB).

### Storing information
- Flash memory on the Electric Scooter Controller (ESC) which holds the device firmware.

### Retrieving information
- Scooter control interface.

### Manipulating information
- Electric Scooter Controller (ESC) controls the scooter following inputs (i.e control signals/commands) specified in the controller firmware or by the scooter backend (SB). The scooter controller also communicates with the SB in real-time, updating situational information about the scooter including telemetry and positional data of the device, and statistical data on the Rider (R) trip (speed, distance travelled, scooter location etc).

### Displaying information
- Scooter display hardware showing speed, distance covered, battery level etc

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**Scooter Backend (SB)**

Scooter backend is comprised of systems that help to monitor the status and location of a fleet of scooters, send commands to the scooter to lock/unlock, manage the user accounts and scooter ride activities. The SB can only be accessed through an administrative web interface and carries out the following functions:
- Manages authentication and authorisation of a rider (R) before accessing its services.
- Stores and monitors situational (i.e scooter availability) information of a fleet of scooters.
- Sends commands to the scooter (e.g. lock/unlock).
- Maintains ride history, support records and records of ride violations.
- Respond in case of emergencies, support or violation of acceptable use of the scooters (e.g. tandem riding violations, skid braking violations).
- Sends OTA firmware update commands to the scooter (S).

**Scooter Mobile Application (SMA)**

The scooter mobile application comes in both android and iOS implementations comprising of the rider profile, ride-hailing and billing components. The SMA carries out the following functions:
- Check scooter (S) availability for use.
- Direct purchase of ride membership and immediate access to S.
- Unlock available scooters.
- Allow for scooter reservation, scooter lock/unlock, record ride start/pause/stop.
- Initiates payment to the SB and displays billing outcomes.
- Store and access the rider profile.
- Allow the sending of situational reports (ride start/pause/stop), emergencies or support requests to Scooter backend (SB)
- Maintains ride history, support records and records of ride violations.

Rider (R)
A rider is a user registered on the system and possesses a valid and active account on the system. A rider should have access to the scooter (S) services provided by the system and cannot use more than one S at a time.

Ride-hailing Service
The scooter ride-hailing service process is a major functional process of the scooter ride-hailing system, consisting of several processes;

- **Find the scooter.** Here, the rider, R can search for the nearest available scooter S through the scooter mobile application SMA. Or check if a located scooter is available for rides using the SMA.
- **Unlock the scooter with the app.** Using the SMA, R unlocks an available bike. This unlock action is recorded by the SMA and SB.
- **Ride scooter.** The R commutes with the S from the pickup location to R’s intended destination.
- **Scooter parking and billing.** Once the ride is completed, the R safely parks the S in an allowed zone. Once the scooter is parked properly, the R ends the ride in the SMA and then the SB issues the invoice and automatically processes the payment. Scooter billing information is recorded by the SMA and SB.