Solving CCS Charging Session Interoperability Analyzer: Confidential Progress Update

September 2023

QualityLogic

Today's Presenters

- **James Mater, Director of Strategy, Smart Energy, QualityLogic**

  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. James has given dozens of presentations and authored multiple papers on interoperability in the smart grid. He is a member of both the UL 1741SC, IEEE 2030, SunSpec J3072 Profile and IEEE 1547 Work Groups. He Co-Chairs the V2G Forum.

- **Jim Zuber, CTO, Smart Energy, QualityLogic**

  Jim is the software architect behind the CCS traffic analyzer being demonstrated today, Many of the testing products architected by Jim and released by QualityLogic over the past 30 years have become de facto testing standards in the smart grid, imaging, and telecommunication industries.

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QualityLogic's Role in the Smart Energy and EV Industries

- **QualityLogic is focused on Smart Energy Testing and Training**
  - IEEE 2030.5, OpenADR, IEEE 1547/UL 1741 SB and WiSUN Test Tools, Training, and Consulting
  - Used by NRTLs, Vendors, Utilities and Research labs to perform Testing/Certification

- **QualityLogic is a Contributor to IEEE 2030.5/CSIP, IEEE 1547, UL 1741, ISO 15118 and other standards**

- **Active in Certification Program Development for industry consortiums and alliances**

- **2023 product focus on the EV space, both charging and grid integration (V2G)**

- **Interest in EV Charging Interop Products: While working on V2G test and certification tools, observed interop issues with charging infrastructure**

HOW DO WE BUILD AN INTEROPERBLE V2G INFRASRUCTURE ON A PROBLEMATIC CHARGING INFRASTRUCTURE? HELPING SOLVE INTEROP ISSUES TO ACCELERATE EV ADOPTION AND ENABLE V2G...
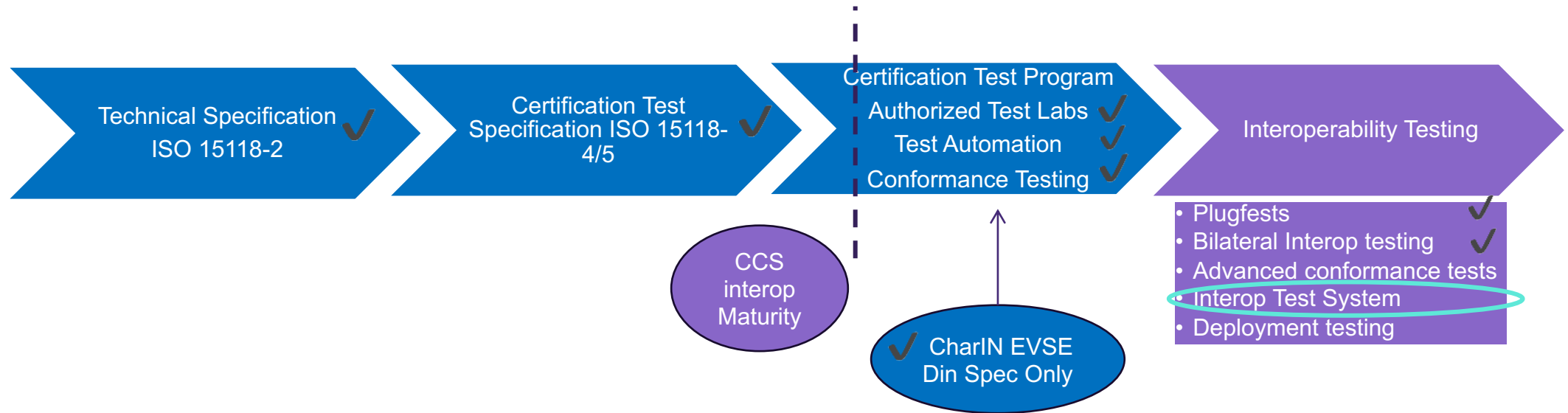
Agenda

- **CCS Interoperability Challenges**

  - Achieving Interoperability: CCS interop maturity status

- **QualityLogic's CCS Interoperability Approach: the Anomaly specification and test automation**

- **EVLab Demo showing 3-5 interesting files processing, and the results reported**

  - Summary of most recent improvements and progress on the Message Analyzer

- **Product development and release schedule**

- **Call for Accelerator Partners**

- **Call for Pcap files**

  - Input files: discussion of the kind of files we can process and the focus of current tests

- **Questions?**

Note: This webinar is conducted under mutual NDAs. All attendee companies should have an NDA in place with QualityLogic or have committed to doing so.

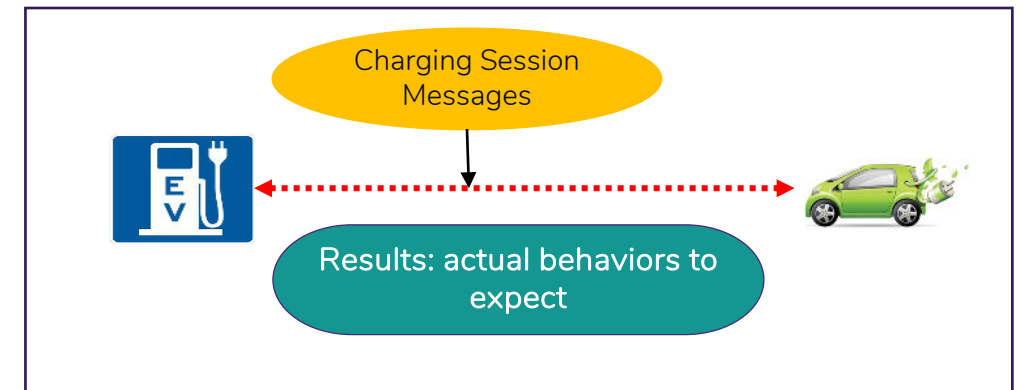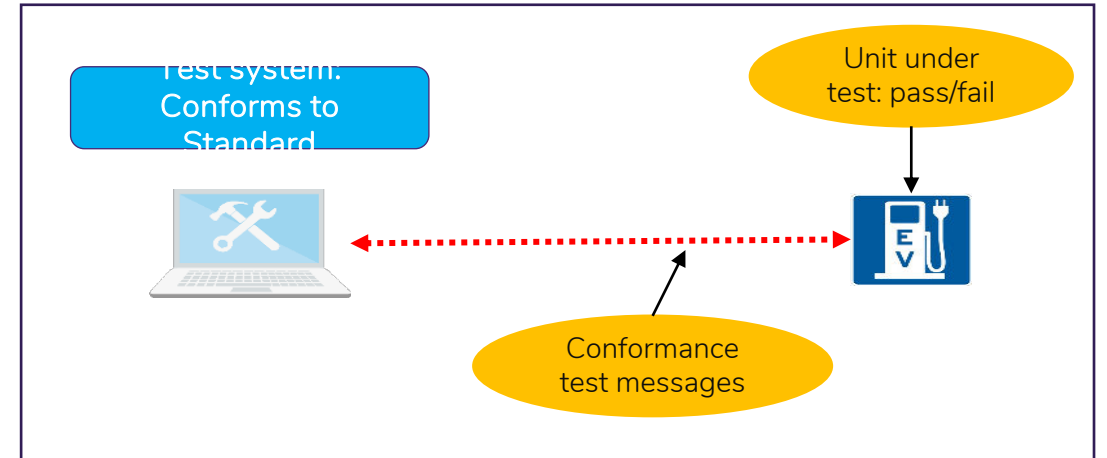# Getting to CCS Interoperability

Getting to Interoperability

Technical Specification
ISO 15118-2 ✓

Certification Test
Specification ISO 15118-
4/5 ✓

Certification Test Program
Authorized Test Labs ✓
Test Automation ✓
Conformance Testing ✓

Interoperability Testing

CCS
interop
Maturity

✓ CharIN EVSE
Din Spec Only

- Plugfests ✓
- Bilateral Interop testing ✓
- Advanced conformance tests
- Interop Test System
- Deployment testing

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	46	
ISO 15118	ISO 15118-4/5	CharIN	2	1	
OCPP	OCPP 1.6	OCA	5	50	
CHAdeMO	CHAdeMO	CHAdeMO	7	>400	
SunSpec Modbus	SunSpec Modbus	SunSpec Alliance	11	69	
IEEE 1547.1	UL 1741 SB	OSHA	11	0	
802.11	Wifi Certified	Wifi Alliance	12	~70,000	

Conformance vs Interoperability

- **Conformance testing: goal is to be conformant**
  - Tests validate compliance to the standard
  - Pass/fail with fail diagnosis
  - Tested against a conformant reference system
  - Compromise test spec: maximize coverage while minimizing the test costs and time ~ 20% of possible tests
  - For CCS, tests and test systems exist but certification programs nascent.

- **Interoperability testing: goal is to interoperate**
  - Testing between real systems
  - Discover interop issues that can be fixed
  - For EVs and EVSEs, rapid increase in pairings and maturing standard increases interop issues

- **Fact of life: two systems can be conformance certified but not interoperate**

Test system: Conforms to Standard

Unit under test: pass/fail

Conformance test messages

Charging Session Messages

Results: actual behaviors to expect

Analyzer Demo

Jim Zuber, CTO

Charge Session Interoperability

- **A surprisingly high percentage of charge sessions fail to complete (30% by some estimates)**

- **About half the failed sessions are attributed to communication issues such as:**
  - Incorrect or 15118 unexpected payload parameters
  - Incorrect or unexpected payload interaction patterns
  - Premature termination of the charge session by the SECC
  - Security certificate validation issues
  - EVSE voltages out of range
  - Control Pilot unexpected state transitions (voltage on charge pilot)
  - Control and proximity Pilot signaling noise
  - Non-conformant SLAC process (attenuation)
  - Payload response timeout issues
  - Etc.

Interop Failures
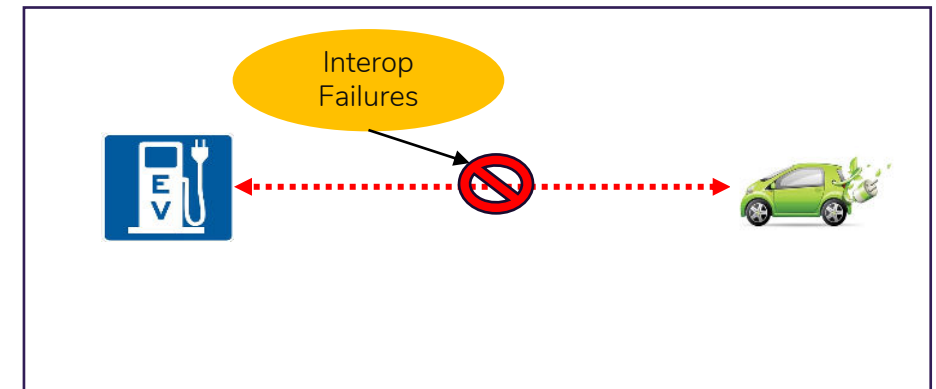
Isolating Interoperability Problems is a Challenge

- The charging process involves a complex set of protocol interactions.
- Traffic is encrypted, compressed (EXI), and runs over PLC, making it a challenge to capture and decode.
- Man-in-the-middle test tools, and non-intrusive sniffers can display traffic and may flag obvious errors, **but a protocol expert is usually required to isolate many problems.**
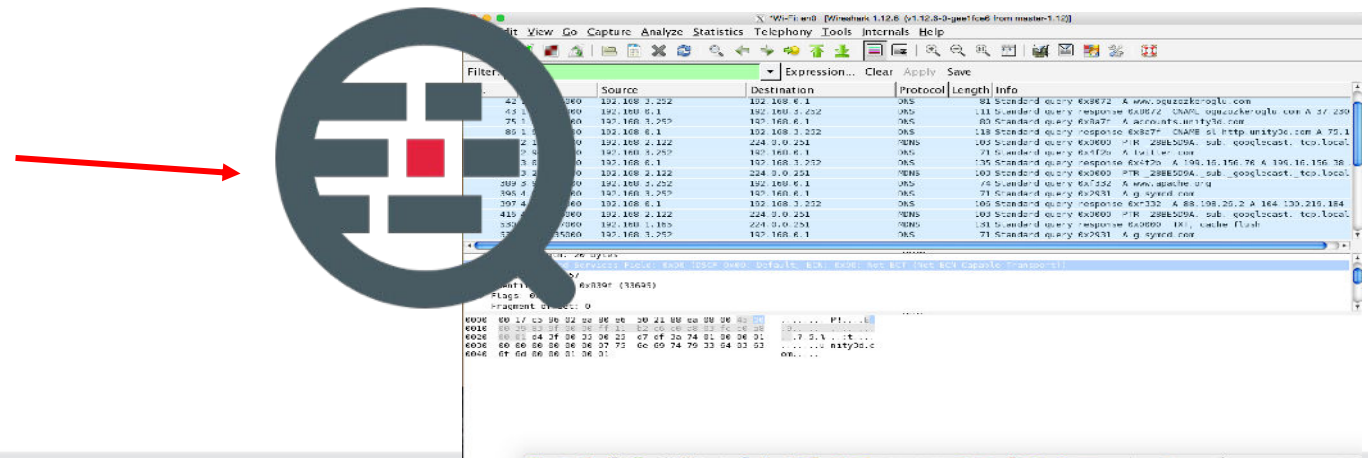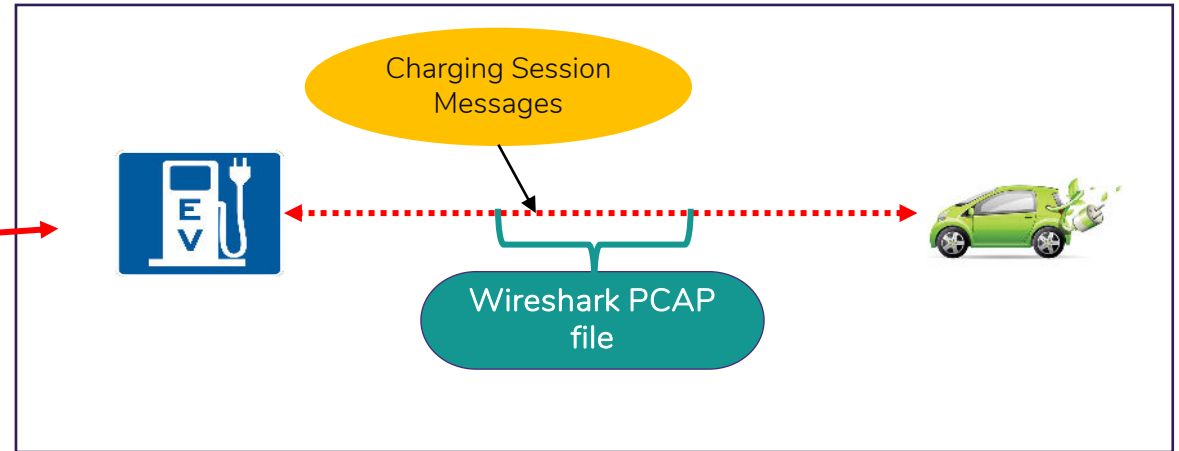
QualityLogic Session Analyzer Approach
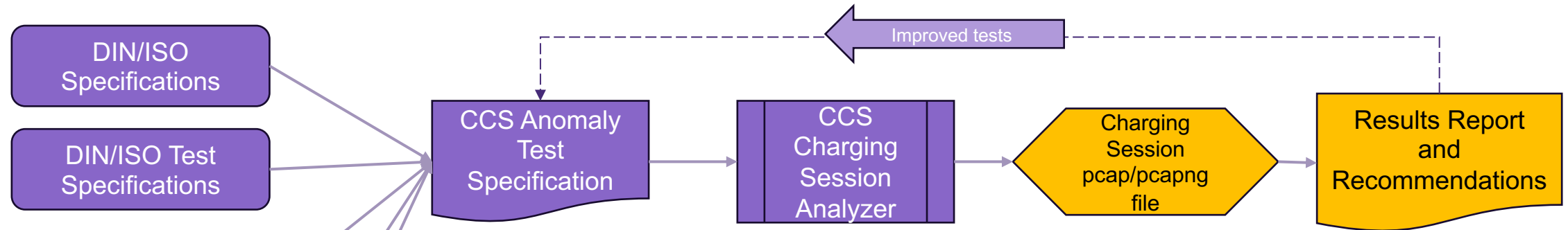
- **Analysis Process**
  - Traffic between an EVCC and a SECC is captured in a Wireshark pcapng format for analysis.
  - The QualityLogic CCS Charging Session Analyzer (CTA) analyzes and detects anomalous traffic patterns.
  - Output summary of anomalous behaviors of both the EVCC and SECC, the causes of the anomalies and suggestions for fixing them
  - **The analysis will improve over time as we gain experience**

Example Use Case: PreCharge Payload Exchange

- **ISO 15118-2 (Table 111) requires a precharge by the EVSE to occur within 7 seconds**

- **This is typically validated for conformance by each vendor as part of conformance testing.**

- **In an interop scenario the EV may just stop communicating with the EVSE if the requirement is not met**
  - Terminate the V2G communication session (V2G2-728)

- **Isolation of this problem would require….**
  - Captured Traffic viewed in Wireshark
  - Identification of the first PreChargeReq voltage, and time stamp
  - Searching through many PreChargeRes payloads to determine the progression of precharging voltage provide by SE
  - Calculation of time deltas between the initial PreChargeReq and subsequent PreChargeRes payloads to determine if the 7 second timeout had been exceeded prior to the voltage reaching the requested value

- **While this analysis isn't necessarily technically complex, it is tedious and time consuming.**

- **A great example of the kind of thing that the QualityLogic Traffic Analyzer can do every time it looks at captured traffic without consuming any time on the part of the user.**

Development Status – Big Picture

Protocol	Analyze SLAC Exchange	Baseline Message Exchange Analysis	Real-World Scenario Analysis (pcaps)	Wireshark Dissector	Analysis Control GUI
DIN 70121	In Progress	Complete	In-Progress	Open Source Solution	Completed
ISO 15118-2					
ISO 15118-20		In-Progress	TBD	TBD	

Development Progress

- **Recent Additions**
  - DIN Spec baseline analysis
  - GUI redesign with partitioning of analysis and reporting functionality
  - Wireshark Integration
  - Mouseover Anomaly Check Descriptions
  - Abort and more robust error trapping
  - Anomaly priority controls analysis sequence
  - Simplified anomaly check names
  - Dramatically improved speed of analysis
  - Improved max pcap file size we can analyze
  - Incorporated initial "tribal knowledge" anomaly checks and reporting
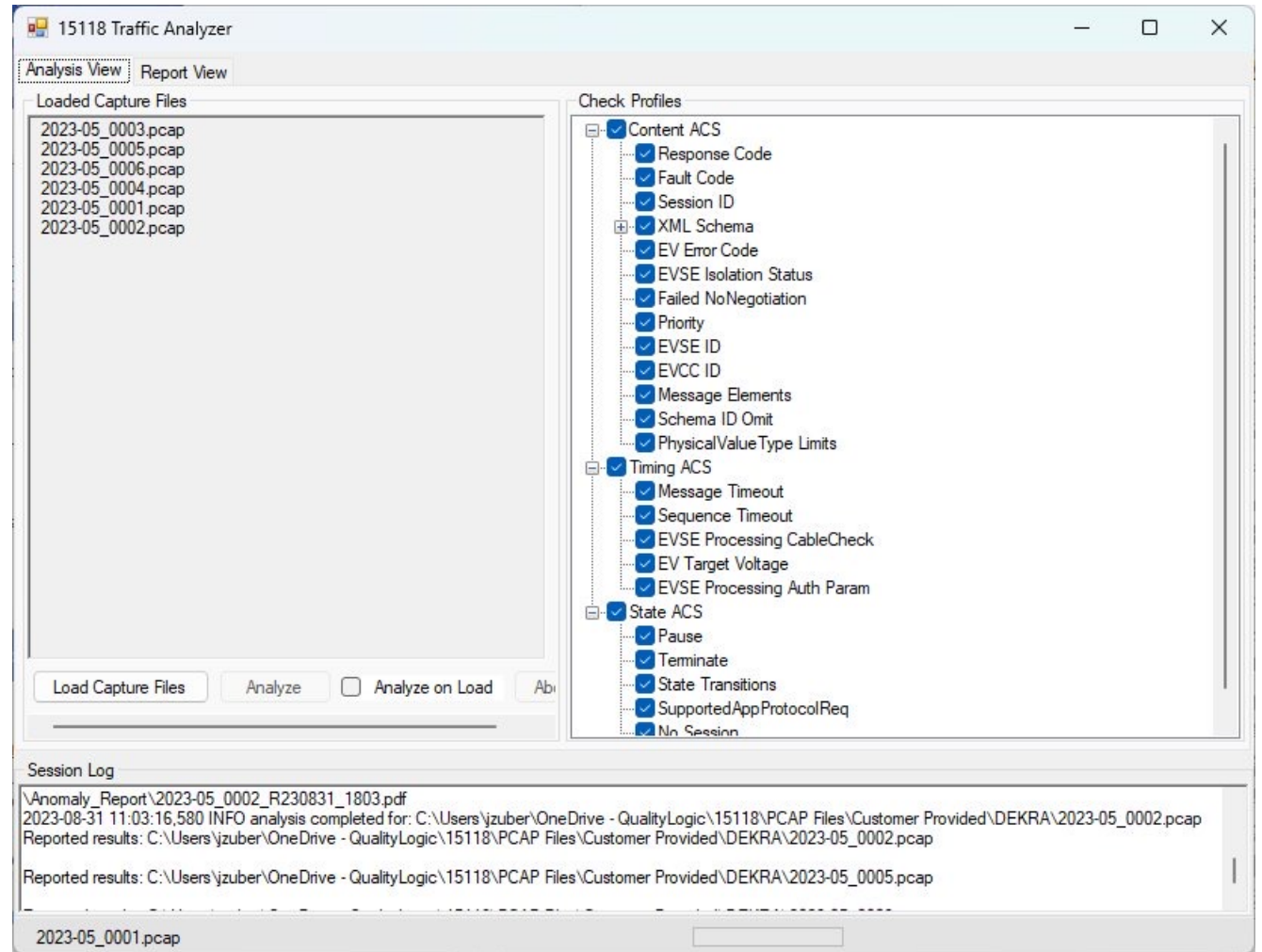
Development Progress Continued

- **Recent Additions**
    - Dramatic improvements in report browser
    - Simple layout to travers from report to anomaly to results
    - Cleaner layout for report text

Development Progress

- **Tasks Ahead…**
  - SLAC baseline analysis
  - 15118-20 baseline analysis
  - Launch of free
  - Addition of anomaly checks derived from real world interop problems
  - Root cause synopsis added to results
  - Graphs showing values that change over time
  - Error count limits
  - Batch processing summary
  - Improved progress indication
  - Command line execution of analysis
  - Etc.

- **Timeline….**
  - Beta Test mid September 2023
  - Monthly Beta Test drops
  - Target release Q1 of 2024

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Demo

- **Live Demo of Analyzer**

Calls to Action

Accelerator Partners and Pcap Files to analyze

CCS Charging Session Interoperability Accelerator Program

- **Up to 5 participants to:**
  - Guide priorities and influence features and functions
  - Use early releases and provide feedback
- **Benefits**
  - Early access to critical new test tools for interoperability
  - Favorable pricing
  - Free maintenance and support during the program
  - Price protection (if commercial price is higher, no additional charge)
  - Right of First Refusal on future product accelerator programs
- **Product**
  - Charging Session Analyzer – Early Adopter releases in Q3/Q4 2023
  - Q1 2024 market introduction

- **Accelerator Pricing Phase 1: Analyzer**
  - Quotation upon request
- **Terms and Conditions**
  - Participation fee due with PO to secure participation slot
  - Milestone payments invoiced upon delivery
  - NDA and Terms and Conditions agreement.

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Call for Pcap Files to Analyze

- **Maturing the Traffic analysis process is dependent on access to real world traffic that triggered interop problems**

- **To further the goal of exposing the analyzer to a wide range of traffic scenarios, QualityLogic is offering a free traffic analysis service (with some limits) during the development of this product.**

- **Files can be submitted [CCS Charging Session Analysis – QualityLogic](#).**

- **Customer must agree to the CCS Charging Analysis Service analysis service terms and conditions and can choose to have a signed NDA in place (optional)**

Questions?