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Programme Area: Light Duty Vehicles

Project: Electricity Distribution and Intelligent Infrastructure

# Title: Completion Report - Systems Integration and Architecture Development – Appendix D1


## 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 (ie, 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 D1, providing a high-level plan of the scope, activities and deliverables that may be required for demonstration and proving in an ETI follow-on project.


## 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 |
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| | |
|---|---|
| Deliverable Title | Plan for Architecture Realisation |
| Deliverable Reference | SP2/IBM/20 |

| | |
|---|---|
| Interim or Final | Final |

| | |
|---|---|
| Original Due Date | 10th August 2010 |
| Initial Submission Date | 10th August 2010 |

| | |
|---|---|
| Author | Nigel Baker-Brian (IBM)<br>Simon Parker (IBM) |

| | |
|---|---|
| Approver | Giles Bridger (IBM) |

| Version | History |
|---|---|
| Various 0.x | Drafts pre submission |
| v.1.0 | Initial Submission 10th August 2010 |
| v.2.0 | Submission following ETI Review Comments |

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

# ETI ED&II Sub-Project 2

# EV Intelligent Infrastructure

# SP2/IBM/20 Plan for Architecture Realisation

Version: 2.0

6th September 2010

# Contents

# ETI EV Work Package 2.4

# EV Intelligent Infrastructure

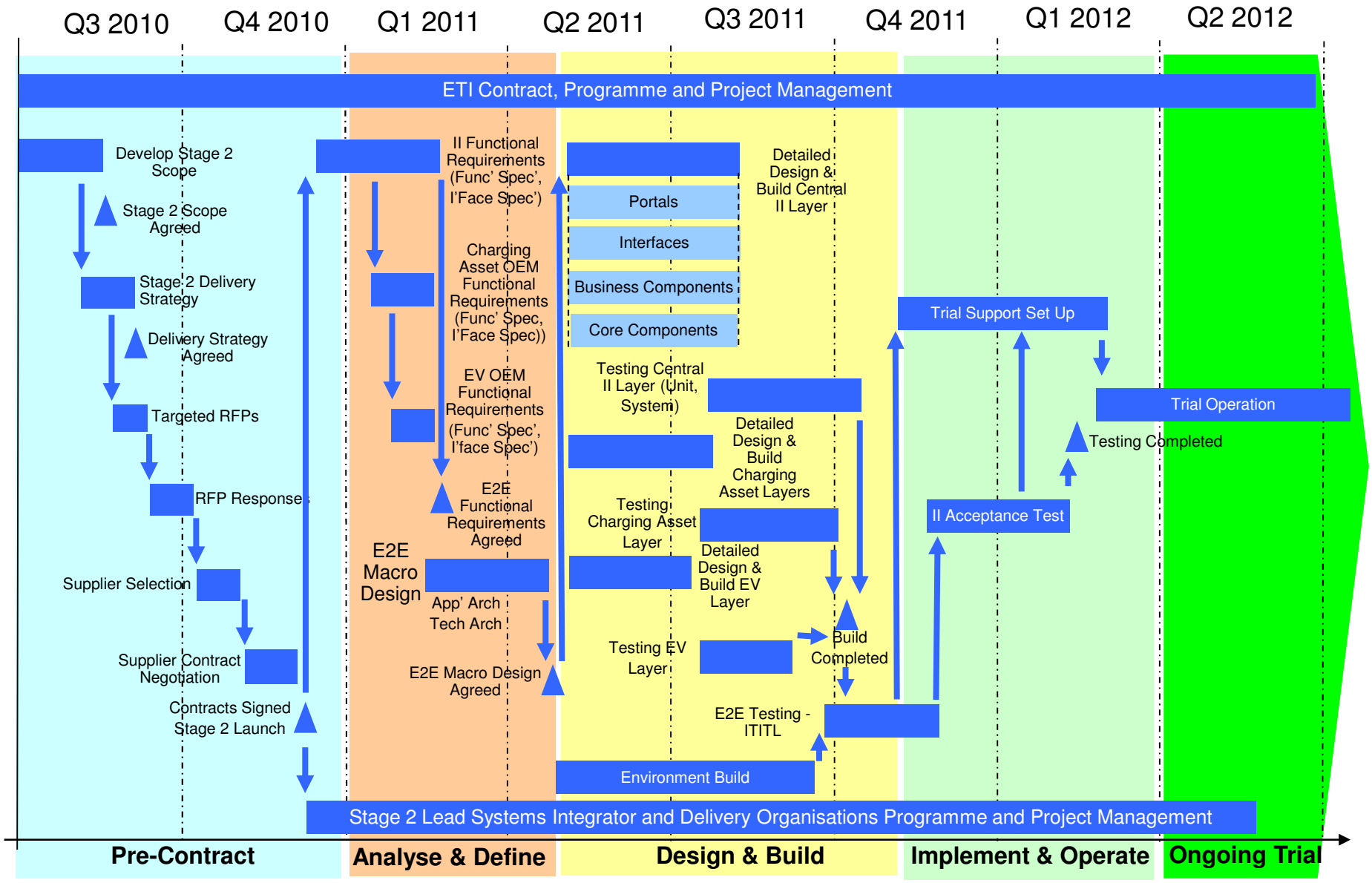
# SP2/IBM/20 Plan for Architecture Realisation

# Executive Summary

# Executive Summary–
# Overview of the main points of the report

- This Plan for Architecture Realisation Report presents:
  - a high-level view of the scope, activities and deliverables required for the provision of an Intelligent Infrastructure in Stage 2, based on our current understanding;
  - the main phases of activity, identifying major milestones, deliverables; and dependencies;
- It is expected that the planning sessions ETI are leading - starting in mid-August, will provide further detail and clarity, which can then be reflected in this deliverable
- The Intelligent Infrastructure for a basic trial will require the following broad capabilities/features:
  - Customer Management; Charge Point Information and Management; Charging Activity Management; Payment Management; Integration; Analytics and Reporting
- For a more advanced trial, the above would be extended (coverage, detail, complexity) to include:
  - Settlement; Demand Management; and Vehicle Interaction
- In either case, some trial specific functionality and technology will be required beyond the core Intelligent Infrastructure, to provide a capability for data capture on the operation of the trial – the recommendation of this report is to view the requirement for the capture of trial data as an extension of the Intelligent Infrastructure and not a requirement which is fulfilled by a separate trial infrastructure – for reasons of cost, including operational efficiency
- The scope of this report is limited to the Intelligent Infrastructure and assumes that a physical charging infrastructure (charge posts, network connections) will be provided either specifically by the ETI for Stage 2 or that existing infrastructures – such as those implemented by the Plugged-in-Places Initiative – will be used.
- On completion of contractual and logistical prerequisites, each component of the Trial Infrastructure would need to under-go the following stages:
  - Detailed Design & Specification; Procurement; Build; Test; Operation; and Support
- More information on both the basic and advanced trial functionality, together with a summary plan of activity and timeframe, are contained in the following 2 pages of this Executive Summary. The body of the report then expands on those artefacts.

# Executive Summary–
# Plan for Architecture Realisation



# Executive Summary –
# Key Intelligent Infrastructure features required in trial stages - Summary

| Broad Feature | Basic Trial | Advanced Trial |
|---|---|---|
| **Customer Management** | Register users, create accounts, handle basic contact - Simple CRM functionality | Extended CRM functionality |
| **Charge Point Information & Management** | Static location information<br>Snapshot status information<br>No consolidated asset view | Real time status information<br>Consolidated asset view across all factors (supplier, operator, location, etc) |
| **Charging Activity Management** | Basic charging variables, e.g. charge after 2300, charge for 4 hours | Extended charging variables and parameters such as charge based on price, as fast as possible, until xx% then stop until time = xx. Also things like booking services, calendars, etc |
| **Payment Management** | Basic payment methods supported – account based, fee based, pay@plug | Extended payment method support, including full ability of users to roam |
| **Settlement** | No settlement in a basic trial | Settlement supported to allocate payments across different providers and operators |
| **Integration** | No external real time integration required. Updates batch based or periodic polling type – such as for charging assets | Real time integration between systems, including simulated and real world external systems (e.g. pricing, demand, payment) |
| **Analytics & Reporting** | Mainly static reports. Some basic analytics | Extended analytics and looking towards optimisation |
| **Demand Management** | Not part of a basic trial | Information and analytical functionality available for demand management |
| **Vehicle Interaction** | No vehicle interaction<br>Standard and standalone vehicle diagnostics | Extensive vehicle interaction, e.g. with charging post, external information source, etc<br>Potential integration of vehicle diagnostics with analytics |
| **Trial Specific Data Capture Infrastructure** | As required | As required |

# ETI EV Work Package 2.4

# EV Intelligent Infrastructure

# SP2/IBM/20 Plan for Architecture Realisation

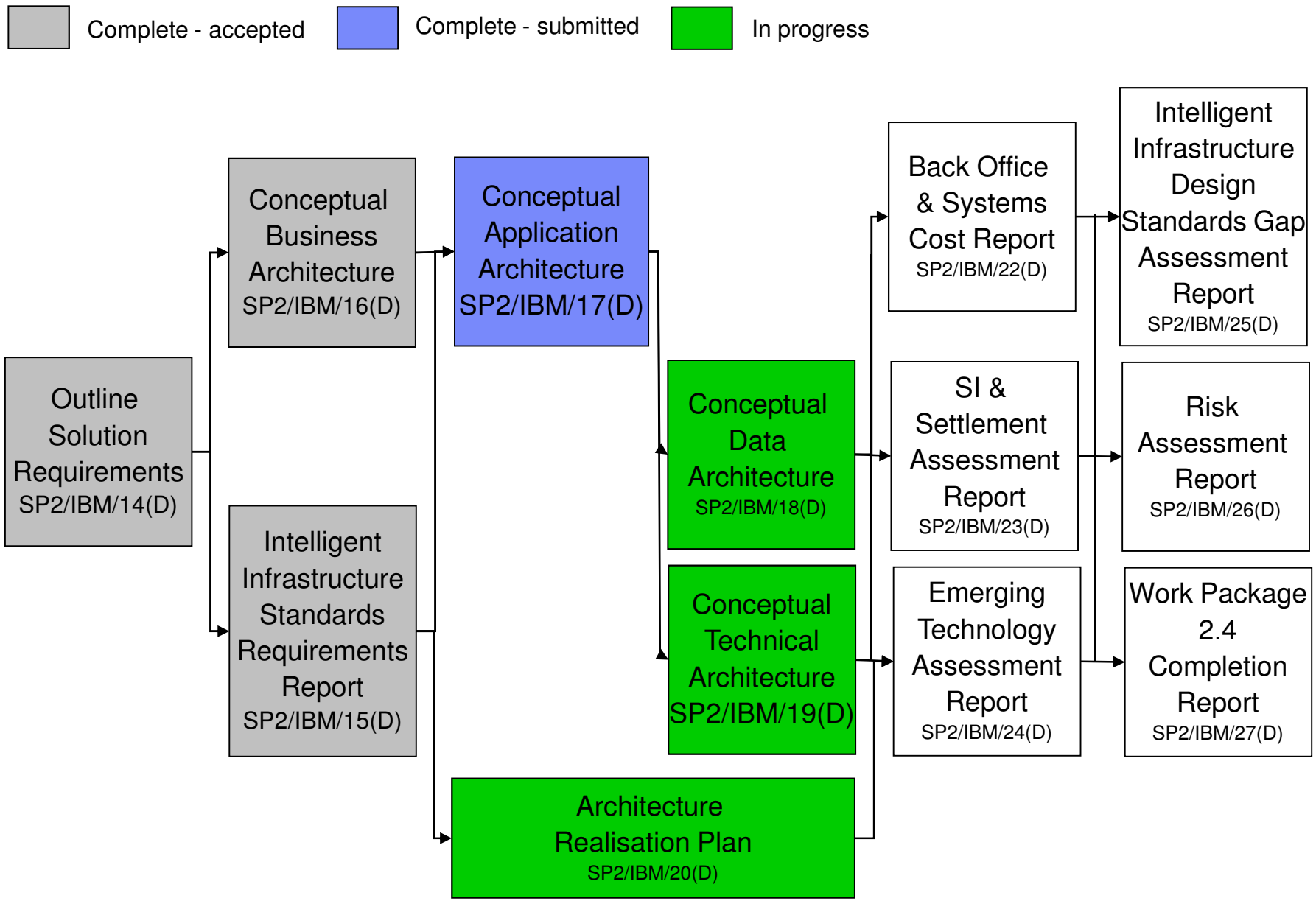
# Introduction

## ETI EV Intelligent Infrastructure – Plan for Architecture Realisation - Purpose and Objective

- Purpose
  - This document is a deliverable of the ETI Technology Contract for the Electrification of Light Vehicles - Project: Electricity Distribution & Intelligent Infrastructure. The deliverable is the Intelligent Infrastructure - Work Package 2.4 – Plan for Architecture Realisation.
- Objective
  - Production of a high-level plan defining the scope, activities and deliverables required in Stage 2*, showing the main phases of activity and the principal streams of activity and identifying any major milestones, deliverables and dependencies.

* *Stage 2 as referred to in the Stage 1 Contract*

# EV Intelligent Infrastructure – Plan for Architecture Realisation - Relationship of this deliverable to other Work Package 2.4 deliverables



# EV Intelligent Infrastructure – Plan for Architecture Realisation - Overview of key Work Package 2.4 deliverables

| Deliverable | Outline |
|---|---|
| Intelligent Infrastructure Requirements Report | Outline solution requirements; High Level System Context; High Level Initial Use Case Model |
| Intelligent Infrastructure Standards Requirements Report | The standards report provides a list of areas that may require a standard; it will not attempt to define or set the actual standards. |
| Conceptual Business / Application / Data / Technical Architectures | Includes artefacts such as CBM, component model, entity relationship diagram, operational model |
| Plan for Architecture Realisation | High-level plan defining scope, activities and deliverables required in Stage 2 |
| Back Office and Supporting Systems Cost Report | Estimate high level costs for the design and build of the back office and systems |
| Systems Integration and Settlement Assessment Report | Settlement landscapes and alternatives and scope of systems requiring integration |
| Emerging Technology Assessment Report | Provide a snapshot evaluation of emerging vehicles technologies and scenarios, such as demand side management, network constraints, vehicle-to-grid and future charging options |
| Intelligent Infrastructure 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 |



- this deliverable

# EV Intelligent Infrastructure – Plan for Architecture Realisation – SP2/IBM/20 Contractual Acceptance Criteria

| Criteria | How the report meets the criteria |
|---|---|
| High-level plan defines the scope, activities and deliverables required in Stage 2. The high-level plan will consist of a summary level Gantt chart showing the main phases of activity on the x axis (typically at the level of 1-6 months‟ duration per phase) and the principal streams of activity on the y axis (typically 5-25 streams or activities) and identifying any major milestones, deliverables and dependencies. | See ‘Scope’ and ‘Plans’ Sections of this document. |

# ETI EV Work Package 2.4

# EV Intelligent Infrastructure

# SP2/IBM/20 Plan for Architecture Realisation

## Prerequisites

# Plan for Architecture Realisation - Prerequisites

- Key prerequisites for the SP2/IBM/20 Deliverable at this time would include:-
  - Common definition of subsequent stages – (see below)
  - Common understanding of purpose and objectives of subsequent stages – (see next slide)
  - Clarification of scope of the Intelligent Infrastructure to be provided for the trial – (see subsequent slides)
- Definition of Stages
  - Stage 1 (Concept Design)
    [Research, analysis and modelling]
    - Consumers and Vehicles Project
    - Electricity Distribution and Intelligent Infrastructure Project
    - Economics and Carbon Benefits Project
  - Stage 2 (Trialling…)
    ['Extensive real-world system scale testing and consumer evaluation in a collaboration with UK locations and global vehicle manufacturers']
    - Detailed Design and Stakeholder Contracting
    - Implementation
    - Operation
    - Decommissioning and Exploitation

**NOTE** : This deliverable has been produced on a provisional understanding of subsequent stages. It is understood that the ETI are leading sessions - starting in mid August to take this forward. If at some later point there is a new / substantially different definition of subsequent stages and there is value in revising this report, then this could be handled through a Variation Request.

# Plan for Architecture Realisation Prerequisites - Vision, Aim and Context for Stage 2

- Vision:
  - The UK test bed capability for the electrification of light vehicles.
- Aim:
  - To create the UK test bed capability for the electrification of light vehicles that will enable the infrastructure systems to be tested at scale, real-world vehicle performance to be assessed and for extensive qualitative and quantitative consumer research to be undertaken with mass-market representative consumers.
- Context:
  - Stage 1 conducted a number of analyses and developed a set of models, together with a Test Plan for verification and validation. Stage 1 only undertook very limited real-world trialling.
  - Stage 2 will create and operate the test bed platform that will provide the extensive data-sets required by this Test Plan. The outputs from Stage 1 will be updated during Stage 2 using these data-sets to produce robust final outputs with extensive supporting evidence from real-world operation.
  - The test bed environment will be decommissioned during Stage 2.

ETI EV Work Package 2.4

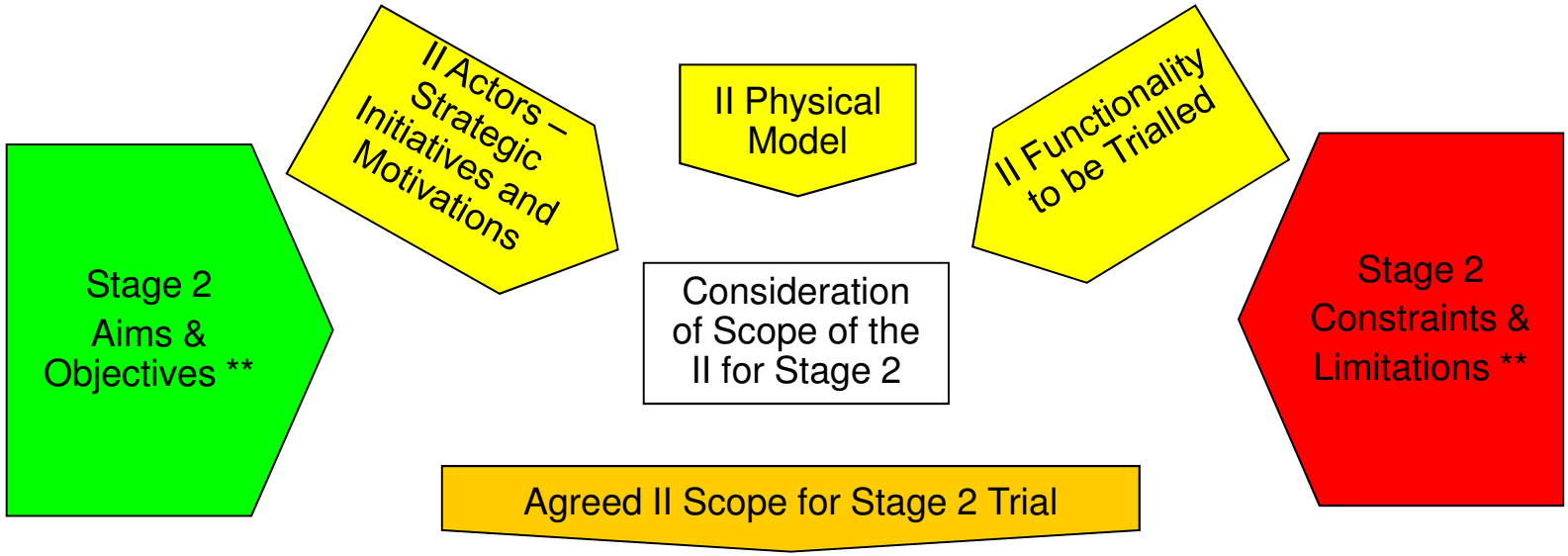
EV Intelligent Infrastructure

SP2/IBM/20 Plan for Architecture Realisation

# Stage 2 and the Scope of the Intelligent Infrastructure

# ETI EV Intelligent Infrastructure – Plan for Architecture Realisation - Scope of the Intelligent Infrastructure for Stage 2 Trial

- To meet the objectives of the trial, including '…enable the infrastructure systems to be tested at scale…', an implementation of the II is required which:-
  - Proves the II Conceptual Design through further detailed specification, design, build, deployment and operation in a large scale test environment.
  - Acts as a Proof of Concept for certain key concepts which are unique or appear to present areas of significant risk to realisation.
  - Produces clear learnings for the II by means of extensive recording and analysis of data with learnings being fed back into the trial, into the conceptual design and the design of the real-world implementation of the II.




** - come directly from the ETI's pre-work on Stage 2

# Stage 2 II Scope – Context Diagram Actors' Strategic Initiatives and Key Motivations - those highlighted in red/underlined to drive consideration of the scope of the trial

## Government & Regulation

- Promote health & environmental improvements in urban areas
- Support the electrification of light vehicles as a significant contributor to meeting the commitment to reduce the amount of $CO_2$ emitted by the UK
- Grow the UK's competence in EVs (a green technology), with the consequential creation of jobs
- Ensure safety, interoperability, quality of services and competition
- Ensure the operation of appropriate tax mechanisms to manage road usage

## Electric Vehicle Charging Services

- Opportunity to develop and provide new revenue generating services that can be offered to EV users and EV related businesses
- Forge relationships with critical partners – landlords, electricity retailers, DNOs, charging equipment suppliers, Local Government (esp. Borough Councils) - to establish 'core' business
- Opportunity to grow the business by vertical expansion into related businesses, products and services to other service providers

## Electricity Supply Chain

- Maintain security of supply and customer service levels (for distribution networks these are maintained by Ofgem and may require updating for EVs)
- Forecast & control demand for power, including techniques like load-shifting to limit stress on localised distribution assets
- Provides an opportunity to further demonstrate green credentials
- Enhance the stability of the network by using techniques such as V2G storage, voltage and frequency regulation
- Efficiently manage any requirements to renew or update the network as a result of increasing EV usage (DNO)
- Exploit business opportunities through sales of new energy (retailers)

## Electric Vehicles and Owners / Users

- Attractive Total Cost of Ownership of EVs when compared to ICE vehicles and other green technologies
- Contribution to environmental cause
- Products are safe, desirable and provide sufficient practicality and ease of use, for example:
  - removal of range anxiety;
  - able to charge at home / work so EV ready to use;
  - familiar in operation & 'look and feel'
  - able to use across different geographies

## Electric Vehicle & EV Infrastructure Providers

- Exploit the market opportunity for EVs and EV Infrastructure and Services and the opportunity to enhance green credentials
- Develop affordable electric vehicles for the global mass market
- Use the provision of EVs to the market as a strategy to meet product portfolio $CO_2$ emissions.
- Exploit the opportunity to grow vertically from being an equipment manufacturer and supplier to a service provider

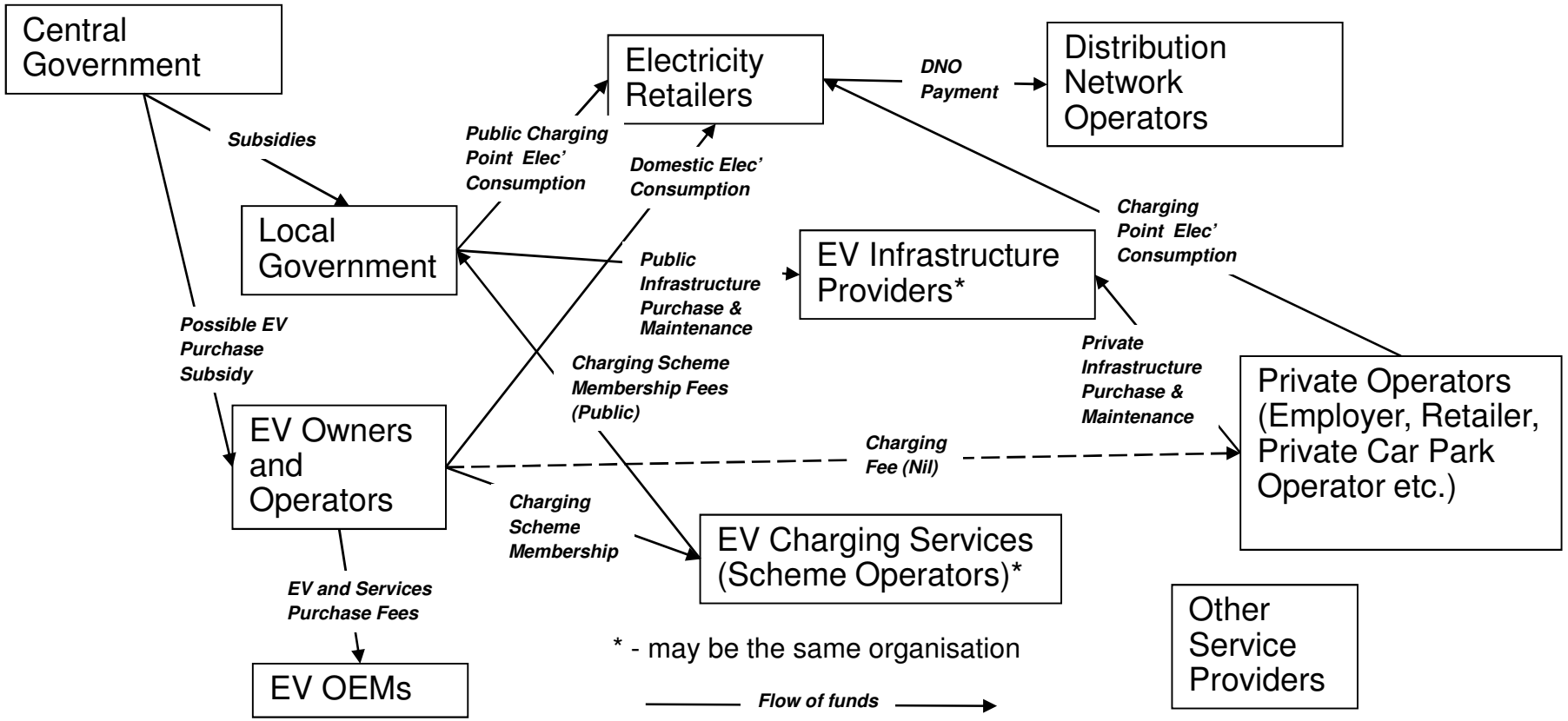
## Other Service Providers

- Opportunity to develop and provide new revenue generating services that can be offered to EV users and EV related businesses
- Target green market segments
- Integrate across different intelligent infrastructures

# Stage 2 Scope – II Models produced to date and 'real-world' trial

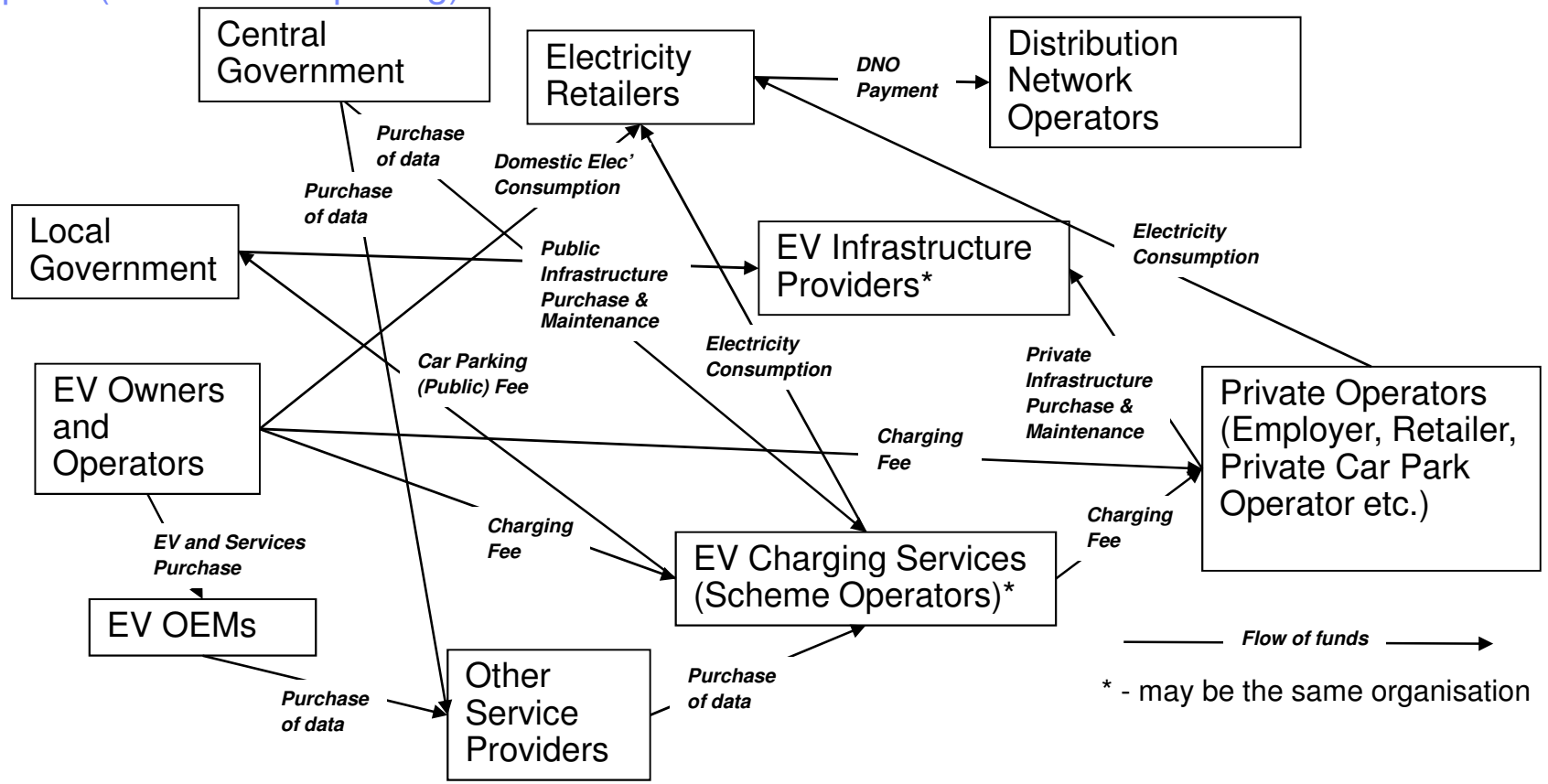
- All Work Package 2.4 deliverables to date have been 'high level/conceptual' models including the Requirements Analysis, the Business Component Model and the Application Architecture
- The trial is a real world trial with actual vehicles, real users and a real intelligent infrastructure - or at least elements of it.
- As a consequence, a 'physical' business component model is missing against which the scope of the II to be trialled can be defined. The physical business component model is the collection of organisations and companies – out in the real world – which will provide the business competencies and business components which were defined in the Conceptual Business Architecture and which, through their commercial activities provide functionality which will be trialled.
- *A key assumption behind this report is that the trial should be undertaken as if we were in the semi-intelligent/smart phases of evolution (see SP2/IBM/16). In these phases it is assumed a mature EV business environment will exist - for example subsidies to purchase EVs and subsidies to Local Authorities to install and operate infrastructure will no longer be in place.*
- It is necessary to have this physical model so that an accurate and comprehensive list of Stage 2 phases and activities can be developed for this deliverable, especially where coordination between organisations is needed
- The following slides define the physical model which should be assumed for the trial.

# Stage 2 Scope - Current Physical Model



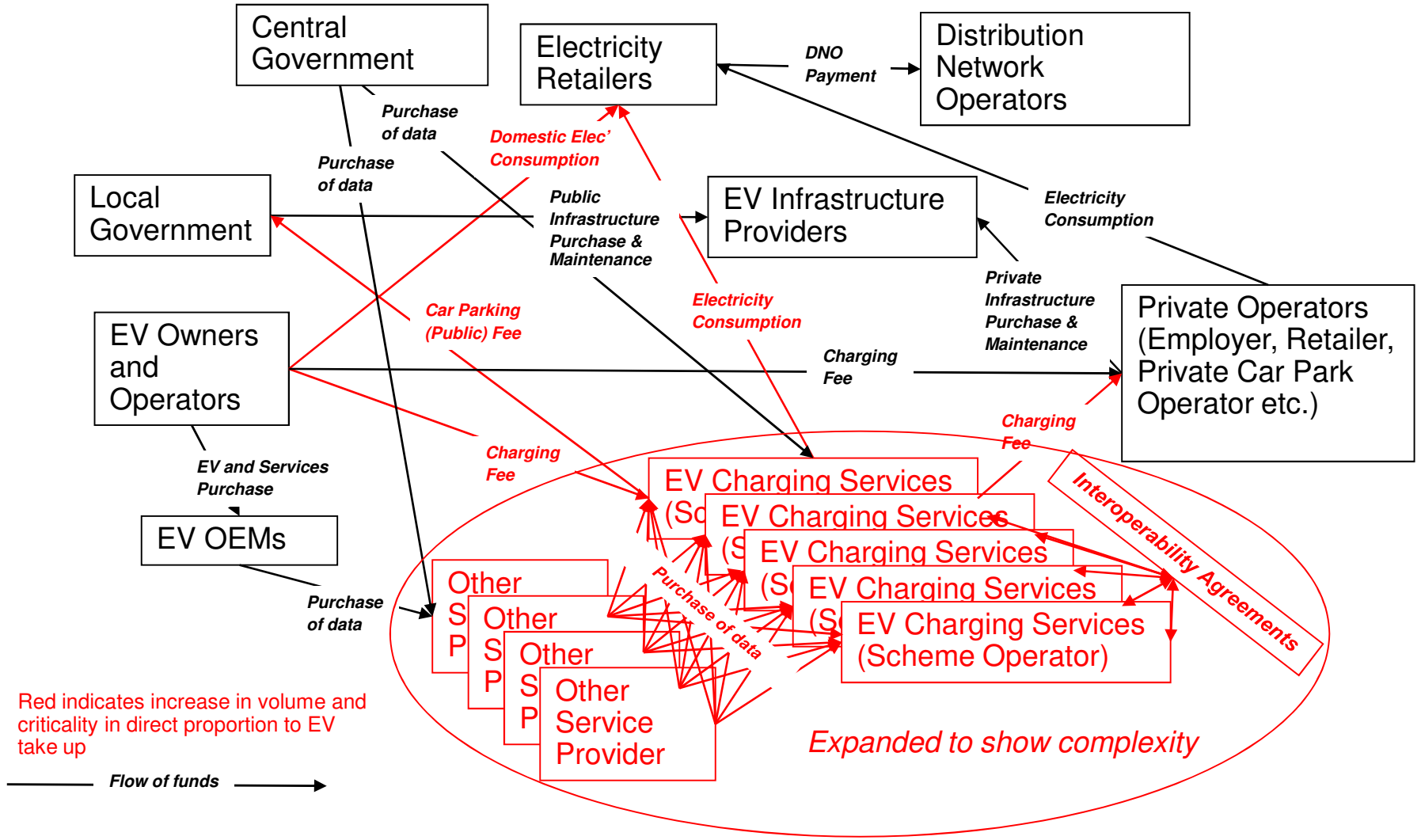

- Local Government providing free electricity and making no explicit charge for car park fees (not an issue for low volumes, low consumption)
- Private operators also paying the electricity bill on behalf of the EV Owner and Operator and in most cases providing a 'free' service
- Electricity retailer being paid for domestic consumption by the EV Owner when charging at home and via the Public and Private Operators when charging non-domestically
- Non-domestic charging revenue is capped per user
- Flow of revenue into the market for non-domestic charging is driven by scheme membership, and ownership of the Customer is by individual Scheme Operator
- EV Charging Services provide the following capabilities – Customer Relationship Services, Payment Services (Simple) – as defined in the Conceptual Business Architecture (SP2/IBM/16)
- EV Infrastructure Providers provide the following capabilities – Charging Location Infrastructure Provision and Charging Location Operation – (SP2/IBM/16).
- In some cases the EV Infrastructure Provider and the EV Charging Services Provider are one and the same organisation.
- Current physical model is reliant on public funds – it is assumed that this will not be sustained into the semi-intelligent/smart evolutionary phases and hence not advisable to base the trial on this model

# Stage 2 Scope - Physical Model – reliance on subsidies removed, and payment by consumption (and variable pricing) introduced



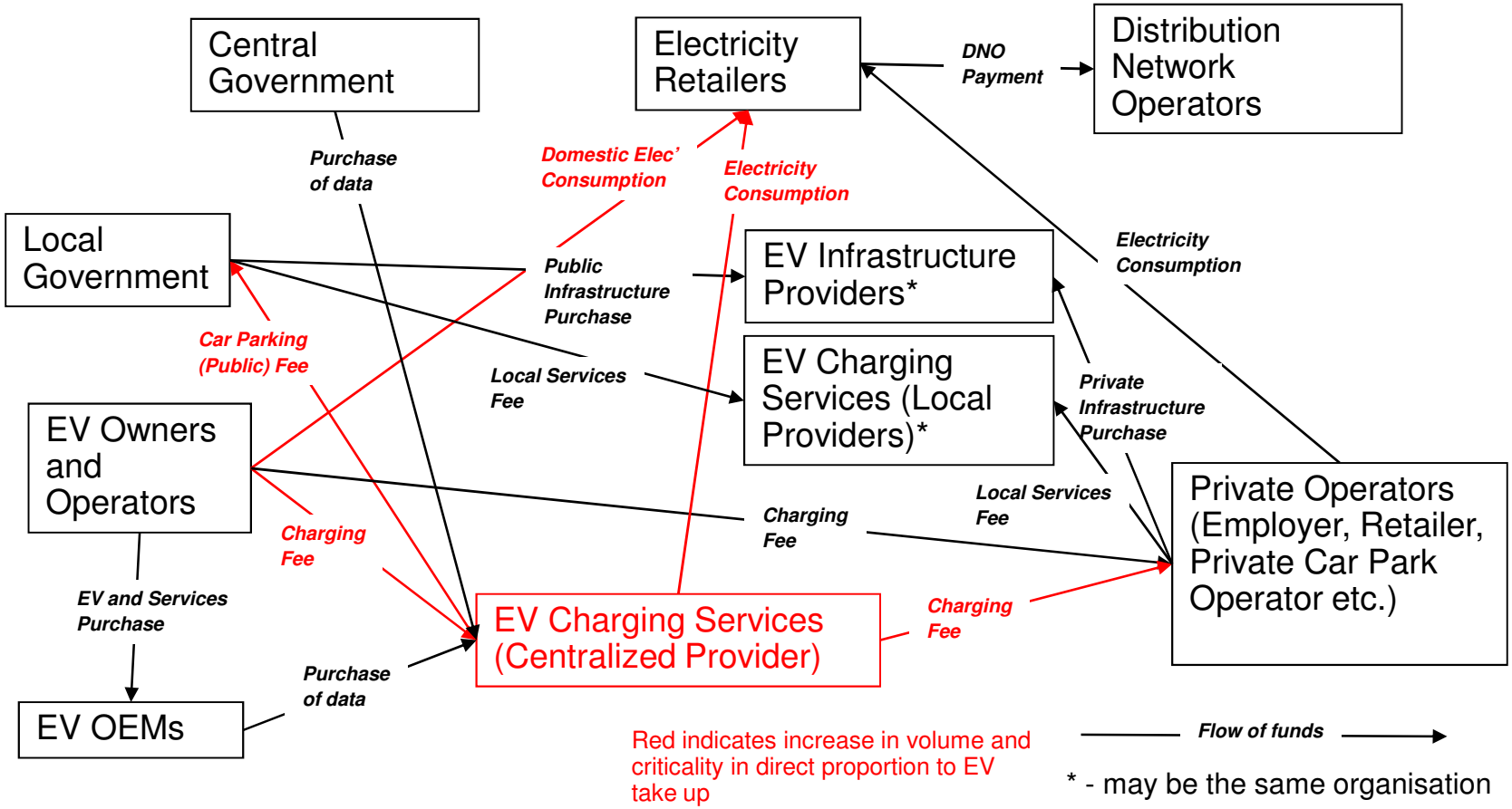

- Local Government regains consumption based revenue for car parking (plus possible additional elements to cover cost of electrical infrastructure provision etc.)
- Electricity retailers are paid on consumption by the operators of the various schemes and have the opportunity to vary prices
- Private operators will probably choose to use a scheme operator to administer charging services (as specialist services will be available and this is not their core business), but may retain the option to handle this directly. Charges arising from Private Operators may still be 'nil', e.g. retailer, employer – as a marketing perk/employee benefit)
- Flow of revenue for non-domestic charging into the market is driven by charging and charging activities and not capped by scheme membership
- Other Service Providers are operating in the market providing II Information Management and Analytics Capability (SP2/IBM/16)
- EV Charging Services provide the following capabilities – Charging Location Operation, Customer Relationship Services, Payment Services (Simple) – as defined in the Conceptual Business Architecture (SP2/IBM/16)
- EV Infrastructure Providers provide the following capabilities – Charging Location Infrastructure Provision and Charging Location Operation – (SP2/IBM/16).
- In some cases the EV Infrastructure Provider and the EV Charging Services Provider are one and the same organisation, but less likely, given the growing size of the market and the specialist capabilities needed to meet the demands of more complex payment services.
- …however there are issues with this physical model as the EV market and the demand for charging services takes off – see next slide

# Stage 2 Scope - Physical Model – as EV take-up increases, schemes multiply




- EV Charging Services – distinct operators emerge, each serving their own Public and Private clients, their own EV owners and operators, and a relationship with an Electricity Retailer (all one-to-one relationships). Interoperability agreements between each other are forged in order that EV Owners and Operators may 'roam' to use infrastructure and services from each operator
- Complex interactions between each services operator to meet the demands of the market for joined up services – additional cost, not taking advantage of economies of scale – flow through to the end-consumer in higher prices for charging. Lack of agreement between operators may preclude the use of services. Different standards for different operators add complexity for the EV owner and operator
- Other Service Providers must engage with all scheme operators to obtain integrated view - flows through to higher costs to the customer
- This is not a model which promotes the development of the market, and not one it is proposed, on which the trial should be based.

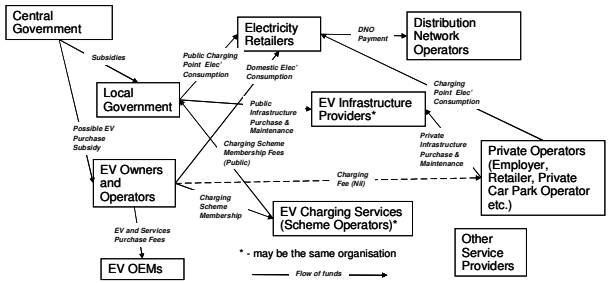
# Stage 2 Scope - Physical Model – distinction between Central and Local Charging Services Providers




- EV Charging Services split between Central Services, including - Customer Relationship Services, Payment Billing and Settlement Services, II Information Management and Analytics and II Provision, and Local Services comprising - Charging Location Operation and, possibly, Local Customer Relationship Services.
- The customer can be owned either by the Local or Central Charging Services organisation.
- Needs legislation and cooperation across the industry to create
- The model promotes universal services, ease of payment, universal availability of infrastructure and lower costs, and therefore is proposed as the physical model to be assumed for the trial.

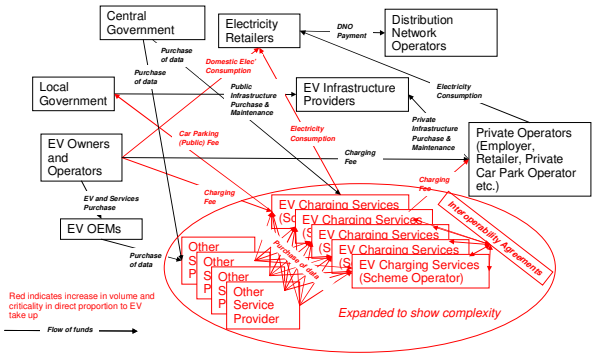
# Stage 2 Scope – Rationale for the proposed Physical Model - Summary

## Current physical model



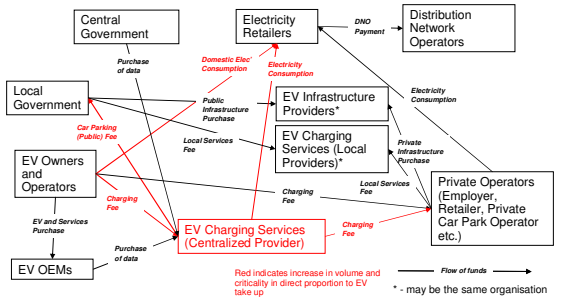

- Subsidized by public funds as follows:
  - Subsidies to the EV customer for the purchase of the EV
  - Subsidies to the Local Authority for the installation and operation of the public charging infrastructure
  - Subsidies to the EV owner/operator - in non-domestic locations – for cheap parking, 'free' electricity and, where appropriate, waiving congestion charges, (corresponding loss of parking and congestion revenue to the Local Authority/Parking Operator)
  - …it is assumed that these subsidies are unlikely to continue into the Semi-Intelligent/Smart Phases
- No payment by consumption of electricity when charging non-domestically – assumed that this is unsustainable because:-
  - There is no link between the cost of the electricity consumed by the user and the charge made by the operator
  - Unable to use electricity price to control and influence demand
- Non-domestic charging revenue is capped per user
- …hence very unlikely to be the physical model in the Semi-Intelligent/Smart phases of evolution and therefore rejected as the physical model for the trial.

## Physical model with many scheme operators – no central operator



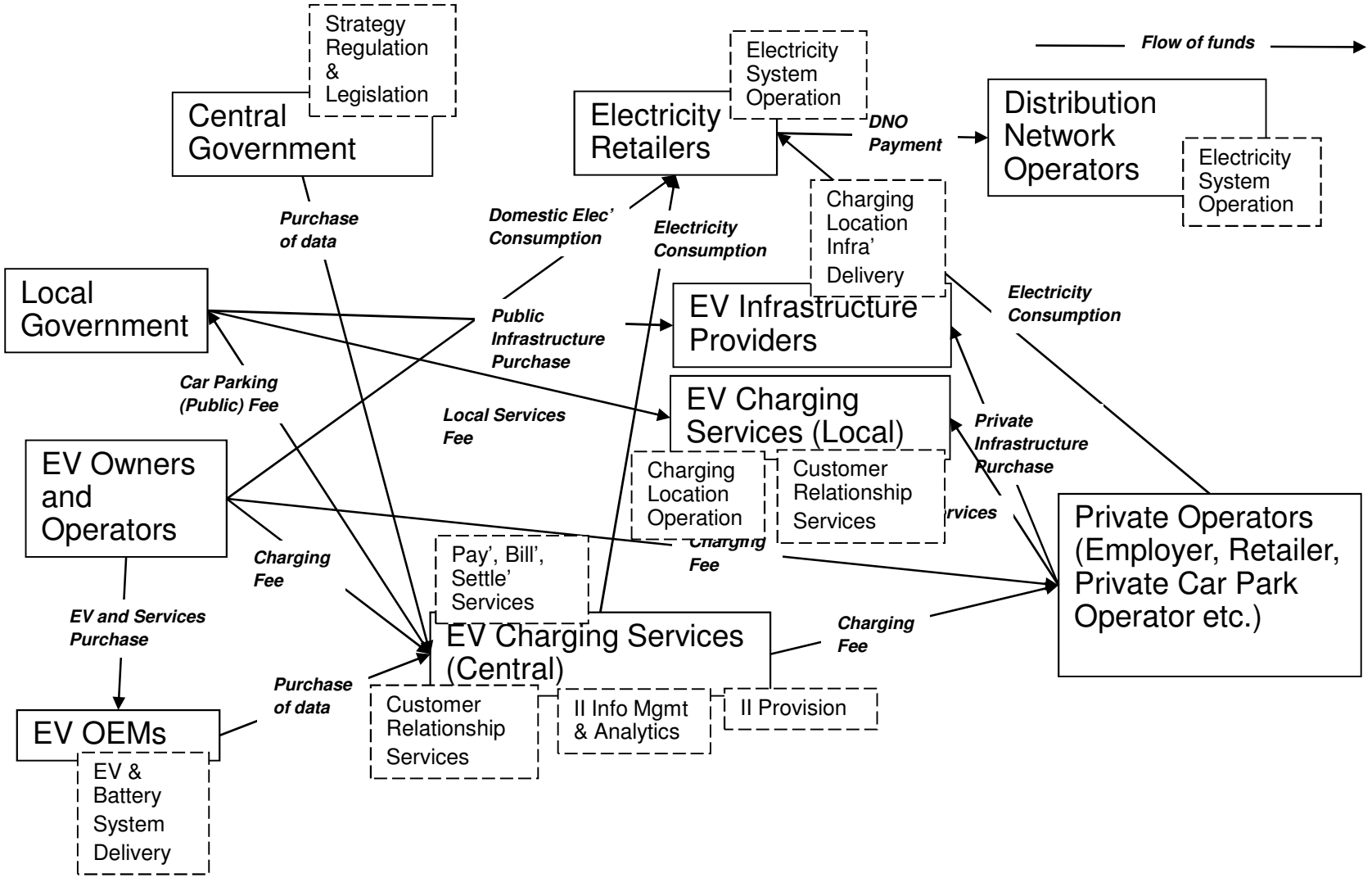

- Addresses the issues with the current physical model, including:-
  - Business model not driven by public subsidy
  - Payment for actual electricity consumed and opportunity to vary price
  - Local Government regains consumption based revenue for car parking
  - Revenue for non-domestic charging into the market is driven by charging and charging activities and not capped by scheme membership
- Other Service Providers can operate in the market providing II Information Management and Analytics Capability
- …but a number of EV Charging Services Operators emerge which may result in:-
  - Complex interactions between operators
  - Lack of agreement between operators may preclude the use of services
  - Different standards between operators add complexity
- … a sub-optimal model for promoting the development of the market – see next model

## …same with central scheme operator




- Addresses the complexity and added cost and proposes:-
  - A split between Charging Central Services, focused on Customer Relationship, Payment-Billing-Settlement, Information Management and Analytics and II Provision, and Local Services focused on Charging Location Operation (infrastructure and asset management).
- Promoting universal services, ease of payment, universal availability of infrastructure and lower costs and hence is proposed as the physical model to be assumed for the trial

# Stage 2 Scope - Physical Model – showing mapping of Business Competencies (ref. Conceptual Business Architecture SP2/IBM/16)



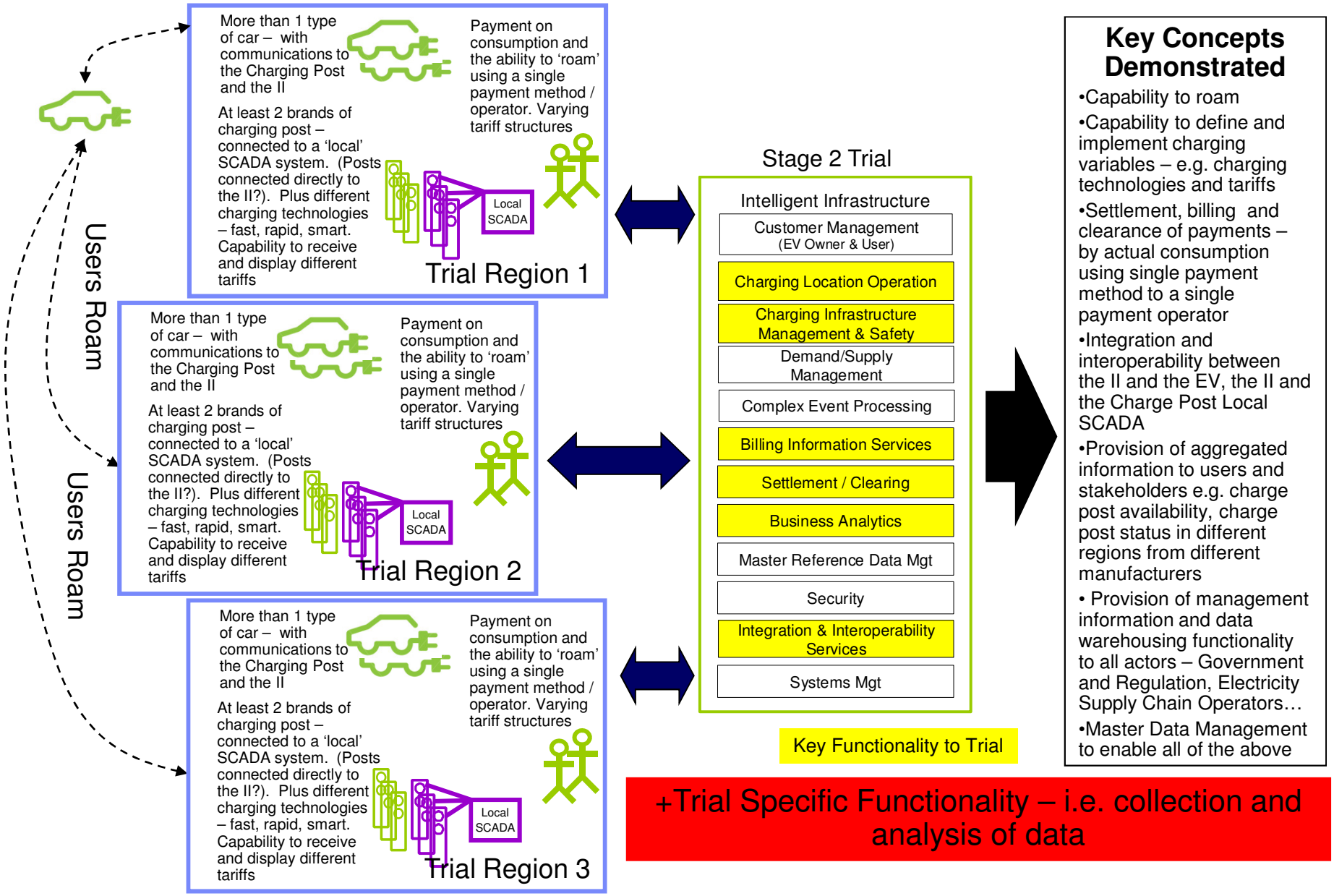
# Stage 2 Scope - What II functionality should be trialled? – Using Conceptual Functionality defined in SP2/IBM/14 – Slide 1 (of 2)

| II Conceptual Functionality (SP2/IBM/14) | Trialled in Stage 2 | Comments/Justification |
|---|---|---|
| **Customer Management** | As a consequence of trialling other functionality | Will be trialled as a consequence of trialling other functionality – e.g. billing and payment which will require master data to be held on customers. Demonstrate that the customer can be owned either centrally or by local operators. |
| **Charging Location Operation** | Yes | (1) Provision of 'joined-up' information e.g. availability of charging posts across different cities can be aggregated and presented to users to a consistent standard, (2) Provision of charging variables, (including charging technologies (rapid, fast..) and varying tariff structures), can be handled consistently throughout the infrastructure - changed centrally, displayed at the charging location, billed against etc.) |
| **Charging Infrastructure Management and Security** | Yes | Data acquisition from Charging Posts and, if possible, from EVs – demonstrate the capability of the II to collect, aggregate and integrate information from OEM SCADA systems and if required individual charging posts. Demonstrate integrated end to end asset management. |
| **Demand/Supply Management** | No | Two aspects - (1)Smart Charging - how demand might be controlled in real time in response to network constraints – in the definition of the II this functionality is part of the DNO's core supply and relies on Smart Grid implementation. (2)The production of management information for use in longer term planning of Demand/Supply Management – this could be trialled. |
| **Complex Event Processing** | No | Cannot be tested end to end in Stage 2 due to lack of Smart Meters, Smart Grids and capabilities in the Electricity Supply Chain Actors – however the production of management information reports used in the Demand/Supply Management/Complex Event Processing Processes can be trialled |

# Stage 2 Scope - What II functionality should be trialled? – Using Conceptual Functionality defined in SP2/IBM/14 – Slide 2 (of 2)

| II Conceptual Functionality (SP2/IBM/14) | Trialled in Stage 2 | Comments/Justification |
|---|---|---|
| **Billing Information, Settlement & Clearing** | Yes | Demonstrate that the II can provide functionality to simplify user payment in a mass market. Payment by consumption to a single payment operator using a single payment method to be trialled regardless of which trial city you are in ('roaming'). |
| **Business Analytics** | Yes | Demonstrate the value of the Intelligent Infrastructure in being able to produce integrated, market wide data which can be drilled into, sliced and diced, **and, crucially, used to meet the requirements of trial specific functionality – collection and analysis of data.** |
| **Master Data** | As a consequence of trialling other functionality | Will be trialled as a result of trialling other functionality as master data is key to the operation of the system. Will demonstrate the advantages of a single voice of the truth. |
| **Security, Systems Management** | As a consequence of trialling other functionality | Included inevitably as a result of trialling other functions. Not that the ETI is keen to trial the situation where authorisation and identification is embedded in the EV, and not held as a separate key/card etc. |
| **Integration and Inter-operability** | As a consequence of trialling other functionality | Demonstrate that the II can provide integration services – infrastructure, data, information, processes - to a divergent market, and hence a very real contribution to the evolution of a self sustaining mass market. Required would be at least 2 different types of cars and charging posts, roaming users, geographically dispersed trial sites/operators. |
| **Trial Specific Data Capture Infrastructure (not in SP2/IBM/14)** | N/A (required for trial) | There will be a need to capture data during trials that may not be part of a mass-market rollout, such as vehicle tracking, data logging and trial specific analytics. For example, detailed vehicle tracking would have data privacy barriers for general rollout but might be acceptable during a trial, if users sign a disclaimer. |

# Stage 2 Scope - What II functionality should be tested? – Trial Scenario



# Stage 2 Scope – Intelligent Infrastructure - High Level Plan – Outline and Construction

A plan for Stage 2, which delivers elements of the Intelligent Infrastructure for trialling – consists of four phases as outlined below

| Phase Name | Pre-Contract | Analyze and Define | Design and Build | Implement and Operate |
|---|---|---|---|---|
| Phase Purpose | 'Setting the parameters for delivery', by defining the high level scope of work, selecting the contractual partners and sealing contracts | Analyzing and defining what the system needs to do and how it will do it. Agreeing detailed requirements with other contracted stakeholders e.g, Charge Post, EV OEMs | Designing, building and testing the system, including integration testing with other contracted partners | Acceptance of the system, implementation into operation for the period of the trial |
| Phase Deliverables | Request for Proposal (RFP), Responses to RFP, Signed Contracts | Functional & Interface Specs' – (including Business Processes, Use Cases), Macro Design – Application Architecture, Technical Architecture | Program Specs, Configuration Specs, Code, Config, Test Specs, Environment Build, Testing | Acceptance Testing, Tested System, Handover to Trial Support Activities |
| Phase Duration (as a rough %tage of Overall Plan) | 30% | 20% | 30% | 20% |

# Stage 2 Scope – Intelligent Infrastructure – High Level Plan – Initial scoping of work across all physical layers (part 1)

| Physical Layer | EV<br>Supplied by ETI Stage 2 | Charging Asset<br>*Possibility of supply by 'Plugged-In Places'?* | Charging Supervisory<br>City of Westminster<br>Charging Location Operator<br>*Possibility of supply by 'Plugged-In Places'?* | II Central<br>Systems supplied by ETI Stage 2 |
|---|---|---|---|---|
| By Functional Area, what works needs to be done, in outline, at each physical layer as part of the ETI Stage 2 Project, in order to trial the proposed functionality (see above)? | | | | |
| Customer Management – *Hold customer details at 2 levels, master at either level.* | - | - | CM1 - Interface between existing Customer Management Systems at this layer & the II | CM2 – Customer Services Manager implementation<br>CM3 – Interface to Supervisory Level – matching CM1 |
| Charging Location Operation – *Provision of joined-up information, provision of charging variables* | - | CL4 – Implementation of functionality to allow charging asset to display and process charging variables esp. varying tariff structures<br>CL8 – Interface to allow charging asset to receive/send charging variables | CL1 – Interface between existing Operational Systems & the II<br>CL5 – Interface for upload and download of charging variables to/from II | CL2 – Charging Location Manager implementation<br>CL3 – Interface to existing Operational Systems – matching CL1<br>CL6 – Charging Activity Manager implementation<br>CL7 – Interface for Charging variables download/upload – matching CL5 |
| Charging Infrastructure Management & Security – *Data acquisition from EVs (if possible) and Charging Assets* | CI1 – Interface to allow EV to communicate with the Charging Asset and send/receive data | CI2 – Interface to match CI1 | CI3 – Processing, storage and Interface to allow CI1/CI2 data to be sent to II<br>CI5 – Interface for upload of data acquired from Charging Assets from existing SCADA system | CI4 – Receipt, storage, processing and display of EV related data – matching CI1/2/3<br>CI6 – Receipt, storage, processing and display of SCADA data – matching CI5 |
| Clearing, Billing, Payment and Settlement – *Payment by consumption to a single payment operator using single payment method* | | P1 – Upload of charge activity data for billing purposes – duration, tariff | P2 – Receipt, storage, processing and upload of charging activity data – matching P1 | P3 – Implementation of Clearance /Settlement /Payment /Billing Managers<br>P4 – Receipt of P1/P2 data, and onward processing using P3 |

# Stage 2 Scope – Intelligent Infrastructure – High Level Plan – Initial scoping of work across all physical layers (part 2)

| Physical Layer | EV<br>**Supplied by ETI Stage 2** | Charging Asset<br>***Possibility of supply by 'Plugged-In Places'?*** | Charging Supervisory<br>City of Westminster<br>Charging Location Operator<br>***Possibility of supply by 'Plugged-In Places'?*** | II Central<br>**Systems supplied by ETI Stage 2** |
|---|---|---|---|---|
| By Functional Area, what works needs to be done, in outline, at each physical layer as part of the ETI Stage 2 Project, in order to trial the proposed functionality (see above)? | | | | |
| Analytics – *Market-wide data, trial specific collection and analysis of data* | AL1 - Data logging devices in EVs to capture data regarding EV usage during the trial<br>AL2 – Interface to upload data to II Analytics | AL3 – extend existing asset functionality and interface to supervisory layer to include data needed in the trial | AL4 – receipt storage and processing of extended data – matching AL3<br>AL5 – additional functionality as needed by the trial<br>AL6 – upload of data to II of AL4 and AL5 data | AL7 – Implementation of Analytics and Reporting Managers<br>AL8 – Receipt, storage, processing of data – matching AL6<br>AL9 – Reporting and querying as required for the II operation<br>AL10 – Reporting and querying as required by the trial |
| Master Data – *Master data is key to the operation of the II* | - | MD1 – Interface to receive, process and store master data required at this layer | MD2 – Interface to upload data which is mastered at this layer<br>MD3 – Interface to receive, process and store master data required at this layer | MD4 – Implement the master reference data manager and sub-components<br>MD5 – Interface to receive, process, store uploaded data – matching MD2<br>MD6 – Interface to download data – matching MD3<br>MD7 – Population of Master Data |
| Security, System Management | SS1 – identification and authorisation and embedded in the EV | SS2 – Charging asset to recognize EV embedded authorisation – matching SS1<br>SS3 – possible extension of Security at this layer | (Assume that CM1 will upload security data of Customers mastered at this layer) | (Assume that CM3will download security related data of Customers mastered at this layer.)<br>SS4 – Implement Security Manager |
| Integration and Interoperability | | | | II1 – Implement Integration Manager (used to deliver all of the above interfaces) |

# Stage 2 Scope – Intelligent Infrastructure – High Level Plan – Summary of Initial Scoping of Work by Delivery Organisation

To deliver an Intelligent Infrastructure for the Stage 2 trial providing the functionality outlined, the following delivery organisations would need to be engaged on the project working under the control of an overall Lead Systems Integrator, who would be responsible for the end-to-end integration of the solution

## EV OEM(s), delivering:-

- Interface from the EV to a Charging Post, sending EV performance and diagnostics data
- Data logging in the EV to capture EV usage data for the trial and an interface to the II to send the data
- Investigate & implement the embedding of identification and authorisation in the EV

## Charging Asset OEM(s), delivering:-

- Interface between the supervisory-layer Customer Management System (if exists) and the Central II Customer Management System
- Functionality & interfaces to enable charging variables to be implemented
- Interface to the Central II for EV data
- Interface to the Central II for operational & SCADA data
- Functionality, & interface to the Central II, for Charging Activity Data
- Functionality & interface to the II to capture trial specific data
- Functionality & interfaces to implement consistent Master Data across the II
- Functionality & interfaces to implement additional security as required

## Intelligent Infrastructure Lead Systems Integrator, delivering:-

- Customer Services Manager implementation & interfaces
- Charging Location Manager implementation & interfaces
- Charging Activity Manager implementation & interfaces
- Interfaces and Processing for EV and Charging Asset SCADA related data
- Settlement & Payment Manager and interfaces
- Analytics Manager implementation & interfaces
- Master Data Management implementation & interfaces
- Security Manager implementation
- Additional portals and common/core services as required to support the functionality – Integration Manager, Reporting Manager
- Infrastructure as required for the Central II Layer
- Overall end-to-end integration

NOTE: Common/Core Services and Infrastructure which are adequate for a trial and which may not have full production strength – in particular may not meet non-functional requirements specified for a production system.

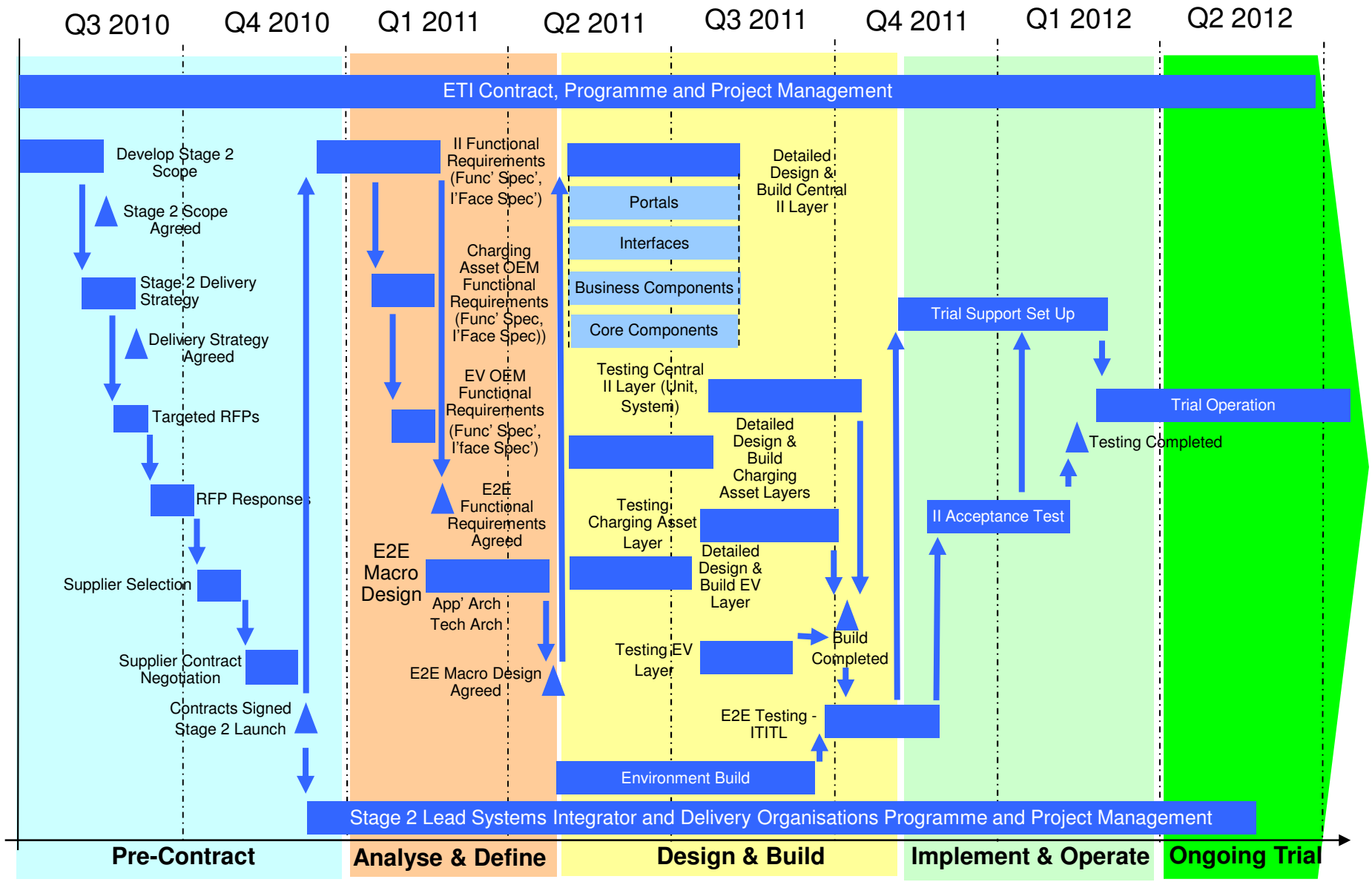
# ETI EV Work Package 2.4

# EV Intelligent Infrastructure

# SP2/IBM/20 Plan for Architecture Realisation

# Stage 2 Plan on a Page

# Intelligent Infrastructure – Stage 2 High Level Plan on a Page



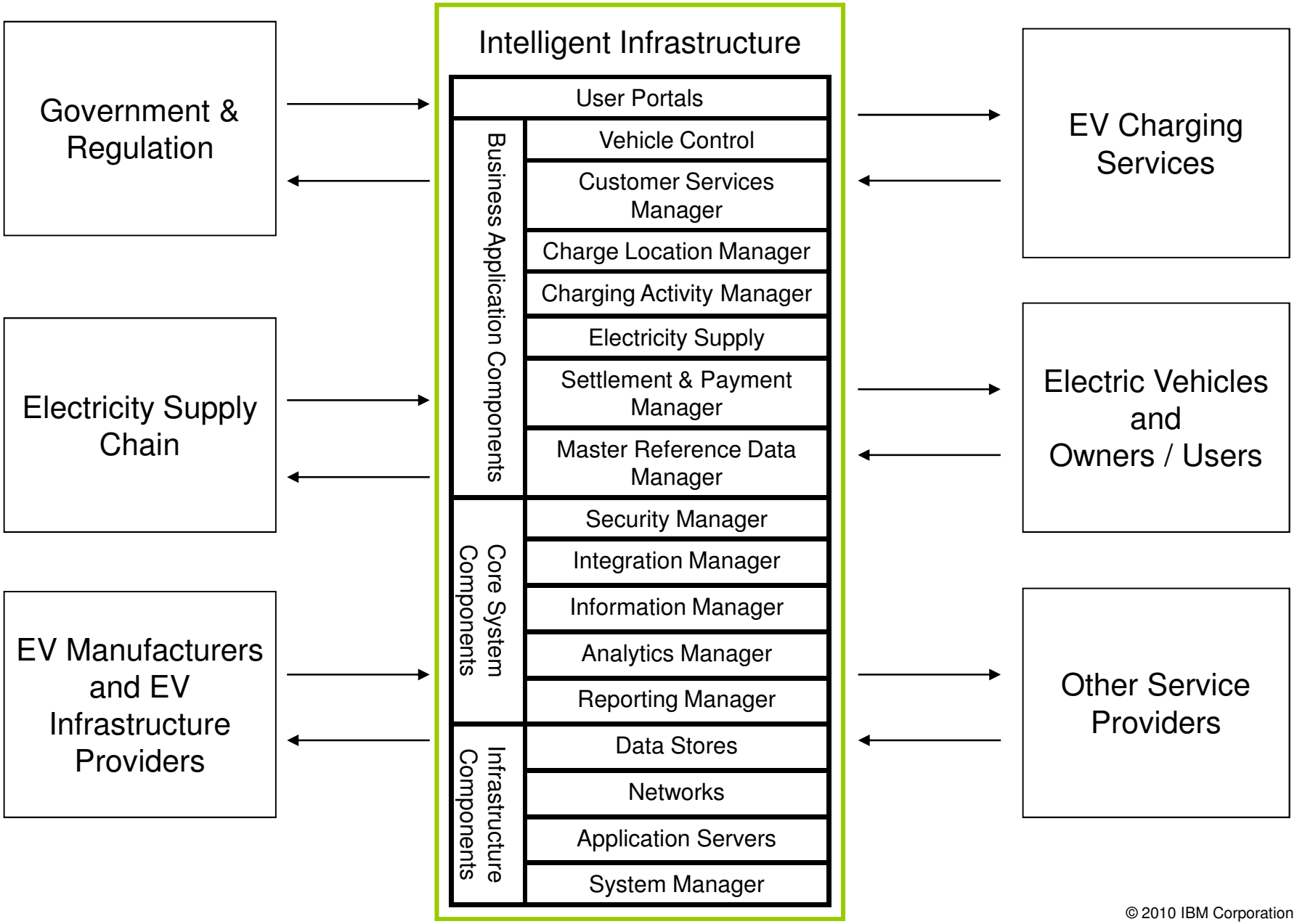
ETI EV Work Package 2.4

EV Intelligent Infrastructure

SP2/IBM/20 Plan for Architecture Realisation

# Intelligent Infrastructure Components
(from the Conceptual Application Architecture Deliverable)

# ETI EV Intelligent Infrastructure Component Model (Level 0) from SP2/IBM/17



# Intelligent Infrastructure Component Description – Level 0

| Component Name | | What it does | What it is | Where it resides (- see below) |
|---|---|---|---|---|
| User Portals | | Access for II Actors to relevant functionality | Bespoke design and build using **C**ommercial **O**ff **T**he **S**helf (COTS) Portal Development Tools | All layers of the II. |
| Business Application Components | Vehicle Control | Provides telemetry, diagnostics, EV configuration and state functionality | Bespoke design and build, COTS SCADA, and developed standard for EV<> II communications | All layers of the II. |
| | Customer Services Manager | Customer Account and Contact Management | COTS package – CRM, Account Management | Charging Supervisory Layer and II Central Layer |
| | Charging Location Manager | Location Viewer, Status Manager, SCADA, Communication, Booking and Asset Management | COTS SCADA 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 | Charging Variables, Activity Monitoring | COTS SCADA, together with bespoke development | Charging Asset Layer, the Charging Supervisory Layer and Central Intelligent Infrastructure Layer |
| | Electricity Supply | Electricity Supply Demand Manager | 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 | Settlement, Clearing, Billing, Payment, Fraud Services | Bespoke configuration using COTS application, relying on feeds of data for consumption, tariffs and contractual agreements | Charging Asset Layer, the Charging Supervisory Layer and Central Intelligent Infrastructure Layer |
| | Master Reference Data | Master Data – e.g. Locations, Assets, Charging Variables etc. | COTS and bespoke data models, bespoke configuration, data loading, interfaces | Charging Asset Layer, the Charging Supervisory Layer and Central Intelligent Infrastructure Layer |
| Core System Components | Security Manager | 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 | 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 the above | COTS System Management | All layers of the II |

# The Intelligent Infrastructure – Illustrative Deployment of Component (Physical Model)

| EV Layer | Charging Asset Layer | Charging Supervisory Layer | II Central Layer |
|---|---|---|---|
| | | City of Westminster Charging Location Operator | |
| User Portals | User Portals | User Portals | User Portals |
| | Vehicle Control | | |
| | | Customer Services Manager | |
| | | Charging Location Manager | |
| | | Charging Activity Manager | |
| | | Electricity Supply | |
| | | Settlements and Payments Manager | |
| | | Master Reference Data Manager | |
| Security Manager | | Security Manager | |
| | Integration Manager | | |
| | | | Information, Analytics, Reporting Managers |
| | | Data Stores | Data Stores |
| | Networks, Application Servers, System Manager | | |

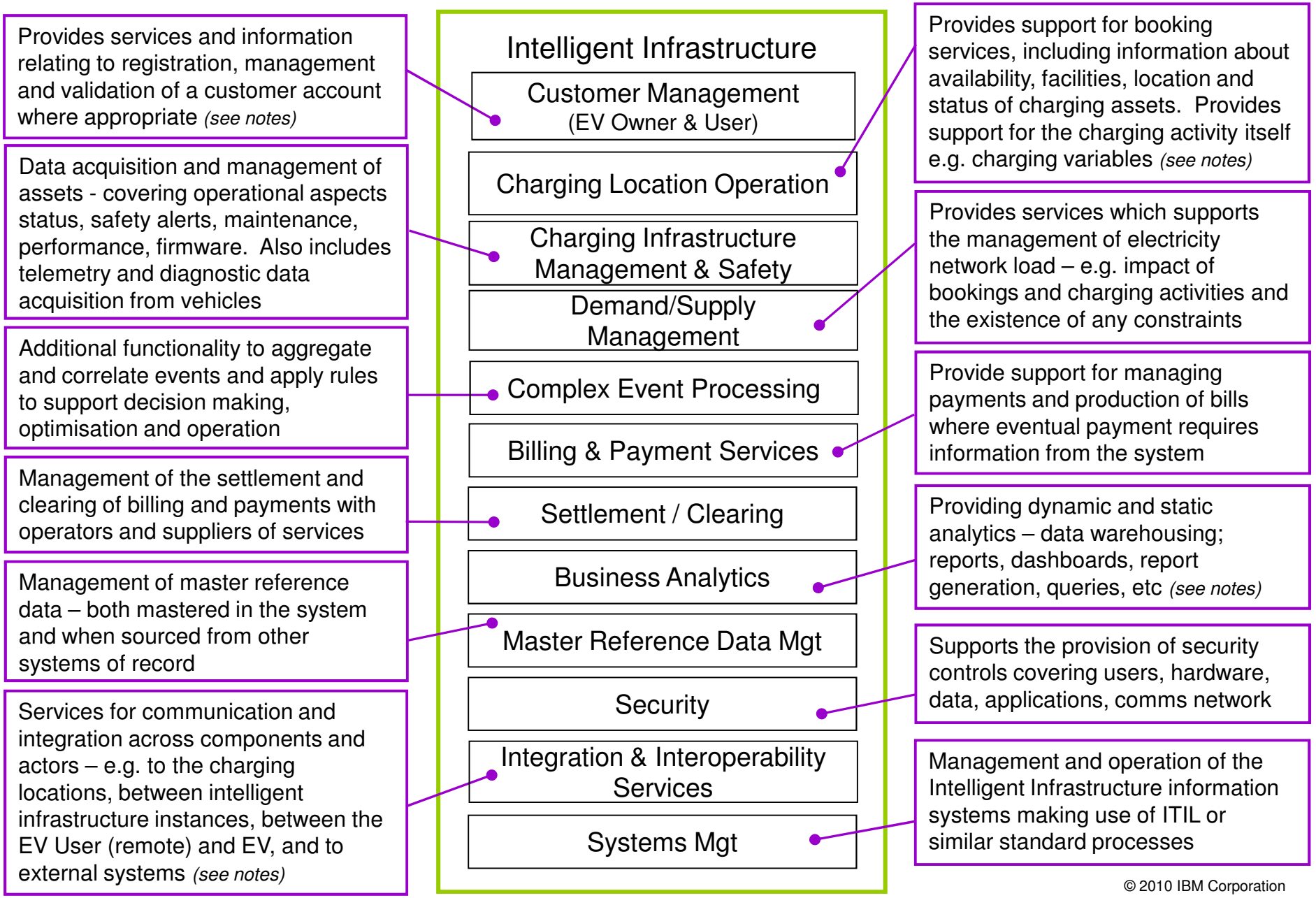
# ETI EV Work Package 2.4

# EV Intelligent Infrastructure

# SP2/IBM/20 Plan for Architecture Realisation

# Appendix

# EV Intelligent Infrastructure – Conceptual Functional Description



# *Capability View* of the Component Business Model for the EV Market (relevant to the Intelligent Infrastructure) from SP2/IBM/16