

**ASIAN DEVELOPMENT BANK**

**TAR:STU 32575**

**TECHNICAL ASSISTANCE**

**FOR**

**COOPERATIVE AIRSPACE MANAGEMENT IN THE PACIFIC REGION**

**August 2000**

## **ABBREVIATIONS**

ADB	–	Asian Development Bank
ADS	–	automatic dependent surveillance
ASECNA	–	Agency for Security of Air Navigation in Africa and Madagascar
ATC	–	air traffic control
CAAFI	–	Civil Aviation Authority of Fiji Islands
CNS/ATM	–	Communications Navigation Surveillance/ Air Traffic Management
DARP	–	dynamic air route planning
FIR	–	flight information region
IATA	–	International Air Transport Association
ICAO	–	International Civil Aviation Organization
PAC	–	Pacific Airways Corporation
PDMC	–	Pacific developing member country
SARATA	–	Southern Africa Regional Air Transport Authority
TA	–	technical assistance
VHF	–	very high frequency

## **NOTE**

In this Report, “\$” refers to US dollars.

## I. INTRODUCTION

1. The regional technical assistance<sup>1</sup> (TA) will examine modalities under which Communications, Navigation, and Surveillance Air Traffic Management<sup>2</sup> (CNS/ATM) can be installed in an amalgamated regional airspace in the Pacific region. The TA is expected to lead to an effective cooperative regional management of airspace. The participating Governments<sup>3</sup> aim to implement the satellite-based CNS/ATM under conditions of an amalgamated airspace in the Pacific region, and the TA will prepare a strategic action plan guiding this implementation process, with attention to participatory consultation and economic efficiency.

2. The Asian Development Bank's (ADB) TA for Pacific airport facilities in December 1994<sup>4</sup> examined the provision, harmonization, and rationalization of air traffic services in the Pacific region, and determined the requirements for introduction of CNS/ATM. It identified substantial economic benefits in regional cooperation through the installation of CNS/ATM and regional management of airspace. Since then various aviation partners of the Pacific developing member countries (PDMCs) have prepared documentation on the subject. The result, however, is fragmented understanding of the financial, economic, institutional, legal, and social implications of the proposal. PDMCs have collectively, through the South Pacific Forum, requested that ADB assume a lead role in developing a feasible strategy for the Pacific region to meet the global requirements in the aviation sector. ADB's comparative advantages in undertaking the role are its neutral and multilateral nature, long-term development perspective, and continuing support to the PDMCs.

3. The International Civil Aviation Organization (ICAO), a specialized agency of the United Nations, is concerned with implementing the new CNS/ATM in the region and worldwide. It is responsible for global standards and recommended practices and develops regional air navigation plans. ICAO's experience in establishing unified airspace management is recognized and has led to successful examples in the Caribbean (COCESNA) and Africa (ASECNA and SARATA). This report was prepared in collaboration with ICAO and based on consultations with PDMCs governments and service providers. The TA framework is in Appendix 1.

## II. BACKGROUND AND RATIONALE

4. The current efficiency of air traffic control (ATC) services is dependent on air-ground communications and surveillance. These radar and very high frequency (VHF) radio communications work on line-of-sight basis. Over long distances, and particularly in oceanic

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<sup>1</sup> The TA first appeared in the *ADB Business Opportunities* in July 2000.

<sup>2</sup> The air navigation infrastructure comprises a collection of radio-based terrestrial facilities such as very high frequency omnidirectional radio (VOR), instrument landing systems (ILS, distance measuring equipment (DME), non-directional beacons, and surveillance radar. These systems have been used for more than 45 years. They are expensive to procure and maintain, and are increasingly unable to cope with the growing volume of air traffic around the world. In 1984, ICAO established a committee on Future Air Navigation Systems (FANS) to study the development of a more cost-effective system of satellite-based air navigation technology to replace the traditional ground-based systems. The Communications Navigation Surveillance/Air Traffic Management (CNS/ATM) System emerged from the recommendations of the FANS committee. CNS/ATM system promises considerable savings for governments in reduced investment and maintenance of ground-based aids and for users of the system through more direct air routes and consequently reduced flight times and costs. Implementation of CNS/ATM system by some countries commenced in 1994. The system will be implemented progressively worldwide by the year 2010.

<sup>3</sup> Fiji Islands, Kiribati, Marshall Islands, Federated States of Micronesia, Nauru, Samoa, Tonga, Tuvalu, and Vanuatu.

<sup>4</sup> TA 5610-REG: *Pacific Airports Project Facility*, for \$600,000, approved on 21 December 1994.

areas of the Pacific, the radio signals encounter capacity limitations. As a result, the flight information regions (FIR) rely on procedural systems for ATC with little or no automation. Subsequently, the flights must be planned via intermediate way-points rather than on the most direct routes. This has an adverse effect on aircraft operating costs.

5. With the new satellite-based CNS/ATM, communications would be linked directly from the satellite to the aircraft, and would not require a line-of-sight between the two. For navigation, CNS/ATM includes satellite constellations, aircraft receivers, and monitoring facilities. An independent on-board aircraft position-determination equipment is a key feature. Surveillance under the CNS/ATM is carried out by automatic dependent surveillance (ADS). It allows the aircraft to automatically transmit its position to air traffic service centers via data-link communications. The new system results in improved data handling and transfer of information between operators, aircraft, and air traffic services.

6. At present, aircraft follow fixed routes based on navigation aids installed on the ground. This creates congestion and prevents aircraft from taking cost-reducing operational advantage of weather. CNS/ATM allows aircraft to fly more direct routes, leading to reduced delays and savings in fuel and equipment. Other benefits include enhanced safety, more efficient use of airspace and airport capacity, and uniform and cost-effective provision and maintenance of CNS. Implementing the CNS/ATM system promotes traffic growth, making the new system economically more attractive as traffic increases over time. Consequently, a delay in implementing the system means loss of benefits in the near term. The air traffic management services that can be provided will no longer be constrained by the limitations of existing terrestrial-based systems. The services can be provided from a single ATC center to large oceanic areas and thereby transcend the traditional compartmentalization of airspace established by FIR boundaries.

7. Provision of upper airspace navigation services is currently the responsibility of eight service providers under nine FIRs as shown in Table 1.

**Table 1: Upper Airspace Navigation Service Provision in Pacific Countries**

Location	Flight Information Region	Service Provider
American Samoa (US)	Nadi FIR	CAAFI
Australia	Brisbane	Air Services Australia
Fiji Islands	Nadi FIR	CAAFI
Kiribati	Nadi FIR	CAAFI
Papua New Guinea	Port Moresby	Dept. of Civil Aviation PNG
Samoa	Nadi FIR	CAAFI
Tokelau (NZ)	Nadi FIR	CAAFI
Tonga	Nadi FIR	CAAFI
Tuvalu	Nadi FIR	CAAFI
Vanuatu	Nadi FIR	CAAFI
New Caledonia (FR)	Nadi FIR	CAAFI
Kiribati North-East	Oakland FIR	Federal Aviation Administration (FAA)
Marshall Islands	Oakland FIR	FAA
Micronesia	Oakland FIR	FAA
Nauru	Nauru FIR	FAA
Niue (NZ)	Auckland FIR	Airways Corporation NZ
New Zealand (NZ)	Auckland FIR	Airways Corporation NZ
Cook Islands	Cook Sector	Airways Corporation NZ
Solomon Islands	Honiara FIR	Airservices Australia
Tahiti	Tahiti FIR	Dept. of Civil Aviation, Tahiti

CAAFI=Civil Aviation Authority of Fiji Islands, FAA=Federal Aviation Administration, FIR=flight information region, FIS=flight information sector.

8. ADB's TA 5610: Pacific Airport Facilities (footnote 4) identified substantial economic benefits in regional implementation and management of CNS/ATM. It recommended (i) the establishment of the Pacific Airways Corporation (PAC) for the management of the unified regional air space, (ii) regional investment in CNS/ATM technology, and (iii) provision of upper airspace navigation services by PAC. Concurrently, the Airways Corporation of New Zealand (ACNZ) and Air Services Australia proposed to provide upper airspace navigation services under airspace management contracts on behalf of the PDMCs.

9. The TA supports the establishment of a unified airspace and CNS/ATM system in the Pacific region. Unified airspace management yields significant safety benefits as navigation services will be provided in a seamless airspace. It becomes unnecessary to transfer the control of traffic from one service provider to another, each potentially operating under varying standards. Unified airspace management eliminates duplication of facilities, which is a cost concern of the International Air Transport Association (IATA). As use of flexible flight tracks and dynamic air route planning (DARP) become feasible through implementation of CNS/ATM technology, the regional approach adopted under TA ensures reimbursement for the maintenance of the aviation facilities of the participating States even when flight routes do not pass a particular State's airspace. Finally, charges for a unified airspace can be set in accordance with the respective costs, while national airspace will have to align its charges with those of the neighboring airspace regardless of the costs.

10. An essential prerequisite to identification and development of a viable strategy for the management of the airspace in the region is the definition of the operational, technical, financial, economic, commercial, and socioeconomic objectives pursued under various available options. These relate to the broader benefits of the options for trade, tourism, and transport sector growth, and, subsequently, acceleration of economic development in the region. The objectives of such a strategy are to (i) promote and enhance aviation safety; (ii) provide and support safe, efficient, cost-effective, and financially self-sufficient air navigation services; (iii) standardize and harmonize aeronautical services and procedures; (iv) rationalize aviation infrastructure and ensure its sustainability; (v) promote commercial development in the aviation sector; (vi) satisfy the demand for suitably qualified human resources in the aviation sector; (vii) provide PDMCs with reasonable returns on aviation investments; and (viii) make civil aviation a catalyst for promotion of commerce, trade and tourism so that through the socioeconomic development of the individual PDMCs, growth in the region is accelerated.

11. In line with ADB's operational strategy in the Pacific, the TA supports a significant regional cooperative undertaking. Efficient communications and transport links have proven essential for enhancing growth in the Pacific. The TA will advance the safety and economic viability of the region's airspace. These benefits lead to reduced cost of air transport, fueling an increase in air transport and travel and, subsequently, economic growth. The transition to CNS/ATM systems is one of the largest undertakings carried out by the aviation community worldwide. This is not only because of the scale of the change, but also because the transition will fundamentally change the way in which air traffic services would be provided. ICAO has developed an indicative schedule leading to a global implementation of CNS/ATM system by 2010. Each provider is attempting to refurbish its depreciated navigation equipment with those compatible with the new CNS/ATM technology in accordance with the Asia/Pacific Implementation Plan for the New CNS/ATM System of ICAO.

12. Establishing a regional management and service provision capacity in the Pacific region is a unique regional effort. The TA supports development of a regional strategy for the

transition to the CNS/ATM system in the region. The benefits from adopting a unified approach to upper and, also in some cases, lower airspace management have been assessed to be far greater than those from fragmented and nationally managed CNS/ATM systems. Reimbursement to the PDMCs from the charges for CNS/ATM services will be directed to improvement of national civil aviation, making air transport safer and more viable.

### **III. THE TECHNICAL ASSISTANCE**

#### **A. Objectives**

13. The TA seeks to establish a feasible and viable strategy for transition to CNS/ATM-based airspace management under conditions of amalgamated and unified airspace in the Pacific region. The TA will (i) prepare a detailed feasibility analysis of options for provision of upper airspace navigation services using a CNS/ATM system; and (ii) evaluate the distribution of costs and benefits to the PDMCs, and impacts on economic development and growth.

#### **B. Scope**

14. The TA includes preparation and achieving consensus on (i) a strategic implementation action plan for cooperative airspace management, (ii) an organizational framework for management of airspace, (iii) cost-benefit analysis for each PDMC, (iv) macroeconomic review of the socioeconomic and growth-related benefits arising from civil aviation development, (v) a strategic human resource plan for airspace management purposes, and (vi) funding and other resource requirements for establishing cooperative airspace management and preparing relevant financial packages for external funding. The detailed terms of reference are in Appendix 2.

#### **C. Cost Estimates and Financing Plan**

15. The RETA is estimated to cost \$497,000 equivalent. The TA will be financed by ADB on a grant basis in the amount of \$350,000 from the ADB-funded TA program. ADB financing will cover remuneration and per diem charges of the consultants, travel and transportation, reporting, and workshops. ICAO will finance additional consultant services in the amount of \$147,000 on a grant basis. The governments will provide office space for the consultants. Detailed cost estimates are shown in Appendix 3. The governments have been informed that approval of the TA does not commit ADB to finance any ensuing project.

#### **D. Implementation Arrangements**

16. ADB will be the Executing Agency for the TA. The TA activities will cover Cook Islands, Fiji Islands, Kiribati, Marshall Islands, Federated States of Micronesia, Nauru, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu. The TA will require a total of 12.5 person-months of consulting services in the fields of CNS/ATM technology and implementation, airspace management, aviation economics and financial analysis, corporate finance, institutional development and legislation, international airspace law, and the relevant ICAO recommendations. The direct engagement of ICAO for the assignment proposed. It is justified for these reasons:

- (i) ICAO has excellent knowledge of and background in the development of CNS/ATM technology and has developed internationally adopted economic analysis methodology for evaluating the benefits of CNS/ATM.

- (ii) ICAO regulates and approves FIRs and endorses proposals for amalgamation of airspace.
- (iii) ICAO has developed a wealth of literature and aviation industrywide guidelines on the requirements of feasibility studies for the provision of air navigation management services.
- (iv) PDMCs have directly requested ICAO's involvement as the consultant under the TA due to its neutrality and credibility as a multilateral agency.

17. The consultant will commence work in September 2000 and present the draft findings of the analysis in December 2000. The duration of the assignment will be about four months and be completed in January 2001. The consultant will frequently communicate with relevant authorities in PDMCs to obtain their concurrence and guidance on the proposals prepared under the assignment. The consultant will organize two review meetings in which ADB, PDMCs, and the consultant will review the prepared reports.

#### **IV. THE PRESIDENT'S DECISION**

18. The President, acting under the authority delegated by the Board, has approved the provision of technical assistance, on a grant basis in an amount not exceeding the equivalent of \$350,000 for the purpose of the Cooperative Airspace Management in the Pacific Region, and hereby reports such action to the Board.

## TECHNICAL ASSISTANCE FRAMEWORK

Design Summary	Targets	Project Monitoring Mechanism	Risks/Assumptions
<b>A. Sector Goal</b>  A common strategy for implementation of satellite-based navigation services under conditions of a cooperative regional airspace management	A strategy with a plan of action for implementing satellite based navigation services within amalgamated regional airspace	A strategy document with milestone and time-bound targets	Timely agreement of the Pacific developing member countries (PDMCs)
<b>B. Objectives/Purpose</b>  Preparation of a strategy and a feasibility study of implementation of communication, navigation, surveillance air traffic management (CNS/ATM) services using satellite technology in a unified regional airspace	Preparation of a draft strategy document by 15 October 2000  Preparation of cost-benefit calculations for the proposed options for implementing CNS/ATM in the region by 15 October 2000  Preparation of draft legal and institutional implications of each option by 15 October  Preparation of human resources development plan required for implementing the strategy by 15 October 2000  Preparation of broad economic and trade related benefits of the proposal by 15 November 2000	PDMC agreements on the proposals  TA reports  Meeting of civil aviation authorities in October 2000  Meeting of civil aviation ministers in November 2000  Review missions	Timely agreement among the PDMCs
<b>C. Project Components</b>  (i) A strategic implementation action plan for cooperative airspace management  (ii) Organizational framework for management of airspace  (iii) Cost-benefit analysis for each PDMC	Inception report covering methodology for addressing the tasks, two weeks after commencement  Midterm report covering approaches and preliminary recommendations on all components of the assignment, by two	Time-bound delivery of outputs on each item in the terms of reference reviewed through the submitted reports  Time-bound and comprehensive consultations with PDMC authorities in obtaining concurrence on proposals	Delay in submission of proposals  Delays in consultation process



<b>Design Summary</b>	<b>Targets</b>	<b>Project Monitoring Mechanism</b>	<b>Risks/Assumptions</b>
(iv) Macroeconomic review of the socioeconomic and growth-related benefits arising from civil aviation development  (v) A strategic human resource plan for airspace management purposes  (vi) Funding and other resource requirements, for establishment of cooperative airspace management and preparation of relevant financial packages for external funding	months after commencement  Draft final report covering all data and details on the recommendations and proposals and reflecting agreements reached for the strategy and feasibility study  Final report one month after the draft final report, providing the outputs of the project		
<b>D. Project Inputs</b>  About 12.5 person-months of consulting services delivered over a 4-month period	Award of contract to the International Civil Aviation Organization for a contract of 12.5 person-months for a total amount of \$497,000	Delivery of inputs on time and delivery of reports as required	Timely delivery of services

## **TERMS OF REFERENCE FOR CONSULTING SERVICES**

### **A. Objective**

1. The objectives are to prepare, consult, and reach an agreement on a strategy for establishing a feasible and viable strategy for transition to a Communications Navigation Surveillance/Air Traffic Management (CNS/ATM) based airspace management under conditions of an amalgamated and unified airspace in the Pacific region. The consultant will prepare a detailed feasibility analysis of options for provision of upper airspace navigation services using the CNS/ATM system and evaluate the distribution of costs and benefits to the Pacific developing member countries (PDMCs), and impacts on economic development and growth.

### **B. Scope**

2. The consulting services will prepare and achieve a consensus on (i) a strategic implementation action plan for cooperative airspace management, (ii) an organizational framework for management of airspace, (iii) cost-benefit analysis for each PDMC, (iv) macroeconomic review of the socioeconomic and growth-related benefits arising from civil aviation development, (v) a strategic human resource plan for airspace management purposes, (vi) funding and other resource requirements for establishing cooperative airspace management and preparing relevant financial packages for external funding.

### **C. The Consultant**

3. TA will require about 12.5 person-months of consulting services from the International Civil Aviation Organization (ICAO). A direct engagement of ICAO is justified because (i) ICAO has an ownership claim to the development of CNS/ATM technology, (ii) ICAO regulates and approves FIRs and endorses proposals for amalgamation of airspace, (iii) ICAO has developed a wealth of literature and agreed-upon aviation industrywide guidelines for requirements in providing air navigation management services, and (iv) PDMCs have directly requested ICAO's involvement as the Implementing Agency under the TA due to its neutrality and credibility as a multilateral agency.

### **D. Terms of Reference**

4. The work will include, but will not necessarily be limited to, the following tasks:
- (i) Prepare a time-bound consultation program that ensures achievement of the TA objectives and includes clear milestones reconfirming the support and agreement of all PDMCs participating in the TA.
  - (ii) Review relevant material prepared previously by different consultants/organizations for the management of the airspace in the Pacific region.
  - (iii) Review air navigation plans for the Pacific region, with regard to density of traffic and implementation of air navigation facilities and services, i.e., (a) evaluating current airspace and CNS/ATM systems, airspace structure, communication and surveillance capability, aircraft navigation performance and air traffic flow management capability in the Pacific region; (b) preparing a proposal for airspace and CNS/ATM systems with several options, taking into consideration, separation minima to be applied, airspace structure and airway systems, air

traffic flow performance, and air traffic system performance including CNS; (c) preparing options for establishing air traffic management operational requirements, and consequent technical specifications/requirements; (d) quantifying equipment requirements; and (e) prepare specification of qualifications, experience required for the personnel to manage the system and determine training needs for the selected personnel, and suggest appropriate on-the-job as well as external training interventions.

- (iv) Examine the options for management of airspace including (a) possibilities with existing service providers, (b) merger of facilities, (c) contracting out of services, and (d) establishing regional capacity and organization for provision of the services.
- (v) Prepare cost estimates of all associated activities for unified airspace management, including retrofitting and upgrading of aircraft operating in the region for capacity to utilize CNS/ATM services.
- (vi) Develop a model for cooperative airspace management over territorial and oceanic airspace in PDMCs, comprising upper and, where applicable, lower space.
- (vii) Prepare a suitable organization and institutional framework for management of the suggested model.
- (viii) Identify, analyze, and prepare a strategy for addressing the legal implications of the proposed strategy.
- (ix) Develop a forecast of annual traffic-overflying as well as landing/departing flights-within cooperative airspace from 2000 to 2010.
- (x) Carry out training needs assessment, and outline training and nontraining interventions required for capacity building.
- (xi) Carry out in adequate detail financial and economic analyses for establishing costs, benefits, contribution, and income-sharing matrix with logical explanations, feasibility and desirability of each organizational options considered. The analyses will comprise all costs and benefits, risks and scenarios, and the respective sensitivity analysis; and consider employment and training benefits in the short and long terms as applicable in the economic analysis. The analyses will address the issue of establishing an acceptable formula for cost recovery charges and analyze the anticipated revenues, propose a reimbursement scheme for the use of the PDMCs' ground-based technology for the benefit of the upper airspace navigation services, if any. The analyses will conform with ADB's *Guidelines on Economic Analysis of Projects* and the relevant guidelines of ICAO.
- (xii) Review the national developmental plans of PDMCs so as to identify and record the impact of civil aviation on the socioeconomic development of the PDMCs and the region.

- (xiii) Prepare a resource implications and mobilization strategy for meeting funding requirements; and prepare proposals for financing the strategy, minimizing the borrowing costs of PDMCs by considering external financing from commercial, bilateral, and multilateral sources including ADB.

## E. Reports

5. The consultant will submit the following reports in English to the PDMCs (two copies each) and to ADB (three copies):

- (i) **Inception Report.** This brief report will be submitted within four weeks of the start of services, outlining the work plan for each item in the terms of reference; any changes in the approach, methodology, and work plan, as well as cost implications to the consultant's service;
- (ii) **Midterm Report.** This report will be submitted two months of the start of the services, and give details of the consultant's methods and procedures employed, and findings and recommendations as developed. The report will seek guidance from the PDMCs on any issues that arise from the analysis and establish agreement with and reconfirm the support of the PDMCs regarding the direction the analysis is taking. This report will contain information on the status of the analysis, addressing each point of the terms of reference.
- (iii) **Draft Final Report.** This report is to be submitted after three and half months of the start of the services, giving details of the consultant's methods and procedures employed, and findings and recommendations based on the scope of the work outlined in the terms of reference. This report will contain all information in sufficient detail to enable recalculation or modification of the major assumptions without the need for supplementary data.
- (iv) **Final Report.** This is to be submitted two weeks after the receipt of comments from the Governments and ADB on the draft final report (these comments will be provided within two weeks of submission of the draft final report). The final report will incorporate all revisions deemed appropriate by the consultant.

**COST ESTIMATES AND FINANCING PLAN**  
(\\$)

Item	Foreign Exchange	Local Currency	Total Cost
<b>A. ADB Financing<sup>a</sup></b>			
<b>1. Consultants</b>			
a. Remuneration	180,000	0	180,000
b. Per Diem	45,000	0	45,000
c. International Travel	75,000	0	75,000
<b>2. Miscellaneous</b>	6,000	0	6,000
a. Communications	2,000	0	2,000
b. Report Preparation	3,000	0	3,000
c. Office Supplies	1,000	0	1,000
<b>3. Contingencies</b>	38,000	0	38,000
<b>Subtotal A</b>	<b>350,000</b>	<b>0</b>	<b>350,000</b>
<b>B. ICAO Funded</b>			
<b>1. Consultants</b>			
a. Remuneration	45,000	0	45,000
b. Per Diem	11,250	0	11,250
c. International Travel	75,000	0	75,000
<b>2. Contingencies</b>	15,750	0	15,750
<b>Subtotal B</b>	<b>147,000</b>	<b>0</b>	<b>147,000</b>
<b>Total (A+B)</b>	<b>497,000</b>	<b>0</b>	<b>497,000</b>

ADB=Asian Development Bank, ICAO=International Civil Aviation Organization.

<sup>a</sup> ADB-funded technical assistance program.

Source: Staff estimates.

(Reference in text: page 4, para. 15)