



Cross-technology Wireless Communication (20150103, Dr. Tian He)

IP Status: Issued US Patent; **Application #:** 15/066,798

Wi-Fi, ZigBee and Bluetooth Spectrum-free Communications

FreeBee, a cross-technology framework implemented in software, can enable communication between Wi-Fi Access Points (APs), ZigBee devices and Bluetooth devices. With no required changes to the air-to-air physical layer Wi-Fi standard, it uses pulse-position modulation (PPM) to encode data in mandatory beacons. The communication comes from the network and therefore does not use any additional spectrum, and it is facilitated via software updates to existing systems, thereby requiring no additional hardware (or any physical changes to existing hardware). The technology could be self-installed and would be considerably less expensive to develop and deploy than existing systems (e.g., those requiring additional hardware and occupying spectrum). Its strong support for highly mobile and extremely duty-cycled receivers gives the technology a wide range of potential applications.

Software Deployment and Updates

Cross-technology wireless communication between Wireless Local Area Networks (WLAN), e.g. Wi-Fi, and Wireless Personal Area Networks (WPAN), e.g. ZigBee and Bluetooth, is not currently possible without additional hardware and/or changes to air-to-air physical layer standard. This technology allows direct communication simply via a software update to existing Wi-Fi APs. Current cross-technology communication technologies also occupy spectrum, a limited resource expected to face increasing challenges in the future, while the software implemented solution uniquely occupies no spectrum and has virtually no effect on legacy wireless devices. In addition, existing technologies require a network setup, which requires considerable time and effort. This software may be distributed online for easy self-installation, thus reducing costs and potentially increasing technology adaptation.

BENEFITS AND FEATURES:

- Implemented via firmware updates; no additional hardware required
- Generates side channel with mandatory beacons that does not consume additional spectrum (bandwidth) and does not disrupt legacy networks
- Self-installation reduces deployment costs and increases ease of use
- Wi-Fi air-to-air physical layer standards remain unchanged
- Continuous broadcast for receivers to listen on demand, supporting mobile and/or duty-cycled receivers
- Mobile device can turn off Wi-Fi module for AP discovery and use Bluetooth instead
- Free communication
- Continuous broadcast from Wi-Fi to other networks
- At least 10 times faster than state-of-the-art

APPLICATIONS:

Technology ID

20150103

Category

Software & IT/Communications &
Networking

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- Wi-Fi (IEEE 802.11 a/b/g/n), ZigBee, (802.15.4) and Bluetooth 4.0 (802.15.1) devices
- Low-energy smart home technology
- Wireless attraction for stores and including restaurants coffee shops that provide free Wi-Fi to attract customers
- Extending smartphone battery life by using Bluetooth instead of power-hungry Wi-Fi interfaces until free Wi-Fi hotspots are available
- Reducing cross technology interference

Phase of Development - Prototype and testing. Test bed with 8 Wi-Fi APs (laptops) and 30 ZigBee nodes; recently completed an AP FPGA. Finished initial design as well as proof-of-concept experiments and measurements.

Researchers

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[External Link](http://www-users.cs.umn.edu) (www-users.cs.umn.edu)

Publications

[*FreeBee: Cross-technology Communication via Free Side-channel*](#)

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