smartCEM

Smart connected electro mobility

D2.4.3 (Platform integration for Newcastle pilot site)

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Table of Contents

Abbreviations

Abbreviation	Definition
3G	3rd generation of mobile telecommunications technology
AD	Activity Diagram
API	Application programming interface
APP	Application (software)
BEV	Battery Electric Vehicle
CAN	Controller Area Network
CIP	Competitiveness and Innovation Framework Programme
CS	Charging Station
CSV	Comma Separated Values
CYC	Charge Your Car
DB	Data base
DOD	Degree of Discharge
EV	Electric Vehicle
FC	Functionality
FTP	File transfer protocol
FTS	Forensic Telecommunications Services
GPRS	General packet radio service
GPS	Global Positioning System
GTFS	General transit feed specification
GUI	Graphical user interface
HMI	Human Machine Interface

Abbreviation	Definition
HTTP	Hypertext Transfer Protocol
ICE	Internal Combustion Engine
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
ITS	Intelligent Transport Systems
IVR	Interactive Voice Response
KPI	Key Performance Indicators
LTE	Long term evolution
MCB	Miniature Circuit Breaker
MSDU	MAC Service Data Unit
NC	Network classes
OBU	On-Board Unit
OCPP	Open charge point protocol
O-D	Origin-Destination
OSM	Open street map
PAYG	Pay as you go
PHEV	Plug-In Hybrid Electric Vehicles
POI	Point Of Interest (EV-related e.g. charging points)
PT	Public transport
RCB	Residual Current Breaker
RCD	Residual Control Device
RDM	Trade name for Richmond Design & Marketing Ltd., suppliers of

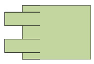
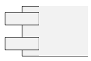
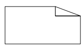
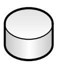
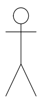
Abbreviation	Definition
	data loggers
REST	Representational state transfer
RFID	Radio Frequency Identification
RQ	Requirement
SaaS	Software as a service
SC	Speed classes
SDK	Software development kit
SH	Stakeholder
SIM	Subscriber Identity Module
SMMT	Society of Motor Manufacturers and Trader
SOA	Service-Oriented Architecture
SOAP	Simple Object Access Protocol
SOC	State Of Charge
TCP/IP	Transfer Control Protocol/Internet Protocol
UC	Use Case
UCAP	Ultra capacitors
UMTS	Universal Mobile Telecommunications System
UN	User Need
UNEW	Newcastle University
VPN	Virtual Private Network
WDM	Workflow and Demand Manager
WiFi	Commercial name of the wireless communication standard IEEE 802.11b

Abbreviation	Definition
WP	Work Package
WSDL	Web Services Description Language
XML	eXtensible Mark-up Language

Table 0-1 Abbreviations

Graphical symbols

Table 0-2 describes the graphical symbols used for depicting the architectures.

Graphic symbol	Description
	smartCEM ICT component
	Existing or external ICT component
	Software service (e.g. interface)
	Data message
	Web server
	Database server
	Database
	General server. It documents, from a high level point of view, an entity that hosts a service.
	Smartphone or Tablet (PAD)
	Wireless communication (WiFi, Bluetooth, 3G, LTE, GPRS)
	Actor: end-user, operator, administrator, EV-driver

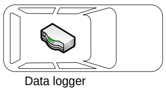
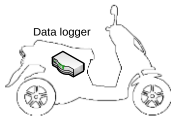
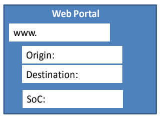
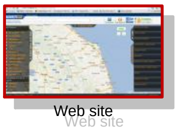
Graphic symbol	Description
	On-board unit, data logger
	On-board unit, data logger
	Generic web portal
	www.transportdirect.info web site
	Multimodal trip planning web site

Table 0-2 Graphical symbols

Executive Summary

D2.4.3 describes the adaptation and integration of existing software platforms into one smartCEM platform as performed in the pilot site at Newcastle upon Tyne, UK.

Several components and interfaces help to define the Newcastle pilot site architecture. These include the software and interfaces surrounding EV-Navigation and EV-Charging Station Management services supplied by CYC and PTV, along with value-added services, namely the EV-Efficient Driving, the EV-City Policy Tool, and the Multi-Modal Transport Planner. Central to all of them is the smartCEM Common App.

These components and interfaces enable services to cooperate and exchange information in a harmonized way to provide users with the best possible experience, contributing towards an enhanced EV traveller experience, and ultimately it is hoped through successful completion of the project, a stimulus towards greater uptake of EVs throughout Europe.

The deliverable presents seven components and five key interfaces. Six issues relating to the implementation are identified: three operational, two user-related, and one technical. None of the issues threatens the overall operation of smartCEM in Newcastle.

1 Introduction

This document is a deliverable of Task 2.4 *Technical adaptation work for pilot sites: platform integration* for the Newcastle upon Tyne pilot site of smartCEM. In this Task project partners work towards the adaptation and integration of existing software platforms into one smartCEM platform. The document also reports the technical adaptation from Task 2.1 *Requirements and specifications* and the design and integration work of Task 2.2 *Develop reference architecture, standards and best practices* and Task 2.3 *Technical Architecture*.

In Task 2.3, ICT providers implemented software components and functionalities in the four smartCEM pilot sites after analysis conducted together with local stakeholders. These components meet the important requirement of being interoperable and re-usable between the different sites. Thus a suite of software components (smartCEM deployment kit) has been implemented as part of the local integration in Newcastle and the other sites.

Local deployment barriers require each pilot site to have a locally-specific implementation of the smartCEM platform. Consequently, an objective of this document is to describe how the smartCEM services must be adapted and connected to existing local applications in Newcastle.

This document can be read in conjunction with D2.3 *Guidelines and requirements for local systems integration into smartCEM*, in which the guidelines to implement the smartCEM services in each pilot site are provided.

D2.4.3 is structured in four main chapters:

- Chapter #2: Architecture. This section provides a graphical overview of the Newcastle local architecture, how components are connected and interfaced locally.
- Chapter #3: Components implemented. Describes the instantiation of the smartCEM components in the local systems.
- Chapter #4: Interfaces and standards implemented. Describes the software interfaces implemented in Newcastle.
- Chapter #5: Conclusion. Provides a summary of issues encountered during the implementation process.

2 Architecture

This chapter describes the local architecture of the Newcastle pilot site, highlighting the updates performed during the implementation process, in comparison to the initial architecture proposed in deliverable D.2.3.

2.1 Proposed architecture

The Newcastle architecture is presented visually in the following diagrams. Figure 2-1 presents the CYC App and PTV Navigator along with the web link connection to the UK Multi-Modal Trip Planner of Transport Direct and the EV-Efficient Driving post-trip analyser. Figure 2-2 shows the in-vehicle data logging technology, smartphone and web interfaces, and the EV Policy Tool.

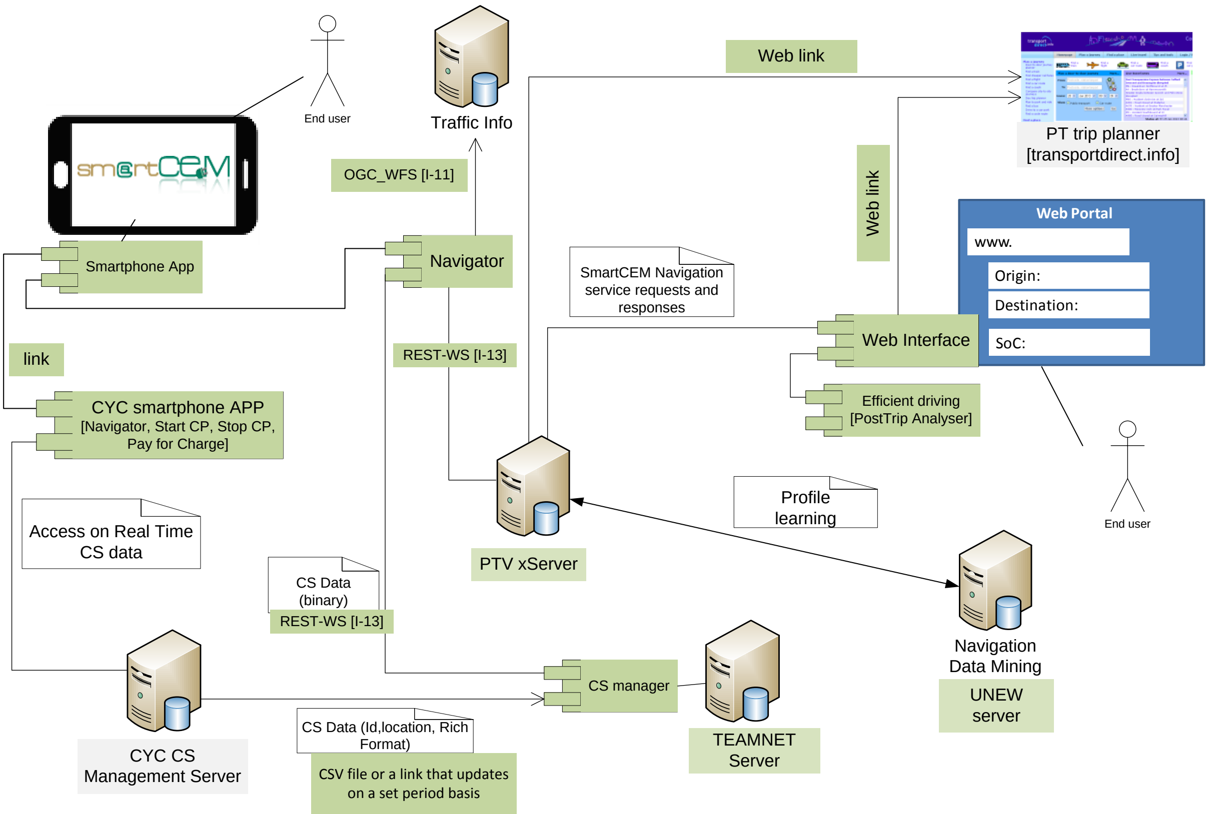


Figure 2-1: PS NCL Architecture 1

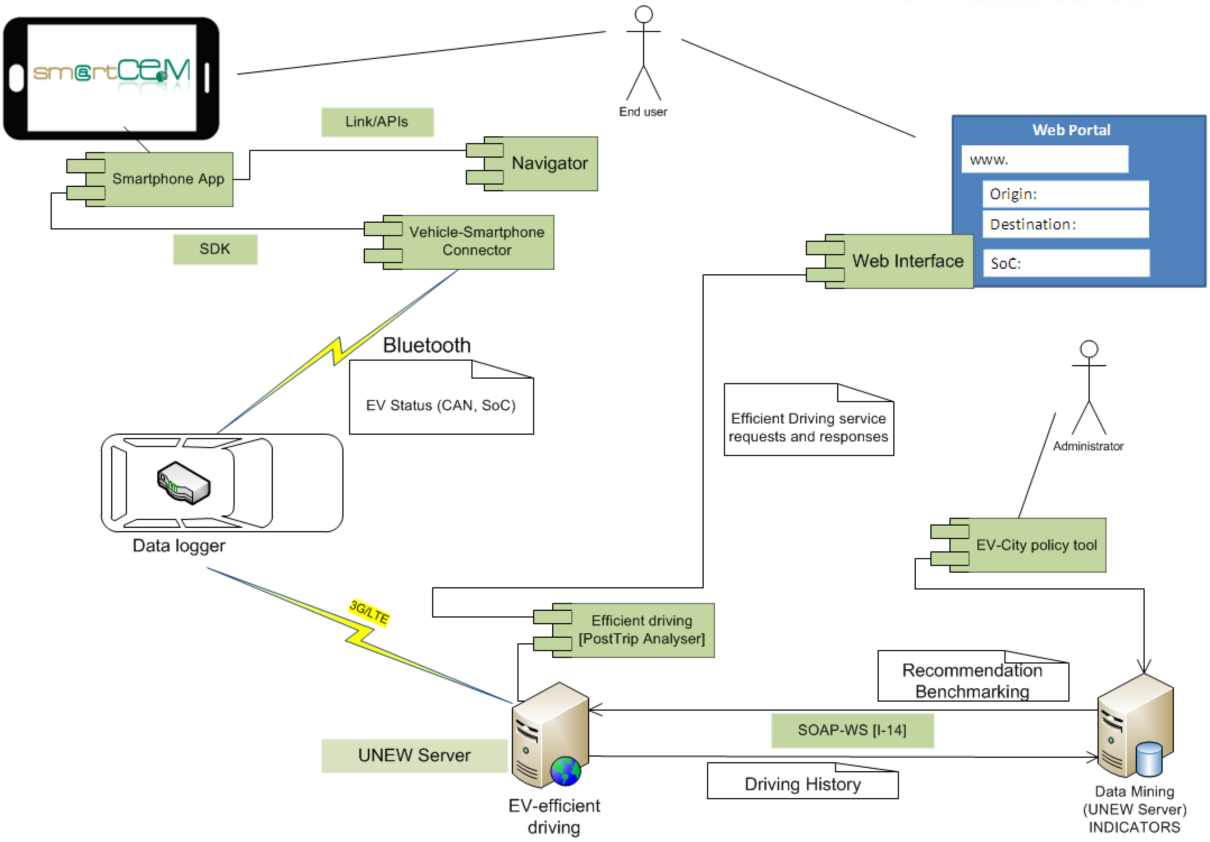


Figure 2-2 PS NCL Architecture 2

2.2 Changes or adaptations to architecture

The architecture remains the same as reported in D2.3. The main user interface for access to services is the CYC (Charge Your Car) App. This App is accessible via the smartCEM Common App when the user is localized (e.g. through GPS) around the Newcastle area. In the Newcastle pilot site CYC data to be made available includes charging station locations and selected charging transactions data. The App combines CS management, mapping and mobile payment technologies to allow users to find charging stations, plan a route, start and stop a session and pay for a charge at all App-ready charging stations across the national network. The App features a live map that shows the current status of all charging stations across the network. For navigation, the user can choose either the CYC navigator or PTV navigator, which are both accessible through the smartCEM Common App and both of which contain charging station maps. These and other components illustrated in Figure 2-1 are discussed in section 3 below.

The interfaces shown in Figure 2-2 are discussed in detail in section 4 below.

There is one technical adjustment to the architecture in Figure 2-1. The arrow between CYC CS Server and TeamNet CS Manager has been reversed. The information flows from CYC to TeamNet as CSV files.

2.3 Architecture limitations

There are three operational limitations to the architecture. Firstly, for commercial reasons there is a limit to the type and amount of data available from CYC for use in smartCEM. Secondly, if a low number of vehicles are participating in the trials there are implications for the vehicle-specific learning process and the supply of online data to the PTV Navigator. Thirdly, there is no control over the content on the Transport Direct site, and the Newcastle PS cannot guarantee its reliability.

In addition there is one identified technical limitation. There is limited 3G coverage in some locations which can delay the sending of trip summaries to the server for the EV-Efficient Driving post trip analyser.

3 Components implemented

This section describes the local system components implemented in the Newcastle pilot site.

3.1 Component #1 – smartCEM Common App

This application gives the user the opportunity to access applications and websites that provide electro-mobility IT services. The smartCEM Mobile Portal is therefore a gateway to all EV services implemented within the project. It is delivered as an Android Application, and once installed, provides information on the EV-services available and offers the potential to install and launch other applications on the Android platform.

The SmartCEM Mobile Portal is currently available at:

http://smartcem.teamnet.ro/SmartWebManager/Apk

It will become available on Google Play by the end of 2013. There are currently no plans to develop an iOs version of the Portal.

3.1.1 Functionalities

The main function of the Mobile Portal is to display lists of EV-related services. For each service, the user is able to:

- Browse descriptive information
- Launch a corresponding application or website

In order to facilitate access and ensure ease of selection, the application displays services by category (in separate UI tabs) and by site (so that the user can select only services that are available at his current location).

There is an option for automatic selection of the current site, based on the GPS coordinates of the running device, as well as the option to display all the services, regardless of their geographical availability. Background information of the project, as well as of the sites is also available within the UI of the application

3.1.2 Process

The smartCEM Mobile Portal provides access to other applications and websites. For this, the following metadata is used:

- The description of smartCEM implementation sites. This includes basic data and the coordinates of the geographical area of each site
- The description of the available smartCEM services. A mapping of services-to-site is specified. Several service categories are defined. A service can be part of more than one category
- The description of the available smartCEM applications and their interfaces. A mapping of service-to-application is specified

All installations of the smartCEM Mobile Portal connect to a central database in order to retrieve the current version of the metadata.

A separate web application, the smartCEM Management Console, manages the metadata used by all Mobile Portal installations.

Once installed on the user's smartphone/tablet, the smartCEM Mobile Portal connects to the central database, downloads the metadata, and presents the user with the UI that allows him/ her to:

- Browse available sites and their information
- Select the current site (the current site can be detected automatically if the mobile device that runs the portal has GPS capabilities)
- Browse available services
- Select any service and launch its corresponding application/website

3.1.3 Issues

3.1.3.1 Applicability

There are no significant issues with this component. The installation of the smartCEM Mobile portal (as well as the auxiliary management web console) has no site-specific implementation details related to the Newcastle pilot site. All the specifics are being handled by customization of the site metadata, within the portal's central database.

3.2 Component #2 - Charge Your Car (CYC) Network and Smartphone App

3.2.1 Functionalities

Charge Your Car (CYC) is the UK's pay-as-you-go recharging network for electric vehicles. CYC launched in 2010 in the North East of England, and is now expanding into a national UK network. CYC recently became a limited company. In North East England CYC forms a core infrastructure component for the operation of smartCEM's UK pilot site.

CYC is not a charge point owner (in smartCEM, and thus throughout this document, charge points are referred to as Charging Stations), but is a single national charging station management system for the ever-expanding national network of charge stations. It enables station owners to connect to the network, making their posts visible to all EV drivers via the CYC live status map. Charge station owners can set the tariff for each station, collect payment, and provide alerts to maintenance teams in the event of a fault. CYC operate a billing and settlement system which allows owners to set a tariff for each post which is then collected from drivers by CYC. At the end of each quarter the income raised by each post is disbursed to owners after service and tax deductions.

For drivers, the CYC Lifetime Card (RFID) provides access to all charging stations on the network whilst the CYC App is the first App that lets EV drivers find and use charging stations. To use the network, EV drivers register a debit/credit card, which connects to their CYC Lifetime Card and App.

In summary CYC offers the following functionality:

- The world's first App that lets you use charging stations
- New charging stations added every month
- Mix of free-to-use and pay-to-use charging stations
- One-click search facilities to view map or lists of charging stations nearby
- Search charging stations by town, postcode or point code
- Filter charging stations by connector type (slow or rapid)
- Live status of charging stations
- Plan a route to a charging stations
- Start, end and pay for a charging session
- Bookmark favourite charging stations

- Latest news and information – new charging stations, etc.
- Helpdesk telephone support
- Activity history
- Personalised online account with downloadable PDF records of usage and payment history

Figure 3-1: CYC App showing national charging station map

3.2.2 Process

In the Newcastle pilot site CYC data to be made available includes charging station locations and selected charging transactions data. The free CYC App (launched July 2013) will be available as a link. The App combines CS management, mapping and mobile payment technologies to allow users to find charging stations, plan a route, start and stop a session and pay for a charge at all App-ready charging stations across the national network. The App features a live map that shows the current status of all charging stations across the network. The App is available to download free from the Apple App Store or Google Play.

This App is accessible via the smartCEM Common App when the user is localised (e.g. through GPS) in and around the Newcastle and wider Tyne and Wear area.

As for the EV-Navigation service, the user can choose either the CYC navigator or PTV navigator (Component #3), which are both accessible through the smartCEM Common App and both of which contain charging station maps. Along his/her trip, the user (EV-driver) is supported by the EV-navigation service by means of the smartCEM Navigator component, running into the user’s smartphone.

3.2.3 Issues

There is a limit to the type and amount of data that is available from CYC for use in the project because of commercial sensitivities. For example, detailed charging data for all CS users will not be made available, but selected transaction data for vehicles involved in the pilot will be made available.

3.3 Component #3 – PTV Navigator

3.3.1 Functionalities

The EV-Navigator is a common component in the smartCEM architecture, designed to run standalone, connected to the vehicle or connected to other applications. It provides classical Navigation functionality such as:

- Map display and route visualisation
- Input of destinations
- Turn-by-turn route guidance
- Various setting-possibilities
- Programming interface

These are combined with functionalities to specifically support the eMobility-user, such as:

- Display reachable range as a polygon, taking into account many vehicle and situation-dependent parameters (see 3.3.2c for more Details)
- EV-Assistant: display current status of electricity consumption and other

current values

- EV-Assistant-Simulator: lets the user simulate potential situations (like range if the battery is only half capacity)
- EV-Charging Station Assistant (see 3.3.2c for more Details)
- EV-Eco-Driving routes (see 3.3.2c for more Details)
- EV-Eco-Driving hints
- EV-Key-Value store interface

Users can integrate the Navigator in a tablet that is installed in the car or given to car users, but it is also possible to use the application on any android Smartphone, so a multitude of screen resolutions and devices can be supported.

3.3.2 Process

a) Learning process

As a basis for most EV-specific functionality a vehicle profile with specific EV-relevant values is needed. This vehicle profile is derived from learning processes.

At the beginning a rough estimation profile will be used, and then refined by learning processes (recommended by the developer based on log files and frame parameter calculations) as well as field test results.

b) Typical usage

If the user starts the Navigator, he sees a map of the current location, where he can orientate himself, browse and explore the map.

Then the user enters the destination. There are various options like addresses, zip codes, last destinations, favourites, home and office, POI or selection positions from the map. It then begins to navigate.

While navigating the user gets turn-by-turn navigation hints, route and manoeuvres (shown visually), and automatic zooming, which always provides a situation-dependent optimal view of any situation. Sign posts and junction views provide additional orientation.

The Navigator runs with 20 languages and 16 Text-to-Speech languages, it can be customized in many aspects, like specific vehicle attributes, map designs, map types, international units.

Special strengths are supporting logistics vehicles, with their different routing needs and local knowledge (tolls, specific measures, dangerous goods, type optimized routes), and the available assistants that support in various situations like a speed assistant or speed traps.

If the Navigator should be integrated into processes (like automatically entering targets and start navigation) an extensive API can be used.

c) EV-use cases

The user of an electric vehicle has various options beyond those described above. If he/ she starts driving be it with or without navigation, he sees in the EV-Assistant how much energy he is consuming, both with the engine and the other energy consumers in the car.

With simulation mode he can also define current values like Battery usage (SOC), usage of climate control (AC/heating) and current temperature, to work on a "what if" status. If there are no current values fed from the car, the system can work completely on simulation, using user input or predefined values, so the system can also be used on any smartphone without the car.

Most important is the reachable range that is calculated on an external server, and transferred fluently into the navigator, showing exactly with a polygon-defined range, how far in each direction the EV could travel.

If the user sees that he may have difficulties in reaching his destination, he can switch to an eco-mode that calculates very energy efficient routes, and shows hints (like given speeds on different roads).

Included in the range calculations are a lot of vehicle/driver-specific parameters like:

- Road type dependent energy consumption
- Road type dependent driven speeds
- Battery degrading over time or distance
- Battery capacity and usable energy portion
- Current state of charge (SOC)
- Temperature influence on battery
- Heating/cooling influences
- Current consumers
- Battery temperature
- Outside temperature
- Height/slope influence factors on energy consumption

- Vehicle weight and additional loads/people
- Current Traffic situation
- Vehicle restrictions like truck restrictions or toll preferences

A charging point assistant helps to find charging points along the routes, to show them on the map and to integrate easily into the route without losing the original target.

3.3.3 Issues

The vehicle-specific learning process may consume a lot of effort, if there are not many vehicles where it can be used.

The same occurs with feeding online data to the Navigator. This may not be applicable if there are not many vehicles or if there are legal restrictions, so the Navigator has to be usable without real time data acquired from the car. The required data can then be entered manually by the user.

Not all functionality is offered from the start especially slope dependant ranges, eco-driving, eco-hints and real time traffic, all of which will be implemented later. Real time traffic, as well as slope dependent ranges and eco-hints are expected for the end of Q1/2014.

3.3.3.1 *Lessons learnt*

A lean learning process for EV-vehicles is highly appreciated, as a too complex learning process may not be possible. The reasons for missing possibilities to implement a complex learning process lie mostly in unavailable vehicle data, e.g. if the data cannot be extracted from the CAN bus of the vehicle, there is a too low quantity of test drives possible, there is no capacity to develop a complex learning process, or there are legal restrictions if vehicles belong to a third party.

3.3.3.2 *Applicability*

The Navigator will not be used in all aspects, especially detailed learning processes, and interface connections for feeding real time data or entering destinations automatically, but it offers the potential if the system is expanded.

3.4 Component #4 – Efficient Driving Post Trip Analyser

3.4.1 Functionalities

This component implements the EV-Eco-Driving application for the Newcastle site. The description below refers to the whole logic of the post-driving eco-driving online tool. It can be divided into two main parts, server side and vehicle side.

Server side: this includes all the software and web portals hosted in UNEW's server for the smartCEM trial.

- **DATABASE:** The main source of historic EV driving data from the Switch-EV trial. It stores the raw second-by-second driving data and processed trip summaries for each trip (including energy use, GPS signal and time stamp).
- **WEB PORTALS:**
  - **Client web:** a public web page where end users can review their trip summary in terms of acceleration and deceleration profile, idling time and energy regeneration
  - **Admin web:** private web page where the system administrator checks and configures all the data related to the eco-driving application
- **BACKGROUND SOFTWARE:** Algorithms that are based on the Footlite project and have been adapted for EVs for smartCEM. It is based on Django and PostgreSQL with additional data handling and analysis using bespoke Python scripts.

Vehicle side: this part includes all the hardware and software installed in on board data loggers. The system is based on RDM data loggers. The loggers enable the collection of real-time second-by-second driving data by connecting to the CANbus through the vehicle's OBD (on-board diagnostics port). In addition to the CANbus the loggers can also record external analogue and digital inputs. These inputs include the GPS and timestamp as well as a number of analogue inputs from current clamps which are attached to various electrical systems of the vehicle to measure current flow and battery drain (and regeneration). The raw data collected (Figure 3.2) monitors all aspects of vehicle usage and it is used in this work to calculate the performance of the vehicles under different topographical and traffic levels. The performance is expressed in terms of energy consumption (kWh) per kilometre driven.

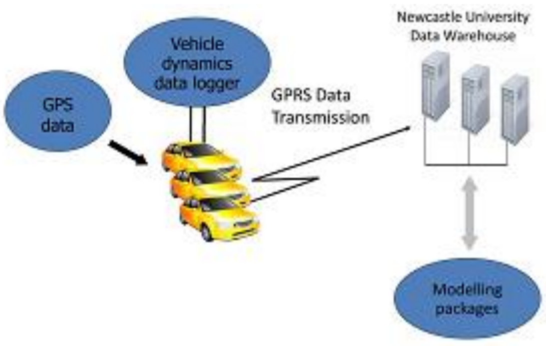


Figure 3-2: Real-time data collection infrastructure

3.4.2 Process

Server side: The server side has been developed using Python and R scripts. The web portal has been designed using Django, PostgreSQL and Python scripts. The portal will also host links to the CYC App and the Transport Direct multi-modal trip planner (Component #6 below).

Vehicle side: On the vehicle side the required data is collected from the CANbus of the vehicle and sent to an on-board logging system. The collection of the data is managed by the loggers currently installed on the vehicle. The data is then uploaded to either a local server in UNEW or to the commercial partner who has supplied the logger. Access is granted by the commercial partner to the server and the files containing the vehicle data are then transferred over to the local Newcastle server where the post-processing algorithms turn it into completed trip data.

3.4.3 Issues

3.4.3.1 *Lessons learnt*

AN EV-Eco-Driving service and web portal were originally deployed for the Footlite project (ICE vehicles). Some of the drivers participating in Footlite were uncomfortable being monitored and having their driving (as they perceived it) 'judged'; the Footlite participants were fleet drivers who were worried that their driving style would be judged by their managers. This is not envisaged as an issue in smartCEM where the drivers are all private motorists who are likely to 'buy in' to the project ethos. Measures will also be taken to minimise negative experiences, possibly through an element of competition being introduced.

3.4.3.2 *Applicability*

This system can be integrated by each of the pilot sites as long as UNEW is provided with the second-by-second data for each trip. Data can be collected through smart phones, data loggers or OBUs.

3.5 Component #5 – EV-City Policy Tool

3.5.1 Functionalities

Multiple factors will define the uptake of EVs, covering investments costs up to daily operational impact. The EV Policy Tool will investigate these factors in various combinations in order to understand the technical impact on the energy balance and travel planning.

The tool will elicit understanding of the interaction between travel and energy planning as a cooperative electro-mobility challenge. The tool will:

- Optimize routes and charging schedules for the whole fleet of EVs
- Provide a planning tool for increased EV penetration
- Help to evaluate impact on user acceptance

For the functioning of the EV Policy Tool, traffic flow data has to be acquired from the test site. Primarily, the tool will be tested with data obtained from the Newcastle pilot site and later extended to other pilots as and when required.

Traffic data is fed into the traffic simulator and the EV penetration will be varied. This will enable the Degree of Discharge (DoD) in the network to be studied. DoD will be an indicator for the amount of charging requests that will be generated within the network of the pilot site.

Once this baseline is established, the next phase will comprise implementation of the demand-based dynamic routing of EVs to the charging stations. In this phase the optimal charging plan for EVs can be dynamically changed such that the optimality is not overly compromised whilst at the same time EV users (drivers) are sufficiently satisfied. This will help increase user acceptance. This phase will also avoid conflicting charging requests.

An initial incorporation of the Newcastle map in a traffic simulator and the key areas where traffic originate are shown in Figure 3.3. This is based on traffic data received from Newcastle City Council. For this study, in a simulation environment, conventional vehicles are changed to EV with standard battery model.

Figure 3-3: Real-time data collection infrastructure

3.5.2 Process

A DoD trend for a single journey is shown in Figure 3.4. Based on the distance this can vary between 0.5% -3.5 %. A few vehicles which are towards the higher end of the graph are the vehicles which are leaving the network and with longest routes. Based on these observations, it is possible to assume that the average DoD of a vehicle with an average number of 20 trip per day is around 70%. This would require at least one charging stop per day.

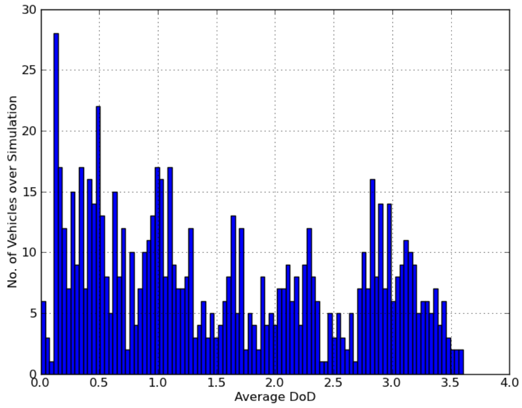


Figure 3-4: Average DoD (%) per single trip

With a more detailed analysis of the trend, the EV Policy Tool enables city planners to install an appropriate network of charging stations. For CS operators, they can provide a more accurate availability of the CS and also ensure that conflicts are resolved so that the EV users can plan their charging stops and also experience minimum waiting time.

In the future, with higher EV penetration, including for example EV delivery vehicles, the policy tool will be able to map an energy optimal route with the possibility of automating the re-delivery attempts (in case of dynamic consumer behaviour). Re-delivery will account for the amount of energy remaining as well as user preference. The same planning tool can be used by individual EV users as well to plan their route to minimise their charge time and therefore to maximise their drive time.

3.5.3 Issues

If required data is not provided or for some reasons not obtainable by the pilot sites then the tool may not be able to process the information and execute the desired outcome. This is not expected to be an issue in Newcastle.

3.6 Component #6: Multi-Modal Trip Planner

3.6.1 Functionalities

Transport Direct (TD) is a web-based national journey planner in the UK that aims to offer real-time pre-trip and on-trip information on door-to-door multi-modal travel. Specifically, Transport Direct enables the user to:

- Compare public transport options with a car route to find the most suitable way of travelling
- Obtain a car route that takes into account predicted traffic levels at different times of day enabling informed travel decisions
- Get an estimate of the cost of a car journey
- Buy train and coach tickets from affiliated retail sites without having to re-enter details
- Use PDAs and mobile phones using the latest browser technology (WAP2.0) over a GPRS or 3G connection to find out departure and arrival times for railway stations throughout Britain and for some bus or coach stops
- Calculate CO_2 emissions for a car or public transport for a specified journey

Transport Direct is “Connecting People to Places” by making it easy for the user to find out where he/ she want to go and how to get there. It works with both public and private travel operators and local/national government and is now working with third parties to make elements of its service available through their websites.

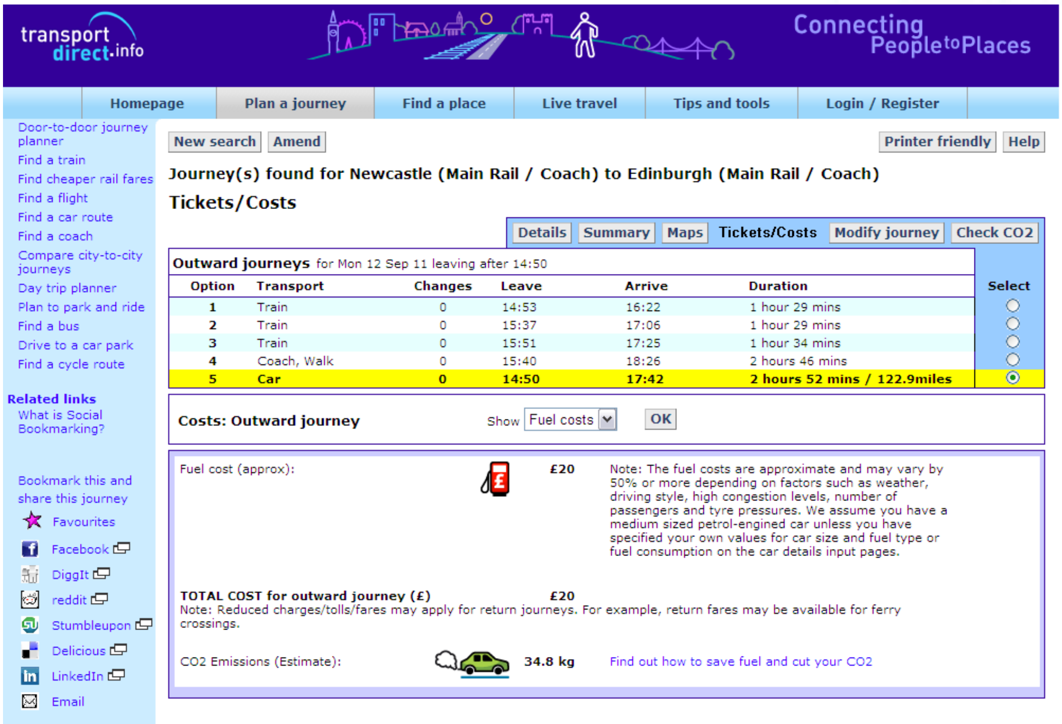


Figure 3-5:Transport Direct multi-modal trip

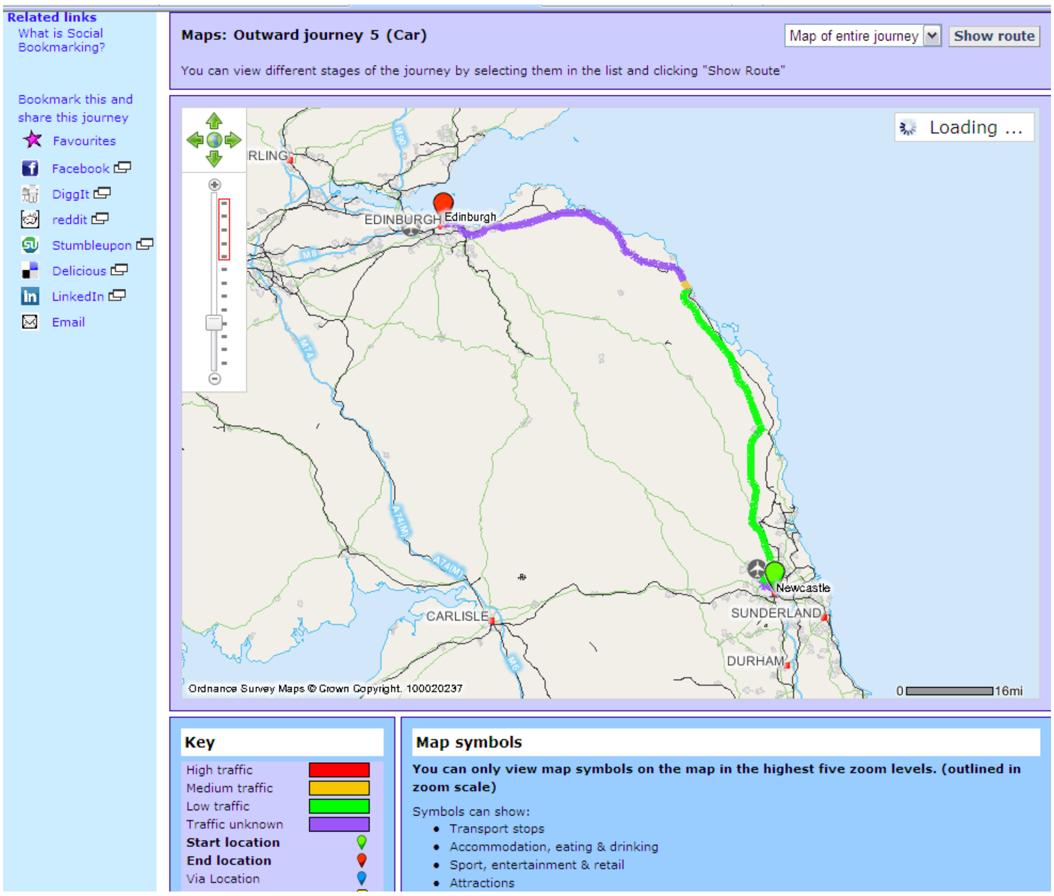


Figure 3-6: Transport Direct car route

3.6.2 Process

Connection with the Transport Direct trip planning website is important to the Newcastle pilot site as it enables the user to plan long distance journeys by a variety of modes. More significantly in the long run it enables EVs and the charge station infrastructure as a mode of transport to be considered for a journey in its own right. To this end a link will be provided to TD from the Efficient Driving web portal (Component #4).

3.6.3 Issues

smartCEM can in no way influence the content on the Transport Direct site, or guarantee reliability. It is an external source of information to which a link is supplied.

3.7 Component #7 – CS Manager

3.7.1 Functionalities

This component implements the EV-charging station management service.

3.7.2 Process

The smartCEM common component interacts with the EV-navigation, in order to provide charging station details (location, IDs, name).

CS data are imported in CSV format from the local charging station provider.

3.7.3 Issues

Care must be taken so that the functionalities of CS Manager do not overlap or conflict with the services provided by the CYC Application. Since the CS Manager only provides static info, it may be of interest to provide a link from CS Manager towards CYC service.

3.7.3.1 Applicability

The installation of the smartCEM CS Manager mobile application has no site-specific implementation details. The integration solution employed between CS Manager App and Navigator app is unique, used in the same configuration for all the sites.

4 Interfaces and Standards implemented

This section describes the interfaces between application systems and subsystems at the Newcastle pilot site.

4.1 Interface #1 Android App and BlueDash™

4.1.1 Functionalities

BlueDash™ (www.dquid.com) is a unit which can be installed in any car to access on-board vehicle data and transmit it via Bluetooth to a smart phone or tablet. The BlueDash™ unit is able to read vehicle data via the CANbus. The data can be used via a potentially endless number of applications. On the touch screen of mobile devices such as iPhone and Android, it is possible to visualise vehicle performance, fuel consumption and emissions. Bluedash is equipped with GPS for positioning data and GPRS for data communications with the DQuid server and, consequently, the UNIMORE server.

4.1.2 Choice of standard

Bluetooth, GPRS, GPS.

4.1.3 Process

The Bluedash™ unit will send data from the vehicle to both the dquid and UNEW servers. Data will then be fed into the smartCEM application installed on the Android-based on-board device (smartphone/tablet). The user will interface directly with the application running on the on board device and will have no contact with the Bluedash unit.

4.1.4 Issues

While there is no direct interfacing of Bluedash and the application, it is of critical importance that the data collected from the vehicle and later processed retain maximum consistency.

4.2 Interface #2: Smartphone Common App and EV Services

4.2.1 Functionalities

The SmartCEM Common App has a very light interface towards the applications that provide EV services. Available functionalities are:

- Install an Android application (if the .apk indicated by the portal metadata is not yet installed on the user's mobile device)
- Launch an Android application (if already installed)
- Launch an internet browser and point it to the website indicated by the portal metadata

There are no prerequisites that need to be fulfilled by the applications that provide EV services. They need not be "portal aware" and may be launched independently.

4.2.2 Choice of standard

Either 3G or Wi-Fi connections could be used to communicate the smartphone Apps with the service's corresponding servers.

4.2.3 Process

The main Application to be provided in Newcastle is the EV Navigator. This provides an on-trip service. In cases in which the App needs to communicate with the server (for obtaining the charging station location, etc.) 3G communications will be used.

4.2.4 Issues

The 3G data tariff involved for the application usage is paid by the end user. The communications rate must be kept to a minimum.

4.3 Interface #3: Data Extraction from Local Database to Central Database

4.3.1 Functionalities

According to the data logging process for the project's evaluation (WP4), data from Newcastle's local database is extracted to a central database located at UNEW.

The local DB for the system will be a PostgreSQL server which has previously been used in the FootLITE and SwitchEV projects to similar effect.

The following different sources will be available for data acquisition:

- Data Loggers: two types of OBUs send data back to the local Newcastle database. In the case of loggers from Hyperdrive, the data is transmitted to the UNEW server via GPRS. This raw data is then processed using python programmes to transform it into text (readable format).

  In the case of RDM loggers used by most vehicles at this pilot site, the initial processing is done by RDM automotive then the preliminary processed files are sent via ftp to the server. The RDM files will need to be extracted because they are sent in a compressed form (.gz) to limit file size.
- CYC Data: charging station location data and data relating to vehicles operating in the trial and their use of charging stations will also be available.
- User Uptake: this is qualitative data provided by the drivers of the vehicles in questionnaire format which will be uploaded to the server.

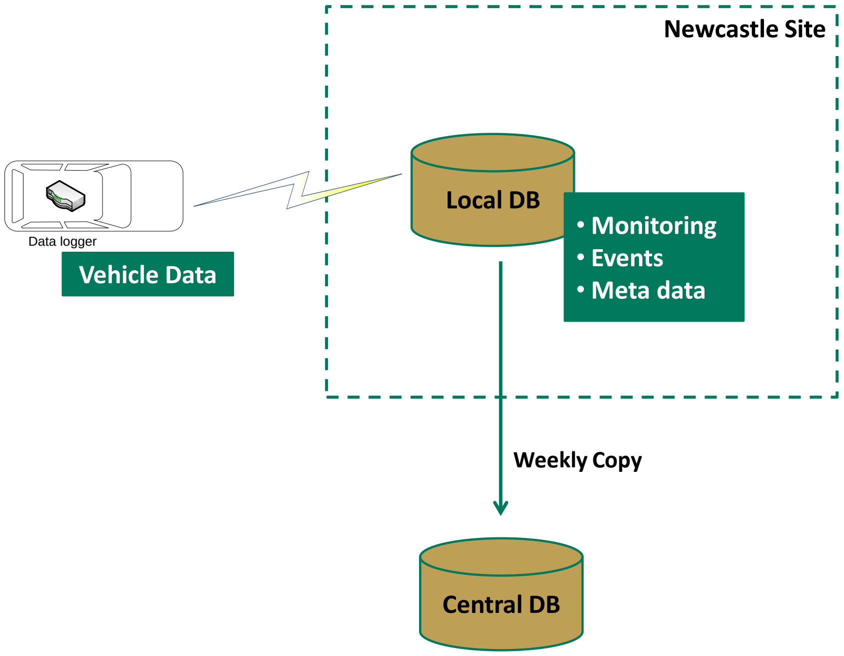


Figure 4-1: Data collection in Newcastle

4.3.2 Choice of standard

Data will be collected in CSV files, and data transfer will take place using the ftp protocol. Data is transferred daily with appropriate file name that includes time and date stamp.

4.3.3 Process

Data loggers will log all recorded data from the CANbus which will be systematically uploaded through GPRS to a local database. This data will be stored "as-is" with no data checking or repairing at this point. An "Events Table" will then be constructed from the second-by-second data. Data upload will occur automatically from the Events Table into the central database on a daily basis.

The process is described in detail in D2.4 *Logging Tools Database Definition*.

Data will also be copied from the CYC local database and sent to UNEW's central server, where it will be stored and post processed for evaluation, according to the indictors established in WP4.

Although data registration locally is made in real-time, the data transfer between both databases will be post-process (not-real time) and made daily.

4.3.4 Issues

UNEW hosts the central database in smartCEM and is responsible for coordinating testing of this interface for all pilot sites. There are at present no issues arising.

4.4 Interface #4 Data Extraction for EV Efficient Driving

4.4.1 Functionalities

Most cars already have an indication about energy use as part of their dash-board. However, in smartCEM additional efficient driving feedback and advice will be given to drivers through an online service which takes into account driving style and charging behaviour:

- Acceleration events (hard and light)
- Speed
- Regenerative braking
- Standard or fast charge

The figures below illustrate aspects of the web interface.

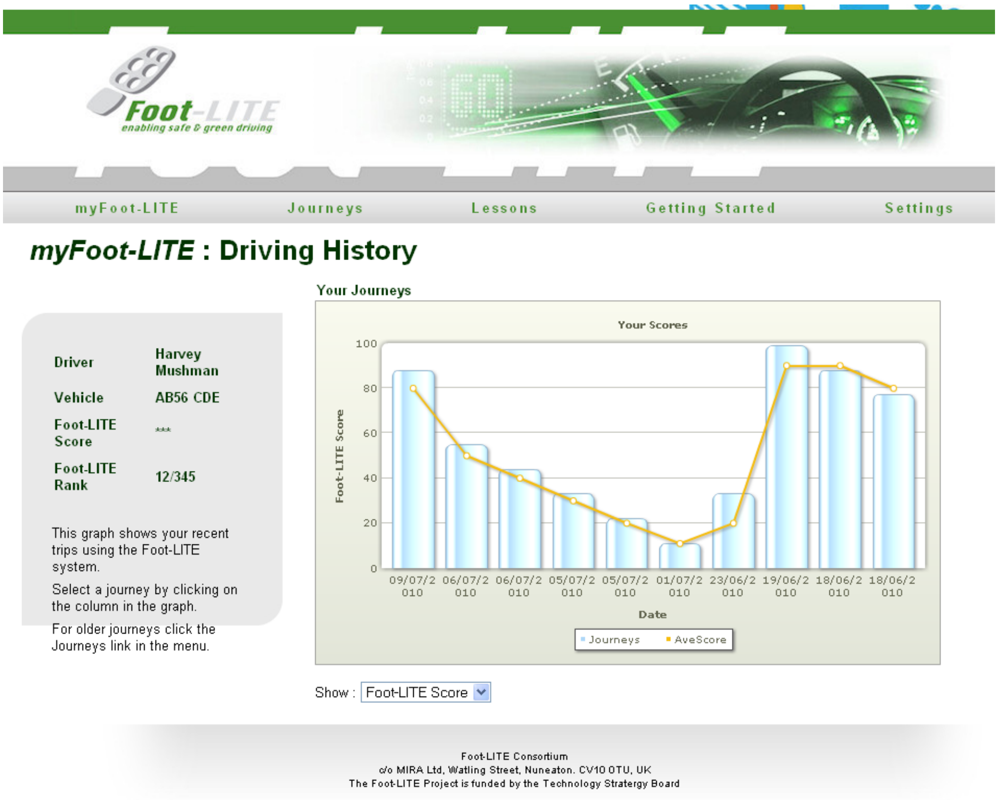


Figure 4-2: Efficient Driving web interface (Footlite): driving history

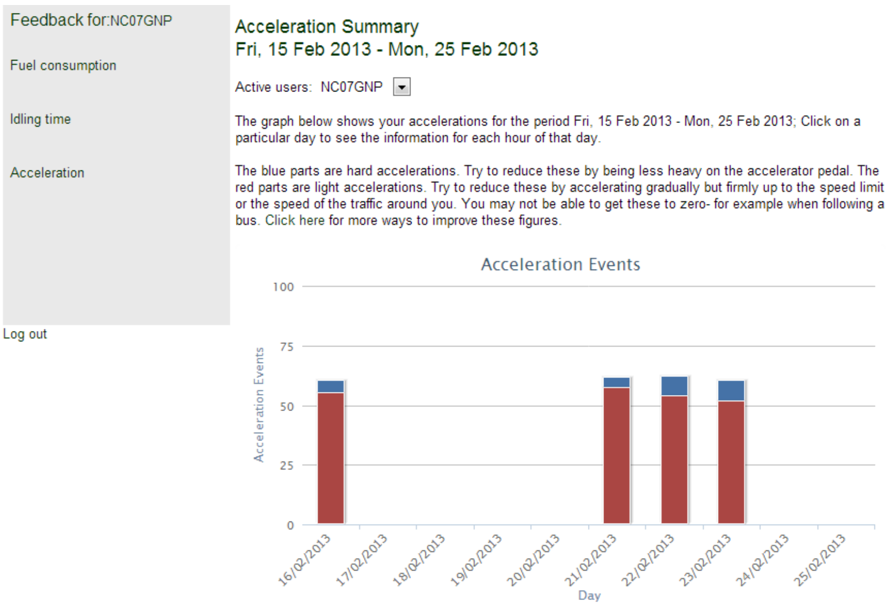


Figure 4-3: Efficient Driving web interface (Footlite): acceleration summary

The service will also make use of parameters derived from the data loggers to offer each driver post trip eco-driving advice to drive more efficiently in terms of speed, acceleration, deceleration, and braking events.

4.4.2 Choice of standard

The service modifies an existing Django website set up as part of the Footlite project to record driving performance of fleet vehicles (ICE).

Web:

- Django 1.3.2 (Python-based web content management system)
- Apache 2.2 Web Server
- Mod_Wsgi configuration

Database:

- PostgreSQL 9.0.3 + PostGIS (spatial extension)

4.4.3 Process

The site is under construction and testing will take place by the end of November 2013. The process will be explained on completion. It will describe modified data structure and modify summary reports based on the modified data structures.

4.4.4 Issues

If vehicles are parked in underground car parks or in areas with limited 3G coverage, this can delay the sending of trip summaries to the server until coverage resumes.

4.5 Interface #5 CS Manager and Navigator

4.5.1 Functionalities

The CS Manager Service maintains a CS database. Each CS entity has a set of attributes, out of which the following are relevant to the Navigator:

Attribute name	Description
Name	The name of the POI (Point of Interest) that is represented by the CS
Street	The street name of the address of the CS
HouseNo	The house number of the address of the CS
PostCode	The postal code of the address of the CS
Town	The town name of the address of the CS
Latitude	The latitude coordinate for the CS
Longitude	The longitude coordinate for the CS
PhoneNo	The phone number associated to the CS (it is usually the phone number of the CS operator)
FaxNo	The fax number associated to the CS – usually the fax number of the CS operator

Table 4-1 Attributes related to the Navigator

These attributes are being made available to the Navigator via a REST web-service, in two formats:

- csv text
- proprietary binary format

The csv text is available at:

<server_url>/CSManagerService/cs?scope=atf&name=<cs_name>

The binary stream is available at:

<server_url>/CSManagerService/cs?scope=dat

4.5.2 Choice of standard

Both outputs obey the format specifications as requested by the Navigator. They are made available online at the URL-s indicated above, in HTTP REST services (GET requests).

- The csv format is “text/plain” content
- The binary format is “application/octet-stream”

The actual conversion between the internal database representation of the CS’s and the binary format is being performed by a specialised tool, supplied by the creator of the Navigator. Later modification and extension of the attributes set is therefore possible with minimal effort.

4.5.3 Process

Whenever the Navigator is making a service request for the binary form of the CS list, the CSManagerService is performing the extraction of the needed attributes and the generation of the corresponding binary stream, by calling the dedicated converter tool supplied by the creators of the Navigator. An exact and up-to-date binary representation of CS data is therefore available at any moment to the Navigator.

4.5.4 Issues

None envisaged.

5 Conclusion

This document describes the local platform components and processes implemented at the Newcastle pilot site for integrating and deploying smartCEM services.

The site deploys the following components:

- smartCEM Common App
- CYC Network and Smartphone App
- PTV Navigator
- Efficient Driving Post-Trip Analyser
- EV-City Policy Tool
- Multi-Modal Trip Planner
- CS Manager

The following interfaces are developed:

- Android App and Bluedash
- Smartphone Common App and EV-Services
- Data Extraction from Local Database to Central Database
- Data Extraction for EV-Efficient Driving
- CS Manager and Navigator

The main issues encountered in Newcastle are user-related, technical, or operational in nature. They are:

- Issue 1 (CYC Network and Smartphone App) - **operational** - for commercial reasons there is a limit to the type and amount of data available from CYC for use in smartCEM.
- Issue 2 (PTV Navigator) – **operational** - if a low number of vehicles is participating there are implications for the vehicle-specific learning process and the supply of online data to the Navigator. This is the case in Newcastle.
- Issue 3 (Efficient Driving Post-Trip Analyser) – **user** - the Footlite project

upon which the service is based found that some drivers were uncomfortable being monitored. Although this is not expected to be an issue in smartCEM because of the different participant profile, mitigation techniques will be applied.

- Issue 4 (Multi-Modal Trip Planner) - **operational** - there is no control over the content on the Transport Direct site, and cannot guarantee reliability.
- Issue 5 (Smartphone Common App and EV Service) – **user** - the end user is liable for the 3G data tariff for utilisation of this application.
- Issue 6 (Data Extraction for EV-Efficient Driving) –**technical** - there is limited 3G coverage in some locations which can delay the sending of trip summaries to the server.

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[8] Charge Your Car http://chargeyourcar.org.uk/ (checked 5th November 2013)

[9] DQuid http://www.dquid.com (checked 5th November 2013)

List of Tables

List of Figures