

**Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN)**

SUBJECT:

Energy Packet Networks (EPN): Basic Limits in Performance and Security of Communication and Computing Systems that Operate with Energy Harvesting

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DESCRIPTION:

Increasingly, Information and Communication Systems (ICTS) are designed to operate wholly or partially with renewable sources of energy. The objective is to minimize operating costs (by reducing or eliminating electricity costs), and also to reduce the Green House and CO₂ gas emissions that can be attributed to such systems.

Over the last decade some novel mathematical models have been developed to analyze such systems, known under the name of « Energy Packet Networks » (EPN) [1,2,3].

Such models represent, on the one hand, the unpredictable flow of incoming energy (e.g., originating from photovoltaic), then the presence of storage batteries that store the intermittent energy, thirdly the actual interconnected microelectronic devices that consume energy when it is available, and finally the flow of computation and communication tasks that provide the work requests to the devices, which then result in energy consumption.

Thus the EPN model allows the prediction of the throughput, overall end to end delays, and energy consumption by flows of computation and communication times in the presence of flows of renewable energy.

The proposed thesis research will apply the EPN model to a realistic ICTS, such as an IoT (Internet of Things) system in a factory or in a building, and determine the needed energy flows for the system to operate. The EPN model will also be used to determine the optimal locations of renewable energy sources (e.g., photovoltaic or piezoelectric energy sources), the location of batteries, and the energy flows to achieve acceptable performance for the ICST system under consideration. The EPN model will also be used to determine the consequences of energy depletion attacks, which may try to stop the ICTS from operating normally, by provoking useless energy consumption in a form of energy related Denial of Service Attack.

BIBLIOGRAPHY:

[1] https://www.researchgate.net/profile/Erol-Gelenbe-2/publication/254008394_Energy_packet_networks_Adaptive_energy_management_for_the_Cloud/links/5647778b08ae451880ac3a9e/Energy-packet-networks-Adaptive-energy-management-for-the-Cloud.pdf

[2] <https://ieeexplore.ieee.org/iel7/6287639/6514899/07442081.pdf>

[3] https://eudl.eu/pdf/10.1007/978-3-642-33368-2_16