

A woman with curly hair, wearing a white ribbed top and light-colored shorts, is looking at her smartphone. She is standing next to a white car that is plugged into a charging station. The scene is brightly lit, suggesting a sunny day. The background shows a parking area with a wooden fence.

S44

S44 Capabilities Overview

January 2024

S44 Team



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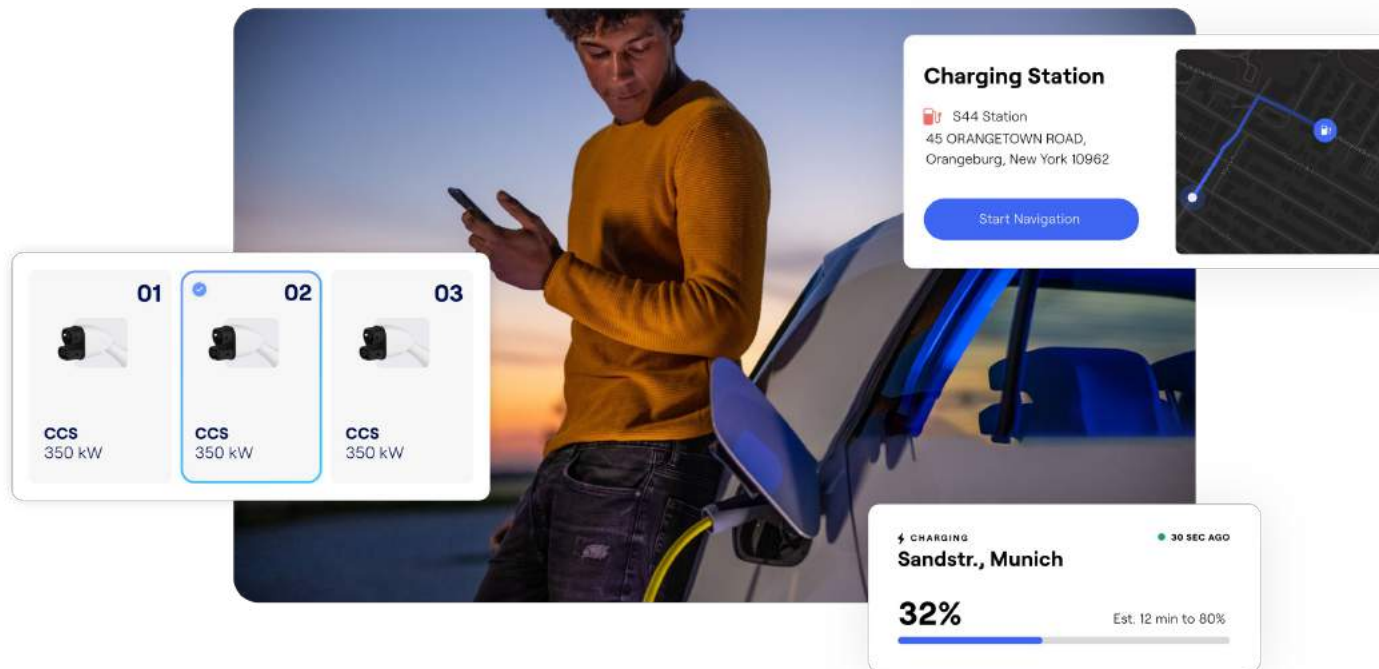
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About S44

Commitment to Electrification & Company Info



Creating Impactful EV Charging Software

Established in 2012, S44 is a custom software company with a virtual-first on-shore team spanning the United States and Germany. Our software development drives fleet electrification with vehicle-to-grid technology, load management solutions, and custom eMSP & CPO software. Our digital experience team applies years of expertise in OCPI and OCPP standards, delivering cutting-edge solutions as strategic partners to EV charging pioneers. In 2023 we launched the first open-source OCPP 2.0.1. compliant CPMS, CitrineOS, paving the way for EV charging stakeholders to support reliability of charging infrastructure and customer success.

Electrification Commitment & Compliance

Experienced & Proven:

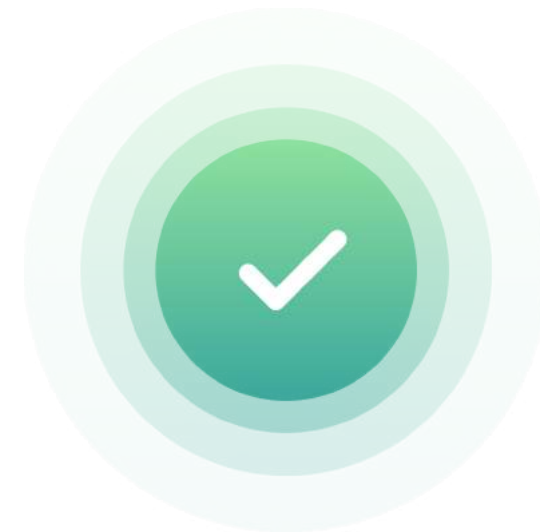
- ✓ Built custom CPO and transitioned a nationwide North America network off an “off-the-shelf” SaaS solution within one year to a cloud-native scalable microservice CPO with interfaces to eMSP using AWS, API Gateways and IdP Integration

OEM Connectivity:

- ✓ Proven experience integrating eMSP solutions and native mobile applications with nine different OEMs including BMW, Honda, Hyundai, Ford, Jeep/Maserati (Stellantis), Audi, Porsche and Lucid Motors

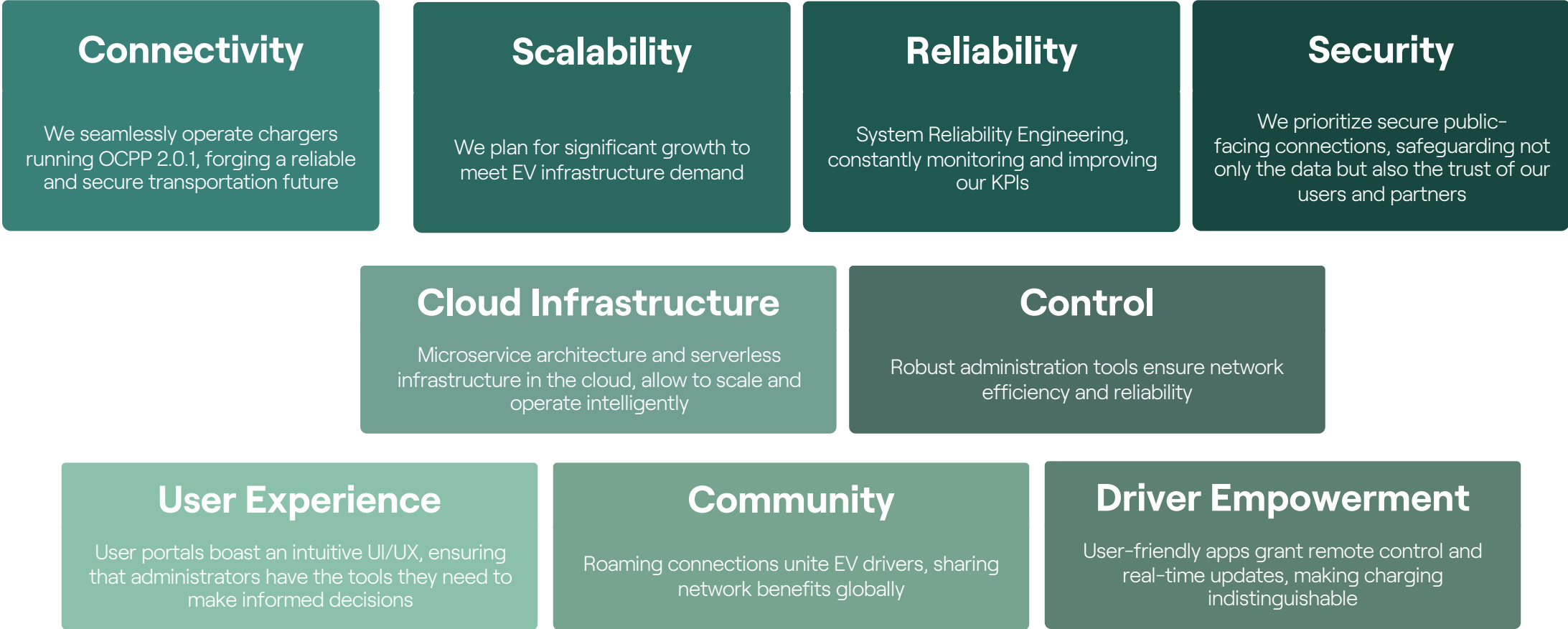
Forward Thinking:

- ✓ Author of the LF Energy project CitrineOS, industries first Open-Source OCPP 2.0.1 CPMS software stack. Strategically positioned to overcome and adapt to future proof charging protocols and inevitable industry compliance changes
- ✓ Active contributor to the EV Roaming Foundation, currently working to define OCPI 3.0 protocol evolution



LFENERGY

S44 Commitment to EV Charging





Capabilities & Services

Custom Software Driving EV Adoption



Energy

EV Charging Applications

eMSP

Native Mobile Apps

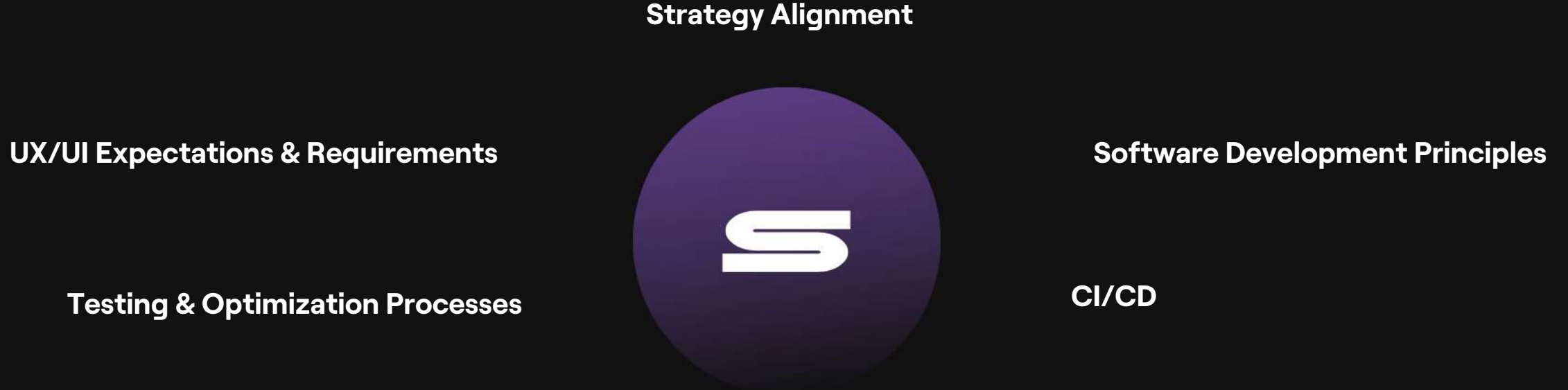


E-Mobility

Fleet Electrification

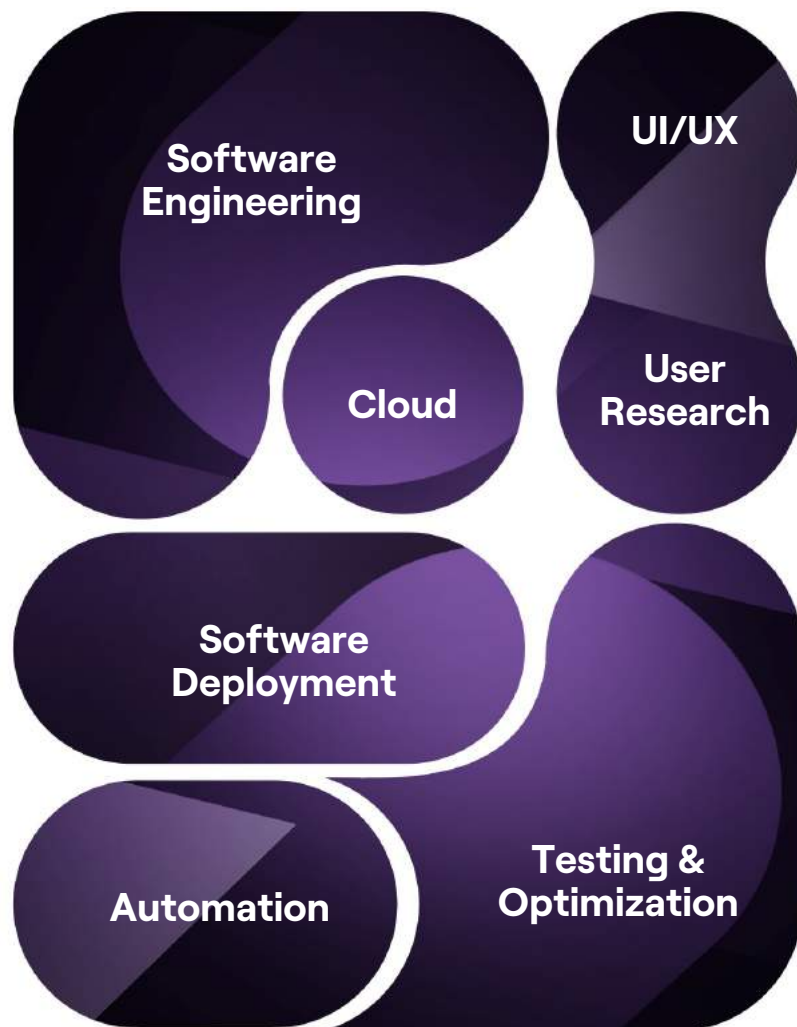
CPMS

CPO



S44 Solutions Approach

We apply Agile methodology as together we work to answer the "Why" - the tool is needed through a product-led mindset and team organization; "What" the desired outcome of our tool is; and "How" it should be structured and optimized to maximize utilization and impact. This means that we begin each assignment by asking critical questions to understand the business need, requirements and end-user engagement, and organize project milestones.



Full Cycle Software Development

User-centric digital experiences transforming industries for a more sustainable future.

S44 Digital Experience Teams create solutions starting with user needs and insights, and pull diverse viewpoints from account leads, software developers, designers, testers, and strategists to maximize impact.

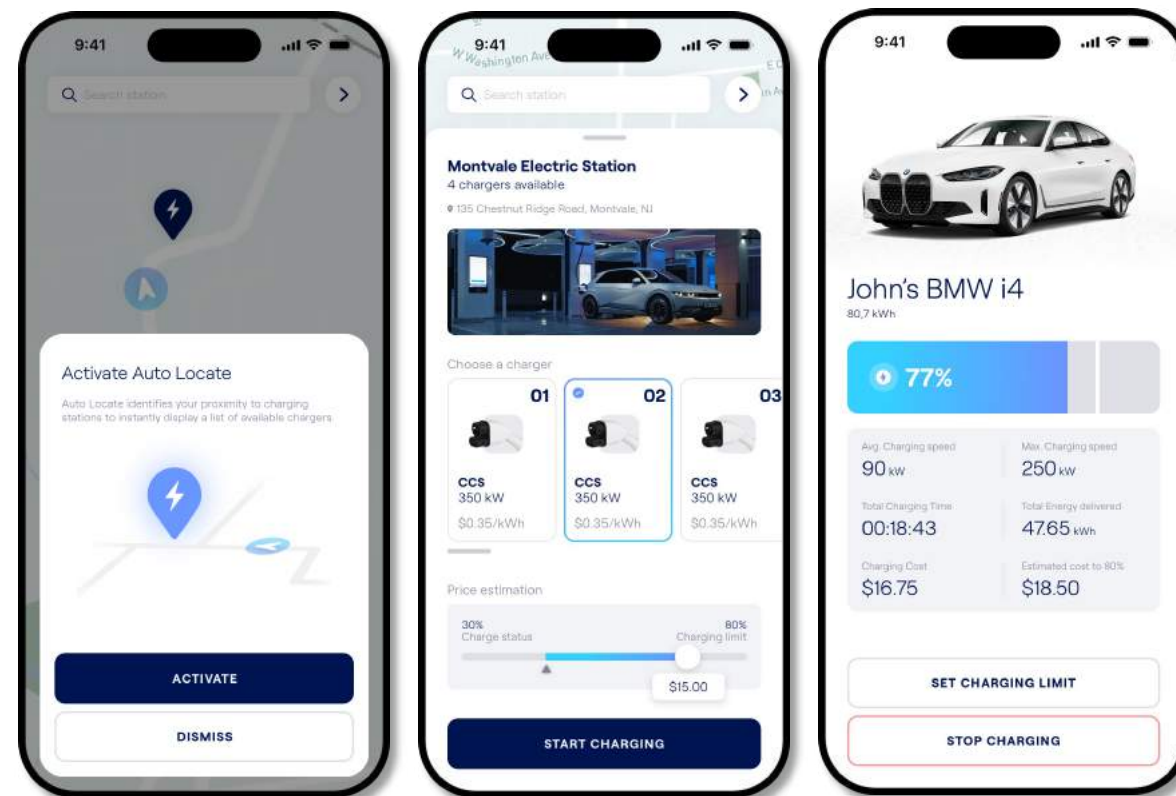
We use agile methodologies to craft customized solutions that prioritize end-user needs, business requirements, technology expertise, and industry expertise, resulting in impactful digital experiences that drive significant business impact.

Onshore development, design and QA teams located in:

- New Jersey & New York City, USA
- Munich, Germany

User Experience & Design

- ✓ UI/UX Product Design is the result of integrated teamwork with developers, researchers and analysts.
- ✓ S44 Digital Experience teams blend creative thinking, technical expertise, and insights from user research to craft innovative charging solutions, offering electric vehicle owners a smart, easy, and convenient way to charge anytime, anywhere.
- ✓ Bespoke EV charging apps grant customers access to our customers' charging networks and offer real-time information on availability, pricing, and compatibility
- ✓ Charging network customers can reserve, pay, and monitor their charging sessions through the app.





CitrineOS

OCPP 2.0.1 Compliant Charger Management Software



Empowering the Global EV Revolution with Open-Source Innovation

CitrineOS mission is to drive the transformation of the electric vehicle (EV) charging landscape, making it more attainable, equitable, and diverse than ever before. For over a decade, creators of CitrineOS – S44 – have been at the forefront of EV charging software, powering automotive OEMs and leading EV network operators.

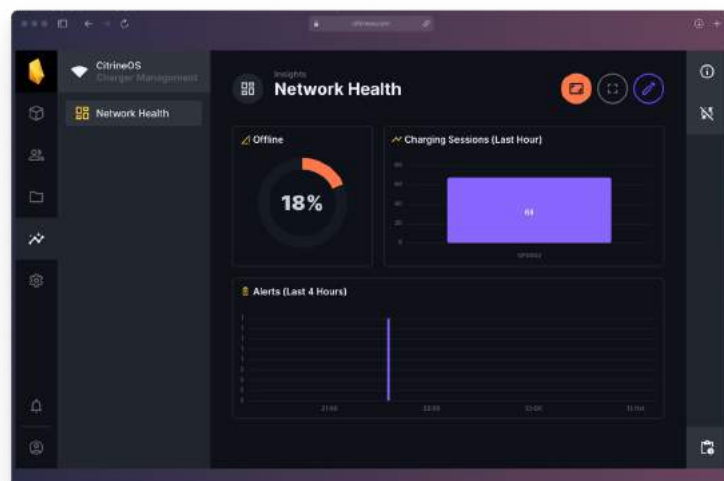
Now, through CitrineOS, we are taking a giant leap forward in advancing the adoption of electric vehicles and diversifying the EV charging infrastructure worldwide.







What is CitrineOS?

CitrineOS is the first and only open-source OCPP 2.0.1 compliant charging management software, that allows you to operate charging station equipment within minutes of getting started.

How does it Impact?

In a landscape of closed networks and outdated protocols hindering EV adoption, CitrineOS is built using the industry's first open-source foundation for creating a scalable, modular CPO network.



-  **Provision New Charging Equipment**
-  **Complete Charging Transactions**
-  **Remotely Control Charging Equipment**
-  **Monitor Uptimes, Power Levels and Degradation**
-  **Manage Energy Consumption and Throughput**
-  **Open Charge Point Protocol (OCPP 2.0.1)**

CitrineOS: Redefining EV Charging Networks with Unmatched Innovation

Rapid Deployment

90% faster time-to-market compared to other custom solutions. 100% API based for fast integration

Future-Proofing

Latest OCPP 2.0.1 protocol implementation. Vastly improved, monitoring and charging station management capabilities

Interoperability

Community and crowd-sourced validation, outperforms limited lab testing

Cloud Agnostic

Runs and scales on any cloud provider. Serverless runtime with low management footprint

Reliability

Constant bug-fixes and enhancement due to active developer community

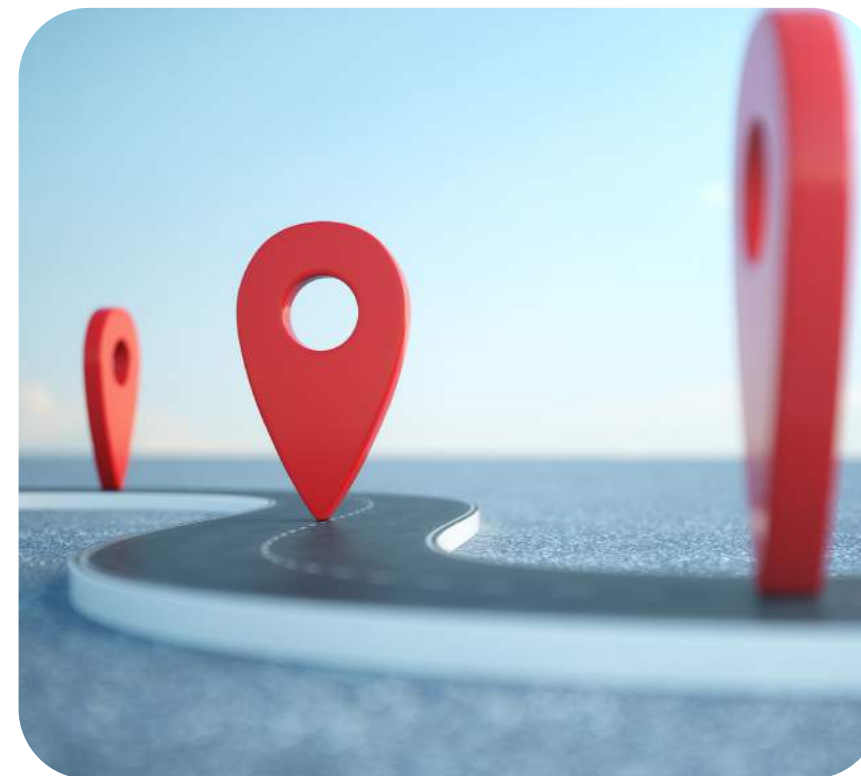
Open-Source Foundation

The core features are yours and everyone's. No vendor-lock, ensuring adaptability for evolving industry standards



Citrine Ecosystem

- ✓ **CitrineOS meets OCPP 2.0.1 core & advanced security certification profile requirements**
 - RC branch with OCTT success exists
 - Full release schedules & OCA certification
- ✓ **Other OCPP 2.0.1 certification modules:**
 - Smart Charging, Advanced Device Management, Advanced User Interface, Reservations, ISO15118 Support, Local Auth List Management
- ✓ **Operator UI based on Directus**
- ✓ **Stripe & Payment Providers Support**
- ✓ **Tester sandbox**



Citrine + S44 Custom Development

CitrineOS

OCPP Charging Station Management System

OCPI Charge Point Operator

Roaming With MSPs

ISO15118 Charge Station Operator

Operator Payment Gateway

Administrative UIs for Network Operations

S44 Custom Solutions:

OCPI eMSP

Roaming With CPOs

ISO15118 Mobility Operator

Customer Payment Gateway

EV Driver Mobile App

Customer Account Management

Call Center Customer Support



Our Approach

Agile, Collaborative & Multi-Disciplinary Solution Development

Scope Management Approach

- Consistently enforce Agile methods to reduce overhead while delivering; reduce defect rate
- Dedicated Product Owner owns requirements and product vision
- Release schedule for transparent value delivery
- Optimized time to market cycles
- Impact-focused and product-driven approach to prioritization
- Continuous knowledge transfer and increased work collaboration between S44 and clients, as internal resources are identified

Universal 2-Week Sprints

CI/CD Automation

Release Cadence & Schedule

Cross-functional product teams

Implementation Workflow



Quality Assurance

In all of our development efforts, we deploy

- ✓ **Functional Testing:** Validate basic functions, including user interface.
- ✓ **Integration Testing:** Ensure smooth data flow between components.
- ✓ **Communication Protocol Testing:** Verify effective communication with EV management systems.
- ✓ **Compatibility Testing:** Ensure solution works across various integrated platforms.





Case Studies

Innovation Supporting Diverse EV Charging Use Cases

Fast Scaling EV Charging Network

Integrate Off-the-shelf Software Components With Custom Services And Applications To Establish A Durable Ecosystem

Originally, our client utilized an Off-the-Shelf solution (Greenlots) for the Charging Backend (CPO). The objective was to shift towards a custom solution and empower our client to own and operate their own network.

Within six months, S44 autonomously spearheaded the design and development of the new solution. The focus was on distinctly separating interfaces between CPO and MSP, enabling a highly scalable OCPP communication stack, and creating intuitive user interfaces (common OCPI library). This approach was tailored to meet the specific requirements of internal stakeholders and existing processes, with the anticipation of real-time data visibility. Also incorporating the network scaling and growing supporting additional user use cases.

To bolster this initiative, we leveraged cutting-edge technologies designed for scalability, observability, reliability, and availability. The solution was built on AWS, incorporating tools such as ApiGateway, EventBridge, ECS, DocumentDB (MongoDB), layered VPC, DMS, OpenSearch, Lambda, CloudWatch, CodeDeploy, and more. Authentication and authorization were facilitated through seamless integration with Auth0. Our approach to automation and testing involved utilizing Jenkins, Postman, Nexus, and other relevant tools.



EV Charging OEM Integration

Provide Multiple OEM Onboarding And Integration via Custom Solution

As the driving force, S44 collaborated closely with clients and OEMs to create a customized onboarding solution for integrating various OEMs into the client's charging infrastructure **in six months**. The solution, which included Plug and Charge (PnC) as an optional feature, accommodated multiple brands such as **BMW, Honda, Jeep, Maserati, Audi, Ford, Mercedes, and others**. S44 designed and developed this new solution, moving away from the constraints of an off-the-shelf solution (Greenlots) for OEM integration.

Our solution empowered OEMs with both standard charging interfaces (OEM service) and the option for tailored interfaces (MSP as a Service). S44 also implemented a streamlined onboarding process, integrating OEMs with clients' centralized authentication system, automating end-user data verification from dealerships, and facilitating enrollment in diverse payment plans—beyond standard OCPI, requiring substantial development effort from S44.

The solution was built on AWS, incorporating tools such as ApiGateway, ECS, DocumentDB (MongoDB), Lambda, CloudWatch, CodeDeploy, and more. Authentication and authorization were facilitated through seamless integration with Auth0.



EV Charging Native Mobile App

Native iOS and Android EV Charging Mobile App With White Label Capabilities

Initially, the client relied on an Off-the-Shelf mobile application (Greenlots) for the end-user charging experience. The goal was to transition to a custom mobile application, granting the client autonomy to own and deploy their unique graphical user interfaces while seamlessly integrating with multiple OEMs and support localization on English and French.

In nine months, S44 autonomously developed new custom Android and iOS mobile native applications. The primary focus was on creating user-centric mobile applications with support for white labeling, allowing multiple OEMs to seamlessly integrate. These mobile applications were intricately connected to a custom EMSP solution, ensuring the provision of charging and user data. This effort also included facilitating mobile push notifications and NFC integration.

Key technologies employed in this development included SwiftUI and Combine, both of which were relatively new at the development time. Design patterns encompassed a combination of MVVM, Clean Architecture, and a custom implementation of Redux. Supporting technologies included AWS Mobile Push Notifications and SNS (Simple Notification Service).



EV Charging EMSP Solution

Custom EMSP Solution, Based On OCPI 2.2.1, Includes Modules For Enhanced Flexibility And Future Needs

Initially, the client relied on the Off-The-Shelf solution (Greenlots), which, in Greenlots' perspective, treated the client as an OEM and offered limited EMSP services. **In 9 months**, S44 took the initiative to independently design and develop a customized, accessible and efficient EMSP solution tailored to meet the specific requirements of the client, enabling seamless integration with various OEMs.

The foundation of the EMSP solution rested upon a series of microservices, facilitating integration with Identity Providers (IdP), interfacing with the Heartland payment provider, functioning as the charging price aggregator, orchestrating mobile push notifications, and serving as the overarching interface between the CPO and the mobile app. To clearly distinguish between CPO and EMSP interfaces, S44 created a common OCPI library. This library served as the foundational implementation for all OCPI modules, providing a EMSP base skeleton that allowed for customization overrides.

Key technologies we used were Java Spring Boot, Micro-Services, AWS Serverless stack, Apigateway, MongoDB, Hazelcast, Docker, Event Bridge, CloudWatch, Postman, Jenkins and may others.



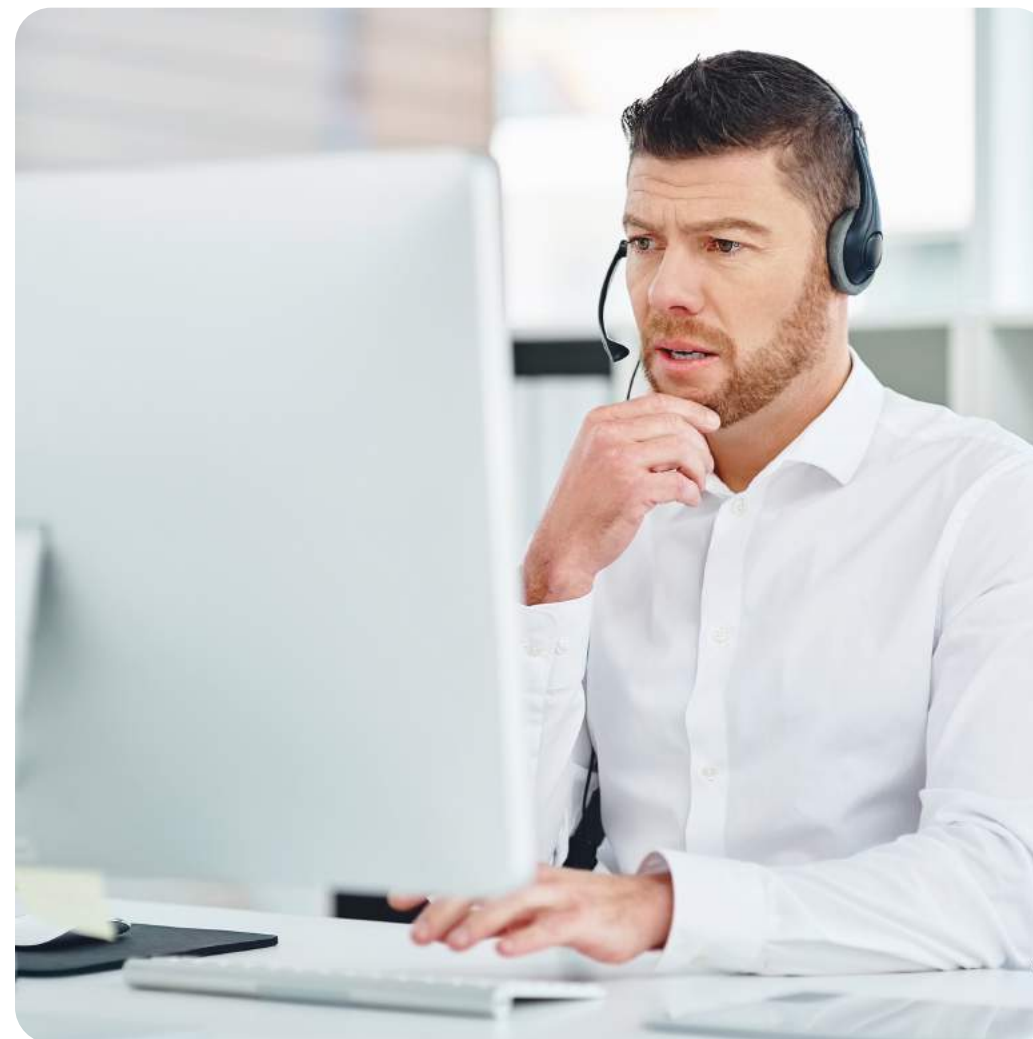
Back Office – Network Management

Custom Software Solution For Seamless U.S. Network Infrastructure Management, Streamlined Operations, And Exceptional U.S. EV Driver Support

Initially, Greenlots provided our client with essential charging management tools for network management, pricing, and billing solutions. Recognizing the need for a more tailored approach, a transition plan was formulated to migrate towards customizable solutions that better aligned with business requirements.

Within one year, S44 developed comprehensive asset management, charger management, pricing management, and help desk solutions. This additionally encompassed vital data migrations, facilitating the smooth transition from Greenlots to the newly customized solutions. These systems facilitated comprehensive commissioning and management of network chargers, offering the creation and utilization of customizable membership-based plans and tariffs, as well as providing robust user management tools, empowering users to effortlessly view and manage transactions and sessions.

To ensure flexibility and robustness, these solutions leveraged established frameworks, services and tools –Directus CMS, Vaadin, React, Spring Boot, AWS ECS, API Gateway, MongoDB, PostgreSQL, OpenSearch., Kinesis, Lambdas, CloudWatch, CodeDeploy, Jenkins, Docker.



Let's Do Great Work Together!

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