The Hidden Benefits of Backscatter Radio and RFID at 5.8 GHz

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This paper presents new systems for reading radio-frequency backscatter tags at 5.8 GHz. Backscatter radio is an incredibly promising technology for the wireless exchange of sensor data, identification information, and digital content using passive, low-cost devices. Today's state-of-the-art RF tags struggle to exchange information with tags and readers separated by even tens-of-centimeters. The gains that become possible when moving to higher microwave frequencies promise to multiply both range and reliability. Research into these high-frequency tools and technology will allow the proliferation of new applications: health monitoring, contactless data retrieval from memory sticks, hull corrosion sensing for aircraft, wireless barcodes, and countless other conceivable uses.

The push to operate RF tags at high-frequency is somewhat counter-intuitive. After all, higher-frequency microwave radio links tend to suffer higher path loss and device losses in the RF chain. Also, RF tags are meant for low-cost, short range communication; if frequency increases, the cost of the tag RF electronics increases. However, there are numerous advantages to working in the upper microwave bands that will eventually outweigh the drawbacks:

1. **High-Gain Read Antennas:** In the 5.8 GHz microwave band, it is possible to build compact, directional antennas and antenna arrays that overcome the severe losses of a passive radio transponder.
2. **Resistance to Conductive Object Degradation:** The far-field performance of an RF tag antenna seriously degrades when placed against conductive objects, yet these effects are actually mitigated as frequency increases [1].
3. **More Available Bandwidth:** There is less spectral congestion and higher available bandwidth in the 5.8 GHz band, which enables a variety of link-enhancing signal processing techniques [2].
4. **Smaller Tag Footprint:** The overall size of an RF tag, which is normally limited by efficient antenna size, will drop; in fact, multiple link-enhancing antennas on the RF tag itself may be used within a smaller footprint.
5. **Spatial-Signaling Techniques:** Griffin has shown in recent research that the ability to integrate multiple antennas onto a compact RF tag allows new signaling schemes that dramatically improve the range and reliability – particularly in the presence of multipath fading [3].
6. **Super-Paramagnetic Materials:** The materials involve magnetic nano-particles that achieve significant permeability in microwave bands. They allow fabrication of RF isolators and thin, flexible microwave circuits at frequencies above 10 GHz [4].

Much of the work discussed is part of the on-going 5.8-GHz RFID research program at Georgia Tech.

References

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