



MEDIATEK

Panther MU-OFDMA Application Note

2021/10/1

William

Version History

Version	Date	Author (Optional)	Description
0.1	2021-9-23	William	Initial draft
1.0	2021-10-1	Micheal Su	Official release

Outline

- ❑ Introductions to Wi-Fi OFDMA and RU Feature
- ❑ Basic Concepts of OFDMA and RU Feature
- ❑ How to Configure – profile
- ❑ How to Debug
- ❑ Test Result

Introductions to Wi-Fi OFDMA and RU feature

802.11ax Features: OFDMA

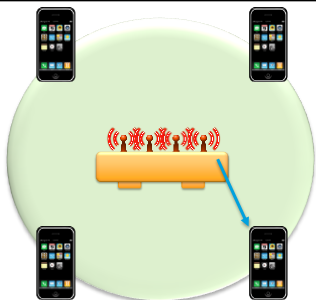
- **OFDMA**
 - As **efficient use** in 4G LTE and 5G, multiple users can be served by different Resource Units(RUs) /Bandwidth simultaneously
- **Uplink Resource Scheduling**
 - Compared to legacy 802.11, where large users compete each other to send UL data, 11ax provides trigger scheduling in **better resource utilization** and better latency experience
- **Uplink MUMIMO**
 - Allow users can send uplink data in the same bandwidth simultaneously for sharing heavy traffic such as social media and content sharing
 - Assume: 11ax with **4x4** AP and **2x2** Client. It would increase **2x** capacity compared to 11ac uplink

*User also represents Non-AP STA

*UL: Uplink

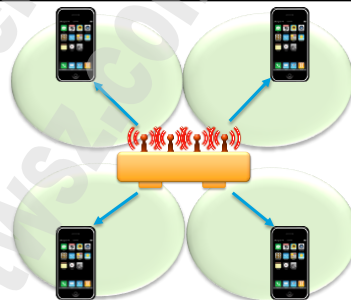
Different Transmit Schemes

Single-User MIMO

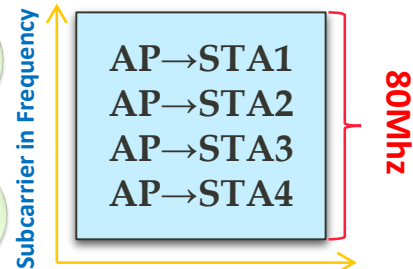


Tx/Rx single user at a time

Multi-User MIMO



Tx multiple users concurrently

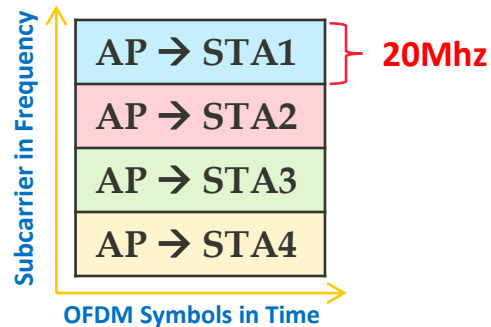


OFDM Symbols in Time
in the same bandwidth

Multi-User OFDMA



Tx/Rx multiple users concurrently, but in the different bandwidth



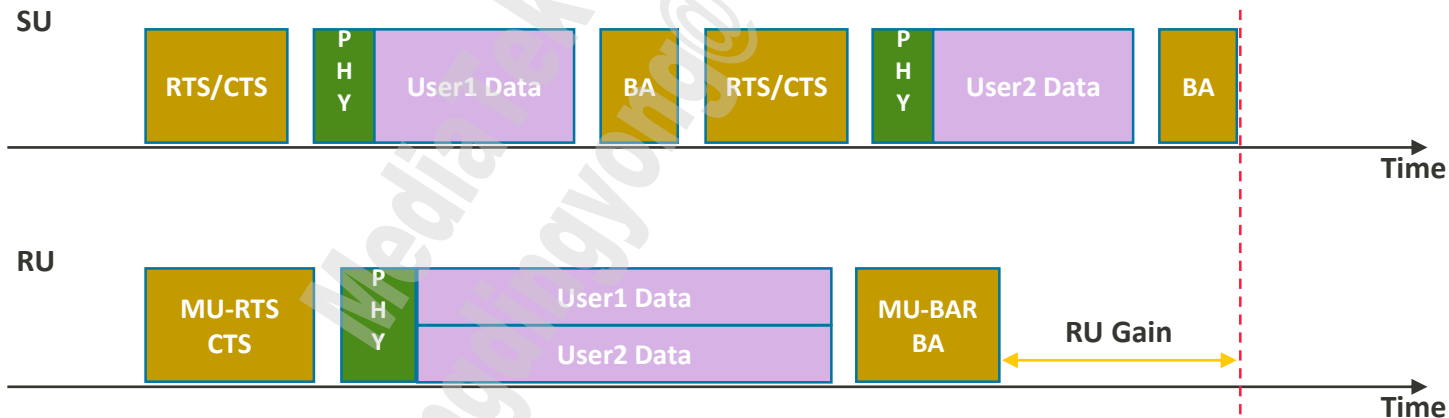
OFDM Symbols in Time

Basic Concepts of OFDMA and RU Feature

What is the RU Latency gain factor?

- **RU latency gain in short PPDU**
 - RU gain is from reducing amount of control frame.
 - Despite the duration of single MU-RTS, MU-BAR is longer than legacy RTS and BA.
 - The total duration of control frame(include SIFS) of RU is shorter than SU.

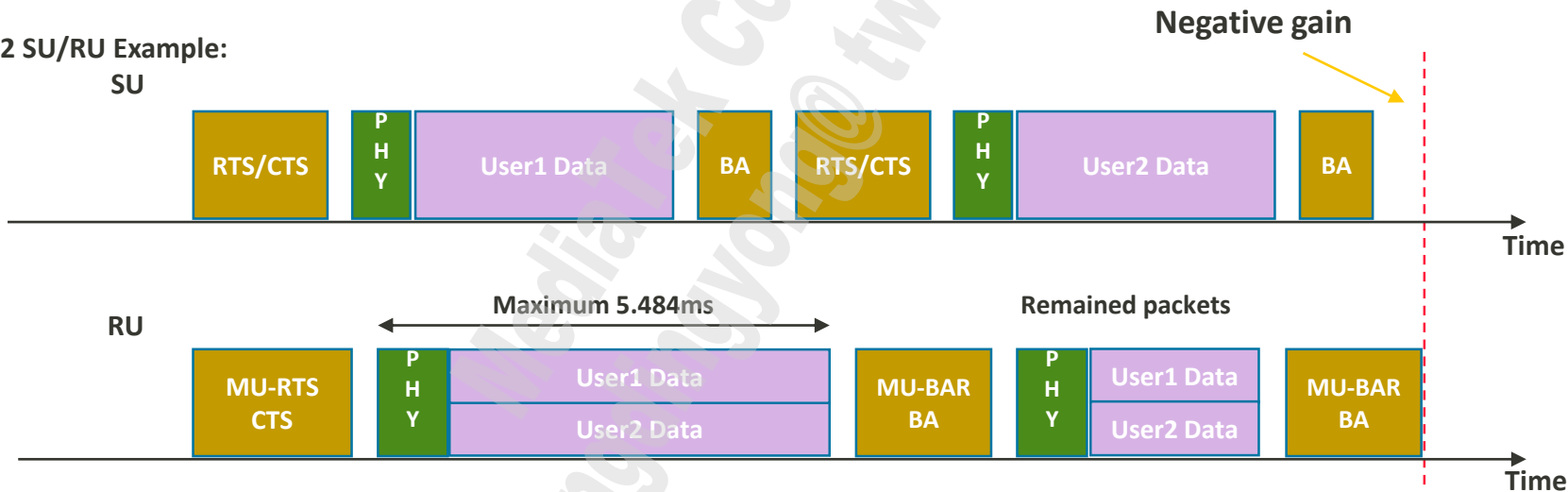
2 SU/RU Example:



What is the RU Latency gain factor?

- RU latency gain in long PPDU is not obvious.
 - The maximum duration of PPDU is **limited to 5.484ms**.
 - Because of long packets cannot aggregate into single MU-PPDU, total PPDU count is not reduced.
 - MU-variant control frame is bigger than legacy control frame.

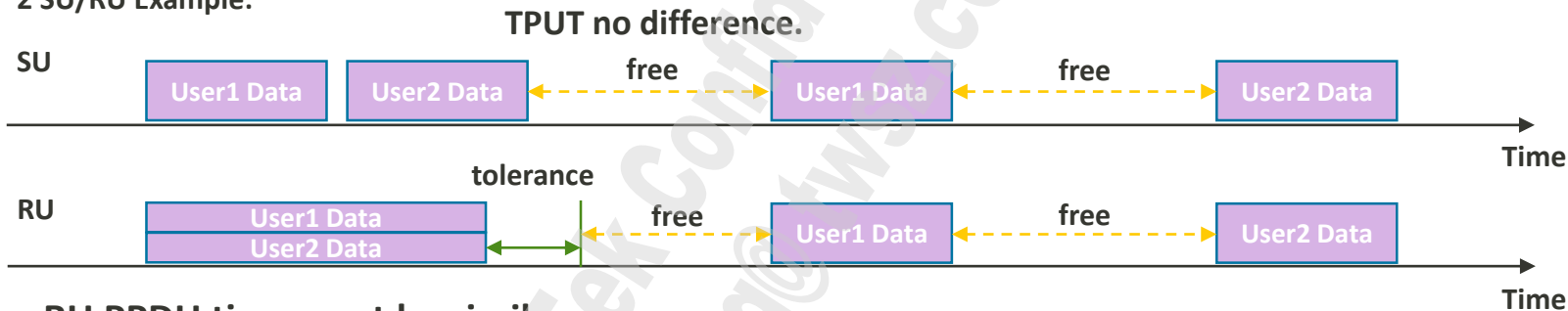
2 SU/RU Example:



Other RU latency gain factors

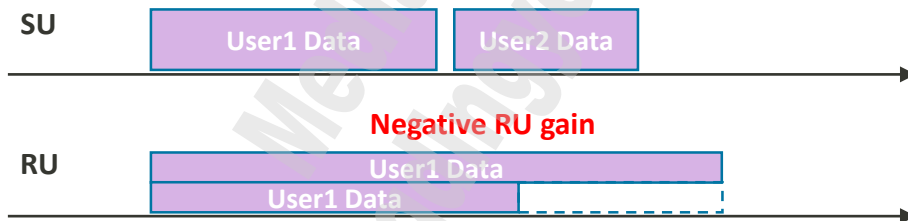
- The air time must be fully occupied.

2 SU/RU Example:



- The RU PPDU time must be similar.

2 SU/RU Example:



Other RU latency gain factors

- For MT7986 RU testing, please use small packet size. E.g. 64B or 128B.
- For MT7986 RU testing, It must connected more then 5 (≥ 5) STAs.
- MT7986 support max 8(2G) + 16(5G) MU candidate STAs.

How to Configure – profile

Enable OFDMA by Profile

- Enable DL/UL OFDMA Feature
- Key parameters in profile
 - MuOfdmaDlEnable=1
 - MuOfdmaUlEnable=1

Enable OFDMA by WebUI

Device Configurations - MT7915.1.1

[Basic](#)[Advanced](#)[HE_MU](#)[WDS](#)[VoW](#)[Power Boost](#)[Others](#)

DL OFDMA

☐ Enable ☐ Disable

UL OFDMA

☐ Enable ☐ Disable

DL MU-MIMO

☐ Enable ☐ Disable

UL MU-MIMO

☐ Enable ☐ Disable[Save and Apply](#)[Save](#)[Reset](#)

How to Debug

TX Statistics Commands

- Show TX Statistics with TX Mode(DL/UL)/TX StaCnt (OFDMA/MUMIMO)
 - `iwpriv ra0 set set_muru_txc_tx_stats=<1:Enable/0:Disable>`
=> enable TX Statistics
 - `iwpriv ra0 show get_muru_txc_tx_stats=<Band>`
=> show TX Statistics

TX Statistics Commands (2/)

1

Downlink:	total count	tx_mode ratio	sub_mode ratio	stacnt ratio
CCK:	18	0%		
OFDM:	0	0%		
HT_MIX:	0	0%		
HT_GF:	0	0%		
VHT:	0	0%		
SU:	0		0%	
MUMIMO:	0		0%	
2MU:	0			0%
3MU:	0			0%
4MU:	0			0%
HE_SU:	44803		54%	
HE_EXT:	0	0%		
HE_MU:	37523	45%		
OFDMA:	37523		0%	
2RU:	6203			7%
3RU:	8310			10%
4RU:	8516			10%
5-8RU:	14494			17%
9-16RU:	0			0%
>16RU:	0			0%
MUMIMO:	0		0%	
2MU:	0			0%
3MU:	0			0%
4MU:	0			0%

2

Uplink:	total count	tx_mode ratio	sub_mode ratio	stacnt ratio
HE_TRIG	0	0%		
OFDMA:	0		0%	
SU:	0			0%
2RU:	0			0%
3RU:	0			0%
4RU:	0			0%
5-8RU:	0			0%
9-16RU:	0			0%
>16RU:	0			0%
MUMIMO:	0		0%	
2MU:	0			0%
3MU:	0			0%
4MU:	0			0%

1. Downlink part

2. Uplink part

3. Tx mode ratio: ratio of different TX mode PPDU.
e.g. CCK/OFDM/ ... / HE_SU/HE_MU

4. sub mode ratio: ratio of OFDMA/MUMIMO PPDU

5. stacnt ratio: ratio of different stacnt PPDU

DL OFDMA Commands

- Force to transmit DL HE-MU PPDU with [StaCnt] users
 - iwpriv ra0 set set_muru_manual_config=dl_comm_user_cnt:[StaCnt]
 - iwpriv ra0 set set_muru_manual_config=update
 - SW will choose a proper RU combination for HE-MU PPDU, a general rule is dividing full BW into [StaCnt] RUs with equal size,
e.g. (RU242, RU242, RU242, RU242)@80M with [StaCnt=4], (RU484, RU484)@80M with [StaCnt=2]
- Release DL HE-MU forcing condition
 - iwpriv ra0 set set_muru_manual_config=dl_init
 - iwpriv ra0 set set_muru_manual_config=update

DL OFDMA Commands (2/)

- Force to transmit DL SU PPDU
 - iwpriv ra0 set set_muru_sutx=1;

CMDRPT TX SU/RU Ratio:

	TOT_MPDU_CNT	Percentage
MODE		
OFDM	7	0.00
HE_SU	241301	100.00

- Release DL SU forcing condition
 - iwpriv ra0 set set_muru_sutx=0;

CMDRPT TX SU/RU Ratio:

	TOT_MPDU_CNT	Percentage
MODE		
OFDM	5	0.00
HE_SU	438305	91.05
HE_MU	43093	8.95

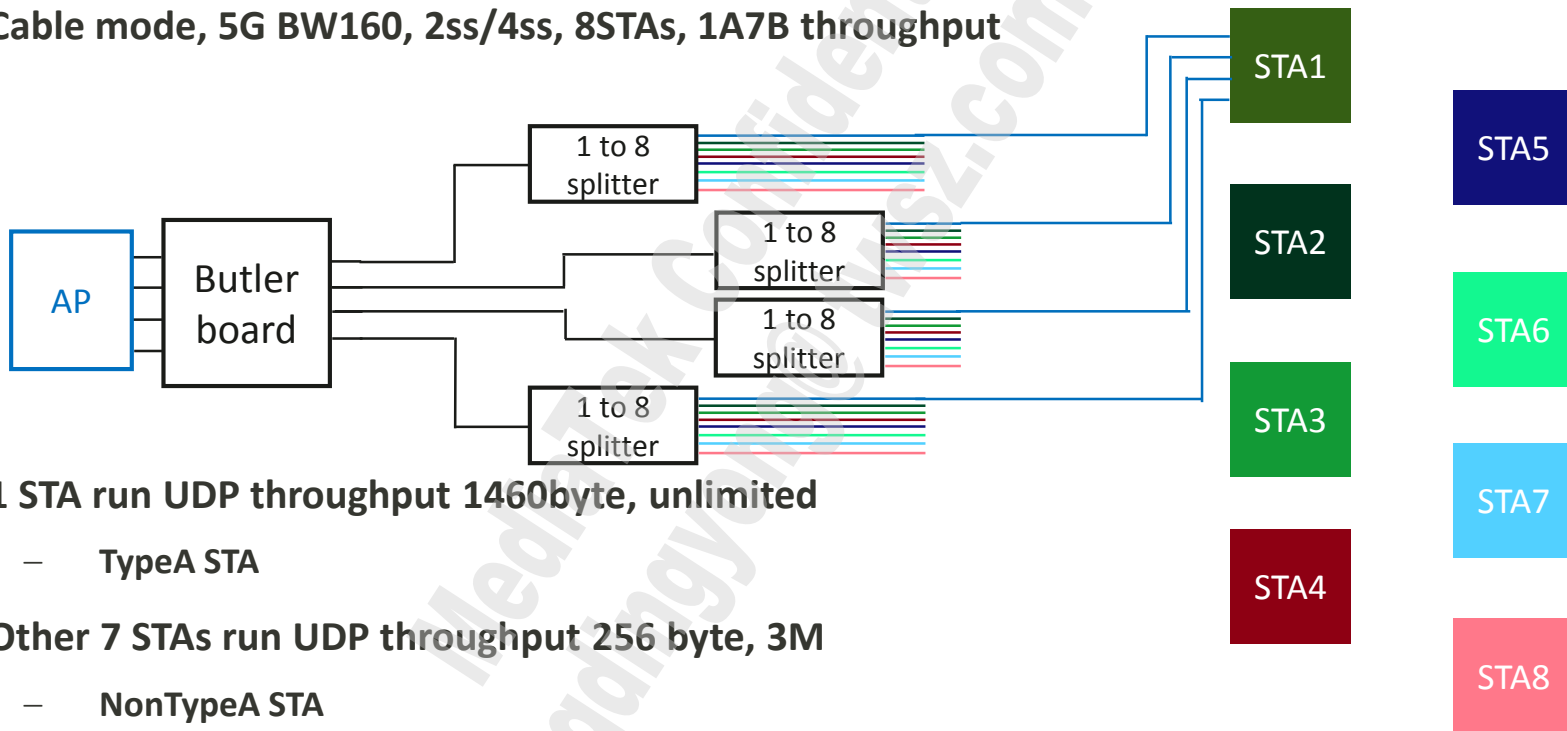
UL OFDMA Commands

- Check MU EDCA status
 - Before delivering throughput, please type the command:
 - `iwpriv ra0 show get_muedca=1`
 - After Log is captured, please type the command to turn off MU EDCA check:
 - `iwpriv ra0 show get_muedca=0`
- Check UL OFDMA FW status
 - `iwpriv ra0 show get_ulru_status`
 - It shows the status of each STA

Test Result

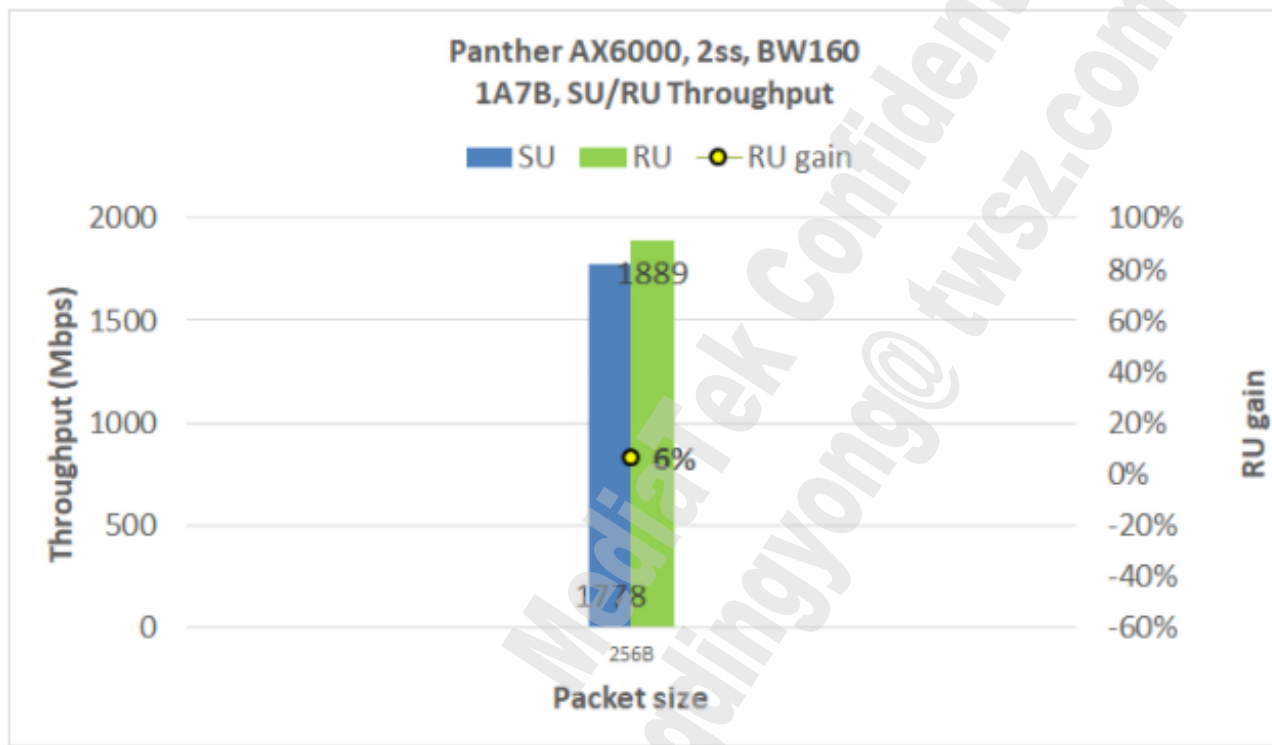
DL/UL OFDMA MTK test Scenario

- Cable mode, 5G BW160, 2ss/4ss, 8STAs, 1A7B throughput



- 1 STA run UDP throughput 1460byte, unlimited
 - TypeA STA
- Other 7 STAs run UDP throughput 256 byte, 3M
 - NonTypeA STA

DL OFDMA MTK test report



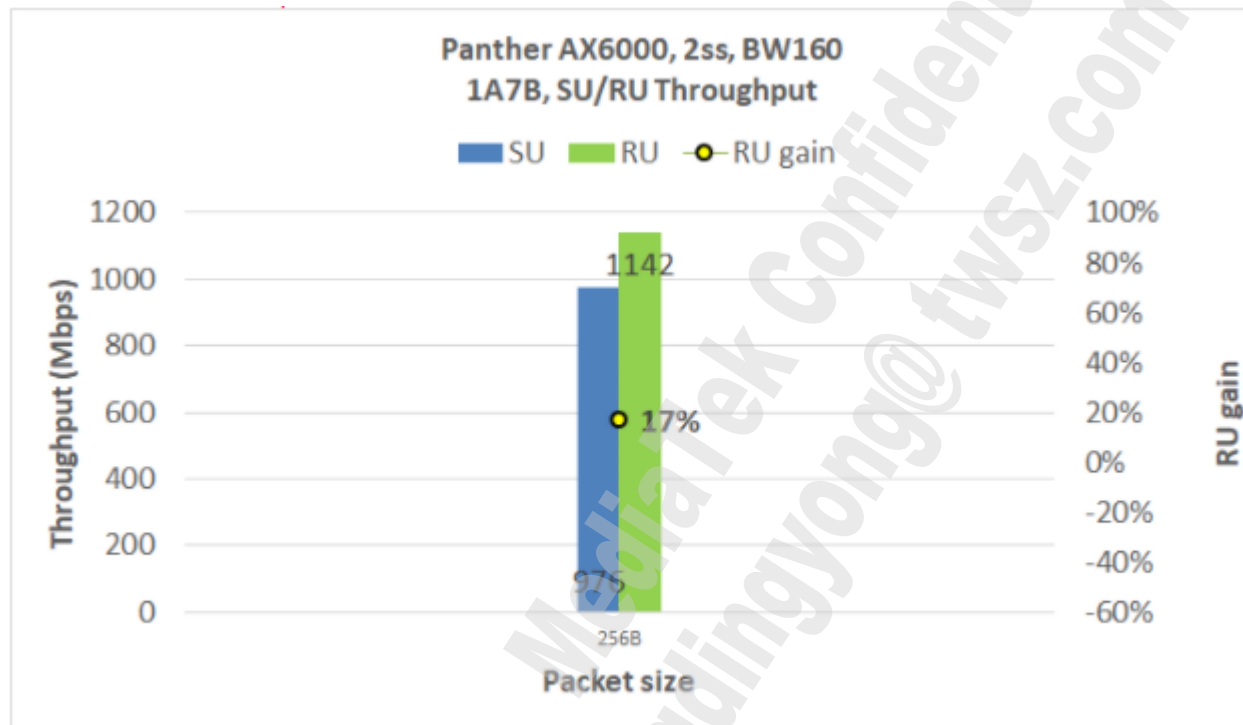
STA:

Panther AP client x 2 +

Toucan x 2 +

Harrier AP client x 12

UL OFDMA MTK test report



STA:

Panther AP client x 2 +

Toucan x 2 +

Harrier AP client x 12

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