Design and Implementation of a Bikesharing Service as part of an open Mobility-Ecosystem

Master Thesis - Final Presentation

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Agenda

1	Introduction
2	Related Work
3	Sharelock – Architecture and Structure
4	Live Demo
5	Evaluation
6	Conclusion
7	Outlook

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DriveNow

DB Flinkster Mein Carsharing

CAR2GO

VISION

Integrating all in one mobility ecosystem

mytaxi

MEINFERNBUS FLIXBUS

What is Sharelock?

Sharelock

iteratec

iteratec Bikesharing Service:

- Electronical bike lock
- Bikesharing System

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Sharelock

Components to implement:

- Administration Frontend
- Android Application for User (communication with server and lock)
- Backend with Interface for open Mobility-Ecosystem

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Comparison Sharing Provider

	Station-based or flexible zone	Locks	Business Model (price 30 min)	Clients	Online/ offline
Open Source Bike Share	Station-based	4 digit PIN locks	Customizable	Private users	Offline
Call A Bike	Both possible	Call a number and receive an unlock code	Pay per time (1 Euro)	Private and train users	Online
Chemnitzer Stadtfahrrad	Station-based	Opening on presentation of identity card	Pay per day (2 Euro)	Tourists and locals	Offline
CERN	Station-based	Opening with membership card on bike station	Free or 1 CHF per day between 01/06 and 30/09	Employees	Online
Google	Flexible zone	No locks	Free	Everyone	Offline
Sharelock	Flexible zone	Opening via app	Pay per time (not stated)	Iteratec employees	Offline

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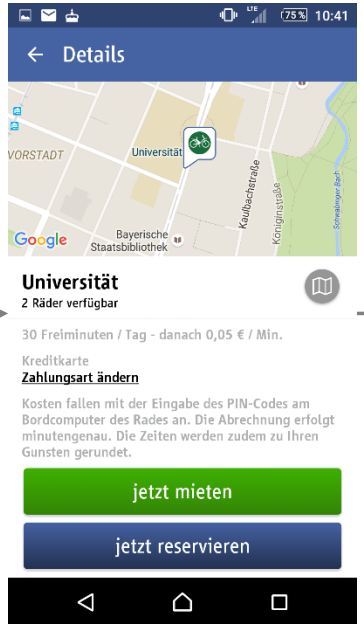
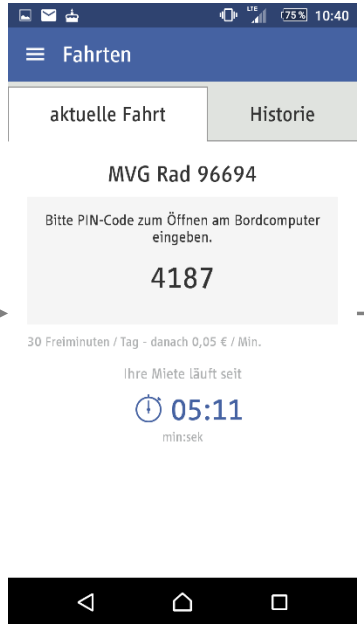
Workflow MVG

Map Overview

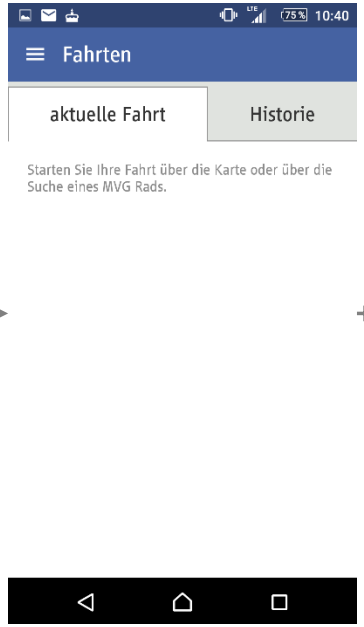
Station/Bike View



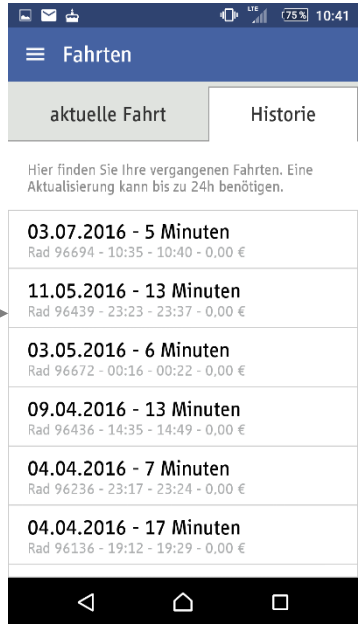
PIN code for lock and actual usage time



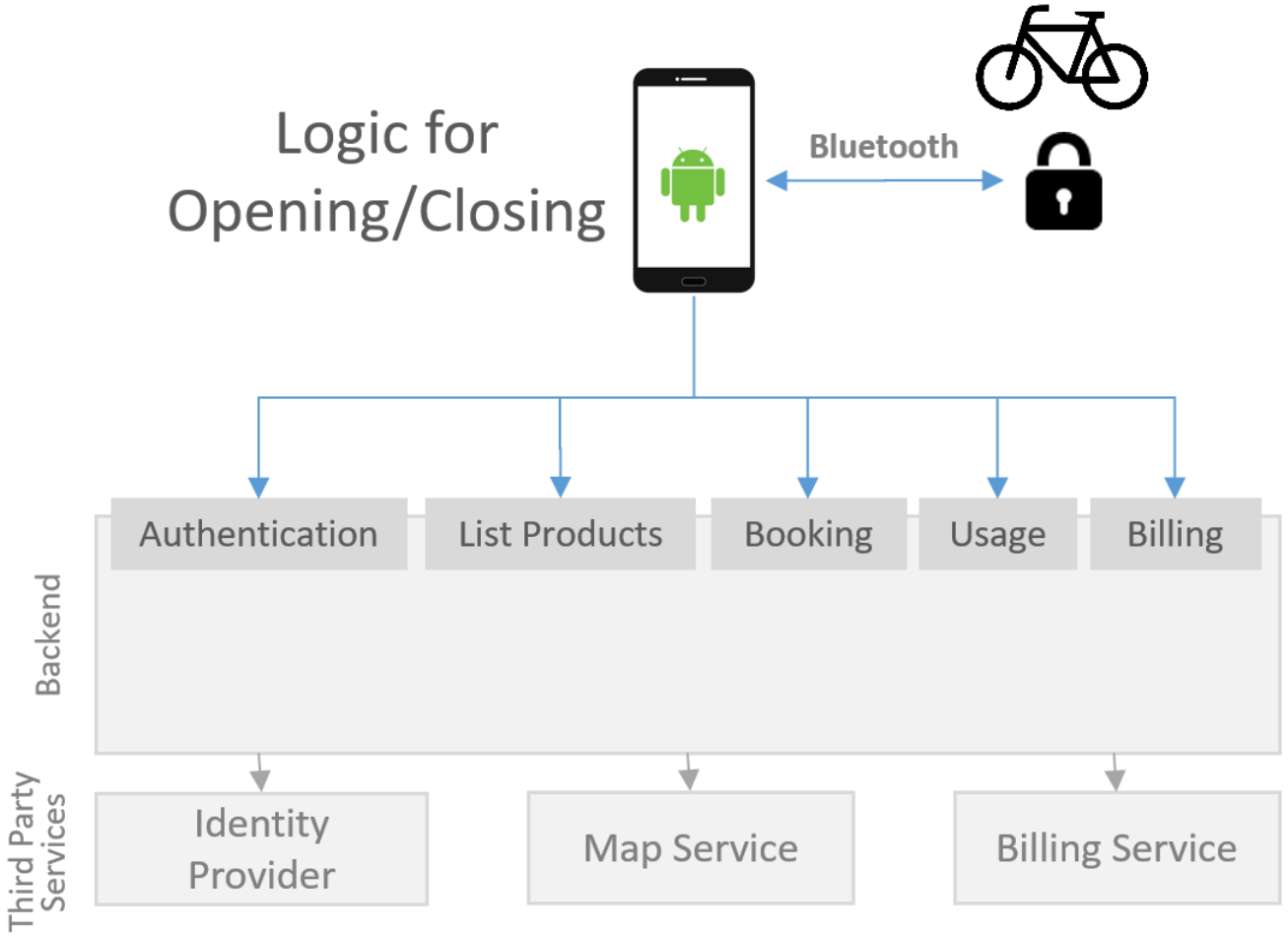
Booking ended



Ride History

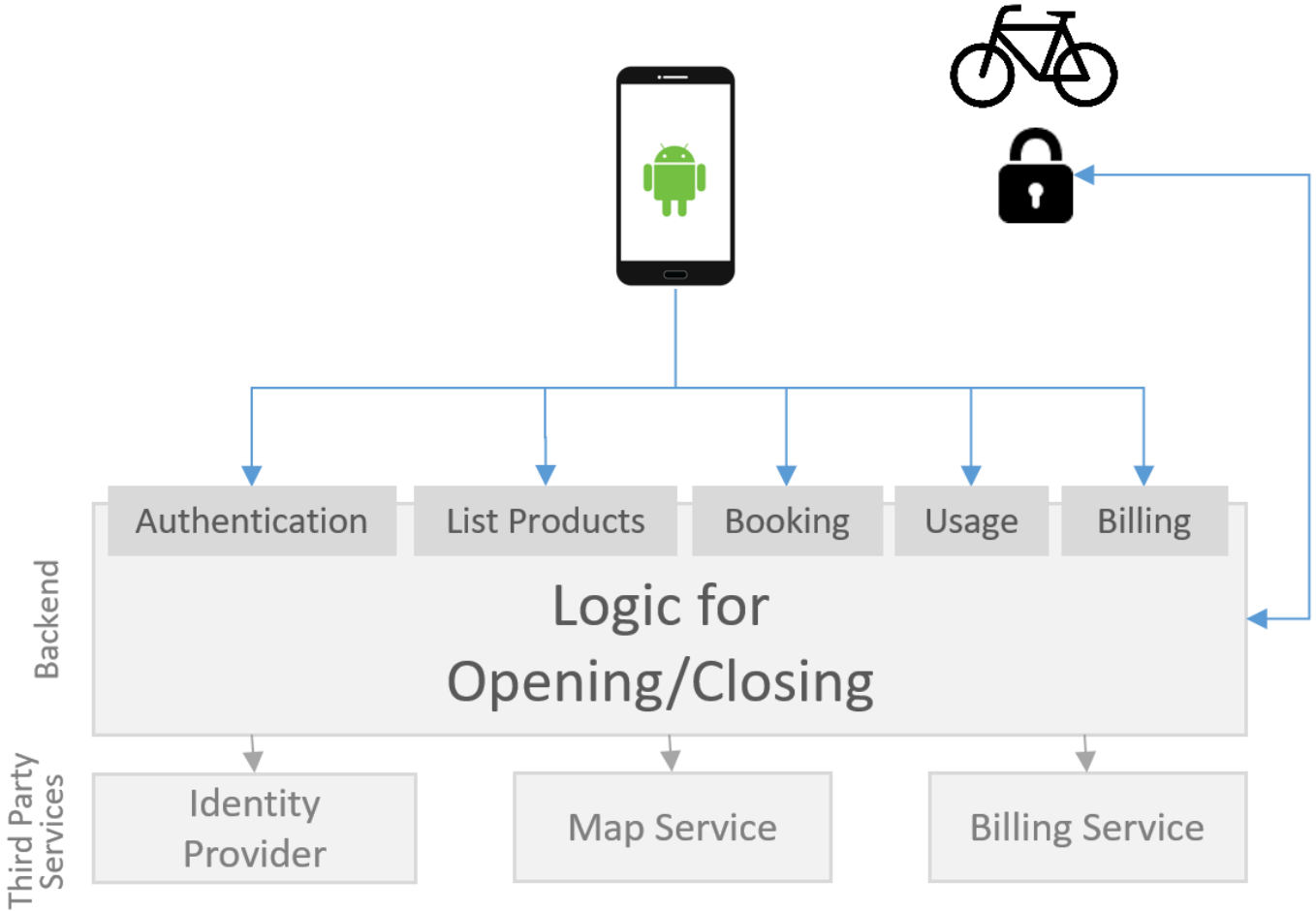


Architecture - Components



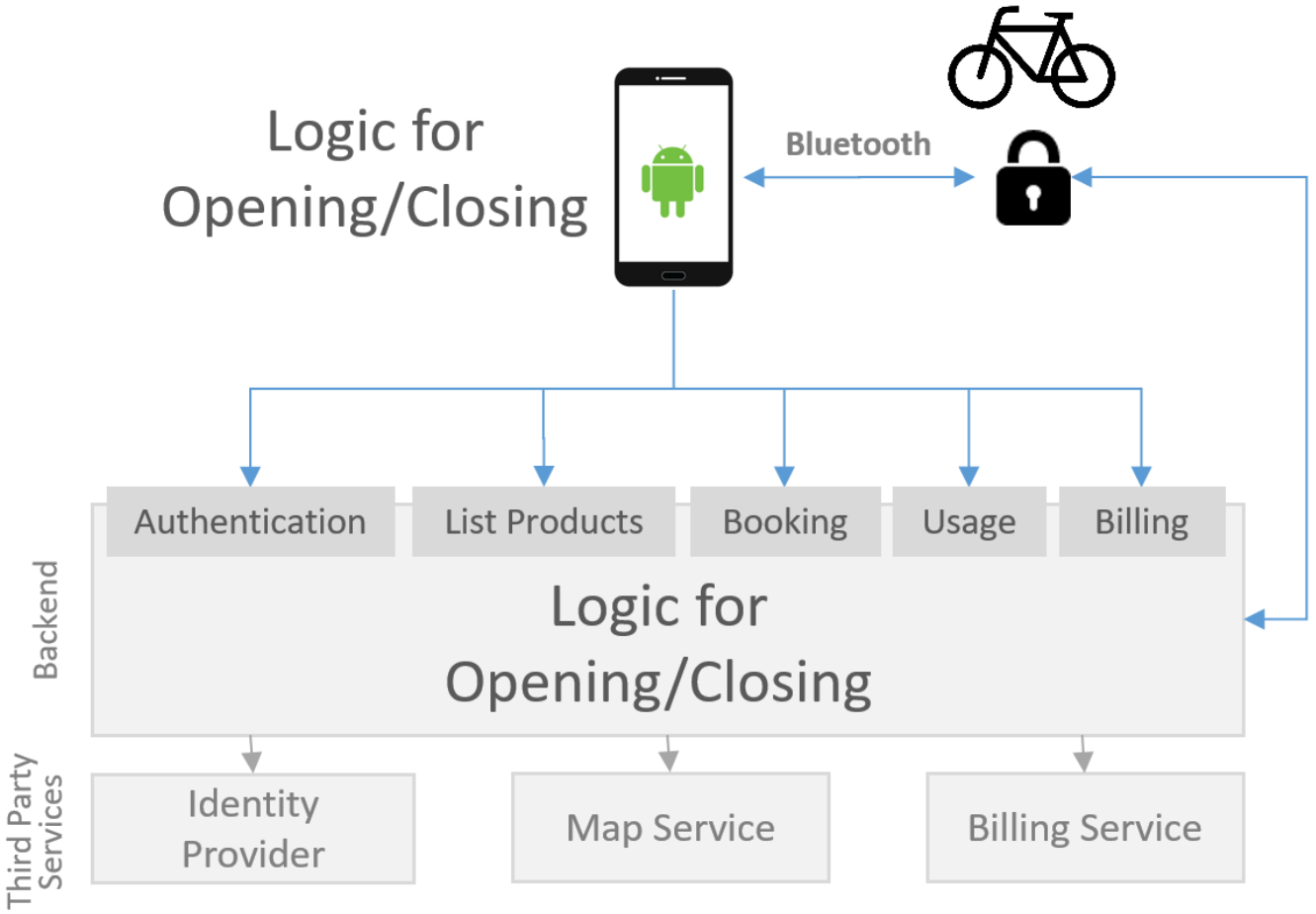
Costs: no monthly internet costs for lock

Architecture - Components



Costs: monthly costs for internet access of the lock

Architecture - Components



Costs: monthly costs for internet access of the lock

Solution

Factor/Architecture	Online	Offline	Hybrid
Number of needed communication technologies	low	high	medium
Price	expensive	free	expensive
Maintainability	good	bad	good
Convenience for user	good	bad	good
Convenience for service provider	medium	medium	medium
Convenience for mobility platform provider	good	bad	good

Decision:
Offline architecture, because of cheap proof of concept

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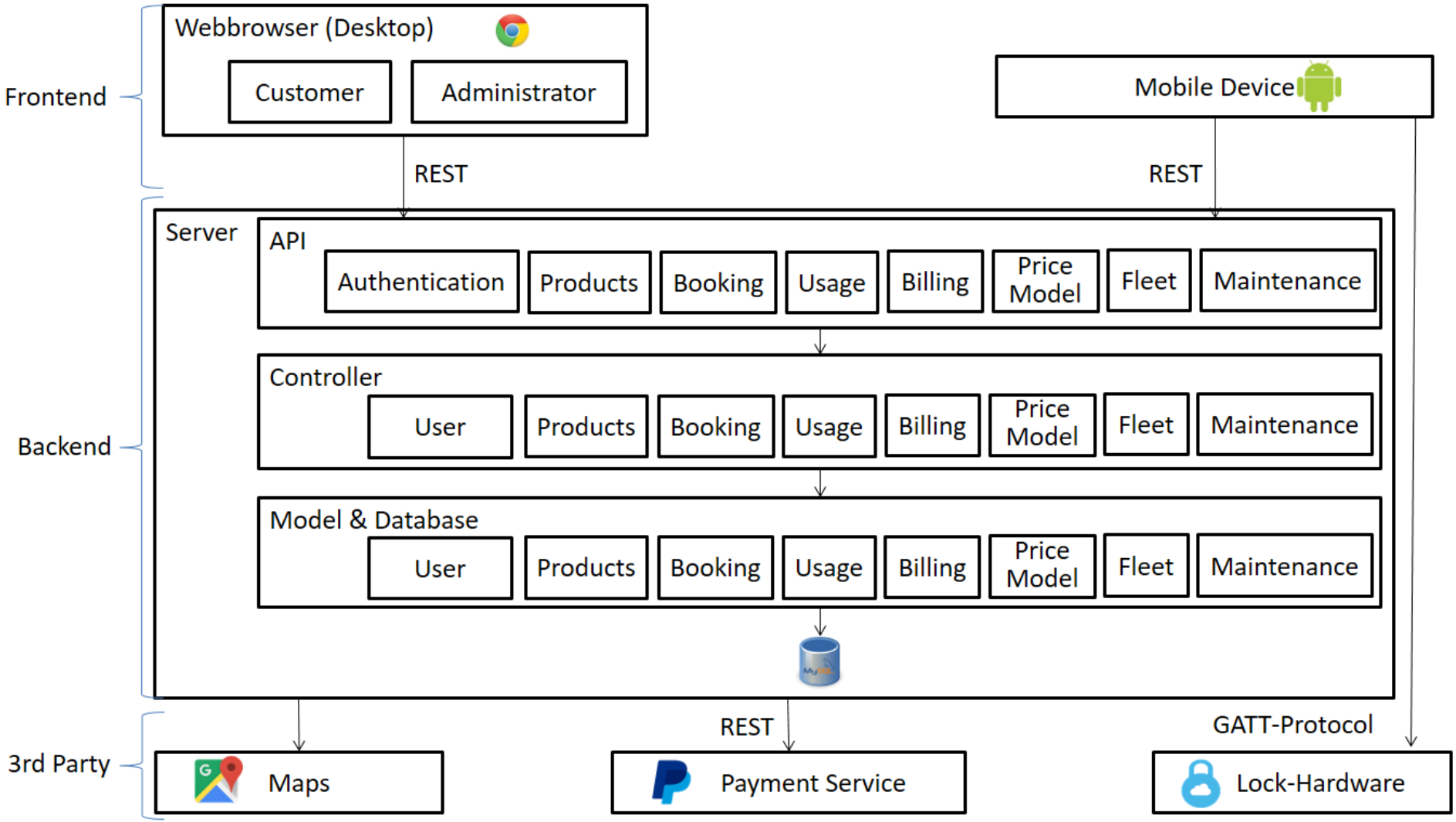
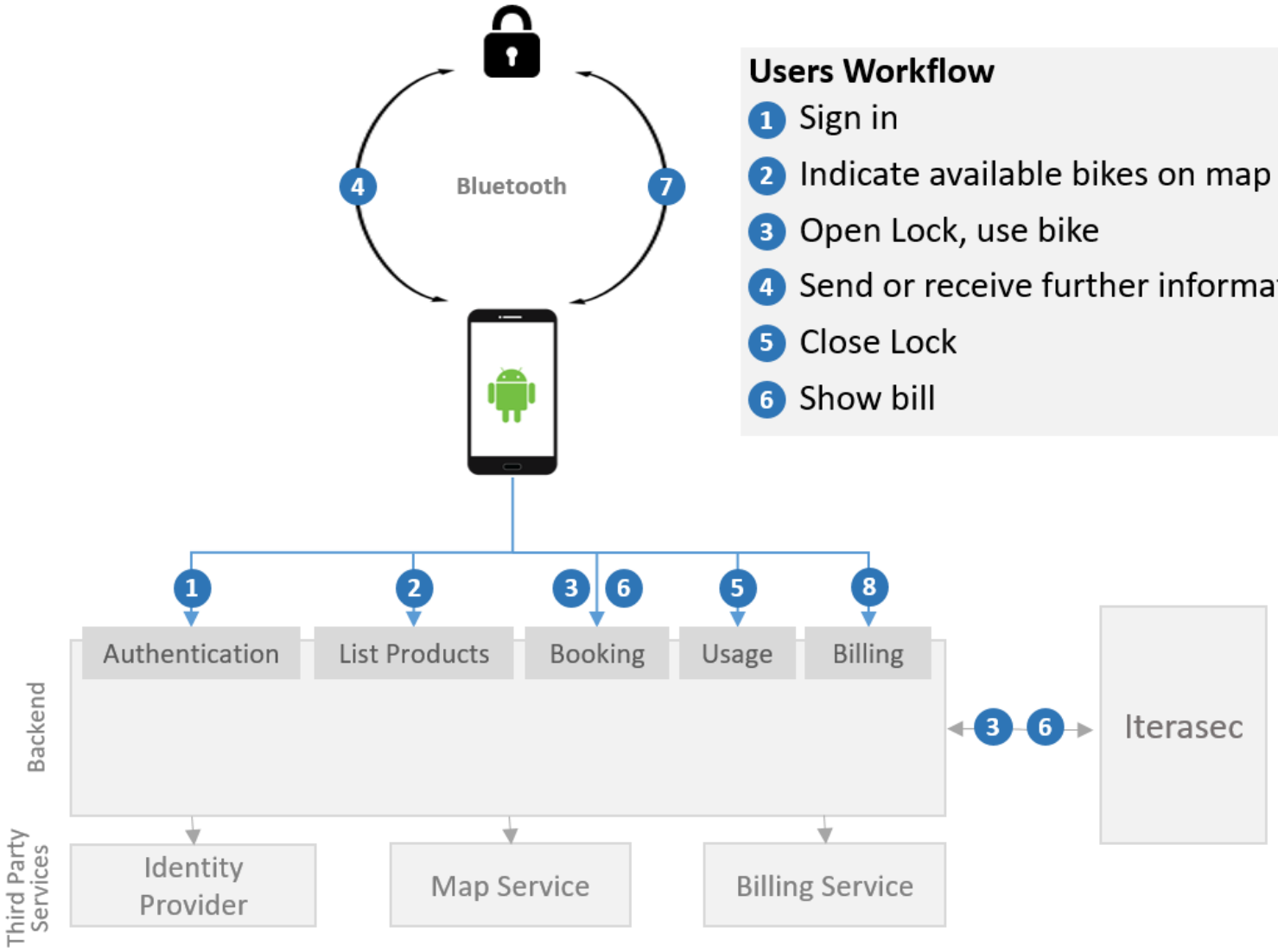
Sharelock - Service and Components



Overall Sharelock Workflow



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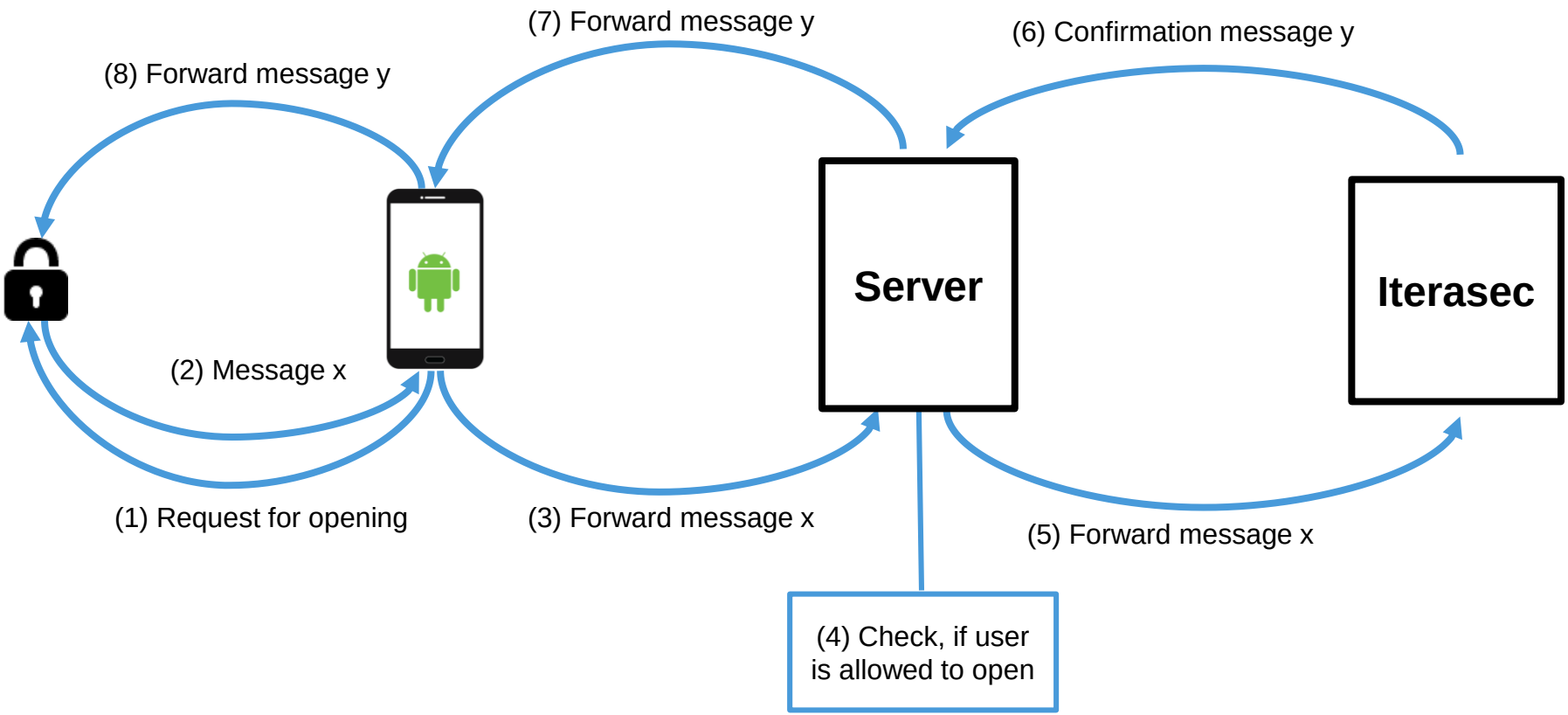
Sharelock Opening/Closing Workflow



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Technology

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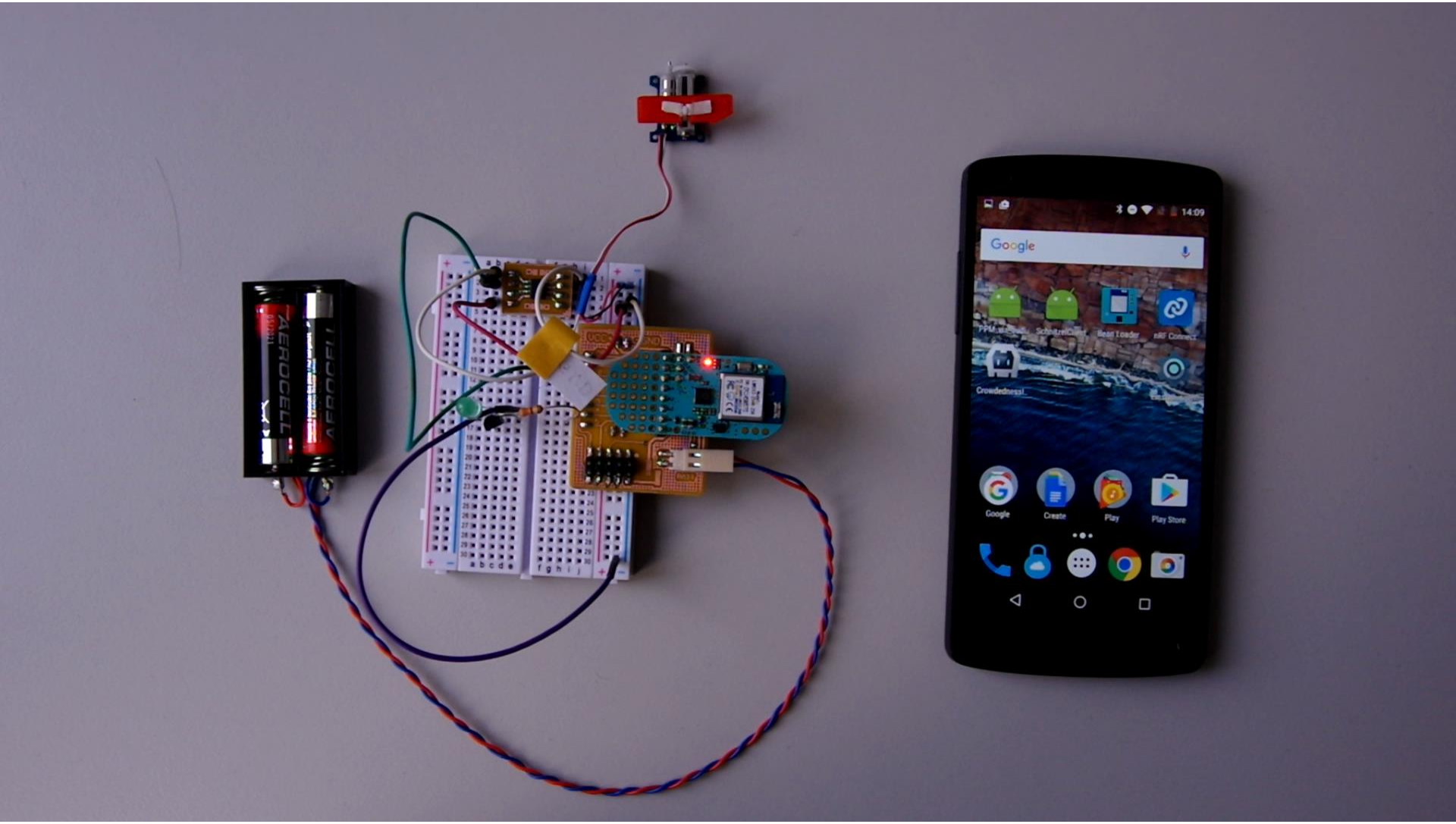
Mobile Application

Frontend

Backend

Lock

LIVE DEMO


AEROCELL
Google
Create
Play
Play Store

Evaluation

Case 1:

- Finding and opening a lock
- Realizing a flat wheel → send notification (maintenance task)
- Closing the lock

SUS Score: 80/100 (*)

Case 2:

- Login to Administration Frontend
- Assign mechanic to maintenance task for the lock
- Put lock back into operation (deblocking)

SUS Score: 79/100 (*)

(*) biased because evaluation was done by technical-oriented students

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Conclusion

»**Implemented:**

- Backend
- Administration Frontend
- Android App

- Basic Functionality covered and evaluated by students
- Sharelock Service can be integrated into Mobility Ecosystem

Outlook

Iteratec:

- Launch Sharelock as soon as possible
  → finishing hardware development
- Providing Sharelock for the employees

Improvements:

- Adding payment service
- Add Machine Learning for maintenance prediction
- Add Google Location for addresses

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Thank you for your attention!

Questions?

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Image Sources

LDAP: https://www.cloudnloud.com/wp-content/uploads/2016/07/ldap.png

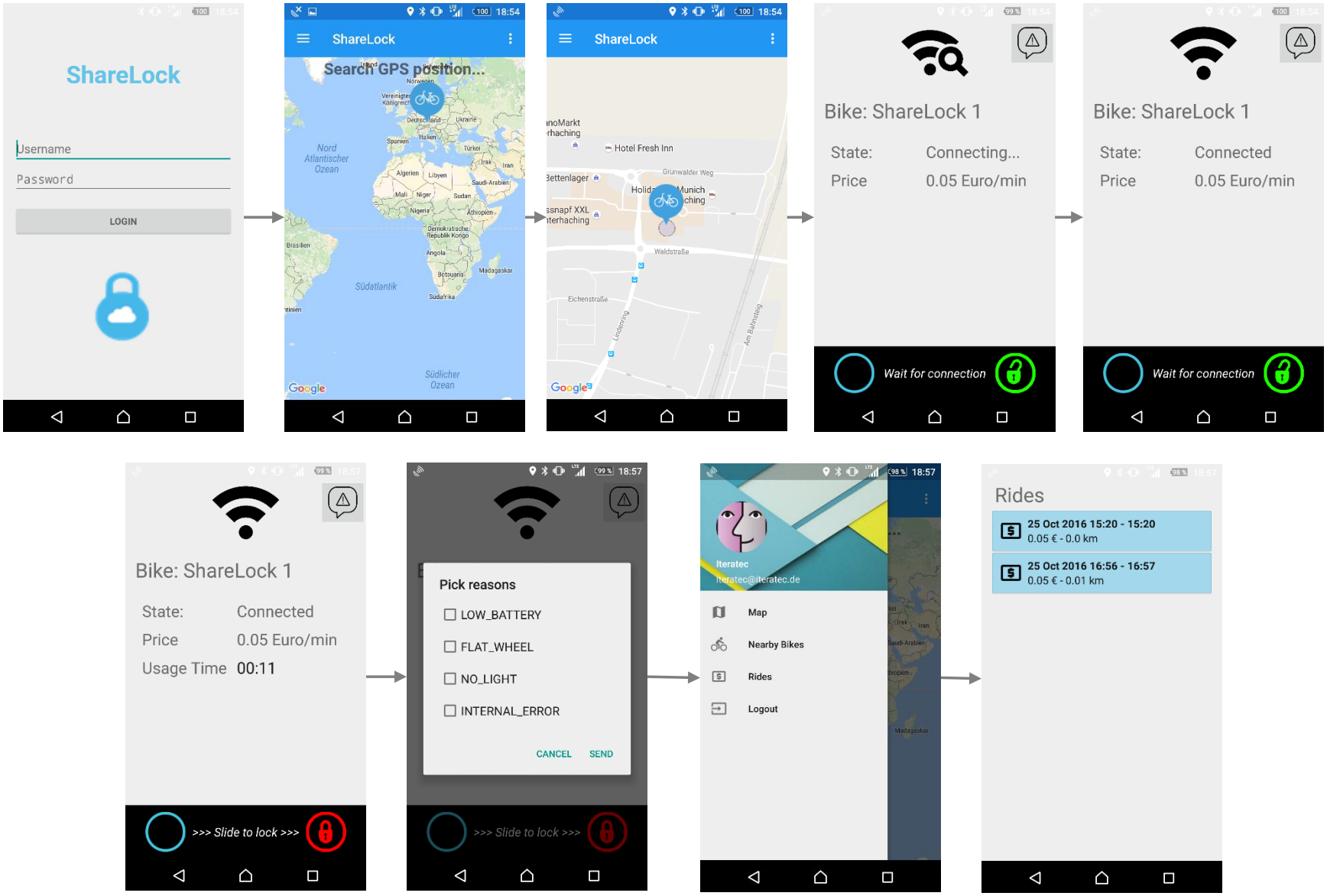
Bluetooth: http://www.giga.de/wp-content/uploads/2012/01/Bluetooth2.jpg

KML: http://d27ixrd8sdmf11.cloudfront.net/images/kml.png

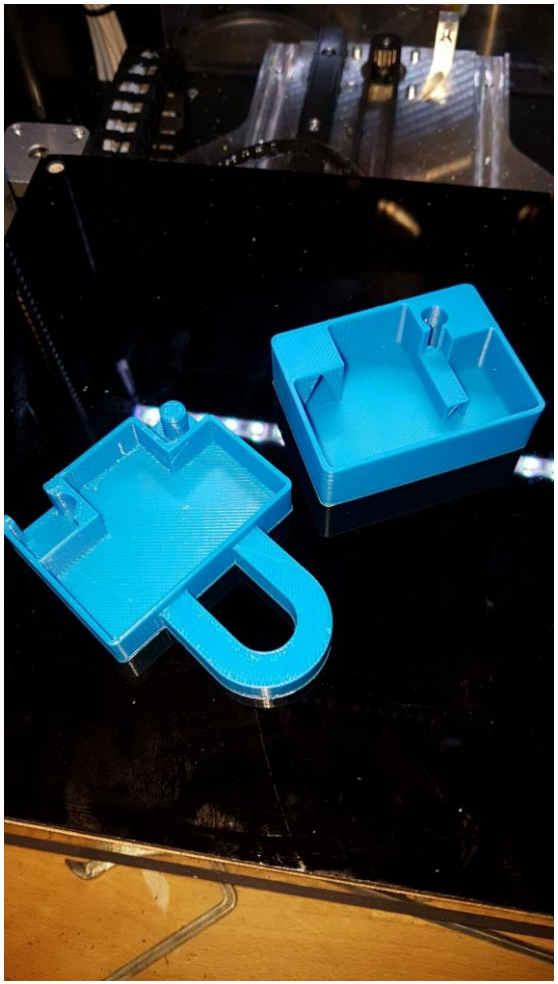
Firebase: https://d13yacurqjgara.cloudfront.net/users/1168564/screenshots/2725163/firebase_logo_shot.png

Bike: https://upload.wikimedia.org/wikipedia/commons/thumb/8/87/Fahrrad_aus_Zusatzzeichen_1000-32.svg/1252px-Fahrrad_aus_Zusatzzeichen_1000-32.svg.png

Mobile Application Workflow



Lock Prototype



Comparison Sharing Provider

	Station-based or flexible zone	Locks	Business Model (price 30 min)	Clients	Online/ offline
Open Source Bike Share	Station-based	4 digit PIN locks	Customizable	Private users	Offline
Nextbike	Both possible	Different types (app, smartcard or login at on-board computer)	Customizable (1 Euro)	Different types (private events, hotels, business,…)	Online
JCDecaux	Station-based	Opening with membership card	Customizable (free with 7 day ticket)	Private users	Online
Call A Bike	Both possible	Call a number and receive an unlock code	Pay per time (1 Euro)	Private and train users	Online
StadtRAD Hamburg	Station-based	Call a number and receive an unlock code	Pay per time (free)	Tourists and locals	Online
Konrad	Station-based	Call a number and receive an unlock code	Pay per time (1 Euro)	Private users	Online
metropolradruhr	Station-based	Combination lock	Pay per time (1 Euro)	Tourists and locals	Online
NorisBike	Both possible	Combination lock	Pay per time (1 Euro)	Tourists and locals	Online
MVG Rad	Both possible	on-board computer	Pay per time (2.4 Euro)	Tourists and locals	Online
Fächerrad	Both possible	on-board computer	Pay per time (1 Euro)	Tourists and locals	Online
MVGmeinRad	Station-based	Opening with membership card on terminal	Pay per time (1.4 Euro)	Tourists and locals	Online
Chemnitzer Stadtfahrrad	Station-based	Opening on presentation of identity card	Pay per day (2 Euro)	Tourists and locals	Offline
BiCiBUR	Station-based	Opening with membership card on terminal and entering PIN	Flat rate for 15 Euro per year	Locals	Online
Melbourne Bike Share	Station-based	Entering PIN code which you receive from terminal with your credit card	Free	Tourists and locals	Online
CERN	Station-based	Opening with membership card on bike station	Free or 1 CHF per day between 01/06 and 30/09	Employees	Online
Google	Flexible zone	No locks	Free	Everyone	Offline
Cargo Bikesharing	Station-based	Opening on presentation of identity card and codeword	Free	Locals	Offline
Sharelock	Flexible zone	Opening via app	Pay per time (not stated)	Iteratec employees	Offline

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REST interface

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billing-resource : Billing Resource — Show/Hide | List Operations | Expand Operations

GET	/rest/bill	getAllBillsForUser
GET	/rest/bill/user/{login}	getAllBillsForUser
GET	/rest/bill/{id}	getBill

booking-resource : Booking Resource — Show/Hide | List Operations | Expand Operations

GET	/rest/booking	endBooking
POST	/rest/booking	startBooking

lock-resource : Lock Resource — Show/Hide | List Operations | Expand Operations

GET	/rest/locks	getLocksForBusinessDistrict
POST	/rest/locks	registerLock
GET	/rest/locks/available	getAvailableLocks
GET	/rest/locks/unregistered	getUnregisteredLocks
PUT	/rest/locks/{id}	updateLock
GET	/rest/locks/{name}	getLock
GET	/rest/locks/{name}/CryptoMessage	getCryptoMessage
GET	/rest/locks/{name}/available	isLockAvailable
GET	/rest/locks/{name}/bills	getBillsForLock
GET	/rest/locks/{name}/close	closeLock
POST	/rest/locks/{name}/deactivate	deactivateLock
POST	/rest/locks/{name}/maintenance	createMaintenanceForLock
GET	/rest/locks/{name}/open	openLock
GET	/rest/locks/{name}/region	getBusinessDistrict
POST	/rest/locks/{name}/updatePosition	updatePosition

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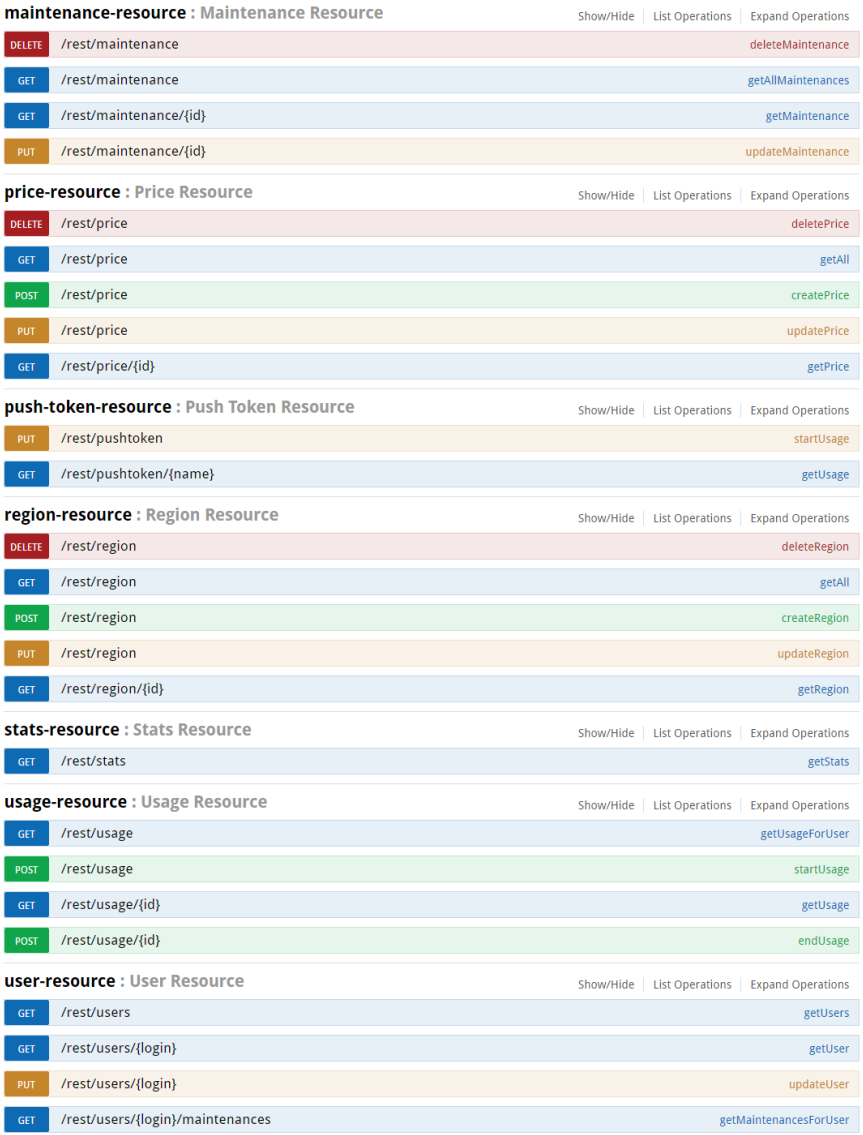
REST interface



Architecture Assessment

Evaluation parameters:

- Costs
- Maintainability
- Number of technologies
- Convenience
  - for user
  - for service provider
  - for mobility platform provider
- Security
- Adaptability

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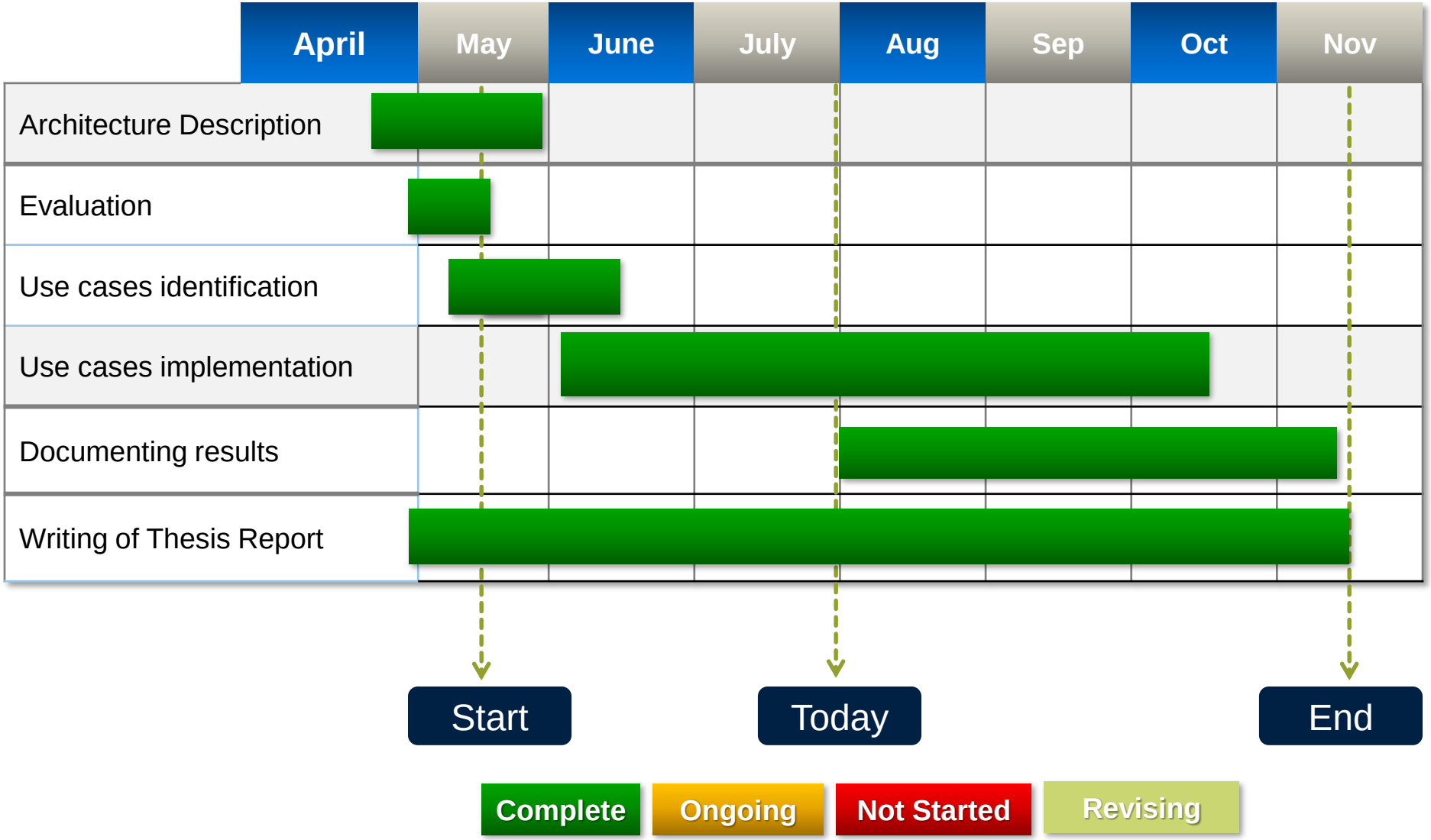
Road


April
May
June
July
Aug
Sep
Oct
Nov
Architecture Description
Evaluation
Use cases identification
Use cases implementation
Documenting results
Writing of Thesis Report
Start
Today
End
Complete
Ongoing
Not Started
Revising

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