

A Little Sharing Goes a Long Way

The Case for Reciprocal WiFi Sharing

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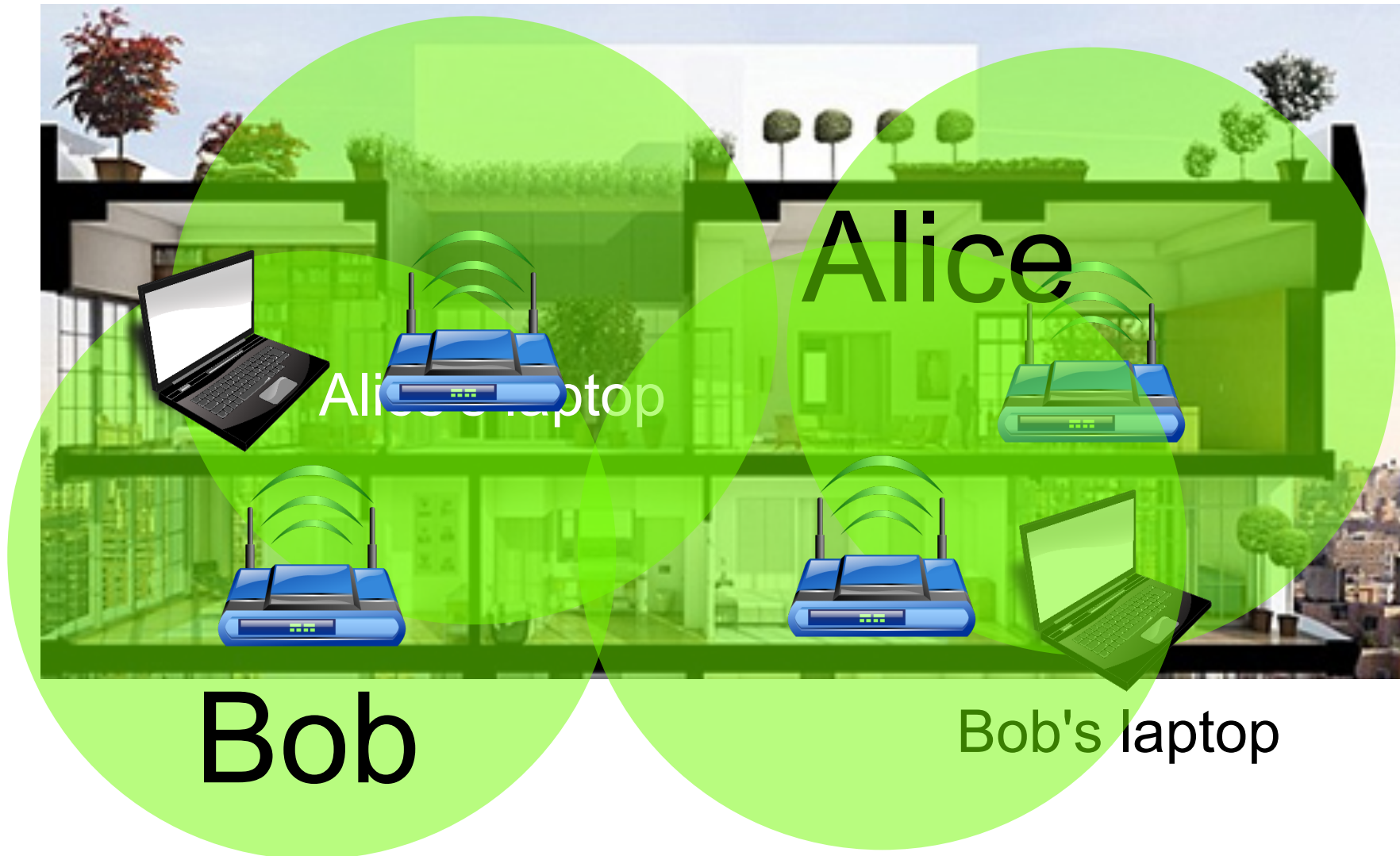
University at Buffalo, The State University of New York

Two Recent Trends

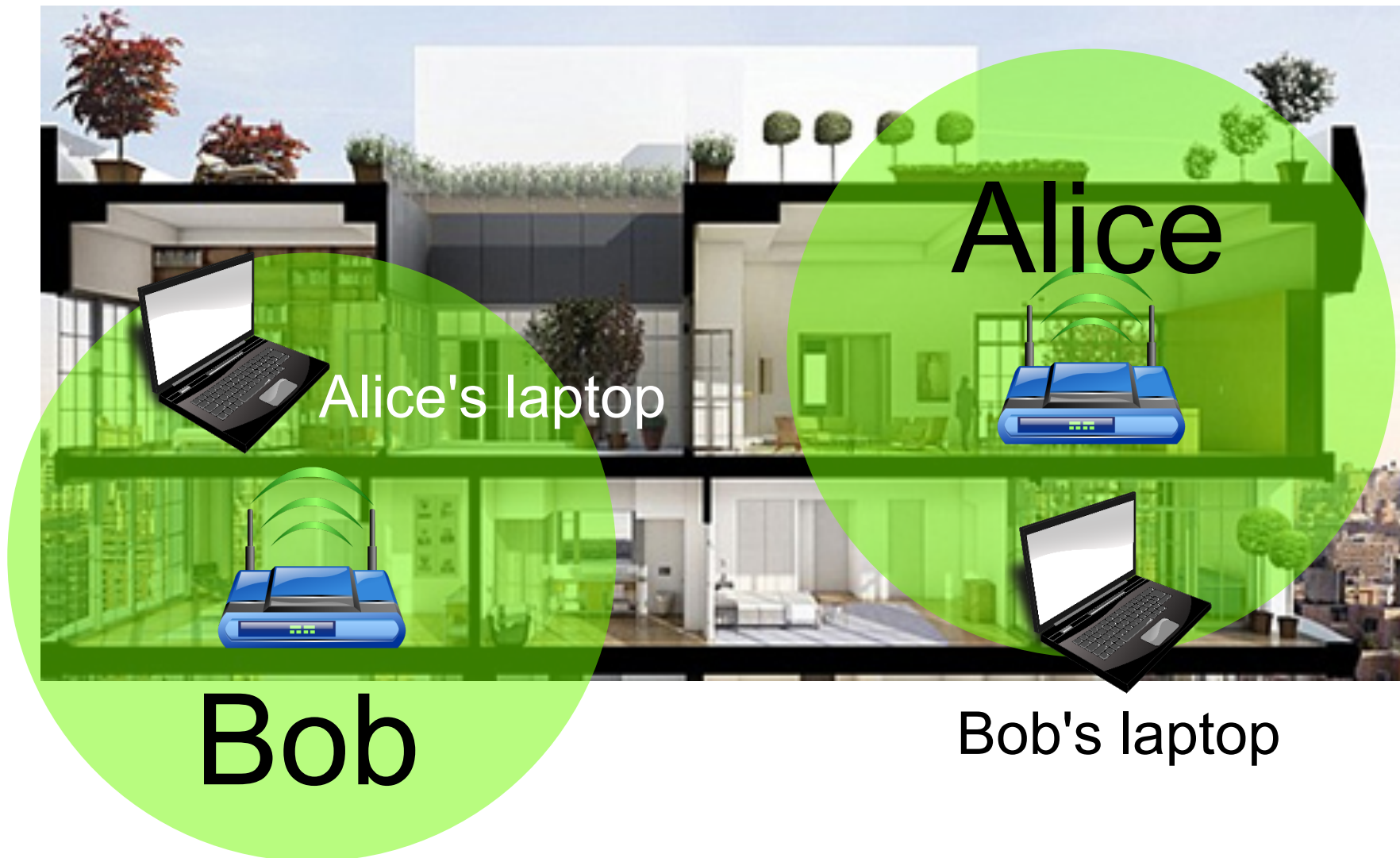
- Increasing broadband penetration creates large number of private home APs
- Increasing percentage of population resides in dense urban environments

Chaotic WiFi Environments

Chaotic WiFi Environment



What If...



Reciprocal WiFi Sharing

- Alice/Bob allows Bob/Alice to use her/his router
- Benefits
 - ▶ Less hardware
 - ▶ Less interference
 - ▶ Better performance

Sounds Good, But...

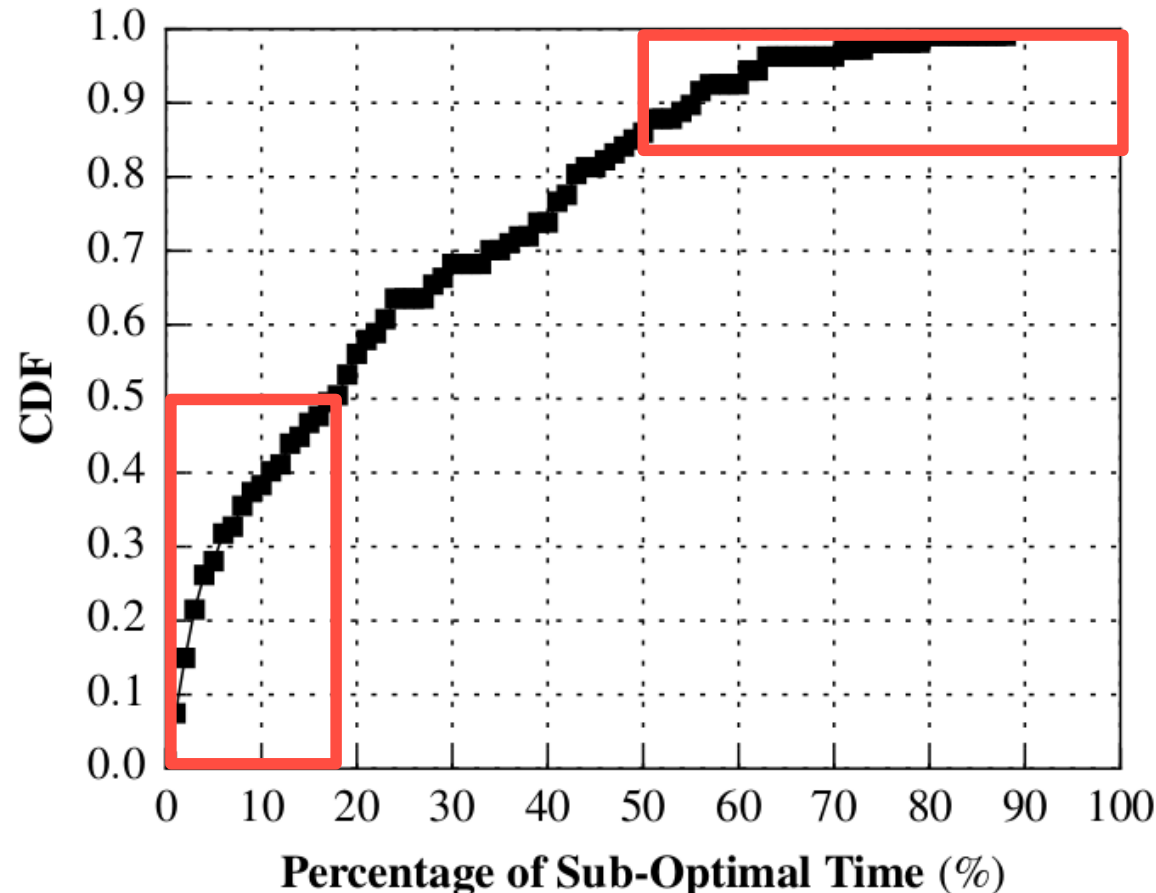
- How often does it happen in practice?
 - ▶ WiFi sharing opportunities in real life
- What is the incentive for sharing?
 - ▶ Reciprocal relationship
- How to enable sharing?
 - ▶ WiseFi system design

PhoneLab WiFi Dataset

- 254 devices, 5 months
- 21M WiFi scans
- 1M observed WiFi APs
- 466K WiFi sessions

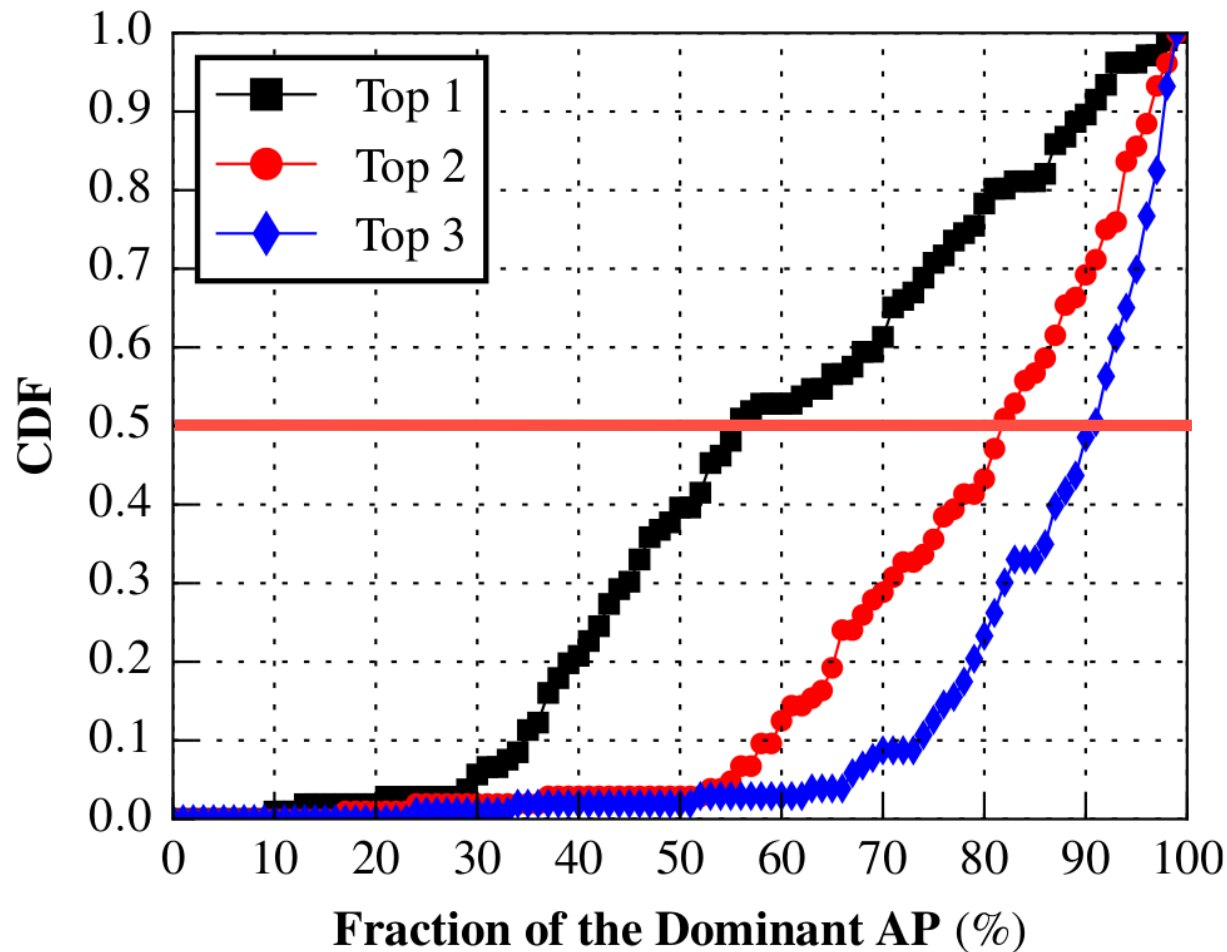
Sub-Optimal WiFi Connection

- 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?

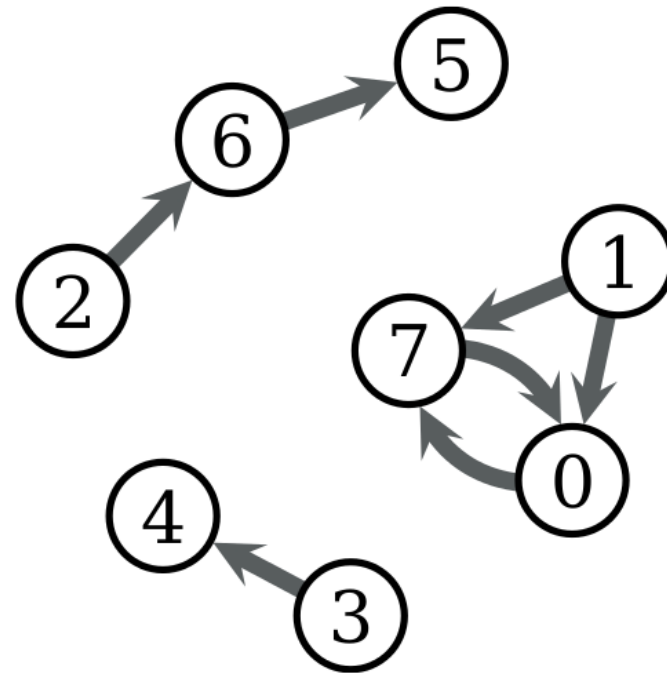


Reciprocal Relationships

- Do they exist in our dataset?

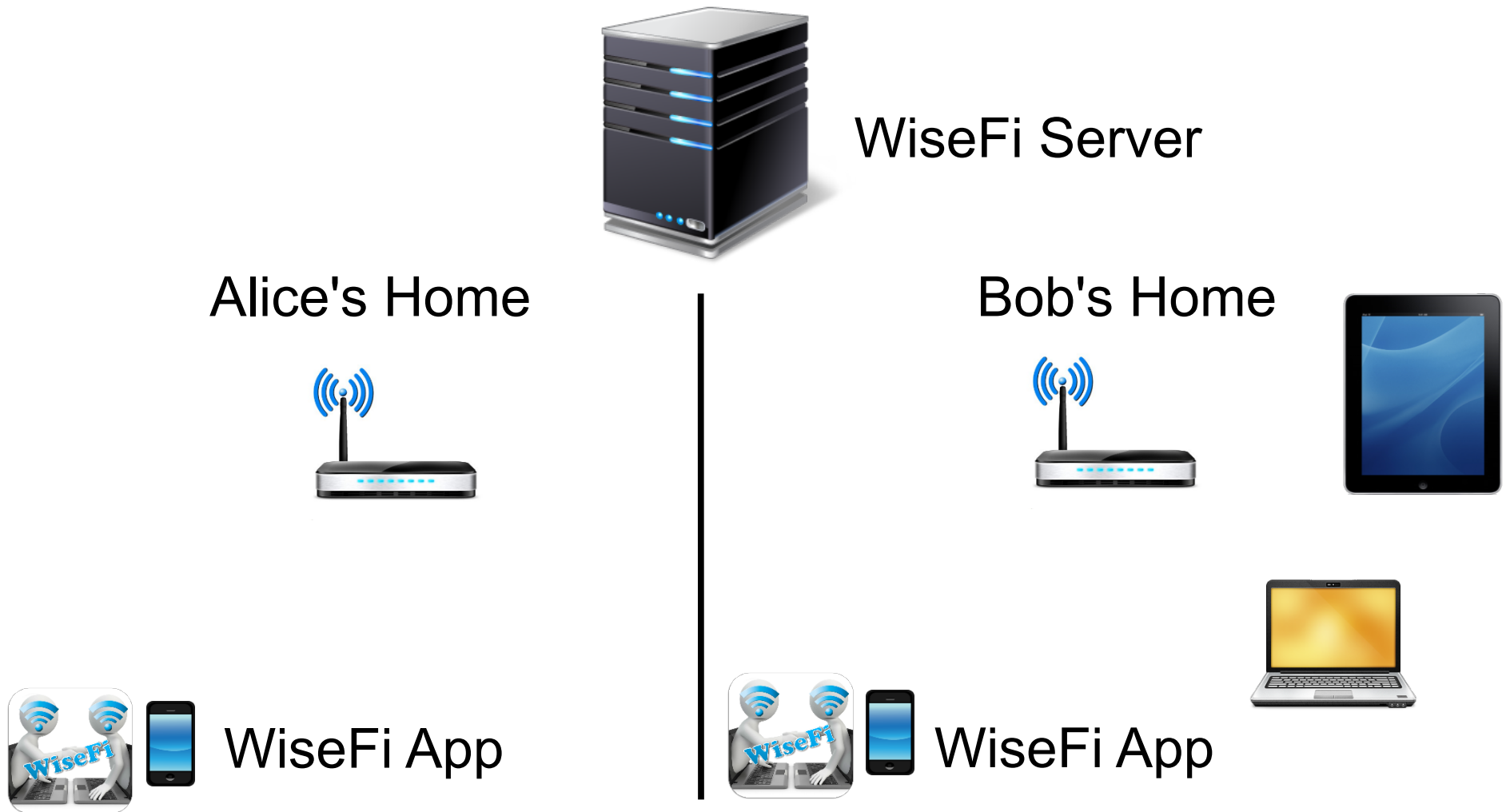


Reciprocal Sharing Graph



(a) **Reciprocal Sharing Graph Among PhoneLab Participants.**

WiseFi System Design



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

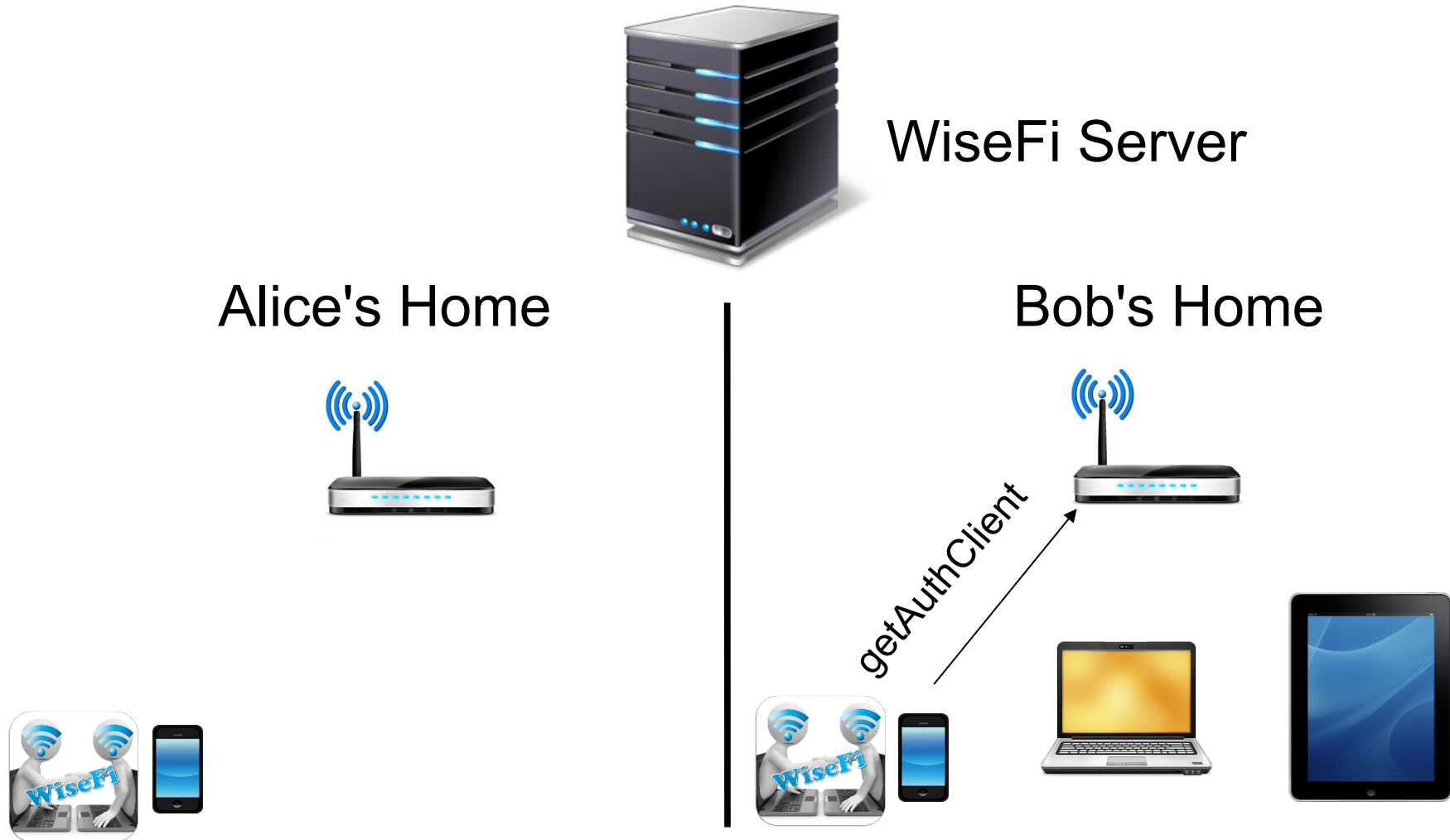
- Goals

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

Our Solution

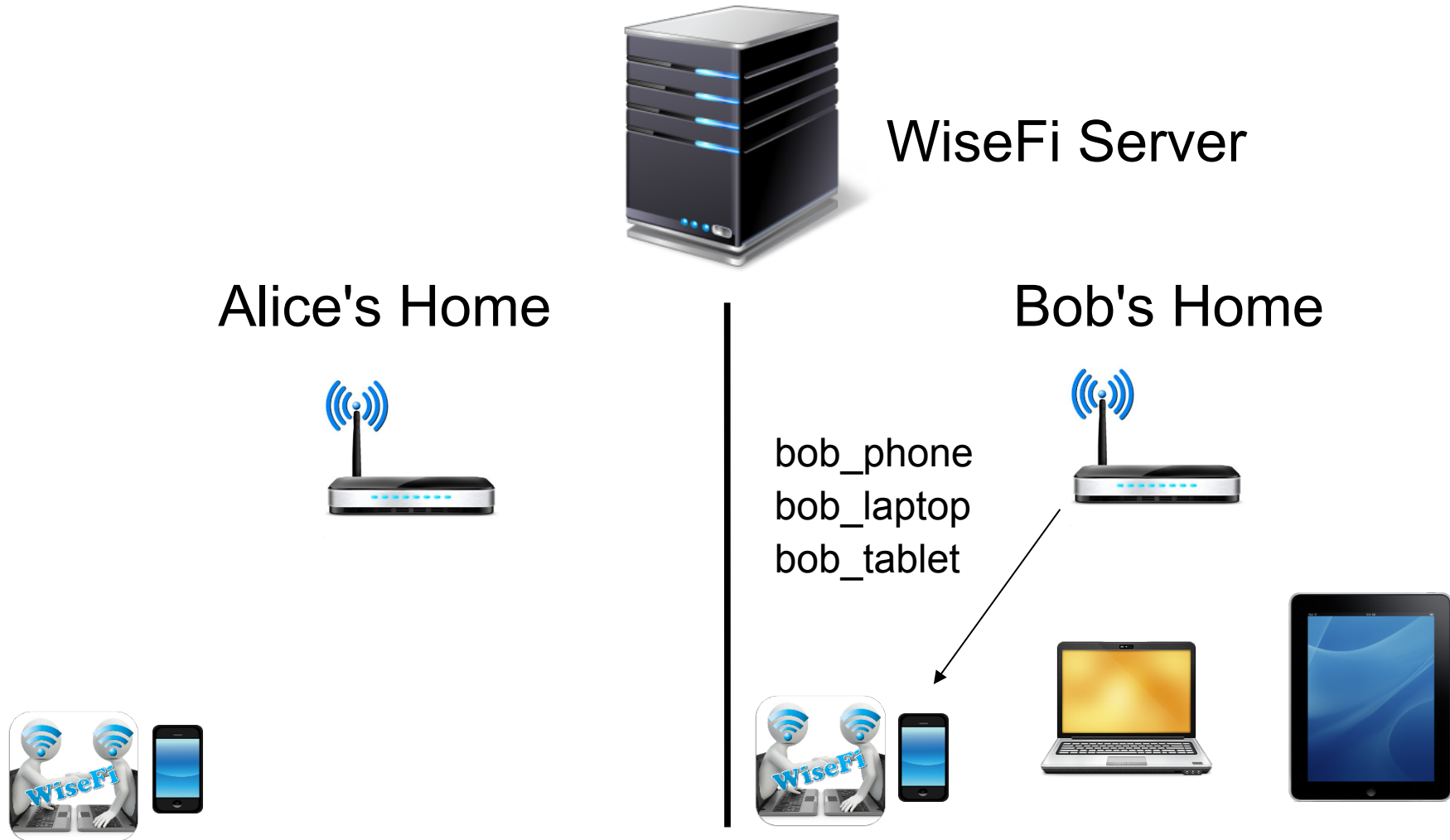
- Dynamic AP configuration API with two simple interfaces
 - ▶ `getAuthClients`
 - Returns list of clients that are authenticated
 - ▶ `setWhiteList`
 - Instructs AP to accept certain clients' association requests, regardless of possible authentication errors

Granting Access



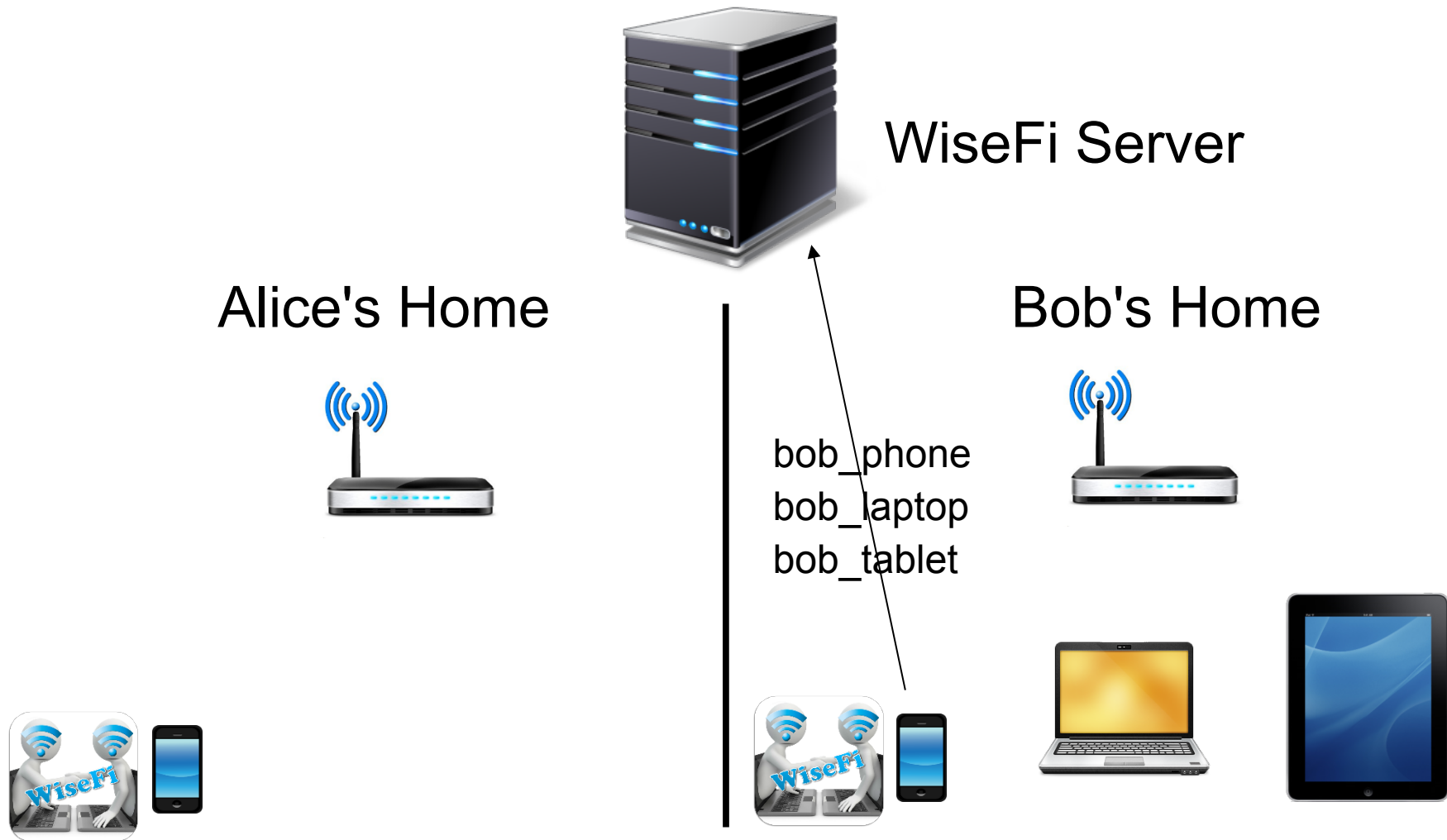
Process of granting access of Alice's home AP to Bob's devices

Granting Access



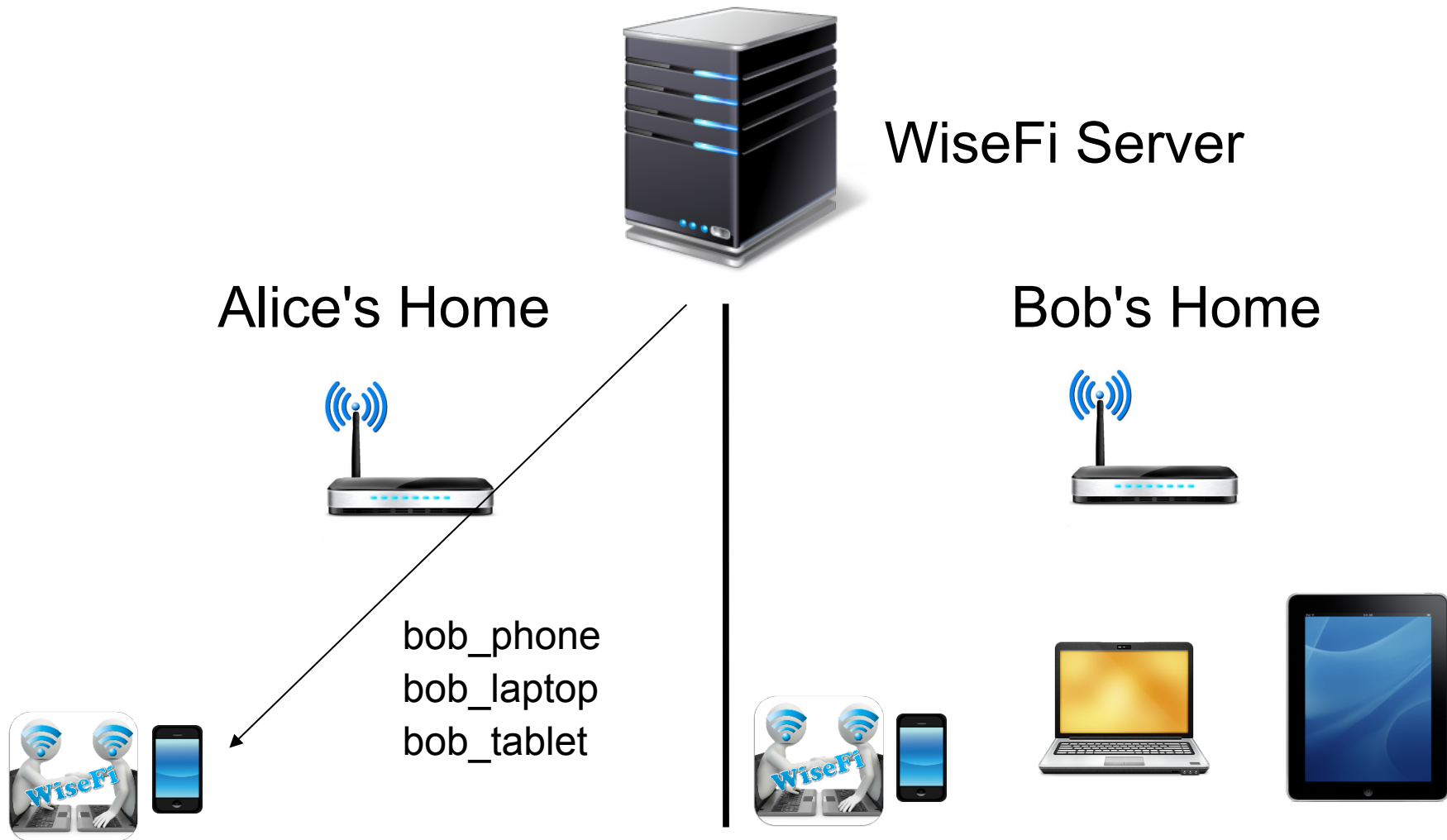
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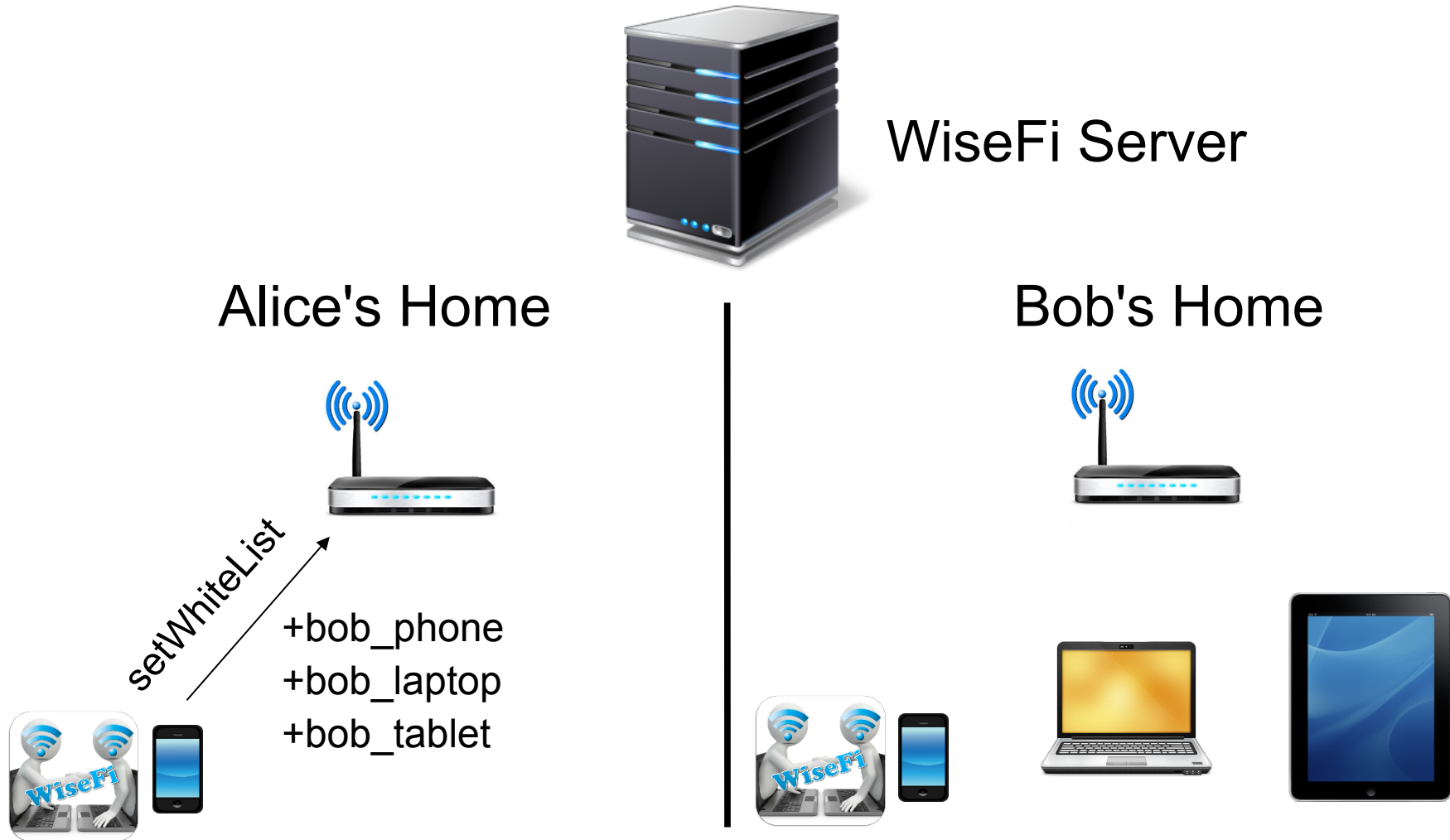
Process of granting access of Alice's home AP to Bob's devices

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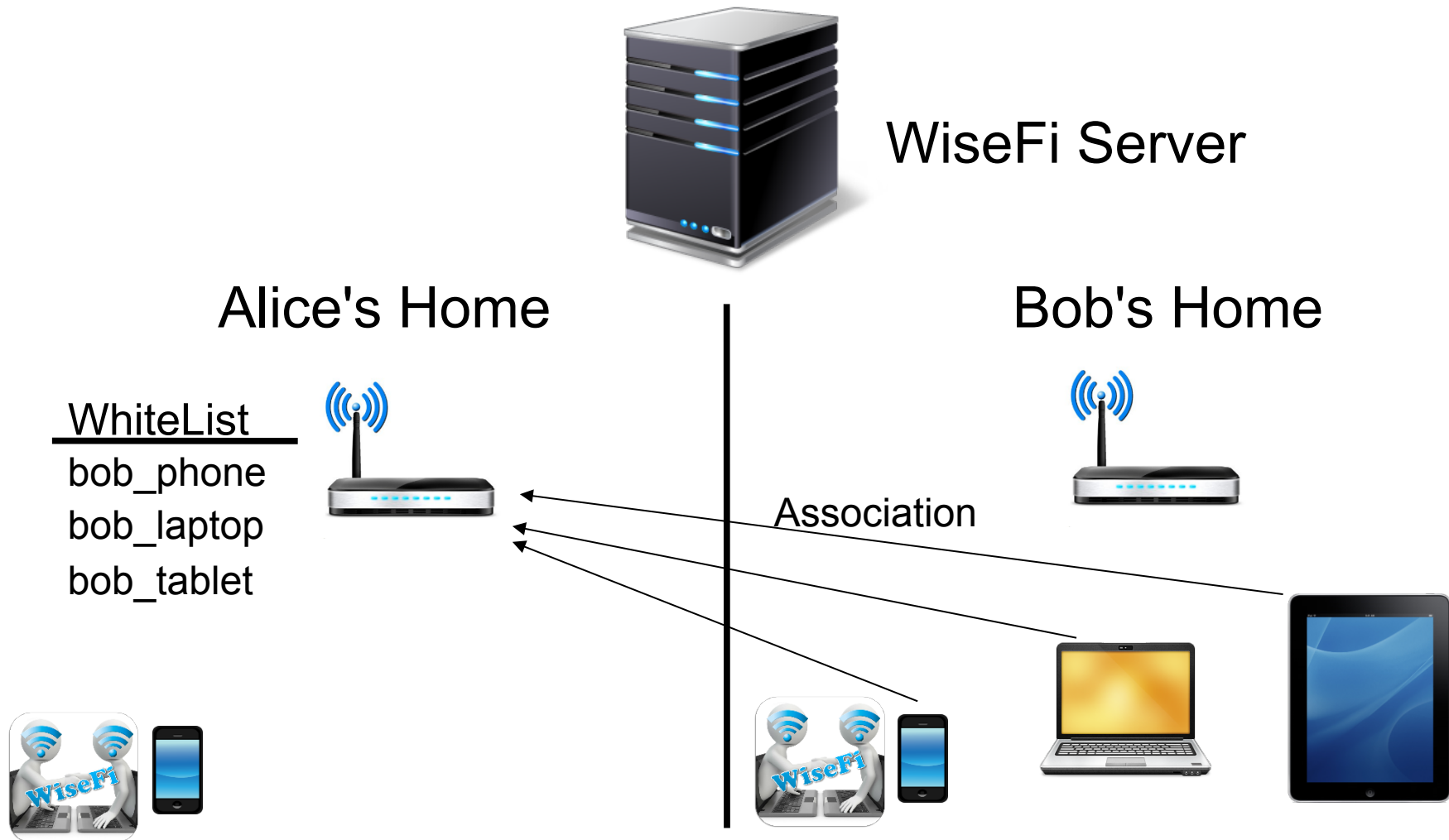
Process of granting access of Alice's home AP to Bob's devices

Granting Access



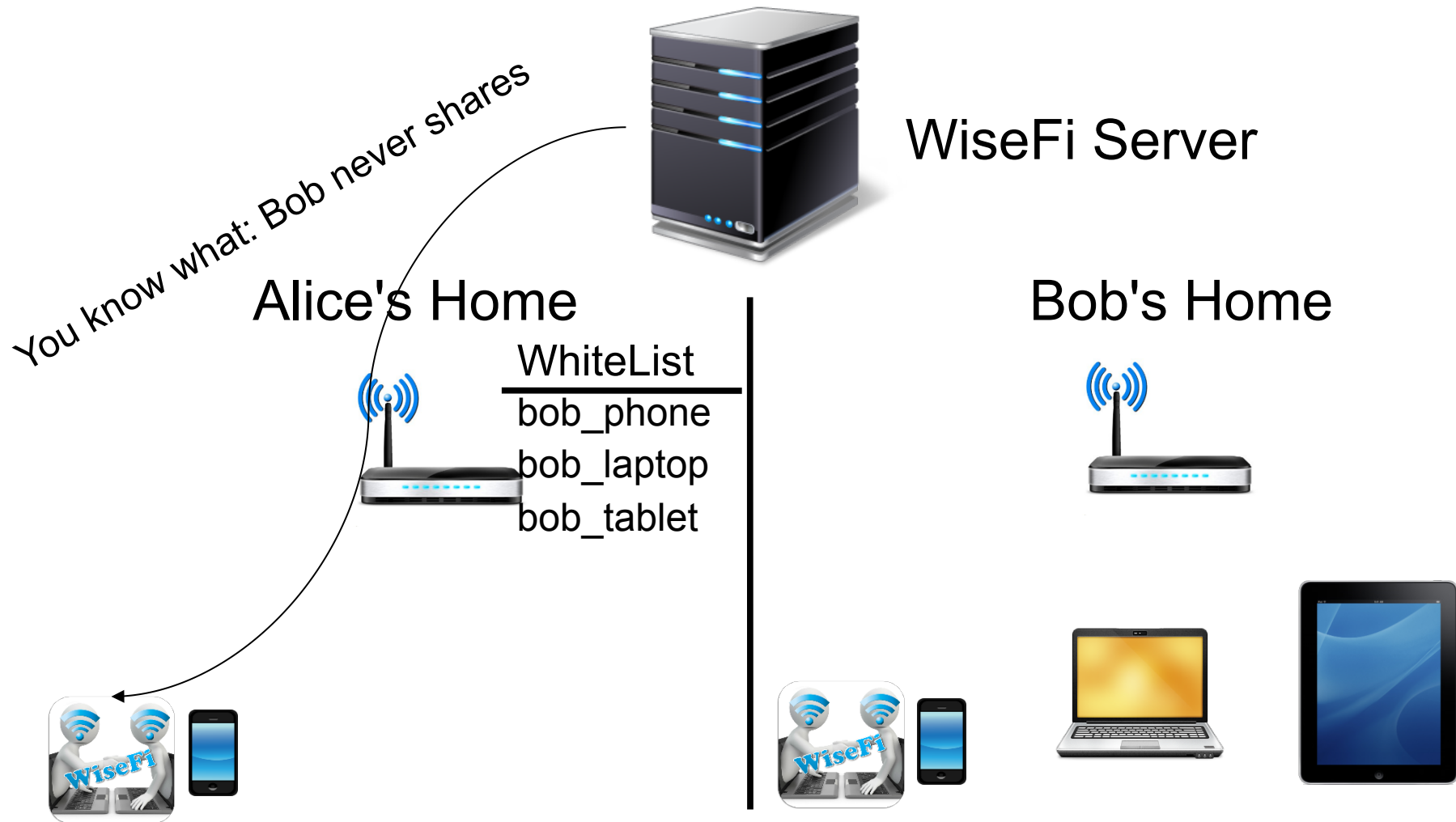
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Granting Access



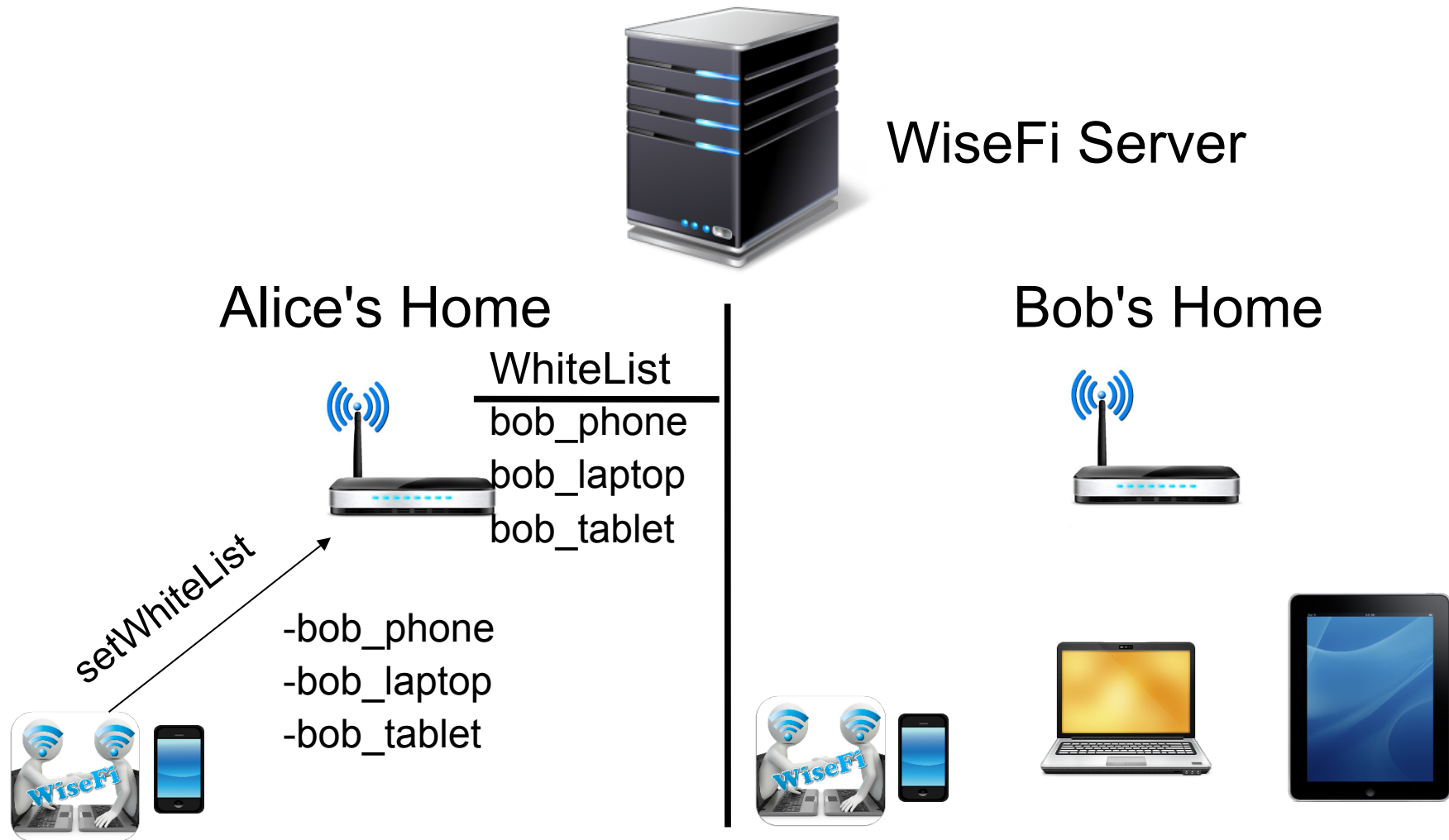
Process of granting access of Alice's home AP to Bob's devices

Revoking Access



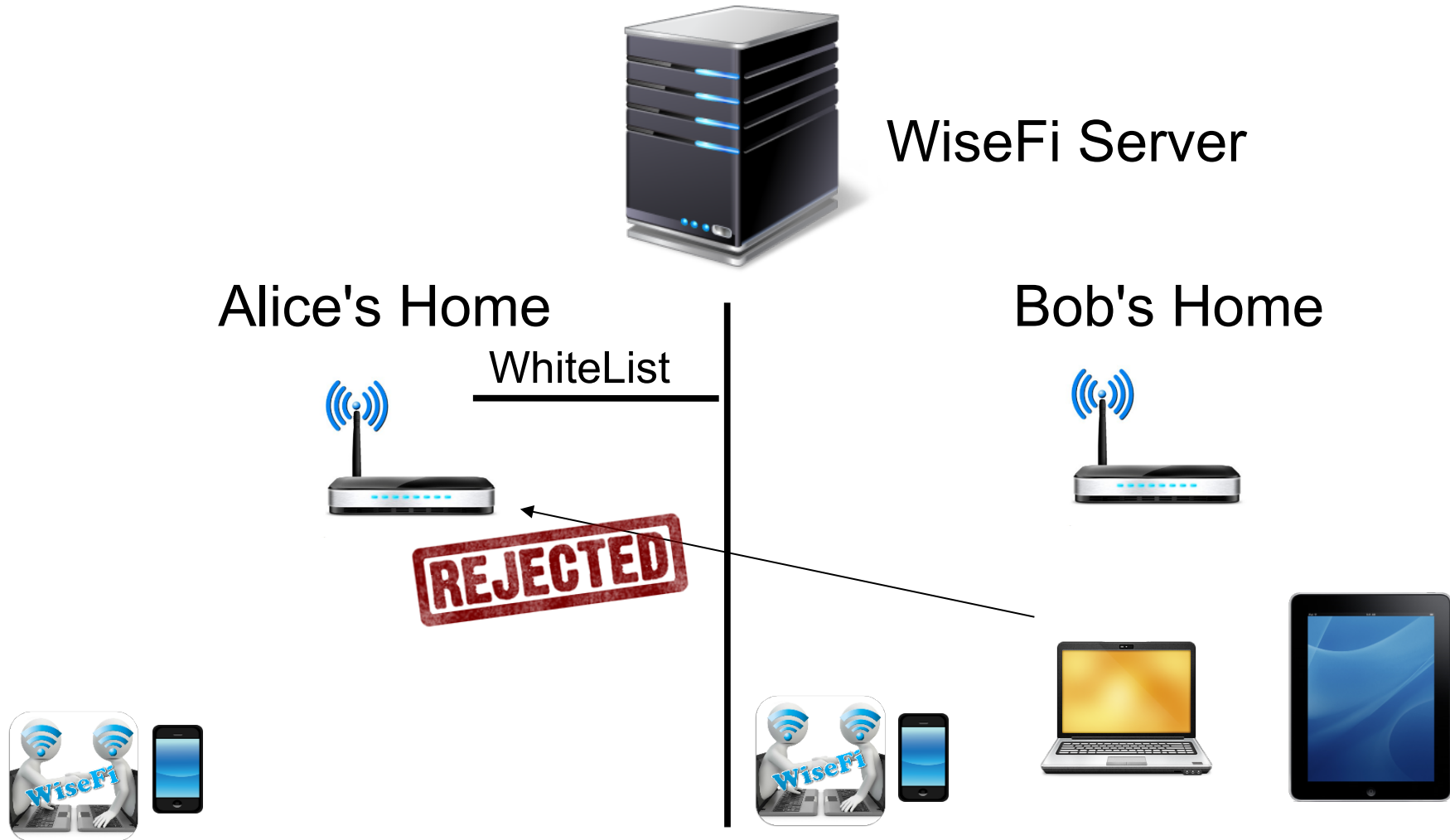
Process of revoking access of Alice's home AP from Bob's devices

Revoking Access



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

Revoking Access



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

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

