

the radio frequency spectrum

By Brian Fiut



Radio frequency strategy in an AMI deployment

Today, an increasing number of water utilities are moving toward advanced metering infrastructure (AMI) systems to help manage the growing challenges of supply and demand. These systems ensure reliable and safe delivery of clean water while leveraging AMI technologies to lower operational costs, monitor distribution systems and deliver improved customer service experiences.

Wireless networks are a foundational component of AMI solutions, offering utilities access to granular, real-time meter data, distribution system performance indicators and two-way communications for remote system control. Network radio frequency (RF) and bandwidth utilization are major factors for utilities as they strive to find a system with unquestionable service reliability.

Network performance is critical for water providers implementing an AMI system. The RF strategies that utilities choose play an important part in ensuring that utilities receive the expected benefits of their AMI systems.

When assessing an RF strategy, business objectives and network performance are two key areas requiring analysis and consideration. An RF strategy typically is viewed as a technical decision; however, the business impacts of the decision need to be viewed as critically as network performance. In order to guarantee performance over the life of the solution, it needs to ensure a prescribed quality of service (QoS) level. QoS performance is measured by capacity, data rate and latency and is essential for AMI networks with growing data needs.

Bandwidth Strategy

There are many important factors to consider when choosing an RF strategy. By considering the business case and overall performance expectations on bandwidth and licensed or unlicensed strategies, it will become evident that an unlicensed strategy is well suited for AMI and is the RF spectrum of choice for many water utilities.

Itron offers its utility customers wideband capability for its AMI solution, operating in the frequency band between 902 and 928 MHz. Wideband systems operate across 120 channels and are designed to receive up to 120 separate transmissions simultaneously, each at a 37.5-kilobits-per-second (kpbs) data rate. This capacity and data rate enable information from all water encoder receiver transmitter (ERT) modules to be delivered with low latency.

Known narrowband competitors operate between 450 and 932 MHz and have typical bandwidths of only 12.5 kHz, with some claiming extensions up to 50 kHz. Their narrowband systems utilize between one and four channels and therefore can only simultaneously receive one to four transmissions, at typical data rates ranging from 1.2 to 8 kbps. In the narrowband case, for a full deployment, each meter's message collected by the system will be several hours old at any point in time, as compared with a wideband system in which the message typically will be less than five minutes old.

Licensing Strategy

While a preponderance of AMI solutions utilize the unlicensed—yet regulated—RF spectrum, some AMI solutions have been developed for licensed frequencies. These latter solutions are rooted in a pre-AMI business model in which a daily meter read sufficed and there was little call for advanced functionality such as two-way capabilities and frequent

interval data driving operational efficiency, system integrity telemetry or conservation-based in-home devices to enable consumer engagement and understanding of their usage.

At first glance, it might seem that licensed frequencies would be preferred; however, network reliability is not guaranteed within a licensed band, nor should an unlicensed band be defined as unreliable.

Use of unlicensed frequencies—typically the industrial, science and medical (ISM) bands—does not mean that the band is unregulated. Every device operating on the band is regulated by the Federal Communications Commission (FCC) and must pass stringent test requirements to ensure that it operates within the guidelines of the band, which protect equal access of the band.

Hundreds of millions of devices operate in ISM bands. Because the users of unlicensed channels expect other users in band, the operational signature of those users also is known. Thus, mature system architecture includes robust interference management techniques. To manage overall system noise, users of unlicensed frequencies utilize multiple proactive communications techniques to avoid interference, thus ensuring a high QoS level.

The licensed wideband spectrum is not publicly available, and if it were, it would be cost-prohibitive. In the AMI industry, licensed solutions are synonymous with narrowband systems. Licensed frequencies do not guarantee interference-free operations. Interference can come from legal adjacent channel users and from other licensed users, as well as unauthorized users, at any time. Different RF power levels are allowed in the licensed bands with ranges from less than 1 W up to 300 W, which can cause interference and adversely impact communications reliability for lower-power devices.

When interference does occur, licensed devices have no option. They are licensed for operation on a single or a small subset of channels, which eliminates their ability to move to open channels, contributing to diminished QoS. Unless and until the FCC grants operations on another licensed channel (if available in the desired service area), the data of the licensed user does not get through in the affected areas.

Adoption of Unlicensed Bands

There is little debate over whether licensed or unlicensed operations best serve the needs of AMI customers as the vast majority of AMI vendors utilize unlicensed bands for their systems operations. In fact, nearly 75% of all North American AMI deployments occur in unlicensed bands. Even some AMI suppliers that utilize licensed frequencies are promoting equipment that uses the unlicensed spectrum as a part of their network.

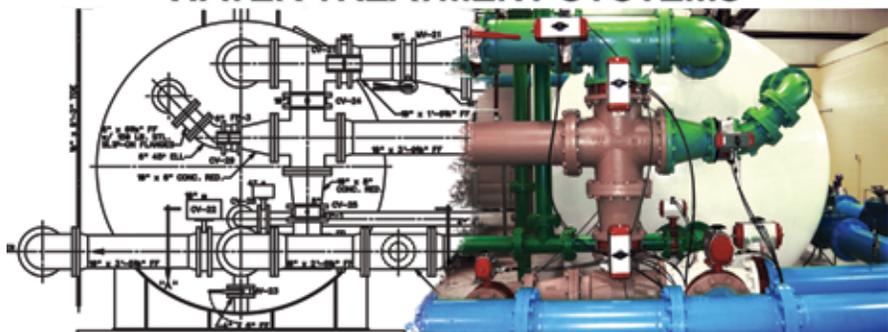
Itron has been developing RF-based meter data collection systems for more than 20 years and has more than 80 million devices in the field that operate within the unlicensed frequency, providing successful fixed network collection systems to utilities around the globe.

In determining whether to go with licensed or unlicensed frequencies in North America, Itron decided to utilize the unlicensed frequency for its AMI solutions because it offers customers greater system flexibility, superior performance and a lower total cost of ownership over the lifetime of the system. Compared with a narrowband approach utilizing one or two channels, the technology simultaneously operates on up to 120 multiple



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independent communications channels. This allows the system to ignore channels with interference noise while leaving the majority of channels available for system data transmission.

In the unlicensed frequency band, radio signals hop frequencies across 120 channels to avoid interference

With an RF solution, customers can gain:

- Agility: Robust, military-derived, frequency-hopping transmissions provide interference immunity;
- Adaptability: Optimal channels are automatically selected for each field collector;
- Established technology: Itron's fifth-generation software-defined radio features powerful digital signal processing capabilities;
- Growth: System capacity and bandwidth designed for performance with adequate margin to support future growth in both population and advanced functionality; and
- Conservative propagation predictions: Leading propagation modeling and actual environmental testing are utilized

to determine conservative deployment parameters.

When selecting an AMI solutions provider, it is helpful to choose a vendor based on business objectives. Are flexibility, performance and cost objectives met? When it comes to providing true AMI capabilities, the industry has moved to the unlicensed spectrum. When choosing a specific AMI solution, it is imperative to understand how the technical choice meets the business case requirements and to consider an RF strategy in which proactive measures ensure long-term robust operations. Unlicensed frequencies offer critical system performance that the majority of AMI vendors have embraced with full confidence to ensure the short- and long-term levels of service that are expected by their customers. [www](#)

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