High Level WIFI7 – Multi Band WIFI CSI analysis and PER. BER Monitoring

Multi Channel Selection:

The new code design proposal is to have multiple channels for downlink traffic from AP to client over which the traffic will be replicated based on the MLO of WIFI7/802.11be. The channel selection is chosen between different bands to avoid interference and efficient channel utilization. The client can be assigned with one channel from Band A (2.5Ghz, say), while the other channel from Band B (2.4Ghz, 5Ghz, or 6 Ghz).

Detailed Machine learning Logic:

1) By using the associated Clients CSI Matrix feedback information for deriving the real Time expected Packet delivery rate on a Per AP Basis. The technique below

a) Calculate BER for different channels which are part of same MLO group and plot BER versus SNR

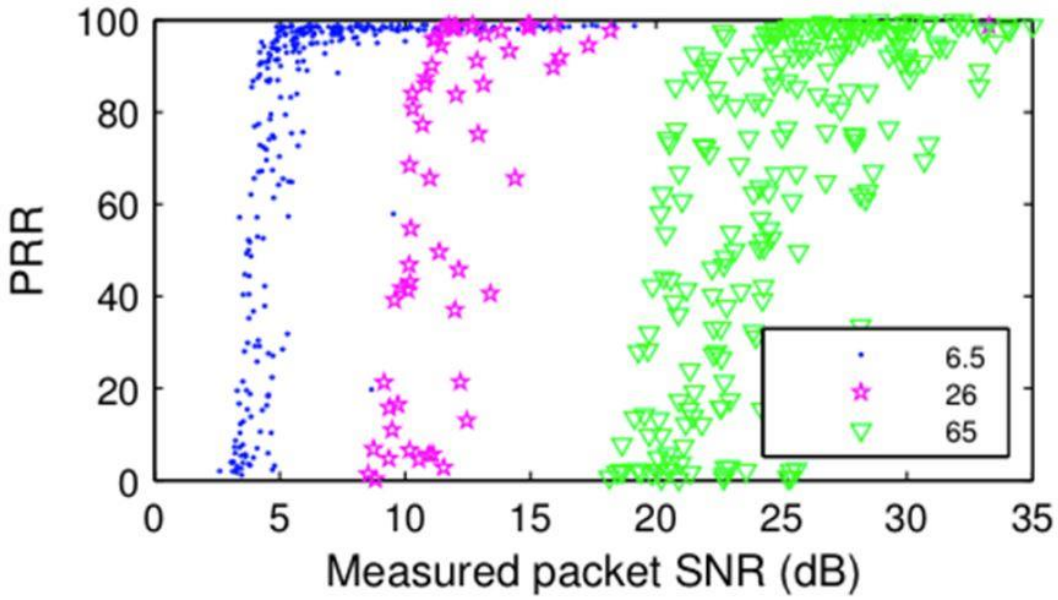
b) Generate anomalous Error patterns from BER for different channels in different Freq Bands. (By doing ML analysis)

c) Parsing & doing a lookup analysis for every associated client (AID- Association Identifier) for the Channel allocation mechanism.

Fig 1) PROBLEM ILLUSTRATION: VARIANCE OF MEASURED PACKET SNR in db IN A FREQUENCY DIVERSITY WIFI CHANNEL

PRR - Packet Retry Rate

X Axis - Measured Packet SNR in db



2) **ML Modelling Logic:**

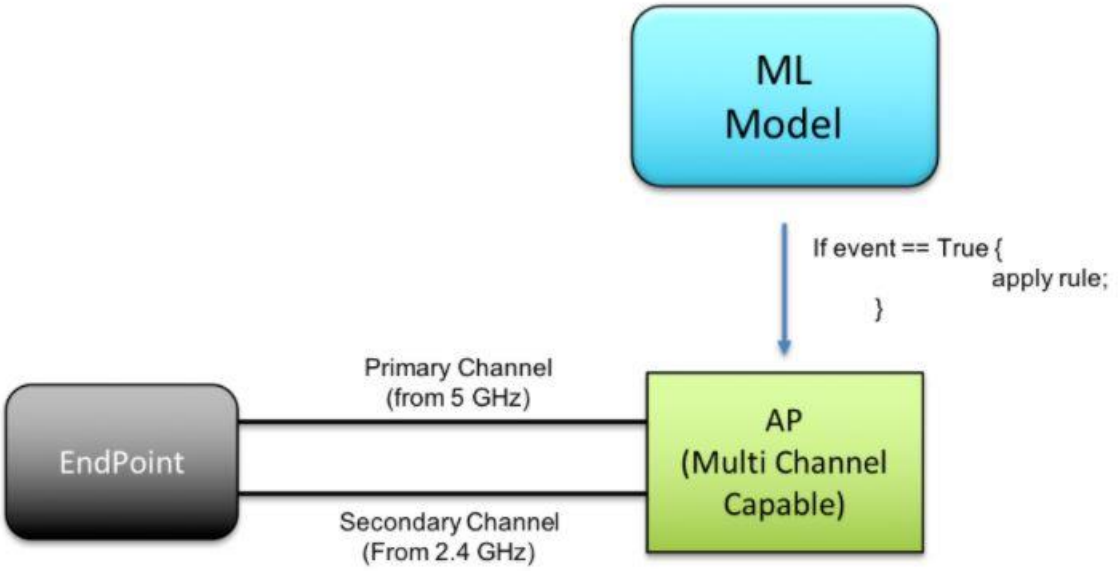
a) Once a New WIFI Client/STA is associated, the AP will collect the CSI information from the STA (by using Data Packets) & then create a Feature Matrix with each column representing one Sub-carrier. [N * M * P , 3D-Array] , where N - CSI, M- M Clients , B- PER/BER Rate.

b) by using this N * M* P array, we then use Eigen Value & Eigen Vector based analysis for deriving the Eigen spectrum - acceptable Packet error rate.

c) Once the real-time mean PER observed by all the WIFI Clients is derived, this PER is compared with the Moving acceptable PER Threshold value for this particular WIFI Channel.

In Current Heuristics based CSI estimation approaches, obtaining CSI for all possible configurations of a 3 * 3 system requires seven samples: 1-stream Modulation and Coding Schemes (MCS) require three probes, one per each TX antenna. Similarly, 2-stream MCSs require three probes to collect CSI for each combination of two antennas. Finally, 3-stream MCSs require a single probe using a transmission from all three transmit antennas. The number of required samples increases dramatically when the system supports 4 * 4 communication or larger channel widths.Moreover, common hardware only provides CSI reports for unicast packets, thus limiting the possibility of opportunistically collecting CSI matrices by eavesdropping; a node must be connected to an access point to actively send or receive probing packets

ML Design Philosophy:



At a very high level, the above mentioned ML model will be used to learn the pattern/event and derive the performance. For example, endpoints connected to 5GHz will have better performance while the total no of users is within certain threshold (such as 50 counts). When it exceeds the limit, the end users starts seeing performance degradation.

This will be learnt and used by the model to trigger multi channel downlink selection while the event is true. Depending on the type of traffic, the channels will be used as below:

- When the traffic is bandwidth sensitive, the channels will be used as bundles and the traffic will be shared between the channels.
- When the traffic is latency/loss sensitive, the channel will be used to replicate the traffic and eliminate at the client side.