OFDM vs OFDMA

(Which to choose and When?)

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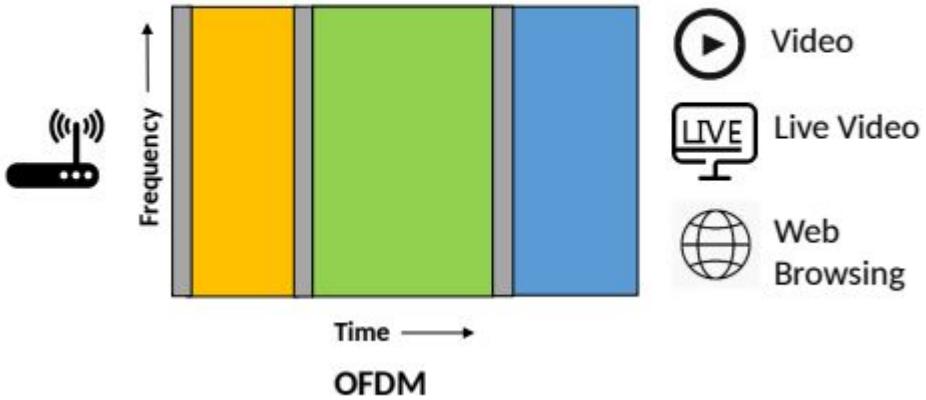
Index

Objective

- Our objective is to dynamically decide between OFDM and OFDMA transmission to be used for a WiFi 6 frame transmission based on estimating which of OFDM or OFDMA transmission which will provide higher throughput and lower latency.

Motivation

OFDM (Orthogonal Frequency Division Multiplexing)



Each user undergoes contention overhead to occupy the channel

Fig 1: Single User Downlink OFDM transmission for 3 users. Grey bars show contention overhead

Motivation

OFDMA (Orthogonal Frequency Division Multiple Access)

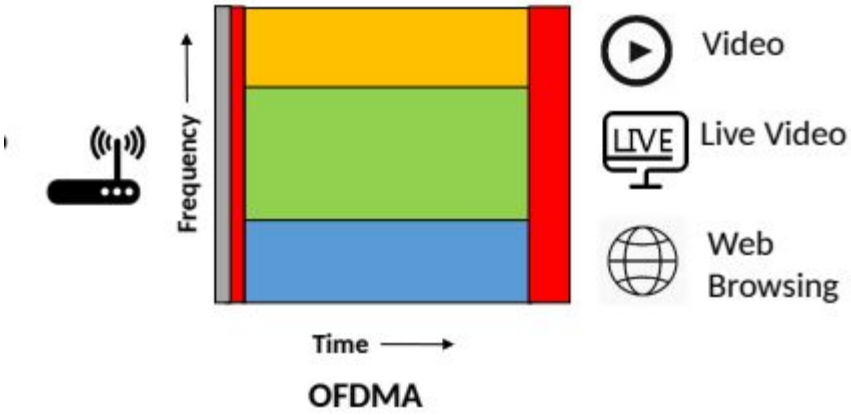


Fig 2: Multi-user downlink OFDMA transmissions for 3 users. Red bars shows non-contention overheads.

Additional overheads due to longer preamble size, trigger frames and Aggregated MU-BAR

Motivation

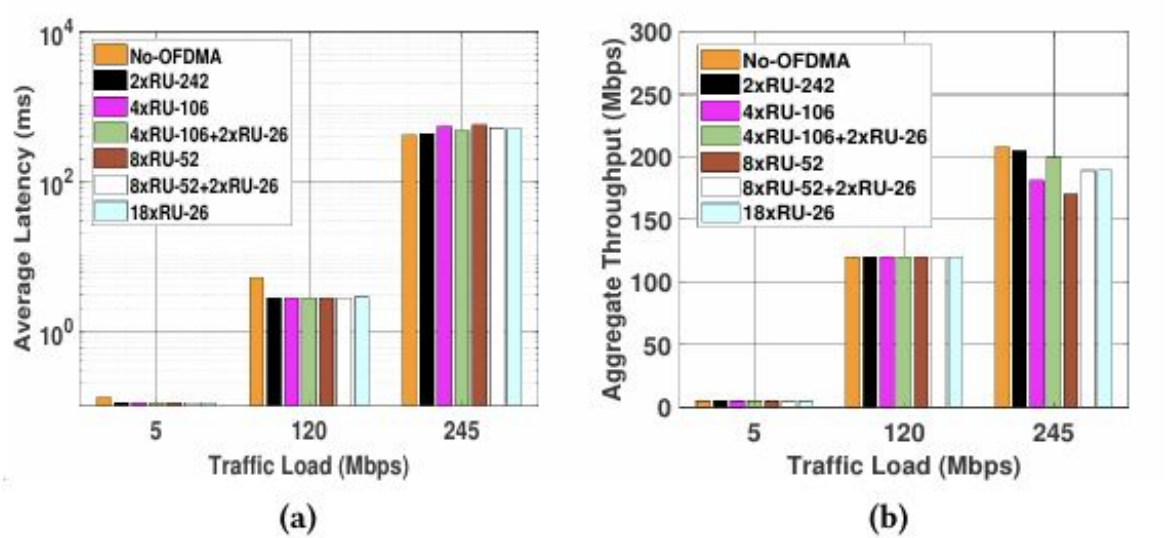


Fig 3. Effect of traffic load for UDP:

(a) average latency for no - OFDMA vs OFDMA **(b) aggregate throughput for no - OFDMA and OFDMA**

As traffic load increases , performance of OFDM better than OFDMA

Ref: "When Is Multiple Access Beneficial? An Analysis of Multi-User Performance in IEEE 802.11ax"

Motivation

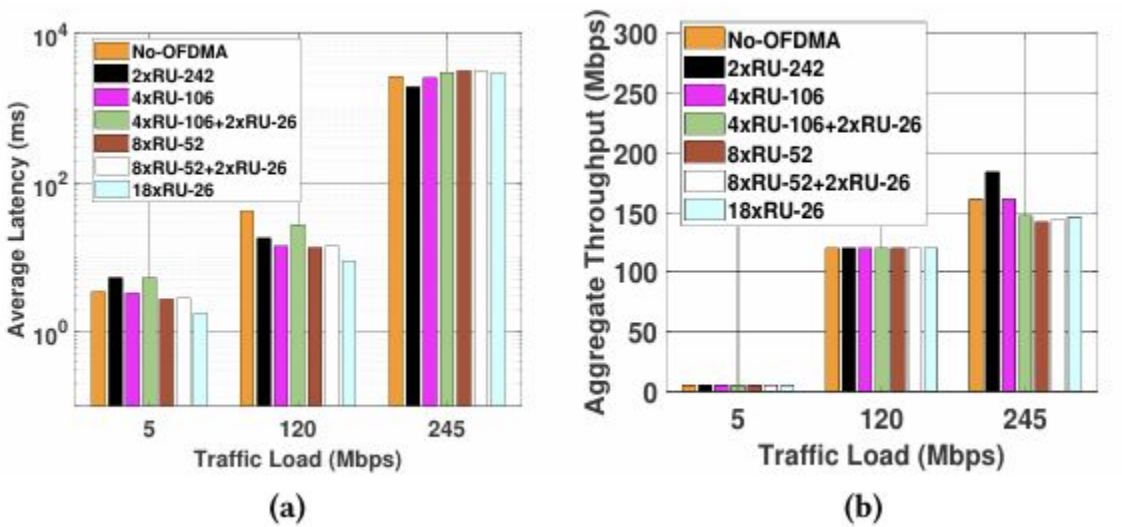


Fig 4. Effect of traffic load for TCP:

(a) average latency for no - OFDMA vs OFDMA **(b) aggregate throughput for no - OFDMA and OFDMA**

Ref: [“When Is Multiple Access Beneficial? An Analysis of Multi-User Performance in IEEE 802.11ax”]

Approach

Throughput Calculation

$$Th_{no-OFDMA} = \frac{8.X.L}{AIFS + BO + P_{dl} + T_{data} + SIFS + P_{ul} + T_{Back}}$$

$$Th_{OFDMA} = \frac{8.\sum_{i=1}^{S} X^i.L}{AIFS + BO + P_{dl} + T_{data} + PE + SIFS + P_{ul} + T_{Back} + PE}$$

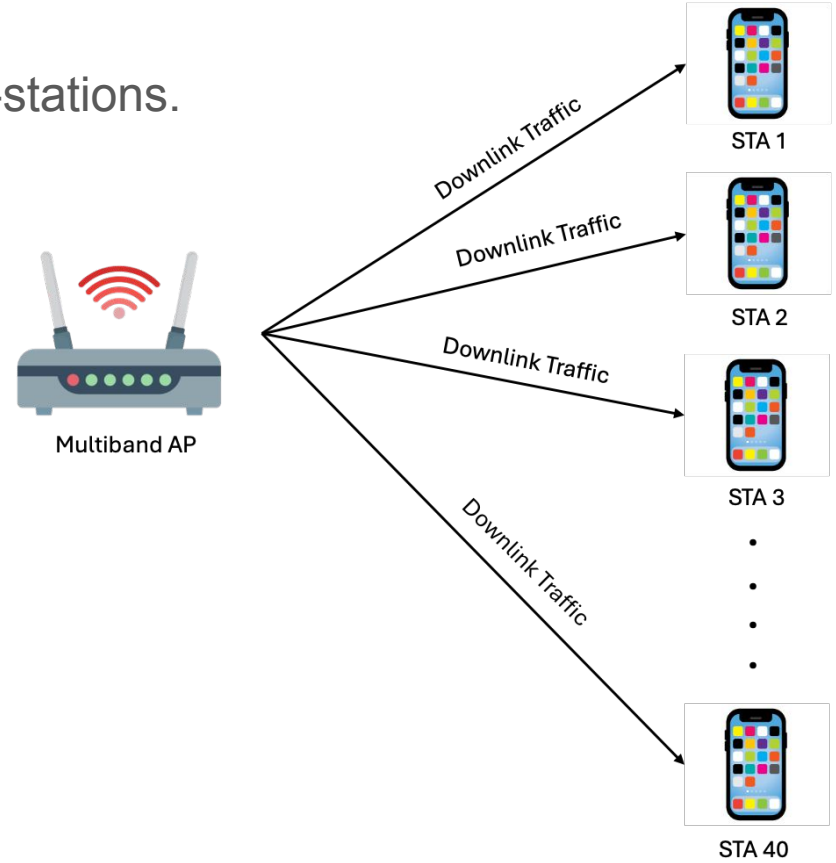
Our decision to switch dynamically between OFDM and OFDMA transmission would be based on the better throughput given by them in different network scenarios.

Experimental Setup

Downlink wifi-transmission from AP to 40 wifi-stations.

- Dense network of 40 stations
- Specify different parameters

```
./waf --run "wifi_sumu15 --nStations=40
--transport=Udp --warmup=1
--simulationTime=10 --channelWidth=40
--dlAckType=3 --mcs=11 -radius=5
--enableDlOfdma=true  --scheduler=2
--payloadSize=1000  --pcap=ofdma
–maxRus=18">>output.txt
```

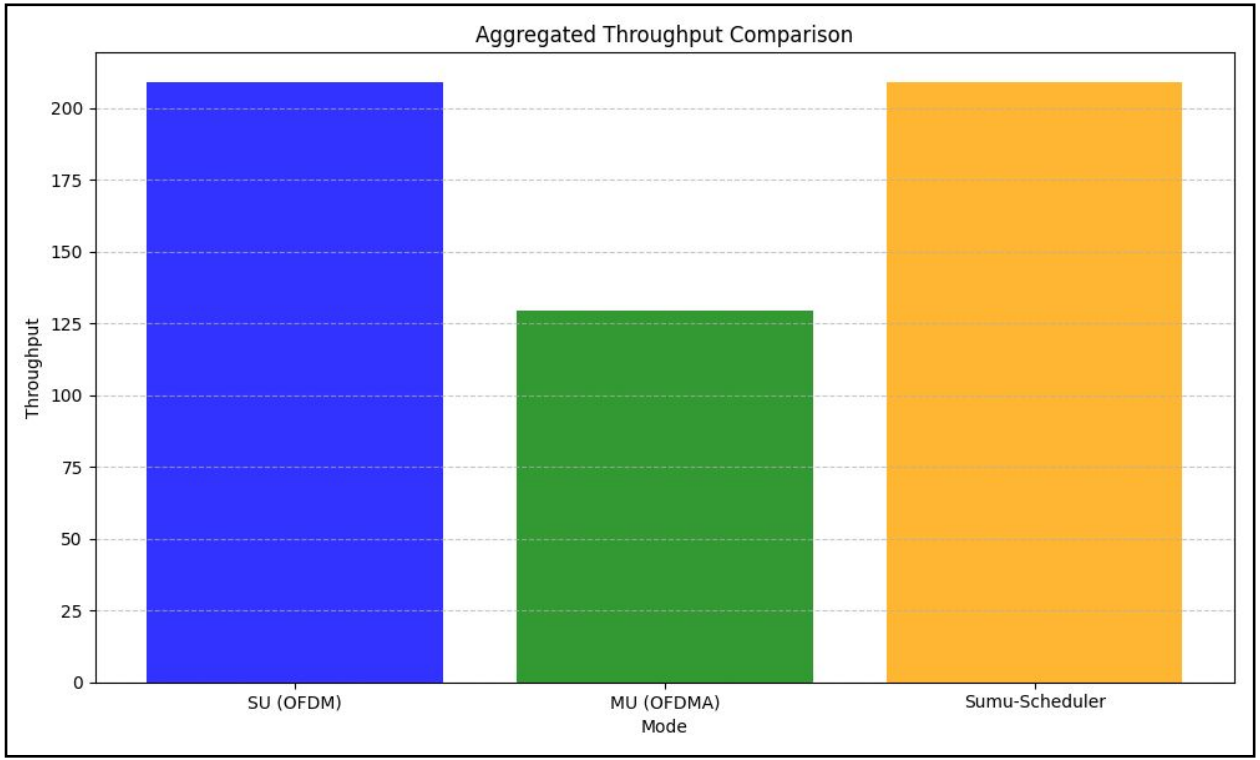


Experimental Setup

We compare our results to the baseline measurements:

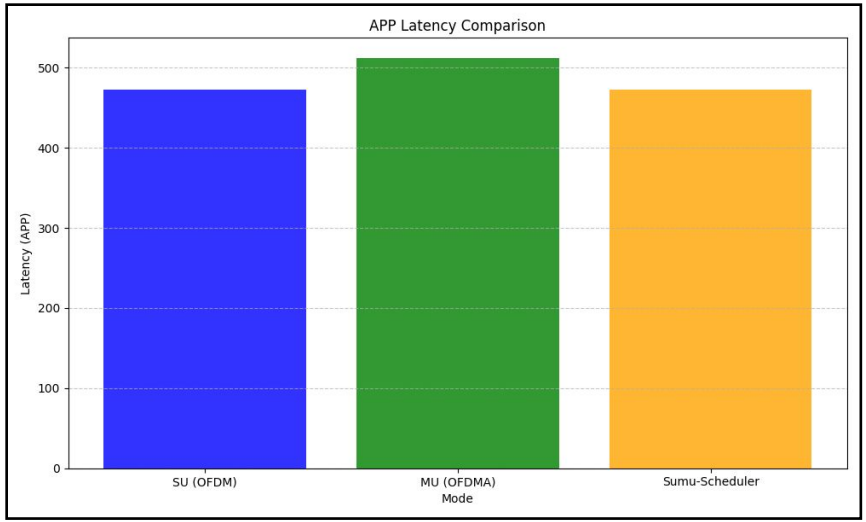
1. Only-SU transmission
2. Only-MU transmission
3. SU-MU transmission (our dynamic tpt switching technique)

Results and Inference

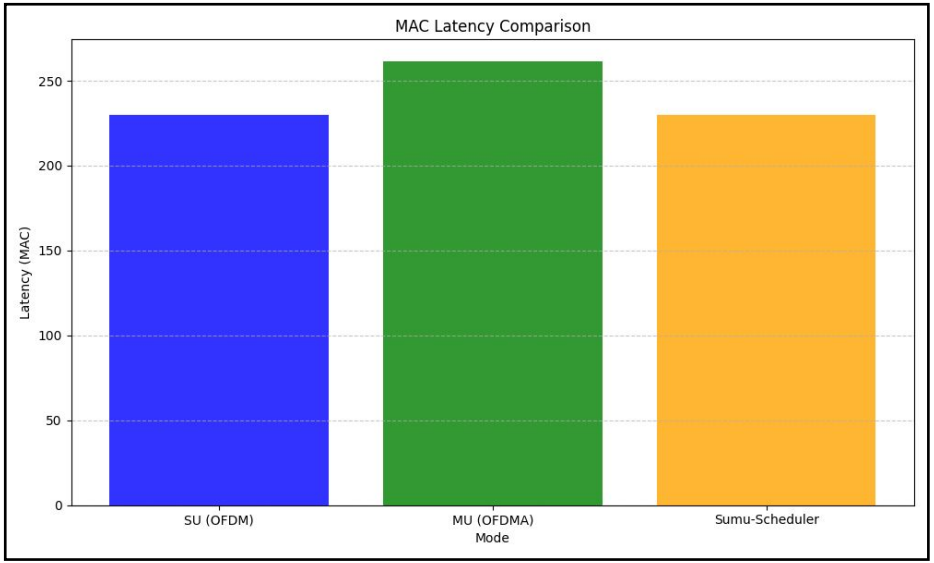


Throughput Comparison (SU, MU, Sumu-Scheduler)

Results and Inference



Application Layer Latency Comparison
(SU, MU, Sumu-Scheduler)



MAC Layer Latency Comparison
(SU, MU, Sumu-Scheduler)

Conclusion

Throughput (Sumu-Scheduler) ≈ Throughput (Single User) > Throughput (Multi-User)

Latency (Sumu-Scheduler) ≈ Latency (Single User) < Latency (Multi-User)

Thank You !

Ready For QnA !!