WORLD FIRST
WIRELESS M-BUS MODULE

By Peder Martin Evjen

Wireless M-Bus is a new standard for communication between electricity, gas, water and heat meters using short range radio in the 868 MHz band. It has attracted great interest among utility companies and regulating bodies throughout Europe, in standardising data collection from battery operated utility meters. The two-way capability opens up new services and provides improved security and reliability.

Radiocrafts has recently launched the world's first radio communication module compliant with the new standard. The module integrates all RF communication and Wireless M-Bus protocol in a small ultra low power device. This article provides information on the Wireless M-Bus standard, and the compact module solution used to implement the standard in metering equipment.

OVERVIEW
The Wireless M-Bus standard (EN 13757-4:2005) specifies the communication between water, gas, heat and electricity meters or concentrators. The standard is becoming widely accepted in Europe as a basis for new advanced metering infrastructure (AMI) installations.

The Wireless M-Bus standard can be used in several modes (S, T and R), making it suitable for both one-way and two-way communication in stationary or mobile systems. The one-way T1 mode has already been used to some extent in heat cost allocators and water meters. But the two-way modes, in particular T2, are very interesting because these open up not only meter reading, but also valve control, time synchronisation, encryption key distribution, etc. The radio specifications for the different modes are summarised in Table 1.

The T mode is made for systems with frequent transmissions. Typically each meter transmits its data once per hour. The high data rate (100 kb/s) ensures very short communication time and hence low power consumption in the RF transmitter.

In two-way systems the T2 mode is also very suitable for battery operated meters, as the RF receiver in the meter is only active for 2-3 ms after a transmission. Only if the concentrator acknowledges the message within this timeslot will the receiver remain on in order to receive further commands.

WIRELESS M-BUS MODULE
The RC1180-MBUS RF Transceiver Module from Radiocrafts is a compact high performance Wireless M-Bus module for use in automatic metering reading (AMR) applications, in meters and in concentrators.

This is the first compact all embedded module compliant with the new Wireless M-Bus standard available in the market.

The module has an UART interface for serial communication and configuration, and a one-pin antenna connection. The module supports all modes, S1/2, T1/2 and R2, including two-way communication. It operates at 12 channels in the 868 MHz frequency band. When used with quarter-wave antennas a line-of-sight range of 600 m can be achieved. The module is designed for use in battery operated systems with more than 20 years of battery lifetime.

The basic module serves as a communication module, acting like a modem. The module is then configured with address information and encryption keys. Application data sent to the module is packed into a Wireless M-Bus frame format and transmitted on air. Encryption is also supported and done by the module. A very low power sleep mode ensures long battery lifetime.

The module functionality can easily be extended to include the complete meter application using the built in real time clock, non-volatile memory and excessive program memory. Such an application module is built to meet customer's specific requirements.

The module supports AES-128 encryption. This is the preferred encryption since the DES suggested in the original Wireless M-Bus specification is outdated. The AES algorithm is running in a co-processor in the module, helping to speed up the encryption while keeping the power consumption at a minimum.

The RC1180-MBUS module is a compact surface-mounted module measuring only 12.7 x 25.4 x 3.3 mm including EMC shielding, replacing tens of components compared to a discrete design. The module is delivered on tape and reel for volume production. The modular design ensures production scalability and quick ramp-up, rational testing of RF parameters even in volume, and regulation compliance. The RC1180-MBUS module is pre-certified for operation under the European radio regulations for license-free use, is CE-marked and RoHS compliant.

RELIABILITY, SECURITY AND LIFETIME
Reliability, security and lifetime are crucial aspects in AMR. These aspects are taken care of in the module design.

The frequency stability and ageing of the frequency base are vital for RF performance and for ensuring reliability over time. The RC1180-MBUS frequency stability is specified for operation over more than 27 years.

Metering data is used for billing of large values, and the integrity of the data is vital. The RC1180-MBUS module supports AES-128, which is one of the safest encryption standards used today. A new key can be transferred to the meter using the two-way capability. The new key is encrypted

Mode	TX/RX at meter	Chip rate (kchip/s)	Receiver sensitivity	Coding	Deviation (kHz)	Frequency (MHz)	Frequency stability (ppm)
S1	TX only	32.768	-105	Manchester	±50	868.3	±57
S1-m	TX only	32.768	-105	Manchester		868.3	±57
S2	TX/RX	32.768	-105	Manchester		868.3	±25
T1	TX only	100	-98	3 out of 6		868.95	±57
T2	TX RX	100 32.768	-98 -105	3 out of 6 Manchester		868.95 868.3	±57 ±25
R2	TX/RX	4.8	-110	Manchester	±6	868.03 +n×0.06 n ≤ 9	±20

Table 1 - Radio specifications for the Wireless M-Bus standard

with a default key to avoid compromising the key during distribution. The decoding of the new key is done internally in the module. Hence, the new key is never transferred openly. This encryption key is used together with a time stamp, which is a part of the encrypted data, to prevent fraud by recording and replay of old messages.

Ageing and battery lifetime are important to ensure low life cycle cost and long service intervals of the metering system. In a typical meter implementation, the module is put in sleep mode most of the time. The most important parameter is therefore sleep mode current consumption, and then keeping transmit and receive times as short as possible. In T2 mode, the receive on-time is as short as 2-3 ms. This timing is handled by the module itself, and ensures the lowest possible current consumption.

CURRENT CONSUMPTION

As an example of the achievable battery lifetime we calculate the power consumption for a system complying with the NTA 8130 standard for The Netherlands.

The battery operated gas meter is transmitting every hour an encrypted data packet including time stamp, equipment ID, meter reading and valve status. The module transmitter current is 37 mA, the receiver current 22 mA, and the sleep current is maximum 1 µA (typical 0.1 µA). Each transmission is approximately 1,100 chips. Using the T2 mode at 100 kb/s, the transmit time for a complete frame is 11 ms and the receive/active time is approximately 4 ms, giving a contribution of 0.14 µA to the total average current. Hence, the average current consumption is completely dominated by the sleep current at 1 µA. The battery lifetime is therefore limited by its shelf life and leakage currents.
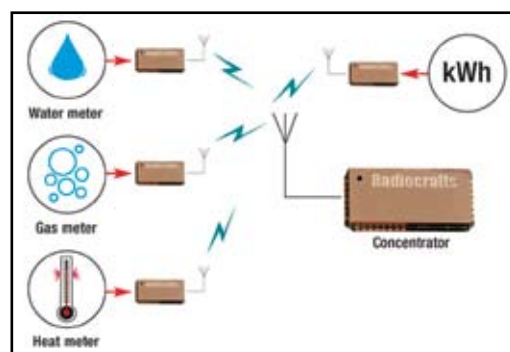
Wireless M-Bus module.

CONCLUDING REMARKS

With the launch of the first Wireless M-Bus module in the market, meter manufacturers, system integrators and AMI providers can now get a complete Wireless M-Bus solution in a small compact module form factor that is easy to integrate into meters and gateways. OEM manufacturers without RF design knowledge can easily add a fully compliant M-Bus solution to their space limited products, and significantly reduce time-to-market, development and compliance testing cost. The module and demo kits are available now. **MI**

ABOUT THE AUTHOR: Peder Martin Evjen is a co-founder and Managing Director of Radiocrafts. He has more than 20 years of experience in radio technology and short range radio communication. He holds an M.Sc. in Electronics Engineering from the Technical University of Trondheim.

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