PERPS
Perpetual Power Supply for IoT

T1ΕΔΚ-00360

The PERPS project proposes a holistic approach to the development of feasible and sustainable innovative, technical solutions for the perpetual operation of IoT edge nodes and portable/wearable electronics. The proposed studies aim to the development of methods, as well as specific power supply units, which will enable current and future embedded networked systems to operate globally by harvesting energy from their surroundings, adapting optimally to the time-varying available ambient energy content. The proposal's baseline innovation lays in the combination of a novel energy conversion integrated circuit (ENC IC), with real-time S/W algorithms, in order to allow the predictive estimation of energy availability at the system's installation site, taking into consideration (hidden) repetitive patterns in the ambient energy signal. Energy estimations will trigger the node's power management system, in order to optimally adapt power consumption to ensure survivability. To maximize gains and scope of application, the ENC IC will be able to harvest in parallel energy from dissimilar sources including (ambient) light, (micro) vibrations and (small) temperature differences. In addition, a study for the integration of triboelectric microgenerators will be conducted to ensure future exploitation of this promising energy harvesting method. Specific research targets include:
• Design of high-efficiency energy conversion microelectronic circuitry (including active rectifiers and DC/DC converters) with ultra-low-power parasitic consumption.
• Design of low-complexity energy estimation algorithms (to be executed in real-time in the node).
• Definition of the power management characteristics which are necessary for fine-grain control and adaptation of the system's consumption, in order to achieve energy survivability with optimal performance.
• Estimation of the actual efficiency of commercial and experimental energy harvesters, as well as field measurements of the energy signals, in order to provide a database for harvester dimensioning per application/installation environment (i.e. needed area of PV cell for indoor applications).

PERPS will implement and deliver the ENC IC, as well as a reference perpetual power supply (PPS), consisting of the ENC IC, commercial energy harvesters, energy accumulator (battery or supercap) and protection and power conditioning circuits. PPS will be fully characterized in the lab and will be subsequently integrated into a purposely developed fully autonomous wireless digitizer (WAD IoT edge node). A number of WAD nodes will be form a wireless sensor network and will be deployed in a ship's engine room, implementing a real data acquisition and relay-to-shore application. Thus, the validity of the PERPS approach will be investigated in a real and demanding application scenario. The PERPS consortium consists of two SMEs, a university and a research center. All participants are highly competent in their fields of expertise, with proven track record in innovation and innovation management. Academic partners have developed in the past novel and highly efficient power conversion circuits, as well as their energy harvesting microsystems. The project's expected results progress far beyond the anticipated growth in the national research potential and know-how: Potential products encompassing the PERPS technology can be implemented with limited additional investment and could be marketed as energy autonomous IoT nodes, or as self-

contained (perpetual) “batteries” for portable/wearable systems, addressing an estimated total market of 1BnUSD with 20% CAGR till 2022. The involved SMEs are ideally positioned to exploit such products, since they present strong export orientation and already target international markets with their existing IoT related products, with the alternative to engage larger suppliers with a technology (IP) licensing collaboration.

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