A Decade of Energy Awareness Technology Evolution for Sensor Nodes

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Abstract

Energy awareness is an important aspect of the design of sensor node hard- and software, particularly for battery-powered or energy-harvesting node architectures. Architectural design choices of such systems must regard a multitude of aspects, including size, weight, memory and processing power. Therefore, energy-related design aspects have in recent years become a feature that is being honoured throughout sensor node design. As a result, various technological solutions and strategies have evolved to facilitate energy-awareness and energy management aspects.

This paper looks back at the evolution of sensor node technology during the 2010s. Out of ongoing research interests, the author has been monitoring the state of the art of research and industrial solutions aiming at improving the support of energy awareness. Advances were observed for various aspects and levels of relevant technological facets, including electronic measurement and control circuitry, harvesting facilities, power-saving mechanisms at both hard- and software level, energy management strategies and algorithms, networking aspects, and advances and extensions related to operating systems for sensor nodes. A conclusion of these observations, given in this paper, identifies technological increments, leaps and sidesteps that have occurred along the way.

For all aspects described, typical and relevant examples of actual sensor node designs, realised by the author and others, are given. For the overall time span of the decade observed, a short qualitative and quantitative analysis of the technological advances achieved is presented. The paper concludes with an outlook of further evolution of advances in energy awareness technology for sensor nodes to be expected in the near future and to be desired in the long run.