

# System Requirements Specification

## Los Angeles County Fleet Management System (LACFMS)

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Version 1.0

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# Table of Contents

Table of Contents	pg. 2
Revision History	pg. 3
1. Introduction	pg. 4
1.1 Purpose	pg. 4
1.2 Intended Audience and Reading Suggestions	pg. 4
1.3 Product Scope	pg. 4
1.4 Definitions, Acronyms, and Abbreviations	pg. 5
1.5 References	pg. 5
2. Overall Description	pg. 6
2.1 Product Perspective	pg. 6
2.2 Product Functions	pg. 6
2.3 User Classes and characteristics	pg. 6
2.4 Operating Environment	pg. 7
2.5 Design and Implementation Constraints	pg. 7
2.6 User Documentation	pg. 7
2.7 Assumptions and Dependencies	pg. 7
2.8 Apportioning of Requirements	pg. 7
3. External Interface Requirements	pg. 8
3.1 User Interfaces	pg. 8
3.2 Hardware Interfaces	pg. 8
3.3 Software Interfaces	pg. 9
3.4 Communications Interfaces	pg. 10
4. Requirements Specification.	pg. 11
4.1 Functional Requirements	pg. 11
4.2 External Interface Requirements	pg. 13
4.3 Logical Database Requirements	pg. 13
4.4 Design Constraints	pg. 14
5. Other Nonfunctional Requirements	pg. 15
5.1 Performance Requirements	pg. 15
5.2 Safety Requirements	pg. 15
5.3 Security Requirements	pg. 15
5.4 Software Quality Attributes	pg. 15
5.5 Business Rules	pg. 16
Appendix A: Conceptual System Design	pg. 18
Appendix B: Glossary	pg. 19

# Revision History

<b>Name</b>	<b>Date</b>	<b>Reason For Changes</b>	<b>Version</b>
Initial Draft	9/8/2017	Initial fill in of all material	0.1
Secondary Draft	11/17/2017	Refining Specification	0.5
Final Draft	12/8/2017	Final Draft	1.0
Edited Draft	4/14/2017	Edited Final Draft	1.1

# 1. Introduction

## 1.1 Purpose

This document explains a set of requirements and functions that the fleet management system will perform. This document shall provide a high level overview of the system. Unless otherwise noted, all requirements specified here are high priority and have not been committed for release. This is version 1.0 revision is not applicable at this time. This document shall be updated in a manner consistent with development found in any AGILE project environment. Additionally, this document is part of another document, the Software Design Document which will provide greater details on the implementation and functions of what is described here.

## 1.2 Intended Audience and Reading Suggestions

This document is intended for developers, project managers, testers, and document writers who wish to read it. **Bold** typeface is used to highlight subsections. **Italics** are used to emphasize words that have been defined in Appendix A. The software document is intended to be used by members of the project team that will implement and verify the correct functioning of the system. Developers, may want to skip to section 2.0 overall description and refer to the Software Design Document. A list of acronyms is provided in Section 1.4 and a glossary of terms defined in Appendix A are to aide the reader.

## 1.3 Product Scope and Product Features

The proposed Fleet Management System *LACFMS* will be developed to retrieve information from County motor vehicles. The system is intended to eliminate the paper based process, improve reporting, and enhance vehicle maintenance capabilities. An authentication system will be integrated into every vehicle which will control access. Only employees of Los Angeles County Parks and Recreation should be able to drive the vehicles, so a lockout mechanism will be applied based on the employee's Identification badge.

Successful implementation of the system will reduce the paper waste footprint, improve use of County resources, improved control over vehicle maintenance costs, and simplify the process of authorizing and reporting usage of County Vehicles.

## 1.4 Definitions, Acronyms, and Abbreviations

CAN	Control Area Network
COTS	Commercial off the shelf
ECU	Engine Control Unit
GPS	Global Positioning System sections
GUI	Graphical User Interface
HQ	Head Quarters
IoT	Internet of Things
LACFMS	Los Angeles County Fleet Management System
MQTT	Message Queuing Telemetry Transport
OBD	On Board Diagnostic
PID	Parameter Identification Number
RFID	Radio Frequency Identification Device
TBD	To Be Determined

## 1.5 References

1. An SRS template for specifications requirement writing under IEEE 830-1980  
<http://standards.ieee.org/findstds/standard/830-1998.html>
2. Devices at the Edge hardware documentation:
  - 2.1 Datasheet references for hardware components will be referenced in Software Design Document.

## 2. Overall Description

### 2.1 Product Perspective

The fleet management system is a new system that replaces the County Vehicle Mileage and Safety Check Form. The fleet management system reports vehicle usage and vehicle diagnostics data to a server infrastructure for release 1.0. The system is expected to evolve over the next several releases ultimately to perform predictive analytics on vehicle data. The implementation build of LACFMS has been broken into three main phases. Each phase is described below.

- The Edge  
The Edge represents hardware components used for data ingestion of sensory devices. The Edge devices operates two fold, gathering sensory data; *GPS* and vehicle diagnostics data. This data is then stored for batch processing or streaming. The microdevice use technologies which are to be configured to broadcast sensory data. This data should use a secure messaging protocol to transfer data to the platform.
- The Platform  
The platform interface is to consume data being sent by devices on the edge. The platform interface is to store data in a reliable technology which can be accessible. The platform interface will pass this data onto an Enterprise interface.
- The Enterprise  
The Enterprise interface is perform predictive analytics on stored vehicle data.

For developers who wish to gain insight on the implementation of such a system, see sections 3.0 and 4.0 referenced in the Software Design Document.

### 2.2 Product Functions

Functions that the application will provide are as follows.

1. Gather *GPS* data for each Los Angeles County Parks and Receptions vehicle.
2. Read employee identification cards to identify the driver of each vehicle.
3. Collect vehicle diagnostics data and store the data in a persistent database.
4. Package and encrypt data for transmission.
5. Permission based access to specified web content.
6. Display trip visualization.

7. Provide access to stored vehicle usage data.
8. the system should allow for the generation of vehicle usage history for any given time period.
9. Data analytics on stored data.

## 2.3 User Classes and Characteristics

- **Driver / Employee**

A driver is an employee of Los Angeles County Parks and Recreation Department in Los Angeles, California. The driver shall interact with the Fleet Management System by swiping/tapping/scanning their Los Angeles County issued badge. This shall be a means of allowing the system to identify the driver of each vehicle. The driver will interact with *LACFMS* by providing input on a web application which will automate the County Vehicle Mileage and Safety Check Form.

- **Maintenance staff**

Maintenance staff may be provided a vehicle usage history of each vehicle by means of report generated by a database query.

- **Supervisors / Management**

A manager or supervisor should also have access of driver history through some database query function which provides a report of such data and data visualization.

## 2.4 Operating Environment

- *OBD-II* scanner will be plugged into the vehicle's On-Board Diagnostics data port.
- System should support batch transmission through wifi access point at county facility.

## 2.5 Design and Implementation Constraints

- WiFi Scanning interface.
- The vehicle must not have any wires cut when implementing the driver authorization system.
- *IoT* best security practices for Internet of Things based projects.



- .NET core is the preferred framework unless otherwise noted.

## **2.6 User Documentation**

- Deployment Instructions will be included in Microsoft Word and PDF Format.

## **2.7 Assumptions and Dependencies**

The system is assumed to receive internet access at County Facilities during some point of operation. The WiFi connection must be reliable for the system to batch transmissions successfully to the server endpoint. Encryption protocols will be used for the transmission of data and a *COTS OBD-II* will be utilized for vehicle diagnostic data ingestion.

## **2.8 Apportioning of Requirements**

Enterprise portions of the project will be delayed until the Edge of the project is completed. See Software Design Document, section 4.0 for overview of System Architecture.

### 3. External Interface Requirements

The system takes input from *OBD-II* scanner which it receives from the vehicle's *ECU*. This data is saved in the memory of the microcontroller within each vehicle. The system generates output to a file onboard the device. The system uses a server to save data to a persistent database located at a county facility.

#### 3.1 User Interfaces.

An Example which LACFMS may look like but not actual

##### Management Application under development



1. User Login

2. List of Trips

3. Display a specific Trip

3.1.1 Managers login into *LACFMS* system. If username and password are valid the manager will be directed to a page which lists Trips collected from *LACFMS* system.

3.1.2 Managers can choose to select a specific driver and trip. The driver of a specific trip will be displayed along with a Map visualization of the actual route taken on this particular trip.

3.1.3 Managers who fails to login in correctly will be prompted again for proper credentials.

##### Driver and Trip Management

3.1.4 Employees login into *LACFMS* system.

3.1.5 Employees will be directed to a welcome page.

3.1.6 There will be a side menu which displays a list of scrollable trips. Each of these trips will be titled with locations of places they have performed work. This menu will be interactive. The user will click on a particular trip, they will be directed to fill out a form similar to the County Vehicle Mileage and Safety Check Form and be asked to release

information for each submission of these trips.

### Registration of new user or employee drivers

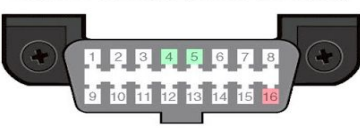


3.1.7 New employees who are asked to drive Los Angeles County vehicles for Parks and Recreation must register to use *LACFMS* system.

## 3.2 Hardware Interfaces

3.2.1 The *OBD-II* data link connector provides an interface to the *ECU*. The *ECU* is connected to sensors in many vehicle subsystems through the *CAN* bus. This protocol defines a method for requesting various diagnostic data and a list of standard parameters that might be available from the *ECU*. The parameters are addressed by Parameter Identification Numbers (*PIDs*).

3.2.2 The system will be capable of storing data and transmitting data by some microdevice which is capable of interfacing with the *OBD-II* data link connector to a server endpoint by WiFi or other technology.

3.2.3 An accurate *COTS GPS* module component will be utilized to gather positional data. Again, this data needs to be stored on a reliable device.

 <p><b>Data Link Connector (vehicle OBDII port)</b></p> <ol style="list-style-type: none"><li>1 Make/Model Specific</li><li>2 SAE J1850-PWM POS(+) or SAE J1850-VPW POS(+)</li><li>3 Make/Model Specific</li><li>4 Chassis Ground (all protocols)</li><li>5 Signal Ground (all protocols)</li><li>6 ISO15765-4 CAN-Bus High</li><li>7 ISO9141-2 K-Line or ISO14230-4 KWP2000 K-Line</li><li>8 Make/Model Specific</li><li>9 Make/Model Specific</li><li>10 SAE J1850-PWM NEG(-)</li><li>11 Make/Model Specific</li><li>12 Make/Model Specific</li><li>13 Make/Model Specific</li><li>14 ISO15765-4 CAN-Bus Low</li><li>15 ISO9141-2 L-Line or ISO14230-4 KWP2000 L-Line</li><li>16 +12v (always on) (all protocols)</li></ol> <p><b>OBD-II Connector(COTS) Connects to vehicle OBD port</b></p>	 <p><b>Microcontroller(COTS) Interfaces with OBD-II</b></p>	 <p><b>GPS Component(COTS)</b></p>
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## **3.3 Software Interfaces**

Application under development

- 3.3.1 The Web application will be built using .NET CORE 2.0 Technologies.
- 3.3.2 Front End Development will utilize a suitable framework.
- 3.3.3 Users will need a web browser.
- 3.3.4 Compatible MAP API.
- 3.3.5 Persistent Relational Database for storage.
- 3.3.6 The Edge interface will interconnect microdevices for data ingestion. The Edge interface must be responsive to large bandwidths.
- 3.3.7. The Edge interface will automate data flow management and monitoring.

## **3.4 Communications Interface**

- 3.4.1. The Edge interface will transmit data site to site over a suitable protocol to Platform Interfaces and databases.
- 3.4.2 The Platform interface will store data from Edge devices and pass it to the Enterprise interface.

## 4. Requirements Specification

The fleet management system is comprised of hardware components used to simplify data ingestion. The *LACFMS* shall interface with these hardware components to extract, store and transmit vehicle diagnostics and *GPS* data using *IoT* practices. The web application shall act as an intermediate allowing employees of Los Angeles County to submit information as a replacement to the County Vehicle Mileage and Safety Check Form. Employees shall authenticate using a web interface. Only Managers will be permitted to view detailed trip descriptions and trip visualizations.

Requirements for developers

4.0.1 The system shall implement the web application using .NET Core Technologies. Various technologies languages will be utilized as the client see fits, this may include Javascript, HTML5 and the Angular framework version 2.0

4.0.2 System shall implement Edge Interface to aide in data flow management and Monitoring. Edge interface is then configured to transmit data to Platform Interface.

4.0.3 *LACFMS* will implement a Map visualization using Google Maps API, Geolocation API to handle *GPS* processing.

### 4.1 Functional Requirements

4.1.1 The system shall gather and store driver route data

4.1.1.1 Positional data collected shall include the following, longitude, latitude and timestamp. Positional data in this context refers to global satellite positioning which will be used in conjunction with trip data. The timestamp shall have a date and the time from a 24 hour clock.

4.1.2 The system shall gather and store vehicle diagnostics data.

4.1.2.1 Vehicle Diagnostics data will be made up of speed, current odometer, and all pertinent data which is collected by the data ingestion device. This data should be all the sensors that exist on the car. Discretion will be used to determine what sensor data does not need to be stored. This data will be used to determine if the

vehicle has any operating abnormalities. Vehicle diagnostics data will be stored within a data lake for later data analysis. The analysed data will be available for maintenance and mechanics.

4.1.3 The system shall gather and store trip data.

4.1.3.1 *LACFMS* shall display the path traveled on a map which will be accessible by the management user. The path or route shall display the velocity of the vehicle along each route traveled.

4.1.3.2 Trip data will be made up of everything that is part of the County Vehicle Mileage and Safety Check Form that drivers normally fill out every time they drive a county vehicle. This data shall be stored within a relational database for supervisors and managers to access. The trip data shall use positional data to determine where the vehicle went and the time and date it went to certain locations. The trips positional data shall be superimposed onto a map.

4.1.4 The system shall interconnect microcontrollers with appropriate technology to perform high bandwidth transactions for proper data ingestion, storage and transmission of stored data.

4.1.5 The system shall require driver validation.

4.1.5.1 The driver of a Los Angeles County vehicle shall sign in to a vehicle by swiping their identification badge. The authentication system may disable the vehicle from starting.

4.1.6 The system shall store data in a persistent storage

4.1.6.1 All data will be sent to a Los Angeles County server infrastructure and stored into a database. Vehicle Diagnostic Data will be saved to a data lake. Trip Data will be saved to a relational database. Trip Data must be queryable by applications for supervisors and managers.

4.1.7 The system should allow for the generation of vehicle usage history for any given time period.

## 4.2 External Interface Requirements

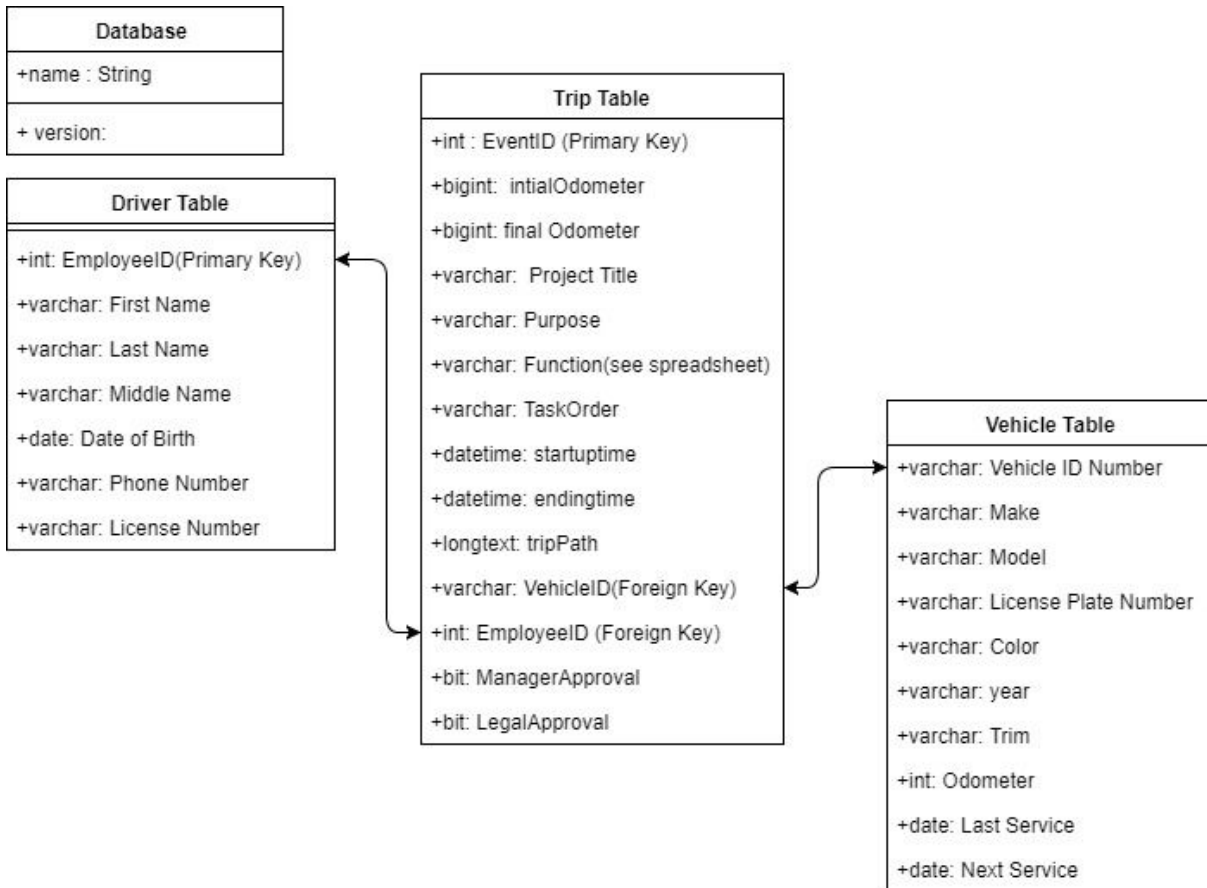
4.2.1 All employees shall input specific trip information into the web application.

4.2.2 The *LACFMS* system shall have a web application which shall register new employees if they do not currently exist in the database.

4.2.3 The *LACFMS* system shall display *GPS* data with vehicle locations.

## 4.3 Logical Interface Requirements

4.3.1 All data gathered from driver will be stored in a relational database such as SQL.



4.3.1 Employees can drive multiple vehicles throughout the day.

4.3.2 Employees must be identified with each vehicle that they have driven.

## 4.4 Design Constraints

4.4.1 Installation of *LACFMS* devices must not splice into a vehicle's wiring.



# 5. Other Nonfunctional Requirements

## 5.1 Performance Requirements

- NFR-5.1.1 Application should be responsive.
- NFR-5.1.2 During a trip, data should be captured at near real time.
- NFR-5.1.3 Routes along the Map visualization should be accurate.
- NFR-5.1.4 The application should be scalable up to 500 simultaneous users/drivers.

## 5.2 Safety Requirements

- NFR-5.2.1 User should not plug the *OBD-II* connector into the vehicle *OBD-II* Port while the engine is running. Ensure that the device is installed while vehicle is off.
- NFR-5.2.2 Federal Motor Vehicle Safety Standards.  
[https://en.wikipedia.org/wiki/Federal\\_Motor\\_Vehicle\\_Safety\\_Standards](https://en.wikipedia.org/wiki/Federal_Motor_Vehicle_Safety_Standards)

## 5.3 Security Requirements

- NFR-5.3.1 Security will utilize *IoT* best practices.

## 5.4 Software Quality Attributes

### Adaptability

- NFR-5.4.1 Capability to be modified to different specified environments.

### Availability

- NFR-5.4.2 System should be available 24 hours a day.

### Confidentiality

- NFR-5.4.3 System should protect sensitive data, and only authorized user should be able to access the map visualization of trip data.

### Interoperability

- NFR-5.4.3 Information is to be shared through a portal like solution displaying system data by means of a web application.

### **Maintainability**

NFR-5.4.4 Fleet management system code base should be easy to maintain.

### **Portability**

NFR-5.4.5 The devices used should be portable, easy to remove and not interfere with the operational use or instrumentation of vehicle.

### **Reliability**

NFR-5.4.6 System should be fault tolerant and operate without error under normal operations. If hardware failures should occur then the underlying software shall be inoperable until hardware is replaced.

### **Scalability**

NFR-5.4.7 Fleet management system should be scalable to varying numbers of vehicles. Los Angeles County Parks and Recreation maintains 500 vehicles in varying makes and models.

### **Usability**

NFR-5.4.8 Fleet management system should be easy to use for each user class specified in section 2.3.

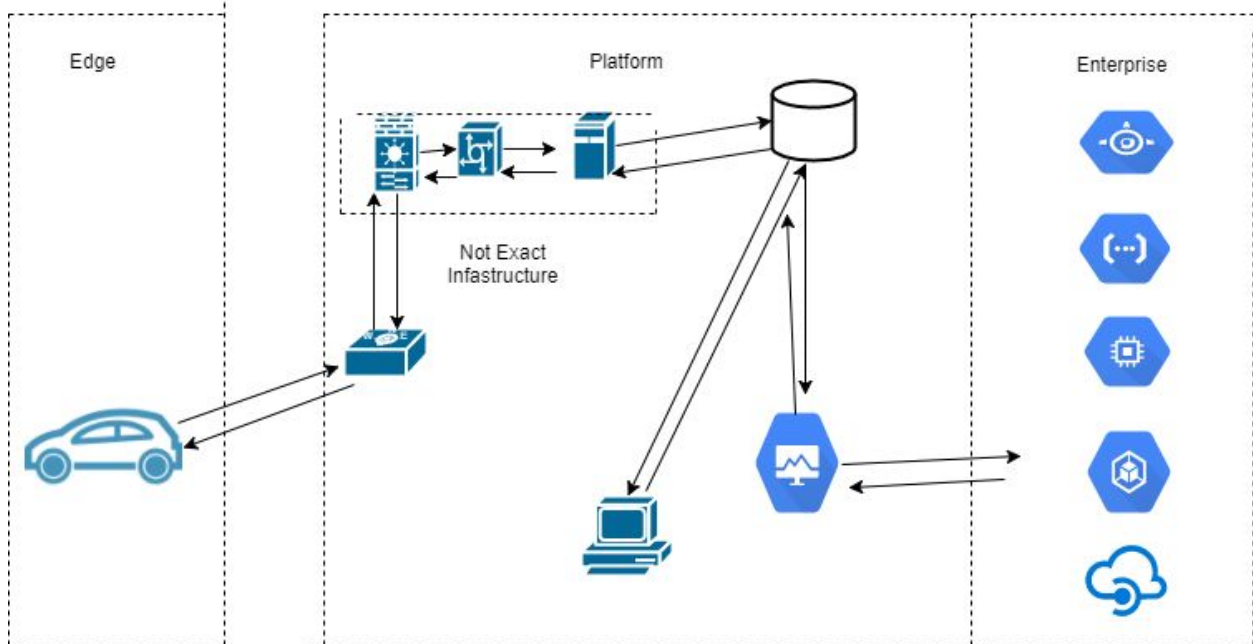
NFR-5.4.9 Web Application should have a mobile perspective.

## **5.5 Business Rules**

NFR-5.5.10 Los Angeles Parks and Recreation Employee must be an authorized employee to drive vehicles which have the *LACFMS*.

NFR-5.5.11 Vehicle Data Usage must be available to authorized person(s) only.

# Appendix A: Conceptual System Architecture



# Appendix B: Glossary

**CAN** - A Controller Area Network (**CAN bus**) is a robust vehicle **bus** standard designed to allow microcontrollers and devices to communicate with each other in applications without a host computer

**COTS (Commercial off the shelf)**, Refers to ready-made merchandise that is available for sale, defined by market need, significant functionality and complexity, and self-contained.

**ECU**-The Parts of the Engine the **ECU** Controls. The **ECU**, also known as the car computer, provides controls for a variety of systems within the engine. The following sections will examine these systems, including the control of air:fuel ratio, ignition timing, and idle speed.

**Global Positioning System**, is a radio navigation system that allows land, sea, and airborne users to determine their exact location, velocity, and time 24 hours a day, in all weather conditions, anywhere in the world.

**Graphical user interface (GUI /gu:'i:/)**, is a type of user interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notation, instead of text-based user interfaces, typed command labels or text navigation.

**Internet of Things (IoT)** The internet of things is the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive.

**LACFMS**: Los Angeles County Fleet Management System(LACFMS): Describes the overall software in this document.

**Low Frequency (LF) RFID** The LF band covers frequencies from 30KHz to 300KHz. Typically LF *RFID* systems operate at 125 KHz, although there are some that operate at 134 KHz. This frequency band provides a short read range of 10 cm, and has slower read speed than the higher frequencies, but is not very sensitive to radio wave interference.

**MQTT Protocol Specifications.** *MQTT* v3.1.1 is an OASIS Standard. ... *MQTT-SN* is a publish/subscribe messaging protocol for wireless sensor networks (WSN), with the aim of extending the *MQTT* protocol beyond the reach of TCP/IP infrastructure for Sensor and Actuator solutions.

***OBD-II*** PIDs (On-board diagnostics Parameter IDs) are codes used to request data from a vehicle, used as a diagnostic tool. SAE standard J/1979 defines many *PIDs*, but manufacturers also **define** many more *PIDs* specific to their vehicles.

**TBD-** To be determined