Demonstration of a Simple, Versatile, Distributed Low-Power Wireless M2M Infrastructure

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***Abstract*—Existing wireless M2M infrastructure based on cellular and WiFi networks is often unsuitable for the growing number of simple, inexpensive, low-power connected devices. We demonstrate an infrastructure architecture capable of simultaneously supporting a variety of low-power wireless technologies, with plug-and-play extensibility of coverage. The demonstration highlights the simplicity and versatility of the architecture, which we call a reel. Real-time connectivity with the Internet and real-time location capability are presented. We conclude with a brief discussion of the potential for and advantages of crowdsourced deployments.**

I. Introduction

Tens of billions of devices are expected to come online in the near future as members of the so-called Internet of Things (IoT). A significant proportion of those devices are likely to be of the simple, compact, mobile, low-power variety and will connect wirelessly with power and budget constraints. Low-power wireless technologies provide an energy-efficient means for such devices to exchange information.

The list of low-power wireless technologies includes Bluetooth Low Energy (BLE), ZigBee, Z-Wave, ANT+, Nike+, DASH7 and many proprietary protocols. These technologies are often optimized for an application such as Personal Area Networks (PAN), home automation, fitness or remote controls, among others. With so many competing options, today there is no single standard for low-power wireless devices.

Wireless Machine-to-Machine (M2M) technology enables the communication of information from one device to another and commonly employs cellular or WiFi networks which represent a global infrastructure thanks to their extensive deployment. However, for wireless devices on a constrained power or cost budget, these networks are often unsuitable. Heterogeneous M2M area network infrastructure for low-power wireless technologies will be required to complement existing cellular and WiFi networks.

II. Demonstration Objective

In "Towards a Simple, Versatile, Distributed Low-Power Wireless M2M Infrastructure" [1] we recall the known need for heterogeneous M2M area networks which support the growing number and variety of resource-constrained wireless devices. We then show the considerations of great importance for such a standard low-power wireless M2M infrastructure. These include support for multiple technologies, extension of coverage, access to power, access to network connectivity with sufficient throughput, and device mobility.

Here we show that our novel design for a low-power wireless M2M area network infrastructure meets these considerations by demonstrating its support for multiple wireless technologies (915MHz active RFID and BLE, extensible to other technologies), plug-and-play ability to extend coverage which also provides power and network connectivity, transfer of low-power wireless packets to the Internet, and ability to locate devices to the nearest node.

III. Requirements

The following will be required in order to perform the demonstration, which requires 1-2 minutes of setup time:

- wired or (reliable) wireless Internet connection
- projector with VGA input
- AC power outlet
- 10m of lateral presentation area (nice to have)

IV. Description

During the demonstration we will present two types of low-power wireless devices: a 915MHz proprietary active RFID tag and a popular BLE device (for example, a smartphone). We will describe the problem of ubiquitous ambient connectivity for these devices due to lack of infrastructure. Then we will present a reelyActive reelceiver which implements a given wireless technology and acts as infrastructure to relay low-power wireless packets with the Internet.

A description of the various means to create a single node of low-power wireless infrastructure based on this novel design will be presented. We will introduce a black-box hub which provides power and Internet-connectivity. By connecting a 915MHz reelceiver to the hub using a common Cat5e cable, the simplest configuration will be presented. This plug-and-play configuration will be shown to communicate wireless packets from a 915MHz active RFID tag with the cloud. A webpage built on the reelyActive API will illustrate this capability.

Next, we will present how to extend support to additional wireless technologies by connecting a reelceiver of a different technology (in this case BLE) to the previous one via Cat5e cable. The webpage will again serve to visualize the successful communication of wireless packets from both the active RFID tag and the BLE device with the cloud.

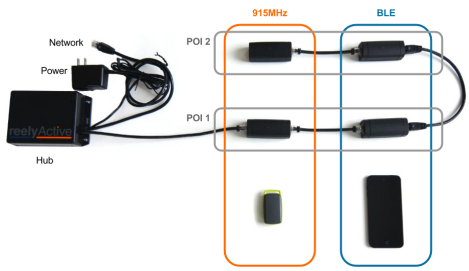

Fig. 1. Hardware setup for demonstration

Next, we will present how to extend coverage over a larger area by connecting another pair of reelceivers. First a long Cat5e cable will be used to connect an additional 915MHz reelceiver some distance away from the first BLE reelceiver. Then a short Cat5e cable will be used to connect a second BLE reelceiver. This will illustrate the plug-and-play extensibility of the infrastructure.

Finally, this configuration will allow the demonstration of the real-time location capability of the infrastructure. The active RFID tag and BLE device will be moved from one pair of reelceivers to the other and the webpage will illustrate this change of position which is determined by the change in received signal strength at each reelceiver.

Figure 1 shows the demonstration hardware setup. If possible, a Cat5e cable of at least several metres will be used to connect the two pairs of reelceivers to best illustrate the concepts of extended coverage and real-time location.

V. Conclusion

This demonstration illustrates how the novel reel architecture addresses the requirements of a low-power wireless M2M area network infrastructure as it offers support for multiple wireless technologies, plug-and-play ability to extend coverage, simple access to power and network connectivity, convenient transfer of low-power wireless packets with the Internet, and the ability to locate devices to the nearest node.

References

[1] J. Dungen, T. Antonescu and P-O. Genest, “Towards a Simple, Versatile, Distributed Low-Power Wireless M2M Infrastructure,” submitted for publication.