



# TOPOHAR: An interface for wireless sensor networks powered by radio wave energy harvesting

## ■ KEYWORDS

Wireless sensor network  
Radio waves  
Energy harvesting  
Integrated circuit  
Ultra low voltage

## ■ PATENT

No patent (ongoing prior rights search)

## ■ LICENSING

Research collaborations  
License agreements

## ■ INVENTORS

Hugo García-Vázquez  
(UMONS, Electronics and Microelectronics Unit)

Alexandre Quenon  
(UMONS, Electronics and Microelectronics Unit)

Grigory Popov  
(UMONS, Electronics and Microelectronics Unit)

Fortunato Dualibe  
(UMONS, Electronics and Microelectronics Unit)

## ■ PROBLEM

**Wireless sensor networks (WSN) are widely and increasingly used with the recent deployment of the Internet of Things (IoT).** Sensor networks are made of autonomous nodes that are spatially distributed and communicating with each other. The nodes are small systems possessing a computing capacity, each of them containing at least a sensor, a radio interface, a processor and a source of electrical energy, generally stored in a battery.

A lot of research has been carried out to reduce the amount of energy required by the sensors to catch and transmit information. However, regardless of the power optimisation that is reached, **the lifetime of the battery is a severe limitation of the WSN system:**

1. The number of charging cycles is limited (max. 1500 cycles for a NiCd battery).
2. Replacing batteries requires costly maintenance intervention. Besides, many deployment configurations make it impossible to access the nodes (e.g. integration in an architectural structure, unattainable zones, prohibitive cost of battery replacement, etc.).
3. Not replacing the battery entails a waste of investment but also a high risk of pollution of the environment due to the degradation of the batteries that are left on site.

## ■ SOLUTION

**The invention proposed is an autonomous circuit developed to harvest energy coming from ambient radio waves.** The solution includes a **large range of functionalities** in a single chip including a digital Finite State Machine which allows for identification of the sought node, reading and formatting of the data to transmit. Energy harvesting and data reception/transmission **use a single antenna.**

**Sensors do not need to be recharged** which solves the aforementioned issues. The circuit can be applied to any type of sensor (temperature, pressure, humidity, pH, vibrations, etc.) and is very useful in places where it is hard to change or recharge batteries.

## ■ INNOVATION

- Integrated radio wave harvesting
- Large range of functionalities included in a single chip (identification of the node, reading and formatting of data, etc.).
- Energy harvesting and data reception/transmission with a single aerial

## ■ TECHNOLOGY STATUS

TRL 2-3 : A prototype has been developed by an external company but still need to be tested.

## ■ MARKETS

The markets are very large as the circuit can be embedded in any type of sensor. Markets include but are not limited to:

- **Health** (biomedical signals surveillance in network, etc.)
- **4.0 Industry** (use of sensors to ensure security, etc.)
- **Smart Building** (monitoring of defaults in a building structure, etc.)
- **Smart Farming** (optimized agricultural production, etc.)
- **Environment**

## Contact

Sandrine Brognaux  
AVRE  
+32 65 37 47 97  
Sandrine.brognaux@umons.ac.be