Chapter 4
Cross–Layer Scheme for Meeting QoS Requirements of Flying Ad–Hoc Networks:
QoS Requirements of Flying Ad–Hoc Networks

Bilal Muhammad Khan
National University of Sciences and Technology Islamabad, Pakistan

Rabia Bilal
Usman Institute of Technology, Pakistan

ABSTRACT

Recently, Flying Ad-hoc Networks (FANETs), enabling ad-hoc networking between highly mobile Unmanned Aerial Vehicles (UAVs), are gaining importance in several military, commercial and civilian applications. The sensitivity of these missions requires precise and prompt data delivery. Thus, the most important communication requirements that need to be addressed while designing FANETs are of high reliability and low latency. Considering these demands, this chapter focusses on mobility models, MAC protocols and routing protocols.

INTRODUCTION

Background

With the world turning into a global village due to technological advancements, automation in all aspects of life is gaining utmost importance. Wireless technologies have resulted in addressing the ever increasing demands of portable and flexible communication. Wireless ad-hoc networks which allow communication between devices without the need of any central infrastructure are gaining significance with monitoring and surveillance applications. A relatively new research area of ad-hoc networks is Fly-

ing Ad-hoc Networks (FANETs), governing the autonomous movement of Unmanned Aerial Vehicles (UAVs) (Bekmezci, Sahingoz, & Temel, 2013).

In the present day world, Unmanned Aerial Vehicles (UAVs) are considered a potential substitute of manned airplanes for several military, civilian and commercial operations. These aircrafts are used to conduct autonomous missions in remote areas in which the involvement of human personnel is considered dangerous and unsafe. Due to technological revolution in electronic and networking systems, UAVs may not only provide cost benefits but also help in efficient and adaptable mission completion for sensitive applications such as traffic monitoring, remote sensing, disaster monitoring, search operations, border surveillance and relaying networks.

The concept of single UAV systems is not new with their history associated with World Wars. Such systems comprise of an infrastructure which communicates with the UAV. This requires each UAV to be equipped with complex hardware systems to maintain its communication with the ground station, thus raising the disadvantages of high cost, reliability issues and link breakages. This led to the development of multi-UAV systems in which a network is formed between multiple UAVs which are made to communicate and collaborate so as to enhance the capability of single UAV systems. There are two distinct approaches for multi-UAV systems. The first is to form an infrastructure-based network between UAVs such that the communication between different UAVs in the network is regulated through a ground base station or satellite (Frew & Brown, 2008). This network model raises several design challenges as each UAV requires dedicated and complex hardware installment. For missions that may require higher number of UAVs, infrastructure-based multi-UAV systems are not feasible and reliable. Moreover, vigorous environmental conditions may cause link breakages between UAV and infrastructure resulting in data loss and increased delays. The second approach is to form an ad-hoc network between them. Such a network between multiple UAVs is termed as a FANET. All UAVs in the network are allowed to carry UAV to UAV communication and only a group of UAVs interact with the ground station. This eliminates the deployment of complex hardware in each UAV. Moreover, even if one of the UAVs turns down, there is no link breakage to the ground station due to ad-hoc network between UAVs.

Ad-hoc nature of FANETs allows their deployment in far-flung mission areas (Martinez-de et al., 2012). This helps in disaster management in places with impaired communication infrastructure or where prompt network establishment is required for receiving precise data from the affected region. Unlike (Mobile Ad-hoc Networks) MANETs and Vehicular Ad-hoc Networks (VANETs), FANETs have some critical requirements which need to be met. High mobility, low node density, low latency, large node distances and frequent topology change are some of the distinguishing characteristics of FANETs.

Motivation and Need

FANETs is an emerging research area and most of the research being done is in military and defense sector and hence not open source. The research has been conducted with the aim of sharing the findings with the research community so that affordable and efficient network models can be used for civilian applications to achieve desirable outcomes.

The amount of work done over the higher layers of FANETs is not enough. Moreover, a significant portion of research in FANETs focuses on the optimization and diversified use of Commercial Off-The-Shelf (COTS) equipment which adds to communication cost. Not many studies exist on Medium Access

27 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/cross-layer-scheme-for-meeting-qos-requirements-of-flying-ad-hoc-networks/226827

Related Content

Assessment of the Engines-Out Flight Performance of a Commercial Jet
Kivanc A. Avrenliand Barry J. Dempsey (2014). *International Journal of Aviation Systems, Operations and Training (pp. 35-54).*
www.irma-international.org/article/assessment-of-the-engines-out-flight-performance-of-a-commercial-jet/138608

Aviation Cybersecurity: Shielding Against Cyberthreats in the Air
Caner Asbaand ule Erdem Tuzlukaya (2024). *Harnessing Digital Innovation for Air Transportation (pp. 47-61).*
www.irma-international.org/chapter/aviation-cybersecurity/340954

Future Trends in Spectrum Management and Technology Choices for Broadband Aeronautical Communications
Stephen John Curran (2014). *International Journal of Aviation Systems, Operations and Training (pp. 1-8).*
www.irma-international.org/article/future-trends-in-spectrum-management-and-technology-choices-for-broadband-aeronautical-communications/111986

Intelligent Expert Decision Support Systems: Methodologies, Applications, and Challenges
Abdel-Badeeh M. Salemand Tetiana Shmelova (2018). *Socio-Technical Decision Support in Air Navigation Systems: Emerging Research and Opportunities (pp. 215-242).*
www.irma-international.org/chapter/intelligent-expert-decision-support-systems/196098

Evaluating Psychological Aircraft Accident Reports for Differences in the Investigation of Human Factors
Marco Michael Nitzschnerand Michael Stein (2017). *International Journal of Aviation Systems, Operations and Training (pp. 15-31).*
www.irma-international.org/article/evaluating-psychological-aircraft-accident-reports-for-differences-in-the-investigation-of-human-factors/214886