

# Humidity Monitoring: Overcoming Challenges and Uncovering New Applications with Distributed Fibre Sensing



**FIBERSIGHT**

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# 1.The company

# The company



## FIBERSIGHT

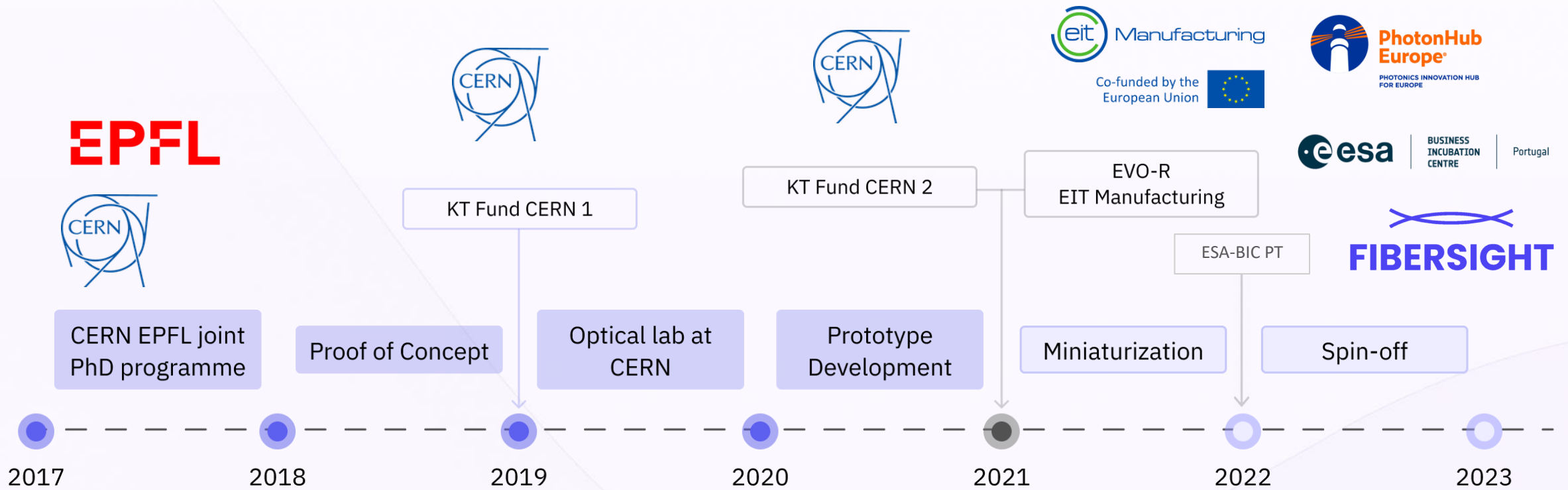
CERN Start-up founded in 2021

Coimbra, Portugal



# Timeline

**Project born in 2017 out of a CERN/EPFL joint Ph.D. programme**  
Novel RH monitoring solution was needed





# The problem at CERN

## Temperature and Humidity (TH)

### TH strictly monitored and controlled over large areas

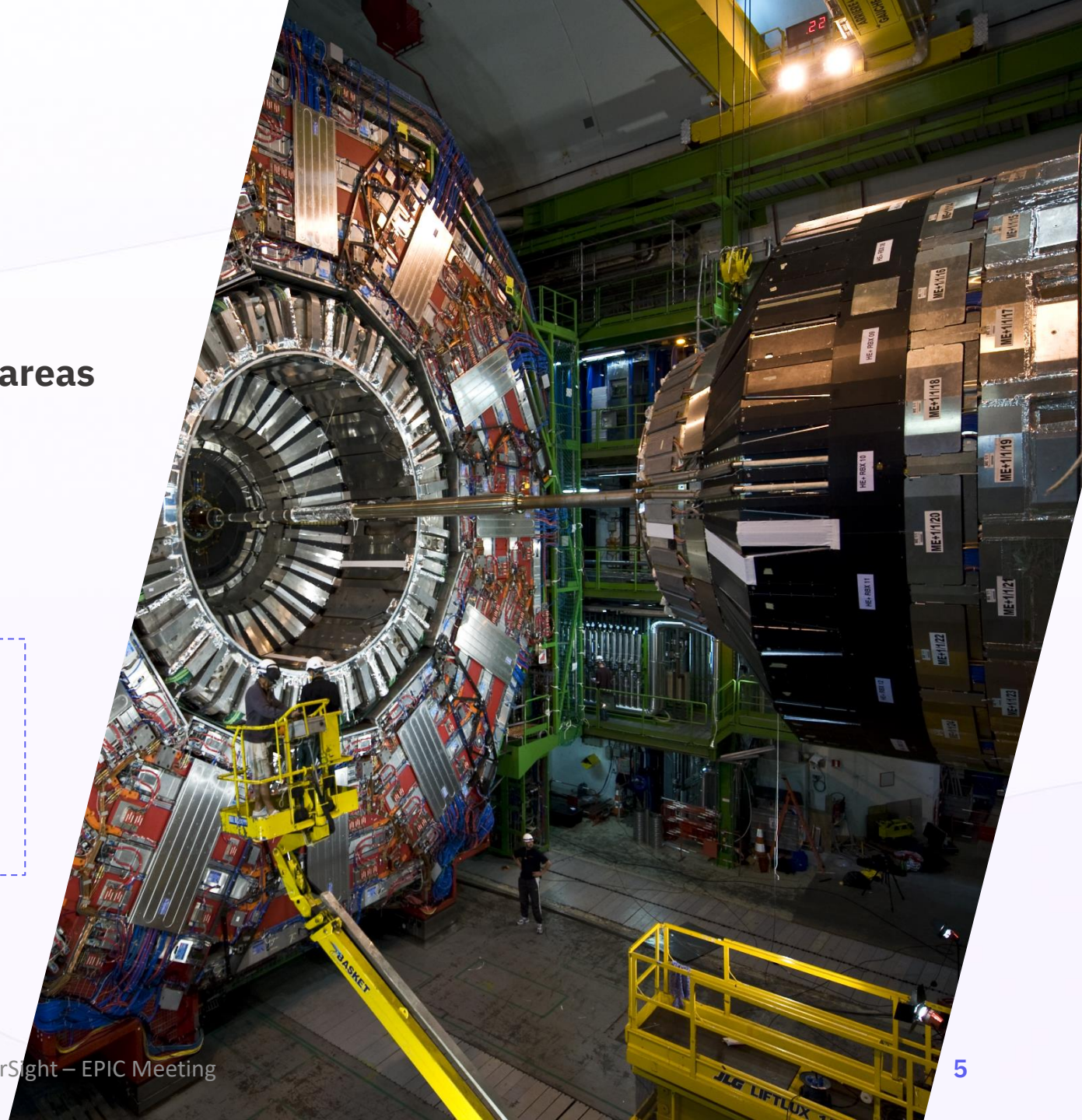
Large detectors, caverns, accelerator tunnels

Current technologies face size restrictions

**CERN needs a distributed sensing solution**

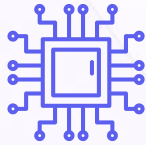
**High multiplexing capability**

**Radiation endurance**



# The problem globally

**Humidity** and **temperature** are key technical parameters  
**strictly monitored** and **controlled** over **large areas**



Electronics



Civil Engineering



Aerospace



Public Water Distribution



Pharmacological



Agriculture



Food Processing

## 2.The product

# The technology

First highly sensitive thermo-hygrometer distributed sensor with kilometres of sensing range

$\varphi$ -OTDR interrogation measures **Rayleigh backscattering**

**Thousands** of sensing points over the length of the fibre

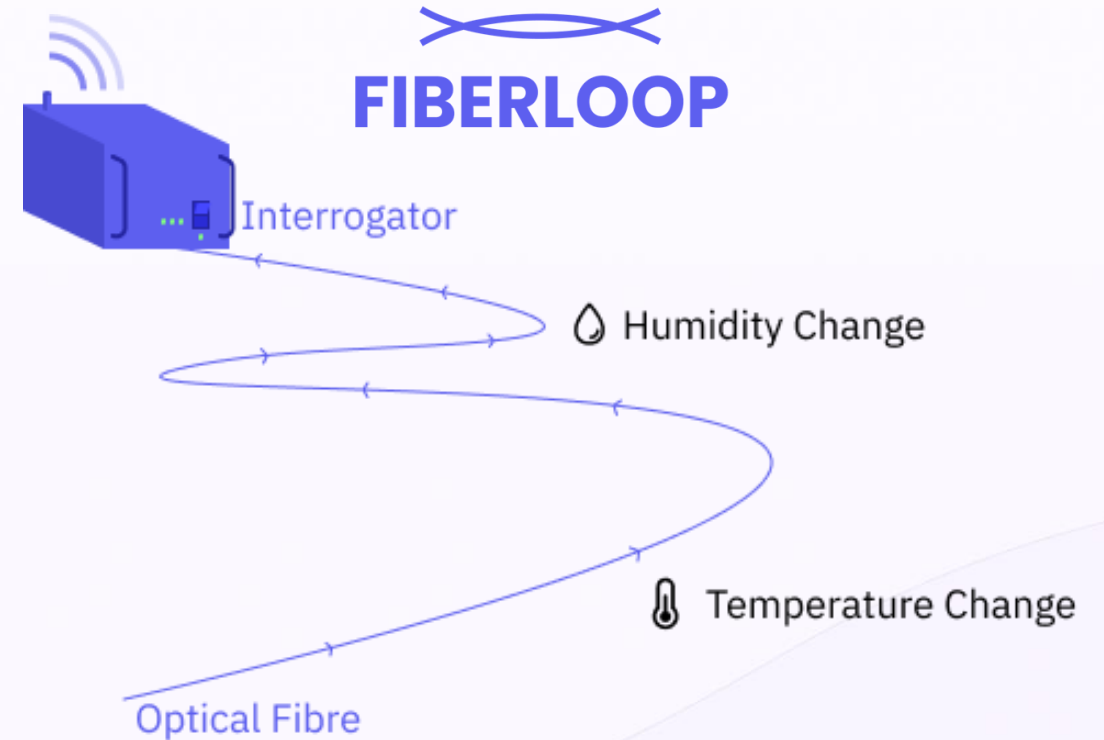
**Commercial telecom** optic fibres

Innovative optical interrogation system

**Decouples** temperature and humidity

Reads **any point** over kilometres

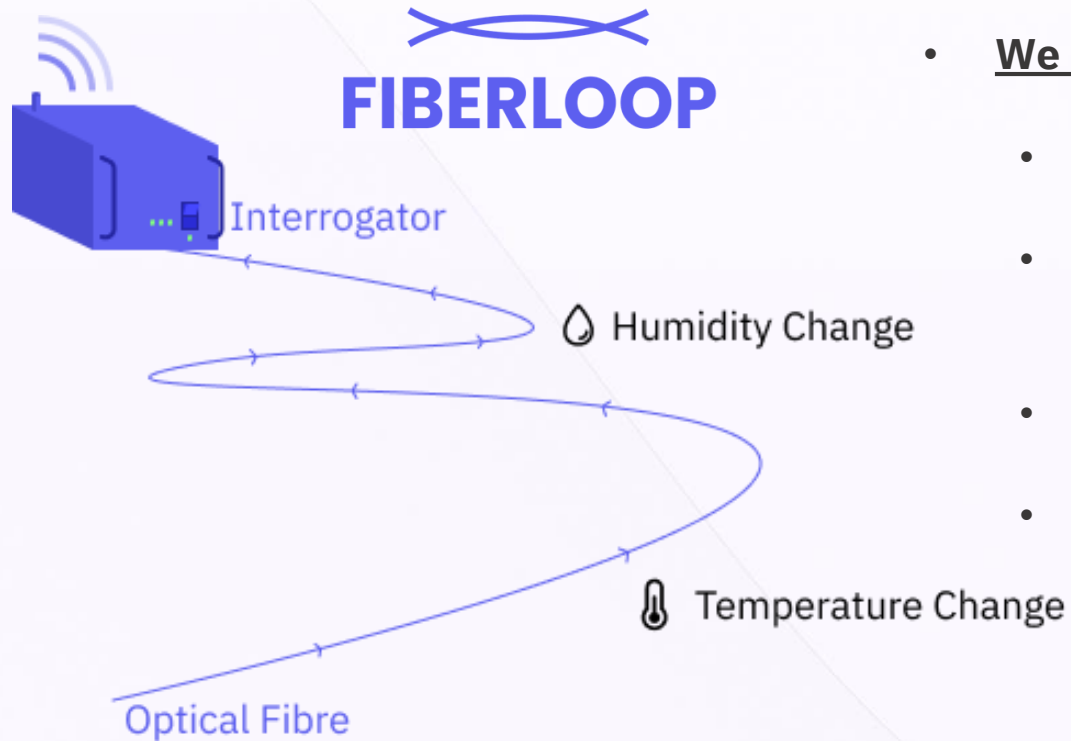
**Single** laser and photodetector





# The technology

First highly sensitive thermo-hygrometer distributed sensor with kilometres of sensing range



- We developed :
  - New low cost interrogator
  - New optical fiber cables optimized for T and RH
  - New data analysis algorithms
  - New AI software

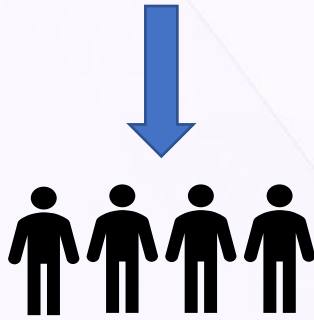


# 3.The applications

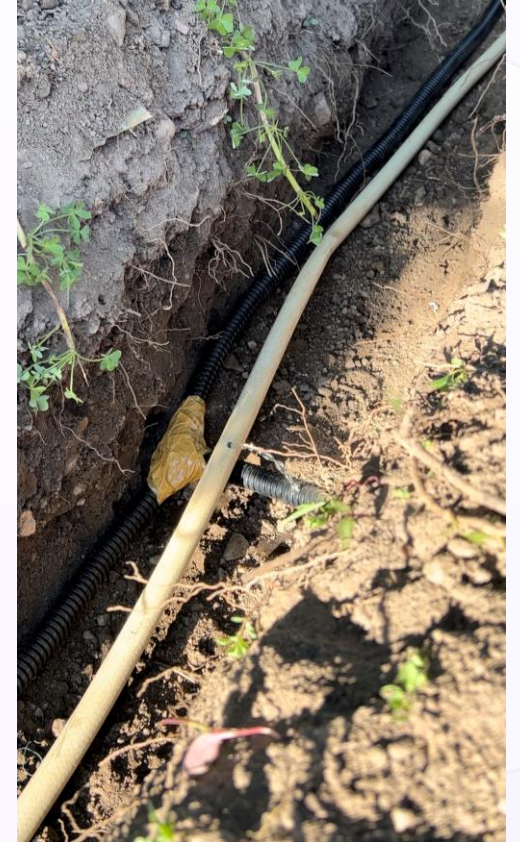
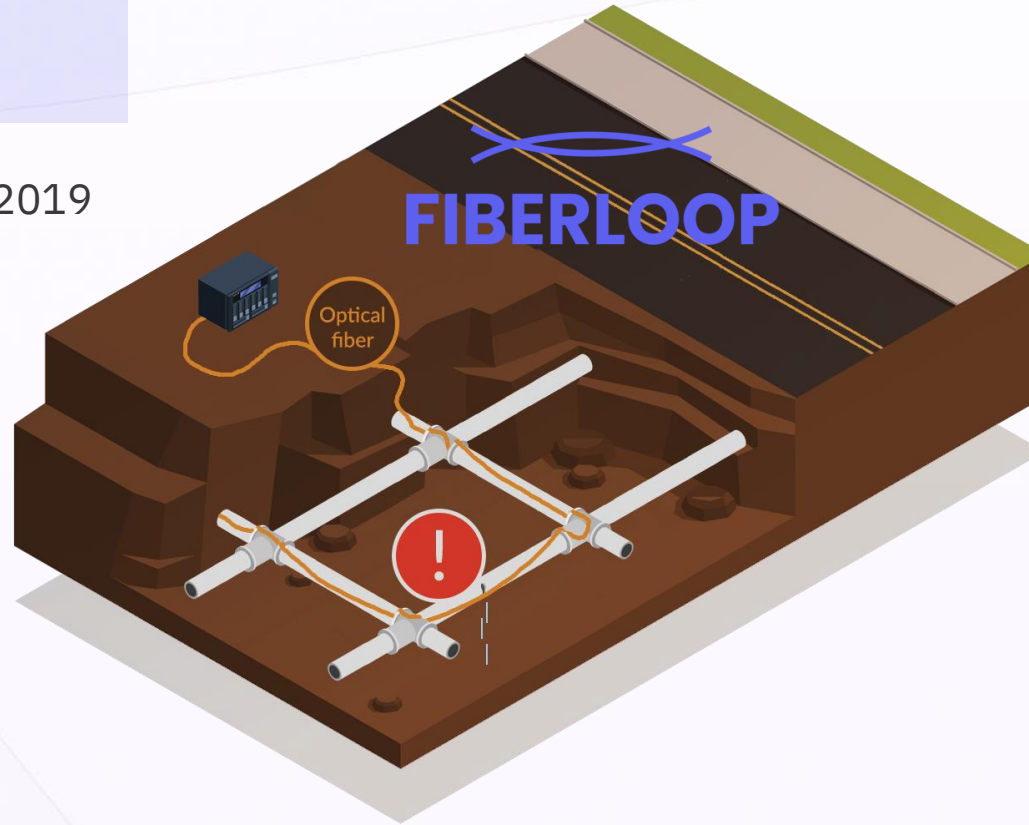
# The problem 1 - Water leaks

## Water leaks in Portugal

- 188.000 millions liters of water – 2019
- 40.000 liters/year per person



4 millions people in Portugal

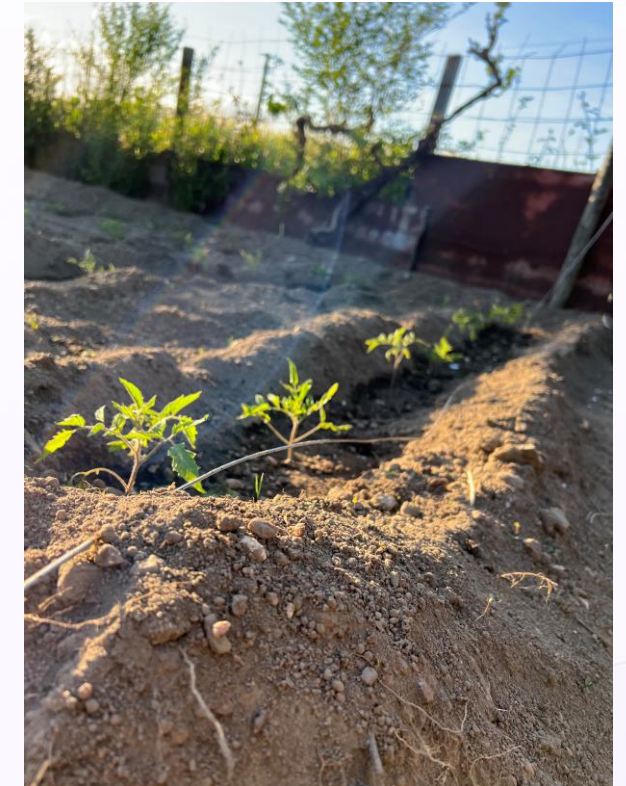
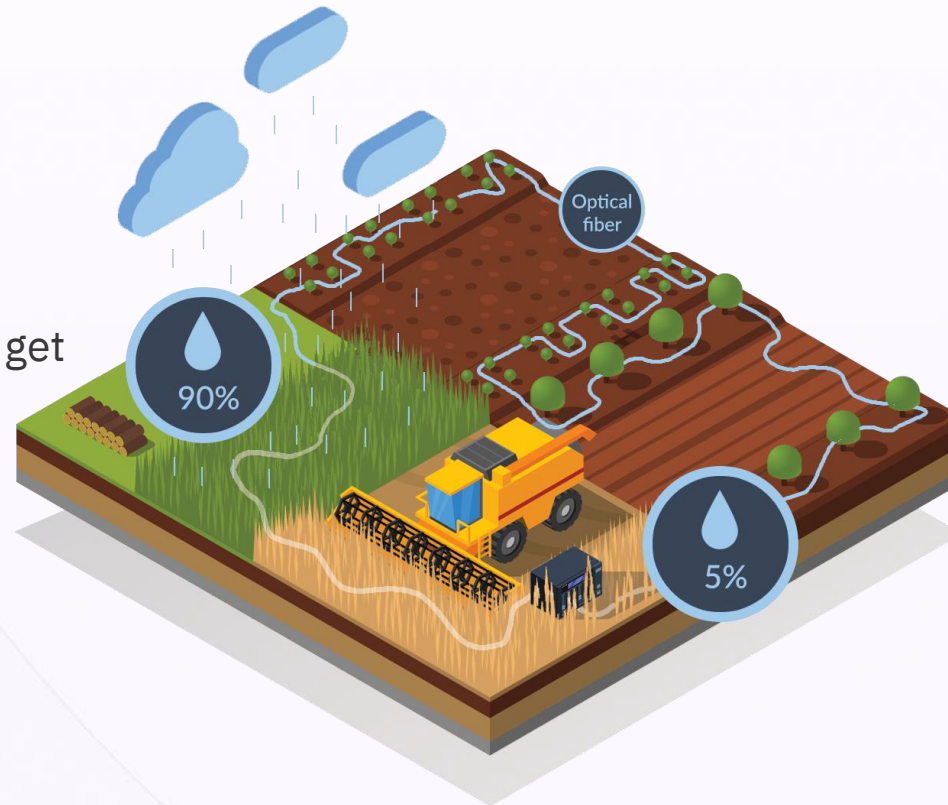


**30% of real water loss**

# The problem 2 - Agriculture

## Irrigation water

- 70% of water use worldwide
- 40% of the water used for farming every year is underutilized
  - Evaporated, run off the field, or get lost in transit.





# Future challenges

## Tech challenges

- Reduce significantly the cost of the hardware
- Improve and develop novel optical fibers for humidity and temperature sensing
- Guarantee long term stability



## Market challenges

- Difficult market players
  - Public utilities
- Large companies with extremely complex processes





# FIBERSIGHT

Thank you.

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# The technology

Pain-points of current technologies



**COST**  
**PRECISION**  
**ENDURANCE**



**FIBERLOOP**

→ **Single acquisition system** + single fibre. <1€ per metre >**20kms**

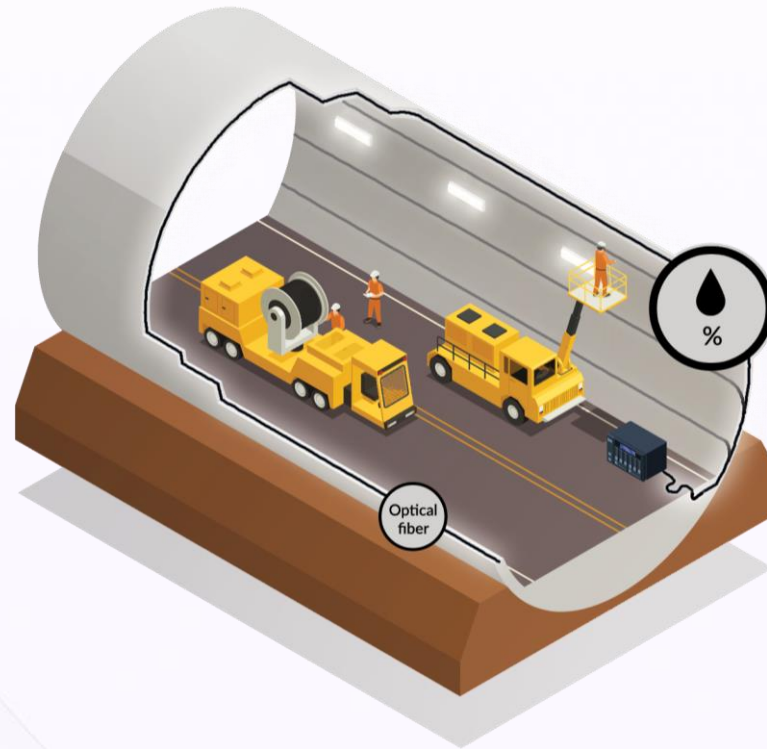
→ More sensing points mean a **more comprehensive measurement**

→ **Radiation endurance** and **immunity to electromagnetic interference**

# The problem 3 - Curing of concrete

## Concrete production

- Cement is one of the two largest producers of Co2 (8% of global emissions)
- In UK, 33% is used in repairs of structural cracks caused by early cracks
  - Non-ideal curing process
  - Fast-drying



# The current solutions

## Pressure sensors

- Spot-checking – inaccurate
- Resistance
- Communications issues



## Acoustic detection

- Manual inspection
- Time-consuming



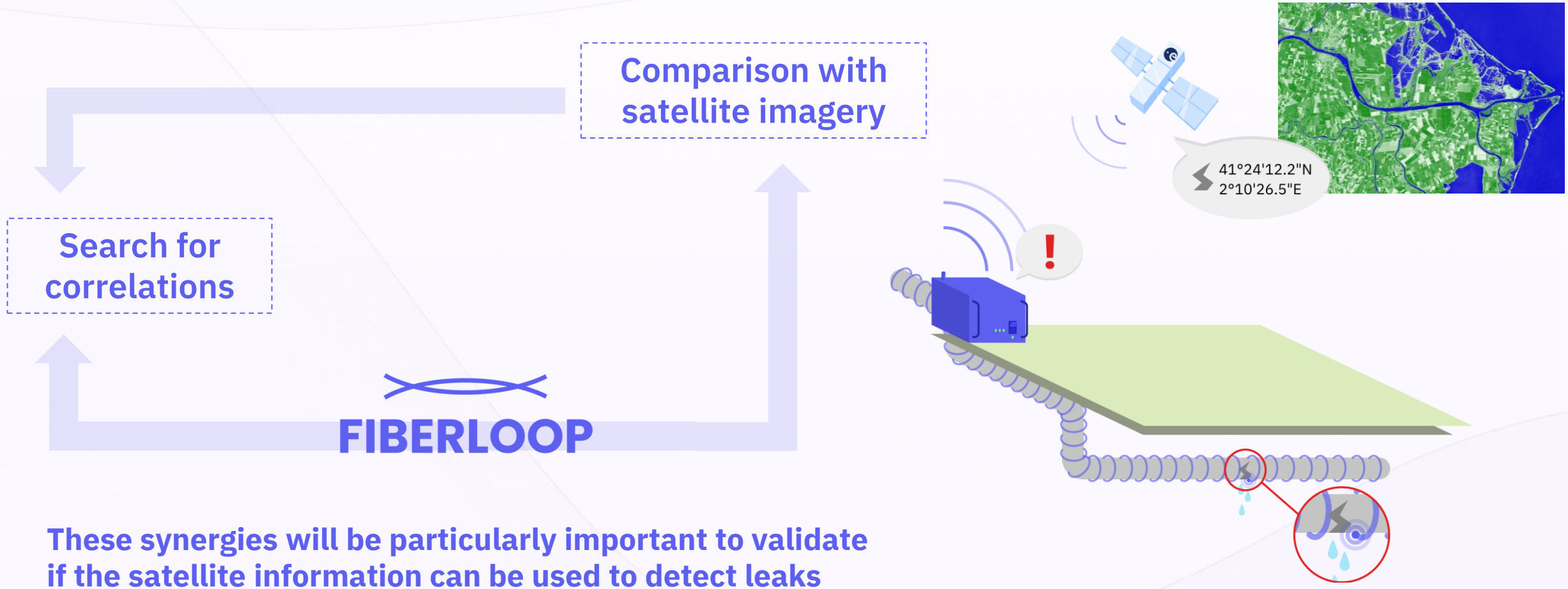
## Optical fibres

- Temperature measurements
- Poor spatial resolutions



# FiberLoop 2.0

## Hybrid Solution – Fibres + Satellite

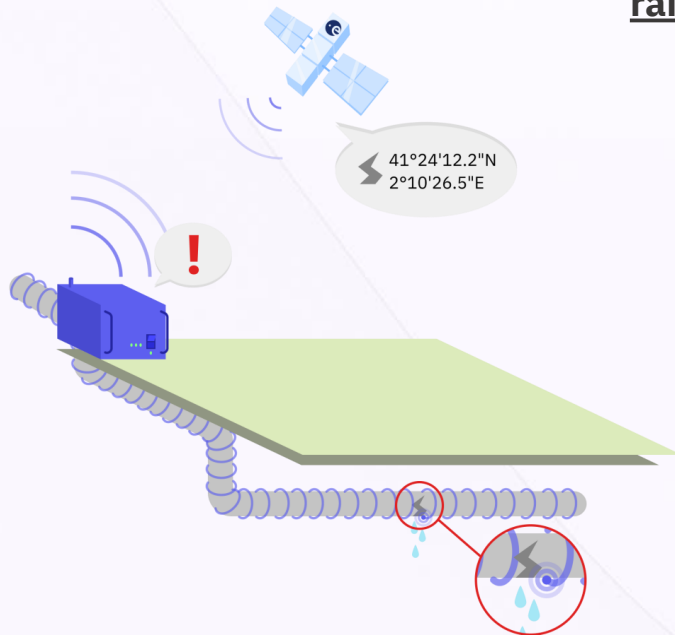


These synergies will be particularly important to validate if the satellite information can be used to detect leaks

# Satellite data

## GNSS

- Galileo satellite
- Relationship between each **fibre section and geolocation**

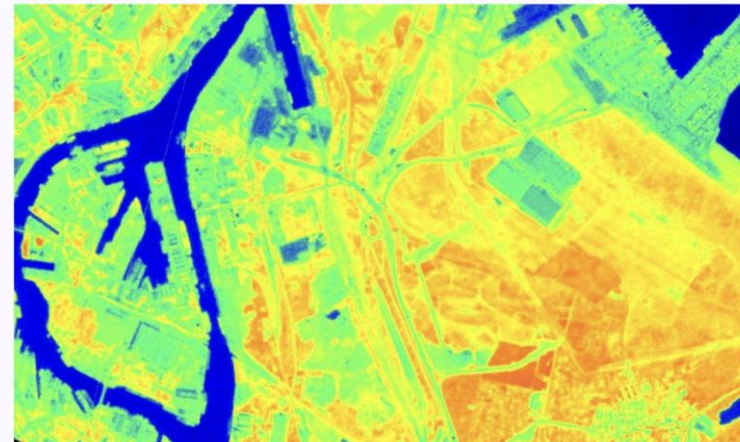


## Weather forecast + Groundwater mapping

- MeteoStat and Copernicus Sentinel
- Distinguish between **rain/groundwater and leaks**

## Imagery correlation - NDWI

- Comparison between **FiberLoop data and satellite imagery**
- Usage of images for leaks detection





# FiberLoop Team



**Tiago Neves, Ph.D.**

Physical Engineer with a Ph.D. in Photonics



**Marta Mercier**

Full-stack Developer



**Manuel Soeiro**

Embedded Systems Engineer



**Catarina Pinto**

Business and Finance Manager

