



Technische
Universität
Braunschweig

Institute of Operating Systems
and Computer Networks

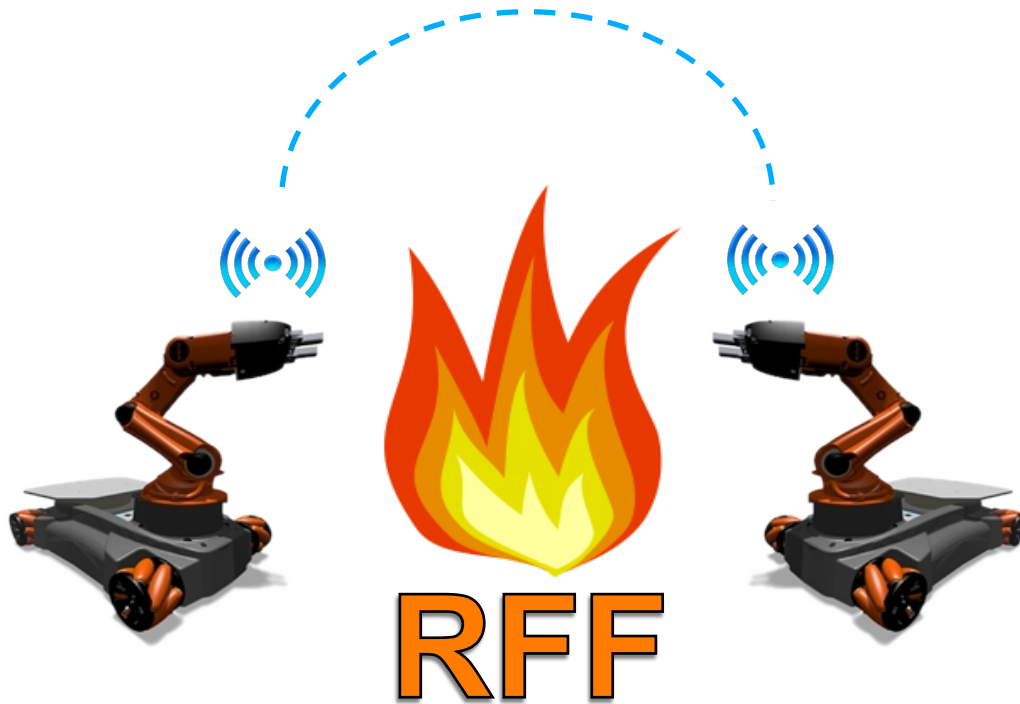


Communication Architecture, Challenges and Paradigms for Robotic Firefighters

Sebastian Schildt, Stephan Rottmann and Lars Wolf

Extremecom 2013, Iceland

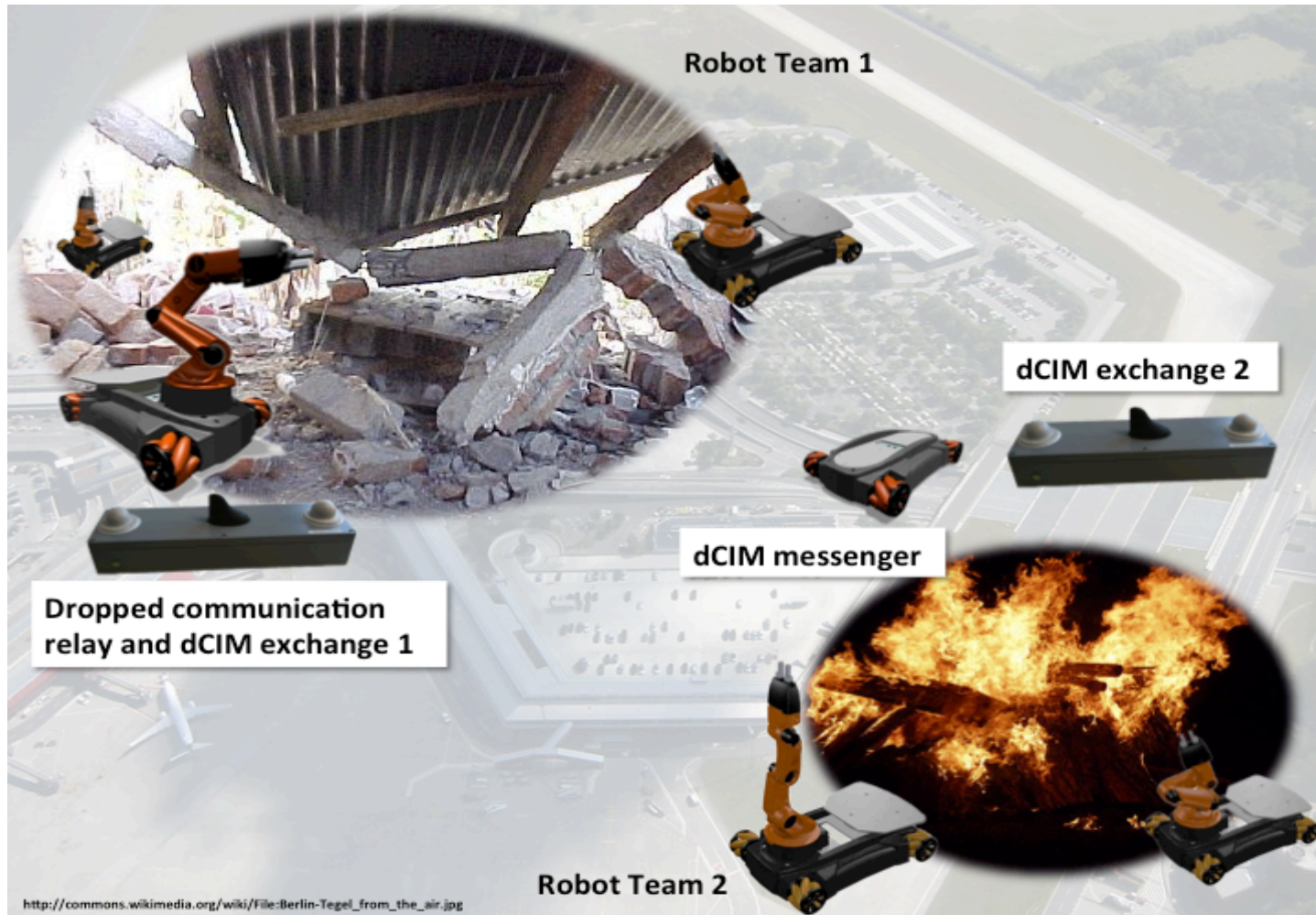
The RFF Project



Situations

- S&R in case of Fire
 - Indoor fire
 - Outdoor (forest fire, bush fire)
- Earthquakes
- Terrorist Attacks
- Operation in Radioactive Environments

RFF Vision



RFF Goals

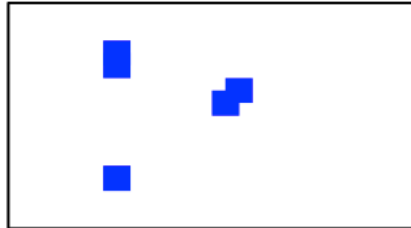
Build IT concepts and framework for robot teams in disaster management scenarios

Combining fields of

- Robot Research: Actuators & Sensors (“the hardware”)
- Multi-Agent Research (autonomy, cooperation, coordination)
- Communication (holding it all together in light of harsh and unpredictable conditions)

This is not an exercise in algorithms: Prototypes and Demonstrators right from the start!

Distributed Common Information Model

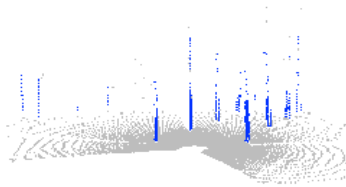


Robot specific abstraction

Used for highlevel planning and decision



Platform-specific
abstraction

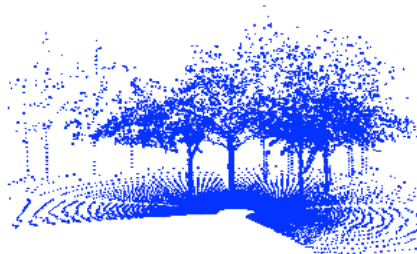


Generic dCIM representation

Shared with other mobile units
Stored on dCim Dropboxes



Sensor-specific
preprocessing



Raw sensor data

Sensory data gathered by mobile units

dCIM Datatypes

- Time and Position
- Gridmaps
 - No topology maps (except a-priori knowledge to seed grid map)
- Distributed Object/Incident database
 - Reporting Unit
 - Coordinates
 - Timestamps
- States, Goals, Plans

Dropbox Concept

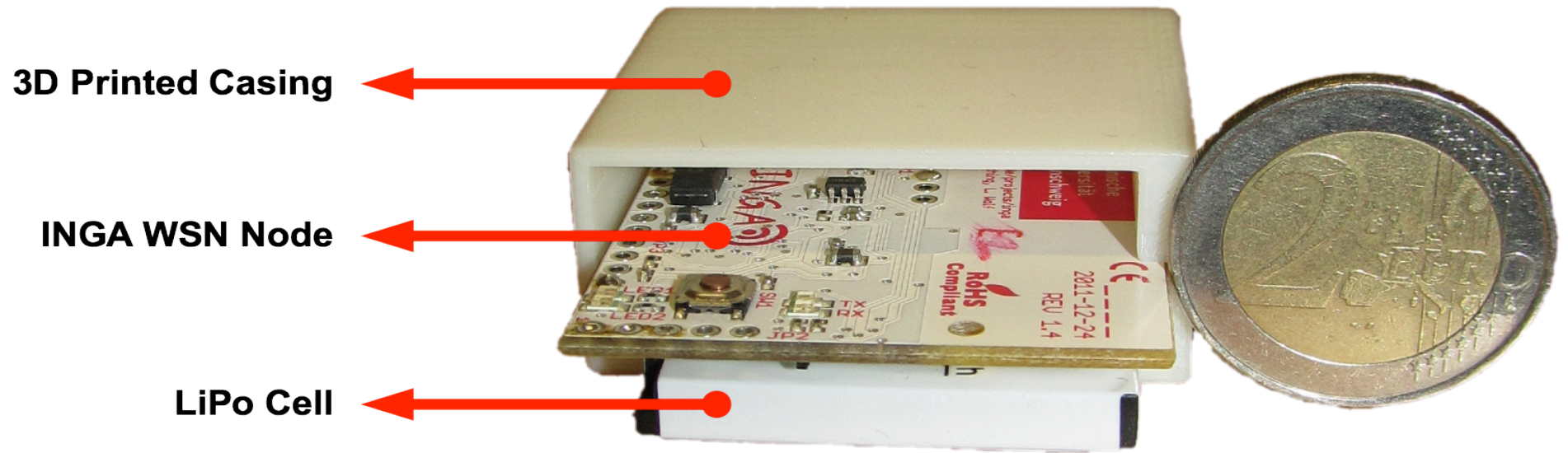
Improve Information Proliferation

Mobile RFF units transport droppable communication boxes

WSN Dropbox

- Battery Powered
- INGA Node
- IEEE 802.15.4 & muDTN

WSN Dropbox

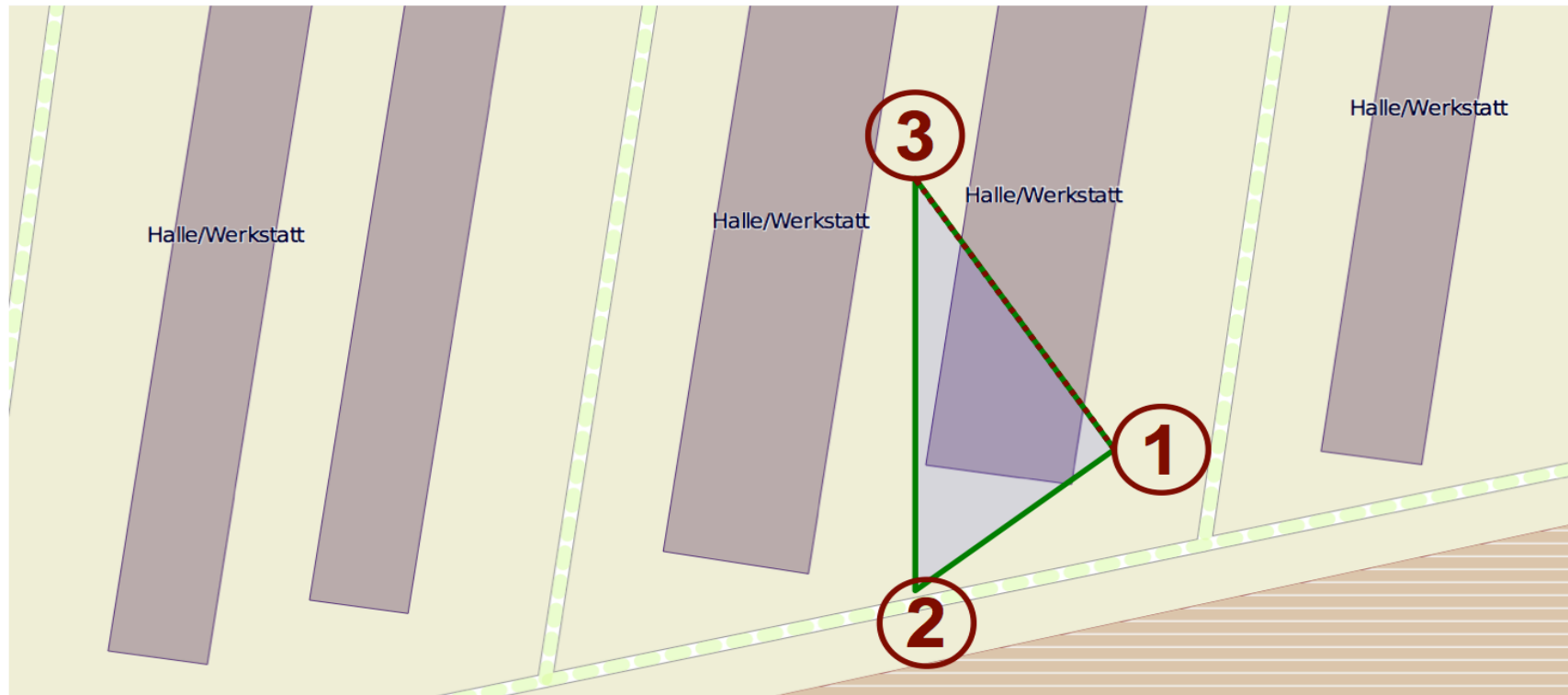


3D Printed Casing

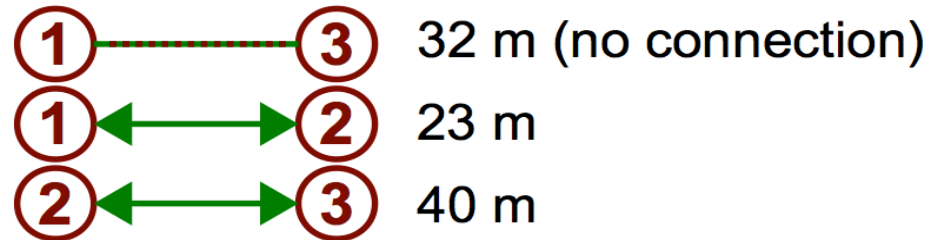
INGA WSN Node

LiPo Cell

WSN Dropbox Scenario



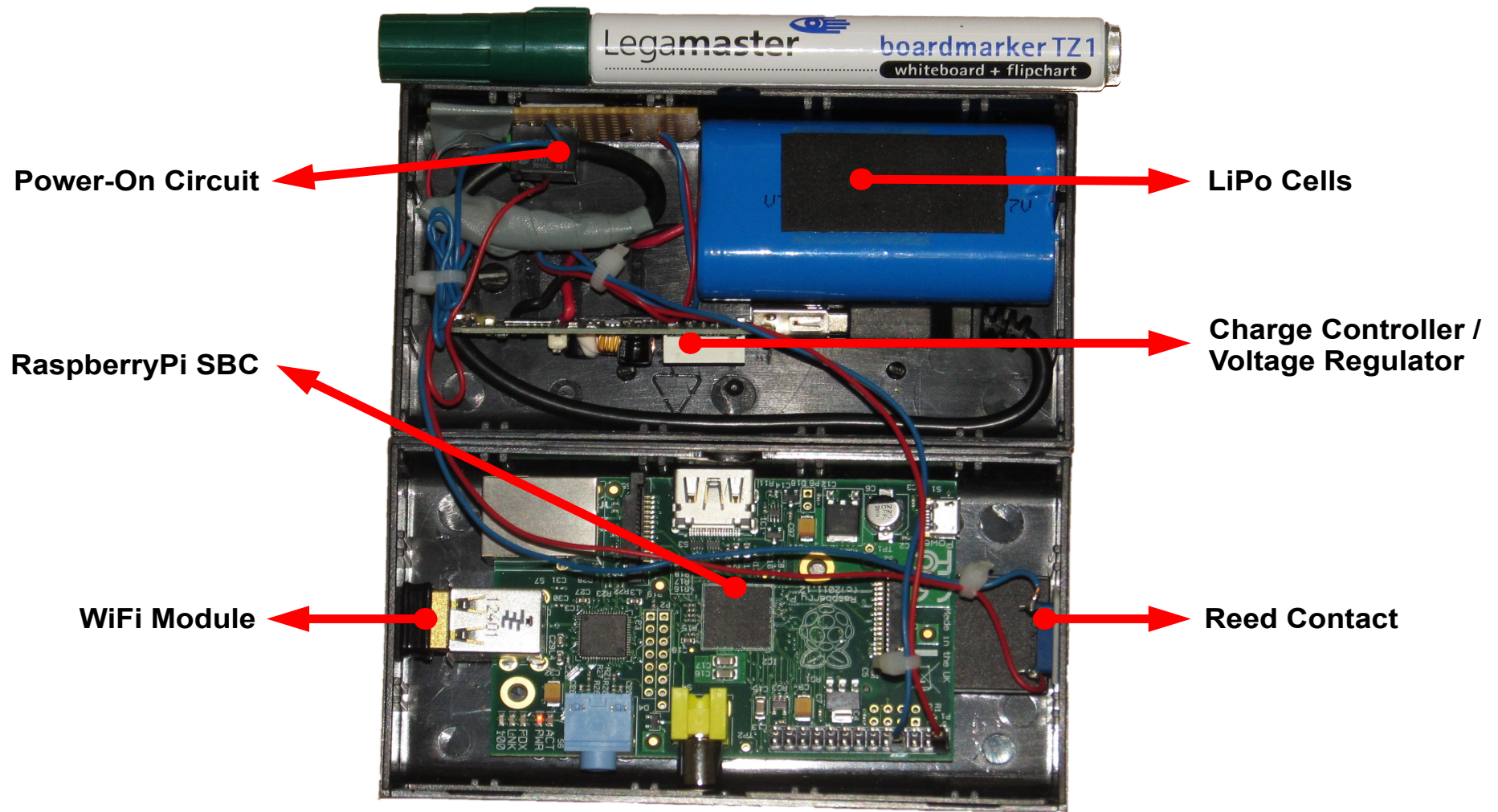
- ① Operator
- ② Dropbox
- ③ Mobile Unit



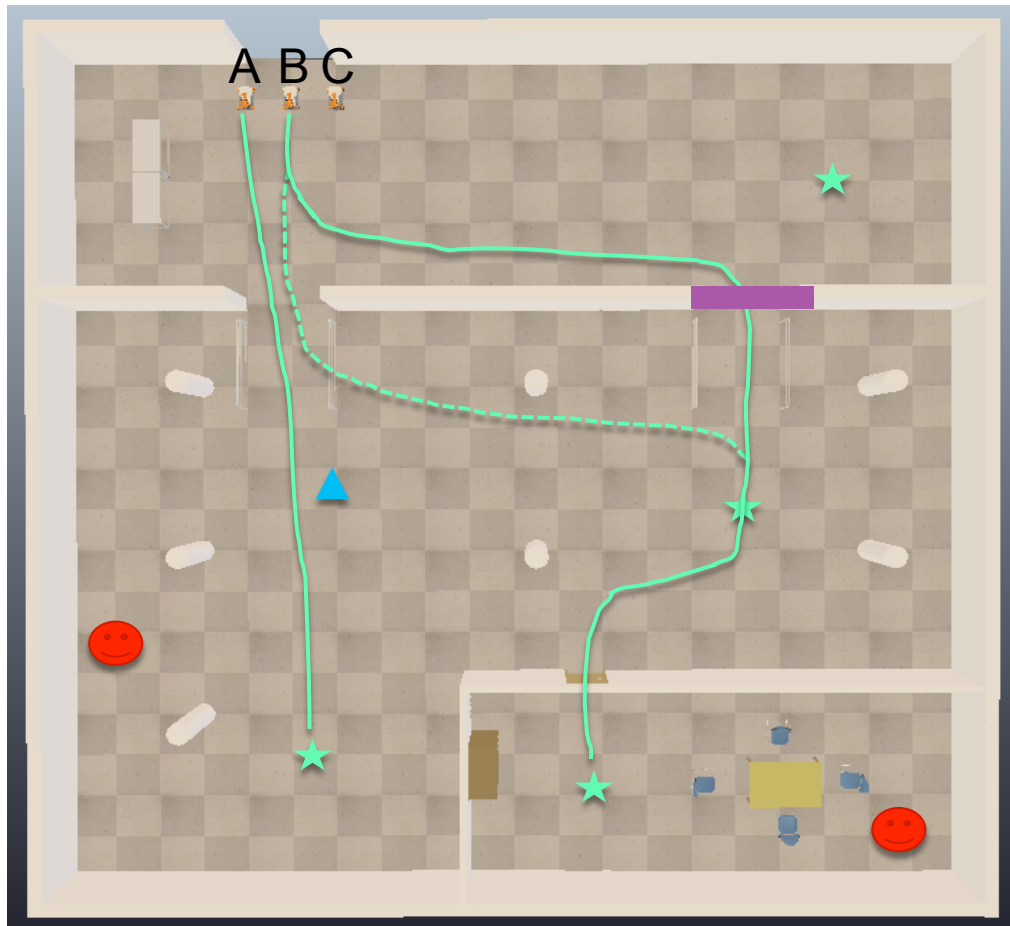
Aggregate and distribute DCIM data

- Battery Powered
- Wi-Fi & IBR-DTN Bundle Protocol Implementation
- Storage
- Raspberry Pi-based
- Sealed custom case
- Inductive Charging

DCIM Dropbox Prototype








Droppbox Scenario 2

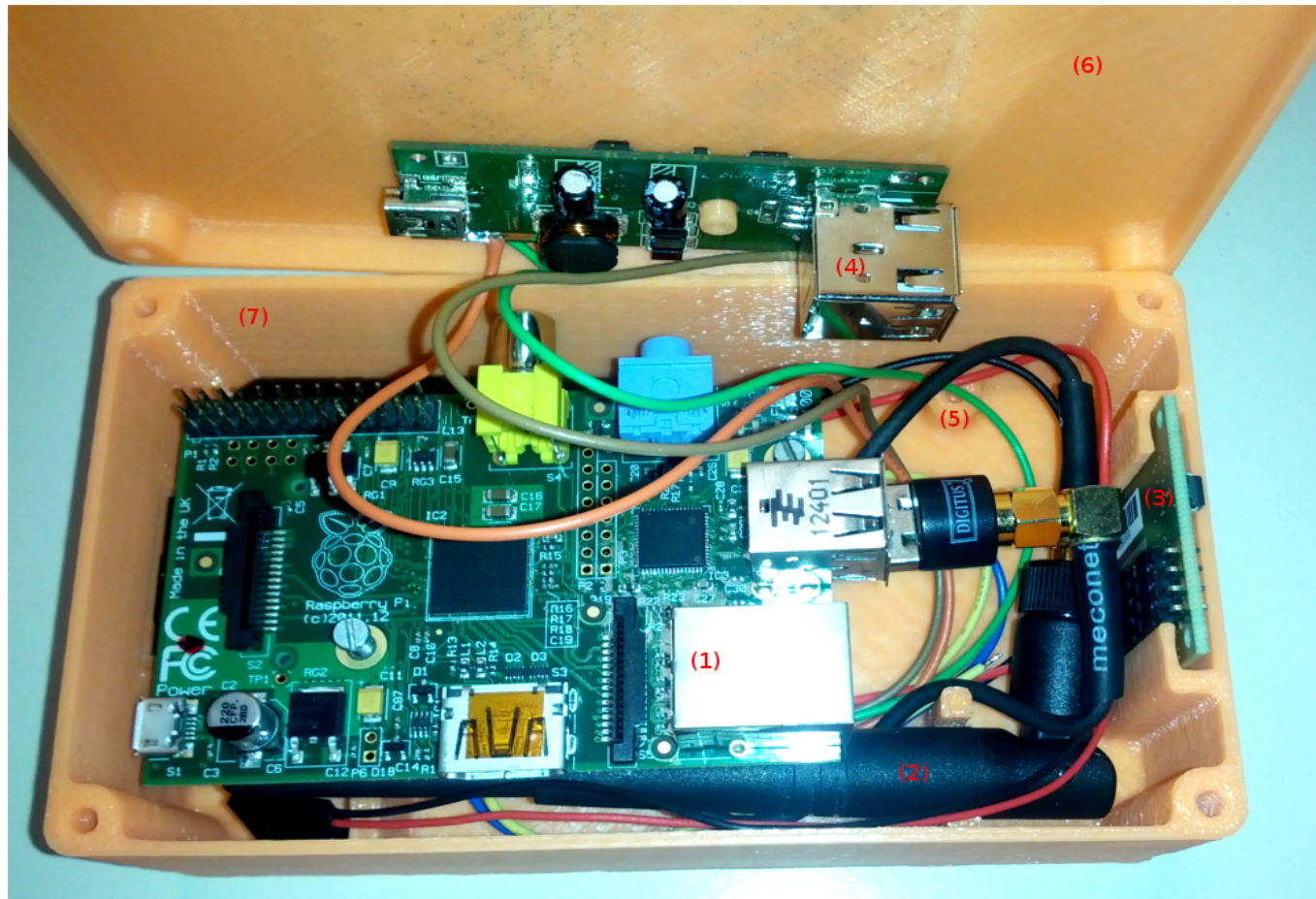


Can be dropped based on a-priori knowledge

Can be dropped, in case of low connectivity, or as markers

-  Trajectories
-  Blocked Path
-  Dropbox
-  Target
-  Robot Destination

Current DCIM Dropbox Prototype (WIP)



From Concepts to Prototypes

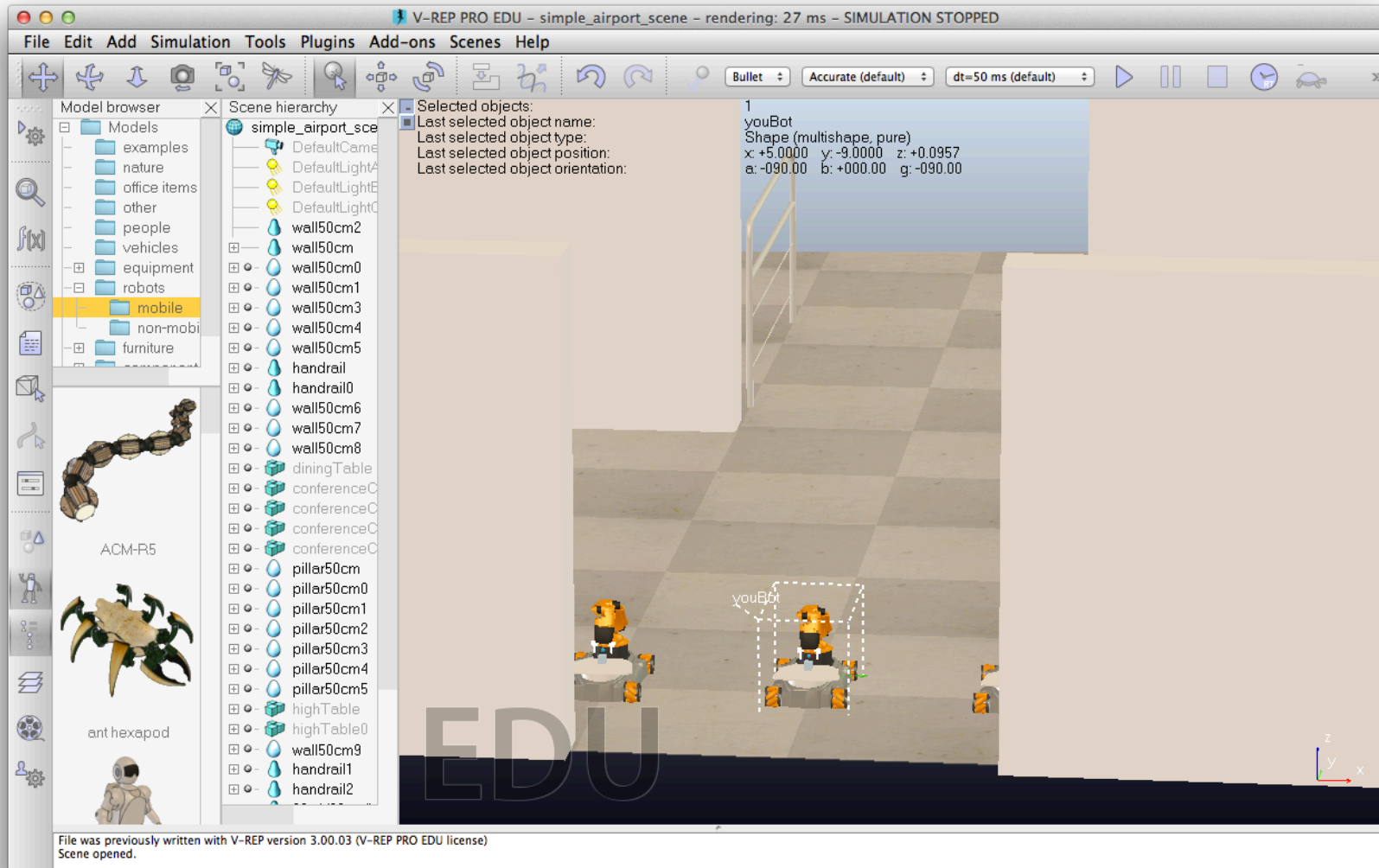
For rapid transition from concepts to working prototypes, RFF uses VREP +ROS for development



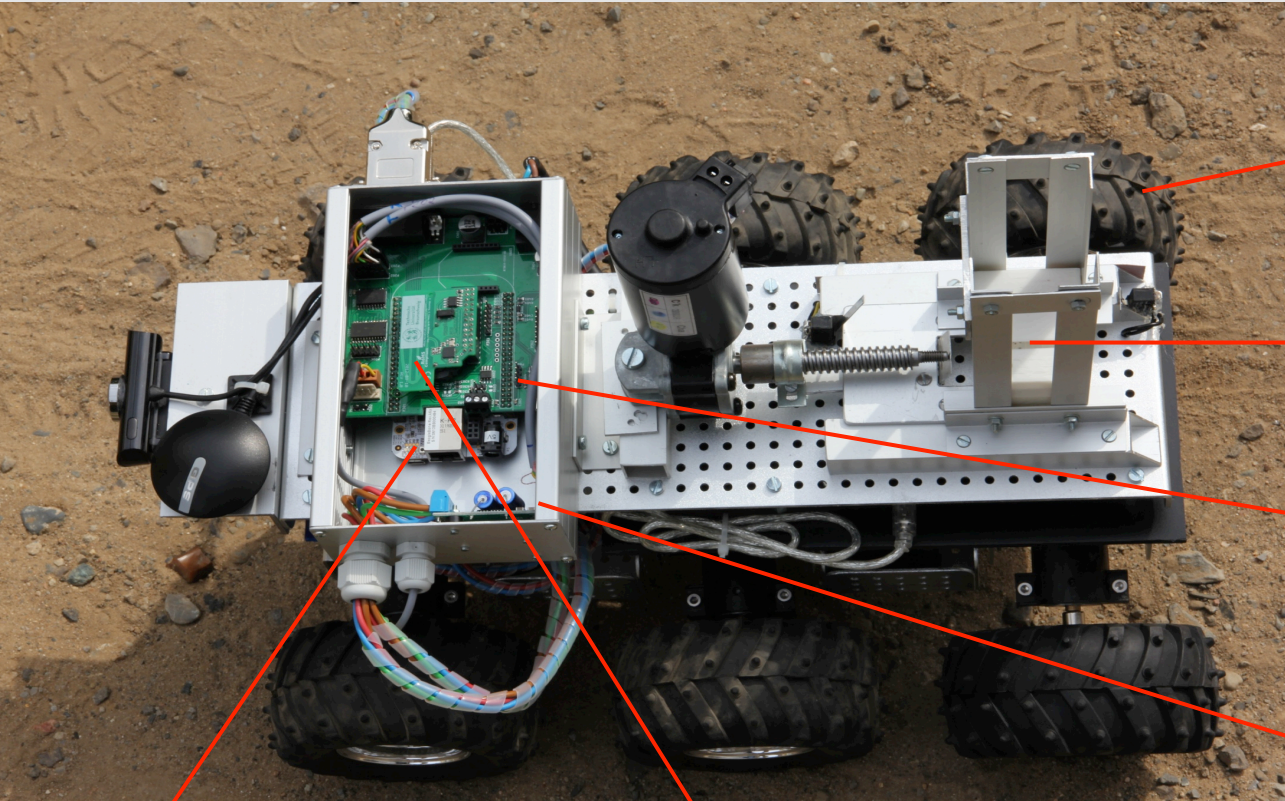
Physics Simulation
Robot Kinematics
Environment
Collisions, etc.

Components and Middleware for
Developing Robot Applications

VREP



Experimental Platform



6-wheeled Dagu "Wild Thumper" Platform

WSN Dropbox Dropping Mechanism

Custom Interface Board

Motor Drivers

Beaglebone SBC
as Controller

raspINGA
IEEE 802.15.4 radio

Experimental Platform

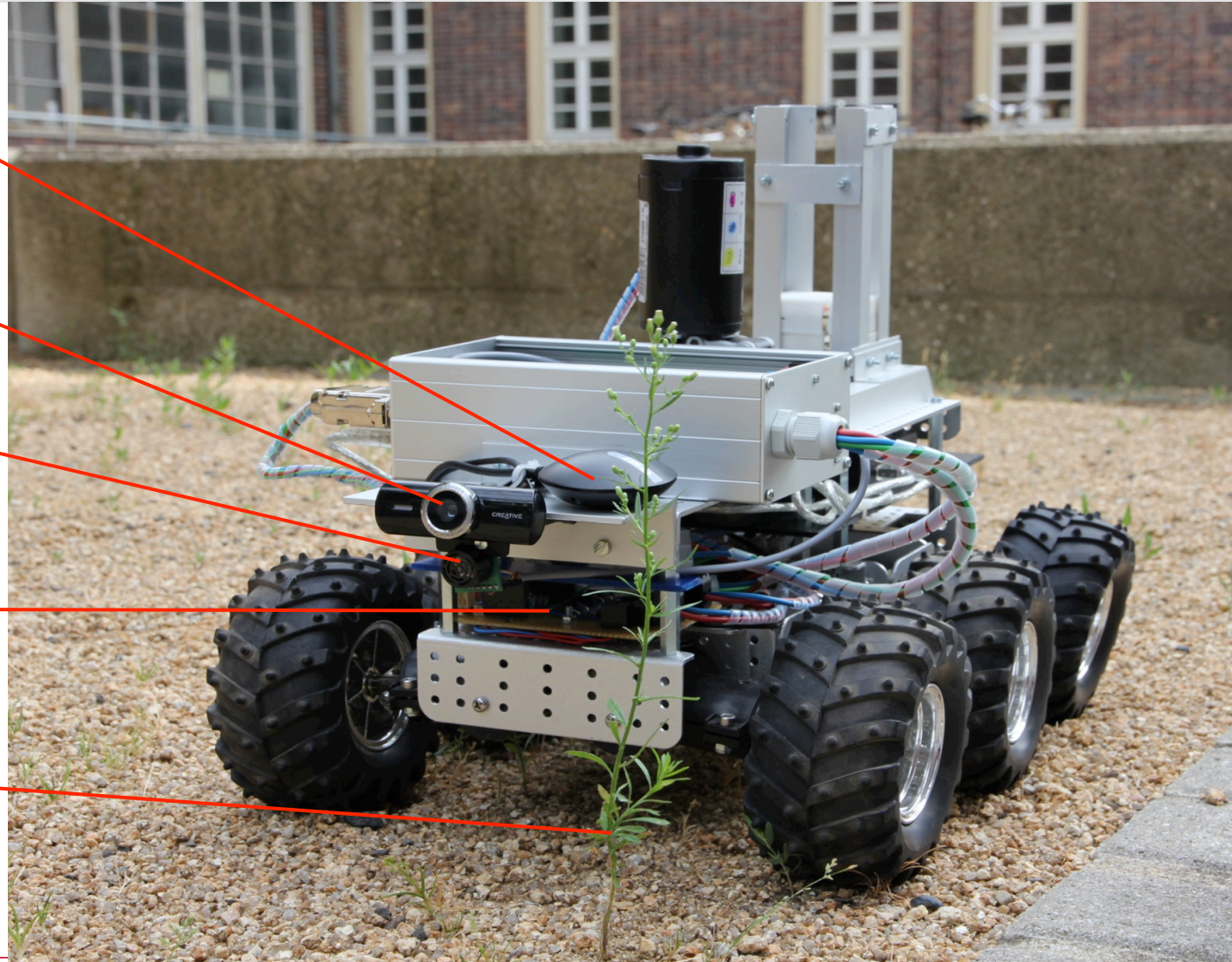
GPS Receiver

Camera

Ultrasonic Distance
Sensor

Dropping Mechanism
Electronics

German Oak
(for size Comparison)



Demo tomorrow?

Questions?