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Physical-layer cross-technology communication via signal emulation (AllBee)

A method to enable high-throughput cross-technology communication using physical-level emulation without hardware or firmware modifications.

IP Status: Issued US Patent; **Application #:** 15/994,472

Applications

- IoT devices
- Home automation
- Manufacturing
- Transportation
- Healthcare
- Battlefield/ad hoc networks

Key Benefits & Differentiators

- **Easy and scalable implementation:** no hardware/firmware modifications needed; software modification only.
- **Cost effective:**does not require multi-radio gateways; no additional radio traffic
- **Compatible:**works with commercial off-the-shelf devices; compliant with pertinent standards such as 802.11, 802.15.4
- **Fast and reliable:**10,000x to 16,000x higher data rate than current technologies, and >99% reliable even in noisy environment.
- Parallel CTC

Cross-technology communication through signal emulation

Researchers at the University of Minnesota have developed a new technology to enable **cross-technology communication between heterogeneous wireless devices without hardware or firmware modifications.** This technology, named AllBee, is a physical-layer cross-technology communication design based on *signal emulation* method. By elaborately enabling a high-rate wireless device to produce a waveform that matches that of a low-rate device, cross-technology communication between devices using different communication protocols is established. For instance, when installed on a WiFi device, AllBee chooses the payload of a WiFi frame in such a way that a portion of this WiFi frame is recognized as a legitimate ZigBee frame by commodity ZigBee devices. Depending on devices and wireless protocols, AllBee is inclusive of communication from WiFi to Zigbee devices (WEBee), communication from Bluetooth to Zigbee devices (BlueBee), and communication LTE to Zigbee devices (LTE2B).

Fast, reliable, and easy to implement CTC technology

One of the common solutions currently used to achieve direct communication between heterogeneous wireless devices is to deploy multi-radio gateways. This method, however, suffers from several drawbacks such as significantly complex and costly hardware deployment, and increased overhead and interferences due to doubling of traffic in and out from the gateways. In addition, multi-radio gateways are not suitable for ad hoc scenarios such as in

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Category
Engineering & Physical Sciences/Instrumentation, Sensors & Controls
Life Sciences/Health IT
Software & IT/Algorithms
Software & IT/Communications & Networking
Software & IT/Health IT

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battlefields or for mass communication in an emergency situation. Another solution is to use packet-level modulation that embeds symbols using the packet length, timing, and sequence patterns. However, packet-level modulation is limited by low throughput (at most a few bits in CTC), which renders the method undesirable for most of the user applications. Other solutions to support CTC between heterogeneous devices may require modifications to hardware or firmware, and may not be in compliance with the standards of both the devices. AllBee, on the other hand, is a dual standard compliant method to reliably facilitate parallel CTC between heterogeneous devices through a simple software modification. The speed, reliability and simplicity of this technology makes it suitable for several consumer IoT products as well as for ad hoc networks.

Phase of Development

Prototype developed. Reliable communication between

- a commodity WiFi device and a commodity ZigBee device at 126 Kbps,
- a commodity Bluetooth device and a commodity ZigBee device at 225 Kbps,
- a commodity LTE (android) device and a commodity ZigBee device >400 meters

has been tested and well-characterized.

Read about XBee-XFi technology, a CTC from low-rate devices (ZigBee, Bluetooth) to high-rate devices (WiFi).

Researchers

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External Link (www.cts.umn.edu)

Publications

WEBee: Physical-Layer Cross-Technology Communication via Emulation
Proceedings of the 23rd Annual International Conference on Mobile Computing and Networking. ACM, 2017 https://dl.acm.org/citation.cfm?id=3117816Proceedings of the 23rd Annual International Conference on Mobile Computing and Networking. ACM, 2017 ,
Bluebee: a 10,000 x faster cross-technology communication via phy emulation.
Proceedings of the 15th ACM Conference on Embedded Network Sensor Systems. ACM, 2017,
LTE2B: time-domain cross-technology emulation under LTE constraints.
Proceedings of the 17th Conference on Embedded Networked Sensor Systems. 2019.,

Ready for Licensing

This technology is now available for license! The University is excited to partner with industry to see this innovation reach its potential. Please contact us to share your business' needs and your licensing interests in this technology. The license is for the sale, manufacture or use of products claimed by the patents.