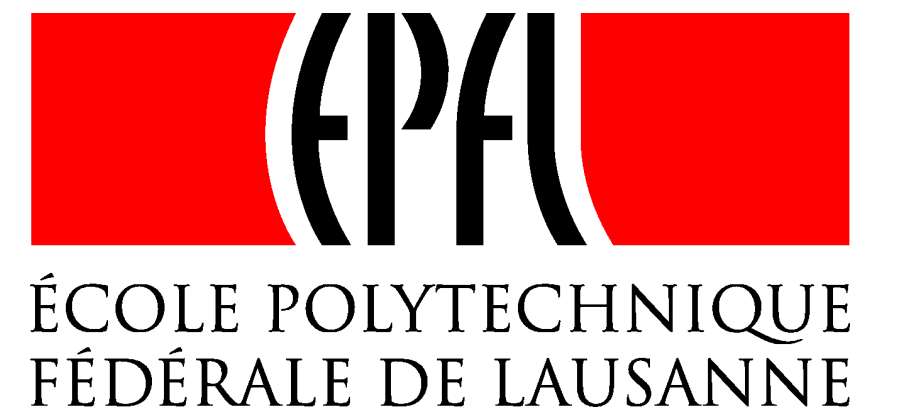




Embedding Intelligence into an Urban Air Monitoring Network

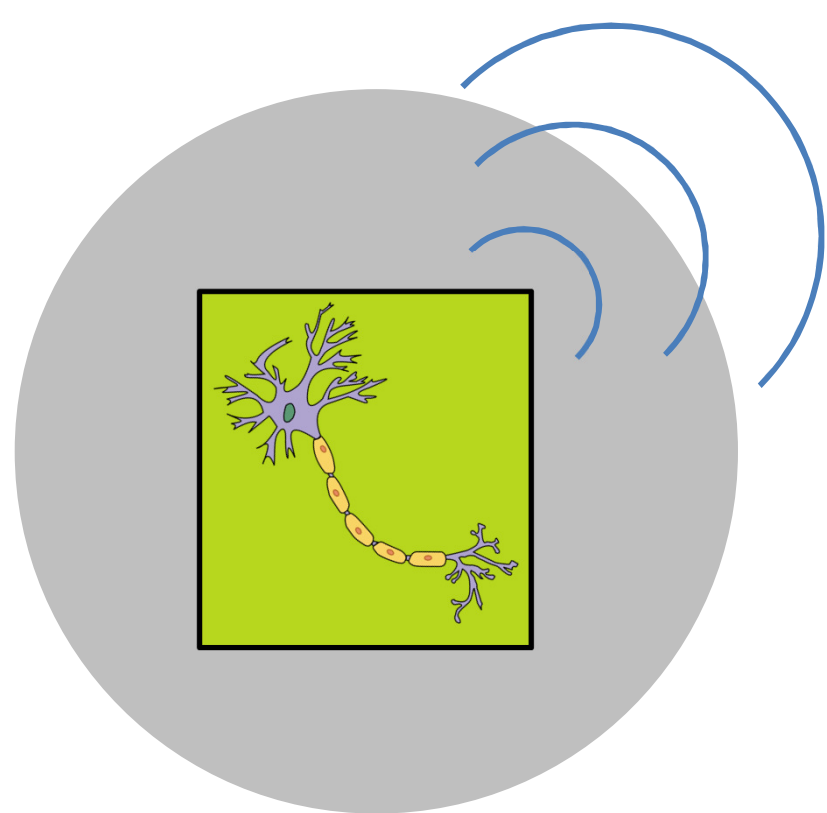
Adrian Arfire, Emmanuel Droz, Alcherio Martinoli

Distributed Intelligent Systems and Algorithms Laboratory
Institute of Environmental Engineering, School of Architecture, Civil and Environmental Engineering



Towards an Intelligent Sensor Node

The majority of current WSNs use **minimalistic nodes** coupled with a powerful **centralized** back-end server:



Benefits:

- very cheap
- low-energy consumption

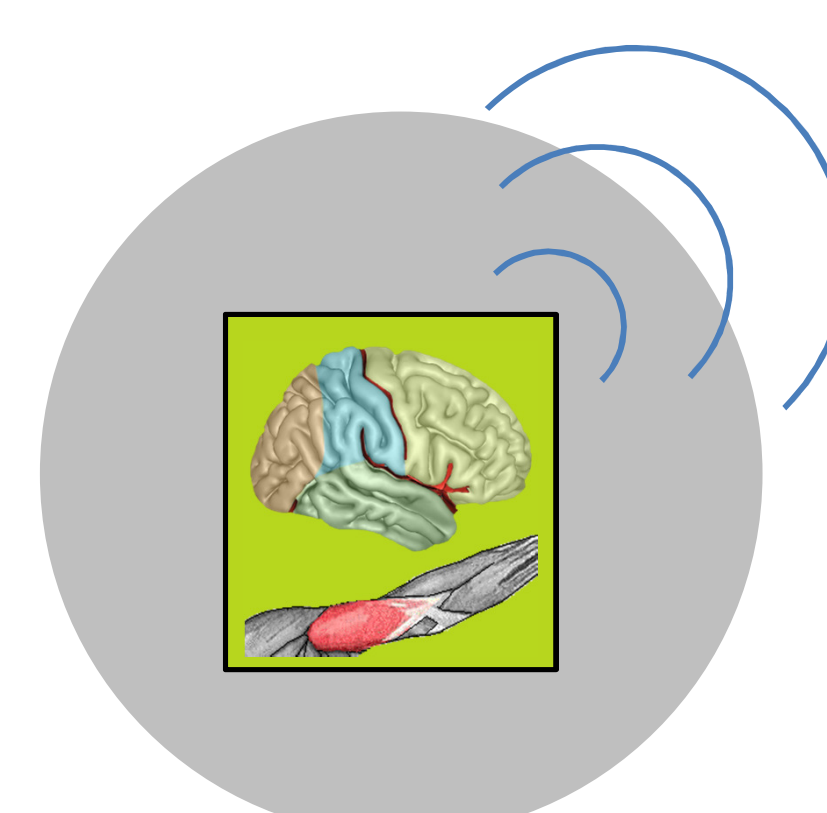
Drawbacks:

- slow network level perception-to-action loop (if it exists at all)
- no pre-filtering in terms of information content of data (creates large datasets with little information value)

Features:

- gather data from sensors
- transmit data to server
- limited on-board filtering (optional)

When energy saving is not a crucial issue a more **distributed** strategy can be implemented based on **intelligent nodes**:



Benefits:

- enables fast local perception-to-action loop for adaptive sampling
- does not flood server with useless data

Drawbacks:

- increased energy consumption
- more expensive

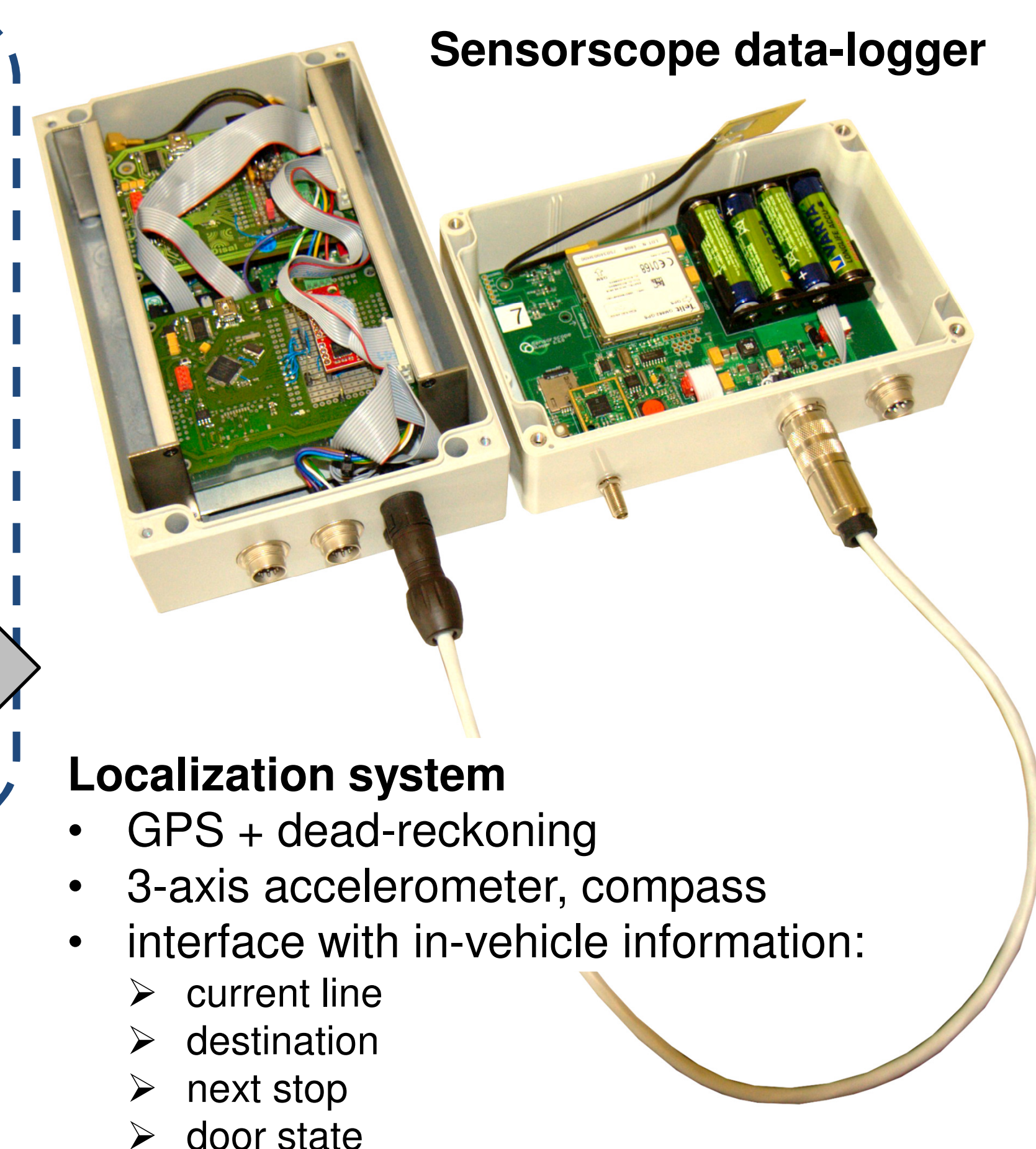
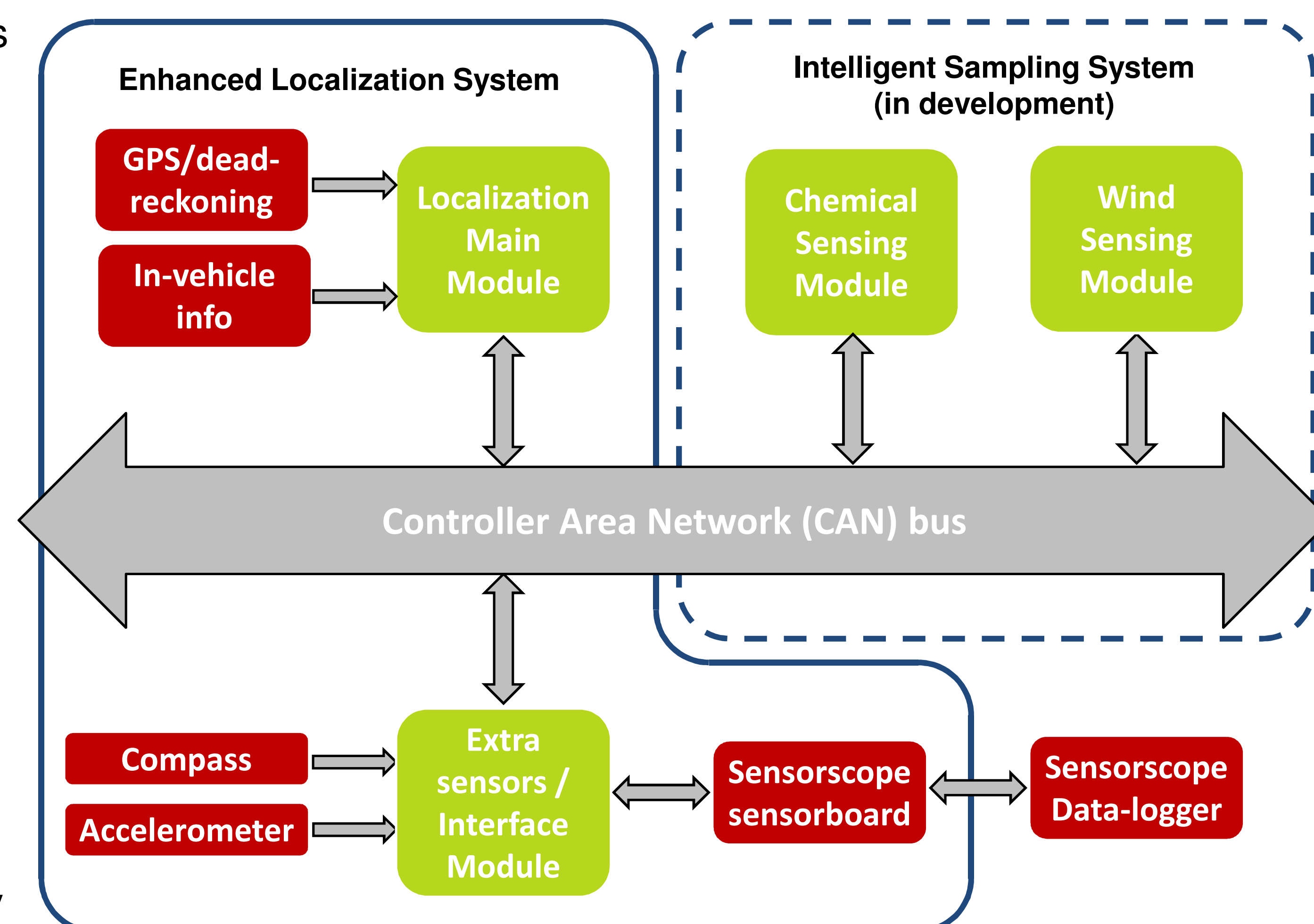
Features:

- gather & filter data from sensors
- schedule measurements locally
- react to environment & network variations (modify measurement plans)
- transmit information rich data to server

Modular Hardware Architecture

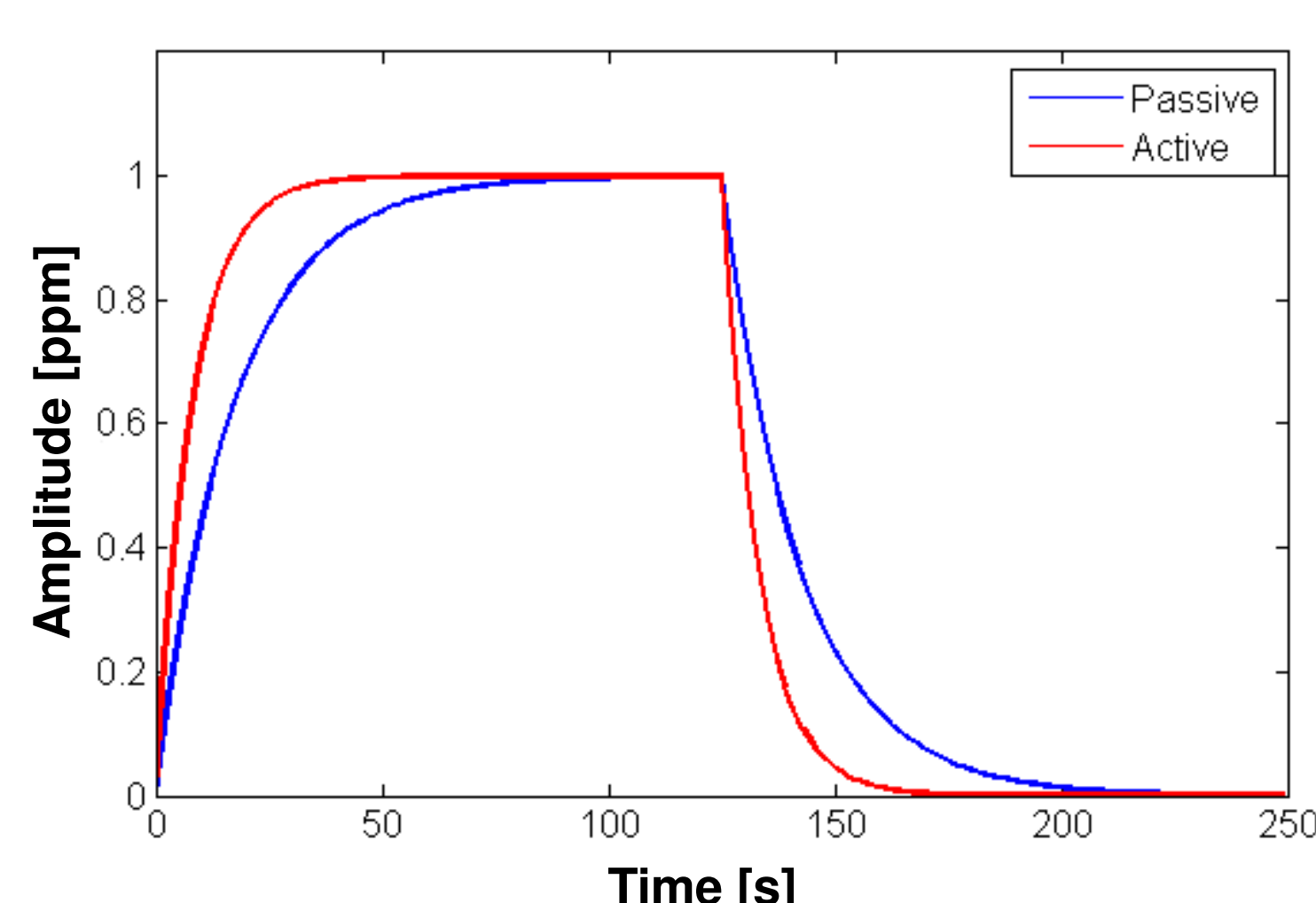
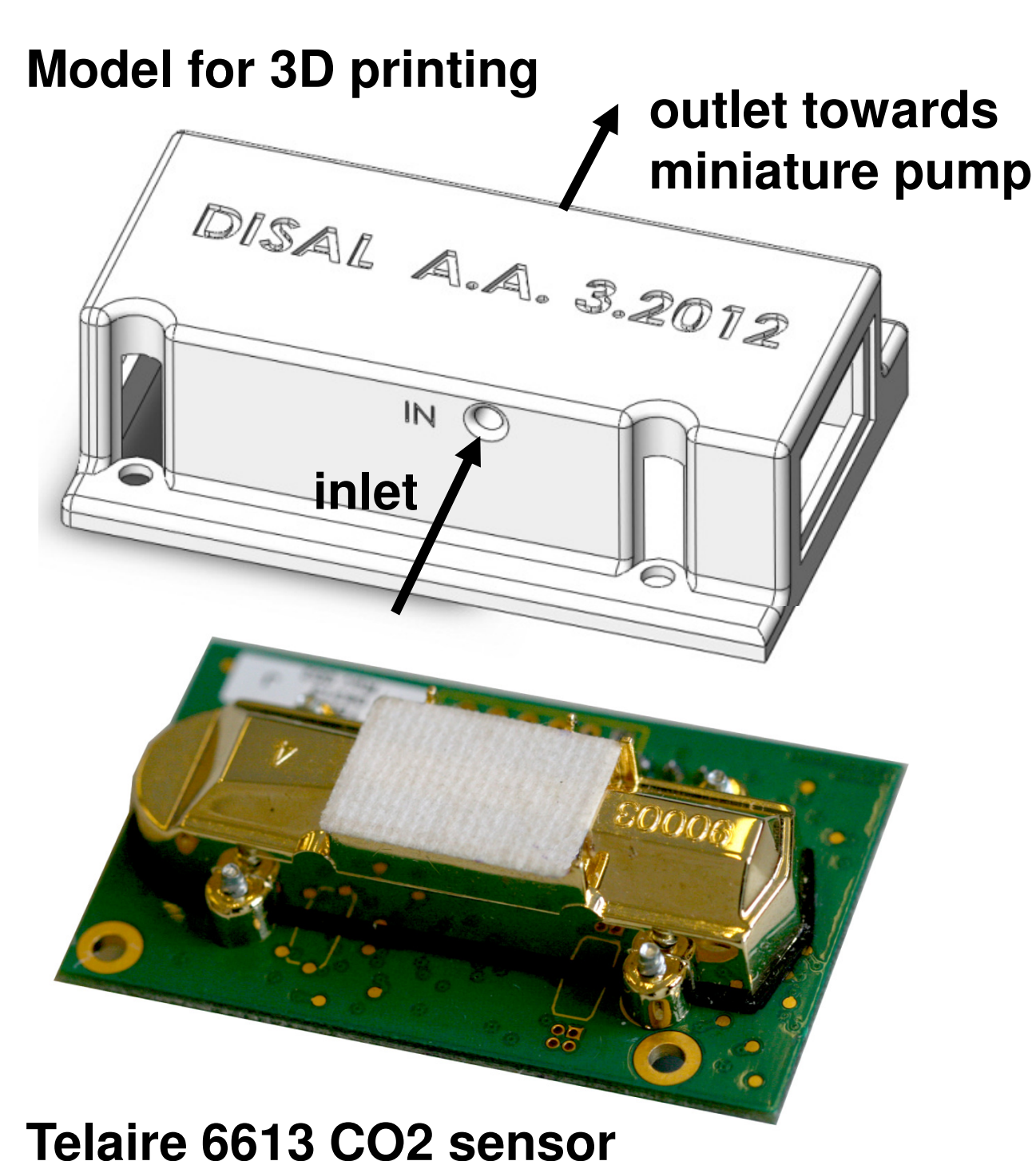
- built around the CAN automotive bus standard
- embedded dsPIC microcontroller for each module
 - increased computational power
 - possibility to control actuators (pump motors, valves etc.)
- back-up on-board data storage
- connectivity:
 - Sensorscope compatible SPI
 - general UART port
- GPRS communication using Sensorscope data-logger

Currently the node has the functionality of an **advanced localization system**.



Active Sampling System

To improve on the slow dynamics of the chemical sensors we are replacing the passive sampling strategy in current deployments with active sniffing.

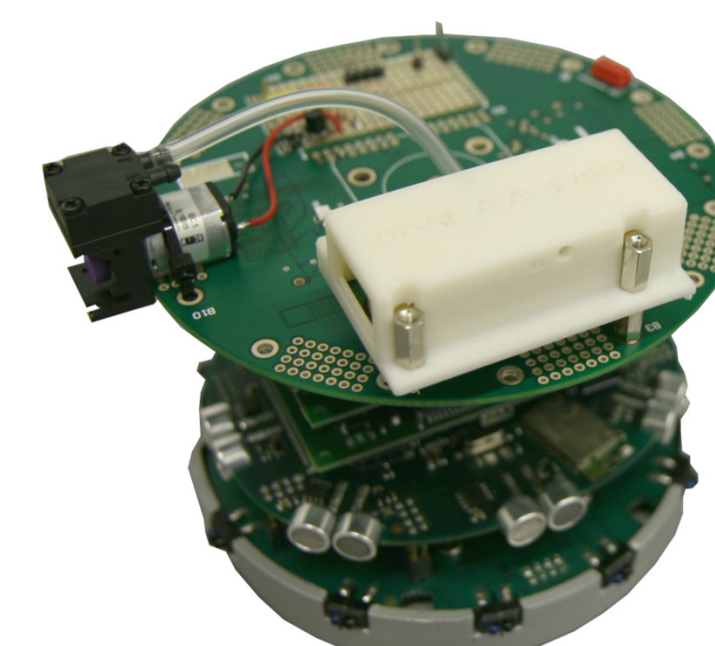


Preliminary evaluations show a response time reduction by more than 50%.

Evaluation Platforms

Apart from the target public transport vehicles, other mobile platforms are used for development and evaluation:

- **miniature mobile robots** enable rapid experiments under controlled conditions (including wind tunnel)
- the quickly deployable **OpenSense electric vehicle** allows in-depth tests on the road



Khepera III robot fitted with active sniffer



Electric vehicle sponsored by PSA Switzerland