EVPKI

Electric Vehicle Public Key Infrastructure

A Program of SAE ITC

ELECTRIC VEHICLE PUBLIC KEY INFRASTRUCTURE (EVPKI) PROGRAM OVERVIEW

SAE ITC

An SAE International Affiliate

The Research Opportunity and How it Emerged…

- EV Charging systems have crucial and growing interface points between the Automotive industry, EV drivers, and the Electric Grid/Energy industry
  - It is critical that these interfaces be ***secure and trusted***
  - ISO 15118 is believed by some to provide a complete message authentication and security approach for EV Charging systems and transactions
- In 2019, ChargePoint, DigiCert, and eonTi set out to verify this belief and performed a "360 Assessment" (gap analysis) of ISO 15118 PKI and cybersecurity

Technical Score: 1.6 out of 5

	Undeveloped	Ad Hoc	Established	Optimized	Specialized
CA Architecture			●		
Assurance Level	●				
Physical Security	●				
Disaster Recovery	●				
Key Management		●			
Protocols & Algorithms			●		
Revocation	●				

Operations Score: 1.0 out of 5

	Undeveloped	Ad Hoc	Established	Optimized	Specialized
Identity & Access Management	●				
Certificate Lifecycle Management	●				
Certificate Revocation	●				
Certificate Repository	●				
Incident Response	●				
Certificate Renewal	●				
PKI Compliance Audit	●				

Significant Gaps Identified in 15118 Requirements and Processes

Governance Score: 1.4 out of 5

	Undeveloped	Ad Hoc	Established	Optimized	Specialized
Certificate Policy (CP)		●			
CPS	●				
Audit Policy	●				
Algorithms and Protocols			●		
Business Continuity and DR	●				
Certificate Revocation Policy		●			
Risk Management	●				

Project Approach and Goals

SAE Cooperative Research Program

SAE Cooperative Research Program (CRP) projects *are joint ventures of industry companies* that meet project criteria to preform targeted, pre-competitive research to solve an industry problem.

SAE CRP *projects develop industry deliverables* that can then be fed into SAE standards to develop a needed J standard.

SAE EV Charging Public Key Infrastructure CRP

The project will *design and test an inclusive, worldwide EV charging industry PKI platform* that is protocol-neutral, secure, trusted, scalable, interoperable, and extensible.

The project is an *industry-led, pre-competitive research* project to strengthen electric vehicle charging system security.

Project Overview

Core Project Members

Core members were the technical leads of the project.

- ChargePoint
- eMobility Power
- Electrify America
- Ford
- General Motors
- MBRDNA (Daimler)
- Rivian
- Shell
- Stellantis

Affiliate Members

Affiliate members were testing partners. They had access to the project virtual test platform and participated in test events.

- AddEnergie
- BMW
- BTC Power
- Evgo
- Denso-Ten
- Zerova

Program Plan

Phase 1 Design Deliverables

- Certificate Policy
- PKI Requirements Document
- PKI Prototype
- Operationalization Planning Report

Phase 2 Testing

Testing validated PKI functionality and scalability, proved PKI interoperability across vehicles, EVSEs and charging providers, and showed compliance with the "Plug n Charge" certificate requirements in ISO 15118-2.

- Virtual Platform Testing – enabled product development with the PKI prototype in a virtual environment
- Live Testing at the National Renewable Energy Laboratory in Golden, CO in April 2022 and September 2022
- September Test included 3 EVs, 5 EVSEs, and 2 EV Charging back offices.

Final SAE EV Charging PKI Platform Deliverables

Industry Review and Gap Analysis

Threat Model

PKI Platform Design Package

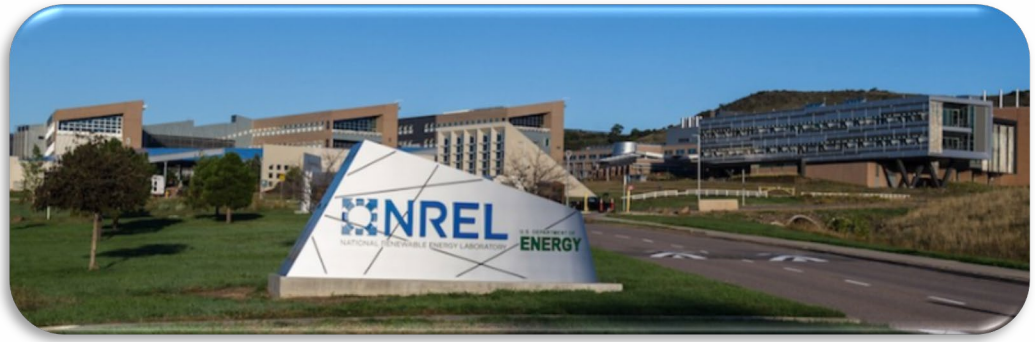
- PKI Requirements Doc (PRD)
- PKI Prototype
- Certificate Policy

Operationalization Report

- The Operationalization Report is the blueprint for the industry consortium to develop rigorous governance policies and operational rules.

SAE EV Charging PKI Test Events

Two Test Events conducted in 2022, hosted by the U.S. Dept. of Energy National Renewable Energy Laboratory in Golden, Colorado.



"Friendly" testing in April 2022 using compliant ISO 15118-2, 256-bit key ECC certificates

- confirmed interoperability with existing vehicle and EVSE communication controllers

Expanded testing in September 2022 using non-compliant & invalid certificate fields to explore specific vulnerabilities in TLS authentication and Plug and Charge authentication

- Test included 3 EVs, 5 EVSEs, and 2 Charging back offices

Lessons learned

- More testing needed in industry focused on PKI compliance across all EV ecosystem players

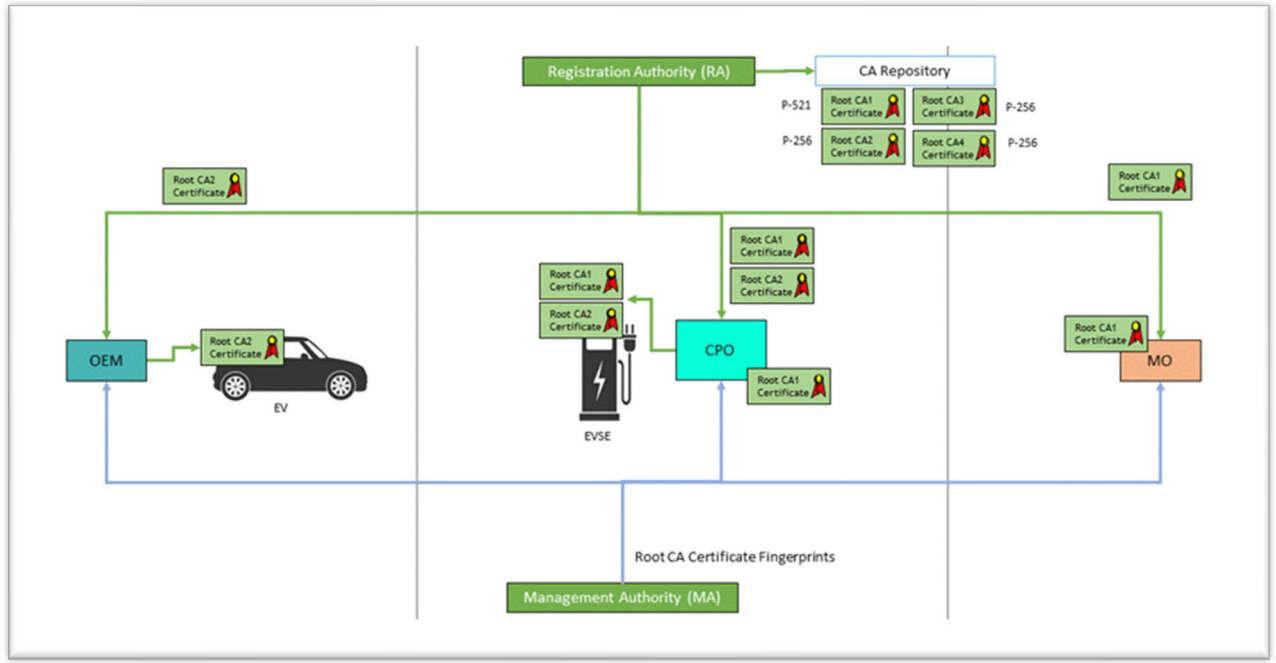
Refining Future Testing

SAE will host future test events open to industry using the SAE EV PKI Virtual Test Platform

- SAE test events will be pay for service
- SAE will engage other EV Charging PKI providers to identify interoperability testing

Next steps: Further modularize and develop testing documentation for open industry testing

- self-testing documentation
- operational user guidelines
- repository of certs
- demo/test examples
- APIs
- past testing reports



Migration to the EV PKI Consortium

Final SAE EV PKI CRP deliverables were completed in January 2023.

In late 2022, the project team began planning a migration to an industry-led consortium to deploy and operate the SAE EV Charging PKI platform across industry.

The consortium is now a program of the SAE Industry Technologies Consortia (SAE ITC). The team carefully planned the consortium and worked in close cooperation with SAE ITC leaders to ensure the consortium enshrines the EV PKI mission and goals.

Electric Vehicle Public Key Infrastructure
A Program of SAE ITC

The consortium is developing the initial strategy to achieve an interoperable, secure, and scalable PKI for the global EV ecosystem, now and into the future. Elements will include development of a Certificate Trust List, establishing a robust testing program, and working collaboratively across industry.

SAE EV Charging PKI Project Value to Industry

Benefit	Feature	Value Add
Lower Cost	Platform operationalization by digital security services firm with demonstrated global experience	• Faster delivery of production & test certs • Lower risk of security breach • Disaster recovery & business continuity • Choice of CAs for issuance of certificates
Increased Trust and Level of Security	• Consortium acts as the Policy Authority (PA) • Full transparency of CAs and Registration Authority operations • Assurance the PKI is administered by subscribers and new CAs according to CP and CPS	• Robust, cradle-to-grave certificate life-cycle mgmt. • Out-of-band operations eliminated • Response robustness in disaster scenario
More Control	PA determines if & when PKI changes are needed due to industry regulations, governance, technical, or operational reasons	• Enforce conformance to CPS • Manage on-boarding of CAs, Trust Lists, ICAs, etc.

About SAE ITC

SAE Industry Technologies Consortia (SAE ITC®) is a 501(c)(6) affiliate of SAE International®. It is a collection of global programs established as direct responses to a variety of technology trends. Each industry consortium has taken shape to address specific technical challenges including vehicle automation and its safe and responsible development. The programs provide ongoing value to public and private organizations as well as communities by effectively evolving as industry evolves.

SAE ITC ® enables public and private organizations to collaborate, even with competitors, under an anti-trust umbrella to quickly and efficiently establish pre-competitive best practices and principles under which they mutually agree to operate. Multiple standards organizations can also participate in this neutral forum setting to establish a more holistic approach to the ecosystem to embody the principles into standards based on their relative areas of strength.

SAE ITC® enables visionary collaboration to define solutions, advance technology, and effectively address new challenges and innovation trends.

https://www.sae-itc.com/

The SAE Group

Common Challenges. Shared Solutions.

As commerce and supply chains transform our world, regulations multiply, and engineering challenges grow more complex, the need for collective solutions continues to proliferate. For this reason, more industries are engaging the strength of the SAE Group to unleash new technologies and new possibilities. The SAE Group offers a robust and essential portfolio of overlapping programs, products, and services that cover the full range of engineering challenges.

Visionary Collaboration. Advancing Technology.

SAE Industry Technologies Consortia® (SAE ITC) enables organizations in multiple mobility-related sectors to collectively define, develop, and implement leading-edge technologies through neutral, precompetitive forums and collaborative technical communities.

Leading Innovation. Trusted Knowledge.

SAE International® offers engineering-based organizations a comprehensive information ecosystem to help develop the highest quality standards and drive innovation through products, people, and processes.

Committed to Absolute Quality

The Performance Review Institute® provides critical process accreditation and quality certification services in support of its stakeholders' most sensitive manufacturing areas and management systems.

Come Join Us!

Please contact Tim Weisenberger to for more information on how to join the EV PKI Consortium.

Tim Weisenberger
Program Manager, EV PKI Consortium
SAE Industry Technologies Consortia

e: tim.weisenberger@sae-itc.org
m: 248.840.2106

Electric Vehicle Public Key Infrastructure
A Program of SAE ITC