

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# الآيَة

قال تعالى :

(وَمَا أُوتِيتُمْ مِّنَ الْعِلْمِ إِلَّا قَلِيلًا)

صدق الله العظيم  
الآية (85)

## DEDICATION

*I would like to dedicate this thesis for:*

*My family,*

*My teachers,*

*My friends,*

*My colleague,*

*Sudan Civil Aviation authority (SCAA),*

*Sudan Air navigation General Directorate (ANS)*

*Sudan Air Navigation Center (ANC),*

*Africans CAA & ANS Providers,*

*All people working to raise the Aviation industry in Africa.*

## Acknowledgements

Many individuals have profoundly influenced me during my graduate studies at (Sudan University of Science and Technology), and it is a pleasure to acknowledge their guidance and support.

I would like to begin by expressing my sincere thanks to my supervisor D. Ibrahim Khider to support me to work on this thesis and taking the time to read and critique my thesis.

I am deeply grateful to D.Ibrahim Khider, my supervisor, for the opportunity to make my master's thesis on this interesting topic and his freely shared knowledge as well as his more-than-helpful pieces of advice. I truly appreciate to him for being such a good listener on those many occasions when I just need to discuss those technical questions, and these discussions helped me to redefine my understanding of this field.

Also I would like to express my deep thanks, gratitude and appreciation to my Examiners D.Mohamed Hussein the Internal Examiner and D.Khalid Hamed the External Examiner for taking time to read and discuss my thesis.

Outside the University I would like to express my thank to Sudan Civil Aviation Authority / Air Navigation Center for supporting me by the equipments I used in the models ,special thank to Department of Air Navigation Systems Engineering.

Finally, I dedicate this work to my friends, my parents and my family who have provided support and encouragement during my academic studies

## Abstract

As air traffic increases, routes get more and more diverse and light and ultra light aircraft are becoming more and more popular, the classic system is beginning to show its weaknesses. The two main issues regarding classic radio communications are delay and the availability and reliability of network infrastructure related problems.

Today's dense air traffic and the worldwide move to Future Air Navigation System (FANS) concepts demand a high level of modern and reliable Air Traffic Control (ATC) network to accommodate customer requirements now and in the future.

This work tries to answer the questions that indicate the fact why a new air traffic control network generation based on higher speed terrestrial and VoIP (Voice over Internet Protocol) links has some essential comparative advantages related to the old circuit switched networks.

The purpose of this thesis is to provide two air traffic control network models for switching voice and data methods for pilot-air traffic controller communications using E1 Leased lines and IP VSAT links.

In the first model, the network is implemented using leased lines over fibre links reduce latency.

In the second model, the network is implemented using IP over VSAT mesh network as an improvement to the bandwidth saving and cost - effective

In these models, the network acts as a “two redundant network” main and standby

The main benefit of these networks is the increase safety, as communications were there are many network without redundancy. Other benefits are solving the problems of delay, packet loss and bad quality of voice and data.

The two proposed network models had to prove in the near future that they are ready to meet the requirements of more flexible, safer and cheaper way of air traffic management.

المستخلص

يشهد العالم حركة مطردة فى مجال النقل الجوي والحركة الجوية عموما هذا النمو يتطلب المزيد من اجراءات السلامة والمراقبة الجوية وهذا لا يتأتى الا باتباع قواعد السلامة الجوية القياسية المنصوص عليها من قبل المنظمة الدولية للطيران المدنى.

من اهم هذه المتطلبات تطبيق نظام متطور لادارة الحركة الجوية والذي يشتمل على نقلة نوعية بالتحول الى نظام الملاحة المستقبلى والملاحة بواسطة الاقمار الاصطناعية بالاضافة الى الاستفادة من خدمات وامكانيات بروتكول الانترنت فى نقل البيانات والصوت على السواء. نسبة للزيادة المتسارعة فى حجم الحركة الجوية اليومية ، اصبحت شبكات ربط ونقل معلومات الحركة الجوية الكلاسيكية تعاني قصور فى الاداء متمثلة فى موثوقية هذه المعلومات ونسبة موجودية خدمة هذه الشبكات.

فى هذا البحث تم تطبيق نموذج لهذه الشبكات باستخدام تقنية حديثة ومتطورة لمعالجة قصور اداء الشبكات التقليدية .

تم تطبيق النموذج باستخدام السعات العريضة عبر خطوط الالياف الضوئية ونتج عن هذا التطبيق الاتى :

- استخدام الربط بواسطة السعات العريضة عبر الالياف الضوئية يضمن ضمان نقل حجم معلومات اكبر وبسرعة فائقة وعدم التداخل مع المؤثرات الخارجية مع قلة التكلفة نسبيا
  - ضمان جودة عالية فى الصوت وهو اهم تطبيقات الحركة الجوية
  - ضمان نقل كافة انواع البيانات الملاحية ويذيد من موثوقية وفعالية خدمات الحركة الجوية
- تم تطبيق النموذج الثانى باستخدام شبكة اقمار اصطناعية (فيسات)
- وننتج عن هذا التطبيق الاتى:

- يوفر خدمة موثوقة تستخدم فى نقل بيانات الصوت والرادار عبر استخدام بروتكول الانترنت وميزات تفضيلية فى التغطية الواسعة وسهولة التركيب
- استخدام بروتكول الانترنت يقلل التكلفة الكلية وذلك باستخدام اجهزة ومعدات الشبكات بمواصفات جيدة ومتوفرة فى السوق
- تقليل تكلفة ايجار المساحة القمرية باستخدام تقنيات ضغط البيانات وبرتكولات التسريع

\* استخدام النموذجان معا يقلل من تكلفة التشغيل والصيانة ويضمن نسبة عالية لموجودية الشبكة والخدمات المنقولة عبرها من المحطات الى المركز الرئيسى.

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## Abbreviations

<b>A/D</b>	Analog –to- Digital
<b>ACELP</b>	Algebraic Code Exited Linear Prediction
<b>AIS</b>	Alarm Indication Signal
<b>ATC</b>	Air Traffic Control
<b>ATM</b>	Asynchronous Transfer Mode
<b>ATM</b>	Air Traffic Management
<b>BECN</b>	Backward Explicit Congestion Notification
<b>BOD</b>	Bandwidth On Demand
<b>BSC</b>	Binary Synchronous communications
<b>CAA</b>	Civil Aviation Authority
<b>CAS</b>	Channel Associated Signalling
<b>CCS</b>	Common Channel Signalling
<b>CES</b>	Circuit Emulation Services
<b>CN</b>	Comfort Noise
<b>CS</b>	Conjugate Structure
<b>CRC</b>	Cyclic Redundancy Check
<b>DAMA</b>	Dynamic Assigned Multiple Access
<b>DCE</b>	Data Communication Equipment
<b>DLCI</b>	Data Link Connection Indicator
<b>DTE</b>	Data Terminal Equipment
<b>DTMF</b>	Dual Tone Multi-Frequency
<b>DSP</b>	Digital Signal Processing
<b>EBCDI</b>	Extended Binary Code Decimal Interchange
<b>E&amp;M</b>	Ear and Mouth signalling
<b>FAS</b>	Frame Alignment Signal
<b>FECN</b>	Forward Explicit Congestion Notification
<b>FR</b>	Frame Relay
<b>FRAD</b>	Frame Relay Access Device
<b>FXO</b>	Foreign Exchange Office
<b>FXS</b>	Foreign Exchange Station
<b>GSM</b>	Global System Mobile
<b>HDB3</b>	High Density Bipolar -3zeros
<b>HDLC</b>	High Level Data Link Control
<b>IP</b>	Internet Protocol

<b>IPX</b>	Internetwork Packet Exchange
<b>ISDN</b>	Integrated Service Digital Network
<b>LAN</b>	Local Area Network
<b>LDC</b>	line Delay Compensate
<b>LDCD</b>	Low Delay Codec
<b>LMI</b>	Local Management Interface
<b>MAPC</b>	Multiple Address Per Carrier
<b>MSC</b>	Mobile Switch Centre
<b>PAMA</b>	Permanently Assigned Multiple Access
<b>PBX</b>	Private Branch Exchange
<b>PCM</b>	Pulse Code Modulation
<b>PSTN</b>	Public Switched Telecommunication Network
<b>PTT</b>	Push –TO-Talk
<b>PVC</b>	Permanent Virtual Connection
<b>PVCR</b>	Programmable Variable Cell Relay
<b>QoS</b>	Quality of Service
<b>RAI</b>	Remote Alarm Indication
<b>R-ASYNC</b>	Reliable Asynchronous mode
<b>SAP</b>	Service Advertising Protocol
<b>SDLC</b>	Synchronous Data Link Control
<b>SNA</b>	System Network Architecture
<b>SS7</b>	Signalling System No.7
<b>SVC</b>	Switched Virtual Connection
<b>T-ASYNC</b>	Transparent Asynchronous mode
<b>TDMA</b>	Time Division Multiple Access
<b>UNI</b>	User/Network Interface
<b>USASCII</b>	United States of America Standard Code
<b>VHF</b>	Very High Frequency
<b>VCCS</b>	Voice Communication Control System
<b>VoIP</b>	Voice over IP
<b>VSAT</b>	Very Small Aperture Terminal
<b>WAN</b>	Wide Area Network