Itron

Factors for Water Billing Accuracy

WHITE PAPER

INTRODUCTION

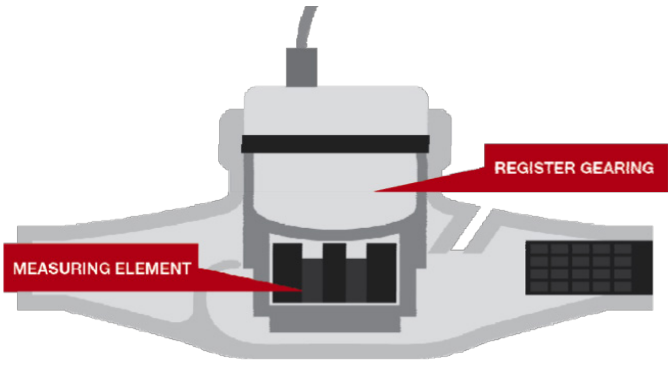
The first bills for water usage were generated through manual meter reading and hand-written methods over a hundred years ago. Since that time, accuracy has been an integral part of delivering potable water to utility customers. Manual meter reading provided many opportunities for human error to cause an incorrect bill. Automated meter reading (AMR) and advanced metering infrastructure (AMI) technologies were introduced to address some of the causes of incorrect meter reading including: visually misinterpreting the physical meter reading, transposing numbers when entering the meter reading, and incorrectly entering the meter reading into the billing system. Although infinitely more accurate than primitive meter reading methods, no AMR/AMI system is perfect.

In the typical AMR or AMI system, the vast majority of meters are read correctly, accurate bills are generated, and those bills are sent to the customer. However, there are instances in all utilities where incorrect bills are sent to the end customer. When the utility uses an AMR/AMI system, it is easy to immediately blame either the meter's electronic register or the AMR/AMI endpoint for billing mistakes. Billing accuracy involves much more than whether or not the meter and communication module are reading accurately. Many factors contribute to billing accuracy, including meter rightsizing, proper installation, and the proper utility billing system settings. This white paper describes other factors and variables that can affect billing accuracy.

HOW THE METER SYSTEM WORKS

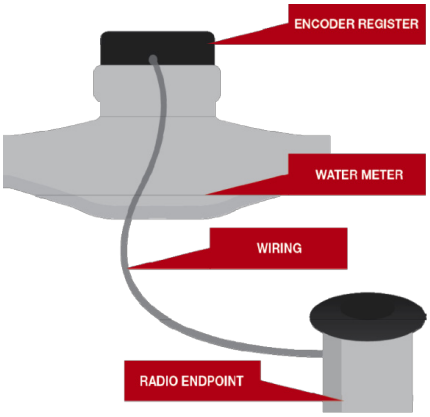
First, to understand the factors for billing accuracy, it is important to understand how the metering system works.

Utilities use water meters to measure water flow throughout their systems and to bill customers for their water usage. In a typical meter, the volume or speed of water flow is measured by a mechanical device. The water moving through the meter's measuring chamber causes a magnet to rotate in relation to the measuring element. A magnetically driven register records the rotations and calculates volume based on gears which are linked to the rotation speed of the measuring element magnet. These gears turn an odometer wheel which reports the corresponding volume. However, to correctly calculate the volume, the register must be the appropriate size and type for the meter or the gear ratio will be wrong. In the event the register is incorrectly matched to the meter, the meter reading may be drastically higher or lower than the actual usage.



Cross-section of a Basic Water Meter

Water meter registers typically are one of three types: direct read, pulse-based (pulser) and absolute encoder. Direct read meters have a display that must be read by a utility meter reader. Absolute encoder registers are read using an inductive probe or by a serial communication-based AMR/AMI device. Pulse-type registers generate an electronic pulse that is counted by the AMR/AMI device.



AMR/AMI Device Set-Up

FACTORS FOR WATER BILLING ACCURACY

A variety of factors can affect water meter billing accuracy.

METER INSTALLATION AND RIGHTSIZING

If the meter is not optimized for a particular application, it will not measure consumption accurately, resulting in revenue losses—or in some cases—over-registration. The ideal meter size and type (compound, turbine, etc.) are important! Refer to the appropriate meter manufacturer's installation recommendations when a new water meter is installed or when an existing meter setting is audited to ensure a long, accurate meter life.

Itron's 100W+ encoder receiver transmitter (ERT) module's advanced functionality can help utilities determine if their meters are the right size (rightsizing) for a particular application. The 100W+ also records water consumption patterns which can be analyzed to help utilities determine water meter replacements. The 100W+ ERT module's rightsizing tool can help utilities identify underperforming water meters that need to be replaced. Rightsizing can be used at any time without the need to physically access the meter or add any equipment.

For more information, see the Itron Meter Rightsizing with 100W Series ERT Module white paper.

ENDPOINT INSTALLATION ERRORS

AMR/AMI endpoints are communication modules that fit on electric, gas, or water meters. Communication endpoints encode consumption and tamper data (information) from the meter and communicate the data (information) to data collection systems including handheld computers, mobile AMR systems, and Fixed Network AMI systems.

Proper meter and endpoint communication module installation is important for billing accuracy. Many errors can occur during installation that can cause an inaccurate meter read—a read that is greater or less than the actual consumption amount.

If any of the following conditions are present during installation, the endpoint module should not be installed:

- The endpoint was handled in a way that was inconsistent with the manufacturer's instructions
- Installation parts are damaged or missing
- Connectors are compromised (for example, wet or dirty)

If an endpoint is installed and the register will be installed later, it is important to secure the connector's protective cap. An exposed connector in the field can lead to water intrusion.

The endpoint cables can sustain damage if they are incorrectly installed in pit lids. It is important to verify that a cable is not pinched. If the endpoint wire is pinched, the cable wires may be exposed to moisture resulting in incorrect reads. If the endpoint cable is pinched in the pit lid, the cable could be disconnected, causing an incorrect read.

Errors can also occur during initial pulser endpoint installation and programming. During programming, it is important to ensure that the starting read on the endpoint and the register both match exactly. Although an endpoint module may be pre-programmed in production with a specific start number, it is critical to ensure that the register reading matches the endpoint during installation programming.

METER MISREADS

Many factors can contribute to misreading a meter. These scenarios could lead to an incorrect reading being collected.

Simple human error can occur in a direct-read situation—a meter reader misreads the register number and logs a number higher or lower than the actual consumption amount. If a meter is installed indoors and the reader cannot access the meter, the reader must estimate the read.

Proper endpoint programming during installation is critical in reporting a correct read. The correct meter register size, number of register dials, and actual register reading all contribute to collecting correct reads. For example, if an installer selects a two-inch register where there should be a one-inch register, the recorded consumption is automatically multiplied by 10 due to the difference in register sizes.

Incorrect data elements in the utility's customer information system (CIS) can lead to incorrectly formatted readings. Multiplier and truncation values must be set correctly based on the register and meter sizes and the number of register dials. Depending on the Itron system the customer uses, multiplier and truncation values are configured in different places within the software application; Multi Vendor-Reading System (MV-RS), Billing Gateway, and Field Collection Software (FCS) applications use truncation tables to multiply and format readings—Fixed Network uses a Decode Value to set the reading formatting. If Itron applications are not configured correctly, incorrect readings could be returned to the utility's CIS. At the time of deployment, Itron system installers can use the utility's CIS values to format the readings.

Misreads can also occur if the endpoint does not capture the data correctly from the pulser-style meter register. This misread occurs on pulser-style meter registers when the endpoint does not count the pulse generated by the meter or the meter register pulses incorrectly. This type of misread could be due to improper installation, damage to the meter or endpoint, or tampering. The reading from the endpoint may be correct as the endpoint recorded it, but it may not match the actual reading on the register.

CHECKING FOR TAMPERING OR LEAKS

Meter or endpoint tampering and leaks can also affect billing accuracy. AMR and AMI technologies that feature tamper information have become increasingly important for utilities. Utilities can no longer rely on the meter reader's monthly read to check for tampering. A tamper is a value or bit set within the circuitry of the endpoint. It changes when a certain fault condition is met.

Itron water ERT modules feature tamper indicators to help utilities identify whether someone tampered with a meter (possibly in attempt to steal water) or identify possible problems with the meter. Monitoring for a change in a tamper value alerts utilities to a problem with a meter or meter tampering.

Some Itron ERT modules feature two tamper values: one that reports leaks and another that reports no communication between the meter and endpoint. Tampers indicate that someone intentionally tampered with the meter or endpoint or that the meter is not communicating with the endpoint. These values are called leak flags and cut cable/physical tamper respectively.

If a tamper or leak is indicated during a meter reading, the information is collected and displays with the meter usage data using walk-by and drive-by reading systems. If the customer is on-site, the meter reader can deal with the problem immediately. With drive-by collection or Fixed Network systems, the utility generates a report in the office from the collected data and provides field service personnel with the information to take appropriate action following the utility's policy.

The hourly interval data gathered by endpoint modules allows utilities to monitor systems for unusually high water usage which could indicate a leak.

REGISTER-BASED ERRORS

The backbone of an AMR/AMI system is the interaction between the register and the endpoint. It is critical that the endpoint receives accurate information from the register. If the information from the register is corrupted or incorrectly generated, the AMR endpoint module cannot report the correct register reading.

ENDPOINT-BASED ERRORS

Utilizing an AMR/AMI system can eliminate many of the potential errors inherent in the meter reading process. While no manufactured system can be expected to work perfectly 100 percent of the time, Itron leads the water industry in manufacturing reliable AMR/AMI endpoint modules (see the Itron white paper Greater Performance by Design). Currently, the Itron endpoint yearly return rate (YRR) is trending well below one percent.

The vast majority (almost 99 percent) of Itron endpoints returned for failures exhibit symptoms that do not result in an incorrect reading being sent to the utility. The most often observed symptom for ERT returns is no problem found. The second most often recorded symptom is a total failure of the ERT (which is immediately identifiable to the utility).

In instances where the endpoint reports an incorrect reading, 75% of the time that reading is lower than the actual usage. Although

not ideal, this symptom does not cause a public relations problem with the utility's end customer (other than a potential catch up bill). Throughout the population of Itron water ERT modules in the field, 0.016% (or 16 endpoints out of 100,000) can be expected to report a number lower than the register shows. The major cause of this symptom can be traced to a zero reading due to a faulty wire, incorrect connector installation, or a programming issue.

In 25% of the cases of an incorrect reading reported by an endpoint, the electronic reading is higher than the actual meter reading. This symptom may cause a public relations issue; however, this problem occurs in very few of the installed Itron endpoints—specifically 0.007% (or 7 endpoints out of 100,000). In most of the endpoints reporting a higher reading, this symptom is due to incorrect endpoint programming.

To help utilities eliminate potentially incorrect endpoint readings in their billing system, Itron software provides reports that give the utility the ability to screen out readings that appear to be either higher or lower than what is historically expected.

USING SOFTWARE TO APPLICATIONS TO DETECT INACCURATE USAGE

There are several methods for identifying and detecting inaccurate usage. Audits can be used to help identify many of the above examples by monitoring month to month usage and calculating estimated ranges for the current month. Tampers can be monitored to detect potential tampering as well as other events such as leaks.

AUDITS

Itron systems provide multiple checks and balances that can be used to determine if the consumption for a particular billing cycle is abnormal. The following audit results are easily detected based on usage expectations delivered from the utility's CIS:

- Zero usage on an active meter. If the Meter Status is marked as Active and the difference between the previous read and the current read is equal to zero, this audit fails.
- Usage on an inactive meter. If the meter is marked as Inactive and the difference between the previous read and the current read is not equal to zero, this audit fails.
- Failed Maximum Usage Check, Failed Minimum Usage Check, Failed Maximum % Usage Check, and Failed Minimum % Usage Check. These audit results indicate failures based on limits and percentages being returned from billing. Four values must be sent down in the Reading record; Low1, High1, Minimum Percent & Maximum Percent.

A Read Audit report displays the cycle or route readings that failed at least one of the six audit checks

- Low1 Threshold has been exceeded
- Low2 Threshold has been exceeded
- High1 Threshold has been exceeded
- High2 Threshold has been exceeded
- Zero Usage on Active Meter
- Usage on an Inactive Meter

A Mobile Tamper Exception Report provides information for ERT modules identified as having a tamper or event condition that relates to the ERT module. Some tampers are triggered from a comparison of a counter value received from the ERT module during the current read to the counter value that was received from the ERT in the previous read. Other Tampers are identified by a flag transmitted from the ERT. The report displays the address, ERT ID, reading, time of reading, and tamper indicators.

For more information, see Itron's white paper, Using MV-RS® to Detect Inaccurate Usage.

CONCLUSION

As with any technology, errors can and will occur. Fortunately, there are very few errors that occur with AMR/AMI technologies. In fact, AMR/AMI technologies are often implemented to fix errors caused by aging infrastructure or human error.

The vast majority of errors found in AMR/AMI systems are not due to the AMR/AMI devices, but rather due to the many factors as discussed above. When installed and utilized properly, AMR/AMI actually enables utilities to catch mistakes before they get into the field.

In order to ensure accurate reads and bills, Itron provides our customers with the tools and resources to successfully install and use our technology. From industry white papers to installation manuals and videos, our goal is to equip our customers with the tools they need for accuracy.

With the proper information and tools, utilities can quickly fix and avoid billing errors, resulting in fewer lost revenues and more satisfied customers.

For more information about Itron products and solutions for the water utility industry including billing accuracy or access to other White Papers, start here: www.itron.com.

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