



International Civil Aviation Organization

SEMINAR ON THE ECONOMICS OF CNS/ATM

Casablanca, 28-30 October 1997

REPORT

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INTERNATIONAL CIVIL AVIATION ORGANIZATION

REPORT ON SEMINAR ON THE ECONOMICS OF CNS/ATM¹

(Casablanca, 28 to 30 October 1997)

1. Introduction

1.1 A Seminar on the Economics of the Communications, Navigation and Surveillance/Air Traffic Management (CNS/ATM) Systems, convened by ICAO for States in Africa and the Middle East, was held in Casablanca from 28 to 30 October 1997.

1.2 The Seminar was the second of its kind and the first for the States covered, intended to provide guidance to States on cost-effectiveness, and financial and related organizational and managerial aspects of implementation of the ICAO CNS/ATM systems.

1.3 Attending the Seminar were 141 participants from 24 Contracting States and 8 international organizations. The complete list of participants appears in **Appendix 1**.

1.4 The Seminar was opened with a welcoming address by His Excellence the Minister of Transport, Merchant Marine, Tourism, Energy and Mines of Morocco, Mr. Driss Benhima, who accredited ICAO as the only body capable of realizing the necessary international understanding of the standards and operational practices as well as the international acceptance through its member States. He also called upon an extended co-operation at the regional level in order to reduce as much as possible the constraints of onboard equipment that are evolving between different regions, and to reach a harmonization of the future operational methods, as well as taking advantage of the economy of scale of equipment.

1.5 The Secretary General of ICAO, Mr. R.C. Costa Pereira, declared in his opening address that through the application of satellite technology States can ensure that air navigation services are provided at a cost which is much less than that required for conventional systems, and that the net benefits to the users (primarily the airlines) will exceed the net costs to the systems providers (primarily the States) by a considerable margin. He also emphasized that the implementation of CNS/ATM systems does not change the responsibility of the States for the provision of air navigation services according to Article 28 of the Chicago Convention but makes it less costly for States to meet their obligations. Finally, he referred to the *World-wide CNS/ATM Systems Implementation Conference*, which ICAO would be convening in Rio de Janeiro in May 1998, where the main objective would be to provide guidance and develop recommendations on how financing can be secured, how cost recovery can proceed and repayment of loans be ensured, and how States can co-operate in the provision and operation of CNS/ATM systems components.

1.6 Opening addresses were also given by the Director General of ONDA (National Airports Authority of Morocco), Mr. Ahmed El Biaz, and the President of ICAO's Air Navigation Commission, Mr. Victor Aguado. ONDA is a public establishment for airports and airspace management and Mr. El Biaz referred to a number of its projects in the air navigation field, which takes into account the

ICAO European (EUR) and African (AFI) regional air navigation plans as well as the Global Co-ordinated Plan for Transition to the ICAO CNS/ATM Systems and the AFI CNS/ATM Implementation Plan.

1.7 Mr. Upali Wickrama, Chief of the Forecasting and Economic Planning Section of ICAO, acted as Moderator of the Seminar and Mr. Östen Magnusson, Economist in the Airport and Route Facility Management Section, served as its Secretary.

1.8 The programme for the Seminar was as follows:

- Opening of Seminar
- CNS/ATM systems elements overview
- Planning process
- Organizational issues
- Cost-effective implementation
- Financial performance
- Cost recovery
- Funding
- Briefing on the 1998 CNS/ATM Implementation Conference
- Summary, conclusions and follow-up actions

In addition Secretariat staff were available and met interested participants for follow-up consultation on specific issues and for "hands-on" familiarization with CNS/ATM cost/benefit software.

1.9 The working languages of the Seminar were English, Arabic and French. The programme, together with certain ICAO publications relevant to the various subjects (a list of which appears in **Appendix 2**) constituted the documentation for the meeting. In addition, printed versions of presentations where available were distributed during the Seminar in the original language of each presentation.

2. CNS/ATM systems elements overview

2.1 Mr. Judimar Chagas, Chief of the ICAO Communications, Navigation and Surveillance Section, described the main features of the CNS/ATM systems as well as the status of technical and operational developments. He emphasized that:

- there is a need for modernization of the system in order to overcome the limitations of the existing system and to cope with current and future air traffic demands;

- the expected benefits will not materialize until there is a full exploitation of the new technologies both in the air and on the ground;
- implementation of CNS/ATM elements will not take place at the same time in the different regions but will come through gradually based on global and regional planning; and
- implementation will not make all conventional systems obsolete overnight but will rather build on existing technologies.

2.2 Concerning planning activities under way, Mr. Chagas pointed out that planning has to be carried out at global, regional and national levels and that the States themselves have the ultimate responsibility for implementation. The importance of co-ordination, co-operation and partnership was highlighted as in many situations they will be the key to successful implementation of the CNS/ATM elements. Mr Chagas also advised participants of the current updating of ICAO's *Global Co-ordinated Plan for Transition to the CNS/ATM systems* and that the major tasks of the ICAO standardization work (development of SARPs and procedures) with regard to CNS are expected to be completed by 1999. Finally, he concluded that the transition period to the new systems would have to be as short as possible in order to minimize the costs but sufficiently long so as not to compromise agreed levels of safety.

3. Planning process

3.1 On behalf of ICAO's regional offices in Cairo, Dakar and Nairobi, Mr. G. P. Moshabesha presented the AFI CNS/ATM Implementation Plan, which had been adopted by the AFI/7 Regional Air Navigation Meeting in May 1997. He highlighted the plan to divide the region into ten homogeneous areas of routing corresponding to the major traffic flows. A set of ATM objectives had been defined for each area of routing. On the basis of these objectives the required communications, navigation and surveillance systems will be derived taking into account the nature of the area (continental or oceanic), the existing systems and the improvements which could be introduced during the time frame of the plan (1995-2005). Mr Moshabesha also highlighted some implementation steps already taken or in progress in the AFI region. Concerning guidance to States and users for the implementation of airborne equipment and ground system elements he referred to the AFI Implementation Plan. He explained the three documents forming the AFI CNS/ATM Implementation Plan.

3.2 Mr. Abdenabi Manar, Administration of Civil Aeronautics of Morocco, presented the AEFMP Plan, which is an air navigation systems harmonization plan for Algeria, France, Morocco, Portugal and Spain. The need for this plan had emerged from the ECAC and EATCHIP work in Europe and the need for France, Portugal and Spain to co-ordinate their planning activities with neighboring States in the AFI region. The plan covers not only harmonization of technical systems and air traffic management but also harmonization of training and working methods. It includes two periods: an initial period up to 1998 and a medium and long-term period for 1998-2000 and beyond.

3.3 The user perspective on the planning process was provided by Ms. Véronique Vincent from IATA. She explained that the benefits to airlines from CNS/ATM implementation could include airspace capacity, reduced fuel burns, reduced flight time with its many implications, reduced contingency fuel requirements, reduced delays and reduced technical fuel stops. As the airlines would have to invest between

\$250,000 and \$1 million per aircraft, Ms. Vincent emphasized that the benefits would need to be demonstrated, including a clear commitment by the provider States, prior to airlines showing willingness to invest.

4. Organizational issues

4.1 Mr. Östen Magnusson described the structure, ownership and control of air navigation services in general and the various options available in connection with the implementation of CNS/ATM in particular, including international operating agencies and other co-operative efforts such as joint financing arrangements and multinational facilities. He gave an overview of the Danish and Icelandic joint financing agreements and the recent arrangement on the joint financing of a North Atlantic height monitoring system, as an example of one possible option to assist in the implementation of CNS/ATM. Concluding his presentation Mr. Magnusson emphasized the availability of guidance material from ICAO on these issues, including a report of the Air Navigation Services Economics Panel (ANSEP) on *Financial and Related Organizational and Managerial Aspects of Global Navigation Satellite Systems Provision and Operation* (Doc 9660) and the new *Manual on Air Navigation Services Economics* (Doc 9161/3).

4.2 On behalf of the Legal Bureau of ICAO, Mr. Magnusson addressed some legal aspects of CNS/ATM. Most importantly, he drew attention to the general conclusion that there are no legal obstacles to the implementation of CNS/ATM and no inconsistency with the Chicago Convention. He introduced the draft *Charter on the Rights and Obligations of States Relating to GNSS services* developed and adopted by the Panel of legal and technical experts during their second meeting in October 1997.

4.3 Mr. Youssouf Mahamat, representing Agence pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar (ASECNA), presented the various projects related to the implementation of the CNS/ATM systems of relevance for regional co-operation within the framework of ASECNA. He also described the origin and evolution of the organization and its role as a regional model for air navigation co-operation. With regard to the implementation of the CNS/ATM systems Mr. Mahamat identified ASECNA's role as covering the following issues: design, realization, management, involvement, training, institutional, financing and assistance.

4.4 Mr. David Featherstone of the International Mobile Satellite Organization (Inmarsat) described Inmarsat as an international Treaty organization where the principal participants and owners are post, telegraph and telephone system (PTTS) providers and national telecommunication agencies from some 80 States. Inmarsat's function is to provide space segment for mobile satellite communications services world-wide for the maritime, aeronautical and land-mobile communities. The space segment is available to all States without discrimination and the aeronautical system is dedicated to the community of aeronautical users. Considering its services Inmarsat could, according to Mr. Featherstone, be regarded as a wholesaler of the space segment to the owners and operators of ground earth stations (GES), the latter which are the organizations in the respective States that actually are the signatories of Inmarsat. To provide global services GES owners have often teamed together into consortia, and entered into commercial arrangements with specialized aeronautical communication service providers (e.g. SITA). Also, Mr. Featherstone focused on the special services to air traffic management and the support services for satellite navigation. For the far term future he foresaw a possible transition to AMSS systems using satellites in non-geostationary orbits. Mr. Featherstone concluded that there are no capital investment requirements on States for communication satellites or their support infrastructure.

4.5 For Société Internationale de Télécommunications Aéronautiques (SITA), Mr. Kieran O'Rourke provided the Seminar with a detailed description of SITA and the CNS/ATM communications services and products it does or can provide. He explained that SITA is an international not-for-profit co-operative instituted by the airlines for the purposes of providing telecommunications to the airlines. Its activities have now been expanded to provide services to civil aviation administrations and air traffic services providers.

5. Cost-effective implementation

5.1 Mr. Upali Wickrama outlined the objectives of cost/benefit analysis and measures of economic viability such as the benefit/cost ratio, rate of return and, in particular, Net Present Value (NPV) which covers the whole life cycle of an investment including transition from an existing system. He explained that NPV calculations would help demonstrate the financial return that could be expected from investments in CNS/ATM, and could also be used to determine the most cost-effective implementation strategy. Mr. Wickrama described the methodology, the year-by-year evaluation of costs (in terms of equipment, services and training) and benefits (in terms of avoided costs of present technology, savings to operators and, to the extent that they may be considered measurable, passenger time savings), and the discounting procedure to present actual costs and benefits. The aggregation of all the costs and benefits (in present value terms) produces a single net present value figure which is a measure of the financial viability of the transition to the new systems in the particular airspace being analysed. It was emphasized that the costs associated with CNS/ATM will depend on the choice of implementation options. The net present values of the various implementation options can be compared in order to determine which option is the most cost-effective.

5.2 The *Economics of Satellite-Based Air Navigation Services - Guidelines for cost/benefit analysis of communications, navigation and surveillance/air traffic management (CNS/ATM) systems* (ICAO Circular 257) was promoted together with computer spreadsheets, which were available within ICAO, to assist States in carrying out NPV analysis for CNS/ATM. These spreadsheets were demonstrated to several groups of participants during the seminar using practical examples.

5.3 In an air transport outlook Mr. Wickrama described the historical development of air traffic and the financial performance of the airline industry. He also introduced ICAO's latest long-term traffic forecasts, which clearly indicate continuing growth in all regions, with aircraft movements now growing in close step with passenger traffic rather than more slowly as in the past.

5.4 Mr. David Diez, Spain, presented a case study carried out by AENA (Aeropuertos Español y Navegación Aérea) with the objective of determining the economic feasibility and financial implications of implementing the CNS/ATM systems in Spain. In the study the guidelines and methodology contained in the *Economics of Satellite-based Air Navigation Services*, ICAO Circular 257, had been applied. Cost data had been provided by some 85 manufacturers and in addition experts from a number of international organizations had been consulted. Twelve alternative technological scenarios had been considered where the differences were related to communications and surveillance. All alternatives showed positive net present values for both the ATS service provider and the users, with an overall net present value in the most profitable scenario at US\$ 389 million (with an additional US\$ 823 million if passenger time savings are considered). However, Mr. Diez concluded that a regional cost/benefit analysis might be more useful in order to achieve the best possible solution for all the States in a region.

5.5 Based on the guidance in ICAO Circular 257 Mr. Wickrama discussed some aspects of case studies in general. He pointed at results from studies made for United States (Oceanic areas) and India (from the airlines point of view), which both indicated that the implementation of the CNS/ATM systems would be cost-beneficial.

6. Financial performance

6.1 Mr. Upali Wickrama called attention to the need to distinguish in cost/benefit analysis between air carrier cost/benefit and State-as-provider cost/benefit, since they would be significantly different and would define the parameters of cost recovery by States through, for example, user charges on carriers. He also addressed the important issue of rate of return, which is a key measure of financial performance used by financial institutions in assessing applications for funds.

7. Cost recovery

7.1 Mr. Östen Magnusson spoke about cost recovery policy and mechanisms, placing particular emphasis on the *Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services*, (Doc 9082/5) which were widely followed by States, and the associated guidance in the new *Manual on Air Navigation Services Economics* (Doc 9161/3). He also described how to determine the costs involved and their allocation to civil aviation among user States, at the state level to non-aeronautical use, between airport and en-route utilization and finally among categories of air navigation services users.

8. Funding

8.1 As an introduction to this issue Mr. Östen Magnusson addressed CNS/ATM systems financing in the context of financing other air navigation services, basic issues related to financing air navigation services, the relevance of financial and economic analysis and the need for and form of a financing plan. Mr. Magnusson also identified the various means of funding and sources of funds, differentiating between domestic, foreign and other sources. The five most relevant sources for the CNS/ATM systems were expected to be direct contributions from government(s), debt financing, internally generated resources, equity financing and leasing.

8.2 Mr. Manfred Krüll, Deputy Director of ICAO's Technical Co-operation Bureau, described the structure and organization of ICAO's technical co-operation programme and the services offered by ICAO. Among typical ICAO projects that he mentioned were establishment, organization and operation of autonomous authorities; establishment of regional and sub-regional air navigation services; development and implementation of State-operated user charges collection systems; and development of CNS/ATM implementation plan, including cost-benefit and cost-recovery analyses. As most of the challenges in civil aviation that the States around the world now have to face no longer can be met at State level, Mr. Krüll suggested that ICAO would be the natural partner in assisting recipient States and to advise donor and funding organizations on the optimal investment of funds dedicated to civil aviation.

8.3 Mr. M.D. Sangare of the African Development Bank (ADB) Group declared that civil aviation needs to co-operate at the regional level in order to mobilize resources and to utilize more effectively the new technology, and that the issue of privatization is gaining practical importance as a mechanism for mobilizing resources for investment. Mr. Sangare also described the role of the bank group

and identified the various kind of projects in the civil aviation sector that it had financed. Since 1984 there had existed a co-operation agreement between ADB and ICAO, and since 1994 also a Memorandum of Understanding signed in order to facilitate collaboration between them.

8.4 Mr. Edgar Saravia of the World Bank focused on privatization as a solution to financing, noting that governments were not always achieving full cost recovery for air navigation facilities at present. He gave some examples of corporatization or privatization of air navigation services around the world. He stated that it is essential to redefine the role of the States and separate regulatory functions from operating functions, where in the latter case an increased private sector participation would secure the funds necessary for the investments needed. Mr. Saravia also invited ICAO to become a partner with the World Bank to ensure full compliance of all air transport regulations and standards by developing the conditions for increased private sector participation in the funding and operation of the sector.

9. Briefing on the CNS/ATM Implementation Conference

9.1 Mr. Judimar Chagas informed about the structure of the *World-wide CNS/ATM Systems Implementation Conference* to be held in Rio de Janeiro from 11 to 15 May 1998, referring to the invitation sent out in State letter M 8/1-97/89 of 17 October 1997. He explained that the main idea with the conference was to address the financial issues and to convince the States and the financing institutions that the time for implementation had come. In parallel with the conference there would be an exhibition to demonstrate that the technology is already available.

10. Summary, conclusions and follow-up actions

10.1 As a part of the summary of the meeting, Mr. Philippe Jacquard, France, described the experiences so far by France related to the implementation of the CNS/ATM systems, the main problem in congested areas being lack of capacity and in less congested areas lack of flexibility.

10.2 A panel of the speakers was set up to reply to questions on operational/technical, financial and training issues. Here the question was raised as to what funds that were available for implementation of CNS/ATM. In addition to the general classification of sources of funds identified by Mr. Magnusson above, the following foreign governmental financing sources were given as examples: World Bank Group, African Development Bank, European Development Fund, Islamic Development Bank, specific aid programmes which certain governments have established to promote economic and social development in various areas of the world and special export-promoting agencies of certain governments, e.g. export-import banks. Mr. Magnusson explained that cost/benefit analyses, cost recovery and autonomous authorities were all important factors when seeking funds for the implementation of CNS/ATM.

10.3 It was also questioned whether a State still would have to implement the CNS/ATM systems if a cost/benefit analysis showed a negative result and/or if all the benefits would go to the users. Mr. Wickrama emphasized the importance to look at the CNS/ATM systems as a package for civil aviation from a regional point of view. In the case where the users would gain significant benefits while the providers would experience net costs, adjustments should be made to the air navigation services charges. Co-operation, at a regional or a sub-regional level, through for example an international operating agency or a joint charges collection agency would facilitate the recovery of costs for the States involved.

10.4 In light of the on-going discussion concerning privatization of ATM (ATS) providers, compared to establishment of public autonomous authorities, it was suggested that the effects of privatization should be seriously analyzed, specially considering the development of international operating agencies for future ATM services.

10.5 In concluding the Seminar Mr. Wickrama made a summary of what had been presented under the various programme items, enclosed in **Appendix 3**. He also referred to the CNS/ATM Implementation Conference in Rio de Janeiro 1998 where the financial issues would be discussed next. At the end of the meeting Mr. Wickrama conveyed his sincere appreciation to the Government of Morocco for the excellent meeting arrangements and the generous hospitality extended to all participants of the Seminar.

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APPENDIX 1

LIST OF PARTICIPANTS

ALGERIA

Mr. Mohamed Tahar Bouarroudj
Directorate of Air Navigation

Office National de la Météorologie
Ministère des Transports
119, rue Didouche Mourad
Alger

Mr. Daoud Lakhdar

Établissement National de la Navigation
Aérienne (ENNA)
1, Avenue de l'Indépendance
BP 829
Alger

ANGOLA

Mr. Madrizi Diambote
Chief, Air Navigation Department

Direcção Nacional da Aviação Civil
Caixa Postal 569
Luanda

BAHRAIN

Mr. Ahmed Al-Jowder
Head of Finance

Ministry of Transportation
Civil Aviation Affairs
Air Transport Directorate
P.O. Box 586
Bahrain International Airport

Mr. Ahmed Al-Sayed
Head of Electronics Engineering

Ministry of Transportation
Civil Aviation Affairs
Air Transport Directorate
P.O. Box 586
Bahrain International Airport

BURKINA FASO

Mr. Moumouni Barro

Direction de l'Aviation Civile
10 Boîte Postale 1331
Ouagadougou 01

Mrs. Nana Guissou

Direction de l'Aviation Civile
01 Boîte Postale 1158
Ouagadougou 01

CAMEROON

Mr. Theodore Kamhoua
Chef du Service de
l'Exploitation technique des aéronefs

Ministère des Travaux Publics et des Transports
Direction de l'Aviation Civile
Yaoundé

Mr. Jean Djon
Ingénieur de la circulation aérienne

Ministère des Travaux Publics et des Transports
Direction de l'Aviation Civile
Yaoundé

CAPE VERDE

Mr. Celso Estrela
Administrator for Air Navigation and
Telecommunication

Empresa Nacional de Aeroportos e Segurança
Aérea - E.P.
Espargos C.P. 45
Ilha do Sal

Mr. José Rodrigues Aquiles
Director
Financing and Planning

Empresa Nacional de Aeroportos e Segurança
Aérea - E.P.
C.P. 58
Ilha do Sal

COMOROS

Mr. Ahmad Mohamed Chanfi
Directeur Général Adjoint

Direction Général de l'Aviation civile et de la
Météorologie
Chouanis B.P. 939
Moroni

CÔTE D'IVOIRE

Mr. Amadou Fadiga

Représentation de l'ASECNA
15 B.P. 918
Abidjan 15

ERITREA

Mr. Tadesse Kiflom
Financial Analyst

Ministry of Transport
Civil Aviation Department
Ministry of Transport
P.O. Box 252
Asmara

Mr. Berhane Zemicael
Chief Electronic Workshop & Laboratory

Ministry of Transport
Civil Aviation Department
Ministry of Transport
P.O. Box 252
Asmara

FRANCE

Mr. Philippe Jaquard
Director of Air Navigation

Ministère de l'Aménagement du Territoire, de
l'Équipement et des Transports
Directeur de Navigation Aérienne
48, rue Camille Desmoulins
92452 Issy-les-Moulineaux Cedex

Mr. Luc Lapine
Adjoint Relations Multilatérales

Ministère de l'Aménagement du Territoire, de
l'Équipement et des Transports
Directeur de Navigation Aérienne
48, rue Camille Desmoulins
92452 Issy-les-Moulineaux Cedex

GHANA

Mr. Edwin Addo
Director of Air Traffic Services

Ghana Civil Aviation Authority
Private Mail Bag
Kotoka International Airport
Accra

Mrs. Mary Obeng
Radio Manager

Ghana Civil Aviation Authority
Private Mail Bag
Kotoka International Airport
Accra

Wg. Cdr. L.E. Dwamena-Mante
Deputy Director

Private Mail Bag
Kotoka International Airport
Accra

GUINEA BISSAU

Mr. Vieira Queta
Director, Administration and Finance

Direction Nationale de l'Aviation Civile
Case postale 777
Aeroporto Internacional Osvaldo Vieira
Bissau

Mr. José Pinto Ferreira
Economist

Direction Nationale de l'Aviation Civile
Case postale 777
Aeroporto Internacional Osvaldo Vieira
Bissau

KENYA

Mr. George Mioui Njagi
Under Secretary (Aviation and Meteorology)

Ministry of Transport and Communications
P.O. Box 52692
Nairobi

Mr. Peter Njoroge
Economist

Directorate of Civil Aviation
P.O. Box 30005
Nairobi

Mr. Benn Amukowa
Planning Engineer

Directorate of Civil Aviation
P.O. Box 30163
Nairobi

LIBYA

Eng. Milad M. Matouk
Chief CNS/ATM Committee

Civil Aviation and Meteorological
Authority
Sharia El- Sayedi
P.O. Box 14399
Tripoli

MOROCCO

Mr. Moufid Mohamed
Director of Civil Aviation

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Rachid Azeroual Rachid
Director of Professional Training

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Abdessalam Sqalli
Director of Air Bases

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Abdel Ali Rabbani
State Engineer

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Abdelmoula Chantit
Chef de la Division des Opérations et de
l'Exploitation Aéroportuaire

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Yaälaoui Abdelouhab
Chief of Air Transport Division

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Abdenbi Manar
Chief of Air Navigation Division

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Abdellatif Lahboubi
State Engineer

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Abdesselam Bousfiha
Chief of Air Navigation Section

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Laärbi Zegoud
Chief of Search and Rescue Section

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Ammar Assou
Chef du Service de la M.T.O. aéronautique

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Abdelmajid Hadj Hamou
Chief of Statistics Section

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Nabil Lakhel
State Engineer

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Hicham Abdelaziz Moumni
State Engineer

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Mohamed Yagoubi
State Engineer

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Zakaria Echehahid
State Engineer

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Lahcen Boulahcen
State Engineer

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Taieb El Harchi
Direction du Budget

Ministère des Finances
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Mustapha Qninba
Direction des établissements publics et des
participations

Ministère des Finances
Boîte postale 1073
Rabat-Principal
Rabat

Mrs. Khadija Bradly
State Engineer

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Mohamed El Metoui
State Engineer

Ministère du Transport et de la Marine
Marchande
Boîte postale 1073
Rabat-Principal
Rabat

Mr. Ahmed Talha

Royal Air Maroc
Casa-anfa
Casablanca

Mr. Fouad Attar	Royal Air Maroc Casa-anfa Casablanca
Mr. Adil Messeoudi	Royal Air Maroc Casa-anfa Casablanca
Mr. Ahmed Khalil Lakhrouit	Royal Air Maroc Casa-anfa Casablanca
Mr. Babou Thami	Royal Air Maroc Casa-anfa Casablanca
CDB. Mohammadi Ghammarte	Royal Air Maroc Casa-anfa Casablanca
CDB. Omar Lechheb Royal Air Maroc	Royal Air Maroc 109 Boulevard Omar Elkhayam Casablanca
Mr. Dafir Arraki	Royal Air Maroc Casa-anfa Casablanca
Mr. Abdelali E. Hajjami	Ministère du Transport et de la Marine Marchande Boîte postale 1073 Rabat-Principal Rabat
Lt. Naoui Karim	Forces Royales Air a/s Office National des Aéroports Aéroport Mohamed V Nouassour Casablanca
Lt. Col. Mohamed Ouafi	Service Central des Transmissions de la Gendarmerie Royale Rabat
Lt. Col. Mohamed Dgadeg	Service Central des Transmissions de la Gendarmerie Royale Rabat

Cdt. Mohamed Ballouk	Service Central des Transmissions de la Gendarmerie Royale Rabat
Lt. Col. Chelouati Mohammed	EMA/FRA Division OPS B.P. 1002 Rabat
Lt. Col. Abdellatif Dinar	Service Central des Transmissions de la Gendarmerie Royale Rabat
Lt. Col. Ahmed El Bachar	Service Central des Transmissions de la Gendarmerie Royale Rabat
Commandant Lahcen Beraoud	Service Central des Transmissions de la Gendarmerie Royale Rabat
Mr. El Mostapha Rahhou	Groupe Aérien Service Central des Transmissions de la Gendarmerie Royale Rabat
Mr. Abdennabi Nasloubi	État Majeur Service Central des Transmissions de la Gendarmerie Royale Rabat
Mr. Habri Ahmed	Service Central des Transmissions de la Gendarmerie Royale Rabat
Mr. Ahmed Ennaji	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Bouchaib Hasbi	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Ahmed Hilal	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca

Mr. Jilali El Hamdani	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Hamid Mokadem	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Anass Lahkim	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Lahcen Ferhat	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Mohamed Abeis	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Brahim Lakhlifi	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Mohamed Fahim	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Lahcen Chakib	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Driss Achbakou Airport Manager	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Mohammed Ouitassane	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca

Mr. Aziz Tazi	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Mohamed Lebied	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Abdellah Bensahal	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Wahb Kermadi	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Ahmed Zine Chief Radar Division	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Mohamed Bendadou	Office National des Aéroports B.P. 5239 Casablanca-Maarif Casablanca
Mr. Moulay Driss El-Hassani El-Alaoui	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Adnane Ouazzani	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Driss Adnane	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Driss El Alami	Office National des Aéroports B.P. 5239 Casablanca-Maarif Casablanca

Mr. El Bachir Beraich	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Abdelfattah Moumni Abdou	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Mohamed Ghassani	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Driss Tarrhaout	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Hassan Chamkmaki	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Mohammed Benlemmouden	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Hassan Tajly	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Mohammed Malkane	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Abdellatif Metoual	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca
Mr. Hicham Benjilali	Office National des Aéroports Aéroport Mohamed V Nouasseur Casablanca

Mr. Moulay Lhassan Zidane

Office National des Aéroports
Aéroport Mohamed V
Nouasseur
Casablanca

Mr. Driss Abdelfadel

Office National des Aéroports
Aéroport Mohamed V
Nouasseur
Casablanca

Mr. Abdellatif Jabir

Office National des Aéroports
Aéroport Mohamed V
Nouasseur
Casablanca

Mr. Lahcen Baha

Office National des Aéroports
Aéroport Mohamed V
Nouasseur
Casablanca

Mr. Abdelkader Mediane Abdelkader

Office National des Aéroports
Aéroport Mohamed V
Nouasseur
Casablanca

NIGER

Mr. Amadou Adamou
Chef du Service Navigation Aérienne

Direction de l'Aviation Civile
Ministère des Transports
B.P. 727
Niamey

REPUBLIC OF YEMEN

Eng. Hussien H. Al-Sayaghi
Deputy Chairman

Civil Aviation and Meteorology Authority
P.O. Box 1042
Sana'a

Eng. Sultan Ahmed
D.G. of Engineering

Civil Aviation and Meteorology Authority
P.O. Box 1042
Sana'a

Mr. Ahmed Hamid A. Al-Athwari
Director, Air Traffic Control

Civil Aviation and Meteorology Authority
P.O. Box 1042
Sana'a

RWANDA

Mr. John Semafara Ntaganda
Director of Aeronautics

Ministry of Transport and Communications
Directorate of Aeronautics
B.P. 898
Kigali

SÃO TOMÉ AND PRINCIPE

Mr. Óscar do Nascimento Aragão
Chief of Economic Department

Entreprise d'Exploitation Aéroportuaire
"ENASA"
Boîte postale 703
São Tomé

SAUDI ARABIA

Mr. Mohammed Ali Al Manabri

Airways Engineering Department
Presidency of Civil Aviation
P.O. Box 15441
Jeddah 21444

Mr. Mohammed Hamawi

Ministry of Defence PCA
P.O. Box 15441
Jeddah 21444

SPAIN

D^{na}. Celia Rios Dochao
Jefe de División de Tarifas de Navegación Aérea

AENA
Oficina de Normas Internacionales
Dirección General de Aviación Civil
Paseo de la Castellana, 67
28071 Madrid

Dr. David Díez
Experto CNS/ATM

AENA
Oficina de Normas Internacionales
Dirección General de Aviación Civil
Paseo de la Castellana, 67
28071 Madrid

SWAZILAND

Mr. Jabu L. Ngubane
Head of Air Traffic Services

Matsapha Airport
P.O. Box 89
Kwaluseni

TUNISIA

Mr. Mohamed Cherif
Director of Telecommunications

Office des Ports Aériens de Tunisie
Aéroport International de Tunis - Carthage
B.P. 137 et 147
1080 TUNIS CEDEX

Mr. Chaouki Mustapha
Principal Engineer

Direction Générale de l'Aviation Civile
1 Rue d'Athènes - Tunis
1000 TUNIS R.P.

Mr. Mohamed Ali Ben Alaya
Chief of Division OPAT

Direction Générale de l'Aviation Civile
1 Rue d'Athènes - Tunis
1000 TUNIS R.P.

Mr. Khaled Maatouk
Director of Management Control

Office des Ports Aériens de Tunisie
Aéroport International de Tunis - Carthage
B.P. 137 et 147
1080 TUNIS CEDEX

UNITED REPUBLIC OF TANZANIA

Mr. Moshi Augustine
Acting Director of Planning and Research

Directorate General of Civil Aviation
P.O. Box 2819
Dar-es-Salaam

Mr. Mumtazhussein Roshan Alloo
Chief of Air Traffic Management

Directorate General of Civil Aviation
P.O. Box 2819
Dar-es-Salaam

ORGANIZATIONS

AFRICAN DEVELOPMENT BANK (ADB)

Mr. Modibo Djimet Sangare
Senior Transport Engineer

Division Infrastructure & Industry North Region
B.P.V. 316
Abidjan
Côte d'Ivoire

AGENCE POUR LA SÉCURITÉ DE LA NAVIGATION AÉRIENNE EN AFRIQUE ET À MADAGASCAR (ASECNA)

Mr. Youssouf Mahamat

32-38, Avenue Jean-Jaurès
B.P. 3144
Dakar

Mr. Amadou O. Guitteye

32-38, Avenue Jean-Jaurès
B.P. 3144
Dakar

**AIRPORTS COUNCIL INTERNATIONAL
(ACI)**

Mr. Baji Rao Chaturvedi
Director of Communication
Airports Authority of India

National Airports Authority
1G1 Airport
Safdarjung Airport
New Delhi - 110037

Mr. Sidi Mohamed Fahim

CNCJA
B.P. 5239
Casablanca-Maarif
Casablanca

**ARAB CIVIL AVIATION COMMISSION
(ACAC)**

Mr. Abdoullah Mejjallid
Director General

48 Eksas
Rabat - Souissi
Morocco

Mr. El Kettami Oussama

P.O. Box 5025
Rabat - Souissi 10105
Morocco

**INTERNATIONAL AIR TRANSPORT
ASSOCIATION (IATA)**

Ms. Véronique Vincent
Manager, Cost Benefit Analysis

33 route de l'Aéroport
P.O. Box 416
CH-1215 Geneva 15 - Airport
Switzerland

Mr. Djamel Otsmane

33 route de l'Aéroport
P.O. Box 416
CH-1215 Geneva 15 - Airport
Switzerland

**INTERNATIONAL FEDERATION OF
AIRLINE PILOTS ASSOCIATIONS
(IFALPA)**

Captain Karim Majdi
Association Marocaine du Personnel Navigant
Technique

AMPNT
Aéroport de Casablanca - ANFA
Casablanca
Morocco

**INTERNATIONAL MOBILE SATELLITE
ORGANIZATION (INMARSAT)**

Mr. David H. Featherstone
Senior Manager
ATS Services Development

99 City Road
London EC1Y 1AX
United Kingdom

**SOCIÉTÉ INTERNATIONALE DE
TÉLÉCOMMUNICATIONS
AÉRONAUTIQUES (SITA)**

Mr. Kieran O'Rourke
Air Ground Services Division

26, ch. De Joinville - Case 31
1216 Cointrin
Geneva, Switzerland

**INTERNATIONAL CIVIL AVIATION
ORGANIZATION**

Mr. R.C. Costa Pereira
Secretary General

999 University Street
Montreal, Quebec
H3C 5H7 Canada

Mr. V. Aguado
Chairman of the Air Navigation Commission

999 University Street
Montreal, Quebec
H3C 5H7 Canada

Mr. M.Z. Anwar
Economics Assistant
Forecasting and Economic Planning Section

999 University Street
Montreal, Quebec
H3C 5H7 Canada

Mr. Judimar D. Chagas
Chief, Communications, Navigation and
Surveillance Section

999 University Street
Montreal, Quebec
H3C 5H7 Canada

Mr. Manfred Krüll
Deputy Director
Technical Co-operation Bureau

999 University Street
Montreal, Quebec
H3C 5H7 Canada

Mr. J. Lare
Technical Officer
Communications, Navigation and Surveillance

Western and Central African Office
15, boulevard de la République
Dakar, Sénégal

Mr. Östen Magnusson
Economist
Airport and Route Facility Management Section

999 University Street
Montreal, Quebec
H3C 5H7 Canada

Mr. G.P. Moshabesha
Air Transport Officer

Eastern and Southern African Office
United Nations Accommodation
Limuru Road, Gigiri
Nairobi

Mr. Upali Wickrama
Chief, Forecasting and Economic Planning
Section

999 University Street
Montreal, Quebec
H3C 5H7 Canada

Mr. M.E.B. Zarroug
Air Transport Officer

Middle East Office
P.O. Box 85
Cairo Airport Post Office Terminal One
Cairo 11776 - A.R.E.

APPENDIX 2

LIST OF ICAO PUBLICATIONS

Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services (Doc 9082/5)

Report on Financial and Related Organizational and Managerial Aspects of Global Navigation Satellite System (GNSS) Provision and Operation (Doc 9660)

Economics of Satellite-Based Air Navigation Services – Guidelines for cost/benefit analysis of communications, navigation and surveillance/air traffic management (CNS/ATM) systems (Circular 257-AT/106)

Manual on Air Navigation Services Economics (Doc 9161/3)

APPENDIX 3

MODERATOR'S SUMMARY OF THE SEMINAR

by Mr. Upali Wickrama

What did I hear in this conference primarily from our participants? Financing, financing, financing. How do we get the money? How do we get better cost information? That was really the theme and we need to address this particular area. First of all, I would like to go back to the first day, the opening of the seminar when the Secretary General of ICAO referred in his opening address that, before implementation of the CNS/ATM system can take place, many organizational changes must be addressed by States, both individually and collectively. And that the seminar is organized to address these issues related to economic and organizational aspects of CNS/ATM implementation. He also referred in his conclusion that we need to look at CNS/ATM not only as just a facilitator for safe and efficient air navigation transport, but also the impact it would have in the overall world economy. In other words, implementation of this system would provide an additional impact towards the world economy.

And we heard from the President of our Air Navigation Commission. He touched upon one particular issue that comes to my mind, "safety, especially in low density areas". Implementation of this system would provide accuracy, precision guidance and safety. Now, the question he proposed was how do you bring safety into cost/benefit analysis? Indeed, we at ICAO consider safety of paramount importance. So, in the implementation phase, we do know that States need to look at safety and we cannot quantify that effect. We cannot put any monetary value to it, but certainly safety is one of the biggest areas of benefits that we need to look at.

So after that fantastic lunch hosted by Morocco we got into the heart of the problem, in key areas. And, we began our deliberations with the CNS systems elements overview. There were clear, explicit advantages of CNS/ATM compared with existing systems and we also identified some of the strategic vision and objectives of CNS/ATM. The current updating of ICAO's coordinated Global Plan was mentioned and it was emphasized that CNS/ATM builds on the existing systems and does not necessarily replace them. In other words, building on the existing technology wherever possible in harmony with global planning and transition programmes. This is the way. So it is not effectively looking at new equipment per se, but the modernization of current technology and its evolution. We also heard from ICAO's Regional Officers regarding what is being done in the regions in terms of planning and implementation in accordance with the AFI/7 RAN Meeting. We heard from Morocco, a sub-regional approach developed by a group of five States, harmonization of the air navigation systems, technology training and what is being done in these areas.

And, when we look at the organizational issues, we had several presentations. From ICAO, we described the structure, ownership and control of air navigation services in general and the various options available in connection with the implementation of CNS/ATM in particular, and we reviewed some of the guidance materials we have. The other area, perhaps most important, drew attention to the general conclusion that in the legal field, there are no legal obstacles to the implementation of CNS/ATM and no inconsistency with the Chicago Convention. So, what we are saying is technical aspects appear to be in place. There are no real legal problems associated with this. Now it is the implementation programme - where is the money going to come from - the financing side again. And, of course, we heard from the service providers about the possibility of them acting both as providers of services and how they can help in these aspects.

Now, next key area that we got into, of course, was costs and benefits - whether and when to enter into financial commitments and how do we use cost/benefit analysis. Or, do we even need it because it has already been established that the CNS/ATM is the future technology - that is the way to go. But, again coming into the issue of financing, we have to analyse the economic viability of the project. And we do know that large capital expenditures in the earlier years would be followed by many years of benefits. And in this context, we discussed the issue of transition to CNS/ATM by service providers and users in a coordinated fashion so that benefits are maximized but keeping in mind that it could not in any way compromise safety. So, we will have some period in time where we will have the two systems running in parallel. Yes, we would indeed like to minimize costs but not at the expense of safety. So, these are areas that we discussed in detail and we had afterwards the session yesterday afternoon, which I thought was most productive of the entire seminar. That is, when we looked at the aspects of questions and answers to get feedback from our participants to see how we can help each other in this field. And there were questions raised in relation to some of the institutional issues as to what might happen beyond this time period when perhaps GPS and GLONASS may not be available. Certainly, what we are looking at right now is the current horizon in this time period. It is something that another group of ICAO is studying into even a longer time horizons of possibilities.

Now, within the financial side, after the cost/benefit analysis presentations, we did have demonstrations of case studies, one from Spain and several others. Each of these studies demonstrates that net benefits of implementing this system would exceed costs whichever way we look at it. However, most of the costs are being borne by one segment, i.e. service providers, but the benefits would go to some other areas (mainly users). And also the issue was mentioned here during the questions that in a developing country where the traffic density is low, would it be worthwhile or beneficial to invest in these systems. The idea here is that in a global context, we believe that it is beneficial. Therefore, the prospects of new flight patterns as a result of CNS/ATM implementation emphasize the importance of international cooperation, not only for implementing the most efficient routes, but also for achieving an acceptable distribution of benefits and financial risks faced by individual States. So, cost/benefit analysis has an important role at the regional level. And, of course, then we came to the discussion of some broader economic and social impact, safety, environmental benefits, productivity improvements as we go along and the cost of automation of these systems. So, all these would have an impact on the overall economy. Now, as far as the cost issue was concerned, we mentioned that at the Rio conference we are going to have an exhibition where technical capability of equipment concerned will be demonstrated, their availability, range of possible cost and other relevant information. And we noted in the discussion of cost analysis that there is some uncertainty regarding the cost of certain types of equipment. We demonstrated yesterday that, in some cases, we may need to look at the range of cost for different equipment and what their broader implications are in terms of sensitivity analysis.

Finally we came into the funding area, we discussed the various sources of and availability of funding, and the role of ICAO's Technical Cooperation Bureau where we can provide some assistance in the area of training, workshops and even get consultation support. I was also really pleased to hear the presentations from the banks concerned and World Bank's commitment to work with us at ICAO to develop strategies that are helpful to the aviation industry as a whole.