Scope and Charter

Offline First Real Time Bus Tracking
University Of British Columbia Okanagan
COSC 499

Authors:

Document Owner(s)	Role	Contact
Wasek Habib	Product Manager	wasek.edu@gmail.com
Matthew De Leeuw	Integration Lead	mattdeleeuw@hotmail.com
Trevor Gallicano	DevOps Lead	trevorg@hotmail.ca
Ini Oladosu	Technical Lead	inioladosu@gmail.com
Kyle Rennie	Client Liaison	kyrenzie@gmail.com

Document History:

Version	Date	Document Revision Description
1.0	October 23, 2018	Initial document
2.0	November 20, 2018	Updated to match changes

1. Identification

Name of Project: Offline First Real-time Bus Tracking App

Sponsor: Fremtid Media

Project Stakeholders:

Stakeholder Names	**Roles**
Fremtid Media	Sponsor/Client
Reza Afzali	Client
Simranpal Bains	Client
Scott Fazackerley	Instructor/Supervisor
UBCO Students/ Residents of Kelowna	Users
COSC Capstone Team 12	Android App Developers
Engineering Capstone Team	Hardware/Infrastructure Team
University of British Columbia	Academic Institution
BC Transit	Open Data Provider
FirstCanada	Kelowna Public Bus Transportation Operator
Kontakt.io	Beacon Provider
Google	Android OS Provider
Here	Maps API Provider for Showing Bus Location on the App

Team:

Team Members	Roles	Responsibilities
Wasek Habib	Product Manager	- Primarily responsible for the project workflow, requirements engineering, software architecture, and ensuring SDLC. - Involved in design and development process.
Ini Oladosu	Technical Lead	- Responsible for the non coding documents - Responsible for UI Design of application - Involved in development process
Matthew De Leeuw	Integration Lead	- Responsible for checking code before integration into master branch (aka) responsible for what gets deployed - Responsible for programming with team on seperate features
Trevor Gallicano	DevOps Lead	- Responsible for continuous integration/deployment - Responsible for automated testing - Involved in development process
Kyle Rennie	Client Liaison	- Responsible for continuous client contact and logging conversation - Involved in development process

2. Project Purpose

Currently there is a ridership of 4.9 million in Kelowna per year, a fair amount of riders (>1%) use the transit app, with this app we are looking to take a portion of the demand for maps and transit for this app. Current apps have issues with telling the user the real time of their bus arrival because they are unreliably crowdsourced, or just use the bus schedule for times. The Transit App has a “GO” function but this is not always available. Bus drivers also want to maximize efficiency but they don't have a way to know if passengers are at the upcoming stops. Another problem transit users have is that not every bus stop has audible notifications. The purpose of the project is to provide a reliable solution to the commuters for tracking their desired busses in real time, passengers waiting at the bus stop to be picked up with an android application, and an audio notification of the upcoming bus to the people waiting at the bus stop. If the project is not completed on time then the company overseeing it can chose to continue with a new or the same team. They would have prototypes and documentation to help them continue with the project, even with a new team.

3. Project Objectives

Create a solution for commuters to track their desired bus in real time using an android app. Passengers waiting at a bus stop should be confident that the bus they are waiting for will pick them up. Passengers waiting at a bus stop who are not paying attention or maybe are visually impaired can have audio notifications of a bus arriving.

4. Success Criteria

- The app will have simple and elegant user experience following standard human computer interaction rules.
- User satisfaction will be measured by a standardized set of questions followed by the usability test and will measure 3 or higher on a 5 point scale.
- The user interface will follow the best UI practices and ‘material design’ standards.
- Response time will not be more than 2-3 seconds assuming the application is awake and fully running on the device.

5. Terminology

- Beacon: Small transmitters that use Bluetooth to send a single signal containing small data packet for other devices to pick up.
- Gateway: Tool that continually scans for beacons in range and send data to the cloud server.
- Location Engine: Dashboard/APIs that allow to access the data (beacon location, health, etc.) that gateway transmits.
- REST API (Application Programming Interface): Tool that helps to communicate between two programs using HTTP protocols.

6. Scope Statement

The project has two parts: Hardware and Software. COSC team is responsible for anything related to the server, location engine, development and deployment of the android application and its connection to the beacons (software side). The offline first android app (proof of concept) will show the user live location and arrival time of the bus (real-time bus schedule) in nearby bus stops. The user will get a push notification of the remaining arrival time of the subscribed bus number when he/she is in a certain range of the beacon at the bus stops. The beacons and gateway will be installed and configured on a bus/car and at bus stops by the engineering team. The engineering team is also responsible for programming speakers and light sensors (small single board computers) located in the bus stops and busses, respectively. The cloud server will send information of bus locations and passenger waiting at the bus stop to internet enabled small board computers. The computers will then communicate with the light sensors and speaker and make some notification. (done by the engineers). If the user clicks on the push notification, it will take him/her to the app and show the live location of the bus on the map. The users will not need an account to use the application. Personal information of the users will not be asked or stored. However, their travel time and distance will be stored anonymously on device and uploaded to the cloud upon internet connection.

6.1. Out of Scope

- The engineering team is responsible for setting up and configuring beacons, gateway, and programming small single board computers.
- Receiving data from the server to the small board computers and communication between small computers and speakers and light sensors are also EE team's

responsibility.

- Data protection and transmission security of the beacons. Kontakt.io is responsible for secured data transmission of the beacons.
- The coverage area will not be outside of UBCO roundabout and EME bus stop.
- Setting up the beacons, checking physical conditions and health.
- Creating mesh network.
- People with strollers or wheelchairs (physically impaired).
- Setting up and working with speakers and displays on bus-stops.
- Any communication between speakers, beacons, and light sensors.
- Any kind of hardware implementation, security, and maintenance, and programming the small board computers are done by the engineering team.
- Cost analysis.
- Wayfinding (Navigation and in-between stops).

7. Requirements

7.1. Functional Requirements

- Android application will connect to the beacons using low-energy bluetooth.
- Application will display a map with the tracked bus's location.
- Application will ask for user's permission to access location.
- System will track the live position of busses.
- Application will display the expected arrival times of the selected bus.
- User will receive a push notification when they are within a set distance of a bus stop beacon.
- User will be notified about the wait time for the next arriving bus.
- Application will be available to all users with no registration.
- Application will show a list of nearby bus/car(s) that has/have beacon installed.
- App will track the current location of a user in the background.
- App will track travel distances and travel times of a user.
- Travel data will be stored on the device anonymously.
- Travel data will be sent to an online database when the device has an online connection.
- Travel times will be deleted from device after they are received by the online database.
- Admins will be able to view data stored in the online database.
- App will send user location to the cloud server.
- App will send nearest beacon information to the cloud server.
- Cloud server will send tracked bus location to an LTE enabled computer at bus stop
- Cloud server will send bus stop location of the passenger to an LTE enabled computer on the bus.

7.2. Non-Functional Requirements

Development

- Developed as an Android application written in java.
- Development process will be completed using the agile method.
- Application will use third-party API's.
- Costs for development (such as cloud service or third party API's) will be covered by the client.

Performance

- User must be connected to the internet and within range of the bus stop.
- Software will handle number of users equal to all bus commuters at UBCO.
- Software will be scalable up to the entire 97 bus route in Kelowna.
- Application will display bus positions accurate within 100 meters.
- Bus position will be updated within 3 seconds (including screen latency).
- System requires all beacons to be functioning.
- System downtime limited to time spent replacing beacons.
- System uses low-energy bluetooth to communicate with application.
- Bus tracking will only show information related to the next bus(es).
- System can track any bus with a beacon.
- Travel times will be stored on device while the device is offline.
- Travel times will be scrubbed before it is stored on the online database.

7.3. Technical Requirements

Tools/Languages/Libraries	**Type**
Android Studio	Development Environment
Balsamiq	Wireframing
Adobe XD	Mockup
Docker	Container based software as a service
Jenkins/Travis	CI Solution
Git	Version Control System

Github	Version Control Hosting Service
Trello	Project Management
Slack	Communication
SQLite	Relational Database
Couchbase Mobile	NoSQL database
AWS/Firebase	Cloud Platform
Toggl	Time Tracking
Java	Client side Programming Language
Node.js	Backend Programming Language
Postman	API debugging and testing tool
Swagger	API designing and documentation tool
Here Maps/Google Maps	Maps API

- The application will connect to the beacon mesh network using Kontakt Beacon APIs. API key will be stored in the app.
- The application will display a map with the bus locations using Here maps API and caching the latest location. API key will be stored in the app.
- Application will ask for user's permission to access to GPS, bluetooth, and internet using AndroidManifest.xml file to ask for user permission.
- System will track the live position of busses both online and offline using Kontakt Beacon APIs and Here maps APIs. API keys will be stored in the app.
- Application will display the expected arrival times of bus using Kontakt Beacon APIs and Here maps APIs. API keys will be stored in the app. Beacon UUIDs and geo-coordinates will be stored in the database.
- User will receive a push notification when they are within a set distance of a bus stop beacon using async push notification. User location and desired bus location in the background will be tracked using GPS and Kontakt Beacon APIs.
- Application will show a list of nearby bus/car(s) that has/have beacon installed using Kontakt Beacon APIs and BLE. API keys will be stored in the app.
- App will track the current location of a user in the background using GPS.
- App will track travel distances and travel times of a user using Here maps APIs to calculate the distance and time. API keys will be stored in the app.

- Travel data will be stored on the device anonymously by using instance id.
- Travel data will be sent to an online database when the device has an online connection using /POST and /PATCH APIs.
- Travel times will be deleted from device after they are sent to an online database using /GET and /DELETE APIs.

7.4. User Requirements

- Use application without an account.
- User receives push notification when entering specified beacon range.
- Users can track bus with map.
- User can see expected bus arrival time.
- Can not log in.
- Able to track single bus.
- Able to use application on Android device.
- Users are Identified by Instance ID.

8. Work Breakdown Structure

Task List	Owner(s)	Estimated Hours					Total Estimate
							184.1
							Average Estimate
Learning	All	Ini	Kyle	Matt	Trevor	Wasek	41.6
Android		17	15	20	12	10	14.8
Maps		3	2	3	3	5	3.2
Kontakt.io		5	3	3	3	5	3.8
CI Tools		12	2	12	12	12	10
AWS/Firebase		5	2	4	2	3	3.2
Databases		2	2	4	2	3	2.6
Node.js		5	5	4	4	2	4

Meetings		36	36	36	36	36	36
Design	All						14.3
Documentation		5	15	4	5	16	9
Paper Prototype		2	4	0.5	1	1	1.
WireFraming		2	2	1	1	2	1.8
MockUp		3	2	2	1	1	1.8
Development							43.8
1. Maps API	Kyle						10.8
1.1 Integrate Maps Into GUI		5	3	8	3	1	4.8
1.2 Show Where Bus is Located		5	3	2	4	5	3.8
2. Kontakt Beacon API	Matt						13.2
2.1get location data from beacons, or arduinos.		4	4	3	3	1	
3. Android SDK	Tbd						6.4
3.1 Collect GPS Data		3	3	2	2	2	2.4

3.2 Store GPS Data		5	2	2	3	8	4
4. Build API	Wasek						13.4
4.1 Integrate Android with Cloud		4	4	4	4	4	4
4.2 Local Database to Cloud Database Path		15	3	10	3	16	9.4
Integration and Testing	Trevor						32.4
Ci Tools Setup		4	1	3	6	1	3
Usability Testing		4	2	5	8	5	4.8
Documentation		5	3	3	6	16	6.6
Unit Testing		2	2	8	10	10	6.4
Integration Testing		5	4	8	8	8	6.6
Acceptance Testing		5	5	5	5	5	5
Final Documentation and Presentation		16	16	16	16	16	16

9. Assumptions

- UBCO will approve installing beacons on campus.
- A beacon will be set up in one bus upon approval from BC transit. If not, the students will use their own transports. The engineering team is responsible for this.

- The engineering team will be responsible for installing and configuring beacons and will provide any help needed as soon as possible when COSC team test them. Both team will be present during the integration testing.
- The beacons given will work and respond as expected. The client and engineering team are responsible for any faulty beacons and hardware issues.
- The developers have knowledge of Git, Java and relational databases.
- Third party APIs (i.e. maps API, beacon API) will work properly.
- The team built APIs will be public and will not ask for any authentications.
- The cloud service (AWS/Firebase) will have at least 99.5% uptime.
- The beacon range will be 50-70 meters.
- The beacons will not be stolen or vandalized.
- The team will be agile, self-organized, and maintain synergy.
- Any expenditure including cloud service, third party APIs, transportation logistics will be provided by the client.
- The communication between stakeholders will be prompt, clear, and efficient.
- Each developer will be working a minimum of 8 hours during school weeks.
- There will not be any requirement changes from the client after October 16, 2018.
- The Beacon response time will be 1-2 seconds.

10. Environmental Constraints

- Requires approval from UBCO and BC transit to install beacons on campus and bus.
- The durability and performance of the beacons in Kelowna weather is unknown.
- Limited in-person meeting with the client.
- Field testing will be challenging during hostile weather.
- Development tool licenses and term of service.
- No control over third party APIs and cloud service.
- Some tasks are dependent on the task completion of engineering team and can not be done in parallel.
- Majority of the developers are not familiar with Android ecosystem, building REST APIs with node.js, and NoSQL databases.
- Lack of domain knowledge will lead to unrealistic estimations.
- Time constraint.

11. Risks

Risk	Likelihood	Severity	Mitigation Plan

Unfinished Project	Medium	High	Plan to stay ahead of deliverables.
Conflict with Engineering Team	Low	High	Frequent communication and transparency.
Losing members	Low	Medium	Involve all team members in development so we can pick up where other left off.
Unmotivated Team Members	Low	High	Constantly staying ahead of deliverable due dates
Faulty Beacons	Medium	High	Have as many as possible so we are not reliant on just a few.
Client company shut down	Medium	High	Continue project with Scott.
No Control Over 3rd Party APIs	High	Medium	Study the APIs as much as we can so we call deal with any issues if they arise.
Environmental Constraints	Medium	High	Have backup plans, which will be discussed with the client.
Beacon Security	Medium	High	Change beacon provider or implement own security.
API Security	Low	High	Implement API key and authentication
Device Security	Low	Low	Delete device database as soon as possible.

12. Project Development Methodology

Scrumban methodology and Trello will be used for project management. The sprints will be one week long starting from every Tuesday. Weekly sync up, demo, planning meeting will be held on Monday. If Monday doesn't work out for some reason, the team will have meeting on Friday or Tuesday before the class (not recommended). Backlog will be created in each week's planning based on the progress and priority. Every week the developers will pick up the tasks from backlog they think they can finish in that week. If a task seems big, sub tasks can be created under that task. The tasks will have story points. 1 point represents 1 hour. Everyone is expected to finish at least 80% of their workload each week, although 100% is preferred. The rest can be carried forward to the next week's sprint. There is no need for daily scrum meeting as trello is synced to the scrum channel. So everything knows who is working on what.

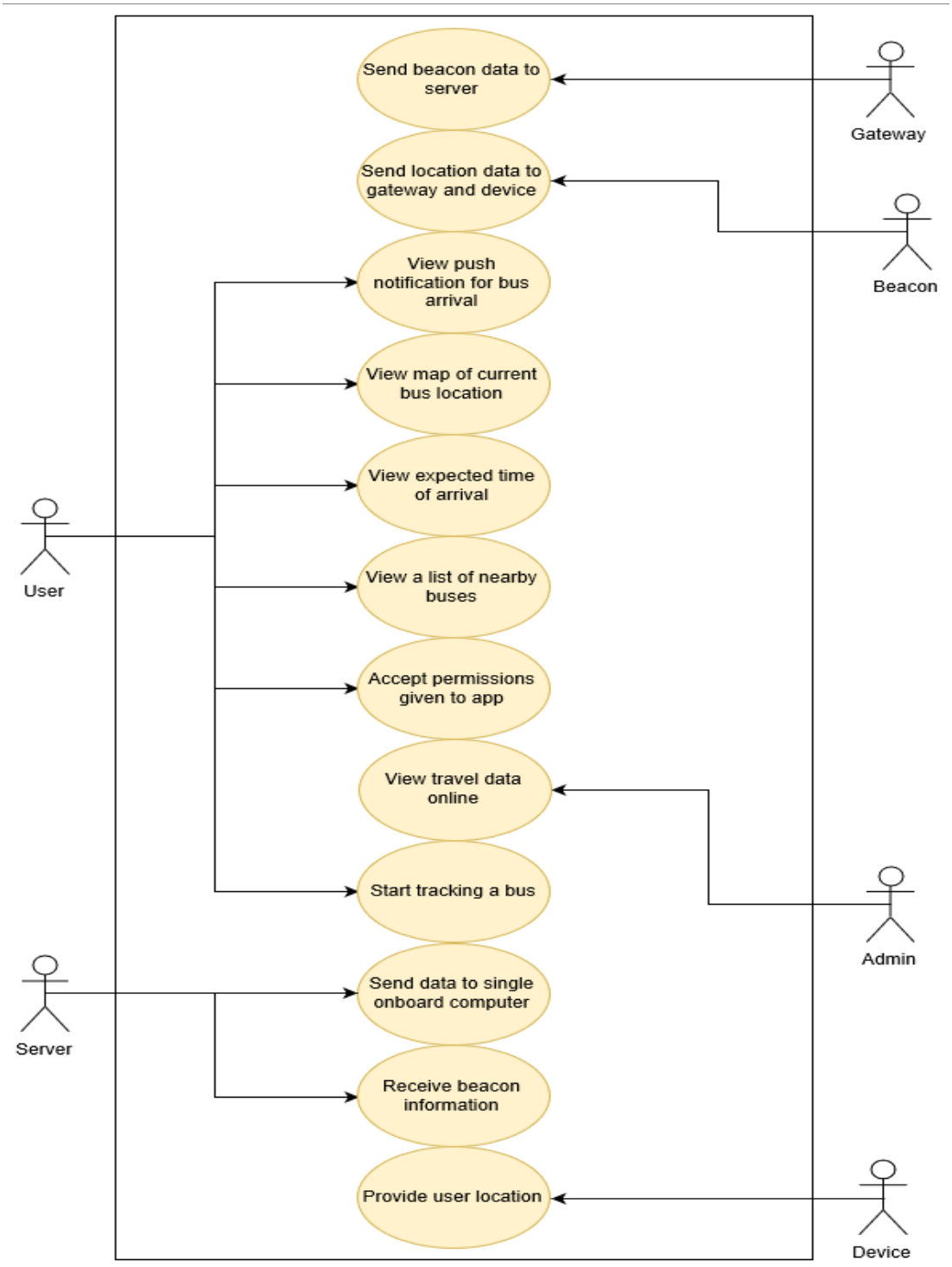
The developers will create and push commits to the branches named with task numbers and create pull requests. Only integration lead or feature owners can review code and merge pull requests to the "Development" branch. The integration or devOps Lead will then update the master branch. The code will be reviewed after running automated test cases and a successful Jenkins build. Non-code documents will be merged by the technical lead.

13. Project Milestones

Milestones / Deliverables	Due Date	Complete (YES / NO)
Scope and Charter Document & Presentation	October 23th, 2018	YES
Design Requirements Document & Presentation	November 13th, 2019	NO
Integration Testing with the Engineering team	November 16th, 2019	NO
MVP Presentations	January 8th, 2019	NO

Testing Documentation and Presentation	TBA	NO
Final Deliverable	TBA	NO
Final Project Presentation	April 8-26	NO

14. UML Use Case Diagram



15. Approval

Product Manager:_____

Signature: _____

Project Sponsor:_____

Signature: _____