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Antenna Design in Ambient Backscatter Communications for IoT Applications

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Abstract

With the emergence of "Smart Technologies", everyday objects can be connected and controlled through the internet. IoT network provides a platform where physical objects with embedded sensors can be connected to each other to share the data. However, limitations in providing energy recourses and allocated spectrum are challenges toward the expansion of IoT applications. This research focuses on the design of wideband antennas, suitable for ambient RF energy harvesting and ambient backscatter communications for IoT applications.

Internet of Things, Opportunities and its Challenges:

- **Opportunities**
  - Rapid growth of digitization
  - Increased number of connected objects
- **Challenges**
- All the connected devices need to be powered
  - Wires are not feasible
  - Batteries are bulky, costly, and require recharging or replacement
- Allocated spectrum is required

Promising Solution

- Ambient Backscatter Communications (AmBC), a novel communication mechanism;
- Ambient RF Energy Harvesting (RFEH), to recycle and reuse the already available, ambient signals in the air.

Proposed Antennas

- **Main Antenna Features**
  - Broadband Characteristics
  - Circular Polarisation (CP)
  - Compact Size and Low-profile
  - High Efficiency
  - Simple Structure and Easy to Fabricate

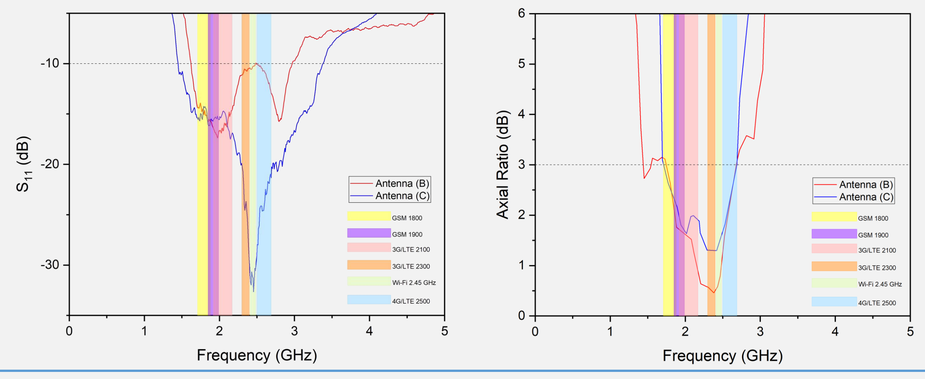
(A) (B) (C)

Antenna	(A)	(B)	(C)
Antenna Size (mm^2)	95.33 × 95.33	150 × 150	50 × 60
Bandwidth	230 MHz	1,350 MHz	1,930 MHz
CP Bandwidth	143 MHz	934 MHz	990 MHz
Max. Gain	4.49 dBic	4.65 dBic	3.70 dBic

Desired Frequency Bands for AmBC and RFEH

	Future Work				Current Work				
	LTE 600	LTE 700	GSM 850	GSM 900	GSM 1800	GSM 1900	3G/LTE	Wi-Fi 2.45	4G/LTE
Uplink (MHz)	617-652	698- 748	824-849	890 - 915	1710 - 1784	1850 - 1900	1920 - 1980	2412 - 2485	2500 - 2570
Downlink (MHz)	663-698	758 - 806	869-894	935 - 960	1805 - 1879	1930 - 1990	2110 - 2170		2620 - 2690

Achievements from the Current Works



UN Sustainable Development Goals

Challenges:

- The environment is negatively impacted by battery manufacturing and disposal of the batteries.
- The harsh chemicals inside batteries are hazardous to humans, if the battery disposed imperfectly.
- Hazardous industrial areas and many remote areas are not easily and safely accessible for data collection in the IoT network.
- Generation of an allocated spectrum is not cost effective and not feasible all the time.

How this project contribute to the UN Sustainable Development Goals:

- Recycling and reusing already available ambient energy is a green source of energy that can be used in urban and semi-urban environments.
- Self-power self-sustainable IoT devices contributes to the sustainable environment and climate action movements.
- Reduction in manufacturing batteries, saves our natural resources.
- RFEH and AmBC technologies helps to expand IoT applications, build resilient infrastructure, and make sustainable cities and communities.

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