



IP PARIS



TELECOM205 – D2 - AMS/RF

Hardware measurements

Germain PHAM, Chadi JABBOUR

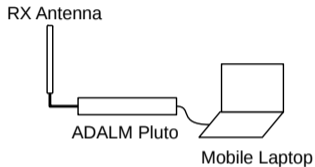
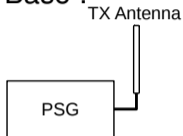
{dpham,jabbour}@telecom-paris.fr

Mar. 2024

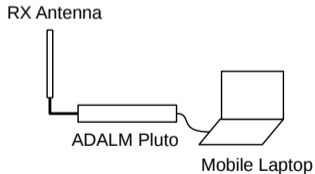
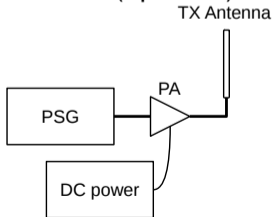


Hardware setup

Base :



With PA (optional) :



Prerequisites I

- A personal computer
 - Windows or Linux (Linux: experienced user only)
 - Regular USB
 - Admin account

Softwares to install:

- IIO Oscilloscope (Analog Devices)
 - Windows : [\[Analog Devices Wiki\] IIO Oscilloscope - Windows Installation](#), Select [\[Github\] adi-osc-setup.exe](#)
 - Linux (Debian/Ubuntu):
 - Option 1: Select [\[Github\] osc-appimage.zip](#)
 - Option 2 (build): [\[Analog Devices Wiki\] IIO Oscilloscope - Linux](#)
 - MacOS (build) (not very well supported): [\[Analog Devices Wiki\] IIO Oscilloscope - MacOS](#)

Prerequisites II

- Python
- Libiio:
 - Win+Linux+OSx : [\[Github\] libiio - Releases](#)
- PyADI-IIO: [\[Analog Devices Wiki\] PyADI-IIO](#)
 - Win+Linux+OSx : `pip install pyadi-iio pylibiio (or pip3...)`
- PlutoSDR driver and utilities:
 - Windows: [\[Analog Devices Wiki\] PlutoSDR - Windows Drivers](#) : [\[Github\] plutosdr-m2k-drivers-win - Releases](#)
 - Linux+MacOS: nothing else is required.
 - some additional documentation is available on: [\[Analog Devices Wiki\] PlutoSDR - MacOS Drivers](#)

Measurement scenario

The big picture : Effect of the distance on Signal Power

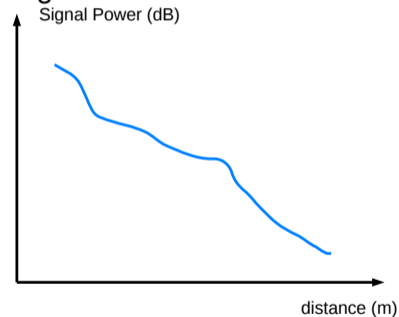
Move along school corridors



★ TX Base station

★ RX Pluto

Signal Power vs distance



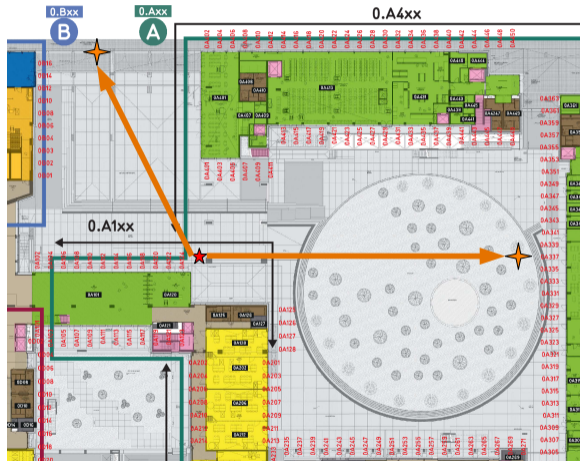
Measurement scenario : Indoor



★ TX Base station

★ RX Pluto

Measurement scenario : Outdoor



★ TX Base station

★ RX Pluto

Measurement scenario : Tests specification

Parameters to test:

- $f_c = \begin{cases} 2.5 \text{ GHz} \\ 600 \text{ MHz} \end{cases}$
- (Pluto VGA = OFF)

Fixed parameters:

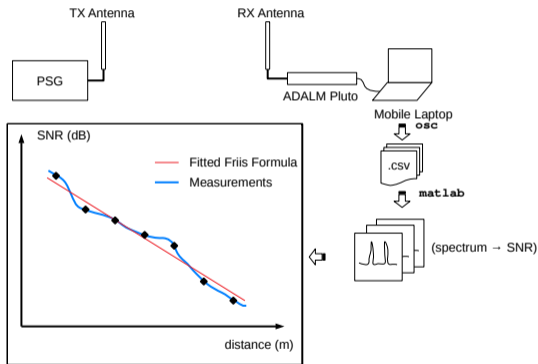
- BW = $[-10; 10]$ MHz
- Baseband Fs = 30.72 MHz
- Pluto Fc = f_c

Comments:

- 2 " f_c " plots SignalPower-vs-distance
- Number of distance points : 10 points
- Measurement accuracy (already done by `acquire_SNR.py`):
 - Run 3 to 5 five successive acquisition
 - Average the computed values

Experimental protocol

1. Setup the base station
 - Power on, setup TX power, set frequency
2. Setup the RX station
 - IIO Oscilloscope: quick check spectrum: F_c , VGA, F_s
 - Move and measure distance
 - Acquire signal
 - Export as CSV
3. Post-process signal using Octave/Matlab
 - See script: `loadCSVmeasurements.m`
 - Download archive at:
[TELECOM205-D2-measurements-script.zip](#)



Before going to the field

Carefully check `acquire_SNR.py`

Please check values F_c and F_{sig_offset} .

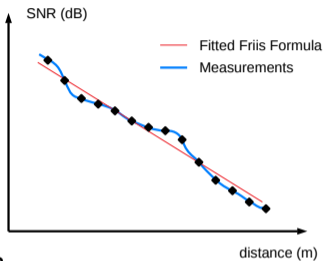
The function `utilities.sig_power()` is A DRAFT ! Check by yourself that it works as expected !

Expected outputs

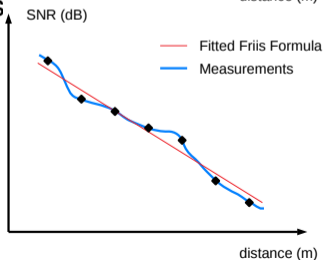
■ Photos !

■ SignalPower-vs-distance plots

- Fit on Friis formula
 - Extract exponent value
- Discussion



Case "2.5 GHz"
(Pluto VGA OFF)



Case "0.6 GHz"
(Pluto VGA OFF)