Wifi Mobility without Fast Handover with MPTCP

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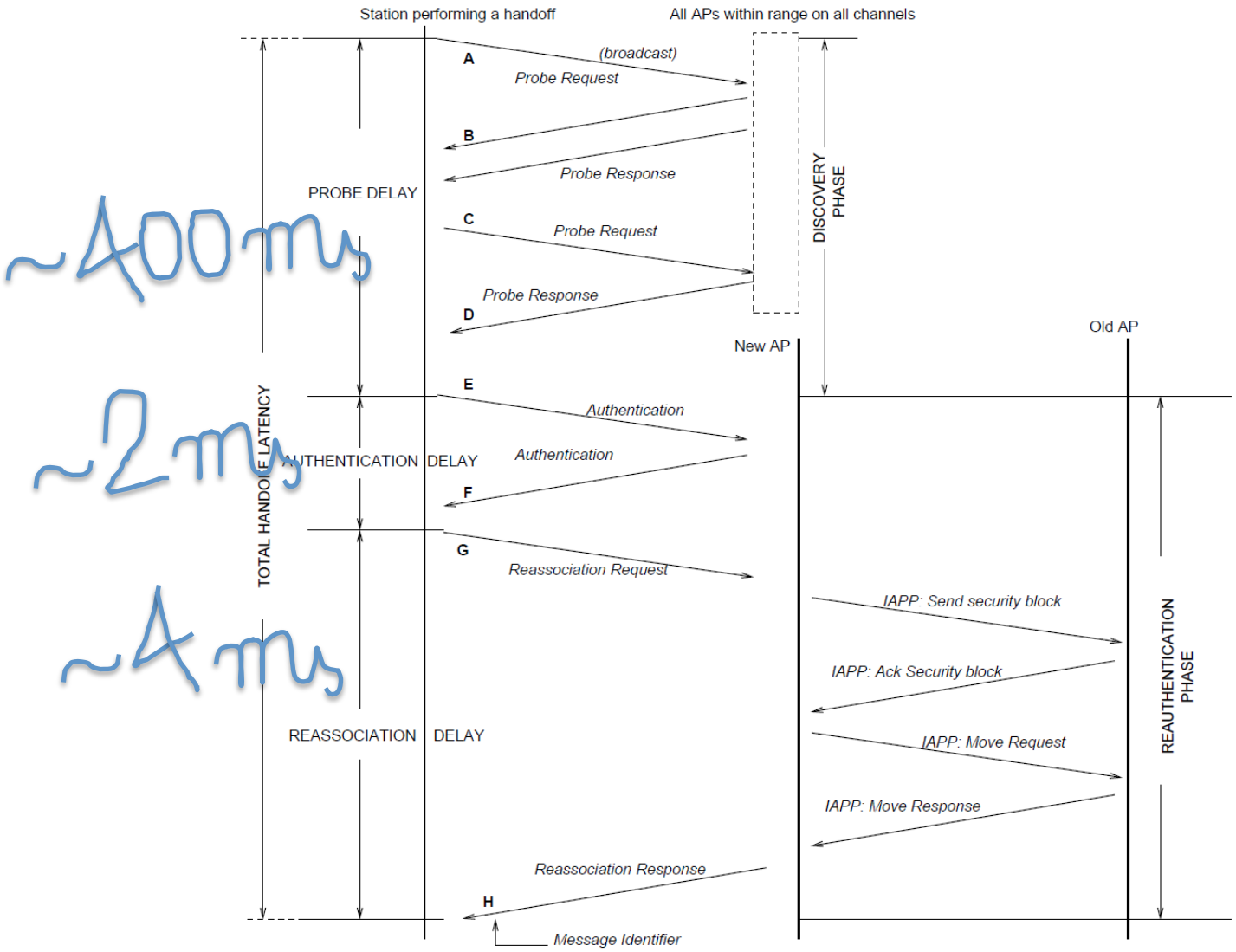
Wifi mobility is important

- Cellular data growing at a rate that is not sustainable in the long run
- Ubiquitous Access Point deployments in urban areas
- Offloading to Wifi has long been touted as a solution
  - ***Wifi is mostly a static connectivity solution***

802.11 handoff standard



Wifi Mobility = Fast Handover

- Lots of work on reducing handover duration by
  - Coordinating Access Points (enterprise deployments)
  - Scanning using a different card
  - …
- True Wifi mobility is still a dream:
  - When to initiate handover?
  - Which AP should we connect to out of the ones available?

How about **NO handover**?

Key idea**: leverage MPTCP's ability to spread data over multiple paths, and **associate to all access points at all times

MPTCP = layer 4 mobility

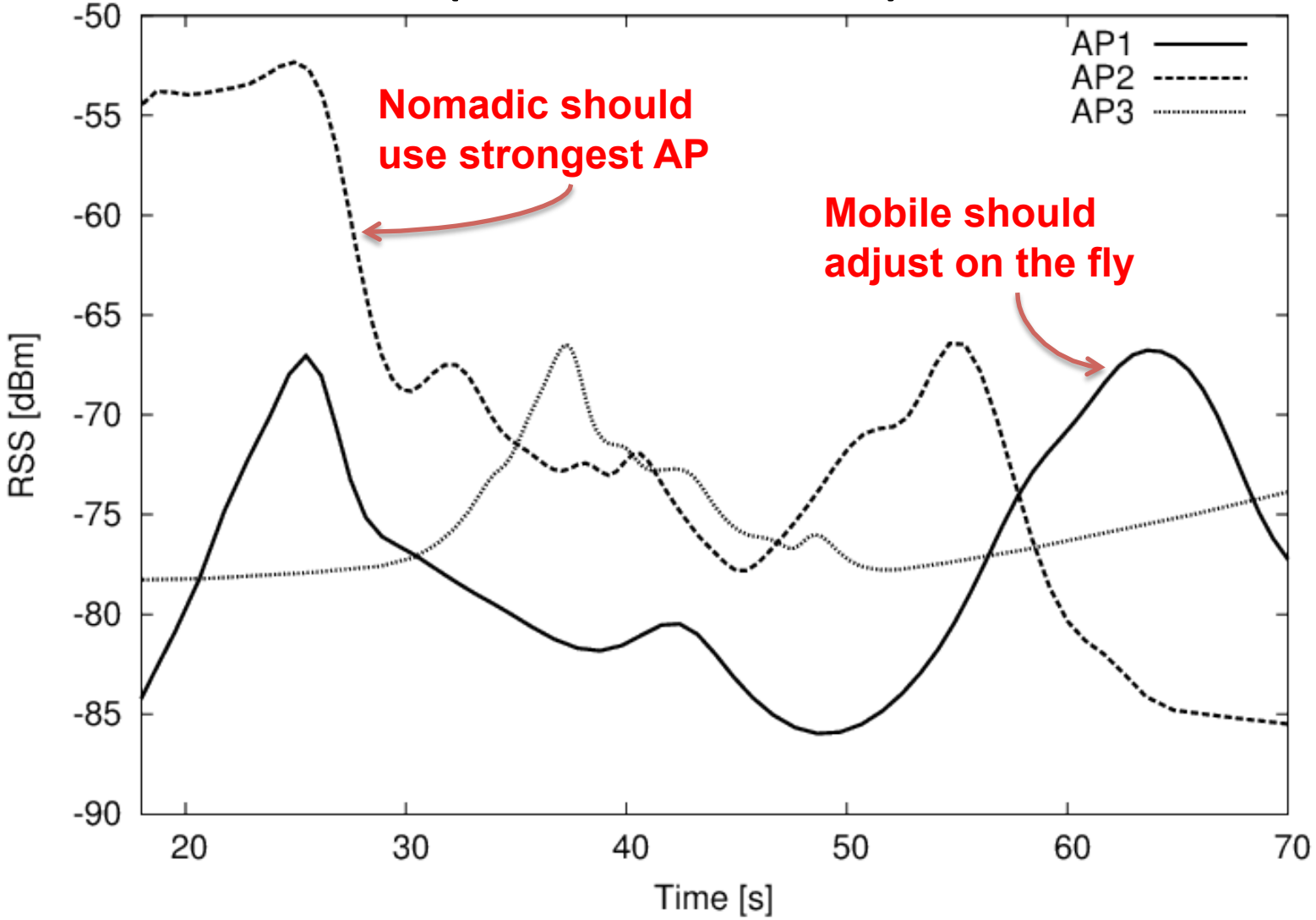
Strawman solution:

- 3 NICs on 3 channels
- no probing, just passive beacon collection
- Automatically connect to all APs on each channel

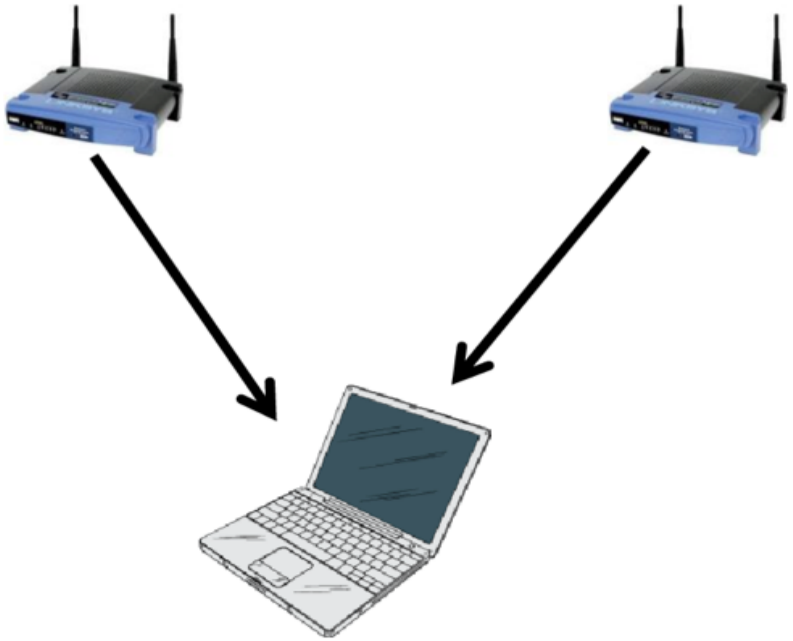
1. all APs on a channel

- Associate to all APs visible
  - acquire IP address
  - let MPTCP balance load
- Would like to:
  - enhance throughput
  - load balance
  - reduce effects of handoff
- Hidden terminals, exposed terminals?

top 3 APs on channel 6,
(UPB/CS walk)



setup: experiments and ns2

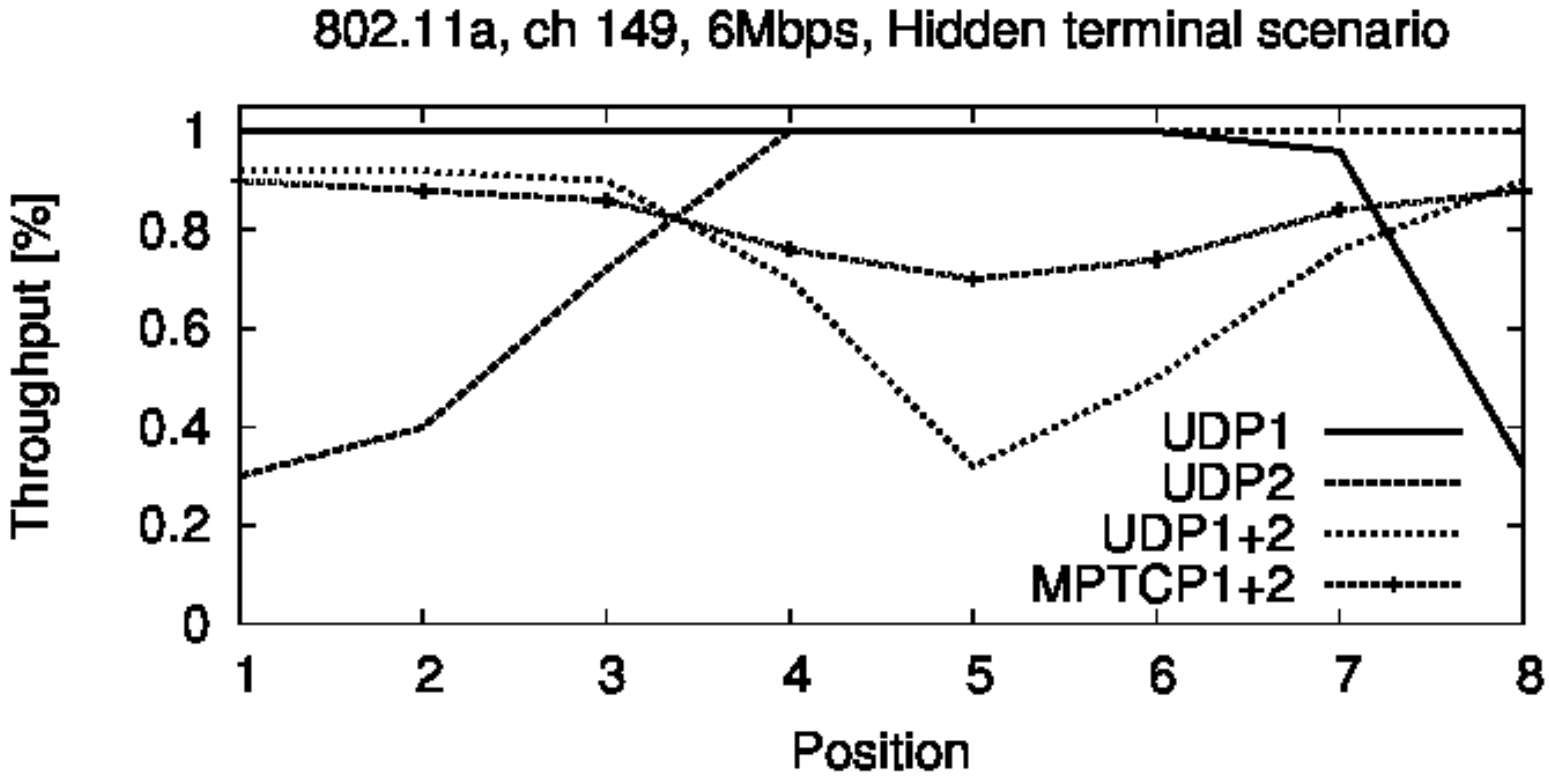


Nomadic/static client

A. APs out of carrier sense = **hidden terminals**
   - Reception interference

B. APs in **carrier sense**
   - Medium shared
   - Sending interference

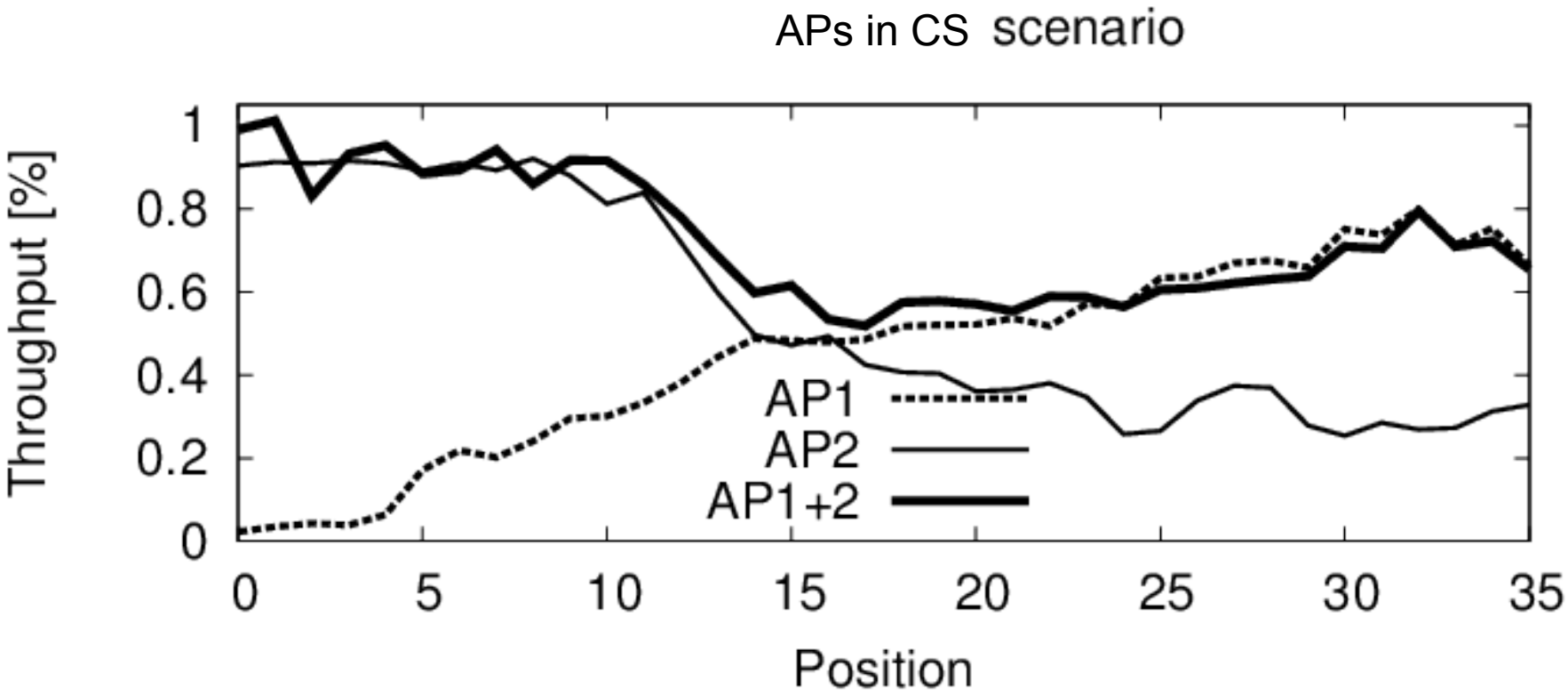
Hidden terminal Experiment



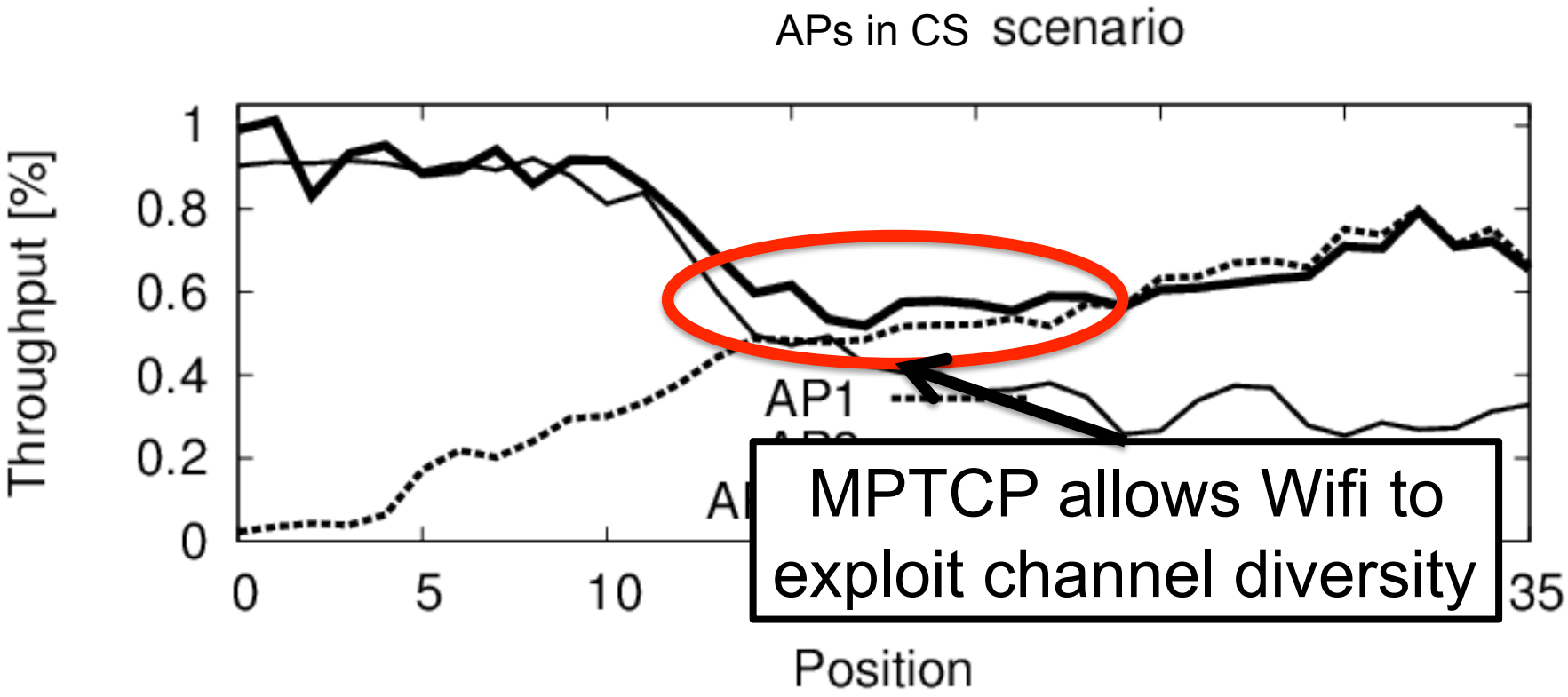
Why does it work so well?

- When TCP competes against another TCP in a hidden terminal scenario, there is a “capture” effect where one TCP monopolises the bandwidth
- **Reason:** the loss rates experienced by slow subflows are much higher

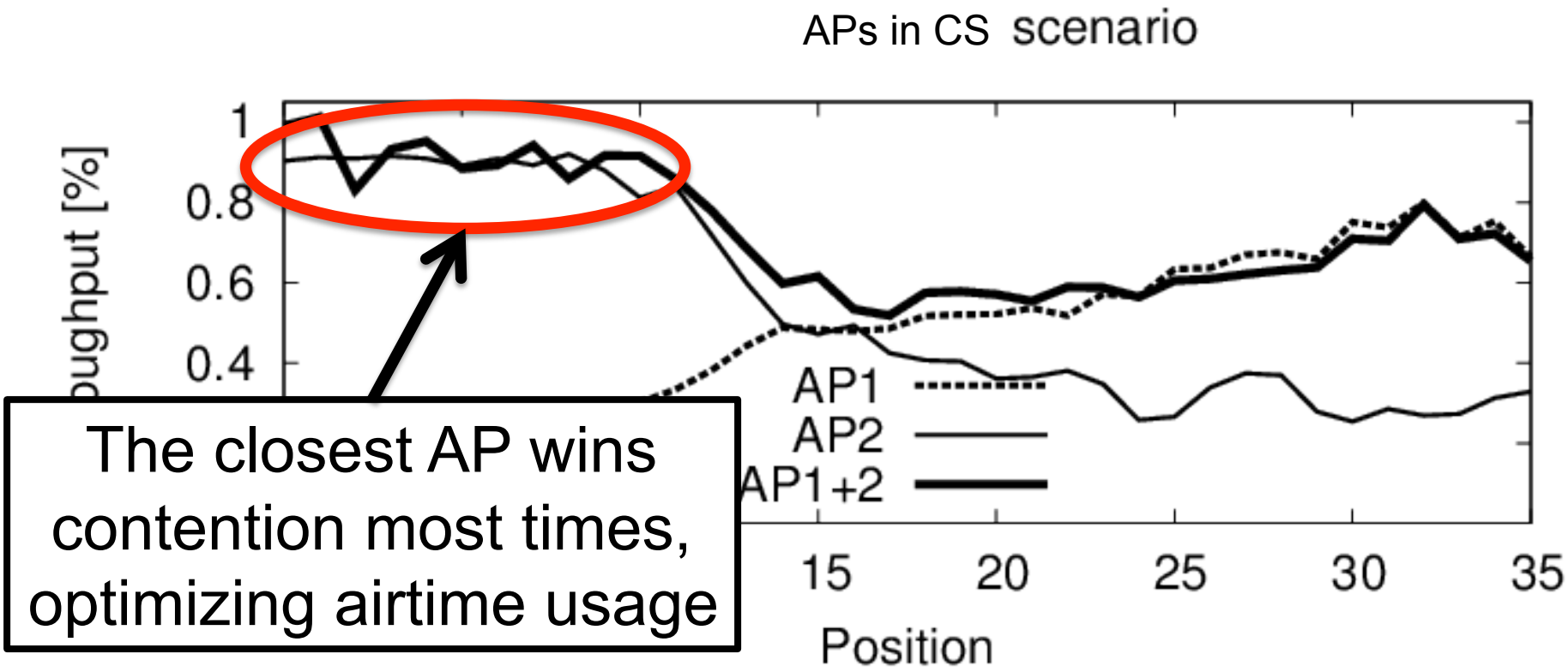
CS experiment: APs see each other



CS experiment: APs see each other



CS experiment: APs see each other

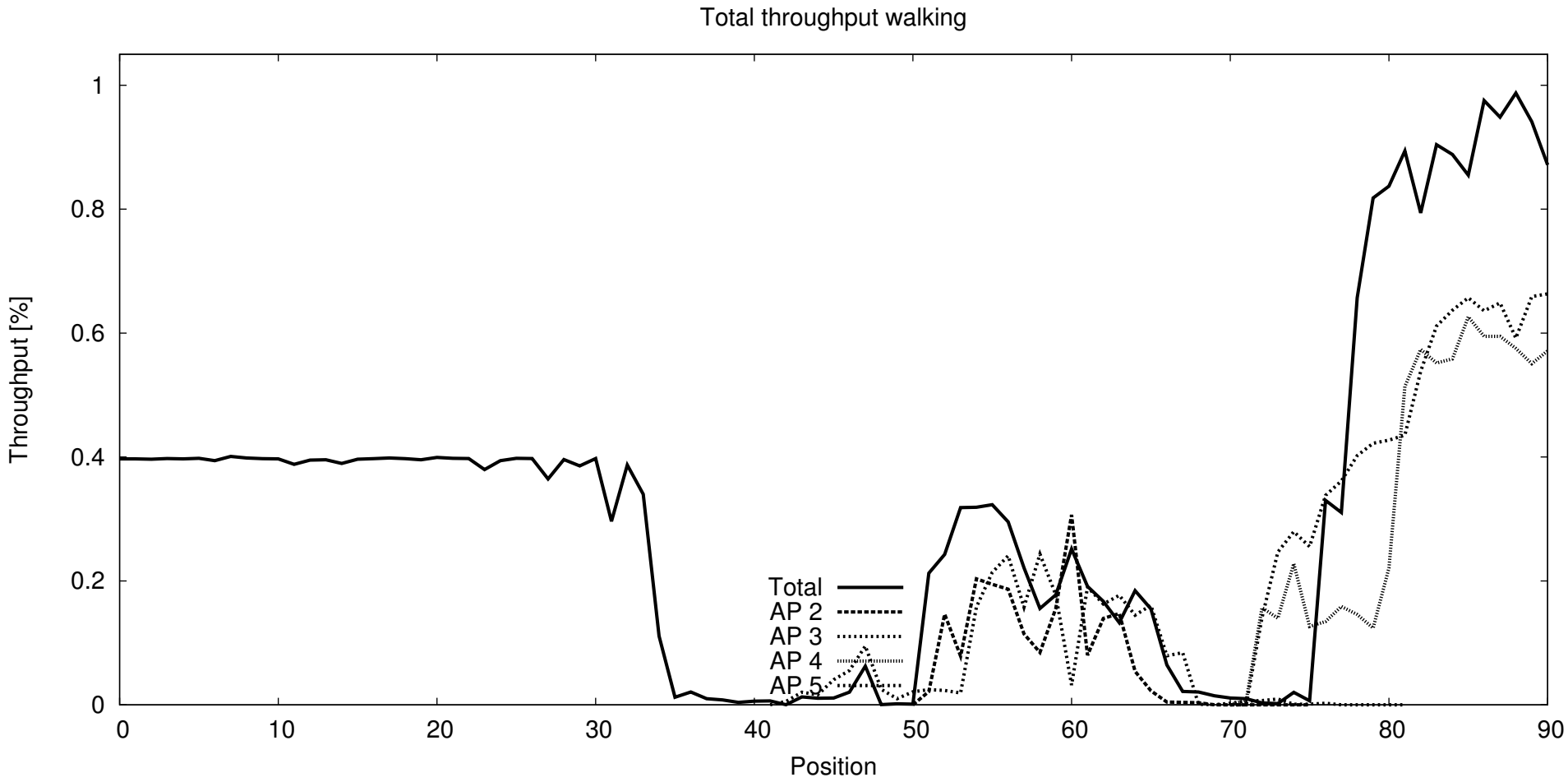


Is it always this good?

- Short answer: **NO**
- Outcome depends on the rate selection algorithm
  - When everyone uses the same rate, effect happens because **retransmissions increase contention interval**
  - When some AP uses a lower rate with few errors, the throughput obtained may be lower

A walk through the CS building

on channel 6



MPTCP = layer 4 mobility

Utopic solution:

- 3 NICs on 3 channels
- no probing, just passive beacon collection
- only use the best AP on each channel

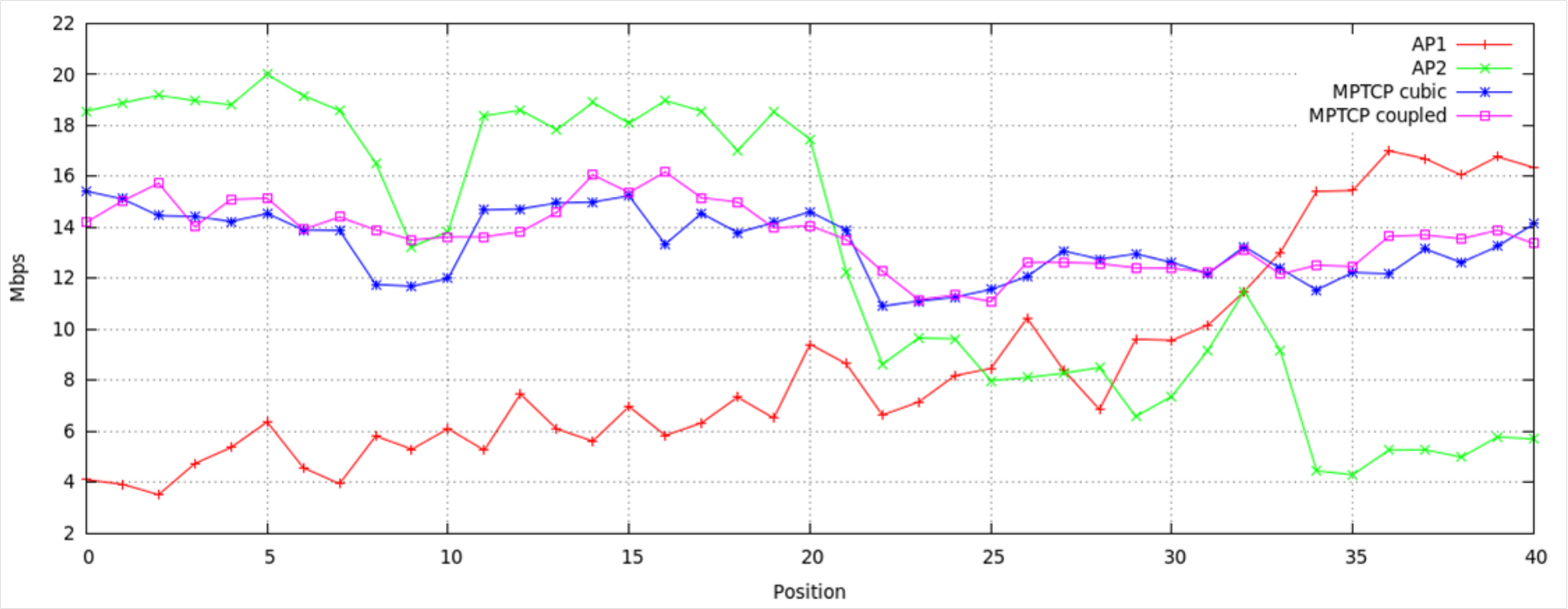
Proposal: **connect to all APs** whenever visible

1. all APs on a channel
2. switch channels

2. switch channels

- channel switch overhead = 3ms
- good performance in all static scenarios
- questions
  - How much time on each channel?
  - Tie decision to queues, TCP, e2e bandwidth?
  - Use only ‘social channels’ 1,6,11?
  - Empty channel scan?

CS experiment: 2 channels



Older results - should be better with the new 5ms code

Use one or multiple NICs?

- Wasteful solution: one NIC/channel
  - \+ best performance
  - \- low energy efficiency
- One NIC + channel switch
  - \+ can deploy today
  - \+ energy efficiency depends on modulation/coding
  - \- overheads, performance
  - ? mobility

Summary

- **MPTCP = layer 4 mobility**
- no handoff scanning overhead
- It is worth associating to **all APs on a channel**
  - HT: no problem
  - CS: some cases need more work.
  - Downlink
    - MPTCP harvests capacity
    - load balancing, fairness **todo**
- May be **worth switching channels**
  - cost of maintaining connections, effect on rate control?