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Adopting Cloud Computing in Aviation Industry for Flight Safety

Syed Faizan Haider, Abdulhameed Mohammad Khateeb

***Abstract*— Flight Data Recorder (FDR) an aircraft component mounted on board, registers and records all different operations and conditions of aircraft during flight. Video animation and reconstruction of the flight progress can then be visualized by investigators to show the last moments before the accident happened after data retrieval from FDR.**

There might be difficulties in some cases where it is hard to rescue FDR from accident scene, or if found, data cannot be retrieved due to exposure to extreme heat. Thus, an alternative source of data is highly crucial; therefore cloud computing technology linkage to aircraft systems in the Real Time for data network environment to maintain continuous flow of data and safety has been stressed upon.

This research examined how concerned stakeholders in the global aviation industry can improve significantly on aviation safety by linking and saving the aircraft's data communications to cloud computing on the ground to facilitate the tracking and monitoring of aircrafts in real time, in case the aircraft crashes and loses or suffers damages on its black box component.

Index Terms: cloud computing, air traffic control (ATC), satellite communication, radar systems, FDR

I. INTRODUCTION

The communication being an essential & critical part of the Aviation industry can't be questioned. The aircraft carrying the human asset has to be carefully monitored for its safety & security. The Communication platform fitted on a modern aircraft can be visualized as the Figure 1.

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Prof. Dr. Syed Faizan Haider, Dep of IS, King Abdulaziz University, Jeddah,Kingdom of Saudi Arabia. Mobile +966 561779901, Email: shadier@kau.edu.sa

Abdulhameed M Khateeb, Dep of IS, King Abdulaziz University,Jeddah, Kingdom of Saudi Arabia, Mobile +966505516185

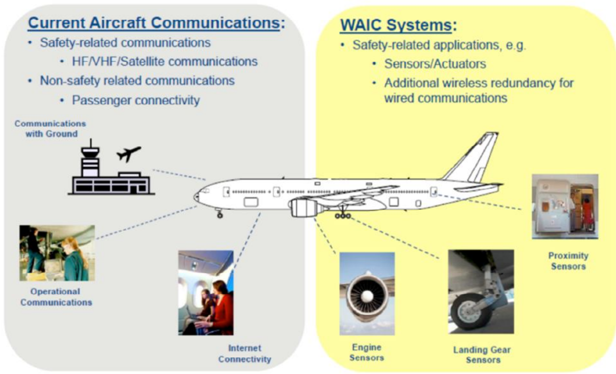

Figure 1: Communication platform fitted on a modern air craft [18]

The aircraft can't be there in the air for very long even on the ocean without the (Signal) communication.

The Radar System used in the Air to ground Communication called general communication is of the type as given in the Figure 2.

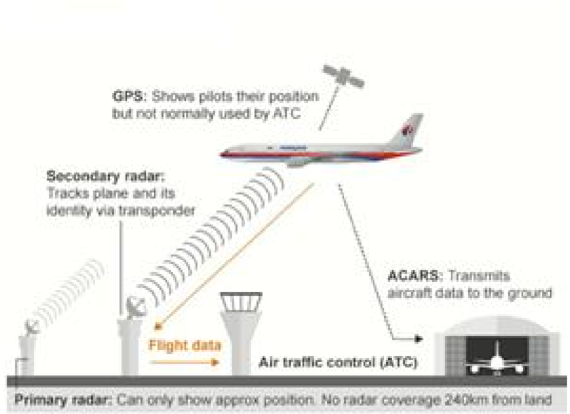

Figure 2: Normal aircraft tracking [1]

The ATC is not always able to track the exact position of an aircraft at all times, a fact attributable to the changing landscape and position of the aircraft, which in most cases is termed as being out of radar range. Examples of the areas where the ATC cannot track the movements and position of the aircraft include when the airplane is travelling over the ocean, and when the aircraft is travelling over a thick jungle [14]. [9]. For example, most of the aircrafts flying from the United States to European destination usually stay out of contact with the ATC because they remain out of radar range from both the US and the European teams because Of the vast Atlantic ocean over which these planes fly to get to their destinations. Like the traffic on the streets, roads &

highways there is traffic in the air as well. This traffic is monitored through the satellite communication and the pilots are required to report their specific longitude and latitude points to the ATC to enable it to pin point the exact position. Here is an instance of the satellite communication as shown below in Figure 3.

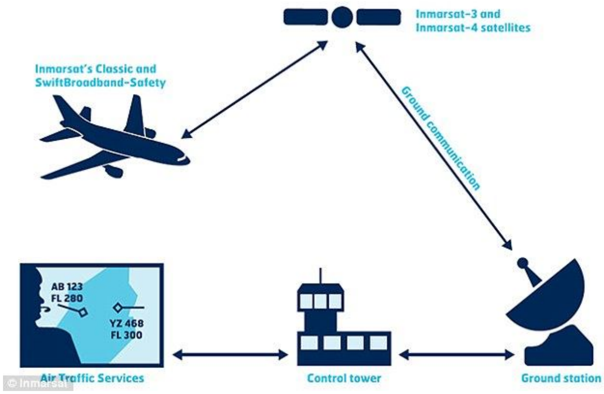

Figure 3: satellite communication [2]

A flight may come across many changing weather situations that either is ought to be avoide or escaped for its smmoth functioning. One of such situations is the "microburst**"**Figure 4 below shows a microburst diagram [1]. ather situations that either is ought to be avoide or escaped for its smmoth functioning. One of such situations is the "microburst" Figure 4 below shows a microburst diagram [1]. A microburst refers to an intense small-scale downdraft that emerges as a by-product of a rain shower or a thunderstorm. A microburst is a perfect example of the invisible airflow hazards that an aircraft can encounter mid-air and cause it to crash, especially when the pilot lacks adequate information on how best to maneuver the plan through the hazardous airflows.

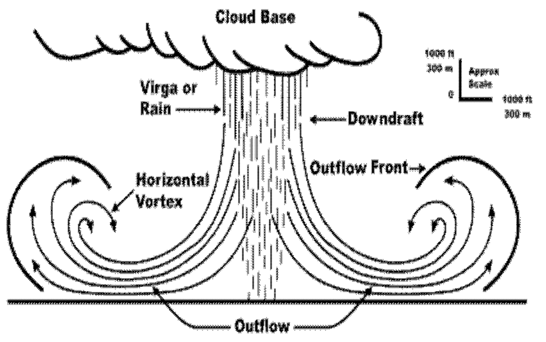

Figure 4: Microburst Diagram [1]

The Malaysian Airline flight number 370 crashed in the ocean and killed everyone on board, and yet its wreckage was not found; neither was its black box found. It remains a mystery to this day how the accident happened, and why it happened, and better yet, how best to avoid a repeat of a similar accident in the future [4].

The use of cloud computing monitoring real time flight data and tracking will be instrumental in establishing the primary causes of aircraft accidents, and help other industry stakeholders learn from these mistakes in order to avoid falling victims to such vulnerabilities. An illustration of the North Carolna State Cloud called "NC State Cloud" could be seen here as Figure 5.

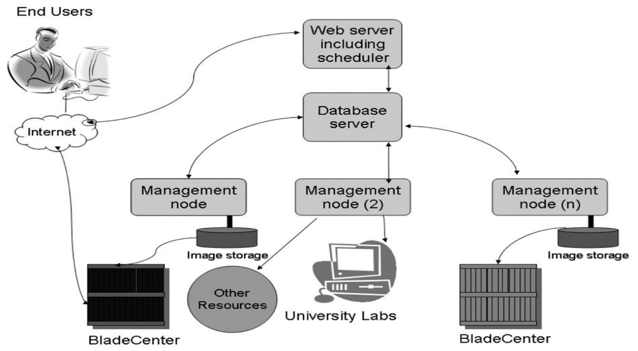

Figure 5: NC Cloud [22]

II. MATERIAL & METHODOLOGY

The study population was the global aviation industry, with a special focus on some of the key aviation industry players, such as the leading airlines in the world, and the major industry regulators. A mixed research methodology, entailing a combination of the quantitative and the qualitative research was used. The sample size used for the study was 250 participants and 12 different case studies relating to companies operating in the global aviation industry. The study population was divided into five main regions, marked by continents, Asia, North America, South America, Europe, and Africa, with each region providing 50 participants to contribute to the growing prevalence of cloud computing platforms being adopted for various uses in the aviation industry. These 250 participants were picked from each of the above mentioned sample frame, in order to obtain an inclusive and comprehensive opinion from all stakeholders in the aviation industry. Random sampling technique was used in selecting the research participants in order to eliminate any form of bias in the representation from the study population [7]. On the other hand, the 12 companies used for the case study analysis were picked and at the same time informed for their significance as the key pace-setters in the adoption of cloud computing platforms in the global aviation industry [10]. These companies included IBM Corporation and Microsoft Corporation, as recognized cloud computing service providers, Airbus Company and Boeing Corporation, as recognized aircraft manufacturers, Delta Airlines, Fly Emirates, British Airways, and KLM Airlines, as recognized and leading global airlines

III. RESULTS & DISCUSSION

The qualitative and quantitative both research techniques have been combined [22], the reason being that the quantitative research method is to complement the qualitative research method, which was conducted as a follow up from the findings obtained from qualitative data [11]. This combination of two research techniques in a single mixed research study helped to mirror the weaknesses of each research method while projecting their strengths [21]. It has been found that most of the aircraft accidents that occur on an annual basis to be the outcome of encounters that aircrafts have with invisible airflow hazards. The current technological developments reported in the aviation industry, especially with regard to aviation sensor technology, presented the concerned industry stakeholder with new perspectives regarding the design of

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advanced aircraft based sensors The cloud computing services provided by IBM come in two platforms; the first platform is the (PaaS), Platform as a Service whereas the second platform is Infrastructure as a Service (IaaS) [24], The Figure 6 below shows that 5 organizations control 64% of the global market share for cloud infrastructure services

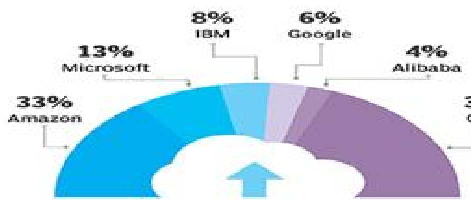

Figure 6: worldwide cloud infrastructure services market share [5]

The Google Cloud Platform also enables Airbus to provide access to satellite imagery for smaller organizations that have streaming technology, APIs, and innovative pricing schemes [12]. The company is in a position to deliver comprehensive and up-to-date satellite imagery and data to more than 1,200 customers in real-time, located in over 100 countries across the globe. The adoption of the Google Cloud Platform by Airbus Corporation [19], is a step in the right direction for the giant aerospace manufacturer with regard to the adoption, integration and implementation of cloud computing platforms in the aviation industry. ICAO approves of the integration of cloud computing in the aviation industry, arguing that the platform is integral in facilitating effective management of the global aviation industry. The reason for this assertion is that ICAO noted that the aviation industry can use cloud computing platforms in creating the Accident Notification System (ANS),

The clouds included are:

- Amazon Cloud,
- Microsoft Azure Cloud,
- Google Cloud Platform.
- The IBM cloud,

Amongst many others.

The following figure **(**Figure 7) shows the graphical delimitation of how users adopted different cloud computing platforms.

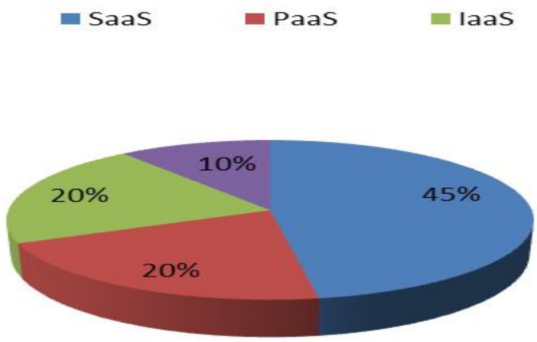

Figure 7 : Users adopted different cloud computing platforms

The other uses of the cloud computing platforms as used by the airlines included storage (10%), Sales and Marketing (15%), CRM (10%), tracking and monitoring of processes and activities (10%), management of staff members (10%), miscellaneous operations and activities (10%), as shown in Figure 8 below.

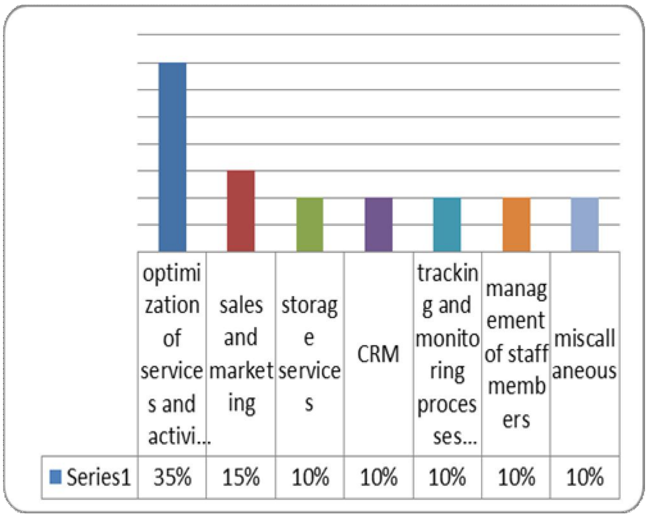

Figure 8 : users adopted different cloud computing platforms

In order to establish the degree of effectiveness that the aviation industry stakeholders derived from the adoption and integration of cloud computing platforms within their operations, particularly as an alternative communication platform for the air to ground communication between the ground teams (ATA) and the pilots. The results obtained from the analysis indicated that the cloud computing platform was a very effective communication alternative for air to ground communications (45%), as opposed to the 30% of the participants who argued that the adoption of cloud computing particularly for communication purposes between the ground teams and the air teams was quite risky as the cloud platform was not entirely tamper proof [22]. Twenty five percent (25%) of the participants were undecided as to whether it was a wise business idea to replace satellite and radar communication with cloud computing services for use in ground to air communication, as indicated in Figure 9

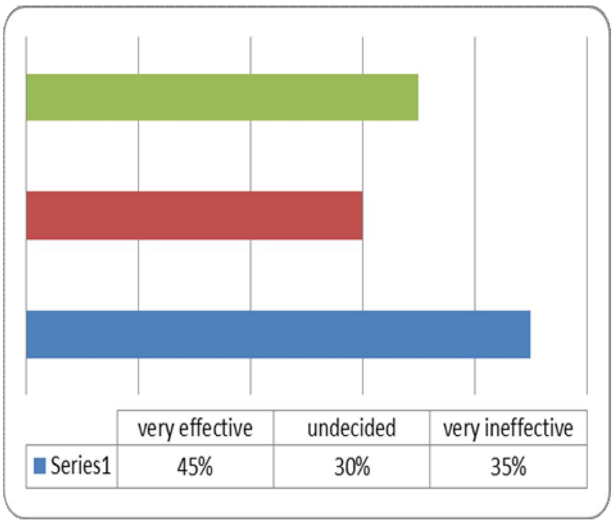

Figure 9 : Effectiveness of Cloud Computing

MATH

The cloud computing is the single best solution that aviation industry players can adopt in order to reduce the growing prevalence of missing aircraft accidents, and improve on the degree of aviation security.is in consonance with [1]. The results and findings of the research study confirm that the cloud computing is indeed integrated in most of the operations and activities of the aviation industry, such as service optimization by airlines. It is not yet being used to track and monitor aircrafts in real time, regardless of the massive support that this proposal gets from different stakeholders in the aviation industry, attributable to security concerns about sharing flight information on the cloud.

IV. RECOMMENDATIONS

The best recommendation drawn from the findings of this study is for the aviation industry stakeholders to consider creating the right cloud computing infrastructure that is purely dedicated to the aviation industry, such as for airlines alone, and probably controlled by an active industry player, such as an airline or an aerospace manufacturer, or any related industry subsidiary as opposed to outsourcing the activity to a third party service provider of cloud computing services, and use it to integrate the use of cloud computing platforms within the industry, particularly with regard to the tracking and monitoring of the aircrafts in the sky in the real time. The approach will effectively improve the quality of service delivery, particularly for all the concerned industry stakeholder, noting that it would not be possible to track and locate the exact position of a plane right from the manufacturing stage However, this proposal is not entirely appreciated by the aviation industry stakeholders because of the security threats involved in sharing confidential flight information on cloud computing platforms.

V. CONCLUSION

The results obtained from both qualitative and quantitative data analyses tallied with the information obtained from the literature review analysis, whereby we reached the conclusion that much as the aviation industry was eager to shift operations to the cloud computing platforms, as evidenced in its use on undertaking most of its other operations and activities, shifting to the use of cloud computing platforms presently would not be feasible because of security concerns, and the absence of a comprehensive cloud computing platform that would actively track and monitor all planes in the sky simultaneously without collapsing.

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