LESSONS IN REPRODUCIBILITY FOR 802.11
OR, IS DETERMINISM DEAD?

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**ABSTRACTIONS: WIRELINE VERSUS WIRELESS**

**WIRELINE**

- Constant link capacity
- FIFO scheduling
- Low (and constant) Packet Error Rate (PER)

**WIRELESS**

- Widely (and wildly) varying capacities
- Contention based scheduling (CSMA/CA)
- Highly variable PER due to interference and contention
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**SIMPLE EXPERIMENTS**

- Use 802.11a network (only one around)
- Six locations in cubicle environment
- Single UDP greedy source using Iperf (periodic traffic)
- Cycle over rate: $r = \{6, 9, 12, 18, 24, 36, 48, 54\}$ Mbps
- Cycle over pkt size: $l = \{48, 128, 328, 628, 928, 1500\}$ bytes
- Measure RSSI (get SNR), PER
- Measure average IPthroughput($l, r, \text{SNR}, \text{PER}$)
USING SNR TO PREDICT PERFORMANCE?

General decrease, but far from monotone in SNR or rate...
Using SNR to Predict Performance?

General decrease, but exceptions, and packet size dependent
Focus on 3 locations with separated SNR:

- $r = 6 \text{ Mbps}$
- $l = 1500 \text{ bytes}$
- SNR=45 dB

Better, but still non-monotone.
In fact, non-stationary not to blame.
Focus on 3 locations with separated SNR:

\[ r = 6 \text{ Mbps} \quad l = 1500 \text{ bytes} \quad \text{SNR}=45 \text{ dB} \]

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FOCUS ON A SINGLE LOCATION

Two CT streams, then a test stream ramps up.

All three streams look fine  [dark blue is for all streams]
Blue stream is *punished* immediately, not due to MAC fair share!
A Corollary, Worse PER

Seems due to poor quality cards plus non-compliant backoff
A SCATTERPLOT IN 4 DIMENSIONS

A location specific empirical *map*

Location marked by $\text{SNR} = (30, 45, 60)$ dB
THE SNRs BEHIND THE MAP

PER hidden here, not so useful
RAW CAPACITY (ONE GREEDY SOURCE)

Dependency on rate and packet size is huge!

Results actually agree with theory with backoff $= CW_{\text{min}}/2$
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LESSONS

- Reproducibility difficult, but possible
- Simple models fail, but not (necessarily) through non-stationarity
- \( \text{PER}(l, r, \text{SNR}) \) dependency complex and location specific
- Location specific view allows sense to be made
- Can be captured empirically in the map
- \( \text{SNR} \) cannot give performance, but can point to relevant sub-map
- Can be used for AB estimation, rate selection algorithm