

Central Receiving Unit Quick Start Guide

THINGY:AQ

Wildland Fire Real-Time Monitoring System
PROTOTYPE DRAFT

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1 Product Overview

Note: The Thingy:AQ real-time air quality monitoring and telemetry system described in this guide was designed and built to meet the requirements of the InnoCentive Wildland Fire Sensor Challenge - Challenge ID: 9933927

The system comprises of multiple Sensors Nodes and a Central Receiving Unit. Communications between the Sensor Nodes and the Central Receiving Unit utilize LoRa (Long Range Low Power) radio technology that offers a compelling mix of long range and low power consumption. The system has been designed to be lightweight and easily deployable by a single, non-specialist operator and to be suitable for harsh environments. The prototype Thingy:AQ systems contains two main system components:

Thingy:AQ Sensor Nodes. These battery-powered Sensor Nodes (SN) measure air pollutants including fine particulate matter $PM_{2.5}$, PM_{10} , carbon monoxide, carbon dioxide and ozone. The Sensor Nodes also measure air temperature, humidity and geo-location data. A unique System ID identifying the Sensor Node, latitude, longitude and System Error status are stored on the Sensor Node and are transmitted in real time over long distance utilizing a LoRa encoded radio link.

Thingy:AQ Central Receiving Unit. The central receiving unit (CRU), a physical system, receives and centrally records data from multiple remote Sensor Nodes and provides a USB port for interfacing into third party presentation platforms.

1.1 Central Receiving Unit Overview

The Central Receiving Unit housing incorporates the data logger electronics, a microSD card used for logging the data, a LoRa (Long Range) radio module, an integrated lead acid battery and a solar charger. The Antenna connector for the LoRa radio is mounted on the bottom of the Central Receiving Unit housing.

1.2 Central Receiving Unit

The Central Receiving Unit is designed to receive data from remote Sensor Nodes via the LoRa radio and record the data with minimal or no operator intervention. Once the system has been turned on, it will start receiving and logging the telemetry data from the remote Sensor Nodes.

The system has been designed to support Remote LoRa Relay Stations. These Remote Relay Stations are used to improve coverage where there is no line of sight visibility between the Sensor Nodes and the Central Receiving Unit as well as to extend the range between the remote Sensor Nodes and the Central Receiving Unit. The LoRa Relay Station manipulates the packets received from the remote Sensor Nodes embedding information within the packet to ensure the Central Receiving Unit can detect and discard duplicate packets.

The operator can interrogate system status, upload recorded data via the Central Receiving Unit USB interface. The data on the Central Receiving Unit is logged on the microSD card. The data can be read from this card without removing the card. When the microSD card is swapped or replaced the system will automatically commence logging to the media.

1.3 Central Receiving Unit Front Panel

The front panel contains the logger's ON/OFF switch, the micro USB socket and three indicator LEDs; POWER, SYS ERROR and RX DATA.

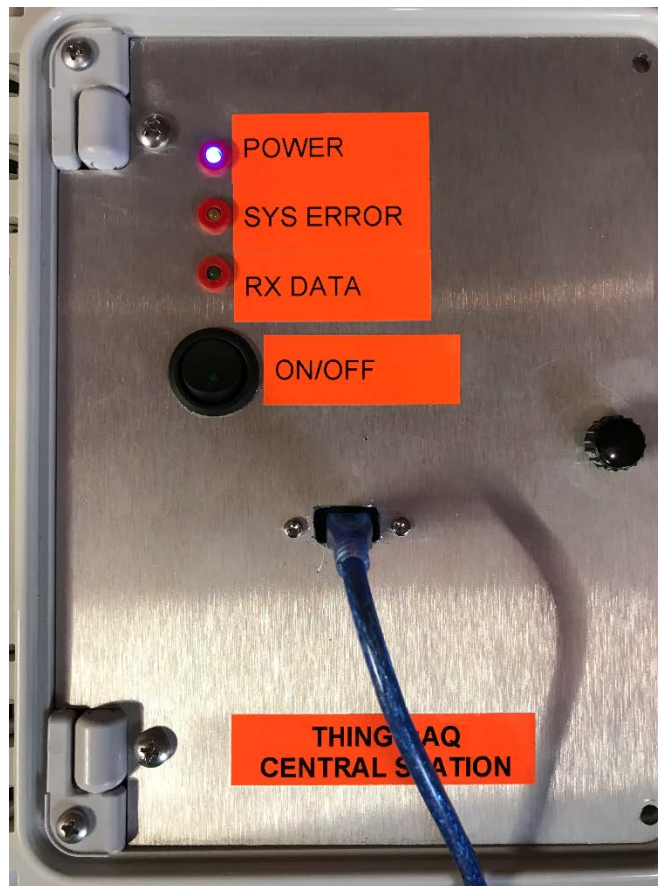


Figure 1 Prototype the Central Receiving Unit Front Panel

1.3.1 POWER SWITCH

Turns the Central Receiving Unit on or off.

1.3.2 POWER LED

The Power LED is blue and it provides an indication of two separate states. When the logger is turned on the blue LED will flash approximately 10 times in rapid succession indicating the processor is operational and the logger is in the initialization phase. When the initialization process is complete the Power LED will remain illuminated.

1.3.3 SYS ERROR LED

The SYS ERROR LED indicates a problem with the logger, either a problem with the microSD card or a low system voltage alarm.

1.3.4 RX DATA LED

The RX DATA LED will flash briefly on the successful reception of a packet from the radio.

1.3.5 MICRO USB CONECTOR

The micro USB connector provides a USB serial interface to the logger. The logger will send formatted data out of the serial interface whenever a packet has been received via the LoRa (Long Range Radio) and successfully decoded. This interface provides the user / operator interface to enable the configuration and interrogation of the logger and to upload data files from the logger to a terminal application.

2 Installing, Starting and Stopping the System

The Central Receiving Unit enclosure contains an integrated lead acid battery and a solar charger. The battery is connected to the solar charger via a pair of in-line mating XT30 connectors. The system is shipped with the battery disconnected. To connect the battery, open the enclosure door and connect together the XT30 connectors (see figure 2.1).



Figure 2.1 Thingy:AQ XC30 Connectors

2.1 Preparing the Central Receiving Unit for Deployment

Mount the enclosure with the provided mounting hardware on the collapsible mast or other stable pole or surface.

1. Connect the antenna cable to the antenna
2. Mount the antenna onto the top of the mast
3. Raise the mast to the required height
4. Connect the antenna cable to the antenna cable connector on the bottom of the logger
5. Open the Central logger enclosure
6. Unscrew the two screws on the righthand side of the front panel
7. Open the front panel of the logger and connect the battery's mating XT30 connectors together. When the battery has been connected, a red LED on the solar charger will be illuminated.
8. Install a newly formatted microSD card into the microSD card socket
9. Close the front panel and screw in the two screws on the righthand side of the panel
10. Plug in either the solar panels, if fitted, or an external power supply
11. Turn on the logger via the ON/OFF switch on the front panel

2.2 Connecting to the Central Receiving Unit

When the operator connects to the USB interface it will be enumerated on the PC as a Maple USB serial port with the USB identifier VID: VID_1EAF and PID: PID_0004. Modern operating systems, such as Windows 10, include the required driver to recognize the USB interface as a serial device and to create a logical serial port. The combination of VID and PID can be used to identify which logical serial port has been assigned to the logger.

A quick way of determining the serial port in use on the PC is to inspect the PC's serial port table immediately before and immediately after plugging into the logger and noting the Comm port number (Comm xx) of the newly creates device. The following image is a screen capture of Device Manager on Windows 10 showing the newly created Comm port (in this case Comm20).

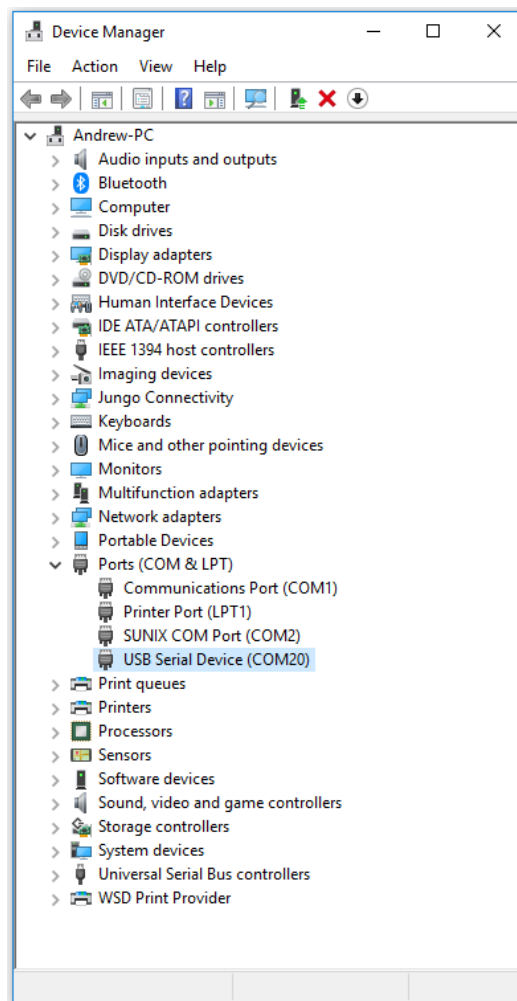
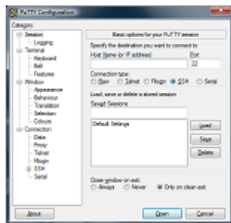


Figure 2.2 Windows Device Manager after plugging in the Central Receiving Unit

2.2.1 Configuring the Terminal application

When using a PC, open your preferred terminal application and configure the terminal application to use the newly created serial port and to select **local echo** mode.

If you do not have a suitable terminal application these are several freeware terminal applications available. One example for Windows is Putty (figure 2.3) which can be downloaded here: www.putty.org



Download PuTTY

PuTTY is an SSH and telnet client, developed originally by Simon Tatham for the Windows platform. PuTTY is open source software that is available with source code and is developed and supported by a group of volunteers.

You can download PuTTY [here](http://www.putty.org).

Figure 2.3 PuTTY Terminal Program for Windows

When the terminal application on the PC is started, configure the serial interface attributes.

Set the Terminal to 57600 baud, 8 bit data, 1 stop, no parity, no flow control, local echo.

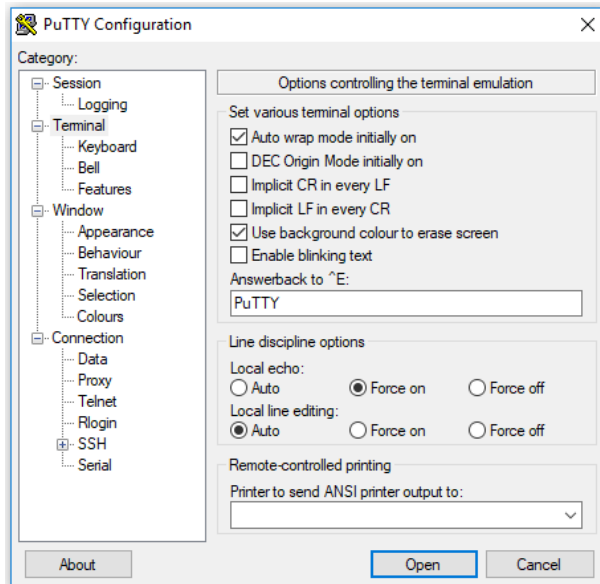


Figure 2.4 PuTTY Configuration Screen for Local Echo

2.3 User Interface

The logger provides a help screen. Help can be access using the short cut ? character followed by ENTER (carriage return / line feed).

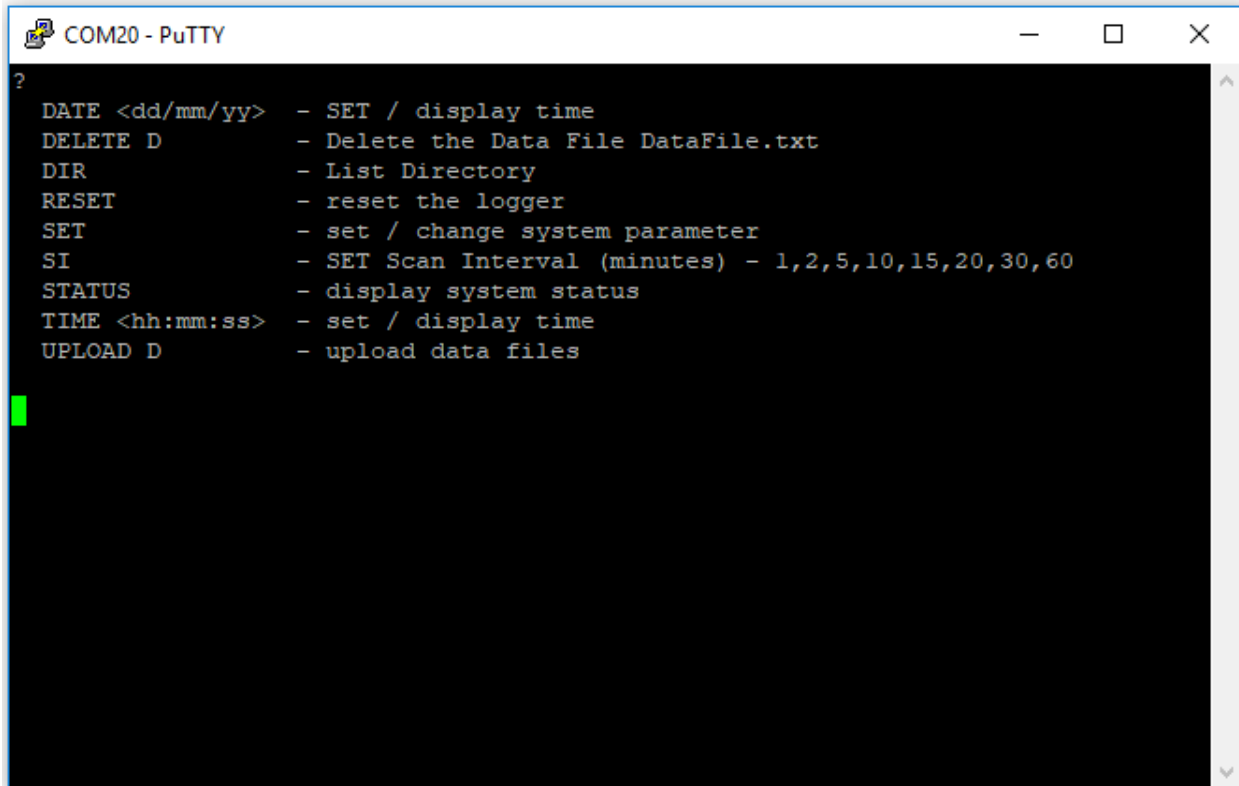


Figure 2.5 User Interface Help Output

2.3.1 Scan Interval, Time and Date

These commands are not used by the Central Receiving Unit and will be removed from the next version of the software.

2.3.2 Status Command

The status command will display the logger’s health status

2.3.3 Directory Listing

The directory contents of the logger’s microSD card can be viewed using the DIR command.

2.3.4 Upload Command

The upload command, **UPLOAD D**, is used to upload data from the logger’s microSD card to the terminal application. This data can then be logged to the PC via the terminal application’s capture capability. The following screen capture shows the configuration of the Putty application to capture the console output.

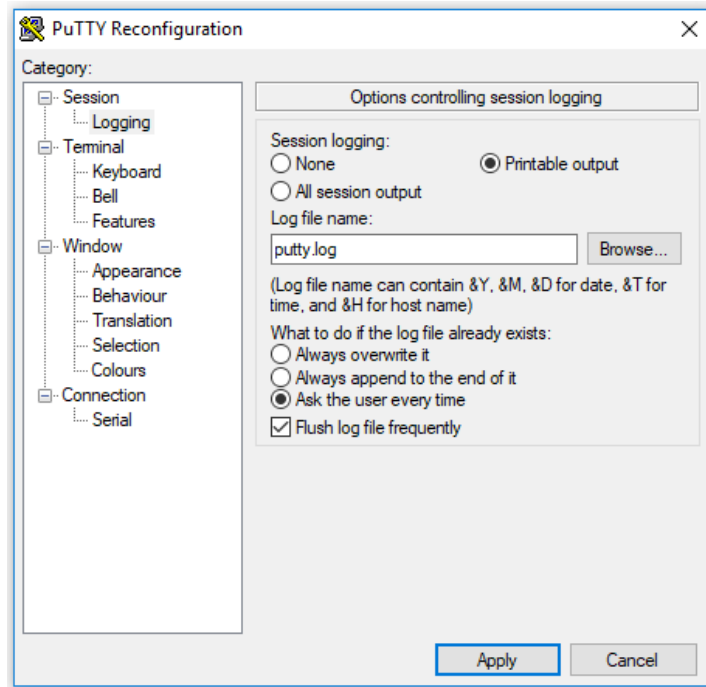


Figure 2.6 Configuring Logging (capture) with Putty Terminal Application

2.3.5 DELETE D

Once the data has been uploaded via the terminal application and the user has confirmed the successful upload by viewing the contents of the uploaded file, the data file can be deleted from the logger via the **DELETE D** command.

2.3.6 Reading the microSD card

Instead of uploading the data file via the terminal application, the user can instead to remove the microSD card from the logger and inserting it into the PC to read the file directly from the MicroSD card. The logger accepts MicroSD cards formatted as either FAT16 or FAT32.

2.4 Sample Data Format

| Date | Time | GPS | | Type | ID | SI | Sys | TempC Deg C | RH % | PM2.5 µgm/m3 | PM10 µgm/m3 | CO2 ppm | CO ppm | O3 ppb | Battery voltage |
|------------------|----------|------------|------|------|----|----|------|----------------|---------|-----------------|----------------|------------|-----------|-----------|--------------------|
| | | Lat | Long | | | | | | | | | | | | |
| 2018/01/13T17:40 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 60 | 23.0 | 42.0 | 0.6 | 1.9 | 885 | 4.9 | 8 | 12.0 | |
| 2018/01/13T17:42 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 60 | 23.0 | 41.5 | 0.6 | 1.2 | 892 | 4.7 | 8 | 12.0 | |
| 2018/01/13T17:44 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 60 | 23.0 | 42.0 | 0.5 | 0.6 | 879 | 4.7 | 9 | 12.0 | |
| 2018/01/13T17:46 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.0 | 0.7 | 2.2 | 865 | 4.6 | 8 | 12.0 | |
| 2018/01/13T17:48 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.0 | 0.6 | 1.5 | 870 | 4.6 | 9 | 12.0 | |
| 2018/01/13T17:50 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.0 | 0.6 | 4.8 | 850 | 4.5 | 10 | 12.0 | |
| 2018/01/13T17:52 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.4 | 0.8 | 3.6 | 852 | 4.6 | 10 | 12.0 | |
| 2018/01/13T17:54 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.5 | 0.5 | 1.5 | 867 | 4.5 | 9 | 12.0 | |
| 2018/01/13T17:56 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.5 | 0.8 | 2.5 | 867 | 4.5 | 9 | 12.0 | |
| 2018/01/13T17:58 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.5 | 0.4 | 0.4 | 854 | 4.5 | 9 | 12.0 | |
| 2018/01/13T18:00 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.5 | 0.7 | 2.1 | 870 | 4.5 | 8 | 12.0 | |
| 2018/01/13T18:02 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.5 | 0.9 | 2.2 | 859 | 4.6 | 8 | 12.0 | |
| 2018/01/13T18:04 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.0 | 0.6 | 1.3 | 868 | 4.7 | 8 | 12.0 | |
| 2018/01/13T18:06 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 41.5 | 0.7 | 4.2 | 859 | 4.6 | 8 | 12.0 | |
| 2018/01/13T18:08 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 41.5 | 0.6 | 3.5 | 854 | 4.6 | 8 | 12.0 | |
| 2018/01/13T18:10 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 41.5 | 0.5 | 1.1 | 856 | 4.6 | 8 | 12.0 | |
| 2018/01/13T18:12 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.0 | 0.7 | 0.7 | 854 | 4.6 | 8 | 12.0 | |
| 2018/01/13T18:14 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.0 | 0.5 | 0.8 | 853 | 4.5 | 9 | 12.0 | |
| 2018/01/13T18:16 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.0 | 0.7 | 1.4 | 853 | 4.5 | 9 | 12.0 | |
| 2018/01/13T18:18 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.0 | 0.6 | 0.8 | 849 | 4.5 | 8 | 12.0 | |
| 2018/01/13T18:20 | 47.69445 | -122.04355 | Data | IDA3 | 02 | 00 | 23.0 | 42.0 | 0.6 | 0.6 | 849 | 4.4 | 8 | 12.0 | |

Figure 2.7 Sample Data Upload