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Programme Area: Light Duty Vehicles

Project: Electricity Distribution and Intelligent Infrastructure

Title: Completion Report - Systems Integration and Architecture Development – Appendix C3

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 C3, which covers the Conceptual Technical Architecture.

Context:

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

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

Deliverable Title	Conceptual Technical Architecture
Deliverable Reference	SP2/IBM/19

Interim or Final	Final

Original Due Date	Friday 20 August 2010
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Approver	Nigel Baker-Brian (IBM)

Version	History
Various 0.x	Drafts pre submission
v.1.0	Initial Submission Tuesday 24 August 2010
V 2.0	22 September 2010 Report revised after ETI review feedback

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

ETI EV Work Package 2.4
SP2/IBM/19 - Conceptual Technical Architecture

Version 2.0

22 September 2010

Contents

1. Executive Summary

1.1. Key Proposals

1.1.1. Identification and Defintion of Locations, Nodes and Components

The work completed to date on the Intelligent Infrastructure has established that the 'solution' is not a single computer system residing in one data centre. The Intelligent Infrastructure is a set of connected capabilities which reside in a number of locations, each of which 'host' a number of components. The following table is a key proposal of this deliverable, summarizing, using non-technical headings, the locations, location nodes (sub-division of a location) and the components which comprise the Intelligent Infrastructure:-

Location	Location Nodes	Component (ref: SP2/IBM/17)
Vehicle	Vehicle Control Unit	EV User Interface EV Telemetry & Diagnostic Manager EV Configuration & State Manager
	Vehicle Communications Unit	EV Communications Controller
Home	Home Area Network	User Portal Charging Parameters Manager
Mobile Device	Mobile Device	Mobile User Interface
External	External Supporting Services	n/a
Charging Location	Charge Points	n/a
Charge Point	Charge Point Control Unit	Charge Point User Interface Charge Point SCADA Manager (RTU / PLU) Charging Parameters Manager
	Charge Point Communication Unit	Charge Point Communications Controller
Internet / Network	Online Customer Services	User Portal Charge Point Location Viewer Charge Point Booking Manager
	System User Services	User Portal

Charging Location Technology Centre	Application Services (CLO)	Customer Services Manager Charge Point Status Manager Charge Point SCADA Manager Charge Point Asset Manager Charge Point Booking Manager Central Payment Manager
	Support Services (CLO)	Security Manager Master Data Manager
	BAU Services (CLO)	The charge location operator's own application landscape
Intelligent Infrastructure (Int Inf) Technology Centre	Application Services (Int Inf)	Customer Services Manager Charge Point Status Manager Charge Point SCADA Manager Charge Point Asset Manager Charge Point Booking Manager Central Payment Manager Fraud Manager
	Support Services (Int Inf)	Analytics Manager Report Manager Settlement & Clearing Manager Security Manager Information Manager Master Data Manager
	Integration Services (Int Inf)	Integration Manager
	BAU Services (Int Inf)	The Int Inf operator's own application landscape
Electricity DNO Technology Centre	Application Services (DNO)	Electricity Demand Manager
	Support Services (DNO)	Analytics Manager Report Manager
	BAU Services (DNO)	The DNO's own application landscape

Charging Location Operations	User Services (CLO)	Charge Location Admin Portal
Intelligent Infrastructure Operations	User Services (INT INF)	Intelligent Infrastructure Admin Portal
Electricity DNO Operations	User Services (DNO	Electricity Utility Portal

A full definition of locations, nodes and components is given in the body of the document.

1.1.2. Definition of the Inteconnection of Locations, Nodes, Users and External Systems

The following relationship diagram is the second key proposal of this deliverable, showing how the different locations, nodes and users are connected in a 'technology neutral' view of the distributed structure of the business solution. ('Technology neutral' means that at this stage we are not defining/proposing any particular make/model of hardware, software etc.)

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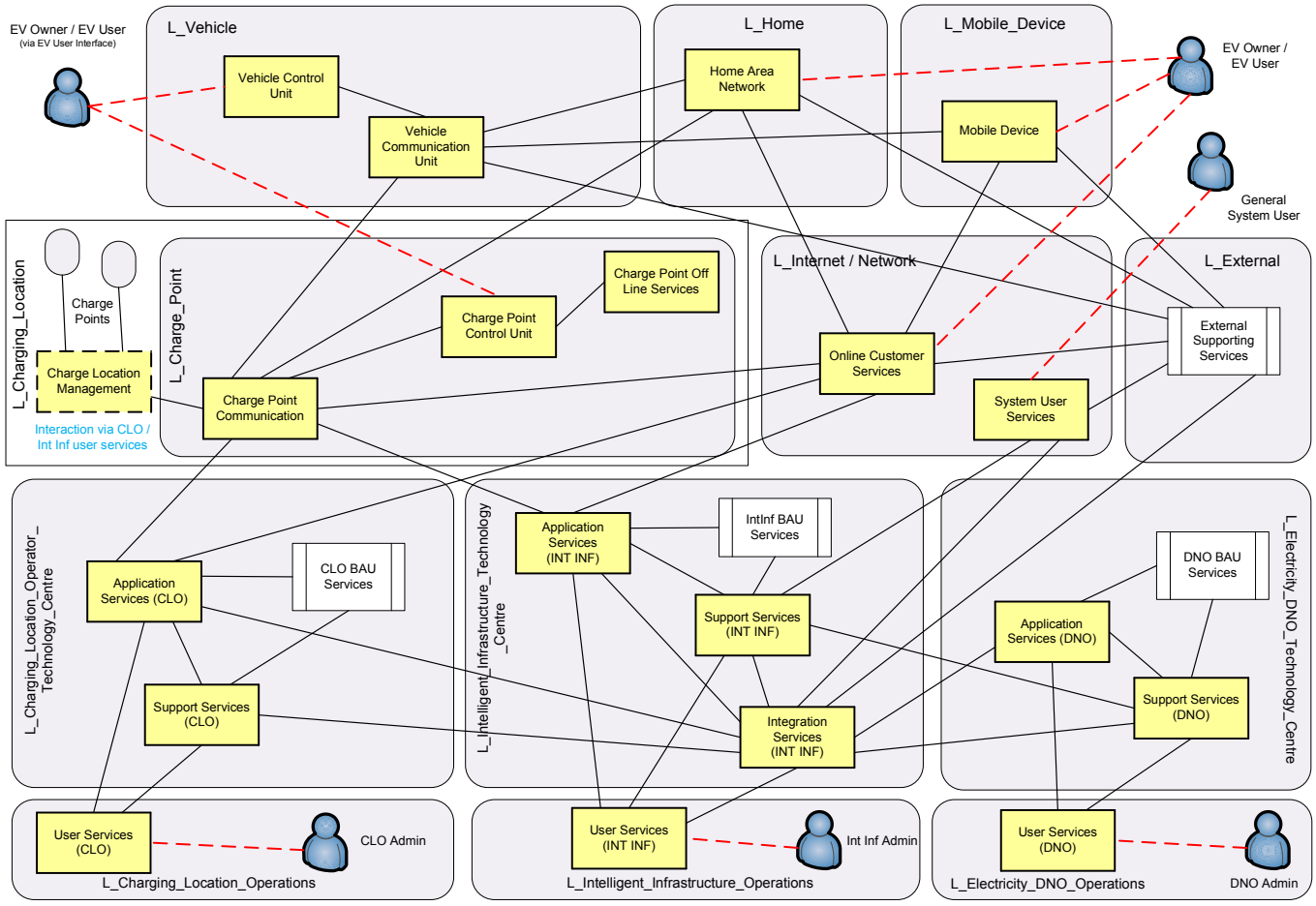
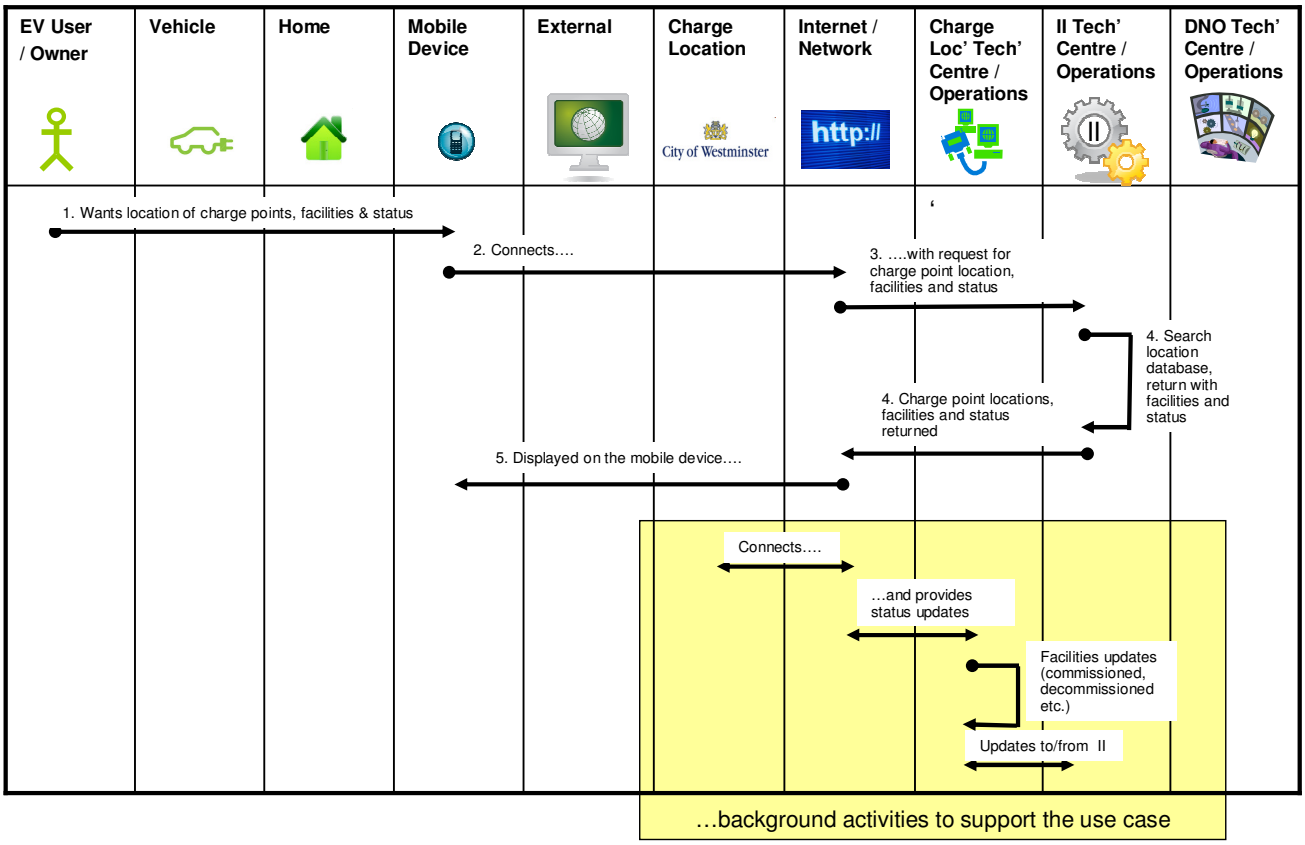


A full explanation of the Relationship Diagram, including how it has been derived and a defintion of the terminology involved is given in the body of the document.

1.1.3. How the locations, nodes and users will interact to meet the requirements of the Intelligent Infrastructure – an example

EV Intelligent Infrastructure – Technical Architecture Walkthrough Diagrams – Locating a charging location, facilities available and current status - using a mobile device



Further walkthrough diagrams are presented in Section 5

Note to Reviewers

This document is a technical specification and the key proposals above are in terms of the models which have been specified. These models will, in future phases of development of the Intelligent Infrastructure (Stage 2 and beyond), be used as the basis for the Logical and Physical Models. As with any iterative analysis and design activity, there may be changes needed to these models as the development activity proceeds

1.2. Executive Summary - Connections to Previous Deliverables

This specification is the first step in identifying the locations where the Intelligent Infrastructure will reside and builds on the previous conceptual work as follows:-

- a set of requirements for an Intelligent Infrastructure was identified in deliverable (SP2/IBM/14)

- using this requirement set, an evolution of the Intelligent Infrastructure was proposed in deliverable (SP2/IBM/16) in terms of 3 phases – Simple, Semi-Intelligent and Smart
- a specification of the Intelligent Infrastructure has been been in developed in terms of its application components (SP2/IBM/17), the data which it must process and store (SP2/IBM/18), and now – this deliverable (SP2/IBM/19) – where the different parts of the Intelligent Infrastructure might reside.

1.3. Executive Summary - Basis for Future Deliverables

The production and acceptance of this deliverable is a vital step in the development of the Intelligent Infrastructure and the work yet to be completed, as follows:-

- it defines for the first time where the different components of the Intelligent Infrastructure will reside – components are the application components which were defined in SP2/IBM/17
- it confirms the interfaces between the different locations/application components.

This information will be used to develop the remaining deliverables as follows:-

- definition of the locations for the Intelligent Infrastructure will indicate which organizations will be responsible for the development of the components - for example components residing on the Electric Vehicle will be developed by an EV OEM, components residing in the Charging Point will be developed by a Charging Asset OEM, and so on
- in turn, this will allow budgetary estimates for the development of the Intelligent Infrastructure to be produced as required for deliverable SP2/IBM/22. Budgetary estimates will be broken down by location/developing organization – e.g. the investment an EV OEM is likely to have to make in order to provide the functionality defined in SP2/IBM/14 at the different stages of evolution as defined in SP2/IBM/16
- and will also allow budgetary estimates to be made for the development of interfaces between the locations/developing organizations
- completion of the above will inform directly the risk profile (SP2/IBM/26), especially the level of integration and cooperation needed across multiple organizations
- considerations of the location, of the organization responsible for development and of the nature of the solution – for example will the solution be a software package, or will it be bespoke developed software - will inform directly deliverables SP2/IBM/23, SP2/IBM/24, SP2/IBM/25..

2. Information about this document

2.1. Purpose

This Report documents – at a Conceptual Level - the distribution of components onto geographically distributed nodes. It illustrates the high level connections between the nodes and indicates non functional characteristics that will be relevant.

It does not provide logical or physical level information about the information technology infrastructure in terms of type of equipment, specifications, configurations, etc and it does not identify specific physical locations where things such as a data centre may be utilised. It does not select or suggest suitable hardware or software products.

2.2. Document Structure

This report contains the following items.

- Executive Summary (previous section)
- Information about the document (this section)
- Conceptual Relationship Diagram – modelled as a conceptual operational diagram describing the topology and geographic distribution of the nodes, the definition of the nodes (computer platforms) and network connections, and where and how users and external systems interact with the system
- Walkthrough Diagrams

2.3. Acceptance Criteria

The Technology Contract for the Electricity Distribution & Intelligent Infrastructure Project contains the following acceptance criteria for this report

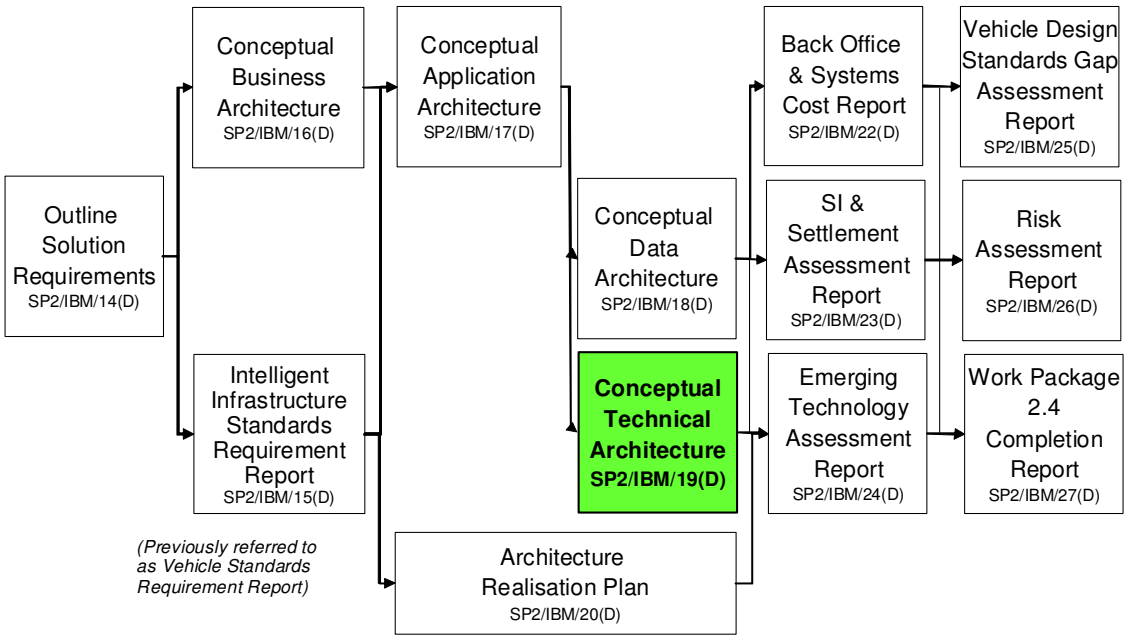
It will be complete when the report comprises the following topics:

- Document Structure - Explanation of how the documentation of the Conceptual Technical Architecture is organised;
- Conceptual Relationship Diagram;
  - At a conceptual level, showing the location of the nodes and required connections to support the intelligent architecture
  - The diagram describes the topology and geographic distribution of the nodes, the definition of the nodes (computer platforms) and network connections, and where and how users and external systems interact with the system.
- Walkthrough Diagrams
  - 3 Walkthrough Diagrams highlighting how the Conceptual Technical Architecture will work in support of selected use case scenarios for particular users using particular access devices in particular locations at various stages of evolution of the architecture (as per description in SP2/IBM/16). The use case scenarios will be selected based on a prioritised view of where the

main technical complexities and challenges lie. Walkthroughs can be divided into those describing the flows associated with business processes, sub-processes, or activities, and those describing the flows associated with technical support activities (for example the preparation and execution of software updates)

2.4. 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.



The table below provides an additional overview of the Reports

Deliverable	Outline
Intelligent Infrastructure Requirements Report	Outline solution requirements; High Level System Context; High Level Initial Use Case Model
Intelligent Infrastructure 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 Technical Architecture	**Conceptual Operating Model using Relationship Diagram, Node Descriptions and Walkthrough Diagrams**

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

3. Operational Modelling

3.1. Overview

The technical architecture is represented using the technique of Operational Modelling. Operational models can be generated at different levels of detail which relate to the need for abstraction and broader scope of the model as detail and understanding develops during the lifecycle of the project.

Three levels of the Operational Model are created when developing the operational aspect of the architecture. These are illustrated in the table and diagram below. The focus of this Report is at the conceptual level.

No.	Level	Description
1	Conceptual	Specifies the placement onto nodes of those components associated with the application, together with the direct node-to-node connections necessary to support the interactions required between these components. While taking account of some technical limitations (such as interaction between application components in different locations), it defers consideration of how the application level components will be supported technically to later levels of analysis.
2	Specified / Logical	Describes the distribution of, and interaction between, all specified components over the locations and zones of the IT system. It specifies: • The placement of specified components onto specified nodes • The specified connections between specified nodes necessary to support the interactions between specified components • The non-functional characteristics of specified nodes and specified connections, acquired from the specified components and their interactions.
3	Physical	In which the hardware and software technologies needed to deliver the Operational Model's characteristics and capabilities are identified and configured, whether they are to be bought or developed.

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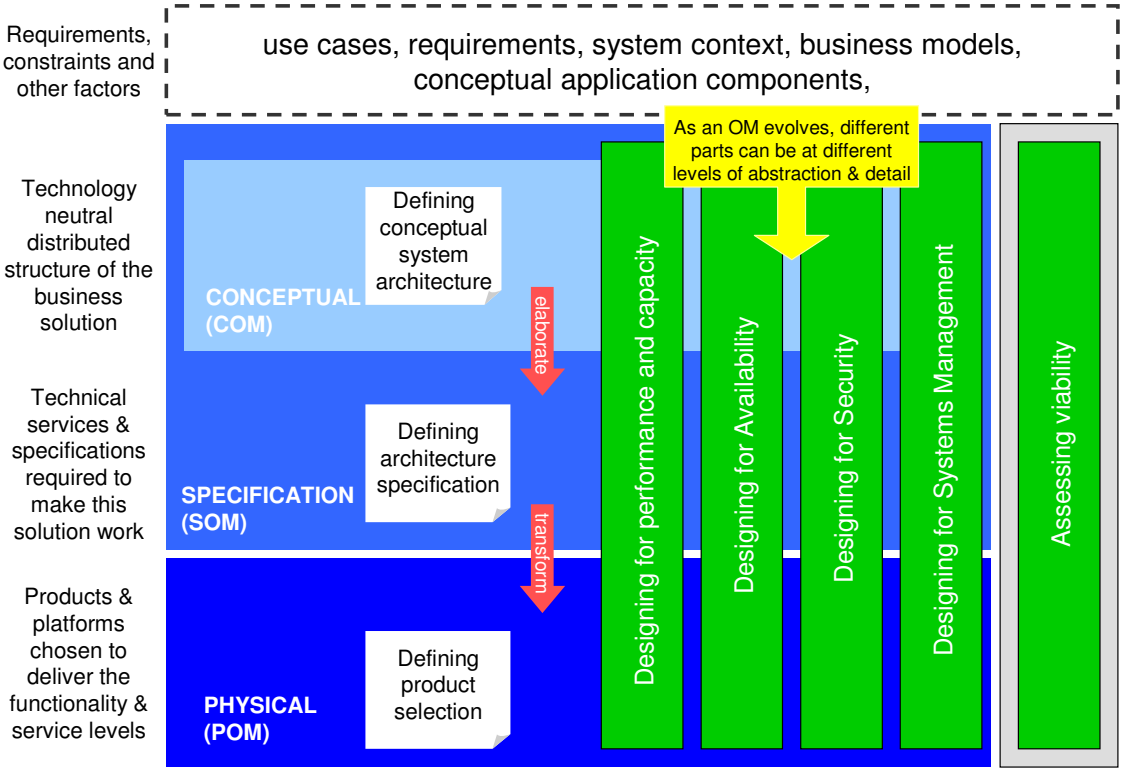


3.2. The focus of this activity

The current program of activity is to produce a Conceptual model with further iterations and levels of detail taken forward during any later stages. The Conceptual Operational Model (COM) determines the shape and outlines the distribution of functionality in the Intelligent Infrastructure.

The COM provides an initial, technology-neutral view of the operational architecture. The key advantage of the COM is that it focuses on the requirements of the business and the underlying characteristics of the business (such as locations and roles).

Two different model diagrams will be used in this conceptual model

- Relationship Diagram showing locations and placement of nodes, together with an illustration of static relationships between nodes; and
- Walkthrough Diagrams to show a more dynamic view as to how the different elements interact to support the various Use Cases placed on the Operational Model

A series of text based descriptions for key elements are also provided.

4. Conceptual Technical Architecture Content

4.1. Definition of Terms

Location

A Location is a geographic place where nodes are grouped together. Conceptual nodes are placed into geographic locations [L]. In later Physical Operational Modelling, a location will typically be implemented as a local area network(s).

Conceptual Node

A conceptual node is an environment into which software can be installed and executed and data can be placed (could be a physical or "virtual" computer). Conceptual nodes can host one or multiple deployment units.

Connection

The potential need for interaction between conceptual nodes is represented as a conceptual connection [CC] showing what connectivity is required to support interactions between application components.

A conceptual connection is synonymous with an interface. An interface may support multiple unrelated business transactions. An end-to-end (E2E) business process may require multiple systems passing transactions via interfaces. There may also be a manual business process involved in an E2E business process. The mechanism for interaction is not specified at this stage, merely the need for an interaction between nodes is being illustrated.

Deployment Unit

Deployment Units represent a grouping of software components and/or sub-components implemented onto nodes. To maintain a clear link back to the conceptual application model, the deployment units used in the conceptual model match to the components in the conceptual application model. Further levels of analysis would identify any grouping of components for deployment.

4.2. Conceptual Relationship Diagram

The high level conceptual technical architecture in the form of a conceptual operational model relationship diagram is given below.

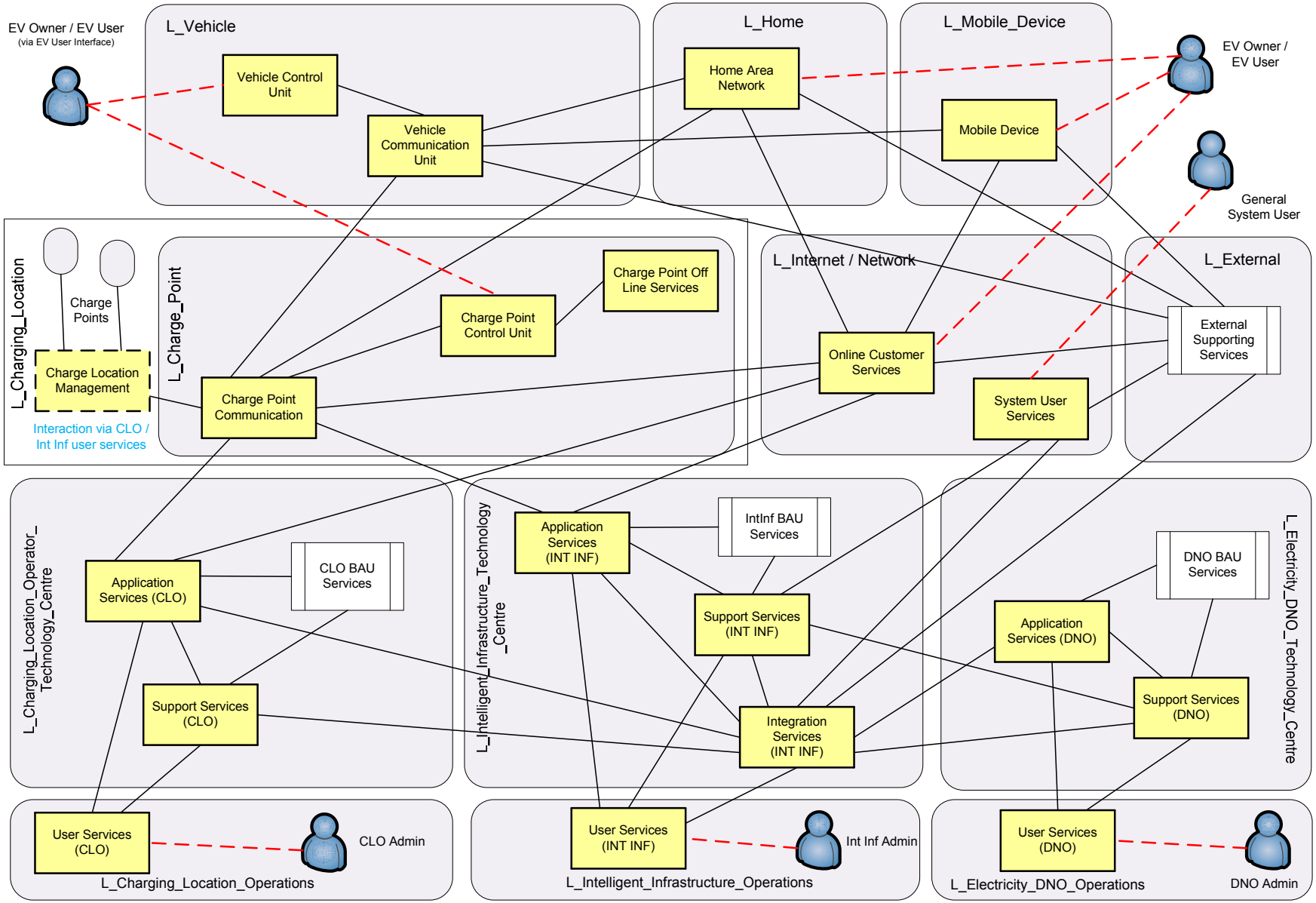
How was it derived?

The Intelligent Infrastructure Requirements Report (SP2/IBM/14) and Conceptual Business Architecture Report (SP2/IBM/16) were used to identify the topology and geographic node distribution relevant to the Intelligent Infrastructure – the toplogy is expressed in the model as a series of Locations. Nodes (defined as 'computational platforms') were assigned to the Locations – note that we are still working at the conceptual level and not at the physical level and hence nodes are referred to at this level as Conceptual Nodes. Key connections between the nodes were identified which, at this level, indicate 'need', and not mechanism.

Using the components defined in the Conceptual Application Architecture (SP2/IBM/17), a mapping of components to conceptual nodes was developed – i.e. which components are likely to be found on which conceptual node. Note that components are defined as software artefacts. Deployment Units represent a grouping of software components and/or sub-components implemented onto nodes. The analysis is summarized in the following diagram and tables.

The Locations and Conceptual Nodes are defined in more detail in tables in Section 4.3 and beyond. The tables describing the Conceptual Nodes include a high level assessment of key non functional requirements. The diagram shows where and how users and external systems interact with the Intelligent Infrastructure.

The Conceptual Relationship Diagram provides a 'technology neutral' view of the distributed structure of the business solution. ('Technology neutral' means that at this stage we are not defining/proposing any particular make/model of hardware, software etc.)


EV Owner / EV User
(via EV User Interface)
L_Vehicle
Vehicle Control Unit
Vehicle Communication Unit
L_Home
Home Area Network
L_Mobile_Device
Mobile Device
EV Owner / EV User
General System User
L_Charging_Location
Charge Points
Charge Location Management
Interaction via CLO / Int Inf user services
L_Charge_Point
Charge Point Control Unit
Charge Point Off Line Services
Charge Point Communication
L_Internet / Network
Online Customer Services
System User Services
L_External
External Supporting Services
L_Charging_Location_Operator_Technology_Centre
Application Services (CLO)
CLO BAU Services
Support Services (CLO)
L_Intelligent_Infrastructure_Technology_Centre
Application Services (INT INF)
IntInf BAU Services
Support Services (INT INF)
Integration Services (INT INF)
L_Electricity_DNO_Technology_Centre
DNO BAU Services
Application Services (DNO)
Support Services (DNO)
User Services (CLO)
CLO Admin
L_Charging_Location_Operations
User Services (INT INF)
Int Inf Admin
L_Intelligent_Infrastructure_Operations
User Services (DNO)
DNO Admin
L_Electricity_DNO_Operations

4.3. Locations

A number of key locations are illustrated in the conceptual model which will have different nodes and deployment units related to them

Location	Description
Vehicle	Represents the EV in terms of a location that can have deployment nodes and deployment units. For example, the EV Control Unit could have II software deployed to it or be used to access II services and data.
Home	Represents a domestic location at which EVs may be charged and from which services may be accessed.
Mobile Device	Represents mobile device technology through which services can be accessed
External Service Provider	Represents those locations that will be the source of services external to the Charge Location operator, Intelligent Infrastructure operator and Electricity DNO operator
Charging Location	Represents a domestic or non-domestic charge location which could have a charge post deployed and be used to access II services and data.
Charge Point	Represents a charge post through which EVs are charged and services accessed
Internet / Network	Communications using the internet and data / voice networks will be a key part of the infrastructure and therefore we are representing this as a location.
Charge Location Technology Centre	Represents the location that the charge location operator runs systems from. Could be their own facility and / or third party managed facilities which they use
Intelligent Infrastructure Technology Centre	Represents the location that the Intelligent Infrastructure operator runs systems from. Could be their own facility and / or third party managed facilities which they use
Electricity DNO Technology Centre	Represents the location that the Electricity DNO runs systems from. Could be their own facility and / or third party managed facilities which they use
Charge Location Operations Centre	Represents the locations from which charge location operators will undertake their activities.
Intelligent Infrastructure Operations Centre	Represents the locations from which Intelligent Infrastructure operators will undertake their activities.
Electricity DNO Operations	Represents the locations from which Electricity DNO operators

	will undertake their activities

4.4. Summary Table

The table below brings together locations, conceptual nodes and deployment units to provide a summary.

Location	**Conceptual Nodes (CN_)**	**Deployment Units (DU_)** **(ref: SP2/IBM/17)**
Vehicle	Vehicle Control Unit	EV User Interface EV Telemetry & Diagnostic Manager EV Configuration & State Manager
	Vehicle Communications Unit	EV Communications Controller
Home	Home Area Network	User Portal Charging Parameters Manager
Mobile Device	Mobile Device	Mobile User Interface
External	External Supporting Services	n/a
Charging Location	Charge Points	n/a
Charge Point	Charge Point Control Unit	Charge Point User Interface Charge Point SCADA Manager (RTU / PLU) Charging Parameters Manager
	Charge Point Communication Unit	Charge Point Communications Controller
Internet / Network	Online Customer Services	User Portal Charge Point Location Viewer Charge Point Booking Manager
	System User Services	User Portal
Charging Location Technology Centre	Application Services (CLO)	Customer Services Manager Charge Point Status Manager Charge Point SCADA Manager Charge Point Asset Manager

		Charge Point Booking Manager Central Payment Manager
	Support Services (CLO)	Security Manager Master Data Manager
	BAU Services (CLO)	The charge location operator's own application landscape
Intelligent Infrastructure Technology Centre	Application Services (Int Inf)	Customer Services Manager Charge Point Status Manager Charge Point SCADA Manager Charge Point Asset Manager Charge Point Booking Manager Central Payment Manager Fraud Manager
	Support Services (Int Inf)	Analytics Manager Report Manager Settlement & Clearing Manager Security Manager Information Manager Master Data Manager
	Integration Services (Int Inf)	Integration Manager
	BAU Services (Int Inf)	The II operators own application landscape
Electricity DNO Technology Centre	Application Services (DNO)	Electricity Demand Manager
	Support Services (DNO)	Analytics Manager Report Manager
	BAU Services (DNO)	The DNO's own application landscape
Charging Location Operations	User Services (CLO)	Charge Location Admin Portal
Intelligent Infrastructure Operations	User Services (INT INF)	Intelligent Infrastructure Admin Portal
Electricity DNO Operations	User Services (DNO	Electricity Utility Portal

4.5. Conceptual Nodes

4.5.1. Introduction

The tables below provide information about the conceptual nodes illustrated in this conceptual model. For each node the table shows name, definition, locations, connections and high level non functional considerations. Later stages of analysis would confirm and expand the conceptual level information.

Template used is outlined below.

Conceptual Node Name	*Name of the CN*
Definition	*Brief description*
Location (s)	*Conceptual Location(s) deployed to*
Connections	*List of conceptual connections*
Deployment Units	*List of conceptual deployment units the CN will host – generally these are the components defined in the Conceptual Application Architecture (SP2/IBM/17)*
Key non functional characteristics	*Brief details of potential areas of non functional characteristics relating to Qualities (run time & non runtime) & Constraints (business & technical) that impact the CN. See Appendix for more information. Related to the operation of the node for the II and not its general use.*

4.5.2. Definition Tables

4.5.2.1. Location - Vehicle

Conceptual Node Name	**Vehicle Control Unit**	
Definition	An embedded system in the vehicle which is used to control activity and manage information deployed to it and relevant for interaction with the intelligent infrastructure.	
Location	L_Vehicle	
Conceptual Connections	Vehicle Communications Unit : To send and receive messages and information between the vehicle and another physical or virtual location	
Conceptual Deployment Units	EV User Interface EV Telemetry & Diagnostic Manager EV Configuration & State Manager	
Key non functional	Qualities	Availability; Usability; User Interface; Portability; Data & Information Integrity; Maintainability

characteristics	Constraints	Marketplace Factors; Technology State of the Art; Standards

Conceptual Node Name	**Vehicle Communications Unit**	
Definition	Represents a node which supports and enables communications to and from the vehicle.	
Location	L_Vehicle	
Conceptual Connections	Vehicle Control Unit Charge Point Communication Unit Home Area Network Mobile Device External Supporting Services	
Conceptual Deployment Units	EV Communications Controller	
Key non functional characteristics	Qualities	Performance; Availability; Security; Data & Information Integrity; Safety
	Constraints	Existing Infrastructure; Standards

4.5.2.2. Location – Home

Conceptual Node Name	**Home Area Network**
Definition	Home Area Network (HAN) technology enables you to remotely connect to and control many automated digital devices throughout the home. This could include interaction with the vehicle or with aspects of charging the vehicle. There is strong potential for a smart meter to integrate with the HAN and communicate peak energy use times to your digital devices. For example, charging could be scheduled based on preferences and the status of the electricity network / electric vehicle. It could also receive signals via the smart meter.
Location	L_Home
Conceptual Connections	External Supporting Services On Line Customer Services Vehicle Communications Unit Charge Point Communications Unit (domestic)
Conceptual	User Portal

Deployment Units	Charging Parameters Manager	
Key non functional characteristics	Qualities	Availability; Security; Usability; User Interface; Data & Information Integrity
	Constraints	Standards; Existing Infrastructure

4.5.2.3. Location – Mobile Device

Conceptual Node Name	**Mobile Device**	
Definition	Represents the potential for using a mobile phone / smart phone type platform as a way of accessing and executing activity relating to vehicle charging.	
Location	L_Mobile_Device	
Conceptual Connections	Online Customer Services External Supporting Services Vehicle Communications Unit	
Conceptual Deployment Units	Mobile User Interface	
Key non functional characteristics	Qualities	Availability; Security; Usability; Portability; Data & Information Integrity; Safety
	Constraints	Regulatory; Existing Infrastructure; Standards

4.5.2.4. Location - External

Conceptual Node Name	**External Supporting Services**
Definition	Represents services that are delivered external to the intelligent infrastructure systems and actors. This could include payment authorisation, navigation information, entertainment services, etc
Location	L_External_Providers
Conceptual Connections	Mobile Device Home Area Network Vehicle Communications Unit On line Customer Services Integration Service (Int Inf)

Conceptual Deployment Units	n/ a
Key non functional characteristics	Would be dependent on the external systems being linked to.

4.5.2.5. Location - Charging Location

Conceptual Node Name	**Charge Point (in location)**
Definition	Used here to represent the fact that charge points will be deployed in charge locations. In that way, they could be viewed as a conceptual node themselves. The charge locations can be domestic, public or commercial.
Location	L_Charge_Location
Conceptual Connections	Charge Points are deployed to the CP Locations and may be linked by a network at that location.
Conceptual Deployment Units	Charge Point (and by definition, all the deploment units deployed to individual charge points)
Key non functional characteristics	As per the various charge point conceptual nodes.

4.5.2.6. Location - Charge Point

Conceptual Node Name	**Charge Point Control Unit**	
Definition	An embedded system in the charge post which is used to control activity and manage information and services deployed to it and relevant for interaction with the intelligent infrastructure. Could include aspects of smart meter functionality.	
Location	L_Charge_Point	
Conceptual Connections	Charge Point Off Line Services Charge Point Communications Unit	
Conceptual Deployment Units	Charge Point User Interface Charge Point SCADA Manager (RTU / PLU) Charging Parameters Manager	
Key non functional	Qualities	Performance (response time); Availability; Security; Usability; User Interface; Portability; Maintainability; Scalability (ability to

characteristics		add additional services); Safety
	Constraints	Regulatory; Existing Infrastructure; Standards

Conceptual Node Name	**Charge Point Communication Unit**	
Definition	Represents the node which supports and enables communications to and from the charge point.	
Location	L_Charge_Point	
Conceptual Connections	Vehicle Communications Unit Charge Point Control Unit On Line Customer Services Application Services (CLO) Application Services (Int Inf)	
Conceptual Deployment Units	Charge Point Communications Controller	
Key non functional characteristics	Qualities	Performance (response time); Availability; Security; Maintainability; Data & Information Integrity; Safety
	Constraints	Existing Infrastructure; Standards

4.5.2.7. Location - Internet/Network

Conceptual Node Name	**Online Customer Services**
Definition	Represents the platforms that will support access to information and services for users of the charging infrastructure.
Location	L_Internet / Network
Conceptual Connections	Home Area Network Mobile Device External Supporting Services Charge Point Communications Unit Application Services (CLO) Application Services (Int Inf)
Conceptual	User Portal

Deployment Units	Charge Point Location Viewer Charge Point Booking Manager	
Key non functional characteristics	Qualities	Capacity; Performance; Availability; Security; Usability; Maintainability; Scalability; Data & Information Integrity
	Constraints	Marketplace; Legacy Integration

Conceptual Node Name	**System User Services**	
Definition	Represents the provision of a facility which enables general system users access to basic functions. There are specific user services highlighted for the main actors (customers, charge location operators, intelligent infrastructure operators, electricity DNO) but this allows for actors such as governement bodies, regulators, manufacturers, etc to have access.	
Location	L_Internet / Network	
Conceptual Connections	External Supporting Services Support Services (Int Inf) – for analytics, reporting Integration Services (Int Inf)	
Conceptual Deployment Units	User Portal – would be developed to provide onward access to the other services hosted elsewhere, for example anaytics and reporting	
Key non functional characteristics	Qualities	Capacity; Availability; Security; Usability; Maintainability; Scalability; Data & Information Integrity
	Constraints	Marketplace; Legacy Integration

4.5.2.8. Location - Charging Location Technology Centre

Conceptual Node Name	**Application Services (CLO)**
Definition	Represents the platforms that are used by a charging location operator to support data and services for core application services relating to the intelligent infrastructure, e.g. customer management, charging activity management, etc. These would be housed in a CLO technology centre which could be their own data centre or a service they source from elsewhere
Location	L_Charging_Location_Operator_Technology_Centre
Conceptual Connections	Charge Point Communications Unit

	On Line Customer Services User Services (CLO) Support Services (CLO) BAU Services (CLO) Integration Services (Int Inf)	
Conceptual Deployment Units	Customer Services Manager Charge Point Status Manager Charge Point SCADA Manager Charge Point Asset Manager Charge Point Booking Manager Central Payment Manager	
Key non functional characteristics	Qualities	Capacity; Performance; Availability; Security; Manitainability; Scalability; Data & Information Integrity
	Constraints	Legacy Integration

Conceptual Node Name	**Support Services (CLO)**	
Definition	Represents the platforms that are used by a Charging Location Operator to support data and services for supporting services relating to the intelligent infrastructure. For the CLO this could include integration services, security, etc. These would be housed in a CLO technology centre which could be their own data centre or a service they source from elsewhere	
Location	L_Charging_Location_Operator_Technology_Centre	
Conceptual Connections	Application Services (CLO) User Services (CLO) BAU Services (CLO) Support Services (Int Inf) Integration Services (Int Inf)	
Conceptual Deployment Units	Security Manager Master Data Manager	
Key non functional	Qualities	Capacity; Performance; Availability; Security; Manitainability; Scalability; Data & Information Integrity

characteristics	Constraints	Legacy Integration

Conceptual Node Name	**BAU Services (CLO)**	
Definition	Represents platforms that may be used by the charge location operator to provide business as usual services which are not directly relevant for the intelligent infrastructure. They could be linked to by the CLO for things such as ERP.	
Location	L_Charging_Location_Operator_Technology_Centre	
Conceptual Connections	Application Services (CLO) Support Services (CLO)	
Conceptual Deployment Units	n / a	
Key non functional characteristics	Any business as usual systems opperated by the CLO would have their own non functional characteristics. It is possible to highlight areas where these might need to be assessed if there are any links with II related systems.	
	Qualities	Capacity; Performance; Availability; Security; Data & Information Integrity
	Constraints	Legacy Integration; Existing Infrastructure

4.5.2.9. Location - Intelligent Infrastructure Technology Location

Conceptual Node Name	**Application Services (Int Inf)**
Definition	Represents the platforms that are used by a charging location operator to support data and information for core application services relating to the intelligent infrastructure. These would be housed in a intelligent infrastructure operator technology centre which could be their own data centre or a service they source from elsewhere.
Location	L_Intelligent_Infrastructure_Technology_Centre
Conceptual Connections	Charge Point Communications Unit On Line Customer Services User Services (Int Inf) Integration Services (Int Inf) Support Services (Int Inf)

	BAU Services (Int Inf)	
Conceptual Deployment Units	Customer Services Manager Charge Point Status Manager Charge Point SCADA Manager Charge Point Asset Manager Charge Point Booking Manager Central Payment Manager Fraud Manager	
Key non functional characteristics	Qualities	Capacity; Performance; Availability; Security; Manitainability; Scalability; Data & Information Integrity
	Constraints	Legacy Integration

Conceptual Node Name	**Support Services (Int Inf)**	
Definition	Represents the platforms that are used by an Intelligent Infrastructure Operator to support data and services for supporting services relating to the intelligent infrastructure – e.g. security, analytics. These would be housed in a CLO technology centre which could be their own data centre or a service they source from elsewhere	
Location	L_Intelligent_Infrastructure_Technology_Centre	
Conceptual Connections	User Services (Int Inf) Application Services (Int Inf) BAU Services (Int Inf) Integration Services (Int Inf) Support Services (CLO)	
Conceptual Deployment Units	Analytics Manager Report Manager Settlement & Clearing Manager Security Manager Information Manager Master Data Manager	
Key non functional	Qualities	Capacity; Performance; Availability; Security; Manitainability;

characteristics		Scalability; Data & Information Integrity
	Constraints	Legacy Integration

Conceptual Node Name	**Integration Services (Int Inf)**	
Definition	Represents the platforms that are used by an Intelligent Infrastructure Operator to support data and services for integration and interoperability relating to the intelligent infrastructure. This includes providing consolidated views of data gathered from different providers, for example enabling the collection of charge location information across providers to give a consolidated view. These would be housed in a CLO technology centre which could be their own data centre or a service they source from elsewhere	
Location	L_Intelligent_Infrastructure_Technology_Centre	
Conceptual Connections	User Services (Int Inf) Application Services (Int Inf) BAU Services (Int Inf) Support Services (CLO) Application Services (CLO) Support Services (CLO) Application Services (DNO) Support Services (DNO)	
Conceptual Deployment Units	Integration Manager	
Key non functional characteristics	Qualities	Capacity; Performance; Availability; Security; Manitainability; Scalability; Data & Information Integrity
	Constraints	Regulatory; Legacy Integration; Standards

Conceptual Node Name	**BAU Services (Int Inf)**
Definition	Represents platforms in their own portfolio that may be used by the intelligent infrastructure operator to provide business as usual services which are not directly relevant for the intelligent infrastructure. This could include things such as ERP systems.

Location	L_Intelligent_Infrastructure_Technology_Centre	
Conceptual Connections	Application Services (Int Inf) Support Services (Int Inf)	
Conceptual Deployment Units	n / a	
Key non functional characteristics	Any business as usual systems opperated by the Inteligent Infrastructure Operator would have their own non functional characteristics. It is possible to highlight areas where these might need to be assessed if there are any links with related systems.	
	Qualities	Capacity; Performance; Availability; Security; Data & Information Integrity
	Constraints	Legacy Integration; Existing Infrastructure

4.5.2.10. Location - Electricity DNO Technology Location

Conceptual Node Name	**Application Services (DNO)**	
Definition	Represents the platforms that are used by a charging location operator to support data and information for core application services relating to the intelligent infrastructure. These would be housed in a DNO technology centre which could be their own data centre or a service they source from elsewhere	
Location	L_Electricity_DNO_Technology_Centre	
Conceptual Connections	Support Services (DNO) User Services (DNO) BAU Services (DNO) Integration Services (Int Inf)	
Conceptual Deployment Units	Electricity Demand Manager	
Key non functional characteristics	Qualities	Capacity; Performance; Availability; Security; Manitainability; Scalability; Data & Information Integrity
	Constraints	Legacy Integration

Conceptual Node Name	**Support Services (DNO)**

Definition	Represents the platforms that are used by a Charging Location Operator to support data and services for supporting services relating to the intelligent infrastructure. For the CLO this could include integration services, security, etc. These would be housed in a CLO technology centre which could be their own data centre or a service they source from elsewhere.	
Location	L_Electricity_DNO_Technology_Centre	
Conceptual Connections	Integration Services (Int Inf) Support Services (Int Inf) Application Services (DNO) User Services (DNO) BAU Services (DNO)	
Conceptual Deployment Units	Analytics Manager Report Manager	
Key non functional characteristics	Qualities	Capacity; Performance; Availability; Security; Manitainability; Scalability; Data & Information Integrity
	Constraints	Legacy Integration

Conceptual Node Name	**BAU Services (DNO)**	
Definition	Represents platforms in their own portfolio that may be used by the intelligent DNO to provide business as usual services which are not directly relevant for the intelligent infrastructure. This could include things such as ERP systems.	
Location	L_Electricity_DNO_Technology_Centre	
Conceptual Connections	Application Services (DNO) Support Services (DNO)	
Conceptual Deployment Units	n / a	
Key non functional characteristics	Any business as usual systems opperated by the Inteligent Infrastructure Operator would have their own non functional characteristics. It is possible to highlight areas where these might need to be assessed if there are any links with related systems.	
	Qualities	Capacity; Performance; Availability; Security; Data & Information Integrity
	Constraints	Legacy Integration; Existing Infrastructure

4.5.2.11. Location - Charging Location Operations

Conceptual Node Name	User Services (CLO)	
Definition	Represent the node that supports the deployment of and access to the CLO portal components that would allow a user to access information and functionality relevant to the CLO.	
Location	L_Charging_Location_Operations	
Conceptual Connections	Application Services (CLO) Support Services (CLO)	
Conceptual Deployment Units	Charge Location Admin Portal	
Key non functional characteristics	Qualities	Performance; Availability; Security; Usability; Maintainability; Data & Information Integrity
	Constraints	Legacy Integration

4.5.2.12. Location – Intelligent Infrastructure Operations

Conceptual Node Name	User Services (INT INF)	
Definition	Represent the node that supports the deployment of and access to the II Operator portal components that would allow a user to access information and functionality relevant to the II Operator.	
Location	L_Intelligent_Infrastructure_Operations	
Conceptual Connections	Application Services (Int Inf) Support Services (Int Inf) Integration Services (Int Inf)	
Conceptual Deployment Units	Intelligent Infrastructure Admin Portal	
Key non functional characteristics	Qualities	Performance; Availability; Security; Usability; Maintainability; Data & Information Integrity
	Constraints	Legacy Integration

4.5.2.13. Location – Electricity DNO Operations

Conceptual Node Name	User Services (DNO)	
Definition	Represent the node that supports the deployment of and access to the DNO portal components that would allow a user to access information and functionality relevant to the DNO.	
Location	L_Electricity_DNO_Operations	
Conceptual Connections	Application Services (DNO) Support Services (DNO)	
Conceptual Deployment Units	Electricity Utility Portal	
Key non functional characteristics	Qualities	Performance; Availability; Security; Usability; Maintainability; Data & Information Integrity
	Constraints	Legacy Integration

5. Walkthrough Diagrams

5.1. Overview

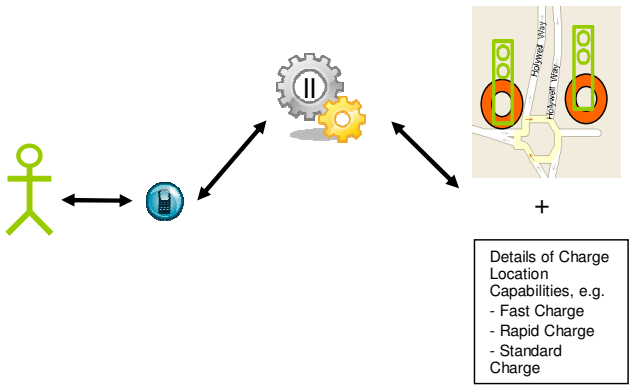
This section contains four walkthrough diagrams highlighting how the Conceptual Technical Architecture will work in support of selected use case scenarios – based on those defined in the Requirements Document (SP2/IBM/14) - for particular users using particular access devices in particular locations at various stages of evolution of the architecture (as per description in SP2/IBM/16). The following use case scenarios have been selected:-

- Locating Charging Locations using a Mobile Device
- Domestic Charging in the 'Smart' Phase of Evolution
- Charging in a 'Non-Domestic' Location in the 'Smart' Phase of Evolution
- Rectification of a Fault in a Public Charging Location

5.2. Locating Charging Locations using a Mobile Device

5.2.1. Illustrative Business Process Model

EV Intelligent Infrastructure - Conceptual Business Architecture - Illustrative Business Process Model – Locating Charging Locations via a Mobile Phone



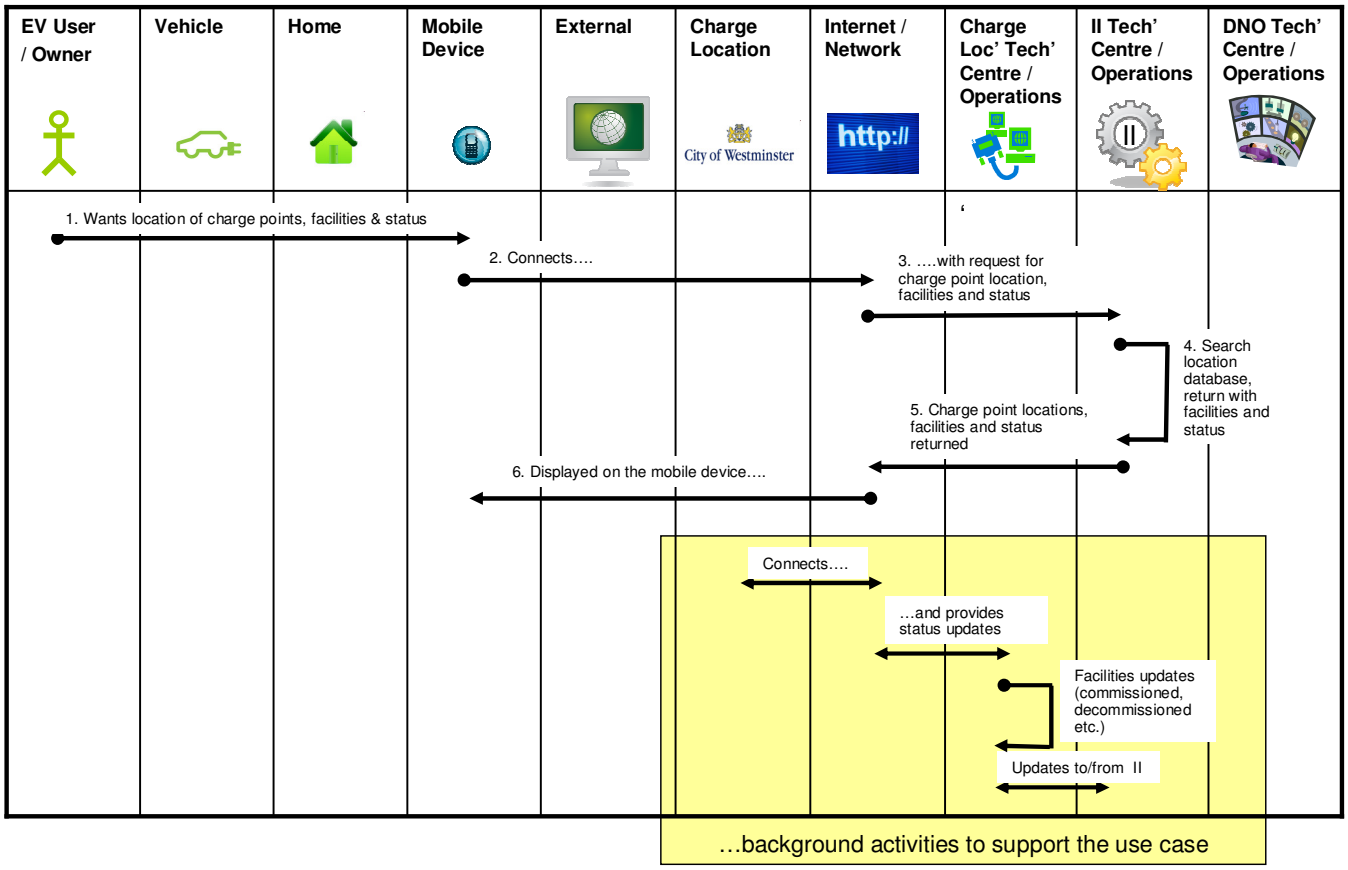
Scenario

- EV user uses Smart phone to log onto Intelligent Infrastructure User Web Portal
- EV user enters search criteria, for example - place name or postcode and, optionally, details of facilities required
- Intelligent Infrastructure searches locations database and returns details of charging locations meeting search criteria

1

5.2.2 Walkthrough Diagram

EV Intelligent Infrastructure – Technical Architecture Walkthrough Diagrams – Locating a charging location, facilities available and current status - using a mobile device



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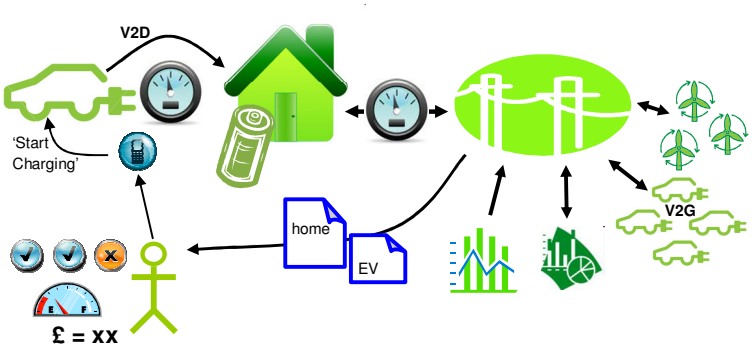
5.3. Domestic Charging in the 'Smart' Phase of Evolution

5.3.1. Illustrative Business Process

EV Intelligent Infrastructure - Conceptual Business Architecture - Illustrative Business Process Model - Domestic Charging – Smart Scenario

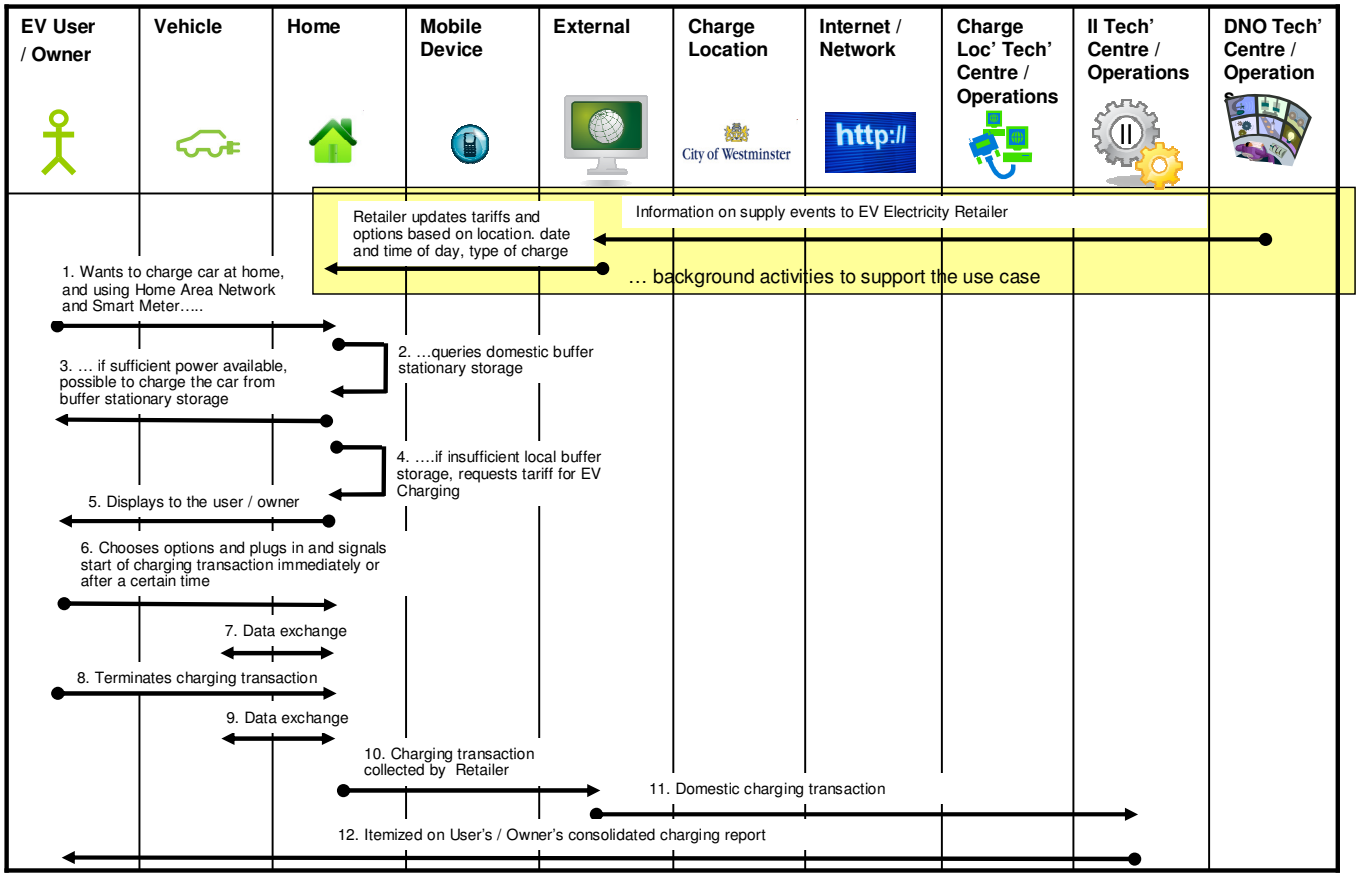


Scenario

- Domestic buffer stationary storage where the 'smart' aspect is applied to the lower tech stationary store which can be used to top up the car when required ie decoupling of the vehicle and the network constraints
- Sophisticated time of use management through interactions with the smart meter and grid
- Able to specify increased range of variables including price, etc
- User likely to have flexible and specific tariff for EV charging usage
- Demand for electricity managed more dynamically with real time decisions made on demand and supply based on historical, projected and actual network loads

5.3.2. Walkthrough Diagram

EV Intelligent Infrastructure – Technical Architecture Walkthrough Diagrams – Domestic Charging in the 'Smart Phase'



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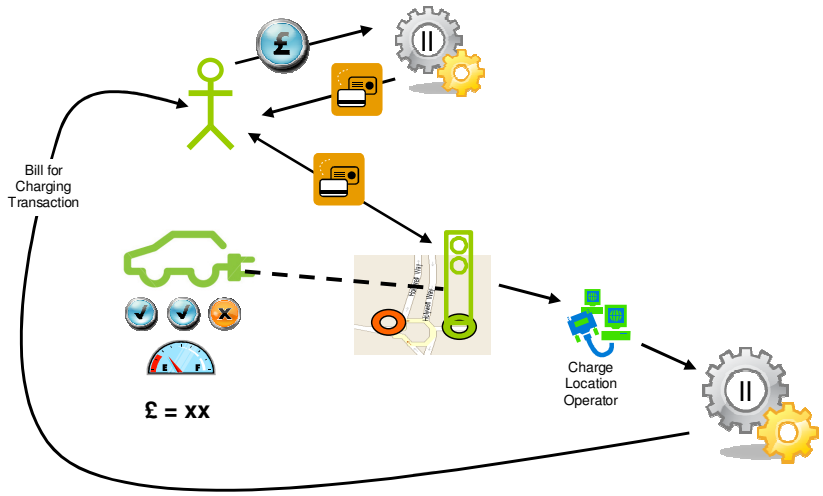
5.4. Charging in a 'Non-Domestic' Location in the 'Smart' Phase of Evolution

5.4.1 Illustrative Business Process

EV Intelligent Infrastructure - Conceptual Business Architecture - Illustrative Business Process Model - Non-Domestic Charging – Smart Scenarios

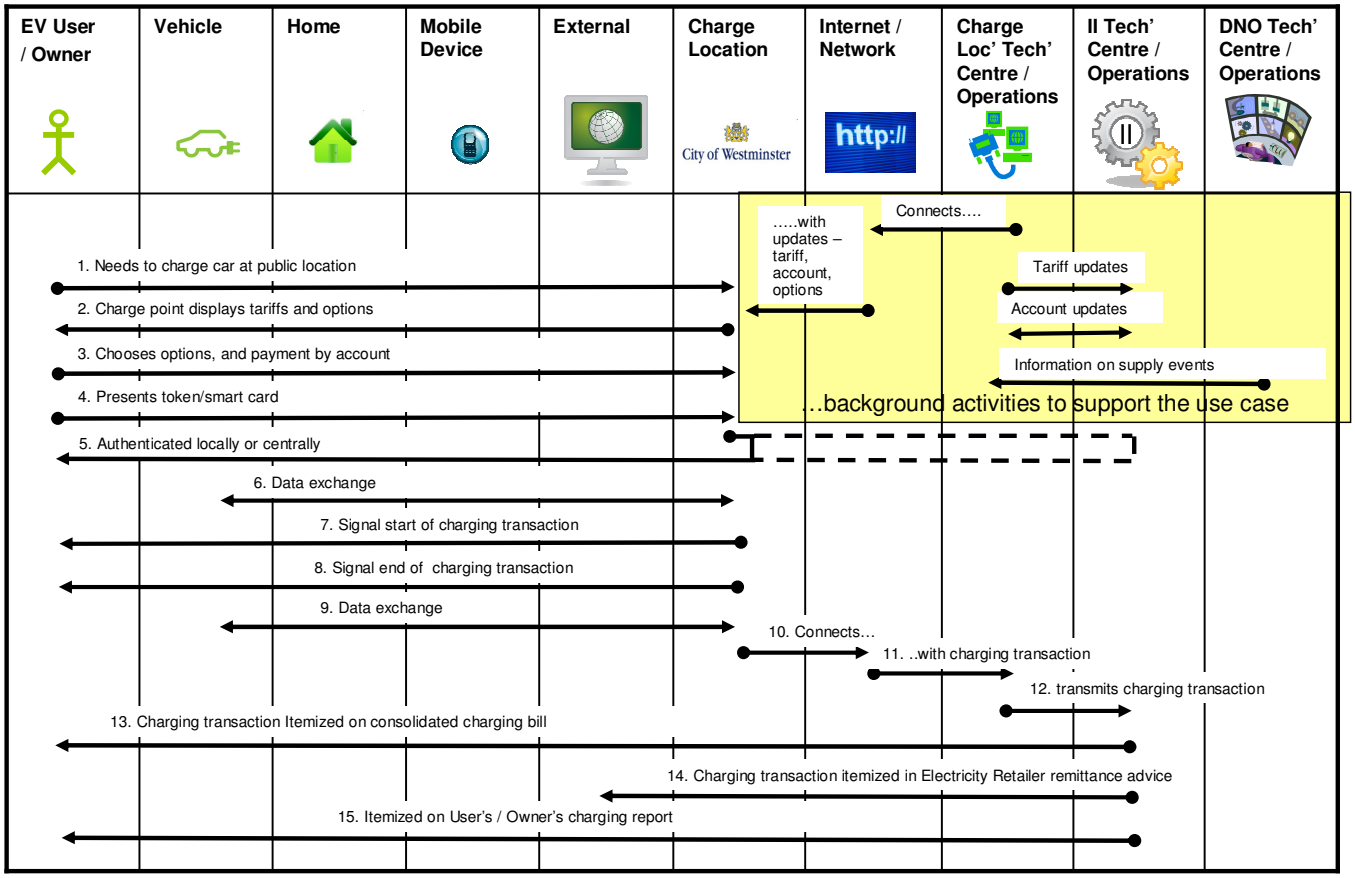


Scenario

- (EV User has registered for a payment on consumption account. They have received an access token/'charging' card.)
- Accesses charge point, authenticates, plugs in without further payment and selects required options from range of variables including for example type of charge – normal, fast, rapid (noting difference in prices).
- Charging location operator collates usage information and sends usage details to II operator
- II operator generates and distributes information to allow settlement and clearing of billing and payments
- II collates usage info, bookings info, demand info, etc

5.4.2 Walkthrough Diagram

EV Intelligent Infrastructure – Technical Architecture Walkthrough Diagrams – Public Charging Location in the 'Smart Phase', payment by consumption on account

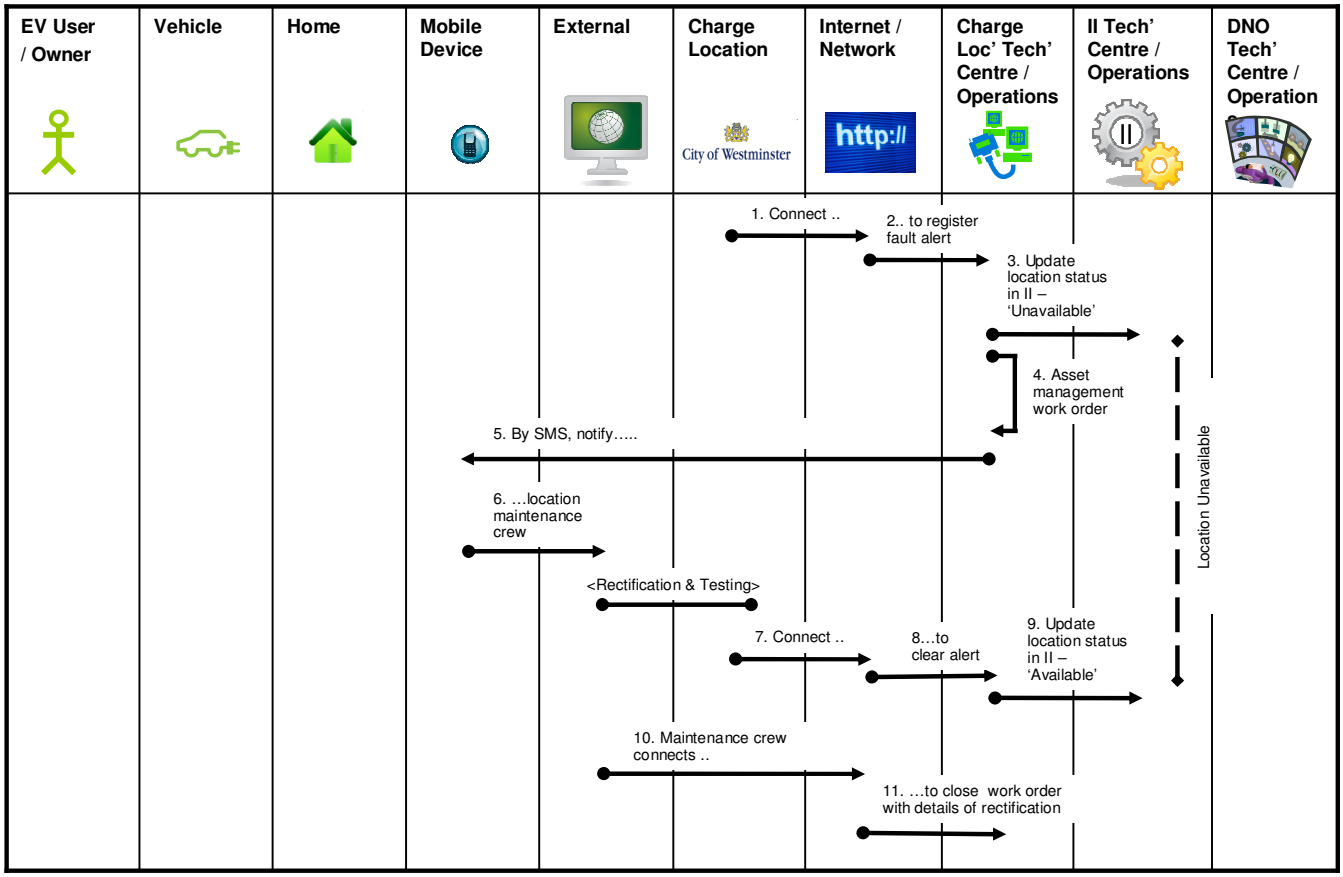


6

5.5. Rectification of a Fault in a Public Charging Location

5.5.1. Walkthrough Diagram

EV Intelligent Infrastructure – Technical Architecture Walkthrough Diagrams – Public Charging Location Fault Rectification



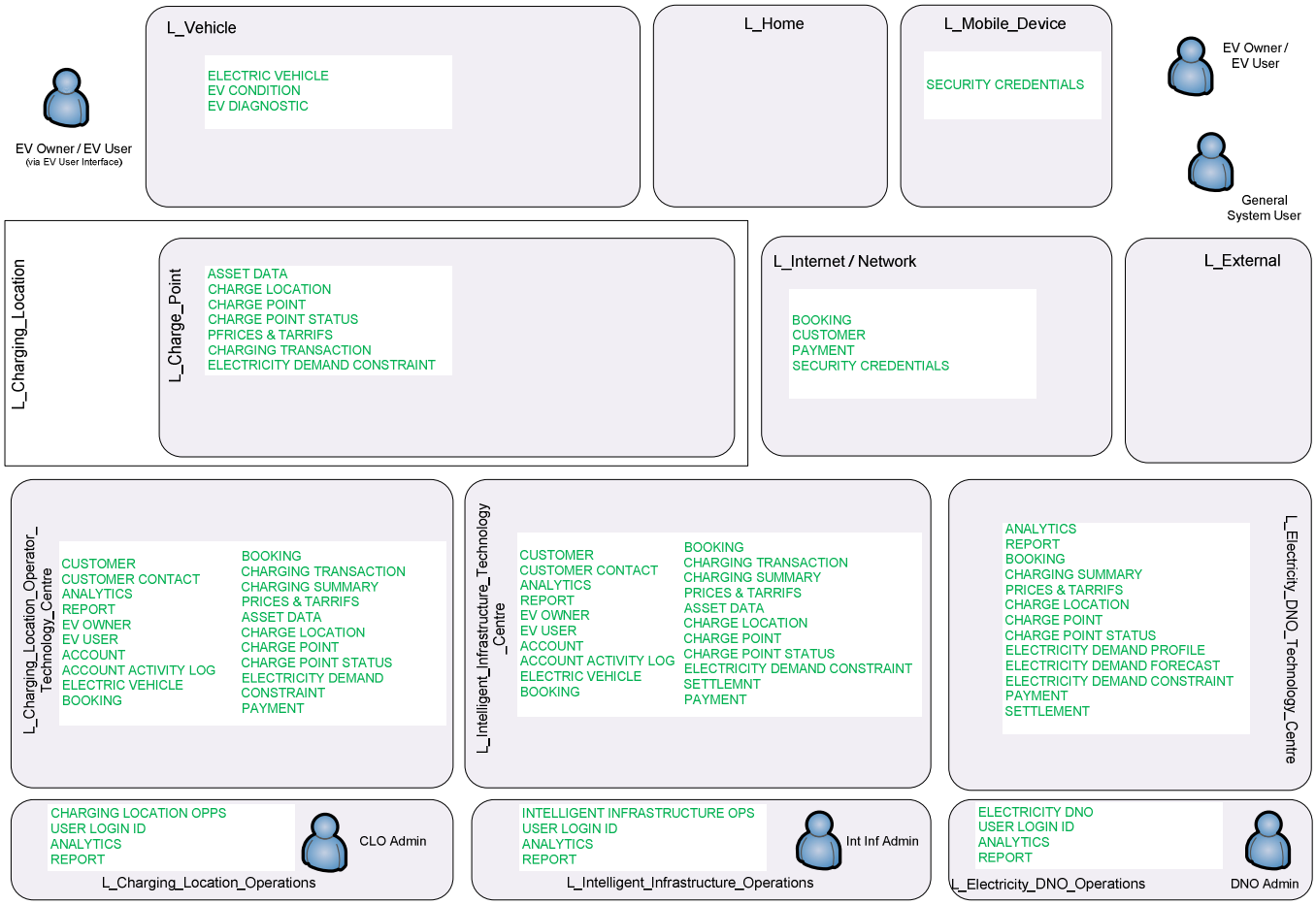
6. Relationship to other artefacts

6.1. Introduction

This section illustrates how the key conceptual data entities are related to and supportive of other intelligent infrastructure artefacts, in particular the requirements and the application components.

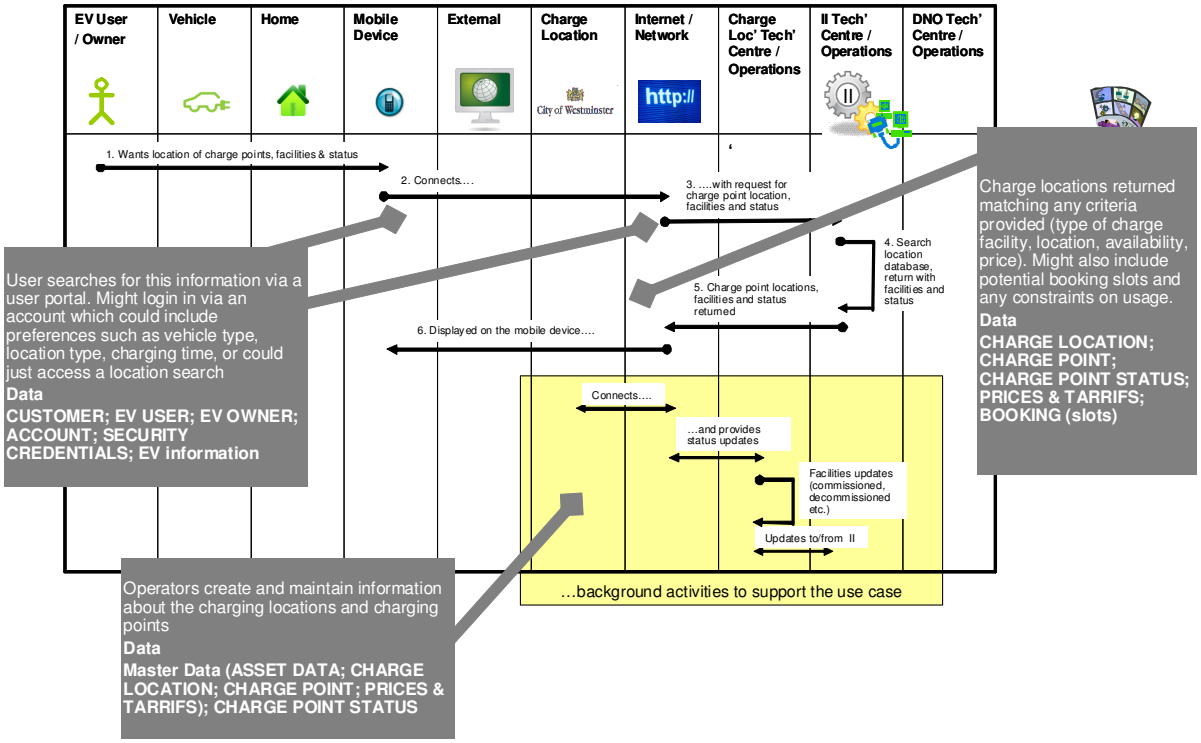
Conceptual Technical Architecture Relationship

The figures which follow indicate the relationship between the conceptual data entities and the conceptual technical architecture. The first figure illustrates where the conceptual data entities are most utilised set against the operational model.

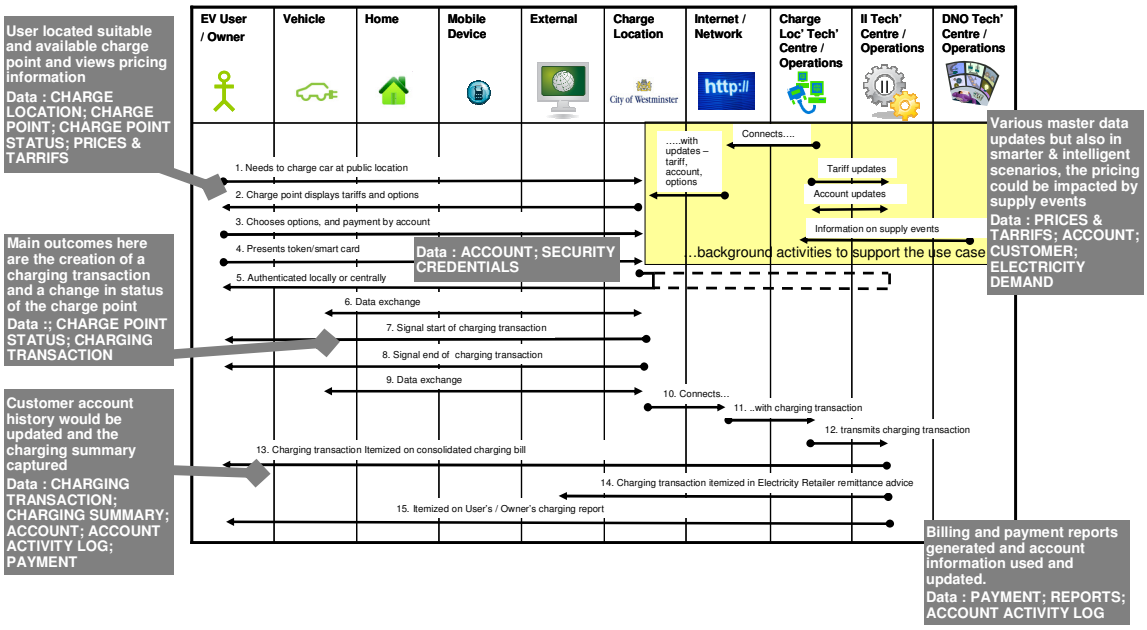


The figures below illustrate which conceptual data entities are involved in the sequence of activity shown on the walkthrough diagrams.

Locating a charging location, facilities available and current status - using a mobile device with key Conceptual Data Entities



Public Charging Location in the 'Smart Phase', payment by consumption on account – with key Conceptual Data Entities

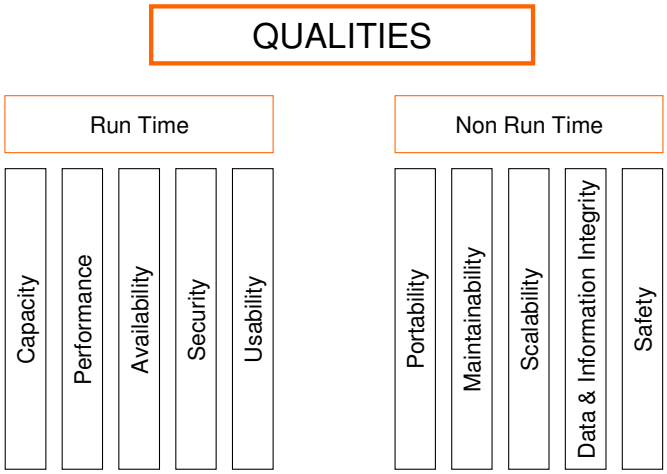


7. Appendix Section

7.1. Outline for non functional characteristics and levels

The conceptual node descriptions in the Report include a brief statement about non functional characteristics using the classification introduced in the Requirement Report (SP2/IBM14). Non-functional requirements (NFRs) specify 'how' the system should operate, rather than 'what' the system should do. Non Functional Requirements define the qualities and constraints to which a system must be built:

- Qualities define the expectations and characteristics the system should support. Runtime qualities are expressed by Service Level Requirements. Qualities might also be related to the development, maintenance, or operational concerns that are not expressed at runtime



- Constraints are limitations or specifications imposed upon a solution. They can concern business aspects of the project, customer's business environment or IT organisation that influence the architecture, or the technical environment that the system needs to operate within.