Car Sharing on Demand

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Car Sharing on Demand:

A car sharing platform for users and providers

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# Declaration

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# Acknowledgements

I would like to thank…

# Abstract

Written here is no more than 250 words of summary of the problem, hypothesis and main conclusions. The abstract will entice people to read the rest of the document.

# Acronyms

|  |  |  |
| --- | --- | --- |
| Acronym | Definition | Page |
| JWT  V2X  V2P  JVM | JSON Web Token  Vehicle 2 Everything  Vehicle 2 Person  Java Virtual Machine | 1  1  3  3 |
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# Introduction

Car sharing today presents today, according to (Turoń, 2023) “one of many solutions to help solve mobility in dense urban areas”, sine it aims to provide an easy and affordable solution for short-term trips and allow an individual to easily access a car sharing service over a smartphone in real time. The author of the article also highlights that in 2023 car sharing solutions existed in “over 59 countries offered by hundreds of different providers”, which could highlight the scalability of such solutions in today’s world and evidence how much this numbers could grow soon (JetBrains, 2024) given the trend.

In 2024 in Germany car sharing services “covered more than 1200 cities with over 300 providers”, according to (Wandering, 2024), which highlights the extension of the car sharing services on of the largest EU countries. He also highlighted that car sharing services can be “a valid option for people who don’t own a car or drive sporadically” and that base free “free floating” providers are a great alternative to “more typical car rentals when it comes to short trips” (Wandering, 2024).

Giving that, the purpose of this project is to introduce a generic car-sharing platform, that allows to provide a general, safe and easy to use solution into the car sharing model landscape.

## Purpose

The purpose of this project is to provide a generic unified solution for car sharing with a centralized backend that aims to establish secure sessions between user and car relying on a non-standard user session authentication method instead providing a secure token (JWT) for each session. This solution fits within a V2X design where the vehicle will be able to communicate with both the server to self-register and provide a status update at a constant rate at the same time as it can communicate with the user once a session as been established to execute diverse set of operations part of the car sharing flow (such as car lock and unlock for example).

## Background

The world today is ever more interconnected, especially in urban canters, which provides the need for more ways of transportation and shared mobility are not excluded, for example shared scooters and bikes and cars are among the most convenient forms of transportation, according to (Turoń, 2023), however in the same article the author explains that in the adopted markets the implementation of car sharing services “one can observe the number of closures, takeovers of companies, or implementation of services on only a pilot basis” (Turoń, 2023, p.1185), which indicates that either the available services are monopolized or inexistent on a commercial way, and according to the author, the arguments behind it are: “the system had an ill-matched business model, funds were not properly managed, the project turned out to be economically un-proﬁtable, information found about the ﬂeet of vehicles was improperly matched to the needs of users, customer expectations were not met, or that the scope of operation of the services was incorrectly deﬁned” (Turoń, 2023, p.1186).

Therefore, the purpose of this solution is the implementation of a cross-platform solution that aims to implement a scalable and generic car sharing platform, which allows for adjustment based on the user needs and that provides a seamless and secure of connecting the user to the car, the solution aims to address both the needs of the user and provider by allowing more flexibility in the offer. This project is going to be implemented in Kotlin, with a design based on a V2X which favours the usage of JWT for password less authentication between user and car.

### V2X

The constant evolution of information networks, such as 5G, pushes for to design vehicle wireless technologies capable of communicating with everything from the cloud, people or even other vehicles, and, according to (Hasan *et al*., 2020), V2X as a technology aims to “improve trafﬁc and resource efﬁciency, incidents and road pollution”. However, this technology is not free from challenges and the author mentions that the biggest concerns are regarding “security and privacy”. In this project the idea is to use V2X to connect vehicles to users both through an off-board entity (cloud server) and directly V2P using JWT as a technology for a safe and password less authentication between user and car.

### JWT

According to (Jones, *et al.*, 2015), the standard defines a JSON Web Token as a “URL-safe means of representing claims to be transferred between two parties”, a JWT is composed by an header containing the signing algorithm and type, a payload which represents the data object (in JSON format) being transmitted between entities, and the signature that validates the token itself generated via HMAC-SHA256 algorithm using a private key. According to (Rana, *et al.*, 2023) which also states that “JWT with the HMAC-SHA256 algorithm provides a high level of security in data exchange”, which in this project is used to mitigate the security challenges from the V2X nature of the project. The JWT can also be used for authorization and authentication which will allow for a user to initialize a safe and unique session desired vehicle.

### Kotlin Multiplatform

Kotlin multiplatform is a Kotlin capability that aims for “reducing time spent writing and maintaining the same code for different platforms”, according to (JetBrains, 2024), this allows for the same code to be shared for both web, mobile and desktop while attempting to preserve most of the benefits of native code. Kotlin provides multiple frameworks that will assist this project such as Compose, which is a cross-platform framework that allows developers to easily develop cross platform applications with shared code for both the models (in Kotlin) and UI (declarative). Kotlin also provides KTOR which is a framework for the web, which allows to both write client and server code, KTOR allows to compile for the JVM and natively which provides a great tear of flexibility for the solution being developed.

## Aims & Objectives

The main goal of this project is to develop a car sharing system that focus on simplicity, safety and scalability as well as generalization which aims to provider users and providers flexibility in offer. The main aims for this project are:

* To create a user application that can request a car service to a service provider by:
  + By using Kotlin Multiplatform to create a cross-platform application.
  + By allowing the user to select available cars on demand.
  + By requesting a safe JWT token to a server to create a session with a car and request commands.
* To create a server
  + By using Kotlin KTOR to implement the server-side code and JWT authentication flow.
  + By requesting the car for updated status.
* To create a test car application
  + By using Kotlin native and KTOR for the https client code.
  + By self-registering to a server as a provider.
  + By establishing a connection with a user once a valid request with a valid token is done.
  + By providing the server with up-to-date status.

## Report Outline

Provide a summary of what each of the following chapters will entail

# Design

In order to produce the desired solution introduced in the previous chapter, first a design must be created in order to understand how the project can be implemented, the design section is composed gathering of requirements (both functional and non-functional), the creation of high-level design (flow diagrams), low level design (class diagrams and sequence diagrams) and the necessary agile project management for the implementation phase by creating an agile board with agile artifacts (such as epics and user stories).

## Requirements

When analysing the aims and goals of project is possible to obtain a high-level view of how the system should be but it lacks details necessary for its implementation, therefore this next topic is focused on gathering and categorizing the functional and non-functional requirements which will be the fundamental guidelines for the overall design and implementation.

### Functional Requirements

### Non-Functional Requirements

## High Level Design

## Low Level Design

## Agile Methodology

# Appendices

# Appendix A: References

Monowar, H., Sibin, M., Takayuki, S. & Hongsheng, L., 2020. Securing Vehicle-to-Everything (V2X) Communication Platforms. *IEEE Transactions on Intelligent Vehicles,* 5(4), p. 22.

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[Accessed 2025].

# Appendix B: Code Listing