



MEDIATEK

MT7986 Tx Beamforming Application Note

2021/10/20

Version History

Version	Date	Author (Optional)	Description
0.1	2021-9-13		Initial draft
1.0	2021-10-20	Micheal Su	Official release

Outline

- ❑ Feature Description
- ❑ How to Configure – profile
- ❑ How to Debug
- ❑ Note

Feature Description

Beamforming

- Beamforming is a signal process technique for directional signal transmission and reception.
- There are two kinds of beamforming, one is explicit and the other is implicit

	Implicit BF	Explicit BF
Operation	<p>Beamformer Beamformee</p> <p>Channel Estimation</p> <p>Normal Signal</p> <p>Beamforming</p>	<p>Beamformer Beamformee</p> <p>BF Training Signal</p> <p>Steering matrix</p> <p>BF report</p> <p>Channel Estimation Feedback matrix</p> <p>Beamforming</p>
Pros	<ul style="list-style-type: none"> • Beamforming to legacy Station that doesn't support beamforming protocol • No overhead for training 	<ul style="list-style-type: none"> • Explicit beamforming performance can be better than implicit beamforming where channel estimation direction and beamforming direction are opposite

How to Configure – profile

Profile Settings

- **Profile location**
 - `/etc/wireless/mediatek/mt7986-ax6000.dbdc.b0.dat` (for BAND0)
 - `/etc/wireless/mediatek/mt7986-ax6000.dbdc.b1.dat` (for BAND1)
- **Explicit Tx Beamforming (eTxBF)**
 - `ETxBfEnCond=1`
- **Implicit Tx Beamforming (iTxBF)**
 - `ITxBfEn=1`
 - **Additional phase calibration is required**

How to Debug

Runtime Debug

TxBfPlyInfo Command Usage

- **iwpriv ra0 set TxBfPlyInfo=[0]:[1]:[2]:[3]**
 - If **[0]=0** means Read Info
 - If **[0]=1** means Set Option
 - **1:[1]:[2]:[3]** Set Option
 - **[1]:** Global Option
 - BIT0 – Disable HE IBF
 - BIT1 – Force Enable IBF
 - BIT2 – Force Disable IBF
 - BIT3 – Force Disbale EBF
 - **[2]:** Group IBF Option
 - BIT0 – Enable IBF SXX Group
 - BIT1 – Enable IBF EXX Group – Enable iBFmer Max Tx Cap == iBFmer Nc
 - **[3]:** Group EBF Option
 - BIT0 – Enable EBF XEE Group
 - If **[0]=2** means Force STA's policy
 - **2:[1]:[2]:[3]** Force STA's policy
 - **[1]:** WlanIdx
 - **[2]:** 0 - 1Nss, 1 - 2Nss,
 - **[3]:** 0 - NONBF, 1 - EBF, 2 - IBF, 3 - EBF then IBF, 4 - IBF then EBF

0: Read Info
1: Set Option
2: Force STA's policy

TxBfPlyInfo – 0: Read Info

- iwpriv ra0 set TxBfPlyInfo=0**

```

root@OpenWrt:/# iwpriv rax0 set TxBfPlyInfo=0
[ 3449.570540] ===== Global Setting =====
root@OpenWrt:/# [ 3449.579405] GloOpt = 0x01, GrpIBFOpt = 0x00, GrpEBFOp = 0x00
[ 3449.586435] ===== STA Info =====
[ 3449.594766] AID 1 Nss 1 Grp=SSS, Ply=EBF Nss 2 Grp=ESE, Ply=EBF Nss 3 Grp=NON, Ply=NBF Nss 4 Grp=NON, Ply=NBF Rlt=NBF
[ 3449.605442] AID 2 Nss 1 Grp=NON, Ply=NBF Nss 2 Grp=NON, Ply=NBF Nss 3 Grp=NON, Ply=NBF Nss 4 Grp=NON, Ply=NBF Rlt=NBF
[ 3449.616116] AID 3 Nss 1 Grp=NON, Ply=NBF Nss 2 Grp=NON, Ply=NBF Nss 3 Grp=NON, Ply=NBF Nss 4 Grp=NON, Ply=NBF Rlt=NBF
[ 3449.626795] AID 4 Nss 1 Grp=NON, Ply=NBF Nss 2 Grp=NON, Ply=NBF Nss 3 Grp=NON, Ply=NBF Nss 4 Grp=NON, Ply=NBF Rlt=NBF
[ 3449.637471] ===== STA Info Connected =====
[ 3449.645801] AID 2 Nss 1 Grp=SSS, Ply=EBF Nss 2 Grp=ESE, Ply=EBF Nss 3 Grp=NON, Ply=NBF Nss 4 Grp=NON, Ply=NBF Rlt=NBF
[ 3449.656570] =====

```

For STA of Wlan Idx 1

If Tx Nss=2, policy is Non-BF

Current Tx Result is NBF

If Tx Nss=1, policy is EBF

- iwpriv ra0 show staintfo**

```

[ 2094.659047] Show_MacTable_Proc(): arg=
[ 2094.662815] Dump MacTable entries info, EntType=0x20001
[ 2094.668036]
[ 2094.668036] MAC                MODE  AID  WCID  BSS  PSM  WMM  MIMOPS  RSSI0/1/2/3
[ 2094.683563] MWDSCap HT Operating Mode : 1
[ 2094.687565] BE:C5:9E:09:60:D8  STA   2    1    1    1    1    3      -56/-58/-58/-61

```

TxBfPlyInfo – 2: Force STA's Policy

- `iwpriv ra0 set TxBfPlyInfo=2:[1]:[2]:[3]` (Force STA's policy)
 - [1]: WlanIdx
 - [2]: 0 - 1Nss, 1 - 2Nss,
 - [3]: 0 - NONBF, 1 - EBF, 2 - IBF, 3 - EBF then IBF, 4 - IBF then EBF

- E.g. For STA1, set Tx 1-Nss to Non-BF

- `iwpriv ra0 set TxBfPlyInfo=2:1:0:0`

```

MAC              MODE  AID  WCID  BSS  PSM  WMM  MIMOPS  RSSI0/1/2/3
MwDSCap HT Operating Mode : 2
C4:0B:31:51:0A:7C STA  2    1    1    0    1    3    -56/-57/-58/-60
.....
AID 2 Nss 1 Grp=MAN, Ply=NB
STA Info Connected =====
Nss 2 Grp=ESE, Ply=EBF Nss 3 Grp=NON, Ply=NB Nss 4

```

- E.g. For STA1, set Tx 1-Nss to EBF

- `iwpriv ra0 set TxBfPlyInfo=2:1:0:1`

```

MAC              MODE  AID  WCID  BSS  PSM  WMM  MIMOPS  RSSI0/1/2/3
MwDSCap HT Operating Mode : 2
C4:0B:31:51:0A:7C STA  2    1    1    0    1    3    -56/-57/-58/-60
.....
AID 2 Nss 1 Grp=MAN, Ply=EBF
STA Info Connected =====
Nss 2 Grp=ESE, Ply=EBF Nss 3 Grp=NON, Ply=NB Nss 4

```

- E.g. For STA1, set Tx 1-Nss to IBF

- `iwpriv ra0 set TxBfPlyInfo=2:1:0:2`

```

MAC              MODE  AID  WCID  BSS  PSM  WMM  MIMOPS  RSSI0/1/2/3
MwDSCap HT Operating Mode : 2
C4:0B:31:51:0A:7C STA  2    1    1    0    1    3    -56/-57/-58/-60
.....
AID 2 Nss 1 Grp=MAN, Ply=IBF
STA Info Connected =====
Nss 2 Grp=ESE, Ply=EBF Nss 3 Grp=NON, Ply=NB Nss 4

```

Debug – Check TxBF Counter

- How to check whether TxBF is applied

- Command to check TxBF apply

- 2G : iwpriv ra0 mac 820ED7A8
ra0 mac:[0x2a0f0]:"0000""0000"

value=0
iBF not apply

value=0
eBF not apply

- 5G : iwpriv rax0 mac 820FD7A8
rax0 mac:[0x2a0f0]:"03e6""0895"

These packets
are iBF applied

These packets
are eBF applied

Note

Note

- There is no station support 2G HT eBF and please test 5G only
- When testing TGn, TGac, and TGax, please turn off iBF to make sure that BF optimization does not take place
- If you want to test eBF only, please turn off the iBF first
 - sed -i 's/ITxBfEn=1/ITxBfEn=0/g' /etc/wireless/mt7986-ax6000.dbdc.b0.dat
 - sed -i 's/ITxBfEn=1/ITxBfEn=0/g' /etc/wireless/mt7986-ax6000.dbdc.b1.dat
 - ifconfig rax0 down
 - ifconfig ra0 down
 - ifconfig ra0 up
 - ifconfig rax0 up

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