Microthermal natural gas metering
Creating value through novel types of data

by Aleksandar Petrović

In addition to basic flow values, static gas meters (and these include microthermal meters) are particularly useful for supplying unique pieces of information, such as the heat capacity of gas. This article examines the benefits of merging this additional information with the data typically available to gas utilities, such as the location of gas meters or gas composition. The merging of data, which is peculiar to static metering technologies, could be used to generate intrinsically new information about the meter and its environment. Today, the remote monitoring of meter health using off-the-shelf technology is a realistic proposition. And the term ‘smart meter’ could well come to stand for one that not only communicates but also cooperates.

1. NEW DEMANDS ON GAS METERING
The monitoring, measurement and billing of natural gas consumption is changing worldwide. Legislation has been passed, primarily in Europe, which requires traditional non-communicating meters to be replaced or upgraded. The ultimate aim is to allow more efficient (remote) data collection, greater consumption transparency, fairer billing and increased user engagement. Together, these factors could well result in raised energy consumption awareness.

2. GENERATING NEW DATA ASSETS
The transition from ‘traditional’ to ‘smart’ has brought about many changes. For one, new gas metering technologies, such as microthermal and ultrasonic, have moved from research laboratories into the mainstream. Second, smart meters, in other words meters that communicate, now generate large data sets that have become important assets in their own right. And, third, gas meters become smart not only by virtue of being able to communicate but also because the on-board sensors can generate new, valuable pieces of information about the meter’s immediate environment. Some advanced gas meters can sense temperature changes, potential gas leakage or even earthquakes, and take appropriate action. Certain ultrasonic gas meters are able to carry out ‘self-diagnosis’ and report potential malfunctions.

3. SUB-METERS FOR GAS METERING
Ongoing developments in measurement technology have led to a revival of interest in other natural gas metering and monitoring applications. These include sub-metering for small apartments. Natural gas sub-meters, such as those typically installed in condominiums or large apartment buildings, combine decreased size with increasingly diverse functionality, making them ever more suitable for direct integration into gas stoves and gas boilers. This means that in future, information about gas consumption in the home could be collected at several different places, providing very tight monitoring and a clear idea of energy consumption (Figure 1).

4. SAFETY AND RELIABILITY CAN PROFIT FROM BIG DATA
By their nature, smart gas meters are exposed to a higher risk of tampering. This is due to the presence of various types of software, their communicating capabilities and, in general, the increased complexity of their design. Although we need to address these weak spots from various angles, some help could come from the data that smart meters generate. We need to find ways to make full use of the data...
assets generated by gas meters. Some static metering technologies appear able to offer unique, exciting signals that could lead to the increased safety and reliability of gas meters to the ultimate benefit of the end user.

Microthermal gas flow measurement technology is playing an increasingly important role in natural gas metering (residential, commercial and industrial). Microthermal and ultrasonic gas meters are gradually replacing the older, diaphragm-type systems. Gas utilities and gas distributors, as well as smart home and smart energy businesses, are interested in improving metering technology with a view to making it more accurate, secure and reliable.

5. HOW CAN WE PROFIT FROM THE BY-PRODUCT SIGNALS GENERATED BY MICROTHEMAL GAS METERS?

Unlike diaphragm- or turbine-based systems, static gas meters do not have moving parts, a feature that should result in increased service life without compromising performance. Furthermore, microthermal gas flow measurement technology provides not only the gas flow-related parameters, such as the standard volume and flow, but also additional parameters associated with the intrinsic physical properties of measured natural gas or its immediate environment. These additional parameters can be amalgamated with the information available to utilities, such as the geographical distribution of gas meters or the geographical distribution of distributed natural gas types, which can result in added value.

6. WHAT UNIQUE DATA CAN MICROTHEMAL GAS METERS GENERATE?

Microthermal natural gas metering devices, such as meters and sub-meters, provide a wealth of information, collected locally, about the flow, composition and physical properties of gas (Category 1 data). The data may include standard volume, flow, temperature, thermal conductivity and heat capacity, as well as parameters determined by the microthermal measurement method, such as the temperature gradient over the sensing element. Importantly, all of these signals are (or can be) generated – but at the moment not necessarily transmitted to the meter manufacturer – by a single sensor embedded on, say, a CMOS chip.

Gas utilities and/or gas distributors, on the other hand, typically have access to additional information relating to the exact geographical/physical location of the gas meter, the gas type/composition available in a particular region, and gas consumption profiles at specific locations (Category 2 data).
7. ADDED VALUE FOR ALL

Merging these two datasets can generate interesting new insights on at least two levels. Maps showing how Category 1 flow, composition and physical properties are distributed within a neighborhood, city or region can provide or corroborate insights into how certain factors vary from one point of measurement to another. These factors include the thermal conductivity and/or temperature and/or heat capacity of natural gas, as well any other microthermal gas meter-specific parameters or combination thereof.

Merging and processing the two types of data can also have other benefits. These include: the detection of outliers (see Figure 2), improved supply quality control, an increase in the meter’s service life and a reduction in the amount of human intervention necessary in the field.

In the case of outlier detection, Category 1 data could be measured or calculated at the point of interest (at the installation point of the microthermal natural gas meter). The merged datasets could be remotely analyzed for outliers across a certain geographical region of interest. For example, the heat capacity of gas should be very similar within regions that use natural gas of the same type and quality. Instead of heat capacity, any of the parameters from Category 1 or a suitable mathematical relation between them can be used. The detection of an outlier should prompt further investigation, because it might indicate any of the following:

- Tampering with the gas meter,
- Logging malfunction,
- Transmission malfunction,
- Gas meter core measurement unit malfunction,
- Gas leakage,
- Changed gas parameters,
- Changed measurement conditions.

One means of increasing meter service life would be to use redundant signals to carry out self-diagnosis. Furthermore, proposed data collection, fusion and analysis from microthermal gas meters open doors to ‘cloud-based’ solutions that enable meters themselves to profit from each other’s signals, measurements and failures. A smart meter might well come to mean a meter that not only communicates but also cooperates with other smart devices.

8. SUMMARY

By carrying out self-diagnosis or being sensitive to changes in the environment, new gas metering technologies will increase meter reliability and versatility. This is a trend providers of gas metering technologies as well as gas utilities will need to bear in mind and comply with.

Static gas meters, such as microthermal gas meters, are particularly well suited to providing unique pieces of information in addition to basic flow values. This additional information can be combined with data typically available to gas utilities, such as the location of gas meters or gas composition, to generate intrinsically new information about the meter and its environment. The remote meter ‘health check’, for instance, is already viable today with technology that is available off-the-shelf.

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