Understanding WiFi-based connectivity from moving vehicles

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Network access from moving vehicles

- Highly attractive, increasing demand
- Our long-term goal: Build a network and develop protocols to support vehicles using WiFi
  - Cheaper and potentially higher throughput than alternatives
  - Opportune time to consider this challenge
- This work: Investigate connectivity characteristics between vehicles and base stations
  - To understand what applications can be supported and what protocols are suitable

Characterizing V-to-BS connectivity

1. Interested in the basic nature of connectivity provided by the wireless fabric
   - E.g., packet loss variation with vehicle movement

2. Can the predictability of vehicular paths mitigate the impact of a fast-changing environment?

Deploy a testbed and analyze measurements

Existing work

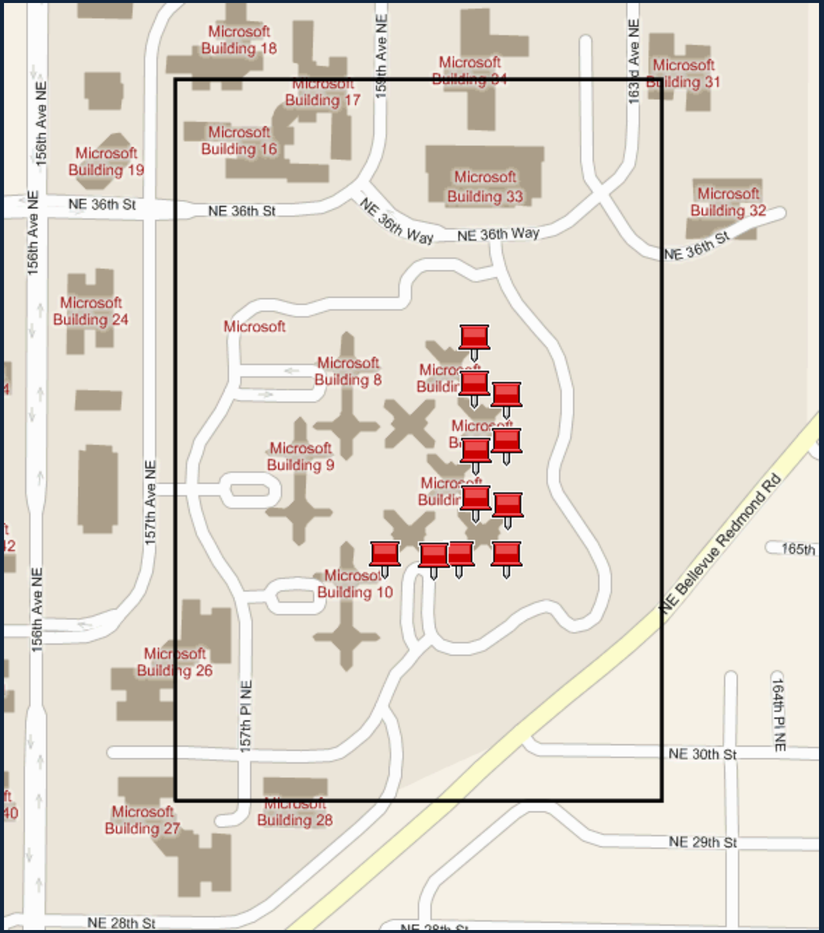
- Either studies what can be done with existing deployments and protocols
  - Current protocols have high overheads that can be easily removed
- Or studies controlled environments
  - Real environments are very different

VanLAN: Our testbed

Uses campus vans as moving vehicles

Basestations are deployed on roadside buildings

Currently 2 vans, 11 BSes

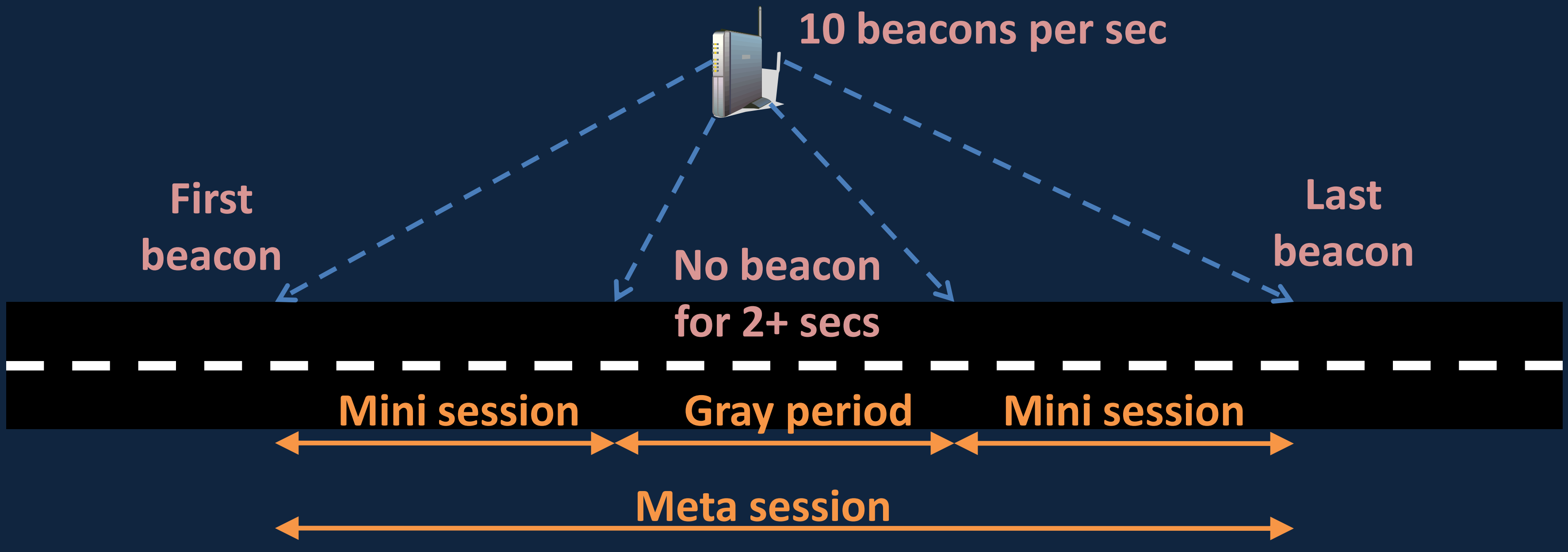


Van deployment

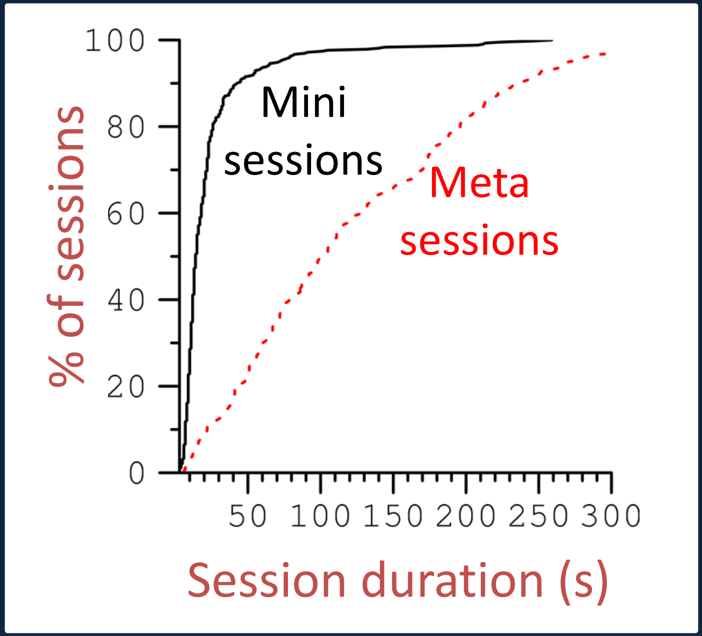
Studying connectivity sessions and disruptions

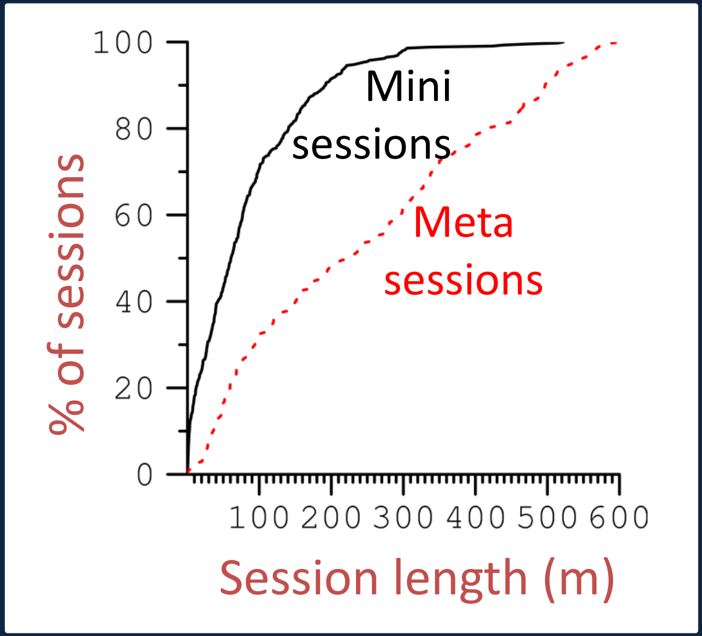
Define two types of connectivity sessions to a BS:

- *Meta session:* from coming in to going out of range
- *Mini session:* period without disruptions in connectivity



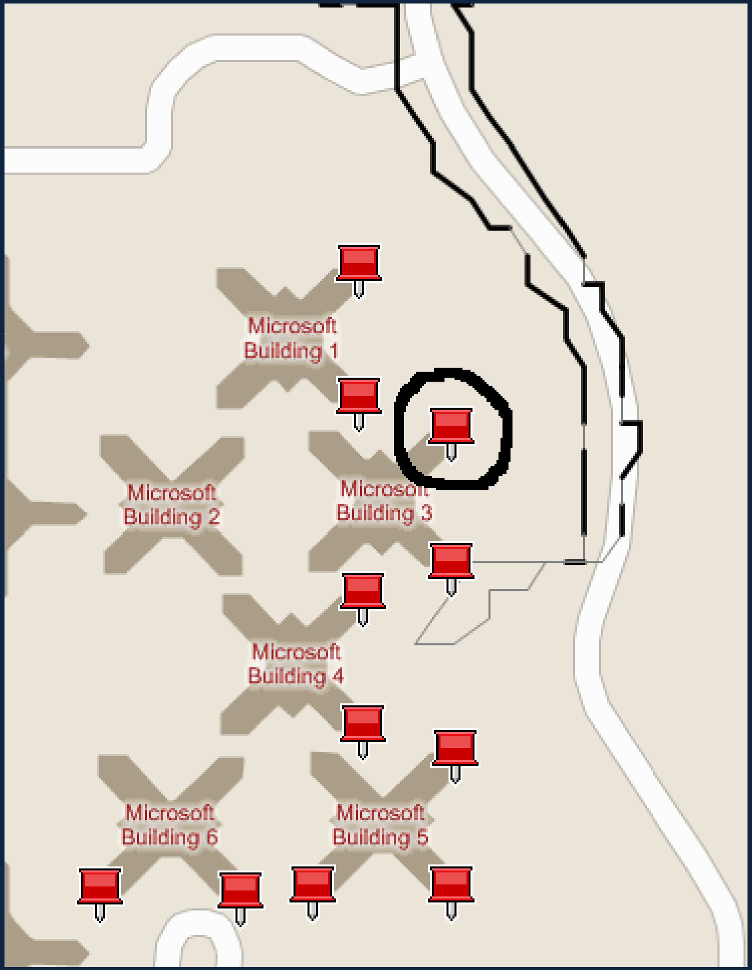
Moving vehicles experience gray periods

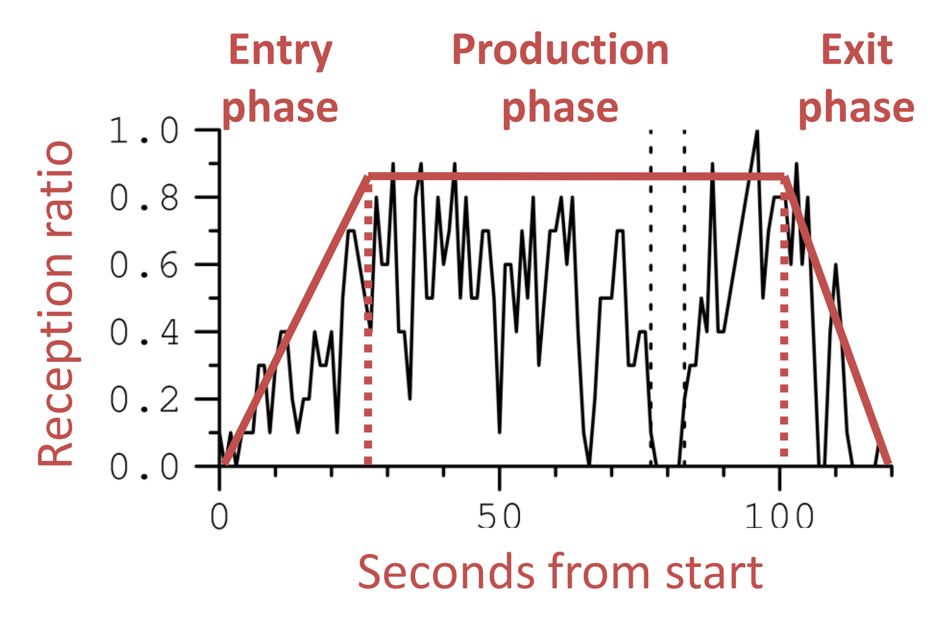




Mini sessions are much shorter than meta sessions

Example gray periods





Observed behavior does not match earlier observations in controlled environments

Properties of gray periods

Very frequent in our testbed

Most are short but some even longer than 10s

Do not consistently occur at the same location

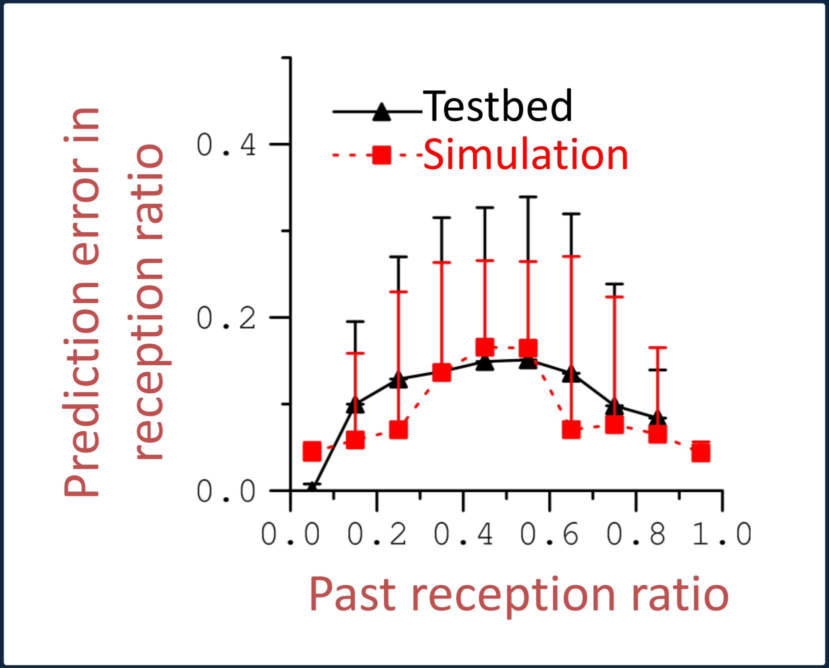
Hard to predict reliably using online measurements, e.g., of RSSI, reception ratio

Implications of gray periods

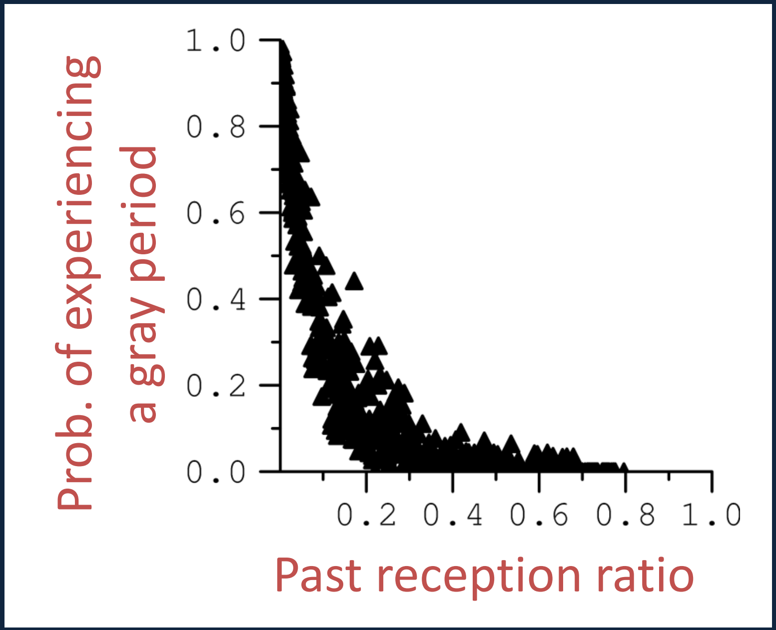
Supporting interactive or disruption-sensitive applications is challenging

Current WiFi association and handoff model performs poorly

Historical information can help predict performance at a location



Historical information can also help identify regions prone to gray periods



Conclusions

Moving vehicles frequently encounter gray periods

- Makes it challenging to support some applications
- Minimizing disruptions requires new protocols

Predictions based on past performance at a location can help

More information and data at http://research.microsoft.com/vanlan/