ON DEMAND DEPLOYMENT OF UNMANNED AERIAL VEHICLES IN WIRELESS COMMUNICATION

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1. ABSTRACT

Unmanned Aerial Vehicles (UAV) have taken a important place in the emerging wireless communication technology. UAVs are defined as the vehicles which are moving without the human operator. These UAVs are used in many applications such as telecommunication base stations, agriculture, military services, drone delivery systems and aerial photography etc. The advantage of these devices is on demand deployment, autonomous, fast response, fully controllable mobility in 3D, can enter any environment. So, in here the on-demand deployment of UAV in wireless communication is discussed. It is basically considered about the UAVs which can use as base stations. While doing this, following challenges are occurred. Positioning the UAVs, reducing the interference, planning the trajectory. Optimal Positioning and intelligent network slicing method can be used to reduce the interference of the UAV base station. According to that the expected outcome from that research would be jointly optimizing both optimal positioning and network slicing method to achieve higher overall positioning of UAV.

2. INTRODUCTION

As said by the name unmanned aerial vehicles are moving without the involvement of the pilot. Drones, remotely piloted air crafts are the common example for UAVs. They help to reach the places that humans can't reach. As well as this is widely applicable in many cases in the communication world. In the agriculture industry to collect the data for massive paddy fields the UAVs are used. they can collect the real time data. As well as the military purposes the UAVs are used as spy and the weapons which are help to reduce the losses of soldiers. The role of base station is played very well by the UAVs. The low coverage areas which really does not need a fixed base station, this UAVs are help for that. According to these, UAVs aided wireless communication can be classified into main three types.

1. UAV-aided ubiquitous coverage
2. UAV-aided relaying
3. UAV-aided information dissemination/ data collection

1. UAV-aided ubiquitous coverage

To assist the existing coverage in a area the UAV can be used. If the site is overloaded with the users the UAV can help for that. As well as if there is some temporary error in the site the UAV can be used. As well as there are some special occasions and places which need more coverage capacity than usual. then the UAVs can add to these places and can be removed anytime. This is the primary topic discussed here.

2. UAV-aided relaying

to provide the connectivity for two or more devices the UAVs can be used. They are acted as relays. These are used in military applications such as communication between headquarters and front line. As well as the data transferring among the data centers are done by using UAVs.

3. UAV-aided information dissemination/ data collection

The data is collected by the UAVs from the agricultural fields, unreachable areas etc. This data collection is done by sensing the area using the sensors. As well as this can be used in disaster management systems.

So, the UAV aided ubiquitous coverage is basically involved with the base stations. If the fixed base station is overloaded or malfunctioned the UAV can be used to resolve these problems. The capacity of the base station can be increased by using the UAVs. While the number of UAVs is increased the interference also increased respectively. The interference can be described as the two or more electromagnetic wave forms to form a resultant wave in which the displacement is either reinforcement or cancelled. So, in this project the interference reducing method is discussed.

3. LITERATURE REVIEW

Since 1990, Unmanned Aerial Vehicles were introduced to the world. The first UAVs were developed for military purposes. The wireless communication-based UAV using GPRS technology was developed in 2006. [1]

UAV wireless communication systems are provided cost-effective wireless connectivity for device without infrastructure coverage. Compared to terrestrial communication base stations or any high-altitude platforms, on-demand wireless systems with low-altitude UAVs are in general faster to deploy, more flexibly reconfigured, and likely to have better communication channels due to the presence of short-range line-of-sight links. However, the utilization of highly mobile and energy-constrained UAVs for wireless communications also introduces many new challenges. In this article, we provide an overview of UAV-aided wireless communications, by introducing the basic networking architecture and main channel characteristics, highlighting the key design considerations as well as the new opportunities to be exploited. [2]

UAVs can be used as aerial base stations to enhance coverage, capacity, reliability, and energy efficiency of wireless networks. On the other hand, UAVs can operate as flying mobile terminals within a cellular network. Such cellular connected UAVs can enable several applications ranging from real-time video streaming to item delivery. In this paper, a comprehensive tutorial on the

potential benefits and applications of UAVs in wireless communications is presented. Moreover, the important challenges and the fundamental tradeoffs in UAV-enabled wireless networks are thoroughly investigated. In particular, the key UAV challenges such as three-dimensional deployment, performance analysis, channel modeling, and energy efficiency are explored along with representative results. Then, open problems and potential research directions pertaining to UAV communications are introduced. Finally, various analytical frameworks and mathematical tools such as optimization theory, machine learning, stochastic geometry, transport theory, and game theory are described. The use of such tools for addressing unique UAV problems is also presented. In a nutshell, this tutorial provides key guidelines on how to analyze, optimize, and design UAV-based wireless communication systems. [3]

A novel machine learning (ML) framework is proposed for enabling a predictive, efficient deployment of unmanned aerial vehicles (UAVs), acting as aerial base stations (BSs), to provide on-demand wireless service to cellular users. In order to have a comprehensive analysis of cellular traffic, an ML framework based on a Gaussian mixture model (GMM) and a weighted expectation maximization (WEM) algorithm is introduced to predict the potential network congestion. [4]

This paper [5] provides an extensive survey on the measurement campaigns launched for UAV channel modeling using low altitude platforms and discusses various channel characterization efforts. We also review the contemporary perspective of UAV channel modeling approaches and outline some future research challenges in this domain.

4. PROBLEM DESCRIPTION & GOALS

The interference is occurred because of the multiple UAVs in the same area as the base stations and all of them are used the same electromagnetic spectrum at the same time. So, reduce the interference is very important thing because the users face the difficulties such as cross talk, missed or error calls, noises. As well as there are different kinds of interference in the UAV base stations. [6]

- Co-channel Interference

This is occurred while transmission the signal in the same frequency. In the small geographical areas, the frequency is reuse for efficient use of spectrum. When the reuse increases the interference also increases. then the usable capacity and the service quality for the customers decrease. As well as the core- channel interference is occurred because of the poor frequency panning, overly crowded radio spectrum or adverse weather conditions. From this, although the poor weather condition cannot control, other two can reduce with proper interference management.

- Adjacent Channel Interference

When the data signals are transmission on close frequencies this happens. This occurs when the imperfect receiver filters allow to nearby spectrum leak into the pass band. This is occurred frequently in between multiple UAVs and overloaded base stations. When using the wide range of spectrum, this adjacent channel interference can be reduced. But it is not cost effective and inefficient.

According to these types of interference, this project will be specialized to co-channel interference and assumed the adjacent channel interference can be neglected in these UAVs. The problems which are occurred because of the multiple UAVs that place in small geographical area, can be reduced by better positioning and network slicing methods.

So, the primary goal of this project is to find a way to reduce the interference among the unmanned aerial vehicles which exist in the same place. When doing this the spectrum efficiency and the quality of the service can be increased.

5. METHODS & PLANS

Choosing a better channel modelling method to Air to Ground communication such as Probabilistic LOS model, Free space path loss model, Rician Fading Model and Elevation- angle dependent model, to find a proper algorithm to interference management in the multiple UAV base stations.

- Overall literature review to plan the project and identify the problems in on demand deployment of UAVs.
- Identify the effective channel models for Air to Ground communication using the literature review.
- Identify the problems related to UAV positioning and network slicing.
- Develop a novel algorithm which will encounter the interference, to overcome the effect to the UAV base stations.

6. EXPECTED OUTCOME

Optimal positioning and network slicing can use to minimize the interference of the Unmanned Aerial base station. By using the effective channel model spectrum allocation to A to G communication, can mitigate the interference of the Unmanned Aerial base stations in wireless communication. for that an algorithm is introduced.

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