Sustainable 'Energy for IoT' Solutions

Tyndall National Institute
Institiúid Náisiúnta

Challenge

The world will have 1 trillion IoT devices within the next few years all needing a power source. Most of these will be wireless sensors at the 'edge' using a 'battery'.
We need to ideally make the battery outlive the device it powers to minimize downtime, maintenance overheads and risk of data loss. We also need our solution to be sustainable, based on eco design and minimizing the number of batteries that end up in landfill.
Many applications have harvestable ambient energies available and these can be used at least to prolong battery life and in many cases eliminate the need for battery replacement.

Solution

Tyndall already develops world leading energy harvesting, storage and CMOS based micro-power management solutions. To drive their integration at device and system level, internally and in collaboration with other external industry and academic stakeholders, we have created 2 research programs supported by the Science Foundation Ireland CONNECT* research cluster
eSiP – An energy Source in Package technology platform ready to integrate existing and emerging 'Energy for IoT' technologies
Energy harvesting powered WSN network demonstrator – the world's 1st demonstrator that enables multiple energy harvesting powered IoT edge devices to be networked and displayed in operation in real life scenarios

For both of these platforms we have an open door policy to explore collaborations with others.
Key elements involves minimizing system level energy and device footprint and maximizing battery life, in many cases leading to power autonomy.

***EH:** Energy Harvesting, **ES:** Energy Storage, **MPM:** Micro-Power Management*

1. eSiP – energy Source in Package Integrate Technology Platforms (from Tyndall, Research Partners, Industry):

- **EH**: Solar cell, Thermoelectric (TEG), Electromagnetic vibrational, Wireless
- **ES**: Micro-batteries, supercaps
- **MPM**: Power management ICs (PMICs)

Progress from COTS to research platforms

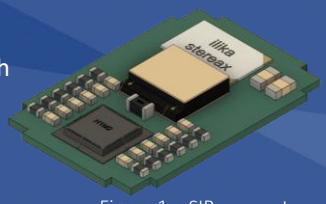

Figure 1. eSIP concept

Integration Technologies:

- PCB, PCB-embedding
- Flexible
- Micro-Transfer Printing (MTP)

2. Energy harvesting powered WSN network demonstrator

World's 1st ecosystem for developers* to collaboratively do real-life energy harvesting experiments at system network level to optimise battery life at node level as well as overall network efficiency.

** Materials, Devices (energy transducers, storage devices, PMICs, sensors), Firmware (e.g. energy efficiency, condition monitoring algorithms), WSN protocols and comms infrastructure*

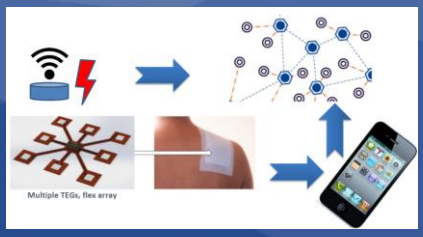

Figure 2. Example – networked TEG powered smart patch

Do YOU have a tech platform for integration?

Collaborations welcome!
www.connectcentre.ie

CONNECT Centre for Future Networks

UCC University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Benefits Summary

A unique opportunity for both industry and academic partners to integrate components into the **eSiP**, assess how well they work as a system level, targeted at real life application.

-> Optimize device design, address inter-operability challenges.

The **EH WSN testbed** will establish networking, power consumption and energy harvesting capability of eSiP type devices in into WSN modules in real life scenarios. It will

- foster collaborations
- attract technology developers interested in embedding/integrating their technology
- attract potential integrators and users of the technology.

Applications

Open for a wide variety of applications but Tyndall and CONNECT are particularly interested in **med tech** (wearables /implantables), **industry 4.0**. and **smart cities** e.g.

- Condition monitoring of equipment in commercial buildings, industrial settings and factories
- Asset tagging
- Environmental and structural health monitoring
- Personnel monitoring

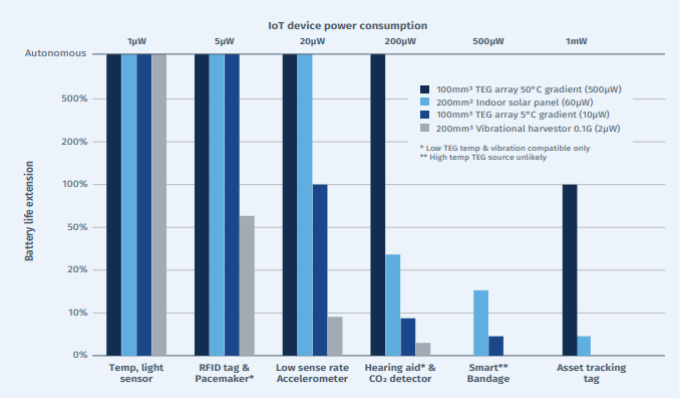

Fig. 3 Energy harvesting 'sweet spot' for IoT edge devices

Source: EU Research infrastructure EnABLES position paper https://www.enables-project.eu/wp-content/uploads/2021/02/EnABLES_ResearchInfrastructure_PositionPaper.pdf

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European Union
European Regional Development Fund

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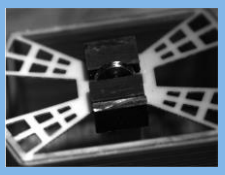
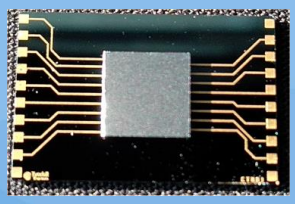
Examples – Tyndall platforms:



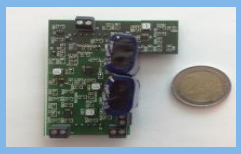
Electromagnetic vibrational energy harvester

MEMS piezo vibrational energy harvester

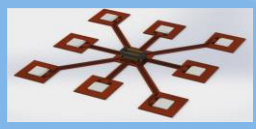
Flexible high density polymer gel micro-battery



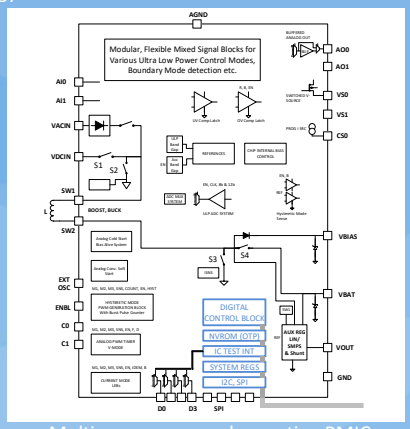
Si based thermoelectric generator



Discrete multi-source energy harvester



TEG flex array for wearables



Multi-source energy harvesting PMIC

Commercial Status:

Platforms from TR3-6 are available. Tyndall is looking for co-developers, system integrators and end users to explore licensing collaborations across the full supply-chain.

Intellectual Property:

More than €30M invested in Energy Harvesting and WSN research over the past 20 years resulting in extensive IP & know-how in design and integration of energy harvesting powered multi-sensor multi-radio WSN platforms for applications Tyndall has an established track record in licensing IP related to IoT devices to SMEs, start-ups and multi-nationals.

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