

KEY FEATURES

- Enables statistical monitoring and battery quality forecasting for mobile device populations in the field
- Shifts safety and quality decisions from limited lab samples under controlled conditions to statistically significant populations representing real-world usage
- Cycle life projection and swell estimation provide future-looking preview of expected cell performance
- Facilitates overview and insight into problem cells that represent potential safety hazards
- Consists of device resident software and analysis services from Qnovo
- Available as an option to Qnovo adaptive charging solutions

GENERAL DESCRIPTION

Qnovo Analytics (QNA) is a software and services suite that facilitates improved battery safety and quality decision-making. QNA shifts long-range battery decisions from limited cell samples tested under lab conditions to statistically significant populations operating in the field. Qnovo’s unique ability to project cycle life and swell performance provides advanced insight into future product safety and performance.

The QNA architecture consists of elements shown in **Figure 1**. A real-time tracking module resident on the device collects key operational parameters over the lifetime of the product. Device-resident predictive safety software tracks individual cell performance in comparison to expected behavior and flags excessive deviations that may represent a safety hazard. This information may be used to take immediate action on a potentially hazardous device.

Individual device information is aggregated to determine statistical performance via over-the-air (OTA) transfer for later population analysis. Qnovo provides analysis services or OEMs may develop internally capabilities based on an open API to access individual device data.

Qnovo Analytics is available as an option to Qnovo adaptive charging (QNS or QNI), as it utilizes the same chemical-based model for predictive safety, cycle life projection and swelling estimation.

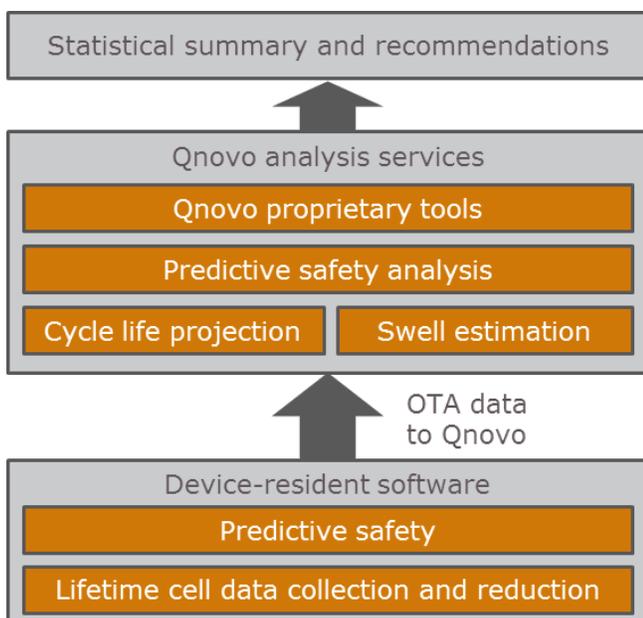


Figure 1: QNA architecture



PREDICTIVE SAFETY

Qnovo adaptive charging operates as a model-based closed-loop control system with multiple layers of built-in safety checks. Qnovo algorithms are designed up-front to mitigate safety-related degradation mechanisms, including lithium plating, excessive swelling, and rapid capacity loss. Additionally during device charging, hundreds of safety checks are performed each charge cycle to ensure that each individual cell continues to perform safely in the system.

Predictive safety, **Figure 2**, begins by establishing normative behavior for each cell family in the lab. Cell characterization determines performance over operating conditions and cell family-specific degradation mechanisms. During charging, individual cell behavior is continuously compared to expected behavior predicted by the battery model, normalized for environmental conditions. The predictive safety algorithm resident on the device identifies cells that are not performing to expectation and may represent a safety hazard in the future.

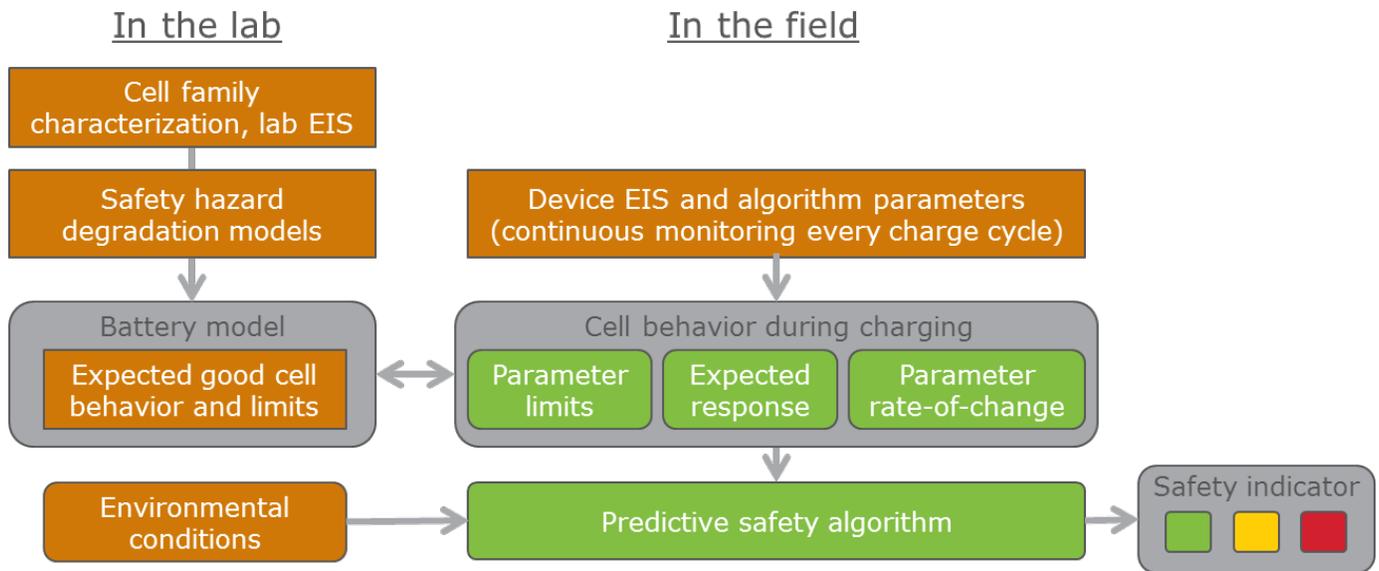


Figure 2: Predictive safety operation

