

 **Electric Era**

Accessing & Enabling Superior EV Charging Station Reliability

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As EV adoption accelerates and stakeholders from governments to retailers race to provide EV charging infrastructure at the pace of demand growth, challenges beyond the speed of deployment emerge. In particular, reliability is of key concern to the EV charging industry. Reliability underpins everything from custom satisfaction to the profitability and viability of EV charging as a business. Still, inferior reliability has become a significant challenge for many EV charging station operators.

In this white paper, Hasitha Dharmasiri, VP of Engineering at Electric Era, explores the nuances of EV charging reliability, breaking down:

<p>Metrics and Measurement</p> <p>Why the absence of industry-standard reliability measurements obfuscates the “true” rate of charging success as experienced by drivers</p>	<p>Root Causes</p> <p>What the most common causes of inferior reliability are in EV charging</p>	<p>Accelerating Superior Uptime</p> <p>How innovative solutions—including those employed by Electric Era—promote a higher standard of reliability, uptime, and session success</p>
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01 Overview

As the electric vehicle (EV) market expands, reliable public charging infrastructure is critical to support existing and future EV adoption. However, while expanding the number of charging points is critical, emphasizing charging station and charger reliability is equally important. Two key metrics are often analyzed to evaluate reliability: Charger uptime and session reliability. Though they are related, these metrics capture different aspects of the EV charging experience.

This white paper will explore the root causes of low session reliability—which range from internet connectivity issues to the complexities of the ISO 15118 communication protocol, interoperability issues between chargers and vehicles, failures in payment authorization, and more. It will also examine the common factors that contribute to low charger uptime, such as equipment vandalism, degradation due to harsh environmental conditions, and, most significantly, the absence of effective fault detection, isolation, and recovery mechanisms. Further, we will discuss how the industry measures key performance indicators for reliability.

Finally, we will outline the methodology Electric Era employs to ensure high levels of reliability across its charging network. By focusing on both hardware and software solutions, Electric Era promotes unmatched



uptime and session reliability. Examples of systems that improve reliability include offline payment support and session authorization, which is enabled by novel, on-site edge compute. Additionally, Electric Era leverages rich telemetry and advanced fault detection systems to enable rapid identification and isolation when problems do arise.

02 What is the difference between session reliability and charger uptime?

The distinction between two common metrics used to evaluate EV charging reliability, namely session reliability and charger uptime, is crucial to understanding the overall performance of EV charging infrastructure.

Charger uptime

Charger uptime refers to the percentage of time a charger is operational and physically available for use.

This metric focuses on the hardware's functional status—whether the charger is powered on and capable of initiating a charge, or is already charging. High uptime is essential to ensure that charging stations are accessible to drivers. But it alone does not necessarily guarantee a smooth user experience.

Session reliability

Session reliability measures the successful completion of a charging session, encompassing the user experience from the moment a driver connects their vehicle to the charger until the session concludes.

Session reliability takes into account a wider range of variables than charger uptime does. A charging station can have excellent uptime but poor session reliability, a situation that may be just as frustrating for users as a charger being entirely offline. Addressing both uptime and session reliability is essential to improving the dependability of EV charging networks and enhancing driver confidence in electric vehicle infrastructure.

The following sections explore this in greater detail.



03 How is uptime measured?

Understanding how uptime is measured is an important first step in assessing uptime in general. The EV and EV charging industries as a whole are not always consistent in their measurements; when evaluating self-reported uptime performance between EV charging service providers, keep this in mind.

Tesla Motors’ definition of uptime

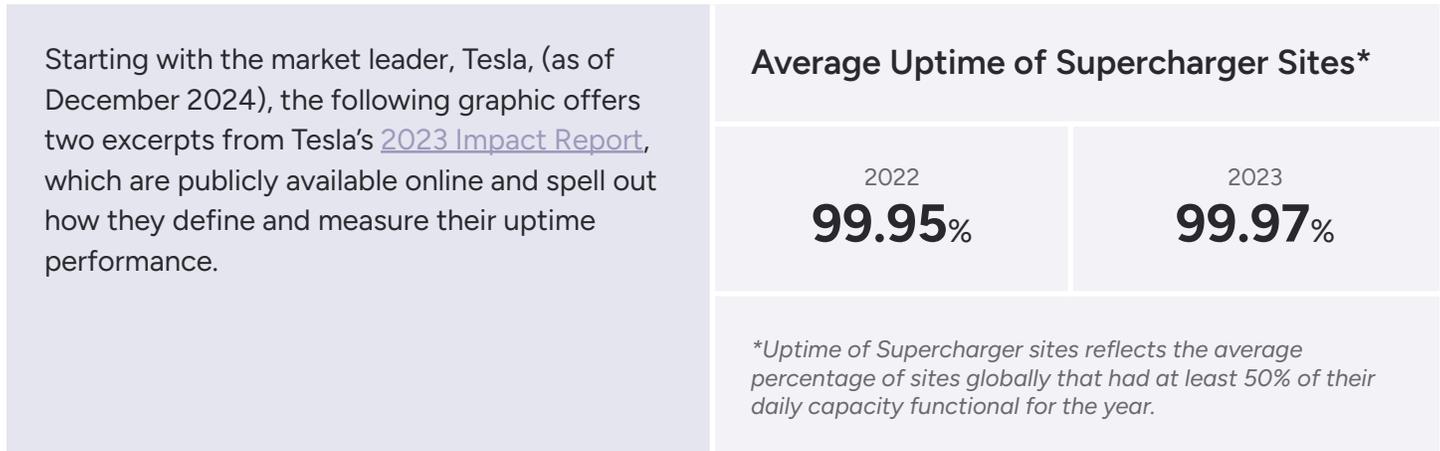


Figure 1: Excerpts of uptime performance as reported by Tesla’s 2023 Impact Report.

The 99.97% figure sounds impressive and represents a yearly downtime of only 2 hours and 36 minutes for a charger that is otherwise available 365 days per year, 24/7. That said, once we evaluate how uptime is calculated by Tesla, we can uncover more complexity.

Tesla defines uptime as: “Average percentage of sites globally,” which indicates that it is averaging the uptime performance across all of its sites. This isn’t unreasonable. However, Tesla also dramatically simplifies its uptime calculations by evaluating stations on a binary basis. A station site is considered “up” if more than 50% of daily capacity (understood to be more than half of all charging ports) is functional and “down” otherwise. For example, a site with 12 ports, where 5 are unavailable for 6 months, still reports 100% uptime.

This sort of approach raises fundamental questions about how uptime—and some providers' definitions of it—correlates with the charging public’s needs. Drivers that rely on public fast charging have two predominant requirements when traveling: 1) that charging stations have functional chargers, and 2) there isn’t a long line for said chargers. While requirement #1 is addressed by Tesla’s metric, requirement #2 is not necessarily. A site at 60% capacity in a busy location can easily see significant congestion with long dwell times. This fails to satisfy drivers’ needs even if it meets Tesla’s uptime performance standards, creating a potential disconnect in what Tesla’s uptime metric communicates.



National Electric Vehicle Infrastructure guidance on uptime

The National Electric Vehicle Infrastructure (NEVI) program lays out an uptime metric requirement that is very different from Tesla's and that is more favorable to drivers. Below is the excerpt from the federal NEVI guidelines ([23 CFR Part 680](#)):

(b) Minimum uptime. States or other direct recipients must ensure that each charging port has an average annual uptime of greater than 97%.

(1) A charging port is considered "up" when its hardware and software are both online and available for use, or in use, and the charging port successfully dispenses electricity in accordance with requirements for minimum power level (see § 680.106(d)).

This approach of using per-port uptime is favorable to meeting drivers' needs for both charger availability and capacity.

There are other complications to consider when assessing reported uptime, such as carve-outs (excluded downtime events). For example, NEVI guidelines lay out the following [list](#) of potential exclusions:

T_{excluded} = total minutes of outage in previous year caused by the following reasons outside the charging station operator's control, provided that the charging station operator can demonstrate that the charging port would otherwise be operational: electric utility service interruptions, failure to charge or meet the EV charging customer's expectation for power delivery due to the fault of the vehicle, scheduled maintenance, vandalism, or natural disasters. Also excluded are hours outside of the identified hours of operation of the charging station.

Note the importance of carve-outs for "reasons outside the charging station operator's control" in the above. Examples include scheduled maintenance, vandalism (an example being cable theft), or electric utility service interruptions (i.e. a power outage). Despite these events being non-at-fault events on the part of EV charging service providers, should they be excluded? Regardless of who is at fault, drivers who rely on fast charging infrastructure are impacted all the same.

Electric Era definition of uptime

Electric Era adopts the per-port uptime metric as defined above by NEVI, but with one primary modification:

The only exclusions to uptime allowed for Electric Era's purposes are power outages or force majeure events, such as natural disasters. This measurement modality ensures that the station operator's incentive is, within reason, always aligned with driver interests. Station downtime due to vandalism or scheduled maintenance still requires a rapid response so as not to disrupt charging customer experiences, which should align closely to what metrics measure and reward.



04 How is session reliability measured?

Session reliability, sometimes referred to as the “plug-in success rate” or the “successful charge attempt rate” (SCAR) is also open to significant interpretation in terms of how it is measured. Most EV charging service providers do not report on this metric to begin with. In this paper, we will present a standardized method provided by the California Energy Commission (CEC), as well as Electric Era’s own measurement methods.

California Energy Commission (CEC) definition of session reliability

Proposed regulation for the CEC, as published in the [latest staff report](#), outlines the state’s plan to measure SCAR:

“Ninety percent of the time that a customer attempts to initiate a charging session at a regulated charger the charging session must last at least five minutes, which will be considered a successful charge for this regulation. The minimum SCAR is defined on a per-port and not-site basis; each charger at a charging site must achieve a SCAR of at least 90 percent to comply.”

It is important to note that carve-outs are present here too. For instance, one notable example includes:

“Some charging session failures such as some external payments failures are not reported in OCPP (Open Charge Point Protocol) and will not be counted toward the minimum SCAR.”

These carve-outs can, as we saw with respect to uptime, misalign the metric with the actual driver experience. As shown later, payment failures are in fact a primary cause of low SCAR.

Electric Era definition of session reliability

To avoid confusion, Electric Era employs a simple metric for SCAR.

A “charge attempt” occurs any time a connector is plugged into a vehicle (including improper insertions).

A “successful charge attempt” occurs when the charging session delivers more than 0.1 kWh of electricity and lasts for more than 30 seconds.

Note that all driver-at-fault and vehicle-at-fault scenarios are considered in Electric Era’s metric: Payment declines, improper insertions, and vehicle incompatibilities will count against Electric Era’s SCAR. While this makes SCAR objectively more “difficult,” it prevents ambiguity in measurement and aligns session reliability performance with drivers’ expectations and experiences.



05 What are the causes of low uptime?

Whether a charger port is available to charge a vehicle requires a large number of systems to operate in concert simultaneously. The failure of any one of these systems can result in downtime. The following graphic illustrates this concept:

Required for charger port operation					
	Grid power available	Internet connectivity	Payment system available	Charger energized	Cable assembly available
Possible failures	Power outage	Cloud downtime	Cloud downtime	AC/DC failure	Cable drops
		Internet outage	Credit card reader tampered with	Safety circuit tripped	Vandalism

Each of these steps in the chain to successful charging uptime is addressed in detail below:

Required step	Possible failure
Grid power available	<p>Power Outage</p> <p>Power service interruptions, while rare, are an obvious source of downtime. Impact to downtime is variable by utility region, but on average, per location, a total of 3 to 8 hours per site per year of downtime is expected due to power outages (based on a recent EIA study). These outages can be mitigated with microgrid-capable, on-site battery energy storage (BESS).</p>
Internet Connectivity	<p>Internet Outage</p> <p>Chargers by default use OCPP 1.6 / 2.0 to communicate with backend servers that provide charging authorization. Internet outages prevent authorization from succeeding, rendering it impossible to authorize a charge.</p>
	<p>Cloud Downtime</p> <p>Similar to the above, if a charger can't open an OCPP websocket connection to its backend server due to a cloud services outage, the outcome is similar to that of an internet outage. Perhaps most impactful in this case is the fact that cloud outages can impact an entire fleet of chargers. While statistical evidence on cloud uptime is scarce and private, anecdotal evidence exists that this can present issues.</p>
Payment System Available	<p>Credit Card Reader Tampering</p> <p>This is a common failure mode amongst unattended credit card payment terminals. In conformance with PCI/PTS standards, payment terminals will contain several anti-tamper mechanisms to ensure that secret key material located inside card readers is kept secret. In particular, credit card readers are designed to fail safe by "bricking" themselves if they detect thermal shock or physical ingress. If</p>



these sensors experience a false-positive trip, it renders the credit card reader unusable without field service replacement.

Cloud Downtime

Similar to the OCPP backend, payment service providers must ensure their gateway service is available to process payments. Anecdotal evidence indicates that a typical payment service provider will ensure 99.99+% SLAs for cloud uptime. Hence, associated issues represent a small fraction of overall downtime.

Charger Energized

Safety Circuit Tripped

UL 2202, the certification associated with DC EV supply equipment, requires a number of safety mechanisms to prevent operator injury when using EV chargers. Two of the most important ones relating to uptime are:

- Hazardous DC voltage shall not be present if access doors to the dispenser are open. Similar to payment terminals, false-positive signatures by door sensors will result in charger downtime.
- Overtemperature, here classified as $>90\text{ }^{\circ}\text{C}$ at the DC contacts for more than two occurrences, shall result in permanent disablement until a field service is performed. This type of requirement can lead to charger downtime if current control loops by the charger to prevent over-temperature are not carefully observed.

AC/DC Failure

A common, highly exercised electrical component in the charging system is the AC/DC conversion hardware, responsible for converting the AC grid voltage to the vehicle DC battery voltage for charging. These are the most electrically stressed components in the charger, and present a failure risk. As a mitigating factor, most DC fast chargers contain several AC/DC conversion modules. These are typically wired in parallel and are capable of being operated even with partial failures.

Cable Assembly Available

Vandalism

Vandalism encompasses a large category of intentional damage to chargers. Overwhelmingly, the most permanent, common, and intentional damage to chargers comes from cable theft; perpetrators cut charging cables near the dispenser entry point in order to capture as much copper (which they can then sell) as possible.

Cable Drops

The cable head itself (sometimes referred to as the “gun”) is composed of tightly toleranced plastic, as well as a temperature sense circuit used for safety. It is also the most likely part of the charger to be repeatedly dropped as part of normal use. In particular, elements such as the CCS clip in Figure 2 are prone to damage.



Figure 2: CCS Combo 1 charger-side connector with damage-prone clip highlighted.

06 What are the causes of low reliability?

Similar to uptime, a large number of systems must work together to charge a vehicle successfully. As a result of this complexity, it is challenging to ensure high session reliability, significantly more so than with gasoline stations and pump infrastructure.

Several industry studies have tried to classify visible causes of low reliability. One such study that we will use to help ground Electric Era's conclusions is a [UC Berkeley study](#) that was conducted in the San Francisco area. In this study, 657 CCS1 connectors were evaluated at 181 open public DC fast charging stations. The results of the study not only provide a measure of session reliability but also break down results for failed attempts by failure causes and mode.

Table 2 and Table 4 from the Berkeley study are used to generate the results below. For our purposes, Electric Era considered only the chargers where charging was actually attempted. Out of the 657 eligible connectors, 6 were excluded for being broken, 23 for having non-responsive UIs, 32 for physical cable access issues, and 101 for already being in use. Here are the results after making these exclusions:



Failure Mode	Count	% total
None / Successful 1st Attempt	189	38.2%
1 or more credit card reader (CCR) failures	85	17.2%
CCR did not work and app was required	92	18.6%
No payment worked and free charging was required	9	1.8%
Could not charge because of a charger error	24	4.8%
Charger experienced a network or communication error	7	1.4%
No payment worked and there was not a valid app fallback	47	9.5%
Charging session terminated early	42	8.5%

Table 1: Failure modes tracked against the 495 attempted sessions

As you can see, payment issues are the predominant source of issue here. Importantly, 186 out of the 495 sessions, while ultimately successful, required more than 1 payment attempt from customers. After payment issues, early termination and charger errors, which stem from interoperability or electrical connection issues, were the second largest overall drivers of charging failures. All of these failure modes are discussed in further detail below.

Payment Failures

With respect to payment failures, drivers of root issues vary. Importantly, full network outages are not necessarily the cause of most payment failures. Intermittent/poor connectivity can be just as, if not more impactful. This study was unable to find industry sources of connectivity-related payment failures. However, Table 1 shows Electric Era’s fleet total offline transactions, as well as those for the site with the lowest signal-strength Internet connection, for periods of time where sites were overall recorded as being online. Bear in mind that Electric Era utilizes 3 redundant internet connections at all sites, and the highest signal strength is selected automatically.

Site	Online Auths	Offline Auths	Percentage Offline
Entire Fleet	1,349	44	3.16%
Site with Worst Internet	94	6	6.00%

Table 2: Electric Era payment authorizations during a period of time where the site was recorded online

Notably, on average, over 3% of transactions still occur offline while the site is considered online. This is attributed to small, intermittent connectivity losses, which can occur during the moment of payment interaction and would otherwise cause charging failure if it weren’t for offline capabilities.



Vehicle Interoperability

Another challenge to session reliability stems from issues with vehicle interoperability. Specifically, the component in the vehicle that communicates with the charger, the Electric Vehicle Charge Controller (EVCC), can cause charging attempts to fail. Vehicle-charger interactions are governed by two major industry-standard specifications: 1) DIN 70121 (largely deprecated) and 2) ISO 15118. ISO 15118 itself is a complex specification—as a proxy for complexity, consider that test suites typically contain between 100-200 test cases to cover. It is relatively common industry knowledge that vehicles do not all conform fully to these specifications. As a result, the functionality of the Supply Equipment Charger Controller (SECC) in a fast charger must be carefully designed to accommodate as many cases as possible.

Vehicle interoperability is also a moving target. It is typical for OEMs to issue over-the-air (OTA) updates to vehicles, rendering a previously tested vehicle now incompatible.

Additionally, there are numerous EVCC manufacturers and there is not a 1:1 relationship between them and OEM brands. Table 2 provides a non-exhaustive list of EVCC manufacturers. Note that there are a large number of providers for the North American EV market:

EVCC Manufacturer	Associated OEM Brands
We Corporation	Hyundai, Kia (e-GMP Platform)
TESTOP	Hyundai, Kia (K-Platform)
Delta Electronics	Ford Motor Company
LG Innotek	General Motors
Visteon	General Motors (Ultium Platform)
Lear	Polestar
Denso Electronics	Subaru, Toyota
Continental	Volkswagen

Table 3: EVCC manufacturers and associated OEM brands (not exhaustive, subject to change)

HomePlug GreenPHY

One important component of ISO 15118 is ISO 15118-3, which describes the “physical layer” that governs, electrically, how vehicles communicate with chargers. This physical layer uses the HomePlug GreenPHY standard present in a CCS or NACS cable, for communication over the control pilot (CP) signal.

Even with OEMs, manufacturers, and other stakeholders utilizing the GreenPHY standard for communication, there are challenges for reliable (and secure) EV/EVSE communication. Due to the fact that typical cable lengths run about 10m and the frequency of operation of GreenPHY is between 2-28 MHz, charging cables



actually operate as antennas, which can induce cross-talk at a multi-charger site. This creates [legitimate security concerns](#), but primarily it forces chargers and vehicles to perform an operation called Signal Level Attenuation Characterization (SLAC) as a “handshake” to ensure that a given EVSE is speaking to its physically connected EV, and not accidentally electrically coupling to another EV via cross-talk.

Ultimately, this complexity can lead to EV/EVSE communication timeouts if and when SLAC does not succeed. Furthermore, it is reasonable to conclude that poor contact between the control pilot signal can have an outsized effect on communication. This can be exacerbated by end-user operation; CCS connectors, which have ergonomic limitations, are not always intuitive to insert properly.

07 What solutions are implemented to enable high reliability and uptime of charging stations?

To address the question raised above, let’s evaluate available solutions and those employed by Electric Era to mitigate issues that can hinder charging port uptime and station reliability.

Mitigating payments-based uptime and session reliability issues

Payments are a significant source of both uptime and session reliability faults. While industry data is somewhat limited in regards to exactly how payments routinely fail in EV chargers, Electric Era has acquired a large amount of evidence from the operation of its own fleet of charging stations.

As discussed, payment hardware reliability is the largest driver of uptime associated with payments in general. Overwhelmingly, the industry utilizes credit card readers (CCRs) that are commonly found in vending machines, which are a typical unattended credit card reader use case. It is important to note that vending machines are not critical infrastructure; it cannot therefore be assumed that CCRs for vending machines should be treated as adequate for EV charging infrastructure. Electric Era validates CCRs that are tested for high environmental stresses. The following are key considerations:

- Direct solar load - in locations where the charger is directly exposed to sunlight for large portions of the day
- Thermal shock from precipitation - typical examples being snow or freezing rain
- Continuous daily thermal cycling - in locations that experience large temperature swings, such as desert biomes
- Dust and water ingress - typically a concern for the sensitive electronics partially exposed to the elements in the chip reader and magnetic stripe reader
- Impact - from rough use of the terminals by inattentive drivers, or wind loading

At Electric Era, supporting offline payments, which supports reliability overall, is handled through a combination of two mechanisms: 1) support of offline payments by the payment gateway service and 2) a compute element on-site that can manage the payment terminal when an Internet connection is failing.

As indicated earlier, payment failures occur largely due to intermittent connectivity. If a pre-authorization fails, Electric Era employs edge compute to accept the pre-authorization regardless and retry periodically, which allows the driver to continue charging unimpeded. Conversion to sale is also retried until success. A

non-zero risk remains that an invalid card is processed offline during a lengthy Internet outage, but this financial risk to the station owner is generally small compared to the outsized risk of poor driver experience and the downstream loss of repeat charging traffic.

Eliminating Internet connectivity requirements for session authorization

In addition to payments, typical chargers require a backend connection in order to authorize and start charging. The following figure shows the typical communication flow exercised by an OCPP 1.6-based system:

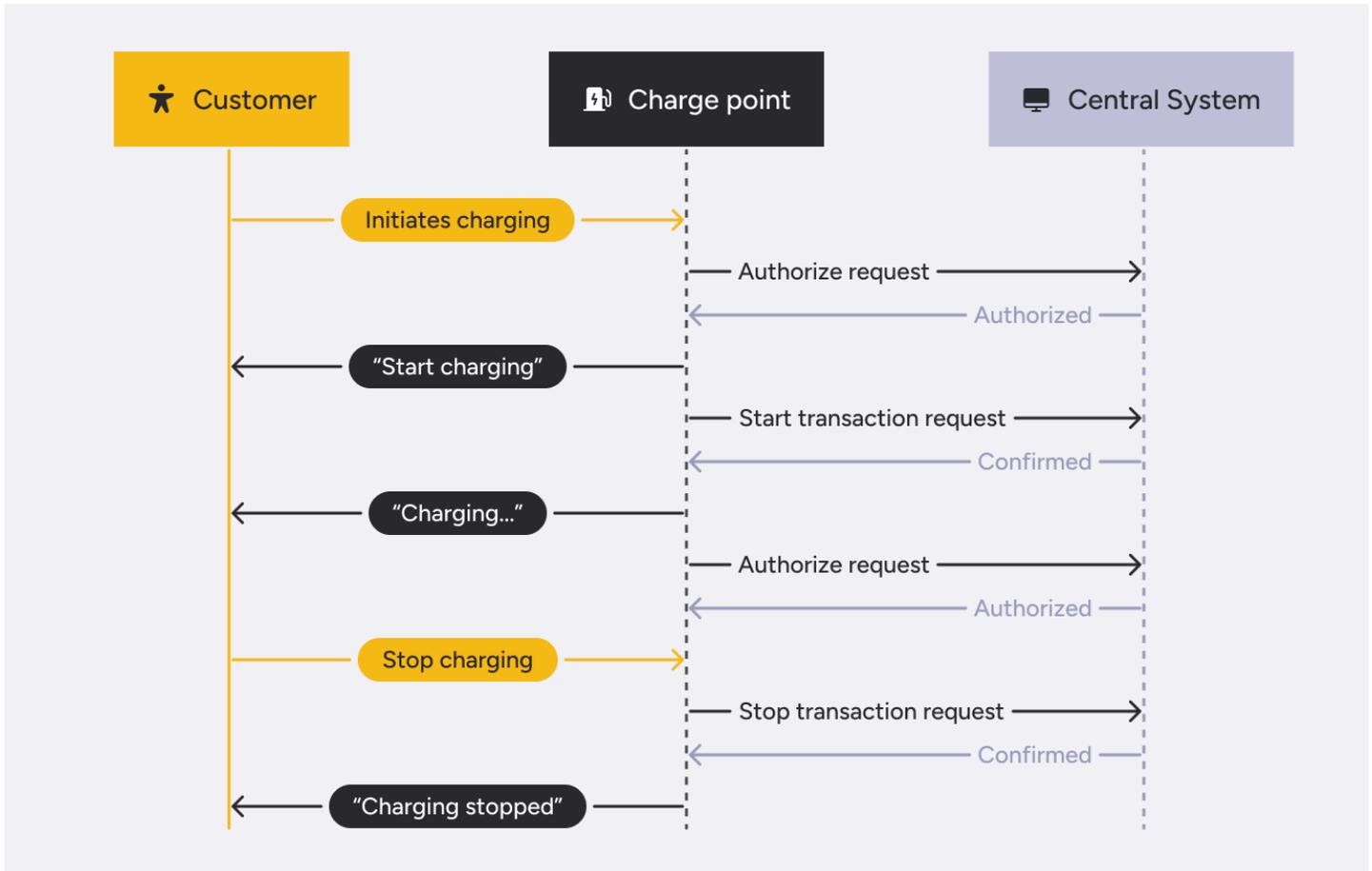


Figure 3: The flow of messages between the end-user driver (customer), the charger (charge point), and the central system (OCPP backend) in a typical transaction.

Notably, interaction with the “Central System”, typically operating as a cloud service, is performed twice (though a StartTransaction.conf is not always required) before charging begins. The Central System is responsible for validation authorization to charge, whether it is from credit card authorization, EV network services like Plug-and-Charge, or some other means (like RFID card). While Plug-and-Charge requires internet connectivity to successfully authorize, credit card authorization, as shown in the previous section, does not.

Electric Era takes advantage of offline payment authorization and additionally runs a Central System at the charging station itself to handle offline charging session authorization. While total outages have been rare, they have occurred, and [anecdotal accounts](#) show that such approaches can have a meaningful positive impact on uptime and driver experience.



Improving and maintaining vehicle interoperability

As discussed in previous sections, vehicle interoperability is also a significant source of low session reliability due to a fragmented ecosystem of EVCC manufacturers and a complex protocol.

Electric Era applies two primary mechanisms to enable continuous improvement and detection of vehicle interoperability issues: 1) rich logging of SECC packets and charger firmware during a charging session, and 2) aggregation of statistics on charging sessions and fault codes segmented by EVCC manufacturer.

Logging is an essential element of debugging individual incompatibilities with vehicles; we won't get into the finer details of how here. It is, however, an important exercise to consider the value of aggregate statistics. Because OEMs issue OTA updates to vehicles in a staggered fashion, it is not always immediately obvious to an EVSE network (Electric Era being no exception) when vehicle incompatibilities arise. Therefore, every session is monitored and cataloged by EVCC ID (the vehicle's ISO 15118-based MAC address) to identify the CCS manufacturer. Aggregate statistics are valuable to network operations center (NOC) operators when filtered by charger/SECC firmware versions to understand if a vehicle interoperability issue has been introduced recently.

Electric Era sees rolling impacts of about 5% fleetwide SCAR due to interoperability issues. Detection typically occurs within a day of the first failed session, and recovery within 2 weeks utilizing the aforementioned systems.

Employing fault detection, isolation, and recovery (FDIR)

The concept of FDIR is not new; several [illustrative studies](#) discuss relevant approaches. Certain industries (e.g., aerospace) rely heavily on the use of FDIR to build self-sustaining systems, important for applications where human or remote monitoring of assets is not possible. EV charging represents a similar opportunity.

Generally speaking, more complex electronic systems are susceptible to undiagnosed software faults. Electric Era specifically targets the charger's payment terminal and human-machine interface (HMI) operating system (OS) with software that continually polls, alerts, and reboots the respective system if a loss of communication is detected. Importantly, such FDIRs must operate passively and not wait for human interaction before a problem is detected.

Principles of fault detection and recovery extend to the domain of end-user interaction. Building on previous discussions of the susceptibility of CCS connectors to SLAC failure due to improper charger insertion, Electric Era isolates this failure mode and presents prompts to users on-screen to guide them towards proper insertion to improve session reliability and end-user satisfaction.



08 Appendix: Electric Era Charging Station Fleet Performance

Session Reliability

The raw data from Electric Era’s full fleet from January 1, 2024 to November 25, 2024 (329 days) is provided below for reference.

Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.	Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.
1	5	4	80.00%		29	3	1	33.33%	72.12%
2	2	2	100.00%		30	0	0	0.00%	61.73%
3	3	2	66.67%		31	2	2	100.00%	65.31%
4	1	1	100.00%		32	3	3	100.00%	71.43%
5	4	4	100.00%		33	1	1	100.00%	71.43%
6	3	2	66.67%		34	1	1	100.00%	76.19%
7	6	4	66.67%	82.86%	35	0	0	0.00%	61.90%
8	2	2	100.00%	85.71%	36	3	3	100.00%	71.43%
9	4	4	100.00%	85.71%	37	2	2	100.00%	85.71%
10	5	4	80.00%	87.62%	38	3	3	100.00%	85.71%
11	8	3	37.50%	78.69%	39	1	1	100.00%	85.71%
12	4	2	50.00%	71.55%	40	1	1	100.00%	85.71%
13	9	6	66.67%	71.55%	41	2	2	100.00%	85.71%
14	9	5	55.56%	69.96%	42	3	3	100.00%	100.00%
15	15	10	66.67%	65.20%	43	1	1	100.00%	100.00%
16	4	3	75.00%	61.63%	44	2	2	100.00%	100.00%
17	6	3	50.00%	57.34%	45	5	5	100.00%	100.00%
18	3	2	66.67%	61.51%	46	1	1	100.00%	100.00%
19	5	3	60.00%	62.94%	47	8	5	62.50%	94.64%
20	9	4	44.44%	59.76%	48	4	4	100.00%	94.64%
21	3	2	66.67%	61.35%	49	6	4	66.67%	89.88%
22	12	7	58.33%	60.16%	50	3	1	33.33%	80.36%
23	11	8	72.73%	59.83%	51	5	5	100.00%	80.36%
24	4	3	75.00%	63.41%	52	4	2	50.00%	73.21%
25	7	4	57.14%	62.04%	53	1	1	100.00%	73.21%
26	1	1	100.00%	67.76%	54	3	3	100.00%	78.57%
27	6	4	66.67%	70.93%	55	2	2	100.00%	78.57%
28	2	2	100.00%	75.70%	56	7	6	85.71%	81.29%



Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.
57	5	2	40.00%	82.24%
58	0	0	0.00%	67.96%
59	1	1	100.00%	75.10%
60	2	2	100.00%	75.10%
61	3	2	66.67%	70.34%
62	2	2	100.00%	70.34%
63	1	1	100.00%	72.38%
64	3	3	100.00%	80.95%
65	2	2	100.00%	95.24%
66	2	2	100.00%	95.24%
67	2	2	100.00%	95.24%
68	2	2	100.00%	100.00%
69	2	2	100.00%	100.00%
70	0	0	0.00%	85.71%
71	4	4	100.00%	85.71%
72	1	1	100.00%	85.71%
73	2	2	100.00%	85.71%
74	2	1	50.00%	78.57%
75	3	3	100.00%	78.57%
76	4	3	75.00%	75.00%
77	4	3	75.00%	85.71%
78	1	1	100.00%	85.71%
79	2	2	100.00%	85.71%
80	15	4	26.67%	75.24%
81	2	2	100.00%	82.38%
82	1	1	100.00%	82.38%
83	3	3	100.00%	85.95%
84	1	1	100.00%	89.52%
85	5	4	80.00%	86.67%
86	16	14	87.50%	84.88%
87	3	3	100.00%	95.36%
88	3	3	100.00%	95.36%
89	2	2	100.00%	95.36%
90	1	0	0.00%	81.07%

Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.
91	3	2	66.67%	76.31%
92	3	3	100.00%	79.17%
93	2	2	100.00%	80.95%
94	6	6	100.00%	80.95%
95	4	4	100.00%	80.95%
96	7	6	85.71%	78.91%
97	2	2	100.00%	93.20%
98	18	8	44.44%	90.02%
99	56	46	82.14%	87.47%
100	2	2	100.00%	87.47%
101	7	7	100.00%	87.47%
102	5	4	80.00%	84.61%
103	5	5	100.00%	86.66%
104	2	2	100.00%	86.66%
105	4	4	100.00%	94.59%
106	2	2	100.00%	97.14%
107	4	4	100.00%	97.14%
108	5	5	100.00%	97.14%
109	0	0	0.00%	85.71%
110	6	6	100.00%	85.71%
111	5	5	100.00%	85.71%
112	5	4	80.00%	82.86%
113	5	5	100.00%	82.86%
114	1	1	100.00%	82.86%
115	5	4	80.00%	80.00%
116	2	2	100.00%	94.29%
117	1	1	100.00%	94.29%
118	8	6	75.00%	90.71%
119	3	3	100.00%	93.57%
120	3	3	100.00%	93.57%
121	3	3	100.00%	93.57%
122	94	83	88.30%	94.76%
123	6	5	83.33%	92.38%
124	5	4	80.00%	89.52%



Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.
125	10	9	90.00%	91.66%
126	12	11	91.67%	90.47%
127	10	6	60.00%	84.76%
128	2	2	100.00%	84.76%
129	2	2	100.00%	86.43%
130	9	2	22.22%	77.70%
131	6	6	100.00%	80.56%
132	8	5	62.50%	76.63%
133	3	3	100.00%	77.82%
134	5	4	80.00%	80.67%
135	4	4	100.00%	80.67%
136	4	4	100.00%	80.67%
137	3	3	100.00%	91.79%
138	7	2	28.57%	81.58%
139	9	7	77.78%	83.76%
140	1	0	0.00%	69.48%
141	7	5	71.43%	68.25%
142	12	10	83.33%	65.87%
143	8	6	75.00%	62.30%
144	10	9	90.00%	60.87%
145	18	14	77.78%	67.90%
146	10	9	90.00%	69.65%
147	13	9	69.23%	79.54%
148	10	9	90.00%	82.19%
149	20	19	95.00%	83.86%
150	10	9	90.00%	86.00%
151	16	10	62.50%	82.07%
152	19	19	100.00%	85.25%
153	20	13	65.00%	81.68%
154	19	14	73.68%	82.31%
155	16	14	87.50%	81.95%
156	9	9	100.00%	82.67%
157	8	8	100.00%	84.10%
158	46	41	89.13%	87.90%

Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.
159	29	27	93.10%	86.92%
160	12	12	100.00%	91.92%
161	19	17	89.47%	94.17%
162	8	8	100.00%	95.96%
163	13	11	84.62%	93.76%
164	9	9	100.00%	93.76%
165	22	18	81.82%	92.72%
166	25	19	76.00%	90.27%
167	23	18	78.26%	87.17%
168	20	20	100.00%	88.67%
169	14	12	85.71%	86.63%
170	23	18	78.26%	85.72%
171	22	18	81.82%	83.12%
172	8	8	100.00%	85.72%
173	14	12	85.71%	87.11%
174	36	29	80.56%	87.44%
175	17	17	100.00%	87.44%
176	23	17	73.91%	85.75%
177	21	19	90.48%	87.50%
178	21	18	85.71%	88.05%
179	21	18	85.71%	86.01%
180	30	29	96.67%	87.58%
181	37	30	81.08%	87.65%
182	24	22	91.67%	86.46%
183	20	18	90.00%	88.76%
184	17	16	94.12%	89.28%
185	22	13	59.09%	85.48%
186	20	18	90.00%	86.09%
187	30	28	93.33%	85.61%
188	22	21	95.45%	87.67%
189	16	14	87.50%	87.07%
190	88	72	81.82%	85.90%
191	20	18	90.00%	85.31%
192	17	17	100.00%	91.16%



Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.
193	17	16	94.12%	91.75%
194	31	27	87.10%	90.86%
195	22	16	72.73%	87.61%
196	27	22	81.48%	86.75%
197	26	26	100.00%	89.35%
198	50	48	96.00%	90.20%
199	17	17	100.00%	90.20%
200	41	37	90.24%	89.65%
201	24	22	91.67%	90.30%
202	54	52	96.30%	93.67%
203	29	28	96.55%	95.82%
204	18	18	100.00%	95.82%
205	19	14	73.68%	92.63%
206	22	19	86.36%	90.69%
207	14	14	100.00%	92.08%
208	21	21	100.00%	93.27%
209	28	24	85.71%	91.76%
210	35	31	88.57%	90.62%
211	21	21	100.00%	90.62%
212	21	19	90.48%	93.02%
213	22	20	90.91%	93.67%
214	24	23	95.83%	93.07%
215	33	30	90.91%	91.77%
216	21	18	85.71%	91.77%
217	18	17	94.44%	92.61%
218	27	27	100.00%	92.61%
219	15	13	86.67%	92.07%
220	24	22	91.67%	92.18%
221	57	48	84.21%	90.52%
222	33	28	84.85%	89.65%
223	19	17	89.47%	90.19%
224	26	25	96.15%	90.43%
225	23	21	91.30%	89.19%
226	32	29	90.63%	89.75%

Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.
227	16	16	100.00%	90.95%
228	17	15	88.24%	91.52%
229	21	21	100.00%	93.68%
230	120	111	92.50%	94.12%
231	39	34	87.18%	92.83%
232	30	27	90.00%	92.65%
233	28	26	92.86%	92.97%
234	29	26	89.66%	91.49%
235	31	28	90.32%	91.79%
236	18	17	94.44%	90.99%
237	71	65	91.55%	90.86%
238	65	60	92.31%	91.59%
239	27	27	100.00%	93.02%
240	20	20	100.00%	94.04%
241	38	35	92.11%	94.39%
242	44	38	86.36%	93.82%
243	27	25	92.59%	93.56%
244	34	32	94.12%	93.93%
245	35	34	97.14%	94.62%
246	37	35	94.59%	93.85%
247	27	25	92.59%	92.79%
248	29	28	96.55%	93.42%
249	34	33	97.06%	94.95%
250	17	17	100.00%	96.01%
251	24	23	95.83%	96.25%
252	42	41	97.62%	96.32%
253	27	27	100.00%	97.09%
254	18	17	94.44%	97.36%
255	27	25	92.59%	96.79%
256	34	27	79.41%	94.27%
257	26	26	100.00%	94.27%
258	34	31	91.18%	93.61%
259	38	36	94.74%	93.19%
260	34	32	94.12%	92.35%



Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.
261	81	79	97.53%	92.80%
262	22	22	100.00%	93.85%
263	33	29	87.88%	95.06%
264	38	35	92.11%	93.94%
265	42	40	95.24%	94.52%
266	53	47	88.68%	93.65%
267	26	24	92.31%	93.39%
268	24	23	95.83%	93.15%
269	26	23	88.46%	91.50%
270	36	33	91.67%	92.04%
271	39	36	92.31%	92.07%
272	40	35	87.50%	90.97%
273	60	46	76.67%	89.25%
274	41	34	82.93%	87.91%
275	41	30	73.17%	84.67%
276	49	45	91.84%	85.15%
277	36	34	94.44%	85.55%
278	35	28	80.00%	83.79%
279	82	76	92.68%	84.53%
280	54	50	92.59%	86.81%
281	28	28	100.00%	89.25%
282	26	26	100.00%	93.08%
283	54	49	90.74%	92.92%
284	36	33	91.67%	92.53%
285	35	32	91.43%	94.16%
286	55	42	76.36%	91.83%
287	45	40	88.89%	91.30%
288	46	42	91.30%	90.06%
289	35	32	91.43%	88.83%
290	38	34	89.47%	88.65%
291	37	35	94.59%	89.07%
292	52	47	90.38%	88.92%
293	54	43	79.63%	89.39%
294	42	39	92.86%	89.95%
295	37	36	97.30%	90.81%

Day	SPD	Successful SPD	Session Reliability	7-day Moving Avg.
296	58	58	100.00%	92.03%
297	30	28	93.33%	92.59%
298	33	30	90.91%	92.06%
299	46	42	91.30%	92.19%
300	58	53	91.38%	93.87%
301	57	55	96.49%	94.39%
302	48	44	91.67%	93.58%
303	43	43	100.00%	93.58%
304	45	41	91.11%	93.27%
305	35	35	100.00%	94.56%
306	55	52	94.55%	95.03%
307	63	58	92.06%	95.13%
308	72	70	97.22%	95.23%
309	43	41	95.35%	95.76%
310	62	60	96.77%	95.30%
311	65	58	89.23%	95.03%
312	41	36	87.80%	93.28%
313	87	79	90.80%	92.75%
314	69	66	95.65%	93.26%
315	73	65	89.04%	92.09%
316	43	41	95.35%	92.09%
317	55	54	98.18%	92.29%
318	53	49	92.45%	92.76%
319	78	74	94.87%	93.76%
320	75	66	88.00%	93.36%
321	83	71	85.54%	91.92%
322	67	59	88.06%	91.78%
323	61	54	88.52%	90.80%
324	50	44	88.00%	89.35%
325	55	54	98.18%	90.17%
326	57	57	100.00%	90.90%
327	70	64	91.43%	91.39%
328	61	56	91.80%	92.29%
329	76	70	92.11%	92.86%

