Smart Metering:
Birdz's Journey from FSK to LoRaWAN®

Technical Case Study

April 2020

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Challenges Faced by Water Suppliers

Water metering is a key part of any public or private utility in charge of municipal infrastructure to supply and distribute water. Key to managing the water resource is measuring, and billing for, water consumption. However, accurate metering is a challenge. On average amounts ranging from 20 to 50 percent of water is lost between water production and water billing points[1]. There are a variety of causes for this, such as:

- Leakage and pipeline bursts
- Water theft
- Private tankers
- Illegal connections
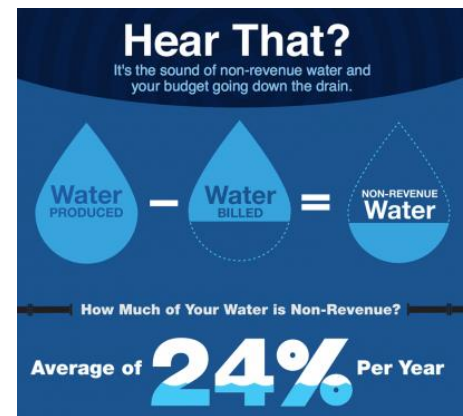- Maintenance problems
- Water meter inaccuracies

FIGURE 1: NON-REVENUE WATER
IMAGE COURTESY OF BIRDZ

Historically, to read water meters people have been dispatched house-to-house and building-to-building, from the building level down to the level of individual units within a building. This is a laborious and costly process. Now, smart metering is a more efficient way to remotely read meters that transmit data through RF communication.

Enter the Internet of Things

With the advent of the Internet of Things (IoT) the process of smart metering became easier and more cost effective.

In early 2003, HomeRider Systems (now Birdz, a division of Nova Veolia), developed a clip-on communication module that turned a water meter into a battery-powered smart meter that could communicate data remotely. This system was deployed in Paris. The smart meters relied on Frequency Shift Keying (FSK) radio modulation to enable meter reading using either Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI). At the time, FSK was the most suitable modulation technique for smart metering because of its low power consumption and lack of complexity, which lead to low-cost transceivers. However, FSK modulation came with range limitations. AMR involves having personnel walk- or drive-by the physical location of each meter to collect data. With HomeRider's AMR deployment, end points (i.e., the smart meters) listen for a nearby "wake up" signal to transmit its data

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[1] Video: Deploying Smart Water Meters: How to Transition from AMR to AMI with LoRa-based Solutions from Birdz: https://www.semtech.com/company/videos#webinars

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using a peer-to-peer protocol. This allowed HomeRider to get more data more quickly than conducting manual readings, which in turn led to economic savings for utilities.

In some areas, depending on the benefit for the utility, HomeRider deployed a radio infrastructure to enable automatic reading with a fixed-network approach, known as AMI. It could switch water meters from being AMR-based to AMI-based. With this deployment, the smart meters automatically uploaded water consumption data to the network, obviating the need for anyone to walk or drive by each and every meter throughout the deployment area. At the same time, however, in areas where network coverage could not be achieved, the utility still relied on the walk by/drive-by approach for reading meters.
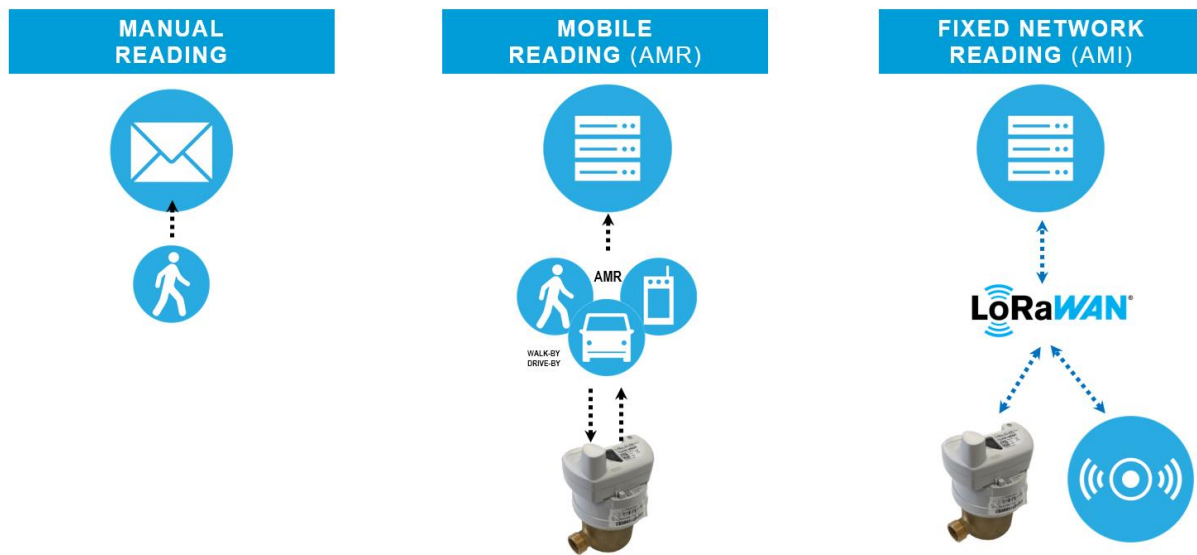
FIGURE 2: COMPARISON OF TYPES OF WATER METER READINGS
IMAGE COURTESY OF BIRDZ

There are three key factors to consider in making the decision to locally deploy a private fixed-network infrastructure for AMI:

1. KPI and data latency: Municipality use cases can vary from monthly to daily readings and may require different meter reading success rates.

2. AMI Infrastructure costs: The availability of "high points" where gateways can be mounted as well as the related rental fees for those high points.

3. The geographical spread and the reachability of water meters, particularly deep indoor constraints and urban density.

The AMI solution helped the water utility to meet its commitments towards the municipality requirements and hence expand its businesses. However, with water meters generally located deep indoors, a dense network was required with the FSK technology. However, the move to an AMI approach required a higher capital expenditure for deploying the necessary gateways. The increased capital expenditure is due to:

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- Limited link budget and limited robustness to interference of FSK Modulation
- High initial overhead with respect to developing and maintaining a proprietary AMI solution
- Utilities preferred broadly-deployed protocols and solutions. Additionally, some water utilities did not want to be tied to a single source AMI technology.

FIGURE 3: DEEP-INDOOR WATER METER
IMAGE COURTESY OF BIRDZ

Introducing LoRa®-based Smart Meters

In 2011 and 2012, Birdz teamed up with Cycleo (now, Semtech), which had just released LoRa® modulation, a technological breakthrough in radio communications. As an alternative to FSK modulation, LoRa provides significant advantages. For example, LoRa-based devices on a network offer a high link budget solution combined with low power consumption, leading to a long battery lifetime. The LoRa technology supports a large number of devices with a low volume of data. Additionally, it allows networks to scale, providing the necessary capacity for water meter deployments. (For full details, see LoRa Modulation Basics (AN1200.22).

Working with Semtech and creating its own networking protocol, Birdz developed a new generation of smart meters and gateways capable of operating with both FSK and LoRa modulations. This allows Birdz to continue with legacy FSK deployments and add new deployments benefiting from LoRa devices' advantages at the same time.

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With Semtech's ICs (SX127x/SX126x) supporting both LoRa and legacy FSK modulation, Birdz was able to upgrade the performance of its new deployments while maintaining backwards compatibility with existing deployments. This was a significant win for utilities because it lowered the risk of forced obsolescence, especially for use cases that typically require 10- to 20-year field lifetimes.

In 2014, in the French city of Lyon, Birdz applied this dual-technology AMI deployment to manage the reading of almost 400,000 smart water meters. Over time, Birdz systematically featured its new deployments with LoRa-based technology.

Despite its advantages, LoRa-based deployments faced some challenges in the field which made it difficult to reach a 100 percent daily meter reading success. There were a few different reasons for this:

- The deep indoor conditions of water pits: some meters are very difficult for a network to reach. To ensure such meters could be reached would have required a high-density network deployment. This level of density would have resulted in an unaffordable total cost of ownership (TCO).
- The deployed networks were private. Using a proprietary network protocol and infrastructure led to high capital and operational expenditures supported by only one customer.
- Towers and city high points: these assets are rare and have expensive rental fees.

Given these limitations, Birdz continues to offer deployments with both AMR and AMI and using both FSK and LoRa modulations.

The AMI infrastructure enables daily monitoring of various key assets for utilities, generating valuable insights which allowed Birdz to develop new added-value services. By providing these new services, Birdz was able to make the transition from AMR to AMI financially feasible. It also helped the company to cope with the challenges related to AMI deployments

FIGURE 4: ADDED-VALUE SERVICES CREATED BY THE AMI APPROACH OF READING WATER METERS
IMAGE COURTESY OF BIRDZ

While taking advantage of the cost savings afforded by the newer technology and the new added-value services, deploying a private local network remains expensive.

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Integrating LoRaWAN®

In 2015, Birdz (at that time, HomeRider) joined the LoRa Alliance® as a sponsor member to contribute to the technical committee work. Based on the existing hardware featuring FSK and LoRa modulation, Birdz added the implementation of the LoRaWAN protocol stack into its devices.

With the growing availability of LoRaWAN network coverage in France, Birdz teamed up with public operators to deploy AMI solutions for its new customers. In December 2018, Birdz, as subsidiary of Nova Veolia, announced a commitment with Orange Business Services, to connect more than three million water meters (using the Orange LoRaWAN network) before 2027. Therefore, in 2019, Birdz started a full AMI deployment using a public Orange LoRaWAN network comprising 30,000 smart water meters in Ajaccio, Corsica and 200,000 in Toulouse.

Advantages of a LoRaWAN Public Network

The key advantage for Birdz of using a public network was that the infrastructure was already there, without the need to deploy and manage a new one. The key reasons Birdz moved to adopt a public LoRaWAN network included:

1. **Moving to a LoRaWAN public network** provides several advantages right off the top:
   a. Availability of a nationwide commercial offer of "connectivity as a service", per device and per year
   b. Availability of a "coverage on demand" option for the "no coverage" areas
   c. Commitment by the public network to ensure availability during the lifetime of meter-reading contracts
   d. Interoperability based on the LoRaWAN protocol
2. **Using a public network** has additional advantages as well:
   a. **Operational Expense:** For mass deployments of meters in deep indoor conditions, the cost model of a public network operator is more effective than a private one due to the volume effect and mutualization between several applications and customers.
   b. **Risk Control**: With a fixed-price offer from public operators, Birdz is able to manage a predictable cost of service. Based on that, Birdz can secure the cost related to reach the required SLAs.

Summary

The key takeaways from Birdz's journey are:

- **Dual technology hardware devices**: The same hardware for smart water metering can operate in both FSK and LoRa modulations. This allows for deployment flexibility for both AMR and AMI modes. With simple firmware commands, the hardware can be reconfigured to support either AMR or AMI in FSK, LoRa or LoRaWAN.

- **AMR and AMI hybrid deployment strategy**: With the dual technology hardware, Birdz proved that it is possible to deploy in AMR mode and then migrate from AMR to AMI at a later time. Using this approach, utilities can progressively move meters from AMR toward AMI when the network coverage is available. Wherever coverage is not available the utilities can still rely on

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AMR or a private AMI solution using the same smart meter. When the AMI infrastructure is not economically sustainable or is out of service, the AMR mode remains a useful back-up option.

- **Adoption of a public LoRaWAN network:** The evolution from AMI in a proprietary, LoRa-based networking solution to a LoRaWAN network solution based on public operators allowed Birdz to benefit from operator-grade services that offer both national coverage and interoperability with LoRaWAN-based devices. This helped Birdz to significantly reduce the capital expenditure immobilization and to optimize the final cost of AMI service for utilities.

ABOUT SEMTECH

Semtech Corporation is a leading supplier of high performance analog and mixed-signal semiconductors and advanced algorithms for high-end consumer, enterprise computing, communications, and industrial equipment. Products are designed to benefit the engineering community as well as the global community. The Company is dedicated to reducing the impact it – and its products – have on the environment. Internal green programs seek to reduce waste through material and manufacturing control, use of green technology and designing for resource reduction. Publicly traded since 1967, Semtech is listed on the Nasdaq Global Select Market under the symbol SMTC. For more information on Semtech's LoRa devices and the LoRaWAN protocol, visit www.semtech.com/LoRa

ABOUT BIRDZ

Born from the merger of Homerider Systems and m2ocity and a wholly-owned subsidiary of Nova Veolia, Birdz, a pioneer in remote water meter reading, deploys its unique know-how at the service of the Smart City. A major player in IoT in France, Birdz offers a very large ecosystem of solutions to manage the city's utilities and preserve the quality of the urban environment: water, energies, temperature, pollution, noise, etc., and control the entire value chain, from sensor design to the useful valuation of millions of data collected. www.birdz.com

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