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LES
LICENSING EXECUTIVES SOCIETY INTERNATIONAL

LESI 2023 MONTRÉAL

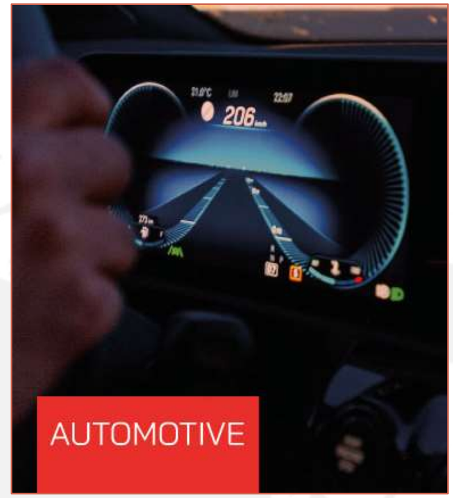
INTERNATIONAL ANNUAL CONFERENCE 30 APRIL-2 MAY

EV Solutions – Connected, Green and Secure

And the IP that supports them.

May 1, 2023

LESI Thought Leadership Program
Track 2



<u>2023 Roll-Out Plan</u> – Session Topics:

- <u>January 24</u> – Connected Vehicle and 5G
- <u>February 9</u> – EV Fast Charging, Smart Grid and Vehicle Range
- <u>March 16</u> – Self Guided Vehicles – What's Happening/What's Next?
- <u>May 1</u> – LESI 2023 Annual Conference (Montreal, Canada)
    - EV Solutions and Grid Readiness

More information:
www.lesi.org/thoughtleadership

Today's Panel

Moderator – John Carney – Chair LESI Auto Industry Advisory Board

Panelists

- **Christopher Ralph** - Manager of Energy Infrastructure and Sustainable Mobility – **The Lion Electric**
- **Jeff Dion** - Senior Director - Product Line Management – **Flo EV Charging**
- **Lauri Fitzgerald** – Senior VP Licensing - **Avanci**

Christopher Ralph – The Lion Electric

Manager of Sustainable Mobility Solutions

I provide electric vehicle transportation, vehicle and charging solutions including:

- back-end infrastructure like chargers, transformers, wind/solar & battery storage
- as well as V2G solutions.

Lion Electric is one of North America’s largest all-electric heavy duty vehicle manufacturers

Busses, trucks and energy services!

Jeff Dion

Senior Director of Product Management

FLO EV Charging

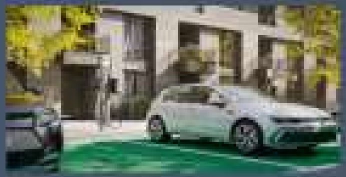
Who We Serve

Drivers
Easy access to faster daily charging

Automakers & Dealers
Rolling out EVs coast-to-coast

Cities & Municipalities
Reduce pollution and provide services for citizens

Utilities
Deliver energy, meet emissions targets, future proof grid



Apartment complexes
Delivering site differentiation and value

Retailers & Site Hosts
Driving retail traffic by providing new amenities

Workplaces
Attract the best talent and show environmental commitment

Fleet Managers
Meeting emissions targets while reducing costs

With Avanci Vehicle, automakers can opt to take a single license on standard terms, covering patented technologies from many different companies, rather than needing to secure many licenses with individual licensors.

Laurie Fitzgerald
Senior Vice President, Avanci

- At Avanci Vehicle, Laurie has driven the expansion of the platform to cover more than 80 automotive brands and licensors responsible for the vast majority of 3G/4G cellular SEPs. She is responsible for all aspects of Avanci Vehicle operations and currently is working to build its latest program to cover the next generation of connected vehicles. Prior to Avanci, Laurie led its affiliate Teletry, licensing BlackBerry's extensive patent portfolio to smartphone and telecom infrastructure manufacturers.
- A patent licensing professional and IP attorney, Laurie has more than a decade of experience working with patent owners and product developers, spanning licensing transactions, patent acquisitions and divestitures, portfolio strategy and valuation, and patent litigation. A regular conference speaker, Laurie features in the IAM Strategy 300 list of leading IP professionals, and World IP Review's Most Influential Women in IP.

5G is a Powerful Platform to Meet the IoT Connectivity Requirements for EV Smart Charging

AVANCI

- High data rates, low latency, and high capacity to support an increasing volume of charging events
- Mobile Edge Computing (MEC) allows local processing of charging data
- Network Slicing provides a dedicated resource for charging services

5G includes Security Enhancements for IoT Connectivity

AVANCI

- Network Slicing and MEC
- More robust encryption algorithm for data
- Protection for subscriber identities
- More intelligent software and “virtual” hardware
- Detection of false base stations
- And more . . .

EV Standards - Established

- Electric vehicles must comply with existing vehicle standards for lighting, braking, occupant safety as do existing ICE vehicle
- EV Specific standards
  - Charge Plug Format (Level 1, 2, & 3 Charging)
  - Wireless Charging - **SAE J2954**
  - Communication EV to Charger – Cabled Systems - **ISO 15118-2:2014** & Wireless Charging **SAE J2847/6**

Other Standards - Being Developed

- **Open Charge Point Protocol** - an **open-source communication standard for EV charging stations** that would let operators mix and match hardware and software
- **ISO15118** international standard defining **V2G communication interfaces, tariff handling and securing communication from the EV through the charging station and on to the charging service**
- **SAE J3271** **Megawatt Charging Systems for Electric Vehicles** – (WIP) - This document describes the megawatt-level DC charging system requirements for couplers/inlets, cables, cooling, communication and interoperability. The intended application is **for commercial vehicles with larger battery packs requiring higher charging rates for moderate dwell time**. A simplified analog safety signaling approach is used for connection-detection to guarantee de-energized state for unmated couplers with superimposed high-speed data for EVSE-EV charging control and other value-added services.

EV Charging – From Slow to Fast

Charge Capability

20 Hours
120-mile range

Level 1 Chargers: Your Basic Wall Plug

Type 1 chargers are just regular wall outlets, the same thing you'd plug your phone into to charge. As you might expect, it takes a very long **time to charge an EV's battery with a type 1 charger — about 20 hours for a 120-mile charge**.
Type 1 chargers use AC (alternating current) power, and range in output from 1kW to 7.5 kW. They're also called "single-phase" plugs, and type 1 connectors are standard for EVs made in the U.S. and Japan.

3 Hours
250 + mile range

Level 2 Chargers: Found at Most Public Charging Stations

Type 2 chargers also use AC power and allow for increased charging speed due to their increased power output. These chargers deliver around **240 volts of power and can charge an EV battery anywhere from five to seven times faster than a type 1 charger**.
Type 2 chargers use a different type of plug to connect than a type 1 charger because they require a connector plug with additional wires to carry the additional power. That plug is called an SAE J1772 connector and is the standard for all EVs produced in North America as of this writing. Many EVs sold today come packaged with some kind of J1772 connector.

30 Minutes
200 + mile range

Level 3 Chargers: The Road Trip EV Charger

Type 3 chargers, also known as DC fast charging or DCFC chargers, will get you the quickest juice-up of any charging station out there. They use DC (direct current) energy, and require special plugs to connect that are different from the J1772 standard. use a different plug construction. **A type 3 charging station can get an EV's battery to around the 80 percent mark in roughly half an hour.**

CCS - Combined Charging Systems – Level #3

Combo 1 – US Version

By Mariordo (Mario Roberto Durán Ortiz) - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=115882524

A CCS1 (Combined Charging Standard 1) DC charging connector, which is used in North America. It is an extension of the J1772 standard AC charging connector.

CCS Combo 1 vehicle inlet showing the J1772 and the two DC fast-charging pins

The **Combined Charging System** (**CCS**) is a standard for charging electric vehicles. It can use **Combo 1** or **Combo 2** connectors to provide power at up to 350 kilowatts. These two connectors are extensions of the IEC 62196 Type 1 and Type 2 connectors, with two additional direct current (DC) contacts to allow high-power DC fast charging.

The Combined Charging System allows AC charging using the Type 1 and Type 2 connector depending on the geographical region. This charging environment encompasses charging couplers, charging communication, charging stations, the electric vehicle and various functions for the charging process such as load balancing and charge authorization.

Electric vehicles or electric vehicle supply equipment (EVSE) are CCS-capable if they support either AC or DC charging according to the standards listed by the CCS. Automobile manufacturers that support CCS include BMW, Daimler, FCA, Ford, Jaguar, General Motors, Groupe PSA, Honda, Hyundai, Kia, Mazda, MG, Polestar, Renault, Rivian, Tesla, Mahindra, Tata Motors and Volkswagen Group.[1][2]

Competing charging systems for high-power DC charging include CHAdeMO (Japanese), Guobiao recommended-standard 20234 (Chinese), and Tesla Supercharger (Tesla).[3]

Combo 2 – European Version

By Paul Sladen - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=61915514

Connectors: Combo 2 (left), compared to IEC Type 2 (right). Two large direct current (DC) pins are added below, and the four alternating current (AC) pins for neutral and three-phase are removed.

Typical Combined Charging System (Combo 2) vehicle inlet

Other Fast Charging Systems

- China - The **GB/T charging standard** is a set of GB/T standards, primarily in the GB/T 20234 family, for electric vehicle AC and DC fast charging used in China. The standards were revised and updated most recently in 2015 by the Standardization Administration of China.

- **Tesla Supercharger** - A Tesla Supercharger is a 480-volt direct current fast-charging technology built by American vehicle manufacturer Tesla, Inc. for electric cars. The Supercharger network was introduced on September 24, 2012, with six Supercharger stations.[1] As of December 2022, Tesla operates 40,432 Superchargers in 4,470 stations worldwide, an average of over 9 chargers per station. There are 1,772 stations in North America, 1,801 in the Asia/Pacific region, and 897 in Europe.[2] Supercharger stalls have a connector to supply electrical power at maximums of 72 kW, 150 kW or 250 kW.[3]

CHAdeMO

CHAdeMO 3.0 released: the first publication of ChaoJi, the new plug harmonized with China's GB/T

Operating under CHAdeMO communication protocol, CHAdeMO 3.0 is the first publication of the next-generation ultra-high-power charging standard, being co-developed by China Electricity Council (CEC) and CHAdeMO Association with the working name "ChaoJi." The Chinese version, operating under the GB/T communication protocol, is also planned to be released next year.

This latest version of CHAdeMO protocol enables DC charging with the power over 500kW (maximum current 600A), while ensuring the connector to be light and compact with a smaller diameter cable, thanks to the liquid-cooling technology as well as to the removal of locking mechanism from the connector to the vehicle side. Backward compatibility of the CHAdeMO 3.0-compliant vehicles with the existing DC fast charging standards (CHAdeMO, GB/T, and possibly CCS) is ensured; in other words, today's CHAdeMO chargers can feed power to both the current EVs as well as the future EVs via an adapter or with a multi-standard charger

CCS Standards - Combined Charging Systems

High-Power DC Couplers

- CCS - standard **IEC TS 62196-3-1** describes the requirements for high-power DC couplers including thermal sensing, cooling and silver-plating of contacts.[29] CharIN are investigating versions over 2 MW for electric trucks, and equipment is being tested.[30][31]

Charging communication

- Unlike the connector and inlet, which depend on the geographical location, the charging communication is the same around the globe. Generally two types of communication can be differentiated.
- **Basic signaling (BS)** is done using a pulse-width modulation (PWM) signal which is transferred over the control pilot (CP) contact according to **IEC 61851-1**. This communication is used for safety-related functions, indicating for example if the connector is plugged in, before contacts are made live (or energized) and if both charging station and electric vehicle are ready for charging. AC charging is possible using the PWM signal only. In this case the charging station uses the duty cycle of the PWM to inform the onboard charger of the maximum available current at the charging station (A pulse width of 5% indicates that HLC shall be used).
- **High-level communication (HLC)** is done by modulating a high-frequency signal over the CP contact (also known as Power Line Communication or PLC) to transfer more complex information, which may be used e.g. for DC charging or for other services such as "plug and charge" or load balancing. **High-level communication** is based on the standard **DIN SPEC 70121** and the **ISO/IEC 15118-series.**

Other EV Standards

- **SAE J2954** - **is a standard for wireless power transfer (WPT) for electric vehicles** led by SAE International. It defines three classes of charging speed, WPT 1, 2 and 3, at a maximum of 3.7 kW, 7.7 kW and 11 kW, respectively. This makes it comparable to medium-speed wired charging standards like the common SAE J1772 system
- **ISO 15118-2** - specifies the **communication between battery electric vehicles (BEV) or plug-in hybrid electric vehicles (PHEV) and the Electric Vehicle Supply Equipment.** The application layer message set defined in ISO 15118-2:2014 is designed to support the energy transfer from an EVSE to an EV. ISO 15118-1 contains additional use case elements describing the bidirectional energy transfer. The implementation of these use cases requires enhancements of the application layer message set defined herein.
- **SAE J2847/6** - **Communication for Wireless Power Transfer Between Light-Duty Plug-in Electric Vehicles and Wireless EV Charging Stations** J2847/6_202009
- **ISO 15118-20 -** is an extension of ISO 15118-2, which additionally **supports wireless power transfer (WPT)**. Each of these services can be offered using **bidirectional power transfer** (BPT) and an automatic connection device (ACD)

Additional Standards

- **Open Charge Point Protocol 2.0** - an **open-source communication standard for EV charging stations** that would let operators mix and match hardware and software. References specific reliance handling ISO 15118 certificates.
- **SAE J3271** **Megawatt Charging Systems for Electric Vehicles** – (WIP) - This document describes the megawatt-level DC charging system requirements for couplers/inlets, cables, cooling, communication and interoperability. The intended application is **for commercial vehicles with larger battery packs requiring higher charging rates for moderate dwell time**. A simplified analog safety signaling approach is used for connection-detection to guarantee de-energized state for unmated couplers with superimposed high-speed data for EVSE-EV charging control and other value-added services.

Licensing Executive Society International – Auto Industry Advisory Board

Chair – John P. Carney

John's career in the automotive business spans 40 years, with background in finance, sales, marketing, M&A and program management. He successfully completed four divestitures as a deal director during Delphi Automotive's 2005 -2009 restructuring effort. John joined the Delphi (now Aptiv) licensing activity in 2009, where he recently retired as the director of the worldwide licensing and IP monetization efforts. Since 2013, Under John's direction, the Licensing and IP monetization team at Delphi/Aptiv has completed over 60 licensing and IP related sale transactions.

John holds a BA in Accounting and an MBA in Finance from Indiana University and passed Certified Licensing Professional exam in 2013. He is currently the Chair of the Automotive Industry Advisory Board for the Licensing Executive Society International, a professional group serving over 7000 members in 32 countries worldwide. John has participated in a variety of industry-based panels of technology convergence in the Automotive market.

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John Philip Carney

Scan the QR code to add me on WeChat

Backup

GAPs in EV Standards – ANSI Summary

ANSI EVSP Roadmap of Standards and Codes for Electric Vehicles at Scale

- https://www.ansi.org/standards-coordination/collaboratives-activities/electric-vehicles

- Gaps Draft: https://share.ansi.org/evsp/ANSI_EVSP_23_001_WORKING_DRAFT_ANSI_EVSP_Roadmap_2023.pdf

ANSI Defined Gaps – Draft - Continued (High Priority)

1 **Summary Table of Gaps and Recommendations**

Row	Section	Section Name	Gap #, Title & Description	R&D Needed	Recommendation	Priority	Organization(s)
Chapter 2. Vehicle Systems							
1	2.2	Battery Safety	Gap V1: **Battery safety.** There is an ongoing need to address safety issues related to battery thermal runaway, water immersion, and vibration resistance.	No	Continue to advance battery safety through NHTSA's participation in the development of Phase 2 of Global Technical Regulation No. 20 for Electric Vehicle Safety	High	NHTSA, WP.29
2	2.2.2	Delayed Battery Thermal Events	Gap V2: **Delayed Battery Thermal Events.** The issue of delayed battery thermal events needs to be addressed.	Yes	Address the issue of delayed battery thermal events in future rulemaking and/or revisions of SAE J2929 and J2990.	High	NHTSA, SAE
3	2.4	Battery Storage	Gap V3: **Safe storage of Damaged Lithium-ion Batteries.** No standards or guides have been identified that address the safe storage of damaged (i.e., unknown condition) lithium-ion batteries, whether at warehouses, repair garages, recovered vehicle storage lots, or auto salvage yards.	Yes. On combinations of failure modes.	A standard or guide for the safe storage practices for EV batteries must be developed, addressing damaged batteries and the wide range of storage situations that may exist, including when the batteries have been separated from their host vehicle.	High	SAE, NFPA, ICC, IEC
4	2.5	Battery Packaging, Transport, and Handling	Gap V4: **Packaging and Transport of Lithium-ion Batteries as Cargo on Aircraft.** Standards are being developed on battery package testing and performance-based packaging for lithium batteries as cargo on aircraft.	No	Complete work on SAE standards in development on battery package testing and performance-based packaging for lithium batteries as cargo on aircraft.	High	SAE

ANSI Defined Gaps – Draft - Continued (High Priority)

Row	Section	Section Name	Gap #, Title & Description	R&D Needed	Recommendation	Priority	Organization(s)
5	2.6	Battery Recycling/Materials Reclamation	Gap V5: **Design for Battery Recyclability/Materials Reclamation.** No standards gap has been identified with respect to battery recycling. However, there is a need for additional R&D on design for recyclability, as batteries are getting less conducive to recycling.	Yes, as noted	Additional R&D is needed by the national labs on design for recyclability of EV (li-on) batteries. This could include addressing the calculation method toward recycling efficiency and recovery rates based on an agreed unit (possibly weight) and/or life-cycle assessment tools, including energy recovery. Recycling is important to reduce the amount of materials to be mined, because the processing of lithium ion produces toxic biproducts.	High	National labs, SAE, ISO
Chapter 3. Charging Infrastructure							
7	3.1.2	Megawatt Charging Systems for Medium & Heavy-Duty EVs	Gap C1: **Megawatt Charging Systems (MCS)**. Standards are needed for MCS to support for heavy duty EVs such as trucks and buses.	Yes. Interoperability testing and data collection.	Complete work on SAE J3271.	High	SAE, NREL, DOE
8	3.1.3.1	Static Wireless Power Transfer	Gap C2: **Static Wireless Charging.** Standards for heavy duty/high power static wireless charging are still in development.	No	Complete work on SAE J2954/2 and other in development standards to deal with heavy duty/high power static wireless charging.	High	SAE, UL, IEC/TC 69, ISO TC22/SC37

ANSI Defined Gaps – Draft - Continued (High Priority)

15	4.1.3	Communication & Measurement of EV Energy Consumption	Gap G2: **Communication of standardized EV sub-metering data.** Standards are needed for communication of EV sub-metering data between third parties and service providers.	No	Develop a standard to communicate EV sub-metering data between a third party and a billing agent (e.g., utility).	High	OpenADE/NAESB, IEEE, Mesa, SunSpec Alliance, OpenFMB
16	4.1.3	Communication & Measurement of EV Energy Consumption	Gap G3: **Standardization of EV sub-meters.** Standards for EV sub-meters, including embedded sub-meters, are needed to address performance, security/privacy, access, and data aspects.	No	Develop standards or guidelines related to the functionality and measurement characteristics of sub-meters for EVs, including embedded sub-meters in the EVSE or EV. Such standards should address different form factors, capabilities, installation, and certification. Organizations developing standards, guidelines or use cases related to EV sub-metering should coordinate their activities in order to avoid duplication of effort, assure alignment, and maximize efficiency.	High	NEMA, USNWG EVF&S, SEPA, EPRI

ANSI Defined Gaps – Draft - Continued (High Priority)

Chapter 5. Cybersecurity							
Row	**Section**	**Section Name**	**Gap #, Title & Description**	**R&D Needed**	**Recommendation**	**Priority**	**Organization(s)**
23	5	Cybersecurity	Gap S1: **Comprehensive review of cybersecurity codes and standards for applicability to the EV charging ecosystem.** Gaps should be identified and prioritized.	No	Conduct a comprehensive inventory and review of standards with regard to cybersecurity applicability across the EV charging ecosystem. Ascertain potential gaps with regard to cybersecurity. In Winter 2023, Southern California Edison proceeded on a project for the California Energy Commission to explore cybersecurity codes and standards gaps with stage 1 focusing on identifying gaps and stage 2 to initiate addressing them.	High	Industry, Government, SDOs
24	5	Cybersecurity	Gap S2: **The lack of an end-to-end secure trust chain and encryption system for the EV charging ecosystem.** This results from the use of different protocols and data transfer mechanisms between EV charging related systems. An entity trust chain is needed across all elements of the EV charging ecosystem incorporating a comprehensive public key infrastructure (PKI).	Yes	Industry consensus and implementation is needed for a comprehensive end-to-end trust chain incorporating a PKI system for the EV charging ecosystem. Consideration could be given to the Cab Authority Browser (CAB) forum as a model to reach consensus. While it appears that in some cases EV-EVSE communications may be fully encrypted, it not clear that other communication channels within the EV ecosystem (e.g., from the charging stations to the EVSPs, and between CNOs) are fully secure. ISO 15118 provides guidance on secure communications, but gaps remain. IEEE P2030.5 indicates there must be end-to-end security but does not provide the means to achieve this. Close coordination should be established with the SAE EV Collaborative Research Project (CRP) which has developed a PKI system and is now shifting to implementation. The European Commission is considering adoption of IEC 62351 and IEC 62443 (both of which reference ISO 15118-2 and 15118-20) to ensure system security, including cybersecurity protection of digital keys. As appropriate, implement codes and standards development to reflect implementation of an industry agreed upon PKI.	High	Industry including equipment and system manufacturers, CNOs, aggregators, PKI infrastructure developers, Government, Associations, and SDOs

ANSI Defined Gaps – Draft - Continued (High Priority)

Row	Section	Section Name	Gap #, Title & Description	R&D Needed	Recommendation	Priority	Organization(s)
25	5	Cybersecurity	Gap S3: **Cybersecurity and Data Privacy.** Due to the nature of cybersecurity, the interactions of systems, and the emerging threats environment, there is an ongoing need for guidelines and standards to address cybersecurity and data privacy concerns specific to EVs and smart grid communications. Architectures should be designed with cybersecurity in mind.	No	Develop guidelines and standards to address cybersecurity and data privacy concerns specific to EVs and smart grid communications.	High	IEC, IEEE, ISO, NIST, SAE, UL