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# AIRTIME FAIRNESS CHALLENGES

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# High Density WiFi



- 1x 802.11n AP (300 Mbps data rates)
- 10x 1SS Device (72 Mbps data rates = 35 Mbps TCP)
- Application throughput:
  - Compressed HD Video (2 Mbps TCP)



- **6% airtime per device**
- 16 devices per cell



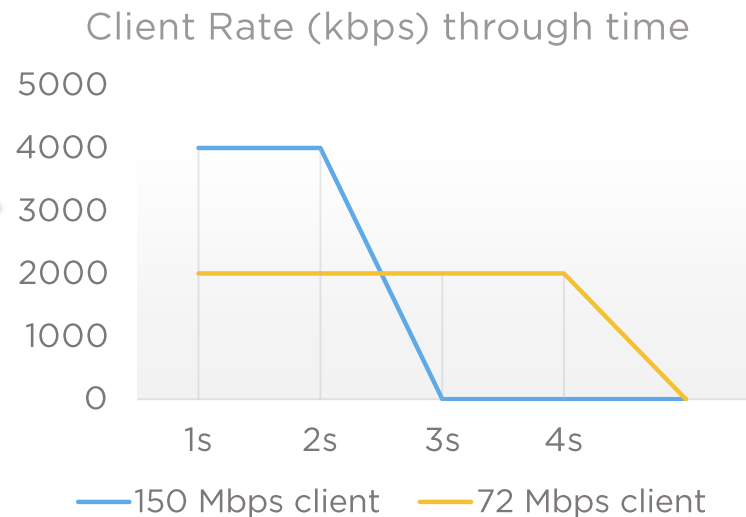
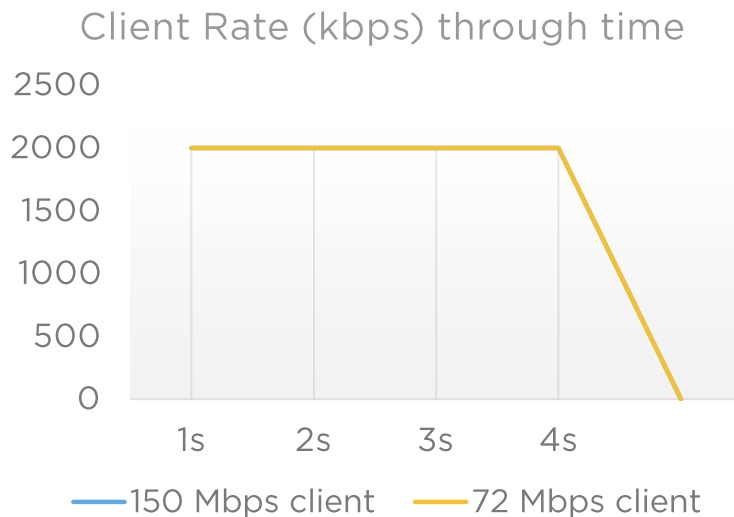
- 1x 802.11n AP (300 Mbps data rates)
- **10x 2SS Device (150 Mbps data rates = 75 Mbps TCP)**
- Application throughput:
  - Compressed HD Video (2 Mbps TCP)



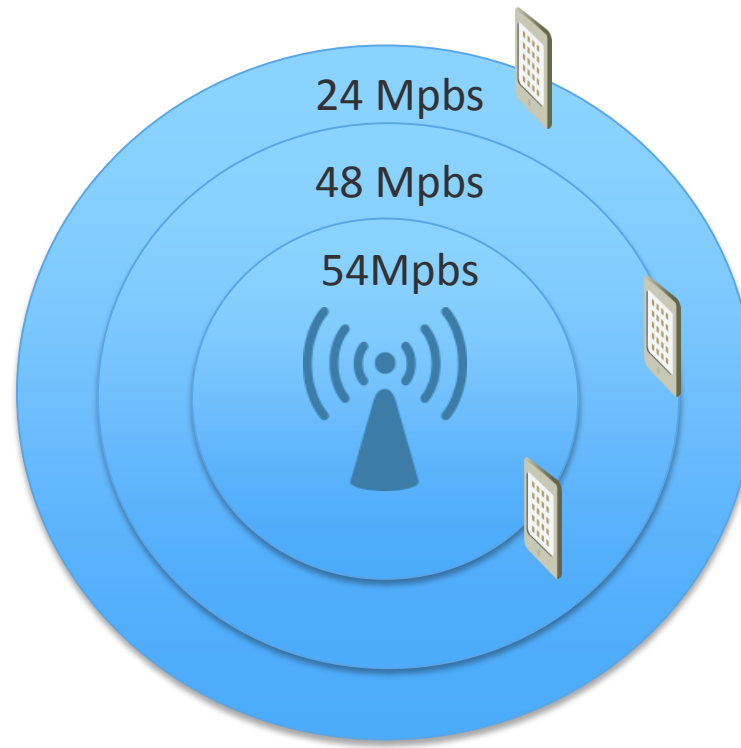
- **3% airtime per tablet**
- 33 devices per cell



- Both devices have the same TCP throughput
  - Sometimes this is what we want
  - Traffic shaping/policing
- But why should more capable devices be punished?



- The same principle applies for rate shifting
- Plan your cell size according to application throughput and number of clients!

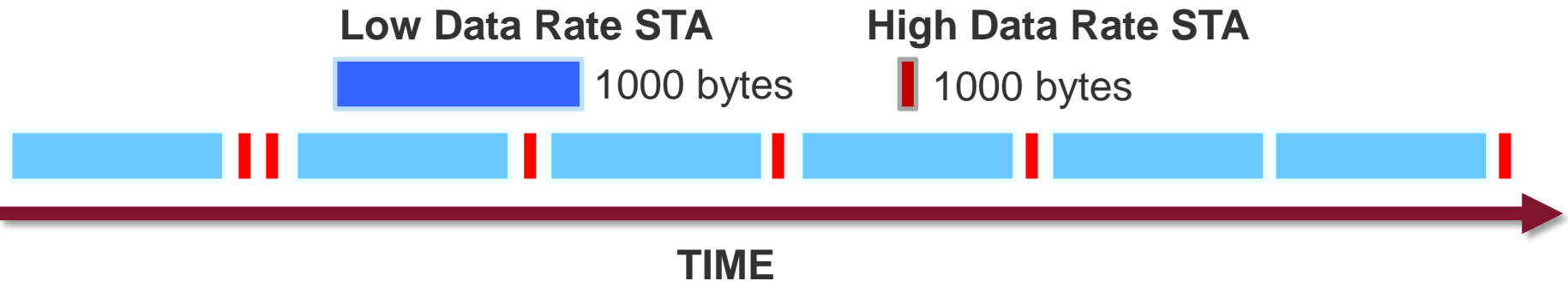


Is there a problem, officer?

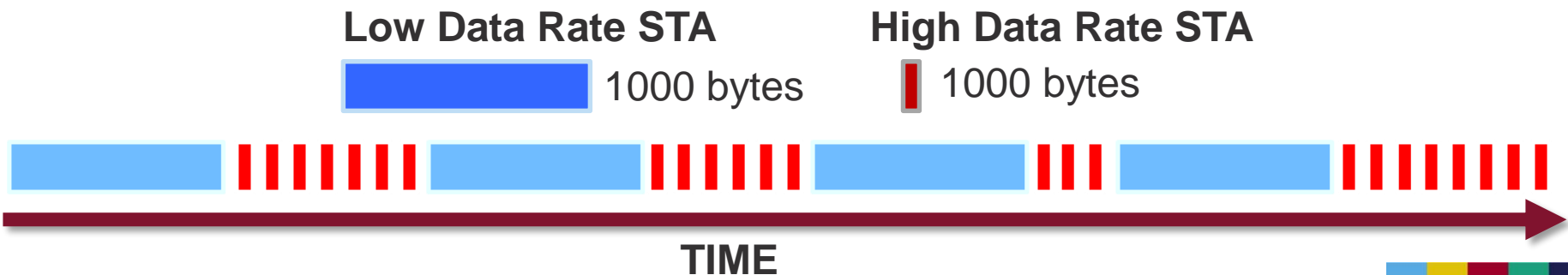


# Airtime Fairness

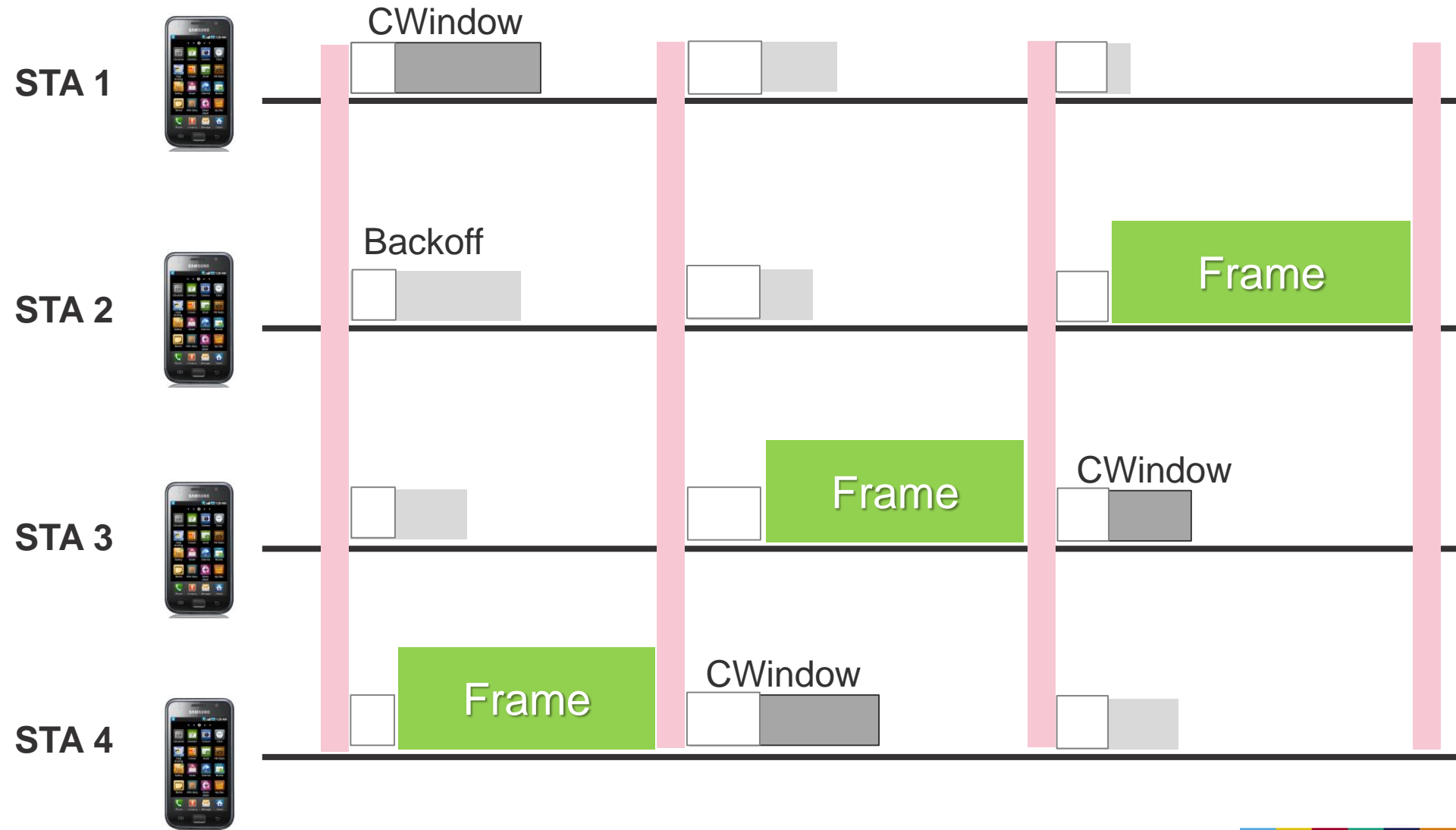
**Standard** arbitration allows low rate STAs to consume a large amount of airtime.



**Proprietary** “airtime fairness” distributes airtime usage fairly based on connectivity rate, improving overall performance.

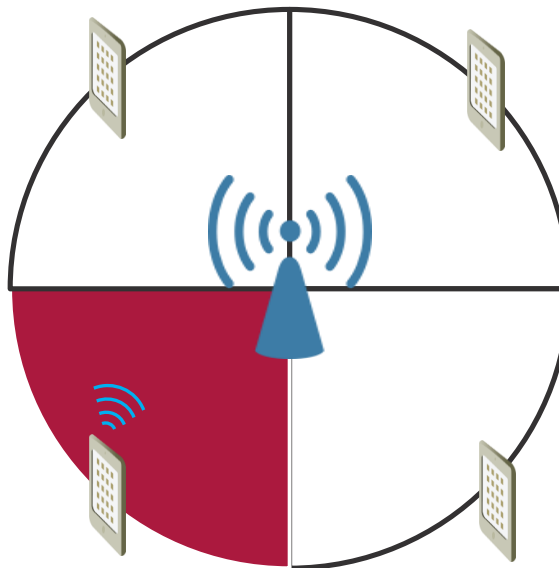


Why do we have this  
problem?



Can we solve this problem?

- Standardized mechanism
- Uses polling
- AP acts as a point coordinator
- Provides managed medium access
- **PCF is NOT implemented in the wild**

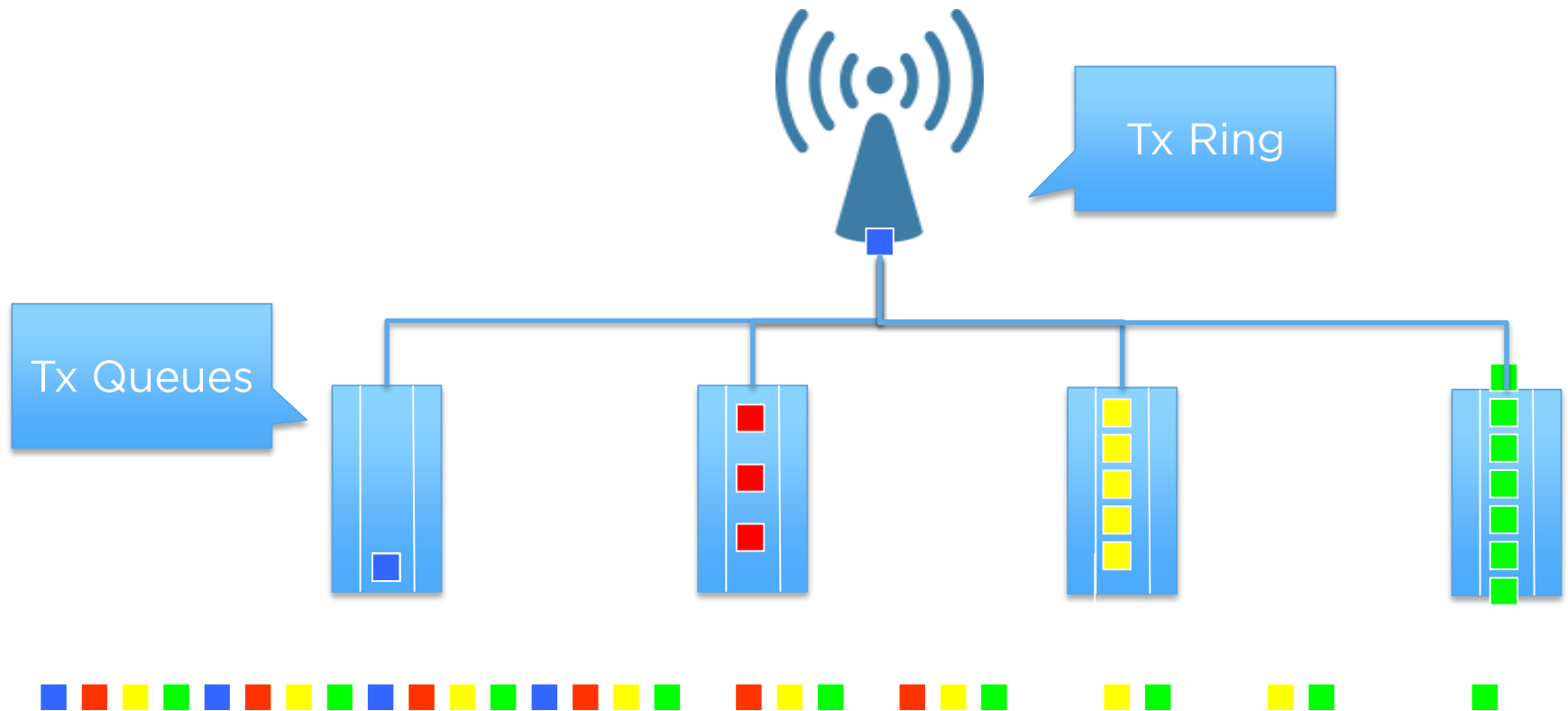


# QoS Mechanisms

- Uses a centralized coordinator
  - QoS aware
  - **Part of each AP**
- The AP allocates TXOP slots
- Provides contention free time
  - The STA doesn't have to contend for every frame
  - Used to transmit QoS data
- **Still based on statistic probability!**
- **Require WMM capable clients!**



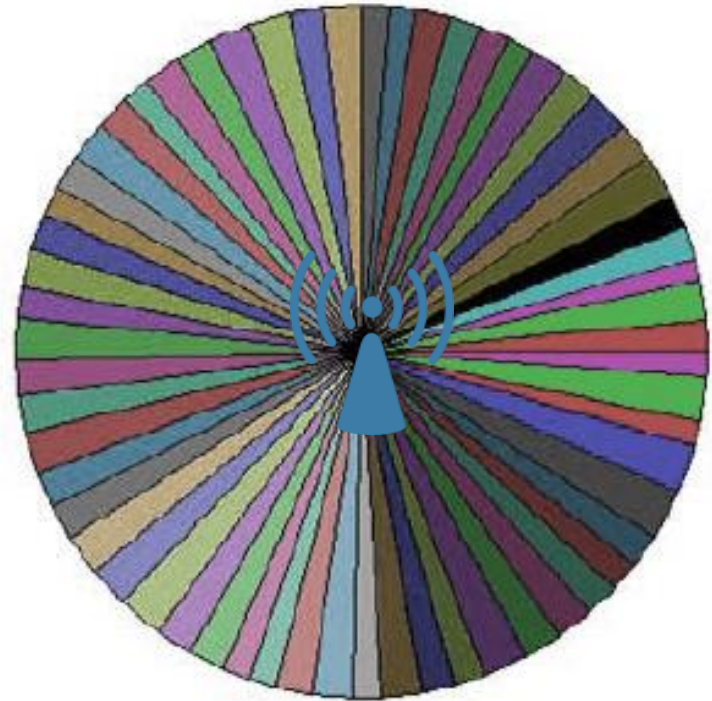
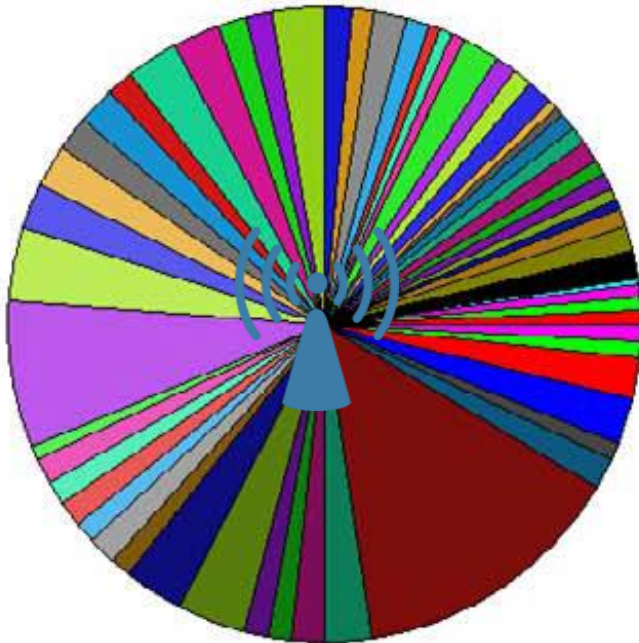
\*May lead to  
starvation of lower AC!





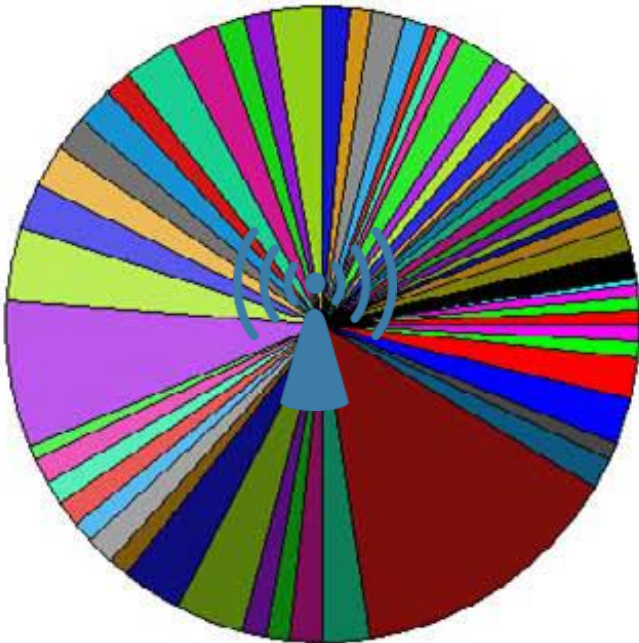
Now what?

# Which AP is fair?

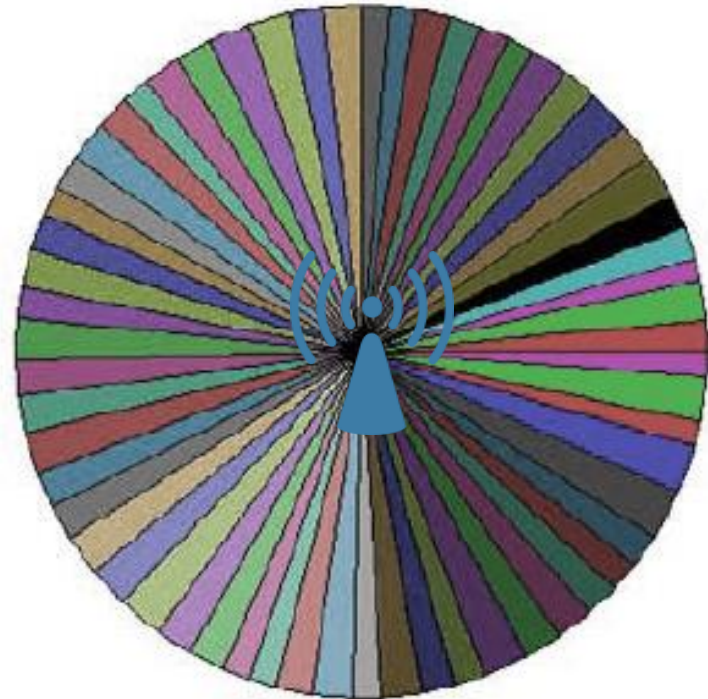


# Which AP is fair?

TCP throughput per client

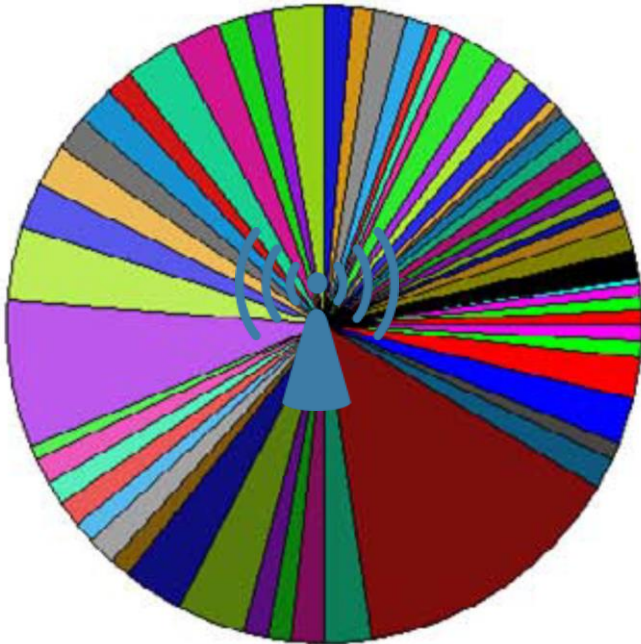


TCP throughput per client

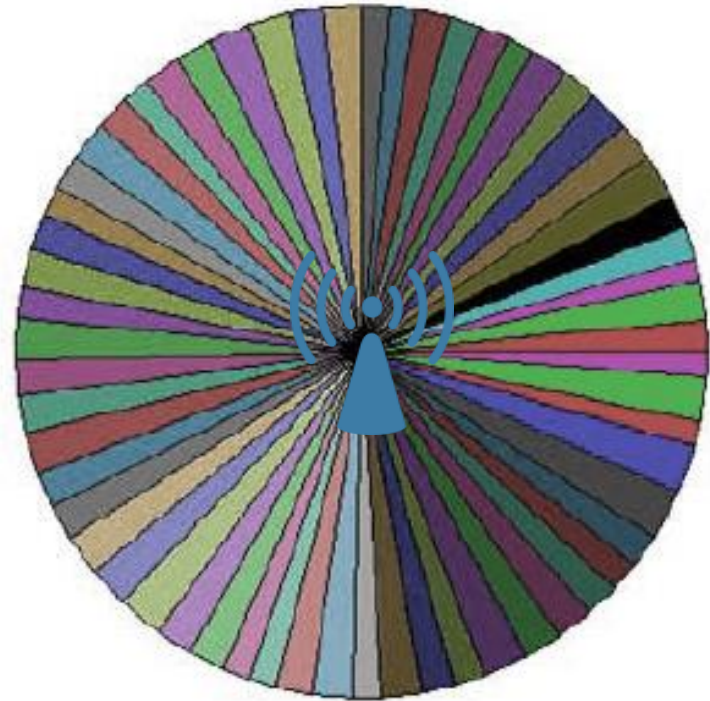


# Which AP is fair?

Airtime per client



Airtime per client



- Usually use AC queues and TXOPs
- Airtime Fairness = ON
  - QoS weights based on airtime
- Airtime Fairness = OFF
  - QoS based solely on AC class
- Unfortunately, different vendors have different interpretations...

*...can improve coverage areas between cells or near obstacles and can ensure **airtime “fairness”** so that all clients, regardless of location or version of the 802.11 standard, have the optimal connection...*



# Key Takeaways

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- Airtime Fairness does not equal TCP throughput
- Improves performance
- We want to finish transmissions as soon as possible
- We try not to penalize more capable clients
- Different people (vendors), different interpretations





