How to authenticate and keep track of batteries with STSAFE-L

What happens to batteries?

Power tools, phones, computers, and many other industrial and consumer goods are increasingly transitioning from wired to battery power. This shift, enabled by significant advancements in battery performance, offers a critical advantage in terms of portability. However, this migration presents a substantial challenge in terms of sustainability and recycling. Consequently, countries and international organizations are beginning to implement regulations aimed at enhancing sustainability.

HOW EUROPE IS REGULATING BATTERIES

With the global demand for batteries expected to increase dramatically, the demand within the European Union (EU) is also set to rise. In response to this trend and to ensure sustainable development and resource efficiency, the European Parliament together with the Council of the European Union have introduced a new regulation regarding batteries. Regulation (EU) 2023/1542 was adopted on July 12, 2023, and includes a comprehensive set of rules, particularly targeting device manufacturers.

THE OBJECTIVE

With this regulation, the European Union aims to ensure that batteries are sustainable throughout their entire lifecycle, from production to recycling. This initiative will promote a circular economy and help minimize the environmental impact of batteries.

> “Provisions to ensure the removability and replaceability of batteries [...] are necessary[1]

WHAT ARE THE CHANGES TO COME?

The first measure introduced by the regulation is to make batteries replaceable, facilitating separate collection and preventing devices from being discarded solely due to battery issues. This will help extend the lifespan of products. Secondly, batteries will need to include a passport detailing their characteristics and chemical composition, accessible via a QR code and an ePassport. Initially, this requirement will apply to batteries over 2 kilowatt-hours. Both measures will be enforced starting in 2027.

Recycling batteries is a major societal challenge that cannot be resolved overnight. Therefore, the European Union has set progressive targets to gradually increase the recycling rate and efficiency of batteries.

Replaceable batteries	ePassport for batteries
Extend product lifetime by making it mandatory for batteries to be replaceable	Require battery passport containing battery characteristics and chemical receipt (QR code + ePassport) for batteries > 2 kWh

» Enforcement planned in February 2027

Source: 1) https://eur-lex.europa.eu/eli/reg/2023/1542/oj

What's at stake for device manufacturers?

DIRECT IMPLICATIONS OF THE NEW REGULATION

Manufacturers of devices containing batteries will face a significant challenge: as batteries must be replaceable, they may lose control over which batteries are used in their devices. This raises several important considerations:

- **Device brand reputation:** How will the device's performance be affected by the use of low-quality third-party batteries, and what impact will this have on the brand's reputation?
- **Warranty policy:** What will be the warranty policy if a device is damaged by a low-quality battery?
- **Liability issues:** What liability will the device and battery makers face if a recycler detects a counterfeit battery containing prohibited chemicals?

Given these concerns, device makers might prefer to clearly authenticate their genuine batteries to distinguish them from others. This allows them to maintain control over the performance and features offered by the device, depending on the installed battery. For example, a device maker could choose to restrict fast charging at high power to only authenticated genuine batteries, thereby preventing potential safety issues.

THE IMPORTANCE OF SUSTAINABILITY

Over the last decade, consumers have become increasingly sensitive to sustainability and their environmental footprint. They recognize the need for action to drive change. This concern is shared by brands and device manufacturers, who have implemented sustainable practices. Ultimately, these practices enhance the brand's attractiveness to customers.

Battery recycling is a particularly visible and tangible aspect from the consumer's perspective. When device manufacturers implement robust recycling policies, it sends a positive signal to consumers, demonstrating a commitment to sustainability.

Device makers may then expect to demonstrate evidence of their sustainable practices. Being able to authenticate their own batteries throughout their entire lifecycle could be a crucial part of this strategy.

AN EXISTING SOLUTION?

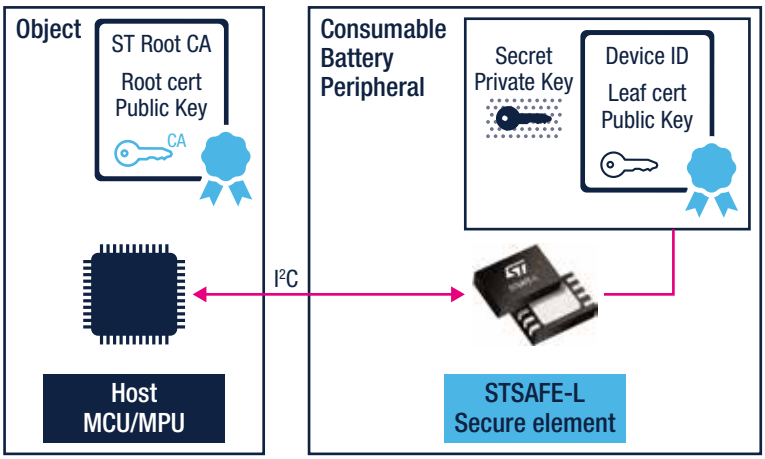
In a nutshell, to comply with European regulations and contribute to a sustainable approach, device manufacturers need to authenticate their batteries and track them throughout their lifecycle.

What if we could provide them with a convenient solution to help them authenticate their batteries?

Providing an authentication solution with STSAFE-L

INTRODUCING STSAFE-L

STSAFE-L is a solution that enables strict authentication of objects. It is based on a secure element which is a dedicated chip coming with cryptographic keys and certificates. STSAFE-L features a customized command set to perform device authentication and monitor device usage.



OPTIMIZED SYSTEM-ON-CHIP (SoC) FOR PRODUCT AUTHENTICATION

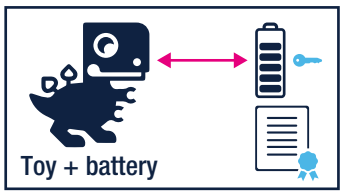
STSAFE-L is preloaded with “secrets” including cryptographic keys and authentication credentials such as certificates to enable strict object authentication. It also includes a basic API that implements security protocols for authentication purposes.

COMPANION CHIP FOR A DEVICE’S HOST MCU/MPU

STSAFE-L is connected to the local host via a simple I²C or single-wire interface.

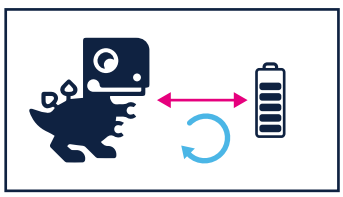
PRODUCT FUNCTIONS

In order to ensure the end-product authenticity, STSAFE-L embeds three main functions:



Verify genuine objects

STSAFE-L includes an authentication protocol based on the asymmetric EdDSA protocol and certificates. It embeds a device leaf certificate containing the device’s unique identity. ST also acts as a Certificate Authority (CA) and provides the root certificate to attest the authenticity of STSAFE-L leaf certificates. In practical terms, for a battery-powered device such as a toy, the toy will be able to verify that the battery is genuine.



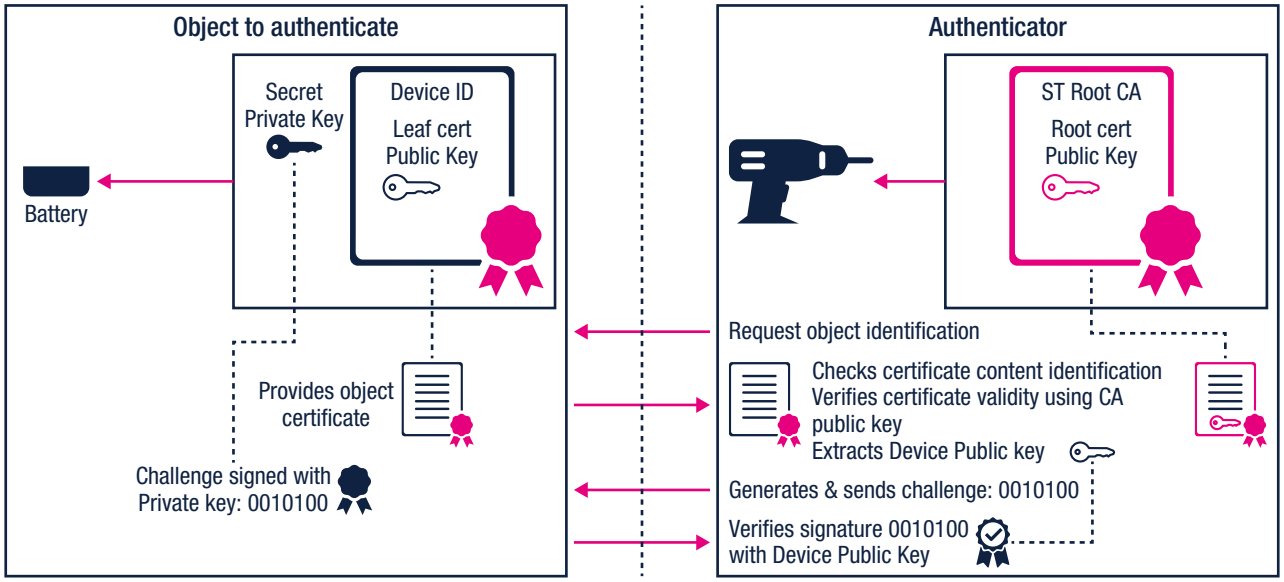
Track number of charges

The STSAFE-L offers secure counters to record a device’s history. For instance, the toy can keep track of how many times the battery has been charged.

Store data securely

Additionally, STSAFE-L offers non-volatile memory to store device information or secrets. This memory can be partitioned, and different access conditions can be set to ensure that data is securely stored.

Authentication process: how does it work?



STSAFE-L is a secure element embedded into the object (in this case, the battery) that requires authentication. The secure element contains the battery certificate, which includes a public key and a secret private key. Conversely, the device (a power drill in this example) acts as the authenticator and contains the Certificate Authority (CA) with its public key.

HOW DOES THE POWER DRILL AUTHENTICATE ITS BATTERY?

1. The process starts with the power drill requesting the object identification from the battery.
2. The battery provides its certificate to the power drill.
3. The power drill verifies the certificate's validity using its own CA public key.
4. Once validity is confirmed, the power drill extracts the public key from the battery certificate.
5. The power drill generates and sends a challenge to the battery.
6. The battery signs this challenge using its secret private key and usends it back to the power drill.
7. Finally, the power drill verifies the signature of the challenge using the public key previously extracted from the battery certificate.

Authentication completed
Genuine battery

Conclusion

STSAFE-L is a System-on-Chip (SoC) solution that provides a simple and reliable way to authenticate objects.

With its customized command set, STSAFE-L can authenticate devices and help monitor their usage. This allows device manufacturers to differentiate genuine batteries from third-party ones and obtain information on battery usage.

Moreover, STSAFE-L is easy to integrate, even for device manufacturers without specific security knowledge.

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ADDITIONAL RESOURCES

STSAFE solution for Authentication [Portfolio overview]

Sustainability at ST [Landing page]

European Union Regulation 2023/1542 on batteries [EU regulation]

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