Home Network Performance Diagnosis

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Internet connectivity is central in today's homes

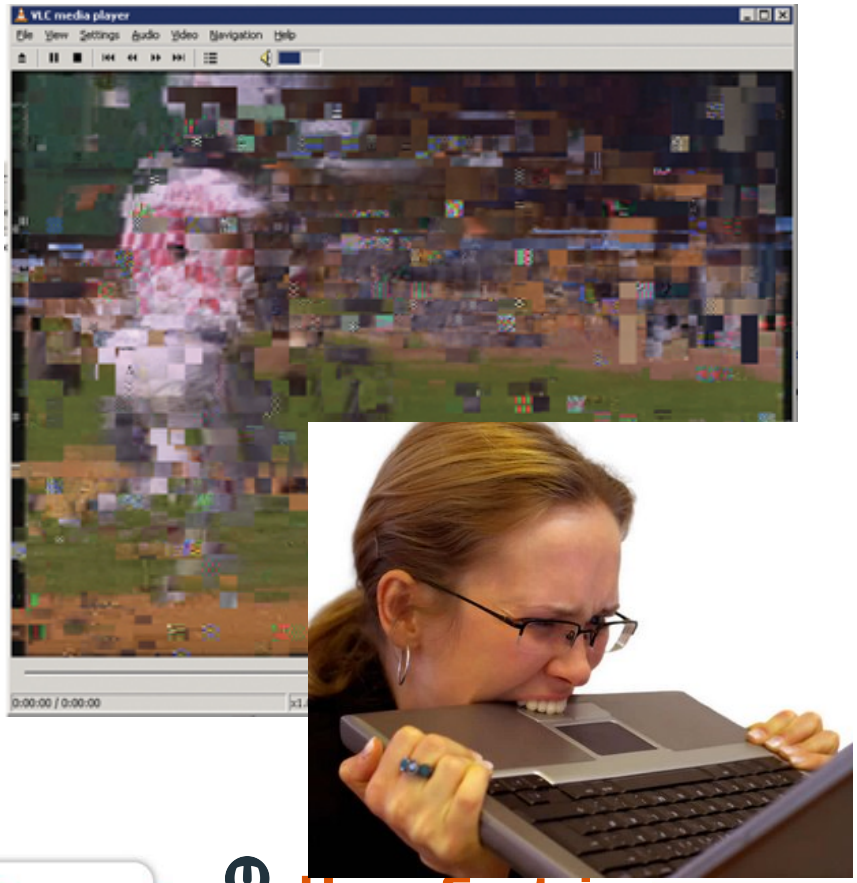
70% of broadband users under 35 get at least some of their TV from online sources

Telecommuting in the US increased 73% from 2005 to 2011

Online video users are expected to double in 2016

Network performance disruptions are frustrating

For users



For ISPs

Problem

- The home network can disrupt networked apps
  - Multiple users/devices/apps compete for bandwidth
  - Poor WiFi increases jitter and reduces bandwidth
- Users don't know what is happening
  - Home networks are complex
  - Most home users are not professional net admins

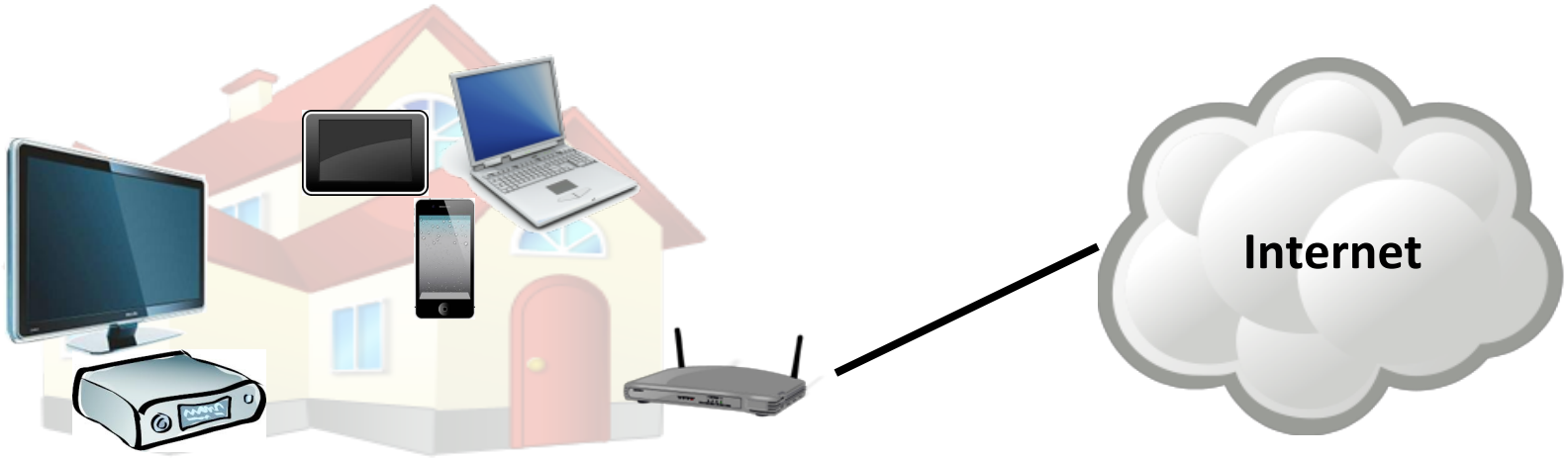
Muse's research

- Goal: improve user online experience at home
  - Build personalized networking technology that guides network performance and diagnosis based on user
- Networked systems at home should adapt to users
  - Priorities, level of expertise, context
- Approach
  - Develop home network performance diagnosis techniques
  - Develop technique to infer of user dissatisfaction with application performance

Our research on home network diagnosis

- Goal: Assist users to diagnose performance problems in the home network
  - Is the problem in the ISP or the home network?
  - If the problem is in the home, what is the cause?
- Challenges
  - Home networks are heterogeneous
  - A number of explanations exist for a symptom
  - Output must be actionable by any user

Possible measurements points in the home



- End-devices
  - Observe poor user experience
  - But, have limited view of the home network and development is harder
- Home gateway
  - Ideally placed between home devices and Internet
  - But, have limited resources and deployment is harder

Our projects on home network diagnosis

- Monitoring and diagnosis from gateway
  - Active measurements of access link performance
  - Passive measurements to locate last-mile bottlenecks
  - Home wireless diagnosis
- The browser as a monitoring/diagnosis platform
  - Fathom: builds monitoring capability in the browser
    - Familiar interface to users
    - Available on many devices
  - Diagnosis with active measurements that leverage collaboration among devices

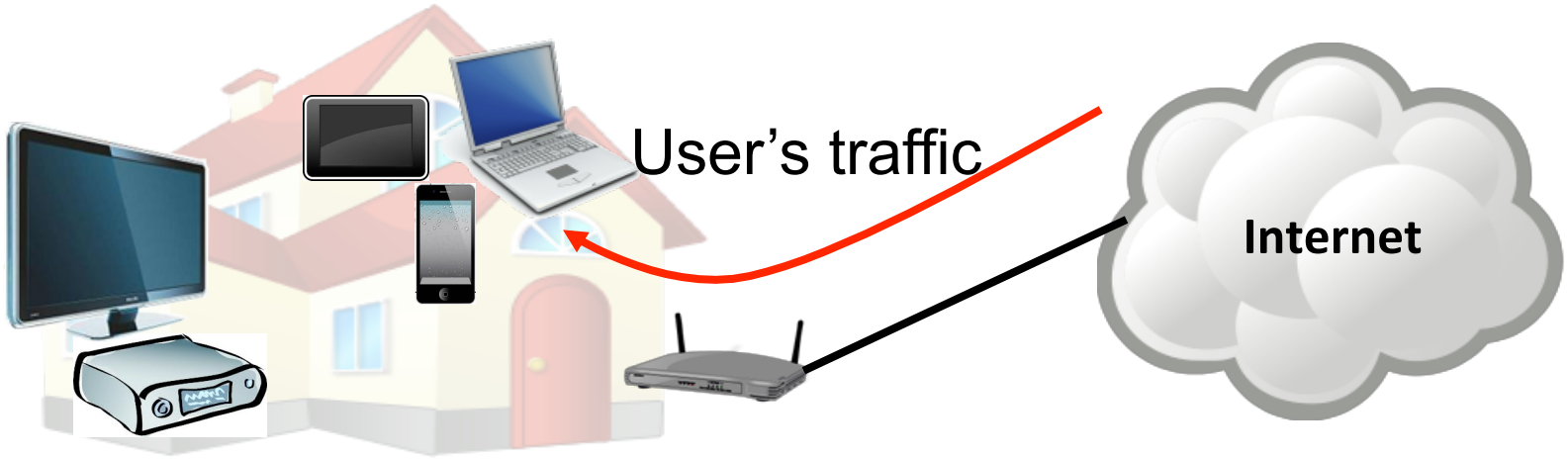
Home or Access? Locating Last-mile Downstream Bottlenecks

with

Srikanth Sundaresan (ICSI),

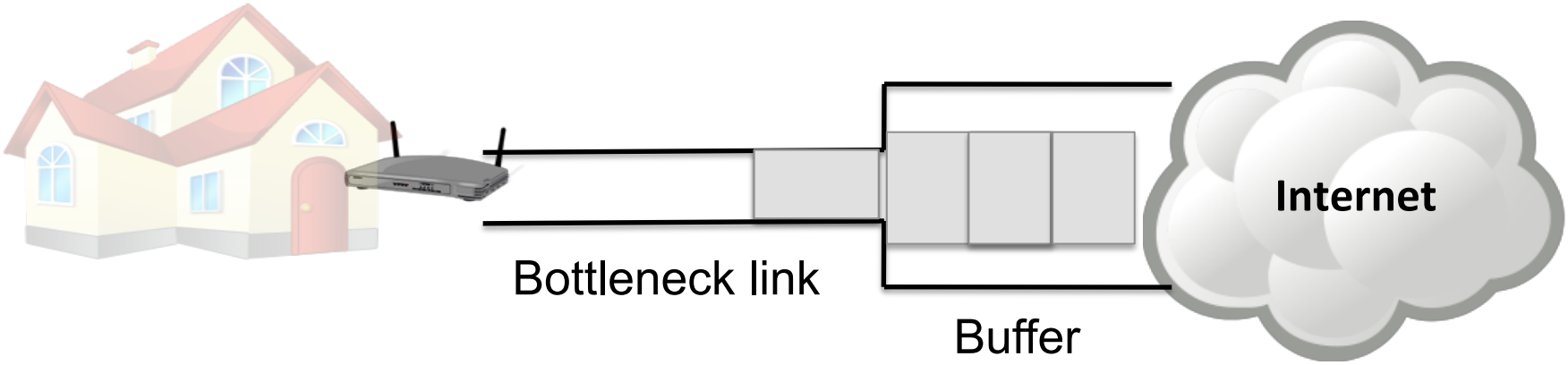
Nick Feamster (Princeton)

Is bottleneck in the ISP or the home wireless network?



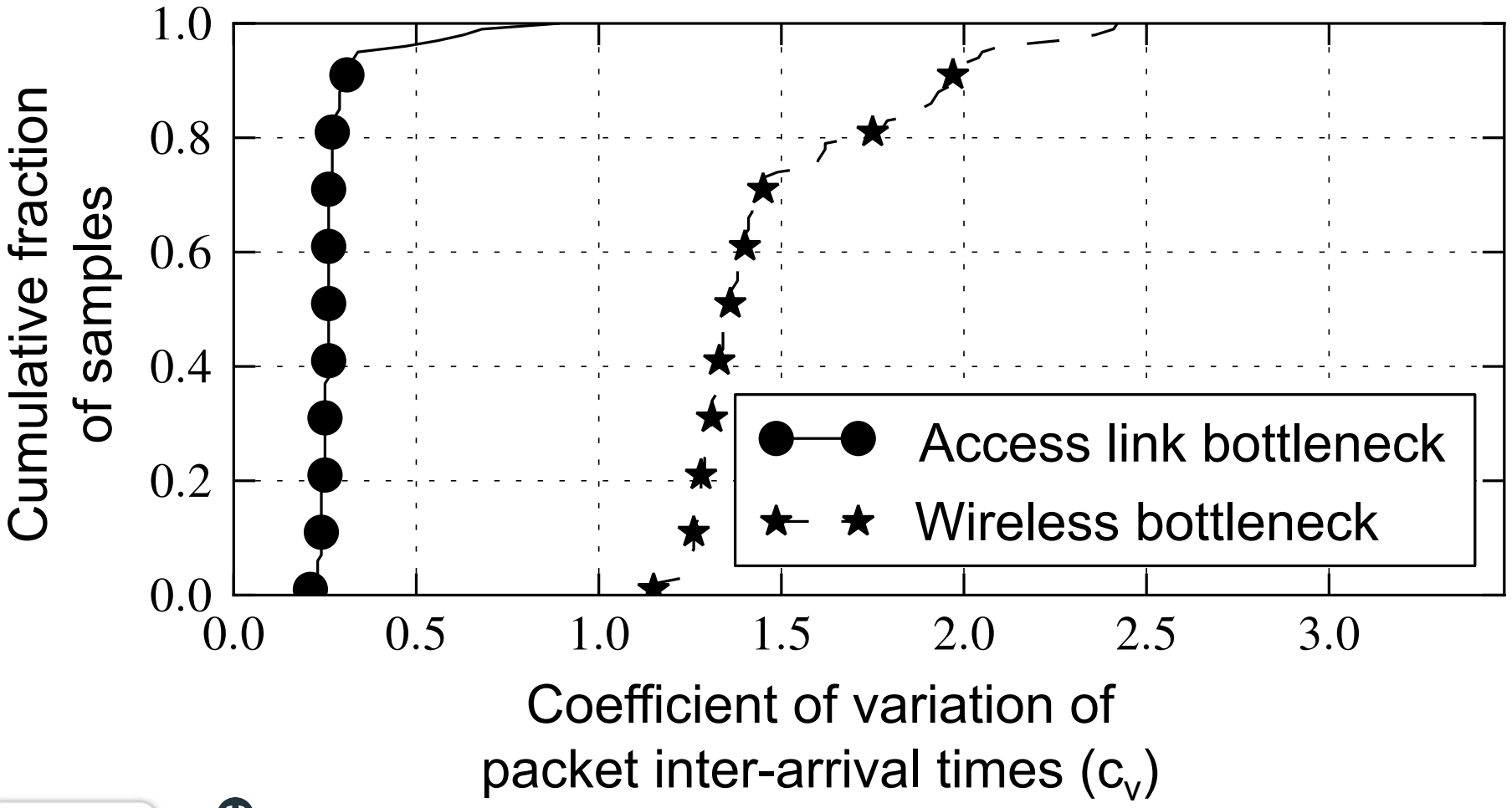
- Approach: passive measurements at gateway
  - Throughput bottlenecks experienced by users
  - No measurement overhead
  - Gateway directly "sees" bottlenecks

Access link bottleneck

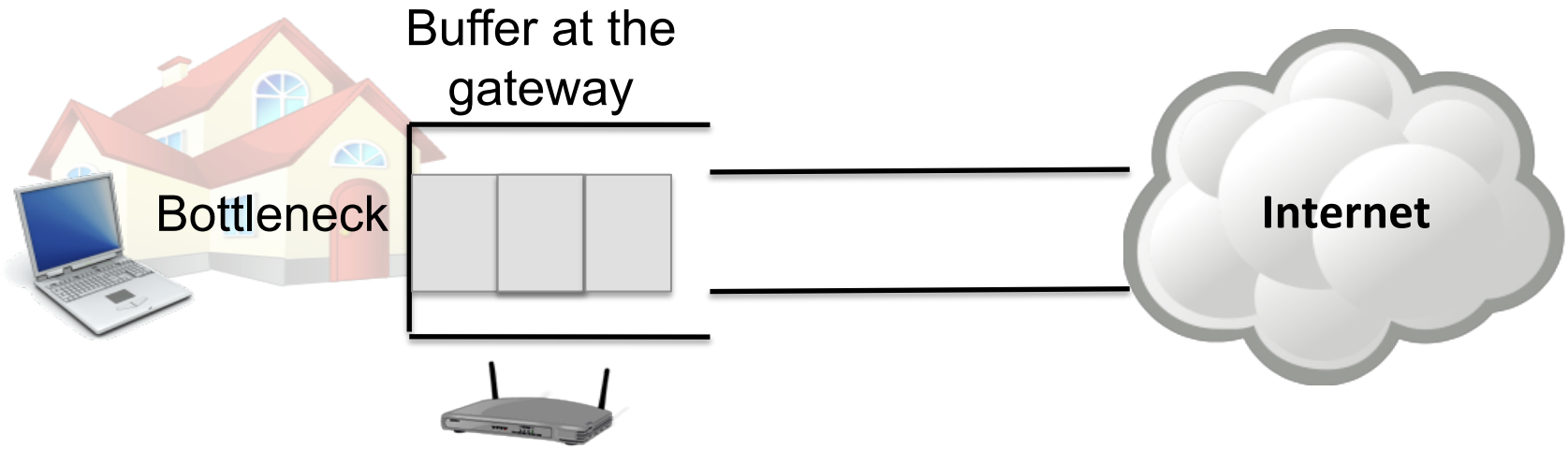


Smooth packet arrivals at the gateway indicate access link bottleneck

Packet inter-arrival times capture access link bottleneck

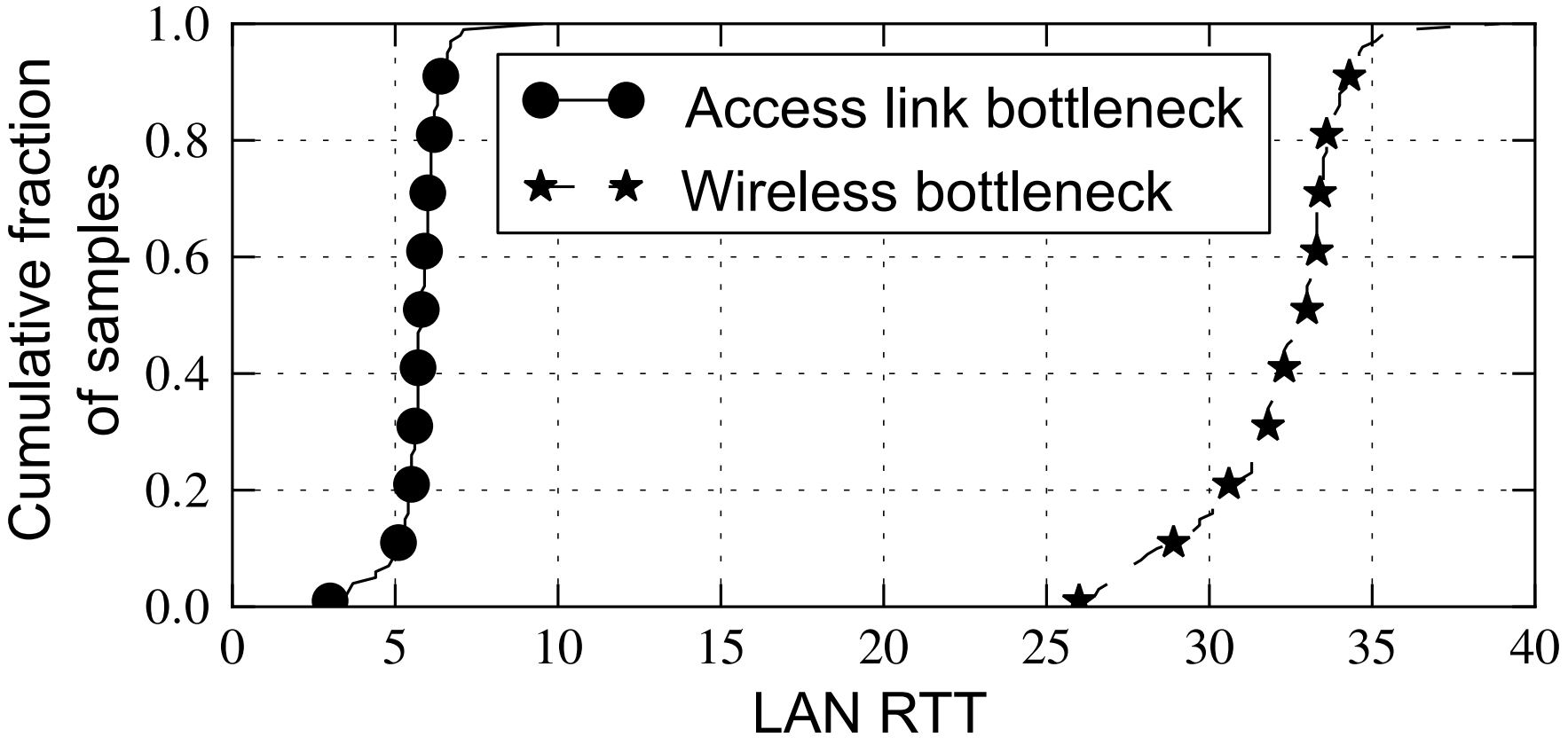


Wireless bottleneck

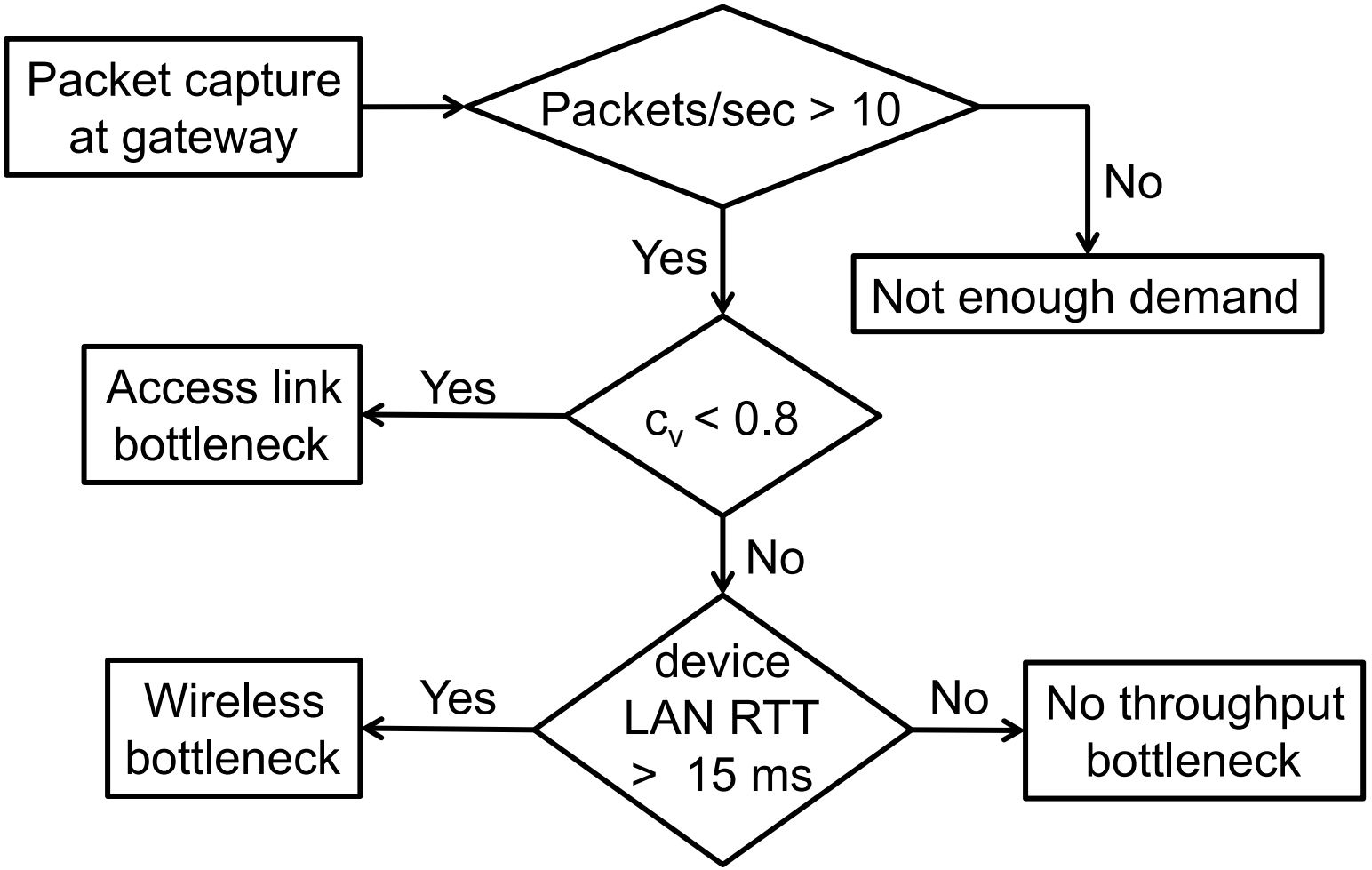


Buffering delays at queue and retransmissions lead to increased RTT

Local RTT captures wireless bottlenecks

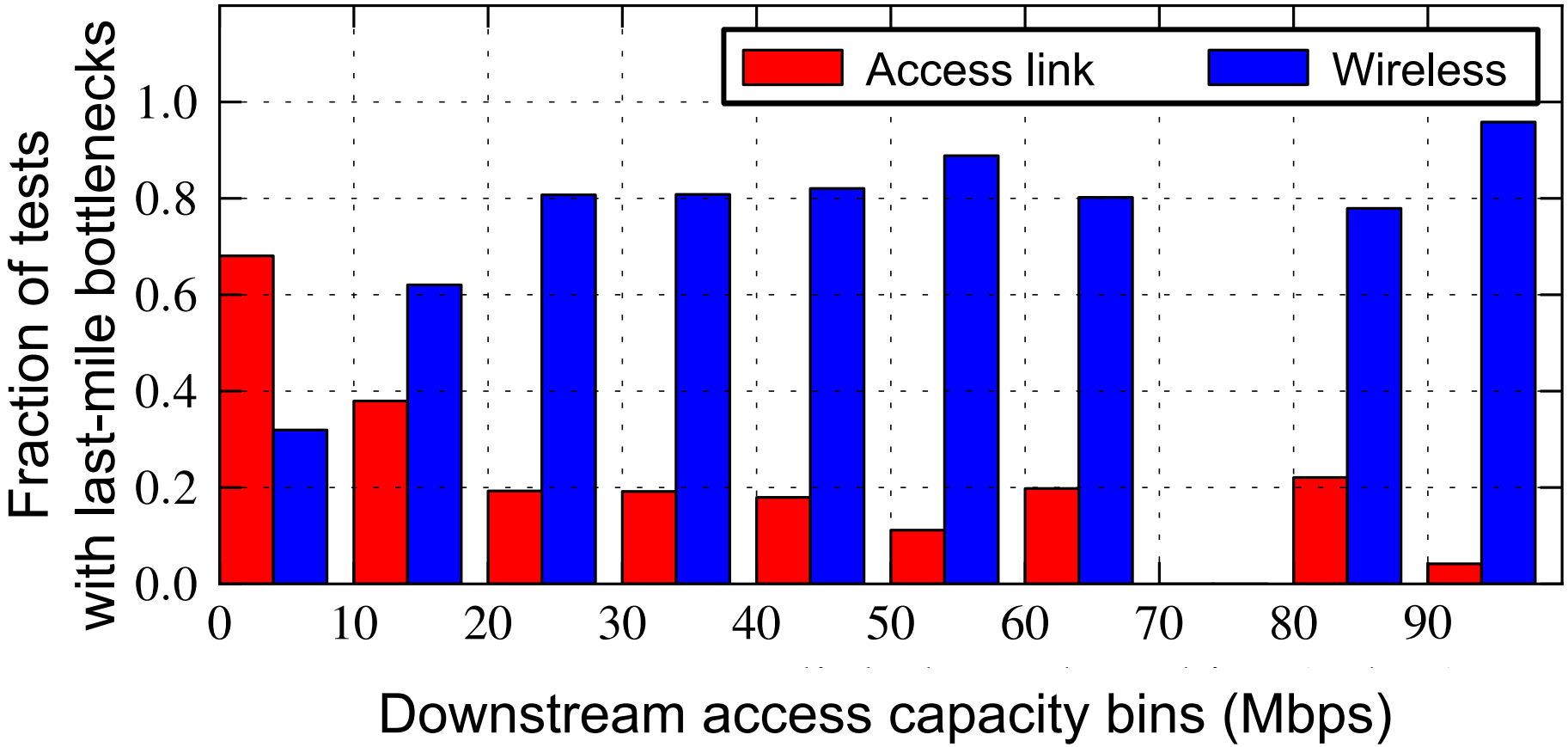


Bottleneck identification algorithm



Prevalence of last-mile bottlenecks

Deployment sponsored by the FCC: 2,652 homes in US



Next steps

- Improve characterization of network problems
  - Deployments with end-device monitoring
  - Deployments with wireless performance monitoring
- Root-cause analysis
  - Explore explore wireless performance metrics
  - Tests across multiple home devices
  - Learn patterns of from multiple homes