Project Name: XER10
Antenna Test Report

Dec. 27, 2024

Prepared by: Larry Jiang

Introduction

- This report presents the passive antenna performance for XER10
- Sercomm integrated 11 antennas into the simulation mockup

  4 WiFi DB antennas (2.4-2.5GHz and 5.15-5.85GHz band of operation)

  4 WiFi 6G antennas (5.925-7.125GHz Band of operation)

  2 IOT Antennas (Zigbee)

  1 BT antenna (2.4-2.5GHz band of operation)
- Cable losses are included in the measurement data

2

Antenna Details

Item	Part number	Connector	Spec	Quantity	Polarization	Ant No.
1	6172003YWA	U.FL	PCB 218mm GN	1	Linear	Zigbee1
2	6172003ZWA	U.FL	PCB 202mm OG	1	Linear	Zigbee2
3	61720040WA	U.FL	PCB 128.5mm BU	1	Linear	6G1
4	61720041WA	U.FL	PCB 141.5mm YE	1	Linear	6G2
5	61720042WA	U.FL	PCB 198.5mm BN	1	Linear	6G3
6	61720043WA	U.FL	PCB 201.5mm BK	1	Linear	6G4
7	61720044WA	U.FL	PCB 150mm WH	1	Linear	DB1
8	61720045WA	U.FL	PCB 212mm GY	1	Linear	DB2
9	61720046WA	U.FL	PCB 245mm RD	1	Linear	DB3
10	61720047WA	U.FL	PCB 201mm BK	1	Linear	DB4

Ant No.	Operating Band	Type	Material	Feeding	Polarization
DB1~4	2400MHz ~ 2500MHz 5150MHz ~ 5850MHz	Dipole	PCB	Cable	Linear
6G1~4	5925MHz ~ 7125MHz	Dipole	PCB	Cable	Linear
ZigBee 1~2	2400MHz ~ 2500MHz	Dipole	PCB	Cable	Linear
BT	2400MHz ~ 2500MHz	PIFA	Printed	Trace	Linear

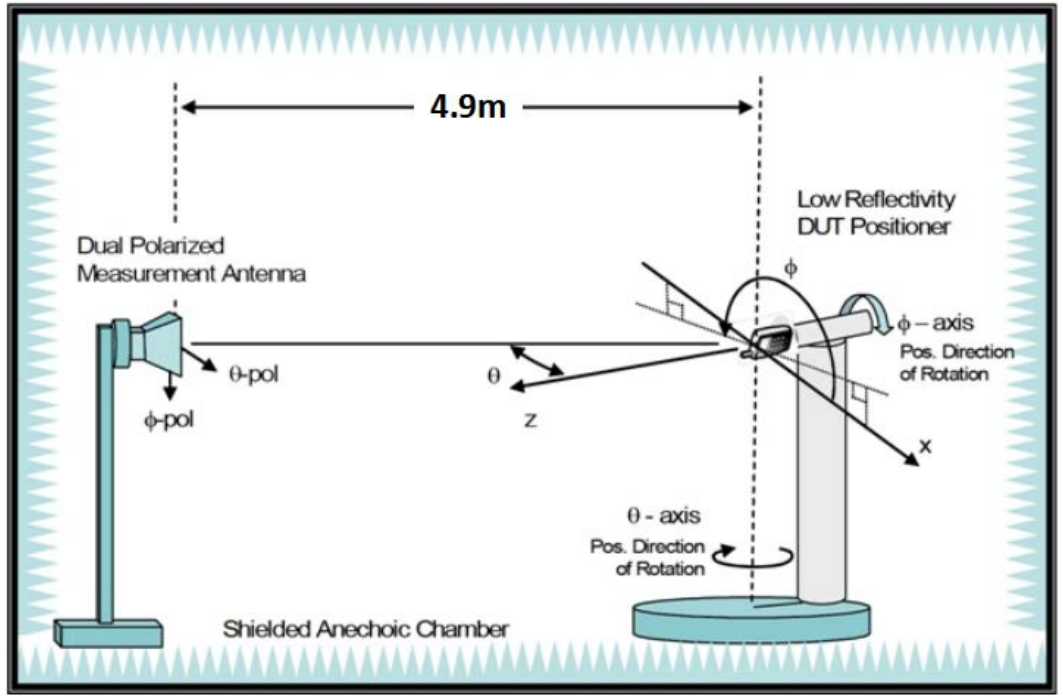
Test Infomation

Item	Description
Brand Name	Comcast
Equipment	XER10
Test Location	8F, No. 3-1, YuanQu St. Taipei, Taiwan 115 R.O.C.
Test Condition	Radiation
Test Engineer	Larry Jiang, Sercomm
Test Environment	ETS-Lindgren AMS-8500 Antenna Measurement Chamber
Test Date	Dec. 27, 2024
Measurement control	EMQuest V1.09

4

Test Configuration

ETS-Lindgren AMS-8500 antenna measurement system with a size of 7.32(L) × 3.66(W) × 3.66(H) m^3 is used for antenna performance test, which is based on the great-circle test method defined by CTIA. The multi-axis positioning system (MAPS) rotates the DUT around two orthogonal axes for full spherical coverage.



5

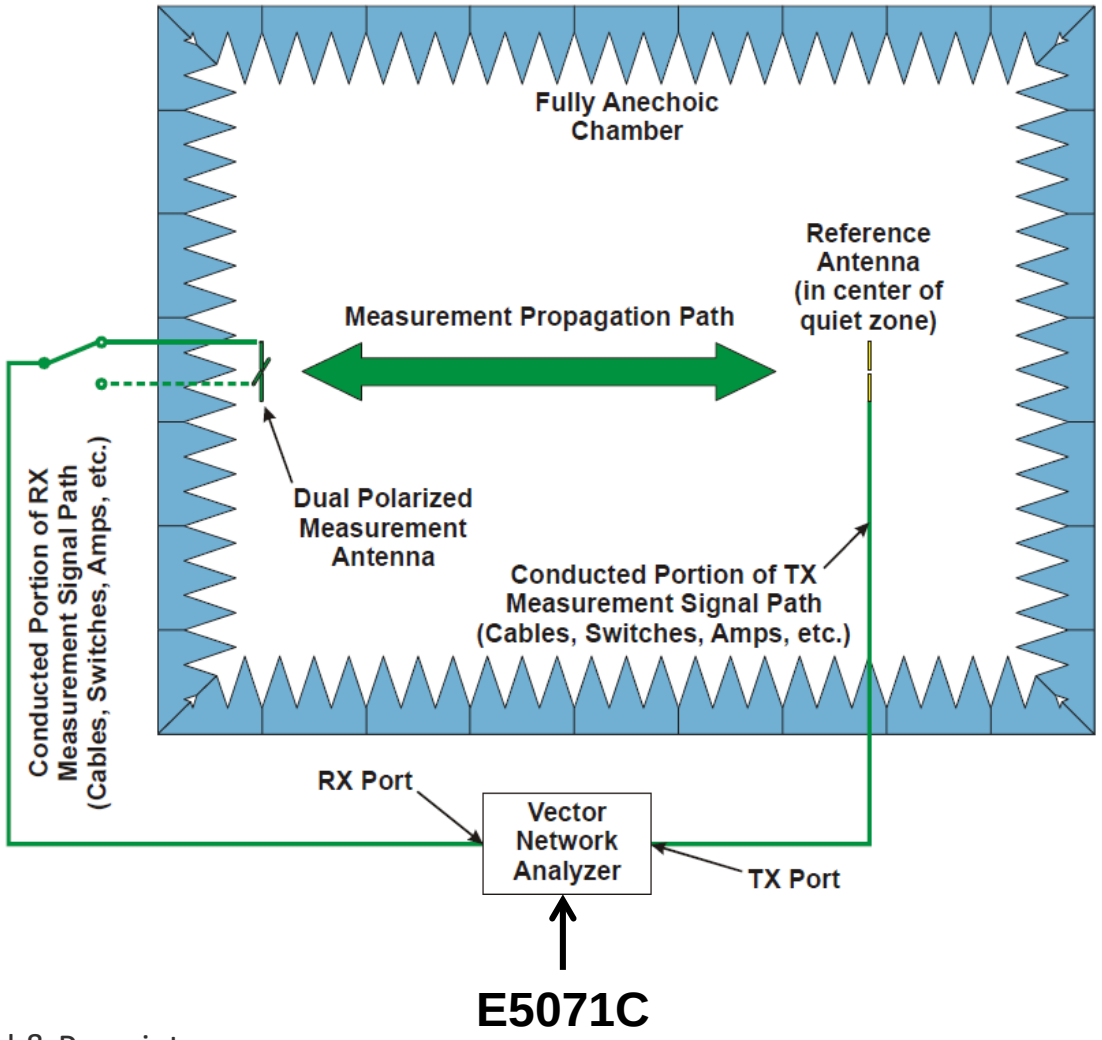
Test Setup & Procedure

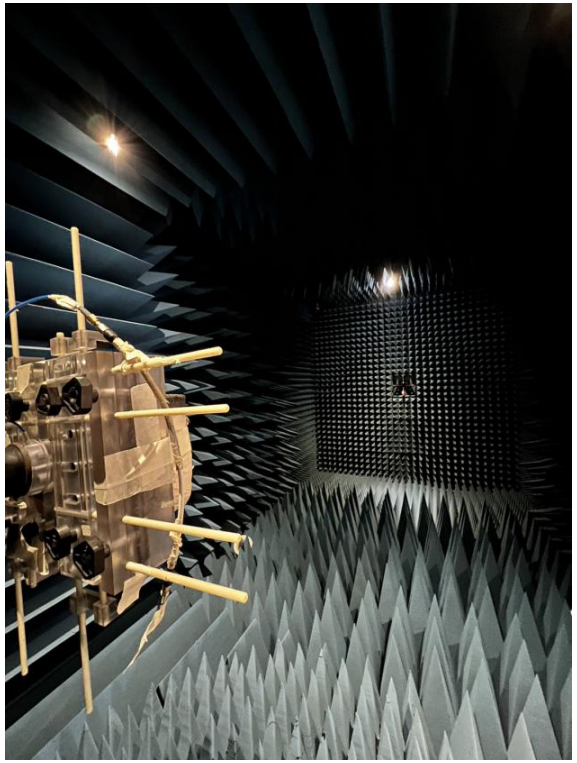
1. Fix the DUT on the dielectric support structure and connect the feeding cable to the antenna used for test
2. Set measurement parameters such as frequency range and sampling angle
3. Perform test and then get far-field data (radiation pattern, gain, efficiency)
4. Repeat test procedure for other antennas

6

Test Equipment & Calibration

Network analyzer and reference antennas are used for calibration. Path loss and cable loss for different frequency bands can be checked and calculated.





Test Equipment & Calibration

Instrument	Brand	Characteristics	Model No.	Serial No.	Calibration Date	Calibration Due Date
Precision Sleeve Dipole	ETS-Lindgren	700 MHz ~ 900 MHz	3126-700	00169715	May 21, 2024	May 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	900 MHz ~ 1000 MHz	3126-900	00169592	May 21, 2024	May 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	1400 MHz ~ 1700 MHz	3126-1550	00164599	May 21, 2024	May 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	1700 MHz ~ 2000 MHz	3126-1850	00169588	May 21, 2024	May 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	2000 MHz ~ 2300 MHz	3126-2150	00169593	May 21, 2024	May 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	2300 MHz ~ 2700 MHz	3126-2500	00169597	May 21, 2024	May 21, 2025
Precision Sleeve Dipole	ETS-Lindgren	5000 MHz ~ 6000 MHz	3126-5500	00169728	May 21, 2024	May 21, 2025
Horn Antenna	SCHWARZBECK	1 GHz ~ 18 GHz	BBHA 9120D	BBHA 9120D-1294	Apr. 07, 2024	Apr. 07, 2025
EMQuest Antenna Measurement Software	ETS-Lindgren	Control chamber system	EMQ-100	1437	Non-Calibration Required	Non-Calibration Required
VNA	Keysight	9 KHz ~ 8.5 GHz	E5071C	MY46316900	July 15, 2024	July 15, 2025

8

Result Summary - Gain & Efficiency Table

Efficiency & Gain														
Frequency (MHz)	DB1		DB2		DB3		DB4		Zigbee1		Zigbee2		BT	
	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)
2400	73	2	70	3.5	71	3.8	72	4.0	70	3	72	3.2	71	3.6
2450	72	2.6	71	3.4	71	3.7	71	4.8	70	3.2	71	3.8	71	3.3
2500	72	3.5	71	3	72	4.8	70	4.3	69	4	71	4.3	69	3.9
5150	72	4.7	74	4.4	74	4.0	74	4.6						
5500	73	4.9	70	4.3	73	4.5	73	3.9						
5850	74	4.8	73	4.6	71	4.7	71	3.8						

Efficiency & Gain								
Frequency (MHz)	6G1		6G2		6G3		6G4	
	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)
5925	74	3.5	72	3.0	74	3.4	75	4.2
6525	73	4.3	75	3.6	75	3.7	73	3.3
7125	72	3.8	74	3.4	71	4.5	73	3.8

Result Summary - Uncorrelated Gain & Correlated Gain

Frequency (MHz)	Uncorrelated Gain (dBi)	Correlated Gain (dBi)
2400	-0.291	5.377
2450	-0.155	4.987
2500	-0.381	4.809

Frequency (MHz)	Uncorrelated Gain (dBi)	Correlated Gain (dBi)
5150	0.536	5.413
5500	0.169	5.748
5850	0.519	5.637

Frequency (MHz)	Uncorrelated Gain (dBi)	Correlated Gain (dBi)
5925	-0.772	4.995
6525	-0.523	5.364
7125	0.515	5.679

10

Calculations (1/2)

Because the antennas are fixed in location within the device the directional antenna gain for MIMO is calculated over a sphere using the raw spatial data taken at 5 degree steps of theta and phi for each antenna using the equations from KDB 662911 D01. The raw antenna data is located in the appendix of this report.

The uncorrelated antenna gain was calculated using KDB 662911 D01, F(2)(d)(ii)

The uncorrelated gain was calculated for each point in the spatial data, and the highest value reported.

2.4GHz uncorrelated calculation:
Maximum uncorrelated gain: -0.155 dBi
= $10*\log(((10^{(G0/10)})+(10^{(G1/10)})+(10^{(G2/10)})+(10^{(G3/10)}))/4)$
= $10*\log(((10^{(-5.383/10)})+(10^{(-2.536/10)})+(10^{(-13.496/10)})+(10^{(4.725/10)}))/4)$

This occurs at: 2450MHz, phi 225/theta 155

5GHz uncorrelated calculation:
Maximum uncorrelated gain: 0.536dBi
= $10*\log(((10^{(G0/10)})+(10^{(G1/10)})+(10^{(G2/10)})+(10^{(G3/10)}))/4)$
= $10*\log(((10^{(-7.055/10)})+(10^{(3.599/10)})+(10^{(-11.37/10)})+(10^{(2.935/10)}))/4)$

This occurs at: 5150MHz, phi 90/theta 25

6GHz uncorrelated calculation:
Maximum uncorrelated gain: 0.515dBi
= $10*\log(((10^{(G0/10)})+(10^{(G1/10)})+(10^{(G2/10)})+(10^{(G3/10)}))/4)$
= $10*\log(((10^{(-20.356/10)})+(10^{(3.646/10)})+(10^{(-12.111/10)})+(10^{(3.259/10)}))/4)$

This occurs at: 7125MHz, phi 265/theta 20

11

Calculations (2/2)

Because the antennas are fixed in location within the device the directional antenna gain for MIMO is calculated over a sphere using the raw spatial data taken at 5 degree steps of theta and phi for each antenna using the equations from KDB 662911 D01. The raw antenna data is located in the appendix of this report.

The correlated antenna gain was calculated using KDB 662911 D01, F(2)(d)(i)

The correlated gain was calculated for each point in the spatial data, and the highest value reported.

2.4GHz correlated calculation:
Maximum correlated gain: 5.377dBi
= 10*LOG(((10^(G0/20)+10^(G1/20)+10^(G2/20)+10^(G3/20))^2)/4)
= 10*LOG(((10^(0.62/20)+10^(-2.47/20)+10^(-4.112/20)+10^(2.043/20))^2)/4)

This occurs at: 2400MHz, phi 240/theta 135

5GHz correlated calculation:
Maximum correlated gain: 5.748dBi
= 10*LOG(((10^(G0/20)+10^(G1/20)+10^(G2/20)+10^(G3/20))^2)/4)
= 10*LOG(((10^(-1.279/20)+10^(-0.116/20)+10^(-2.578/20)+10^(2.167/20))^2)/4)

This occurs at: 5500MHz, phi 130/theta 35

6GHz correlated calculation:
Maximum correlated gain: 5.679dBi
= 10*LOG(((10^(G0/20)+10^(G1/20)+10^(G2/20)+10^(G3/20))^2)/4)
= 10*LOG(((10^(-0.161/20)+10^(0.378/20)+10^(1.219/20)+10^(-3.493/20))^2)/4)

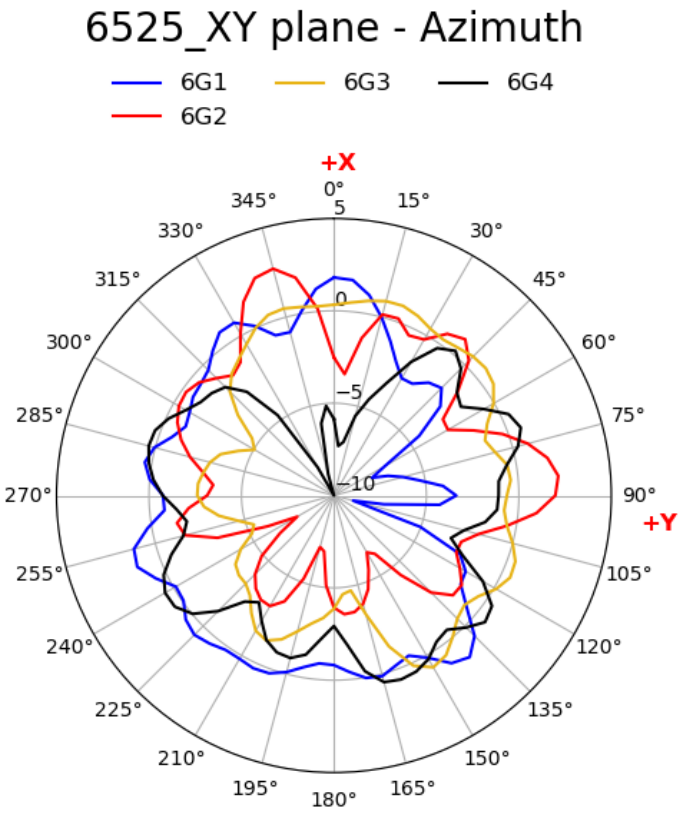
This occurs at: 7125MHz, phi 145/theta 25

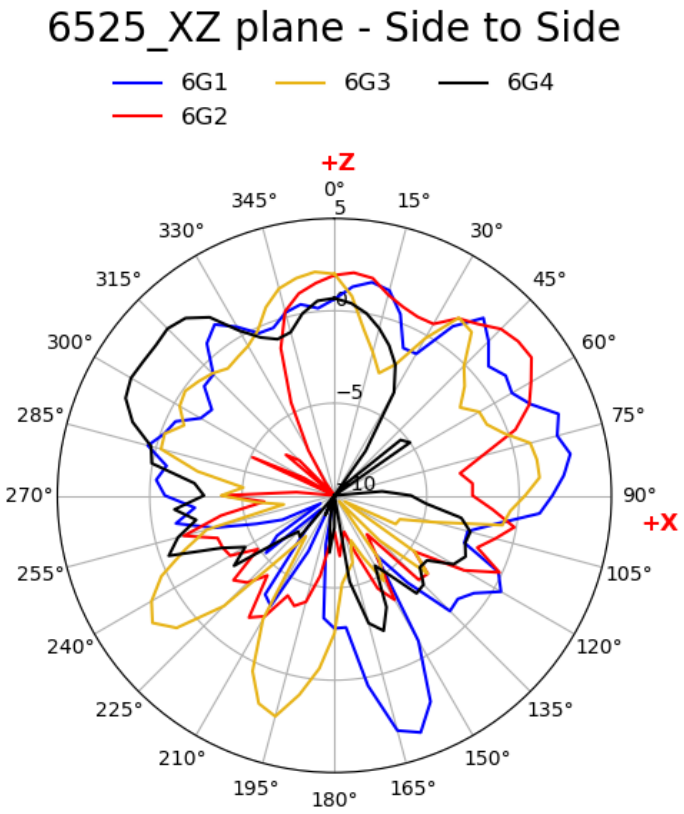
12

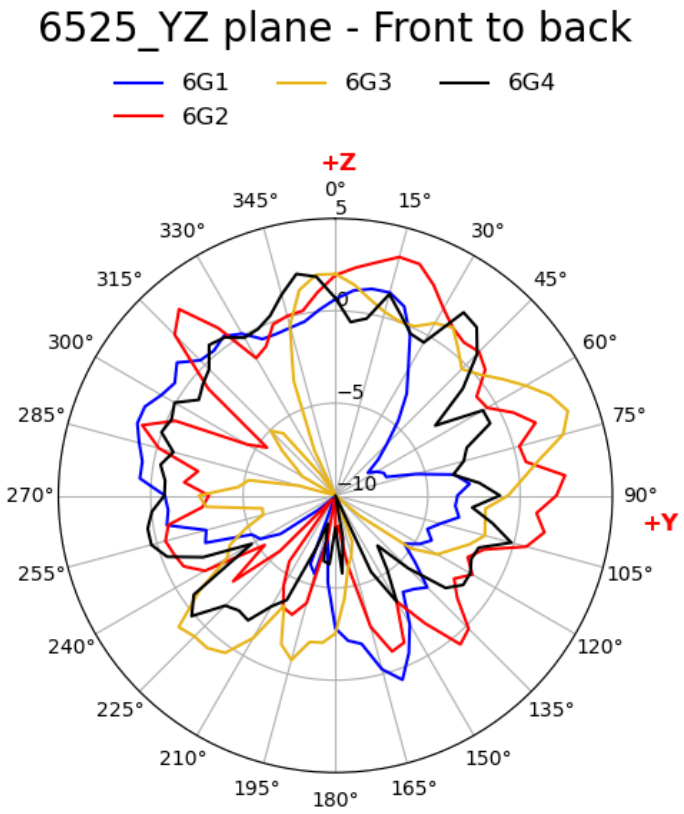
Appendix

13

System Coverage - WIFI 6G



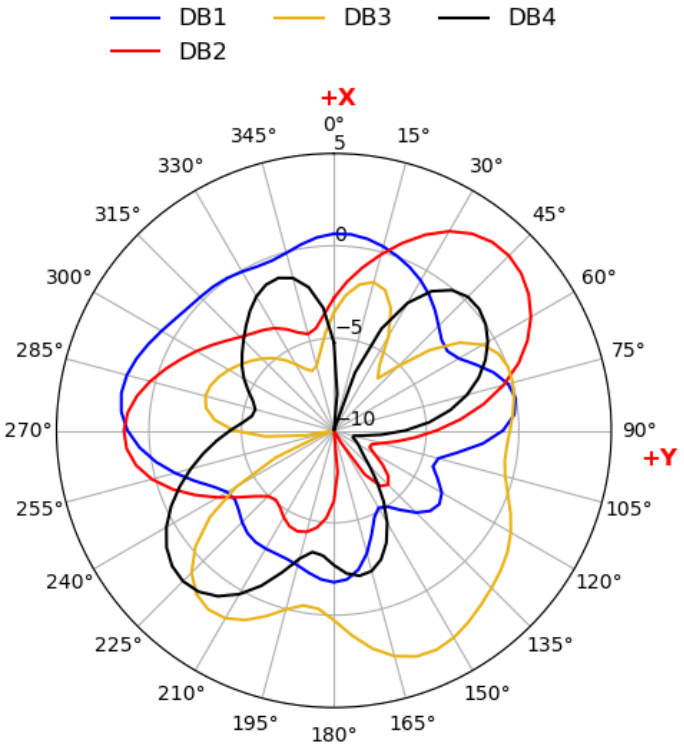




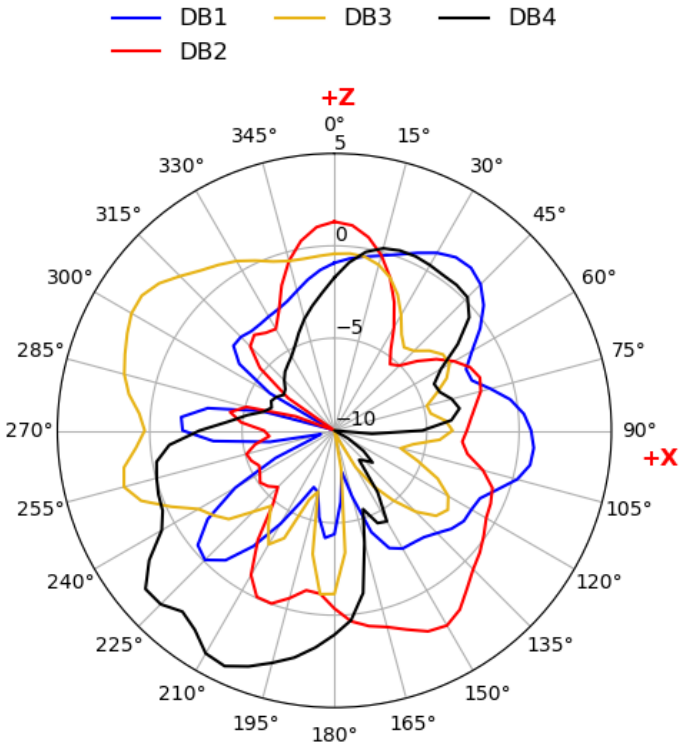
14

System Coverage - WIFI DB 2G/5G @2G

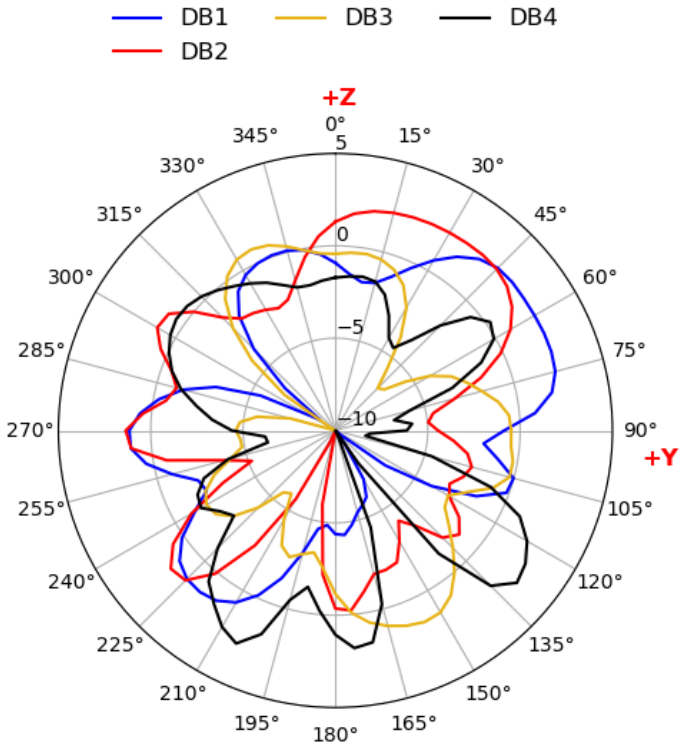
2450_XY plane - Azimuth



2450_XZ plane - Side to Side



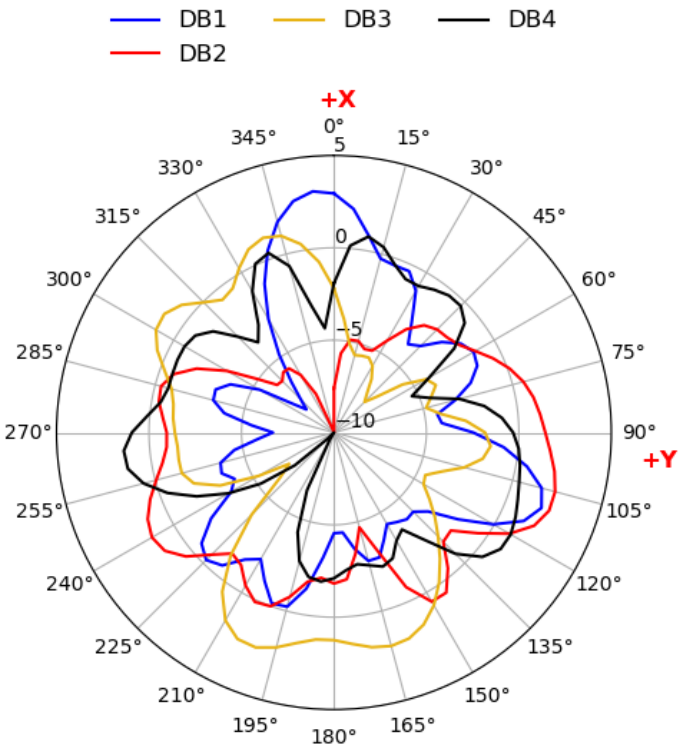
2450_YZ plane - Front to back



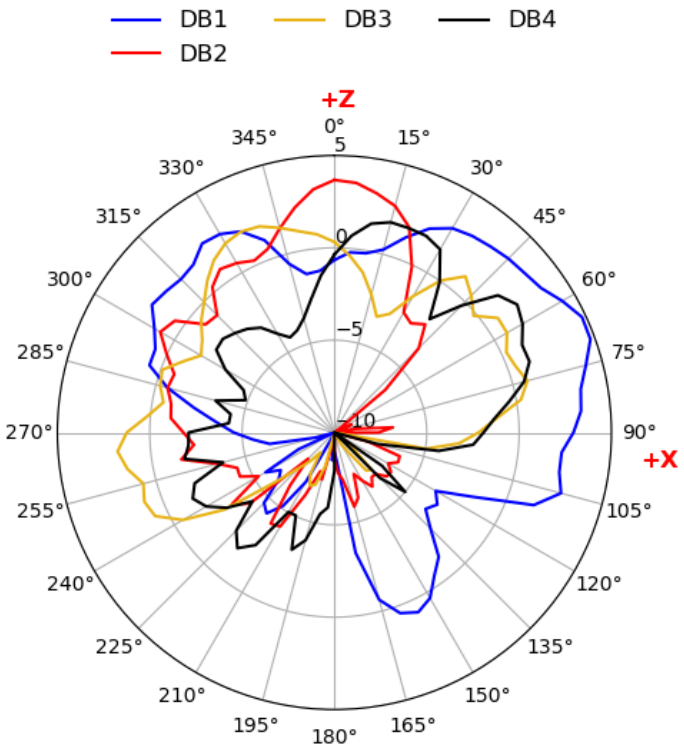
15

System Coverage - WIFI DB 2G/5G @5G

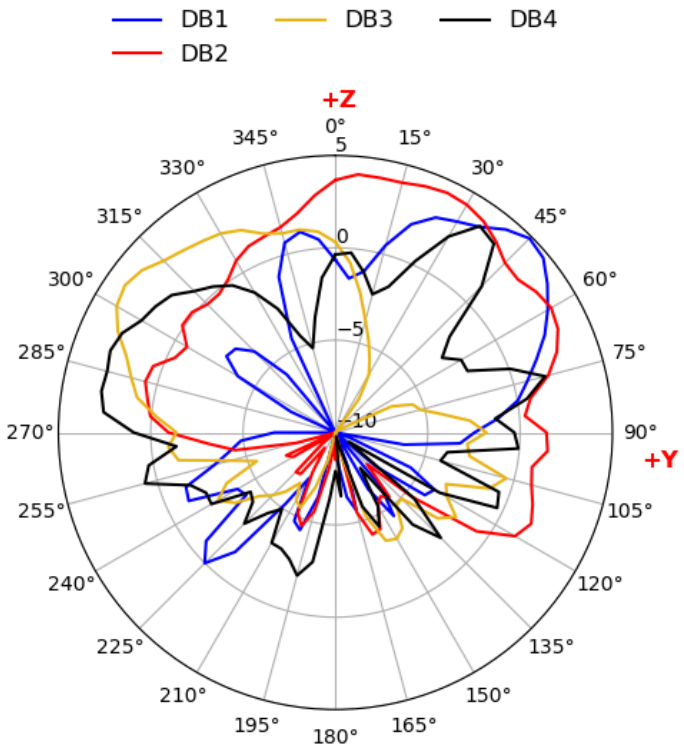
5500_XY plane - Azimuth



5500_XZ plane - Side to Side



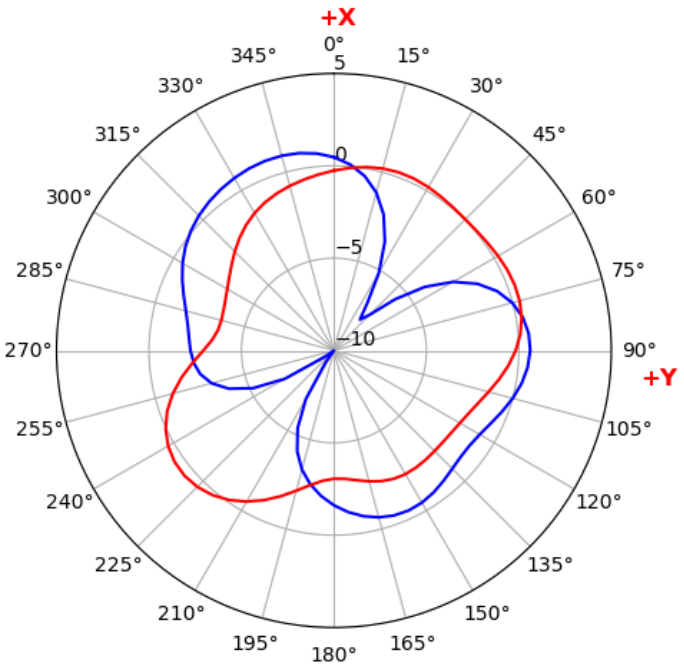
5500_YZ plane - Front to back



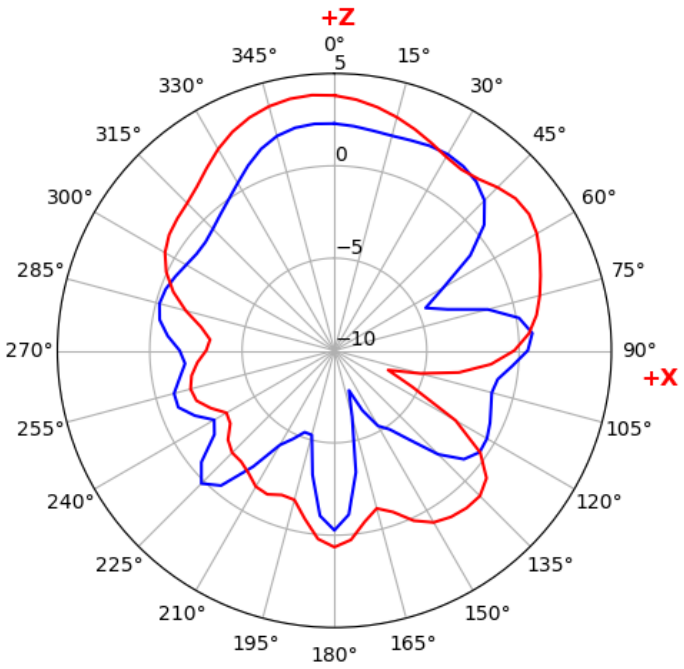
16

System Coverage - IOT ZigBee @2G

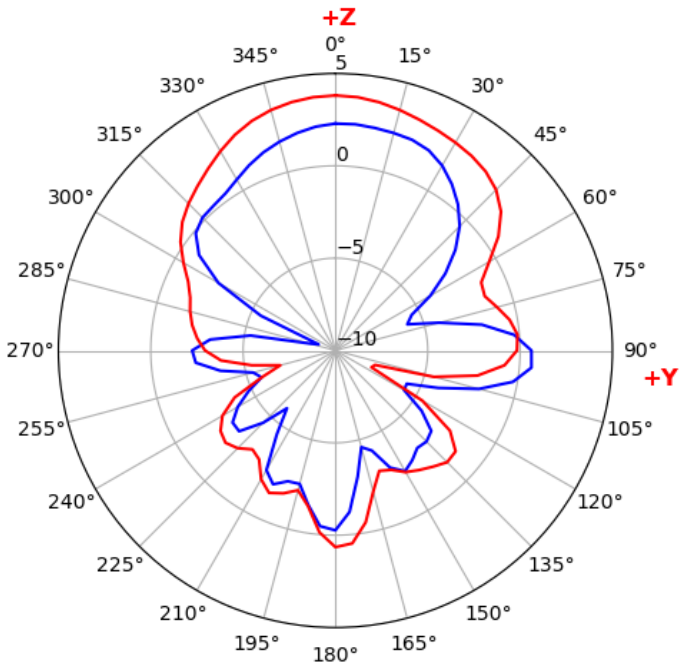
2450_XY plane - Azimuth



2450_XZ plane - Side to Side



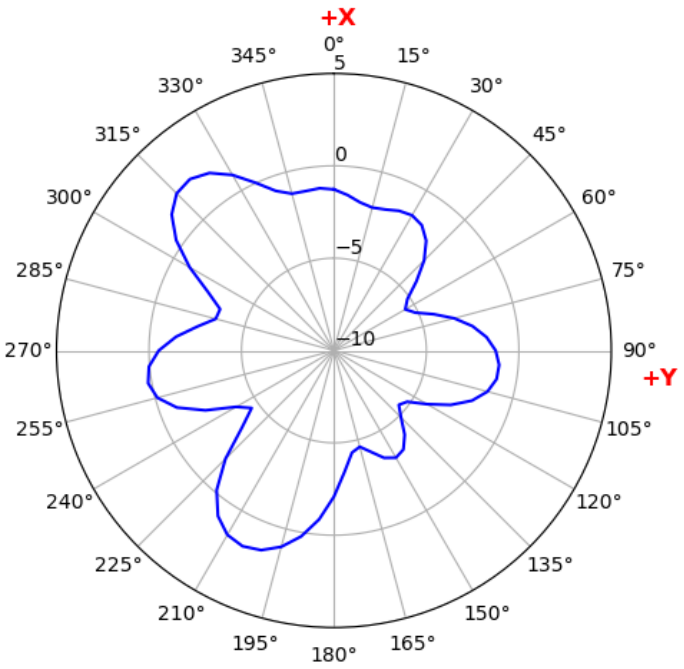
2450_YZ plane - Front to back



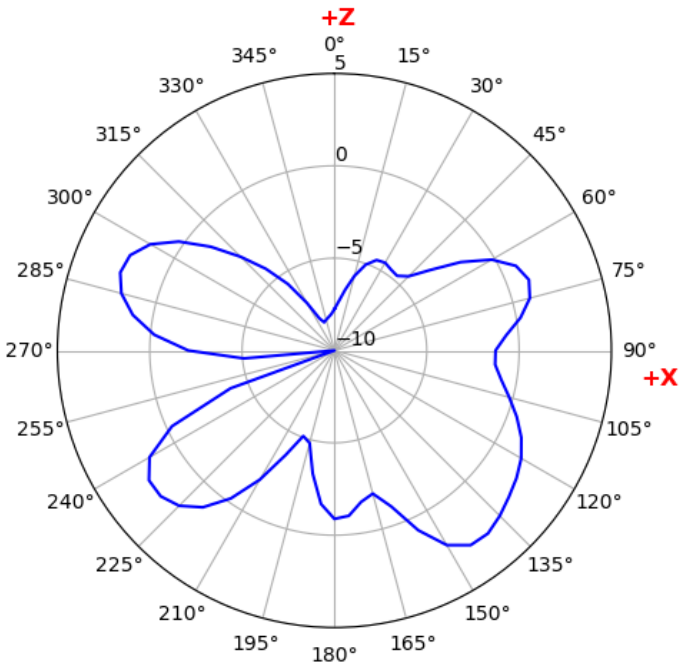
17

System Coverage - BT @2G

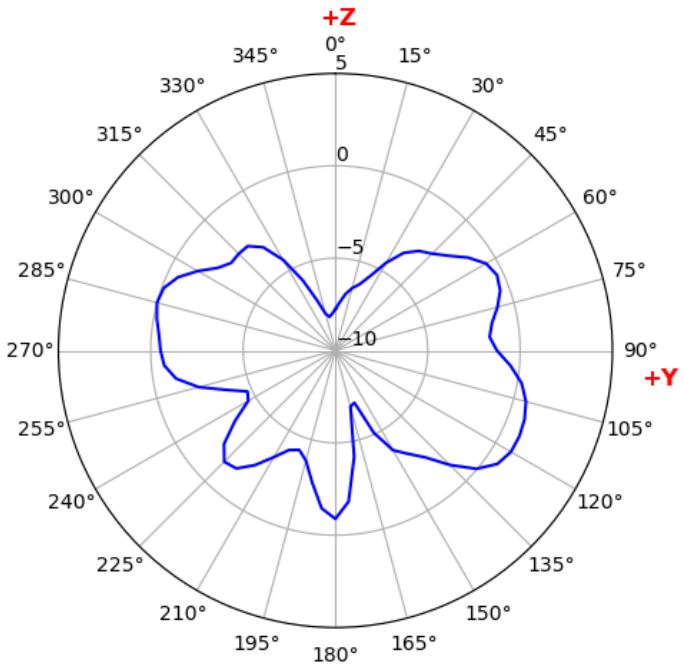
BT_XY plane - Azimuth



BT_XZ plane - Side to Side



BT_YZ plane - Front to back



18

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