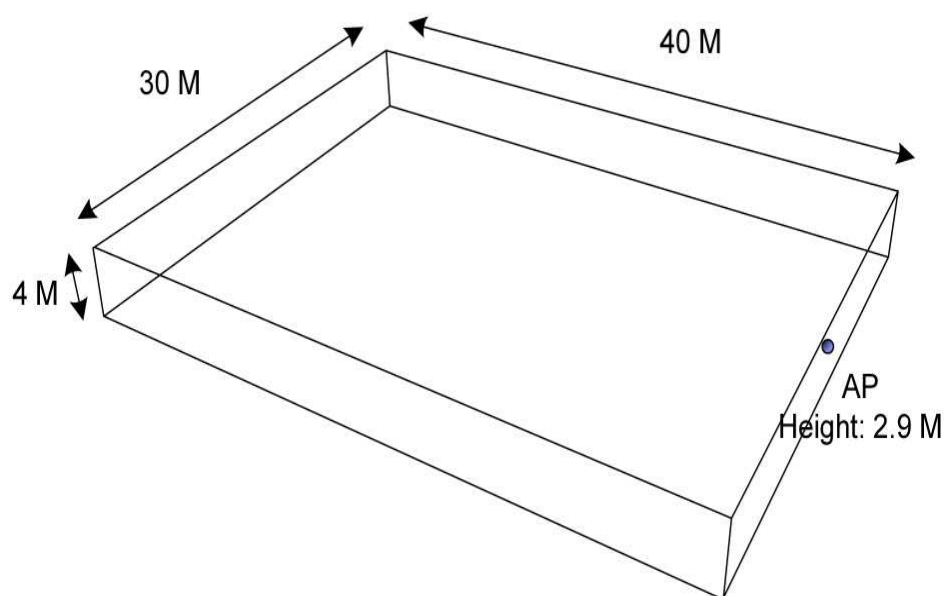


Fading due to multi-path propagation:

→ indoor: large lecture room

→ empty with no obstructions



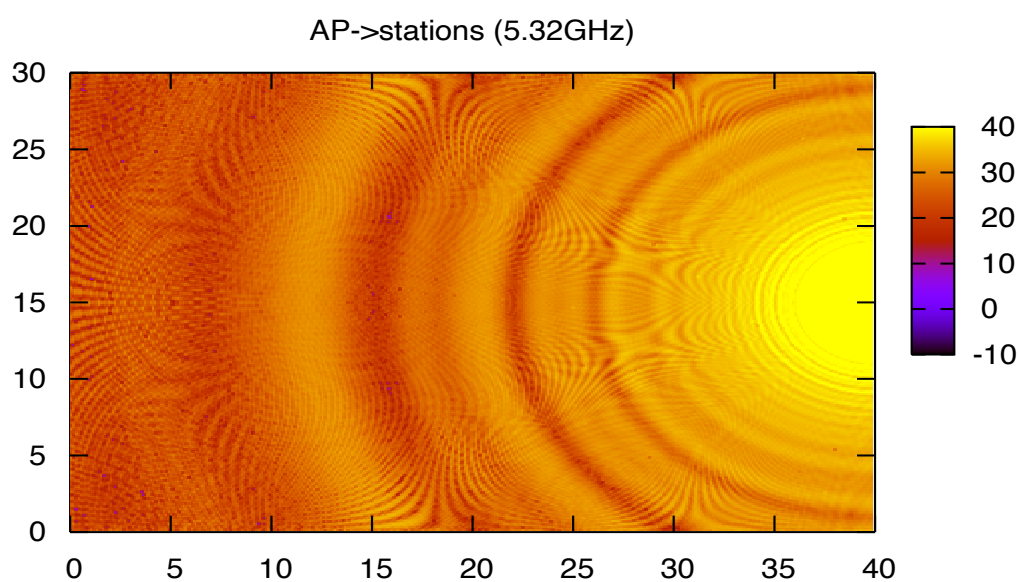
→ 802.11 WLAN hot spot (infrastructure mode)

→ signal reception at different locations in the room

Signal strength reception at height 0.7 m:

→ approximately table height

→ carrier frequency: 5.32 GHz



→ signal strength varies by distance

→ but also varies by location

→ connection to microwave oven?

Multi-path fading:

→ EM waves interfere constructively and destructively

→ depends on phase

Locations of destructive interference:

→ bad signal reception even though close to AP

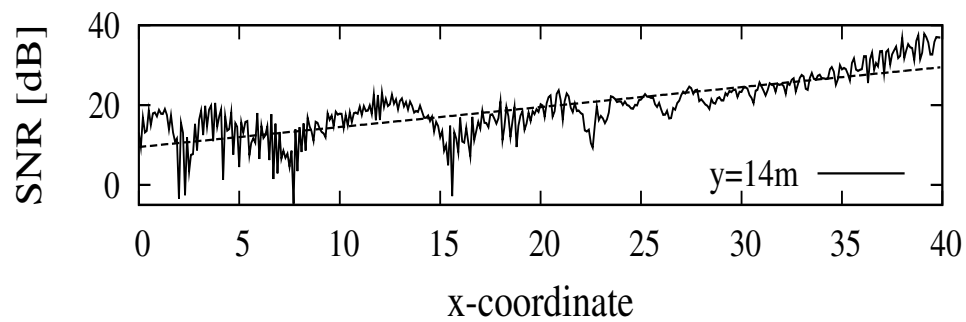
Locations of constructive interference:

→ good signal reception even though far from AP

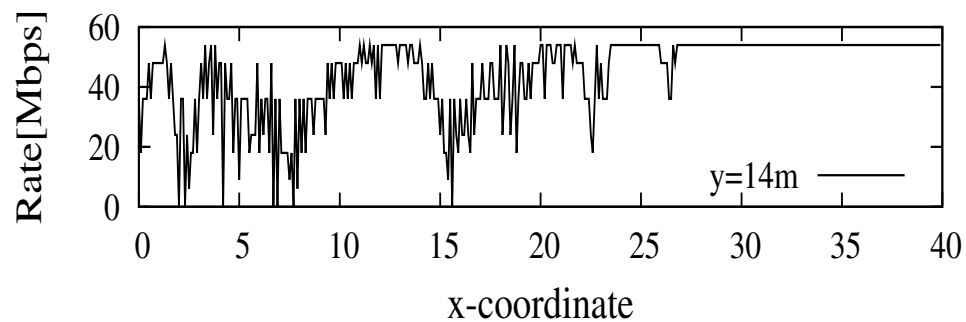
What impact does it have?

Throughput:

→ SNR and throughput along straight line from AP



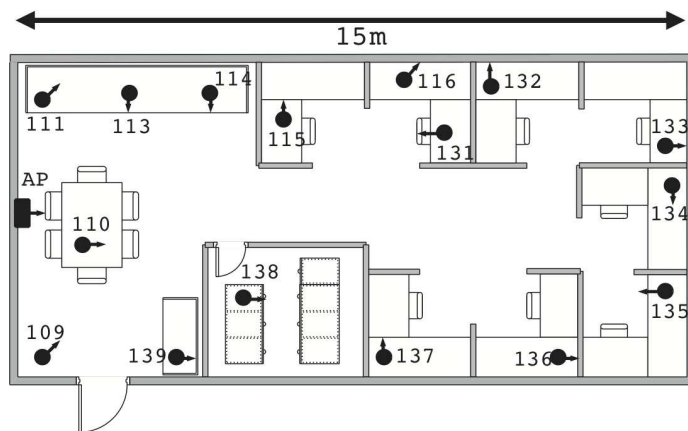
→ significant SNR variation



→ good locations, bad locations

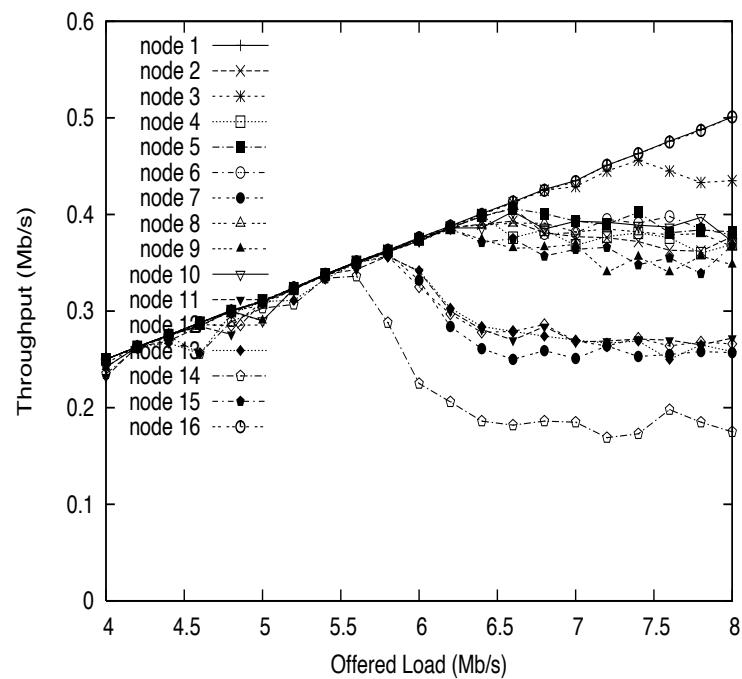
→ leads to unfairness, even starvation

Indoor office 802.11 WLAN hot spot:



Throughput share of 16 HP/Compaq pocket PCs:

→ uplink CSMA competition



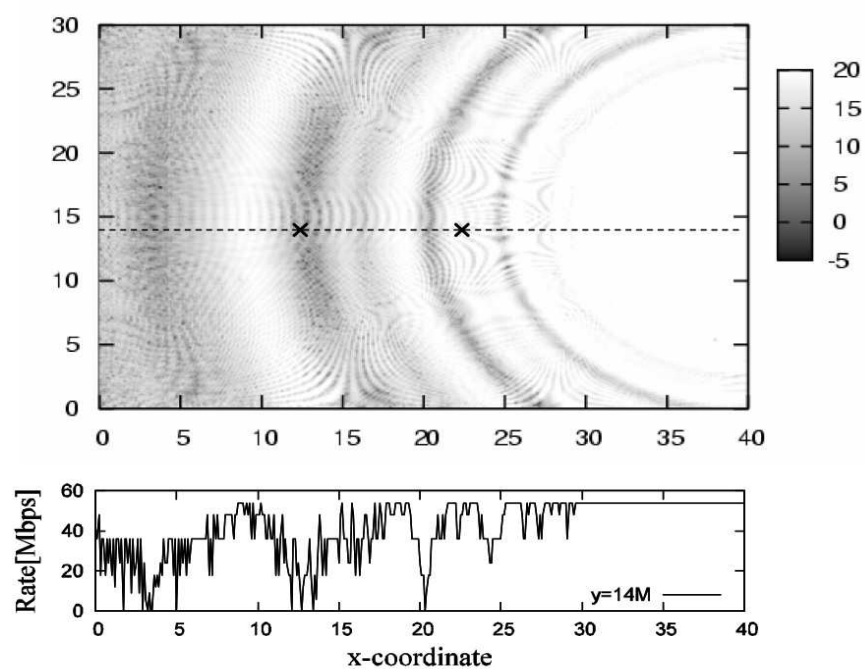
→ offered load: stress placed on the system

→ significant unfairness

→ what can be done?

Changing carrier frequency:

→ 5.805 GHz (channel 12)



→ qualitatively similar to channel 8

→ but quantitatively different

Use OFDM to send bits on different subcarriers

→ combined with error correction

→ why WiFi runs CSMA/CA over OFDM

Use multiple antennae

→ MIMO (multiple input multiple output)

→ spatial diversity

→ advanced technique: beam forming

→ e.g., Starlink: how dish antenna tracks LEO satellite