

# Wireless Sensor Network protocol developed for microcontroller based Wireless Sensor Units, and data processing with visualization by LabVIEW

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In today's rapidly evolving competitive and information technology based-world **there is a growing demand for faster and more effective decision-making in real-time**, capturing, interpreting, evaluating, and decision making based on that data. The age of data collection using wired sensors draws to a close, as the low mobility inhibits widespread applicability. High installation and maintenance costs as well as the difficulties related to cabling also make them outdated. Most of these disadvantageous features are avoidable using wireless sensors.

Sensor networks are created by linking a large number of sensors which are spatially located in different locations and their communications with each other gives a range of new application areas without using any special hardware components.

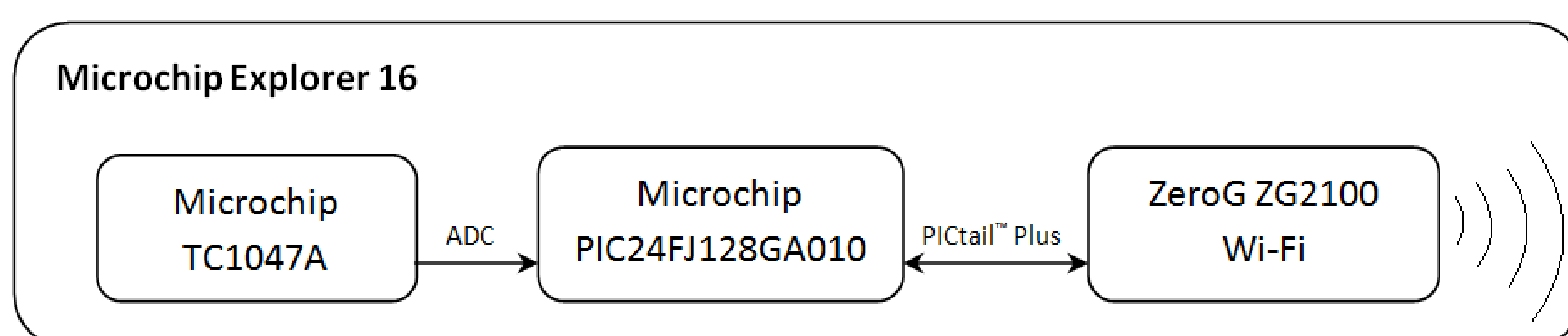
**The use of wireless sensors – despite their prevalence – is mostly complicated and difficult.** An attempt was made to build a network of easily accessible tools to ease implementation. For the reduction of development time, the real-time data acquisition and processing was done by using LabVIEW blocks. The developed system is easy to upgrade.

**Today, a wide variety of standards are available in the data transfer between components in wireless sensor networks.** If we know the conditions of the tasks at hand and the terrain conditions, it is easy to find a sufficient IEEE declared transmission mode.

WiFi stands for Wireless Fidelity, which is one of the most popular technologies built today on the **802.11 standard**. To an ordinary observer, WiFi means that the cables disappear around the computer, but in fact it involves more than that. First, we must understand the **concept of ISM band** (Industrial, Scientific and Medical band) which is throughout most of the world (e.g. in Hungary, but not in Italy) and is a usable frequency band, which is freely available for industrial, scientific and medical purposes. For example, similarly the **2.4-2.5GHz and 5.725 to 5.875GHz ranges are used for data traffic in WiFi technology**. The WiFi-enabled devices communicate by radio to other WiFi devices.

## The Wireless Sensor Unit

Under the designation of **WSU** (Wireless Sensor Unit) we refer to the complex unit, which via a wireless connection, can provide the measurement results. The unit consists of three modules: **1)** the actual sensor, **2)** wireless communication module and **3)** a microcontroller performing the conversion between the two. Analog signals emitted by the sensor to a microcontroller via its analog / digital converter are converted into digital values, and then they are sent on the channel provided by the wireless communication module via electromagnetic waves.



| Standard     | Release (year)                                                                              | Data rate (Mbit/s) | Indoor range (m) | Outdoor range (m) |
|--------------|---------------------------------------------------------------------------------------------|--------------------|------------------|-------------------|
| IEEE 802.11  | 1997                                                                                        | 2                  | 20               | 100               |
| IEEE 802.11a | 1999                                                                                        | 54                 | 35               | 120               |
| IEEE 802.11b | 1999                                                                                        | 11                 | 38               | 140               |
| IEEE 802.11g | 2003                                                                                        | 54                 | 38               | 140               |
| IEEE 802.11n | 2008                                                                                        | 248                | 70               | 250               |
| IEEE 802.11i | protocol (recommendation) stack to enhance the current and future wireless network security |                    |                  |                   |
| IEEE 802.11y | 2008                                                                                        | 54                 | 50               | 5000              |

## The assembled system

The WSU was achieved by an Explorer 16 programmable development kit manufactured by **Microchip**. The main aspect of the kit is a development board, which includes an integrated **TC1047A**-type temperature / voltage converter. This is fixedly connected to the card (PIM Installation Processor Module) interface, where a **PIC24FJ128GA010** is connected. The board provides an interface to the basic I / O functions (buttons, LEDs, SPI, UART, LCD, EEPROM) and contains the important PICtail™ Plus interface, which is capable of accommodating **ZeroG's ZG2100** WiFi module.

**National Instruments LabVIEW** development environment has been assisting in testing, measurement, and control applications developments for over 20 years. The engineers and developers – regardless of experience – can create interfaces for measurement and control hardware in a short time, in a cost-effective way. They **can analyze the measured data, share results, and distribute systems**. For these reasons, we also chose the LabVIEW as the processing unit. Its task was to show the values on the PC that came through the WiFi router and was sent by the WSU.

**The Sensor Network Protocol** defines the communication between the PC and WSU in every detail. The data set consists of 4 bytes, of which the first byte is the type of the sensor (in this case 0x01 meant the heat sensor), where the top bit is reserved for future use. The second byte is ID of the sensor, which should be equal to the sensor IP's last byte. The uppermost bit is also reserved for future use, in such way a maximum of 126 sensors can be used simultaneously. The last two bytes contain the value of the measurement; this (sub-divided by 160 at present) gives the measured temperature to one decimal place preciseness.

## Conclusion

**As a result, we can say that LabVIEW is perfectly suited for displaying and processing signals provided by sensor networks in wireless configuration. The PIC microcontroller is only suitable for sending small amounts of data with low sampling rate; therefore, it was sufficient in our work, but cannot be recommended for any other usage.**

