Chapter 52
FANET Based Flights Monitoring Simulation System Over Cloud

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Abstract As mounting population and need of advance commutes systems, available vehicular ad hoc networks (VANET) systems will not suffice the communication complex issues between vehicles on land, water and air. In order to meet ever growing challenges, VANET cloud computing techniques start contributing with its supple state line less storage, high end virtual techniques and logical schema connectivity to make commute rich, safe and pleasure experience to users. In this paper, we proposed an architectural model for flight monitoring simulation, which optimizes the scheduling of flights in the most prominent manner by centralizing all resources at single cloud which optimizes the time management of effective communication among resources. This model will be an immense resource not only for commercial flights but also for air force navigation systems. VANET existing systems were designed for vehicular networks while our proposed solution flying ad hoc networks (FANET) or Flights Air Networks adapts VANET approach on high speed air traffic, FANET may use electromagnetic waves for data transfer between flights as electromagnetic waves speed is much higher than flights speeds, it may ensure timely communication between flights and other communicating sources.

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52.1 Introduction

Cloud Computing is a computing for enabling convenient, dynamic scalable, on demand network access to a shared of pool of configurable computing recourses over the internet [1]. The cloud computing provides many advantages such as on-demand self service, ubiquitous network access, storage utility, software utilization, rapid elasticity, platform and infrastructure utilization, managed distributed computing power etc. [2]. It basically is a collection of storage systems, servers and devices to amalgamate data, software and computing power distributed across the network at various points. Cloud computing proposes a model that gives an on-demand, economy of scale and pay for use IT services over internet. The infra structure setup by the cloud computing architecture is known as cloud. Infrastructure as a Service (IaaS), Software as a Service (SaaS) and Platform as a Service (PaaS) [3], are prime services offered by cloud computing techniques.

In this paper, we are proposing cloud computing in flying ad hoc networks (FANETs). It will work as similar works as in vehicular ad hoc networks (VANETs) on the roads [4]. VANET is a collection of vehicles moving on the road. In VANET, cars use as mobile nodes and every participating vehicle plays role of wireless router with 100–300 m transmission range. Communication in VANET may be uses infrastructure as RSU and infrastructure less as MANET with 1000 and 300 m transmission ranges respectively [5]. Similarly, FANETs [6] are ad hoc networks connecting the unmanned air vehicle (UAVs). FANET can be understood as special form of MANET and VANET specially designed for flying objects at very high speeds. FANET collects data from the FCLOUD environment and relays to the wireless sensor networks, FANET support VANET approach of peer to peer communication. In this work, we are proposing cloud computing techniques to design “FCloud” which updates flights with latest information on routes, traffic and other important alerts. However, secure communication is an issue of cloud computing in FANET.

52.2 Literature Survey

Scalability of multi-UAV applications is proposed in limited FANET models and still requires further research. In [7], a FANET design was proposed for the range extension of multi-UAV systems. In this paper, forming a link chain of UAVs by utilizing multi-hop communication can extend the operation area is presented. However, the existing systems used by airports deploy open architecture conforming with ISO/OSI. It uses commercial Intel processors from HP for servers and workstations and LINUX Red-Hat operating system. High resolution displays of order: 2048 × 2048: SDD screen for radar controllers, 1600 × 1280: FDD screen, 1600 × 1280: SDD screens for tower are used. The data base requirements for DBM used are postgre SQL. The existing system uses high-level languages like ADA,

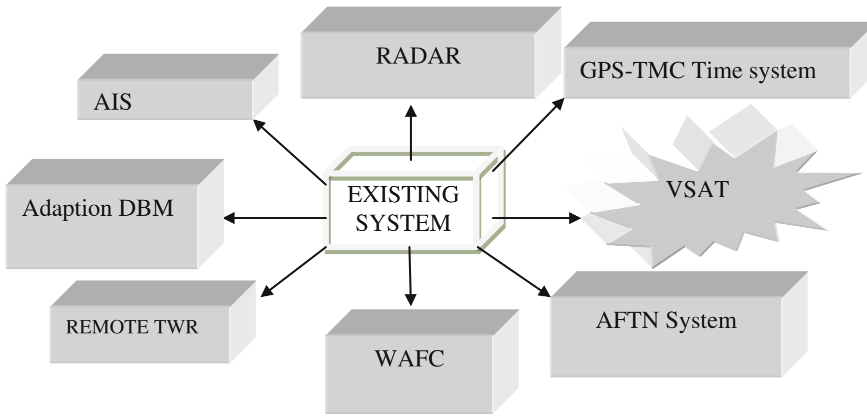

Fig. 52.1 The architecture of existing flight communication system

C and C++. The system uses standard graphics like X-Windows and Motif and the existing network is based in the Ethernet standards. All servers and workstations have connection to the double operational LAN. Figure 52.1 shows the architecture of existing flight communication system. There is collection of so many modules as radar. One for surveillance radar and other for communication meteo radar, GPS-TMC time system synchronizes location of flights at particular span, VSAT is remote positions system, AFTN system is ATS messages, WAFC is for meteo messages, remote TWR is for radar tracks, FP messages, adaption DBM is environment and adaption data, AIL FPLs, NOTAMs etc. Data-centric routing solutions may be used in FANETs for different types of application on the same multi-UAV system. Data-centric solution are needed to perform in network data aggregation. Space decoupling: communicating parties can be anywhere. Time decoupling: data can be dispatched to the sub-scribers immediately or latter. Flow decoupling: delivery can be performed reliably. FANET cross-layer architecture is introduced in 1961, where the interaction between the first three layer OSI reference model is facilitated.

52.3 Problem Statement

The existing system deploys many servers at each station under air traffic controllers (ATC) to communicate between different stations and between pilots, the more number of servers increases the probability of human errors, communication delays, signal losses and weak time management system on higher traffic air spaces. There is a need of synchronization of resources like communication devices, flights and communication networks to develop vital importance and emerged as a problem with existing systems. Cloud may be better solution for FANET.

52.4 Proposed Methodology

Cloud computing techniques offers high end integration of resources, technologies, platforms and can provide centralized space for all communication needs between stations and vehicle (Flights). To serve the purpose we designed specific cloud named "FCloud" secure communication using cloud is presented in [8]. Figure 52.2 shows the architecture of FCloud using cloud computing in flight management.

The proposed methodology has three phases.

In the first phase, cloud computing techniques offers high end integration of resources, technologies, platforms and can provide centralized space for all communication needs between stations and vehicle (flights) [9]. In phase two, network is established between FCloud and flights by utilizing several network protocols [10], it enable network with essential features as communications front-end for radars, Interpretation and broadcasting of radar messages, validates several signals through link definition algorithms as and when required (Fig. 52.3).

In the third phase, different models are connected to other layers like actuator models, which define various speed monitoring tools and gets information from network and cloud simultaneously to fix on parameters in run time environment.

Non linear aircraft models which changes directions as per need based or instructions provided are also connected by FANET cloud and updated as soon as system alerts them hence reduces risk situations. Several sensor models are also deployed at this stage which are connected to FCloud and upload information sensed from the surrounding and other sources. Figure 52.4 shows UAV system, which work in between phase 2 and phase 3.

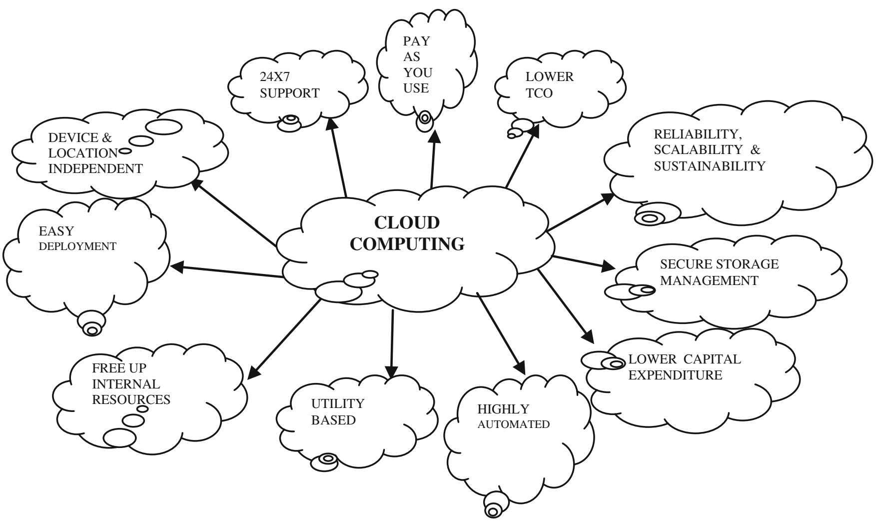

Fig. 52.2 The architecture of FCloud

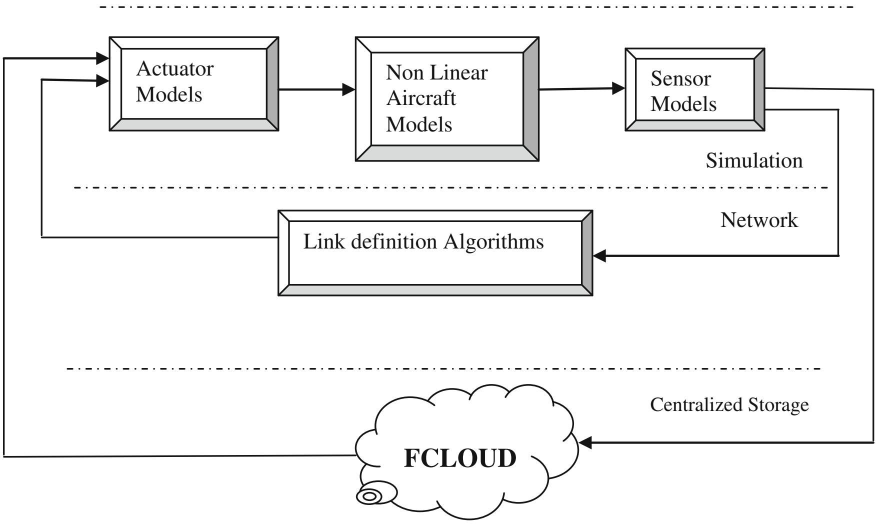

Fig. 52.3 The architecture of proposed methodology

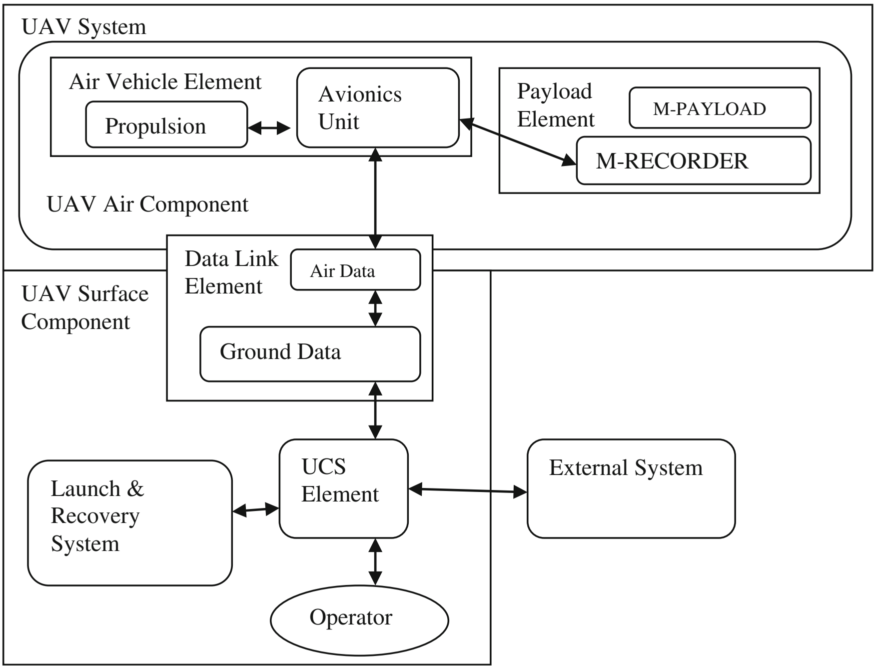

Fig. 52.4 UAV system interoperability architecture [11]

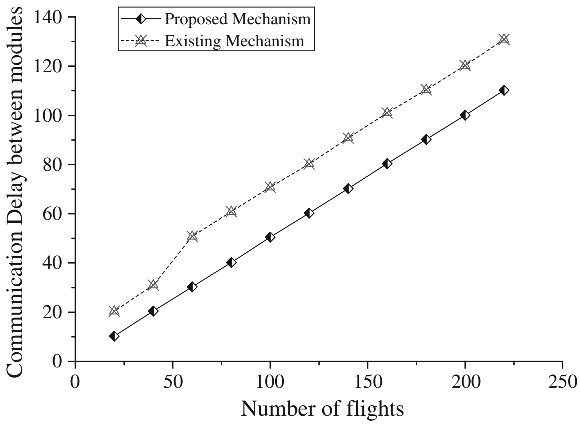

Fig. 52.5 Communication delay between modules of existing system and proposed model

52.5 Simulation Setup and Results

To illustrate some results of the proposed FCloud, we have taken 'Eucalyptus (software)' [12] which stores all data and recourses required for communication purpose and run under CentOS 6.5 (64 bits) under VMware virtual machine environment [13].

The ns2 simulator under Fedora Linux environment uses for flight communication and fetches data from FCloud for communication between stations and airplanes. Figure 52.5 shows the comparison of existing system and proposed system. It is observed that the proposed mechanism is taking less communication delay in comparison of existing system. We have taken 220 flight data for this simulation. It is clearly shown that communication delay gradually increases when number of flight increases. The result shows that the efficacy of proposed mechanism.

52.6 Conclusion

In this paper, we proposed a FANET based Cloud named FCloud for integrating diversified resources into single cloud system hence optimizing time of communication by reducing delay. This proposed technique is used for reducing risk between flights schedules. The result shown, there is fair improvements in reducing delays with the existing system however challenges still associated with security of FANETs and 3D simulations.

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