

Home Network or Access Link?

Locating Last-mile Downstream Throughput Bottlenecks

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It is Difficult to Locate Problems in the Last Mile

lifehacker

Why Is My Internet Suddenly So Slow?



Adam Dachis
Filed to: ASK LIFEHACKER 2/18/14 10:00am

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Many sources of problems

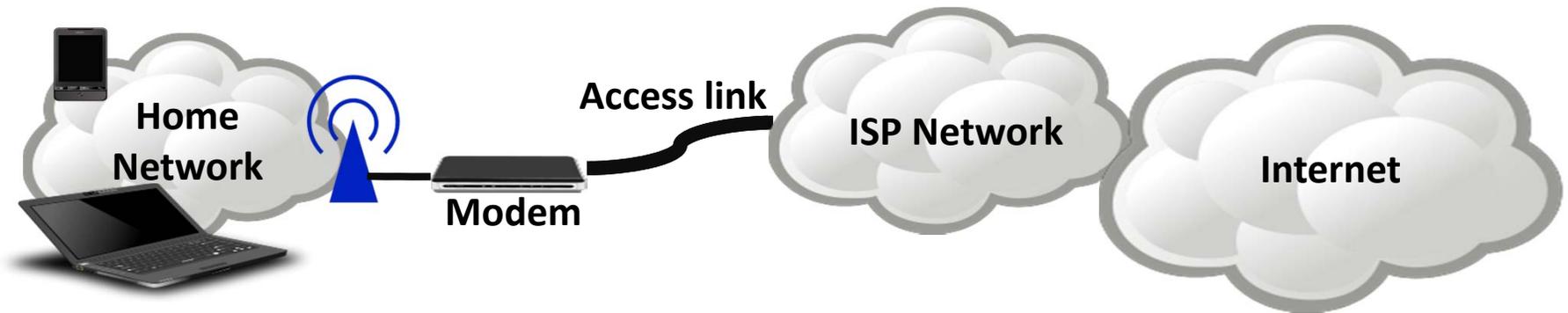
- ISP congestion
- Wireless / End-Clients

Or beyond

- Peering
- Server-side

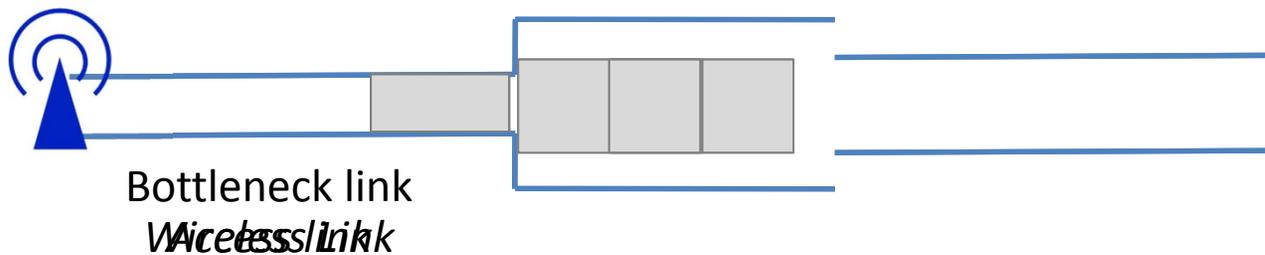
How can we determine whether the problem is the home wireless network or the last mile?

Exploiting the Gateway's Vantage Point to Locate Bottlenecks



- End hosts do not have sufficient visibility
 - No global view: can identify *presence* of bottlenecks, but not location
- The gateway has visibility into access link, wireless network, and user traffic

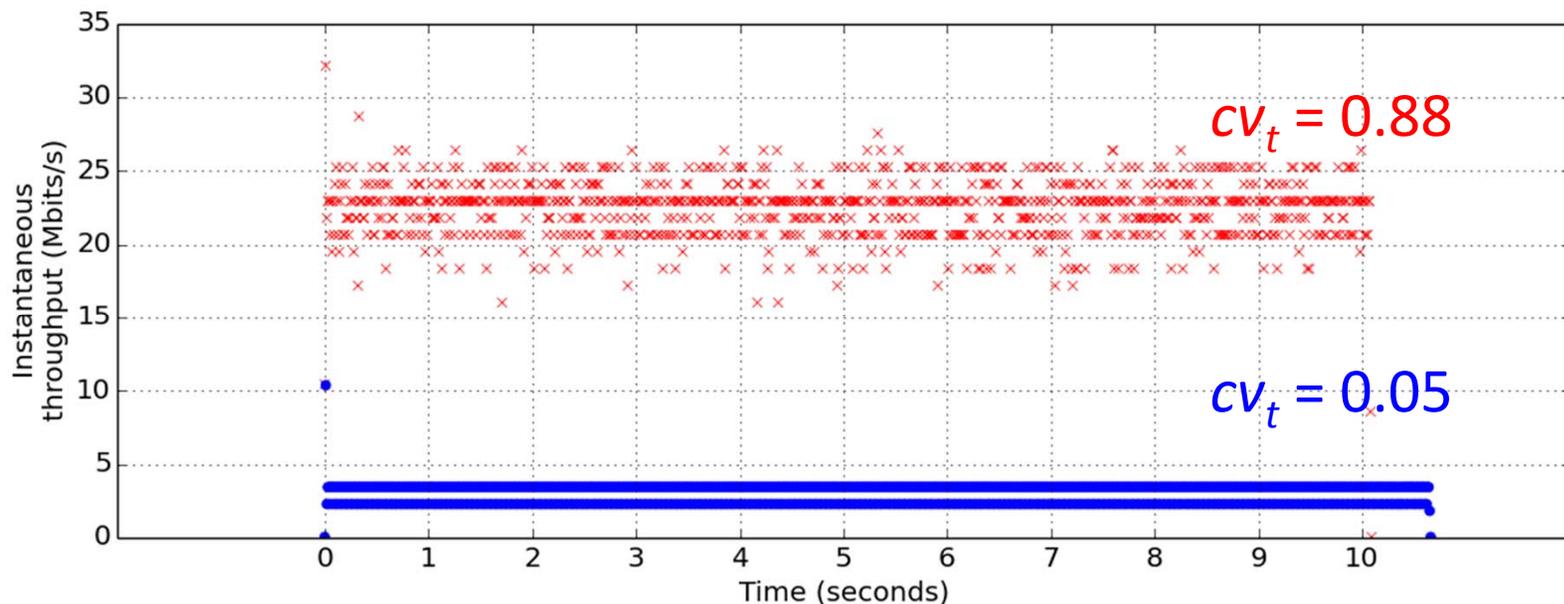
Locating Last-mile Bottlenecks Using Buffering Information



Packets get buffered at bottleneck link

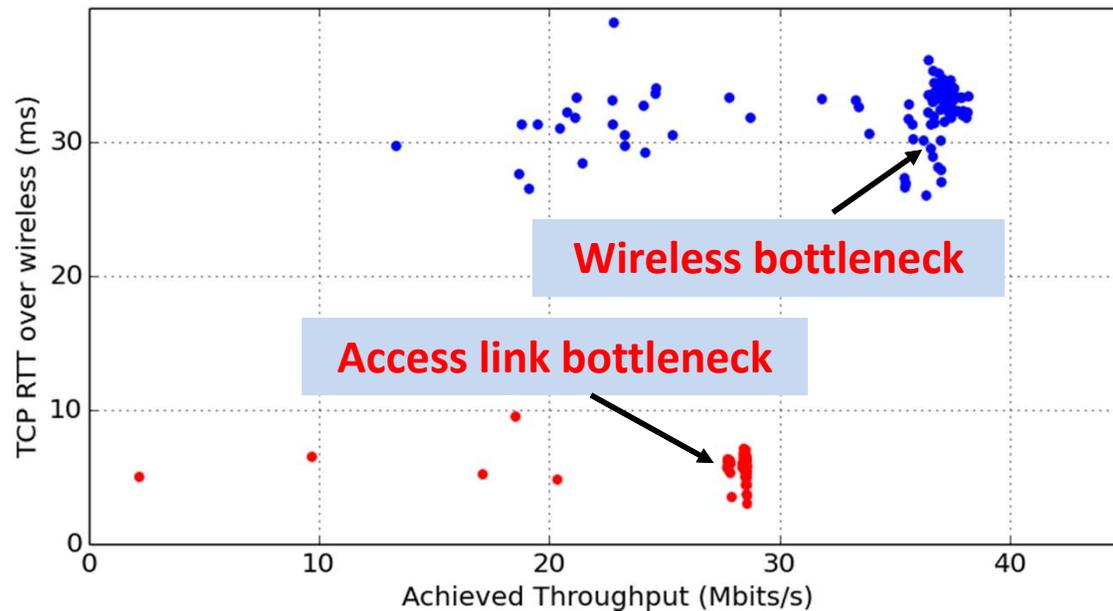
- Smoothed departures on bottleneck leads to steady packet inter-arrival times at the destination
- Buffering delays at queue leads to increased RTT

Bottlenecked Packets Have Steady Inter-arrival Times



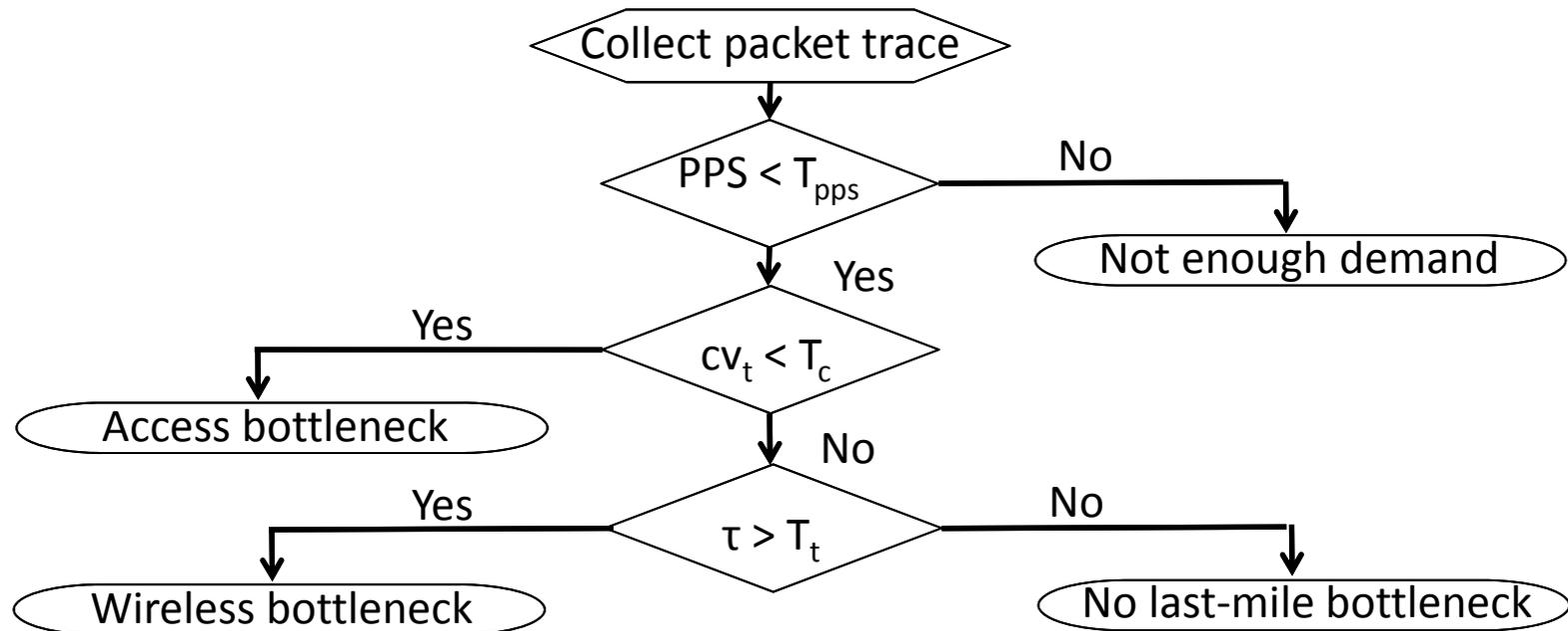
Packets *after* bottleneck have low coefficient of variation of inter-arrival time (cv_t)

Using LAN RTT to Detect Wireless Bottlenecks



LAN RTT (τ) between gateway and client increases significantly if the wireless is the bottleneck

Home or Access?: A Light-weight Bottleneck Locator for the Gateway



System Prototype Design

- Collect pcaps on device
 - No payload: only TCP/IP headers
 - Headers completely anonymized on device
 - 10 seconds or 10,000 pkts, whichever comes first
 - Number of devices using network (anonymized)
 - Wireless configuration
- Data collected 3 times an hour
- Offline analysis of anonymized data

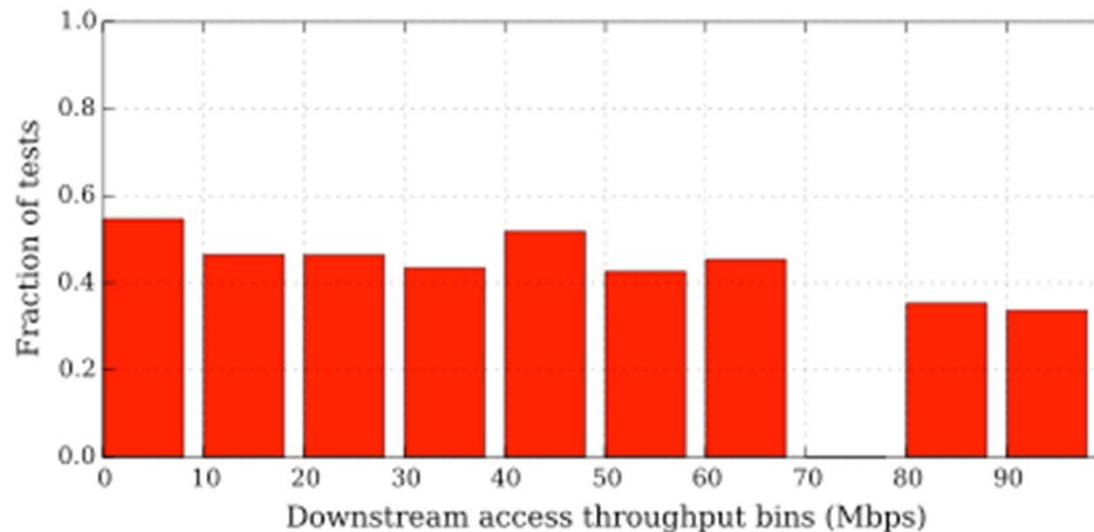
Deployments: Pilot

- On Project BISmark deployment
 - Netgear WNDR 3700v2, 3800 (802.11 agn)
 - 650MHz processor, 128 (64 for 3700v2) MB RAM
 - 64 homes worldwide, 1 month
 - Augmented with wireless header data

Deployments: FCC MBA

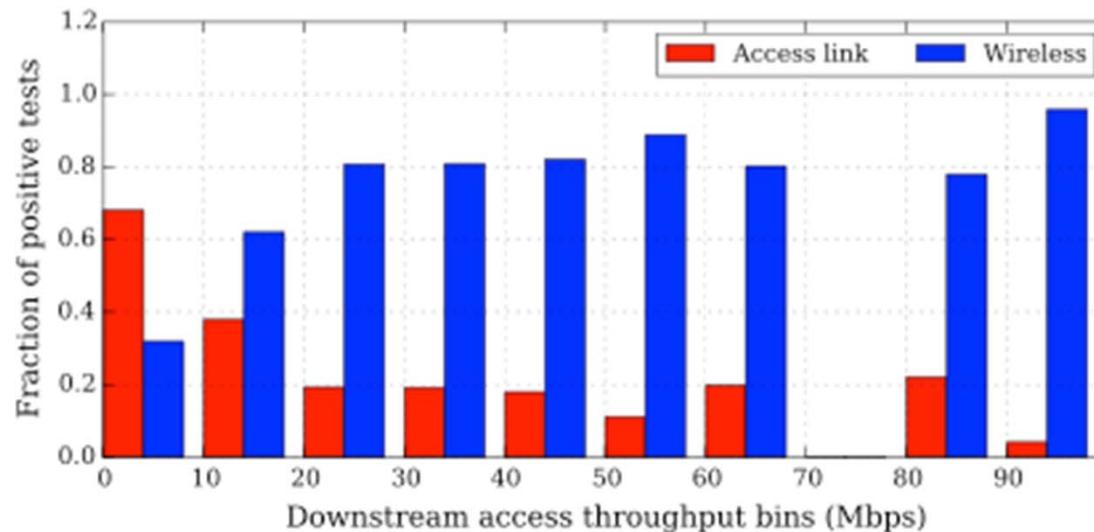
- Ported the tool with significant support from SamKnows and FCC (~15 months)
 - Netgear WNR 3500L (802.11 bgn)
 - 480 MHz processor, 32 MB RAM
 - Much stronger resource constraints, production environment
 - 2652 homes in US, 2 days

How Frequent are Throughput Bottlenecks?



40-55% of tests with significant traffic see throughput bottlenecks

Access-link vs Wireless bottlenecks



**Access link bottlenecks are only significant < 20 Mbps.
Wireless bottlenecks dominate beyond 20 Mbps.**

Project Status

- Proof-of-concept system works on OpenWRT
 - FCC deployment had some resource constraints issues
 - Actively developed for improved robustness
 - Online version demo'd at ACM SIGCOMM 2014
- Caveats: Does not work for upstream traffic or with wireless upstream (WiMax/4G)
- Looking for deployments in home routers!
 - Wireless data can add to understanding of bottlenecks

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