



Poster: Distributed Network Resource Sharing AP in Inter-WLAN Environments

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ABSTRACT

As the number of wireless device deployments grows, it is desirable to share the highly limited wireless bandwidth efficiently and cooperatively. In WLAN, using a central controller for resource sharing and management is a common practice in mid-size and large-size network. However, in case of small businesses (*i.e.*, restaurants, coffee shops, etc.), business owners cannot afford to obtain the controller. To realize the bandwidth sharing among Access Points (AP) in a distribute manner, seamless handoff of mobile devices (*i.e.*, smartphones and tablets) between small-business owned Access Points (APs) via association control and maintain stable TCP connection are essential but quite challenging. This poster proposes a novel way to cooperatively share wireless resources among the APs. This includes an efficient association control between stations and APs, dedicated virtual access point per station, and tunneling support maintaining existing TCP connection after relocation to another AP.

CCS CONCEPTS

• **Networks** → *Network architectures; Network resources allocation; Local area networks; Network mobility; Routing protocols; Wide area networks;* • **Computer systems organization** → *Distributed architectures; Embedded software.*

KEYWORDS

Distributed Network, WiFi, Wireless Network, Virtual Access Point

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1 MOTIVATION

Every access point (AP) in residential or small-business settings operates as an isolated network (e.g., its own DHCP server). Due to

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the common practice, it is difficult to cooperatively share wireless network resources between APs.

There are two challenges to solving this problem:

- To share wireless network resources, each AP should be able to exchange wireless network information between neighboring APs and support seamless (< 80 ms) handoff of associated station[s] to the neighboring AP (if promising). (Section 2).
- The problem of efficiently assigning stations to APs in a multi-rate environment is an NP-hard problem [3]. To make the solution practical, we need an algorithm that solves the problem within a polynomial time (Section 3)

Figure 1 shows a representative use case of a system that can handle the problem and its challenges. A Starbucks store is crowded at specific times (say, after lunch or dinner hours), but a nearby Panda Express restaurant is relatively idle during the times. In this common scenario, if customer[s] in the Starbucks can exploit idle network resources of Panda Express, WiFi services of all customers in Starbucks would be significantly improved. To achieve this improvement, each AP shares information about the wireless network utilization with neighboring APs and reallocate stations to neighboring APs in over-lapped communication ranges.

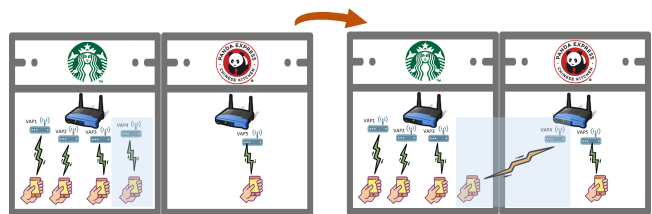


Figure 1: Motivation: use case

2 SYSTEM ARCHITECTURE

In order to achieve the promising behaviours of APs, we propose a novel system in this poster. Figure 2 shows architecture of the system including seamless handoff support, Virtual Access Point [5], Control Plane Agent, Data Plane Agent, and Tunneling Interface on Top of wireless router. To build the system on the off-the-shelf WiFi routers, we replace vendor operating system with OpenWRT [4].

Our proposed system are composed of 4 components as follow :

- **Virtual-AP:** this component confirms station access to AP by binding station’s MAC address, AP’s MAC address (i.e., BSSID), SSID, and station’s IP address. It maintains connection between station and AP and move the binding information to neighboring AP.
- **Control Plane Agent:** the agent collect WLAN channel conditions and share station information between APs. The Handoff Decision Algorithm 3 determines the handoff of the station through shared information.
- **Data Plane Agent:** this agent determines packet encapsulation or forwarding according to Control Plane Agent’s decisions.
- **Tunneling Interface:** this component operates tunneling protocol based on Control Plane Agent’s decisions and maintains the re-located station’s TCP stream.

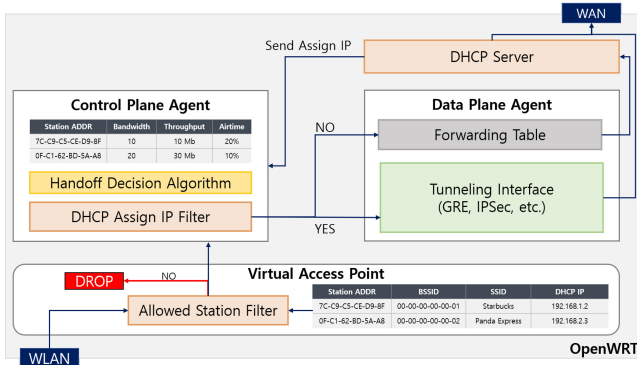


Figure 2: Architecture of proposed distributed AP

3 ASSOCIATION CONTROL ALGORITHM

To solve the NP-hard problem mentioned in Section 1, we adopt to use reinforcement learning due to its guaranteed performance and responsiveness [1]. However, it is hard to train the reinforcement learning agent in real-life environments due to cost and time. Thus, we adopt to use network simulator (namely ns-3) to train the agent through ns3-gym [2]. We plan to compare trained model with existing algorithms [3, 6] We will further connect the simulator to real devices over testbed to identify the performance and limitations of simulator based reinforcement learning (Figure 3).

4 CONCLUSION AND FUTURE WORK

Unlike sharing wireless network resources based on existing central controllers [5, 7], we propose to share wireless network resources and seamless handoff in a distributed network. In addition, we propose an association control algorithm based on reinforcement learning.

During a station’s handoff, it uses the tunneling protocol to maintain the station’s TCP stream. However, as the number of hops between APs increases, overhead also increases. we plan to devise an algorithm to efficiently decides whether maintaining or restarting the station’s TCP stream which also remains as our future work.

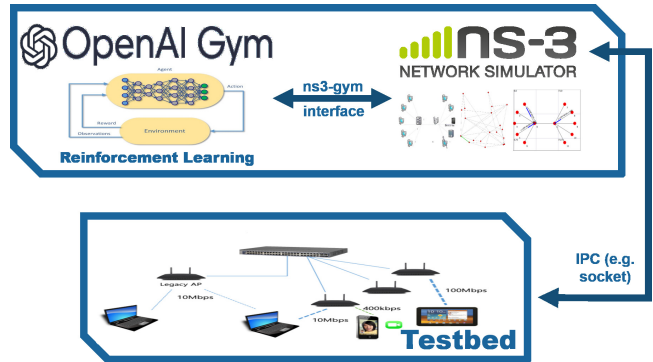


Figure 3: Apply ns3-gym to testbed

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