A Longitudinal Study of the Prevalence of WiFi Bottlenecks in Home Access Networks

Ranya Sharma, Nick Feamster, Marc Richardson

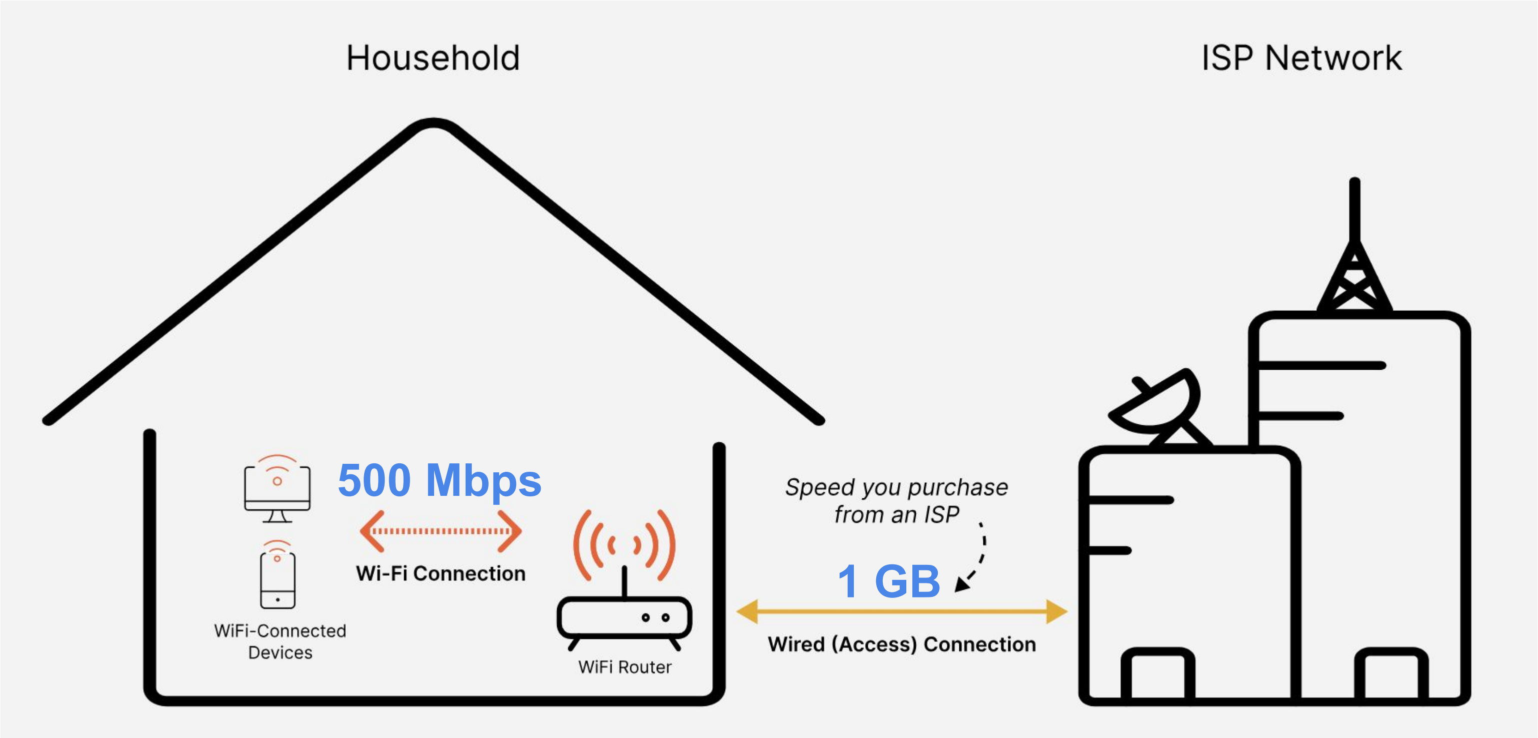
THE UNIVERSITY OF CHICAGO

Presented at ACM IMC 2024

Motivation

- Increasing demand for effective WiFi use
- User experience impact
- Infrastructure investment

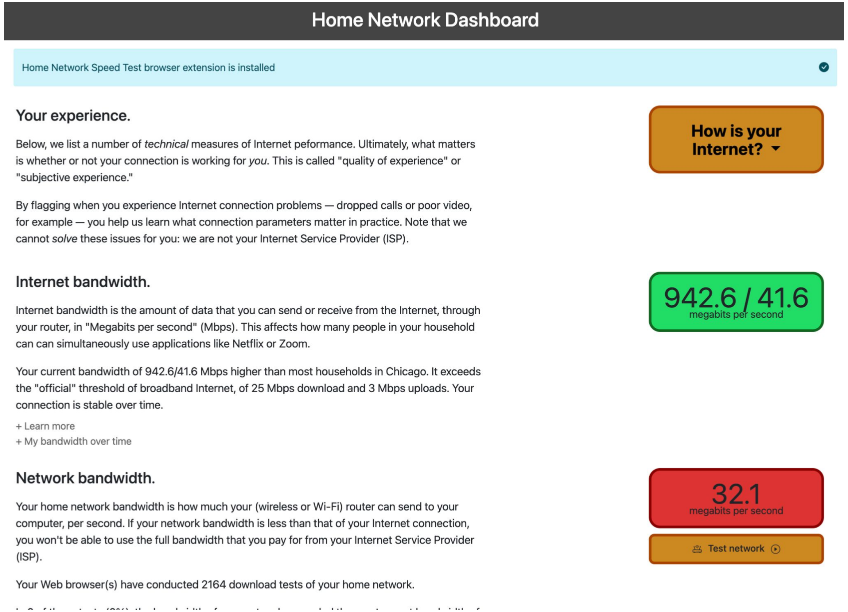
Connection in a Household



Research Question

Does upgrading your service plan guarantee improved Internet performance over WiFi connections?

Study Method

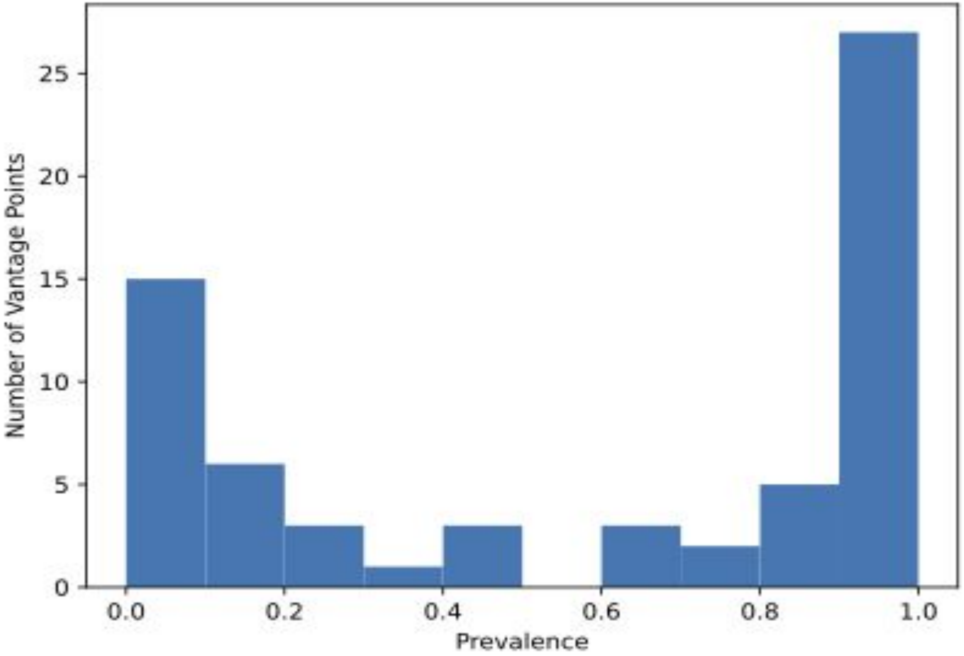


Our Study

Period: 9/18/21 - 9/30/23

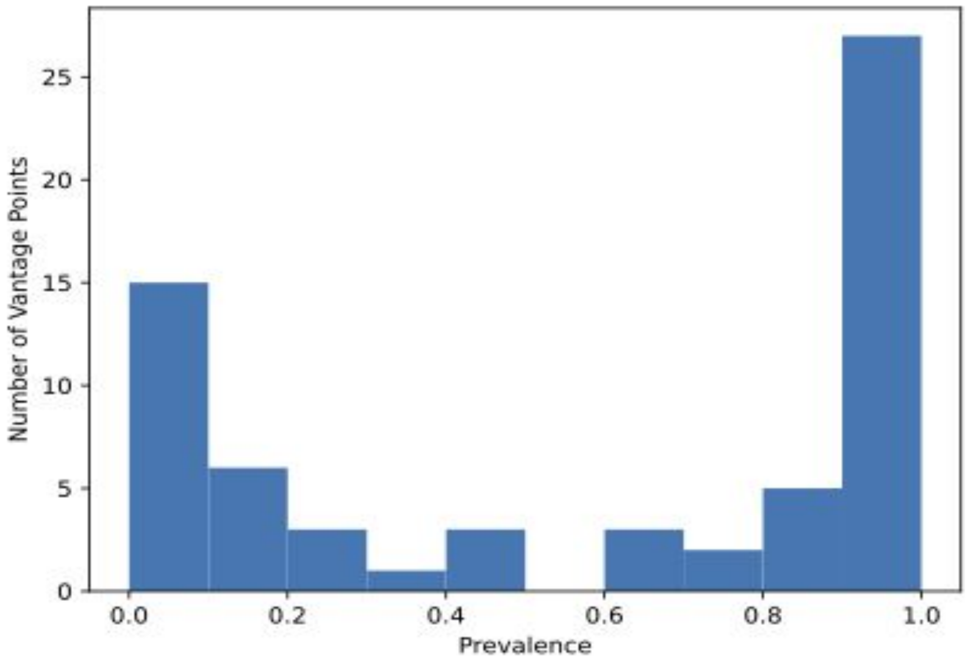
Households: 52

Almost Always or Almost Never a Bottleneck



Prevalence of WiFi bottlenecks by vantage point

Almost Always or Almost Never a Bottleneck



Prevalence of WiFi bottlenecks by vantage point

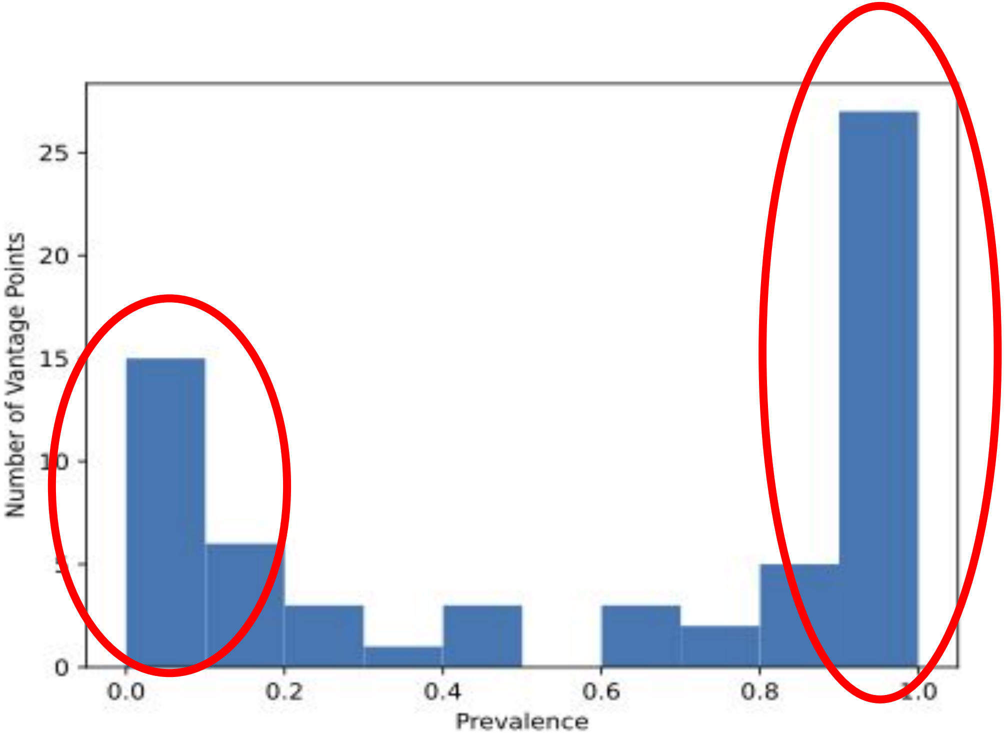
Example

100 total measurements

WiFi throughput < access speed: 20 measurements

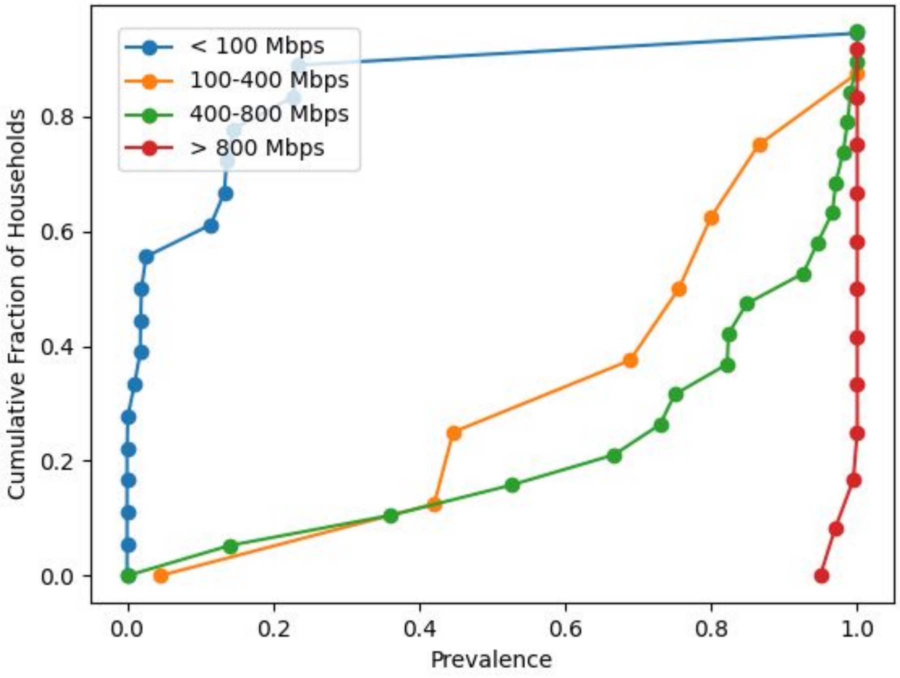
Bottleneck prevalence: 20/100 = 0.2

Almost Always or Almost Never a Bottleneck



Prevalence of WiFi bottlenecks by vantage point

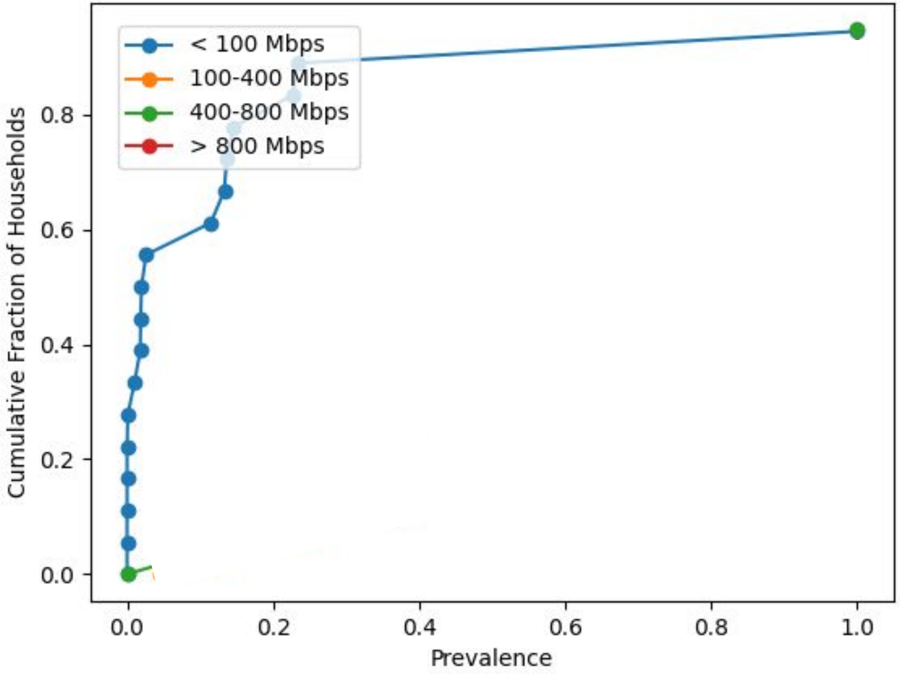
Higher Speed Tier = More Bottlenecks



Prevalence of WiFi bottlenecks by speed tier

Higher Speed Tier = More Bottlenecks

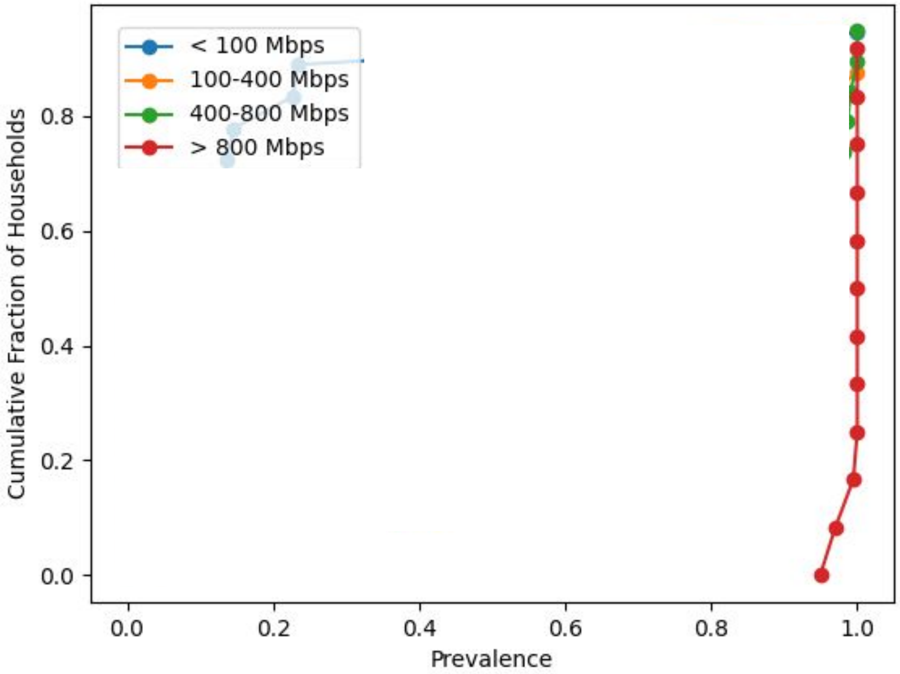
< 100 Mbps Households



Prevalence of WiFi bottlenecks by speed tier

Higher Speed Tier = More Bottlenecks

> 800 Mbps Households



Prevalence of WiFi bottlenecks by speed tier

Median Access Throughput

Households with Frequent WiFi Bottlenecks	Households with Rare WiFi Bottlenecks
689.64 Mbps	58.35 Mbps

Magnitude of WiFi Bottlenecks

- Median WiFi Throughput
- Median Access Throughput
- “Actual” Throughput
    - Min(Median WiFi Throughput, Median Access Throughput)

Magnitude of WiFi Bottlenecks

Speed Tier	Gap between Actual Throughput and Access Throughput
200-400 Mbps	109.91 Mbps
400-800 Mbps	240.00 Mbps
> 800 Mbps	600.30 Mbps

Results

Most households either experience no bottlenecks or are frequently affected

Higher speed tiers correlate with increased WiFi bottleneck prevalence

Median access throughput correlated with WiFi bottleneck prevalence

A Longitudinal Study of the Prevalence of WiFi Bottlenecks in Home Access Networks

Ranya Sharma, Nick Feamster, Marc Richardson

- We provide empirical evidence to highlight WiFi's role as a bottleneck in home broadband networks
- Open-source tools and data, ongoing measurements
    - Publically available
- Application to public policy

Acknowledgements
This work was supported by NSF Awards CCRI-2213821, IMR-2224687, and IMR-2319603.
We thank Jesse London, Matt Triano, and the Internet Equity Initiative team for their work

ranyasharma@uchicago.edu https://internetequity.uchicago.edu/