Marie Francine Lagadec · ETH Zürich
Alexandre Lagadec · ZHAW Zürich
Cyril Roth, Daniel Strässler · ZHAW Winterthur
Supervision: Moritz Thielen · ETH Zürich

# データの宅急便

## Dēta no takkyūbin · Data delivery service

A universal post-disaster monitoring system using sensor node deployment in inaccessible areas

# Team

## Marie Francine Lagadec

B.Sc. Materials Science and M.Sc. Micro and Nanosystems, ETH Zürich

Idea, team and project management, design, presentation and brochure

## Alexandre Lagadec

B.Sc. Computer Engineering, ZHAW Zürich

Sensor node software, communication sensor node / station / web application

## Cyril Roth

B.Sc. Electrical Engineering, ZHAW Winterthur

Team and project management, sensor node deployment, prototype building

## Daniel Strässler

B.Sc. Electrical Engineering, ZHAW Winterthur

Quadrocopter, sensor node deployment, prototype building

# Post-disaster monitoring scenarios

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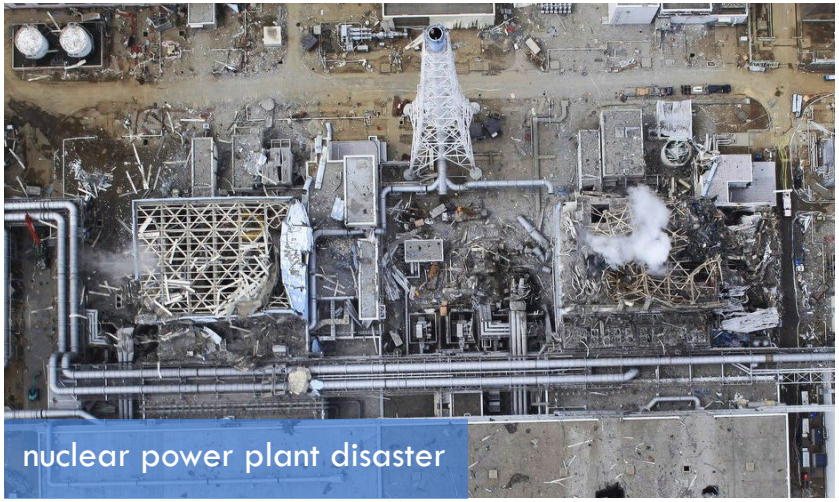
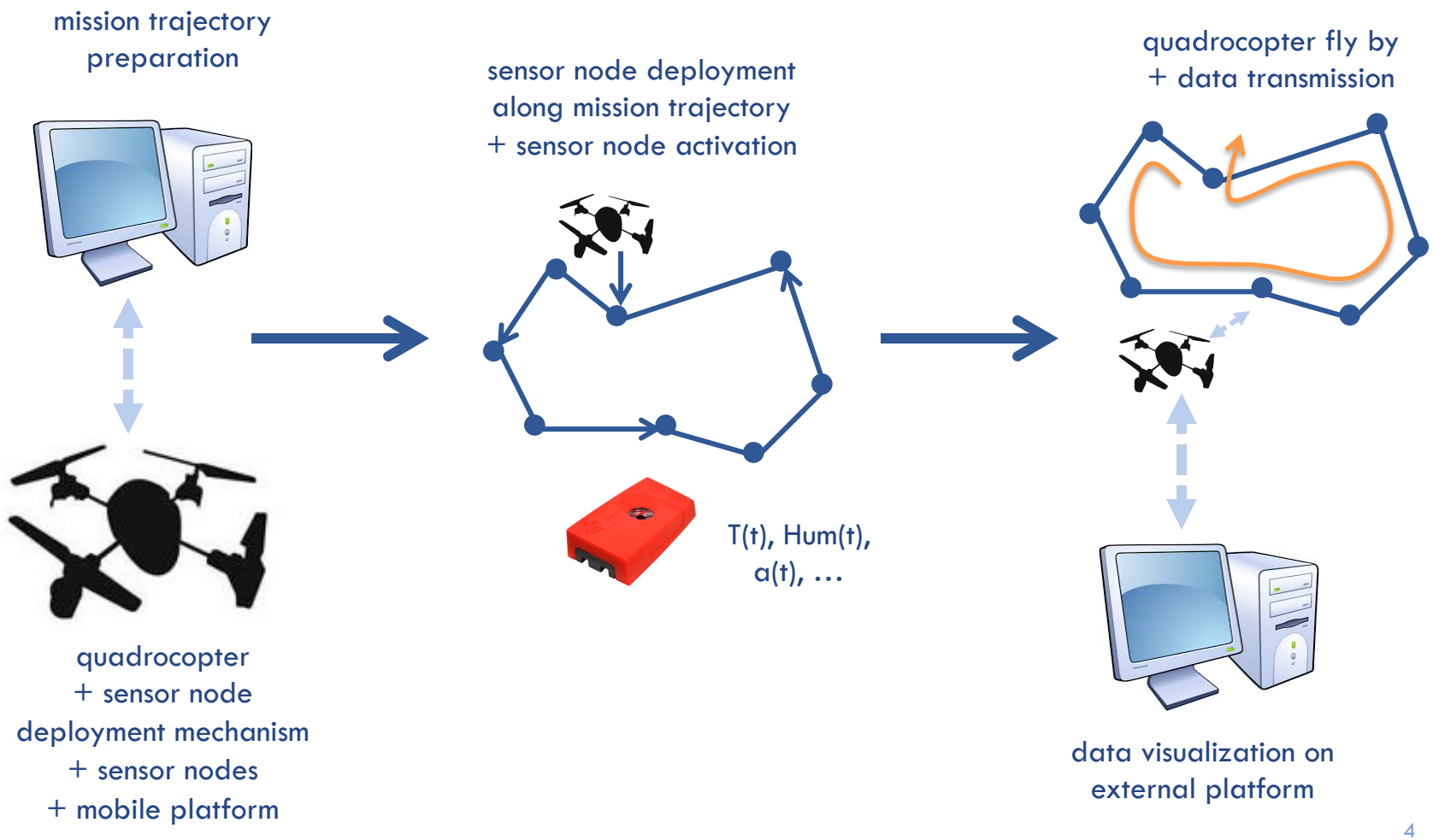


http://www.japwar.com

http://theextinctionprotocol.wordpress.com

http://japanpropertycentral.com

# System overview



# Benefits

quick, reliable deployment of sensor nodes in critical areas

time-resolved local and global information in critical areas

low-cost, off-the-shelf devices with highly flexible hard- and software architecture

embeddable into already existing alarm and monitoring systems

# Competition

innovative implementation
of well-known technologies

no cheap, general alternatives,
only highly customized and
technical solutions

adjustable complexity
(wide product range)

market base: governments,
municipalities, landowners, etc.

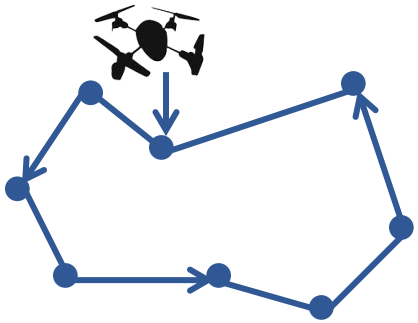
# System overview

critical
pending
achieved

mission trajectory preparation

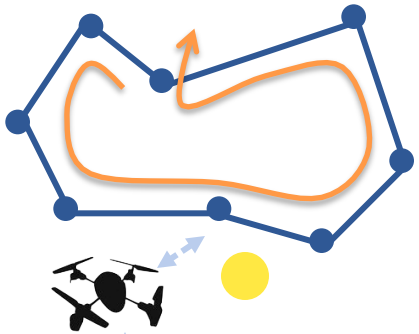
quadrocopter
+ sensor node deployment mechanism
+ sensor nodes
+ mobile platform

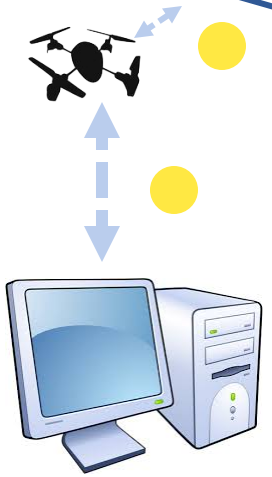
sensor node deployment along mission trajectory
+ sensor node activation



T(t), Hum(t), a(t), …

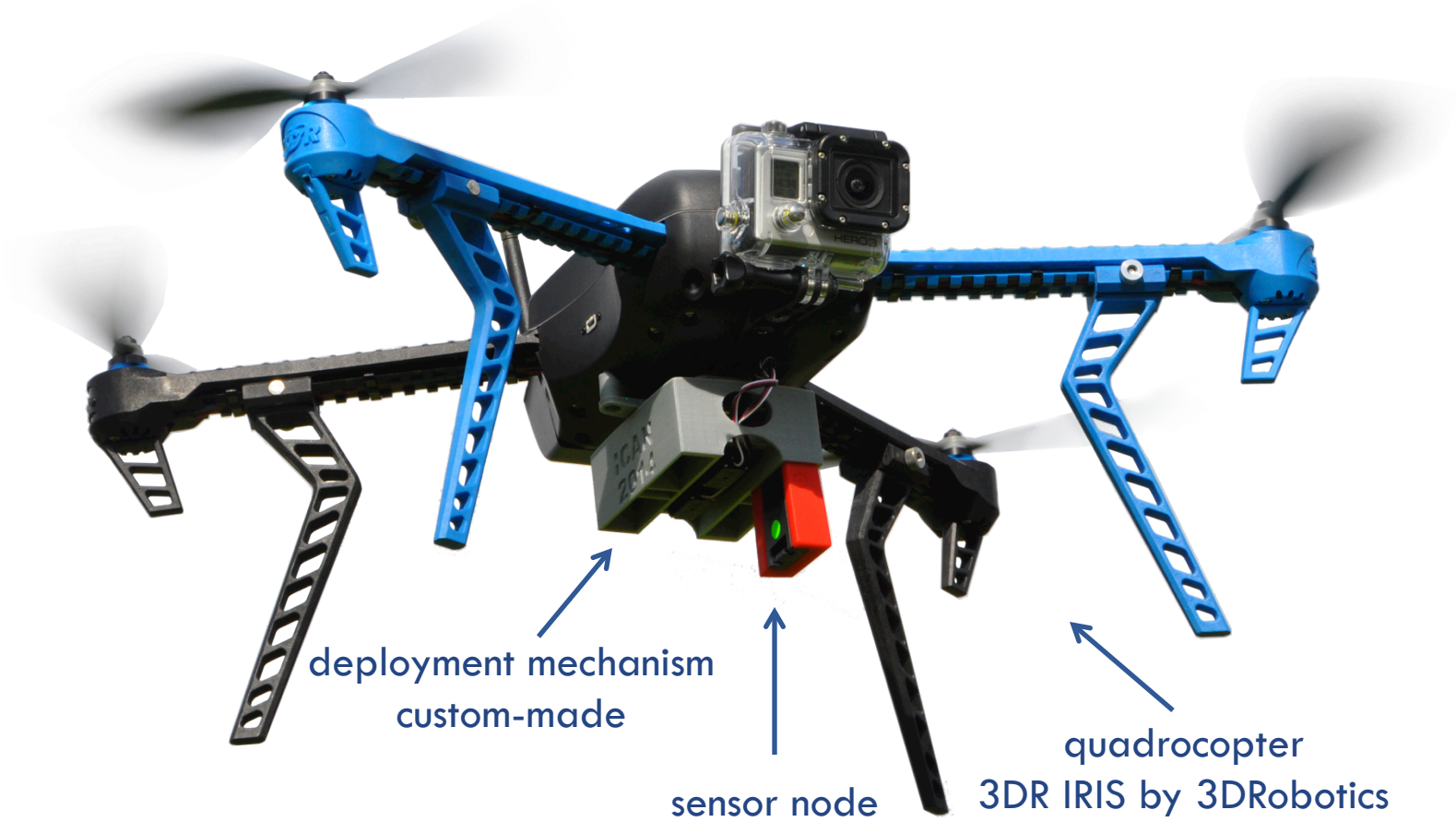
quadrocopter fly by
+ data transmission





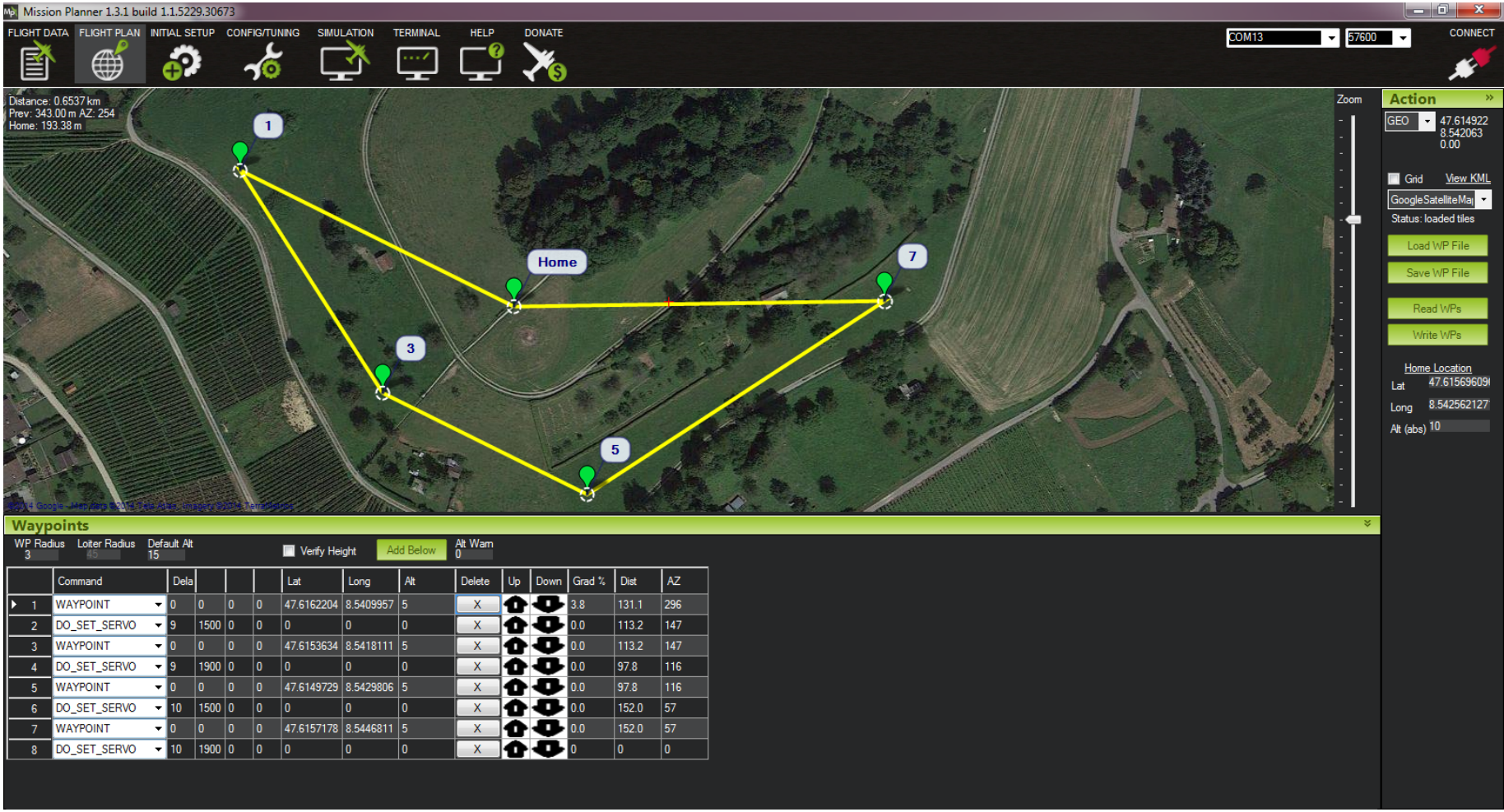
data visualization on external platform

# Prototype so far



# Prototype so far

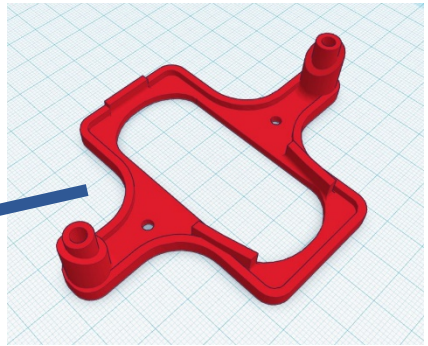
# Mission trajectory

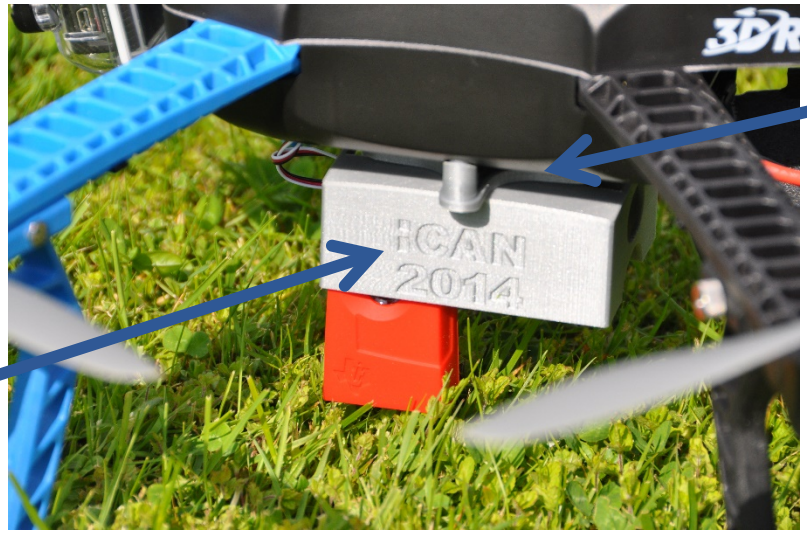


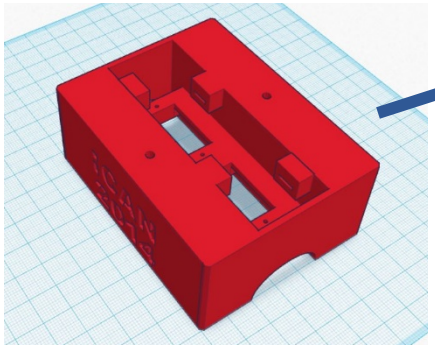

| | Command | Dela | | | | Lat | Long | Alt | Delete | Up | Down | Grad % | Dist | AZ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | WAYPOINT | 0 | 0 | 0 | 0 | 47.6162204 | 8.5409957 | 5 | X | | | 3.8 | 131.1 | 296 |
| 2 | DO_SET_SERVO | 9 | 1500 | 0 | 0 | 0 | 0 | 0 | X | | | 0.0 | 113.2 | 147 |
| 3 | WAYPOINT | 0 | 0 | 0 | 0 | 47.6153634 | 8.5418111 | 5 | X | | | 0.0 | 113.2 | 147 |
| 4 | DO_SET_SERVO | 9 | 1900 | 0 | 0 | 0 | 0 | 0 | X | | | 0.0 | 97.8 | 116 |
| 5 | WAYPOINT | 0 | 0 | 0 | 0 | 47.6149729 | 8.5429806 | 5 | X | | | 0.0 | 97.8 | 116 |
| 6 | DO_SET_SERVO | 10 | 1500 | 0 | 0 | 0 | 0 | 0 | X | | | 0.0 | 152.0 | 57 |
| 7 | WAYPOINT | 0 | 0 | 0 | 0 | 47.6157178 | 8.5446811 | 5 | X | | | 0.0 | 152.0 | 57 |
| 8 | DO_SET_SERVO | 10 | 1900 | 0 | 0 | 0 | 0 | 0 | X | | | 0 | 0 | 0 |

# Deployment mechanism I

mounting platform

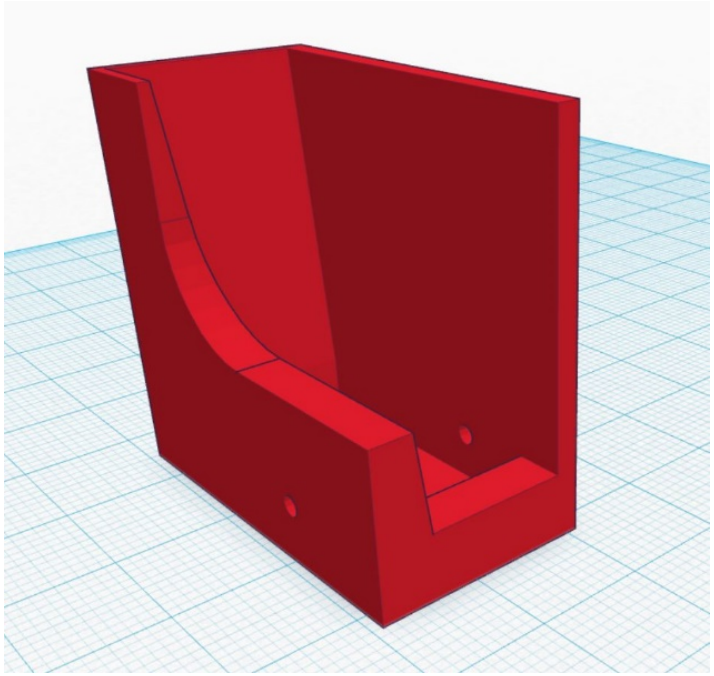


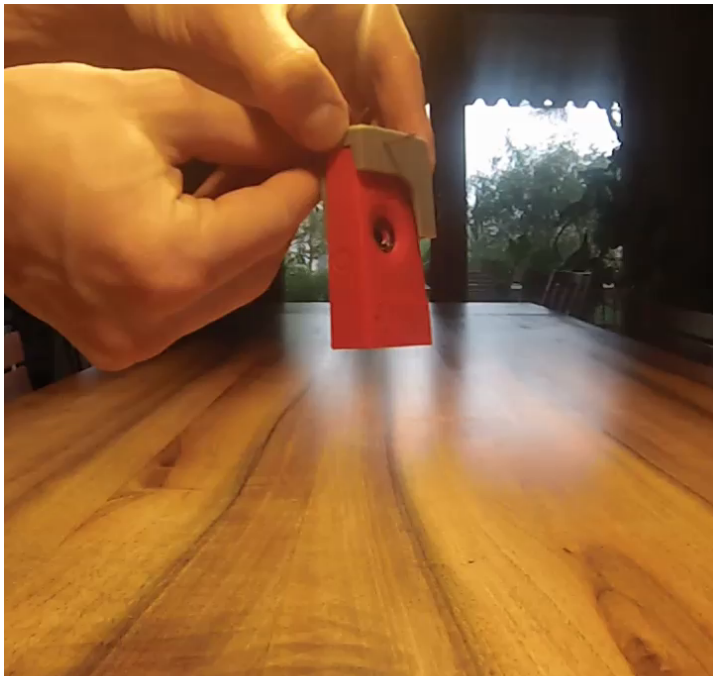


SensorTag deployment mechanism housing

# Deployment mechanism II





# Communication

## Overview


### achieved

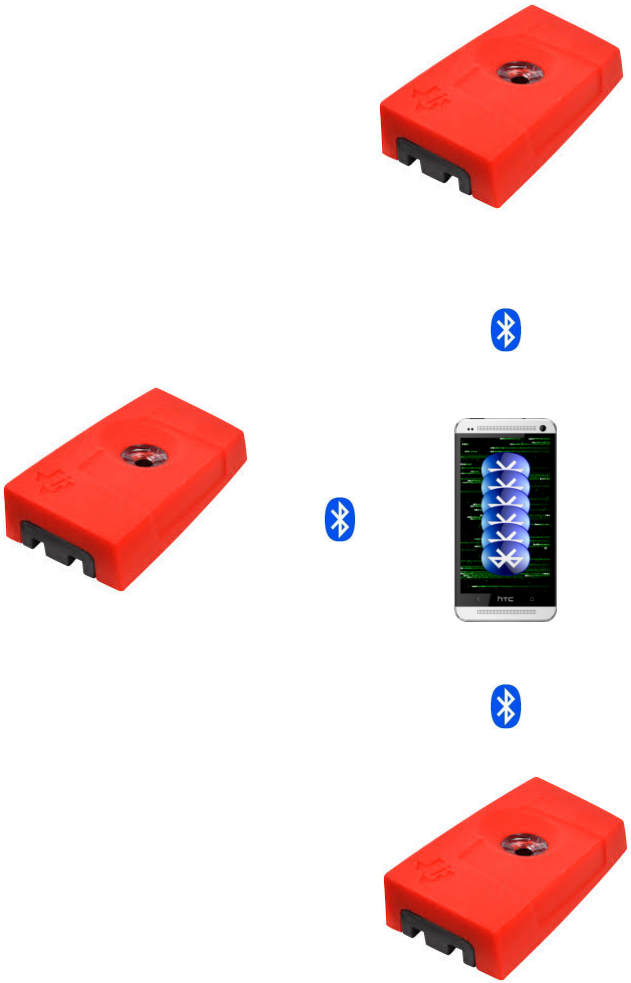
- Architecture
- High-level approach
- Choice of tools

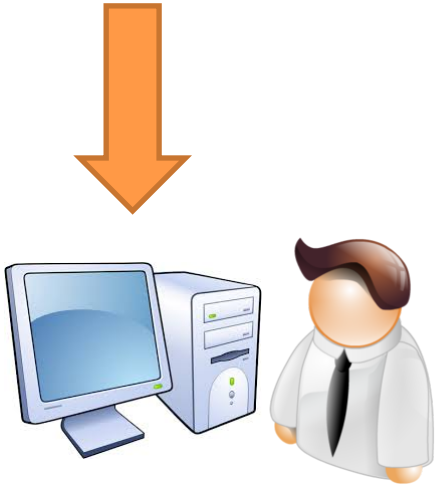
### pending

- API design
  - BLE protocol
  - Android / AppEngine endpoints
- Implementation (and revision)
  - APIs
  - Data processing
  - Data visualization
- Tests
  - Unit tests
  - Integration tests
- Documentation
- Presentation

# Communication

## Architecture



# Communication

## Architecture

SensorTag #1

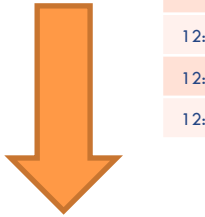
| Sens | Val |
|---|---|
| Temp. | 24°C |
| Hum. | 40% |

SensorTag #2

| Sens | Val |
|---|---|
| Temp. | 25°C |
| Hum. | 39% |

| Time | STag | Sens | Val |
|---|---|---|---|
| 12:00:10 | #1 | Temp. | 24°C |
| 12:00:10 | #1 | Hum. | 40% |
| 12:00:10 | #2 | Temp. | 25°C |
| 12:00:10 | #2 | Hum. | 39% |


| Time | STag | Sens | Val |
|---|---|---|---|
| 12:00:10 | #1 | Temp. | 24°C |
| 12:00:10 | #1 | Hum. | 40% |
| 12:00:10 | #2 | Temp. | 25°C |
| 12:00:10 | #2 | Hum. | 39% |



SensorTag #3

# Communication

## Architecture

SensorTag #1

SensorTag #2

| Sens | Val |
|---|---|
| Temp. | 23°C |
| Hum. | 41% |

SensorTag #3

| Time | STag | Sens | Val |
|---|---|---|---|
| 12:00:40 | #3 | Temp. | 23°C |
| 12:00:40 | #3 | Hum. | 41% |

Google App Engine

| Time | STag | Sens | Val |
|---|---|---|---|
| 12:00:10 | #1 | Temp. | 24°C |
| 12:00:10 | #1 | Hum. | 40% |
| 12:00:10 | #2 | Temp. | 25°C |
| 12:00:10 | #2 | Hum. | 39% |
| 12:00:40 | #3 | Temp. | 23°C |
| 12:00:40 | #3 | Hum. | 41% |

# Communication

## High-level approach

- SensorTag
  - Increase advertising timeouts (default: 30s)
- Hand-held
  - Learn from / re-use official TI source code (mobile application)
  - Log SensorTag data
  - Key: timestamp, SensorTag ID
  - Propagate logs to the web server
- Web application
  - Cloud-hosted
  - Persist logs
  - Visualize logs

# Communication

## Choice of tools

- SensorTag
  - IAR Embedded Workbench for 8051 (CC2540)
- Hand-held
  - Eclipse
  - Android Development Tools (ADT) plugin
- Web application
  - Eclipse
  - Google plugin
  - AppEnginge connected Android project
    - Endpoint client library generation (Android)

Thank you
for you attention!