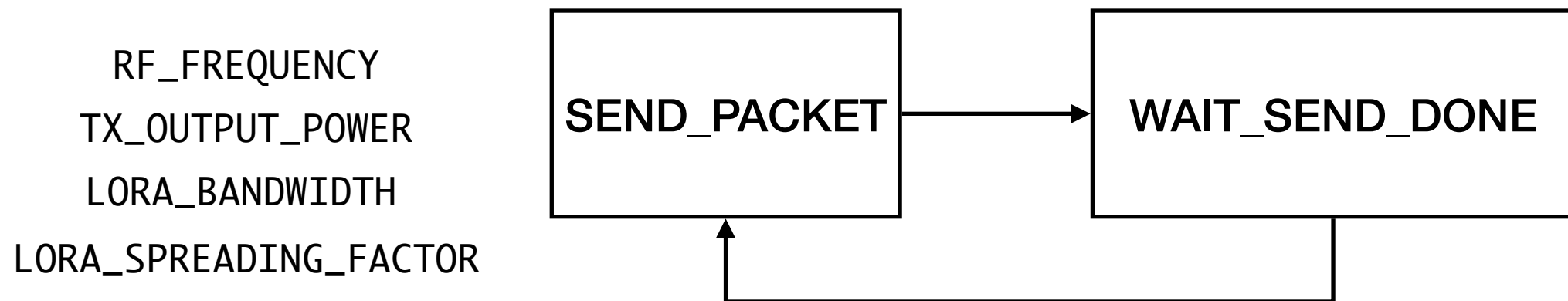


Wireless SDR Tools for LPWANs

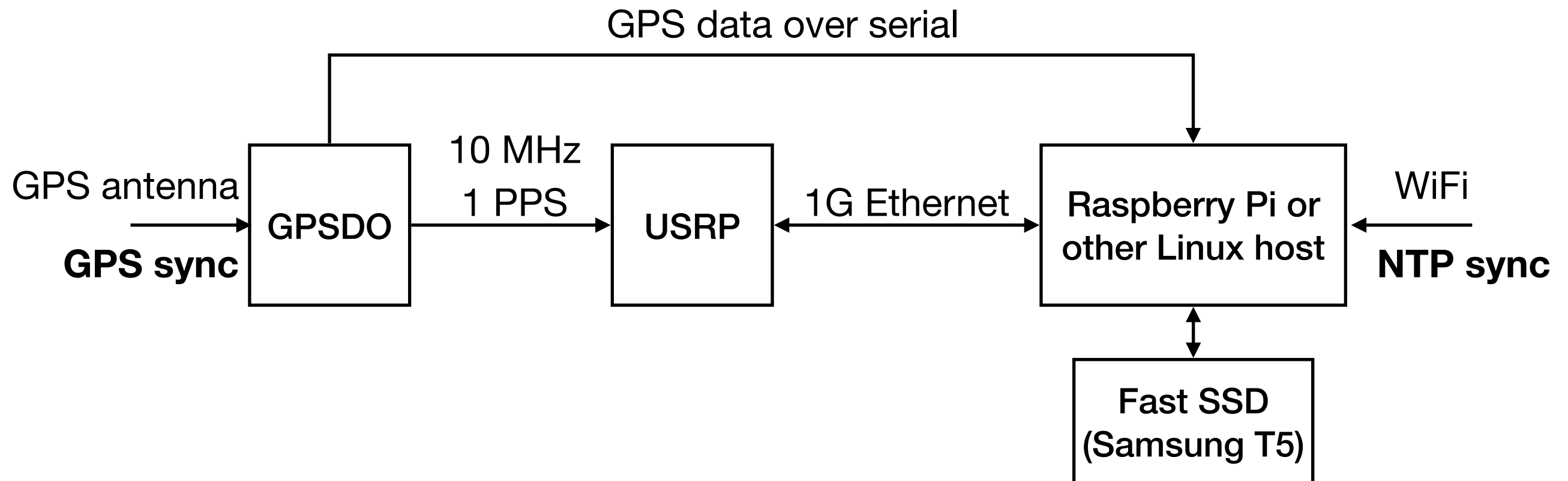
Adwait Dongare

TX-only LoRa Client

- SX1262 Devkit
- Nucleo L476RG
- Github: <https://github.com/adwaitnd/sx1262-tx>
- MBED: https://os.mbed.com/users/adwaitnd/code/SX126X_TXonly/

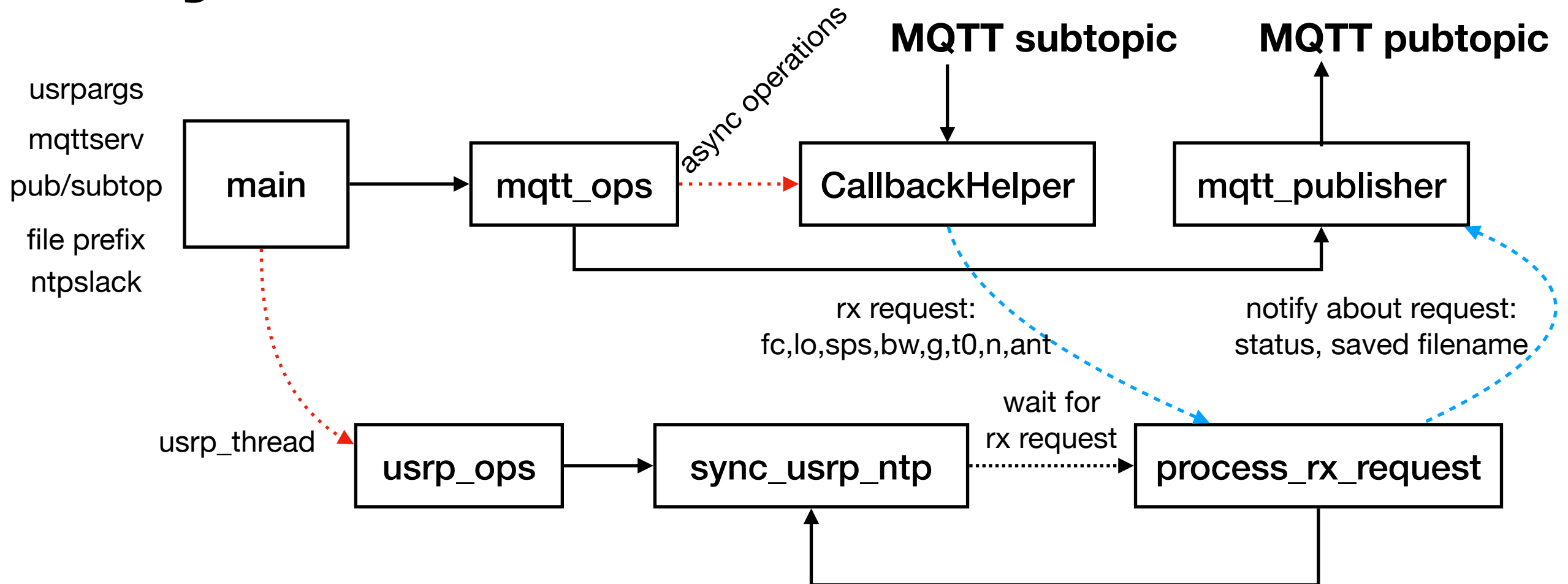


Synchronous SDR Hardware



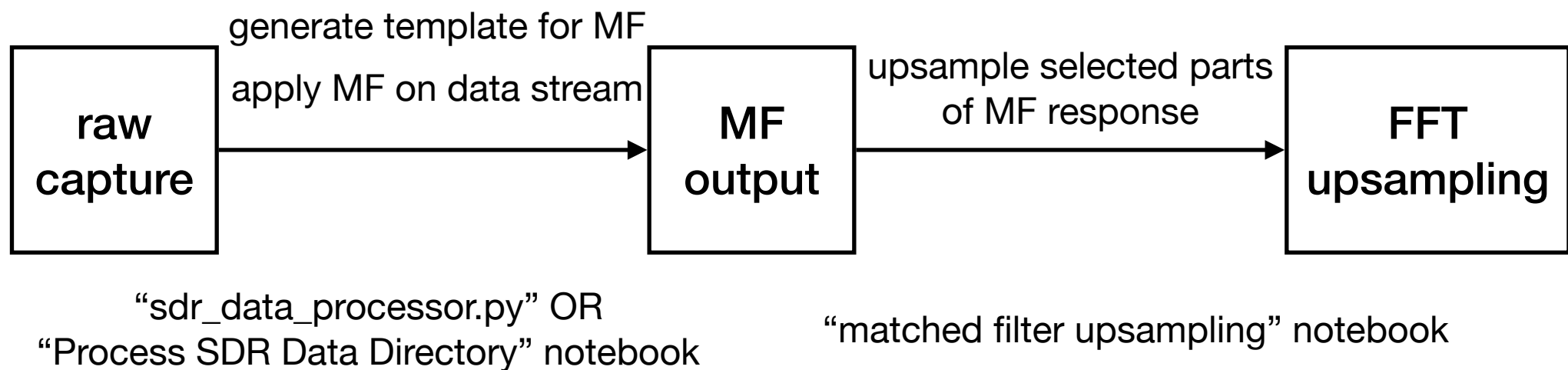
- GPSDO and USRP are synced by GPS.
RPI/Host is synced by NTP.
We have to assume NTP and GPS time are pithing a few tens of ms within each other for this system to work out
- RPi with on-board SD card it too slow to keep up with USRP output

Synchronous SDR Software



- Github: <https://github.com/adwaitnd/usrp-apps>
- source code and running script: apps/timed_rx_file_mqtt
- MQTT for sending timed commands
- Program parameters: USRP args, MQTT server, host ID, topics, file prefix/location

Matched Filtering and Upsampling



- `sdr_data_processor.py` generates a template for matched filtering and filters out one capture file
- “Process SDR Data Directory” performs the operation on all files in a directory (assumes all files in a director are only capture files)

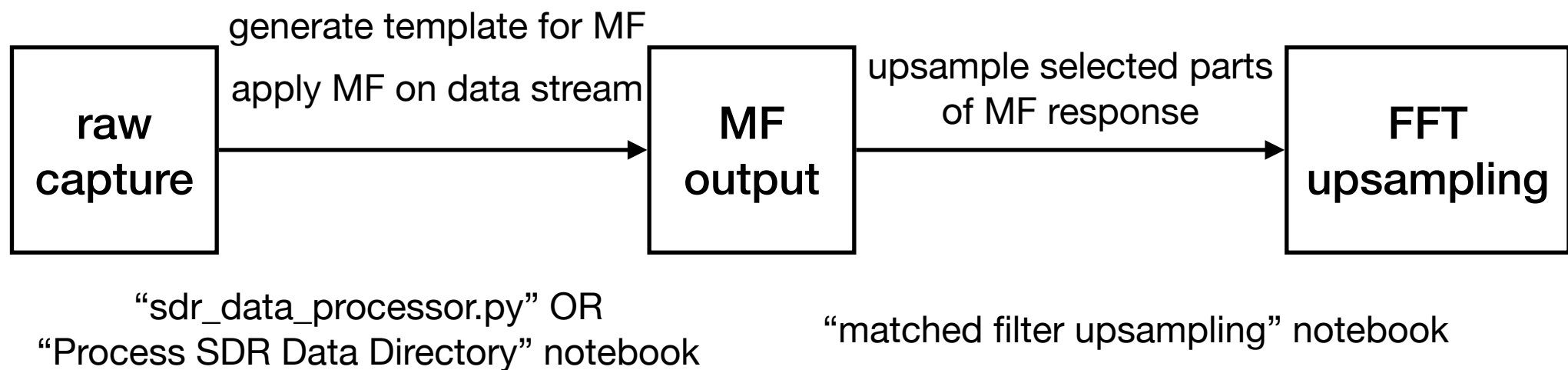
Workflow 1/3: Setup

1. Program SX1262 clients using sample code
Github: <https://github.com/adwaitnd/sx1262-tx>
MBED: https://os.mbed.com/users/adwaitnd/code/SX126X_TXonly/
2. Connect GPSDO 1PPS and 10 Mhz lines to USRP and make sure GPSDO is locked to GPS
3. Run `timed_rx_file_mqtt` on each gateway so it listens for capture requests

Workflow 2/3: Capture

1. Send trigger messages on the correct MQTT topic with the format described in usrp-apps/scripts (<https://github.com/adwaitnd/usrp-apps/tree/master/scripts>)
2. Captured files on each gateway will be saved with the filename format:
“fileprefix_freq_YYYY-MM-DD_hh-mm-ss.sss.dat”

Workflow 3/3: Analyze



1. Use `sdr_data_processor.py` to filter a single capture or “Process SDR Data Directory” to process an entire directory of samples as a batch. The output is a numpy binary with matched filter response
2. Use “matched filter upsampling” notebook to view the MF outputs, select particular regions of the capture and to upsample particular time intervals in the capture.

Wireless Insite Ray Tracing Output Processing

- All output is either ASCII-format p2m files or sqlite files
- Tools for processing ray tracing outputs: https://github.com/adwaitnd/lpwan-sdr-analysis/tree/master/wireless_insite