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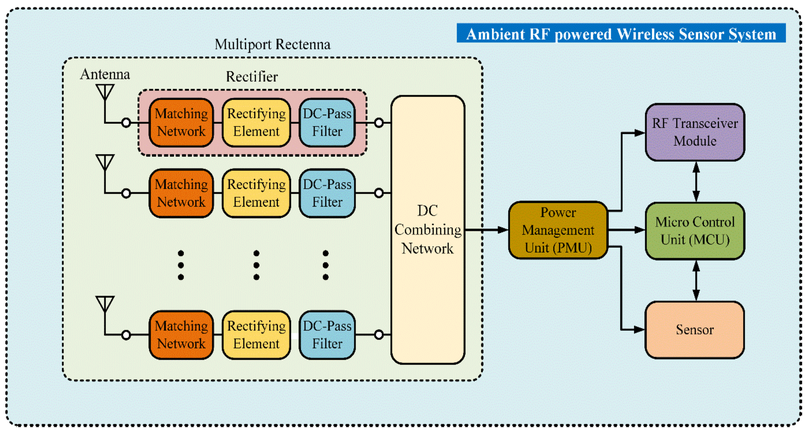
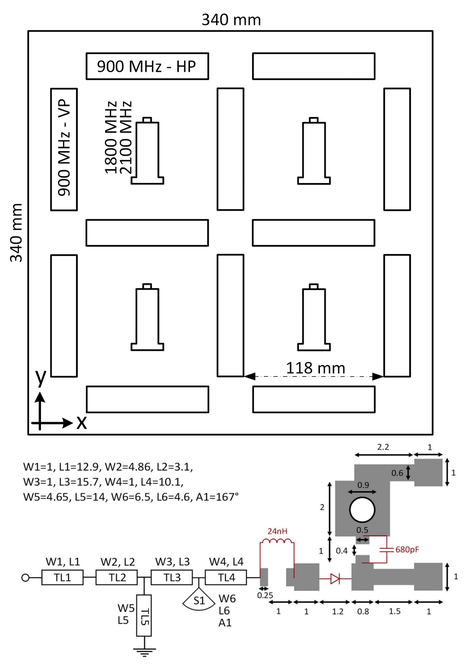
Department of Electronic and Computer Engineering

An Ambient RF Powered Wireless Sensor System

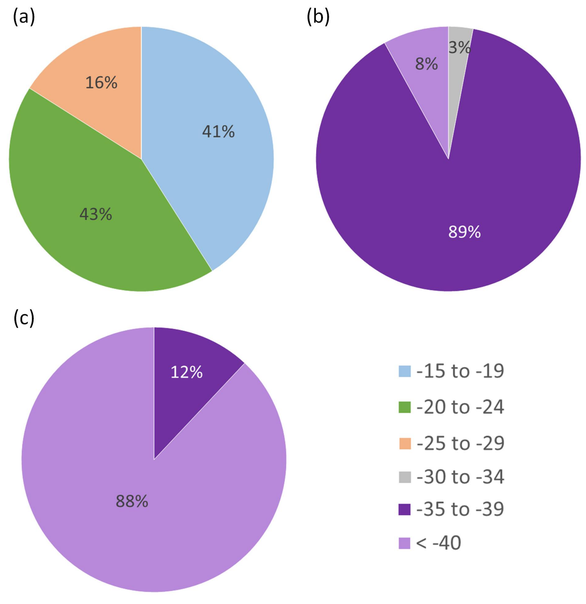
Prof. Ross Murch's Research Group



Block diagram of the proposed ambient RF powered wireless sensor system. From left to right the components are respectively the antennas, rectifiers, PMU and AU (MCU, Sensors and RF transceiver module).

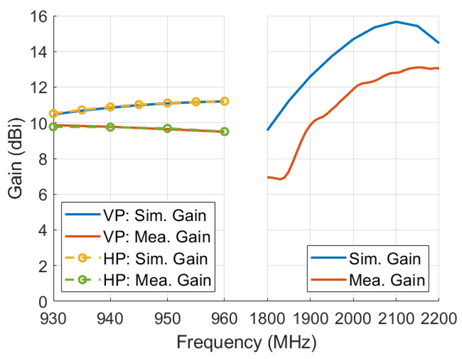


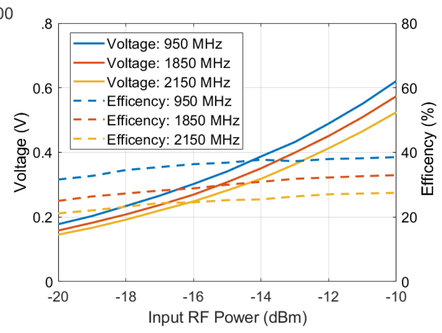
(Top) Geometry of the proposed multi-band dual-polarized patch antenna array; (Bottom) topology layout of rectifier for single band 900 MHz range (units: mm).



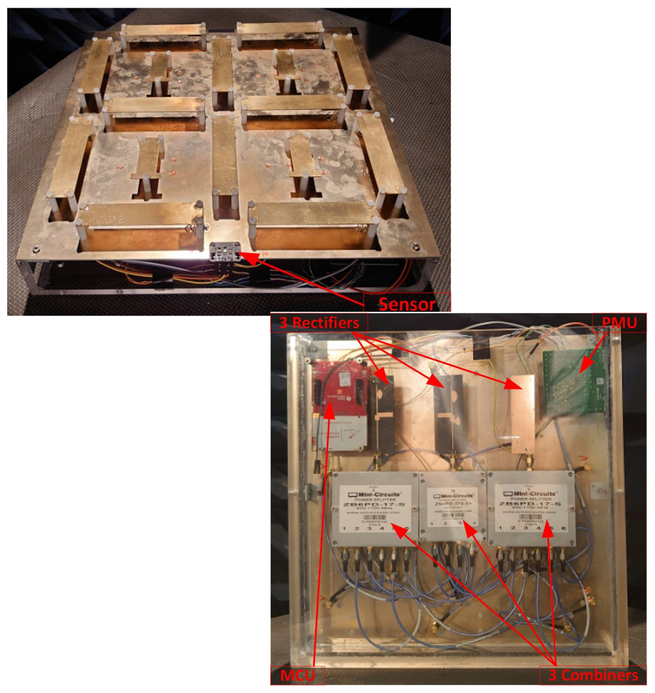
72-hour datalog of ambient RF power strengths measured in computer barn at HKUST campus: (a) 950 MHz; (b) 1850 MHz; and (c) 2150 MHz (units: dBm).

Simulation and Experimental Results





(Left) Simulated and measured antenna array gains. The discrepancy is due to the use of physical combiners and cables, closely spaced antenna elements and imperfect fabrication of individual radiating elements in measurement. (Right) Measured output voltage and RF-to-DC efficiency of the proposed single band and dual-band rectifiers.



Prototype of multi-band dual-polarized ambient RF powered wireless sensor system: (Top) 3D view; (Bottom) backside view where key modules are also identified (Prototype volume including antennas and acrylic box: 34 x 34 x 7.2 cm^3).

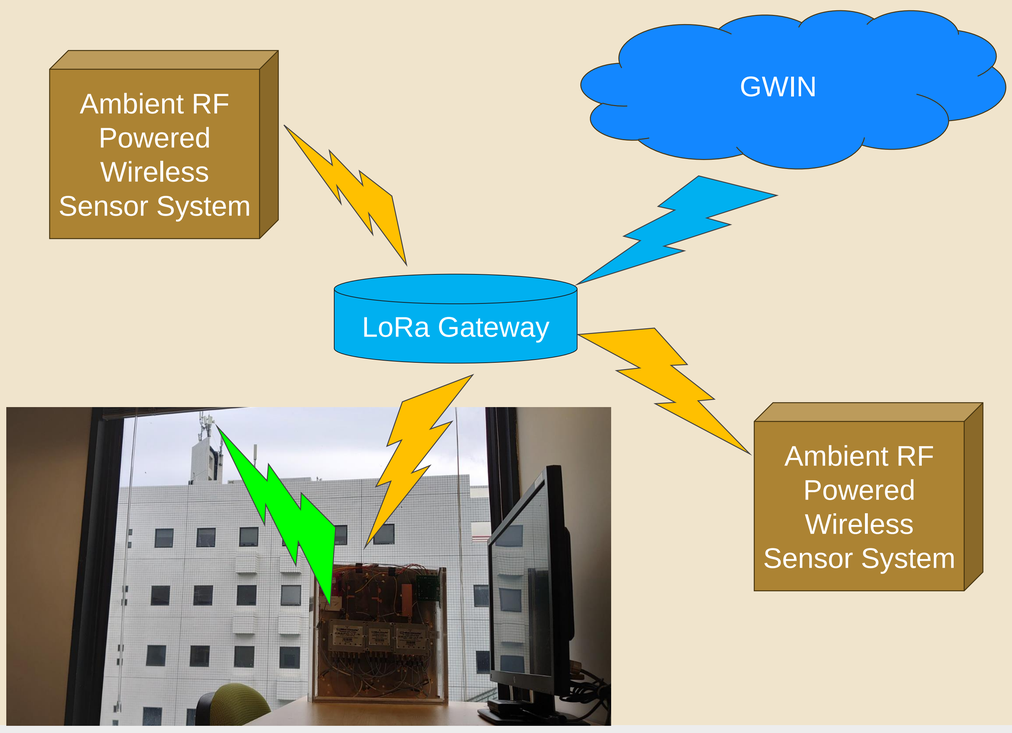
Our prototyped ambient RF energy harvesting system. In the top left a basestation can be seen and our ambient RF energy harvesting sensor system can be seen in the foreground of the window 50 m away. The system provides sensor measurements every 15 minutes and a cold start time of 6 hours.

A unique feature of the system is the use of off-the-shelf modules including PMU – TI BQ25570evm-206; MCU – TI LAUNCHXL-CC2640R2; Sensor – Adafruit BMP280; Supercapacitor – Kemet FCS0H473ZFTBR24; BLE-LoRa bridge – Heltec HTCC-WB32LA-F.

Our Related Journal Publications

1. M. -T. Chiu, C. -Y. Chiu, C. Ng, L. -O. Wong, S. Shen and R. Murch, "An Ambient RF Powered Wireless Sensor System," in ***IEEE Open Journal of Antennas and Propagation***, vol. 3, pp. 1382-1393, 2022, doi: 10.1109/OJAP.2022.3225169.
2. S. Shen, Y. Zhang, C. -Y. Chiu and R. Murch, "Directional Multiport Ambient RF Energy-Harvesting System for the Internet of Things," in ***IEEE Internet of Things Journal***, vol. 8, no. 7, pp. 5850-5865, Apr. 2021, doi: 10.1109/JIOT.2020.3032435.
3. Y. Zhang, S. Shen, C. -Y. Chiu and R. Murch, "Hybrid RF-solar Energy Harvesting Systems Utilizing Transparent Multiport Micromeshed Antennas," in ***IEEE Transactions on Microwave Theory and Techniques***, vol. 67, no. 11, pp. 4534–4546, Nov. 2019, doi: 10.1109/TMTT.2019.2930507.
4. S. Shen, Y. Zhang, C. -Y. Chiu and R. Murch, "An Ambient RF Energy Harvesting System where the Number of Antenna Ports is Dependent on Frequency," in ***IEEE Transactions on Microwave Theory and Techniques***, vol. 67, no. 9, pp. 3821–3832, Sep. 2019 doi: 10.1109/TMTT.2019.2906598.

Ambient RF Energy Harvesting Technology can be included into IoT Sensing for 6G



Acknowledgment

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