

## THE PROBLEM ADRESSED

Cities grow denser and denser. Safety and durability of facilities such as vehicle traffic, human presence detection or civil infrastructures is becoming a critical issue. More and more sensors and AI are needed for city monitoring.

Nevertheless, several hundred of fiber-optic telecommunications cables already crisscross cities and already interconnect urban areas. They are used for data transmission but can also be used to monitor urban environments without adding new sensors.

SAFER aims at providing wide-scale supervision and health diagnostic solution for deployed infrastructure and alert infrastructure operators of threats and accidents to preserve the integrity of their assets and reduce the outage time of their services.

A team at GTO (Optical transmission group) is working towards making simultaneous monitoring and communication over deployed optical fiber cables a reality through several internal research projects and joint research with industry.

## TECHNOLOGY

- Distributed Acoustic Sensing (DAS)
  - Based on Rayleigh backscattering of light
  - Detection of phase variation due to strain events impacting the fiber

- Detection of multiple strain events along a fiber cable based on the roundtrip propagation time of the scattered signals
- DAS deployed over existing telecom fiber cables
  - No need to deploy dedicated fibers
  - Detect vibrations impacting other infrastructure assets in the vicinity of fiber cables

## COMPETITIVE ADVANTAGES

- DAS architecture adapted for coexistence of sensing with data transmission over access networks, specifically passive optical networks (PON)
  - Zero impact on data transmission (seamless integration!)
  - Removal of fiber ambiguity problem in 1-to-N-fibre architectures (wider coverage!)
  - Minimal modification of hardware in the network (low cost!)
  - No requirement for sensors dedicated to infrastructure monitoring.

## APPLICATION

- Monitoring optical telecom cables
- Monitor public transport infrastructure (roads and railways)
- Monitoring water/energy distribution networks

## DEVELOPMENT STATUS

- We validated a DAS architecture for PON through simulations and a **proof-of-concept experiment**.
- A market study **was conducted** for technology transfer opportunities

## INTELLECTUAL PROPERTY

- Patent application "Distributed Acoustic Sensing for Point-to-Multipoint Optical Fiber Networks"

## INVENTORS & CONTACTS

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## PUBLICATIONS

- P. Choudhury & E. Awwad, "Wavelength and Code Orthogonality Based Distributed Acoustic Sensing over a Passive Optical Network", IEEE OFC 2025
- - P. Choudhury & E. Awwad, "In-band Sensing and Communication for Optical Access Networks using  $\Delta\phi$ -OTDR with Simplified Transceivers", IEEE Sensors Letters 2024

## LOOKING FOR

- Expanding to new use cases with companies
- Discussions with potential manufacturers and end-users