RASD e-Mall Hints (1)

1.1 Purpose

- limit the carbon footprint of our urban and sub-urban mobility needs by:
  - having a platform/app/system (eMSP) that allows monitoring electric mobility with the use of CPMS in order to optimize its services such as:
    - knowing where to charge the e-vehicle (locate charging stations owned and managed by CPOs)
    - planning charging processes in a way to limit constraints on our daily schedule
    - choose from various charging possibilities based on special offers set by various external energy providers (DSO)

1.1.1 Goals (WP <==> G)

Sub-system = eMSP (e-Mobility Service Provider)
Sub-system = CPMS (Charge Point Management System)

- G1: The eMSP should allow the user to obtain information about the charging stations.
- G2: The eMSP should allow the user to book a charge in a certain charging station before the vehicle runs out of energy.

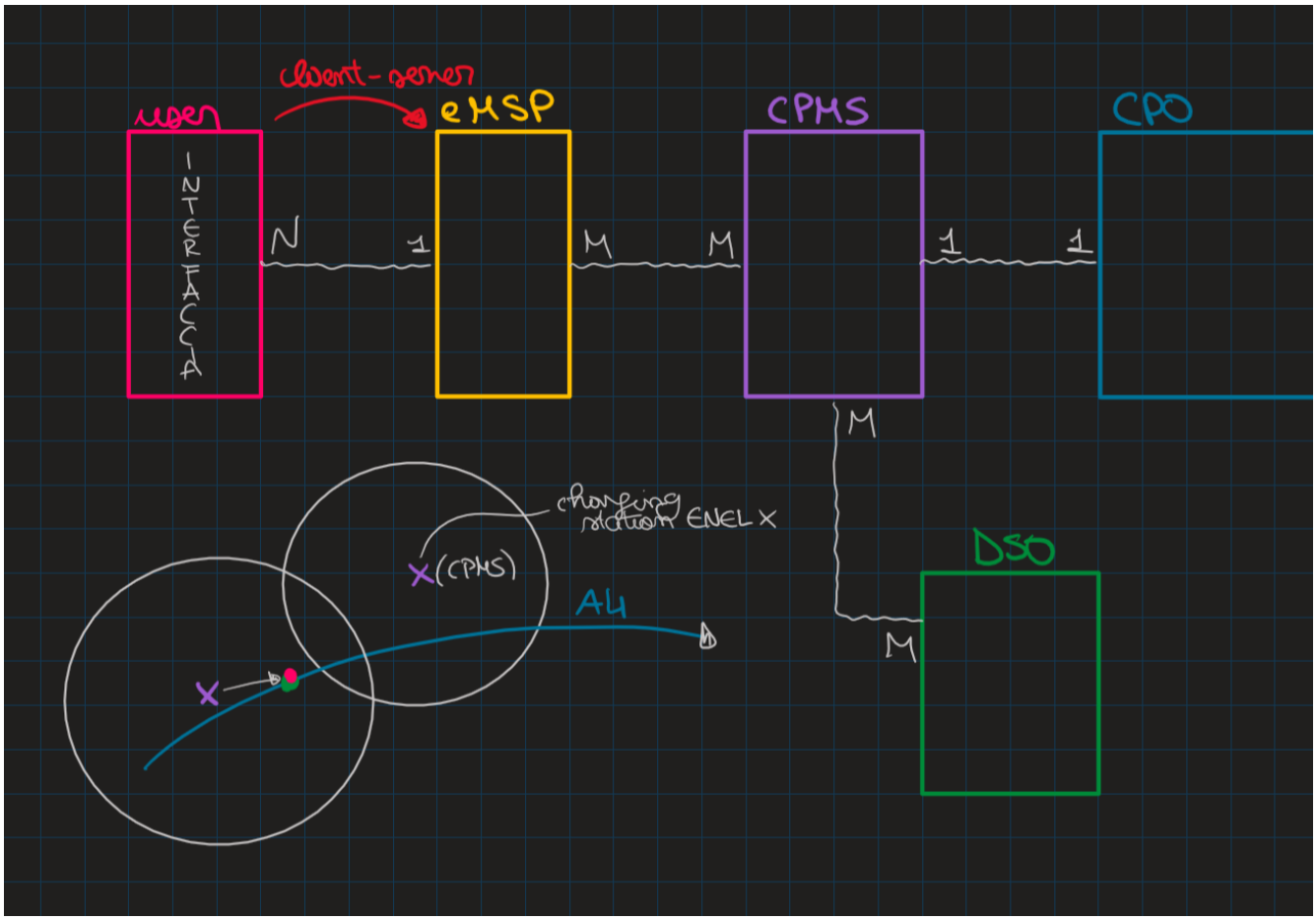
- G3: The eMSP should allow the user to manage the charging process (from its start to the payment) once he/she reaches the charging point.
- G4: The eMSP should give the possibility to the user to receive updates on the charging process.
- G5: The eMSP should show the user the optimized path to the destination based on the residual energy of the vehicle.
- G6: The CPMS should be able to handle the acquisition of energy from external third party providers (DSO).
- G7: The CPMS should be able to gather information about the DSOs' current price of energy.
- G8: The CPMS should store informations about the location, external and internal status of a charing stations. ("external/internal").
- G9: The CPMS should provide energy according to the type of socket chosen by the user.
- G10: The CPMS should decide where to get energy from (station batteries, DOS, mix).

1.2 Scope

ACTORS:

- Registered USER
- e-MSP (e-Mobility Service Provider) is the remote sub-system (passive server) called by the user which gathers informations by contacting CMPSs through uniform APIs.
  -which uses the exposed interfaces by CMPSs and used by users on their own local app instances.

- CPO (e.g. ENEL X/IONIX) (Charging Point Operator) administrated through CPMS and deployed through:
  - Charging stations
- CPMS (Charge Point Management System) administrates CPO's IT infrastructure by managing the relationship between the energy acquired by a DSO and the charging vehicle connected to the charging station's sockets.
- DSO (Distribution System Operators): external third party energy providers.



1.2.1 World Phenomena

- WP1: User's e-vehicle is running out of energy.
- WP2: User physically looks for an available charging station.
- WP3: Charging station's socket doesn't work properly.

- WP4: Catastrofic environmental disasters (earthquakes, avalanches, hurricanes, floods, heavy storms).
- WP5: Accidental damages occured on the infrastructures.
- WP6: User prepares the vehicle (parks, open the charging socket) for the charing process.

1.2.2 Shared Phenomena

#todo TODO: system = sub-system + sub-system or not
SP1: The charging station doesn't provide the guaranteed services presented by the eMSP. (Discrepancies between the real-world situations and the services CPO intends to guarantee)
SP2: The user looks up for a nearby charging station.
SP3: The user chooses the best charging station from the available ones based on its preferences.
SP4: The system shows the user informations about the charging process.
SP5: The system shows the user several payment methods.
SP6: The system automatically decides from which DSO energy should be acquired.
SP7: .....

1.3 Definitions, acronyms, abbreviations

1.3.1 Definitions

#todo

1.3.2 Acronyms and abbreviations

RASD - Requirements Analysis and Specification Document
WP - World Phenomena
SP - Shared Phenomena
GX - Goal number X
DX - Domain assumption number X
RX - Requirement number X
e-MSP - e-Mobility Service Provider
CPO - Charging Point Operator
CPMS - Charge Point Management System
DSO - Distribution System Operator
API - Application Programming Interface
VIN - Vehicle Identification Number

1.4 Reference Documents

The specification document: "Assignment RDD AY 2022-2023_v3.pdf"

1.5 Document Structure

#todo ..

2 Overall Description

2.1 Product perspective

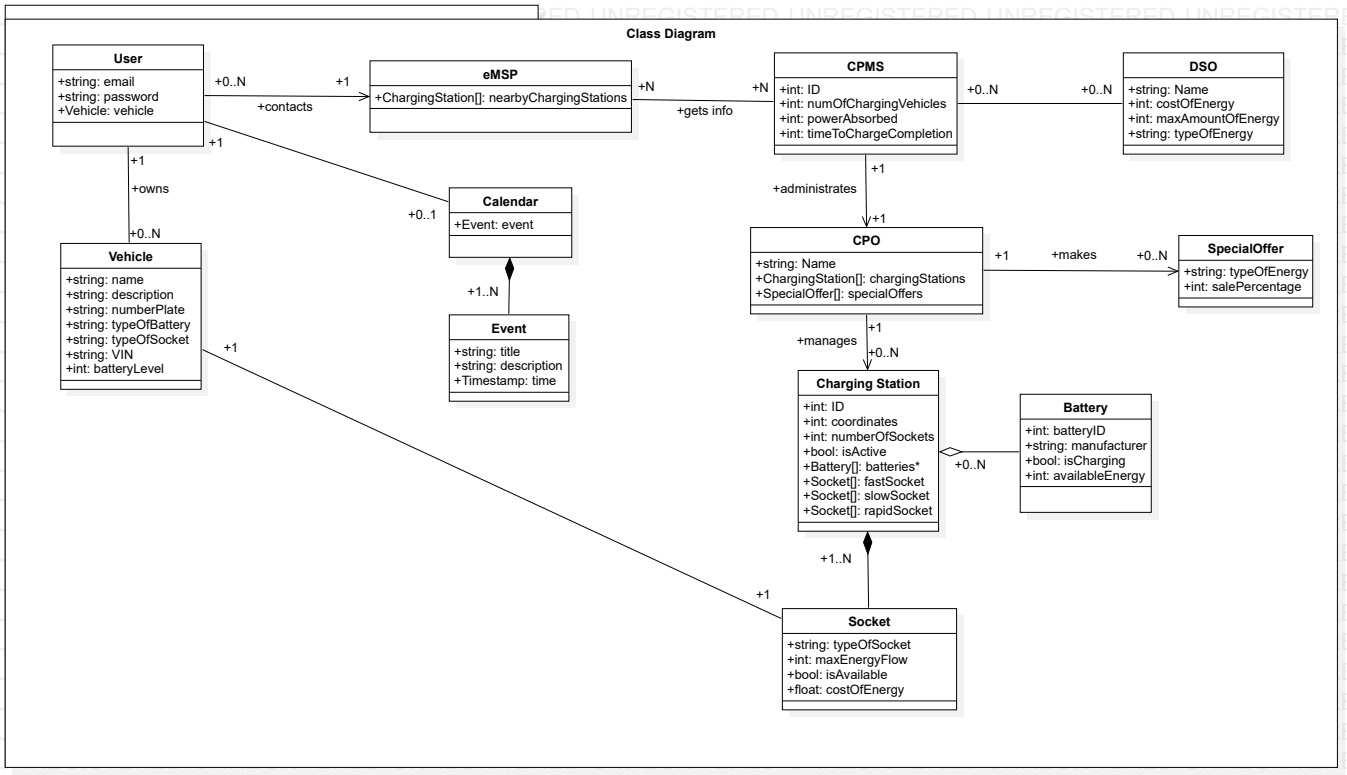
2.1.1 Scenarios

1. Unregistered user wants to use e-Mall
    1. Registering

    2. Access its profile and consult next charges
2. User looking up for charging stations (+filters)
    1. User wants to know the position of charging stations so selects SEARCH section of APP
        1. based on current location
        2. at a certain position
    2. Filtering and Sorting (ASC, DESC)
        1. range of distance from current or remote position
        2. range of price
        3. preferred CPOs
        4. prederred payment methods
        5. availability of sockets
        6. type of sockets
        7. special offers (range of sales percentage)
3. User booking a charge
    1. Selecting a certain charging station from the list provided
    2. Reads infos about the charging station
    2. Selects a timestamp for the booking and make a reservation
    3. Requires booking
    4. Receiving ack for the booking or notifying a failure (overlapping of the timestamp with other events in the calendar) and requiring other timestamps.
4. User scheduling a travel
    1. Select TRAVEL section of the APP
    2. Inserts destination and time of travelling.
    3. System calculates the best path using certain algos (e.g.Dijkstra, Bellman-Ford) and possibly based on battery

level if requested by the user and shows it to the user
    4. User confirms or declines the proposal.
5. User's vehicle is running out of battery
    1. System detects that battery is running out of ernergy
    2. System notifies the user in order to go an charge the vehicle suggesting the most convenient one.
6. Charging process executing (failure managements)
    1. User reaches the charging station
    2. User takes the proper socket and connects it to the vehicle
    3. User selects the percentage to achieve
    4. User selects Start on APP to start the charging process and selects target battery level or duration of the charge.
    5. Different sources (battery, direct (DSO deciding), mix (deciding), deciding DSO)
7. Payment

2.1.2 Class Diagram



2.1.3 State Diagrams

2.3 User characteristics

1. Unregistered user
2. Registered user
3. #to-do il cpo è fisico?!

2.4 Assumptions, dependencies, constraints

2.4.1 Domain assumptions

- D1: There exist uniform APIs allowing the user to interact through the eMSP with one or multiple CPOs.
- D2: There exist uniform APIs allowing the CPOs to interact with one or multiple DSOs through the CPMS.

- D3: The user inserts valid data when performing the registering phase.
- D4: The user approaches the charging station once he/she has book a charge within a certain time.
- D5: The user interacts with the charging station by following the instructions attached to the charging station.
- D6: The user interacts with eMSP by following the guideline provided by the eMSP.
- D7: Absence of inconsistencies between the a-priori defined energy flow offered by the DSO and the actual one used to charge the vehicle.
- D8: The user pays the booked service after the charging process has finished.
- D9: The user schedules a travel to a timestamp greater than the current one.
- D10: The system works properly in absence of inconvenient and unexpected events during travel.
- D11: The user frees the charging station once the charging process has finished.
  #todo

3 Specific Requirements

3.1 External Interface Requirements

3.2 Functional Requirements

3.2.1 Use case diagrams

3.2.2 Use case descriptions

3.2.3 Requirements

- R1: The eMSP should allow an unregistered user to register an account.
- R2: The eMSP should allow a registered user to look for a charging station.
- R3: The eMSP should be able to access the registered user's calendar.
- R4: The eMSP should be able to retrieve a list of the nearby charging stations based on the current position of the user's vehicle.
- R5: The eMSP should be able to show the registered user the list of the nearby charging stations.
- R6.0: The eMSP should allow the registered user to select a charging station from the list of nearby charging stations.
- R6.1: The eMSP should be able to detect if the battery status is going below a fixed threshold.
- R6.2: The eMSP should automatically show the user a list of nearby charging stations when the battery threshold is overpassed.
- R7: The eMSP should allow the registered user to book a charge at the selected charging station.
- R8: The eMSP should have access to the registered user's infotainment system.
- R9: The eMSP should allow the user to insert filters on the looking up operation of the charging stations.

- R10: The eMSP should allow the user to get information about the charging station selected (sockets available, type of sockets, costs, special prices).
- R11: The CPMS should allow the CPO to choose the DSOs from which to acquire energy.
- R12: The CPMS should allow the CPO to choose either to directly distribute the energy acquired or to store it into batteries collocated at charging stations.
- R13: The CPMS should allow the user to monitor the information about the charging process (price, energy flux rate, estimated remaining time, battery's charging status).
- R14: The CPMS should manage payment processes with different payment methods, responsible for the transactions.
- R15: The eMSP should allow the user to decide the desired battery level at the end of the charging process or the duration.
- R16: The CPMS should be able to dynamically calculate the residual time for the charging process.

HINTS:

- User can insert preferencies on the range of the charging stations's look up but the system can scale it based to the vehicle's remaining battery level.
- User decide where to go by inserting a destination and the system proactively calculates the most convenient path by individualizing the possible charging stations on it.

3.2.4 Mapping on Goals

G1 - D1, D3, D6 - R1, R2, R4, R5, R9, R10
G2 - D1, D3, D4, D6, D9 - R1, R2, R3, R4, R6.0, R7, R9, R10
G3 - D1, D2, D5, D7, D8, D10 - R11, R12, R13, R14
G4 - D1, D3, D5, D6, D7, D10 - R1, R13, R14
G5 - D1, D3, D10 - R1, R2, R4, R5, R6.0, R6.1, R6.2, R7, R8, R9, R10
G6 - D2, D7, D10 - R11, R12
G7 - D2 - R10, R11
G8 - D1, D4 - R10, R13
G9 - D2, D7 - R11
G10 - D2, D7 - R11, R12

#todo D11, R15, R16