Deploying Ubiquitous Connectivity:

Mechanisms for Resource Allocation and Authentication

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Wireless Routers Abound

• Cheap
• Widespread
• Programmable

• Presents a new opportunity…
Ubiquitous Connectivity

• Widespread Internet access through existing APs
  – Cheap, high bandwidth

• Need incentives to share
• Need backwards compatibility
New Considerations

• Resource sharing

• Security concerns

• (Mobility between APs)

• (Cooperation between APs)
Local View

Internet

Apartment
Global View

ISP

Internet

Apartment
Authentication

• WPA Enterprise
  – Per-user encryption keys
  – RADIUS authentication
    • Global: ISPs
    • Local: on the router (tinyPEAP)
    • Router associates flows with users
Resource Allocation

• What is the Shared Resource?
  – Bottleneck Bandwidth to the Internet?
  – Wireless air time?
Sharing Air Time

Problem: nothing queues up!
Sharing Air Time

A

\[\text{a}_1, \text{a}_2, \text{a}_3 \ldots \text{a}_7, \text{a}_8\]

B

\[\text{b}_1, \text{b}_2, \text{b}_3\]

Router Outbound Link

\[\text{a}_7, \text{a}_8 \text{ and } \text{b}_3 \text{ are Q'd.}\]
Much Better Utilization
Wireless Weighted Fair Queuing (WWFQ)

• Core idea: Sharing two resources
  – Wireless air time
  – Uplink bandwidth

• Enforce this idea on flows:
  – Ingress mechanism
  – Egress mechanism
**WWFQ Ingress**

- Establish fair sharing of air time
  - Drop packets if clients exceed their share
  -
  - $\frac{D_i}{r_i} > W_i \left( T - T_{ref} \right)$
  -
  -
- Share based on *rate* and *class*
• Partition uplink bandwidth
• Two-level WFQ scheme:
  • Within a class:
    • Choose candidate packet among flows based on rate
  • Among classes:
    • Choose from candidates based on rate and class weight
Evaluation

- Modified Linux kernel
  - Implemented egress scheme (wwfq qdisc)
  - Approximated ingress scheme (TBF filter)

- TOPOLOGY:
  - Focused on upstream traffic
Higher Utilization

Throughput for Queuing Mechanisms (Different Clients and Rates)
Fair Sharing

Throughput for Queuing Mechanisms (Different Clients and Rates)
Future Work

• Automate Ingress filter
• Deal with mixed (up/down) flows
  – Still sharing air time
  – Kernel tricks for policy across queues
• Port to router!
Summary

• Share connectivity with commodity routers

• Security:
  – Authentication with WPA / RADIUS

• Resource Allocation:
  – Share air time and uplink bandwidth
  – Improve fairness and utilization
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