POWER TOOLS FOR EDGE OPTIMIZATION: ULTRA-LONG-LIFE LITHIUM BATTERIES

By Sol Jacobs, vice president and general manager of Tadiran Batteries

Physical edge devices are being deployed throughout the IIoT, predominantly powered by ultra-long-life primary (non-rechargeable) bobbin-type lithium thionyl chloride (LiSOCl2) batteries. This chemistry is preferred for its exceptionally high capacity and energy density, wide temperature range, low self-discharge rate, and superior performance in harsh environments.

A prime example is AI-enabled edge devices that use bobbin-type LiSOCl2 batteries to deliver enhanced data intelligence, including immediate and autonomous response by recognizing patterns, detecting anomalous events, real-time reporting, predictive modeling, and other benefits to perform tank-level

What the heck is “data scaffolding”?

By Aric Prost, senior global director OEM with Stratus Technologies

In an era of unprecedented industrial information, much of this new data may be bottlenecked where it is generated at the operational edge. This data is at risk of being stranded due to bandwidth and connectivity constraints, aging IT systems, or latency.

Existing infrastructure requires modernization and new efficiency to create value in the form of increased safety, equipment availability, and profit achieved through actionable insights. But how do you do that?

Organizations can rapidly modernize factory-floor equipment with edge-computing platforms, whether to run HMI SCADA applications close to critical equipment, store and analyze sensor data, or consolidate industrial software to digitalize processes or create smart machines. Properly architected edge-computing infrastructure creates the data "scaffold" imperative to harness data locally for sharing across the plant floor or to the cloud. Much like a physical scaffold, data scaffolding creates a supportive framework with which to turn data into actionable insights and competitive advantages. Properly built, this facilitates data flow and information availability throughout an organization.

Acquire edge data for actionable insight

According to a McKinsey report published at the outset of the pandemic, digitizing operations was a rapid step manufacturers needed to take in order to adjust to the new normal. The report noted that “greater use of advanced analytics and big data could optimize risk management.” Indeed, manufacturers’ digitization efforts are often measured against how well they improve operations reliability and safety/environmental performance.

To be effective, these digitization projects must be geared toward improving analytics while laying the groundwork for predictive maintenance, artificial intelligence (AI), and machine learning (ML). Each requires large amounts of high-quality data, and manufacturing industries have struggled to make their data usable for these endeavors.

Edge computing provides the local processing and data storage to enable these capabilities. When it comes to more complex equipment, this is especially crucial as data often flows in a closed-loop, creating siloes of databases and information. For digital-transformation projects to succeed, data sources need to be identified, filtered and connected.

Issues with data can arise from an insufficient quantity or availability of data, limited access to databases, corrupted or incomplete data, missing format and tags between sources, and security issues. All of this can derail the value of data acquisition. With edge computing, manufacturers can more easily organize, analyze and protect data to better understand how machines are working together, how well they fit in the process, and where improvements can be made.

Edge computing enables smart machines to become smarter

Digital transformations need free-flowing data—information availability—in order to do the higher-level analytics required for AI, machine learning, predictive maintenance, and big-data projects. Unfortunately, production, operation and equipment data often exist in a silo, closed off from the rest of the organization. These sources of data need to be connected to see the full picture and ensure decisions are based on identification of the root cause.

In this way, data platforms or architectures are helpful scaffolding; they allow companies to collect, store, analyze and share data with verified individuals on both local and remote networks. This ensures faster information-sharing within an organization, and faster insights as a result. Data scaffolds can also help fill in missing data, which helps organizations utilize AI, ML and predictive maintenance—and paves the way for resiliency in a rapidly-shifting environment. Along with this, edge-computing systems can integrate with modern architectures while adding functionality as needs change, giving manufacturers more flexibility to interpret data and make adjustments as required.

Unlocking data at the edge

According to IDC, pandemic-induced workforce changes and operations practices will “be the dominant accelerators for 80% of edge-driven investments and business model changes in most industries” through 2023.

Manufacturing isn’t immune to these trends. Digitization efforts connect data providers to a larger analytic framework and will help drive larger business decisions with all factors from the shop to the top floor. As physical devices become increasingly sophisticated (think sensors, valve actuators, motor starters, etc.), they’ll have analytics capabilities on the same level as PCs. Data from these devices—and a company’s data writ large—must be managed correctly. Any gaps in how an organization manages its data degrades its ability to make sound decisions and can affect critical processes like product changeover, planned downtime, equipment replacement and processing changes.

But data is complex, and the relationships of how it is stored, shared and used continue to evolve. Operating and manufacturing companies have moved toward digitization and integrating data into their processes and decision-making, which is a vital step toward agility in a landscape that has already developed a dependency on the data it knows about.

However, data on its own isn’t enough to stay nimble: decision-makers must make sure they have the proper scaffolding in place for their data. Data must be "unlocked" in such a way that it can flow through an organization.

Without the proper data scaffold, digital-transformation projects can easily fall flat. By deploying a modern edge-computing architecture, manufacturers can gain valuable insights from critical equipment to gain the insight and efficiency of AI, ML and predictive analytics.

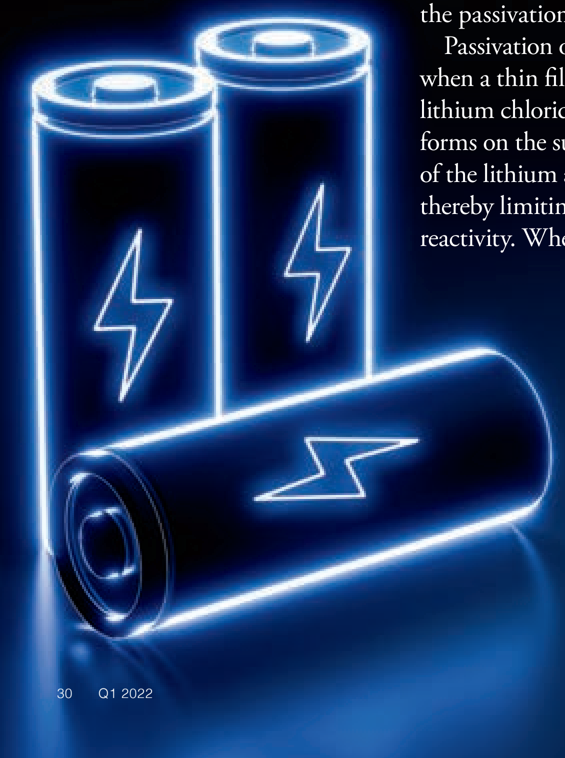
monitoring and to manage field assets such as pipelines, control valves, and flow meters.

These intelligent edge devices deliver state-of-the-art Infrastructure 4.0 solutions to help reduce deferred maintenance costs, operational stress, and compliance-reporting issues faster and more accurately than cloud-based solutions. They provide a comprehensive end-to-end solution that is modular, scalable, flexible, autonomous, plug-and-play with no coding required, sensor agnostic, and adaptable to virtually all low-power communications protocols and third-party software. Consider that military-grade cybersecurity is deployed using TLS v1.3 encryption libraries and firmware. Bobbin-type LiSOCl2 batteries deliver extended operating life to reduce long-term maintenance costs.

THE IMPORTANCE OF CHOOSING INDUSTRIAL-GRADE LITHIUM BATTERIES

There are two types of industrial-grade low-power devices: those that draw low average current measurable in microamps along with pulses in the multi-amp range, which can use lithium primary cells; and those that draw higher amounts of energy (background current and pulses) measurable in milli-amps, requiring the use of an energy-harvesting device in combination with a lithium-ion (Li-ion) rechargeable battery to store high pulses.

All batteries experience self-discharge, as chemical reactions exhaust available capacity even when a cell is disconnected or in storage. However, the rate of annual self-discharge varies, mainly based on the cell's current discharge potential, the quality of the raw materials, and the ability to harness the passivation effect.



Passivation occurs when a thin film of lithium chloride (LiCl) forms on the surface of the lithium anode, thereby limiting reactivity. Whenever a load is placed on the cell, the passivation layer initially causes high resistance and a temporary dip in voltage until the discharge reaction starts to dissipate the LiCl layer; this process repeats each time the load is removed.

The level of passivation is also influenced by how the cell is manufactured and by its current capacity, the amount of time in storage, storage and discharge temperature, and prior discharge conditions. As removing the load from a partially discharged cell increases, the level of passivation relative to when it was new. Passivation is ideal for reducing self-discharge, but too much of it can overly-restrict energy flow.

Standard bobbin-type LiSOCl2 cells are uniquely able to harness the passivation effect but cannot generate high pulses due to their low-rate design. This requires a hybrid solution by combining a standard bobbin-type LiSOCl2 cell that delivers low-level background current with a patented hybrid-layer capacitor (HLC) that delivers the high pulses needed to power bi-directional communications. These hybrid cells feature a unique end-of-life voltage plateau to provide "low-battery" status alerts and can withstand prolonged exposure to extreme temperatures.

Be aware that significant differences exist between high-quality bobbin-type LiSOCl2 cells that feature a self-discharge rate as low as 0.7% per year (able to last up to 40 years) and inferior-quality cells with a self-discharge rate of up to 3% per year, which limits their operating life to 10-15 years. These differences are not easily distinguishable, so due diligence is required when evaluating different brands, including well-documented long-term test results and in-field data comparing equivalent devices under similar loads and environmental conditions.

A REAL-LIFE EXAMPLE

With 600 miles of watermains, Erie County, Pennsylvania uses pressure-reducing valves to prevent leaking pipes and bursting watermains, which is especially critical to this 100-year-old system serving more than a million people.

Previously, service crews lacked the data intelligence needed to anticipate potential ruptures to the main water line. The municipality installed Ayyeka AI-enabled edge devices to provide a comprehensive end-to-end solution that continuously monitors pressure levels and provides automatic text message, email, or automated phone-call alerts whenever pressure levels begin to drop. Proprietary software is used to detect small leaks before they lead to costly and disruptive watermain ruptures, while hybrid bobbin-type LiSOCl2 batteries are used to reduce long-term maintenance costs and to deliver the high pulses required to power bi-directional communications. ◻