

The Mediatek logo, consisting of the word "MEDIATEK" in a bold, sans-serif font, is centered within a white, parallelogram-shaped background element.

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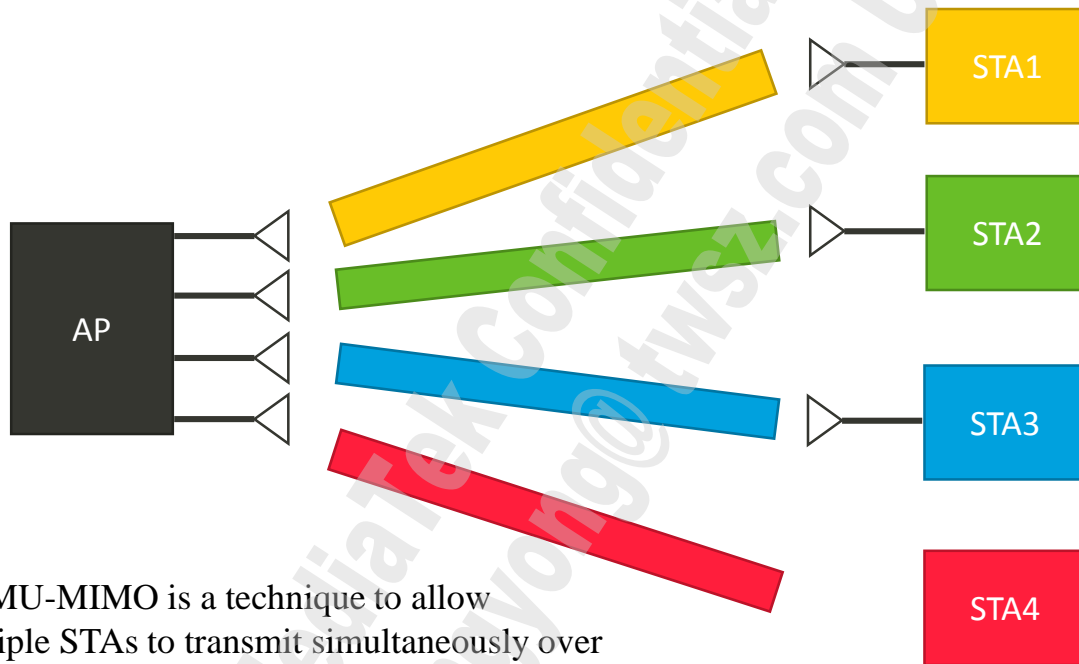
# UL MU-MIMO Application Note

2021.09.24

# Version History

Version	Date	Author	Description
1.0	2021-09-24	Wish	External version

# Introduction



UL MU-MIMO is a technique to allow multiple STAs to transmit simultaneously over the same frequency resource to the receiver.

# HE PHY Capability

We only support full BW UL MU-MIMO in AP now.

B0	B1	B7	B8	B11	B12	B13	B14	B15	B16	B17
Reserved	Supported Channel Width Set	Punctured Preamble Rx	Device Class	LDPC Coding In Payload	HE SU PPDU With 1x HE-LTF And 0.8 $\mu$ s GI	Midamble Tx/Rx Max NSTS	NDP With 4x HE-LTF And 3.2 $\mu$ s GI			
Bits: 1	7	4	1	1	1	1	2			1

B18	B19	B20	B21	B22	B23	B24	B25	B26
STBC Tx $\leq$ 80 MHz	STBC Rx $\leq$ 80 MHz	Doppler Tx	Doppler Rx	Full Bandwidth UL MU-MIMO	Partial Bandwidth UL MU-MIMO	DCM Max Constellation Tx	DCM Max NSS Tx	
Bits: 1	1	1	1	1	1	2	1	

Full Bandwidth UL MU-MIMO	<p>For an AP, indicates support for MU-MIMO reception of an HE TB PPDU on an RU that spans the entire PPDU bandwidth (UL MU-MIMO).</p> <p>For a non-AP STA, indicates support for the transmission of an HE TB PPDU on an RU that spans the entire PPDU bandwidth (UL MU-MIMO).</p>	Set to 0 if not supported. Set to 1 if supported.
Partial Bandwidth UL MU-MIMO	<p>For an AP, indicates support for receiving an RU in an HE TB PPDU where MU-MIMO is employed in the RU, the RU size is greater than or equal to 106-tones, and the RU does not span the entire PPDU bandwidth (UL MU-MIMO within OFDMA).</p> <p>For a non-AP STA, indicates support for transmitting an RU in an HE TB PPDU where MU-MIMO is employed in the RU, the RU size is greater than or equal to 106-tones, and the RU does not span the entire PPDU bandwidth (UL MU-MIMO within OFDMA).</p>	Set to 0 if not supported. Set to 1 if supported.

# Trigger Frame

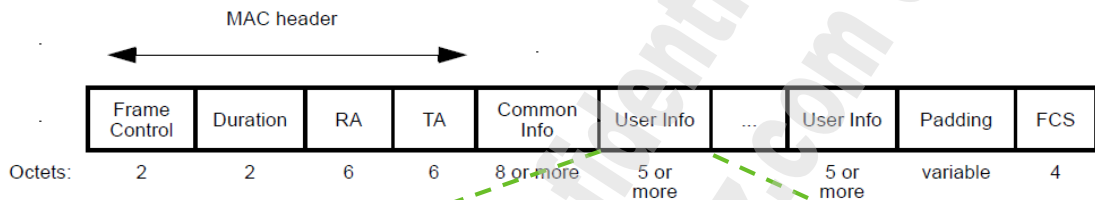


Figure 9-64a—Trigger frame

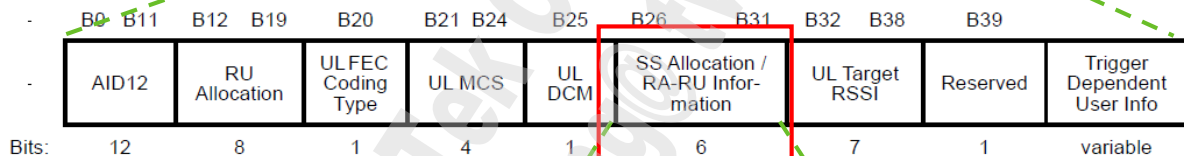


Figure 9-64d—User Info field

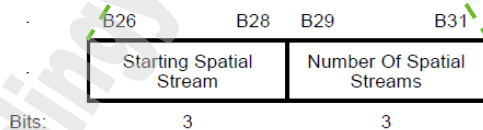


Figure 9-64e—SS Allocation subfield format

# AP Side Configuration

- Enable feature in DAT file.

```
root@LEDE:/# cat /etc/wireless/mediatek/mt7915.1.dat | grep 'lEnable'
MuOfdmaDlEnable=1
MuOfdmaUlEnable=1
MuMimoDlEnable=0
MuMimoUlEnable=1
```

- Check AP feature by driver command

iwpriv ra0 show apcfginfo

```
root@LEDE:/# iwpriv ra0 show apcfginfo
[ 1215.314216] show ap cfg info:
[ 1215.317281]
[ 1215.323130] WirelessMode      17      9/14
[ 1215.328447] TxPower          0       100
[ 1215.333682] TxPreamble       1        1
[ 1215.338741] RSTThreshold(config) 2347   2347
```

...

```
[ 1215.481332] MuOfdmaDlEnable    1        0
[ 1215.486384] MuOfdmaUlEnable    1        0
[ 1215.491432] MuMimoDlEnable     0        0
[ 1215.496481] MuMimoUlEnable     1        0
[ 1215.501530] CommonCfg.ETxBfEnCond  0        0
[ 1215.506578] ETxBfEnCond        0        0
[ 1215.511626] CommonCfg.ITxBfEn     0        0
[ 1215.516675] ITxBfEn            0        0
[ 1215.521723] MUTxRxEnable       0        0
[ 1215.526770] -----
[ 1215.532863] current channel    157
[ 1215.537824] extension channel  ABOVE
```

# Peer STA Capability

- Check Peer STA's Capability.

```
# iwpriv ra0 show get_muru_glo_addr
```

```
# iwpriv ra0 show get_muru_stacap_info=<wlanIdx>
```

```
root@LEDE:/# iwpriv ra0 show get_muru_stacap_info=1
[ 186.191416] Muru_StaCap_Info
[ 186.194481] |-(0x0041095C) rDlOfdma
[ 186.197988] |-(0x0041095C) u1PhyPunRx = 0
[ 186.202180] |-(0x0041095D) u120Min40M2G = 0
[ 186.206548] |-(0x0041095E) u120Min160M = 0
[ 186.210825] |-(0x0041095F) u180Min160M = 0
[ 186.215098] |-(0x00410960) u1Lt16SigB = 0
[ 186.219285] |-(0x00410961) u1RxSUCCompSigB = 0
[ 186.223818] |-(0x00410962) u1RxSUNonCompSigB = 0
[ 186.228606] |-(0x00410964) rUOfdma
[ 186.232096] |-(0x00410964) u1TrigFrmPad = 2
[ 186.236457] |-(0x00410965) u1MuCascading = 0
[ 186.240903] |-(0x00410966) u1UoRa = 0
[ 186.244740] |-(0x00410967) u12x996Tone = 0
[ 186.249011] |-(0x00410968) u1RxTrgFrmByllac = 0
[ 186.253717] |-(0x0041096C) rDlMimo
[ 186.257122] |-(0x0041096C) fgVhtMuBfee = 0
[ 186.261391] |-(0x0041096D) fgParBWDlMimo = 1
[ 186.265832] |-(0x00410970) rUlMimo
[ 186.269233] |-(0x00410970) fgFullUlMimo = 1
[ 186.273590] |-(0x00410971) fgParUlMimo = 1
```

# MU Group Info

# iwpriv ra0 show get\_muru\_glo\_addr

# iwpriv ra0 show get\_mu\_grouptbl=<group id>

## 2MU

```
root@LEDE:/# iwpriv ra0 show get_mu_grouptbl=8
[67052.315207] MURU MUM GROUP TABLE ENTRY: GROUP IDX = 8
[67052.320295] -DW0 (Addr: 0xE00C57F8)(Value: 0x80004101)
[67052.325525]   -u1NumUser    = 1
[67052.328762]   -u1DLGi       = 0
[67052.331994]   -u1ULGi       = 0
[67052.335222]   -u1Ax        = 1
[67052.338442]   -u1PFIDUser0 = 0
[67052.341670]   -u1PFIDUser1 = 1
[67052.344898]   -u1PFIDUser2 = 0
[67052.348124]   -u1PFIDUser3 = 0
[67052.351352]   -u1DLVld     = 0
[67052.354571]   -u1ULVld     = 1
[67052.357809] -DW1 (Addr: 0xE00C57FC)(Value: 0x00000086)
[67052.363034]   -u1RuAlloc    = 134
[67052.366427]   -u1NssUser0    = 0
[67052.369653]   -u1NssUser1    = 0
[67052.372882]   -u1NssUser2    = 0
[67052.376110]   -u1NssUser3    = 0
[67052.379343] -DW2 (Addr: 0xE00C5800)(Value: 0x00000000)
[67052.384565]   -u1DLMcsUser0 = 0
[67052.387789]   -u1DLMcsUser1 = 0
[67052.391014]   -u1DLMcsUser2 = 0
[67052.394233]   -u1DLMcsUser3 = 0
[67052.397458]   -u1DLWfUser0 = 0
[67052.400683]   -u1DLWfUser1 = 0
[67052.403908]   -u1DLWfUser2 = 0
[67052.407133]   -u1DLWfUser3 = 0
[67052.410360] -DW3 (Addr: 0xE00C5804)(Value: 0x000000AA)
[67052.415582]   -u1ULMcsUser0 = 10
[67052.418896]   -u1ULMcsUser1 = 10
[67052.422202]   -u1ULMcsUser2 = 0
[67052.425427]   -u1ULMcsUser3 = 0
[67052.428651]   -u1ULWfUser0 = 0
[67052.431876]   -u1ULWfUser1 = 0
[67052.435101]   -u1ULWfUser2 = 0
[67052.438320]   -u1ULWfUser3 = 0
```

## 4MU

```
root@LEDE:/# iwpriv ra0 show get_mu_grouptbl=71
[66935.350211] MURU MUM GROUP TABLE ENTRY: GROUP IDX = 71
[66935.355434] -DW0 (Addr: 0xE00C5BE8)(Value: 0x83104103)
[66935.360664]   -u1NumUser    = 3
[66935.363898]   -u1DLGi       = 0
[66935.367129]   -u1ULGi       = 0
[66935.370349]   -u1Ax        = 1
[66935.373578]   -u1PFIDUser0 = 0
[66935.376806]   -u1PFIDUser1 = 1
[66935.380035]   -u1PFIDUser2 = 2
[66935.383262]   -u1PFIDUser3 = 3
[66935.386482]   -u1DLVld     = 0
[66935.389709]   -u1ULVld     = 1
[66935.392944] -DW1 (Addr: 0xE00C5BEC)(Value: 0x00000086)
[66935.398168]   -u1RuAlloc    = 134
[66935.401570]   -u1NssUser0    = 0
[66935.404798]   -u1NssUser1    = 0
[66935.408028]   -u1NssUser2    = 0
[66935.411261]   -u1NssUser3    = 0
[66935.414516] -DW2 (Addr: 0xE00C5BF0)(Value: 0x00000000)
[66935.419800]   -u1DLMcsUser0 = 0
[66935.423030]   -u1DLMcsUser1 = 0
[66935.426249]   -u1DLMcsUser2 = 0
[66935.429474]   -u1DLMcsUser3 = 0
[66935.432700]   -u1DLWfUser0 = 0
[66935.435925]   -u1DLWfUser1 = 0
[66935.439149]   -u1DLWfUser2 = 0
[66935.442368]   -u1DLWfUser3 = 0
[66935.445601] -DW3 (Addr: 0xE00C5BF4)(Value: 0x0000BB8B)
[66935.450823]   -u1ULMcsUser0 = 11
[66935.454135]   -u1ULMcsUser1 = 11
[66935.457448]   -u1ULMcsUser2 = 11
[66935.460762]   -u1ULMcsUser3 = 11
[66935.464078]   -u1ULWfUser0 = 0
[66935.467304]   -u1ULWfUser1 = 0
[66935.470523]   -u1ULWfUser2 = 0
[66935.473748]   -u1ULWfUser3 = 0
```



## UL MU-MIMO test result v.s Panther AP clients

Test Case	Peak T-put under UDP (Mbps)			Peak T-put under TCP (Mbps)		
	SU	MU	MU Gain	SU	MU	MU Gain
<b>*HE 5G BW80 (2SS, 2SS)</b>	1026	1616	57.5%	1005	1620	61.2%
<b>*HE 5G BW160 (2SS, 2SS)</b>	1495	1960	31.1%	1859	2757	48.3%

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