Tackling the IoT Battery Problem with Passive Backscattering

Article

Internet of things (IoT) devices, particularly wireless sensors, enable new levels of efficiency by gathering data for homes, enterprises, manufacturing, and transportation. Sensor data is used to measure everything from temperature, humidity, and light to room occupancy and asset and security monitoring, all to make residential and industrial processes smarter. As well as sensors, wireless connected devices are proliferating in a wide range of residential, commercial, and industrial applications.

As a testament to the growing importance and ubiquity of IoT, some reports estimate that there will be as many as 29 billion connected devices by 2030 [1]. Owing to these massive numbers, the scale of IoT connectivity faces a major challenge: battery life.

Many IoT solutions are designed to be small, battery-powered modules connected to wireless networks based on standardized protocols like Wi-Fi, Bluetooth®, or via proprietary ones. Unfortunately, the power consumption of the radio for a wirelessly connected device is often the largest contributor to the expected battery life, with many products requiring several battery changes per year. As a result, significant concern surrounds the affordability and environmental impact of the rapid expansion of IoT.

To ensure a future where IoT deployments are cost-effective and sustainable, new, innovative approaches are required for radio design. Passive backscattering is one of the most promising options to lower the power consumption of wireless communications. As the name suggests, the passive nature of backscattering means that no energy is created at the connected device. Signals are passively reflected back into the wireless network, making it one of the most power-efficient radio frequency (RF) techniques.

The IoT Battery Problem: Creating Waste

From a sustainability perspective, the need for frequent battery changes in IoT devices presents a huge challenge. A primary concern is the amount of waste and landfill that these battery changes present.

According to estimates from EnAbles (European Infrastructure Powering the Internet of Things), approximately 78 million batteries powering IoT devices will be dumped globally every day by 2025 [2]. These batteries, consisting of toxic materials, eventually corrode and decay in landfills releasing chemicals that have a deleterious impact on the environment. Moreover, even though some batteries are recycled, less than half actually undergo this process, and the recycling itself incurs considerable energy costs which further exacerbate environmental impacts. Beyond, there are sustainability concerns associated with the manufacturing of new batteries.

Estimates indicate that the energy used to manufacture a CR2032 battery, a common choice in IoT modules, is 4.8 times the energy that it can store [3]. With inefficient hardware that requires many batteries throughout its lifetime, the net result is huge amounts of energy spent on battery manufacturing. Battery production also relies on the sourcing of raw materials like lithium, graphite, nickel, and cobalt, all of which have high carbon footprints associated with their mining and refining.

With billions of devices being deployed every year, the aggregate impact of battery use on the environment from IoT devices will be serious if not resolved.

The IoT Battery Problem: Driving Up Costs

In addition to environmental waste, one of the most pressing challenges associated with frequent battery changes in IoT devices is the increased cost they represent.

There is a capital cost - or inventory expense - associated with needing multiple batteries for the device's operation over its lifetime. This recurring expense is a barrier to widespread use, as are the cost and logistics of changing batteries.

Maintenance to change batteries multiple times per year, as well as device downtime during battery changes, are key concerns to be addressed. In industrial operations, downtime means a loss of production capacity and, hence, an increased total cost of ownership.

Finally, there are the costs associated with disposing of dead batteries and fabricating new batteries since both the manufacturing and recycling processes are expensive and time-consuming.

Ultimately, all of these costs accumulate and drive up the overall price of IoT deployments. As the industry moves towards tens of billions of deployed devices over the next decade, cost-effective solutions are a necessity.

The IoT Battery Solution

Creating a future where IoT deployments are both sustainable and cost-effective necessitates techniques to extend battery lifetime of these devices. To do this, HaiLa is pioneering passive backscattering technology that enables hyper power-efficient wireless links for IoT systems. HaiLa's solution is protocol-agnostic with a first adaptation to Wi-Fi. As the most ubiquitous commercial and residential Wireless Local Area Network (WLAN) communications protocol, Wi-Fi is ideal for IoT connectivity.

Passive backscattering works by detecting ambient RF signals, such as Wi-Fi signals, inserting data from a sensor, and reflecting the data back into a Wi-Fi receiver in the WLAN network. A completely passive technique, backscattering enables wireless communication between devices without the need for a high-power radio transmitter.

The result is that passive backscattering removes the largest source of radio power consumption, greatly reducing the overall power consumption of the IoT device and enabling the use of a single battery over the product's lifetime. Such efficiency leads to a drastic reduction in the number of batteries needed to support the large-scale IoT rollout over the next decade. With continued focus on reducing the power of IoT wireless connectivity, HaiLa's technology will ultimately pave the way for energy harvested power sources, eliminating the battery altogether.

In this way, HaiLa's ultra-low power RF technology has the promise to significantly lower the costs and environmental impact of IoT deployments.

IoT sustainability for the future

With billions of connected devices reaching the field by 2030, IoT is poised to revolutionize many different industries, ranging from home and building automation and consumer electronics to manufacturing, transport, and medical technology. However, the inefficiency of existing hardware, particularly the radio units, requires IoT devices to undergo frequent battery changes to remain operational, posing significant challenges for sustainable and cost-effective rollout.

To address these challenges, HaiLa has developed extremely power-efficient passive backscattering technology that re-purposes existing Wi-Fi infrastructure for IoT connectivity. HaiLa's groundbreaking solution removes the need for IoT battery changes and has the potential to completely eliminate them, leading to a more sustainable and affordable future.

References

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