A Time-Reversal Paradigm for Green Internet of Things

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In recent years, with the explosive growth of wireless communication, the energy consumption of wireless networks and devices is experiencing a dramatic increase. Because of ubiquity of wireless applications, such increasing energy consumption not only results in a high operational cost and an urgent demand for battery/energy capacity to wireless communications operators, but also causes a more severe electromagnetic pollution to the global environment. Therefore, an emerging concept of "Green Communications" has received considerable attention in hope of finding novel solutions to improve energy efficiency, relieve/reduce radio pollution to unintended users, and maintain/improve performance metrics.

To qualify as a green wireless technology, one must meet two basic requirements: one is low energy consumption (environmental concerns) and the other is low radio pollution to others (health concerns) besides the intended transmitter and receiver. In the first part of the talk, we argue and show that the time-reversal (TR) signal transmission is an ideal paradigm for green wireless communications because of its inherent nature to fully harvest energy from the surrounding environment by exploiting the multi-path propagation to re-collect all the signal energy that would have otherwise been lost in most existing communication paradigms. Our theoretical analysis and simulations show that a potential of over an order of magnitude of power reduction and interference alleviation can be achieved. We also demonstrate a very high multi-path diversity gain exhibiting in a TR system. In essence, TR transmission treats each multi-path as a virtual antenna and makes full use of all the multi-paths. Experimental results obtained from measurements in real RF multi-path environment are shown to demonstrate the great potential of TR-based transmission as an energy-efficient green wireless communication paradigm. In the second part, we will demonstrate why the TR paradigm is an ideal technology for the future green Internet of Things.