



EFR32/BCM6755 ZigBee, Wi-Fi PTA Co-Existence Testing

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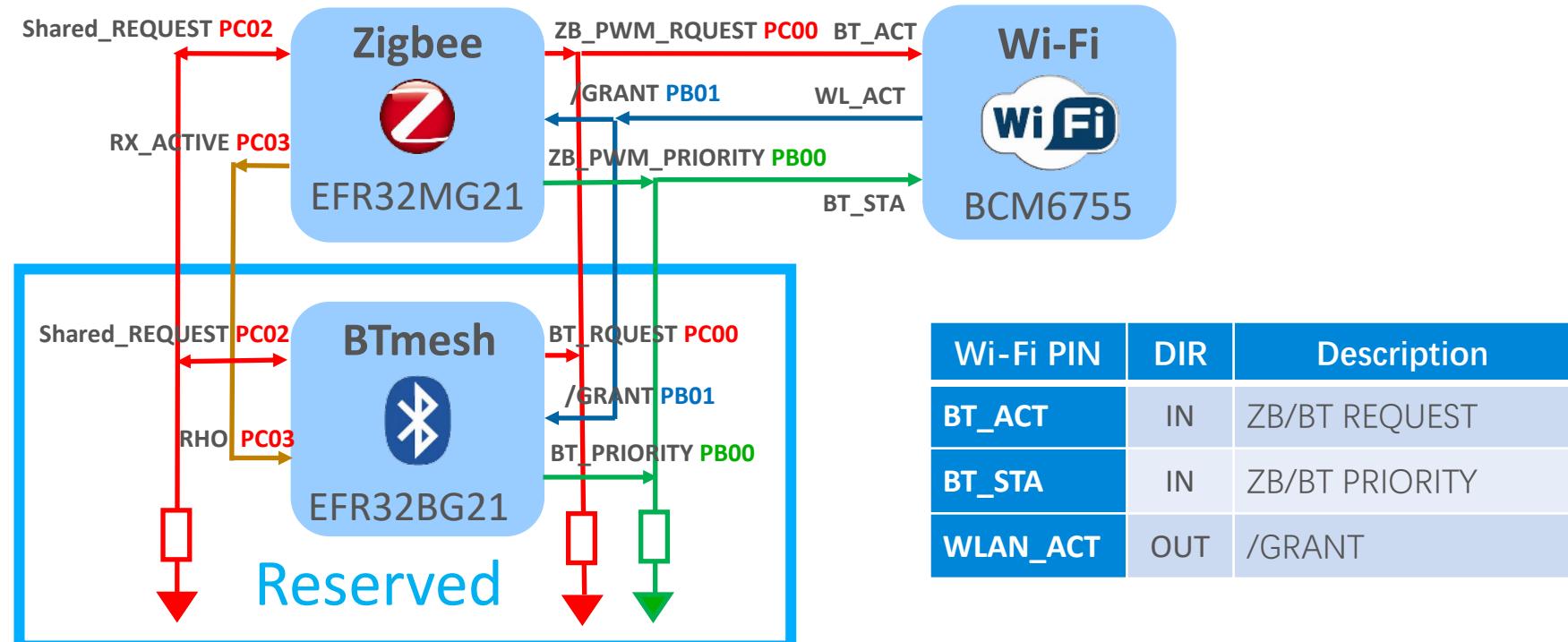


1. Wi-Fi + Zigbee PTA CoEx Test Setup (CMCC WiFi6 Router)

BCM6755 based Wi-Fi6 router ZigBee, BT-mesh PTA CoEx

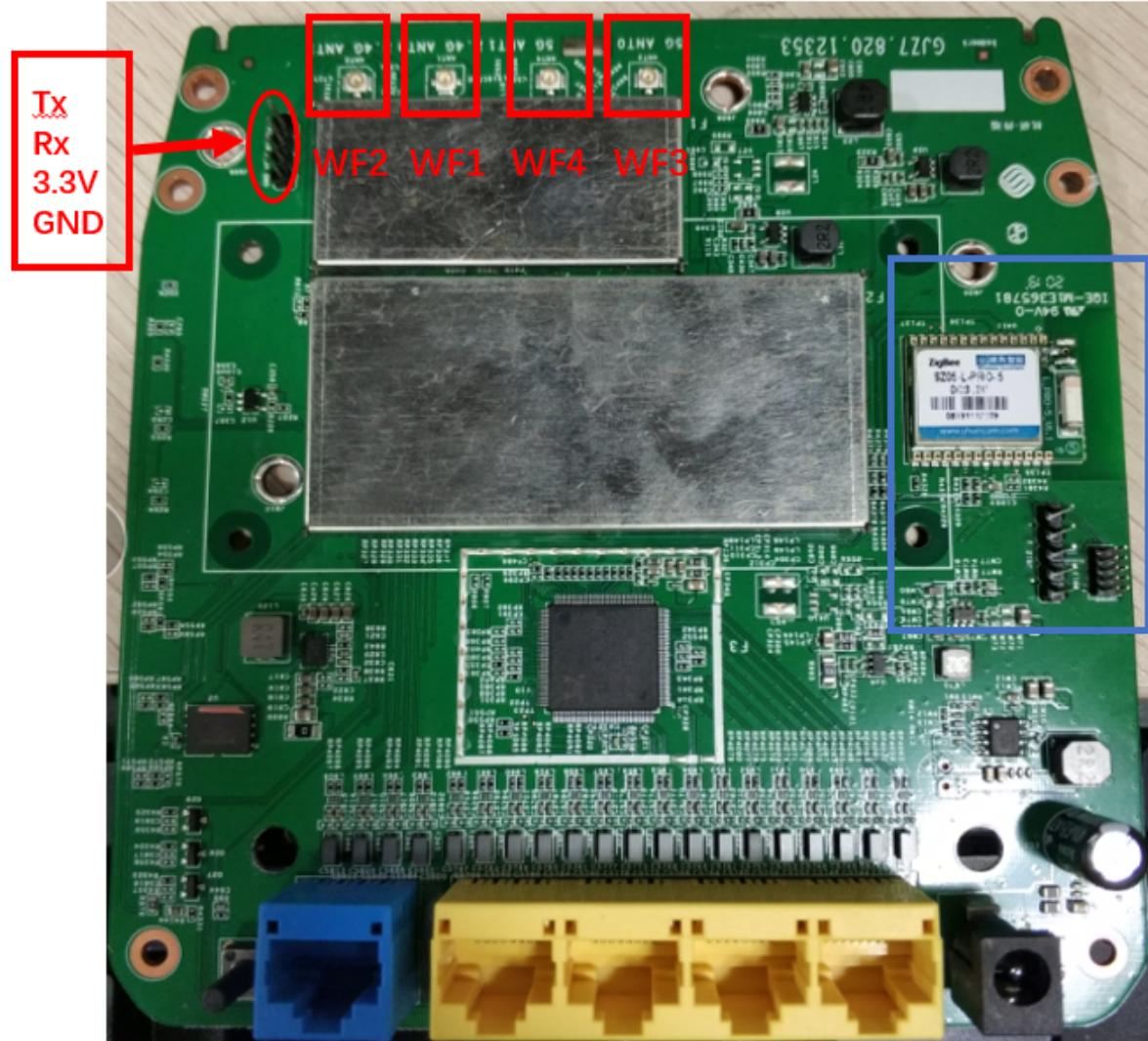
PTA CoEx for Multi-EFR32 Radios

- PTA CoEx config for multi-EFR32 radios with typical 3-Wire PTA signals sharing one PTA channel to Wi-Fi
- Each implement the PWM and OR the PWM signal with REQUEST and PRIORITY with signals tri-stated
- Zigbee and BT-mesh with shared REQUEST as back-channel for communications
- REQUEST||PWM, PRIORITY||PWM, Shared REQUEST tri-stated lines need external 1.5k pull down



Access BCM6755 Router RF Connectors and Debug I/F

WiFi串口线序：



- WF1 : 2.4G ANT0
- WF2 : 2.4G ANT1
- WF3 : 5G ANT0
- WF4 : 5G ANT1
- ZB0 : Zigbee

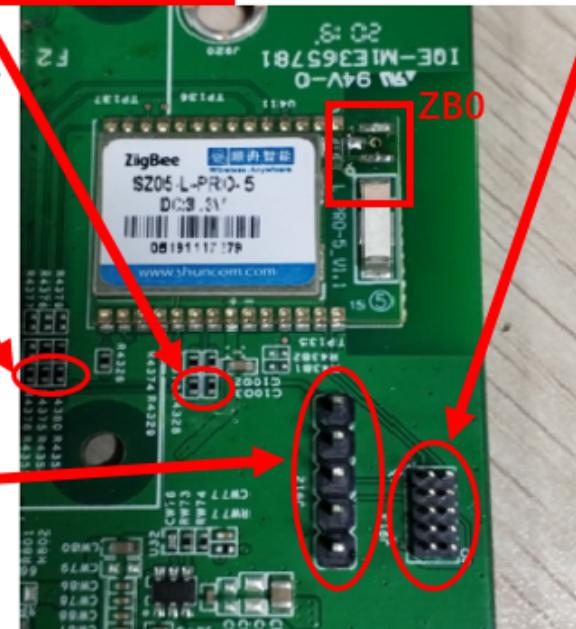
6755与ZigBee串口电阻：
Zb_Uart_Tx Zb_Uart_Rx

三线共存：
Tx_CONFIG
STATUS
RF_ACTIVE

3.3V
GND
SWDIO
SWCLK
Reset



PTI_DATA	PTI_FRAME
SWCLK	SWDIO
SWO	Zigbee_Tx
Zigbee_Rx	Reset
GND	3.3V



3-wire PTA CoEx Pins Definition (BCM7655)

Zigbee:

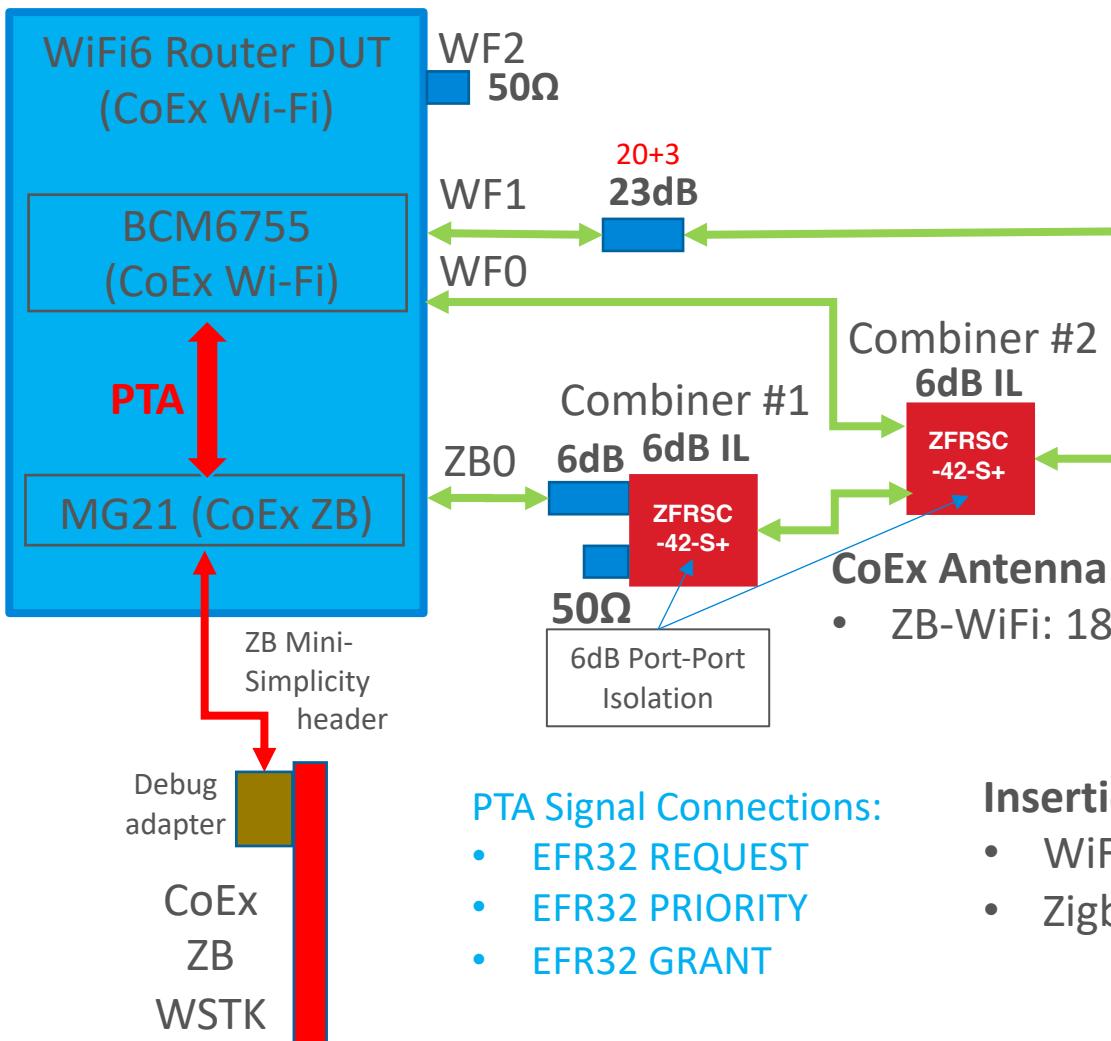
- EFR32MG21 module:
 - TX PA05
 - RX PA06
 - REQ| |PWM PC00 Out/Active-high/PD1.5k
 - PRI| |PWM PB00 Out/Active-high/PU1.5k
 - GRANT PB01 In/Active-low
 - SHA_REQ PC02 Tri-state/Active High/PD1.5k
 - RX_ACTIVE PC03 Out
 - FEM_TXA PD02
 - FEM_RXA PD03
 - PTI_SYNC PC05
 - PTI_DATA PC04
 - SWDIO PA02
 - SWCLK PA01
 - SWO PA03

Bluetooth-Mesh: (Reserved for future)

- EFR32BG21 module:
 - TX PA05
 - RX PA06
 - REQ| |PWM PC00 Out/Active-high/PD1.5k
 - PRI| |PWM PB00 Out/Active-high/PU1.5k
 - GRANT PB01 In/Active-low
 - SHA_REQ PC02 Tri-state/Active High/PD1.5k
 - RHO PC03 In
 - FEM_TXA PD02
 - FEM_RXA PD03
 - PTI_SYNC PC05
 - PTI_DATA PC04
 - SWDIO PA02
 - SWCLK PA01
 - SWO PA03

PTA CoEx Testing - Wi-Fi + Zigbee

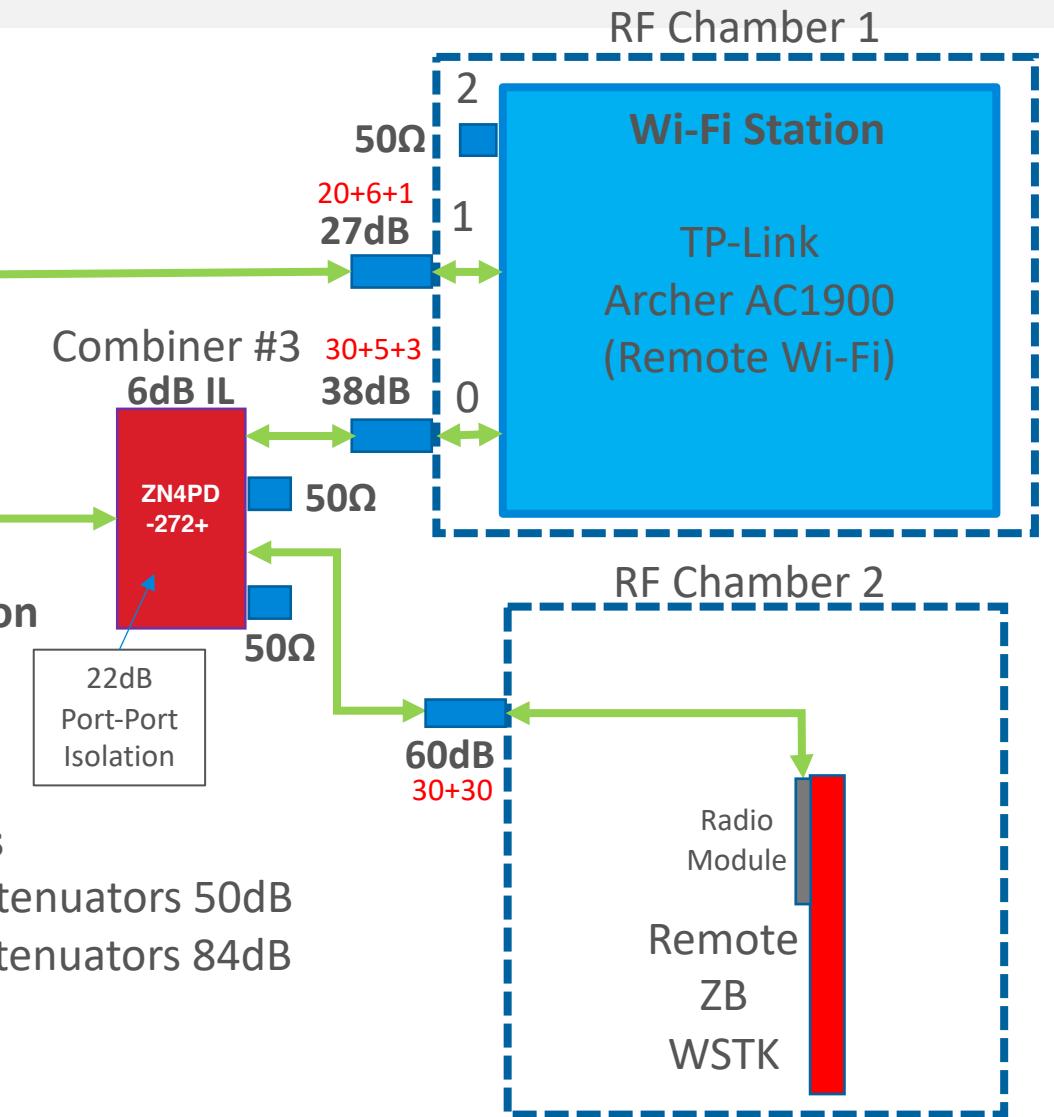
Wi-Fi Access Point



- PTA Signal Connections:**
- EFR32 REQUEST
 - EFR32 PRIORITY
 - EFR32 GRANT

Insertion Loss

- WiFi: attenuators 50dB
- Zigbee: attenuators 84dB



Entire Setup, including Laptops and power, should be inside an RF Shield room (~55dB 2.4GHz ingress attenuation)

Power Levels and RSSIs Summary

RF Paths Attenuations, TX Power settings and RSSIs

- This simulate a tough cases for CoEx BLE/ZigBee to listen the Remote BLE/ZigBee's incoming messages

CoEx Wi-Fi

RF path	TX Pwr	RSSI
Wi-Fi	20dBm	-48dB

Remote Wi-Fi

RF path	TX Pwr	RSSI
Wi-Fi	0dBm	-28dB

CoEx BT/ZigBee

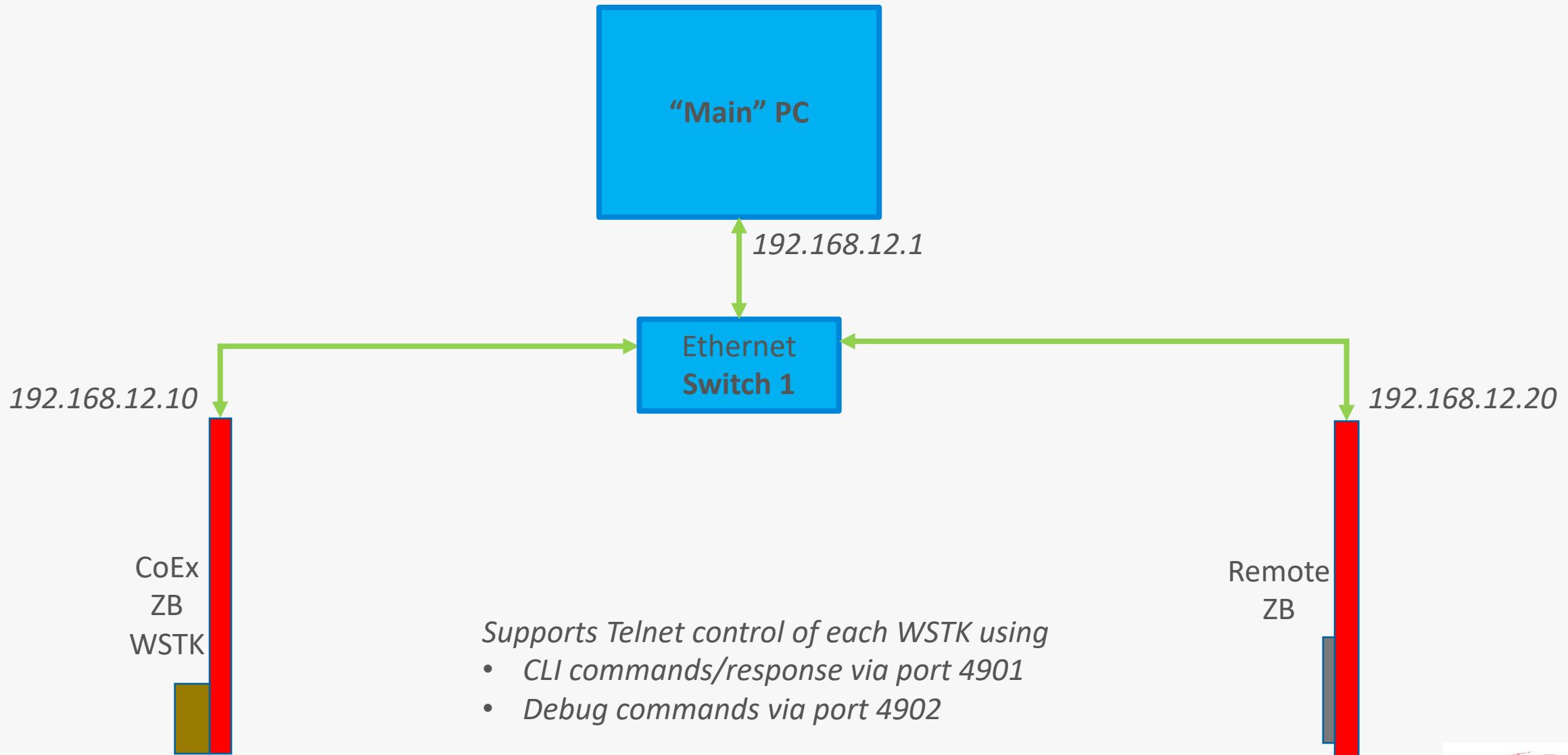
RF path	TX Pwr	RSSI
BTmesh	10dBm	-80dB
ZigBee	20dBm	-80dB

Remote BT/ZigBee

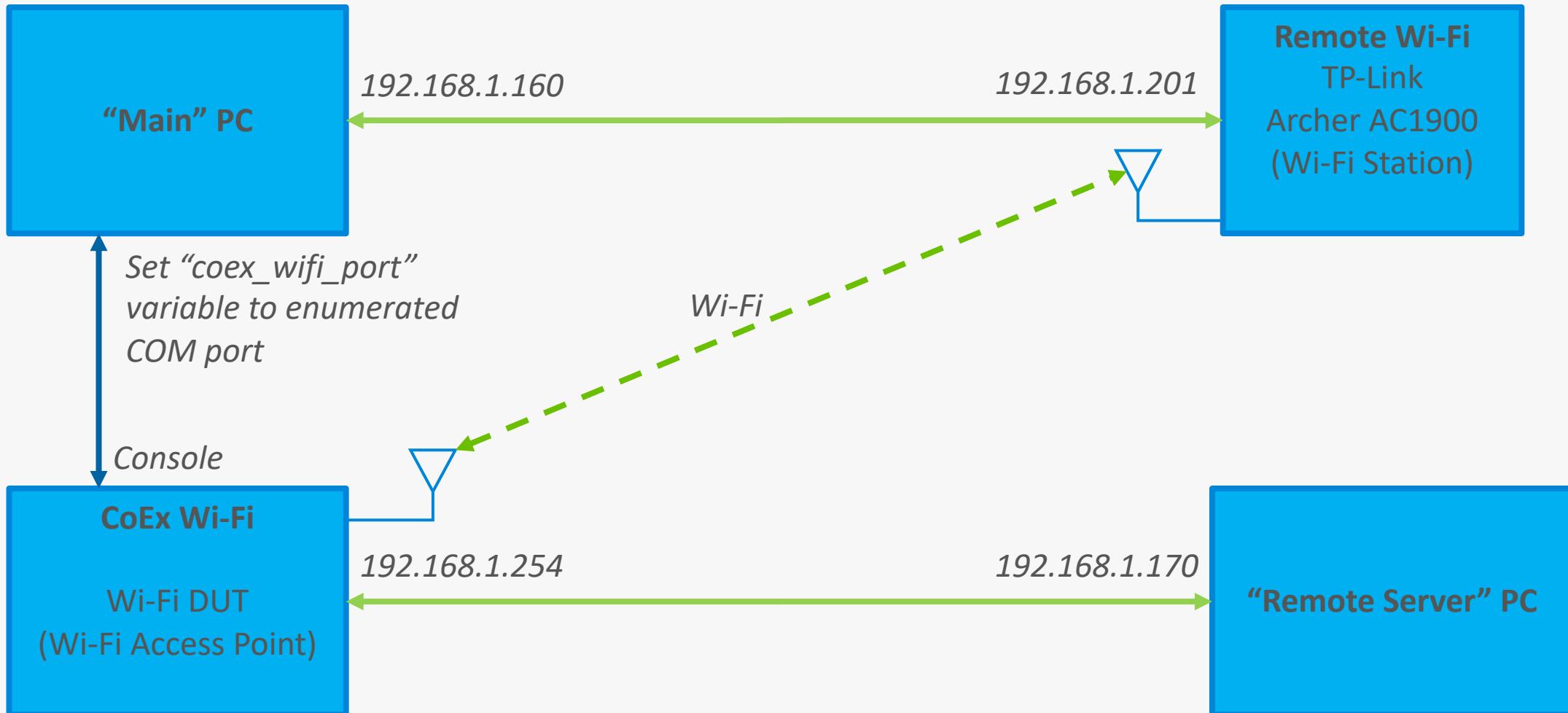
RF path	TX Pwr	RSSI
BTmesh	3dBm	-73dB
ZigBee	3dBm	-63dB

- Note: CoEx & Remote Wi-Fi TX power are actual measured powers in dBm*

EFR32 PTA CoEx Testing – Ethernet Subnet #1

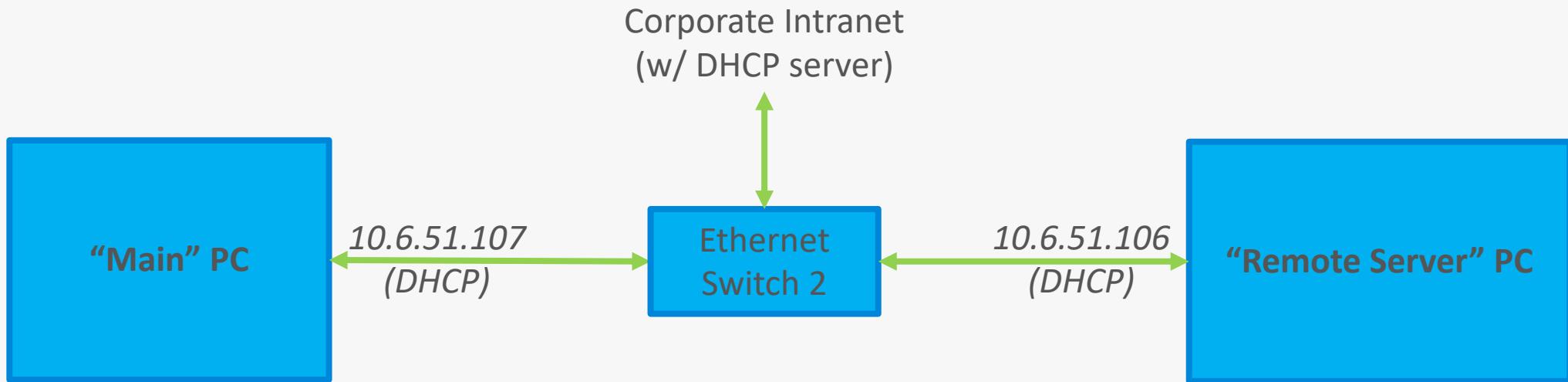


EFR32 PTA CoEx Testing – Ethernet Subnet #2



*Customer Wi-Fi is controlled via COM/console and TP-Link is controlled via Telnet
Iperf IP traffic is routed between “Main”<->TP-Link<->DUT<->“Remote Server”
Windows Firewall MUST be open to allow in-coming iperf (or ping) traffic*

EFR32 PTA CoEx Testing – Ethernet Subnet #3



Allows each PC to access Python scripts, use socket interface, and records data collection and iperf results to Intranet file server

Note: "Remote Server" assigned IP address must be assigned to Python "remote_PC_network_ip" variable to support socket interface



3. Wi-Fi + Zigbee PTA CoEx Test Flow



High-level PTA CoEx Test Flow (1)

- **Basic Flow**

- Configure Wi-Fi and reassociate
- Start iperf traffic
- CoEx form Zigbee network, remote device join network to run ZB unicast TX/RX throughput test
- Record configuration and IoT radio results
- Stop iperf traffic and record average iperf traffic

High-level PTA CoEx Test Flow (2)

- CoEx Wi-Fi **17dBm** (default TxPower at 11n mode), TP-Link TX power: **0 dBm**
- Run co-existence tests over the following Wi-Fi traffic and configurations:
 - Iperf Wi-Fi streaming direction: DUT>TP-Link (CoEx->Remote) and TP-Link->DUT (Remote->CoEx)
 - Iperf **TCP** throughput target: **(10, 20,)30, (40,) 50, 60, 70, 80, 90(,100,110)** Mbits/s as **limited by 100M Ethernet port**
 - Wi-Fi
 - PTA [enable, disabled], Channel: **1, (6, 11 Optional)** Guard Interval: Short
 - [Bandwidth, MCS Index] configurations: **(MCS7, HT20), (MCS15, HT40), (Auto MCS, HT20), (Auto MCS, HT40)**
 - Zigbee
 - CoEx power: **13 dBm**, Remote power levels: **3, (10, 20 optional)** dBm, Zigbee direction: CoEx->Remote and Remote->CoEx
 - Zigbee Channel: **Far-away, (adjacent, and co-channel to Wi-Fi channel optional)**
 - Zigbee network form and joining device test and TX/RX throughput tests

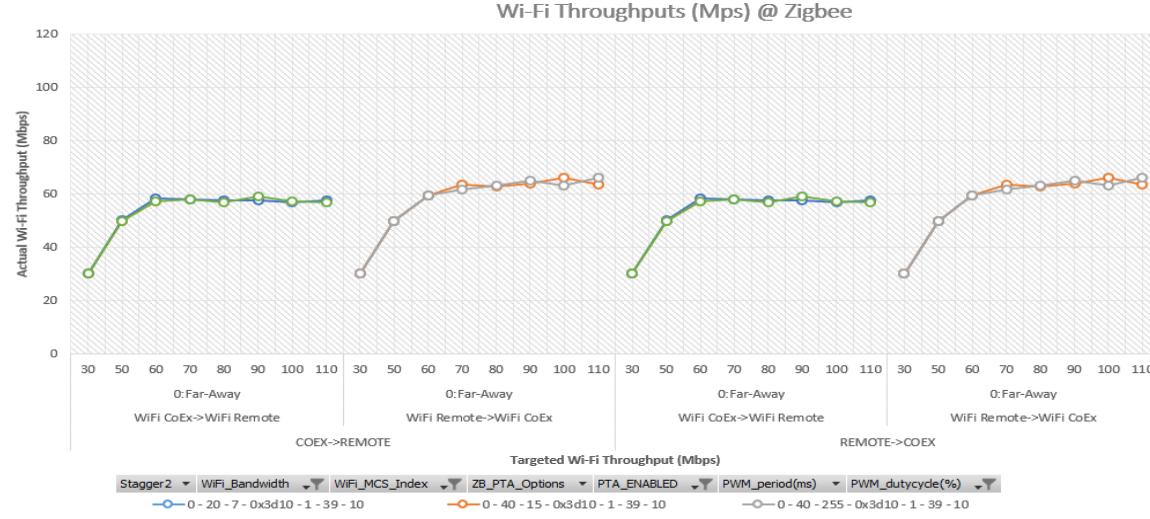
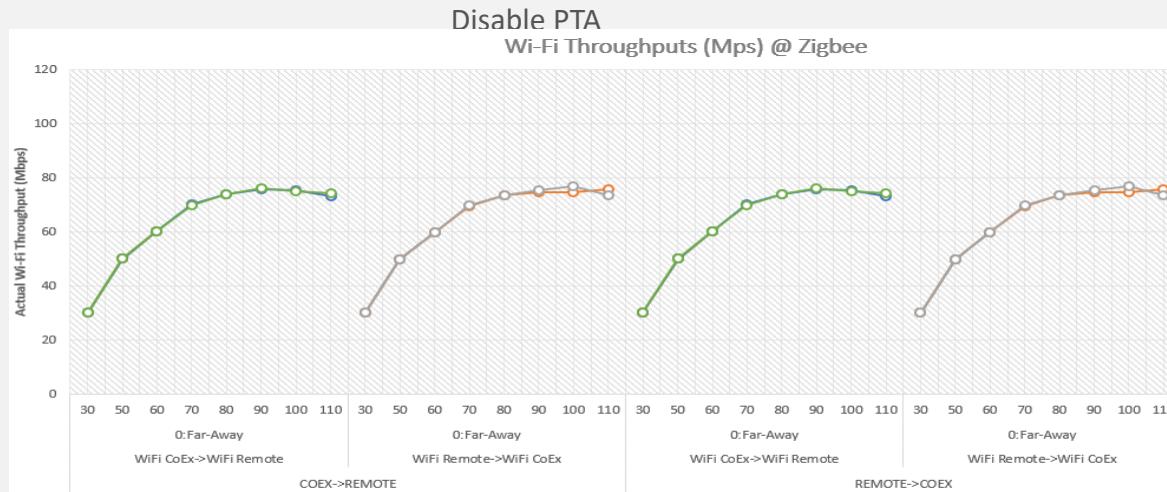


1. Test Result: Wi-Fi v.s. Zigbee Coexistence

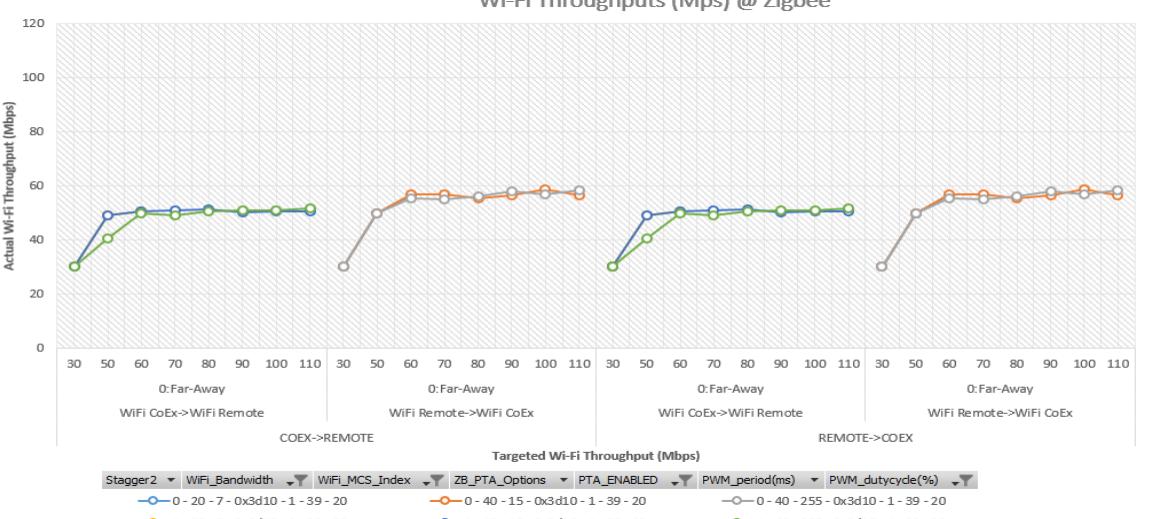
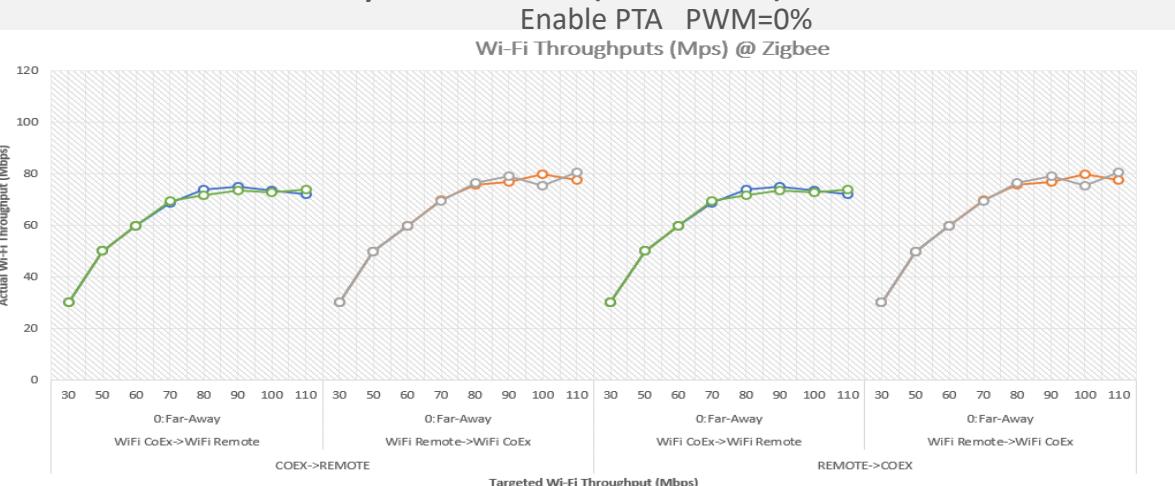
CMCC BCM6755 platform + updated CMCC MG21 Module

- Wi-Fi Throughputs (30,50,60,70,80,90,100,110Mbps)
- Zigbee Join Success Rate(%)
- Zigbee CCA Failure Per Message
- Zigbee Mac Retry Per Message
- Zigbee Message Failure Rate(%)

Wifi Throughputs (Mps) @Zigbee



Far-away: Wi-Fi ch1(HT20/40), ZB ch24m, 10dBm



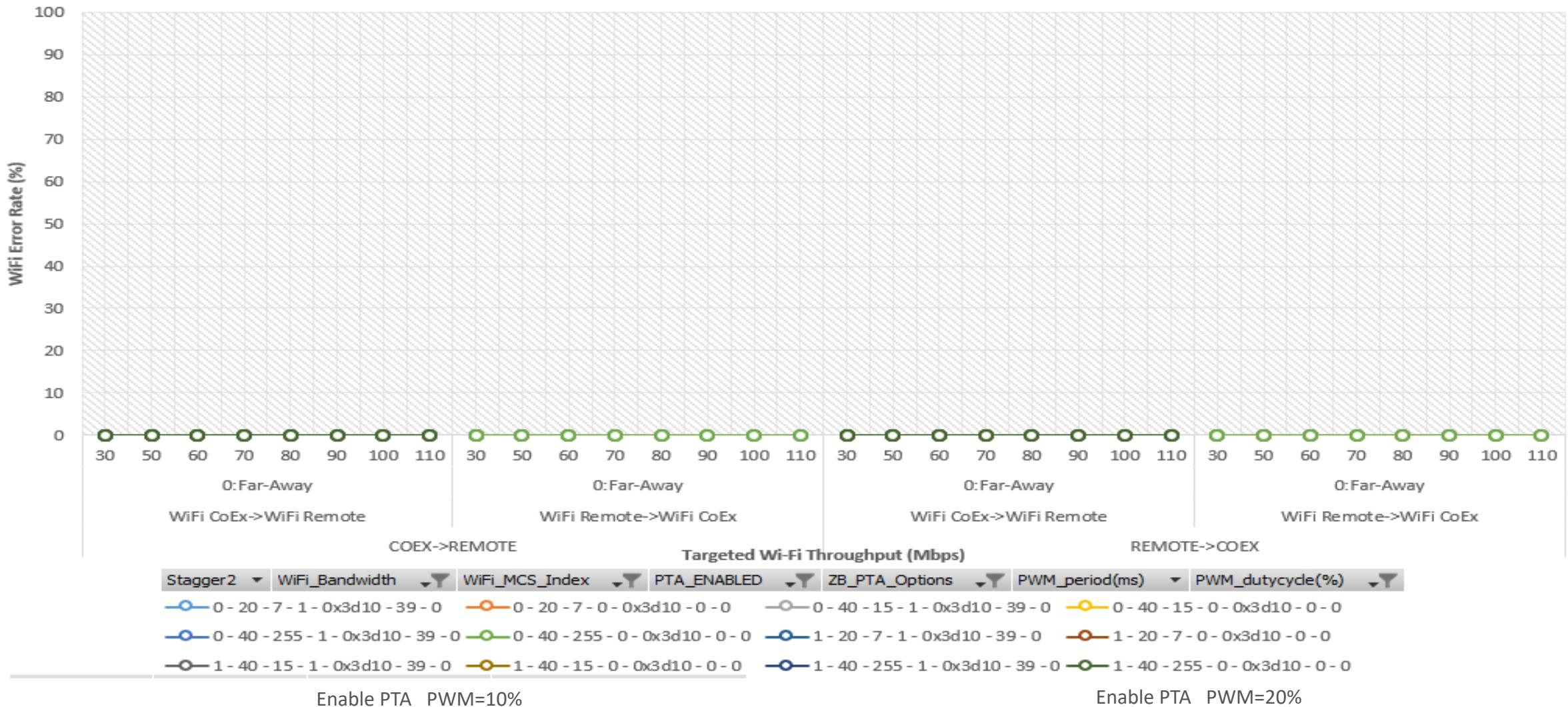
Wifi ErrorRate (%) @Zigbee

Disable PTA

Far-away, 10dBm

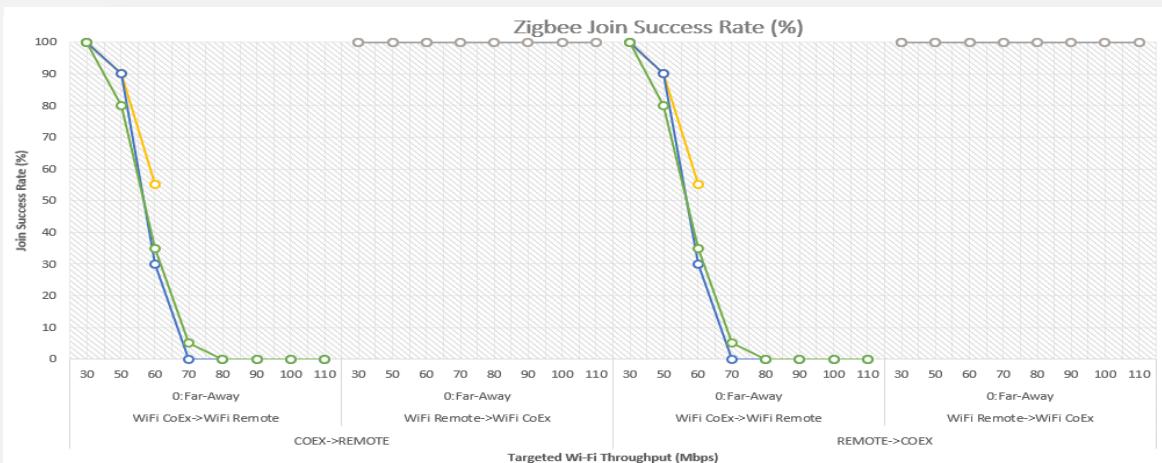
Enable PTA PWM=0%

Wi-Fi Error Rate (%) @ Zigbee

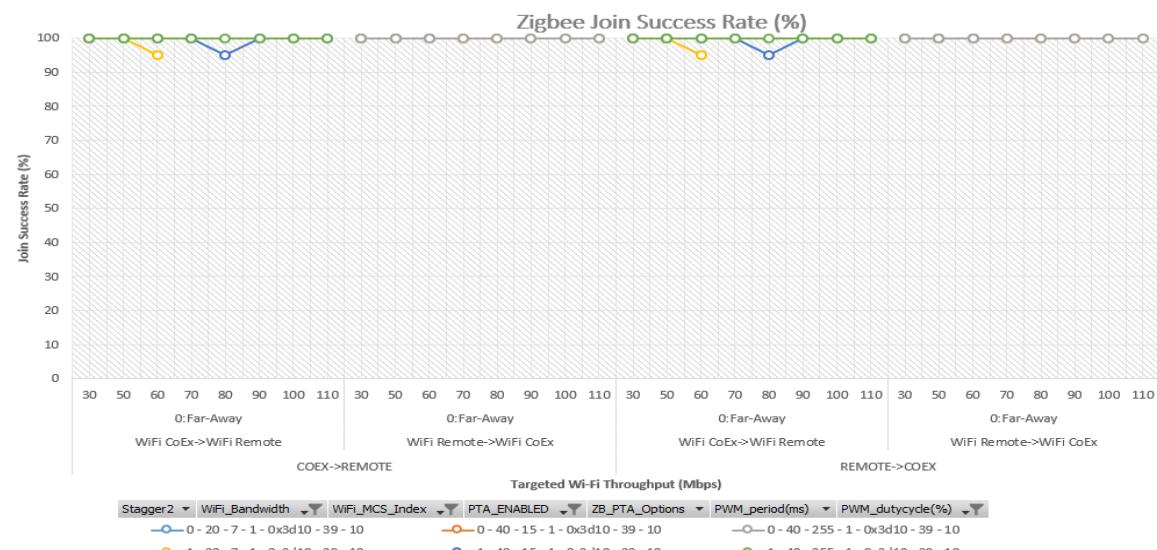
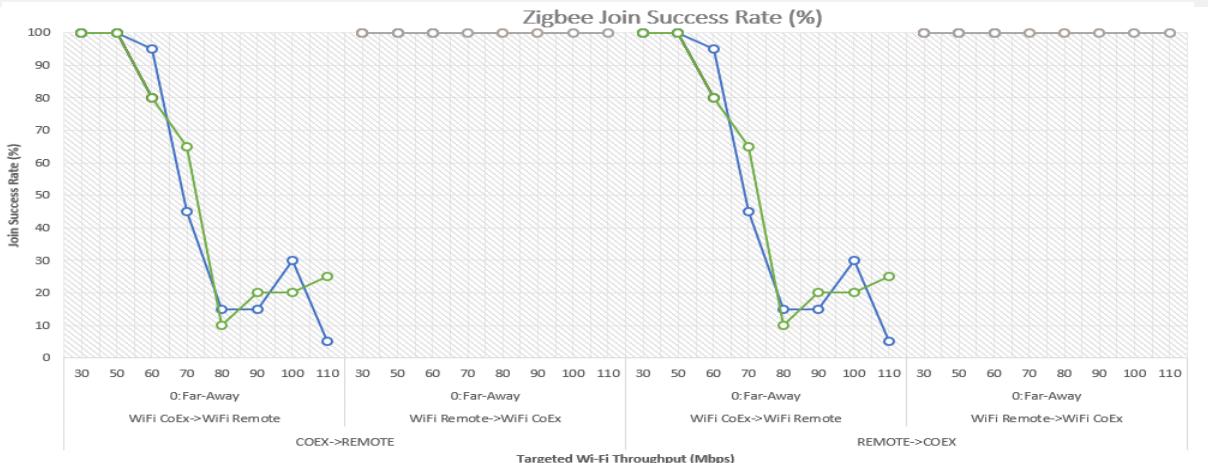


Zigbee Join Success Rate(%)

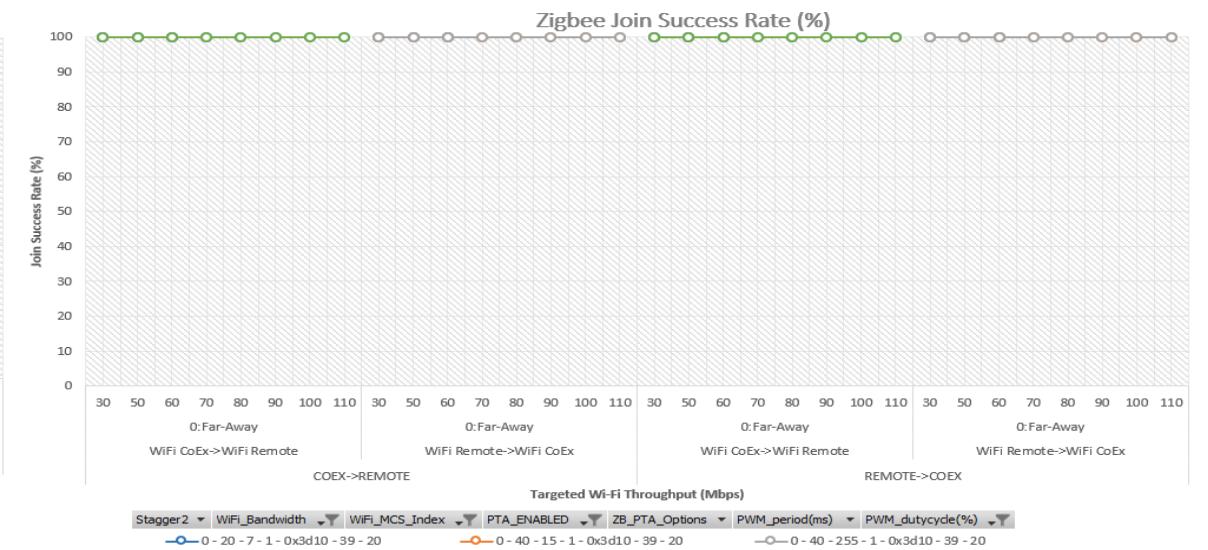
Disable PTA



Far-away: Wi-Fi ch1(HT20/40), ZB ch24, 10dBm
Enable PTA PWM=0%

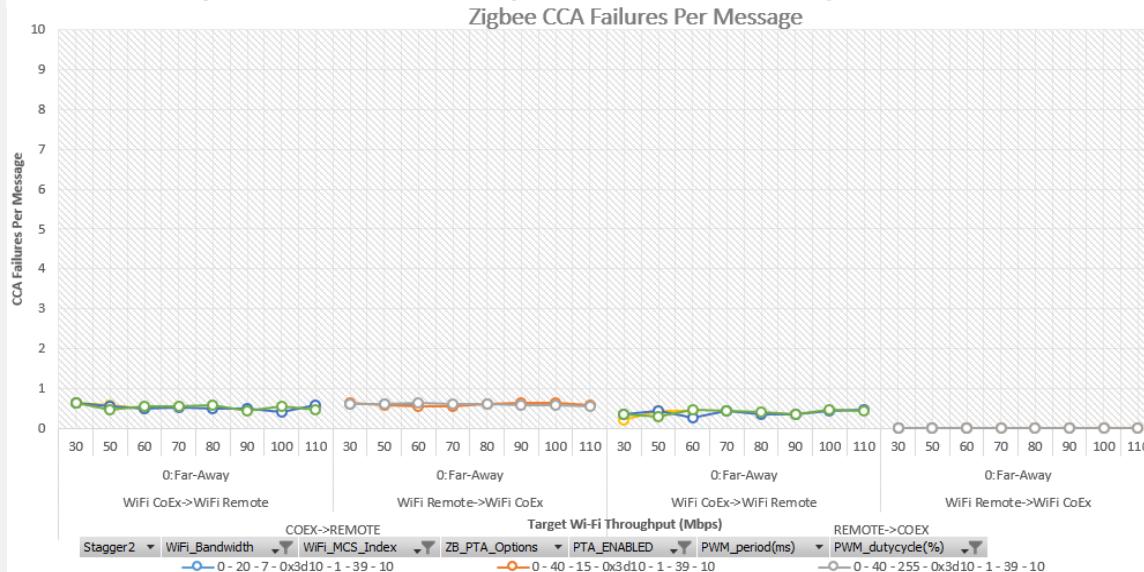
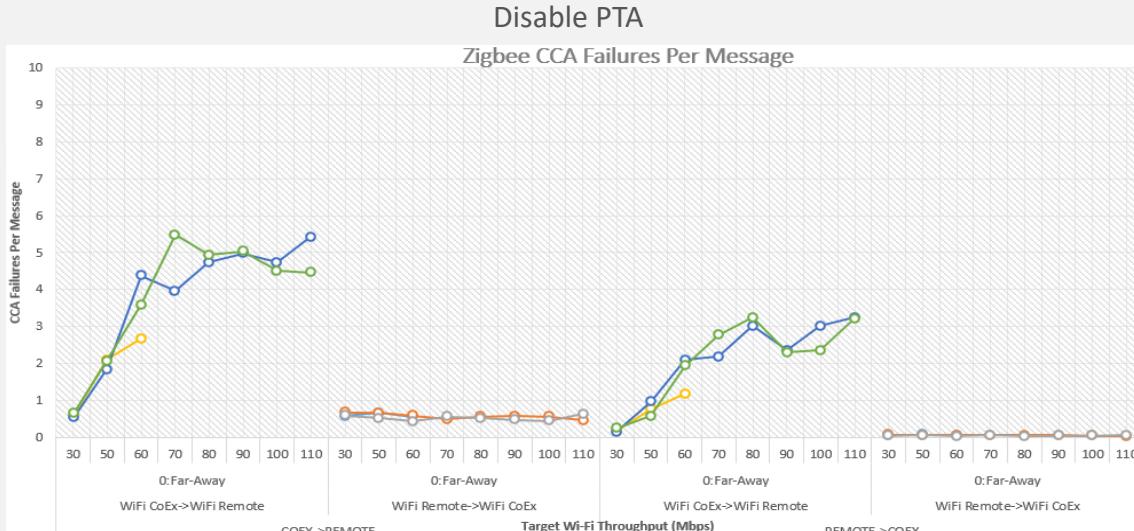


Enable PTA PWM=10%



Enable PTA PWM=20%

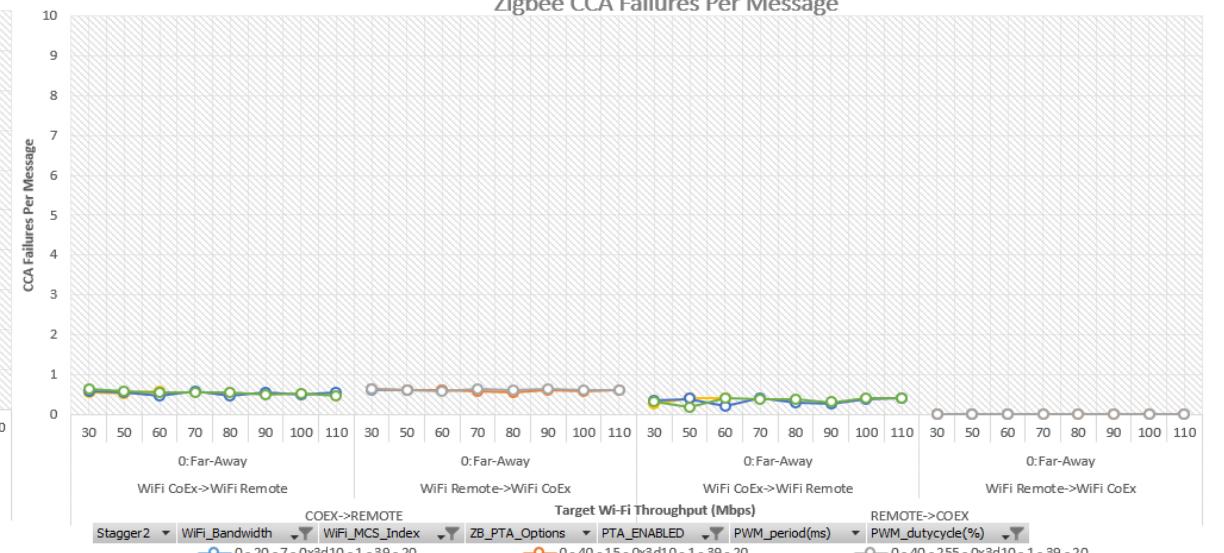
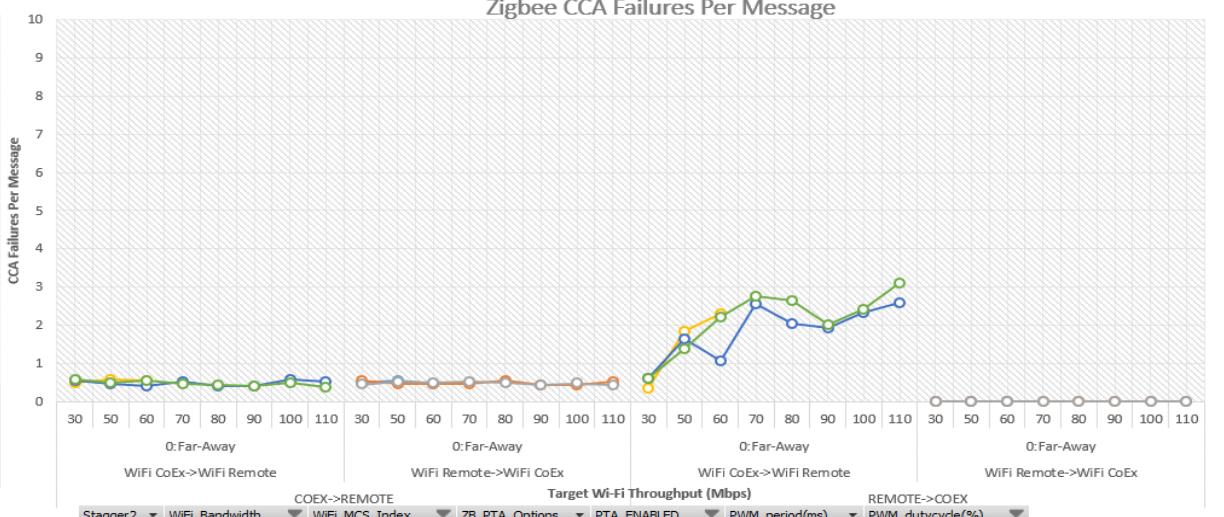
Zigbee CCA Failure Per Message



Enable PTA PWM=10%

Far-away: Wi-Fi ch1(HT20/40), ZB ch24, 10dBm

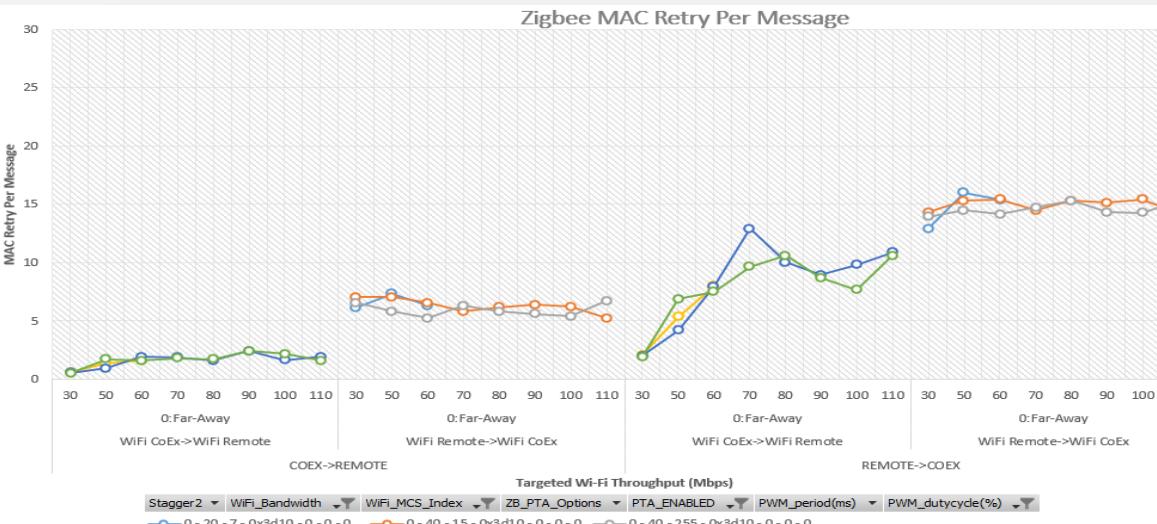
Enable PTA PWM=0%



Enable PTA PWM=20%

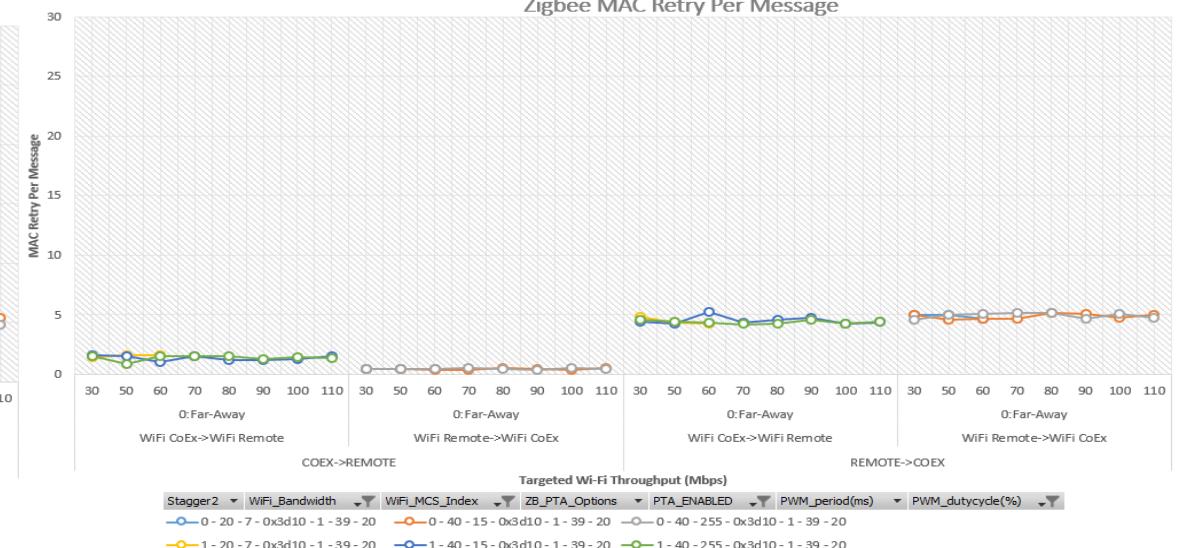
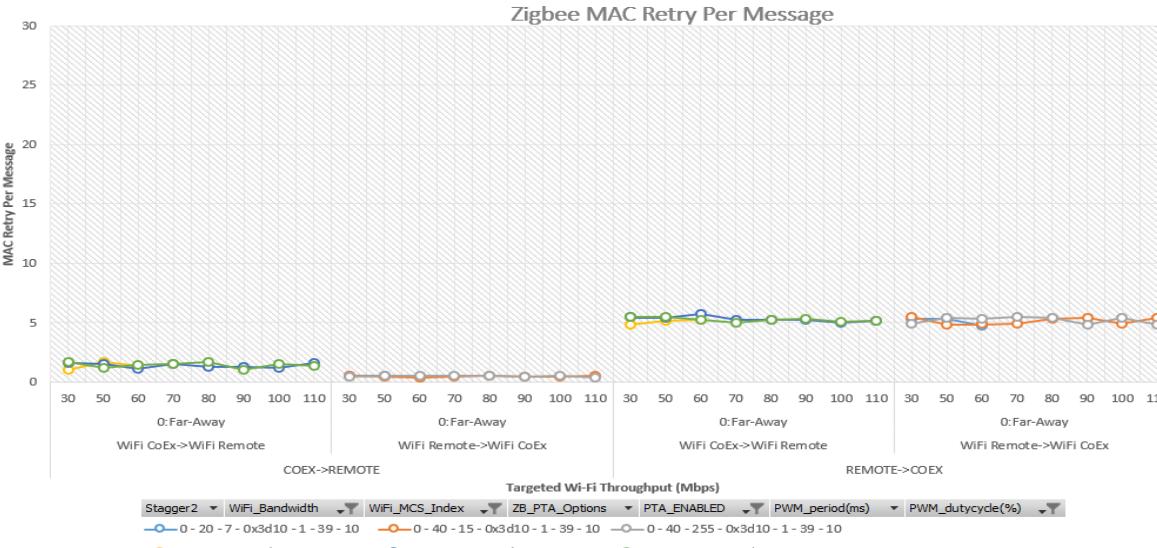
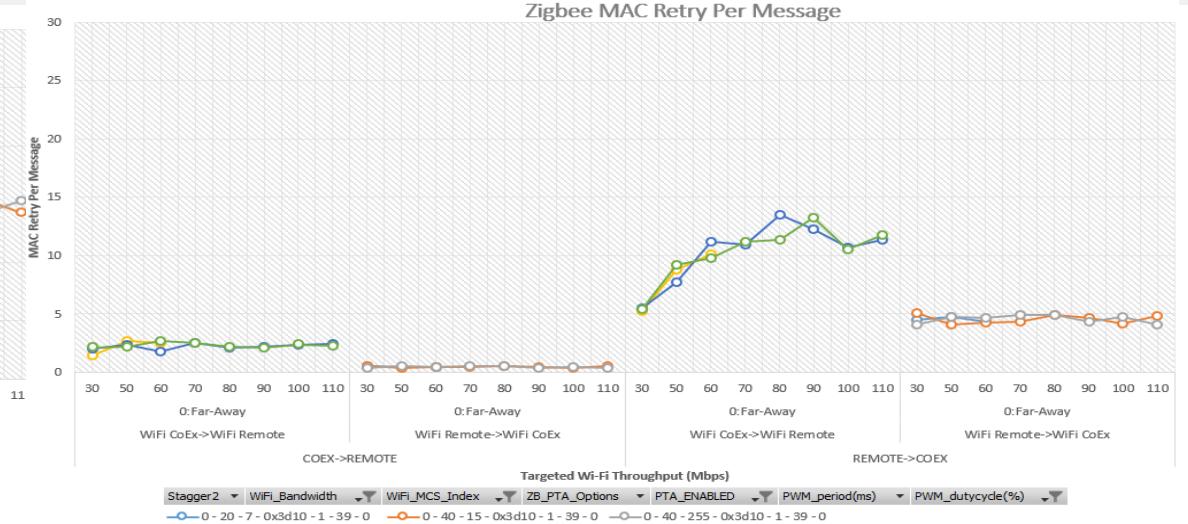
Zigbee Mac Retry Per Message

Disable PTA



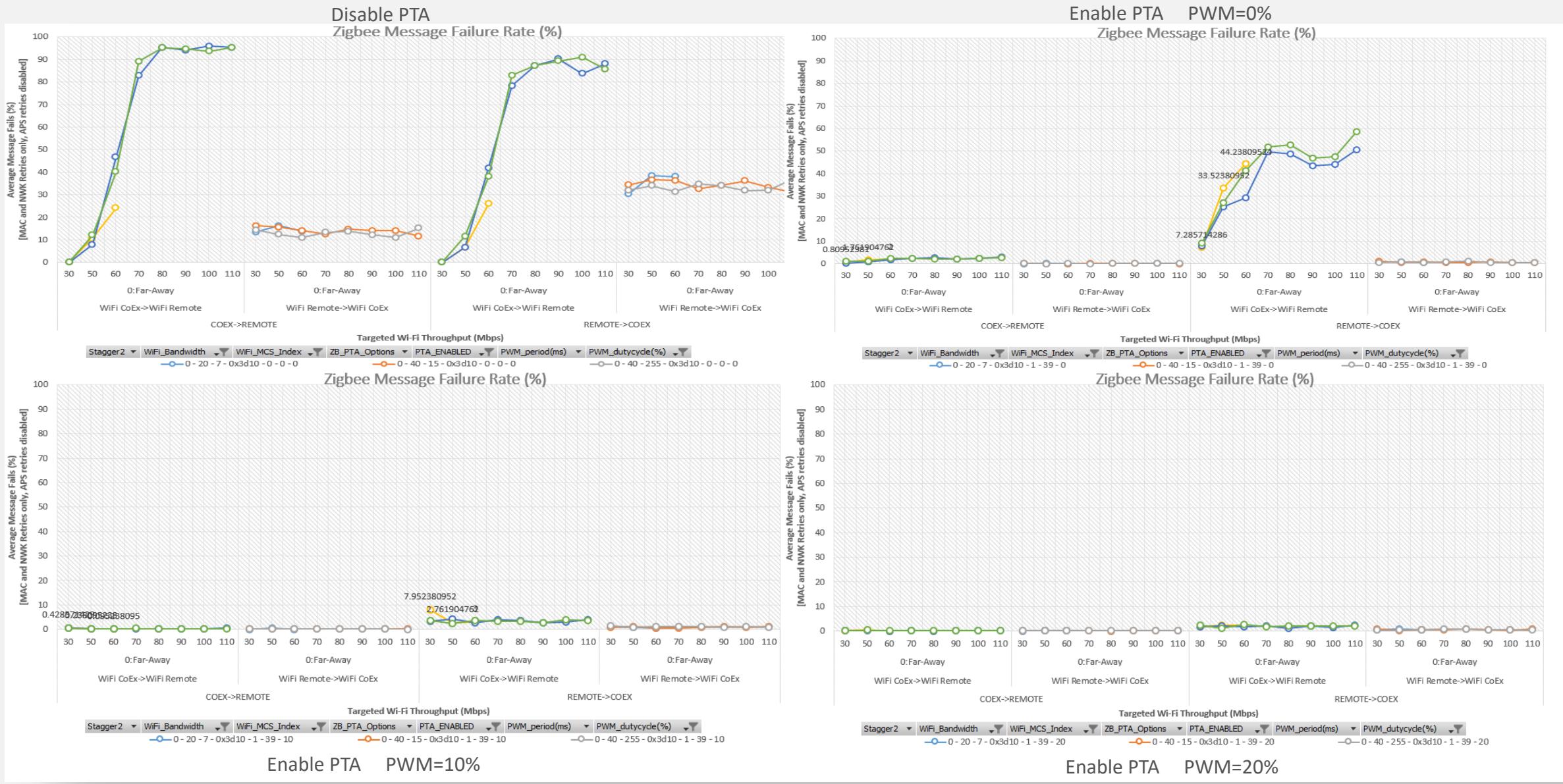
Far-away: Wi-Fi ch1(HT20/40), ZB ch24, 10dBm

Enable PTA PWM=0%



Zigbee Message Failure Rate(%)

Far-away: Wi-Fi ch1(HT20/40), ZB ch24, 10dBm



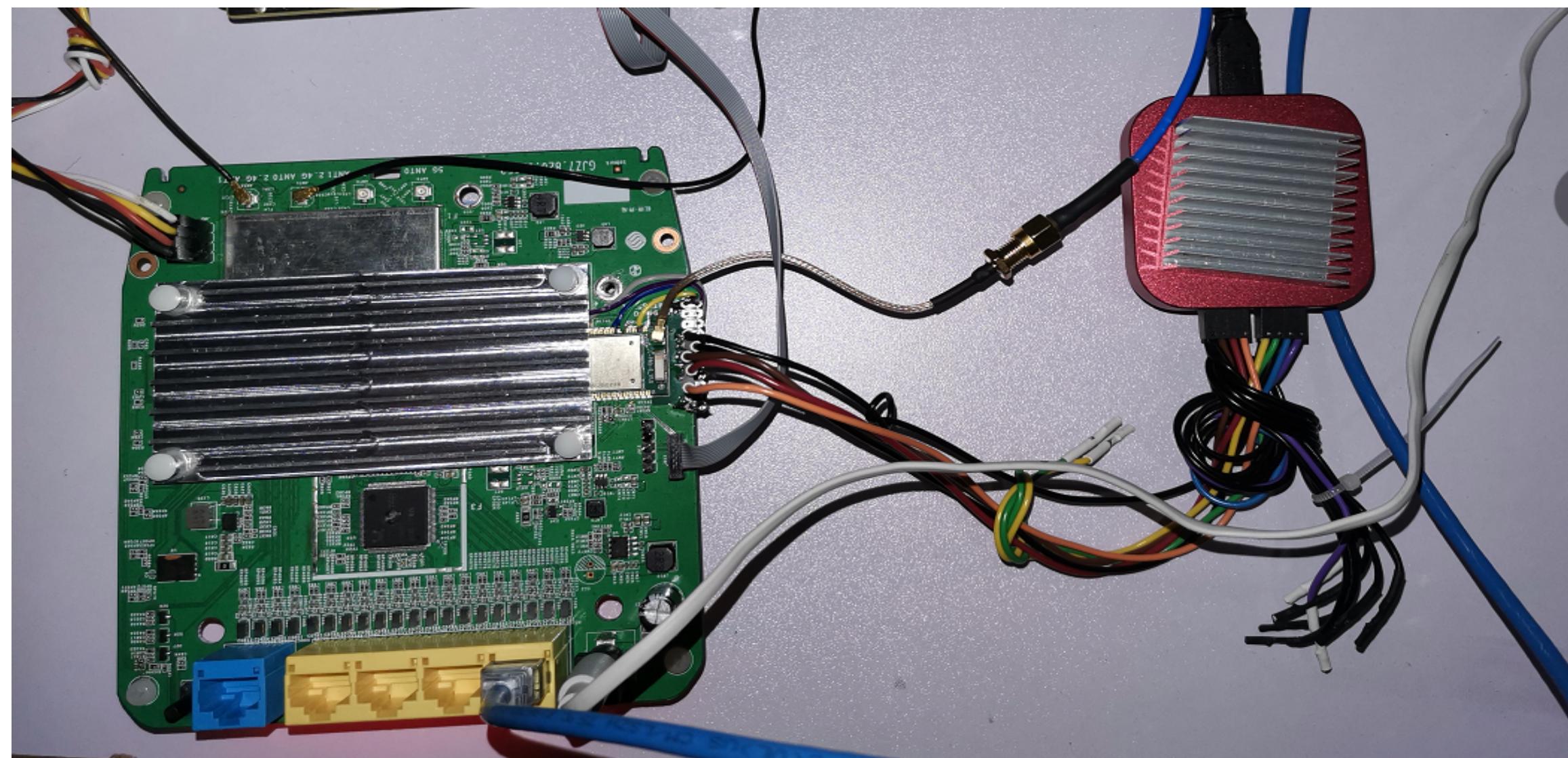


2. Test Result: Wi-Fi v.s. Zigbee Coexistence

2nd CMCC BCM6755 mainboard + CMCC MG21 Module with shield

- Wi-Fi Throughputs (10,20, 30,50,60,70,80,90,100,110Mbps)
- Zigbee Join Success Rate(%)
- Zigbee CCA Failure Per Message
- Zigbee Mac Retry Per Message
- Zigbee Message Failure Rate(%)

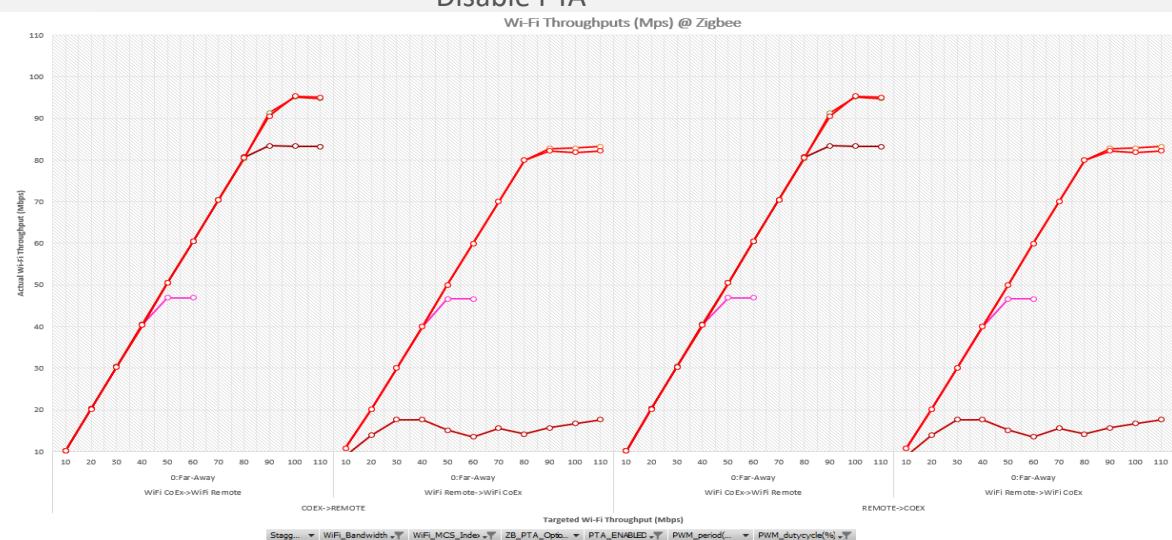
Access BCM6755 Router RF Connectors and Debug I/F



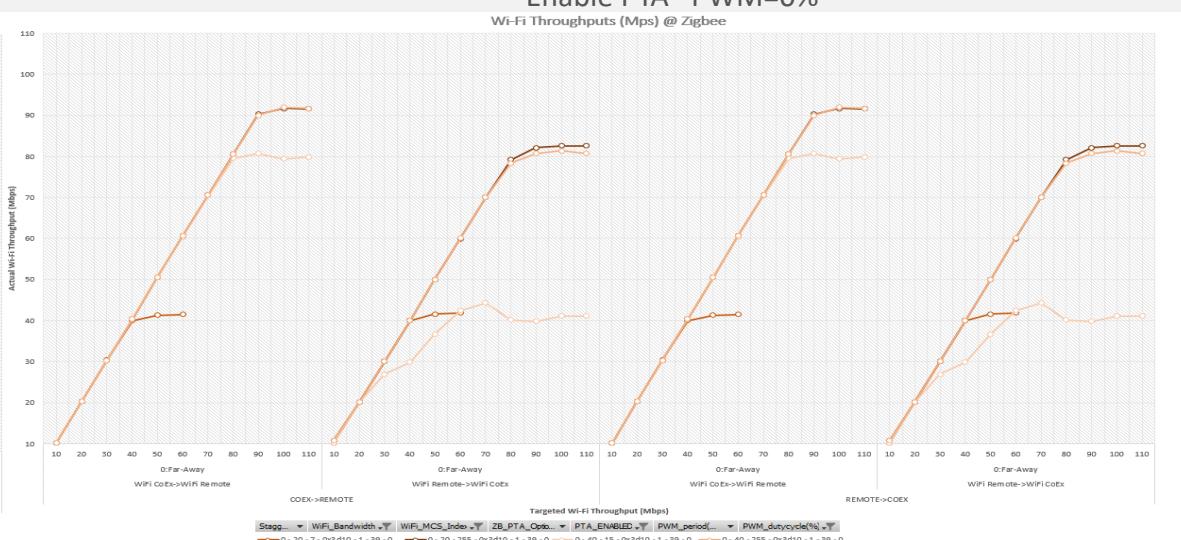
Wifi Throughputs (Mps) @Zigbee

Far-away: Wi-Fi ch1,11(HT20/40), ZB ch24,11

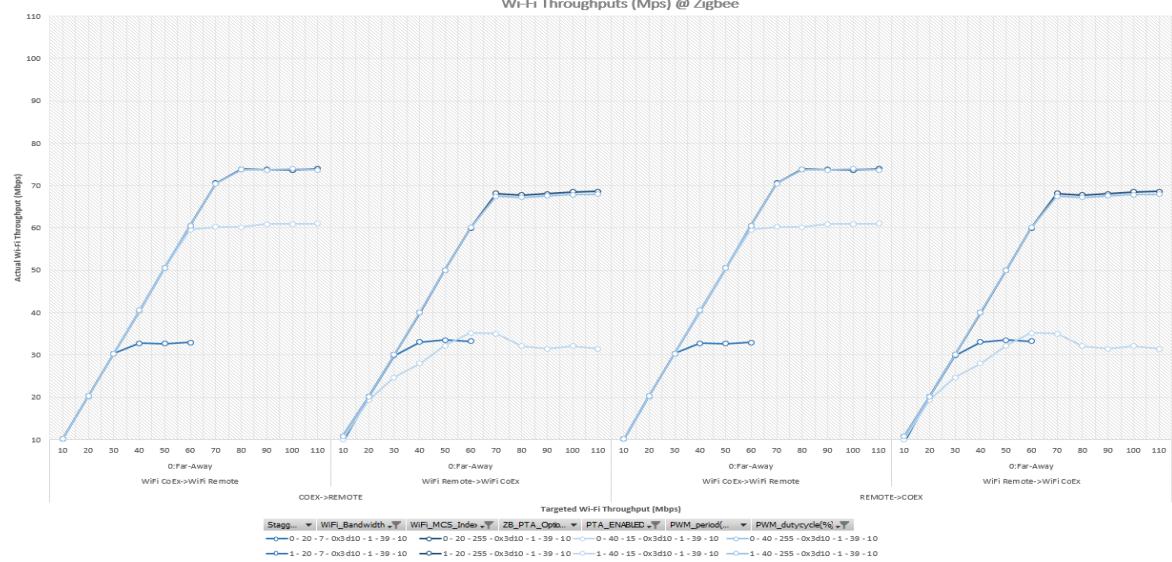
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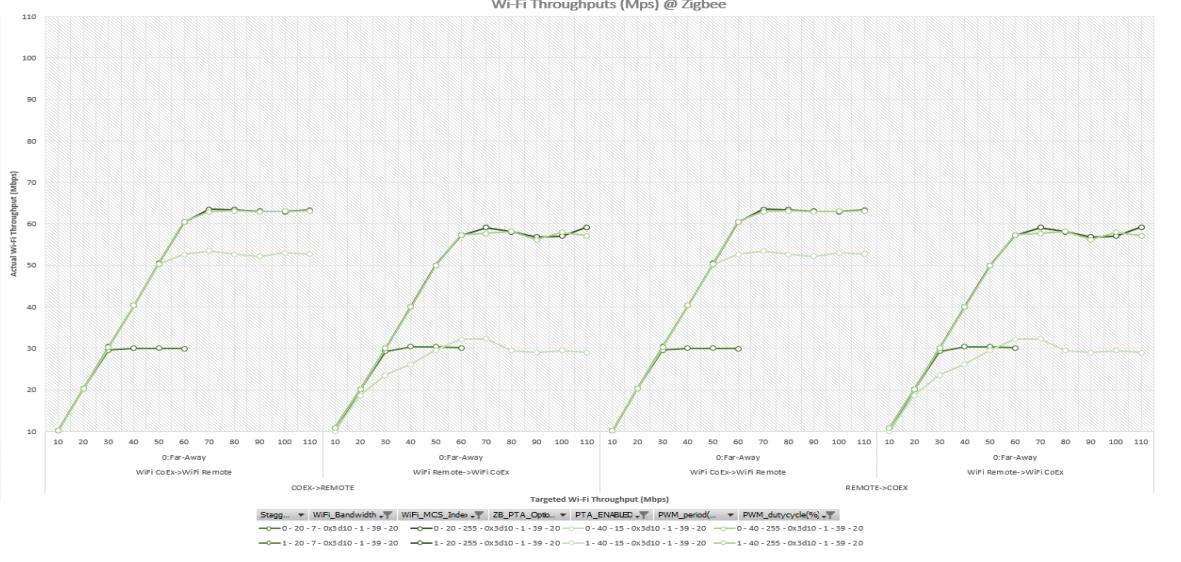
Enable PTA PWM=0%



Wi-Fi Throughputs (Mps) @ Zigbee



Wi-Fi Throughputs (Mps) @ Zigbee

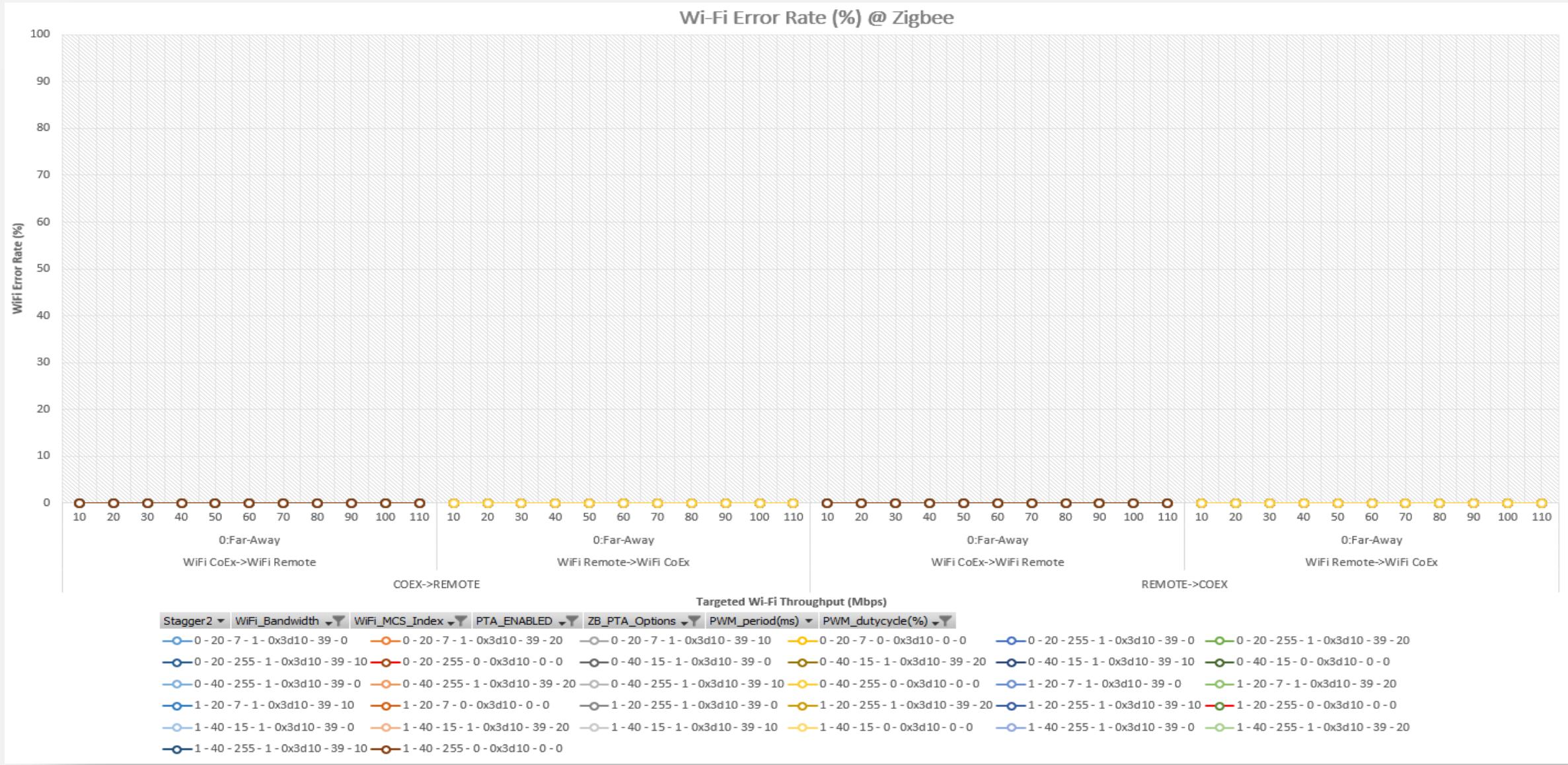


Enable PTA PWM=10%

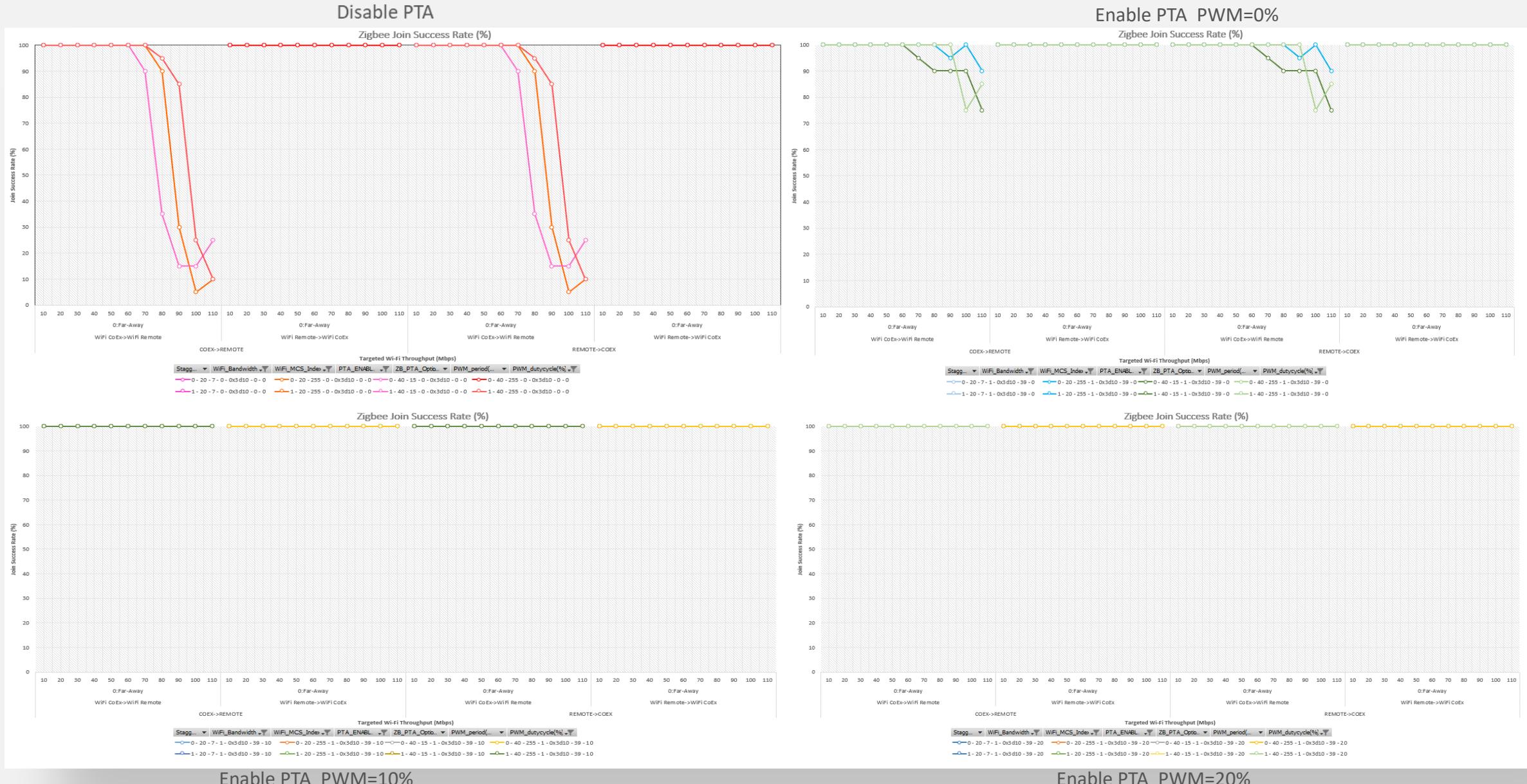
Enable PTA PWM=20%

Wifi ErrorRate (%) @Zigbee

Far-away: Wi-Fi ch1,11(HT20/40), ZB ch24,11

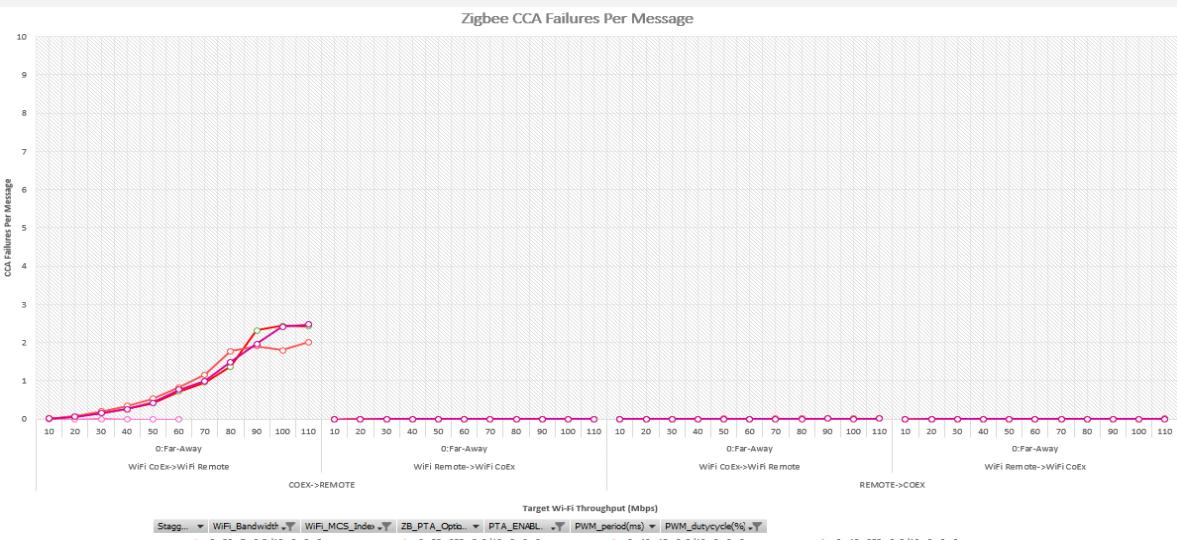


Zigbee Join Success Rate(%)



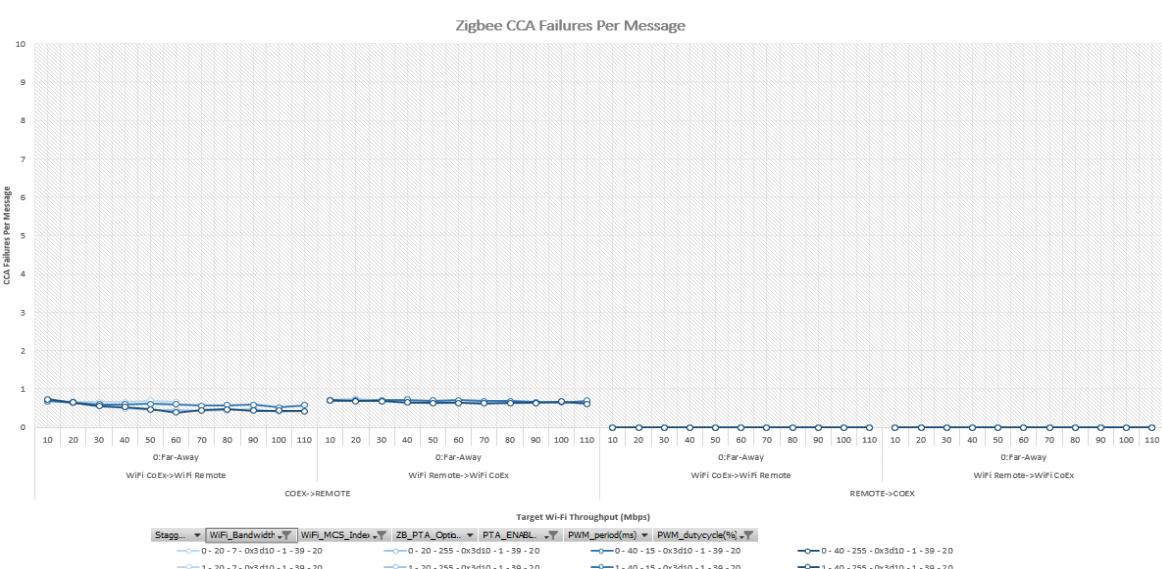
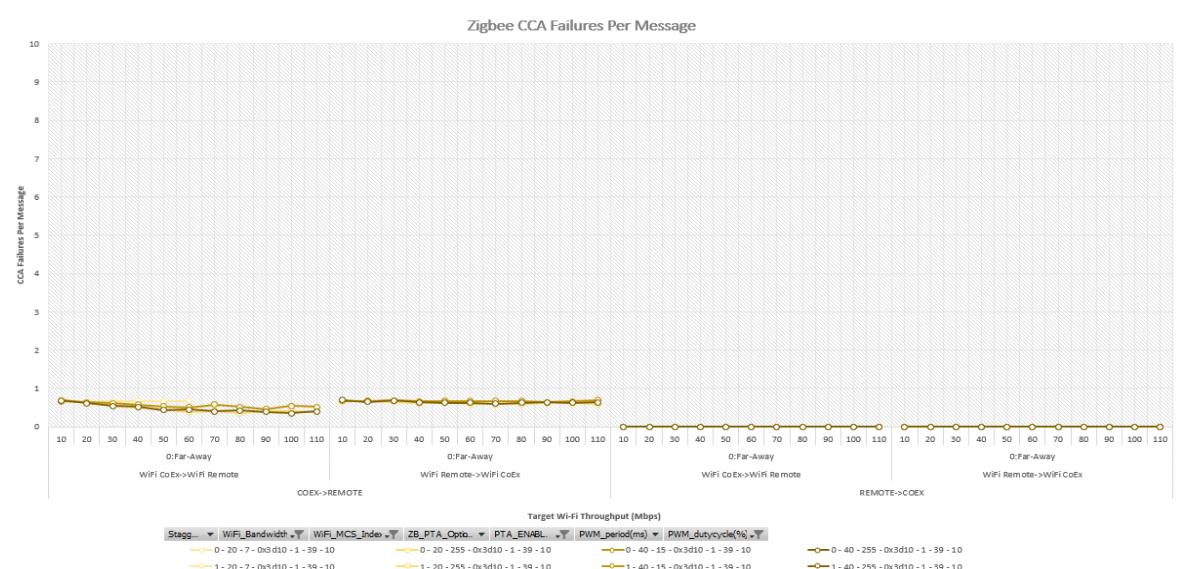
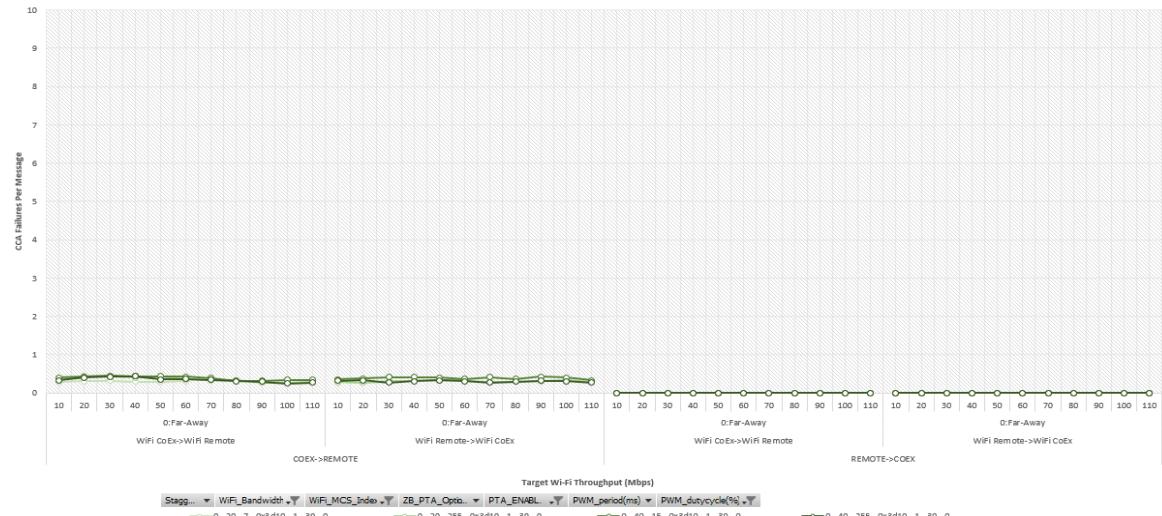
Zigbee CCA Failure Per Message

Disable PTA



Far-away: Wi-Fi ch1,11(HT20/40), ZB ch24,11

Enable PTA PWM=0%

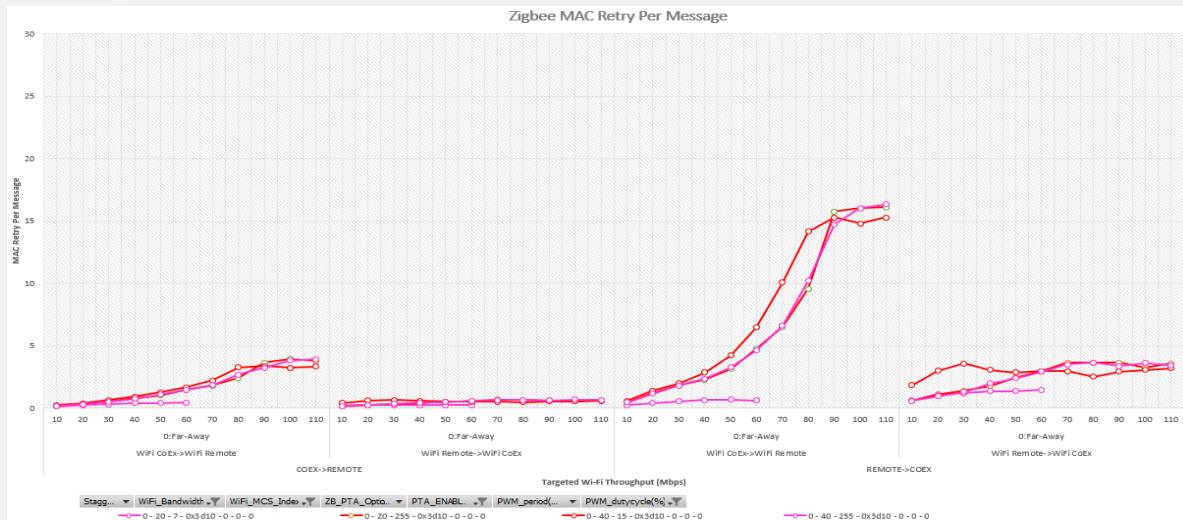


Enable PTA PWM=10%

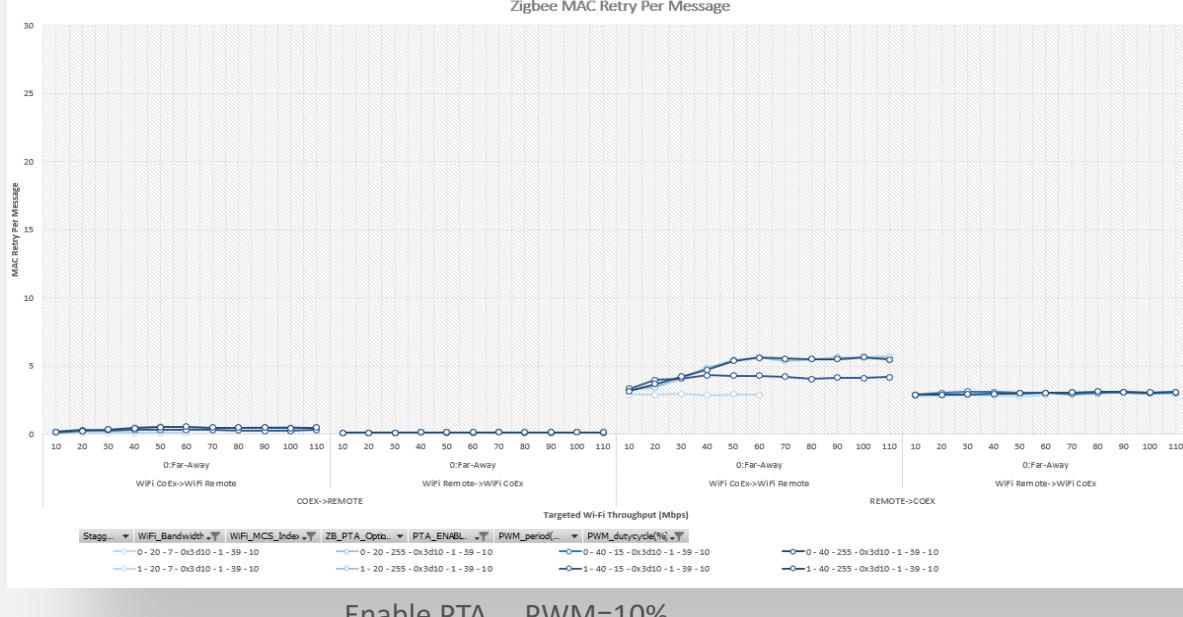
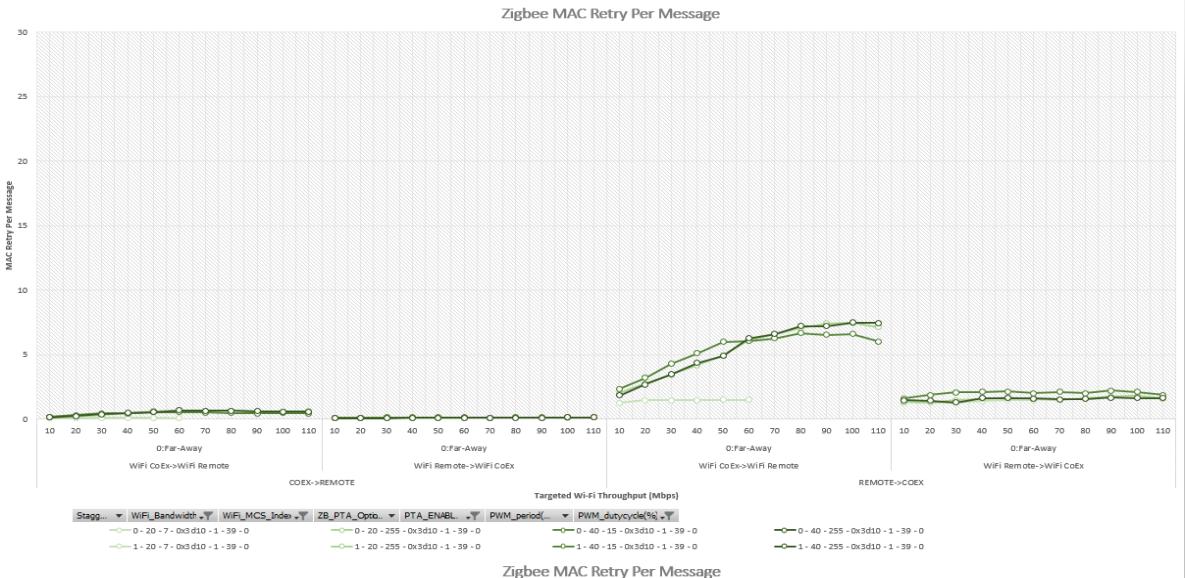
Enable PTA PWM=20%

Zigbee Mac Retry Per Message

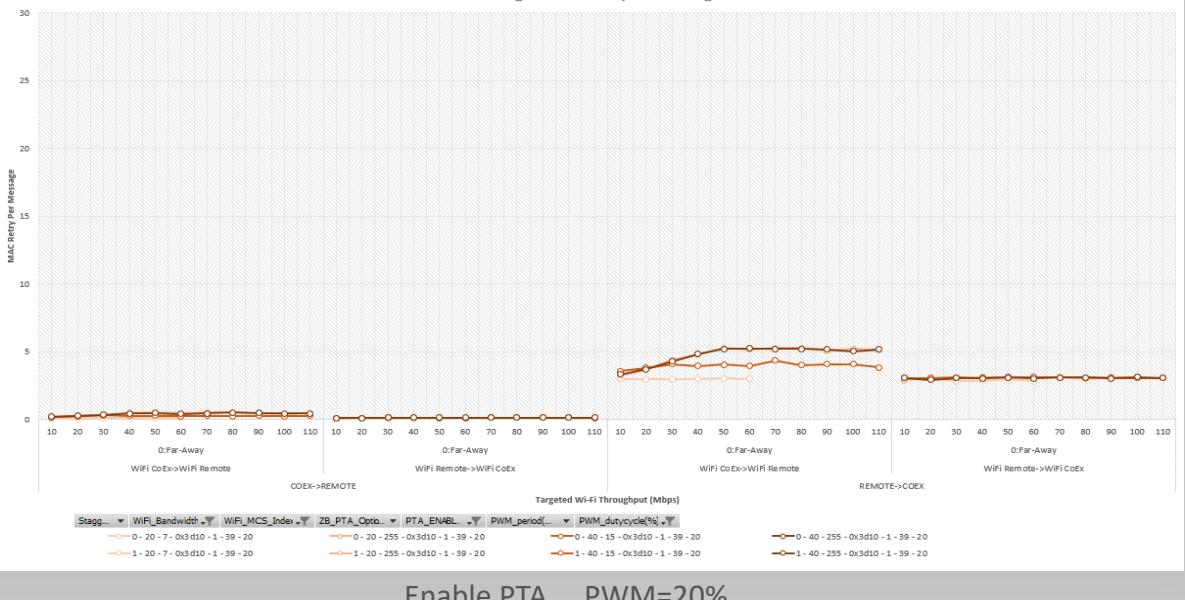
Disable PTA



Far-away: Wi-Fi ch1,11(HT20/40), ZB ch24,11
Enable PTA PWM=0%

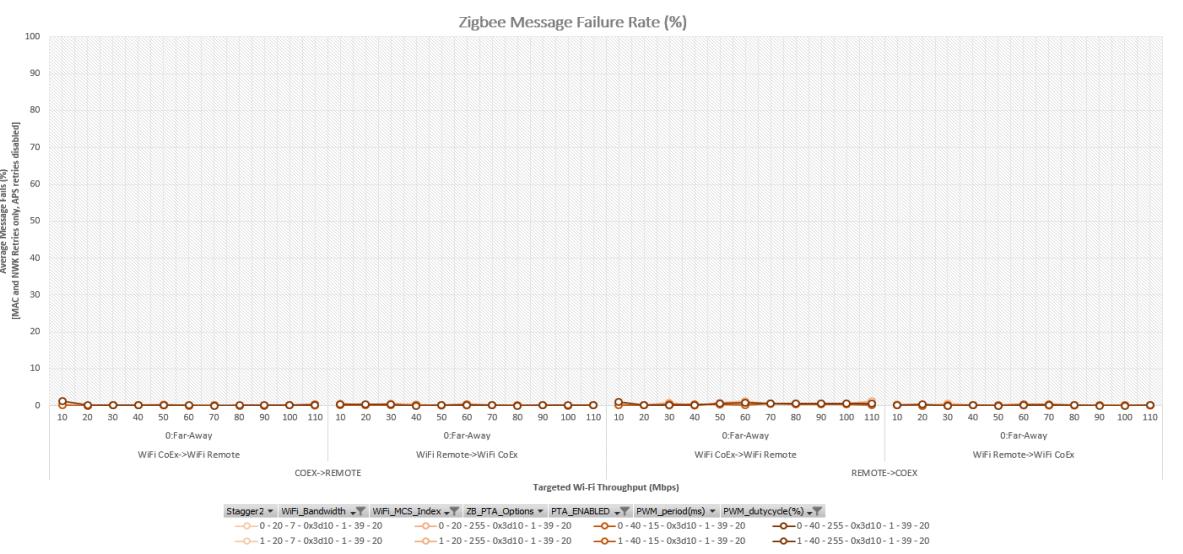
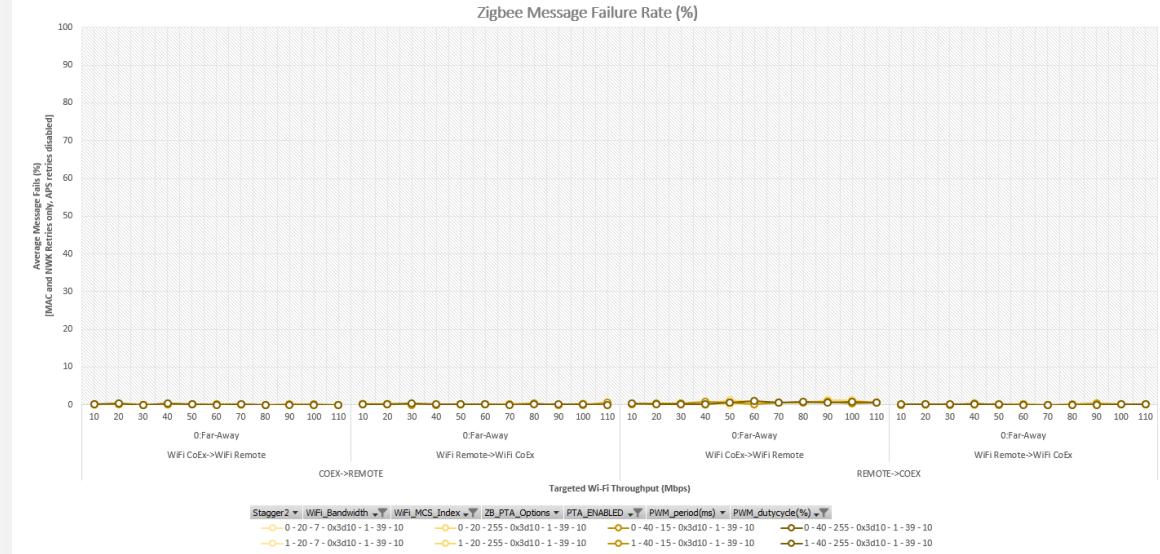
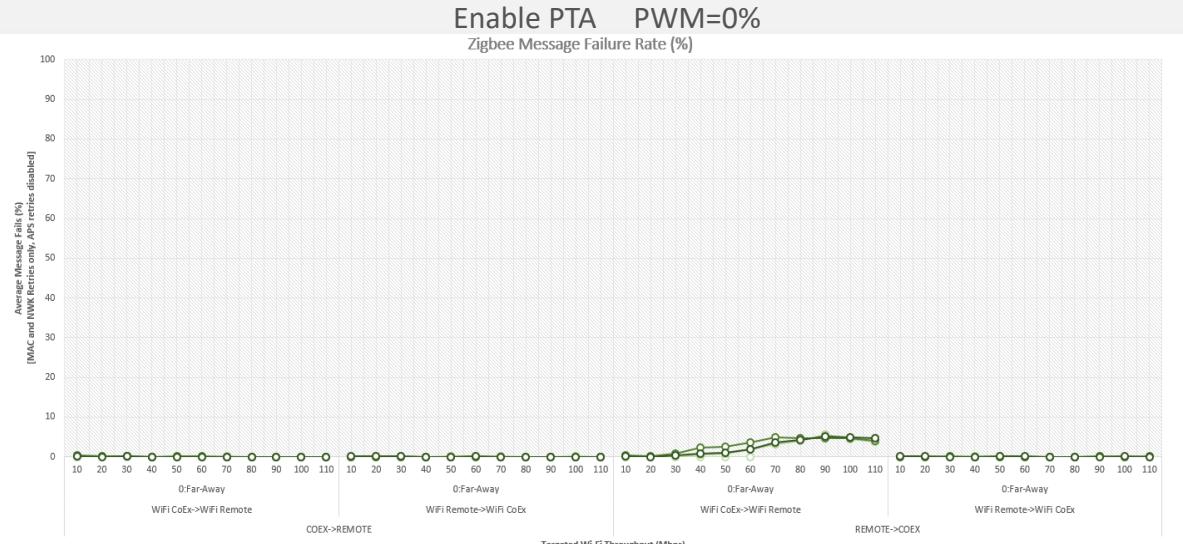
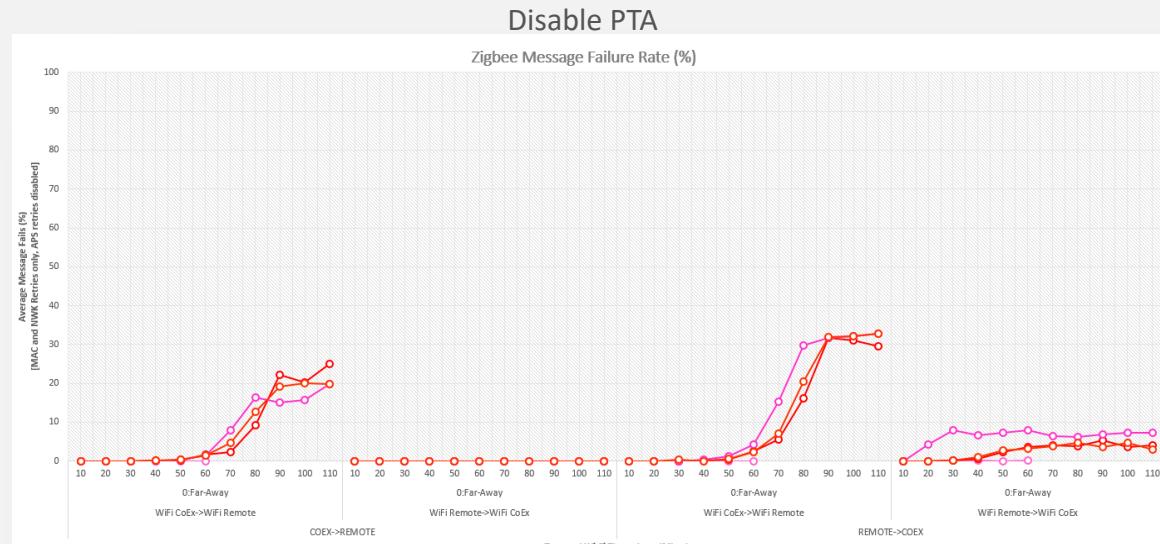


Enable PTA PWM=10%



Zigbee Message Failure Rate(%)

Far-away: Wi-Fi ch1,11(HT20/40), ZB ch24,11



Thank you!

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