

**Sudan University of Science and  
Technology**

**College of Engineering**

**School of Electronics Engineering**



# **Design and Overview of Oceanic Aircraft Communications**

تصميم و نظرة عامة للاتصال بين  
الطائرات في المحيطات

A Research Submitted in Partial fulfilment for the Requirements  
of the Degree of B.Sc. (Honours) in Electronics Engineering

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## الآية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قال تعالى:

(إِنَّ فِي خَلْقِ السَّمَاوَاتِ وَالْأَرْضِ وَاخْتِلَافِ اللَّيْلِ وَالنَّهَارِ وَالْفُلْكِ الَّتِي تَجْرِي فِي الْبَحْرِ بِمَا يَنْفَعُ النَّاسَ وَمَا أَنْزَلَ اللَّهُ مِنَ السَّمَاءِ مِنْ مَاءٍ فَأَحْيَا بِهِ الْأَرْضَ بَعْدَ مَوْتِهَا وَبَشَّرَ فِيهَا مِنْ كُلِّ ذَاتٍ وَتُضْرَفُ الرِّيحُ وَالسَّحَابُ الْمُسَخَّرَ بَيْنَ السَّمَاءِ وَالْأَرْضِ لآيَاتٍ لِقَوْمٍ يَعْقِلُونَ)

البقرة: 164

## DEDICATION

You held my hand to steady me

Till I was ready to make a stand

On my own two feet

You were there to show me

How to truly believe

In the miracle of creation

In the good and the bad

When my head was down you prayed for me

To my caring parents *Aldaw Ali &Awatif Ahmed*,

Beloved sisters *Nisreen,Shaza,Shireen,Alaa &*

*Eman*and to my beautiful nieces *Leen &Tala*

I dedicate this humble work.

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(واشكروا نعمة الله إن كنتم إياه تعبدون)

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## ABSTRACT

Every day the sky carries about 8million people flew on nearly 100,000flights, thus It is very important to coordinate the movement of air traffic to makeairplanes stay a safe distance apart in order to avoid collision, and keep an eye on aircraft during it flight time, The limitation of conventional radar technology, relatively lowaccuracy and the fact that radars are only placed on land, make it difficultor even impossible to track airplanes when they are flying over oceans. The mainobjective of this research is to highlight surveillance technologies and give a simplified method to track aircrafts in non radar areas, simple scenarios were simulated using system tool kit software which is a tool designed for simulating airspace,25 aircrafts paths were selected from 2524 real routes and modeled with simple link budget calculation .

## المستخلص

السفر بالطيران غير مسار العالم تماماً, و سهل على الناس السفر حيث أتاح امكانية الانتقال حول العالم بكل سهولة و يسر و في فترات زمنية قصيرة. كل يوم تشهد السماء حوالي 100 ألف رحلة جوية تحمل حوالي 8 مليون نسمة. لذلك من المهم تنظيم حركة الطائرات لتبقى في حدود مسافة معقولة منعا للتصادم ولإجراءات السلامة , قصور و عدم دقة اجهزة الرادار التقليدية و حقيقة ان الرادارات تُنشأ على اليابسة فقط, تصعب عملية تتبع الطائرات عندما تحلق فوق المحيطات الشاسعة . الهدف الاساسي من هذا البحث هو تسليط الضوء على اجهزة المراقبة والاستطلاع المستخدمة من قبل المراقبة الجوية واعطاء مفهوم مبسط لتتبع الطائرات عبر المحيطات حيث لا توجد تغطية بأجهزة الرادار , أيضاً تمت محاكاة التصميم المقترح باستخدام برنامج مجموعة أدوات النظام و هو برنامج مصمم خصيصاً لمحاكاة الفضاء , 25 مسار من أصل 2524 مسار حقيقي للطائرات اختير لتبسيط المحاكاة , كما تم حساب مؤشرات لجودة الرابط المقترح.

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## ABBREVIATION

AANET	Aeronautical Ad hoc NETwork
ACC	Area Control Center
ADS-B	Automatic Dependent Surveillance Broadcast
AeroRP	Aeronautical Routing Protocol
AMM	Aircraft Mission Modeler
ASN	Aviation Safety Network
ATC	Air Traffic Control
ATM	Air Traffic Management
AWOS	Automatic Weather Observing Station
CDTI	Cockpit Display of Traffic Information
FAA	Federal Administration for Aviation
FCM	Fuzzy C Means
FIS-B	Flight Information Service Broadcast
GLSR	Geographic Load Sharing Routing
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GPSR	Geographical Position-Based Routing
GRAA	Geographic Routing protocol for Aircraft Ad hoc

GUI	Graphical User Interface
HAP	Higher Altitude Platform
ICAO	International Civil Aviation Organization
LOS	Line Of Sight
MANET	Mobile Ad hoc NETwork
MFD	Multi-Function Displaying
NAS	National Airspace System
NATs	North Atlantic Tracks
OTS	Organized Track System
PSR	Primary Surveillance Radar
RADAR	RAdio Detection And Ranging
RCS	Radar Cross Section
RF	Radio Frequency
RGR	Reactive Greedy Reactive
SNR	Signal to Noise Ratio
SSR	Secondary Surveillance Radar
STK	System Tool Kit
TCAS	Traffic Collision Alerting and Avoidance
TCP/IP	Transmission Control Protocol/Internet Protocol
TDMA	Time Division Multiple Access
TDOA	Time Difference Of Arrival
TIS-B	Traffic Information Service Broadcast
UAANET	Unmanned Aeronautical Ad hoc NETwork

UAV	Unmanned Aerial Vehicle
USPR	Universal Software Radio Peripheral
VHF	Very High Frequency
WAM	Wide Area Multilateration