Wio-E5 LoRa Transceiver Peer to Peer Mode

Revision 0
7 May 2025

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Introduction

LoRa is a low energy chirp spread spectrum wireless system commonly operating in unlicensed ISM (Industrial, Scientific, and Medical) radio frequency bands, at frequencies around 433 MHz, 868 MHz, or 915 MHz. LoRa was designed for minimum power consumption and short data messages sent infrequently but with very high probability of success. It is intended that all LoRa network nodes use LoRaWan, an encrypted RF networking protocol, and configured to connect to gateways that are also connected to the Internet cloud. LoRaWan gateways forward RF messages from sensors or other devices to IoT (Internet of Things) backend providers such as Helium or The Things Network for processing and/or forwarding to IoT service subscribers.

The Seeed Studio Wio-E5 LoRa Transceiver Module contains an STMicroelectronics STM32WLE5JC wireless microcontroller with an on-chip sub-GHz digital radio subsystem and a LoRa modulator that comes pre-programmed with firmware that implements a Hayes AT command interpreter. Most of the Wio-E5 commands are devoted to LoRaWan operations. A small set of test commands enable operating the transceiver in test mode *aka* P2P (***Point to Point*** or ***Peer to Peer***) mode, sending and receiving LoRa Implicit Header frames that are:

- Broadcast (*i.e.* contain no sender or recipient address information).
- Unencrypted.
- 1 to 253 bytes of payload.
- 2 bytes of CRC checksum.

Point to Point is a bit of a misnomer, as all Wio-E5 transmissions in test mode are broadcasts and any Wio-E5 configured with the same RF parameters (center frequency, spreading, bandwidth, etc,) call passively monitor such transmissions. ***Peer to Peer*** is rather more correct, as a group of Wio-E5 modules in test mode can communicate freely among themselves instead of individually with an assigned LoRaWan gateway.

This document describes a methodology for using the Wio-E5 Transceiver Module in test *aka* P2P mode, especially (but not limited to) operating under an amateur radio license in the 33 cm band, which in the U.S. has a secondary allocation at 902 to 928 MHz. In contrast to unlicensed ISM operations, operating under an amateur radio license eliminates constraints on duty cycle, dwell time, and ERP (Effective Radiated Power **=** transmit power **x** antenna gain).

U.S. amateur radio operators using spread spectrum in the 33 cm band are limited to 10 watts of transmit power without any limit on ERP. This allows an Wio-E5 operating under an amateur radio license in the 33 cm band to transmit at its full power (22 dBm or 158 milliwats) into a high gain directional antenna without any fear of exceeding ISM ERP limits. It would also be entirely feasible and legal for an Wio-E5 to drive a 10 watt external power amplifier.

Amateur Radio LoRa P2P Network Flavor #1 Protocol Specification

A Flavor #1 LoRA Amateur Radio network shall consist of 2 to 255 stations, each station consisting of a Wio-E5 LoRa Transceiver module (or a different compatible module) in test *aka* P2P mode with hardware CRC enabled.

Every station in a Flavor #1 network shall use the same RF settings (spreading, bandwidth, and center frequency) and the same call sign, that of the Amateur Radio operator who owns or administers the network.

Every station in a Flavor #1 network shall only transmit and receive unencrypted implicit header frames with 1 to 253 bytes of payload and two CRC checksum bytes.

Flavor #1 Network Address Header

The first ten bytes of the implicit header frame payload shall be reserved for network address information and shall contain the following fields:

- 8 ASCII characters for the network ID (the call sign of the Amateur Radio Operator who owns and/or administers the radio network). The network ID characters shall be capitalized, left justified, and space padded. Unlike AX.25, the network ID bytes are not left shifted one bit. *Example:* `N7AHL  `.

- 1 binary byte for the destination node ID. The destination node ID shall be ARCNET address style: 0 for broadcast or 1 to 255 for unicast.

- 1 binary byte for the source node ID. The source node ID shall be ARCNET address style: 1 to 255.

Flavor #1 Network Received Frame Processing

The Wio-E5 module shall silently discard any received RF frame that fails CRC checksum verification.

The Wio-E5 device driver shall silently discard any received RF frame without a matching network ID *aka* call sign.

The Wio-E5 device driver shall silently discard any received RF frame without a broadcast destination node ID or a matching unicast destination node ID.

The Wio-E5 device driver shall silently discard any received RF frame with broadcast source node ID.

Web Links

These are provided for the benefit of printed document readers. They are listed in the order of apperance in the text above.

LoRa:

https://www.semtech.com/lora/what-is-lora

ISM Radio Band:

https://en.wikipedia.org/wiki/ISM_radio_band

LoRaWan:

https://www.thethingsnetwork.org/docs/lorawan/what-is-lorawan

Internet of Things:

https://en.wikipedia.org/wiki/Internet_of_things

Helium:

https://www.helium.com/iot

The Things Network:

https://www.thethingsnetwork.org

Wio-E5 LoRa Transceiver Module:

https://wiki.seeedstudio.com/LoRa-E5_STM32WLE5JC_Module

STM32WLE5JC Sub-GHz Wireless Microcontroller:

https://www.st.com/en/microcontrollers-microprocessors/stm32wle5jc.html

Hayes AT Command Set:

https://en.wikipedia.org/wiki/Hayes_AT_command_set

LoRa-E5 AT Command Specification:

https://files.seeedstudio.com/products/317990687/res/LoRa-E5%20AT%20Command%20Specification_V1.0%20.pdf

LoRa Implicit Header Frame:

https://www.rfwireless-world.com/terminology/iot/lorawan-implicit-vs-explicit-headers

Amateur Radio 33 cm Band:

https://en.wikipedia.org/wiki/33-centimeter_band