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OPEN SENSOR NETWORK

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OUTLINE

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2. Technologies

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3. Open Sensor Network

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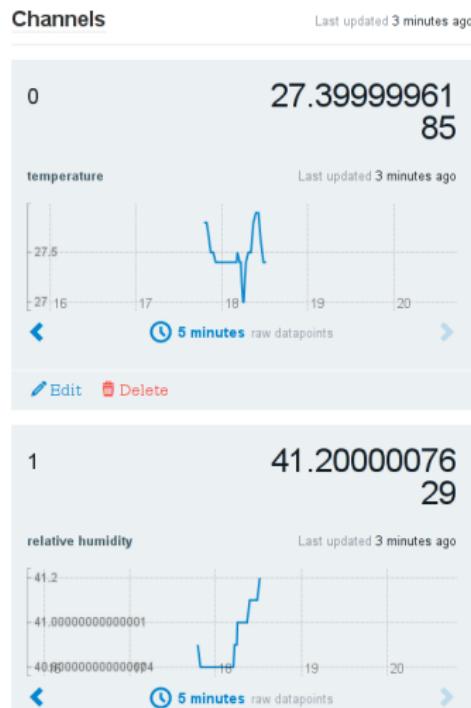
INTRODUCTION

INTRODUCTION

- Sensor network
 - Distributed, autonomous sensors inside a *node*
 - Gather information
 - Act to certain events
- Exponential demand
- Unlimited possibilities
 - Disaster relief
 - Smart cities
 - Health care
 - ...

INTRODUCTION

- Guide (or tools) to easily deploy a sensor network
 - Out-of-the-box
- Make information available to developers
- Gather heterogeneous information
- Real-time data
- Use of open technologies

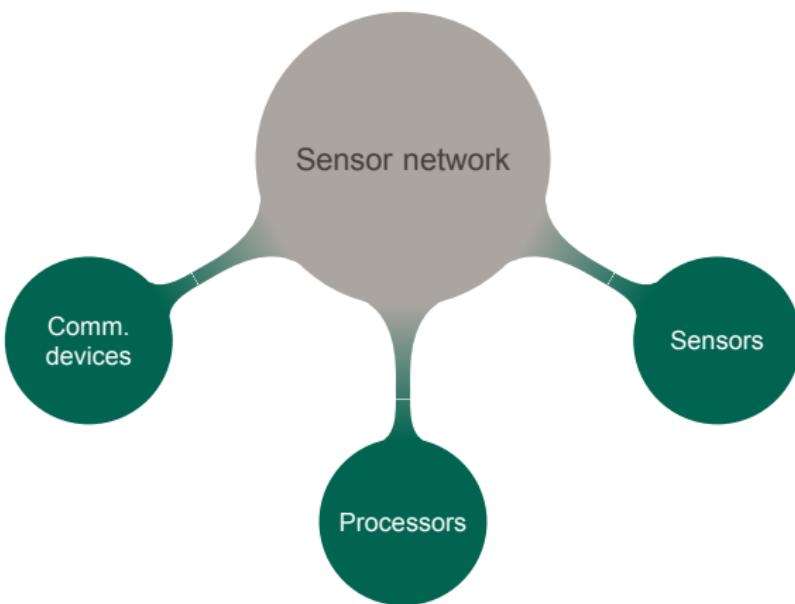


Xively graphs, own elaboration

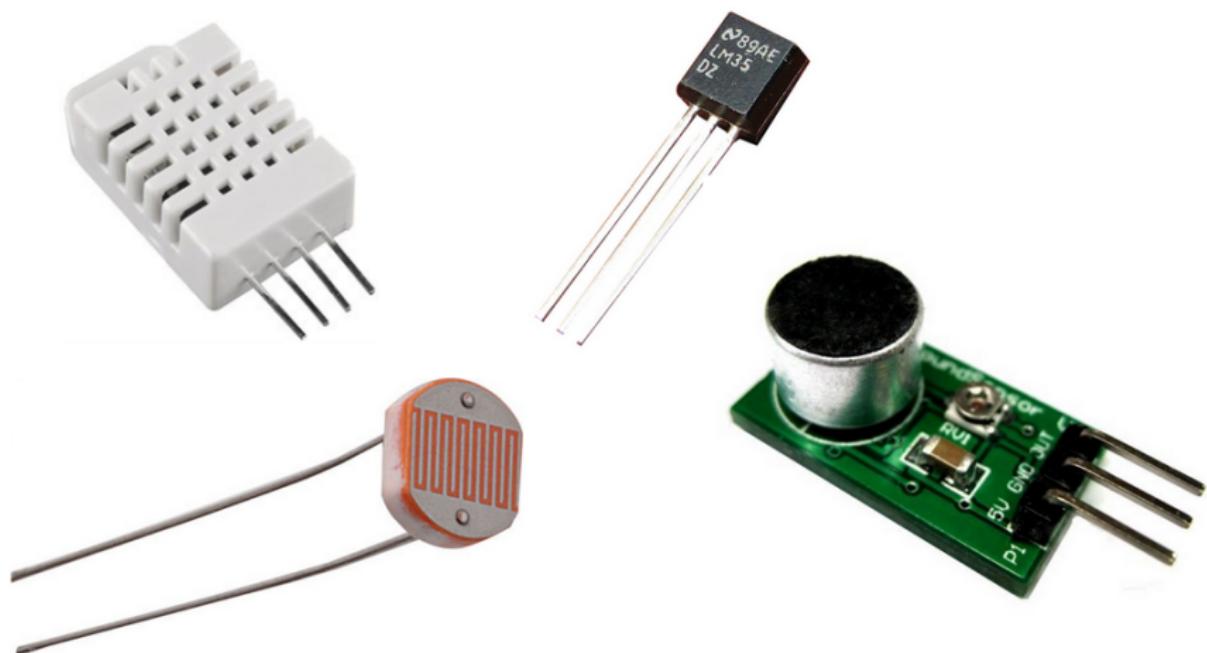
TECHNOLOGIES

BUILDING A SENSOR NETWORK

→ 3 essential blocks conform every sensor network



SENSORS



Several sensors, (From left to right and top to bottom) Aosong Inc., Texas Instruments, Cytron, Emartee

ARDUINO

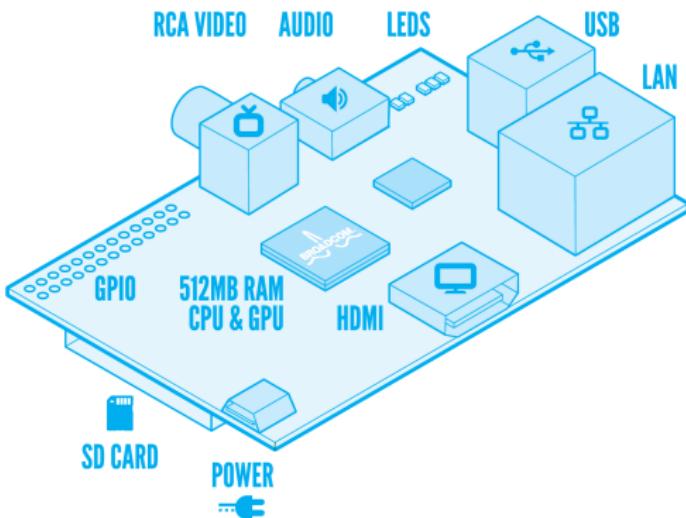
- Open source hardware
- Prototyping board
 - Fast prototyping
 - Unexpensive
- Huge & active community
- Programs written in C/C++
- I/O pins



Arduino UNO, Copyright by
the Arduino Team

RASPBERRY PI

- ARM box
 - Low energy consumption
 - Versatile
 - Runs GNU/Linux
- Arch Linux
- Python



Raspberry Pi, Copyright by the Raspberry Pi Foundation

XBEE®

- XBee®
 - Implements a ZigBee protocol stack
- Several frequency bands & power levels to choose from
- Cheap
- 4 analog-to-digital converter input pins
- Configurable through X-CTU
 - Configuration files ready to use in the GitHub repository



An XBee® RF module,
Copyright by Digi
International

OPEN SENSOR NETWORK

TWO TYPES OF NODES

- Two node designs have been considered
 - Two different needs
- Standalone XBee®
 - No processing power apart from the ADC
 - Very long lifetimes
- Arduino-based node
 - Can perform calculations
 - More energy consumption

```
1 if DigitalSensors:  
2     return ArduinoNode  
3 else if ComputingPowerIsNeeded:  
4     return ArduinoNode  
5 else:  
6     return StandaloneXBee
```

STANDALONE XBEE® NODE

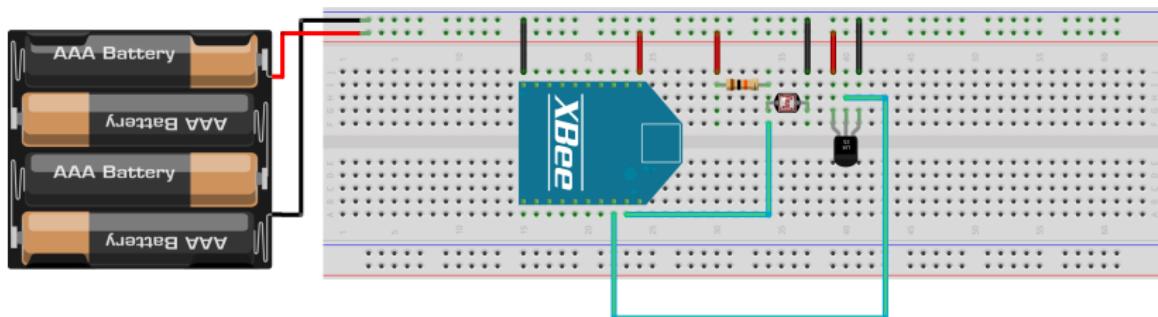


XBee® I/O pins, own preparation

- Data collected through AD0...AD3 pins
- Transmit readings with a given period
- Encapsulates data into a ZigBee packet

STANDALONE XBEE® NODE

- A basic example of this kind of node, measuring:
 - Light levels
 - Temperature

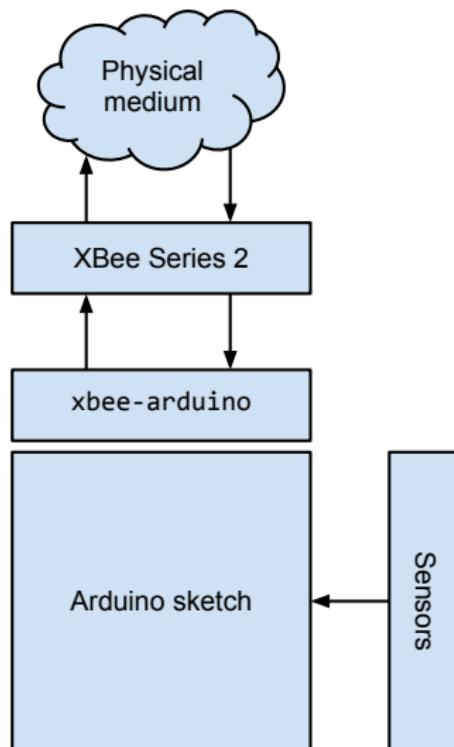


Made with Fritzing.org

Standalone XBee® node, own preparation

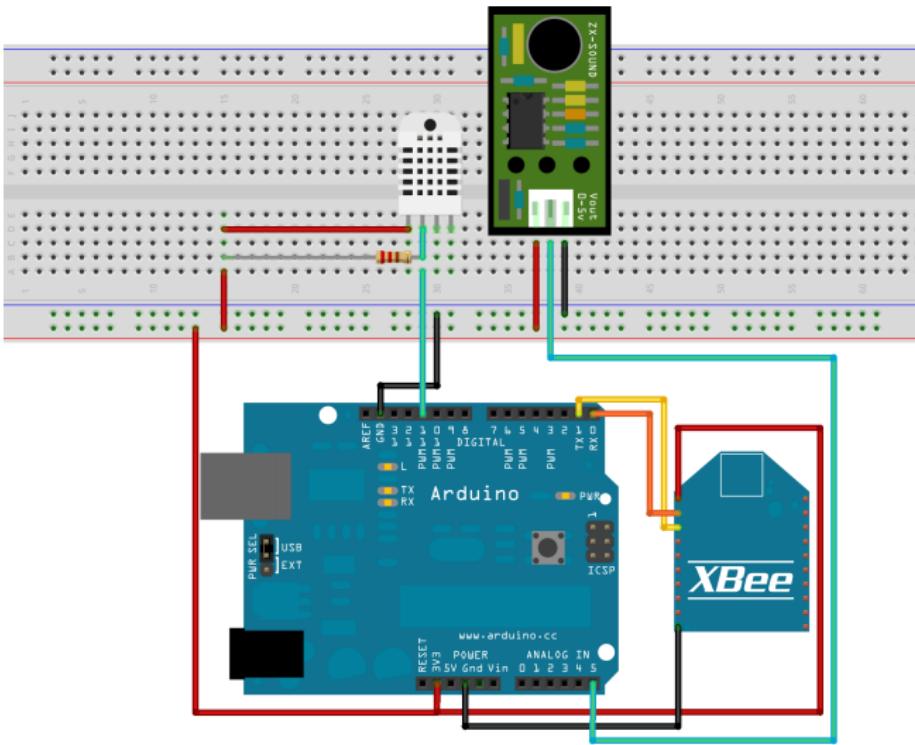
ARDUINO-BASED NODE

- Uses the xbee-arduino library
- Problem
 - They can send *any* kind of information
 - How will the sink decode it?
- Solution
 - *Metadata* sent along with sensory information



Overview of an Arduino node, own preparation

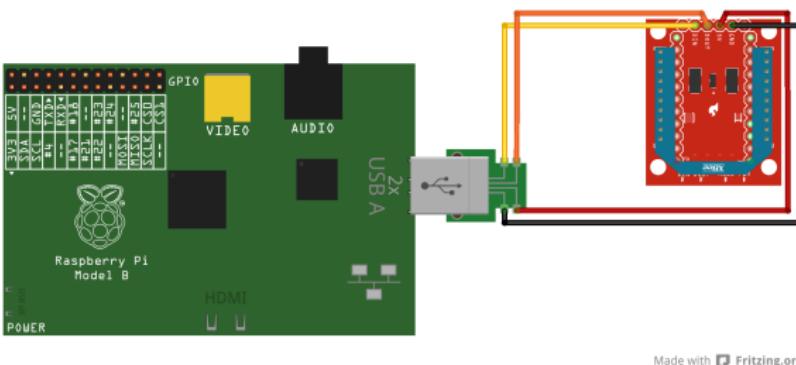
ARDUINO-BASED NODE



Made with Fritzing.org

Example of an Arduino node, own preparation

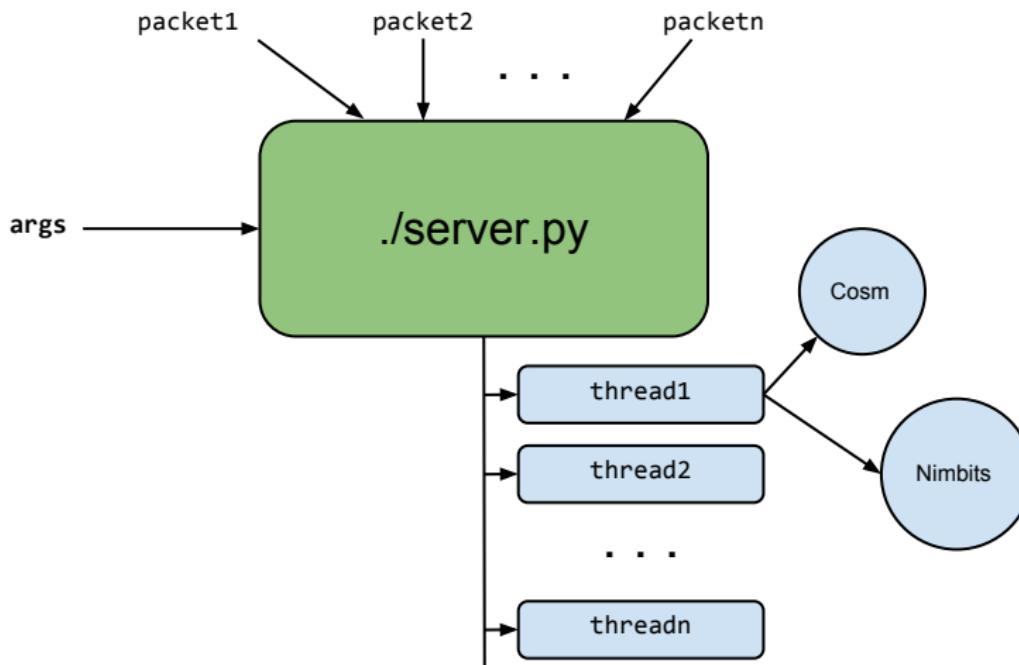
NETWORK SINK



Overview of the sink, own preparation

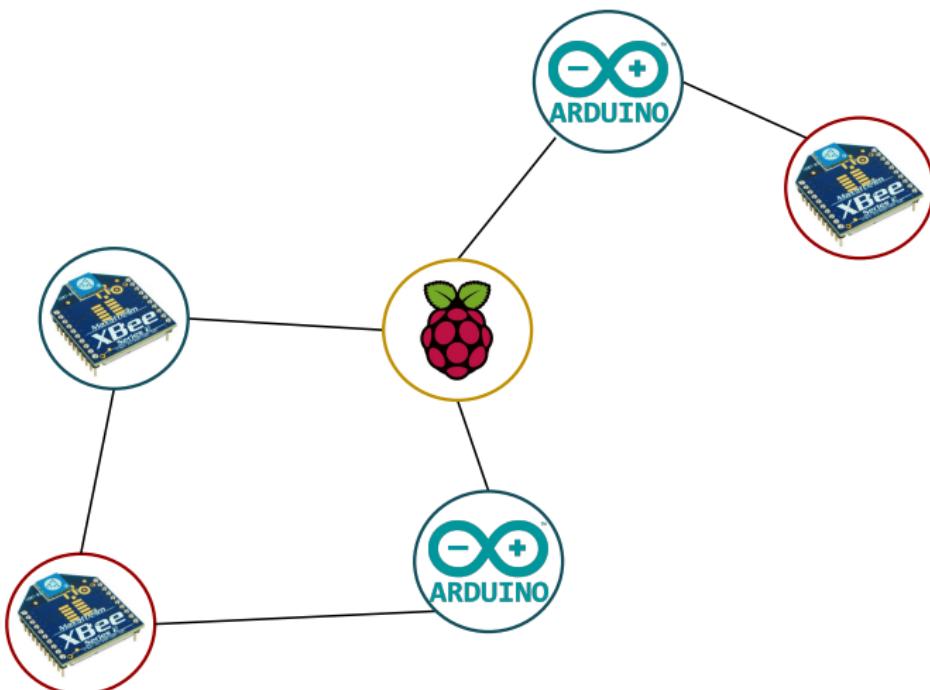
- Connected to the ZigBee network sink
- Receives & processes all the information
- Initializes the Python script at boot time as a daemon
 - Daemon script

SINK SCRIPT OVERVIEW



Script overview, own preparation

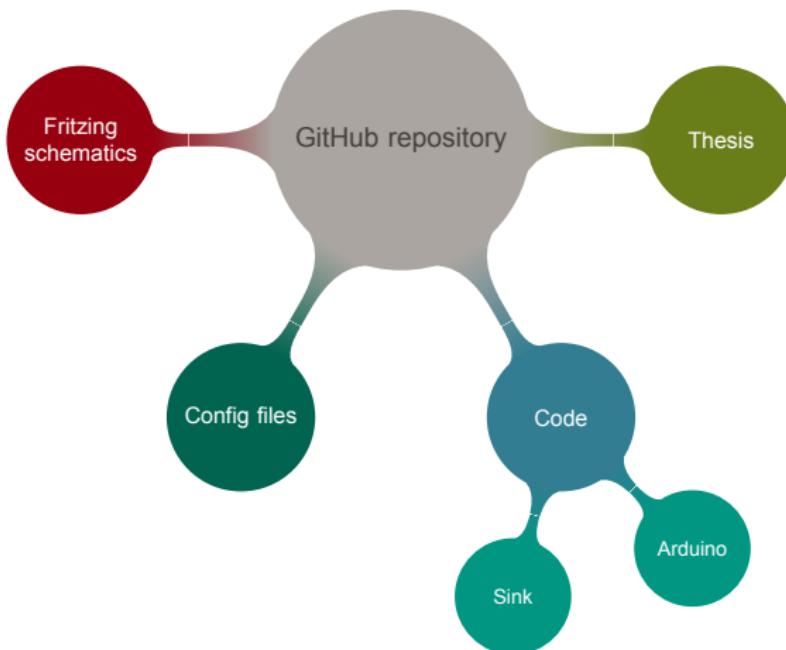
SYSTEM OVERVIEW



MY CONTRIBUTION

→ Tools available at

<https://github.com/aandreuisabal/OSN/>



RESULTS AND CONCLUSIONS

RESULTS AND CONCLUSIONS



Real Arduino-based node, own preparation

RESULTS AND CONCLUSIONS

- 2.4 GHz band is saturated, go for 868 MHz
 - No more than 25 meters separation
- The proposed solution is:
 - Cheap
 - Versatile
 - Easily deployable
- Visibility of the project
 - Talk in the Battle of the Wireless Mesh @ Aalborg (DK)
 - Escolab @ Tànger building (UPF)
 - Wireless Sensor Networks @ UPF
 - Appearance @ Radio Blue (DE)

FUTURE WORK

FUTURE WORK

- Improve energy consumption in Arduino based nodes
 - Use the narcoleptic library
 - Modify the native AVR libraries
- Create more uploaders
- Automatic generation of the metadata
- Make the system *completely* open
 - Open ZigBee devices
 - Use of the DASH7 protocol

Outline

Introduction
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Technologies
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Open Sensor Network
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Results and conclusions
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Future Work
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Thank you.