How to communicate without ever running out of battery?
We seek to find ways to communicate without interruption by optimizing energy expenditure for wireless communications powered by energy harvesters.

**MOTIVATION**

Wireless devices equipped with energy harvesters enable communicating continuously without the power grid and reduce carbon footprint.

**NEAR FUTURE**

- Space exploration powered by solar radiation
- Wireless sensor networks deployed in rivers to predict floods
- Wireless sensor networks for monitoring animal behaviour
- RFID tag inventory systems
- Solar powered cell phone

**COMMUNICATION RATE**

The transmitter can send data by storing harvested energy and using it efficiently to maximize reliable communication rate (as defined by Shannon).

**CHALLENGES**

- Limited energy storage capacity per device
- Limited energy harvesting efficiency
- Imperfections in energy storage, e.g. leakage, capacity loss, etc.
- Accuracy of the prediction of the harvested energy
- Adapting to unexpected changes in the available energy

**COMMON SOURCES OF ENERGY HARVESTING**

- Mechanical Energy – from sources such as vibration, mechanical stress and strain
- Thermal Energy – waste energy from furnaces, heaters, and friction sources
- Light Energy – captured from sunlight or room light via photo sensors, photo diodes, or solar panels
- Electromagnetic Energy – from inductors, coils and transformers
- Natural Energy – from the environment such as wind, water flow, ocean currents, and solar
- Human Body – a combination of mechanical and thermal energy naturally generated from bio-organisms or through actions such as walking and sitting

It is important to note, that all these energy sources are virtually unlimited and essentially free, if they can be captured at or near the system location.

**KEY COMPONENTS OF AN ENERGY HARVESTING SYSTEM**

An energy harvesting system generally requires an energy source such as vibration, heat, light or air flow and three other key electronic components, including:

- An energy conversion device such as a piezoelectric element that can translate the energy into electrical form
- An energy harvesting module that captures, stores and manages power for the device
- An end application such as a ZigBee-enable wireless sensor network or control and monitoring devices