Radiocrafts
Embedded Wireless Solutions

AN009: IMPLEMENTING WITH RADIOCRAFTS WIRELESS M-BUS MODULE

APPLICATION NOTE

We Make Embedded Wireless Easy to Use

Implementing with Radiocrafts Wireless M-Bus module

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Introduction

Wireless M-Bus (EN 13757-4:2013) is the only European Standard specifically targeting wireless reading of electricity, gas-, water-, heat-meters and heat allocators. The Radiocrafts module MBUSx and MPC1 is dedicated to these specific applications. This Application Note will help selecting the correct module for your Wireless M-bus implementation and informs you were to find more detailed information.

Wireless M-Bus history

Wireless M-Bus has its root in the wired M-Bus user group that were very active in the 90's. Initially they created the wired M-Bus standard for meter reading. Later that standard became part of the European standard EN1434 for reading heat energy meters.

The M-Bus specification was later enhanced and Wireless M-Bus was introduced. This standardization work was transferred to CEN, technical committee (TC) 294, that created the new European standard EN 13757 "Communication system for meters and remote reading of meters". That standard currently consists of:

- EN13757-1:2014   Data exchange
- EN13757-2:2004   Physical and link layer
- EN13757-3:2013   Dedicated application layer
- EN13757-4:2013   Wireless meter readout
- EN13757-5:2015   Relaying
- EN13757-6:2015   Data exchange

As seen, the -4 variant introduced the wireless meter reading that will be discussed in this document. Wireless M-Bus is a radio and data link specification. The application layer for M-Bus is specified in EN 13757-3.

To get all the details, you need to buy the standard. It is widely available online. Here is one example:

http://shop.bsigroup.com/SearchResults/?q=EN13757

National tailoring of Wireless M-Bus

The EN 13757-4 is an open standard and includes a lot of different options and possibilities. In order to get a standard for interoperability within a region, the standard must be tailored locally by limiting options and possibly adding capabilities. This has been initiated by industry organizations in Germany (OMS), and has now developed into a pan European approach.

Wireless M-Bus in Germany (OMS)

In order to standardise communications of consumption measurement, suppliers have joined forces to develop the Open Metering System Specification based on the European standard EN 13757-x. Thus OMS-meters talk the same language, are interoperable - independent from the supplier they come from or the kind of consumption they record. The OMS specification currently consists of **3 parts**:

Volume 1: General - Open Metering System Overview
Volume 2: Primary Communication - communication between counter or actuator and the gateway
Volume 3: Tertiary communication - communication between the gateway and the network operator (Head End System). The Volume 3 is currently not under development.

As seen, Volume 2 informs about the wireless link between the Meter and the Concentrator.

The OMS specification can be downloaded for free at:
http://oms-group.org/en/download4all/

Wireless M-Bus in Italy (CIG)

The Italian "CIG Interchangeability Task Force" has published UNI/TS 11291-11-4, Gas measurement systems – Hourly based gas metering systems, Part 11-4, Communication profile PM1.

RC1701HP-MBUS4 includes special features to support this companion standard. For details, see AN019.

Wireless M-Bus basics

Wireless M-Bus specifies a *meter* device (Slave) and an "*Other*" device or "Communication partner" (Master). The "other" is often referred to as a concentrator.
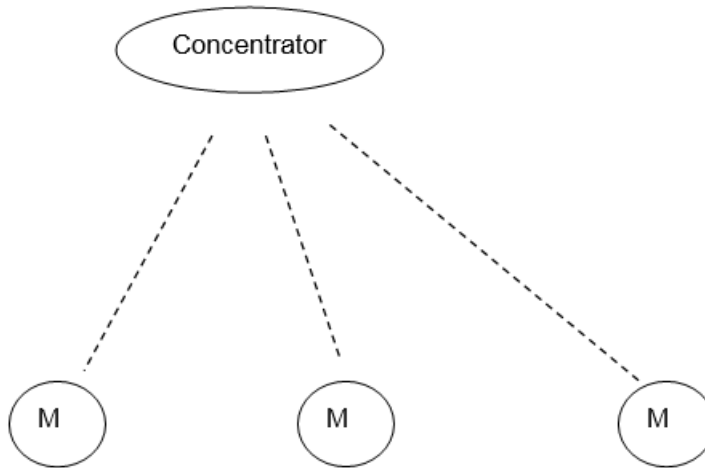

Figure 1: Wireless M-Bus system with 3 meters

The EN13757-4 specifies the physical layer and the data link layer for communication between the meter and the concentrator. This includes:

- Radio parameters
- Packet frame format
- Access method

The Wireless M-Bus specification has several options for the radio parameters. MBUS modes defines data rates and frequency, and both one-way and two-way communication are included. See **Error! Reference source not found.** for overview and how to select correct Radiocrafts module.

Radiocrafts Module	Frequency Band	Data-rate from meter	One-way	Two-way
RC1170-MBUS3 / MPC1 RC1180-MBUS3 / MPC1	865 MHz 869 MHz	4.8kb/s		R2
RC1170-MBUS3 / MPC1 RC1180-MBUS3 / MPC1	865 MHz 869 MHz	32.768 kb/s	S1	S2
RC1170-MBUS3 / MPC1 RC1180-MBUS3 / MPC1	865 MHz 869 MHz	100kb/s	T1	T2
RC1170-MBUS3 / MPC1 RC1180-MBUS3 / MPC1	865 MHz 869 MHz	100kb/s	C1	C2
RC1140-MBUS3 / MPC1	433 MHz	2.4 kb/s	C1, T1	C2, T2
RC1701HP-MBUS4 / MPC1	169 MHz	2.4 / 4.8 / 9.6 kb/s	N1	N2

Table 1: Modes in Wireless M-Bus

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All the modes is specified to use license free ISM band for Europe, but each of the different modes has its own radio requirement such as the specific channel, frequency accuracy, data rate tolerances etc.

One of the key features for Wireless M-Bus is battery operated meters. Gas and water meters are normally not connected to mains power and therefore have limited energy available. In addition, the replacements of meters are costly so the battery lifetime should be several years. Actual lifetime requirements may vary from country to country, typically 10 – 20 years.

To handle the battery lifetime requirements, the radio in the meters will be in sleep mode most of the time, and transmit only in small timeslots. The concentrator can never initiate any communication as the meter will be in sleeping mode most of the time.

The two-way communication is enabled by the meter going into receive mode for a short time after transmission, thereby allowing the concentrator to send messages at these specific timeslots. The timing is different for different modes and the timing is specified in the standard.

The addressing scheme in Wireless M-Bus is a legacy from wired M-Bus. It is only the meters that have addresses, and the meter address is used both when transmitting to, and from, the meter. Hence, the concentrator must have an overview/table of the meters that is connected to it. These meters will be registered at the concentrator during the installation phase.

System solution

Normally a Wireless M-Bus system (**Error! Reference source not found.** d) is a completely alternative system to the wired M-bus (a). But there are cases were the two technologies can be combined in one system. Those options are shown as b) and c). Alternative b) is treated in detail in Application Note AN010.
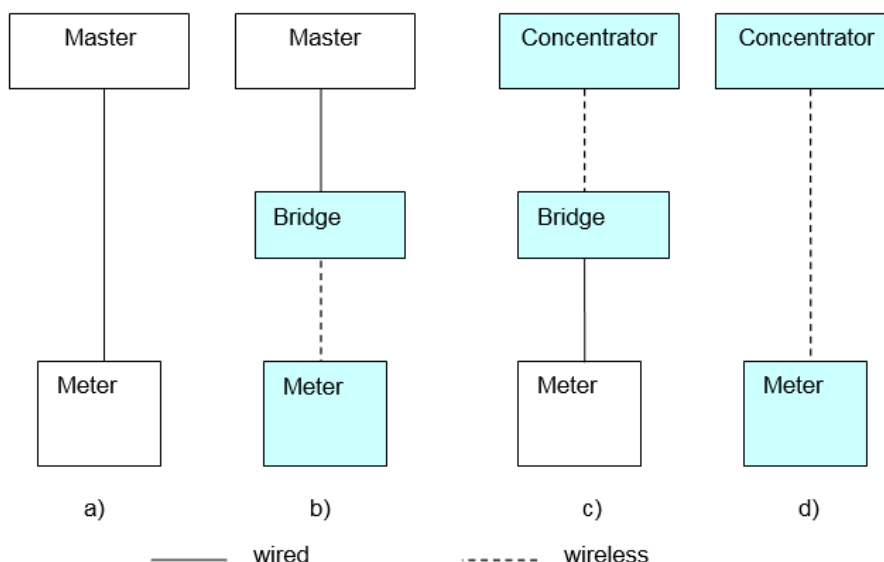

Figure 2: Different M-Bus and/or Wireless M-Bus system

Wireless M-Bus modem, or a complete application module?

The MBUSx module act like a modem, and can be used in several ways in the following devices:
- Meter
- Concentrator
- Bridge
- Repeater

The Radiocrafts MBUSx modules come with functionality supporting the Physical Layer (PHY), Data Link Layer (DLL), Transport Layer (TPL) and Network Layer (NWL) of the EN13757 standard. In this case most of the communication control is done in the host controller, and the module is used as a communication port, or modem. The MBUSx module is a flexible device and support many optional functionalities such as encryption and timing of two way communication. It is up to the end user to decide how much of the functionality supported by the module actually being used, and what should be handled externally.

The MPC1 module is a stand-alone application module supporting Meter devices that has a pulse output feature. The pulse rate of this output will change by the consumption measured by the meter. The MPC1 will count the pulses continuously, calculate consumption, and include this information in a standard EN13737 packet that is transmitted periodically.

Radiocrafts MBUSx modules as standard Wireless M-Bus Meter or Concentrator

One way to use the Radiocrafts MBUSx modules is to use it as a wireless modem. This means that the application messages are generated in an external controller and transferred to the module via UART (See **Error! Reference source not found.**). For concentrator that normally has a lot of processing power this will be a good approach.
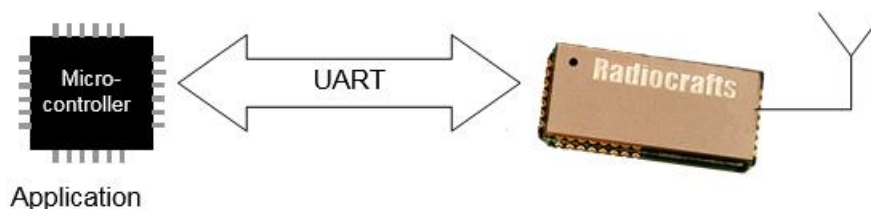

Figure 3: Using the MBUSx as a modem

Via the same UART interface the application can configure the module parameters like:
- M-Bus mode
- Output power
- Meter or concentrator (Salve/Master) functionality
- Channel
- Address
- EAS-128 encryption
- Master Installation

Details of all supported features in MBUSx are specified in the MBUS_User_Manual. This document can be downloaded from the sign-in area of Radiocrafts website at:
https://radiocrafts.com/wp-login

Error! Reference source not found. shows the basic principle for how the Radiocrafts MBUSx module can be used as a modem in both the concentrator and meter. One-way communication (T1/S1) is shown here for simplicity, but similar, more complex sequence charts might be done for two-way communication as well. Set-up/configuration and installation must be done prior to operation.
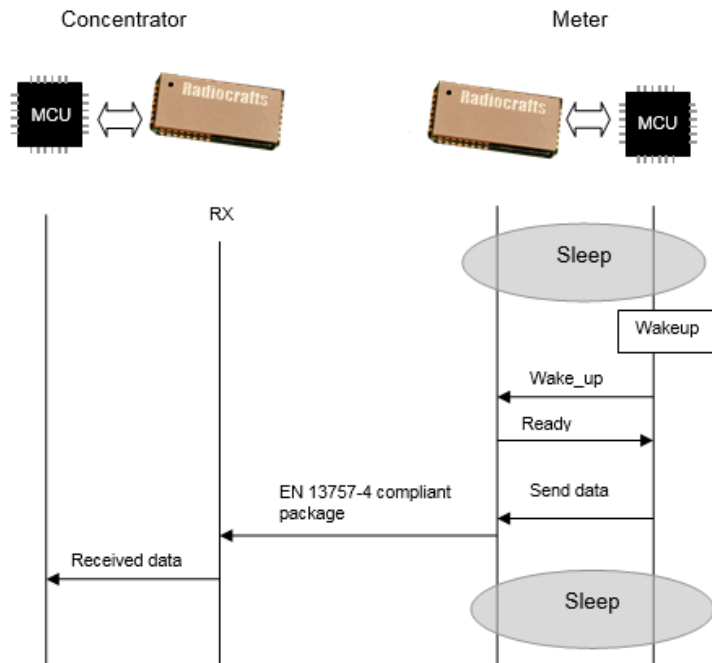

Figure 4: Conceptual use of the MBUSx in one-way communication

Even though most of the application is done by the external controller, there might be some application functions that are best handled by the module. Encryption, addressing and acknowledge are such functions that are included in the module.

Figure 5 illustrates how the MBUSx module handles the TX/RX timing for two-way communication, even if when to transmit from the meter is controlled externally. The external controller will also control when the module is in sleep, receive mode etc.

On the Concentrator side the MBUS module can handle the address list of all meters and only send received packets from installed meters to the host controller.
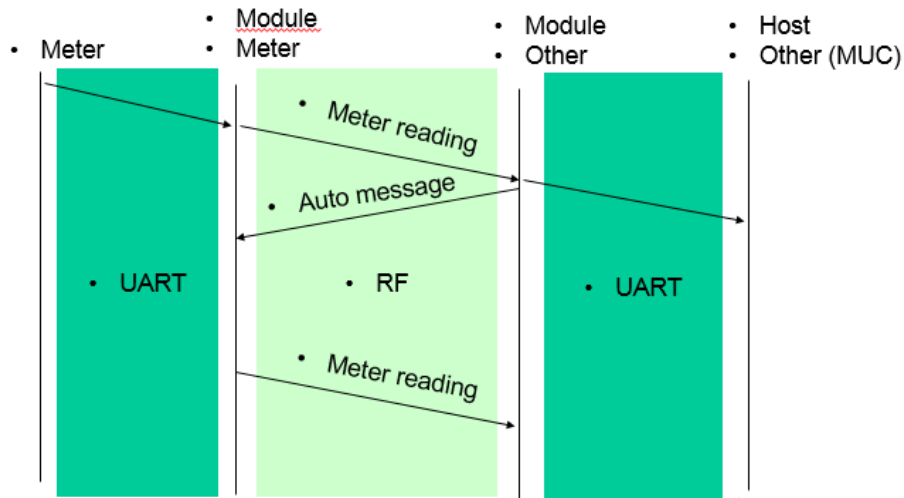
Figure 5: Conceptual use of the MBUSx in one-way communication

Radiocrafts MPC1 modules including a standard Wireless M-Bus Meter application

The Radiocrafts MPC1 modules support all modes as for MBUS3 / MBUS4, but an external host controller is not needed. The module includes the necessary application layer to handle the meter side of a Wireless M-Bus system. The MPC1 is normally in sleep mode and wake up periodically to transmit the metering information based on pulse counting from the meter pulse output (See 6). A MBUSx module can be used on the concentrator side to receive the packets.

The MPC1 can be configured over the UART or by using the Over-The-Air configuration from a MBUS3 module. Parameters to configure are:

- o M-Bus mode
- o Output power
- o Channel
- o Address
- o EAS-128 encryption
- o TX periodic time
- o Pulse input (pull-ups, filter etc)

Details of all supported features in MPC1 are specified in the MPC1_User_Manual. This document can be downloaded from the sign-in area of Radiocrafts website at:
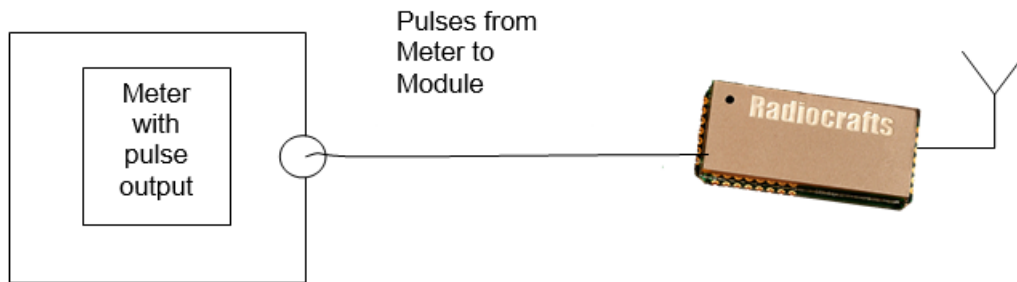https://radiocrafts.com/wp-login

Figure 6: Using the Radiocrafts MPC1 with pulse input

Modules with Custom Specific Application Functionality

Both the MBUSx and MPC1 modules can be customized to meet specific customer requirements. A complete application within the module can be made by Radiocrafts. Please contact sales@radiocrafts.com for more info on tailoring application.

Document Revision History

Document Revision	Changes
1.0	First release
1.1	Added links to documents and standards New OMS info, MPC1 info. Removed old info
1.2	Design Update

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