M2M DATA GENERATOR UTILIZING WIRELESS M-BUS WITHIN SMART GRID INFRASTRUCTURE

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Abstract: Current forecasts predict that the Industrial Internet of Things (IIoT) will account for about 10 billion devices by 2020. Unique, recently unthought of demands are initiating new ideas, particularly Industry 4.0[1] and SmartGrid networks. In this paper, a newly developed multi-platform software tool capable of testing capabilities of Wireless M-Bus (WM-Bus) networks via simulating sensor-like behavior and communication is presented. As utility companies lack these features, this software implementation and hardware design open the door for initial verification of WM-Bus-based data transmissions without the need to invest money into expensive development and certification where WM-Bus is used for data transmissions.

Keywords: Wireless M-Bus, data generator, testing tool, simulation, sensor behavior

1 INTRODUCTION

The Internet of Things (IoT) stands for one of the most important topics in communications these days. Although the forecast of 50 billion devices by 2020 may be outdated, the general trend that early analysts predicted is unquestionable. It may come as a surprise, that these systems have already been developed and in many places, they are soon to be deployed or even already running – a considerable part of those devices, that are already in duty, uses a wireless communication protocol of Wireless M-Bus (WM-Bus) to communicate with the outer world. The main contribution of this paper is to provide insights into the generator of Wireless M-Bus data, which is being developed.

2 THE ROLE OF WIRELESS M-BUS IN INDUSTRY 4.0

M-Bus (wired) was developed in the early 1990s and extended with its wireless form in 2005 (when the first draft of the EN 13757-4 was published, approved a year later), which is 5 years before the terms of IoT and Industry 4.0 started gaining on popularity in 2011 and even longer before they got to attention of the mass market in 2014. Despite that, Wireless M-Bus presents a solid competition to protocols and networks tailored just for Industrial Internet of Things, such as Sigfox, LoRa or Narrowband-IoT. Since it follows very similar goals (sensor-independence, battery-longevity, meter-automation), but holds a few years advantage, it is even better established, settled and stabilized than most of its competitors [1]. In Europe, including the Czech Republic, WM-Bus commonly operates at the frequencies of 868, 433, 169 MHz. Its communication model is based on the ISO/OSI scheme, but, as M-Bus is not a network, the unnecessary layers are not used and are missing from the specification. Additionally, there is a number of operation modes, which were defined to meet different needs when utilizing the protocol in various scenarios (i.e. Mode F for extended range

[1] Industrie 4.0 is a term coined by the German Federal Government to optimize industrial production and provide smart manufacturing solutions.

communication, Mode T for more frequent data transmission), but ultimately, maximizing battery lifetime at the sensor side is their common goal.

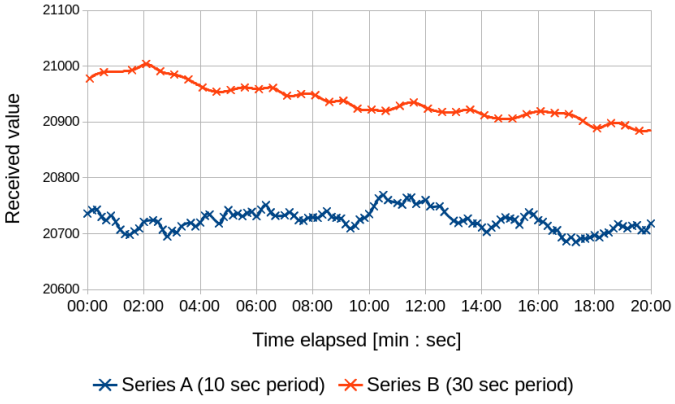
3 DEVELOPED WIRELESS M-BUS SOFTWARE GENERATOR

In order to ease the testing and accelerate the development process of various Wireless M-Bus solutions, whether it be software (for configuration, testing, simulation) or hardware (sensors, data concentrators, other parts of the wireless infrastructure) applications, a software generator has been created. The tool at hand is a multi-platform Wireless M-Bus telegram manufacturing suite, capable of creating arbitrary, yet standard-compliant protocol messages and sending them to the network. Since it is written in Java programming language, it can run on most of the modern computer operating systems where the Java JVM or its derivatives are installed, i.e., Windows, Macintosh, Linux.

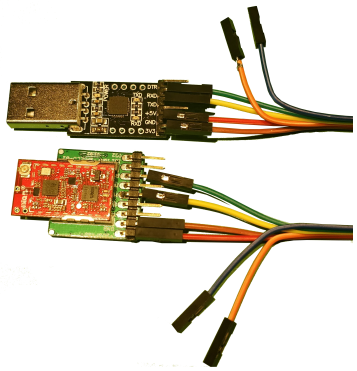
The developed application features two user interfaces: (i) graphical (GUI), and (ii) command-line (CLI). The graphical user interface represents the main way the generator should be approached by a human user. It allows for bit-precise WM-Bus telegram specification with applicable properties [5] ranging from the basics (manufacturer ID, device type), to the special ones (device subunit bit, storage number nibble), in a guided manner with preselected values and lists of choices, and extensions (up to the single WM-Bus telegram's size limit of 255 bytes).

The purpose of command-line access is to allow the application to be controlled either remotely, via a text-based connection like SSH, or by a non-human operator, i.e., a script. Nevertheless, the key features, available in both approaches include, allow to:

- construct a valid WM-Bus telegram based on user's needs, append the message with standard-compliant extensions, checksum and other fields,
- apply one of 4 encryption modes, choose the key and initialization vector,
- save the telegram and create more or edit previously saved,
- choose for data fluctuation and parameterize it,
- schedule any (or more) of the telegram specifications for periodic sending to supported hardware for wireless transmission.



(a) Fluctuated data series as received from the software WM-Bus generator



(b) IQRF module (red), debugger (green), UART bridge (khaki)

Figure 1: Generator output (a), hardware detail (b)

4 HARDWARE

Board used during the development and targeted for the final product is IQRF TR-72D-WMB [4], which is the size of a mini SIM card (commonly referred to as just SIM card). Currently, this is the only hardware the generator can work with. It is an IQRF[2] transceiver, manufactured specifically for Wireless M-Bus. On the board, there are pins to allow for UART (wired) communication, and an embedded antenna for transmitting and receiving WM-Bus telegrams. Thanks to low power demands, this device is predetermined to being battery powered.

The UART interface is meant to provide configuration and management, and is also needed for programming and debugging purposes. In this case, it was connected via two other hardware devices: debugger (IQRF CK-USB-04A [2]), and a USB to UART converter (CP2102 Classic USB Bridge [3]). Complete appliance, assembled from three aforementioned devices, is portrayed in Fig. 1b.

5 TEST SCENARIO AND INDUSTRY USAGE

Within the practical evaluation, a test-scenario was established, where the software generator is utilized together with the hardware, in order to simulate real environment measurements and send data to a remote concetrator. Another device, commercially available conventional sensor, was set to measure the same physical property and send the data to the same concetrator at the same frequency (868 MHz). As it was then feasible to compare both received data series, it can be clearly stated the results from the software multi-platform generator have a data pattern hardly distinguishable from the market product. The key output is represented by the fact the software tool can be used in the very first stage of verification of planned WM-Bus communication between smart meters and data concentrators.

6 CONCLUSION

Presented software generator embodies a powerful tool for testing WM-Bus infrastructure. Running on multiplatform software and using cheap hardware, its features open the door for initial verification of data transmissions for utility companies without the need to invest money into expensive development and certification of smart meter where WM-Bus is used for data exchange.

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[2] IQRF is a wireless transmission technology for packet-oriented communication via radio in sub-GHz bands.