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
For each of the above charging modes, the CIO provides:
- WPT (charging) zone access control
- EV authorisation
- Load balancing
- Energy/Charging management

Charging Architecture

- Electric Vehicle On Board Unit (EV OBU)
- Road Side Unit (RSU)
- Road Operator
- FABRIC Electric mobility platform (FEMP)
- Charging Infrastructure Operator (CIO)
  - Charging Infrastructure (Electric Vehicle Supply Equipment)
    - Static charging
    - Stationary charging
    - Dynamic charging
- Energy Retailer
- Distribution System Operator (DSO)
- Clearing House
## ICT Requirements - Functionalities

FABRIC listed 31 functionalities grouped into 6 categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of functionalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
</tr>
<tr>
<td>F</td>
<td>10</td>
</tr>
</tbody>
</table>

### Category A: User accounts, booking and billing
- 5 functionalities

### Category B: Dynamic routing for EVs
- 10 functionalities

### Category C: Vehicle identification, charging lane access control and management/ enforcement
- 3 functionalities

### Category D: ICT control of Wireless Power Transfer
- 2 functionalities

### Category E: Driving assistance while charging
- 1 functionality

### Category F: Distribution Supply Operator (DSO) and grid management
- 10 functionalities

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

<table>
<thead>
<tr>
<th>ID:</th>
<th>A2: BOOKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>FABRIC Charging Infrastructure Booking</td>
</tr>
<tr>
<td>Goal</td>
<td>Users should be able to book a lane (or stationary charging spot), including up to immediately before use</td>
</tr>
<tr>
<td>Description</td>
<td>… <em>(described in D2.2.1)</em></td>
</tr>
<tr>
<td>Priority</td>
<td>High</td>
</tr>
</tbody>
</table>
| 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
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
Thank you!

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