IoT Device Manufacturer
Improves Battery Life by 50%

This manufacturer, based in the United States, develops Internet of Things (IoT) devices for large utility companies rolling out smart city applications. One of its chief concerns is ensuring that all IoT devices it releases are reliable and can last for at least 7 years or more without needing a new battery. In mission-critical IoT applications for the smart city, access to the AC power grid is generally not an option, making battery-operated IoT devices with low-power consumption a must. Many of these devices are wirelessly connected and operate unattended in difficult to reach locations. One application alone can require thousands of IoT sensors. In this scenario, having to change batteries prematurely could be quite costly.

While evaluating its IoT device prototypes, the manufacturer realized it had a significant battery drain problem. Roughly half of all prototypes tested were using more power than expected, even though prior lab testing had assured the manufacturer that the power consumption would be much lower. The manufacturer struggled to determine the cause of the problem, while sticking to the original product release schedule and staying within budget.
To avoid a potentially costly misstep in terms of a required redesign, unsuccessful release or even a product recall, the manufacturer needed to find a way to isolate and identify the conditions under which battery drain would increase. To do that, it required a test solution that could accurately characterize the current consumption of devices across all possible operating modes (active, idle, sleep, and standby). The manufacturer also needed to test its prototypes under real-world network and installation environment conditions. In low coverage areas or when a network misconfiguration/implementation occurs, for instance, IoT devices often require more repetitions of transmission to successfully transfer data. The more repetitions required, the higher the power consumption and the faster the battery drain.

**Fast, Accurate Identification of Battery Life Issues**

To help determine the root cause, the manufacturer turned to Keysight Technologies with its CX3324A Device Current Waveform Analyzer and UXM Wireless Test Set. The CX3324A employs a patented high dynamic range and fast-sampling power sensing technology that allows it to accurately measure current drain in battery-powered devices with just one measurement. Competing approaches all require multiple measurements, missing critical interdependencies. The Keysight technology dynamically adjusts as the battery transitions through its different operating modes, ensuring that current drain is measured as accurately as possible at each point. The UXM provides an easy way for engineers to confidently assess design readiness by testing RF performance under real-world conditions. It does this by emulating many different types of cellular networks, including CAT-M1 and NB-IoT specifications.

Using the CX3324A waveform analyzer, the manufacturer quickly identified a problem with coupling between its power supply components. As it turned out, the low-power operating condition demanded by the utility companies required a tighter tolerance on the power supply rails. This meant that fast transients on the power rail were being generated by data transmission and it was interfering with the device’s clock (Figure 1). With this information, the manufacturer was able to identify a quick fix. It simply changed some of the power supply components to eliminate the coupling.
Using the UXM test set to simulate different network conditions, including intermittent connectivity, the manufacturer discovered a second problem in its prototypes. The devices behaved as expected in most environments, but not when operating at the edge of the cell network. Here, intermittent connectivity forced the devices to retransmit data many times, draining the battery at more than fifty times the normal rate. By making a simple change in the design, the manufacturer was able to stop the devices from overly aggressively attempting to reconnect to the network during intermittent connectivity conditions.

Figure 1. Example transient current measurement with the CX3324A
A Winning IoT Device Design

Using Keysight’s waveform analyzer and wireless test set solutions, the manufacturer quickly and easily identified two issues negatively impacting the battery life of its IoT prototypes, before they entered final production. The CX3324A’s current drain measurements helped eliminate fast transients on the devices’ power rails, resulting in a 50% improvement in battery life. The UXM’s emulation of different cellular network conditions allowed the manufacturer to discover and fix a design flaw that made its devices’ batteries drain too quickly. And, since the flaw was identified before the devices went into operation in the field, a potentially costly recall was avoided, saving the company millions. The manufacturer not only delivered its devices on time, within budget, and with the features its utility customers required, but it now has a winning IoT design it can confidently adapt for future customers and applications beyond the smart city.

“With long battery life a key requirement for our customers, our battery drain issue threatened to be a real deal-breaker. Keysight’s solutions resolved our design problems quickly, allowing us to meet customer requirements and deliver new devices on time and with full confidence they will perform as expected in the real world.”

Senior R&D Engineer

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