A Little Sharing Goes a Long Way
The Case for Reciprocal WiFi Sharing

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Two Recent Trends

- Increasing broadband penetration creates large number of private home APs
- Increasing percentage of population resides in dense urban environments

Chaotic WiFi Environments
Chaotic WiFi Environment
What If…

Alice

Bob

Alice's laptop

Bob's laptop
Reciprocal WiFi Sharing

Alice/Bob allows Bob/Alice to use her/his router

Benefits

- Less hardware
- Less interference
- Better performance
Sounds Good, But...

- How often does it happen in practice?
  - WiFi sharing opportunities in real life

- What is the incentive for sharing?
  - Reciprocal relationship

- How to enable sharing?
  - WiseFi system design
PhoneLab WiFi Dataset

- 254 devices, 5 months
- 21M WiFi scans
- 1M observed WiFi APs
- 466K WiFi sessions
How often does a neighbor's AP provide better signal than home AP?
Dominant Neighbor APs

Are there certain neighbor APs that provide better signal most of the time?

![Graph showing the cumulative distribution function (CDF) of the fraction of the dominant AP. The graph compares the performance of Top 1, Top 2, and Top 3 APs, with Top 1 providing the best performance.]
Reciprocal Relationships

Do they exist in our dataset?

(a) Reciprocal Sharing Graph Among PhoneLab Participants.
WiseFi System Design

WiseFi Server

Alice's Home

WiseFi App

Bob's Home

WiseFi App

WiseFi App
WiseFi System Design

- How to detect reciprocal relationship?
- How to enable sharing?
  - W/o sharing WiFi credentials
- How to ensure that sharing remains mutually beneficial?
Sharing Mechanism

Goals

- Security: do not share WiFi credentials
- Control: grant and revoke access
  - Multiple neighbors
  - Multiple devices per neighbor
- Protection: network isolation
Our Solution

- Dynamic AP configuration API with two simple interfaces
  - getAuthClients
    - Returns list of clients that are authenticated
  - setWhiteList
    - Instructs AP to accept certain clients' association requests, regardless of possible authentication errors
Granting Access

WiseFi Server

Alice's Home

Bob's Home

Process of granting access of Alice's home AP to Bob's devices
Granting Access

Alice's Home

WiseFi Server

Bob's Home

bob_phone
bob_laptop
bob_tablet

Process of granting access of Alice's home AP to Bob's devices
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Process of granting access of Alice's home AP to Bob's devices
Granting Access

Process of granting access of Alice's home AP to Bob's devices
Grantsing Access

Process of granting access of Alice's home AP to Bob's devices
Revoking Access

Process of revoking access of Alice's home AP from Bob's devices
Revoking Access

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Sharing Mechanism Advantages

- No WiFi credential exchange
- Painlessly revoke access
  - w/o changing Alice’s WiFi password
- No modification on WiFi clients
  - Only software updates on AP side
Monitoring Sharing

Why monitoring?
- Ensure reciprocity
- Post-sharing verification
  - Is neighbor's AP really “better”?

What to monitor?
- Network usage → reciprocity
- Network performance
  - Throughput, latency, etc.
Open Questions

- How to incentivize participation?

- Legal concerns
  - Am I responsible for neighbor's illegal network activity through my AP?
  - Same with OpenWireless, FON, etc.

- How to ensure fair play?
Summary

- Used PhoneLab WiFi dataset to demonstrate reciprocal sharing opportunities

- WiseFi system design
  - Opportunity detection
  - Simple AP configuration API
    - No WiFi credential exchange
    - Easy to revoke access
    - No client-side modifications
Thanks!
Monitoring Network Usage

- One extra AP configuration API
  - `getWhiteListClients`
    - Returns clients that are currently associated through white list mechanism

- Periodic `getWhiteListClients` queries to monitor Wifi connection time
Alternative Solution

- Use “virtual network” feature on routers to set up “Guest Network”
  - Not all APs support this feature
  - Not easy to “revoke” access
CDF of Node Out Degree

![CDF of Node Out Degree Graph]