



# Aerial Base Station Allocation Strategy

Wilson R. S. Silva, Diego L. Cardoso

## ► To cite this version:

Wilson R. S. Silva, Diego L. Cardoso. Aerial Base Station Allocation Strategy. 10th International Workshop on ADVANCEs in ICT Infrastructures and Services (ADVANCE 2023), Federal University of Ceara, University of Evry, Feb 2023, Fortaleza-Jerricoacoara, Brazil. 6p, 10.48545/advance2023-shortpapers-2\_1 . hal-04077319

**HAL Id: hal-04077319**

**<https://hal.science/hal-04077319>**

Submitted on 21 Apr 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Aerial Base Station Allocation Strategy

Wilson R. S. Silva<sup>1\*</sup> and Diego. L. Cardoso<sup>2†</sup>

<sup>1</sup> Instituto Federal do Pará, Vigia de Nazaré, Pará, Brazil  
rogerio.soares@ifpa.edu.br

<sup>2</sup> Universidade Federal do Pará, Belém, Pará, Brazil  
diego@ufpa.br

## Abstract

Unmanned aerial vehicles (UAV) serving as aerial base stations (ABSs) can be deployed to provide wireless connectivity to ground devices in events of increased network demand, point-failure in existing infrastructure, or disasters. However, positioning, signal coverage is still a challenge for this technology. In this work we propose a UAVbs allocation strategy to provide wireless signal to dynamically distributed users. Experimental results show that the proposed using swarm algorithm design maximizing the number of connected devices in the UAV-BS.

## 1 Introduction

Aerial Base Stations (UAVs) serving as aerial base stations (UAV-BSs) can be deployed to provide wireless connectivity to ground devices. The adjustable altitude and mobility of UAVs make them suitable candidates for flexible deployment as aerial base stations (UAV-BSs) [3]

UAVs are one of the supplements of 6G. We can use drones in 6G as mobile hot spots during disaster situations, when the ground base stations (BSs) or even the electrical infrastructure are damaged and when the users are out of service, according to work [1].



Figure 1: UAV coverage wireless.

Recent popularity of UAVs and all of these potential applications, integrating UAVs in mobile networks is still a challenging topic. In this context, several issues still remain, such as determining the optimal deployment location of multiple UAVs, designing their optimal trajectory [2].

---

\*Designed and implemented the class style

†Did numerous tests and provided a lot of suggestions

In this paper we propose a solution to determine the optimal placement of multiple UAVs scenario. Based on that, a simulation scenario is built, in which an urban area is considered and user traffic demands are generated. we propose the utilization swarm algorithm to find the optimal placement of multiple UAVs BS.

The remainder of this paper is as follows. Section II introduces the proposed System Model. Section III shows the simulation results, while Section IV concludes the paper.

## 2 Proposed System Model

### 2.1 UAV Base Station

According to work [4] the UAV is carrying a directional antenna, and it has a coverage wireless. This is illustrated in Fig. 1, where  $\theta$  is the directivity angle,  $H$  is the UAV height and  $R$  is the radius of coverage.

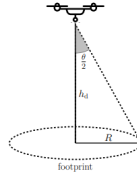


Figure 2: UAV coverage wireless [4].

The model as which considers free space path loss between the user and the UAV, which depends on whether or not there is line of sight (LOS) in the link between the UE and the UAV. Where  $f$  is the carrier frequency,  $d$  is the link distance,  $c$  is the light speed, as shown in work [4].

In the work of [5], he considers that there is a transmission between a user allocated and a drone. Then each user's data rate is that found from.

### 2.2 Problem formulation

UAVs are equipped with antennas capable of providing network access to mobile users. According to the height of the UAV, it will have a certain cellular coverage area. The problem is finding the ideal height, coverage radius and power to provide access to mobile users on the ground. This is an optimization problem. Based on this, the following cost function is proposed approach .

$$\min \sum_{u=1}^u (h) \quad (1)$$

$$\text{subject to: } p < \text{Power} \quad (2)$$

$$r < \text{Radius} \quad (3)$$

Where  $U$  is sum the of UAVs bases stations.  $P$  is the signal Power.  $h$  is the Height of the uav and  $r$  is communication Radius. To provide access to the network for users, the UAVs must remain at a certain height, signal strength and communication radius.

## 2.3 Allocation Strategy

To solve the above optimization problem, which consists of finding the ideal height, power and radius of the UAVS BS. The proposed algorithm consists of:

1. user cluster using kmeans;
2. for each cluster (i)
3. optimize uav height, power and radius
4. end for
5. plot the solution

## 3 Simulation and results

In our experiments, We consider 5 UAVs BS with backhall dedicated. Assume that there are 500 stationary users in the specified geographical area of 500x500 distributed in a uniform. The simulation are performed in Matlab®2022.

The figure below shows the allocation of users in the chosen scenario. There is a central BS that provides the backhall for the UAVs. Each UAV BS provides wireless signal to distributed users.

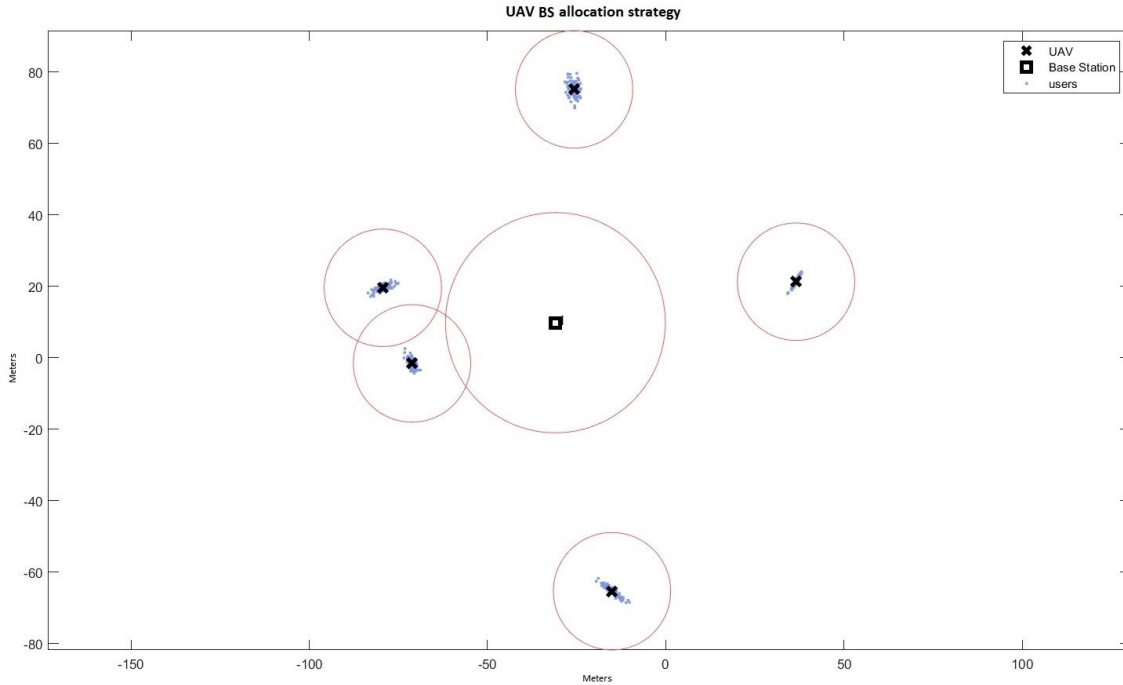


Figure 3: Allocation the UAVs BS.

The a Figure below shows performance metrics the algorithm PSO used to allocation UAV BS of the users. Note that the power of the uav increases according to the coverage radius of the wireless signal.

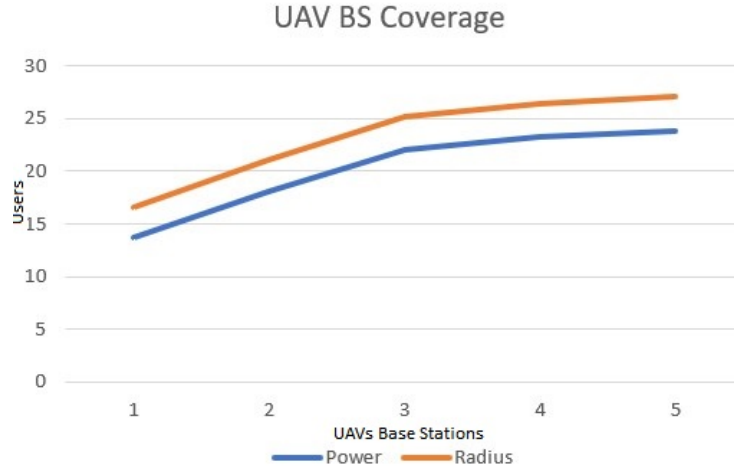


Figure 4: Power UAV BS coverage wireless.

Each group is being served according to the QoS of the users. Realize that more than 98% of users are being served by the wireless signal per cluster served. This is shown in the Figure below.

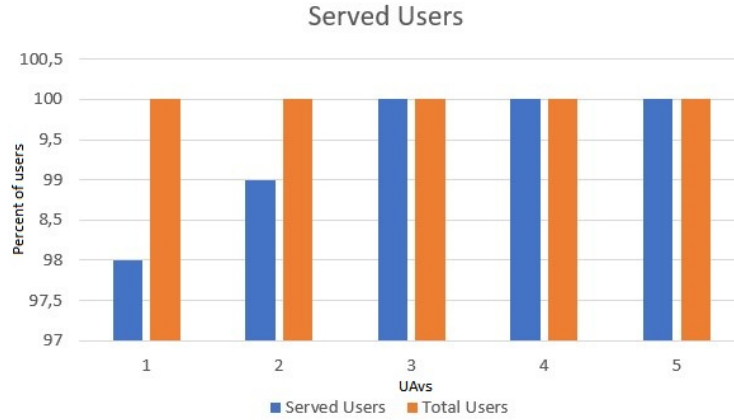


Figure 5: Percent of users served by each UAV BS.

## 4 Conclusion

In this paper, the problem the allocation optimal for multiple UAVs BS in is studied. We formulate the problem which finds the optimal placements, radius and power for multiple UAVs BS using swarm algorithm. This propost, allocation more than 98 percent of users in the chosen scenario. In future, we will investigate others algorithm to optimal of UAVs to cover the movable user in the area remotes.

## References

- [1] Malkawi W, Shakhathreh H, and Musa A (2021). 3D placements of drones in a millimeter-wave network to maximize the lifetime of wireless devices. *International Journal of Advanced and Applied Sciences*, 8(11): 119-128
- [2] M. Ozturk, J. P. B. Nadas, P. H. V. Klaine, S. Hussain and M. A. Imran, "Clustering Based UAV Base Station Positioning for Enhanced Network Capacity," 2019 International Conference on Advances in the Emerging Computing Technologies (AECT), 2020, pp. 1-6, doi: 10.1109/AECT47998.2020.9194188.
- [3] B. Omoniwa, B. Galkin and I. Dusparic, "Energy-aware optimization of UAV base stations placement via decentralized multi-agent Q-learning," 2022 IEEE 19th Annual Consumer Communications Networking Conference (CCNC), 2022, pp. 216-222, doi: 10.1109/CCNC49033.2022.9700536.
- [4] M. Ozturk, J. P. B. Nadas, P. H. V. Klaine, S. Hussain and M. A. Imran, "Clustering Based UAV Base Station Positioning for Enhanced Network Capacity," 2019 International Conference on Advances in the Emerging Computing Technologies (AECT), 2020, pp. 1-6, doi: 10.1109/AECT47998.2020.9194188.
- [5] Wa'ed Malkawi \*, Hazim Shakhathreh, Ahmed Musa. 3D placements of drones in a millimeter-wave network to maximize the lifetime of wireless devices. Volume 8, Issue 11 (November 2021), Pages: 119-128.
- [6] T. M. Shami, D. Grace and A. Burr, "Load Balancing and Control Using Particle Swarm Optimisation in 5G Heterogeneous Networks," 2018 European Conference on Networks and Communications (EuCNC), 2018, pp. 1-9, doi: 10.1109/EuCNC.2018.8442519.

# Publication Agreement for Papers Accepted for Publication in ADVANCE '2020 Proceedings

Please fill in this form and submit it in a pdf format (with your final version of the paper) using your easychair account:

**Paper No.: 1290**

**TITLE OF PAPER:** UAVBS Allocation Strategy Using Swarm Algorithm

**AUTHOR(S):** Wilson Rogério Soares e Silva

## **PUBLICATION TITLE: Proceedings of ADVANCE Conference**

By submitting your work for publication in the Proceedings of **Sixth International Workshop on ADVANCES in ICT (ADVANCE)**, you have agreed, by default, to the following terms and conditions:


- (a) The author and coauthor(s) must complete this form and submit it via easychair along with the camera-ready. If the paper is a work made for hire and the author or coauthor(s) do not have the authority to sign the paper, the owner of the paper must also sign the form.
- (b) You grant the publisher of ADVANCE Proceedings a right to publish your work and to distribute the published work according to the relevant laws and regulations governing publications.
- (c) You must be either the owner of the work or have obtained permission from the owner of the work (e.g. your employer) to publish the work. You have agreed to take the responsibility to solve any disputes that may arise anytime in the future with regard to the ownership of the work and the right of publishing the work, including penalty and compensation payment.
- (d) If excerpts from copyrighted works are included in your paper, you must have obtained written permission from the copyright owners and show credit to the sources in your paper. You have agreed to take the responsibility to solve any disputes that may arise anytime in the future with regard to copyright materials that you have used in your work.

If any of the above terms and conditions does not apply to your work or you do not agree with any of these provisions, please inform the **ADVANCE Workshop** Organizing Committee immediately at the following address:

E-mail: [advance2020@easychair.org](mailto:advance2020@easychair.org)

### **Corresponding Author's**

**Signature:** 

**Title/Employer:**   
(if not signed by author)

**Print Name:** WILSON ROGÉRIO SOARES E SILVA

As the form is being signed by the corresponding author on behalf of the others, the following additional statement must be accepted and signed by the author signing for the co-authors: "I represent and warrant that I am authorised to execute this transfer of copyright on behalf of all the authors of the article named above."

**Date:** 11/01/2023 **Corresponding Author's Signature:** 