

Advancing EV Charging Interoperability: Significant Advancements in CCS Analyzer V1.2

Webinar March 2025

QualityLogic

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Today's Presenters

• James Mater, Director of Strategy, Smart Energy,

James is one of the industry-leading experts on smart grid standards, interoperability, and the maturity of eco-systems of products based on these standards. He is a member of IEEE 2030.5 WG, IEEE 1547 WG, UL 1741 SC, SunSpec J3072 Profile, OpenADR Profile WG, CharlN NACI WGs and Focus Groups, Chair of the V2G Forum and more.

Christian Burns, Software Engineer

Christian is a talented Java, Kotlin, and Python developer and leads the development of the QualityLogic CCS Analyzer.

Toru Murakami, Software Engineer

Toru has been working on the CCS Analyzer for the past year and is an accomplished software engineer with deep understanding of ISO 15118.







- Introduction to QualityLogic
- The CCS Interoperability Challenge
- CCS Analyzer Overview
 - Background and common use cases
 - Customer experiences and feedback
- What's New in Version 1.2?
 - Key feature enhancements
 - Release timeline
- Demo of Key New Features
- Limited Time Introductory Offer (Expires March 27)*



QualityLogic Products for End-End Interoperability

- Tools to test compliance and interoperability with Charging and V2G standards
- Support for end-end testing
- Primarily SW based (vs HW for other vendors)
 - Improve productivity faster schedules, better results
 - Reduce costs of OEM and ecosystem interoperability
 - Improve interoperability quality – reducing business risks





QualityLogic Products by Function





Some of Our Smart Grid Customers





The CCS Interoperability Challenge

ChargeX Survey of public comments*

- 335 events analyzed
- 6 of top 7 issues communications interop issues



* ChargeX Consortium report "Customer-Focused Key Performance Indicators" (INL/RPT-24-77388).



Public Charging Satisfaction: Drag on EV Sales

- "...public Level 2 charging has declined to 617 (on a 1,000-point scale), 16 points lower than a year ago..."
- Major issues are charging speed, location and charging failures: 1 in 5 visits result in not charging.
- JD Power 2023 US EV Experience Public Charging Study, Aug 2023.

J.D. POWER

Public Charging Satisfaction Data by State

Top 3 Public Charging Locations:

Retail Center
 Parking Garage
 Hotel

Public Charging Satisfaction Score:

CA

LEVEL 2 CHARGING STATION: 571/1000 DC FAST CHARGER: 595/1000

co

25% of people find public charging experience unreliable

Source: J.D. Power 2023 U.S. Electric Vehicle Experience (EVX) Public Charging StudySM

Please contact your J.D. Power account executive or Brent Gruber (Brent.Gruber@jdpa.com) if you have questions.



California

Achieving Interoperability Through Bi-Lateral Testing (Brute Force)?

• Typical eco-system interoperability uses plugfests to

- Validate conformance and interoperability test cases for use in automated test systems
- Improve both the standard and the testing standard for it
- In lieu of Conformance certification testing, CCS is attempting to achieve interoperability through lots of 1-1 and plugfest testing events.
 - · Inefficient process for achieving interoperability
- Costs of "Brute Force" interoperability
 - Time-consuming and expensive
 - Slows interoperability achievement
 - · Becomes unwieldy to scale
 - Fixes are bi-lateral one-off vs community improvements



CCS Interoperability Challenge: Bi-Lateral Interop

Bi-Lateral Interoperability (every OEM responsible for interop with all EVs or EVSEs)

- Charge or conform to the standard
- Non-conformant solutions
- Expensive process
- Costly to scale





EV Comms Certification Programs and Maturity

Standard	Certification Program(s)	Owner	ATLs	Certified Products	Interop Maturity
OpenADR	OpenADR 2.0a/b	OpenADR Alliance	10	>200	
IEEE 1815 (DNP3)	DNP3	DNP3 Users Group	1	11	
IEEE 2030.5	CSIP	SunSpec Alliance	11	66	
ISO 15118	ISO 15118-4/5	CharlN	2	1	
OCPP	OCPP 1.6	OCA	6	200	
CHAdeMO	CHAdeMO	CHAdeMO	7	>400	
SunSpec Modbus	SunSpec Modbus	SunSpec Alliance	11	69	
IEEE 1547.1	UL 1741 SB	OSHA	11	>100	
802.11	Wifi Certified	Wifi Alliance	12	~70,000	



If We are Achieving Interoperability the Hard Way, Let's Improve the Process

Automating Interoperability Test Session Analysis



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Making Interoperability Testing More Efficient

Potential Interop Improvement strategies:

- Improve interoperability test processes from Ad Hoc to Strategic Interop testing
- Permanent interop facilities such as Elaad NL, ACM, CEC Charge Yard
- Standardize charging session capture content and file format output (PCAPs)
- Standardize Minimum Required Error Codes
- Improve interoperability test tools to automate analysis of root cause and other issues





Manual Analysis vs Automated Session Analysis

Manual Charging Session Analysis Use Cases

- Reviews PCAP files in Wireshark (or views raw PLC logs)
- Investigates causes of failed/aborted charging sessions
 - Deep dive to determine specific failure causation
 - Determine where the failure originates EV and EVSE
 - Identify potential fixes
 - Documents Interop issues for further analysis, discussion and remediation strategy
- Extracts timing statistics to support benchmarking of chargers and EVs (if time allows)
- Analyses regression test charging sessions prior to firmware release
- Trains and supports field techs and new Interop
 engineers
- Ignores successful sessions even though there is valuable information there

CCS Analyzer Use Cases – Automated CCS Analysis

- All current manual use cases PLUS
- 10-30 X faster analysis of PCAP files
- Enables less experienced engineers to conduct analysis of charging sessions including service technicians
- Integration into development tool chain
- Enables analysis of successful charging interop sessions and timing data (typically not analyzed due to time)
- Illuminates EV-EVSE interop issues in end-end charging failures
- Aggregation of all charging session data for trend analysis
- Aggregation of timing statistics to automate benchmarking
- Real-time analysis of charging sessions
- And more ...



Today's Analysis Speed

Manual, Slow, Uncovers "Tip of the Iceberg"



AND, repeat interoperability testing forever to:

- test legacy EV / EVSE firmware releases & new standards



Next Generation

Faster, Deeper, Smarter EV - EVSE Interoperability Testing

"Now I'm able to run 50-100 or more sessions in the same time it takes to manually analyze just one session. This enables us to look at files we otherwise wouldn't have had time for, giving us the ability to identify hidden issues."

~ Jeremy Bibeau, EVgo





Today's CCS Session Analysis Tools



The Analysis Gap – What Are We Missing

Valuable information hidden from today's Interop Process



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The Information Gap in Today's Charging Session Analysis Process

Root causes of Charging Failures

🖶 TimingStatsTable

Phase	Duration (s)
CM_SLAC_PARM.REQ to CM_SLAC_PARM.CNF	0.004
CM_SLAC_PARM.REQ to CM_SLAC_MATCH.CNF	1.344
SDP_Req to SDP_Res	0.025
SessionSetupReq to SessionSetupRes	0.070
ChargeParameterDiscoveryReq to Res - finished	1.820
CableCheckReq to CableCheckRes - finished	20.240
PreChargeReq to PreChargeRes - finished < 500 V	4.518
PowerDeliveryReq to PowerDeliveryRes	0.039
AuthorizationPealto AuthorizationPeal finished (OCDD a	5 470

Anomalies that may cause interop issues

- Message/Sequence timing
 - Performance timeouts of individual messages
 - Sequence timeouts of spans of messages
- Physical value constraints/units
- Charge schedule deviation
 - Deviations from the agreed schedule
 - Power delivery deviation
 - Deviations from the requested current
- EVSE ID format
- EVCC ID format
- No current delivered
 - No current demanded/delivered
- Low priority protocol selection
- Incorrect SLAC attenuation profile calculation

- Typical root causes identified in 10-30 min by manual analysis of the charging session PCAP file
- Hidden issues found with automation, identified in seconds.
 Not usually identified due to time.
- Timing statistics not extracted due to time constraints



Top 10 Interop Issues Observed

	Anomaly	Occurrences	Ease of Detection
1	V2G State Transition	86	Moderate
2	Session Termination	79	Easy
3	EV Target Power Demand	60	Moderate
4	EVSE ID	51	Moderate
5	Physical Value Constraints	44	Hard
6	No Current Delivered	35	Hard
7	SLAC State Transition	28	Moderate
8	EV Target Voltage	23	Moderate
9	FAILED Response Code	21	Easy
10	Message Timeout	19	Moderate

- Data collected from 317 capture files



CCS Charging Communication Stages With Timings





Introducing V1.2 of the CCS Analyzer

CLI, MCS, improved Analysis and Reporting



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Quick CCS Analyzer Demo

• Quick Product Intro (for those who have not seen it before)



V1.2 Enhancements

- Command Line Interface automates PCAP analysis tasks to enable integration into current and new workflows.
- **Prioritization of Anomalies** to speed identification of most likely root cause(s) of failures. This differentiates the serious interoperability problems from the interesting but less critical.
- **Reports Improvements** easier report navigation including links to section. (Time permitting, we will include charts and session timing tables the reporting).
- Comparisons of different charging sessions:
 - Compare the timing statistics for two PCAPs in the current report directory.
 - Compare two Charging Sessions in a Chart e.g., a single charger with two charging ports.
- *Megawatt Charging System (MCS) Support* support for the new MCS standard in ISO 15118-20. This is important for the Truck and Bus transportation industry. Note that we are not yet finding MCS PCAP files to test our analyzer implementation against.



More V1.2 Enhancements

- Shortcut Buttons for Charts, Timing stats, CP table and Reports shortcut buttons on GUI to access
 the core features of the PCAP analysis. These are now accessible only by right-clicking on an
 Anomaly or the analyzed PCAP file.
- **TLS Failure Context** add context to each TLS failure report including client and server hello negotiation parameters, certificate names, expiration dates, CA, etc.
- *Multi Session and Multiple PCAP Snapshots* table for a multi-session PCAP file or multiple distinct PCAP files that shows sessions where errors are present. Enables users to zero in on problem sessions without needing to look at each session in the collection,
- **TCP Anomaly Reporting** TCP Anomaly reporting such as port resets.
- Improving Chart Legend improve the usability by simplifying the Legend and other aspects of the Session charts.



Demo of Key V1.2 Enhancements

- Command Line Interface Toru
- Improved root cause analysis Toru
- Improved reporting Toru
- Timing comparisons Christian
- MCS Christian





- Ask about our 14-day free trial
- Ask us for a private **CCS Analyzer demo.**



Introductory Special Offer

- For purchases of a full CCS Analyzer license with maintenance by March 27.
- We are offering a second license for the price of a one-year Maintenance Contract.
- For more information, contact <u>info@qualitylogic.com</u>







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