



Low-end to high-end cross-technology communication via cross-decoding (XBee-XFi)

A method to enable high-throughput, concurrent cross-technology communication from low-end to high-end wireless devices using cross-decoding technique.

Technology No. 2019-076

IP Status: PCT Patent Application Filed; **Application #:** PCT/US2019/058118

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 on receiver-end device only.
- **Cost effective:** does not require multi-radio gateways; no additional radio traffic.
- **Concurrent communication:** multiple IoT devices can communicate simultaneously with WiFi devices.
- **Ubiquitous internet connectivity** for low-end IoT devices; repurposing billions of WiFi devices as IoT gateway to the internet.

Receiver-side cross-technology communication with cross-decoding

Researchers at the University of Minnesota have developed a new technology to enable **cross-technology communication (CTC) from low-end wireless devices to high-end wireless**

devices without hardware or firmware modifications. This technology, named XBee-XFi, is a physical-layer CTC design based on *receiver-side cross-decoding* method. Implemented by a simple software update on the receiving high-end device, a commercial bluetooth/WiFi device can receive and decode multiple narrowband transmissions from low-end devices. This low-end to high-end heterogeneous CTC technology neither requires additional hardware, nor demands firmware updates on commodity devices. Moreover, no software modification is required on the low-end device which has lower degrees of freedom. Using a novel *signal disentangling* design, this technology enables multiple, heterogeneous IoT devices to concurrently communicate with WiFi devices, thereby improving the network efficiency in densely-deployed IoT environments.

Fast, reliable, and easy to implement CTC technology

One of the common solutions currently used to achieve CTC 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 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. XBee-XFi, on the other hand, reliably facilitate CTC from low-end IoT devices to high-end devices through a simple software modification. The speed, reliability and simplicity of this technology makes it suitable for several consumer IoT products and applications.

Phase of Development

Prototype developed. Reliable CTC between

- a commodity WiFi device and a commodity ZigBee device at 3.1 Mbps; demonstrated concurrent receipt of 2 streams of ZigBee and 8 streams of BLE with 97% accuracy.
- a commodity high-end device and a commodity ZigBee device at 250 Kbps (15,000x higher data rate than state-of-the-art physical-layer CTCs), with 85% accuracy.

has been tested and well-characterized.

Researchers

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[External Link](http://www.cts.umn.edu) (www.cts.umn.edu)

Publications

[Achieving receiver-side cross-technology communication with cross-decoding.](#)

Proceedings of the 24th Annual International Conference on Mobile Computing and Networking. ACM, 2018.,

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