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

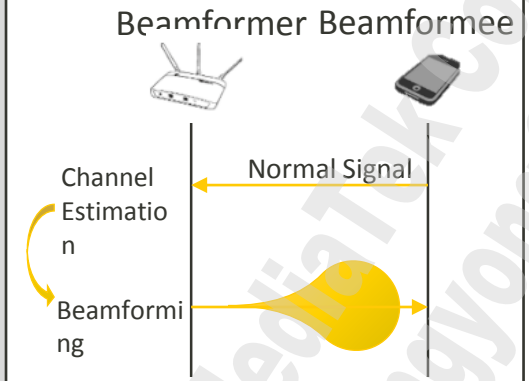
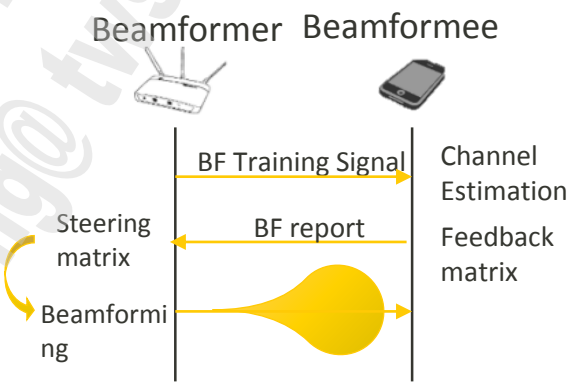
Outline

- 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		
Pros	• Beamforming to legacy Station that doesn't support beamforming protocol • No overhead for training	• 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 Opion
        - 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=1, policy is EBF

If Tx Nss=2, policy is Non-BF

Current Tx Result is NBF

- **iwpriv ra0 show stainfo**

```
[ 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
- E.g. For STA1, set Tx 1-Nss to EBF
  - iwpriv ra0 set TxBfPlyInfo=2:1:0:1
- E.g. For STA1, set Tx 1-Nss to IBF
  - iwpriv ra0 set TxBfPlyInfo=2:1:0:2

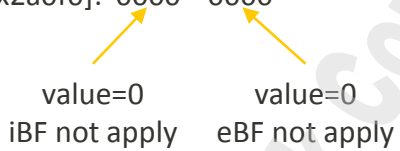
```
MAC                 MODE  AID  WCID   BSS PSM WMM MIMOPS RSSI0/1/2/3
MWDSCap HT Operating Mode : 2
C4:0B:31:51:0A:7C  STA   2    1      1   0   1   3      -56/-57/-58/-60
……
============================== STA Info Connected ==============================
AID 2 Nss 1 Grp=MAN, Ply=NBF Nss 2 Grp=ESE,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

```
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
……
============================== STA Info Connected ==============================
AID 2 Nss 1 Grp=MAN, Ply=EBF Nss 2 Grp=ESE, Ply=EBF Nss 3 Grp=NON, Ply=NBF Nss 4
```

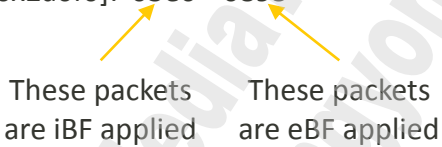
```
MAC                 MODE  AID  WCID   BSS PSM WMM MIMOPS RSSI0/1/2/3
MWDSCap HT Operating Mode : 2
C4:0B:31:51:0A:7C  STA   2    1      1   0   1   3      -56/-57/-58/-60
……
============================== STA Info Connected ==============================
AID 2 Nss 1 Grp=MAN, Ply=IBF Nss 2 Grp=ESE,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



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



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