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Programme Area: Light Duty Vehicles

Project: Electricity Distribution and Intelligent Infrastructure

Title: Completion Report - Systems Integration and Architecture Development – Appendix C1

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 C1, which covers the Conceptual Application Architecture.

Context:

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

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Deliverable Title	Conceptual Application Architecture
Deliverable Reference	SP2/IBM/17

Interim or Final	Final
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Original Due Date	16th July 2010
Initial Submission Date	19th July 2010
Amended Version Date	11 th August 2010

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Version	History
Various 0.x	Drafts pre submission
v.1.0	Initial Submission 19th July 2010
v.2.0	Version 2 after comments from the ETI – 11 th August 2010

IP Ownership	As defined in the ETI Technology Contract for WP2.4
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ETI EV Work Package 2.4

SP2/IBM/17 - Conceptual Application Architecture

Version 2.0

11th August 2010

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1. Executive Summary

1.1. Outline of the Report

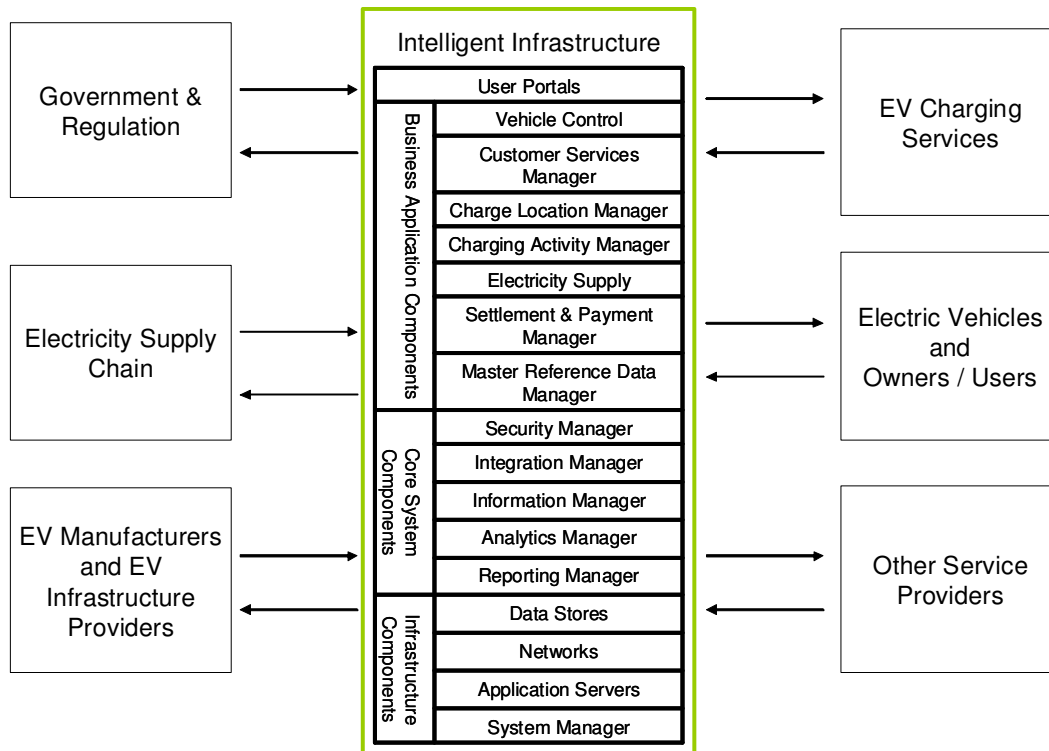
This document describes the Conceptual Application Architecture for the Intelligent Infrastructure and is based on the initial definition of Intelligent Infrastructure Requirements (SP2/IBM/14) and Conceptual Business Architecture (SP2/IBM/16).

The Conceptual Application Architecture is represented as a high level Component Model focused on the “logical” rather than the physical level i.e. it illustrates the high level technology / product neutral components. The Report includes :

- Component Relationship Diagrams and Models of different types and at different levels;
- Component descriptions, showing the key responsibilities and;
- Other selected information illustrating relationships between and context for the components.

1.2. High Level Model

The Conceptual Application Architecture for the Electric Vehicle Intelligent Infrastructure is represented as a high level conceptual component model which is depicted as follows, showing also the actors from the System Context Diagram (see SP2/IBM/14):-



1.3. Conceptual Application Architecture – Component Definition

The definition of each component is given in the table below:-

Component Name	What it does	What it is	Where it resides (- see below)
User Portals	Access for Intelligent Infrastructure (II) actors to relevant II functionality	Bespoke design and build using Commercial Off The Shelf (COTS) portal development tools	All layers of the II.
Business Application Components	Vehicle Control	Bespoke design and build, COTS Supervisory Control And Data Acquisition (SCADA) or Distributed Control System (DCS), and developed standard for EV<> II communications	All layers of the II.
	Customer Services Manager	COTS package – CRM, account management	Charging Supervisory Layer and II Central Layer
	Charging Location Manager	COTS SCADA/DCS and asset management tools, together with bespoke development and developed standards for information exchange	Charging Asset Layer, the Charging Supervisory Layer and Central Intelligent Infrastructure Layer
	Charging Activity Manager	COTS SCADA/DCS, together with bespoke development	Charging Asset Layer, Charging Supervisory Layer and Central Intelligent Infrastructure Layer
	Electricity Supply	Bespoke development using the information, analytics & reporting managers and developed standards for II<>Electricity Supply Chain	Charging Asset Layer, the Charging Supervisory Layer and Central Intelligent Infrastructure Layer
	Settlement & Payment Manager	Bespoke configuration using COTS application, relying on feeds of data for consumption, tariffs & contractual agreements	Charging Asset Layer, the Charging Supervisory Layer and Central Intelligent Infrastructure Layer
	Master Reference Data	COTS and bespoke data models, bespoke configuration, data loading, interfaces	Charging Asset Layer, the Charging Supervisory Layer and Central Intelligent Infrastructure Layer

Component Name	What it does	What it is	Where it resides (- see below)	
Core System Components	Security Manager	Functionality providing security of components and security of the overall infrastructure	Configuration and bespoke development of security features across components - Portals, Integration, Data Stores	Required by all components, and at all layers of the infrastructure
	Integration Manager	Enables integration and interoperability	Configuration and development using a COTS package	Charging Asset Layer, the Charging Supervisory Layer and Central Intelligent Infrastructure Layer
	Information Manager	Information and knowledge management	Configuration and development using a COTS package	Central Intelligent Infrastructure Layer
	Analytics Manager	Analytics and data warehousing functionality	Configuration and development using a COTS package	Central Intelligent Infrastructure Layer
	Reporting Manager	Preconfigured reports, bespoke reporting, ad-hoc queries	Configuration and development using a COTS package	Central Intelligent Infrastructure Layer
Infrastructure Components	Data Stores	Databases supporting all of the above components	COTS RDBMS (Relational Database Management System)	Charging Supervisory Layer and Central Intelligent Infrastructure Layer
	Networks	Networks supporting the Intelligent Infrastructure	COTS Network Infrastructure	Resides across all layers of the II
	Application Servers	Application servers supporting all of the above	COTS Application Servers	All layers of the II
	System Manager	System Management of above	COTS System Management	All layers of the II

1.4. Foundational components

Certain components could be considered to be foundational (these are illustrated in section 4.2) – that is they form the core of what the intelligent infrastructure should be seeking to provide. This would be based on the intelligent infrastructure having a focus on providing:

- common capability to all stakeholders where this is useful;
- supporting early adoption and use of a particular capability;
- providing capabilities that are required but which market participants are not able to provide

1.5. Home Re-Charging

The dominant model for re-charging is widely accepted to be that users will do so at home. Although the logistics and dynamics are different, domestic charging can still be supported by many of the components outlined in the conceptual architecture.

- Simple : Recharging at home is the most used approach but is relatively isolated from the intelligent infrastructure apart from things such as some customer information or where a compatible charging post is used which can provide information and basic charging options;
- Semi Intelligent : Domestic re-charging remains the most used approach. Now able to get more interaction with the Intelligent Infrastructure across different services.
- Smart : Domestic re-charging still the most used approach. Now significantly integrated with the II via the use of smart meters and smart grids and real time information on prices, demand, charging preferences, etc;

A table in Section 9 provides a view on the relevance of the components for home re-charging.

1.6. Main features of the evolution of the Application Architecture

The application components required at different stages of evolution of the infrastructure will be shaped by various factors including EV adoption, maturity of the market in different areas and the cost of developing and deploying the infrastructure.

Initial stages, labelled as **Simple**, would require a light touch intelligent infrastructure which supports and enables market development and use of services offered and managed by a range of providers. This points towards components providing:

- simple portals to giving access to basic services and information;
- basic information about the charging locations and their status;
- offering the first elements of an integration service to facilitate collection and sharing of information from all the actors for the benefit of everyone involved;
- support for simple payment methods;
- foundation level business analytics and optimisation capability, especially in the area of usage and demand

In the next stages of evolution, referred to as **Semi-Intelligent**, the number of application components, their coverage and complexity increases to support additional volumes, market maturity and a value in having common and shared services adopted and provided across the landscape. This points towards the following themes being important:

- increased importance, opportunity and value from extending the Integration services as the market grows and diversifies and the need for more frequent exchanges of information becomes a factor;

- increased focus on needing to understand the demand for electricity for charging vehicles beyond largely historical metrics creates an opportunity to deepen the functionality of Business Analytics and establish foundation level demand management information;
- emerging value from centralised settlement, payment and billing services which will be common to many stakeholders but which will not differentiate them in the market;
- user interaction with the EV and integration of the EV with the intelligent infrastructure becoming more relevant

A third layer of evolution analysed is referred to as **Smart**. At this point, both the need and the potential for extended intelligent infrastructure application services provides further opportunity to offer provisioning and value adding services. This points towards the following themes being important:

- Significant integration of the EV with the intelligent infrastructure. Users are able to interact with the vehicle and charging infrastructure via an extended range of approaches, including mobile devices;
- Increased functionality in charging activity management – to meet the increased sophistication (Smart Charging) introduced in order to control and influence charging activity and hence electricity consumption;
- Increased functionality in electricity supply management – to meet increased sophistication (Smart Grids) introduced to balance supply and demand;
- Increased functionality in integration management – to meet the demands of Smart Charging and Smart Grids;
- Increased demand for data, reporting and analytics from intelligent infrastructure actors, especially Government, Regulation and Other Service Providers;
- Increased sophistication of the infrastructure to meet the demands of the all of the above.

1.7. Key Conclusions

The coverage and complexity of the application components will vary depending on a mix of factors. Within the three broad evolutionary stages of simple, Semi Intelligent and Smart there are likely to be various 'sub stages' with the development and evolution of components varying on a case by case basis and with components at different stages being linked together.

At this stage, it is felt likely that having everything at the simple level or everything at the smart level would not be sustainable or realistic.

Though fit for purpose, the application components implemented initially would potentially reach a point where volumes and expectations (e.g. information, payment methods, timescales) could not be sustained.

At the other end of the scale, the smart component approach would be potentially over engineered for some components and / or incur a cost beyond the value offered.

The semi intelligent stage of evolution could be the stage where most of the components settle down and provide a balance in meeting the demands of the services, stakeholders and market dynamics that will develop.

Certain components could be considered to be foundational – that is they form the core of what the intelligent infrastructure should be seeking to provide. This would be based on the intelligent infrastructure having a focus on providing:

- common capability to all stakeholders where this is useful;
- supporting early adoption and use of a particular capability;
- providing capabilities that are required but which market participants are not able or willing to offer.

Further analysis and refinement, such as through any future real world trials would be important in establishing the optimum configuration of components. It seems likely this could be a core of semi intelligent level components, pragmatic adoption of smart level components and fit for purpose retention of simple services.

2. Information about this document

2.1. Purpose

This document describes the Conceptual Application Architecture for the Intelligent Infrastructure and is based on the initial definition of Intelligent Infrastructure Requirements (SP2/IBM/14) and Conceptual Business Architecture (SP2/IBM/16).

The Conceptual Application Architecture is represented as a high level Component Model focused on the “logical” rather than the physical level i.e. it illustrates the high level technology / product neutral components. It comprises Component Relationship Diagrams and text based descriptions, showing the key responsibilities.

In line with the other reports in WP2.4, at this stage, the Conceptual Application Architecture provides an initial high level view to assist in scoping a pragmatic boundary for the work package activities and deliverables. The expectation is that this information will be refined, matured, developed during the remainder of this and future phases.

The context covers the conceptual application components which apply to the Intelligent Infrastructure (II) and not all of the applications and application components that will be used to support the full range of business activities undertaken by the various stakeholders. For example, it does not describe the conceptual applications components used by a vehicle manufacturer or a DNO in support of their wider business.

2.2. Key changes for this version

Following review by the ETI nominated reviewers, a number of comments were addressed resulting in:

- Changes being made to the Executive Summary.
- Provision of some additional information around domestic / home re-charging.
- Other minor clarifications.

2.3. Acceptance Criteria

The contract outlines the following acceptance criteria

Complete when the final report comprises the following topics:

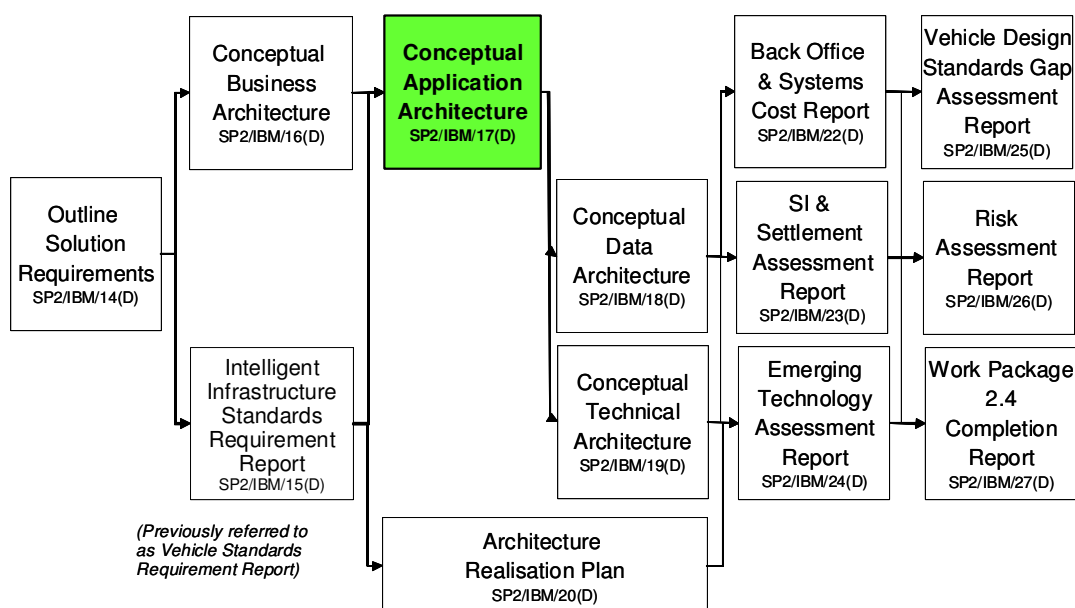
Document Structure - Explanation of how the documentation of the Conceptual Application Architecture is organised.

Component Relationship Diagrams: - 3 component relationship diagrams showing the dependencies between the various components at various stages of evolution of the architecture (as per description in SP2/IBM/16). Per component, showing the key responsibilities. - The Conceptual Application Architecture describes the “intelligent architecture” in terms of its software components with their responsibilities, relationships, and the way they collaborate to deliver the required functionality defined in SP2/IBM/14. - This is the main deliverable documenting the functional aspects of the architecture. - In this phase, the Conceptual Application Architecture is focusing on specifying the components responsibilities and characteristics to deliver the requirements defined in SP2/IBM/14. These specifications are typically technology and product neutral. - Examples of components at this level are: a Messaging Service or a Clearing House, - As such, the Conceptual Application Architecture documents the specifications and corresponding realisations of all components (either application and/or technical), which ultimately will be placed on the Conceptual Technical Architecture.

Based on the above, the report provides a view of the application architecture which focuses at a conceptual / logical level. Further levels of detail covering a full logical view (*defining protocols and programming models and further detailing component relationships and collaborations*) and physical view (*realises the logical components in previous levels by selecting specific products and technologies*) will be taken forward in and macro and micro design phases

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.



Note that all deliverables have a full title which is preceded by Light Vehicle Electrification.

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 Application Architecture	Component Relationships illustrated by component models and component descriptions
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. Document Structure

This report contains the following items.

Overall Conceptual Component Relationship Diagram (section 4)

This diagram shows the full conceptual model for the Intelligent Infrastructure based on the requirements and business architecture as currently described. The model splits the components into layers showing user interaction, the main business application components, supporting common / core components and infrastructure.

A further version of this model is provided with an overlay providing an initial view as to whether the component could be considered core to the Intelligent Infrastructure or discretionary which allows for the fact there are a number of factors yet to be determined about the intelligent infrastructure functionality and how it is to be provided.

Evolutionary Stage Conceptual Component Relationship Diagrams (section 5)

A version of the main Conceptual model for each of the three stages of evolution as currently described in the conceptual business architecture model. The stages are Simple, Semi-Intelligent and Smart. In each model, colour coding and labelling is used to indicate the stage of development of each individual component.

Static Component Relationship Diagrams (section 6)

These diagrams illustrate the static relationships which exist between components at a high level. In further stages of the project they will be elaborated to provide more information, possibly including the development of interaction diagrams.

Component Descriptions (section 7)

For each component in the model, an initial description is provided which includes component name, description, key responsibilities, key interactions and an indication of 'existence-level' for the Simple, Semi – Intelligent and Smart views.

Component Interactions (section 8)

Illustrates the relationships between different conceptual application components

Component Context for domestic charging (section 9)

A summary of the potential context for domestic charging in relation to the application component groups. A view is provided as to whether the component will be relevant for domestic charging scenarios, in which evolutionary stage and to what degree

Mapping of conceptual application components to logical deployment layers (section 10)

Although not formally part of this deliverable, (it is to be defined in more detail in SP2/IBM/19 Conceptual Technical Architecture), the following depicts the four logical layers of the Intelligent Infrastructure and how the conceptual components may map onto the physical architecture:-

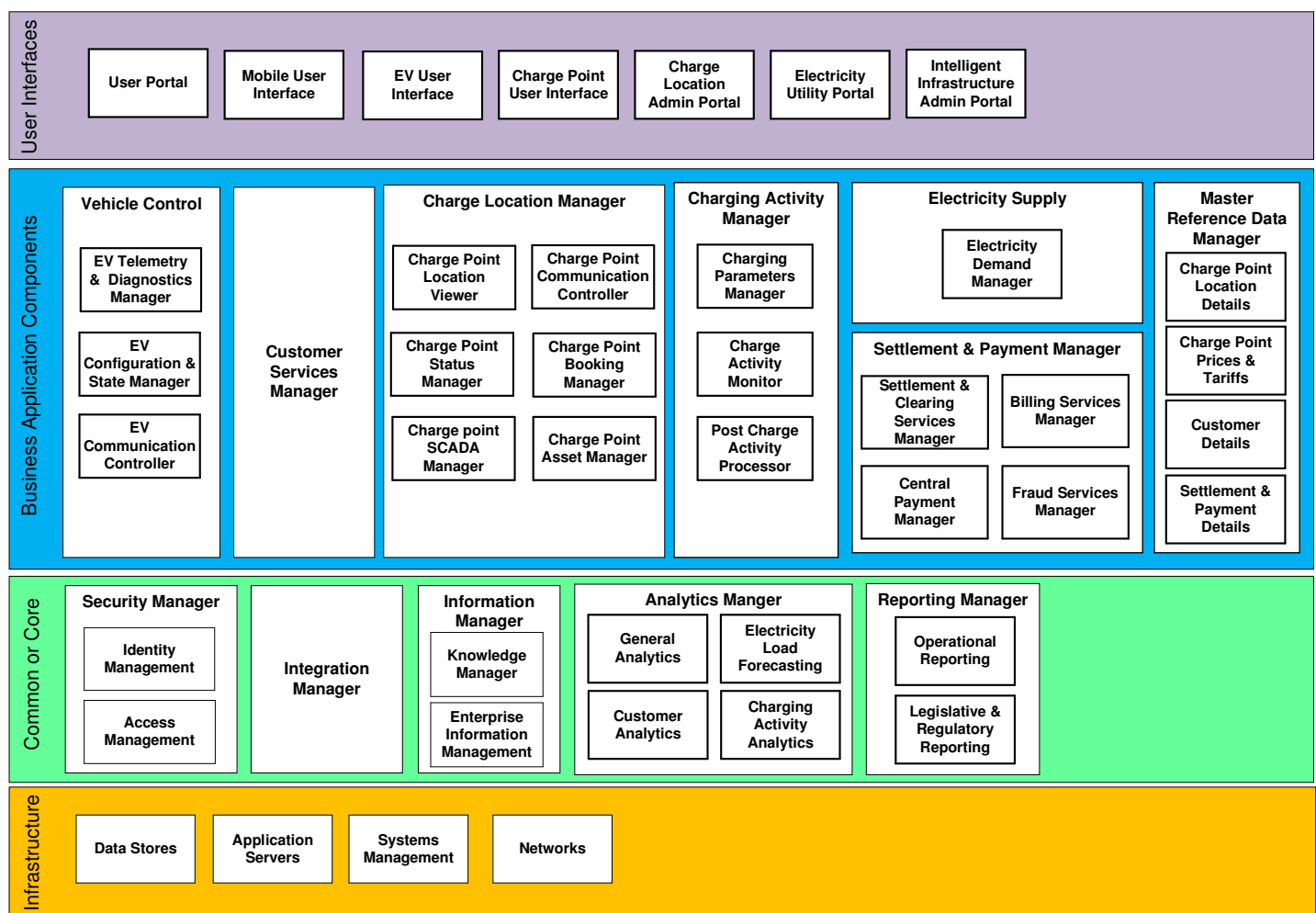
4. Overall Conceptual Component Relationship Diagram

4.1. Overall Conceptual Component Relationship Diagram

This model illustrates the full conceptual application architecture model for the Intelligent Infrastructure based on the requirements and business architecture as currently described.

The model splits the components into layers showing user interaction, the main business application components, supporting common / core components and infrastructure.

Where beneficial to the illustration, the components are grouped together, though this should not be taken to mean that these components will be provided as one solution.



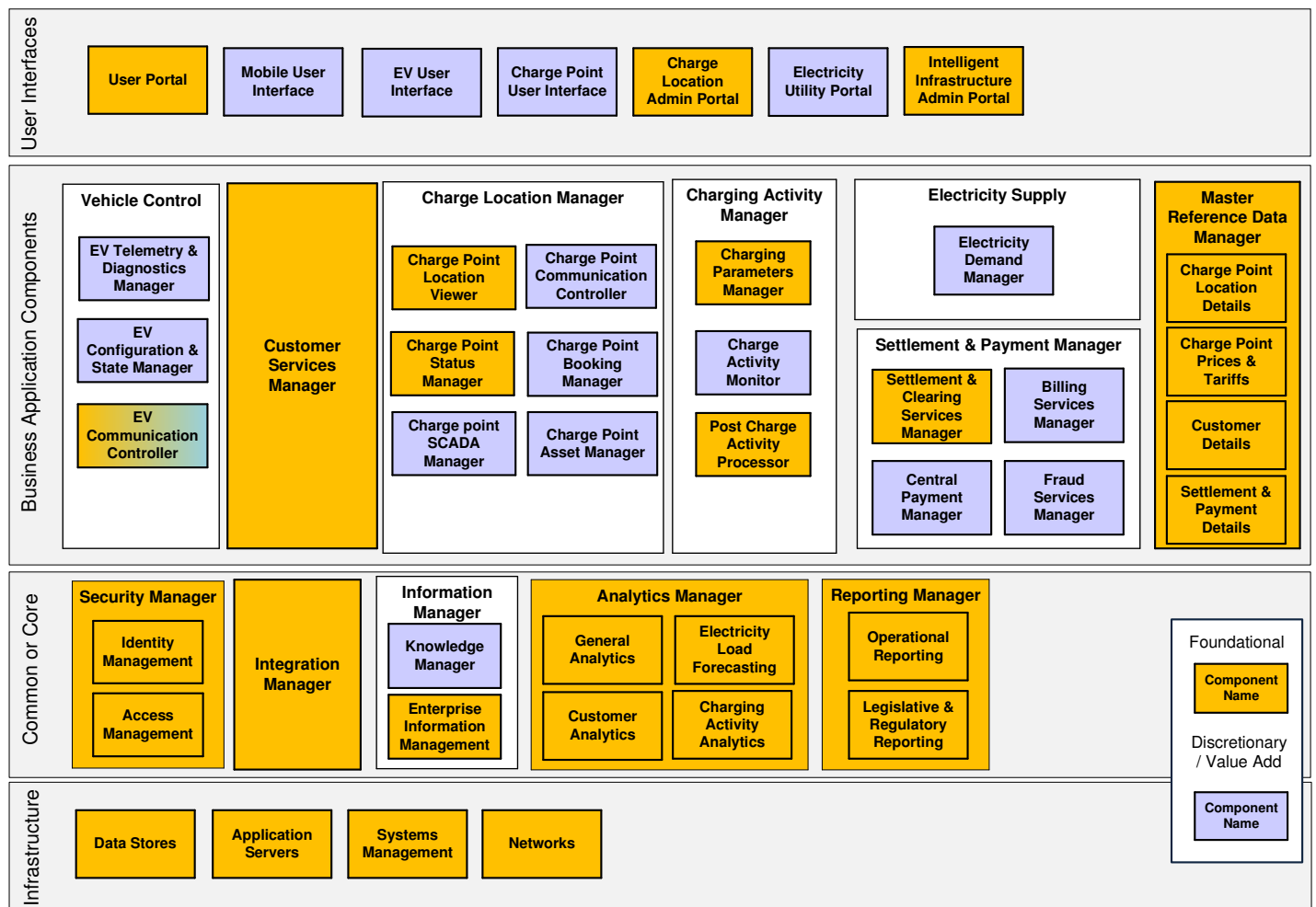
Descriptions of each component are given in section 7.

4.2. Overall Conceptual Component Relationship Diagram – Foundation / Discretionary View

This view provides an illustration of the components based on whether or not they could be considered as foundation or discretionary components.

The foundation components are seen as being pivotal to the successful development and sustainability of the intelligent infrastructure.

The discretionary components are viewed as useful functionality for the intelligent infrastructure to provide on behalf of all actors, but they could equally be provided via alternative solutions, including existing provision where suitable.



5. Conceptual Component Relationship Diagrams - Evolutionary Phases

5.1. Introduction

The Conceptual Component Diagrams in this section illustrate the build up of the application architecture at a conceptual level during the different evolutionary phases described in the Conceptual Business Architecture (SP2/IBM/16).

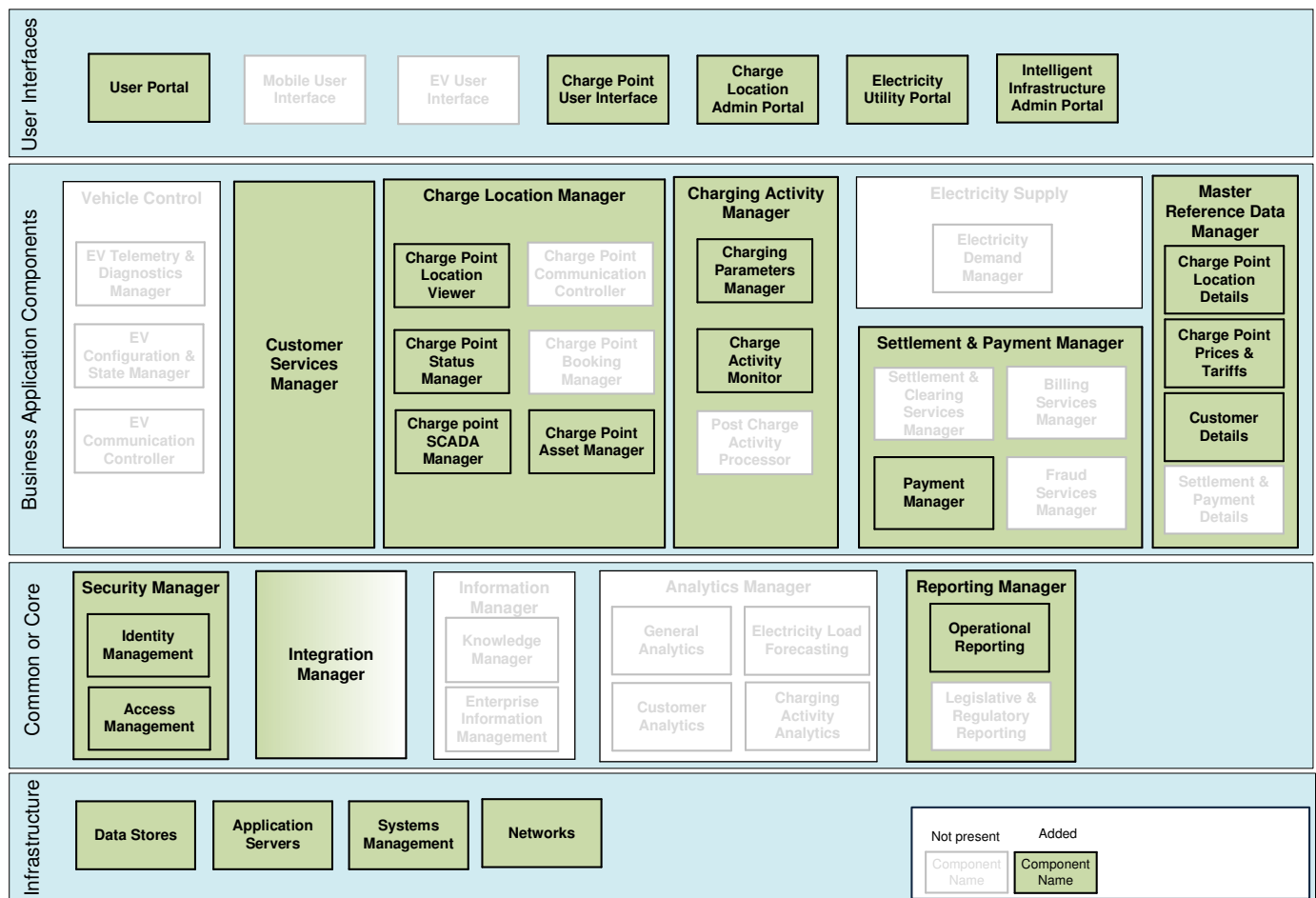
In each model, the components least likely to be included are greyed out and those most likely to be present are colour coded to indicate a level of development:-

- Light Green is used to indicate that the component is provided to support the basic level of functionality required as outlined in the 'Simple' model of the Conceptual Business Architecture
- Orange is used to indicate that the component has developed to include increased functionality / complexity as outlined in the 'Semi-Intelligent' model
- Blue is used to indicate that the component has developed to include a further degree of functionality / complexity as outlined in the 'Smart' model

5.2. Conceptual Component Relationship Diagram - Simple

The model below provides a view of the components that should be considered to support the initial phases of the intelligent infrastructure and prepare it for transition to follow on phases. The key themes here include:

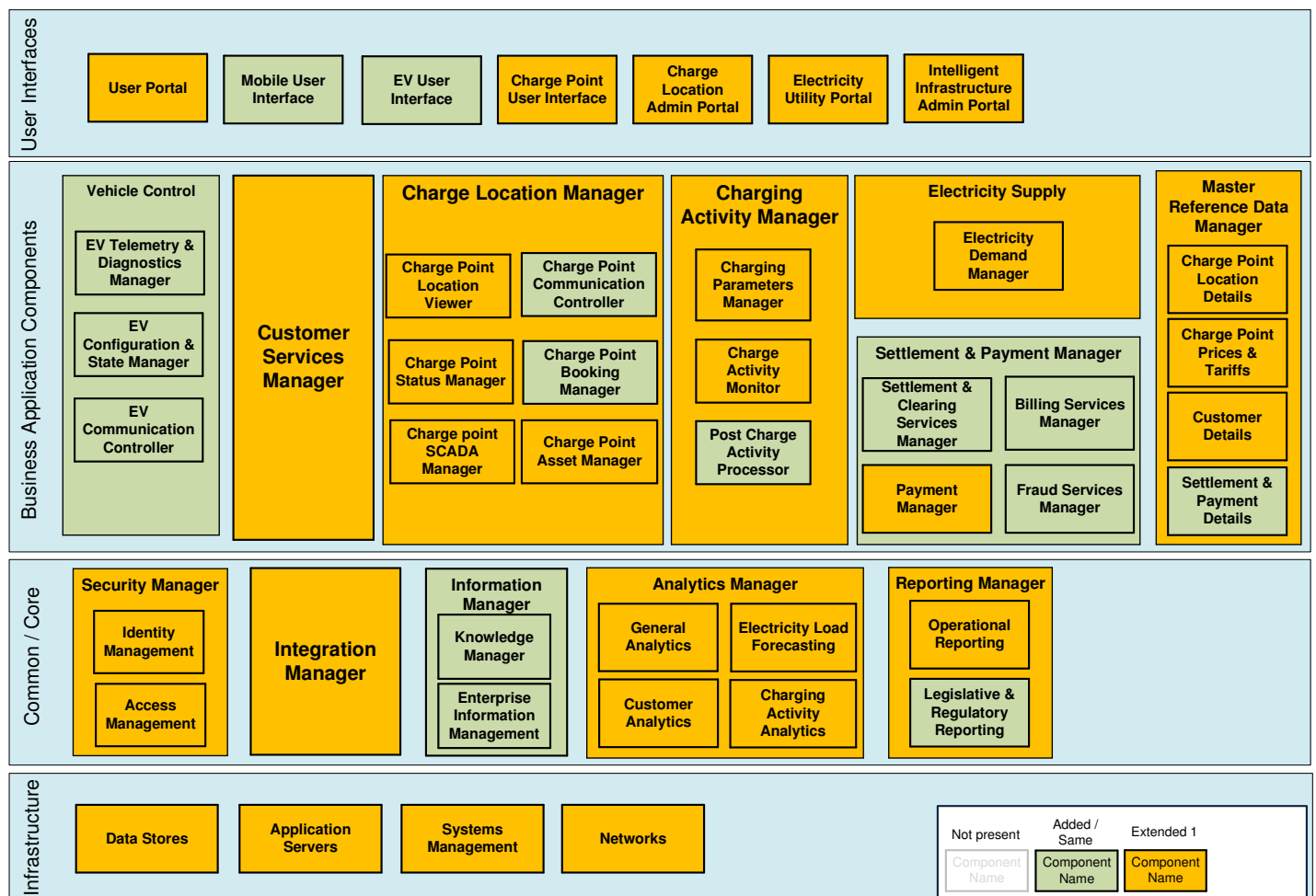
- recharging at home is the most used approach but is relatively isolated from the intelligent infrastructure apart from things such as some customer information or where a compatible charging post is used which can provide information and basic charging options;
- availability of a common user portal to provide access to basic services and information as well as the initial provision of a range of stakeholder portals;
- providing basic, but consolidated information about the charging locations and their status;
- putting in place the first elements of an integration service to facilitate bringing together information from all the actors for the benefit of everyone involved;
- providing functionality to enable a simple payment method (e.g. subscription fee);
- establishing the business analytics and optimisation capability to provide all stakeholders with useful but simple information about the use of the charging and electricity infrastructures



5.3. Conceptual Component Relationship Diagram – Semi-Intelligent

The model below provides a view of the components that should be considered to support the development of the intelligent infrastructure to becoming semi – intelligent. The key themes here include:

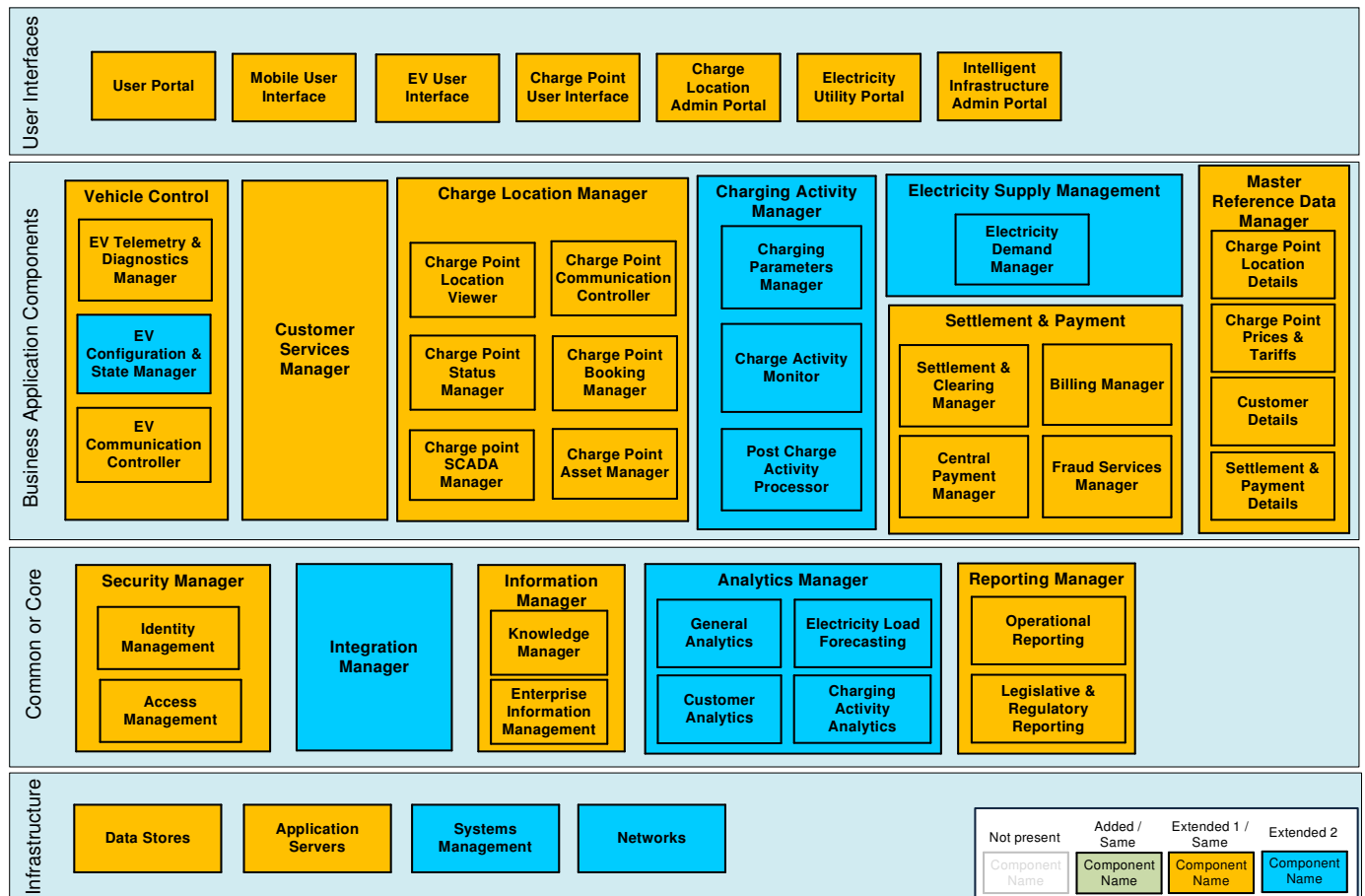
- Domestic charging remains the most used approach. Now able to get more interaction with the Intelligent Infrastructure (see bullets below)
- Continued evolution of user interfaces, customer services, charge point information and charging activity to support an anticipated increase in volumes and maturing usage patterns;
- Increased opportunity and value from Integration and business analytics and optimisation services as the market grows and diversifies;
- Increased focus on needing to understand the demand for electricity for charging vehicles beyond largely historical metrics;
- Emerging value from centralised settlement, payment and billing services which will be common to many stakeholders but which will not differentiate them in the market;
- The integration of the EV with the intelligent infrastructure being taken forward; User interaction with the vehicle is via EV User Interface functionality. The user might also make use of other hand held devices which integrate with the car; Vehicle interaction without the user is via EV Communication Controller functionality;



5.4. Conceptual Component Relationship Diagram – Smart

The model below provides a view of the components that should be considered to support the development of the intelligent infrastructure to becoming smart. The key themes here include:

- Domestic charging still the most used approach. Now significantly integrated with the II via the use of smart meters and smart grids and real time information on prices, demand, charging preferences, etc;
- 'Full' integration of the EV with the intelligent infrastructure; User interaction with the vehicle is via EV User Interface functionality; The user might also make use of other hand held devices which integrate with the car; Vehicle interaction without the user is via EV Communication Controller functionality;
- Increased functionality in charging activity management – to meet the increased sophistication (Smart Charging) introduced in order to control and influence charging activity and hence electricity consumption;
- Increased functionality in electricity supply management – to meet increased sophistication (Smart Grids) introduced to balance supply and demand;
- Increased functionality in integration management – to meet the demands of Smart Charging and Smart Grids;
- Increased demand for data, reporting and analytics from intelligent infrastructure actors, especially Government, Regulation and Other Service Providers;
- Increased sophistication of the infrastructure to meet the demands of the all of the above.



6. Conceptual Component Relationship Diagrams - Static Relationship View

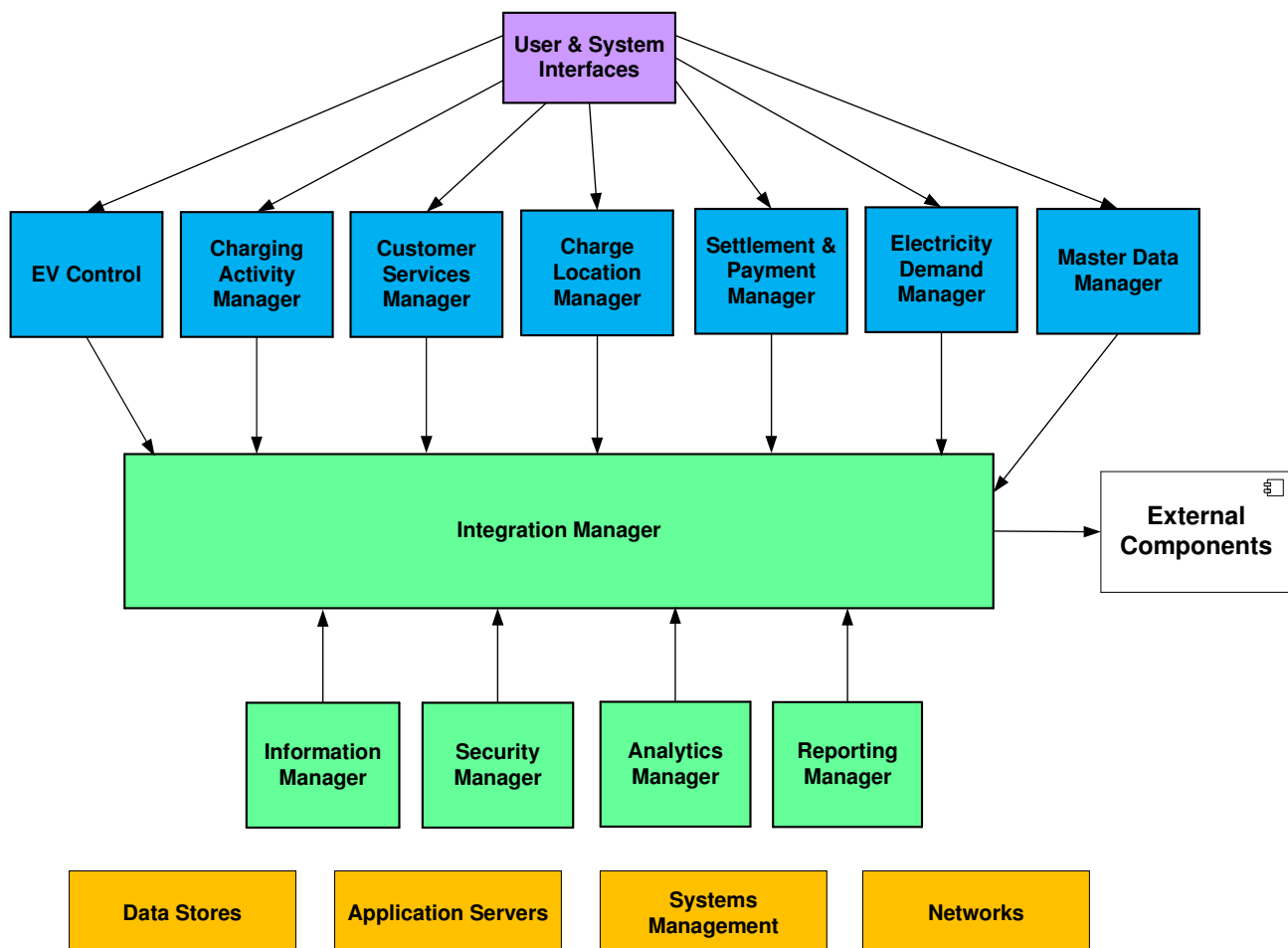
6.1. Introduction

The models in this section focus on a high level view of relationships between components, referred to as static relationships.

Different versions of the model in this form are provided to reflect different stages and different user perspectives.

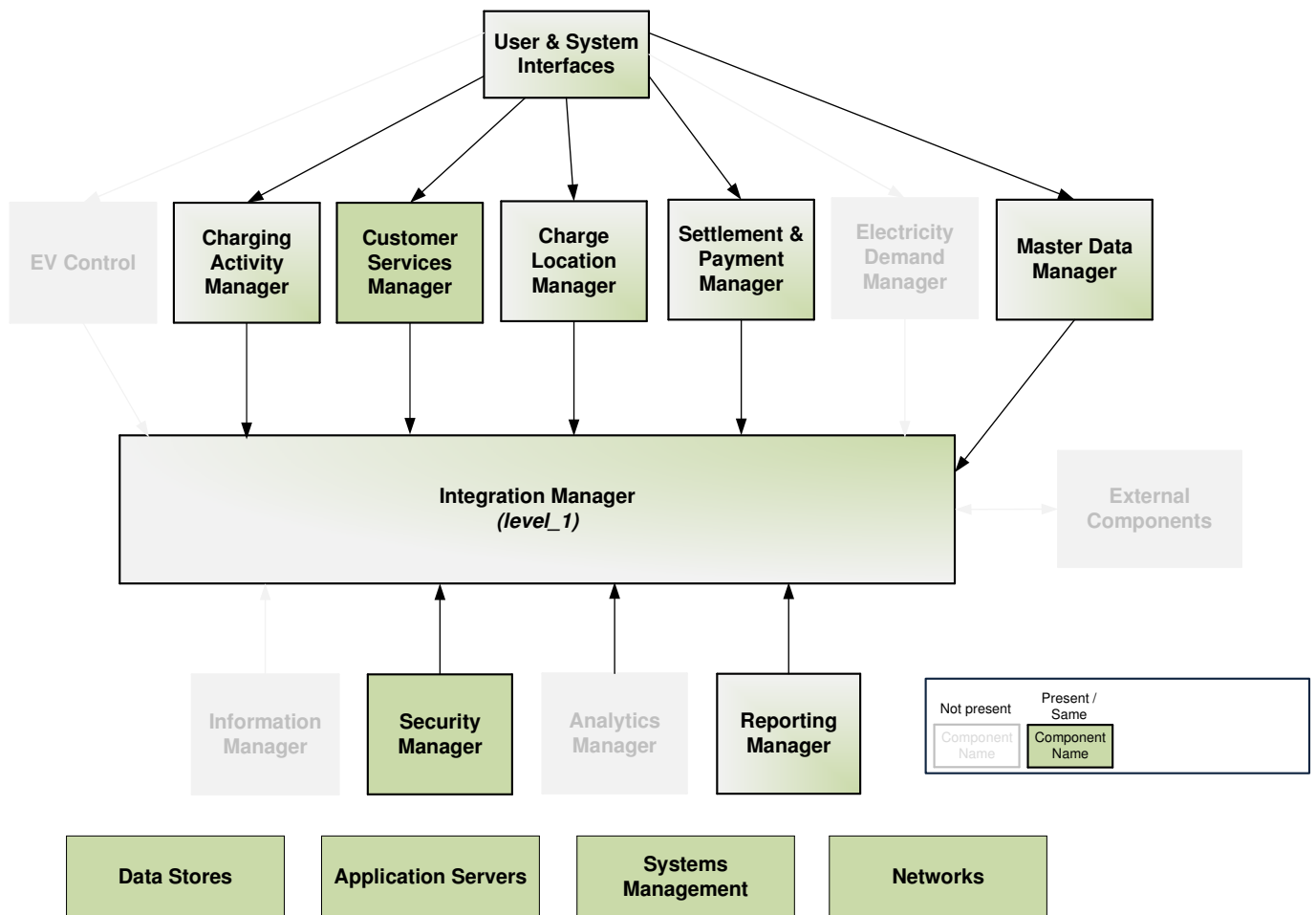
6.2. Static Relationship View – Overall

The model in this section illustrates the static relationships in the component model.



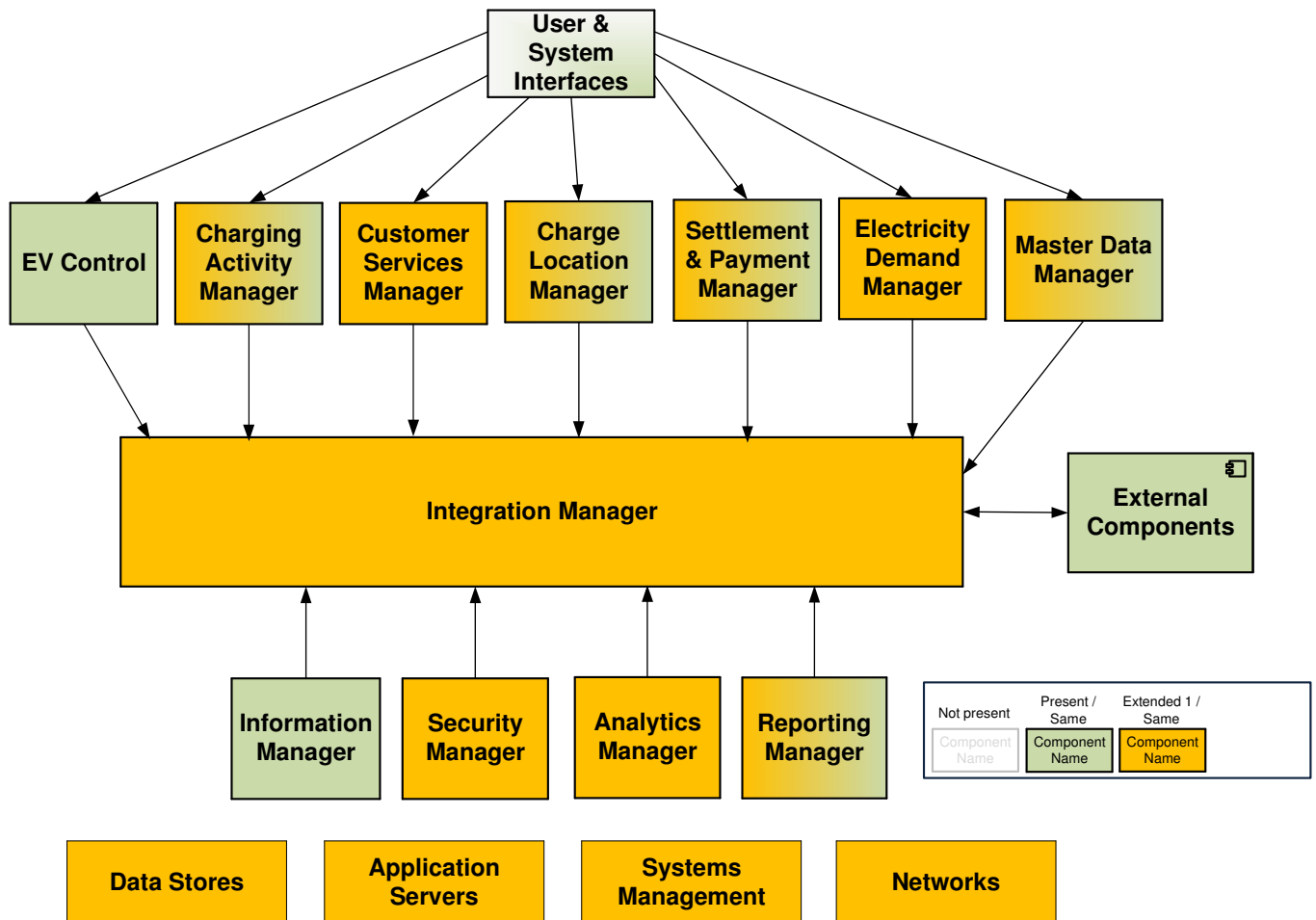
6.3. Static Relationship View – Simple Model

The model in this section illustrates the static relationships in the simple model. The model shows which components are most relevant, the links between components, and provides a reminder of the level of functionality the components are at.



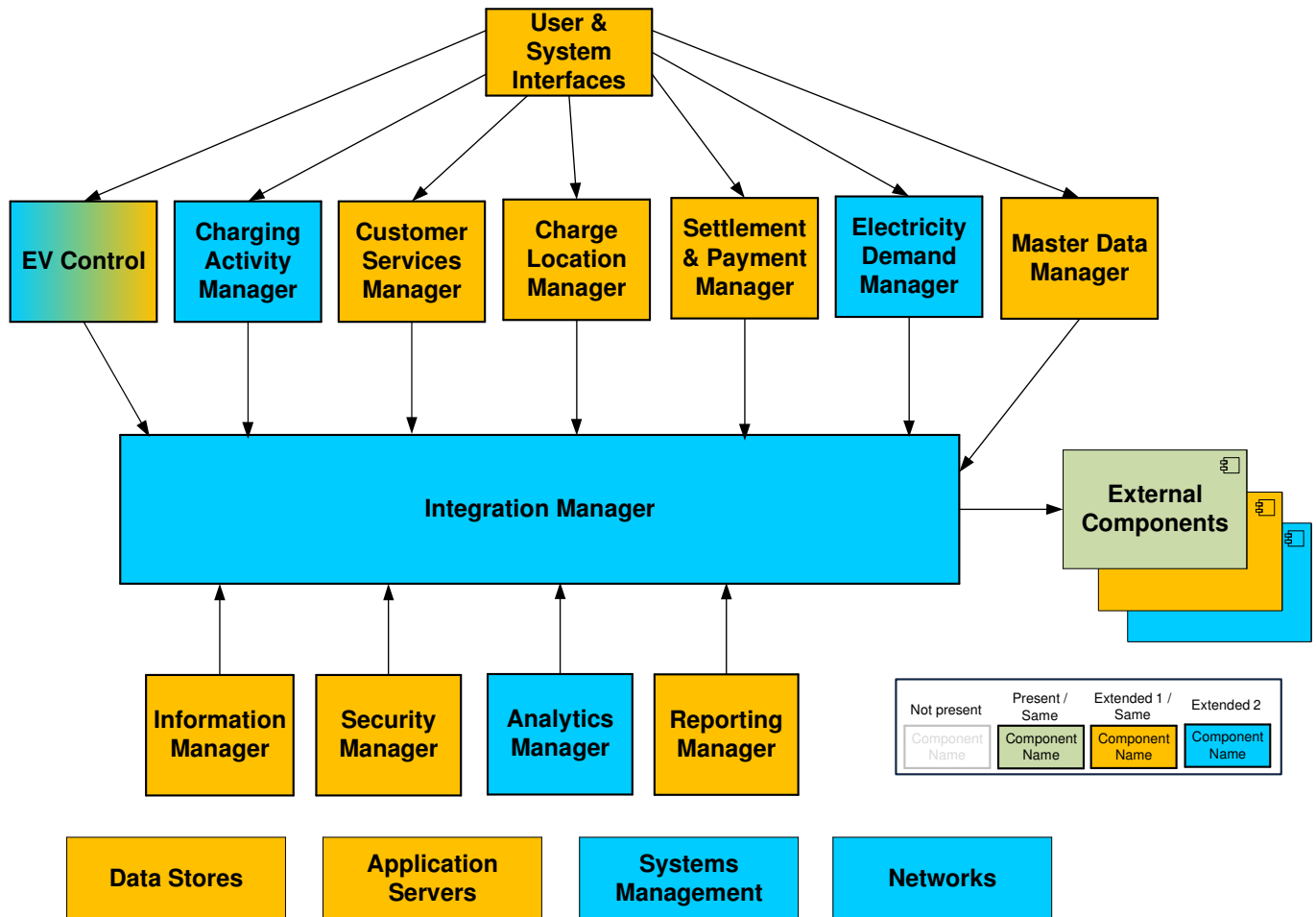
6.4. Static Relationship View – Semi-Intelligent Model

The model in this section illustrates the static relationships in the semi-intelligent model. The model shows which components are most relevant, the links between components, and provides a reminder of the level of functionality the components are at.



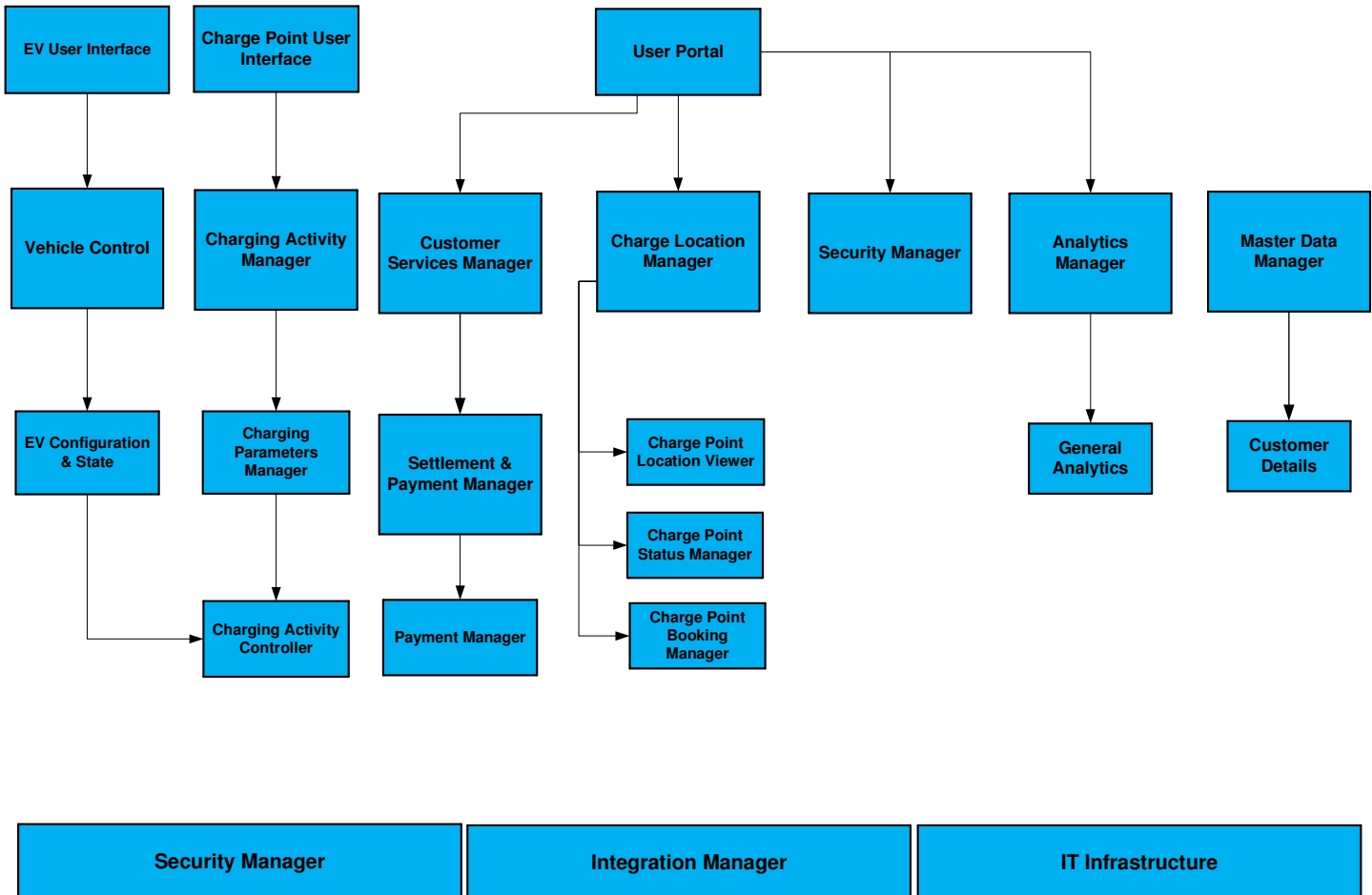
6.5. Static Relationship View – Smart Model

The model in this section illustrates the static relationships in the smart model. The model shows which components are most relevant, the links between components, and provides a reminder of the level of functionality the components are at.



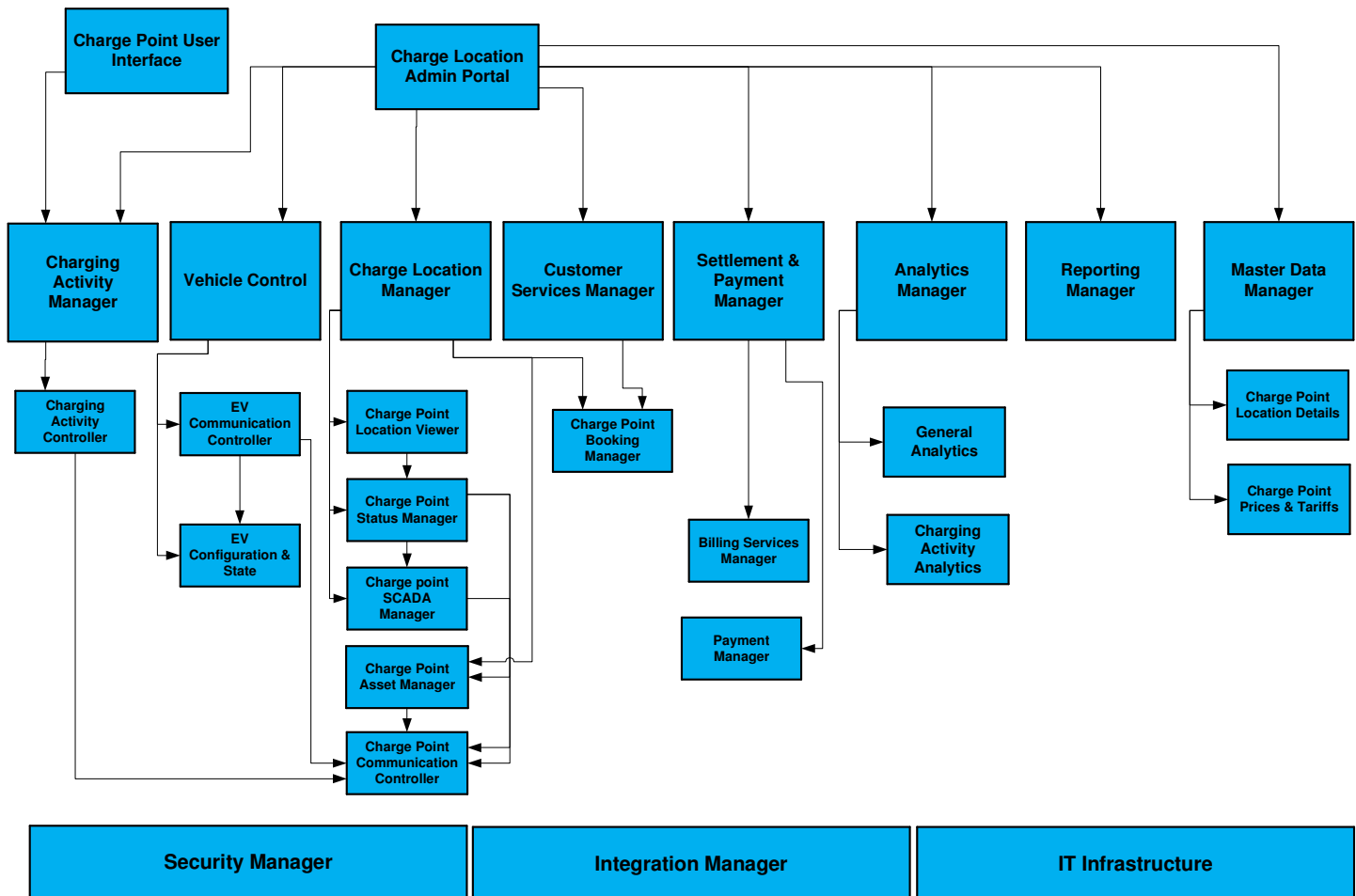
6.6. Static Relationship - User View

The model below illustrates the relationship between components from the perspective of user-focused activities:-



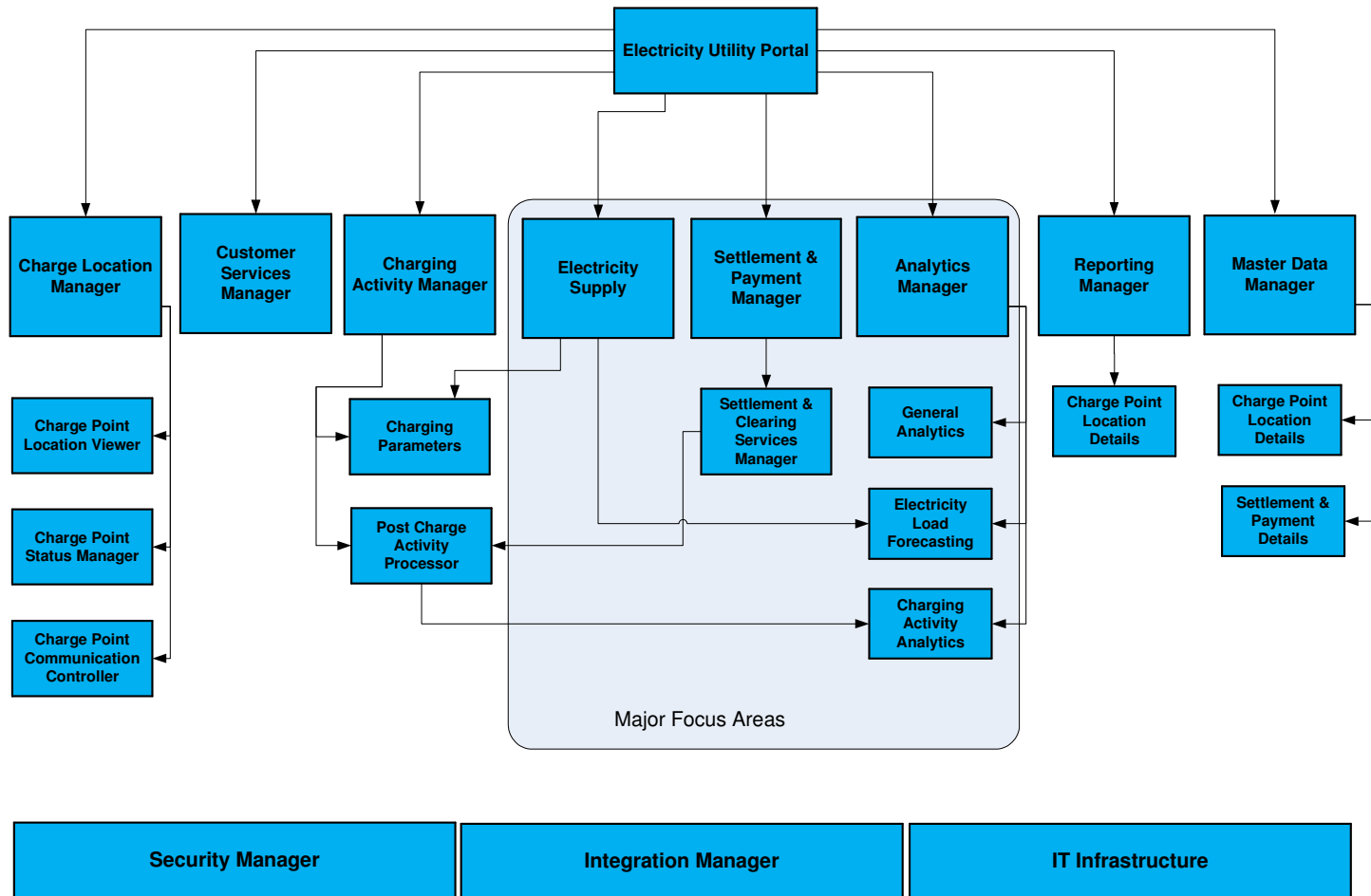
6.7. Static Relationship - Charge Location View

The model below illustrates the relationship between components from the perspective of Charge Location focused activity.



6.8. Static Relationship - Electricity DNO View

The model below illustrates the relationship between components from the perspective of DNO focused activities.



7. Conceptual Application Architecture - Component Descriptions

7.1. Introduction

This section provides a set of component descriptions for each of the components in the main conceptual view and includes the following information:

- Component Name
- Description
- Key Responsibilities
- Interactions
- Evolution of functionality through simple, semi-intelligent and smart business models

7.2. User Access Level (Dialogue Control)

The conceptual components covered here at this stage are:

- User Portal;
- Mobile User Interface;
- EV User Interface;
- Charge Point User Interface;
- Charge Location Admin Portal;
- Electricity Utility Portal;
- Intelligent Infrastructure Admin Portal

Component Name	User Portal	Classification : Foundation
Description	Allows a user to access information and services connected with the charging of vehicles, including setting up and managing an account, specification of preferences, payment services and information about charging locations and their availability. Provide self service access for users to a range of different services and information sources.	
Key Responsibilities	Allow new users to register an account Allow existing users to maintain their account details and preferences Provide access to payment services Provide access to charging location information services	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple Semi Smart	Functionality increasing to meet the requirements across the business models

Component Name	Mobile User Interface	Classification : Discretionary
Description	Component which supports access to services in the intelligent infrastructure via a mobile device. Main use is likely to be for less complicated functionality such as customer account access, charging location information and mobile payments.	
Key Responsibilities	Access basic customer account information Access information about charging locations Support payments Support the communication of charging scenario option to the user	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	(Existing mobile <> EV communication for EV pre-conditioning – but not via the intelligent infrastructure)
	Semi	Initial functionality largely around charge point location and status. Provided across a wider area and made possible by the integration services provided through the II. Potential for some mobile payment. Potential for EV pre-conditioning via the intelligent infrastructure
	Smart	Additional functionality provided, potentially supporting things such as communication with the car as it charges or the charge post to query the charge level or indicate a need to take a journey earlier than planned. Increased support for mobile payment and potentially links to pricing services. For example, supporting the user in control of the charge options via the mobile device.

Component Name	EV User Interface	Classification : Discretionary
Description	Component which supports access to services and information in the intelligent infrastructure via the electric vehicle. Initially this would be initiated by the user, though it could evolve to include interaction initiated and managed by the vehicle	
Key Responsibilities	Allow access to charge point information – location details and availability Support the communication of charging scenario options to the user	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Not a factor in the simple model
	Semi	Some basic interactions supported via an interface in the EV - likely to be focused around geographic and routing information connected with Charge Locations
	Smart	Increased amount of information on charge location availability, pricing, etc

Component Name	Charge Point User Interface	Classification : Discretionary
Description	Component which supports access to services in the intelligent infrastructure, allowing interaction between the user and the charge point. Would include the user providing information about their account and indicating charging preferences, as well as the charge point displaying information to the user.	
Key Responsibilities	Allow user / vehicle to select and specify charging parameters Allow user to view information	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Simple charge point interface focused on simple push buttons and timing

		options for charging. Might be a basic set of indicators or small screen
	Semi	Increased functionality and choice discharged at the post around charging options. Likely to be enabled via communication from the post to other components
	Smart	

Component Name	Charge Location Admin Portal	Classification : Foundation
Description	Allows an operator access to information around the maintenance and monitoring of the charge posts and charging activity. Applies mainly to the non domestic scenario where a commercial operator would be managing the charge locations and charge points.	
Key Responsibilities	Allow operator to maintain and view the status and availability of the charge point network Allow operator to view information about the charging activity Support the monitoring, analysis and reaction to charge point network events Support the activities around Asset Management	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Basic functionality largely around standard reporting, information about the charging network location and availability. Provide the ability to view and access asset details. May only give a view by network and not be consolidated
	Semi	Increased amount of information available, including access to wider amount of analytics and reports. Access to full management of the network assets supported. Ability to access or view information about the network in real time. Remote control of the charging network. Can provide a more integrated view
	Smart	Functionality extended to provide operational capability to match changes in the network at this point

Component Name	Electricity Utility Portal	Classification : Discretionary
Description	Component which supports access to services in the intelligent infrastructure, allowing the Electricity DNO to make use of functionality and information, primarily around the demand for electricity to charge vehicles.	
Key Responsibilities	Allow access to information Allow access to business analytics and reporting services Allow access to information about charging activity	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Basic access for reporting and historical information
	Semi	Increased information and analytics.
	Smart	

Component Name	Intelligent Infrastructure Admin Portal	Classification : Foundation
Description	Component which supports access to services in the intelligent infrastructure connected with the administration of the intelligent infrastructure itself. These could be discharged by specifically contracted service operators or contact centre agents, or by other actors performing the role of intelligent infrastructure operator.	
Key Responsibilities	Undertake any intelligent infrastructure support activities Provide assistance to other II Users Support customer management services, including acting as a single point of contact for users Administer the settlement, payment and other potentially centralised services Undertake charge point administration where charge points are not supported by a dedicated operator Ensure the production and distribution of standard reports Provide administration support for security services around identity management and access management	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Basic functionality that reflects the initial deployment of simple infrastructure. Limited to things such as reporting and, support for users and stakeholders
	Semi	Increased functionality as required. A potential development area could be supporting common or safety net services around certain functions e.g. asset management, settlement, payment
	Smart	

7.3. Business Application Function Level

The conceptual components covered here at this stage are:

- Vehicle Control
 - o EV Telemetry & Diagnostics Manager
 - o EV Configuration & State Manager
 - o EV Communication Controller
- Customer Services Manager
- Charge Location Management
 - o Charge Point Location Viewer
 - o Charge Point Status Manager
 - o Charge Point Communication Controller
 - o Charge Point Booking Manager
 - o Charge Point SCADA Manager
 - o Charge Point Asset Manager
- Charging Activity Management
 - o Charging Parameters Manager
 - o Charge Activity Monitor
 - o Electricity Demand Manager

- Settlement & Payment Management
 - o Settlement & Clearing Services Manager
 - o Central Payment Manager
 - o Billing Services Manager
 - o Risk, Fraud and Compliance Services Manager
- Master Reference Data Manager
 - o MRD - Charge Point Location Details
 - o MRD - Charge Point Prices & Tariffs
 - o MRD - Customer Details
 - o MRD - Settlement & Payment Details

7.3.1. Vehicle Control Components

Component Name	EV Telemetry & Diagnostics Manager		Classification : Discretionary
Description	Component related to the provision of telemetry and diagnostics information and services from the vehicle as part of the Intelligent Infrastructure. This is not intended to refer to the general vehicle systems in this area but allows for specific services and information connected with the Intelligent Infrastructure to be supported		
Key Responsibilities	Run any II specific telemetry and diagnostic packages Create information around telemetry and diagnostics to support services provided through the Intelligent Infrastructure		
Interactions	See Section 8 – Component Interaction Matrix for a full analysis		
Levels	Simple	N / A : Very little, if any, intelligent infrastructure specific telemetry and diagnostics	
	Semi	Depending on standards, there could be some initial Intelligent Infrastructure enabled telemetry & diagnostics capability though this might only be standard elements and not be communicated other than when the vehicle is connected to an appropriate outlet	
	Smart	Potential to support a wide variety of telemetry and diagnostic capability. Has accelerated between semi and smart as the vehicle moves to being a more integrated component of the wider environment	

Component Name	EV Configuration & State Manager	Classification : Discretionary
Description	Component which provides support for the intelligent infrastructure where information around the configuration and status of the vehicle and battery are need to support operations	
Key	Condition Monitoring - Includes diagnostics and monitoring to determine proactively the	

Responsibilities	potential for a failure whilst also being able to determine the cause of a specific fault. Configuration Management - Concerning aspects such as draw capacity, type of charging supported (standard, rapid, fast) which interfaces are supported, what services are offered Vehicle State - Concerning aspects such as remaining range, current charge capacity	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Not available in this model
	Semi	Increased functionality to reflect the maturing requirements
	Smart	

Component Name	EV Communication Controller	Classification : Discretionary
Description	The component which concerns the interaction of the vehicle with other services external to it. This would include charging posts, wireless networks and meter devices. The services utilised here allow the EV to send and receive information across a range of transactions relevant to the Intelligent Infrastructure	
Key Responsibilities	Provide support for managing interactions between the vehicle and other services	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	May be present as part of individual vehicles
	Semi	Enables communications with the intelligent infrastructure aspects of the charging post
	Smart	Extended to enables communications with other nodes and components, e.g. direct to a booking service

7.3.2. Customer Services Manager Component

Component Name	Customer Service Manager	Classification : Foundation
Description	<p>Provides the functionality used to manage customer services within the intelligent infrastructure covering general customer relationship functionality. Specific areas include account management, contact management, customer problem and issue management, managing promotional or marketing activity.</p> <p>It will be complimentary to customer management systems that are already used by those actors with customers. The account details may be managed by various actors depending on the ownership of the relationship. The customer may have multiple relationships, for example:</p> <ul style="list-style-type: none"> - at an intelligent infrastructure level (if that is the approach adopted) - with charging scheme & location operators; - with energy retailers; - with a vehicle owner (e.g. leasing or hire car fleet) 	

	The non II relationships would be especially relevant in the case of domestic re charging of a vehicle which, at all phases will be the most widely used approach.	
Key Responsibilities	<p><u>Account Management</u></p> <ul style="list-style-type: none"> - Allow creation of an account - Allow specification of a variety of preferences and service subscription - Allows maintenance of account information and profiles, either by the user or by a charging scheme provider - Request a security token for access to the network - Provide basic information on account status and usage history <p><u>Contact Management</u></p> <ul style="list-style-type: none"> - Allows the relevant actors to generate, send, receive and process customer contact across all channels. (generate outbound contact; receive inbound contact; manage documents; request information; fulfil information request; manage contact history) <p><u>Customer Problem & Issue Management</u></p> <ul style="list-style-type: none"> - Allow the management of service issues, complaints and feedback by both customers and service operators 	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Basic user information held. May not be integrated to any great degree
	Semi	Increased Integration capability allows consolidated view and management of customer accounts
	Smart	Extended to cope with Smart level as required.

7.3.3. Charging Location Manager Components

Component Name	Charge Point Location Viewer	Classification : Foundation
Description	This component processes information about charging locations including geographic location, number and types of charge points, generic information concerning use of the location and so on. This information is made available through the various portals for different types of user. Though potentially most used for non domestic charge point information, there is nothing to prevent recording the details of domestic charge points.	
Key Responsibilities	<p>Process charge point location information and make it available for use</p> <p>Search for charging stations using location or other agreed, simple parameters</p> <p>Display charging locations on a map or as a directory</p> <p>Provide access to information about a charging location, such as number of charge points, type of charging available, any constraints (such as opening times and memberships)</p> <p>Request new charging stations at specific locations</p>	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Can provide details on charge points. Supports requests to search for charge points. Provides information that allows charge points to be displayed on a map
	Semi	Largely as per Simple but has potential to support additional information through integration with other components and data sources

	Smart	Extended to cope with Smart level as required e.g. more information and granularity on performance data, bookings etc
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Component Name	Charge Point Status Manager	Classification : Foundation
Description	<p>Component which processes information about the status of charging locations and make it available for use by different types of user and other components. Likely to be closely linked to or combined with the Location Details Manager.</p> <p>The charge point status values are likely to be along the following lines : planned; under construction; available, out of service, in use; available at (date / time); booked / reserved</p> <p>Could also be used to manage dedicated domestic charge points, especially in semi intelligent and smart scenarios</p>	
Key Responsibilities	<p>Receive and process information from different systems, e.g. SCADA and Asset Management system</p> <p>Handles information from various service providers</p> <p>Indicate the status of charge point – i.e. available or in use.</p> <p>Able to display charging location status on a map and as a list</p>	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Supports the update of charge point status by charge point at a frequency suitable for the charge point – i.e. some charge points may be more popular and so require more status updates. May only be viewable charge point network by charge point network unless integrated
	Semi	Largely as per simple but enhanced in terms of consolidated view and potentially additional information – enabled by integration services available in this stage
	Smart	Extended to cope with Smart level as required – e.g. more granularity on availability

Component Name	Charge Point Communication Controller	Classification : Discretionary
Description	<p>The component which concerns the interaction of the charge point with other services external to it. This would include the EV, wireless networks and roadside furniture (e.g. display signs). The services utilised here allow the charge point to send and receive information across a range of transactions relevant to the Intelligent Infrastructure</p>	
Key Responsibilities	Provide support for managing interactions between the vehicle and other services	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Charge point has ability to communicate but not doing so in terms of intelligent infrastructure

	Semi	Enables communications with the intelligent infrastructure aspects of the charging post
	Smart	Extended to support increased frequency and volume. Can support additional messages required at this stage.

Component Name	Charge Point Booking Manager	Classification : Discretionary
Description	Component which allows relevant actors to make a charging location booking, change / cancel an existing booking or view bookings from within the intelligent infrastructure. Provides a consolidated view across location operators. Bookings could be made by a customer via any valid channel. By providing a consolidated view to authorised users of the II, bookings could for example be viewed and cancelled in the event of a network constraint or a change in the charging location status.	
Key Responsibilities	Supports requesting a booking; cancelling a booking; amending a booking; confirming a booking; viewing bookings	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	N / A
	Semi	Potential basic booking capability enabled by integration with charge location availability information but initiated manually by a user through the User portal or via a contact centre
	Smart	Extended capability – for example that allows a space to be booked via other methods such as vehicle initiated communication

Component Name	Charge Point SCADA Manager	Classification : Discretionary
Description	Component which provides support in the II for the control and monitoring of the status and condition of charging assets and locations. Assumes that it is likely operators and asset owners would have their own Supervisory Control And Data Acquisition (SCADA) or Distributed Control System (DCS) systems covering the operational functions in this area. If so, the II may take a feed or have a view of relevant data to support a consolidated view. Also, provision is made for the II to have to provide some aspects of SCADA itself for any charging assets which are not managed by an operator.	
Key Responsibilities	The SCADA components will have four key functions - Data acquisition; Networked data communication; Data presentation; Control These functions are performed by four kinds of SCADA components <ul style="list-style-type: none"> - Sensors (either digital or analog) that directly interface with the managed system; - Remote telemetry units (RTUs) deployed in the field at specific sites and locations – charging posts and locations in this case. RTU serve as local collection points for gathering reports from sensors and delivering commands; - SCADA master units larger consoles acting as SCADA central processor – allow a human interface to the system and automatically regulate the managed system in response to sensor inputs; 	

	- The communications network that connects the SCADA master unit to the RTUs in the field.	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Will exist in networks already deployed and operated by charge point service providers. Limited consolidation at the intelligent infrastructure domain. Could be some intelligent infrastructure capability around charge points which are not part of any provider network
	Semi	Extended consolidation viewed at the intelligent infrastructure domain level across multiple networks enabled via integration. Independent networks likely to provide a feed to the intelligent infrastructure
	Smart	Extended to cope with Smart level as required

Component Name	Charge Point Asset Manager	Classification : Discretionary
Description	<p>Component which enables the II to have a view of / manage charging assets in terms of commissioning, planning, installation and maintenance.</p> <p>Assumes that it is likely operators and asset owners would have their own asset management systems covering detailed asset, work, service, contract, inventory, and procurement management. The II would take a feed or have a view of relevant data. This would also include things like service management and workforce management for charging asset servicing, maintenance, etc.</p>	
Key Responsibilities	<p>Support investment planning and asset specification and design</p> <p>Manage procurement and asset construction, installation, and implementation</p> <p>Enable asset maintenance (scheduled, preventive and predictive)</p> <p>Facilitate asset decommissioning and disposal (including supporting any regulatory interface)</p>	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Will exist in networks already deployed and operated by charge point service providers. Limited consolidation at the intelligent infrastructure domain. Could be some intelligent infrastructure capability around charge points which are not part of any provider network
	Semi	Extended consolidation viewed at the intelligent infrastructure domain level across multiple networks enabled via integration. Independent networks likely to provide a feed to the intelligent infrastructure
	Smart	Extended to cope with Smart level as required

7.3.4. Charging Activity Manager Components

Component Name	Charging Parameters Manager	Classification : Foundation
Description	Component which supports the specification and processing of charging parameters and variables. Plays a key role in the semi and smart stages as the information about the charging required will have an impact on or be influenced by a range of factors such as location, pricing, demand for electricity, amount of charge, type of charge	
Key Responsibilities	<p>Allow the specification of charging parameters</p> <p>Integrate with other components to establish implications or constraints connected with the parameters</p> <p>Provide some event processing and optimisation capability</p>	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Basic parameters along the lines of current arrangements which is largely time switch based - charge now or charge after peak time.
	Semi	Increased parameters and variables can be specified and / or considered via interaction with the II including location, pricing, demand for electricity, amount of charge, type of charge, etc. Facilitated by the Integration, Analytics, Optimisation and event processing functionality it is anticipated an Intelligent Infrastructure could provide for the use of all
	Smart	Extended capability based on the above. Takes account of more real time, dynamic and predictive factors.

Component Name	Charge Activity Monitor	Classification : Discretionary
Description	Enables the charging activity to be started and monitored based on the charging variables provided and the status of charging	
Key Responsibilities	Schedule and control charging activity based on Charging Parameters and any Network Constraints	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Basic functionality recognizing the start and finish of the Charging Activity
	Semi	Increased functionality and integration with other components
	Smart	

7.3.5. Electricity Supply Component

Component Name	Electricity Demand Manager	Classification : Discretionary
Description	Component which supports the management of the demand and supply of electricity relating to EV charging and involves the analysis of demand based on historic and, in later business models, dynamic information. It provides the following functionality (1) support of constraints and rules to be factored into the use of charging locations, (2) electricity price and tariff management in relation to the provision of electricity for charging an electric vehicle or battery – (from an initial price which does not differentiate from the 'normal' price of electricity to, in more complex business models, dynamic pricing which would take into factors such as time of day, location, availability, network load, over / under supply, etc), (3) management of prices for vehicle to grid transactions, (4) communications with DNOs and electricity retailers	
Key Responsibilities	Support the provision of information relating to constraints on EV charging to the intelligent infrastructure Provide DNOs and electricity retailers with data and information regarding electricity demand for EV charging, initially historic data, moving increasingly to real-time; Manage variable prices and tariffs on behalf of the intelligent infrastructure	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Not available in this model
	Semi	Functionality to support data and information to DNOs and Electricity Retailers based on historic data and information. Functionality to support electricity price and tariff management.
	Smart	Data and information to DNOs and Electricity Retailers based on real-time, or pseudo real-time data and information. The ability to factor in supply constraints in EV charging.

7.3.6. Settlement & Payment Manager Components

Component Name	Settlement & Clearing Services Manager	Classification : Discretionary
Description	<p>Component provides transactional clearinghouse services functionality - clearance (identifying what transactions need to occur and between whom); settlement (processing the resultant payments and transfers) – managing the flow of information and funds that will be involved to the various stakeholders. ;</p> <p>Ensures that participants get paid for their part in the charging event:-</p> <pre> graph TD subgraph Stakeholders direction LR UP[Utility Provider] GO[Grid Operator] TP[Third Parties] end subgraph Events direction LR EA[Event A Consumer Decision] EB[Event B Physical Charge] EC[Event C Transaction Settlement] end EA -- "Operator ID Ability to pay" --> EB EB -- "Payment" --> EC UP <--> GO GO <--> TP TP <--> UP UP <--> EA GO <--> EB TP <--> EC </pre>	
Key Responsibilities	Clearance settlement payment orchestration Calculate settlement payment Distribute settlement payment Submit settlement statement Receive settlement payment	

Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Not available in this model
	Semi	Major part of functionality in place allowing variable charging by electricity consumption and varying third party contractual arrangements (e.g. Charge Location Operator)
	Smart	Additional functionality as a result of the Smart model - TBD

Component Name	Payment Manager	Classification : Foundation
Description	To allow the relevant actors to request and make payments for charging transactions. Whilst it is likely that in most scenarios, the intelligent infrastructure will not be used to request, authorise and take payment, there may be the need to provide services and information to support payment transactions.	
Key Responsibilities	request payment; display payment types; select payment type; make payment; request payment authorisation; authorise payment; take payment; view payment details; view payment history; request refund;	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	N / A – payment in this model is flat fee, subscription, not via the intelligent infrastructure
	Semi	Major part of functionality in place to meet the requirements of payment by consumption of electricity, at point of use or post use, to a single payment provider
	Smart	Additional functionality as determined by the Smart model - TBD

Component Name	Billing Services Manager	Classification : Discretionary
Description	Component which supports relevant actors in managing the activity involved in producing a bill / statement for users of vehicle charging services. Should provide information and services which don't constrain different bill / statement options, such as individual bills, site bills (e.g. large business customer with a small number of sites), consolidated bills (e.g. large business customer with many sites and more centralised payment processing) and different delivery methods, such as electronic bill presentment, paper billing, etc.	
Key Responsibilities	Manage requests for billing Obtain billing information Generate billing information Allow viewing of information;	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Not required
	Semi	All key responsibilities listed above are supported at this stage.
	Smart	Further functionality as determined by the Smart model – TBD

Component Name	Risk, Fraud and Compliance Manager	Classification : Discretionary
Description	Components which provides services in support of risk management, fraud management and compliance activity. This in summary could cover transparency and reduced loss from unmitigated risk, reduced waste / take out cost from fraud and abuse; Complying with voluntary and mandated regulations.	
Key Responsibilities	Risk Management Fraud Management Compliance Management	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Not required. May be some informal provision within individual systems and processes
	Semi	The context of the semi intelligent phase means that risk, fraud and compliance are all relevant at an initial stage with an emphasis on monitoring and reporting. Moving towards analytics more at this point
	Smart	The components become more integrated and start to provide proactive / predictive / preventative capability

7.3.7. Master Reference Data Manager Components

Component Name	Master Reference Data Manager	Classification : Foundation
Description	The component which is used to collect process and manage master reference data within the Intelligent Infrastructure for use by other components and services. Data may be mastered centrally and federated to other layers of the intelligent infrastructure or vice versa, depending on the ownership of the master data	
Key Responsibilities	Collect MRD Process MRD Distribute MRD	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Basic MRD and largely managed manually with some basic workflow control
	Semi	Increased amount of MRD. Potential to automate the identification, processing and distribution of master reference data. This route might only be adopted for MRD which is complex or as high churn and the manually activity supported by workflow could be suitable otherwise
	Smart	Continued approach as per Semi but reflecting any additional factors

Component Name	MRD - Charge Point Location Details	Classification : Foundation
Description	<p>The data component of MRDM which concerns charge point location details. This information is sourced, maintained and made available for use elsewhere in the system, notably through the Charge Point Location Viewer.</p> <p>It would include information on the owner / operator of the charge point; number and type of charging point outlets available; any constraints or conditions relating to the charge point; the location co-ordinates of the charge location</p>	
Key Responsibilities	As per MRDM	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	As per MRDM note
	Semi	As per MRDM note. Additionally, as volumes of charge points are added then an automated approach might be more suitable. For amendments to existing locations, a workflow supported manual approach could be adequate as long as changes are relatively low in number and complexity
	Smart	As per MRDM note though should take account of the note in the Semi Intelligent row above

Component Name	MRD - Charge Point Prices & Tariffs	Classification : Foundation
Description	<p>The data component of MRDM which concerns pricing and tariff details for charging locations which are not dynamically updated. The data would be sourced from charge location operators but made available to other users and components as part of charge location information</p>	
Key Responsibilities	As per MRDM but data is specific to charge point prices and tariffs	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	As per MRDM note
	Semi	As per MRDM note though this is a very strong area for considering an automated approach for pricing updates as pricing becomes more dynamic and dependent on other variables. Could consider a manual workflow driven approach for any lower volume elements such as setting up a new tariff
	Smart	As per MRDM note though should take account of the note in the Semi Intelligent row above

Component Name	MRD - Customer Details	Classification : Foundation
Description	<p>The data component of MRDM which concerns customer reference data. Examples would include any account details, addressing information, links to vehicles, etc.</p>	
Key	As per MRDM	

Responsibilities		
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	As per MRDM note
	Semi	As per MRDM note – subject to low rate of change. May adopt an auto process for any bulk upload of customer information
	Smart	As per MRDM note

Component Name	MRD - Settlement & Payment Details	Classification : Foundation
Description	The data component of MRD which concerns settlement and payment reference data. Examples would include bank account & payment card validation software and reference codes for settlement participants.	
Key Responsibilities	As per MRDM	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	as per MRDM
	Semi	as per MRDM, dependent on volumes – likely to be low and also likely to be periodic – e.g. bank account modulus changes
	Smart	as per MRDM

7.4. Common / Core Function Level

The conceptual components covered here at this stage are:

- Security Manager
 - o Identity Management
 - o Access Management
- Integration Manager
- Knowledge Manager
- Enterprise Information Management
- Analytics Manager
 - o General Analytics
 - o Electricity Load Forecasting Analytics
 - o Customer Analytics
 - o Charging Activity Analytics

- Reporting Manager
 - o Operational Reporting
 - o Legislative & Regulatory Reporting

7.4.1. Security Manager Components

Component Name	Security Manager	Classification : Foundation
Description	<p>This component offers and co-ordinates security services for a range of activities across the infrastructure for users and application components. Addresses issues and risks related to the ability to control access to business / personal information and data. Its scope includes both physical and logical security measures which might be required. Used to offer security services such as single sign on and user authorisation.</p> <p>Controls access to applications, data, and resources, protecting business and personal information from unauthorised access, in addition to enforcing policies for acceptable use of the infrastructure and services</p> <p><u>Identity Manager</u>: Component that forms part of the security manager. Concerned with the management of user identities and credentials within the intelligent infrastructure.</p> <p><u>Access Manager</u>: Component that forms part of the security manager. Concerned with the management of access to intelligent infrastructure systems and information</p> <p>Security coverage could be applied to</p> <ul style="list-style-type: none"> - People and identity : Capability that manages user identity and their rights to access resources - Data and information : Capability that supports data classification, access control, and archiving - Application and process : Provision of capabilities concerning application design and development to remediate vulnerabilities, block attacks and control access - Network, server, and endpoint : Systems management type functionality that provides proactive threat analysis and vulnerability management on networks and hosts - Physical infrastructure : Could extend to include physical security around access to charging assets and locations, including automating alerts and response 	
Key Responsibilities	Enabling identity management and access management via functions such as authentication and single sign on. It is responsible for verifying user authorizations and providing authorization update functionality. It's not responsible for security while initiating browsing of or access to any external websites.	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Supports simple user access and authentication. Could include access to services via user / admin portals and also a smartcard for any physical asset access.
	Semi	Increased security services reflecting the nature of the architecture at this point. Increased number of users and access methods. Potentially allowing users and vehicles to authenticate. Mobile access security.

	Smart	Extended to reflect the smart characteristics
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7.4.2. Integration Manager Component

Component Name	Integration Manager		Classification : Foundation
Description	Component of the intelligent infrastructure which provides the services and features that support integration within the II and with other systems external to it. This is a key component and is central to the II undertaking its role. It provides the mechanisms by which applications will use to share data across the enterprise. Typical characteristics of this interaction include the amount (size) of the data, real time or batch integration (frequency) and response time for target system to receive sent information (latency). Based on these characteristics, IT will use different mechanisms to achieve the most efficient and reliable integration approach.		
Key Responsibilities	Provision of interfaces within the intelligent infrastructure and also to external systems Data Integration Service Integration Extract Transform & Load Enterprise Service Bus Messaging		
Interactions	See Section 8 – Component Interaction Matrix for a full analysis		
Levels	Simple	Basic services matched to the components and services in use at the time. Likely to be more batch focused than real time. Small number of adaptors.	
	Semi	Increased scale as more interaction types and increased volumes are supported. Extended functionality to handle more real time integration requirements and increasing 'conversational' integration. Increased number of adaptors	
	Smart	Integration capability extended in line with the wider development of the architecture towards more dynamic and predictive components.	

7.4.3. Information Manager Components

Component Name	Knowledge Manager		Classification : Discretionary
Description	Component of the intelligent infrastructure which provides services to manage knowledge in the form of documents and content. Part of an overall Information Management component group.		
Key Responsibilities	Content Management Document Management		
Interactions	See Section 8 – Component Interaction Matrix for a full analysis		

Levels	Simple	N / A No specific intelligent infrastructure requirement in the simple stages. Could be some existing provision in some areas, such as where a charge provider can provide potential customers with information
	Semi	Additional functionality reflecting the growing complexity of the intelligent infrastructure
	Smart	

Component Name	Enterprise Information Management	Classification : Foundation
Description	<p>Component which provides services for managing the information in the II that is not managed through the Master Data components. This includes setting policies for the use of data and managing the lifecycle of the information through to eventually archiving / disposal. As more data and information begins to collect in and be processed by the II, this component will increase in importance. Part of an overall Information Management component group.</p> <p>Information Lifecycle Management covers policies, processes, practices and tools used to align the business value of information with the most appropriate and cost effective IT infrastructure. The lifecycle aspects relates to undertaking this alignment from creation to disposal. The general lifecycles are Creation and Receipt; Distribution; Use; Maintenance; Disposition</p>	
Key Responsibilities	<p>Data usage policy</p> <p>Information lifecycle management</p>	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Not formally provided – capability present in different ways and likely to be part of other components that are created or already exist
	Semi	Increased volume and integrated nature of information. The services here provide support for data usage policies and information lifecycle management.
	Smart	Components already in place could be enhanced to support the increased interconnections that come with the smart model. This most likely involves more dynamic information lifecycle management (reacting faster to changes in information)

7.4.4. Analytics Manager Component

Component Name	Analytics Manager	Classification : Foundation
Description	<p>This component provides the business analytics capability for the intelligent infrastructure. It is considered one of the key features that validates the need for an intelligent infrastructure related to wide spread use of Electric Vehicles. It will enable participants in the market to consume information in different formats, gain insight into system activity and make appropriate decisions at all stages.</p> <p>Would provide a standard analytics framework and associated toolsets.</p> <p>Would include key focus areas illustrated below.</p>	

	<p><u>Electricity Load Forecasting</u></p> <p>The main Intelligent Infrastructure feature that will be used by the DNO. Would take information and events from across the intelligent infrastructure and make this available to the DNO, either from within the intelligent infrastructure boundary via the DNO Portal or via an integration with the DNO's own systems. Provides access to capabilities considering 'demand profile', 'geographic factors', 'charging types', 'concentrations', etc. As it develops, the analytics and optimisation features will extend to consider predictive and simulated scenarios.</p> <p><u>Customer Analytics</u></p> <p>Provides access to information about the people using the charging infrastructure – 'customer types', 'services used', 'charging profile', 'price point behaviour' type of detail. As it develops, the analytics and optimisation features will extend to consider predictive and simulated scenarios.</p> <p><u>Charging Activity</u></p> <p>Provides access to information about the use of the charging infrastructure – 'when', 'where', 'what type', 'how long', 'how often' type of detail. As it develops, the analytics and optimisation features will extend to consider predictive and simulated scenarios.</p> <p>The model below conceptually illustrates how the analytics and optimisation capabilities might be assembled.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p style="text-align: center;">Specific Information Grouping Platforms</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 25%;">General Analytics</td> <td style="width: 25%;">Electricity Load Forecasting</td> <td style="width: 25%;">Customer Analytics</td> <td style="width: 25%;">Charging Activity</td> </tr> </table> <p style="text-align: center;">Business Analytics and Optimisation Platform</p> <table border="1" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Performance Management & Analysis</p> <ul style="list-style-type: none"> Dashboards, Scorecards, OLAP, Ad-hoc Query & Analysis Production Reporting </td> <td style="width: 50%; vertical-align: top;"> <p>Advanced Analytics</p> <ul style="list-style-type: none"> Time-series, Cluster & Pattern-based Mining Predictive Tools, Scenario and what if tools Optimisation </td> </tr> </table> <p style="text-align: center;">Information Platform</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td>Information Integration and Master Data Management</td> </tr> <tr> <td>Enterprise Content Management</td> </tr> <tr> <td>Data Warehouse and Other Data Management</td> </tr> </table> </div>	General Analytics	Electricity Load Forecasting	Customer Analytics	Charging Activity	<p>Performance Management & Analysis</p> <ul style="list-style-type: none"> Dashboards, Scorecards, OLAP, Ad-hoc Query & Analysis Production Reporting 	<p>Advanced Analytics</p> <ul style="list-style-type: none"> Time-series, Cluster & Pattern-based Mining Predictive Tools, Scenario and what if tools Optimisation 	Information Integration and Master Data Management	Enterprise Content Management	Data Warehouse and Other Data Management
General Analytics	Electricity Load Forecasting	Customer Analytics	Charging Activity							
<p>Performance Management & Analysis</p> <ul style="list-style-type: none"> Dashboards, Scorecards, OLAP, Ad-hoc Query & Analysis Production Reporting 	<p>Advanced Analytics</p> <ul style="list-style-type: none"> Time-series, Cluster & Pattern-based Mining Predictive Tools, Scenario and what if tools Optimisation 									
Information Integration and Master Data Management										
Enterprise Content Management										
Data Warehouse and Other Data Management										
<p>Key Responsibilities</p>	<p>Provide access to a range of analytical services. Data Warehousing; Data Management; Dashboards; Scorecards; Cubing; Reporting; Predictive & Scenario Modelling; Optimisation</p>									
<p>Interactions</p>	<p>See Section 8 – Component Interaction Matrix for a full analysis</p>									
<p>Levels</p>	<table border="1" style="width: 100%;"> <tr> <td style="width: 15%;">Simple</td> <td>Basic platform components and core tooling</td> </tr> <tr> <td>Semi</td> <td>Increased integration and enhanced tooling and support for specific analytics groupings</td> </tr> <tr> <td>Smart</td> <td>Building on the framework to support deeper analytics and more immediate</td> </tr> </table>	Simple	Basic platform components and core tooling	Semi	Increased integration and enhanced tooling and support for specific analytics groupings	Smart	Building on the framework to support deeper analytics and more immediate			
Simple	Basic platform components and core tooling									
Semi	Increased integration and enhanced tooling and support for specific analytics groupings									
Smart	Building on the framework to support deeper analytics and more immediate									

		and dynamic delivery of analytics. Extends toward simulations, what if scenarios and optimisation.
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7.4.5. Reporting Manager Components

Component Name	Reporting Manager	Classification : Foundation
Description	Component which supports the creation of reports and making them available to the relevant users. Concerns provision of standard services for queries and management information type reporting. Can be scheduled automated reports through to more on demand management information. Has two specific grouping – Operational Reporting and Legislative & Regulatory	
Key Responsibilities	view reports; schedule reports; define reports; select reports; maintain reports; send reports;	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Simple	Basic reporting, low volume and low coverage. Focused on performance and metrics
	Semi	Increased reporting depth, volume and coverage. Extends to cover specific reporting needs around legislation and regulation. More reports needed and on demand as well as scheduled
	Smart	Extends from the semi intelligent stage to reflect any increase for on demand and integration.

7.5. Key Infrastructure Level

The conceptual components covered here at this stage are:

- Data Stores
- Application Servers
- System Management
- Networks

7.5.1. Data Stores Component

Component Name	Data Stores	Classification : Foundation
Description	Used to refer to data stores of all types covering transactional information, master data, persistent and non persistent data and information stored in an analytics or data warehouse type system	
Key Responsibilities	Store data Allow queries on the data	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	All levels	

7.5.2. Application Servers Component

Component Name	Application Servers	Classification : Foundation
Description	Used to refer to the underlying hardware and system software of the intelligent infrastructure	
Responsibilities	Raw computing power for all applications and data stores	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	All levels	

7.5.3. System Management Component

Component Name	Systems Management	Classification : Foundation
Description	Covers various pieces of functionality that will be used to manage any aspects of the Intelligent Infrastructure which are deployed from an availability and performance perspective. This would include application, infrastructure and network components	
Key Responsibilities	<p>Monitor system availability and performance</p> <p>Generate alerts and warning to the system operators</p> <p>Take rule driven actions to prevent or address an issue with the IT infrastructure were appropriate</p>	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	Systems Management components will be specified and deployed across the infrastructure as part of any deployment at any of the levels of intelligent infrastructure development.	

7.5.4. Networks Component

Component Name	Networks	Classification : Foundation
Description	Used to refer to the communications hardware and software required within the intelligent infrastructure	
Responsibilities	Enables communications across the intelligent infrastructure	
Interactions	See Section 8 – Component Interaction Matrix for a full analysis	
Levels	All levels	

7.6. Other components

During the analysis, a number of other components have been considered. They have not been captured in the initial conceptual view as they are either not directly related to the application functionality (i.e. are more technical / physical) or they require additional clarification / iteration of the models which will come in future phases.

They are captured here for completeness and for consideration during review.

Component Name	Security / Access Token	Classification : Foundation
Description	A token held by and associated with a user and / or a vehicle which identifies that the user / vehicle is registered and able to access the charging infrastructure	
Responsibilities	Provides access for a user and / or vehicle to the charging infrastructure Support authentication of user / vehicle to the system	
Interactions	Security Manager Charge Point Communication Controller	
Complexity	Low / Medium	



8. Conceptual Application Architecture - Component Interaction Matrix

The table on the next page illustrates the relationships between different conceptual application components. A symbol in the cell indicates a potential relationship will exist between the different application components.

9. Overview of potential component context for domestic charging

The table below provides a summary of the potential context for domestic charging in relation to the application component groups. A view is provided as to whether the component will be relevant for domestic charging scenarios, in which evolutionary stage and to what degree using the following symbols.

-	Not considered to be a major factor at this stage ○	Will be relevant but at an initial level or be constrained ●	Very relevant and likely to have increased levels of functionality applied
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As with other conceptual level analysis, the information will be refined during this and future stages of the project.

Component	Potential to be relevance for domestic charging	Simple	Semi	Smart
User Portal	May be used to access information about the customer account	○	●	●
Mobile User Interface	Domestic users could make use of services to manage charging remotely	-	○	●
EV User Interface	The EV could develop to support interaction with the domestic charge point automatically	-	○	●
Charge Point User Interface	Domestic users with a specific charging post could utilise any user interface on the post. Simple functionality could be selection of when to charge for example.	○	○	●
Charge Location Admin Portal	Charge post providers do offer services to install and manage domestic charge posts and this could be a growing factor as the volumes and complexity increase	○	○	○
Electricity Utility Portal	Giving the DNO access to information relating to domestic charging. Would be initially relevant through derived information on the consumption of electricity in the home but could develop to be more dynamic and real time.	○	○	●
Intelligent Infrastructure Admin Portal	Only when the domestic charging infrastructure is more integrated to the wider infrastructure	○	○	○
EV Telemetry & Diagnostics Manager	Not seen to be directly relevant	-	-	-
EV Configuration & State Manager	Potential for the EV to communicate with the domestic charge post /. Home network in future models	-	○	○
EV Communication Controller	Potential for the EV to communicate with the domestic charge post /. Home network in future models	-	○	○
Customer Services Manager	Basic information might be available to start with. Becomes more relevant when the charging points become part of wider networks, the volumes increase, etc.	○	○	●
Charge Point Location Viewer	Limited initial relevance to domestic charging. Could be used by DNO to help in assessing demand or by charge location operators where managing the charge post	-	○	○
Charge Point Status Manager	Limited initial relevance to domestic charging. Could be used by DNO to help in assessing demand or by charge location operators where managing the charge post	-	○	●
Charge Point Communication Controller	As specific domestic EV charge points are rolled out the there would be developments to utilise communication to and from the charge point	○	○	●
Charge Point Booking Manager	Not seen to be directly relevant	-	-	-
Charge Point SCADA Manager	Becomes more relevant where a charge location operator or other actor is providing a service to monitor and manage the domestic charge point	-	○	●
Charge Point Asset Manager	Becomes more relevant where a charge location operator or other actor is providing a service to monitor and manage the domestic charge point	-	○	●
Charging Parameters Manager	Vehicle specific charge points are able to allow selection of basic parameters (e.g. charge now, charge after 2300). More options will develop and there is no reason why the a dedicated domestic charge point could not be included.	○	○	●
Charge Activity Monitor		○	○	●
Post Charge Activity Processor	In later stages of evolution where the domestic charge point may be more integrated with other elements then various aspects of the charge activity in a domestic context could be made available for wider use	-	○	○
Electricity Demand Manager	Unless handles through specific domestic charge points, the majority of domestic charging activity would initially blend into the general electricity demand and consumption. As the volume increases and as additional features like smart grids and device recognition become available, demand management would need to incorporate the domestic charging activity.	-	○	●
Settlement & Clearing Services Manager	Limited relevance to domestic charging scenarios	-	○	○
Payment Manager	Payment in the domestic setting is likely to be via current provision - domestic energy bills, pre pay meters, etc. Therefore not currently thought that the full range of payment options needs to be available in a domestic setting, other than for things such as guest user activity.	○	○	●
Billing Services Manager	Initial domestic charging activity may well just blend into the current home energy billing arrangement. Relevance increases in terms of domestic charging activity being billed as part of existing or a separate home energy bill.	-	○	●
Risk, Fraud & Compliance Manager	In future stages of evolution there will be a need to factor in potential fraud relating to domestic charging, e.g. utilising a specific EV charging facility for activity other than EV charging	-	○	○
Master Reference Data Manager	At some stage domestic charge point data, customer data and pricing data would all be relevant	○	○	○
Security Manager	Increasing relevance in line with general charging activity would apply.	-	○	●
Integration Manager	Initially integration of domestic charging activity unless via a specific facility would be low. This would evolve as volumes increase and additional features become important - e.g. being able to have visibility of demand	-	○	●
Analytics Manager	Initially analytics relating to or involving domestic charging activity unless via a specific facility would be low. This would evolve as volumes increase and additional features become important - e.g. being able to have visibility of demand, analysis of usage patterns, correlating activity to prices, etc	○	●	●
Reporting Manager	Initially reporting around domestic charging activity unless via a specific facility would be low. This would evolve as volumes increase and additional features become important in a similar way to that for analytics	○	○	●

10. Conceptual Application Architecture - Logical Layers

Although not formally part of this deliverable, (it is to be defined in more detail in SP2/IBM/19 Conceptual Technical Architecture), the following depicts the four logical layers of the Intelligent Infrastructure and how the conceptual components may map onto the physical architecture:-

