This document was prepared for the ETI by third parties under contract to the ETI. The ETI is making these documents and data available to the public to inform the debate on low carbon energy innovation and deployment.

Programme Area: Light Duty Vehicles

Project: Electricity Distribution and Intelligent Infrastructure

Title: Completion Report - Systems Integration and Architecture Development – Appendix A2

Abstract:

This project was undertaken and delivered prior to 2012, the results of this project were correct at the time of publication and may contain, or be based on, information or assumptions which have subsequently changed. The purpose of this deliverable was to develop an open architecture (i.e. system design requirements) for recharging infrastructure to enable the system to be operated and managed effectively while also enabling compatibility between different business models. This is Appendix A2, providing an initial list of areas that may require a standard; it does not attempt to define or set the actual standards.

Context:

This project looked at the potential impact of electric vehicles on the UK electricity distribution grid.

Disclaimer:

The Energy Technologies Institute is making this document available to use under the Energy Technologies Institute Open Licence for Materials. Please refer to the Energy Technologies Institute website for the terms and conditions of this licence. The Information is licensed 'as is' and the Energy Technologies Institute excludes all representations, warranties, obligations and liabilities in relation to the Information to the maximum extent permitted by law. The Energy Technologies Institute is not liable for any errors or omissions in the Information and shall not be liable for any loss, injury or damage of any kind caused by its use. This exclusion of liability includes, but is not limited to, any direct, indirect, special, incidental, consequential, punitive, or exemplary damages in each case such as loss of revenue, data, anticipated profits, and lost business. The Energy Technologies Institute does not guarantee the continued supply of the Information. Notwithstanding any statement to the contrary contained on the face of this document, the Energy Technologies Institute confirms that the authors of the document have consented to its publication by the Energy Technologies Institute.

CONFIDENTIAL	not to be disclosed other than in-line with the terms of the ETI Technology Contract

Deliverable Title	Electrification of Light Vehicles – Intelligent Infrastructure Standards Requirement Report (Formerly known as Vehicle Standards Requirement Report)
Deliverable Reference	SP2/IBM/15

Interim or Final	Final

Original Due Date	18th June 2010
Initial Submission Date	18th June 2010

Author	Simon Parker (IBM)
Author	Nigel Baker-Brian (IBM)

Approver	Nigel Baker-Brian (IBM)

Version	History
Various 0.x	Drafts pre submission
v.1.0	Initial Submission 18th June 2010
v.2.0	Updates following ETI Review 9th July 2010

IP Ownership	As defined in the ETI Technology Contract for WP2.4

ETI EV Work Package 2.4

SP2/IBM/15 - Electrification of Light Vehicles – Intelligent Infrastructure Standards Requirement Report

Version 2.0

2nd Submission

14th July 2010

Contents

1. Introduction 5

2. Information about this document 5

2.1. Purpose 5
2.2. Acceptance Criteria 5
2.3. Overview of key Work Package 2.4 deliverables 6
2.4. Information about this version 7

3. Context for Vehicle Standards Requirements 7

3.1. Definition of a Standard 7
3.2. Why having pragmatic standards is a good thing 8
3.3. Broad areas of interest for actors 9

4. Candidate areas for standards 9

4.1. Scope 9
4.2. Summary list of key areas for standards 10
4.2.1. General Areas 10
4.2.2. Specific Functional Areas 11
4.3. Prioritisation of Candidate Areas for Standards 17

Appendix : Examples of current activity on standards 20

Scope 20
Legislative and Administrative Activity 20
Vehicle Industry Associations 21
Standards Bodies 22
Other Instances of potential or emerging standards 25

Appendix : Sources 25

1. Introduction

Stakeholders in all areas of the market around vehicle electrification have indicated that the identification, definition and adoption of standards is key to enabling and accelerating wide-spread adoption of EVs. The standardisation of components such as electric plug connectors, communication protocols, billing arrangements, safety and telemetry are understood to be key areas.

Currently a wide variety of industry groups, working councils and research bodies are specifying and investigating candidate standards. For example, significant progress is being made through international bodies like SAE, ISO and IEC. A factor here at the moment is that there are at best overlapping and at worst potentially competing standards bodies and standards.

Policy makers are also aware of the need in this area - The European Union agreed in early 2010 that the European Commission should push for the standardisation of electric vehicles and lead in drafting a strategy to avoid obstacles that might delay deployment.

2. Information about this document

2.1. Purpose

This report identifies areas of the intelligent infrastructure where standards would be beneficial and provides relevant commentary where appropriate. It provides an initial high level view to assist in progression of the discovery project activity, the expectation being that this information will be refined, matured and developed during the remainder of this and future phases.

This report does not attempt to provide an inventory of standards nor to provide an assessment of the standards or identify gaps. This activity is the subject of a future deliverable - Vehicle Design Standards Gap Assessment Report (SP2/IBM/25)

2.2. Acceptance Criteria

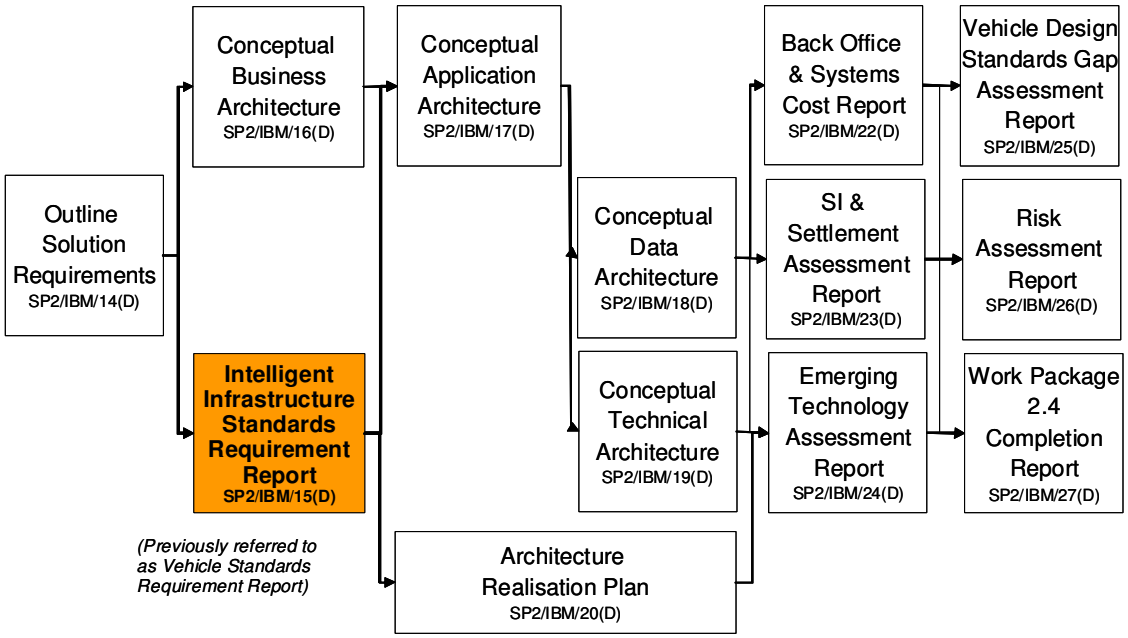
The contract outlines the following acceptance criteria

> *Complete when the final report identifies a list of standards required to support the Intelligent Architecture Requirements, for example standards related to Communications protocols; Security; Access and Authentication; System Messages; Safety; Equipment Monitoring and Actuation*
>
> *An example of the level of analysis would be: A standard is required for the Electric Vehicle Supply Equipment (EVSE) i.e. the physical electrical cord and connectors that are specified by applicable SAE standards (e.g., SAE 2293, J1772, J2836 & J2847) that provide transfer of electrical energy from energy portal to PEV. This can be 120V or 240V AC depending upon connection.*
>
> ***The vehicle design standards report provides a list of areas that may require a standard**; it will not attempt to define or set the actual standards.*

Based on the above, and the scope of SP2/IBM/25, this report focuses on identifying a list of areas that may require a standard, providing brief and relevant commentary where appropriate.

2.3. Overview of key Work Package 2.4 deliverables

This deliverable is shaded in both the model and table below. The table provides a brief overview of the full set of deliverables in WP2.4.



Deliverable	Outline
Intelligent Infrastructure Requirements Report	Outline solution requirements; High Level System Context; High Level Initial Use Case Model
Intelligent Infrastructure Standards Requirement Report *(Formerly known as Vehicle Standards Requirement Report)*	**The report provides a list of areas that may require a standard; it will not attempt to define or set the actual standards.**
Conceptual Business / Application / Data / Technical Architectures	Decide on the overall shape and style of the architectures and evaluate alternative high-level architectures and choose between them Includes artefacts such as CBM, component model, entity relationship diagram, operational model
Plan for Architecture Realisation	High-level plan defining scope, activities and deliverables

	required in Stage 2
Back Office and Supporting Systems Cost Report	Estimate high level costs for the design and build of the back office and systems
Systems Integration and Settlement Assessment Report	Settlement landscapes and alternatives and scope of systems requiring integration
Emerging Technology Assessment Report	Provide a snapshot evaluation of emerging vehicles technologies and scenarios, such as demand side management, network constraints, vehicle-to-grid and future charging options
Vehicle Design Standards Gap Assessment Report	Provides an Inventory of current vehicle design standards and a gap analysis of them against the requirements of the intelligent architecture
Risk Assessment Report	Develop recommendations as to the areas and levels of risk mitigations / avoidance and safety / security to be pursued for further analysis and design

2.4. Information about this version

This is version 2.0 of the Report and incorporates comments from a review of version 1.0 by the reviewer nominated by the ETI.

A list of comments and notes on how they have been addressed has been updated and will be provided to the ETI along with version 2.0. The main changes are noted below for information.

- **Change of Report name** – the reviewers all indicated that they felt the title of the Report did not accurately reflect the useful scope of the information it contained. Formerly known as Vehicle Standards Requirement Report Therefore, the Report has been re-titled Intelligent Infrastructure Standards Requirement Report
- **Point of view on relative priorities** – reviewers commented that the areas identified as potentially benefiting from a standard was comprehensive but that it would aid consumption and additional thinking if a high level priority was applied. A table has been created in section 4.3 to provide such a view. This prioritisation will need to be reviewed and refined as the projects progress in stage one and in future stages.

3. Context for Vehicle Standards Requirements

3.1. Definition of a Standard

According to BSI, a standard is a published specification that establishes a common language, and contains a technical specification or other precise criteria and is designed to be used consistently, as a rule, a guideline, or a definition.

3.2. Why having pragmatic standards is a good thing

The markets, technologies and products involved in the adoption of electric vehicles are evolving rapidly. Without constraining the market unnecessarily, all stakeholders agree that clearer understanding is needed concerning the need for standards, what work is being done on standards and where the gaps and overlaps are.

Standardisation work should represent the interests of all stakeholders concerned, both producers and consumers. Having a pragmatic set of standards around the components of the intelligent infrastructure provides a number of benefits, such as:

- encouraging investment and fostering innovation;
- providing reassurance and confidence in the quality of a product or service;
- helping provide the EV user with a consistent recharging solution, for example, avoiding the need to carry different cables and access tokens;
- supporting consistent and secure communication between key components and actors;
- avoidance of serious barriers to any large scale deployment and adoption of EV's and infrastructure to support them;
- providing useful education, presenting guidance and information to both user and manufacturer who want to make or use a new product;
- supporting simplification and rationalisation, reducing time and material expenditures and thus allowing a conservation of energy and material resources – very relevant in the case of electric vehicles and the intelligent infrastructure;
- contributing to future proofing, minimising the potential impact of taking decisions which might constrain the development of the industry or lead to technology and process dead ends.

3.3. Broad areas of interest for actors

The table below illustrates which key actor types (discussed in more detail as part of SP2/IBM/14) have either an interest in or would be impacted by standards in the following areas:

	Government	User / Owner	EV OEM	EV Infrastructure Providers	EV Infrastructure Services (Charging, II)	Electricity supply Chain	Other Service Providers
● Major interest / impact ○ Lesser interest / impact							
Physical Connection		○	●	●	○	●	
Communications		●	●	●	●	●	●
Charging Activity		●	●	●	●	●	●
Charging Location	○	●	○	●	●	●	
Electricity Supply	○	○	○	●	●	●	○
Back Office	○	●	○	●	●	●	●
Telemetry		○	●	●	●		○
Regulation	●	●	●	●	●	●	●

……..EV Infrastructure Providers, EV Infrastructure Service Providers, the Electricity Supply Chain, EV OEMs and the User Community need to be most heavily involved in any definition and implementation of standards.

4. Candidate areas for standards

4.1. Scope

There are many areas which will benefit from the definition and adoption of standards across the full extent of vehicle development and operation. This report highlights only those areas with most relevance to the intelligent infrastructure as currently understood.

For example, it does not deal with the full range of vehicle development, component testing, energy provision and electrical standards which will be required. Some of these are being examined in other work packages (e.g. power interface standards are part of WP 2.2), whilst others are being taken forward by the 'business as usual' activities of industry participants and associations and by other research activity.

Any activity to take this area forward and arrive at a definitive strategy for standards development should consider regulated industries with similar characteristics – for example financial services, telecommunications and energy. This could provide a useful model in this area.

4.2. Summary list of key areas for standards

This section illustrates key areas which would benefit from the development and adoption of standards. There may already be standards in some or all of these areas. An inventory and assessment of existing standards which will be the subject of SP2/IBM/25.

4.2.1. General Areas

4.2.1.1. Terminology

There is a real need for the definition and adoption of an industry wide terminology / vocabulary for EV charging and operation. An example here would be charging type descriptions where 'fast', 'faster', 'quick', 'rapid', etc are used interchangeably. The important aspect here is the definition. Commercial business providers will seek to create brand names and product names, hence all the more important for users to understand the underlying definition.

Currently, a number of standards bodies seem to be pursuing this area (see appendix).

4.2.1.2. Compliance and Regulation

There may need to be standards associated with any eventual regulatory activity around EV ownership and use and also charging operations. Standards may include reporting (content, frequency, etc) and information retention requirements.

Additionally, the evolution of the EV and charging market may see the development of trade associations, chartered bodies, ombudsmen, official regulators and the like. This ecosystem will be developed over time, taking on key roles not only in regulation, but in the endorsement of standards.

4.2.1.3. International Harmonisation

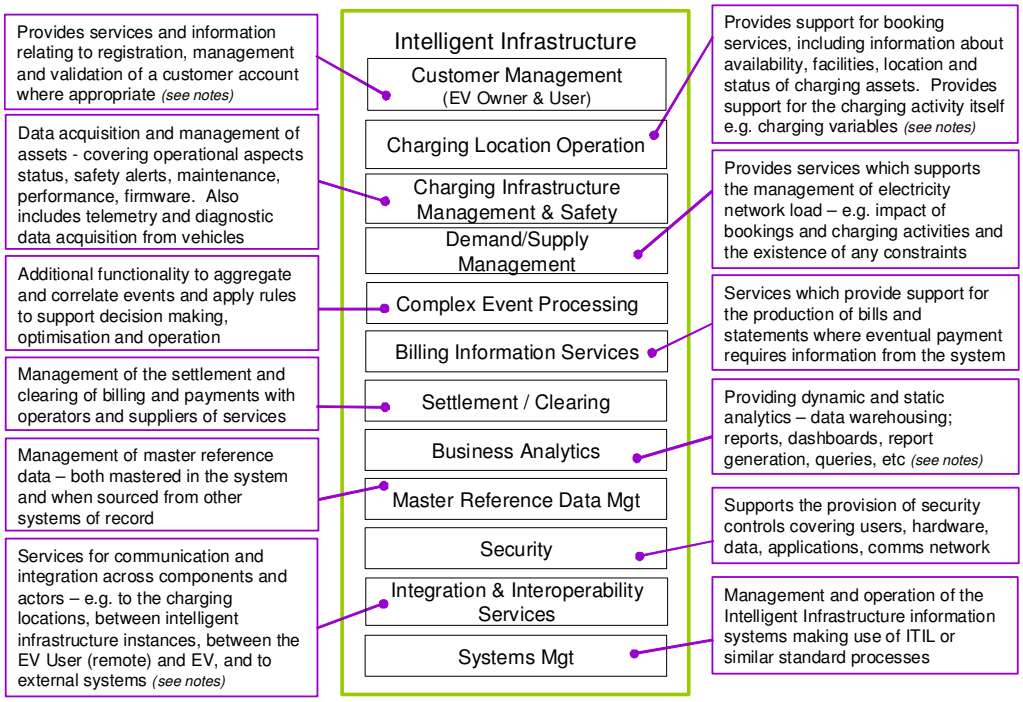
There is a need to consider the international dimension in this market and the drive that will exist towards harmonising standards across geographies. This doesn't mean there needs to be a one size fits all approach, but that where appropriate there should be a drive to harmonisation. This doesn't just apply to the physical plug but to 'run time' areas such as safety standards, protocols for billing and mechanisms for authentication.

4.2.1.4. Impact of related initiatives in other industries

The adoption and integration of electric vehicles touches on a variety of policy areas and industries which brings a challenge in respect of alignment of standards. Governments may need to take an active role in ensuring that automotive, telecoms, energy and environmental factors are keeping in step with each other. For example, the smart meter and smart grid initiatives must factor in the take up of electric vehicles when considering any roadmap for standards and investment. Without taking these steps, there is a real risk of standards not joining up and of investment needing to be repeated or increased.

4.2.2. Specific Functional Areas

The functional areas defined in the Intelligent Infrastructure Requirements Report have been used to categorise areas which may require more specific standards. This may result in a new standard or in amendments to existing standards. At this point we are only indicating the areas and not making any assessment. In some cases, functional areas have been merged to simplify the lists.



4.2.2.1. Customer Management (EV Owner & User)

4.2.2.1.1. Account Management Standards

- Considering elements such as when an account is required, what data is required and in what format and any standard process for creation and ongoing management
- Establishing common criteria for exchanging information on customers and accounts, such as for account transfers, 'bad customer' notification, guests.

4.2.2.1.2. Contact Management Standards

- Considering elements such as standard notification types, standard information and declarations included in different types of customer contact, etc

4.2.2.1.3. User and Vehicle Identification Standards

- Considering elements such as standard formats for battery / car serial numbers; management of tokens held by the vehicle, the user or both; linking a vehicle with a user and owner, and multiple vehicles with an owner in the case of fleet/lease/pool situations.

4.2.2.2. Charging Location Operation

4.2.2.2.1. Communication between the EV and Charging Location before / during charging

- To provide commonality and understanding for communications when a request for charging is made and charging is executed
- Information exchange around the state and condition of the vehicle / battery – such as the type of battery, level of charge, draw capacity, range.

4.2.2.2.2. Communication between the EV and User / Owner

- The users / owners of electric vehicles may need to be able to interact with the vehicle as it charges. Useful to have some standards around information and control during the charging activity, e.g. status, updates and potential changes, how long remaining and cost to date
- This would not prevent manufacturer specific information / approaches regarding the vehicle and its operation but provide some basic ground rules for what should be communicated and how

4.2.2.2.3. Communication between the Charging Location and EV User / Owner

- The users / owners of electric vehicles may need to be able to interact with the charging location. Useful to have some standards around information and control during the charging activity, e.g. status, updates and potential changes
- This would not prevent manufacturer specific information / approaches regarding the vehicle and it operation but provide some basic ground rules for what should be communicated and how.

4.2.2.2.4. Physical Connection between the EV and Charging Location

- Standards around any physical connection are important in terms of recharging. The standards for the physical connector and the electrical standards for the connection will be covered by another deliverable from the consortium – namely 'SP2/E.ON/04 Charging Network Requirements Report', due for delivery in September.
- Also important is communications and it is in this area that the intelligent infrastructure is most impacted. Please see the Appendix for the list of standards, (particularly from the Society of Automotive Engineers ('SAE')), which are in the process of being prepared in this area.

4.2.2.2.5. Charging Location Information

- Standard formats for the information available about a location – important for things like searching, viewing, navigating
- Standards across providers for indicating the status of a location – e.g. planned, out of service, booked, charging, available, occupied but not charging etc

4.2.2.2.6. Booking a Charging Location

- Standard formats for information required for booking a charging slot – e.g. timings, facilities, charges, alternatives
- Guidance or criteria for when booking might be applicable / not applicable such as type of charging infrastructure, location, time of day, availability in a geographic area

4.2.2.2.7. The control of the Charging Activity

- Standard procedures for charging – stop, start, pause, etc
- Standards for charging variables, both supplied by and displayed to the EV / User
- Standard for how the different types of charging would be operated, such as 3kw / 7kw / 12kw / 50kw charging; AC / DC; conductive charging; inductive charging
- Agreed metrics and units for measurement of the charging activity
- For the EV and the Charging Location – what to display, how to display it
- Common alerts and warnings
- Accessibility requirements across charging locations

4.2.2.2.8. Domestic Charging

- The candidate areas for standards described above (4.2.2.2.1 to 4.2.2.2.7) are the complete set for the charging operation regardless of which location the activity is taking place in – a subset of these would be applicable to domestic charging - the candidate areas defined above which are not applicable to domestic charging are 4.2.2.2.5 and 4.2.2.2.6.
- Currently domestic charging is achieved by plugging into the home's ring main, although it is understood that there are 'faster' charging options becoming available. Also currently available on the market are domestic EV charging sockets with a built in timer which delays charging to take advantage of cheaper tariffs – requiring a separate off peak agreement and meter. Electrical standards for these existing devices will be described in deliverable SP2/E.ON/04.
- Looking forward to the Semi-Intelligent and Smart Business Models (see SP2/IBM/16) and the advent of Smart Charging domestically, then again it is deliverable SP2/E.ON/04 where the standards for this topic will be addressed.

4.2.2.3. Charging Infrastructure Management & Safety

4.2.2.3.1. Communication between the EV and Charging Location for diagnostics & telemetry

- To provide commonality and understanding of data formats, standard identifiers, interactions and interfaces concerning diagnostic and telemetry communication

4.2.2.3.2. Connection and communication between EV and Battery

- To support interaction and exchange of data on battery type, battery condition, etc that may be required for use in the charging activity

4.2.2.3.3. Communication between the Charging Location and the Electricity Supply Grid

- Could include standard set of information and criteria expected between the charging location operator and the DNO – elements such as status updates (representation of information about the location – is it active, available, in use, etc) and condition monitoring (alerts & warnings)

4.2.2.3.4. General Safety standards for elements such as

- Onboard rechargeable energy storage systems
- When charging the EV / battery at home
- For operation of a commercial EV / battery charging facility
- Design of the physical connection to the EV
- Common standards for signage at charging locations

4.2.2.4. Demand / Supply Management

4.2.2.4.1. Provision of information on demand for electricity

- Consider elements such as data standards for providing demand information, frequency, derivation, etc. Initially, the demand will be based on static and historic information but as the market develops, forecast information and real time information may be included
- Vehicle to Grid and Vehicle to Home may require a range of standards to be created / amended specific to the energy supply

4.2.2.4.2. Supply Constraints

- Consider elements around the criteria for the implementation of supply constraints on electric vehicle charging

4.2.2.4.3. Smart Grid and Smart Meter

- Amendment / creation of smart grid and smart meter standards for application to electric vehicle charging interactions. A need for smart meter / grid standards to consider electric vehicle take up

- In some aspects, standards in the smart meter / grid area have been slow to emerge. Cenelec, the body for electrotechnical standardisation that sets the EU standards, is working hard in this area with a deadline is 2012

4.2.2.5. Billing, Payment and Settlement Services

4.2.2.5.1. Billing

- What type of information is needed on what type of bill, for example are there any existing billing and statement guidelines for utility type bills which would need to be assessed?
- Standards and protocols to support billing in a roaming scenario

4.2.2.5.2. Payment standards

- Any changes to existing method of payment standards and authentication methods / processes
- Standards for EV charging specific methods of payment / scenarios

4.2.2.5.3. Settlement / Clearing standards

- Standards for what is settled and how – e.g. timeframes, templates
- Energy Trading - any amendments or additions to standards used in Energy Trading as a result of increased EV take up and the creation of specific offerings. May relate to areas such as tariffs and pricing, V2G 'price' & settlement, valuations of storage of electricity, etc.

4.2.2.6. Business Analytics

Consider elements around the need for standards on reporting.

Consider the need for standard formats for interfaces and data around extracting, transforming and loading data.

4.2.2.7. Master Reference Data Management

Agreements between parties on the definitions of common business terms and the ways those terms are named and represented in data.

Providing a set of "rules" that may describe how data are stored, exchanged, formatted, or presented.

Agreement of policies and procedures for defining rules and reaching agreement.

4.2.2.8. Security

4.2.2.8.1. Standards for authentication

- Relates to the EV and the User

4.2.2.8.2. Changes to existing standards for checking credentials with existing or planned external data sources

- This relates to things such as drivers and vehicles information at the DVLA or Insurance provider databases.

4.2.2.8.3. Standards for different token types

- Different form factors or mechanisms - key fob, smart card, RFID tag, mobile device, etc
- Considerations such as what type of information is required on the token, how it interacts and where it is located on the vehicle would have impacts on the intelligent infrastructure

4.2.2.9. Integration & Interoperability Services

4.2.2.9.1. Interface standards

- There will be a general need across many areas of the intelligent infrastructure to establish standards, criteria and guidelines for exchange of information e.g. types of interface, timing, accuracy, etc
- Might extend to standard non functional requirements in some cases

4.2.2.9.2. International / cross scheme roaming standards

- Common protocols and identifiers across charging infrastructure networks – for the network your are on, for the format of any account or security identifiers, etc - like the International Bank Account Number (IBAN) which is defined under ISO 13616-1:2007 and has an official registrar which is SWIFT
- Common service descriptions – so things like checking availability, charging activity, types of charge, etc
- Ground rules for roaming, e.g. you get equivalent services to your home location when roaming, not allowed to participate in V2G when roaming, etc

4.2.2.9.3. Communication between the EV and external information provision (e.g. internet, GPS, weather, route information)

- To provide commonality and understanding of data formats, standard identifiers, interactions and interfaces concerning communication to these external information sources

4.2.2.9.4. Communication between the EV and roadside furniture / traffic management systems (e.g. via UTMC compliant messages)

- Important to support interaction with these other components and to allow composite information and services to be consumed
- It may be a case of adoption of the existing standards rather than creation of new ones

Information provision in the event of an emergency, such as providing details to emergency services.

4.2.2.10. Systems Management Services

Consider elements around common messages and triggers for system management across providers.

Adoption of ITIL and definition of ITIL standard processes for System and Service Management for relevant systems.

4.3. Prioritisation of Candidate Areas for Standards

This Section proposes a initial view on prioritisation for the definition and introduction of the standards in candidate areas described above. The prioritisation is from the perspective of the Intelligent Infrastructure and is presented in the form of a **MoSCoW** analysis, where:-

M – candidate area is considered as a 'must have' without negotiation

S – candidate area is considered as a 'should have' if at all possible

C – candidate area is considered as a 'could have' if it doesn't affect anything else

W – candidate area is considered as a 'won't have' at this time, but would like in the future

The analysis also includes a justification for the prioritisation and a commentary on the desirability of having a standard in place for the next phase of the Project, the Stage 2 Trial, the scope of which has not been agreed, and hence is liable to change over the duration of the Stage 1 projects and in future Stages.

Please note that electrical standards are not covered – these are the subject of deliverable SP2/E.ON/04.

Ref Id	Candidate Area	MoS CoW	Justification	Stage 2 Trial
4.2.1.1.1	General Areas - Terminology	M	Needed for the future development of the market – for example various standards bodies are producing artefacts in this area and also the SMMT is producing a glossary / FAQ style report in the early part of the second half of 2010	N/A
4.2.1.2	General Areas – Compliance	M	Needed for the future development of the market – will	N/A

Ref Id	Candidate Area	MoSCoW	Justification	Stage 2 Trial
	and Regulation		develop over time	
4.2.1.3	General Areas – International Harmonization	M	Needed for the future development of the market – will develop over time	N/A
4.2.2.1.1	Customer Account Management – Account Management Standards	S	Required to facilitate interoperability across system actors and different suppliers	Draft standard desirable
4.2.2.1.2	Customer Account Management – Contact Management Standards	S	Required to facilitate interoperability across system actors and different suppliers	Draft standard desirable
4.2.2.1.3	Customer Account – User and Vehicle Identification Standards	M	Required to facilitate interoperability across system actors and different suppliers	Draft standard essential
4.2.2.2.1	Charging Location Operation – EV <>Location Comms'	M	Required to facilitate interoperability across system actors and different suppliers	Draft standard desirable
4.2.2.2.2	Charging Location Operation – EV <> User / Owner	S	Communications with the EV to pre-condition the vehicle during charging is highly desirable (range extension)	N/A
4.2.2.2.3	Charging Location Operation – Location <> User / Owner	M	Required to facilitate interoperability across system actors and different suppliers	Draft standard essential
4.2.2.2.4	Charging Location Operation – Physical Connection – EV <> Charging Location	M	Required. SP2/E.ON/04 will define.	SP2/E.ON/ 04 applies
4.2.2.2.5	Charging Location Operation – Charging Location Information	S	Required to facilitate interoperability across system actors and different suppliers	Draft standard desirable
4.2.2.2.6	Charging Location Operation – Charging Location Booking	C	Nice to have (questions over feasibility of the function)	N/A (if not in scope)
4.2.2.2.7	Charging Location Operation – Control of the Charging Activity	C	Nice to have – desirable for the longer term	N/A
4.2.2.2.8	Charging Location Operation – Domestic Charging	M	Required. SP2/E.ON/04 will define.	SP2/E.ON/ 04 applies
4.2.2.3.1	Charging Infra' Mgmt' & Safety – EV<> Charge Location Diagnostics & Telemetry	S	Required to facilitate interoperability across system actors and different suppliers	Draft standard desirable

Ref Id	Candidate Area	MoS CoW	Justification	Stage 2 Trial
4.2.2.3.2	Charging Infra' Mgmt' & Safety – Connection & Comms' EV <> Battery	S	Required to facilitate interoperability across system actors and different suppliers	Draft standard desirable
4.2.2.3.3	Charging Infra' Mgmt' & Safety – Comms' Charging Loc'n <> Electricity Supply Grid	M	Needed for control before market size becomes critical	N/A
4.2.2.3.4	Charging Infra' Mgmt' & Safety – General Safety Standards	S	Needed before the market reaches a critical size. SP2/E.ON/04 applies in some of the examples	Draft standards desirable
4.2.2.4.1	Demand / Supply Management – Info' on demand for electricity	M	Needed for control before market size becomes critical	N/A
4.2.2.4.2	Demand / Supply Management – Supply Constraints	M	Needed for control before market size becomes critical	N/A
4.2.2.4.3	Demand / Supply – Smart Grid and Smart Meter	M	Needed to ensure compatibility with electricity supply chain SMART initiatives	N/A
4.2.2.5.1	Billing, Payment, Settlement - Billing	S	Required to facilitate interoperability across system actors and different suppliers	Draft standard desirable
4.2.2.5.2	Billing, Payment, Settlement – Payment Standards	S	Required to facilitate interoperability across system actors and different suppliers	Draft standard desirable
4.2.2.5.3	Billing, Payment, Settlement – Settlement /Clearing Standards	S	Required to facilitate interoperability across system actors and different suppliers	Draft standard desirable
4.2.2.6	Business Analytics	C	Nice to have – desirable for the longer term	N/A
4.2.2.7	Master Reference Data Management	M	Required to facilitate interoperability across system actors and different suppliers	Draft standard essential
4.2.2.8.1	Security – Authentication	M	Required to facilitate interoperability across system actors and different suppliers	Draft standard essential
4.2.2.8.2	Security – Credentials of External Data Sources	S	Required to facilitate interoperability across system actors and different suppliers, but in the longer term	N/A

Ref Id	Candidate Area	MoS CoW	Justification	Stage 2 Trial
4.2.2.8.3	Security – Standards for Tokens	M	Required to facilitate interoperability across system actors and different suppliers	Draft standard essential
4.2.2.9.1	Integration & Interoperability – Interfaces	S	Required to facilitate interoperability across system actors and different suppliers	Draft standard essential
4.2.2.9.2	Integration & Interoperability – Roaming	M	Needed for the future development of the market	Draft standard essential
4.2.2.9.3	Integration & Interoperability – EV <> External Info' Provision	C	Nice to have – desirable for the longer term	N/A
4.2.2.9.4	Integration & Interoperability – EV <> Roadside Furniture	C	Nice to have – desirable for the longer term	N/A
4.2.2.10	Systems Management Services	M	Required – standard IT management practice	N/A

Appendix : Examples of current activity on standards

Scope

This section provides a brief illustration of some the activities taking place concerning standards, including referencing certain existing or emerging standards.

It is not intended to provide an inventory of existing or emerging standards. The Technology Contract for the Electricity Distribution & Intelligent Infrastructure sub project specifies that this is to be undertaken in a later deliverable - Vehicle Design Standards Gap Assessment Report SP2/IBM/25(D) due in mid December 2010

From the sources examined, the main areas of focus, perhaps unsurprisingly, seem to be on vehicle safety, communications and physical connections. It is not clear if the industry is looking at the need for standards around customer management, settlement, payment, etc.

Legislative and Administrative Activity

European Union

- A European strategy on clean and energy efficient vehicles has been announced. This strategy aims to provide a European framework for clean and energy efficient vehicles, including the promotion of clean and energy efficient vehicles based on conventional internal combustion engines and facilitating the deployment of ultra-low-carbon vehicles such as electric and hydrogen vehicles. The strategy contains over 40 actions on a wide range of policy fields covering: regulatory framework for reduction of environmental impacts, research and innovation in green technologies, market uptake and consumer information, trade and employment aspects as well as specific actions on electric vehicles such as standardisation, charging and refuelling infrastructure or recycling and transportation of batteries. (http://ec.europa.eu/enterprise/sectors/automotive/competitiveness-cars21/energy-efficient/index_en.htm)

- A document, Roadmap on Regulations and Standards for the Electrification of Cars, was issued on 26th April by the European Commission (http://ec.europa.eu/enterprise/sectors/automotive/files/pagesbackground/competitiveness/roadmap-electric-cars_en.pdf). The directive refers to a roadmap of actions :
    - Introduce electric safety requirements to EC vehicle type-approval legislation by mandating the application of UNECE Regulation 100 – Council Decision to be adopted in 2010;
    - Amend Directive 2007/46/EC by a Commission Regulation to specify the applicable requirements for electric vehicles regarding other technical requirements – to be adopted in 2010;
    - Launch a study to identify missing provisions to complete EC type-approval legislative framework – conclusions of study to be available in 2010, consider appropriate actions on the basis of conclusions;
    - Mandate the European standardisation bodies to adopt a European harmonised approach for charging system – mandate to be issued in 2010.

Vehicle Industry Associations

Examples of associations active in the field (there are many, many others)

- Energy Technologies Institute (ETI) – Is investing significantly through its Plug-in Vehicle Economics and Infrastructure project activity which although not explicitly creating standards, is looking to establish the implications and need for standards in supporting the development of a market for the adoption of plug in vehicles
- The Society of Motor Manufacturers and Traders (SMMT) - Exists to support and promote the interests of the UK automotive industry at home and abroad. They created an Electric Vehicles Group in 2009 in which around 1 in 4 of all SMMT members are participating. The SMMT are taking forward a number of initiatives, including production of a Glossary / FAQ style document for electric vehicles and development of an industry-wide EV training programme which it intends to act as best practice for the automotive sector
- World Electric Vehicle Association (WEVA)
- Electric Vehicle Association of Asia Pacific (EVAAP)
- Japan Electric Vehicle Association Standards (JEVS)
- European Association for Battery, Hybrid and Fuel Cell Electric Vehicles (AVERE) - a European network comprised of members including Users, NGO's, Associations, Interest groups, Public Bodies, Research & Development entities, Vehicle and Equipment Manufacturers, Electricity Utilities
- Electric Drive Transportation Association (EDTA)
- CHAdeMO Association - A coalition of Japanese automakers and engineering companies including Nissan, Toyota, Mitsubishi and Fuji Heavy Industries have linked with the Tokyo Electric Power Company to form CHAdeMO (Charge de Move). The main aim is to standardise charging stations for high-speed battery chargers for electric cars. The companies involved will expand to non Japanese organisations including ABB, PSA and Bosch.
- Eurelectric - European Electricity Industry
- Electric Power Research Institute (EPRI) – Electric Transportation Program 18
- Ecotality North America – the EV Project - partnering with Nissan North America to deploy up to 4,700 zero-emission electric vehicles, the Nissan LEAF, and 11,210 charging systems to support them in five states. Will collect and analyse data to characterise vehicle use, evaluate the effectiveness of charge infrastructure, and conduct trials of various revenue systems for commercial

and public charge infrastructure. Ultimate goal is to use the lessons learned to enable deployment of the next 5,000,000 EVs.

Standards Bodies

Overview

There are a variety of standards bodies who are involved in and relevant to the intelligent infrastructure and electric vehicle operation. The major issue here at the moment is that there are at best overlapping and at worst potentially competing standards bodies and standards.

Society of Automotive Engineers (www.sae.org)

The SAE already have a large number of standards defined around the EV / PHEV and are in the process of developing a further suite of standards for EV / PHEV communications. The first of these, SAE J2836/1 & J2847/1, was published in May 2010, the others are expected later in the year / early next year.

- SAE J2836/1 & J2847/1 - Communication between Plug-in Vehicles and the Utility Grid
- SAE J2836/2 & J2847/2 - Communication between Plug-in Vehicles and the Off-board charger in the EV Supply Equipment (EVSE)
- SAE J2836/3 & J2847/3 - Communication between Plug-in Vehicles and the Utility Grid for Reverse Power Flow
- SAE J2836/4 & J2847/4 - Diagnostic Communication for Plug-in (all vehicles) Vehicles
- SAE J2836/5 & J2847/5 - Communication between (all vehicles) Plug-in Vehicles and the their customers

SAE also have, other standards, such as J1772 which is related to the design of the connector used for charging vehicles, as well as lots of other relevant areas of interest in terms of vehicles generally. For example:

- SAE J1715 : Hybrid Electric Vehicle (HEV) & Electric Vehicle (EV) Terminology;
- SAE J1772:2010 : SAE Electric Vehicle Conductive Charge Coupler;
- SAE J1773:1999 : SAE Electric Vehicle Inductively Coupled Charging;
- SAE J2289:2000 : Electric Driver Battery Pack System Functional Guidelines;
- SAE J 2787 : Hybrid Terminology

International Organisation for Standardization – ISO (www.iso.org/iso/home.html)

ISO are generally considered responsible for global standards development for vehicle related items. Through ISO Technical Committee 22 / Subcommittee 21 (Electrically Propelled Vehicles), two key working groups are leading the standardisation efforts around

- Vehicle operation conditions, vehicle safety and energy storage installation (working group 1); and
- Definitions and methods of measurement of vehicle performance and of energy consumption (working group 2)

Without providing a full list of all the standards, some of the key standards for the intelligent infrastructure include:

- ISO 6469-1:2009 : Electric road vehicles - Safety specifications - Part 1: On-board rechargeable energy storage system (RESS);
- ISO 6469-2:2009 : Electric road vehicles - Safety specifications - Part 2: Vehicle operational safety means and protection against failures;

- ISO 6469-3:2001:2003 : Electric road vehicles - Safety specifications - Part 3: Protection of persons against electric hazards (new edition to be published);
- ISO 8713:2005 : Electric road vehicles – Vocabulary (under revision, see below);
- ISO 8715:2001 : Electric road vehicles - Road operating characteristics;
- ISO/TR 11955:2008 : Hybrid-electric road vehicles - Guidelines for charge balance measurement
- ISO/IEC 15118 (New - Drafts under development) : Road vehicles - Communication protocol between electric vehicle and grid - Part 1: Definitions and use-case ; Part 2: Sequence diagrams and communication layers
- ISO 23273-1:2006 : Fuel cell road vehicles - Safety specifications - Part 1: Vehicle functional safety

International Electrotechnical Commission (IEC) http://www.iec.ch/

The IEC prepares and publishes International Standards for all electrical, electronic and related technologies — collectively known as "electrotechnology". In the UK they are active through the British Standards Institution (BSI). The area of responsibility is roughly that ISO deals with vehicle related items, while IEC deals with other items.

Have a specific Technical Committee in this area – TC 69: Electric road vehicles and electric industrial trucks. This TC aims to prepare international standards for road vehicles, totally or partly electrically propelled from self-contained power sources, and for electric industrial trucks. They have looked into power supplies and chargers, on board electrical storage, inductive charging, communication between vehicle and grid, electrical interfaces.

Without providing a full list of all the standards, some of the key standards for the intelligent infrastructure include:

- IEC 61851-1 (revisions in progress) : Electric vehicle conductive charging system - Part 1: General requirements;
- IEC 61851-21 (revision activity) : Electric vehicle conductive charging system - Part 21: Electric vehicle requirements for conductive connection to an a.c./d.c. supply;
- IEC 61851-22 (revision activity) : Electric vehicle conductive charging system - Part 22: AC electric vehicle charging station;
- IEC 61851-23 – (new revision activity item) : Electric vehicle conductive charging system - Part 23: d.c. electric vehicle charging station;
- IEC 62196-1 : (revision) : Plugs, socket-outlets, vehicle couplers and vehicle inlets - Conductive charging of electric vehicles - Part 1: Charging of electric vehicles up to 250 A a.c. and 400 A d.c.;
- IEC 62196-2 : (development) : Plugs, socket-outlets and vehicle couplers – Conductive charging of electricity vehicles – Part 2: Dimensional inter-changeability requirements for a.c. pin and contact-tube accessories;
- IEC/TR 60783 : Wiring and connectors for electric road vehicles;
- IEC/TR 60784 : Instrumentation for electric road vehicles;
- IEC/TR 60786 : Controllers for electric road vehicles

European Standardisation (EN)

A number of European standards for EV / PHEV have been published, mostly ISO or IEC standards adopted as EN:s. The officially recognised European standards bodies are European Committee for Standardization or Comité Européen de Normalisation (CEN); the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI).

As noted earlier, the EC are becoming active in this space and it is understood that new activities on standards started in spring 2010 to review the needs of additional European standards. This is as a response to European market needs and the EC Directive and Mandate, in the field of electric vehicles and charging infrastructure. The bodies involved include CEN, CENELEC and ETSI are involved.

There are many EV / PHEV standards, some of the key ones which may be relevant to the intelligent infrastructure include:

EN standards (CEN) http://www.cen.eu/cen/pages/default.aspx

- EN 13447:2001 : Electrically propelled road vehicles – Terminology;
- EN 1987-1:1997 : Electrically propelled road vehicles - Specific requirements for safety - Part 1: On board energy storage;
- EN 1987-2:1997 : Electrically propelled road vehicles - Specific requirements for safety - Part 2: Functional safety means and protection against failures;
- EN 1987-3:1998 : Electrically propelled road vehicles - Specific requirements for safety - Part 3: Protection of users against electrical hazards.

EN standards (CENELEC) http://www.cenelec.eu/Cenelec/Homepage.htm

- CLC/prTS 50457-1:2006 : Conductive charging for electric vehicles -- Part 1: D.C. charging station;
- CLC/prTS 50457-2:2006 : Conductive charging for electric vehicles -- Part 2: Communication protocol between off-board charger and electric vehicle;
- EN 61851-22:2002 : Electric vehicle conductive charging system -- Part 22: AC electric vehicle charging station;
- EN 61851-21:2002 : Electric vehicle conductive charging system -- Part 21: Electric vehicle requirements for conductive connection to an a.c/d.c. supply;
- EN 61851-1:2001 : Electric vehicle conductive charging system -- Part 1: General requirements;
- ENV 50275-2-3:1998 : Conductive charging for electric vehicles -- Part 2-3: D.C. charging station;
- ENV 50275-2-4:1998 : Conductive charging for electric vehicles -- Part 2-4: Communication protocol between off-board charger and electric vehicle;
- ENV 50275-1:1998 : Conductive charging for electric vehicles -- Part 1: General considerations;
- ENV 50275-2-1:1998 : Conductive charging for electric vehicles -- Part 2-1: Connection of an electric vehicle to an a.c./d.c. supply;
- ENV 50275-2-2:1998 : Conductive charging of electric vehicles -- Part 2-2: A.C. charging station

European Telecommunications Standards Institute (ETSI) http://www.etsi.org/WebSite/homepage.aspx

- The European Telecommunications Standards Institute (ETSI) produces globally applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies. Their significance to electric vehicle and intelligent infrastructure operations will come as a result of the need for communications between different actors and the intelligent infrastructure.

- They are involved in Intelligent Transport Systems with a significant program of work, including a number of activities around the automotive area.
- In that respect, the International Telecommunications Union (ITU) (www.itu.int/en/pages/default.aspx) would also be relevant in the areas of communications between the EV and other components of the intelligent infrastructure.

Underwriter Laboratories www.ul.com/global/eng/pages/?noredirect

Underwriters Laboratories is an independent product safety certification organisation which evaluates products, components, materials and systems for compliance to specific requirements, and permits acceptable products to carry a UL certification mark, as long as they remain compliant with the standards.

UL is the key North American developer of safety-related EV Standards. They actively cooperate with other standards developing organisations around the subject of EV safety.

World Standards Cooperation (WSC)

The World Standards Cooperation (WSC) established in 2001 and includes the ITU, the ISO and the IEC in order to strengthen and advance the voluntary consensus-based international standards systems of ITU, ISO, and IEC. The WSC also promotes the adoption and implementation of international consensus-based standards worldwide; and resolves any outstanding issues regarding cooperation in the technical work of the three organisations

Other Instances of potential or emerging standards

Daimler and RWE

Together with 20 car manufacturers, suppliers and energy providers, RWE and Daimler have jointly developed a charging plug (Mennekes) they claim will be established as a standard throughout Europe. They claim that the target of all cooperation partners is to create a mandatory standard for charging interfaces for electric vehicles in Europe respectively worldwide. They see this global standardisation as an essential precondition for setting up a smoothly functioning as well as customer-friendly electricity charging infrastructure so that electric vehicles are accepted by customers and used across all vehicle classes in the long run.

To standardise the communication interface between the vehicle and the charging station Daimler and RWE have also jointly developed a communication protocol that is available to third parties free of charge on the internet to enable them to develop their own products – in line with the open source idea.

Urban Traffic Management & Control (UTMC)

http://utmc.uk.com/

UTMC systems are designed to allow the different applications used within modern traffic management systems to communicate and share information with each other. This allows previously disparate data from multiple sources such as ANPR cameras, Variable-message sign (VMS), car parks, traffic signals, air quality monitoring stations and meteorological data, to be amalgamated into a central console or database. The idea behind UTMC is to maximise road network potential to create a more robust and intelligent system that can be used to meet current and future management requirements.

There is a potential link to the communication element of the intelligent infrastructure and EV's – for example using information about car parking and traffic flow as part of the management of the charging activity and routing.

Appendix : Sources

Some of the sources examined include

- ETI Project : SP2/IBM/14 Intelligent Infrastructure Requirements Report
- Information received from the ETI, IAG, IBM and consortium partners
- Society of Automotive Engineers (SAE) – website and various articles referencing their work
- International Standards Organization (ISO) – website and various articles referencing their work
- International Telecommunications Union (ITU) – website and various articles referencing their work
- The European Telecommunications Standards Institute (ETSI) – website and various articles referencing their work
- Underwriters Laboratories – website and various articles referencing their work
- Meeting Report for 'The Fully Networked Car Workshop', Palexpo, Geneva, 3-4 March 2010
- Eurelectric - European Electricity Industry – Declaration on Standardisation of Electric Vehicle Charging Infrastructure
- Report by the Royal Academy of Engineering 'Electric Vehicles: charged with potential' May 2010 (www.raeng.org.uk)