

# First Responder UAS Data Gatherer Challenge (UAS 6.0): Reading List for Mesh and Relay

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While the UAS 6.0 Wireless Data Gatherer prize challenge focuses on a UAV visiting multiple ground stations and transferring data in a store-and-forward manner, future public safety UAS will also have the ability to function as part of mesh network and communications relay. This operation will facilitate real-time communications.

In this document, we present a few examples of prior work in using UAVs as part of mesh or mobile ad-hoc (MANET) networks, or otherwise as relays for communications. This is not an all-inclusive list but these papers have been selected to demonstrate some areas of research, and provide examples of past work in this area. *Inclusion in this list does not imply recommendation or endorsement by NIST, nor does it imply that the content identified is necessarily the best available.*

Knight, R. (2023) Restoring Communications After a Disaster. Inside Unmanned Systems.

This article presents a case study of the use of UAVs after a natural disaster, focusing on the use of a UAV to provide temporary communications while a longer term solution was being implemented. It describes how the UAV provides advantages over other short term solutions, such as portable communication masts.

Dao, N. (2021) Survey on Aerial Radio Access Networks: Toward a Comprehensive 6G Access Infrastructure. IEEE Communications Surveys & Tutorials, Vol. 23, No. 2, Second Quarter.

This paper provides an overview of prior work in the use of UAVs in providing radio based network access - a system they call aerial radio access networks (ARANs). They also discuss how ARANs fit into a broader communications ecosystem. While their discussion focuses on 6G systems, the principles of physics and radio propagation are, to at least a first approximation, generally applicable.

Esrafilian, O. (2020) Autonomous UAV-aided Mesh Wireless Networks. IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS).

A major challenge in the use of UAVs as communications relays is determining where they should be for best performance. While some level of modeling might be able to determine

approximate locations in the sky, real time measurements of signal strength need to be incorporated into the planning process. This paper discusses a method for doing this, and experiments in simulation and on a real autonomous UAV.

Meesriyong, K. et al. (2020) An Experimental Study of Wi-Fi Access Service using Drones in Container Yard. 20th International Conference on Control, Automation and Systems (ICCAS).

The problem of maintaining radio communications in dynamic, challenging environments is of course not limited to public safety. This paper describes an application in a container yard, where radio obstructions are continuously changing. It describes the necessary radio environment modeling and UAV movement planning to provide the necessary coverage in this dynamic environment.

Sheh, R. et al. (2024) Autonomous Aerial Drones Connecting Public Safety: Opportunities and Challenges for the Future. Association for Uncrewed Vehicle Systems International (AUVSI) Xponential.

Relaying communications using UAVs presents a variety of challenges beyond simply those of radio communications. This paper presents a survey of various uses of UAVs in public safety communications, and discusses some of the other challenges that exist, including issues relating to cybersecurity and AI risk management.