

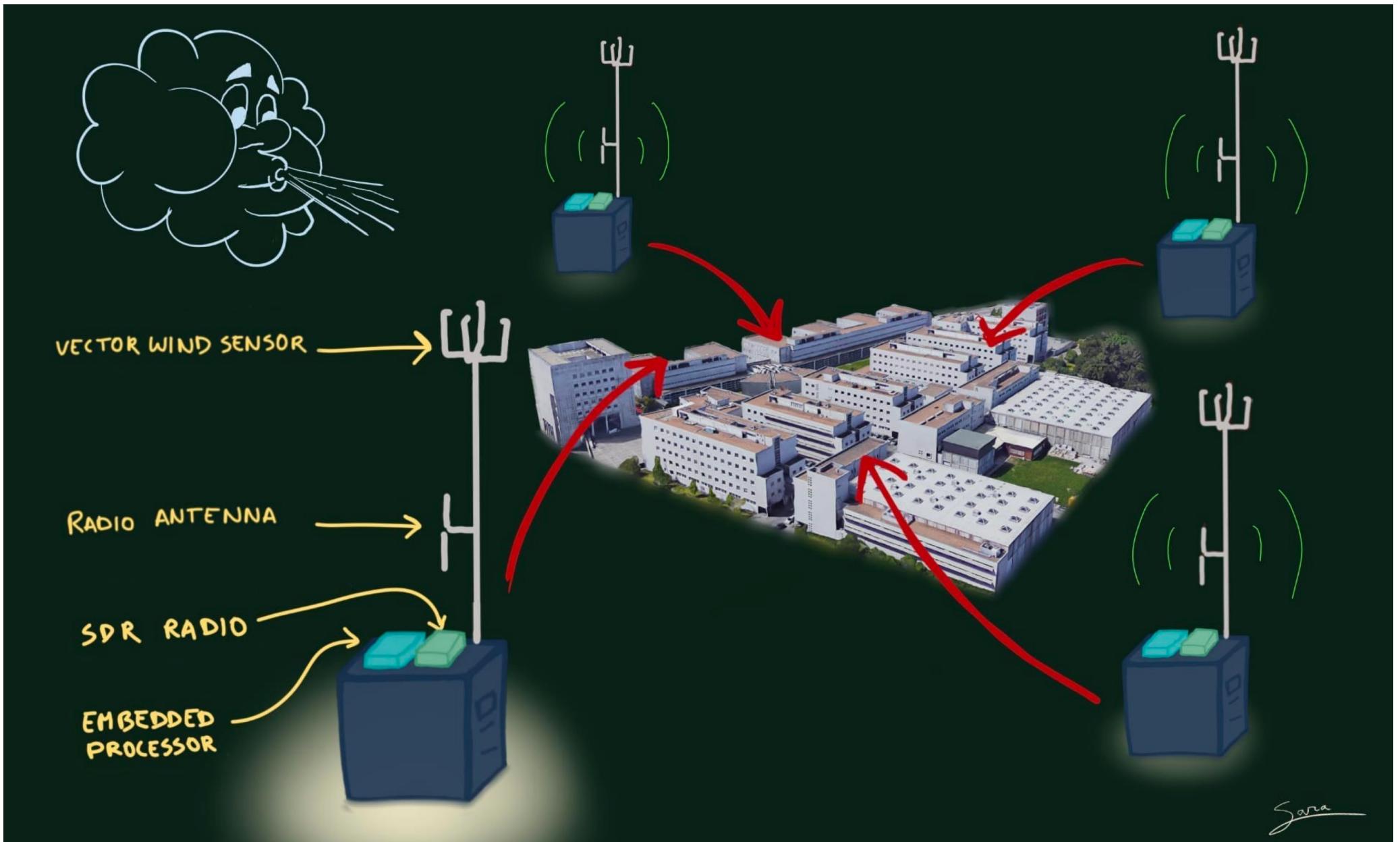
WindFlow

SETEC 2020/21

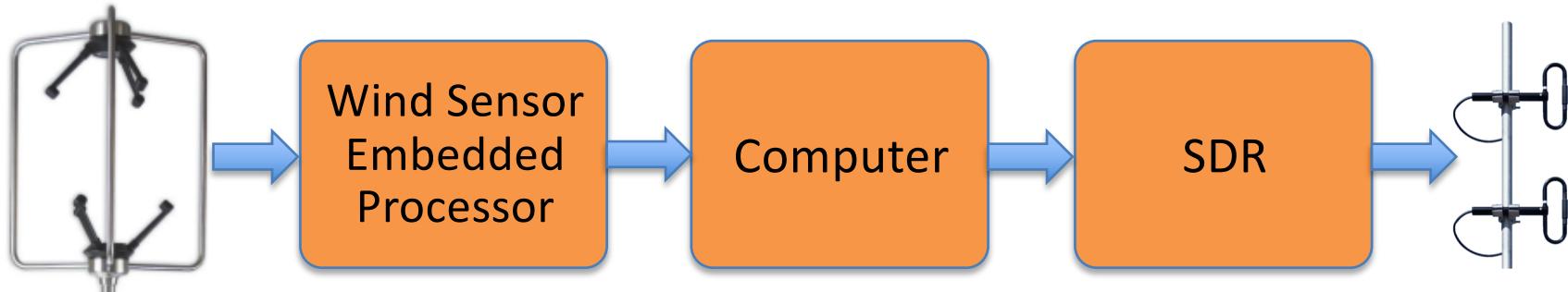
Objectives

- Assess the feasibility of using a vector wind sensor array to measure fast wind flow phenomena.
- Build or adapt a scientific 3D sonic wind sensor using background from a previous course (PSD).
- Connect four sensors in a real-time ad-hoc radio network.
- Collect synchronized vector wind measurements at the main station (20 Hz sample rate or better).
- Low-power SDR based communications with waveforms/network protocols implemented by you.

Concept of the Project

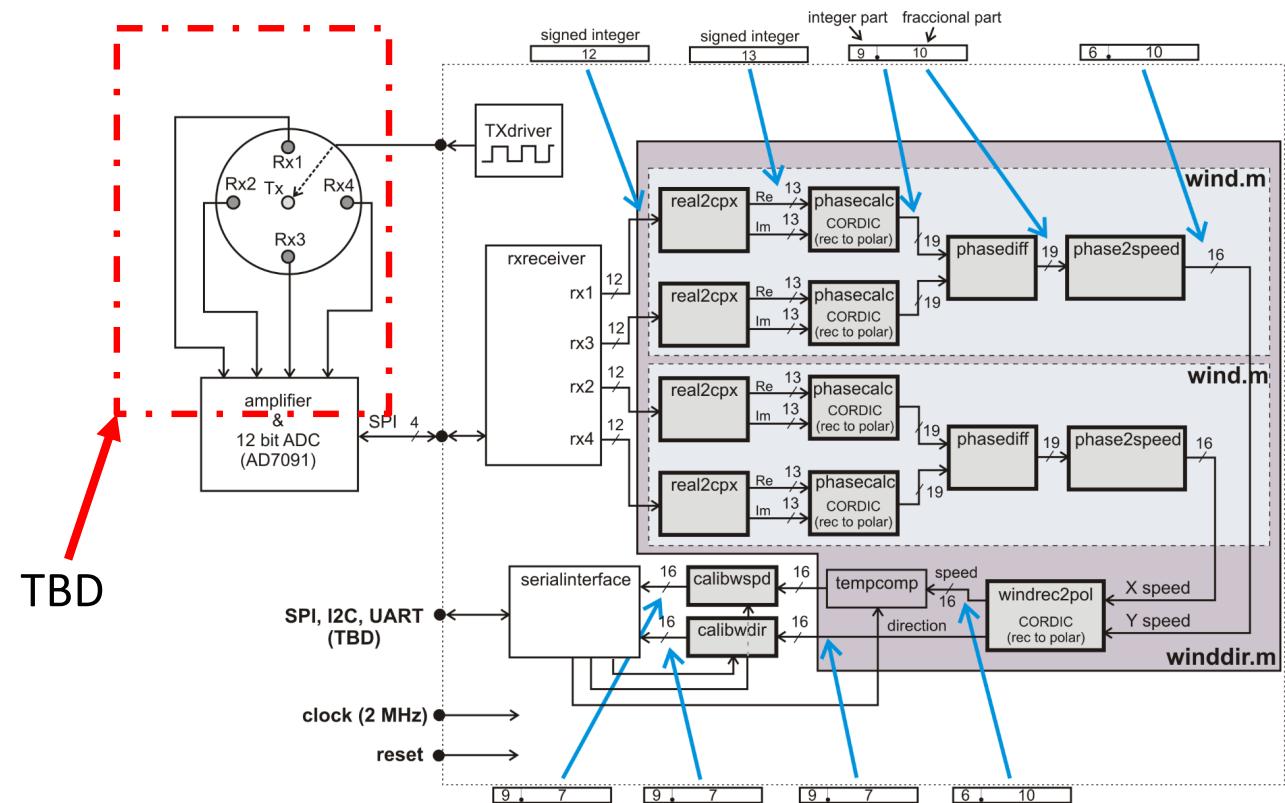
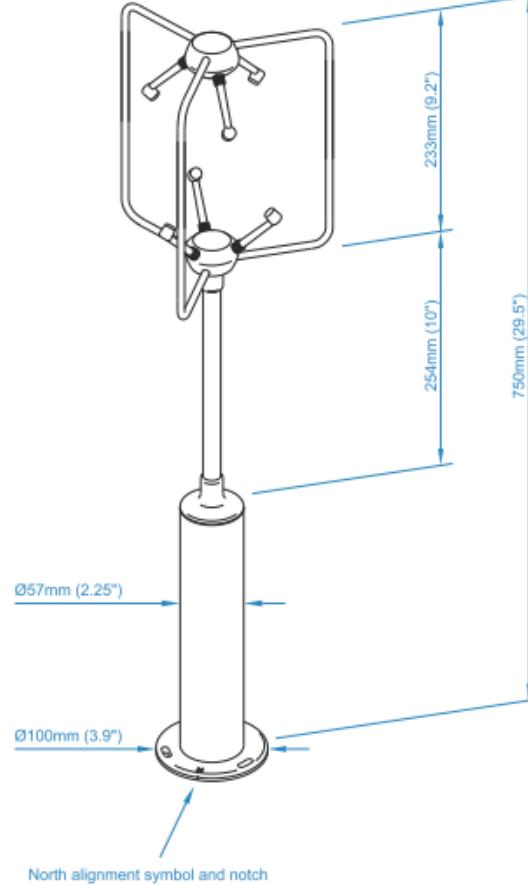


Block Diagram of Each Node



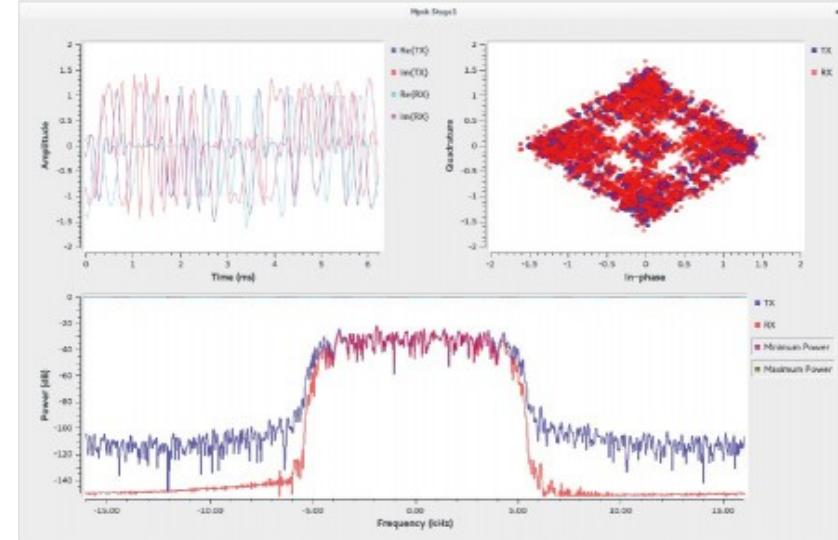
- Wind sensor: based on phase shift of acoustic wave;
- Controlled by embedded processor (FPGA);
- Data, networking and waveforms managed in CPU;
- USB interface to Software Defined Radio (SDR);
- Separate or combined TX/RX antennas;
- Computer (CPU) can be an embedded solution.

Vector Wind Sensors



2-axis sonic anemometer (PSD 19/20)
Signal processing block diagram

SDR Platforms



- TX and RX port, covering ISM 2.4 GHz band.
- Controlled in real-time by GNU Radio (and more).
- Four units available.

Critical Aspects

- Wind measurements are vectorial (2D or 3D);
- Wind sampling rate must be 20 Hz or higher;
- Radio is the only connection amongst units;
- Sample synchronization is required;
- Freedom to chose or develop waveforms;
- Low data rate, but faster than most IoT protocols;
- Scalable packet oriented protocol required;
- Networking protocol to share medium required.
- Interested in results: Prof. Laginha Palma (DEM).

Project Teams

Vector Wind Sensor (WS)

- Inclusion of audio devices
- Extension from 2D to 3D
- Calibration
- Interface and data protocol

(10 to 12 students) (JCA)

Supporting Hardware (HW)

- Sensor + antenna installation
- Antenna development
- Site survey and selection
- Demonstration planning

(8 to 10 students) (AAM)

Waveforms (WF)

- Modulation / demodulation
- Packet detection & sync
- Data coding / link budget
- Inter-node time correlation

(10 to 12 students) (SRC)

Network Protocol (NP)

- Addressing
- Medium access and sharing
- Packet forwarding
- Automatic (ad-hoc) topology

(10 to 12 students) (SRC)

Deliverables

- Quality Manual (Oct 12th)
- Market Survey (Oct 19th)
- Bill of Materials (BoM) (Mid Oct)
- Requirements and Compliance Report (Oct 26th)
- System Concept (Nov 2nd)
- Intermediate Report
 - Presentation (End Nov)
- Final Report (Soon after demo)
 - Presentation (Beg Jan)
 - Demonstration (Beg Jan)
- (Weekly short progress reports and cross evaluation)

Team Organization

- Definition of team members.
- Definition of team leaders.
- Definition of weekly time slots for leader meetings.
- Warning about evaluation:
 - Global project evaluation is most relevant.
 - Performance of each team: “team delta”.
 - Performance of student within team: “student delta”.
 - Leadership is valued.
 - Student self and cross-evaluation taken into account.