HeedNet: ISPs Fighting Back Interference

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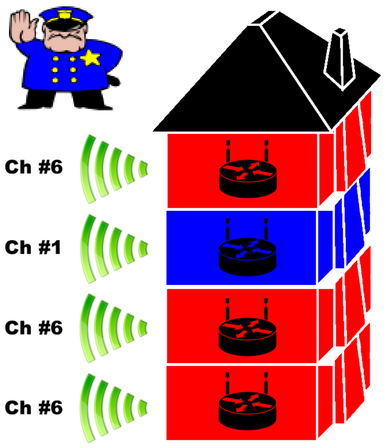
Abstract

We present an ISP edge router-based **interference management** scheme (**HeedNet**) to alleviate collision-based interference on **high-density** residential WiFi networks. **Edge routers** under the ISP control **schedule** the packet flow to those **access points** found to interfere with each other, **reducing** the amount of **collisions**. This makes HeedNet an **easy-to-deploy** solution for ISPs without the need for costly **software/hardware upgrades** of consumer APs.

Motivation

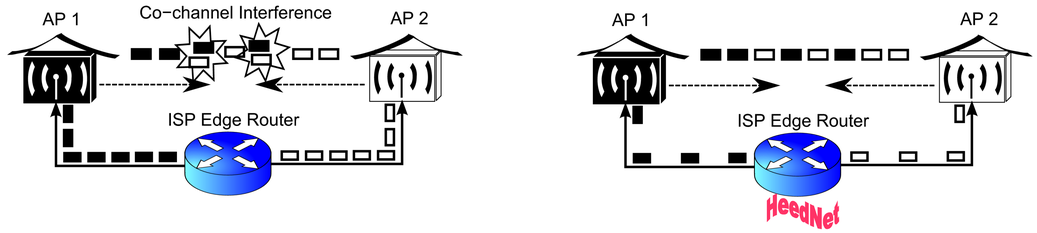
Inter-cell interference mitigation is difficult in unplanned high-density residential WLANs.



Residential Wi-Fi networks are simply chaotic in deployment, capacity, coverage, and interference planning. Several factors render complete elimination of **inter-cell interference** difficult in these **high-density** unplanned WLANs, such as the **low number** of non-overlapping channels, **restrictions** on ISP contracts, and difficulty of deploying **new software** to existing legacy IEEE 802.11 access points.

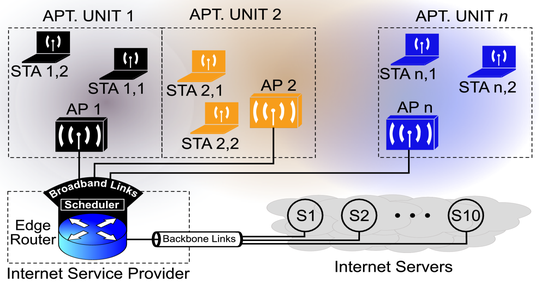
HeedNet Introduction

ISP edge router schedules IP packets to those APs known to interfere. With help from STAs, each AP is allotted an equal time-slot, and the schedule is ordered to minimize effects of overlapping wireless transmissions.



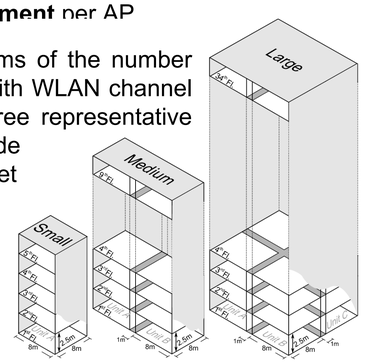
HeedNet is a **backhaul network driven** approach to interference management, letting the **edge routers** of the ISP network participate in residential Wi-Fi network interference mitigation by **scheduling** outgoing traffic towards those APs **determined** to interfere with each other. The objectives of HeedNet are to ameliorate the reduced **system capacity** due to interference and to improve **fairness** by preventing some APs from starving.

STAs assist HeedNet by providing **RSSI** measurements of the APs they observe. The HeedNet agent on the ISP edge router determines the **subset of interfering APs** to schedule, establishes the **ordering of schedule**, and maintains the **time-slot allotment** per AP.



We have surveyed **1379** NYC apartment buildings in terms of the number and distribution of floors/units and used it in conjunction with WLAN channel usage statistics from Wigle.Net database to construct three representative high-density deployment **scenarios**. These scenarios include up to **50** interfering WLANs and are implemented as QualNet **simulations** for initial investigations.

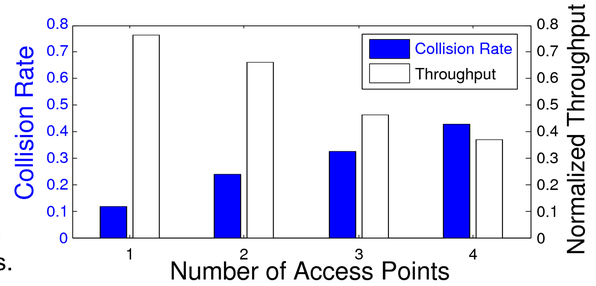
Initial results from the simulation experiments indicate potential system capacity improvements **exceeding 30%** and **substantial** fairness rehabilitation.



Severity of Interference

Significant system capacity loss observed even with four interfering APs.

With a TCP-dominated **realistic** workload (a proportionate mix of web browsing, VoIP and file downloads), high-density IEEE 802.11g WLAN experiments conducted on the **ORBIT** wireless testbed revealed **significant** system capacity losses **up to 40%** due to inter-cell interference, even with **four** interfering APs.



Larger-scale experiments are **needed** to evaluate interference scenarios that we believe to be common cases in medium to large-sized apartment complexes.

Ongoing and Future Work

HeedNet is work-in-progress with algorithm fine-tuning and a proof-of-concept implementation on the way.

Currently, we have developed the **HeedNet algorithms** required to

- **select** the subset of interfering APs to schedule
- **order** the APs in scheduling to minimize the effects of spill-over packets in the air
- **maintain** the time-slot allotment to optimize the performance of HeedNet

These algorithms are currently being **fine-tuned** for better performance and evaluations are carried out in large-scale simulation experiments. Parallel to this, a **proof-of-concept implementation** is being designed on the ORBIT testbed to address **practical issues** that may arise in the implementation and adoption of HeedNet in real-life.

Our **future work** agenda includes items like, investigation of performance under an **incremental adoption** strategy, as well as HeedNet extensions to support networks served by **multiple ISPs**.