A New Architecture of Wi-Fi APs with Prediction-based Autonomous Channel Migration Function

Shugo Kajita, Tatsuya Amano, Hirozumi Yamaguchi, Teruo Higashino
Graduate School of Information Science and Technology, Osaka University, Japan

Mineo Takai
University of California, Los Angeles, USA

1. INTRODUCTION

Wi-Fi throughput enhancement is required for the Tokyo Olympic in 2020. This is mainly because Wi-Fi can be a monetary-cost-effective solution for foreign tourists. However, especially in urban areas, Wi-Fi access points (APs) have deployed densely for the coverage enhancement of each service. Due to the dense deployment, there is a chaotic and disorderly environment in urban cities. Chaotic frequency usage causes interference and performance degradation.

Channel migration is a simple and effective method for alleviating interference. In 2.4GHz band, due to the partial channel overlapping, some transmitted power leaks to the adjacent channels and becomes noise. This makes it more complex to select the best channel considering the traffic and signal strength diversity. For such a dense Wi-Fi problem, the IEEE802.11ax task group reports that Wi-Fi throughput can be nearly doubled [3]. Meanwhile, our goal is autonomous and efficient frequency reuse of each AP which has the existing architecture like IEEE802.11g. In our previous work, we have designed a function formula that predicts the Wi-Fi performance at each Wi-Fi AP, based on the measurement of IEEE802.11 MAC frames, the highly-precise Wi-Fi simulation, and machine learning technique [2]. In this paper, we propose a new architecture for intelligent APs that incorporate the prediction function formula.

2. PREDICTION-BASED CHANNEL SELECTION

Figure 1 shows the overview of our intelligent AP. It has MAC frame monitoring module and performance prediction module for channel migration. We use three parameters to estimate the performance because they are easy to be captured using off-the-shelf devices with the function called monitor mode. These parameters are received signal strength indicator (RSSI), temporal channel utilization obtained by counting the MAC frame bytes, and channels respectively.

Our function formula predicts the Wi-Fi performance under the interference from surrounding APs. Due to limited channel resources, traffic saturation causes performance degradation significantly. Therefore, in the first step of the prediction module, we apply Support Vector Machine-based saturation classifier to predict saturation with given values of parameters. If the channel condition is classified as "unsaturated", there is no performance degradation. Otherwise, we apply multiple regression analysis to predict how severe the saturation is. This prediction formula is trained beforehand using over 10,000 simulation scenarios obtained by realistic network simulator called Scenargie [4].

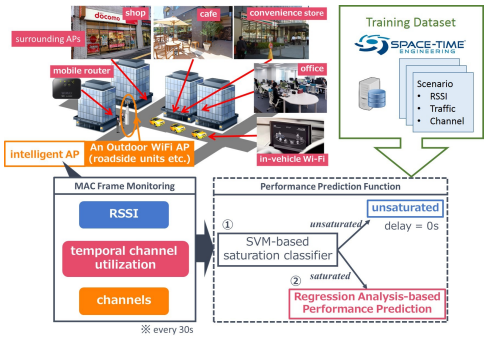

Figure 1: Overview of Intelligent AP

In our preliminary experiment, we confirmed that our intelligent AP can predict the best channel in the urban simulation scenario. This realistic scenario is based on the radio map of Osaka city [1] and real Wi-Fi traffic measurement. We are currently in the process of investigating channel migration policy using this function.

3. ACKNOWLEDGEMENT

This research and development work was supported by the MIC/SCOPE No. 165007009.

4. REFERENCES

[1] Wi-Fi Observation Area Map of Osaka City. http://map.wifibigdata.org.

[2] S. Kajita, T. Amano, H. Yamaguchi, T. Higashino, and M. Takai. Wi-Fi Channel Selection Based on Urban Interference Measurement. In *Proc. of the 13th Int. Conf. on Mobile and Ubiquitous Systems: Computing, Networking and Services (MobiQuitous 2016)*, pages 143–150, 2016.

[3] K. Shin, I. Park, J. Hong, D. Har, and D.-H. Cho. Per-node throughput enhancement in Wi-Fi densenets. *IEEE Communications Magazine*, 53(1):118–125, 2015.

[4] Space-Time Engineering, LLC. Scenargie. http://www.spacetime-eng.com/.