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The University of Texas at Austin **Electrical and Computer**

Engineering

Bluetooth Low Energy Transceiver for IoT Applications

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Objective: Validate and Calibrate Bluetooth-Low Energy Transceiver

(1. Project Overview and Goals)

(3. Selectivity Setup and Measurements)

Desired Packet Trigger

Interference Power Level Trigger

- Bluetooth Low Energy (BLE)
 - Hops among 40 2-MHz channels
 - Gaussian Frequency Shift (GFSK) Modulation
 - 1Mbps bit rate
 - Applications in smart homes, wearables etc.
- Test Bluetooth-LE v4.2 in 2.4GHz band in presence of in-band adjacent/alternate channel interference under variable settings

Modulation	Bit Rate	Clock Frequency
GFSK	250kbps	32MHz
BLE	500kbps	26MHz
MSK	1Mbps	

Optimize transceiver driver settings to meet performance targets

Target Ratio Measure	Condition	
BLE Packet Error Rate <30.8%	Various operational settings	
NXP Carrier to interference	At interferer frequency	
Ratio <-50dB	offsets >= 3MHz	

(2.Procedure)

Build Hardware Measurement Setups:

- Replicate GFSK and MSK sensitivity setup
- Develop BLE and GFSK selectivity setup

Collect Received Packet Statistics:

- Collect #good, #bad, #missing packets
- Modify and add calibration functions

Interpret and Visualize Data:

- Iterate/generate PER plots
- Cross check with teams in France



DC Profiling and Optimization Bluetooth - LE 3MHz Selectivity (after optimization) Threshold Board A Board B Board C Board D AGC Trial Setting 1 AGC Trial Setting 2 AGC Trial Setting 3 AGC Trial Setting 4 (4. Sensitivity Setup and Measurements) • Desired signal sent to board at different transmission power level to verify C/I Ratio

• Desired signal along with interference signal which varies in frequency offsets/power

RF Desired Signal

RF Interference Signal

home area networks

Threshold

AGC Trial Setting 1

AGC Trial Setting 2

AGC Trial Setting 3

AGC Trial Setting 4



- Sending 1500 BLE packets
- Operating at different settings
- Sweeping TX power 100dBm till 10dB

Bluetooth - LE 3MHz Selectivity (before optimization)

-49

-52

-52

-50

DC Calibration

Board B

Board A

Board C Board D

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-50

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(5. Sensitivity and Selectivity)

Applications: smart energy

security systems

BLE (2.44GHz BT = 0.5 h = 0.5)			
Data Rate	Sensitivity level		
(kbps)	(dBm)		
1000	-94		
500	-98		
250	-99		

BLE (2.44 GHz 1Mbps BT = 0.5h =0.5)				
		Interference power		
Interferer freq. offset	C/I Ratio	where PER>30.8%		
(MHz)	(dB)	(dB)		
-3	-54	-13.5		
-2	-47	-19.5		
3	-47	-19.5		
2	-55	-11.5		

