Wireless sensors as an efficient way to improve sustainability in water management by a significant reduction of water wasting

Daniele Trinchero

POLITECNICO DI TORINO

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Authors and Institutions

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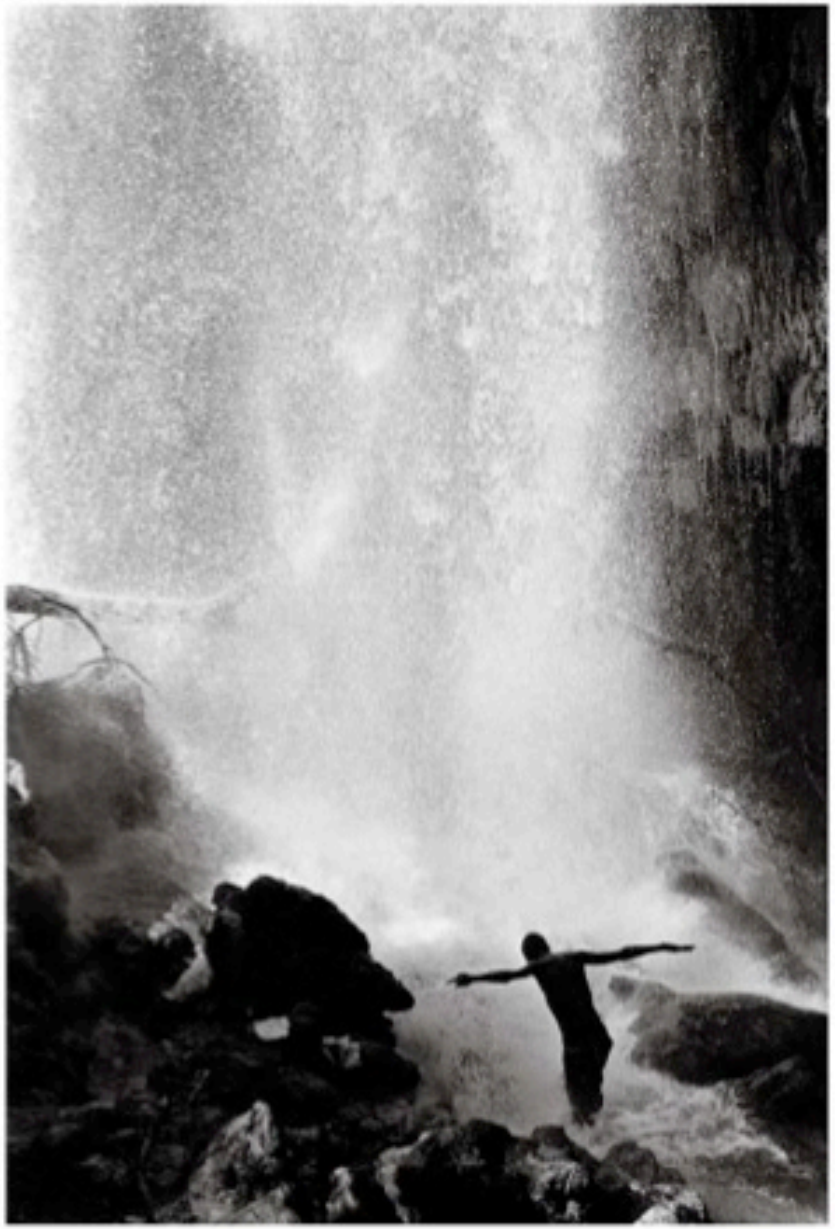
Water: a basic need for everybody



Synthesis of the problem

- ✓ Constant increase of water demand
- ✓ Exponential decrease of natural resources

Is the water distribution system able to address these changes?

Up to 70% of water is lost along the distribution path

Expedite and refine leakage identification procedures

Leakages in Water Distribution Networks

How to know about presence of breaks?

If known, how to find breaks along the path?

The path is kn

If not, how to

Traditional monitoring techniques

Action	Gas	Geo-phone	Vibro-meter	Hydro-phone	GPR
Path identification	No	No	No	No	Yes
Leakage identification	Med	Med/ Large	Med	Small	Med
Survey	No	No	Yes	Yes	No
Direct connection	No	No	Yes	Yes	No
Distance	∞	1 km	200 m	100 m	∞
Excavations	No	No	Yes	No	No
Empty pipe	Yes	No	No	No	No
Cost	High	Med	Med	Small	Med

iXem Labs - who we are?

iXem Mission

the study of **wireless communication systems**
the research of more advanced wireless communication techniques
the promotion of wireless technology for realisation of telecommunication networks all over the world
the overcome of the digital gap between different Countries and within each Country
the development and distribution of software to ease the design and setup of wireless networks
the development of tools to study personal exposure to high power radiofrequency emissions

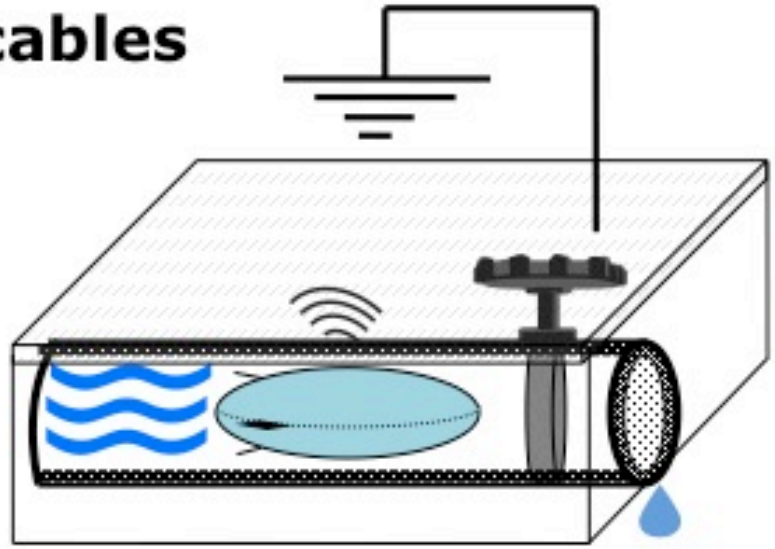
May ICTs do anything for the problem?

Non Anchored Mobile Hydrophones

- ✓ A mobile hydrophone without cables

  can we make it?

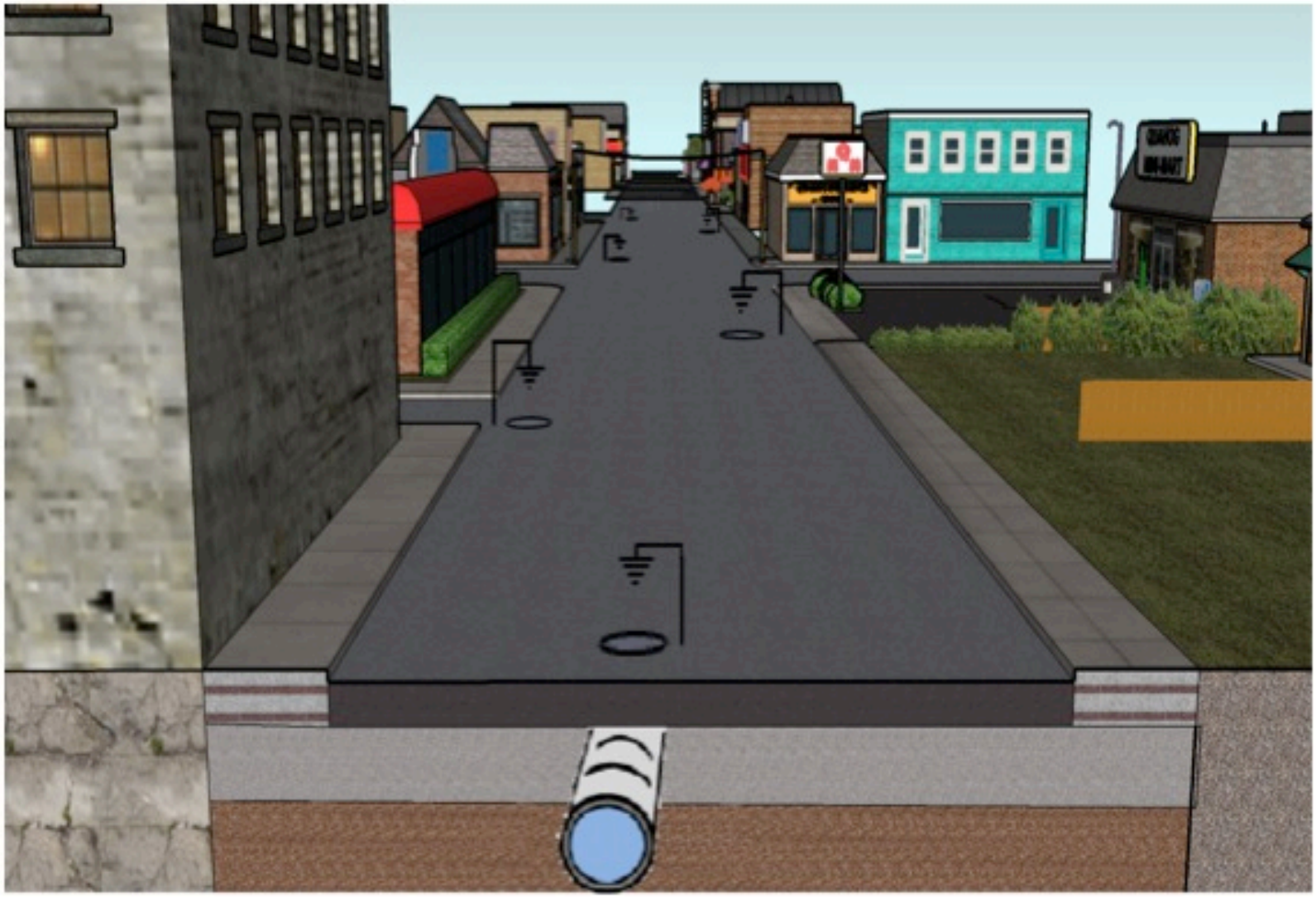
- ✓ Let's go WIRELESS



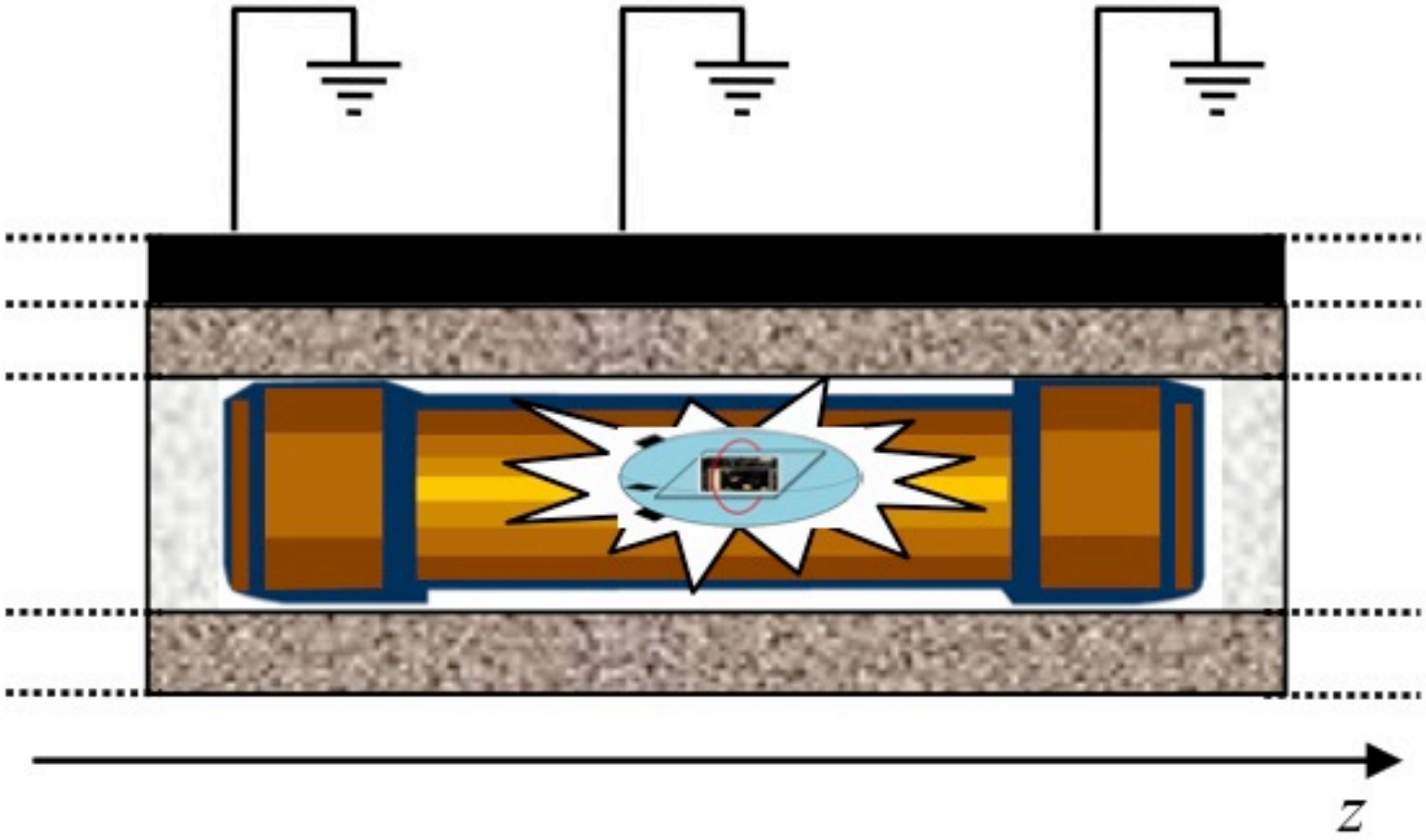
- ✓ Collect survey data in the pipe
- ✓ Avoid any anchorage
- ✓ Radio-transmit selected data and info to the surface

Costs and time reduction

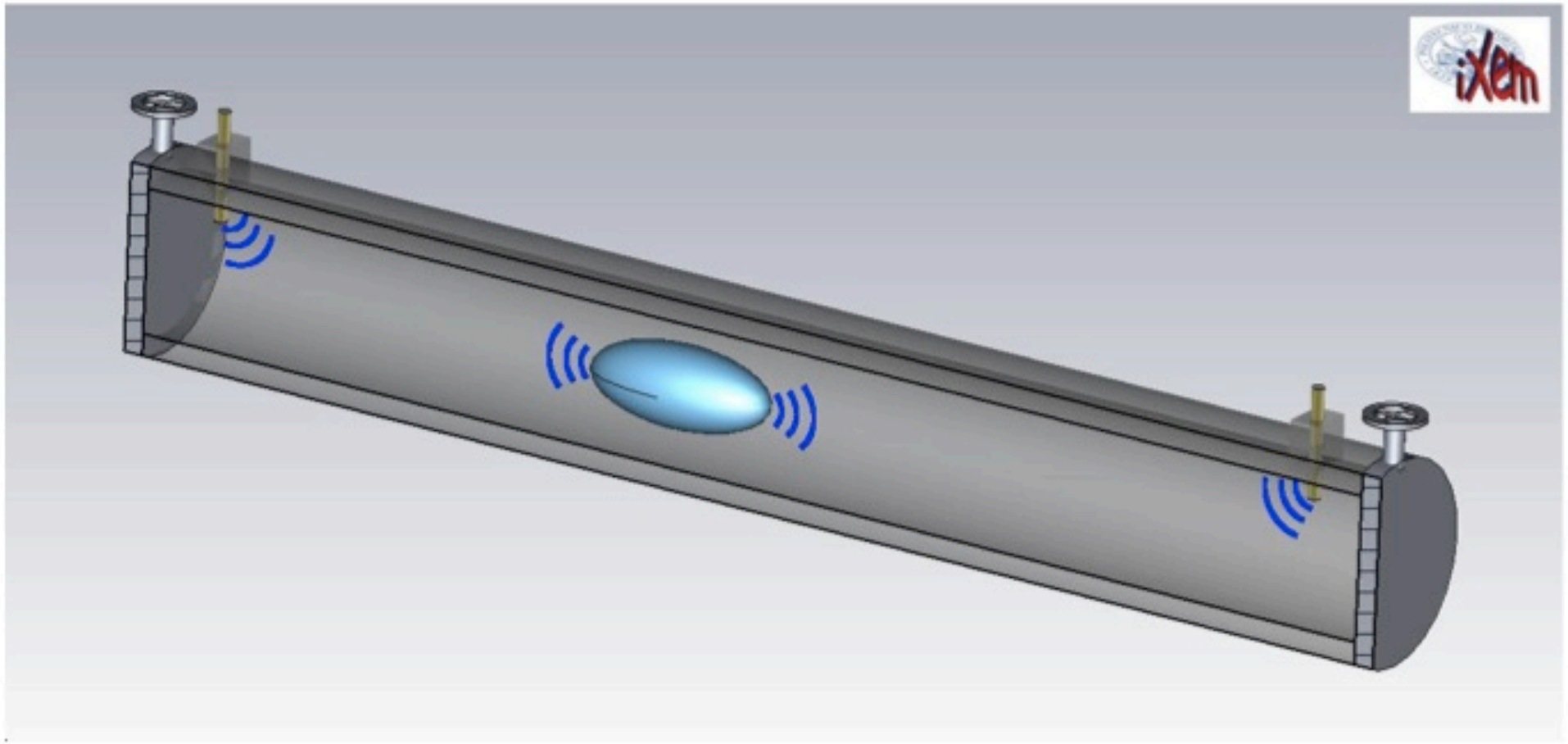
Our underground mobile wireless application



Our underground mobile wireless application



Alternatively ...



WaterMOLE: our solution

SENSOR

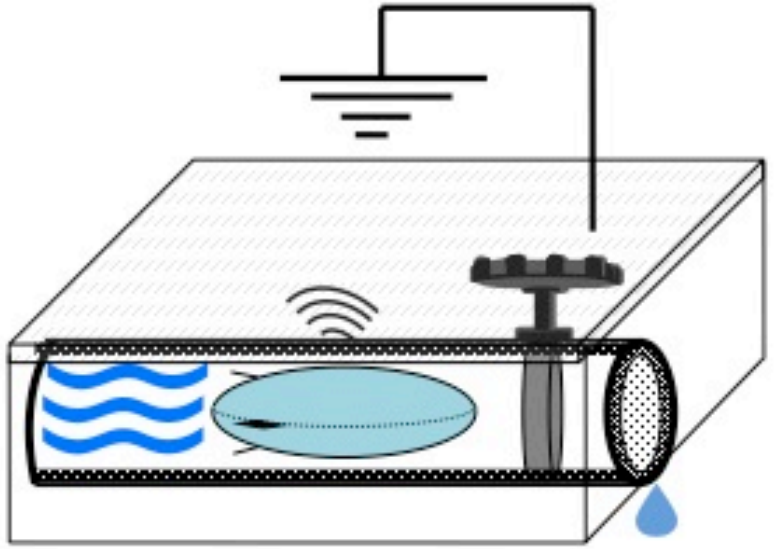
omni-directional hydrophone

sampler

memory

wireless radio

antenna



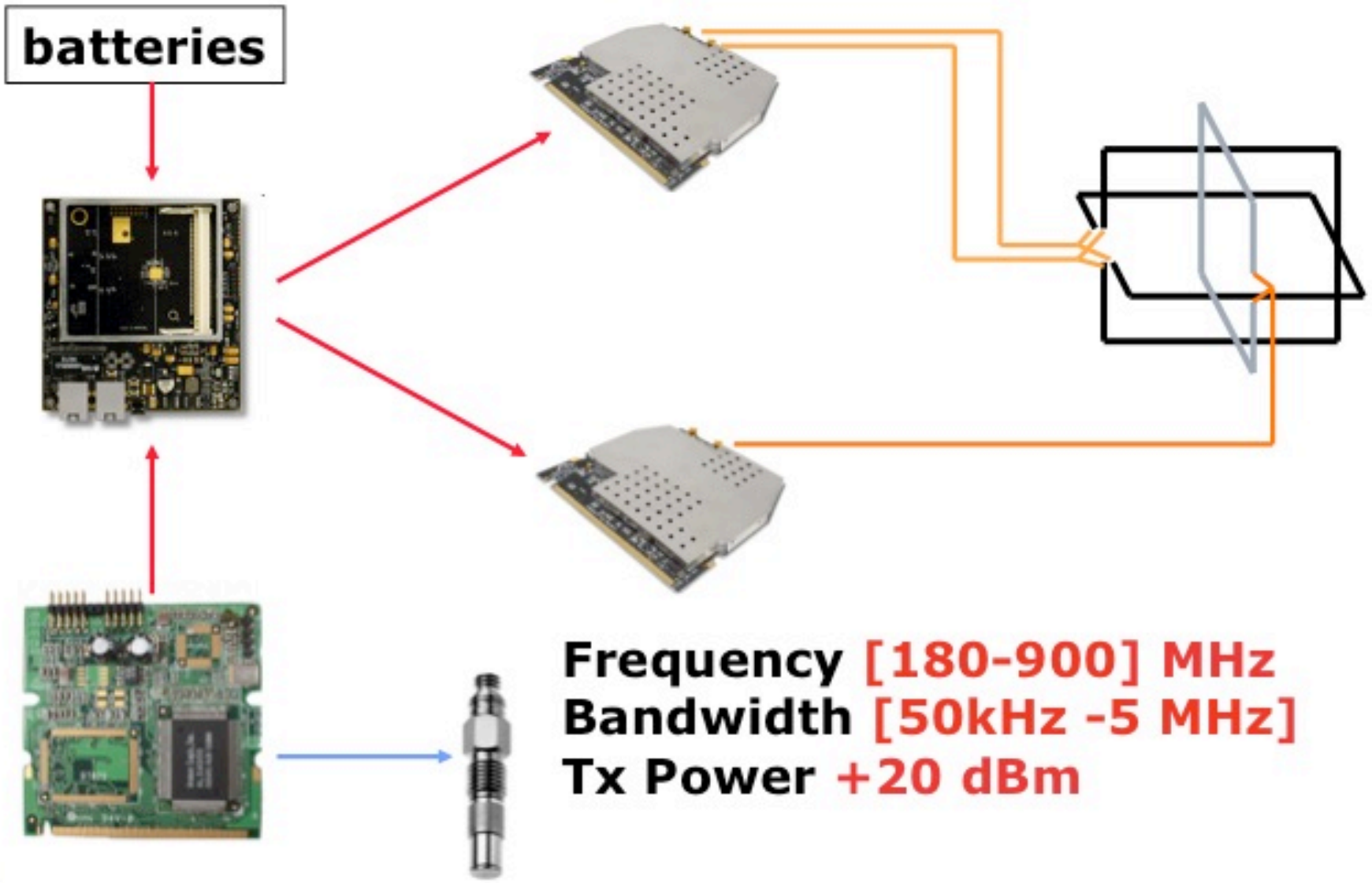
on-site analysis

ground receiver

TX

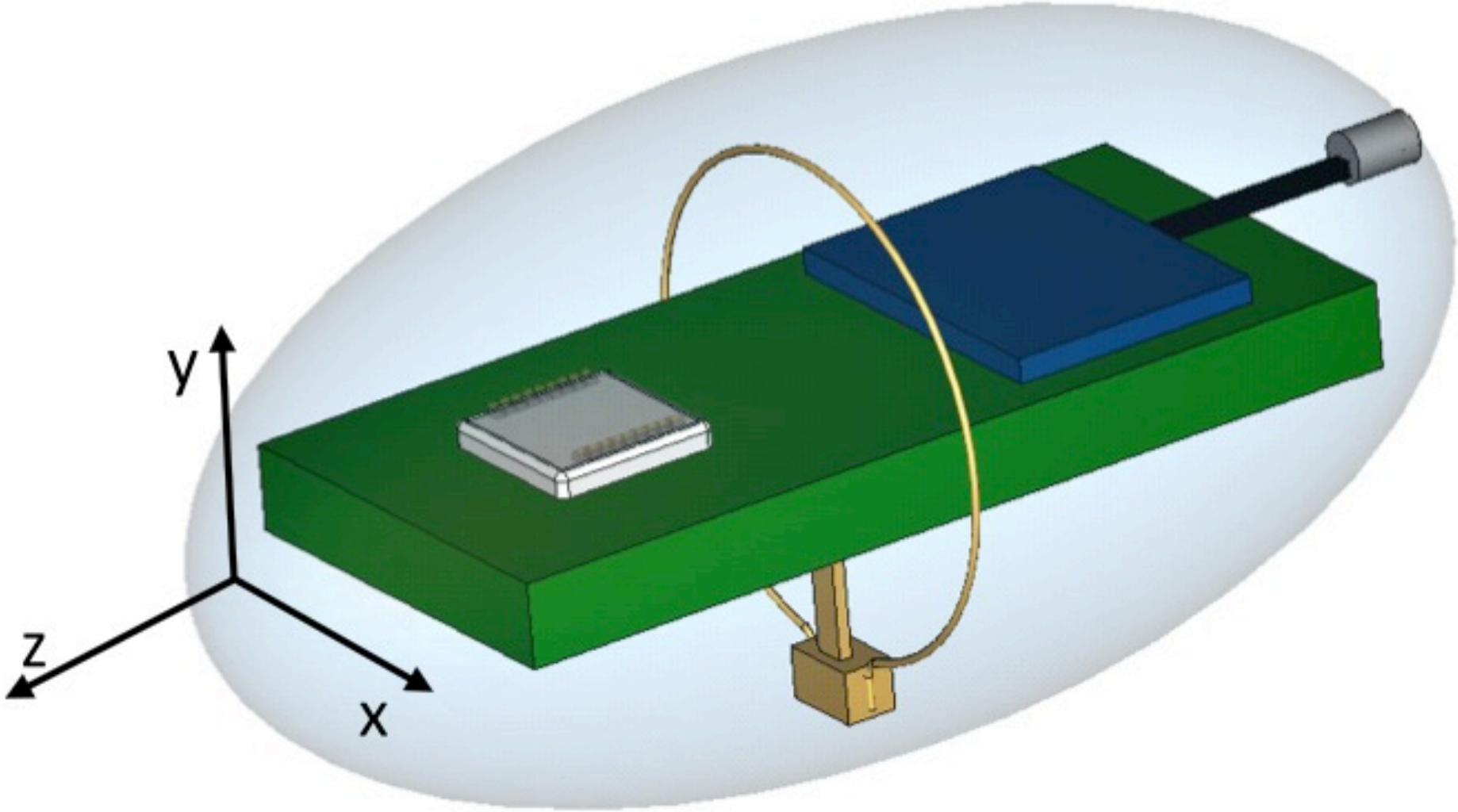
remote analysis

System configuration

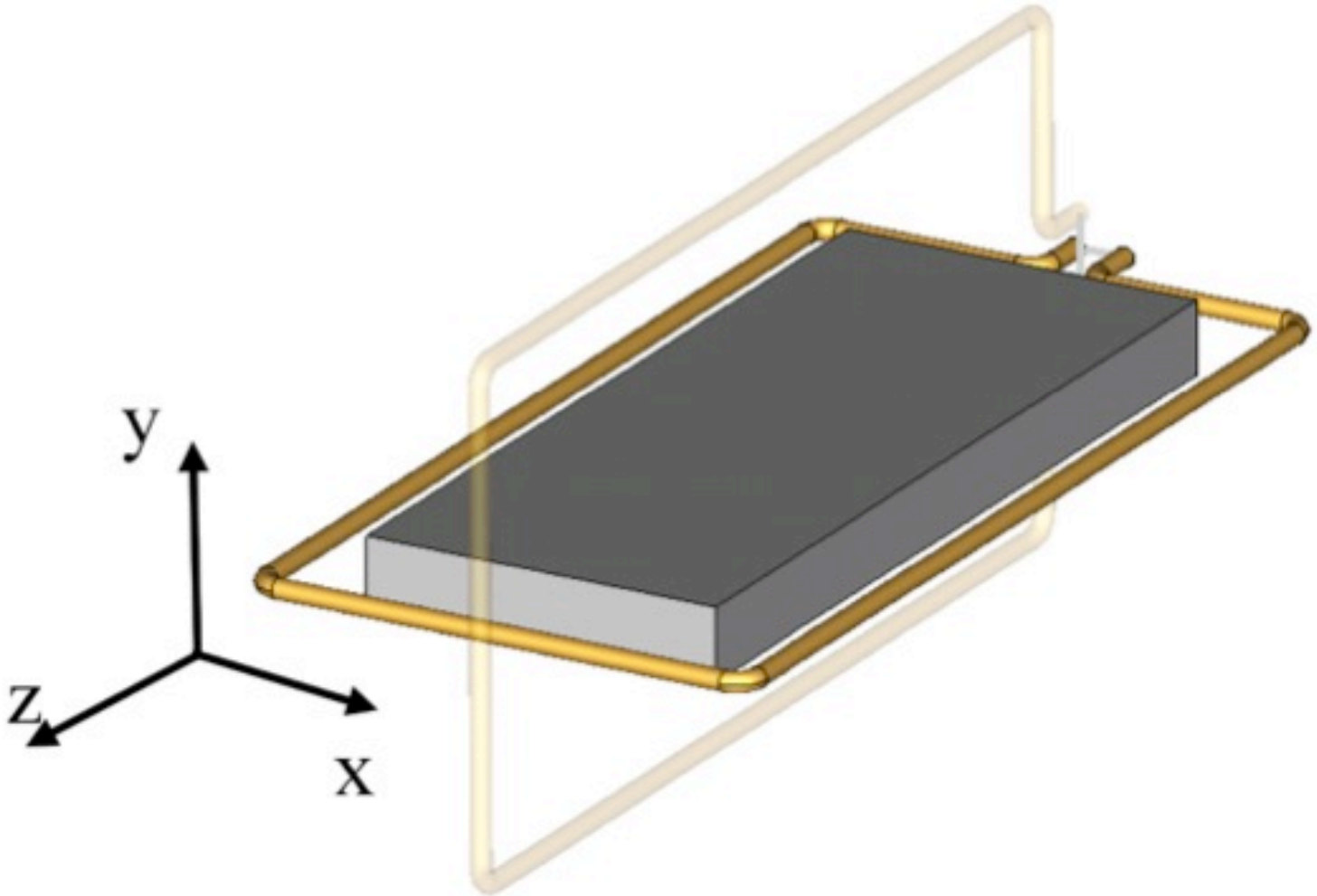


Frequency [180-900] MHz
Bandwidth [50kHz -5 MHz]
Tx Power +20 dBm

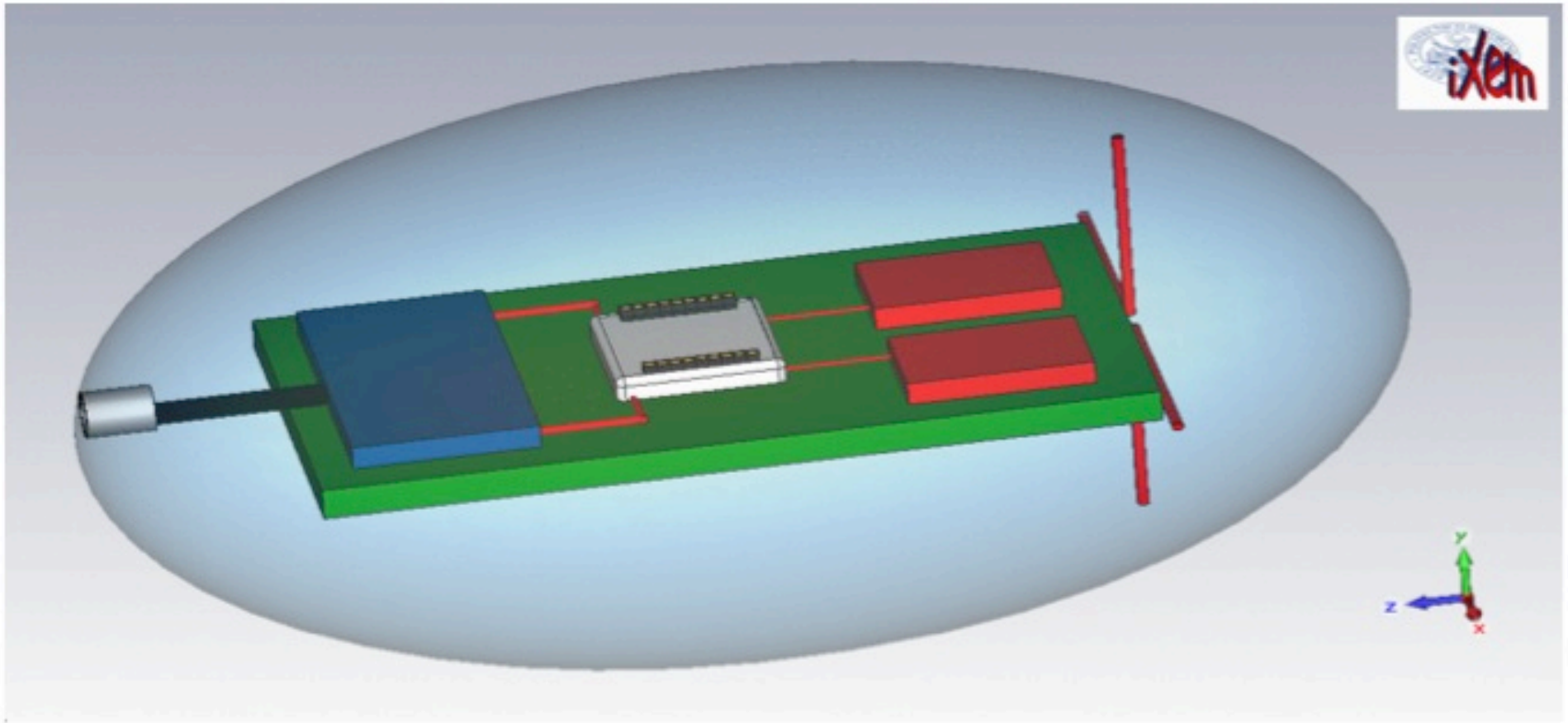
Sensor model



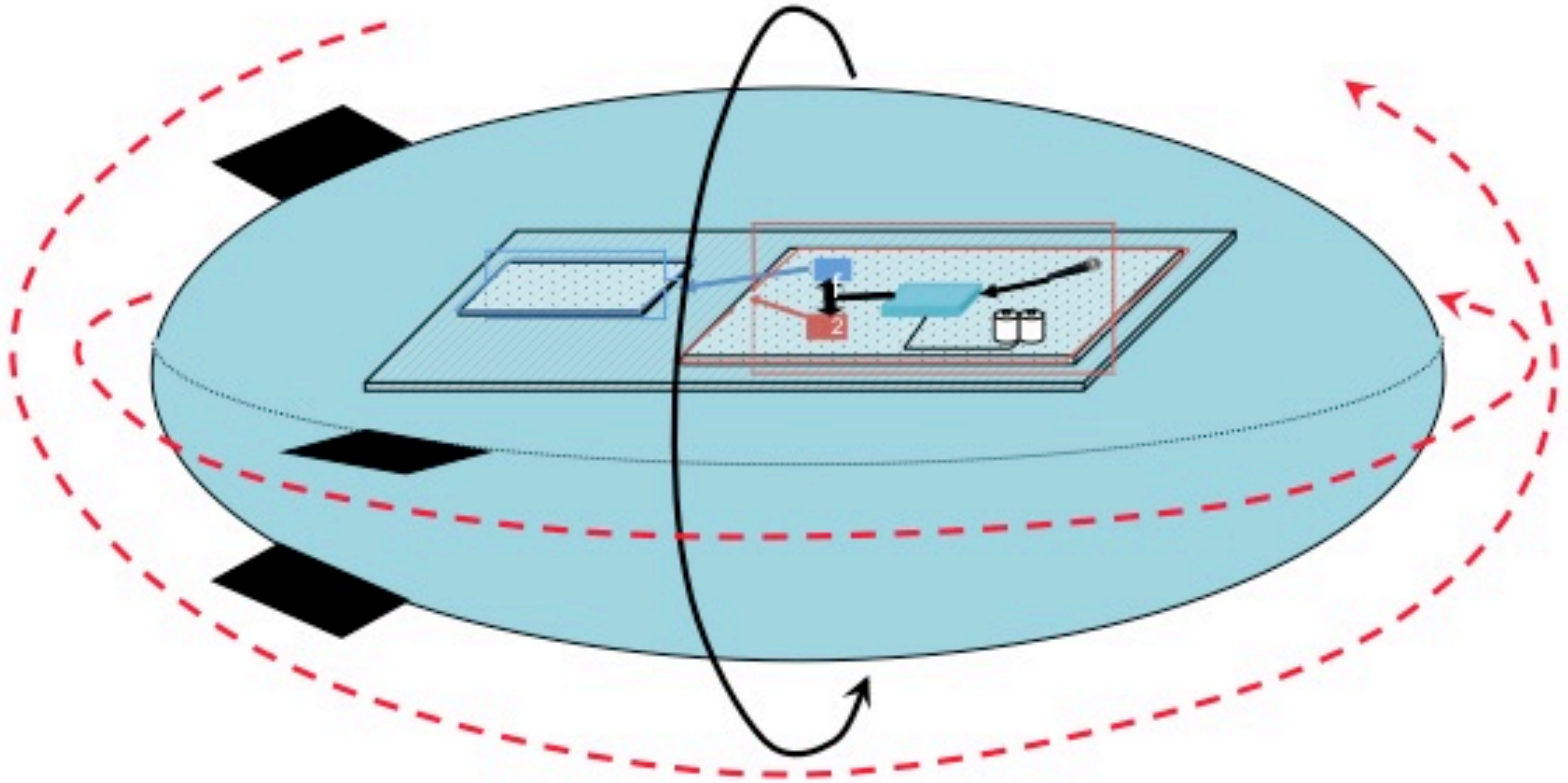
Sensor model



Sensor model



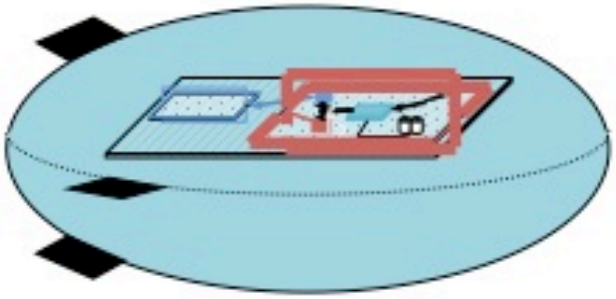
Sensor shape

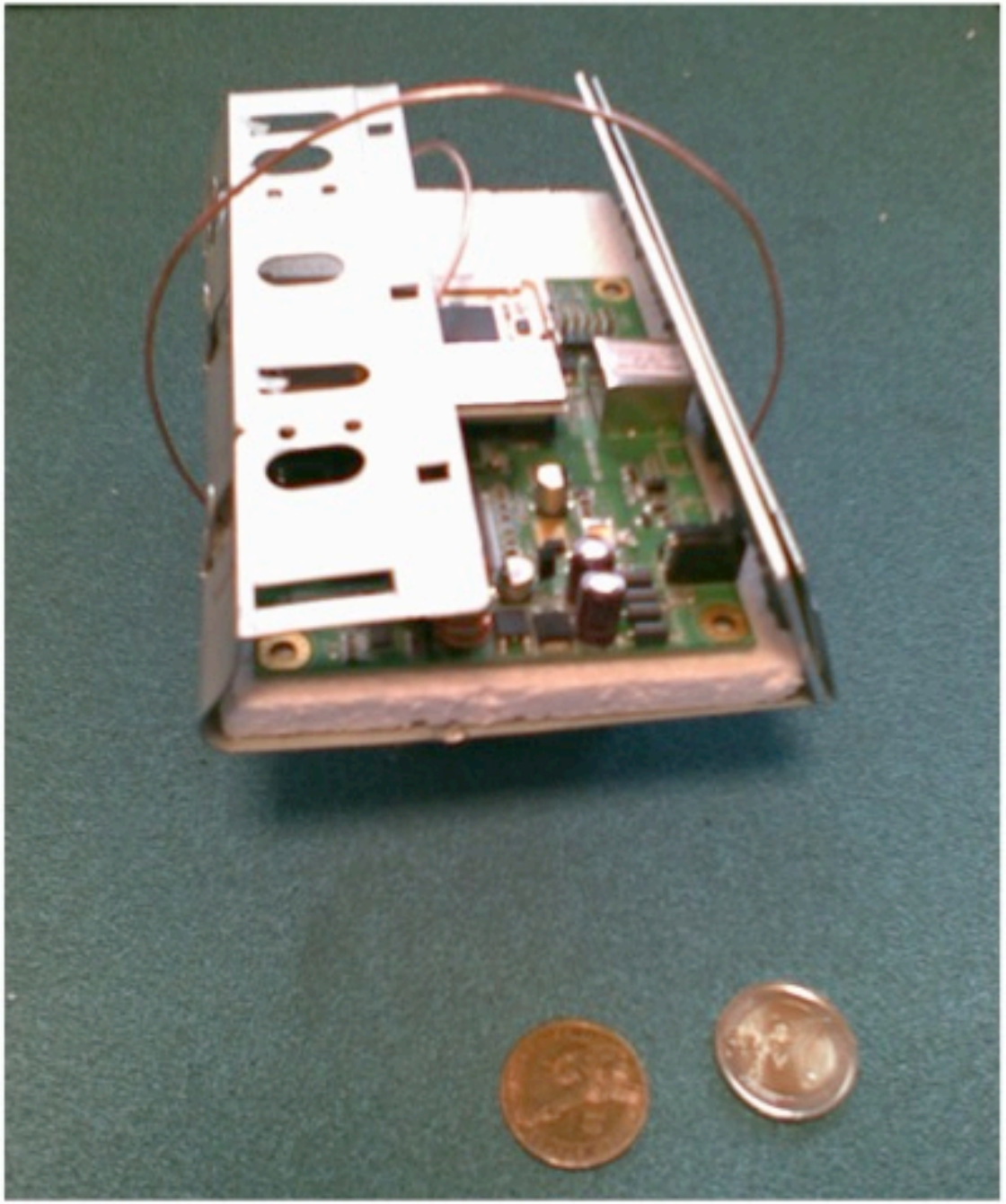


rotations are possible ONLY in the transversal plane

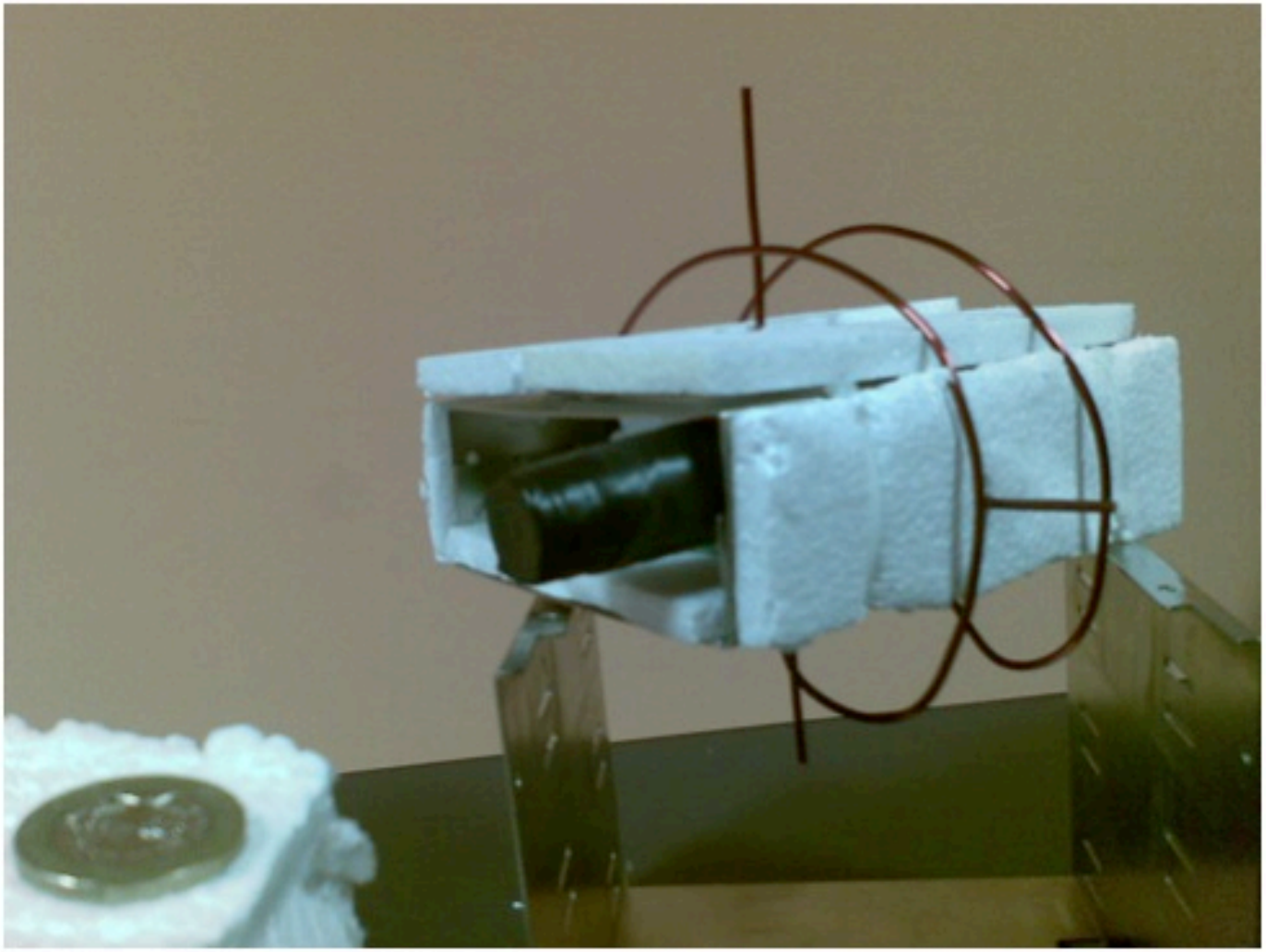
RADOME → **waterproof**
filled with spray foam
two shells glued with silicon

Sensor assembling

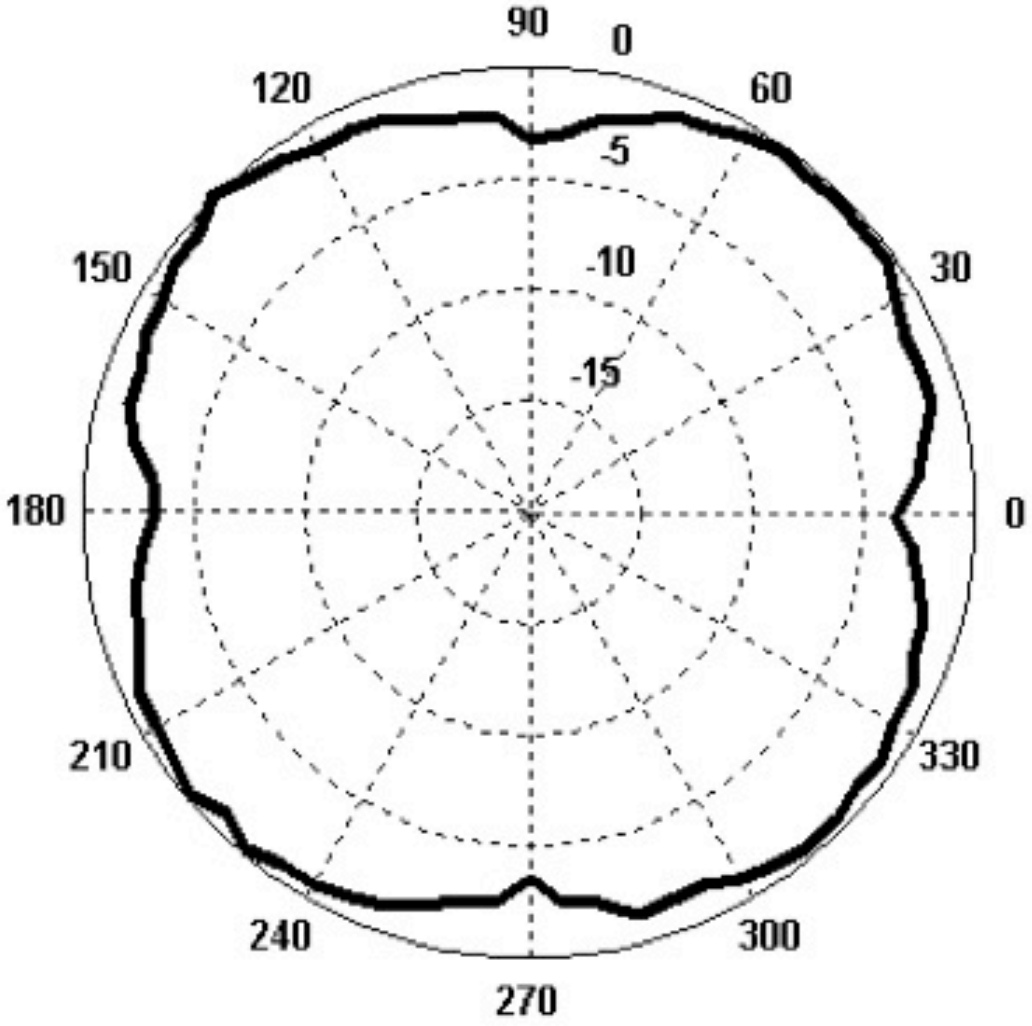




Sensor assembling

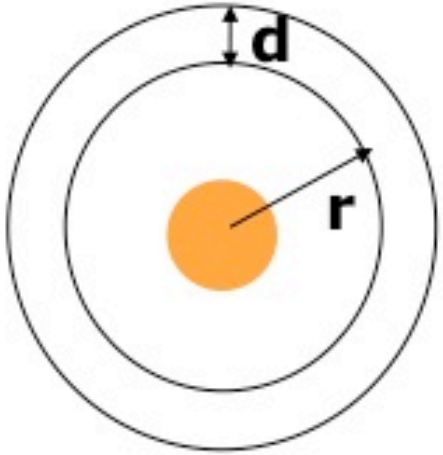


Antenna pattern



Transmission measurements

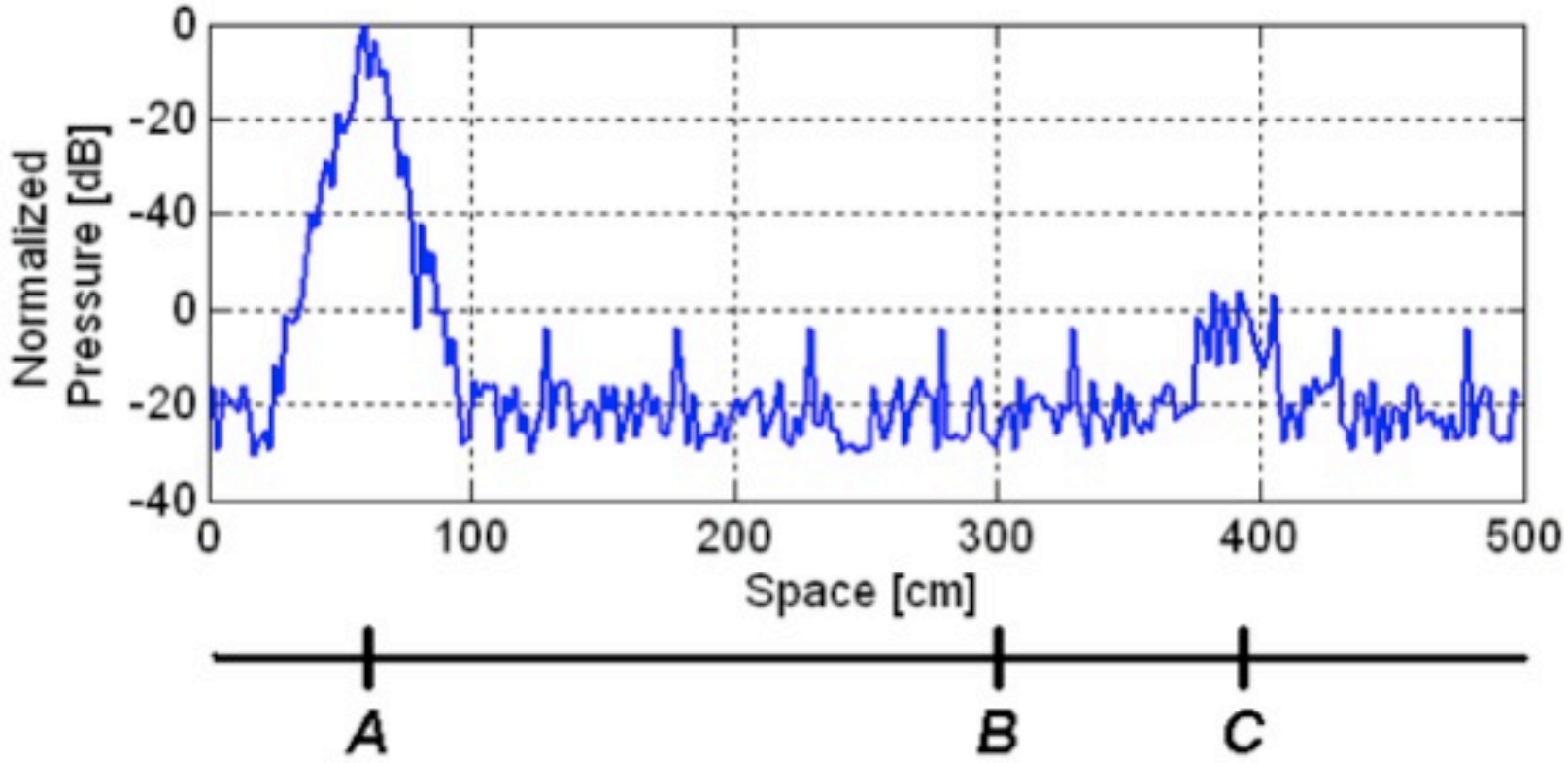
polypropylene pipe



d = 1,5 cm
10 cm < r < 20 cm

non-buried pipes,
buried pipes at different depths (5 cm up to 250 cm)

Our underground mobile wireless application



Wireless Mobile Sensors in Underground Pipes

Basic communication parameters:

- carrier frequency
- on-board power requirements
- sensor dimensions compared to pipe dimensions

Radiofrequency design:

- antenna form
- EMC constraints
- radome design

Advanced communication parameters:

- modulation bandwidth
- protocol advances
- error corrections

Did I introduce a new technology?

iXem Labs

LACE
Laboratorio Antenne e Compatibilità Elettromagnetica

http://www.iXem.polito.it/

iXem Mission

Where you can't imagine to place an antenna, we (try to) DO