Diagnostics for Electric & Autonomous Vehicles
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Outline of Content

1. E-Mobility Market Trend & Ecosystem & Challenges
2. Opportunities for Diagnostics in E-Mobility Ecosystem
3. KPIT’s Technology Offerings for E-Mobility
Automotive sector headed towards electrification

We expect:
- 14 fold market increase to $140bn by 2020
- Global EV sales to rise from just 0.3mn cars in 2014 to 4mn by 2020 under our base case scenario

- Range anxiety should reduce due to:
  - Mass EVs offering 200 mile range – Bolt, Tesla M3 and VW e-golf in 2017
  - IHS expects global EV charging points to increase 18-fold to 18.5mn by 2021

High EV purchase subsidies in a number of countries (in EUR)

> 50 new EV models will be introduced over 2016-20

Range anxiety will reduce with increased charging infrastructure and 200 mile range for mass EVs

Reference: EV Expo Conference 2016, Presentation by Asad Farid, EBRENBERG
Global BEV/PHEV & Charging Technology Roadmap & Market Projection


**EV/PHEV roadmap milestones**

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle sales</td>
<td>7 millions</td>
<td>30 millions</td>
<td>70 millions</td>
<td>100 millions</td>
<td></td>
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<tr>
<td>Global market share</td>
<td>9%</td>
<td>30%</td>
<td>50%</td>
<td>60%</td>
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### Policy framework
- Adequate incentives for EV/PHEV purchase and production in line with targets; continuation of recharging infrastructure development in key areas.

### Vehicles/batteries
- EVs should become commercially viable without significant subsidies; support should continue for widespread expansion of recharging infrastructure.
- Fast recharging options have achieved lower costs, with batteries as well as charging infrastructure support for widespread implementation of fast recharging as needed to ensure widespread availability.
- Availability of higher power/energy-dense batteries should position policy makers to encourage remaining segments of light-duty vehicle markets to “go electric,” including greater use in larger, longer-distance vehicles.

### Codes/standards
- Batteries continue to improve; introduce new generation of batteries that significantly outperform lithium-ion at a similar cost.
- EVs achieve superiority to internal combustion engines in most respects, close the gap in driving range.

### Recharging/electricity infrastructure
- Ensure plugs and charging systems are compatible across major regions, including basic “smart metering” systems for home and public recharging stations; develop protocols for fast recharging.

### RD&D
- Establish home recharging and begin major investments in street/office/daytime commercial recharging, including rapid recharging where appropriate.

E-Mobility Ecosystem – Beyond Vehicle
Vehicle to Grid (V2G) – Energy & Communication in E-Mobility System
EV/PHEV & EVSE System Interfaces to Intelligent Transportation System

Road side system (Charging infra and RSU)
- RSU
- CCU
- AU
- Road equip gateway
- Traffic info
- Location based info
- Probe data collection

External actors
- Traffic operator
- Parking operator
- Other operator

In vehicle system
- Charging device
- HMI
- CCU
- Traveller assistance
- Navigation
- Charging
- Vehicle gateway

eCo-FEV backend
- Trip assistance
  - Charging assistance
  - Notification
  - ID management
  - Rights management
  - Infra. Data management
  - FEV data management
  - Data aggregation
  - Vehicle Relation Manag.

Energy provision
- AAA
- Charging monitoring
- EVSE availability

Service provider
- eCo-FEV data center
- ID provider

Internet

CCU: Communication Control Unit
AU: Application Unit
HMI: Human Machine Interface
ID: Identity
AAA: Authentication, Authorization, Accounting
EVSE: EV Supply Equipment
FEV: Fully Electric Vehicle
Challenges & Demands In E-Mobility Ecosystem

- Integration of vehicle with energy power grid and infrastructure network.
- Complex connectivity via IoT among all the E-Mobility actors (Energy provider, vehicle OEM, services, traffic management, driver, and payment system etc.)
- Continually evolving international & regional standards
- Functional safety compliance demands (ISO 26262)
- Cyber security demands for secured information and safety
- Continued OBD II compliance for PHEV & HEV electrified powertrain system
- High quality and reliability requirements
- Complexity of vehicle architecture and variants management
- Over the Air Flash (OTA)
- Complex service diagnostics
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Opportunities and Demands for Diagnostics in E-Mobility Ecosystem

Diagnostics service and data are needed by all the actors in the E-Mobility ecosystem

Diagnostic Data Analysis/Synthesis are needed by
- Engineering development and product design to continuously improve product reliability, safety and drivability
- Energy providers to manage energy demands intelligently
- Urban Planning: Traffic and Road and Charging infrastructures planning and management
- OEMs EOL configuration and calibration
- Vehicle after sales services & maintenance
- Fleet management for delivery vehicles, buses and drive share services, etc.
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KPIT Technologies Aligned with E-Mobility Trends

**Electrification & Fuel Efficiency**
- Electrified Powertrain Systems Engineering & Functional Safety & V&V
- Emb. SW Development for e-mobility System

**Connectivity**
- OBITS Intelligent Transport System
- KIVI KPIT In Vehicle Infotainment Platform
- Konnect Shrink wrapped connectivity platform for Pass Cars and Bikes

**Autonomous Driving**
- Vehicle architecture/ Systems definition / Functional safety
- Camera based Algorithms, Validation Tools
- Vehicle Control Algorithms

**Consumer experience**
- **Digital transformation** in customer engagement and commerce journey
- Rolling out SAP/ Oracle/ ERP implementations
- OTA/ Diagnostics/ Prognostics/Connectivity Tech/PLM

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KPIT’s Offerings for EV Charging & Charging Communication

**KPIT Product Offerings**

- **Software Package**
  - ISO 15118 & DIN 70121 Based V2G Communication stack with AUTOSAR stack
  - GB/T 27930 DC charging communication stack

- **Product Design Platform**
  - Stand Along EVCC Communication ECU HW & SW Design
  - 22KW Off Board Fast DC Charger ECU HW & SW Design
  - DC Fast Charging EVSE Gateway ECU (ISO 15118 CCS to GB/T 27930) HW & SW Design
  - Test Case Suite Automation Suite for ISO 15118 Part 4 & Part 5 & DIN 70121
  - Test Case Suite Automation Suite for GB/T 27930

**KPIT Engineering Service Offerings**

- Master Control Board HW Design for Integrated OBC/DCDC/PLC
- Software Architecture & Design for integrated OBC/DCDC/PLC Microcontroller
- AUTOSAR BSW & Application Software Integration
- Software Unit Testing & Integration Testing
- Conformance Testing to ISO 15118/DIN 70121 or GB/T 27930 & SAE J1772, IEC 61851 for CCS
- Charging Control Use Cases Functional & Fault Injection HIL Setup & Test Automation (LV & HV HIL)
- Vehicle - EVSE Interoperate ability Test (AC, DC CCS Charging)
KPIT’s Unique Position for E-Mobility – Synergy of Technologies

- Autonomous Driving System operation requires more electrical power supply in vehicle than conventional powertrain vehicle. Therefore, OEM’s plans ADAS implementation for electrified vehicles.
- Fully automated driving requires connectivity capability for dynamic route & road infrastructure information.
- Electrified vehicle works more effectively in urban environment for energy management due to stop-go driving pattern.
- Diagnostics and prognostics technologies are continuously developed in all the areas in E-Mobility ecosystem.

KPIT is well positioned for technologies required in E-Mobility Ecosystem.
Thank You

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