CHAdeMO

CHAdeMO DC charging standard: evolution strategy and new challenges

Stuttgart, 16 April 2019
Tomoko BLECH
Agenda

- CHAdeMO basics
- CHAdeMO principles for evolution
- New challenges
  - HPC
  - Plug-and-Charge
  - V2X
- Summary
CHAdeMO and CHAdeMO Association

What do we do?
Association members

Our members:

420 entities
from 41 countries

And many, many more..
CHAdemo members in Europe

130
EU members

26
Countries

2015/5  2016/5  2017/5  2018/5  2019/4
CHAdEMO charger points in Europe

9 180
TOTAL

Note: as of April 2019 (preliminary)
Source: ChargeMap, EAFO, Zap-Map, NOBIL, Gireve, GoingElectric, PlugShare
CHAdEMO installation by region

Source: CHAdEMO Association, as of September 2018
# CHAdeMO: international/regional standards

<table>
<thead>
<tr>
<th>Connector</th>
<th>CHAdeMO (Japan)</th>
<th>CCS Combo1 (US)</th>
<th>CCS Combo2 (DE)</th>
<th>GB/T (PRC)</th>
<th>TESLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Inlet</td>
<td><img src="image" alt="Connector" /></td>
<td><img src="image" alt="Vehicle Inlet" /></td>
<td><img src="image" alt="Vehicle Inlet" /></td>
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</tbody>
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<table>
<thead>
<tr>
<th>Standard</th>
<th>CHAdeMO</th>
<th>CCS Combo1</th>
<th>CCS Combo2</th>
<th>GB/T</th>
<th>TESLA</th>
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<tbody>
<tr>
<td>IEC</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>IEEE</td>
<td>✓</td>
<td>✓</td>
<td>✓ (SAE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>JIS</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>GB</td>
<td>✓ (Reference)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
CHAdEMO charge points and plug-ins in Europe

Evolution of EU fast charge points (cumulative)

Cumulative European BEV sales by fast charging inlet type (2010-2017)

- CHAdEMO compatible: 41%
- CHAdEMO
- CCS
- Tesla SC
- AC Fast

Share (%)*

Source: EAFO, JATO, EV-volumes.ocm; BEVs only

*Total does not include non fast-chargeable BEVs (17%)
GLOBAL FAST-CHARGEABLE BEV INLET SHARE

2.4M BEVs
Cumulative 2008-2018

- CHAdeMO: 22%
- GB/T: 37%
- CCS: 13%
- Type-2 AC: 6%
- Tesla SC: 22%
- 44% CHAdeMO compatible

Source: EV-volumes.ocm; BEVs only, excluding non fast-chargeable BEVs (33%)
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CHAdeMO principles for evolution

- Adaptation (as flexible as possible)
- Backward compatibility
- Core values
Adaptation (as flexible as possible)

DC charge at home/office
(6-10kW)

Enhanced V2X Functionality

Battery as energy device
• Peak cut
• PV connection
• VPP participation
• Resilience
• Leisure

High Power Charging
(50kW+)

Varied charge options

More varied charging
(22kW, 50kW, inductive, smart charge..)
• Full charge
• Top-up
• During stay
• Low Power (low cost)
• Charge guided by AI

Battery capacity

- 60kWh
- 40kWh
- 30kWh
- 24kWh
- 16kWh
- 10.5kWh
- 9kWh
Backward compatibility

CHAdeMO 0.9

62.5kW (125A x 500V)

1.0

200kW (400A)

1.1

1.2

CHAdeMO 2.0

400kW (1kV)

Fully backward compatible
Core values: safety, CAN, interoperability

New techno
High power/voltage, V2X, PnC, Smart Charging...

Compliant variants

CHAdeMO Core
Safety / Communication protocol / Certification...

Regional variants

CHAdeMO (THE ORIGINAL)
Next-gen ultra-fast protocol: harmonisation with GB/T

**New protocol**

- Target 900kW (600A x 1.5kV)

- Co-development with CEC (China Electricity Council)

- For vehicles including trucks, buses and passenger vehicles, and even electric aircrafts, which require reduction of the charging time

**ChaoJi**

- New connector shape

- **Full backward compatibility** with current CHAdeMO and current GB/T (and CCS)

- Aimed for 2020

- V2X and PnC included in scope
All possible with CHAdeMO

OFFICE/HOME CHARGING

DESTINATION CHARGING

PATHWAY CHARGING

VPP 
DR via V2X

Billing Authentication PnC

High Power

Pantograph Wireless Dynamic

Vehicles of all size

- Already developed
- Development on-going
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HPC development timeline

CHAdEMO 1.2/2.0

2018
Prototype tests (JP/EU)

2019
Production connection tests

2020
HPC: specs and roadmap

**CHAdemo**

<table>
<thead>
<tr>
<th>Current</th>
</tr>
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<tbody>
<tr>
<td>0A</td>
</tr>
<tr>
<td>125A</td>
</tr>
<tr>
<td>200A</td>
</tr>
<tr>
<td>400A</td>
</tr>
<tr>
<td>600A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9/1.0/1.1 62.5kW</td>
</tr>
<tr>
<td>CHAdemo 1.2/2.0 200-400kW</td>
</tr>
<tr>
<td>3.0 ChaoJi-2 900kW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GB/T</th>
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<tbody>
<tr>
<td>187.5kW</td>
</tr>
</tbody>
</table>

**New GB/T ChaoJi-1**

- 900kW
  - (600A x 1.5kV)

**ChaoJi key points:**
- Control-pilot circuit harmonised with new GB/T and CCS (and IEC 61851-23-1)
- Backward compatibility with CHAdemo, GB/T and (potentially) CCS
- Simple, light and compact connector
- Future proof covering currents up to 600A with liquid-cooling
- V2G and PnC ready
- Optional combo-style inlet integrating AC type-1, -2 and GB/T-AC

Harmonisation 2020/2021
**HPC: challenges and potential solutions**

<table>
<thead>
<tr>
<th>Charger</th>
<th>CHAdeMO R4~2.x</th>
<th>GB/T-2011 or 2015</th>
<th>CHAdeMO 3.0 (ChaoJi-2)</th>
<th>New GB/T (ChaoJi-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAdeMO R4~2.x</td>
<td>OK</td>
<td></td>
<td>Use adapter</td>
<td>Use adapter</td>
</tr>
<tr>
<td>GB/T-2011 or 2015</td>
<td></td>
<td>OK</td>
<td>Use adapter</td>
<td>Use adapter</td>
</tr>
<tr>
<td>CHAdeMO 3.0 (ChaoJi-2)</td>
<td>Use CHAdeMO-ChaoJi dual charger</td>
<td></td>
<td>OK</td>
<td>OK</td>
</tr>
<tr>
<td>New GB/T (ChaoJi-1)</td>
<td>Use GB/T-ChaoJi dual charger</td>
<td></td>
<td>OK</td>
<td>OK</td>
</tr>
</tbody>
</table>

- New ChaoJi EVs will be able to charge with the existing CHAdeMO and GB/T chargers using an ‘inlet adapter’.
- Existing CHAdeMO and GB/T EVs are **not allowed** to use any adapters, so they will need to use the dual chargers during the transition period.
- Backward compatibility with CCS is also technically possible, detailed specification is under consideration.

Note: the amendment of IEC 61851-1 is necessary for the use of adapter
HPC/PnC development timeline

**CHAdemo1.2/2.0**
- 2018: Prototype tests (JP/EU)
- 2019: Production connection tests
- 2020: Prototype tests (PRC), Prototype tests (JP), Publication, EU TF discussions, Proposal to Specs WG

**ChaoJi-2**
No PnC: DC fast charging

- Start/endsession
- Card verification, parameters
- Billing status
- Charge start / end time
- Charge quantity

SA: Secondary Actors
- Charge point operator (CPO)
- Electric power company
- Distribution system operator (DSO)
- Automaker (OEM)
- Credit card company
- …
PnC: how it works

CCS PnC (15118 Ed1)

CHAdeMO PnC (CHAdeMO2.0)

ISO/IEC15118

TCP/IP

XML Protocol

EVSE

TCP/IP

Primary Actor

TCP/IP

XML Protocol

EVSE(DC)

Secondary Actor

TCP/IP

XML Protocol

EVSE

EV/PHEV

EV/EVSE Functions

- Start/End session
- Card verification
- Billing status / details
- Charge status

- Certificate update
- Cable check
- Current demand
- ...
V2X: how it works

Typically up to 10kW

V2X protocol
V2X products in the market

V2V (Vehicle)

V2L (Load)

V2H (Home-off Grid)

V2G/B/H (Grid)
V2X Market trend: multi-source systems

Multi-source system for homes

Large-scale multi-source system

Source: Nichicon

Source: TU Delft and Last Mile Solutions, PRE Power Developers
V2X Challenges

**Technology**
- Technically “proven”
- Further reduction of hardware price / weight needed, while maintaining DC output power quality

**Regulations/Market access**
- Lack of standardised V2G grid access rules
- Technical standardisation and co-ordination

**Users**
- Low user awareness
- Further business model evaluation
- Adjacent issues e.g. insurance for battery degradation, etc.

Source: IREC-Task 28 Operating Agent; Everoze & EVConsult; CHAdeMO interviews
Summary

- **CHAdeMO’s ABC**
  - Adaptability, **B**ackward compatibility, **C**ore values
    (CAN / safety / interoperability, low impact to the grid)

- **Prescribe the minimum**
  - Leave the rest to the market, especially communication

- **Collaborate**
  - … including harmonisation
  - And evolve with the market

THANK YOU!
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