



By Sol Jacobs, Vice President and General Manager, Tadiran Batteries, USA

# ADAPTING LITHIUM BATTERY TECHNOLOGY TO HIGH PERFORMANCE AMR DEVICES

**Increasingly sophisticated utility meter AMR devices require increasingly powerful lithium battery solutions. The latest generation of AMR devices, which use improved technology, are feature-rich and power-hungry. This means that more is required of the batteries that power them.**

Battery manufacturers are under continual pressure to respond to the changing needs of AMR manufacturers, including adapting current lithium battery technology to reduce size, weight and costs. At the same time, battery manufacturers must find new ways to increase capacity to handle the high current pulses of AMR devices.

## **PUSHING LITHIUM BATTERY TECHNOLOGY TO THE LIMIT**

The newest generation of AMR devices generate high current pulses at periodic intervals, with little or no background current between signal transmissions. Lithium thionyl chloride batteries are generally preferred to power AMR devices, because of their inherent long life and high energy density. But as utility meters become increasingly complex, this chemistry is being pushed to its limits in order to deliver higher performance without sacrificing product life, as battery failure can disrupt the billing process and result in costly service calls.

Of all the available lithium battery chemistries, bobbin-type Li/SOCL<sub>2</sub> cells offer the advantages of higher energy density and voltage, excellent temperature characteristics, low self-discharge rates and excellent safety characteristics. However, bobbin-type cells have two major obstacles with regard to high pulse applications - passivation after storage at elevated temperatures, and low current due to the low rate design.

To address these problems, engineers began experimenting with a hybrid battery which uses lithium thionyl chloride chemistry in tandem with a unique Hybrid Layer Capacitor (HLC). These hybrid cells can supply pulses measured in AMPs, whereas standard lithium thionyl chloride cells can only supply milli-amps. The hybrid cell offers all the benefits associated with thionyl chloride bobbin cells when compared to other lithium

technologies. These benefits include higher capacity, lower self-discharge (less than 2% per year), lower ESR (equivalent serial resistance), no passivation effect, and a broader temperature range (-40°C to +85°C).

The Hybrid Layer Capacitor is charged by the battery and powers the pulses via its low output impedance. It is recharged by the battery in advance of the next pulse, to eliminate passivation effects. Combining the HLC with a lithium battery also allows end-of-life measurements. Monitoring the battery + HLC's open circuit voltage allows available capacity to be accurately measured, since capacitance of the battery pack is a function of the open circuit voltage.

## **AMR FIXED NETWORK WIRELESS SYSTEMS**

One of the key players in the AMR fixed network wireless systems market has developed a system capable of providing intra-day readings of consumption patterns, equipment tampering, maximum current, flow meter operation and other data. Its ability to link a single transmitter with up to ten separate meters, including multi-utility data from gas, water and electric meters connected to one data collection device, is unique to this system. By offering a single source solution across a wide spectrum of utility services, the system opens the door to new revenue streams and further cost savings.

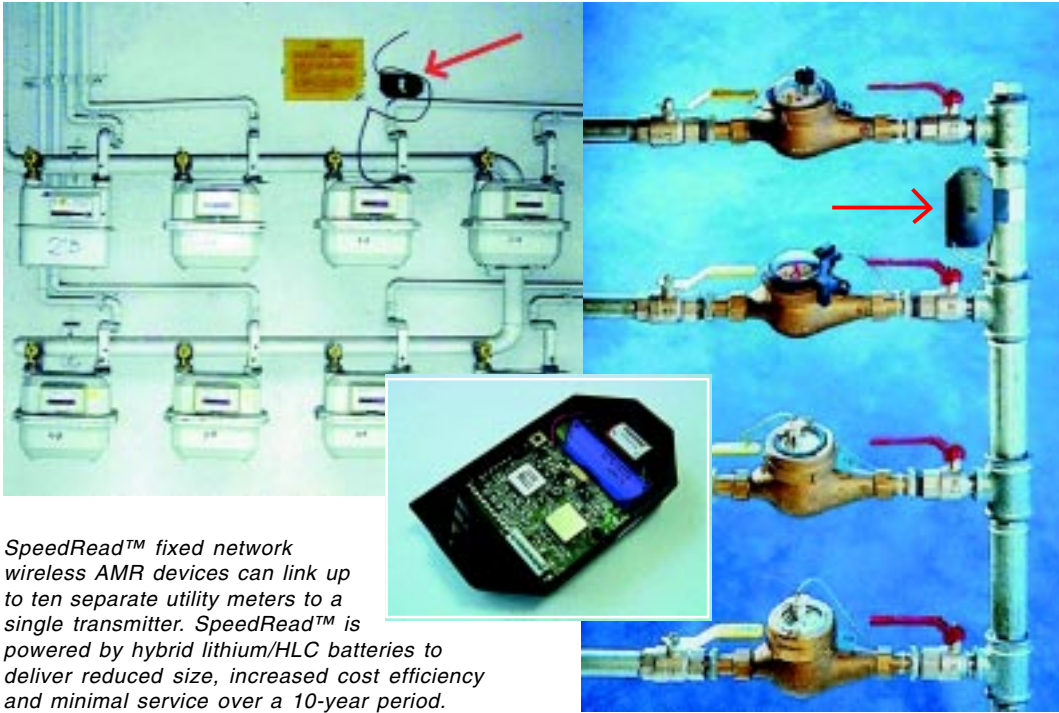
In designing a system that transmits many times a day, a battery that would not compromise battery life expectancy for increased power was required. Extending the time between battery replacements was critical, since longer life translates into an important marketing advantage: reduced field service to replace batteries.

Conventional lithium thionyl chloride batteries did not offer the voltage or capacity to handle multiple daily data transmissions, so the designers selected a hybrid lithium battery. They believe it

## **ABOUT THE AUTHOR:**

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*SpeedRead™ fixed network wireless AMR devices can link up to ten separate utility meters to a single transmitter. SpeedRead™ is powered by hybrid lithium/HLC batteries to deliver reduced size, increased cost efficiency and minimal service over a 10-year period.*

offers an ideal solution, allowing their system to be smaller and more cost-efficient, with minimal service required over a ten year period. Other examples where these new hybrid lithium batteries have been successfully adapted to high pulse applications include prepaid water and gas meters.

**PREPAID WATER METERS**

In certain regions of the world, principally Europe and the Far East, prepaid meters are becoming increasingly common. One recent application involves a Far East manufacturer of prepaid water meters who requires a battery with a minimum voltage of 2.4V, operating life of five years or longer, the smallest footprint and overall volume possible, along with the ability to withstand extreme temperatures (-10°C to +55°C) and high humidity (93%).

This specific application originally called for a standard lithium thionyl chloride D-sized battery that can provide approximately six years of average service life. However, the device was able to use only 14% of the battery's theoretical capacity, due to the build-up of a passivation layer caused by high ambient temperatures. The D-size cell was also too large for customer requirements.

Equivalent performance can be achieved using one 2/3AA lithium battery and one Hybrid Layer Capacitor (smaller than a 1/2AA cell). The hybrid battery solution is smaller, more cost effective, and provides up to seven years of service life.

**PREPAID GAS METERS**

One Far Eastern manufacturer of prepaid gas meters requires a minimum voltage of 2.8V, operating life in excess of seven years, and the ability to withstand the most extreme temperatures (-35°C to +85°C). Based upon the typical load profile, a standard lithium thionyl chloride C-size cell can provide up to 6.65 years of operation, while a high capacity D-size cell can provide up to 14.01 years of operation. To handle the current pulses, both batteries require a large aluminum electrolytic capacitor (47000 MICOF) in parallel. This solution is highly problematic, as the aluminum electrolytic capacitor has a relatively high rate of leakage, wasting primary battery energy. The combination of the D-size cell and the capacitor also exceeds customer size requirements.

Using a hybrid lithium/HLC battery, one C-size lithium thionyl chloride battery in tandem with a small hybrid layer capacitor can provide up to 8.08 years of operation. A similar pack using one D-sized cell can provide up to 18.07 years of operation. The hybrid lithium/HLC pack does not suffer from passivation effects, or the leakage problems associated with aluminium electrolytic capacitors.

As the current wave of deregulation continues and AMR/utility meter device manufacturers strive to make their technologies increasingly feature-rich, they must work closely with battery manufacturers to ensure that emerging battery technologies can keep pace with rapid product advancements.[mi](http://www.tadiranbat.com)

**ABOUT THE COMPANY:**  
*Tadiran is a leading manufacturer of Lithium Thionyl Chloride batteries, including PulsesPlus™ cells. Tadiran also manufactures primary batteries in a variety of configurations, including cylindrical, coin-sized cells and packs. Tadiran products are also available with many different terminations and assemblies. High temperature and high power models are also available. Tadiran batteries are UL-listed and manufactured to ISO 9002 quality standards.s.*

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