FABRIC

Feasibility analysis and development of on-road charging solutions for future electric vehicles

ICT Needs and Solutions

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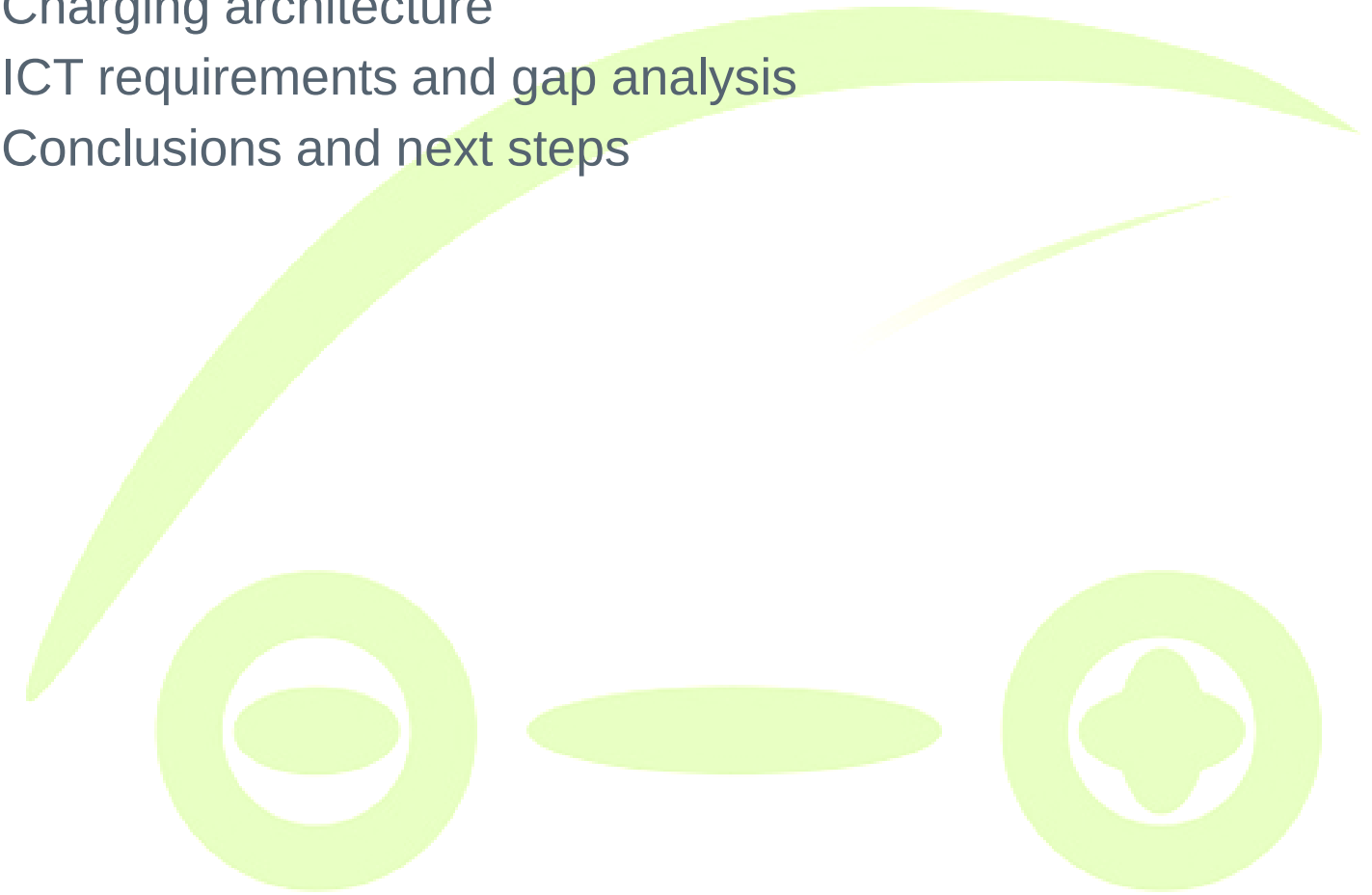
Agenda

1. Electric Vehicle charging modes in FABRIC
2. Charging architecture
3. ICT requirements and gap analysis
4. Conclusions and next steps



Electric vehicle charging modes

Static charging

- Typically over 5 minutes duration, at an off-road location
- Vehicle motor switched off, driver presence not necessary except to verify start of charging

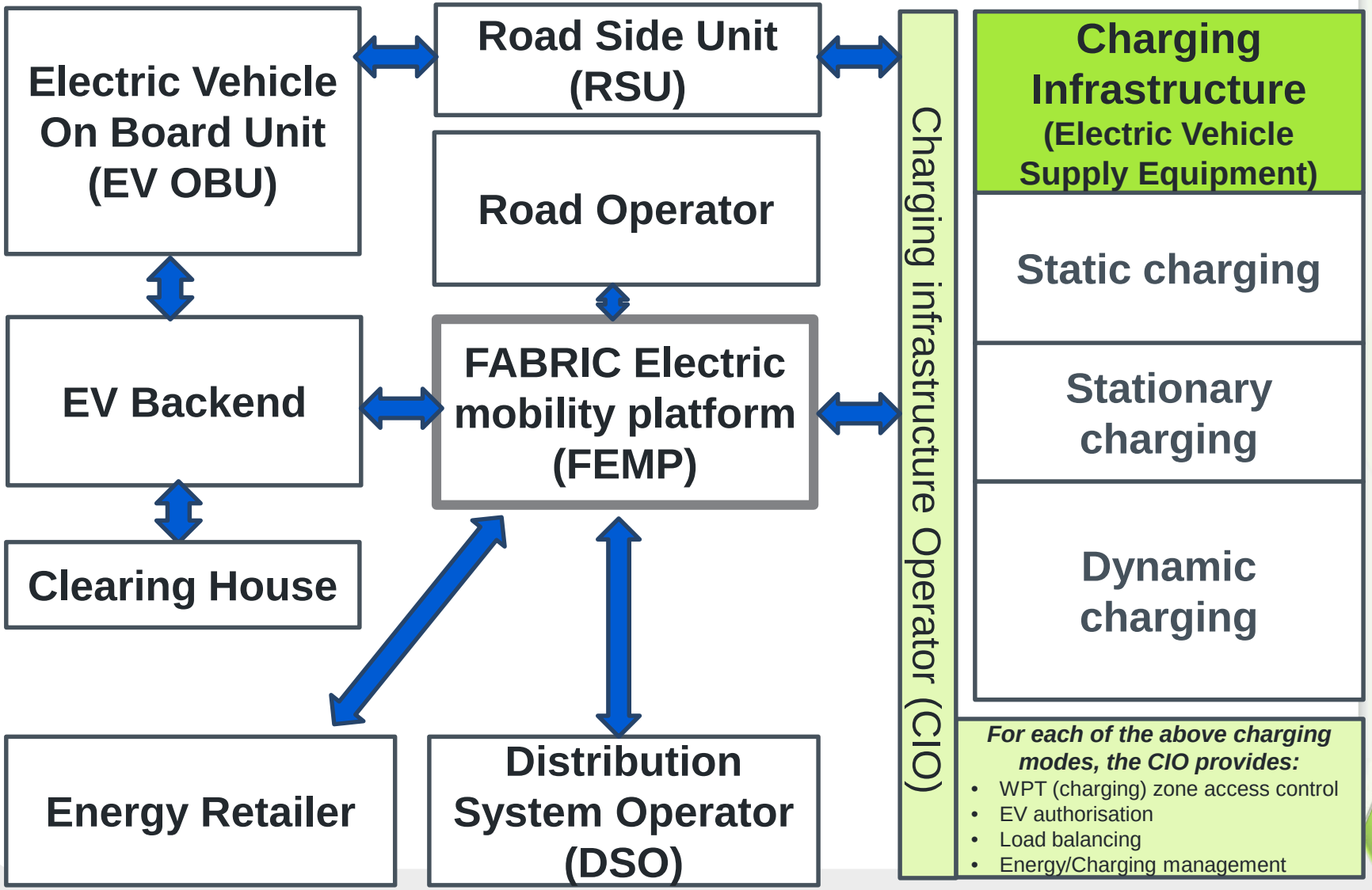
Stationary charging

- Typically under 5 minutes duration, on road (or roadside)
- Driver is present and vehicle motor may be on or off

Dynamic charging

- Charging time depends on vehicle speed and dimensions of the charging infrastructure: perhaps several seconds, almost certainly under 1 minute
- Vehicle is being driven either in a shared traffic lane or a dedicated lane
- With wireless charging, several pads will be needed in order to provide sufficient charge to a moving vehicle

Charging Architecture



ICT Requirements - Functionalities

FABRIC listed 31 functionalities grouped into 6 categories:

	Category	Number of functionalities
A	User accounts, booking and billing	5
B	Dynamic routing for EVs	10
C	Vehicle identification, charging lane access control and management/ enforcement	3
D	ICT control of Wireless Power Transfer	2
E	Driving assistance while charging	1
F	Distribution Supply Operator (DSO) and grid management	10

Ref: FABRIC Deliverable 2.2.1: User needs, system concept and requirements for ICT solutions

ICT Requirements - Functionalities

Requirements were given for a projected future system concept in the year 2030+

Priority of functions:

- 23 High (essential)
- 5 Medium (important, but not essential for an early prototype)
- 3 Low (nice to have)

ICT Requirements - Example

Function Class A: User accounts, booking and billing

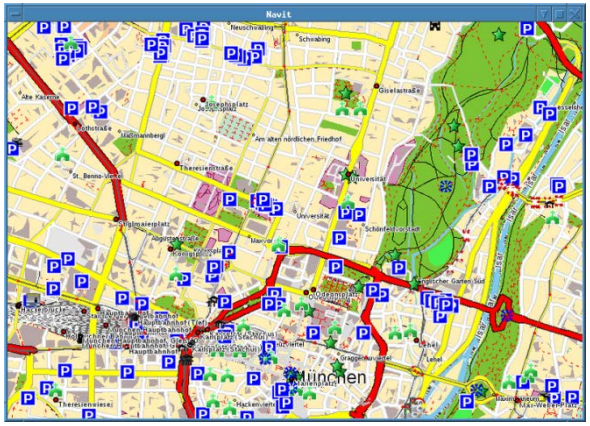
ID:	A2: BOOKING
Name	FABRIC Charging Infrastructure Booking
Goal	Users should be able to book a lane (or stationary charging spot), including up to immediately before use
Description	… *(described in D2.2.1)*
Priority	High
Related use cases from FABRIC D4.3.1	#1.2: Logging in to FABRIC interface (end users) #1.6 : Emergency charging #6.1: Dynamic route and booking management
Validation criteria	Rapidity of handling bookings. Reliability of handling booking from OBUs in other areas (interoperability)
Acceptance criteria	Client satisfaction
Related FABRIC sub-systems	Handled by EV OBU, and transmitted via EVB to FEMP

ICT requirements – 1
User accounts, booking and billing

- Account creation and eligibility
- Account should allow driver to use charging stations of different operators and in different countries
- A booking system would enable charging station operator to meet demand
- Need to take into account the difference between transmitted energy and energy that is actually received by the vehicle
- Gaps:
  - If booking is necessary, need a mechanism to take into account delays in reaching the charging infrastructure
  - Billing process: no contact with driver + energy gap

ICT requirements – 2
Dynamic routing for EVs

- Itinerary choice
- Charging infrastructure location and availability
- Low charge warning and routing to closest charging infrastructure
- Charging location choice
- Trip timing
- Saving preferences
- Gaps:
  - Existing navigation systems meet essential requirements: Itinerary choice, locating infrastructure, route calculation
  - Future requirement: Real time availability and pricing info



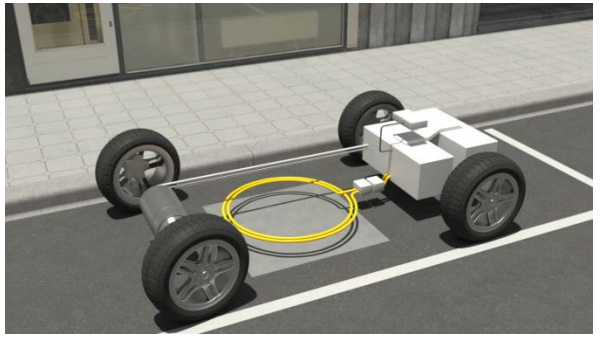
ICT requirements – 3
EV identification, lane access control and management / enforcement

- Speed of identification & authorisation for dynamic charging should be much faster than for static charging
- Need a mechanism to take into account delays in reaching the charging infrastructure for booked vehicles

- Access to lane could be controlled (traffic signals or barriers), possibly with camera enforcement, or free access (all vehicles)
- Gaps:
  - Current detection technologies are ANPR and DSRC
  - In-lane guidance can be provided by Lane Control Signals, VMS, on-board HMI: Common symbols and signing strategies needed

ICT requirements – 4
ICT control of Wireless Power Transfer

- Smart metering:
  - May be energy transferred from the road (in which case off-vehicle metering would be required)
  - or energy received by the vehicle (on-board metering) – then needs to take account of energy loss.



- Emergency cut-off function
- Gaps:
  - Challenge for accurate metering:

    The higher the speeds and traffic densities, the more difficult it is to meter energy use accurately

    Affects customer billing

ICT requirements – 5
Driving assistance whilst charging

- Provision of information on approaching and activating charging, including pricing
  - On-board unit: needs to minimise driver distraction
- Trajectory and speed advice:
  - FABRIC not looking at automated driving, but this could be a future scenario

- Gaps:
  - Several Advanced Driver Assistance Systems (ADAS) and automated vehicle control applications have the potential to fulfil the requirements (Open and Closed systems)
  - Adaptive Cruise Control (ACC), Intelligent Speed Adaption (ISA), Lane Departure Warning (LDW)

ICT requirements – 6
Distribution Supply Operator (DSO) and grid management

- Maintain distribution system balance, need direct control strategies and intelligent distributed algorithms
- Direct load control: centralised modules that collect aggregate charging information from EVs and assign optimised energy schedules
- Optimisation strategies can be formulated, e.g. based on energy supply availability: smart pricing schemes
- Gaps:
  - Charging service must be strictly provided in-time while a given vehicle is on the charging lane
  - Need a decision on actual metering deployment (on- or off-board)
  - Standardisation needs

Conclusions

- Dynamic charging needs ICT solutions
- Requirements and use cases identified in FABRIC project:
  - See “Downloads” section of www.fabric-project.eu
- The state-of-the-art of ICT solutions meets some of the requirements of dynamic charging
- Main gaps are in ICT for the wireless power transfer, EV identification, billing and booking
- ICT solution interoperability is a key requirement for European roll-out of dynamic electric charging: both technical compatibility and institutional interoperability

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Thank you!

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