



Protect. Renew. Empower.

WHITE PAPER

Can EV charging interoperability and PKI save us from the charging chaos?

The process of charging Electric Vehicles (EVs) can sometimes be more of a hassle than a joyride. But the future is looking bright! It's time to turn this bumpy ride into a smooth experience and we are here to help.

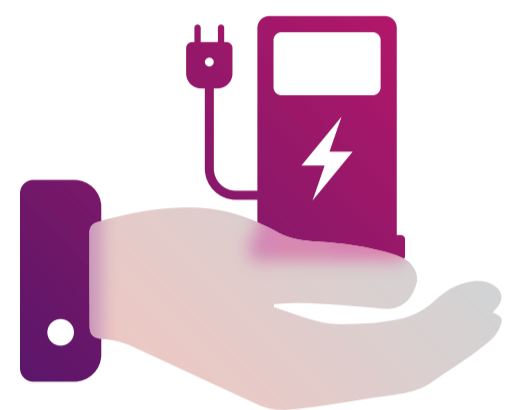
In this white paper, we will take a closer look at the EV charging interoperability and discover what the perfect customer journey should look like. We'll cover the transformative potential of Public Key

Infrastructure (PKI) and Vehicle-to-Grid (V2G) technology and showcase the real-world success of how Irdeto is turning all these advancements into a reality, one charge at a time.

What does the EV charging ecosystem look like?

The EV charging ecosystem is a complex puzzle involving various stakeholders, technologies and standards. Grasping how these elements interact is vital for a seamless and reliable charging experience. Interoperability, the ability for different systems to work together harmoniously, is at the heart of this ecosystem, eliminating barriers and providing a prime user experience to drive the adoption of EVs globally.

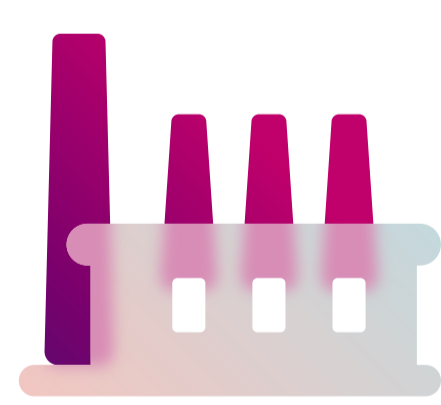
EV ecosystems stakeholder and their roles



eMobility Service Providers (eMSPs)

eMSPs manage customer relationships and provide access to charging infrastructure through memberships and apps. They act as the bridge between EV users and charging networks, offering services that include locating charging stations, facilitating payments and managing user accounts.

Interestingly, eMSPs aren't limited to companies directly involved in the EV industry. They can range from local electricity providers to, in more expansive scenarios, even cable TV companies, who may bundle charging subscriptions with their other services. This model allows for a wide variety of businesses to tap into the growing EV market.



Original Equipment Manufacturers (OEMs)

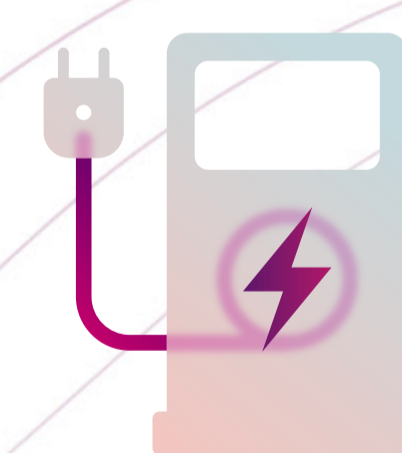
OEMs produce vehicles and integrate the necessary technology to communicate with charging infrastructure and are compatible with various charging standards and protocols. Advanced features to include in their vehicles are, for example, Plug and Charge (PnC) and V2G capabilities.



Certificate Authorities (CAs)

CAs issue and manage digital certificates used for secure communication between EVs and charging stations. These certificates are crucial for authentication and establishing trust within the charging ecosystem.

Take a closer look at our infographic below which brings this ecosystem to life. It maps out the EV charging journey in detail and shows how Irdeto's solutions simplify and secure each stage.



Charge Point Operators (CPOs)

CPOs own and operate the charging stations, making sure they are up and running addressing any technical issues that may arise. They manage the availability of charging points and provide real-time updates to eMSPs and users.

EV Charging Ecosystem - Irdeto CrossCharge

■ Contract Certificate

● V2G Root Certificate

▼ OEM Provisioning Certificate

◆ EVSE Leaf Certificate



Root Certificate Pool (RCP)

Stores ISO-15118-2 and ISO-15118-20 root certificates for secure, valid and up-to-date communications within the PnC ecosystem.



Contract Certificate Pool (CCP)

Retains signed contract data generated by eMSPs and provides access to CPOs and OEMs for secure and compliant transactions.



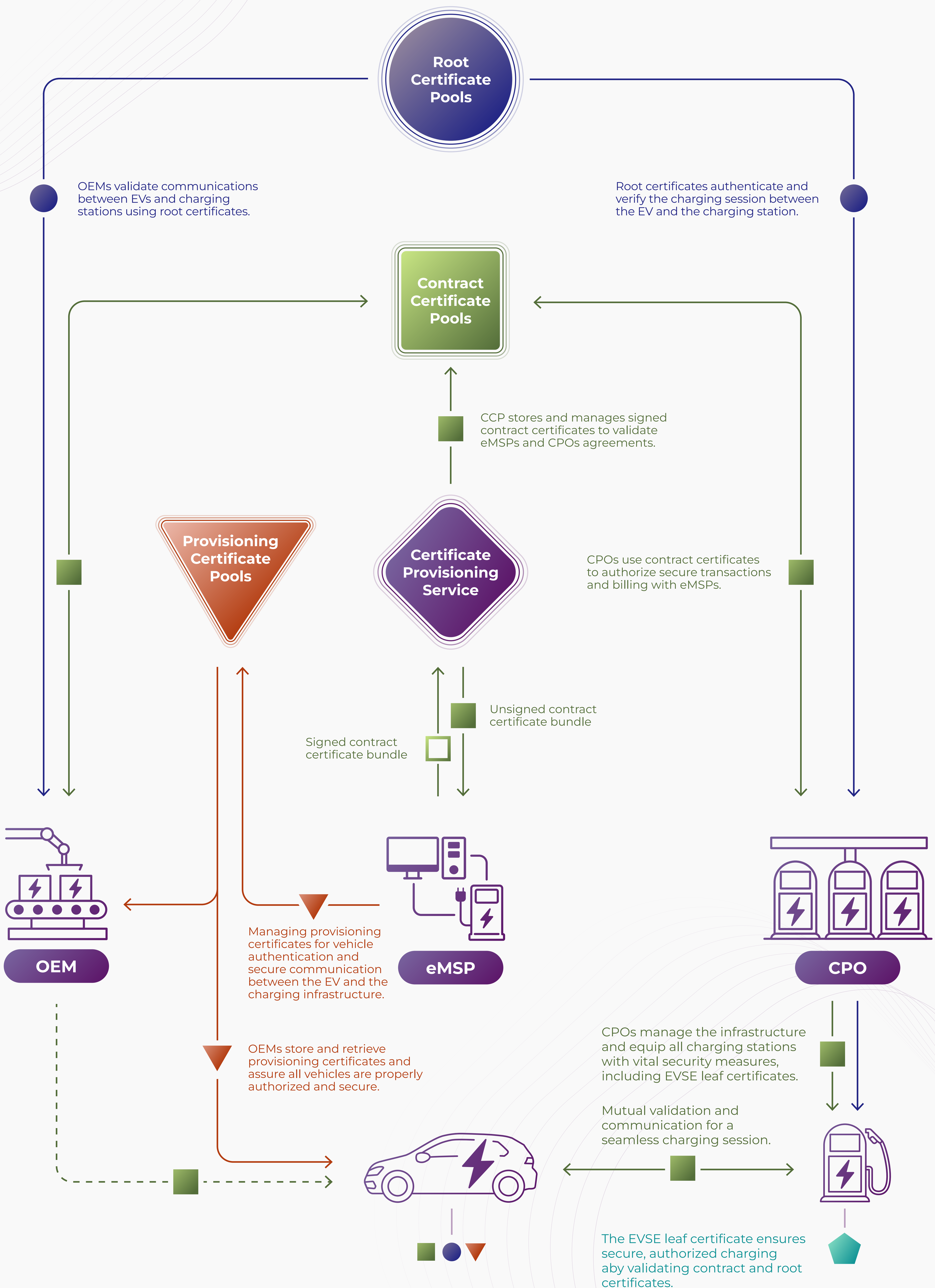
Provisioning Certificate Pool (PCP)

Securely stores OEMs provisioning certificates and makes them and their certificate chain accessible to eMSPs.



Certificate Provisioning Service (CPS)

Enables eMSPs to generate and sign contract certificates, securely storing it in the CCP for further use by relevant OEMs and authorized CPOs.



All the certificates are created with Irdeto's [Key Lifecycle Management Service](#).
 Want to know more about our solutions? Visit our [website](#) or contact us [here](#).

Next-level interoperability with PKI

CAs issue and manage digital certificates used for secure communication between EVs and charging stations. These certificates are crucial for authentication and establishing trust within the charging ecosystem.

What is a root CA?

Root CA is the highest trust anchor in the PKI hierarchy, responsible for issuing and signing the foundational digital certificates that authenticate the identities of EVs, charging stations and grid operators.

How do you apply PKI in EV charging?

While the root CA is the top-level certificate authority, PKI is the one that includes the entire network of subordinate CAs, digital certificates and cryptographic processes. This infrastructure manages the entire lifecycle of digital certificates, from issuance to revocation and takes care of encryption, authentication and safety of every transaction within the EV ecosystem.

How does this work in a real-life scenario? When an EV interacts with a charging station, for example, PKI is the one verifying both parties' identities before any energy transaction occurs. This process is vital to prevent unauthorized access and potential cyberattacks that could disrupt the charge or compromise sensitive data.

To fully reap the benefits of PKI, we must first address the current obstacles within the broader EV charging ecosystem.

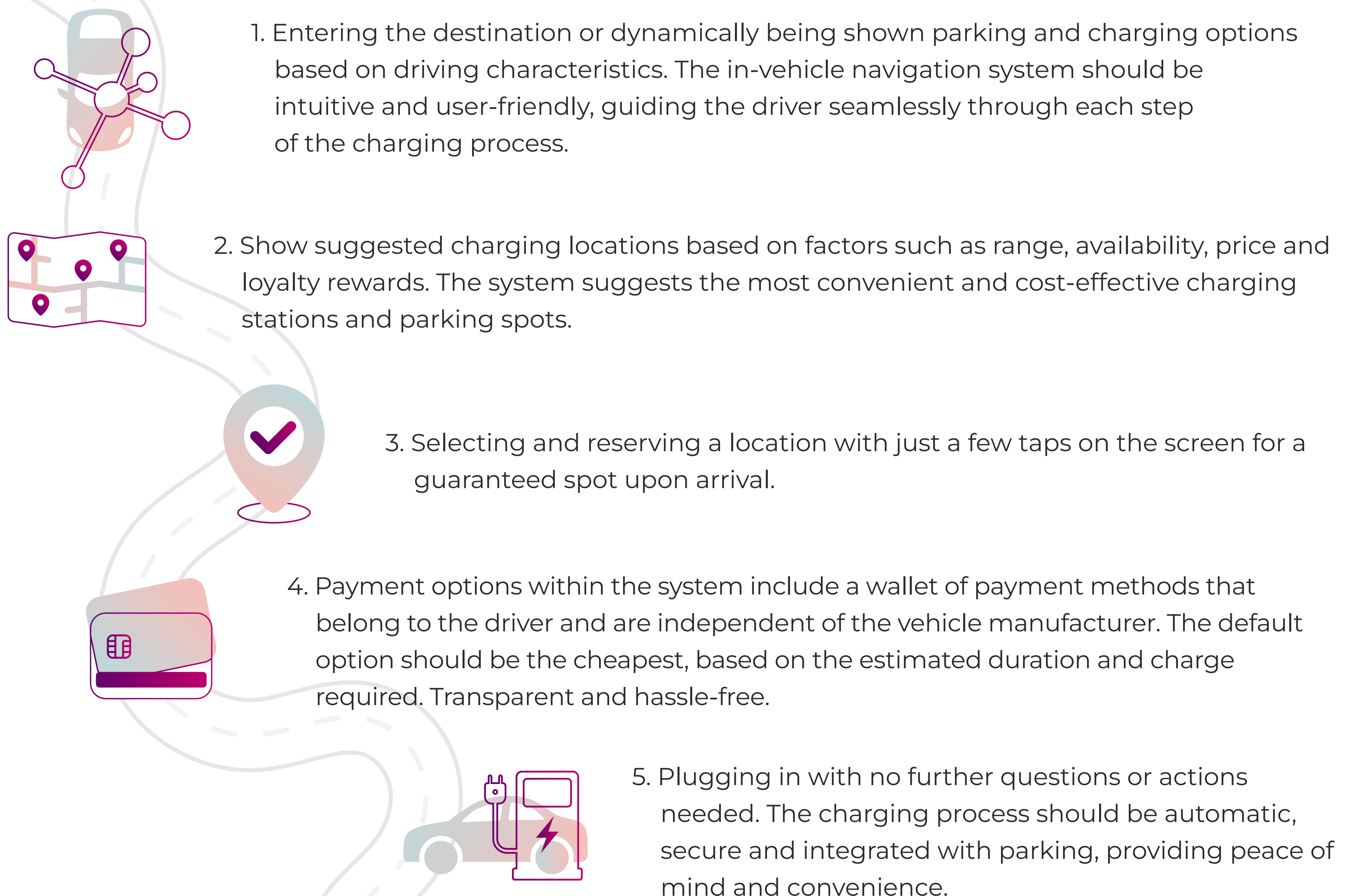
Challenges within the current state of EV charging

From finding a functioning charging station to navigating multiple apps and payment systems, EV drivers are faced with many obstacles:

- **Finding the charging station:** Locating a suitable charging station usually involves using in-vehicle displays, CPO apps and mapping services. But too often, problems like outdated app info, long wait times and physical barriers can complicate the process.
- **Inconsistent infrastructure:** The availability and reliability of public charging stations vary widely. A study found that over 25% of non-Tesla fast chargers in the San Francisco Bay Area were not functional due to problems like network connectivity issues, broken plugs, unresponsive screens and payment system failures.
- **Range anxiety:** Unlike traditional vehicles, EVs require thoughtful trip planning. Factors like speed, topography and weather can drain your battery faster than expected, making access to charging stations crucial to avoid disruptions.
- **Payment issues:** EV charging payments should be straightforward, but instead they often aren't. Payment gateway failures and the need for different payment systems and methods at different stations complicate the process even further.

By addressing these challenges, we can start creating a flawless and user-friendly charging experience.

The ideal EV charging journey



How Irdeto is turning this journey into reality

Irdeto is successfully tackling these challenges with its advanced PnC capabilities under the ISO 15118 standard, within a multi-PKI ecosystem.

In collaboration with Parkopedia, who provides detailed information about parking availability, prices and real-time occupancy for over 90 million spaces worldwide, we are extending our expertise to EV charging.

We are creating a future where EV drivers can effortlessly locate and access charging points, pay for parking and charge their vehicles directly from their in-car media systems and finally eliminate the need for multiple apps, credit cards or legacy technologies like radio frequency identification cards.

Here's how we're making a difference:



Seamless interoperability

EVs from various manufacturers can connect with different charging stations without issues, eliminating the need for multiple apps and memberships.



Data ownership

Unlike competitors who might sell customer data in a loosely compliant way, Irdeto has the highest standards of security and privacy and maintains complete ownership and control throughout the entire process.



Technological edge

With advanced technologies and standards such as ISO 15118 and Open Charge Point Protocol (OCPP) 2x, our solutions are more than ready for the future.



Full key lifecycle management service

With handling of key creation, distribution, maintenance and revocation, Irdeto guarantees top-level security.



End-to-End (E2E) control

By verifying the entire charging process from plug-in to completion, our solutions offer complete control without vendor lock-in.

Irdeto's multi-PKI capabilities proved at the Cleveland Festival

The ideal EV charging journey came one step closer to reality at the recent CharIN Festival and Conference 2024 in Cleveland. This event brought together titans of the automotive world to test and push the limits of EV interoperability and security.

WHAT WAS TESTED?

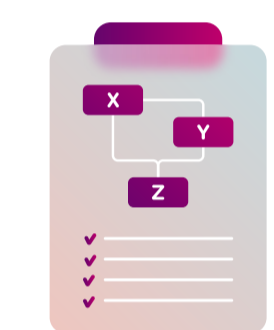
During the event, essential aspects of EV charging interoperability and safety were put to the test:



Transport Layer Security (TLS) connection stability: Ensuring that secure communication protocols between the vehicle and charging station are reliable and consistent across various hardware setups.



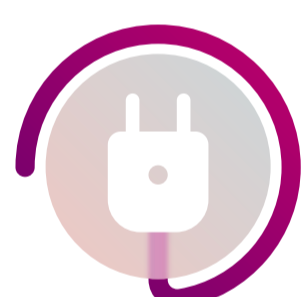
Interoperability: Testing the ability of EVs from different manufacturers to connect and communicate with charging stations from different PKI providers.



Security protocols: Evaluating the robustness of security measures against potential cyber threats during the charging process.



Certificate handling: Testing the system's response to both valid and invalid certificates to ensure vehicles correctly identify and react to security credentials.



PnC effectiveness: Going beyond E2E charging protocols by testing PnC within a complex multi-PKI environment.

Through these tests, we can make certain that charging infrastructure can support the next generation of EVs.

What was the testing methodology?

Irdeto was one of three PKI providers that participated in the event, next to Hubeject and ISS.

We provided a charge point management system and a charger with installed leaf certificates, while EVs were provided with root certificates, enabling them to securely communicate with the chargers. For compatible vehicles, we provided contract certificates for installation via the OEM's backend. Utilizing two advanced stations, one of them being the certified OCPP 2.0.1 platform from SWTCH, we mirrored real-world conditions as closely as possible.

Vehicles arrived at the charging stations where they automatically identified and authenticated the correct root certificates for communication, testing each of the three chargers.

The aim was to prove that EVs could handle multiple PKI certificates and still successfully complete the PnC process.

Was multi-PKI testing a success?

More than a success, it was a victory! With Irdeto's participation, we proved that our system can successfully complete PnC with multiple vehicles and chargers.

Our biggest wins were:

1. **Successfully testing TLS connection stability** with two notable stations. Our system was reliable and consistent across each hardware setup.
2. **Unparalleled interoperability** across all participating vehicle manufacturers.
3. **Flawless security in certificate testing:** The test scenarios included valid and invalid certificates. Our system flawlessly handled all potential real-world anomalies and security threats.
4. **Multi-PKI PnC excellence:** Our tests confirmed its reliability in real-world scenarios, setting a new benchmark for what E2E charging should encompass in the future.

The Testival marked a significant milestone, but it was merely the starting line. We are committed to becoming a vital part of a truly interoperable network, where plug-and-play and V2G technology are not just a concept, but a reality for all users.

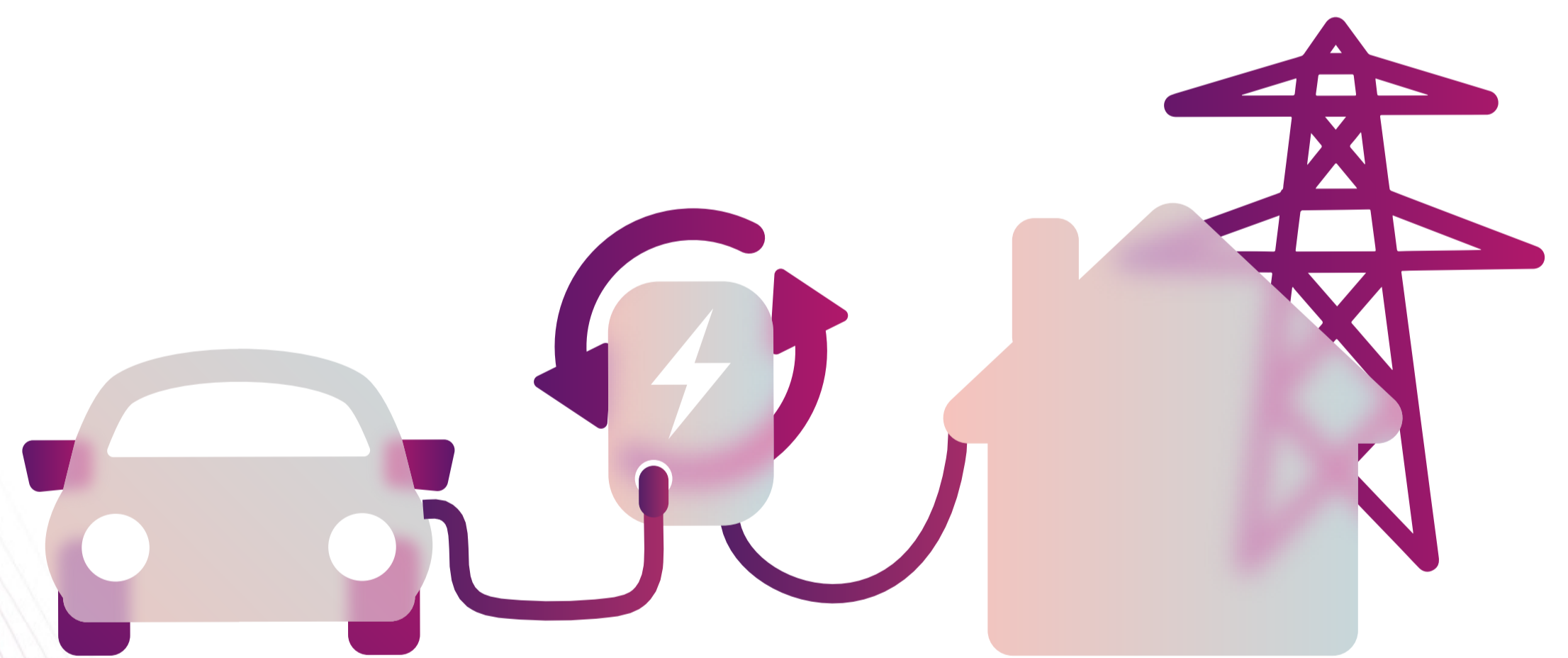
Opening new opportunities in the EV ecosystem with V2G

The EV ecosystem has been introduced with new opportunities with V2G. It presents a specific use case of technology that takes the charging experience a step further, allowing EVs to both draw power from and supply back to the grid.

THE BENEFITS OF V2G

The bidirectional flow of energy authorized by V2G offers a few benefits:

1. **Grid stability:** With EVs feeding the excess energy back into the grid, they are improving grid stability and resilience, especially during peak demand periods.
2. **Cost savings:** EV owners can save between 10-20% on annual electricity costs by participating in V2G programs, with potential earnings of up to \$1,200 annually in certain regions like California.
3. **Renewable energy integration:** By storing and redistributing energy from renewable sources, V2G supports the integration of sustainable energy solutions and balances the intermittent nature of solar and wind energy.



THE HIGH POTENTIAL OF V2G MARKET GROWTH

The V2G market is experiencing exponential growth, valued at USD 3.1 billion in 2023 and projected to grow at a compound annual growth rate of over 50% from 2024 to 2032, reaching an impressive USD 119.6 billion by 2032!

Adoption rates are also on the rise, with projections indicating that by 2030, nearly 50% of EVs on the road will be V2G-capable, significantly expanding the grid's energy storage capacity.



Changing the future, one charge at a time

While others are only imagining the future of EV charging, Irdeto is building it. Our solutions are designed to tackle the pain points head-on. As we continue to push the boundaries of what's possible, we invite you to join us in creating the perfect charging experience together.

Reach out to us today at irdeto.com!