MA-AFAS

CONTRACT N° : G4RD-2000-00228

PROJECT N° : GRD1-1999-10516

ACRONYM : MA-AFAS

THE MORE AUTONOMOUS - AIRCRAFT IN THE FUTURE AIR TRAFFIC MANAGEMENT SYSTEM

D46 – Identification and Status of Standards

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Airtel ATN Ltd (Ireland)	Qinetiq (UK)
ETG (Germany)	EUROCONTROL (France)
NLR (Netherlands)	

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Airsys ATM (France)	Alenia Difesa (Italy)
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FRQ (Austria)	Indra Sistemas (Spain)
NATS (UK)	SCAA (Sweden)
SC-TT (Sweden)	Skysoft (Portugal)
SOFREAVIA (France)	Stasys Limited (UK)

Report Number:	**81SG/N/11/1/11/1**
Project Reference number :	**MA-AFAS – WP4.2.2**
Date of issue of this report :	**1st July-02**
Issue No:	**1.0**
PROJECT START DATE :	**1/3/2000**
DURATION:	**36 Months**

Project funded by the European Community under the 'Competitive and Sustainable Growth' Programme (1998-2002)

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D46 – IDENTIFICATION AND STATUS OF STANDARDS

Document No: 81SG/N/11/1/11/1

Issue: 1.0

Contains 102 pages total
Comprising:

7	pages front matter
95	pages text and figures

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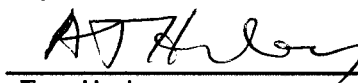
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REFERENCES

1. *Standards Identification Document,* version 1.0, 2nd May 2001

2. *Annex I*, MA-AFAS, 2000.

3. *Status of GPS SBAS/GBAS Standards and Regulations*, prepared for United Kingdom National Air Traffic Services on contract number 45171211, 13th October 2000.

4. *Proposal for a first package of GS/AS applications,* CARE/ASAS, EUROCONTROL/02-040, version 1.4 draft, June 25, 2002.

1 INTRODUCTION

1.1 Background

Annex 1 (ref. 2) to the More Autonomous-Aircraft in the Future ATM System (MA-AFAS) contract shows that the aim of WP4 of the program is to identify the steps required to transition from the trials demonstration of an avionics package to in-serve pre-operational validation. Development of appropriate standardisation/regulatory material for new equipment, including both technical and operational aspects, is essential for this transition to occur, and foster user buy-in.

This document, based on Standards Identification Document (ref. 1) issued to all MA-AFAS partners in 2001, has been produced as deliverable D46, intended to identify standards activities relevant to MA-AFAS. It is the first deliverable (of two) from work package 4.2.2, the objective of which is to progress technical standards development (including spectrum allocation), and to define a plan for longer-term work standards. This latter work will enable the transition from the current Air Traffic Control (ATC) system to that envisaged in the MA-AFAS operational concept.

This document is the deliverable for the first phase of work. It details the content and current status, and details progress of identified standards.

1.2 Scope

The More Autonomous Aircraft in the Future Air Traffic Management (ATM) System (MA-AFAS) project encompasses a number of themes, all of which require standardisation work. This document has been produced from the air traffic service provider's (ATSP's) viewpoint, and thus does not address all aspects of MA-AFAS. Support has been received on other aspects from other partners. Of the MA-AFAS themes, Precision Approach (PA) is addressed in the most depth, and thus the document is also based on Status of GPS SBAS/GBAS Standards and Regulations (ref. 3), prepared for UK NATS in 2000. The other themes have been addressed selectively. Spectrum issues are addressed.

Only a summary of the large volume of information available is given in this report. Links to relevant websites are given wherever possible to enable topics of interest to be pursued.

Legislative issues will not be included.

The spectrum issues will look at the systems involved in each theme, and determine the status of spectrum allocation for each system. This work will be done from an ATSP's perspective, but will include airborne equipage issues where possible.

1.3   Document Overview

1.3.1 Objectives

This document aims to meet the MA-AFAS milestone intended to develop user buy-in. This is part of the establishment of a safe strategy implementation, based on economic benefit, standards, and world-wide agreement.

1.3.2 How the Report is Organised

This document identifies committees and working groups within standards bodies relevant to MA-AFAS. It then overviews recent development for selected working groups and gives the status of the associated standards. It provides an overview of the content and status of these documents, identifies conflicts between the standards and provides conclusions with regard to user interoperability.

Chapter 3 Current Relevant Standards identifies the committees and working groups (WG)s within RTCA, ARINC, European Organisation for Civil Aviation Equipment (EUROCAE) and International Civil Aviation Organisation (ICAO) that are relevant to MA-AFAS. The content and status of associated standards and documents relevant to MA-AFAS are then described.

MA-AFAS partners do not attend all of the groups mentioned in Chapter 3, and so Chapter 4 Review of Selected Work Group Activities details the progress of work standards bodies of interest. This information has been supplied by either a MA-AFAS partner who attends, or from members of the WG. It gives a brief review and status of these documents and emphasises efforts concerned with the PA theme. This analysis of standards notes the deficiencies and areas that need attention in order to meet MA-AFAS objectives.

Chapter 5 concludes the identification of standards activities relevant to MA-AFAS and indicates the required direction of future work. Annex A gives an overview of the standards bodies themselves.

1.4   Description of Work

This document is the first deliverable of work package 4.2.2, the aim of which is to investigate requirements for standards and this will comprise two parts.

There will be a review of the current international standards, status of standards body working groups, and identification of what needs to be done in order for it to be appropriately standardised.

The standards to be investigated will be:

- ICAO Standards and Recommended Practises (SARPs) and Procedures for Air Navigation Services (PANS)

- EUROCAE/RTCA Minimum Operational Performance Standards (MOPS)

- RTCA Minimum Aviation System Performance Standards (MASPS)

- ARINC equipment standards

- Airworthiness requirements and standards

- Other certification requirements

- International Telecommunications Union (ITU) decisions on spectrum allocation and management

This area of work:

- Identifies the issues constraining the development of MA-AFAS systems (e.g. lack of standards, spectrum considerations)

- Makes recommendations on how to progress during the project

- Identifies standards affected

- Identifies new standards required

- Reviews the output of airworthiness work

In parallel to this review activity, this task included attendance at standards panels / workshops (as held by the appropriate standards bodies such as ARINC, RTCA, ICAO and ITU) with the aim of introducing appropriate standards.

This attendance involved chairing and participating in discussions, and production of working papers and drafting standards, for EUROCAE and ICAO WGs. An inside view of these WGs, and their current work plans, in the context of MA-AFAS is reported. This was done primarily for navigation, and those communications and surveillance standards bodies attended by the partners involved.

In the latter part of the work package, a Transition Plan For The Evolution of Standards will be prepared which will identify the strategy required for standards to be introduced to implement the new Communications, Navigation and Surveillance (CNS)/ATM

requirements as addressed by MA-AFAS. These CNS/ATM standards transition requirements will also be addressed from an ATSP's perspective. Elements of this plan will be presented to the relevant working groups of the Obstacle Clearance Panel (OCP), Aeronautical Mobile Communications Panel (AMCP) and Global Navigation Satellite System Panel (GNSSP) panels of ICAO. This work may be used to form part of any overall Transition Plan detailing how adoption of MA-AFAS autonomous operation concepts will take place. Such an overall Transition Plan (which may involve safety, training, procedures etc.) is outside the scope of this work package.

2 CURRENT RELEVANT STANDARDS

2.1 Introduction

This chapter shows the standards committees and associated documents applicable to MA-AFAS. Annex A lists a number of panels and groups. Their objectives, and their relevance to MA-AFAS, are discussed below.

2.2 RTCA

2.2.1 Committee Selection

Committee	Of interest to MA-AFAS?
SC135, Environment Testing (DO-160D)	
SC147, Traffic Alert and Collision Avoidance (TCAS)	
SC159, Global Positioning System (GPS)	✓
SC165, Aeronautical Mobile Satellite Service (AMSS)	
SC172, VHF Air-Ground Communication	✓
SC181, Navigation Standards	✓
SC186, Automatic Dependent Surveillance – Broadcast (ADS-B)	✓
SC187, MODE S Airborne Beacon & Data Link System	
SC188, High Frequency Data Link (HFDL)	
SC189, Air Traffic Services Safety and Interoperability Requirements (ATS SIR)	✓
SC190, Application Guidelines For RTCA DO-178b/ED-12b (software)	
SC193, Terrain and Airport Databases	✓
SC194, Air Traffic Management Data Link Implementation	✓

SC195, Flight Information Services Communications (FISC)	
SC196, Night Vision Goggles	
SC197, Rechargeable and Starting Batteries	
SC198, Next Generation Communications (NEXCOM)	
Program Management Committee	
Free Flight Steering Committee	✓
Free Flight Select Committee	✓
Certification Steering Committee	
Certification Select Committee	

Table 1: RTCA Committee Selection

The work of SC-190 has produced "Application Guidelines for RTCA DO-178b/ED-12b (Software)". This is a standard to which MA-AFAS software has been designed. However, it is not proposed that any work involving this standard needs doing to further MA-AFAS aims.

2.2.2 SC-159 Global Positioning System

2.2.2.1 Role

SC-159 develops minimum standards that form the basis for Federal Aviation Administration (FAA) approval of equipment using Global Positioning System (GPS) as a primary means of civil aircraft navigation. It is divided into group, the following of which are of interest:

- WG-2: GPS/Wide Area Augmentation System (WAAS)

- WG-4: GPS/Local Area Augmentation System (LAAS)

- WG-5: Airport Surface Surveillance

In addition to ongoing activities with GPS/WAAS, GPS/LAAS, GPS/Inertial and GPS/Airport Surface Surveillance applications, the committee is completing a Signal-in-Space Interface Control Document (ICD) for L5 and an Assessment of Radio Frequency Interference for L1/L5.

2.2.2.2 Publications

The committee's latest publications are given below.

- DO-208 Minimum Performance Standard for Airborne Supplemental Navigation Equipment Using Global Positioning System (GPS)

This document sets forth the operational goals and applications, and recommends standards and test procedures for airborne supplementary navigation equipment (2D and 3D) using Global Positioning System (GPS) inputs in the en route, terminal, and approach modes or any combination thereof. A supplemental navigation system may be used, as a primary navigation reference in an aircraft when an approved and operational sole means navigation system is available. The report defines performance, functions, and features for 2D airborne equipment, which performs only lateral guidance, and 3D equipment, which performs both lateral and vertical guidance. Change 1 provides editorial changes to subparagraphs on Marginal Geometry Tests, Good Geometry Tests, and Dynamic Tests. Appendix B has been rewritten to provide corrected computations to calculate geodesics on the World Geodetic System (WGS)-84 ellipsoid. A new Appendix K provides simulation of a second-order Gauss-Markov process.

- DO-228 Minimum Operational Performance Standards for Global Navigation Satellite System (GNSS) Airborne Antenna Equipment

This document defines the antenna performance for antennas that will be used with GNSS receiver equipment. Contains Minimum Operational Performance Standards (MOPS) for Global Navigation Satellite System (GNSS) airborne antenna equipment designed to use GPS or GLONASS augmented by other systems/equipment/techniques as appropriate to meet the performance requirements for primary means of navigation for en route, terminal, non-precision, and precision approach phases of flight. Incorporated within these standards are equipment characteristics that should be useful to users, designers, manufacturers, and installers of equipment. Change 1 was developed in response to input from antenna manufactures. Changes include references to RTCA DO-160D versus DO-160C, updates to the minimum frequency range, axial ratio, frequency selectivity requirements, and the differential group delay to ensure airborne equipment is protected by the LAAS and WAAS ground monitoring facilities during precision approach operations.

- DO-229B Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment

This document contains MOPS for airborne navigation equipment (2D and 3D) using the GPS augmented by the WAAS. The changes to RTCA DO-229A include information to ensure consistency with ICAO SBAS SARPs, information in support of ionospheric correction calculations, Appendix Q - WAAS Requirements for Helicopters, and updates to the sections and appendices affected by these changes. The regulatory application of these standards is the responsibility of the appropriate government agencies. In the United States (US), the FAA plans to publish Technical Standard Order (TSO) C-145 and C-146 for GPS/WAAS equipment. TSO C-146 will reference the requirements and bench tests procedures

- DO-235 Assessment of Radio Frequency Interface Relevant to the GNSS

This document identifies potential sources of radio frequency interference (RFI) and assesses the vulnerability of GPS and GLONASS receivers to that interference. Candidate mitigation techniques are also examined, and selected techniques are recommended for adoption in appropriate standards. The Category I precision approach operational scenario was used to determine the minimum interference distance from mobile ground interference sources.

- DO-245 Minimum Aviation System Performance Standards for Local Area Augmentation System (LAAS)

This document contains the MASPS for the LAAS (Ground-Based Augmentation System (GBAS)). This system was developed to support PA and landing operations and other navigation and surveillance applications within a local area including and surrounding an airport. The LAAS is being developed to support differential GNSS-based PAs and landings to include Category I, II, IIIa, and IIIb. Applications other than PA may also be supported. GPS/LAAS is intended to be interoperable with the GPS WAAS and to be used to provide radio navigation vertical and lateral guidance for aviation Instrument Flight Rules (IFR) PA and landings through touchdown and rollout.

- RTCA DO-246A, GNSS Based Precision Approach Local Area Augmentation System (LAAS) – Signal-in-Space Interface Control Document

This document defines the characteristics of the LAAS signal in space for systems providing Performance Type 1 service. The content of the ICD has been harmonised with standards developed by ICAO and EUROCAE at the time of release.

It is expected that the document will be updated as harmonisation efforts continue. The revised DO-246A includes: 1) harmonisation of message types with SARPs and EUROCAE ICD, 2) the most current WAAS MOPS information, and 3) updates of the sections and appendices affected by these changes.

- RTCA/DO-253, Minimum Operational Performance Standards for GPS Local Area Augmentation System (LAAS)

This document provides the MOPS for Airborne Navigation Equipment Using the GPS augmented by the LAAS. The standards in the document define minimum performance requirements, functions, and features for LAAS airborne equipment to support CAT I precision approach operations. Compliance with these standards by manufacturers, installers, and users is recommended as a means of assuring that the equipment will satisfactorily perform its intended functions under conditions encountered in routine aeronautical operations.

2.2.3 SC-172 VHF Air-Ground Communication

2.2.3.1 Role

SC-172 has developed recommendations for future Very High Frequency (VHF) air-ground (A/G) communications system improvements. The committee is working with EUROCAE WG-47 in preparing two MOPS documents for VHF Digital Radio Communications Operating within the Radio Frequency Range 117.975 - 137.000 MHz. The first MOPS developed will be for Carrier Sense Multiple Access (CSMA), Mode 2. The second MOPS will be for Time Division Multiple Access (TDMA), Mode 3. WG-47 has developed the physical layer that describes the radio and modulation functions. This layer is the same for both modes 2 and 3. SC-172 is developing the protocol layer (channel access) material that is unique for each mode. The MOPS documents published by SC-172 will include both the physical and protocol layer material.

2.2.3.2 Publications

The following publications are expected:

- MOPS for Carrier Sense Multiple Access, Mode 2 (WG-3) Oct 01
- MOPS for Time Division Multiple Access, Mode 3 (WG-3) Oct 01

2.2.4 SC-181 Navigation Standards

2.2.4.1 Role

This Special Committee (joint with EUROCAE WG-13) prepares MOPS for the airborne navigation functions in systems using at least one navigation source.

WG1 is working on vertical and time additions to DO-236A.

A MOPS for Required Navigation Performance (RNP) Area Navigation (RNAV) is expected from SC-181 in 2001.

2.2.4.2 Publications

- RTCA/DO-200A, Standards for Processing Aeronautical Data

This document provides the minimum standards for the processing of aeronautical data that are used for navigation, flight planning, terrain awareness, flight simulators, and for other purposes. The standards cover data processing quality assurance and quality management requirements. They provide the user the necessary assurance that delivered aeronautical databases meet the appropriate quality requirements for the data. DO-200A supports new technology and the expanding scope of aeronautical data by providing a more structured approach to the extremely important issues of data quality and data integrity management.

- RTCA/DO-201A, User Recommendations for Aeronautical Information Services

This document, produced by WG-2, recommends changes needed to provide improved operational effectiveness of airborne navigation systems in which stored databases are used. It provides several aeronautical information requirements and design standards needed to support computer-based systems including the presentation of problem areas and recommended standardized practices. It supports the aviation community's recommended standards for the preparation and transmission of data for assembly of airborne navigation system, flight planning, and flight simulator databases and provides a means to update databases in ways that assure they remain current and valid. This document has been co-ordinated with EUROCAE.

- DO-236 Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation

This document contains the MASPS for RNAV systems operating in a RNP environment. Section 1 includes the assumptions made within the MASPS and describes the minimum navigation performance functions, operational goals, and applications needed to operate in RNP RNAV airspace. Section 2 describes the minimum system performance standards needed for the identified functions. Section 3 explains minimum performance standards for each subsystem/function that is a required element of minimum system performance. Section 4 provides an acceptable method for demonstrating system/subsystem performance compliance. A transition approach to full compliance with the MASPS is included in an Appendix. Revision "A" to DO-236 is being balloted for approval by RTCA SC-181 and has been jointly developed with EUROCAE Working Group 13.

2.2.5 SC-186 Automatic Dependent Surveillance – Broadcast

2.2.5.1 Role

The committee is tasked to develop operational requirements and minimum performance standards for Automatic Dependent Surveillance- Broadcast (ADS-B). The committee will consider both airborne and ground user needs for this capability. The following WGs are active:

- WG1 - Operations and Implementation.

- WG2 – Traffic Information Services – Broadcast (TIS-B).

- WG3 - 1090 MHz MOPS for ADS-B.

- WG4 - Application Technical Requirements.

- WG5 – Universal Access Transceiver (UAT) MOPS, WG6 - ADS-B MASPS Revision A.

The terms of reference for SC 186 show that it is involved in work of interest to MA-AFAS, notably:

It will state operational requirements based upon the airborne and ground user needs for an ADS-B system. The development activities will consider work from other bodies.

The committee should:

1. Develop MASPS for Airborne Separation Assurance (ASA), including detailed application descriptions and end-to-end requirements analysis, initially for the following applications:

    i. Conflict Detection and Resolution (CD&R)

    ii. Enhanced Visual Acquisition

    iii. Enhanced Visual Approach

    iv. Runway and Final Approach Occupancy Awareness

    v. Airport surface Situational Awareness.

2. The ASA MASPS should be the repository for applications descriptions and requirements. Develop MOPS for a Cockpit Display of Traffic Information (CDTI). Take into account the work already done for the Traffic Alert and Collision Avoidance System (TCAS) traffic display. Recommend the minimum display requirements to perform specific proposed ADS-B applications. Co-ordinate the CDTI MOPS work with SAE S-7 and G-10 committees. Version 1 of the CDTI MOPS will include requirements for the following applications:

    i. Enhanced Visual Acquisition

    ii. Enhanced Visual Approach

    iii. In-Trail (or lead) Climb/Descent in Non-Radar Airspace

    iv. In-Trail (or lead) Climb/Descent to Co-Altitude in Non-Radar Airspace

3. Version 2 of the CDTI MOPS will add considerations for the following applications:

    i. Final Approach Spacing

    ii. Departure Spacing

    iii. Conflict Detection and Resolution

    iv. Pilot Situational Awareness Beyond Visual Range

    v. Runway and Final Approach Occupancy Awareness

vi. Airport Situational Awareness

4. Develop MOPS for an ADS-B system operating on 1090 MHz frequency. Take into account the operational requirements and proposed applications reflected in the ADS-B MASPS. This work shall be co-ordinated with the work ongoing within the Flight Information Services (FIS) Communications SC to consider any use of 1090 MHz frequency for FIS. Version 1 of the 1090 MHz MOPS will reflect requirements using the current TCAS receiver processing techniques. Version 2 of the 1090 MHz MOPS will consider advanced reception and decoding techniques to improve the probability of decoding messages and increase the operational range of the system.

5. Develop MASPS for TIS-B. The TIS-B MASPS shall provide recommendations for the transmission of ground-derived surveillance information on aircraft and vehicles to suitably equipped users for display and use in airborne and surface applications. TIS-B compatibility and interoperability with ADS-B applications must be addressed.

6. Develop MOPS for ASSAP. Take into account items such as surveillance processing, alerts functions, algorithms and required quality of surveillance performance. Develop recommended definitions of Required Surveillance Performance (RSP). Version 1 of the ASSAP MOPS will define required surveillance performance, describe basic surveillance processing using ADS-B reports, describe performance requirements for enhanced visual approaches and enhanced visual acquisition, and provide guidance material for alerting in support of these two visual applications. Version 2 of the ASSAP MOPS will further expand the levels of required surveillance performance, describe non-normal/failure mode surveillance processing, and specify requirements for algorithms, performance, and avionics interfaces for final approach spacing, airport surface situational awareness, and runway and final approach occupancy awareness.

7. Update and maintain, as required, the February 19, 1998 ADS-B MASPS (RTCA Document No. RTCA/DO-242). Co-ordinate the ADS-B MASPS with EUROCAE WG-51.

8. Develop performance standards for the UAT. Use this work to develop MOPS for the UAT.

9. Review and comment on the EUROCAE WG-51 draft VDL Mode 4 MOPS.

2.2.5.2 Publications

- RTCA/DO-242, Minimum Aviation System Performance Standards for Automatic Dependent Surveillance - Broadcast (ADS-B)

- RTCA/DO-243, Guidance for Initial Implementation of Cockpit Display of Traffic Information (CDTI)

- RTCA/DO-259, Application Descriptions for Initial Cockpit Display of Traffic Information (CDTI) Applications

- RTCA/DO-260, 1090 MHz MOPS for ADS-B (a Joint document with EUROCAE)

The committee has worked on a Detailed Application Description for CD&R. It will be initiating development of UAT performance standards and MOPS and completing a review of the EUROCAE VDL Mode 4 MOPS. The document – "Application of Airborne Conflict Management: Detection, Prevention, & Resolution" is planned for Plenary review. It is also working on MOPS for Airborne Surveillance and Separation Assurance Processing (ASSAP), Version 1, and TIS-B MASPS.

2.2.6 SC-189 Air Traffic Services Safety and Interoperability Requirements (ATS SIR)

2.2.6.1 Role

SC-189 (joint with EUROCAE WG-53) Air Traffic Services Safety & Interoperability Requirements is producing products that will provide recommended standards for the total system including ground-based systems.

The FAA intends to use its products such as the Interoperability Requirements for ATS Applications and Services Using Aeronautical Telecommunications Network (ATN) Baseline 2 to qualify aircraft and operations using data link for specific operational environments.

2.2.6.2 Products

- Guidelines for Approval of Provision and Use of Air Traffic Services Supported by Data Communications, Completed.

- Interoperability Requirements for ATS Applications Using ARINC 622 Data Communication (Future Air Navigation System (FANS)-1/A), Completed.

- Interoperability Requirements for ATS Applications and Services Using ATN Baseline 1, 03/02.

- Guide to ATN Baseline 1 Ground System Accommodation of FANS-1/A Airborne Systems, 04/02.

- Safety and Performance Requirements (SPR) Standard for Initial Oceanic Air Traffic Services Supported by Data Communications, 09/02.

- Safety and Performance Requirements (SPR) Standard for Domestic En Route Air Traffic Services Supported by Data Communications, 09/02.

- Interoperability Requirements for ATS Applications and Services Using ATN Baseline 2, 09/02.

2.2.7 SC-193 Terrain and Airport Data Bases

2.2.7.1 Role

This SC is working jointly with EUROCAE WG 44 to identify industry requirements for terrain, obstacles, and airport information to support current and future airborne and ground systems. One subgroup will prepare Industry Requirements for Terrain and Obstacle Information for Aeronautical Use. The objective will be to highlight for government and user organizations, industry's requirements for digital and analogue terrain and obstacle information. Another subgroup will prepare Industry Requirements for Airport Mapping Information to define industry needs for supporting avionics that display aircraft position dynamically superimposed on airport diagrams.

The work of this committee could be useful for the Taxi theme.

2.2.7.2 Publications

- Industry Requirements for Terrain and Obstacle Information for Aeronautical Use, due Jan 02

- DO-272 Industry Requirements for Airport Mapping Information, issued December 2001.

2.2.8 SC-194 Air Traffic Management Data Link Implementation

2.2.8.1 Role

This SC was established to continue work that evolved from the FAA's National Airspace System Modernisation Task Force and will facilitate the government/industry consensus on the path to achieve an Air Traffic System (ATS) operational data link. The work of SC-194 will directly support the Controller Pilot Data Link Communications (CPDLC) Program. Four WGs are active. WG 1, Principles of Operation and Implementation Plan, will develop comprehensive principles of operation for domestic en route ATS using the Aeronautical Telecommunications Network (ATN) and a roadmap for implementation. WG 2, Flight Operations and ATM Integration, will produce an integration document to outline implementation requirements for future aeronautical data link systems and services. WG 3, Human Factors will develop Minimum Human Factors Standards for Air Traffic Services Provided via Data Communications Utilizing the ATN. WG 4, Service Provider Interface, will define interface requirements necessary to integrate the ATN into the U.S. National Airspace System (NAS).

2.2.8.2 Publications

- Build II, Plans and Principles

- Do-269 Implementation Requirements for Services Integrating Flight Operations and Air Traffic Management Using Addressed Data Link.

- Interface Requirements Document for U.S. National Airspace Systems (WG-4), due Dec 01

2.2.9 Free Flight Steering Committee

This committee is responsible for establishing an agreed-to implementation strategy and milestones for Free Flight. It periodically reviews government and industry progress in meeting implementation commitments, via the appropriate metrics. In conjunction with this, the committee identifies new free flight implementation opportunities as well as events or situations that are inhibiting progress, and reviews actions that are taken. The Free Flight Steering Committee serves as the forum for developing consensus on the single integrated Government/Industry Operations Concept, the architecture necessary for implementing that operational concept, evolutionary changes to the concept and architecture, and CNS/ATM system-level requirements to assure complementary performance characteristics and implementation dates.

The Free Flight Steering Committee functions as a Federal Advisory Committee with meetings open to the public.

2.2.10 RTCA Free Flight Select Committee

Not open to the public.

2.3   EUROCAE

2.3.1 WG Selection

Committee	Of Interest to MA-AFAS?
WG-13, RNP RNAV	✓
WG-28, Global Navigation Satellite System	✓
WG-41, Surface Movement Guidance and Control Systems	✓
WG-43, Multi-Mode Receiver	✓
WG-44, Terrain Data Bases	✓
WG-45, Data Link Applications	✓
WG-47, VHF Data link	✓
WG-50, Recording for ATM	✓
WG-51, Automatic Dependent Surveillance-Broadcast	✓
WG 53, Air Traffic Services	✓

Table 2: EUROCAE Working Group Selection

2.3.2 WG-13 RNP RNAV

2.3.2.1 Role

This working group is no longer active.

2.3.2.2 Publication

- ED-75A Minimum Aviation System Performance Specification: Required Navigation Performance for Area Navigation

The document (issued in September 2000) is an extended version of ED-75 published in 1997. It includes requirements for Vertical Navigation (VNAV) and time of Arrival Control, and conforms to the needs of future CNS/ATM operating environments.

2.3.3 WG 28 Global Navigation Satellite System

2.3.3.1 Role

GNSS Mission: Utilisation of satellite-based systems for navigation and PA.

Two active SGs are directly of interest to the PA theme:

- SG-2 Ground Based Augmentation (Ground System) Document in MOPS for Cat 1 ground subsystems
- SG-3 GNSS Approach/GBAS (Avionics)

Document in MOPS for Multi-Mode Receiver (MMR) using SBAS and GBAS signals in PA Cat 1.

2.3.3.2 Publications

- ED-97 Interim Technical Performance Statement for EGNOS / WAAS Airborne Equipment

The document defines interim performance standards for European Geo-stationary Navigation Overlay Service (EGNOS)/WAAS. It contains the best estimate of operational performance statements for airborne EGNOS/WAAS receiver equipment intended to be used as a primary means of navigation for all phases of flight from En-route down to Non Precision Approach (NPA). The document defines interim performance standards for EGNOS/WAAS receiver equipment for use as a primary means of navigation for all phases of flight from en route down to NPA. The terminology EGNOS/WAAS is generically used to refer to SBAS providers such as EGNOS and WAAS. The document specifies EGNOS/WAAS equipment using the GPS constellation. The document defines performance, functions, and features for a 2D system providing only lateral guidance. This document was issued in January 2000.

- ED-95 Minimum Aviation System Performance Specification for a Global Navigation Satellite System Ground Based Augmentation System to Support CAT1 Operations

The purpose of this document is to define and allocate the system performance requirements to the major sub-systems contained in the GNSS Ground Based

Augmentation System (GBAS). Operational concepts included in this document are based on aircraft interfaces already used for Instrument Landing System (ILS) operations and ATC procedures as close as possible to the ILS ones.

This document was issued in November 1999.

- ED-72 A Minimum Operation Performance Specification for Airborne GPS Receiving Equipment used for Supplemental Means of Navigation

The document specifies the equipment performance and the test methods used for verifying performance in simulated operating conditions, in environmental conditions, and after installation in an aircraft. The GPS receiver can be used either as stand-alone equipment or as a sensor input to an RNAV system. This document was issued in April 1997.

- ED-88 Minimum Operational Performance Specification for Multi-Mode Airborne Receiver (MMR) Including ILS, MLS, and GPS Used for Supplemental Means of Navigation

This document specifies minimum performance standards for airborne equipment, which may receive transmissions from three types of ground transmitters, ILS, Microwave Landing System (MLS), and GPS. It supplements earlier documents ED-36A, ED-46B, and ED-47B that are for single types of transmission, and ED-74 that is for ILS and MLS. The present version of the document only covers the use of GPS and an en route aid. A new version of the document is being prepared which covers the use of GPS as an aid to PA and landing operations.

2.3.4 WG-41 Surface Movement Guidance and Control Systems

2.3.4.1 Role

Improvement of ground traffic safety and increase of airport capacity.

2.3.4.2 Publications

Document in preparation: Update and completion of Interim MASPS for Aircraft-Surface Movement Guidance and Control System (A-SMGCS) (ED-87)

2.3.5 WG-43 MMR

2.3.5.1 Role

Now that the MMR MOPS have been published, the work of this group is done by WG-28.

2.3.5.2 Publications

- ED-88 Minimum Operational Performance Specification for Multi-Mode Airborne Receiver (MMR) including ILS, MLS and GPS used for Supplemental Means of Navigation

This document (Issued August 1997) specifies MOPS for airborne equipment which may receive transmissions from three types of ground transmitters, ILS, MLS and GPS. It supplements earlier documents ED-36A, ED-46B and ED-47B that are for single types of transmission, and ED-74 that is for ILS and MLS. A further document will be prepared covering the use of GPS as an aid to PA and landing operations.

2.3.6 WG-44 Terrain Data Bases

2.3.6.1 Role

WG-44 prepares guidelines for preparation of terrain databases for aeronautical use.

SG2 deals with Terrain and obstacle data. Sub Group 3 is involved in airport maps, and is thus of interest to the Taxi Management Theme.

2.3.6.2 Publication

Document in preparation: Terrain Databases, Guidance for Airport Mapping Databases.

2.3.7 WG-45 Data Link Applications

2.3.7.1 Role

WG-45 is primarily investigating certification and implementation of air-ground data link systems. It is of relevance to numerous topics of the MA-AFAS project, with particular emphasis on the following functions:

- Meteorological Information
- Flight Information Services

        Data-link Automatic Terminal Information Services (D-ATIS)

        Data Link – Runway Visual Range (D-RVR)

        Data Link – Significant Meteorology (D-SIGMET)

The group's work has included:

- Assistance with definition of free text formats to be defined in appendix to ED-106 document
- Provision of examples of ground failure messages

The topics that will be pursued in this report are:

- D-ATIS
- D-SIGMET
- Data Link Clearance (DCL) Standards

2.3.7.2 Publications

Document in preparation: Oceanic Clearance Document.

- ED-85 Data-Link Application System Document (DLASD) for the "Departure Clearance" Data-Link Service

This document (Issued June 1988) is intended to capture minimum interoperability, performance and safety requirements for a service based on data-link communications used for Departure Clearance. It allocates these requirements to the airborne, communication and ATS domains and describes acceptable means of demonstrating compliance.

2.3.8 WG-47 VHF Data link

2.3.8.1 Role

Development of specification for VHF data link equipment.

2.3.8.2 Publications

- ED-92 Minimum Operational Performance Specification for an Airborne VDL Mode-2 Transceiver Operating in the frequency range 118-136.975 MHz

The above was issued in March 2000. This document contains specification for airborne VHF communication equipment intended to provide the physical layer link for air-ground data communications.

2.3.9 WG-50 Recording for ATM

2.3.9.1 Role

The role of this working group is the consideration of in-flight recording for data link communication in ATM. This is considered to be relevant to data links in general, but outside the scope of the MA-AFAS project.

2.3.10 WG-51 Automatic Dependent Surveillance-Broadcast

2.3.10.1 Role

WG51 is involved in the use of broadcast communication for increased airborne surveillance information, and is currently reviewing Package 1(ref. 4) applications. It has 3 sub groups. SG1, 1090 MOPS, is currently inactive. SG2, VDL4 Interim MOPS, is currently suspended. Reactivation is under consideration, as work is required to complete the full MOPS. SG3 is active, and deals with airborne surveillance applications. A new SG will be created to work on ground surveillance applications.

2.3.10.2 Publications

RTCA SC-186 has published the ADS-B MASPS. The next version of this document is intended to be joint EUROCAE/RTCA.

2.3.11 WG-53 Air Traffic Services

Joint with RTCA SC-189.

2.4 ARINC (AEEC)

From the Industry Activities section of the ARINC website, it can be seen that the Airlines Electronic Engineering Committee (AEEC) is an international standards organization, comprising major airline operators and other airspace users. The AEEC establishes consensus-based, voluntary form, fit, function, and interface standards that are published by ARINC and are known as ARINC Standards. ARINC Standards specify the air transport avionics equipment and systems used by more than 10,000 commercial aircraft worldwide.

There are three classes of ARINC Standards:

- ARINC Characteristics—Define the form, fit, function, and interfaces of avionics equipment. There are two series of ARINC Characteristics: The ARINC 700series defines digital avionics; older, analog avionics are defined in the ARINC 500series.

- ARINC Specifications —Are principally used to define either the physical packaging or mounting of avionics equipment, data communication standards, or a high-level computer language.

- ARINC Reports —Provide guidelines or general information found by the airlines to be good practices, often related to avionics maintenance and support.

2.4.1 Communication

2.4.1.1 Air-Ground Communications Systems

2.4.1.1.1 Air-Ground Communication Systems Subcommittee

The objective of the Air/Ground Communications Systems Subcommittee is to develop standards for Satellite and HFDL communications systems compatible with the existing Aircraft Communications Addressing and Reporting System (ACARS) and emerging ATN as defined by the ICAO SARPs. The standards provide the air transport industry with Global Air/Ground Communications capabilities by enabling the transfer of character and bit oriented information over Satellite and HF Data Link. Updated standards will improve network performance, increase uniformity in data link service provider interfaces, and expand Air Traffic Service (ATS) messages.

The standards being developed appear only to consider future satcom and HF datalink, and thus there is no work being done of interest to MA-AFAS.

<u>*Current Drafts:*</u>

01-044/DLK-911 Circulation of Draft 2 of Supplement 6 to ARINC Specification 618, "Air/Ground Character-Oriented Protocol Specification"

2.4.1.2 Data Link Systems

2.4.1.2.1 Data Link Systems Subcommittee

The objective of the Data Link Systems Subcommittee is to develop standards for the aircraft Communications Management Unit (CMU) and VHF Data Link communications networks compatible with the existing ACARS and emerging ATN as defined by the ICAO SARPs. The standards provide the air transport industry with Global Air/Ground Communications capabilities by enabling the transfer of character and bit oriented information over VHF Data Link media. Updated standards will improve network performance, increase uniformity in data link service provider interfaces, and expand ATS messages. To that end the Data Link Systems Subcommittee is developing and maintaining the following standards:

- ARINC Specification 618 provides the ACARS protocols for transferring character-oriented data between aircraft systems and ground systems.

- ARINC Specification 620 sets forth the specific interface definition between the data link service providers and both the airborne and ground user. Specification 620 also contains definitions of common character-oriented Aeronautical Operational Communications (AOC) messages.

- ARINC Specification 622 specifies the additional processes to be applied to ATS applications to enhance the functionality of the ACARS system.

- ARINC Characteristic 724 describes the Mark 2 version of the ACARS equipment. This standard is being updated to reference new air/ground protocol standards and to improve the description of Data/Voice selection.

- ARINC Characteristic 750 specifies the form, fit and function for a VHF Data Radio (VDR) capable of VHF Voice and Data communications including a high-speed ARINC 429 interface between the VDR and the CMU. The 31.5 KBps data link modem is included for VDL Mode 2 operation.

- ARINC Characteristic 758 specifies a CMU Mark 2 that operates as a bridge/router to transfer data link messages over Satellite, VHF, and HF Data Link mobile air/ground communications networks for operation in the CNS/ATM environment. The protocol set includes ACARS, ARINC 622 and ATN.

Subcommittee activities include development of draft Supplements to support evolving systems interfaces and protocols.

The Subcommittee has tasked three ad hoc working groups to develop strawman materials for Project Paper 631A VDL Mode-2 Implementation Specification, Project Paper 637A, Transport and Internetworking Protocols, and Project Paper 638A Communications Applications.

There is a long-term objective to develop a system of network management for the ATN. A strawman for Project Paper 639 has been drafted. However, there is no activity to complete this document at the present.

Current Drafts

01-042/DLK-907 Circulation of Draft 5 of Supplement 18 to ARINC Specification 429, "Mark 33 Digital Information Transfer System (DITS), Part 3, File Data Transfer Techniques"

01-045/DLK-912 Circulation of Draft 5of Supplement 2 to ARINC Specification 619, "ACARS Protocols for Avionic End Systems"

01-046/DLK-913 Circulation of Draft 4 of Supplement 5 to ARINC Specification 620, "Data Link Ground System Standard and Interface Specification (DGSS/IS)"

01-043/DLK-910 Circulation of Draft 3of Supplement 4 to ARINC Specification 622, "ATS Data Link Applications over ACARS Air-Ground Network"

01-050/DLK-914 Circulation of Draft 2 of Supplement 3 to ARINC Specification 623, "Character Oriented Air Traffic Service (ATS) Applications"

01-011/VDL-03 Circulation of Draft 1 of Supplement 4 to ARINC Specification 631, "VHF Digital Link Implementation Provisions"

01-005/ATN-05 Circulation of Draft 2 of Supplement 2 to ARINC Specification 637, "Aeronautical Telecommunications Network (ATN) Implementation Provisions, Protocols and Services"

00-066/VHFC-100 Circulation of Draft 2 of Supplement 11 to ARINC Characteristic 716, "Airborne VHF Communications Transceiver"

01-012/VDL-04 Circulation of Draft 1 of Supplement 4 to ARINC Characteristic 750, "VHF Data Radio"

01-041/CMU-41 Circulation of Draft 7 of Supplement 2 to ARINC Characteristic 758, "Communications Management Unit (CMU) Mark 2"

Associated Documents: 618, 619, 620, 631A, 637A, 638A, 639, 724B, 750, 758

Conclusion

Existing ARINC standards appear not to be appropriate to the MA-AFAS avionics. The MA_AFAS CMU has some features (FM SNDCF, FM VDL4 DLS) which deviate from the ARINC 758 CMU architecture. It may prove possible to make future MA_AFAS avionics products certifiable without ARINC standards.

2.4.1.3 Data Link (DLK) Users Forum

The Data Link Users Forum is a co-ordinating activity among airline and cargo carriers, civil aviation authorities, airline manufacturers, avionics manufacturers and data link service providers. Although the DLK Users Forum has no deliverables in the form of Characteristics or Specifications, it advises AEEC activities on the desirability of the provisions in existing and future standards. The forum has three areas of focus:

- Technical issues that promote world-wide interoperability of air/ground protocols and ground/ground interfaces between data link service providers and their customers,

- Business issues related to billing of communications services, to the cost of adopting evolving communications technologies and to maximising the benefits of the applications these technologies make available, and

- Operational issues related to the development of operational concepts for data link communications and the expansion of applications that maximise the utility of the user networks.

The objective of the DLK Users Forum is to facilitate a smooth transition to the second-generation air/ground data link at least cost on a schedule that will preclude any deterioration of performance on the existing air/ground network. In conjunction with this process, the DLK Users Forum will lobby for the early support for, and introduction of, ATS communications applications by Civil Aviation Authorities (CAAs).

2.4.2 Navigation

2.4.2.1 GPS/XLS

2.4.2.1.1 Joint GPS/XLS Subcommittee

The objective of the joint GPS/XLS Subcommittee is to develop and maintain standards for GNSS. These include standards for the WAAS and LAAS standards as being defined in the RTCA MOPS.

- GNSS Sensor - ARINC Characteristic 743A

- MMR - ARINC Characteristic 755

- Air Data Inertial Reference System (ADIRS) - ARINC Characteristic 738

- ADIRS - Project Paper 738A

Future work includes further development of draft Supplement 4 to ARINC Characteristic 743A and draft Supplement 2 to ARINC Characteristic 755. These Supplements continue to define GNSS Navigation function in relation to GBAS and SBAS. Completion of these Supplements is scheduled tentatively for fourth quarter of 1999.

Work continues on Draft 6 of ARINC Characteristic 738 and Draft 1 Project Paper 738A with projected completion for 2nd quarter of 1999. Project Paper 738A defines a 4MCU integrated digital ADIRS form factor. Additional changes were developed to make these standards compatible with ARINC Characteristic 743A. This should conclude the activity on ADIRS for the foreseeable future.

Circulation of Draft 2 of Supplement 3 to ARINC Characteristic 738, "Air Data Inertial Reference System (ADIRS)"

01-003/GPS-144 Circulation of Draft 2 of Supplement 1 to ARINC Characteristic 738A, "Air Data Inertial Reference System (ADIRS)"

01-001/GPS-142 Circulation of Draft 6 of Supplement 4 to ARINC Characteristic 743A, "GNSS Sensor"

Associated Documents: 743A, 755

2.4.2.2 ARINC Characteristic 755 Multi-Mode Receiver (MMR) – Digital

This document describes the characteristics of a digital radio/processor capable of receiving ILS, MLS, and GNSS source inputs. The desired operational capability of the equipment, standards necessary to ensure interchangeability, form factor, and pin assignments are included. The MMR provides flight path deviation guidance to the aircraft during final approach and landing phases of flight.

The main pending issues associated with this document includes incompatibilities with DO-253 and the ICAO GNSSP SARPs. Improvements to the document are expected to be co-ordinated through the AEEC XLS sub-committee. This activity is currently underway.

2.4.2.3 ARINC Characteristic 756 Multi-Mode Receiver (MMR) – Analogue

This document describes the characteristics of a digital and analogue radio/processor capable of receiving ILS, MLS, and GNSS source inputs. The desired operational capability of the equipment, standards necessary to ensure interchangeability, form factor and pin assignments are included. The MMR provides flight path deviation guidance to the aircraft during final approach and landing phases of flight. The main pending issues associated with this document includes incompatibilities with DO-253 and the ICAO GNSSP SARPs. Improvements to the document are expected to be co-ordinated through the AEEC XLS sub-committee. This activity is currently underway.

756-2 is also known as the GNSS Navigation and Landing Unit (GNLU).

2.4.2.4 743A-3 GNSS Sensor

The GNSS sensor standard integrates GPS/GLONASS sensors. The sensor provides position information for display to pilots and data to other navigation systems on the aircraft.

The main pending issues associated with this document includes incompatibilities with DO-253 and the ICAO GNSSP SARPs. Improvements to the document are expected to be co-ordinated through the AEEC 743 sub-committee. This activity is currently underway.

2.4.2.5 Navigation Data Base

2.4.2.5.1 Navigation Data Base (NDB) Working Group

The objective is to maintain a global navigation database to support emerging navigation equipment. Develop and document departure and approach procedures for existing navaids.

New proposal will be considered for draft Supplement 15 during the next Navigation DataBase (NDB) Working Group meeting.

Current Drafts: 00-162/NDT-99 Circulation of Draft 2 of Supplement 16 to ARINC Specification 424, "Navigation System Data Base"

Associated Documents: 424

2.4.3   Surveillance

The ARINC Surveillance work only appears to cover TCAS and Mode-S.

2.5   International Civil Aviation Organisation (ICAO)

2.5.1 Introduction

ICAO is divided into a number of bureaus. Of prime interest to MA-AFAS are the Air Navigation Bureau, the Communications, Navigation and Surveillance (CNS) Bureau, and the Air Traffic Management (ATM) Bureau. Within each bureau are a number of sections.

The objectives of selected ICAO panels and groups, and their relevance to MA-AFAS of each, are discussed below.

2.5.2 Aeronautical Mobile Communications Panel (AMCP)

2.5.2.1 WG-B

Working Group B is developing frequency planning criteria for VDL-4.

2.5.2.2 WG-C

AMCP Working Group C is a forward-looking group that has been charged with the following activities:

To explore the long term system requirements for aeronautical VHF systems in the light of the ATM concept, scenarios for all flight and operational requirements for implementation beyond 2010 to be developed by the ATMCP and OPLINKP.

- To explore the likely airspace user needs for aeronautical VHF systems beyond 2010.
- To acquire current implementation plans for aeronautical VHF systems.
- To consider the need to develop SARPs for the UAT system.
- To consider in its work difficulties related to channel labelling.
- To monitor the progress of developments of interoperability of Aeronautical Mobile Satellite Service (AMSS) networks complying with AMSS SARPs. To review Annex 10 radiotelephony procedures.
- To analyse issues associated with the introduction of end to end digital voice communications.
- To monitor the development of wireless communications systems on airports.
- To monitor the development of relevant industrial standardisation activities.

WG-C is also working on the Required Communications Performance (RCP) concept.

2.5.2.3 WG – M

AMCP WG M was set up at AMCP 7 as part of a new structure of WGs. It is a charged with the following activities.

- To develop a configuration control procedure for the maintenance of the detailed technical specifications;

- Maintain the material in the manuals for VDL Modes 2,3 and 4, HF data Link and the AMSS, and the implementation manuals for these systems. In carrying out these activities, experience gained from actual implementation and operational use has to be taken into account; and

- Review of certain aspects related to the frequency availability for the implementation these systems.

Of particular interest to MA-AFAS, this WG also aims to develop SARPs for VDL Mode-4 frequency allocation in the navigation/surveillance band, 108MHz to 118MHz.

2.5.3   OPLINK (ADSP)

OPLINK, formerly the Automatic Dependent Surveillance Panel (ADSP), has three active working groups:

- WG - A (ADS-B)

- WG - B (Datalink Applications)

- WG - C (Required Communications Performance)

2.5.4   Aeronautical Telecommunications Network Panel (ATNP)

2.5.4.1 Establishment

The Air Navigation Commission (ANC) agreed to the establishment of the Aeronautical Telecommunication Network Panel (ATNP) in 1993.

This section gives a brief overview of past activities, information on the working groups and the work programme of the panel. This panel is examined in particular detail, as its work is highly relevant to MA-AFAS.

2.5.4.2 Past Activities

ATNP/1 (1994) examined and endorsed two documents developed by the now-dissolved Aeronautical Fixed Service Systems Planning for Data Interchange Panel (ASPP), which covered exchange of ATS messages over existing AFS and the ATN. The panel also made plans to progress its work in this regard, formed three working groups: one to handle the systems planning and concept, one to develop SARPs for

ATN internet, and one to develop SARPs for the application and other upper layers of the ATN. ATNP finalized the first set of the latter for the ATN (named "CNS/ATM-1 Package") in 1996.

In 1997, the panel formed a Configuration Control Board (CCB) to identify and resolve defects in ATN technical provisions. The following year, the first set of ATN SARPs was incorporated in Annex 10. These SARPs were supplemented by technical specifications shown in the "Manual of Technical Provisions for the ATN" (DOC 9705), First Edition. A complete set of guidance material was developed for publication as an ICAO manual. Work continued towards further SARPs and associated guidance material.

The second edition of DOC 9705 was published in 1999, and also the panel developed SARPs and technical specifications for ATN security, system management, directory services and made a number of enhancements to existing ATN provisions. Newly developed material was finalized at a meeting of the working group of the whole (WGW) in December 1999 in Tokyo, Japan.

The third meeting of the panel was held in Montreal in 2000. New material on ATN security, system management, directory services and other enhancements to existing technical provisions were finalized at that meeting. However, it was suggested that while amendments to ATN SARPs be processed by ICAO right away, detailed technical specifications be withheld until results of validation activities could be finalized at the fourth meeting of the working group of the whole (WGW/4) in August 2000.

The panel will finalize the third edition of DOC 9705 (in support of newly developed ATN features/ applications/ enhancements) and appropriate guidance material.

2.5.4.3 Work Programme

1) Further develop procedures for evolution and operation of data communication elements of the aeronautical fixed service (AFS).

2) Assess requirements for incorporation of new features like multicast, encryption and QoS management in the ATN and develop appropriate technical provisions as necessary, while ensuring backwards compatibility and interoperability

3) Monitor the development of new operational requirements and new fixed/mobile subnetworks and develop appropriate technical provisions as necessary, while ensuring backwards compatibility and interoperability.

4) Monitor actual ATN implementations in order to provide expert advice as necessary and to maintain the relevance and currency of SARPs, technical specifications and guidance material.

5) Define, as required, elements, operations or functions that will have institutional implications in the provision of communication services over the ATN.

2.5.4.4 Working Groups

The panel is now structured into:

> a) Working Group A — Applications and implementation;
>
> b) Working Group B — Communication services; and
>
> c) The CCB (with the existing terms of reference, which is the maintenance of ATN technical specifications and guidance material).

Working Group A monitors the development of new concepts (e.g. the required communication performance (RCP)) and operational requirements and assesses/develops the relevant technical provisions. It also monitors ATN implementation activities and provides expert advice as and when required. Specific work items of this working group are:

> a) Develop additional provisions in response to new and/or revised application user requirements received from operational bodies. For example: requirements for new flight information service applications; requirements for air traffic flow management applications; requirements for new inter-centre applications, etc;
>
> b) Develop application enhancements to existing ATN provisions based on implementation experience.
>
> c) Further develop procedures for evolution and operation of the data communication elements of the aeronautical fixed service (AFS).
>
> d) Develop guidance material for an ATN financial accounting architecture.
>
> e) Identify potential institutional issues and monitor development of solutions to those that can be addressed by the ATNP; and
>
> f) Monitor the implementation of the ATN and provide expert advice as and when required.

Working Group B develops new/revised provisions related to internet communications service (ICS), upper layer communications service (ULCS), systems management and security. Specific work items of this working group are:

> a) Develop additional provisions in response to new and/or revised user requirements received from operational bodies for communication services. For example, requirements for a more flexible and extendable means of mobile subnetwork route selection, requirements for multicast services, etc.
>
> b) Assess and develop communication service enhancements to existing ATN provisions based on implementation experience. For example, investigate improved data compression techniques, consider enhancements to the connection oriented transport service, etc.
>
> c) Develop proposed amendments to other ICAO documents relating to security to better reflect the requirements for the ATN security services.

d) Develop enhancements to existing ATN provisions to add provisions for data confidentiality (encryption) to the ATN security services.

e) Develop enhancements to existing ATN provisions to add provisions for security for Generic ATN Communication Services (GACS) and multicast users.

f) Develop provisions for subnetwork dependent convergence functions (SNDCF) within the ATN provisions for additional subnetwork types. For example, broadcast mobile subnetworks, asynchronous transfer mode (ATM) ground subnetworks, etc.;

g) Develop provisions for Quality of Service (QoS) management functions; and

h) Provide expert advice on ATN communication services as and when required.

The CCB was established in 1997, with the terms of reference that it will maintain the correctness of ATN SARPs and guidance material by systematically identifying and correcting defects.

2.5.5 All Weather Operations Group (AWOG)

The All Weather Operations Group I(AWOG) s a pan-European group concerned with the planning of activities to enable future all weather operations (i.e. precision approaches). The group does not produce standards, as this is the task of the GNSSP.

2.5.6 Global Navigation Satellite System (GNSSP)

The ANC established the GNSS Panel (GNSSP) to develop SARPs and suitable guidance material for satellite navigation systems such as GPS and GLONASS and their augmentations.

During GNSSP/3 the panel re-organized into two WGs.

2.5.6.1 WG-A

WG-A deals with the operational issues concerning the introduction of SBAS and GBAS, and is thus directly relevant to the MA-AFAS PA theme. These issues include updates to various ICAO documents such as circular 267 ("ICAO Guidelines for the Introduction and Operational Use of the Global Navigation Satellite System") and amendments to Annexes 11 and 15.

WG A has developed and reviewed a draft revision to ICAO circular 267.

2.5.6.2 WG-B

WG-B is responsible for "technical issues", including validation of the panel approved SARPs for GNSS and the development of updates to the SARPs to support future

developments such as Galileo, GPS L5, etc., and is thus directly relevant to the MA-AFAS PA theme. The primary focus of Working Group B has been on the validation of the SARPs. Delays to the validation would have meant a delay to the augmentation system standards by as much as 3 years. The validation was concluded on schedule, and so the publication of the SARPs covering augmentation system (i.e. SBAS and GBAS) will be take place.

2.5.6.3 Documents

2.5.6.3.1 GNSS SARPs

The third meeting of the GNSSP was held in April 1999 in Montreal. At GNSSP/3, SARPs for GPS, GLONASS, Aircraft Based Augmentation Systems (ABAS), SBAS, and GBAS were reviewed and accepted by the panel pending validation. These SARPs support en route and terminal operations as well as category I precision approach operations. A recommendation was made to the ANC to provide the SARPs to the member states for review with the proviso that validation of the requirements would continue in parallel with the states' review. Any problems discovered during validation would be addressed through a co-ordinated response to the State Letter.

Change 77, which incorporates GNSS SARPS, should be included in Annex 10 in December 2002.

2.5.7   Obstacle Clearance Panel (OCP)

The OCP is developing approach criteria for PAs to be performed by GNSS. The work was been divided into that being developed for SBAS, and that for GBAS.

2.5.7.1 GNSS SBAS WG

This WG is developing three sets of approach criteria using SBAS; CAT I, Approach with Vertical guidance (APV) II, and APV I.

2.5.7.2 GNSS GBAS WG

This WG is developing a set of approach criteria for CAT I GBAS.

2.6   ITU

The International Telecommunications Union (ITU) co-ordinates frequency usage on a world-wide basis. Of the numerous sub-groups, WP8B and 8D are of interest to MA-AFAS.

8B deals with radar, and part of its work is to decide on the use of the 108-117.975 MHz band. It is intended that for the transmission of GBAS transmissions will be in this band, and this is also the most likely band into which VDL4 would be placed on a world-wide basis.

2.7   Applicability of Standards Groups and Documentation

It can be seen that there are large number of standards bodies. The terms of reference of the bodies appear to encompass most of the topics of interest to MA_AFAS.

3 REVIEW OF SELECTED WORKING GROUP ACTIVITIES

3.1 Introduction

Chapter 2 identified committees and documents of interest to MA-AFAS. This chapter presents an overview of recent activities of selected WGs from those identified.

As the development of various specifications in forums (such as ICAO, RTCA, EUROCAE, and ARINC has been undertaken) in parallel, there are a number of activities that are still pending to complete harmonisation of the individual outputs. Further, as SBAS systems reach the test and validation phase, requirements to adapt or improve standards and specifications become apparent.

In view of this, the following provides a review of activities pending to complete the standardisation of requirements for SBAS receivers for civil aviation.

The work groups reviewed are given in the tables below.

3.1.1 RTCA

Committee	Progress Available
SC159, Global Positioning System (GPS)	✓
SC172, VHF Air-Ground Communication	
SC181, Navigation Standards	✓
SC186, Automatic Dependent Surveillance – Broadcast (ADS-B)	
SC189, Air Traffic Services Safety and Interoperability Requirements (ATS SIR)	✓
SC193, Terrain and Airport Databases	
SC194, Air Traffic Management Data Link Implementation	
Free Flight Steering Committee	

Table 3: RTCA Committee - Progress Available

3.1.2 EUROCAE

Committee	Progress Available
WG-13, RNP RNAV	
WG-28, Global Navigation Satellite System	✓
WG-41, Surface Movement Guidance and Control Systems	
WG-43, Multi-Mode Receiver	
WG-44, Terrain Data Bases	
WG-45, Data Link Applications	✓
WG-47, VHF Data link	
WG-50, Recording for ATM	
WG-51, Automatic Dependent Surveillance-Broadcast	
WG 53, Air Traffic Services	

Table 4: EUROCAE Working Group - Progress Available

3.1.3 ARINC

Sub-Committee	Progress Available
A-G Systems Sub-Committee	
Data Link Systems	✓
DLK Users Forum	
Joint GLS/XLS	✓
MMR - Digital	✓
Navigation Data Base	

Table 5: ARINC Committee - Progress Available

3.1.4 ICAO

Panel	Progress Available
AMCP WG-B	✓
AMCP WG-C	✓
AMCP WG-M	✓
AMCP WG-F	✓
OPLINK WG-A	✓
OPLINK WG-B	✓
OPLINK WG-C	✓
ATNP	✓
AWOG	
GNSSP WG-A	✓
GNSSP WG-B	✓
OCP GNSS SBAS	✓
OCP GNSS GBAS	✓

Table 6: ICAO Panel - Progress Available

3.1.5 ITU

Meetings for WP8B and WP8D have been attended, and overviews of the latest meetings are included in this chapter.

3.2   RTCA

3.2.1 Overview

This section outlines progress with selected RTCA SCs. No update was available for SC-172, SC-186, SC-193, SC-194, or the Free Flight Select Committee.

3.2.2 SC-159

3.2.2.1 Working Groups Overview

Notes from the fifty-fifth meeting are given below.

WG-2 resolved the few remaining issues concerning the new DO-229C.

WG-4 addressed the CAT II/III operations and revisions to DO-246A and DO-253. No date was set for CAT II/III update. DO-246A and DO-253 revisions will be distributed. Changes include harmonisation with the SARPs, differential positioning service for area navigation and changes in the GBAS siting constraints.

WG-5 continues to monitor the ICAO work, DFW test program, NASA and SafeFlight 21.

3.2.2.2 DO-208

The functional and performance requirements for GNSS have migrated to the DO-229 standard, so no further development of DO-208 is expected.

3.2.2.3 DO-228

There are no known issues related to DO-228 at this time. Any revision to DO-228 is expected to be co-ordinated through SC-159 WG-2.

3.2.2.4 DO-229B

The main issues related to DO-229B stem from inconsistencies with the ICAO GNSSP SARPs and continued refinement of the standard to improve availability. Inconsistencies with the SARPs include the standard airborne multipath model, the signal quality monitoring constraints, and the specification of a code/carrier smoothing filter. Further development of DO-229 by SC-159 WG-2 is ongoing.

3.2.2.5 DO-235

The main issues are with regard to RFI sources relevant to GNSS including proposals from AMSS for "band-sharing" and proposed Ultra-Wide-Band (UWB) services. The aeronautical GNSS community is participating in proceedings of the ITU where these proposals are under evaluation. SC-159 WG-6 is meeting to support these proceedings. WG-6 has initiated assessing the RF issues relevant to the second GPS civil frequency

(L$_5$). Operational scenarios being considered in this assessment include category II and III precision approaches as well as ground-based transportation applications. The outcome of this activity may include changes to future RTCA GNSS standards.

3.2.2.6 DO-245

The main issues pending with DO-245 stem from inconsistencies with DO-253, DO-246A, and the ICAO GNSSP SARPs. Compatibility with the FAA LAAS Ground Facility Specification also will be a consideration. DO-245 is expected to be revised to be aligned with the CAT I PA requirements as they have evolved during the development of the RTCA LAAS MOPS, EUROCAE GBAS MASPS, and ICAO GNSSP SARPs. The requirements to support category II and III precision approaches will be further addressed. SC-159 has recognized the need to address additional operational requirements related to LAAS Position Velocity and Time (PVT) performance. Thus, the revision to DO-245 will also define system requirements and allocations for navigation using the LAAS to support RNAV operations. SC-159 WG-4 is commencing work on a revision to DO-245 this year to address inconsistencies and add additional system requirements as indicated above. Areas of inconsistency among standards documents include:

• Coverage Volume

• Service Availability

• PVT Requirements to Support Non-Landing Applications

• Accuracy Contributions of Residual Signal-In-Space (SIS) Errors

• SBAS Ranging Accuracy

• Integrity and Continuity Allocation Trees

• VHF Data Broadcast (VDB) RF Field Strength

• Final Approach Segment (FAS) Data Definition

• Airborne Accuracy Requirements

• Availability Assessment

• Troposphere and Ionosphere Correction Models

• Differential Correction Processing

3.2.2.7 DO-246A

The main issues pending with DO-246A stem from inconsistencies with ICAO GNSS SARPs. SC-159 WG-4 began work on a revised LAAS ICD in January 2001. The revised ICD is expected to incorporate minor changes for consistency with the GNSSP SARPs and to reflect operational experiences gained with early LAAS implementations. Differences between DO-246A and the SARPs presently include: Type 2 and Type 4 message update rates, magnetic variation field definition, minimum slot duty cycle, and transmitter noise (error vector magnitude).

3.2.2.8 DO-253

The main issues pending with DO-253 stem from inconsistencies with ICAO GNSS SARPs and harmonisation of requirements with EUROCAE. SC-159 WG-4 is planning to begin work on a revised LAAS MOPS starting in January 2001. The revised MOPS are expected to incorporate changes for improved consistency with SARPs and to reflect operational experiences gained with early LAAS implementations. The current areas of inconsistency include:

- VHF Data Broadcast (VDB) Received Power Variations

- VDB Time Slot Decoding

- VDB Adjacent Channel Rejection

- VDB In-Band Off-Channel Rejection

- VDB FM Immunity

- VDB Desensitisation Over-Bounding of Residual Ionospheric Errors

- Standard Airborne Multipath Model

- Signal Quality Monitoring Constraints

- Requirements Related to the Precision Approach Region

A change to the FAS data block definition may be required to allow the MMR to automatically determine the currency of the PA Database with the Universal Time Co-ordinated (UTC) time derived from the GNSS signals.

3.2.3 SC181

3.2.3.1 DO-200A

There are no known issues related to DO-200A at this time. Further development of DO-200 is expected to be co-ordinated through SC-181.

3.2.3.2 DO-201

An updated version of DO-201, DO-201A, has been completed by RTCA SC-181 and is expected to be approved and released shortly.

3.2.3.3 DO-236

Revision "A" to DO-236 is being balloted for approval by RTCA SC-181 and has been jointly developed with EUROCAE Working Group 13. The issues in DO-236 have been addressed with a revision that is expected to be approved by SC-181 (DO-236A).

3.2.4 SC-189

A detailed report of most recent meeting (Dec 01) can be found at the following address.

http://www.rtca.org/comm/summaries/189sum15%20Final%2012%202001.PDF

This is summarised below.

Publications
The SC is working on changes to "Interoperability Requirements for ATS Applications and Services using ATN Baseline 1", and to Annex F, ED78A/Do-264".

Sub Group 1 Interoperability

The INTEROP sub-group planned to complete work on the ground accommodation document for FANS 1/A and ATN Baseline 1.

Work is planned to begin on the interoperability document for ATN Baseline 2. Discussion indicated a need for consistency in the terms related to services.

This SC discussed the Initial Oceanic operations, which plans is to start with individual service descriptions, add extended service descriptions, develop an Operational Performance Assessment (OPA) and an Operational Safety Assessment (OSA) on the extended services, and then complete their SPR.

The scope now contains the following communication basic services; preflight, notification of aircraft readiness for data communication, contact advisory, data communication initiation, transfer of communication, information exchange and reporting, clearances and clearance requests, and connection termination. Discussion indicated that emphasis needs to be placed on position reporting.

The scope also contains the following extended services: separation assurance, route conformance monitoring, re-routing procedures, and weather deviation procedures. It is looking for human factors expertise.

This SC also discusses the South Pacific Air Traffic Services Co-ordinating Group (ISPACG), and Initial Continental operations. A key issue is interoperability.

It was debated as to whether RCP should be defined for a service or for an airspace. The consensus was to do both in matrix form by characteristic, identifying the RCP type needed within a given airspace. Airspace jurisdiction officials within respective States would decide how to handle this within their jurisdictions.

This SC also discussed output of the RGSCP, and LINK 2000+, FAA ADL Program, SC-194, and Boeing RRF.

3.3   EUROCAE

3.3.1 WG-28

3.3.1.1 ED-97

This document has been published as an Interim Technical Performance Standard and is not usable as a basis for certification. The document was not published as a MOPS because of the rate of change of the technology and the lack of full validation. In terms of scope, this document specifies performance and functionality only for en route through NPA and lateral guidance. Further work is needed to incorporate vertical guidance and expand the scope to address new operational capabilities including PA.

3.3.1.2 ED-95

The main issues pending with ED-95, as with DO-245, stem from inconsistencies with the SARPs. Compatibility with the FAA LAAS Ground Facility Specification also may be a consideration. Revisions are needed to address SARPs inconsistencies and add additional system requirements for advanced operations. Areas of inconsistency include:

- Coverage Volume

- Service Availability

- Position, Velocity, Time (PVT) Requirements to Support Non-Landing Applications

- Accuracy Contributions of Residual Signal-In-Space (SIS) Errors

- SBAS Ranging Accuracy

- Integrity and Continuity Allocation Trees

- VDB RF Field Strength

- FAS Data Definition

- Airborne Accuracy Requirements

- Availability Assessment

- Troposphere and Ionosphere Correction Models

- Differential Correction Processing

3.3.1.3 ED-88

This document is being updated to support GLS operations. In the current draft material the GLS functionality, performance and testing is specified largely by referencing RTCA

DO-229B and DO-253. Following completion of the ICAO SARPs, this standard is expected to be updated for consistency.

3.3.2 WG-45

3.3.2.1 Meeting Report

The 31st EUROCAE WG-45 Meeting was held on 13th, 14th & 15th December 2000 in the UK.

The document version "ED-106 DRAFT 4.DOC - 27/10/00 October 2000" (DLASD for the Oceanic Clearance (OCL) Data-Link Service) was reviewed. This document also looks at safety assessment analysis. ED-106 OCL DLASD is due to be complete by January 31st2002.

DGAC-STNA gave a presentation on the implementation of DCL data link services in France. French aeronautical information relating to the implementation of DCL data link services was provided.

NATS Ltd. presented a paper on the implementation of Oceanic Clearance, Pre-Departure Clearance and ATIS data link services.

A discussion took place concerning the NATS Ltd implementation of VOLMET using the ARINC 623 (see Page 28) ATIS En Route option, although this has not been included in EUROCAE ED-89.

It has been decided that ED-85 DLASD for DCL will be updated by adding the Appendix B with the message formats from AEEC 623.

EUROCAE WG-53 / RTCA SC 189 will consider AEEC 623 accommodation with FANS 1/A or ATN (when defining Interoperability requirements for FANS-1/A, ATN and 623).

WG-45 has chosen to close down, and so no further meetings for WG-45 have been planned.

3.3.3 WG-47

No meeting report received.

3.3.4 WG-50

No meeting report received.

3.3.5 WG-51

No meeting report received.

3.4   ARINC

3.4.1 Communication

3.4.1.1 Air/Ground Systems Sub-Committee

No meeting report received.

3.4.1.2 Data Link Systems

3.4.1.2.1 Data Link Systems Subcommittee

The following meeting reports are available at the ARINC website:

- Report of the DLK Systems Subcommittee Meeting Held December 13-14, 2000 in San Diego, California

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  Report of the Flight Data Recorder Ad Hoc Meeting Held March 13, 2000 in Seattle, Washington

- Report of the VDL Subcommittee Meeting Held December 15, 2000 in San Diego, California

These reports were considered not to be of direct interest to MA-AFAS.

3.4.1.3 Data Link (DLK) Users Forum

No meeting report received.

3.4.2 Navigation

3.4.2.1 GPS/XLS

3.4.2.2 756

The main pending issues associated with this document includes incompatibilities with DO-253 and the ICAO SARPs. Improvements to the document are expected to be co-ordinated through the AEEC XLS sub-committee. The development of a second supplement (Supplement 2) is currently underway.

Specific deficiencies associated with Supplement 1 include:

- External GNSSU: Provisions have been made for the GNSS receiver to be external to the MMR. However, a number of technical issues would need to be solved to achieve an interoperable external GNSS solution. These issues include overall latency (dynamic loop characteristics, computational delays, and transport delays), tuning interface definition, and data interface definitions. The XLS sub-committee has agreed that the external GNSS solution should be removed from ARINC 755. This is reflected in current Supplement 2 draft material.

- Precision Approach Selection (GBAS): Current standard is written around four-digit tuning. Migration to five-digit tuning is reflected in Supplement 2 draft material.

- Precision Approach Selection (SBAS): Current standard does not fully define the database interface standard. This interface is not yet fully developed in Supplement 2 draft material.

- Airplane Personality Data: The approach to providing aircraft-specific lever arm data is not fully developed in the current standard. Current approaches to providing lever-arm data include configuration strapping, external input of airplane personality data, and the external airplane personality module. A revised airplane personality data block message has been incorporated into Supplement 2 draft material.

- Deviation Data Latency, Bandwidth, and Update Rate: Current standard is immature with regard to latency. The current standard contains an ILS-equivalent latency specification. However, the nature of latency and dynamic response in a GNSS receiver and its overall effect on closed-loop autoland system behaviour is different than for ILS. Internal research and development has demonstrated the effectiveness of using different latency characteristics for GNSS than ILS. The current DO-253 standard reflects the acceptability of longer latency for GNSS than ILS. The XLS sub-committee has reached consensus to change the GNSS latency specification to correspond to DO-253.

- Scaling and Sensitivity: Current standard is incompatible with DO-253 and the SARPs. Supplement 2 will be changed to largely reference DO-253 for consistency.

- GLS Failure Monitoring: The current standard copies ILS characteristics and is immature with regard to fault detection in GNSS. The nature of GNSS receiver faults and their effect on guidance system outputs is different for GNSS than for ILS. There has been considerable discussion as to whether the ARINC 755 standard should require dual-thread monitoring for GLS: these discussions are expected to continue. Rockwell Collins Inc. supports the concept of the use of dual-thread redundancy to ensure compatibility of the MMR with current dual-dual automatic landing systems.

This standard currently assumes that the Precision Approach Database is stored externally to the MMR. This may be changed in the future to ease database implementation.

3.4.2.3 755

Issues with ARINC 755 are very similar to those for ARINC 756, and the solutions adopted for ARINC 756 are expected to be adopted within the ARINC 755 standard.

3.4.2.4 743

The main pending issues associated with this document includes incompatibilities with DO-253 and the ICAO SARPs. Improvements to the document are expected to be co-ordinated through the AEEC 743 sub-committee. This activity is currently underway with the planned development of Supplement 4. This supplement should address the following compatibility issues:

- Incomplete definition of receiver output characteristics in differential mode. Definition of integrity levels, figures of merit, measurement block outputs, and maintenance information will require revision.

- GBAS tuning and differential corrections interface: The document is written around a mix of Special Category I (SCAT-I) standards and MOPS-incompatible tuning scheme.

- External GNSSU description incomplete: This option is not expected to be supported.

- Passive antenna/internal pre-amplifier receiver design: This design does not reflect the current design and maintainability approaches for GNSS and may not be need to be supported in Supplement 4.

3.4.3 Surveillance

From "Meeting Report, AEEC Special Session, December 12, 2001", it can be seen that AEEC has traditionally relied upon the development of ARINC standards to establish the introduction of new technologies into the air transport industry. It was noted that other organisations are becoming the source of new systems definitions, notably ADS-B and VDL Mode 4.He suggested that AEEC consider the use of alternate techniques, such as exploratory meetings and users forums, to influence the technology selections coming from these activities.

3.5 ICAO

3.5.1 AMCP

3.5.1.1 WG-B

The 11th Meeting of AMCP WG-B was held in Montreal, 29th August–7th September 2001.

AMCP Working Group B was tasked at AMCP/6 with the following objectives:

- To develop frequency planning criteria for VDL Modes 2, 3 and 4

- To assess potential aircraft and co-site constraints for VDL

- To develop guidelines for the introduction of VDL in the VHF band

- To address the need for developing spurious emission limits (Ref. AMCP/6, Rec. 3/2) and

- To study the need to increase spectrum allocated to AM(R)S in the band 117.975 – 137 MHz

Issues that were resolved:

- A number of scenarios in terms of traffic load needed to be defined for VDL mode 4, these should include both ADS-B and communications scenarios.

A working paper was accepted that contained proposed interference channel loading for VDL Mode 4.

- The need for retriggering of the VDL Mode 4 receiver when in the presence of interference.

It was agreed that retriggering for VDL Mode 4 was necessary since its interference performance was inferior to the requirements of the SARPs without it.

- Upon satisfactory conclusion of the various issues, derivation of the relevant planning criteria

- Planning criteria for VDL Mode 2 as proposed by EUROCONTROL was accepted by the meeting.

Issues partly resolved:

- The test method to be used in determining the interference potential between VDL Mode 4 and the VHF Omni-Range (VOR) terrestrial navaid, GBAS and ILS remains to be resolved.

One working paper proposed methods for assessing the interference potential between VDL Mode 4 and both ILS and VOR. These will be submitted to GNSSP for comment.

The development of the test method for determining the interference between VDL Mode 4 and GBAS is on going.

- The correct values of Signal to Pulse to be used when testing VDL Modes 3 & 4 against a DSB-AM victim.

The value of 18dB for VDL Mode 3 was recommended by the FAA and accepted by the group. The meeting noted that the on channel Desired to Undesired (D/U) ratio equivalent to results achieved with an 18dB Signal to Pulse ratio was approximately 30dB. The value for VDL Mode 4 has yet to be determined.

Issues to be resolved:

- The correct values of Signal to Pulse to be used when testing VDL Mode 4 against a DSB-AM victim.

- Validation of whether a SINAD reduction of 6dB is equivalent to a S+N/N degradation of 6dB.

- Testing of VDL Mode 3 vs. VDL Modes 2, 3 & 4

- The test methods to be used in determining the interference potential between VDL modes 2 & 3 at the band edge of the ARNS and AM(R)S.

- The test method to be used in determining the interference potential between VDL Mode 4 and GBAS.

- Determination of amendments to ITU-R Recommendations SM1009-1 & M1140 as a consequence of the introduction of new services in the band 108-137 MHz.

- Which two frequencies can be identified for VDL Mode 4 as global signalling channels

- Upon satisfactory conclusion of the various issues, derivation of the relevant planning criteria

- Development of relevant guidance material taking into consideration a validation of the various assumptions under which the planning criteria have been developed

Testing

The test methods agreed at the 8th Meeting of Working Group B and those proposed for testing interference to VOR and ILS at the 10th meeting of AMCP WG B were used for a majority of the testing carried out since the 10th Meeting. A large amount of testing has been carried out by both DFS and EUROCONTROL with additional testing by the FAA and SITA.

However, no testing has so far been reported for the following scenarios:-

- DSB-AM interferer, VDL Mode 3 victim

- VDL Mode 2 vs. VDL Mode 3

- VDL Mode 3 vs. VDL Mode 3

- VDL Mode 3 vs. VDL Mode 4

Planning Criteria

Planning criteria for VDL Mode 2 has been proposed for inclusion in the guidance material. No planning criteria have been proposed for VDL Modes 3 and 4.

On-Board Compatibility

A working paper presented by Airbus indicated that from test carried out on their aircraft the on-board co-site issue should not be a constraining factor in the implementation of VDL Mode 2 and the determination of suitable planning criteria.

GNSSP Co-ordination

An informal meeting with the GNSSP spectrum group was held to address certain aspects of VDL/DSB-AM vs. ILS/VOR/GBAS compatibility. AMCP WG-B requested confirmation that the test methods they have developed so far were correct and assistance with developing one for GBAS.

3.5.1.2 WG-C

3.5.1.2.1 AMCP WG C-1

The first WG-C meeting was held in 2000, and reflected the following topics:

Long Term System Requirements

The ICAO Secretariat had sought input from the ATMCP on operational concepts in the 2010 plus time frame but these were not thought to have the level of maturity necessary to be considered by AMCP. The lack of even an embryonic long term ATM concept was of great concern to Group and raised doubts as to whether it was useful to address the air-ground communications infrastructure for the post 2010 time frame. However, considering the long lead times necessary for the development, standardisation, certification and implementation of a new air-ground communications infrastructure, it was agreed that work must start in parallel with requirements determination. Initial work will need to be based on assumptions of the perceived ATM requirement and these assumptions will need to be co-ordinated with the appropriate ICAO Panel.

Required Communications Performance

Draft Version 1.4 of the Concept of Required Communication Performance prepared by OPLINKP was reviewed. Comments were generally unfavourable, as progress in ADSP has been slow. The Group was also concerned that human factors would be included in the concept of required communications performance. Consequently, the Group had

concerns as to the usefulness of the work carried out by OPLINKP on RCP in defining the technical performance of communications systems. Also, it was concerned about whether it could be used to determine the RCP type to be applied in a specific volume of airspace, and how operational approval could be achieved.

VDL Implementation

The FAA presented their current plans for the implementation of VDL. Initially, a set of non-time critical CPDLC messages will be implemented in 2001 using VDL Mode 2 via a service provider. They have no plans to implement their own VDL Mode 2 infrastructure. A contract for multi-mode radios will be let in 2001 as part of the NEXCOM programme. These radios will form the initial element of the deployment of VDL Mode 3. The current plan is to deploy VDL Mode 3 voice services in high and super high sectors from 2008. Migration of data services such as CPDLC and Pre-Departure Clearance (PDC) is not now expected to begin before 2010. The NEXCOM radios have been specified to include an 8.33 kHz capability and this may well be the FAA's solution to VHF congestion in the near term.

EUROCONTROL presented the European strategy for mobile sub networks. This was based on the introduction of VDL Mode 2 in 2003 together with horizontal expansion of 8.33 kHz operations in 2002 and vertical expansion 2005. It was also stated that VDL Mode 3 and VDL Mode 4 are being considered for communications services around 2010. VDL Mode 4 is also being considered for local implementations of ADS services from 2003 and more generally from 2006. Included in the presentation was a graph of the percentage of successful frequency assignments that could me made in the period up to 2010 if 8.33 kHz spacing was extended in both the horizontal and vertical planes. It suggested that even with full implementation of 8.33 kHz spacing the success rate for frequency assignments would start to drop from about 2004 and be down to 50% by 2010. In EUROCONTROL's view, frequency congestion in Europe would not be alleviated by the introduction of VDL Mode 3 because this system would not provide a significant benefit over 8.33 kHz spacing

Sweden gave an update on the North European ADS-B Network (NEAN), NEAN Update Program (NUP), and Mediterranean Update Program (MEDUP) programmes. It was claimed that these programmes will deliver an extensive pre-operational ADS-B platform in the participating states supporting various ADS-B applications. This will include the integration of ADS-B in some operational ATC centres by 2003 and air to air applications by 2005.

Review of Annex 10 Radiotelephony Procedures

An initial review of radiotelephony procedures contained in Annex 10 was undertaken to determine whether they should be revised to take account of data communications and satellite communications. The Group agreed that this subject required further work.

Future Systems

The FAA gave a presentation on UAT and described the work going on as part of the Capstone Programme in Alaska. No proposal to start work on SARPs was brought forward since the need for SARPs would depend on the technical link analysis work underway in the US and Europe. Significant work on the detailed specifications for UAT and their validation has been completed. The preparation of SARPs would therefore be a relatively easy process and could be completed in possibly 12 to 18 months from a decision to proceed.

EUROCONTROL provided a progress report on Gatelink. At present, all standardisation aspects are being carried out under AEEC SC 763 ANFS (Aircraft Network File Server). In general, the Working Group doubted the ability of the proposed system to be standardised in Annex 10 and support a full range of ATS and AOC data communications systems because:

- Internetworking uses Internet Protocol (IP) and is not ATN compliant.

- It is intended to operate in the 2.4 GHz ISM Band where it will not receive regulatory safety protection.

- It is the subject of many patents.

A paper from Sweden addressed the potential of VDL Mode 4 to support communications applications other than surveillance. It was agreed that if ICAO standardised VDL Mode 4 as a mobile subnetwork of the ATN it was available to carry all ATN applications.

ESA presented a paper on a project to develop a service demonstrator for a Satellite Data Link System (SDLS). It was claimed that a modern, specifically designed aeronautical satellite communication system could provide voice and data communications with a performance equivalent to that obtained from terrestrial systems. Furthermore, the current state of SATCOM technology should allow aircraft installations having similar technical constraints and costs to terrestrial VHF systems.

The Working Group as a whole expressed concern at the pace of technological change in the field of communications and the ability of the ICAO standardisation process to keep up. A paper from ARINC noted that that standards for VDL Modes 2, 3 and 4 had been under development for nearly 10 years and it was expected that these systems would be deployed during the next 10 years. However, several developments were currently underway which would provide high-speed data communication with aircraft for airline and passenger use. Thus, the passenger may have access to a data communication system with a capacity that far exceeds any system available in the cockpit. These new systems would not operate in protected spectrum allocated for aeronautical mobile services but, if they provide the required quality of service, they could be used for ATS and AOC applications. If this happens the role of ICAO standards will diminish.

Need for VHF Beyond 2010

A paper from EUROCONTROL, supported by a paper from International Air Transport Association (IATA), suggested that the demand for VHF assignments would continue to grow and would not be satisfied by further extensions of 8.33 kHz spacing. Furthermore, VDL Mode 3 would not provide a sufficient increase in channels to make the move worthwhile. A complementary paper from the FAA suggested that future expansion of VHF channels would be met by the introduction of VDL Mode 3. The meeting concluded that VDL Mode 3 was now unlikely to be the future ICAO VHF system as recommended at the 1995 Communications Divisional Meeting.

There was discussion on whether the current growth in the requirements for VHF channels would continue beyond 2010. It was accepted that, in the core areas, re-sectorisation would not solve capacity problems beyond 2010 but that additional channels would still be required outside of the core and to support expansion of airport operations. The rate of expansion will however depend on future ATM concepts to be developed by ATMCP. The meeting therefore agreed to send a communiqué to ATMCP requesting an assessment on the future need for voice channels.

On the assumption that the current VHF Band would not have the capacity to meet future demands, the only options were considered to be extending the band into the VOR Band or transferring part of the communications into another band. The meeting therefore agreed to send a communiqué to AMCP WG F requesting an assessment of the possibility of extending the present VHF band or obtaining alternative AMS(R)S allocations.

Future VHF Selection and Usage

No specific proposals were brought forward on VHF selection methods. The meeting agreed that it should address methods of automating frequency selection in order to relieve this workload in the future. It was however accepted that the channel labelling issue was a real concern to pilots and controllers and needed to be revisited by ICAO.

Multi-Use of Vocoders

This WG is also looking at issues regarding multiple use of Vocoders in end to end digital voice communications.

Communications Scenarios

WG C agreed that it should prepare a report titled, "Communications Scenarios from the Present to Beyond 2010". This report would rely heavily on input from ATMCP and previous work carried out by NATS in support of AMCP. An outline contents list was prepared with the following headings.

- Inventory of the Problems

- Overview of Alternatives

- Considerations on Spectrum utilisation

- Institutional Aspects

- Increasing Communications Usage for Navigation and Surveillance Services

- Inventory of Perceived and Stated Communications Requirements

- Consideration of Shared/Dedicated or General Purpose Systems

- Recommendations to ICAO on how to proceed to achieve common global interoperable communications infrastructure

Interoperability of AMSS Networks was discussed. Thus this first meeting of WG C kicked off a significant programme of work covering a broad spectrum of topics.

- Definition of communications requirements post 2010.

- Definition of meaningful Required Communications Performance (RCP) parameters.

- Investigation of alternative, more user-friendly channel-labelling schemes.

- Investigate options for new air-ground communications systems.

- Active participation in the European Space Agency (ESA) SDLS programme

- Theoretical and practical assessment of multiple use of vocoders.

- Preparing material for report on communications scenarios

3.5.1.2.2 AMCP WG C-2

The second meeting of the ICAO AMCP WG-C was held on 7-11 May 2001.

Dialog regarding the WG's comments on RCP, sent to the OPLINK panel, were discussed.

The request to AMCP panel members for information on VDL implementation resulted in updates from Spain, Japan, USA and EUROCONTROL.

WG-C to revisit the Annex 10 radiotelephony procedures.

WG-C requested WG-M to validate VDL Mode 4 as a communication system.

WG-C requested WG-F to assess the possibility of alternative AMS(R)S allocation.

WG-C to draft a communiqué to ATMCP on the shortage of voice channels.

WG-C to assess the potential of reducing the frequency channel management for pilot and controller.

WG-C to develop guidance material for the use of air-ground vocoders in tandem with ground vocoders.

WG-C to identify most urgent issues to accommodate a mobile communication system, operating outside the VHF com band, beyond 2010.

WG-C to identify lead to provide updates on standardisation activities. An inventory was made by EUROCONTROL of EUROCAE communication-related activities

Overview of Recent Developments

ENRI is studying the introduction of VDL mode 2 and 3 in Japan. Avicom will start operating VDL Mode 2 AOA (ACARS over AVLC-Aviation VHF Link Control) in the third quarter of 2002 for AOC. No plans have been made yet on the implementation of CPDLC. The ENRI study contained the testing of VDL Mode 2, VDL Mode 3 and the Human Machine Interface (HMI) in support of data link communications. VDL Mode 3 testing is underway with a planned completion date of 2004. Foreseen future work is the evaluation of methods for suppression flight deck noise in the voice transmissions to improve voice quality, ATC applications for VDL Mode 3 and further developments in HMI such as voice recognition. As other countries were also evaluating VDL Mode 2 and VDL Mode 3 it was requested that VDL Mode 2 test results be made available and WG-C be kept informed on the progress of VDL Mode 3 and HMI evaluation.

Japan to provide the test results from VDL Mode 2 testing.

In Japan, the present planning of the MTSAT programme is to launch the first satellite in 2003 and a second in the summer of 2004. The MTSAT system is designed to meet the SARPs to be fully compatible with satellite systems operating to conform to these SARPs. Log-on problems in case of a satellite failure have been investigated.

Liaison with other Panels and working groups

The group had reviewed a draft document developed by OPLINKP WG-C (RCP Concept, Version 1.4) and it had provided a number of general and detailed comments on the document to OPLINKP. OPLINKP WG-C reviewed the AMCP communiqué and other comments on the RCP Concept document and produced a final revision of the document. OPLINKP WG-C deemed the final revision of the RCP document ready for submission to the ANC and subsequent transmission to States for review and comment.

AMCP WG-C reviewed the new version of the RCP document. The meeting noted that OPLINKP had made a significant effort to accommodate the comments produced by AMCP. In particular, useful clarifications had been provided on OPLINKP's main concern with aspects of the design of the human-machine interface. Also, the OPLINKP had recognised that it would have been useful to define a statement of

performance requirements limited to the technical communication portions of the communication process and termed required technical communication performance (RTCP).

The meeting concluded that the original requirement from AMCP/4 calling for the development of a means "to assess the various technical options of communications systems against the RCP parameters" was not fully met even by the last version of the document.

AMCP WG-F was requested to look for alternative frequency bands for aeronautical safety communications to alleviate the congestion of the present VHF Com band. WG-F concluded that the 5 GHz band would be the most likely candidate to support new aeronautical services. Possible alternatives are 960-1215 MHz and the 328.6-335.4 MHz when the use of these bands would be reduced due to an anticipated transfer of the present aviation services to another band. WG-F suggested that WG-C look at bands above 10 GHz in light of the prevailing propagation conditions and the associated system design constraints. It was requested that a clarification as to whether the military UHF sub bands in the range 222-400.05 MHz could be considered as a possible band to be used for civil aviation.

WG-C to ask WG-F whether the UHF band has been considered as a candidate for aeronautical (R) service.

ATNP has proposed that the establishment of a consulting process to review the potential impact on ATN implementation of changes to the ATN specifications originated by "other ICAO bodies" . The group generally agreed with the view that any changes to ICAO technical provisions should be thoroughly co-ordinated among all relevant ICAO expert bodies, in order to minimize the impact of the changes on the implementation of the systems supporting such provisions. Informal co-ordination through the Secretariat would be the preferred mechanism to identify the potential impact of changes and to propose measures to minimize their impact. Should the informal co-ordination fail to resolve all the issues identified, the ANC should be briefed by the Secretariat on the issues that remain open and on their proposed resolution, and would take action as required.

AMCP members are advised to bring to the attention of their respective ATMCP members the need to consider the physical and financial constraints regarding the air ground communication capacity.

AMCP/WG-C in its first meeting discussed the additional capabilities of the VDL Mode 4 datalink and has recognised the potential of VDL Mode 4 to support time-critical communication services as an ATS datalink. Following a request from WG-C, WG-M decided to establish a subgroup to examine the issue of using VDL Mode 4 as a generic ATC/AOC datalink capable of supporting time-critical applications.

WGM at their second meeting (May 2001) was presented with a draft report on a comparative analysis of the performance of the different VHF systems to support point-

to-point communications. This report will be further developed by the subgroup and it will be discussed in the next WG-M meetings with the intention to develop appropriate recommendations to the AMC Panel.

Urgent Issues

WG-C identified as most urgent tasks the potential to introduce a mobile communication system operating outside the VHF band beyond 2010. The most urgent actions relate to the identification of the most appropriate band where such a system would operate.

New Systems to be considered

Universal Access Transceiver (UAT):

The US member of the panel invited the group to consider the need for the development of SARPs for the UAT. The group recalled that the AMCP/7 meeting had agreed that an element of the new work in Working Group C would be to consider the need for the developments of such SARPs. The paper also provided information on related activities, including the FAA "Capstone" program, a joint FAA/EUROCONTROL ADS-B link alternatives assessment and the development of UAT MOPS. Standardisation concerns were also discussed.

The outcome of the ADS-B/situational awareness links assessment conducted by the Technical Link Assessment Team (TLAT) was reported. It was commissioned by both (1) the Safe Flight 21 (SF21) Steering Committee consistent with the recommendations of the RTCA Free Flight Select Committee and (2) the EUROCONTROL ADS Programme Steering Group (PSG). The assessment had been conducted on three candidate ADS-B/situational awareness links: the SSR Mode S Extended Squitter, the VHF Digital Link (VDL) Mode 4 and the UAT.

The group was informed that the report was intended to serve as a primary technical input to FAA and EUROCONTROL selections of ADS-B link technologies for implementation. It was emphasised that these selections of ADS-B link technologies would be based on a number of considerations (e.g., cost/benefit and institutional/transitional issues) in addition to the technical factors discussed in the report.

It was also clearly stressed that the report did not contain an ADS-B link recommendation.

The meeting was informed that detailed system descriptions of the candidate links and significant supporting information for the Technical Link Assessment Criteria, traffic scenarios, and TLAT simulations/analyses were available at the following websites:

www.eurocontrol.be/projects/eatchip/ads

www.faa.gov/safeflight21/

The current priority of WG-C was the planning of the work to be conducted by WG-C itself, rather than the discussion of details of the TLAT report with which most WG-C members were not familiar. It was therefore agreed that, at least for the time being, the issue would be pursued outside WG-C.

A subgroup was formed to develop a proposal for the future actions that the WG would need to undertake in order to assess the need for UAT SARPs. The proposal developed by the subgroup was then reviewed by the WG.

The WG agreed that it should conduct a comparative analysis in order to establish whether the need for UAT SARPs could be justified on the basis of any additional benefits that the UAT would be able to deliver over and above the existing ADS-B candidate links already included in Annex 10 (Secondary Surveillance Radar (SSR) Mode S extended squitter and VDL Mode 4), conditional on the resolution of any associated substantive issues. This analysis will be based on the TLAT report, although that had not been aimed to support the work of WG-C. It was decided that the group should seek the help of other ICAO technical groups in their respective area of expertise, due to the volume of technical data.

In particular, the group agreed that OPLINKP (WG-A) should be requested to confirm that the ADS-B operational requirements used by the TLAT were representative of and broadly consistent with the ICAO ADS-B requirements under development by OPLINK itself.

The group also agreed that SCRSP and AMCP WG-M should be requested to review the detailed technical descriptions, respectively, of the SSR Mode-S Extended Squitter and of VDL Mode 4 in order to confirm their consistency with the relevant ICAO provisions. Finally, the group agreed that AMCP WG-F should be requested to review the spectrum availability issues and provide advice as to their resolution.

This WG also considered satellite-based A/G communications.

EUROCONTROL's efforts regarding VHF congestion were discussed. Two paths were identified; address the WRC process to identify and secure necessary additional spectrum, and identify the communication infrastructure.

Thus there is a need to find a use for aviation allocated spectrum in the 5 GHz band as the whole allocation can't be justified on the basis of MLS implementation.

The "E-TDMA Concept" was discussed. It is a cellular layout of inter-connected ground stations, providing data link services to all airspace. The system would be designed to be flexible, could be tailored, and sustainable in terms of having a migration path to provision of additional services. It was noted that the concept would not be limited to the VHF band. The working group agreed to hold this item in abeyance until more interest is shown.

Output of EUROCAE WG55 on safety-related communication requirements in a high air-traffic density airspace. Though the document dealt specifically with next-generation AMSS, it was stated that the high-level requirements would be similar for VHF. In discussing the issue the WG-C agreed that in particular the 'Operational Communication Requirements" of the report to AMCP/8 should be stated at the highest possible level without addressing specific technology.

In conformance with the tasks assigned to WG-C, the report will focus on safety communication within the VHF band. However, considering the present and anticipated capacity constraints in the VHF band, other types of aeronautical communication or systems operating in other bands have to be taken into account.

The report should contain some of the following considerations:

- Regional aspects
- Long term planning of capacity
- Decision making in aviation
- Relevant activities in other fora
- Monopolies and
- Intellectual Property.

The following meeting schedule was agreed:

- WG-C3: 15-19 October 2001, Alaska
- WG-C4: 20-24 of May 2002; Tentatively Europe/Seattle
- WG-C5: October 2002: Tentatively Japan

3.5.1.3 WG-M

Only the aspects relevant to MA-AFAS are reported below. Issues concerning HFDL and VDL3 have not been included.

3.5.1.3.1 Meeting 1

AMCP updates since AMCP/7

The ANC agreed to publish the detailed technical specifications and the implementation manuals for VDL Modes 3 and 4. The meeting was informed that ICAO will also publish the implementation manual for VDL Mode 2, which was agreed at AMCP/4, together with the detailed technical specification. The manuals for VDL Modes 3 and 4 have been submitted for editing and translation.

The ANC noted the concerns, expressed by some States and other international organisations and supported by the Secretariat on the absence of frequency planning characteristics and protection requirements for all modes of VDL with regard to the feasibility of their implementation in an efficient manner in the VHF band. The ANC was informed that the matter is still being studied by AMCP, but that, to date, no significant progress has been reported. Some States and international organisations are undertaking testing of VDL with a view of developing protection requirements. The Commission agreed that inclusion of the SARPs for Next Generation Satellite Systems is not appropriate at this point time.

The meeting was further informed that Working Group F had completed the draft ICAO position for the ITU World Radio Communication Conference 2003. The meeting noted that the work of WG-B was closely related to that of WG-M and expected WG-B to develop substantial material on the introduction of VDL in the VHF band.

General Discussion on Common Configuration Control Procedures for the Manuals for HFDL, VDL Modes2, 3 &4

The meeting was informed that ICAO does not expect in principle to publish amendments more frequently than once a year.

Amendments to the AMSS SARPs are more complex as this material is already in Annex 10. Amendment proposals for the AMSS SARPs should follow the formal amendment procedures as established by ICAO. It was agreed by the meeting that WG-M should develop proposals for removing from Annex 10 the detailed specifications for AMSS and incorporate them in a technical manual.

VDL Mode-2 Manual Progress and Configuration Control Procedures

Various Amendment Proposals for VDL Mode 2 were reviewed by the meeting.

After discussion, updated amendment proposals were reviewed by the meeting. It was agreed that ARINC would undertake to complete the review of these proposals as early as possible to enable their introduction in the first edition of the manual on detailed technical specifications.

VDL Mode-4 Manual Progress and Configuration Control Procedures

At this time, the work of the Mode-4 VSG is considered to be complete. The Mode-4 VSG is in an inactive state at this time.

Review Status of AMCP WG-C Liaison Statements

The meeting discussed the potential for using VDL Mode-4 in the aeronautical mobile service. The meeting agreed that first a comparative analysis, following the model presented to AMCP/5 is required before further work can be initiated.

This work should address the feasibility of VDL Mode-4 as a communications system and the added benefits of VDL Mode-4 as compared to the other data links.

It was suggested that at a meeting of WG-M in April 2001, the progress of this work could be further studied.

Review aspects of the frequency availability for potential use by HFDL and VDL Modes 2, 3 & 4

The meeting identified that the VDL Mode 4 SARPs require two Global Signalling Channels, mainly for ADS-B. Information presented to the meeting also identified the need for other channels and the meeting agreed that these should be co-ordinated on a regional basis.

The meeting was presented with test data that showed that it would be advisable to make the band 108 – 117.975 available for VDL Mode-4. The Secretary was requested to inform WG-F about this discussion.

The meeting discussed the resulting working paper summarising the draft results of VDL Mode-4 interference testing.

Review of ATNP Communiqués

The meeting reviewed in detail a proposal from the ATNP to amend Table 1-3 of the ATN Manual. This table is addressed in the mapping of ATN network priorities to mobile subnetwork priority.

The meeting noted that the ATN is not capable of distinguishing between different applications given the same priority. Therefore, all messages with ATN Priority 11 (high priority safety messages including ADS-C messages) would be accommodated by every air/ground data link that can carry these messages. Therefore, VDL Mode-4, intended to carry only ADS-C messages, will automatically be capable of carrying other (ATC) messages with the same priority. The solution of this problem has been referred to a future meeting since the working group is considering the feasibility of using VDL Mode-4 also as a communication link.

The meeting noted a number of fundamental errors in the table that require further attention.

3.5.1.3.2 Meeting 2

The second meeting of AMCP Working Group M was held on 25 April to 3 May 2001.

5

AMCP Updates since AMCP/7

The ICAO council has formally adopted the SARPS for VDL Modes 3 & 4. Unlike AMSS, HF and VDL Mode 2 whose SARPS were published as one document within Annex 10, only the physical layer part of the SARPs for Modes 3 & 4 are to be published in the Annex. The remaining SARPs will be published separately as detailed technical specifications and implementation manuals. The existing SARPs for VDL Mode 2 which were agreed at AMCP/4, in the same manner as Modes 3 & 4 to leave a core VDL SARPs dealing with the physical layer only in Annex 10.

The reason for splitting the SARPs into the three documents is mainly to allow changes to be made more quickly since changes to the detailed Technical specifications and Implementation manuals can be agreed by WG-M but changes to the core SARPs have to be agreed at Panel meetings.

VDL Mode-2 Manual Progress and Configuration Control Procedures

Various Amendment Proposals for VDL Mode 2 were reviewed by a sub-group of the working group the participants were from STNA and ARINC. Several of these amendment proposals were then reviewed and agreed by the meeting.

VDL Mode-4 Manual Progress and Configuration Control Procedures

The first meeting of AMCP WG C recognised the potential capabilities of VDL Mode 4 to support other time critical communication services as an ATN sub-network in addition to the surveillance application for which it had been validated. WG-M was invited to identify the activities and steps necessary to validate Mode 4 to include other communication functions within its SARPs.

WG-M at its first meeting decided to establish a sub-group to examine this further. One of the main issues concerns the use of Frame Mode SNDCF in place of International Standards Organisation (ISO) 8208 and related to this is the need for an appropriate Forward Error Correction (FEC) scheme and the use of an alternative DLS protocol to AVLC.

FEC had not been considered necessary during the validation of Mode4 due to the periodic repetition of the surveillance information and its short length. However, in non-surveillance applications the nature of the data changes and the penalty of retransmissions could be significant. Despite modelling and extensive discussion, the sub-group could not reach consensus.

The DLS protocol in the Mode 4 SARPs, which is a virtual, cut and paste of Mode 2's and had relied on Mode2's validation as proof that its own SARPs were validated. It was noted that the extensive exercise carried out by the FAA in the validation of Mode 3 had

The WG meetings had been brought forward from April, in particular to enable completion of the RCP document so that it could be submitted to ANC. The document was then likely to be circulated via State Letter for comment.

WG-A

There was considerable discussion concerning a proposal from Spain to revise the ADS Figure of Merit (FoM) granularity down to 0.0005nms. It also proposed that ADS-B and ADS-Contract (ADS-C) should use the same basis for the FoM. The basis for such a fine granularity was stated to be the anticipated need of using ADS to support SMGCS on the ground at airports. The conclusion was that ADS-B & ADS-C were unlikely to use a common FoM with identical accuracies but that the avionics could downlink something like Current Accuracy of Position (probably as a separate [new] message group). The ground systems could then decide how to use this data.

WG-B

A WP giving CPDLC uplink & downlink message pairings was discussed in detail & revised during the meeting. There were detailed discussions on the Document 4444 AIDC message set and a significant number of changes were made, which may lead to major revisions with the AIDC SARPs.

A paper proposing that aircraft should be capable of downlinking details of the CPDLC message set they can support (to ease interoperability problems) received little support.

EUROCONTROL presented a paper on the FLIPCY service with a view to getting this included in the Manual. It was stated that ADS did not have the full capability to support this because it only downlinked Latitudes and Longitudes for waypoints and not names.

A paper was submitted concerning the deletion of some messages as a result of inputs from the Human Factors strategy Group. It was stated that this issue would remain open until after the next Panel meeting and this would then be followed by the State Letter procedure.

Detailed reports were received of the progress of the three sub-groups. All had completed final change pages for Document 9705 Ed 3 arising from review and further validation activity. All had dedicated most of their time to the production of new Guidance Material for the new Security, System Management and Directory Services Sub-volumes that would be released as part of Document 9705 Ed 3. Most material was technically complete.

A Validation Report for the GACS (Generic ATN Communication Service) was presented. EUROCONTROL had had the service coded and successfully tested, a flight trial is expected.

Items of Future Work were agreed:

- The development of Encryption functionality as part of the ATN Security provisions would be progressed to satisfy airline requirements.

- The inclusion of IP subnetworks into the ATN Ground Internetwork was endorsed. A meeting dedicated to resolving this quickly was called.

Relevant Possible Future Work Items:

- The development of a LDAP interface to the Directory Service should be considered.

- Management of Security Key Infrastructure

- Impact on Key Management on Avionics

- Consideration of an appropriate sunset date for the non-secure ATN internetwork needs serious consideration and is an Institutional Issue that requires expert communications and regulatory input.

WG-C

A revised version (v2.0) of the RCP Concept paper was developed for submission to ANC.

Significant comments had been received from both AMCP and RGCSP. These were discussed and taken into account where considered possible in the new draft. However, the WG seemed to feel that, while it could define a method of specifying RCP, actual figures were implementation-dependent and, particularly considering the human factors contribution, needed to be specified by States' airspace planners as part of any implementation. It seemed to be left to the Technical Panels to define what technical performance (RTCP) could be achieved by the various subnetworks.

All WGs – major input from, and co-operation with, other Panels (RGCSP, AMCP, SICASP, and ATMCP) required.

WG A – More work to be done by Chairman on the proposed Concept of Use required by ICAO. States need to review policy on air-to-air operations. Papers are required to finalise Figure of Merit implementation. Each State's ADS-B policy is to be reviewed and presented at the next meeting.

WG B – Remaining AIDC procedures approved for Document 4444. More solutions required for perceived operational interoperability problem. Air/ground CPDLC message set comparison methods to be detailed. Figure of Merit needs more work. CPDLC Message pairing needs UK input.

WG C –RCP concept document v 2.0 for submission to ANC, followed by circulation and State comment. WG in abeyance until State replies received, and review required.

3.5.3 ATNP

3.5.3.1 Reports

The ATN WG B (ATN Communication Service) meeting was held in Hawaii on 02/03/01.

Detailed reports were received of the progress of the three sub-groups. All had completed final change pages for Doc 9705 Ed 3 arising from review and further validation activity. All had dedicated most of their time to the production of new Guidance Material for the new Security, System Management and Directory Services Sub-volumes that would be released as part of Doc 9705 Ed 3. Most material was technically complete, there was some general editing required.

A Validation Report for the GACS (Generic ATN Communication Service) was presented. EUROCONTROL had had the service coded and successfully tested, and a flight trial was expected.

Items of Future Work were agreed.

- The development of Encryption functionality as part of the ATN Security provisions would be progressed to satisfy airline requirements.

- The inclusion of IP subnetworks into the ATN Ground Internetwork was endorsed. A meeting dedicated to resolving this quickly was called.

Possible Future Work Items were discussed

- The CAR/SAM Region may require an SNDCF for Frame Relay networks - WG B indicated that SG B1 would undertake this work if a definite requirement existed.

- The development of a LDAP interface to the Directory Service should be considered.

- Management of Security Key Infrastructure

- Impact on Key Management on Avionics

Consideration of an appropriate sunset date for the non-secure ATN internetwork needs serious consideration and is an Institutional Issue that requires expert communications and regulatory input.

3.5.3.2 Conclusions

The Frame Mode SNDCF has been included in Edition 3 of ICAO Doc 9705, which is the technical provisions that define the ATN protocols and services. Edition 3 is due to be published in Summer 2002.

The ATN has no VDL4-specific datalink services, as no services are specific to any particular subnetwork. All the ATN services are point-to-point, and VDL4 is only ICAO approved for surveillance applications (at the moment), thus the only ATN service that can use a VDLM4 subnetwork is ADS-C. If/when ICAO approve VDLM4 for more that just surveillance applications, the other ATN Services i.e. CPDLC services and FIS could also utilise this subnetwork.

3.5.4 GNSSP

For the Precision Approach theme, both implementations of an SBAS service (EGNOS and WAAS) are designed and developed to comply with ICAO SARPS. Pending approval by the ICAO Air Navigation Commission, the GNSS SARPs will be published as part of ICAO Annex 10 in mid to late 2001. ICAO activities will now be focused on new developments such as Category II/III GBAS, GPS modernisation, ground-based regional augmentation systems (GRAS) and Galileo. It is expected that an update of the GNSS SARPs will be completed approximately 3 to 4 years after the first publication in 2001.

The third meeting of the GNSSP was held in April 1999 in Montreal. At GNSSP/3, SARPs for GPS, GLONASS, Aircraft Based Augmentation Systems (ABAS), SBAS, and GBAS were reviewed and accepted by the panel pending validation, which has now been completed. These SARPs support en route and terminal operations as well as category I precision approach operations.

It is expected that the ICAO ANC will approve the SARPs such that Annex 10 to the Convention on International Civil Aviation will be amended to incorporate these new standards. Then the GNSSP will begin a future work program. Tasks on the future work program include SARPs for Ground-Based Regional Augmentation Systems (GRAS), GBAS SARPs to support Category II/III precision approach operations, GPS L5, Surface Movement Guidance & Control, and Galileo.

During GNSSP/3, the panel reorganised into two working groups. Working Group A is responsible for "operational issues" associated with GNSS, which includes updates to various ICAO documents such as circular 267 ("ICAO Guidelines for the Introduction and Operational Use of the Global Navigation Satellite System") and amendments to Annexes 11 and 15. Working Group B is responsible for "technical issues", including validation of the panel approved SARPs for GNSS and the development of updates to the SARPs to support future developments such as Galileo, GPS L5, etc.

3.5.4.1 WG-A

Working Group A has developed and reviewed a draft revision to ICAO circular 267.

3.5.4.2 WG-B

The primary focus of Working Group B has been on the validation of the SARPs. With validation now concluded on schedule, the WG-B GNSSP SARPs should be published as part of ICAO Annex 10 in mid to late 2001.

GNSSP WG-B has discussed the debate in AMCP concerning VDL Mode 4 frequency expansion, by reviewing results of AMCP WG-F on the future use of the band 108 - 118 MHz for air-ground data link.

WG-F had agreed that the frequency band would be allocated to the AM (R) Service for the use of systems related to air navigation. This would include GBAS and VDL Mode 4 applications that are only used for ADS purposes.

The meeting noted that a more generic allocation to AM (R) S in the band, with the necessary regulatory provisions to safeguard the interest of the aeronautical radio navigation service (ILS, VOR) would be preferable. This would enable ICAO to develop material of a technical and operational nature to use this band in a more efficient manner. Introduction of any system in this band would require agreed compatibility studies, to be co-ordinated with the GNSSP. This approach would not require future ITU involvement if the use of this band by the aeronautical radio navigation service is reduced as a result of successful implementation of GNSS for both en route and final approach landing navigation.

GNSSP WG-B Members have been informed that some European countries want to change the purpose of VDL Mode 4 from surveillance only use to surveillance and CPDLC, etc. use. AMCP Members have been informed that such a change of purpose of VDL Mode 4 would influence the frequency sharing discussions within GNSSP.

3.5.5 OCP

3.5.5.1 GNSS SBAS

OCP has been developing criteria for performing CAT I precision approaches using SBAS. This group is looking to adopt the same criteria as for performing CAT I precision approaches using ILS, and thus the major effort is to prove equivalency.

For SBAS (APV) II, the group is investigating how this can be done. One approach is to modify CAT I by using reduced vertical performance, and the other is to develop wholly new criteria. The latter is a major task, and would not be complete by the OCP 13 meeting, at which the changes for the 2004 revision of PANS-OPS will be finalised. Thus the new criteria would not be published until the 2007 revision of PANS-OPS.

For SBAS APV I, the options for developing the criteria are to use the existing barometric vertical navigation (Baro VNAV) criteria, or to develop new criteria to take advantage of better SBAS lateral accuracy.

Most recently, the FAA has proposed a further set of approach criteria, LPV. OCP are currently working to see how this fits in to the overall strategy. This will be further discussed at the next OCP, which will be held jointly with the GNSSP.

An OCP GNSS SBAS Working Group Meeting was held at Oklahoma City on 5th – 7th June 2001.

The meeting concerned SBAS operations and criteria and four working papers were presented. These covered Proposed PANS-OPS Vol.1 amendments for APV, Proposed PANS-OPS Vol.1 amendments for SBAS, Structure of a new PANS-OPS Vol. II chapter "SBAS Criteria", Draft proposal for Operational Requirements for APV II, and Use of SBAS for arrival and departure operations.

A strawman for an SBAS chapter was drawn up. The operational requirement for APV II operations was accepted but the WG recognised that further work was needed in respect of Annex 14, charting and cockpit (Human Factors (HF)) issues. In addition, flight trials quantifying Flight Technical Error (FTE) during manual flying were required. The UK and US are undertaking flight trials in the summer of 2002. It was also mentioned that a cost benefit study from operators should also take place before further development of APV II criteria. The amendments to PANS OPS Volume I were accepted with the thought that it was beneficial to have material explained in approach category rather than sensor specific chapters. The WG saw the benefit of SBAS for arrival and departure operations.

Actions:

- Provide formal statement on SBAS Crew Resource Management (CRM) requirement for OCP London mtg.

- Produce WP for Missed Approach guidance for OCP London mtg.

- Define distinction between GBAS guidance and SBAS navigation.

- Produce WP on use of GBAS and SBAS for GP angles > 3.5°.

- Rationalisation of GBAS and SBAS for parallel runway operations and new PANSOPS chapter.

- Carry out HF study into cockpit display annunciation.

Any delay in developing SBAS criteria could impact upon introduction of SBAS operations when EGNOS becomes operational in 2005/6.

3.5.5.2 GNSS GBAS

This OCP WG is developing a set of criteria for GBAS CAT I. There are two options for this. One is to adopt existing ILS criteria if equivalence can be proved. The other is to develop a new collision risk model. The detail of the text to be submitted for OCP 13 for inclusion in the 2004 revision of PANS-OPS will be decided at a meeting in April 2002.

3.6 ITU

3.6.1 WP8B

A meeting of WP8B was held on November 2nd, 2001.

Of particular interest at this meeting was agenda item 1.28, "to permit the use of the band 108-117.975 MHz for the transmission of radio navigation satellite differential correction signals by ICAO standard ground-based systems;"

ITU-R Working Party 8B is responsible for the preparations on this agenda item in terms of the preliminary drafting of the appropriate section of the Conference Preparatory Meeting (CPM) Report. The CPM Report provides different methods that the WRC could adopt to satisfy each agenda item, together with advantages and disadvantages for each. Roughly speaking, it is used by States who have not been in a position to participate in the ITU-R preparations as a guide to what they should do at the WRC.

This agenda item was originally a proposal from the UK and was deliberately restricted to ground based, i.e. GBAS. It has also been proposed that VDL-4 be permitted in this same band under this agenda item, but there may be problems due to limited time available for this.

The current draft CPM draft text contains two methods:

- Method 1: adopt a footnote that will permit the use of the band 108-117.975 MHz on a world-wide basis for GBAS but recognise that ICAO is standardising other expanded aeronautical surveillance applications in the 108-117.975 MHz aeronautical radionavigation service band and propose an agenda item for WRC2006 to examine those applications.

- Method 2: reserved for the use and development of ICAO standard systems that support navigation and surveillance functions on the condition that priority and protection be given to the aeronautical radionavigation service.

The introduction of VDL4 changes the sharing situation with FM broadcasting operating below 108 MHz, as the transmitters would now be airborne. If GBAS can be considered as being similar to ILS / VOR, i.e. fixed on the ground (at airports) and likely to fall within the operational envelope of an equivalent ILS installation from the point of view of FM broadcast, then compatibility studies between VDL4 and FMBC would need to be carried out and liaised within the ITU process to the responsible BC groups. With the timescales between now and when the CPM report needs to be complete this may not

be possible within the ITU framework. It would therefore be possible that adopting method 2 (supported by ICAO) to permit VDL4 could result in GBAS failing to get an appropriate allocation at WRC2003, as the additional studies for VDL4 wouldn't be complete.

The proposal at WRC2003 for an agenda item for WRC2006 does not guarantee that it will appear on the final agenda for 2006.

3.6.2 WP8D

The 12th Meet was held in November 2001. There were 175 participants from 31 administrations and 8 international organisations.

The meeting was divided into the following sub work groups, of which SWG – 8D5: Radio Navigation Satellite Service is of interest.

Topics discussed included:

- RNSS 1164-1215 MHz Impact of RNSS on DME/TACAN. A UK-commissioned report has been produced.

- RNSS 1215-1300 MHz power flux density (pfd) limit protection criteria – sharing with radar.

The next meeting is due to be held in May '02.

4   CONCLUSIONS AND FURTHER WORK

4.1   Conclusions

This chapter concludes on the identification of standards activities relevant to MA-AFAS, and indicates the required direction of future work in preparation for the transition plan for the evolution of standards. Conclusions have been drawn out by MA-AFAS Theme.

Overall there is a lot of work ongoing in standards bodies that is relevant to MA-AFAS. However, there is no co-ordinated effort to ensure that specific issues are resolved in order to create an environment suitable for MA-AFAS. It is also apparent that international standardisation is important, but the role of standards bodies may diminish if the process can not keep up with technical change.

4.1.1   Precision Approach

4.1.1.1 Service

The concept of Required Navigation Performance (RNP) has been adopted.

4.1.1.2 Avionics

There has been much work undertaken with the development of appropriate material including:

- RTCA DO-228, DO-229B, DO-235, DO-236, DO-245, DO-246A, DO-253, DO-200, DO-201, DO-208

- ARINC Characteristics ARINC 755, ARINC 756, and ARINC 743A-3

- ICAO GNSS Panel Standards and Recommended Practices (SARPs for SBAS and GBAS)

- EUROCAE Working Group 28 documents including ED-88, ED-95, and ED-97

The GPS Landing System (GLS) standards are completing the process of converging to provide a harmonised certification basis. This study has identified some inconsistencies between national and international standards, and there is strong momentum to eliminate any conflicts that would thwart interoperability. The major areas where harmonisation efforts is still in progress are summarised below:

- DO-229B: harmonization with GPS and SBAS SARPs

- DO-245: harmonization with GBAS SARPS and DO-253

- DO-246A: harmonization with GBAS SARPs

- DO-253: harmonization with GPS and GBAS SARPs

- ARINC 755: harmonization with DO-253, inclusion of original equipment manufacturer (OEM) requirements

- ARINC 756: harmonization of GLS characteristics with ARINC 755

- ARINC 743A-3: harmonization with DO-253 and DO-229B

- ED-95: harmonization with GBAS SARPs

- ED-88: harmonization with GPS, SBAS, and GBAS SARPs

It can be concluded that the progress of the above navigation standards will be sufficient to support joint certification of fully interoperable GBAS avionics systems within the next 12-18 months.

4.1.1.3 Procedure Design

The April 2002 joint OCP/GNSSP meeting is set to make major decisions regarding approach criteria.

4.1.2 Taxi Management

There appears to be little effort currently on standardisation for taxi management. However, this theme requires the availability of airport mapping databases, and WG-44/SC-193 is addressing this issue.

4.1.3 Communications

4.1.3.1 VDL4

For VDL Mode 4, the following standardisation steps have been covered so far:

- ICAO SARPs for surveillance applications over VDL4 exist. VDL 4 has been standardised by AMCP as a point to point datalink for surveillance applications. Validation of these standards has been done in the NEAN project.

- RTCA MASPS or ARINC avionics standard remain to be standardised.

- EUROCAE/RTCA MOPS are in the process of being standardised.

4.1.3.2 Status of ATN

The Frame Mode SNDCF has been included in Edition 3 of ICAO Doc 9705, which is the technical provisions that define the ATN protocols and services. Edition 3 is soon to be published.

The ATN has no VDL4-specific datalink services, as no services are specific to any particular subnetwork. All the ATN services are point-to-point, and VDL4 is only ICAO approved for surveillance applications (at the moment) thus the only ATN service that can (legally) use VDLM4 subnetwork is ADS-C. If/when ICAO approve VDLM4 for more that just surveillance applications, the other ATN Services i.e. CPDLC services and FIS could also utilise this subnetwork.

4.1.3.3 Data Link Services

Progress is being made with D-ATIS and D-SIGMET services.

4.2   Further Work

The next stage of the work will address the areas where work on standards appears deficient, and suggest work groups into which suitable topics can be introduced.

5 ACRONYMS

ABAS   Aircraft Based Augmentation Systems

ACARS   Aircraft Communications Addressing and Reporting System

ADIRS   Air Data Inertial Reference System

ADS   Automatic Dependent Surveillance

ADS-B   ADS Broadcast

ADS-C   ADS Contract

ADSP   Automatic Dependent Surveillance Panel (ICAO)

AEEC   Airlines Electronic Engineering Committee

AFS   Aeronautical Fixed Service

a/g   Air-ground

AIC   Aeronautical Information Circular

AIP   Aeronautical Information Publication

AMCP   Aeronautical Mobile Communications Panel (ICAO)

AMSS   Aeronautical Mobile Satellite Service

ANC   Air Navigation Commission (ICAO)

APV   Approach with Vertical Guidance

AOC   Aeronautical Operational Communications

ASSAP   Airborne Surveillance and Separation Assurance Processing

A-SMGCS   Advanced SMGCS

ATC   Air Traffic Control

ATM   Air Traffic Management

ATN   Aeronautical Telecommunications Network

ATS   Air Traffic Service

ATS	Air Traffic System
ATSP	Air Traffic Service Provider
ATSU	Air Traffic Services Unit
CCB	Configuration Control Board (of ICAO ATNP)
CDTI	Cockpit Display of Traffic Information
CD&R	Conflict Detection and Resolution
CFMU	Central Flow Management Unit
CMU	Communications Management Unit
CNS	Communications, Navigation and Surveillance
CPDLC	Controller Pilot Data Link Communications
CPM	Conference Preparation Meeting
CRM	Crew Resource Management
CSMA	Carrier Sense Multiple Access
D-ATIS	Data-link Automatic Terminal Information Services
D-ATSU	Downstream ATS Unit
DCL	Departure Clearance service
DFW	Dallas Fort Worth
DITS	Digital Information Transfer System
DLASD	Data Link Application Systems Document
DLK	Data Link
DLL	Data Link Logon
D-RVR	Data Link – Runway Visual Range
D-SIGMET	Data Link – Significant Meteorology
DSC	Downstream Clearance
DYNAV	Dynamic Route Availability Service

EGNOS	European Geostationary Navigation Overlay System
EOBT	Estimated Off Block Time
ESA	European Space Agency
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration
FAS	Final Approach Segment
FDPS	Flight Data Processing System
FEC	Forward Error Correction
FFAS	Free Flight Air Space
FIS	Flight Information System
FIS	Flight Information Services
FLIPCY	Flight Plan Consistency
FM	Frequency Modulation
FMBC	Frequency Modulation Broadcast
FMS	Flight Management System
FMU	Flight Management Unit
FTE	Flight Technical Error
GACS	Generic ATN Communications Service
GBAS	Ground Based Augmentation System
GLS	GPS Landing System
GNLU	GNSS Navigation and Landing Unit
GNSS	Global Navigation Satellite System
GNSSP	Global Navigation Satellite System Panel (ICAO)
GPS	Global Positioning System
GRAS	Ground Based Regional Augmentation System

HF	High Frequency
HF	Human Factors
HFDL	HF Data Link
HMI	Human Machine Interface
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ICD	Interface Control Document
ICS	Internet Communications Service
IFR	Instrument Flight Rules
ISO	International Standards Organisation
ITU	International Telecommunications Union
ILS	Instrument Landing System
ITU	International Telecommunications Union
JAA	Joint Aviation Authorities
LAAS	Local Area Augmentation System
LDAP	Lightweight Directory Access Protocol
MA-AFAS	More Autonomous Aircraft in the Future ATM System
MAS	Managed Air Space
MASPS	Minimum Aviation System Performance Standards
MLS	Microwave Landing System
MOPS	Minimum Operational Performance Standards
MMR	Multi-Mode Receiver
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NATS	National Air Traffic Services

NDB	Navigation Data Base (ARINC)
NDB	Non-Directional Beacon
NPA	Non-Precision Approach
OCP	Obstacle Clearance Panel (ICAO)
OCL	Oceanic Clearance DataLink
PA	Precision Approach
PVT	Position Velocity Time
QoS	Quality of Service
RCP	Required Communications Performance
RFI	Radio Frequency Interference
RNAV	Area Navigation
RNP	Required Navigation Performance
RSP	Required Surveillance Performance
RTCP	Required Technical Communication Performance
SARPS	Standards and Recommended Practises
SBAS	Satellite Based Augmentation System
SC	Special Committee (RTCA)
SDLS	Satellite Data Link System
SG	Sub-Group
SID	Standard Instrumented Departure
SIS	Signal In Space
SMGCS	Surface Movement Guidance and Control System
STAR	Standard Arrival Route
TBD	To Be Defined
TCAS	Terrain Collision Avoidance System

TDMA	Time Division Multiple Access
TIS-B	Traffic Information Service – Broadcast
TMA	Terminal Manoeuvring Area
TSO	Technical Standard Order
UAT	Universal Access Transceiver
ULCS	Upper Layer Communications Service (ATN)
UMAS	Unmanaged Air Space
URCO	Urgent Communication
US	United States
UTC	Universal Time Co-ordinated
UWB	Ultra WideBand
VDB	VHF Data Broadcast
VDL	VHF Data Link
VDR	VHF Data Radio
VHF	Very High Frequency
VNAV	Vertical Navigation
WAAS	Wide Area Augmentation System
WG	Working Group

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APPENDIX A. ROLES OF STANDARDISATION BODIES

A.1 International Civil Aviation Organisation (ICAO)

ICAO was created to ensure the safety, efficiency, and regularity of civil aviation. The Chicago Convention established ICAO to:

* Develop international civil aviation in a safe and orderly manner,

* Establish international air transport services on the basis of equality of opportunity, and

* Ensure international air transport services are operated soundly and safely.

The constitution of ICAO is the Convention on International Civil Aviation, drawn up by conference in Chicago in November and December 1944. ICAO became a specialised UN Agency in 1947.

With 182 Contracting States as of 1 January 1994, ICAO's chief role remains to be the facilitation of international standardisation through developing International Standards, Recommended Practices, and Procedures. These standards cover numerous technical fields of aviation, including:

* Rules of the air,

* Units of measurement,

* Airworthiness,

* Aeronautical telecommunications,

* Air traffic services, and

* Aerodromes.

After a Standard is adopted, it is put into effect by each ICAO Contracting State in its own territories. As aviation technology continues to develop, the Standards are kept under constant review and amended as necessary.

A.1.1 Standardisation Instruments

The ICAO Council adopts international Standards and Recommended Practices (SARPs), and approves Procedures for Air Navigation Services (PANS) to achieve world-wide uniformity whenever this will facilitate and improve air safety, efficiency, and regularity.

The necessary international standardisation is achieved primarily through the creation of Annexes to the Convention on International Civil Aviation. The Annexes are the

responsibility of the Air Navigation Commission, the main parts of which are International Standards and Recommended Practices (SARPs). Collectively the Contracting States that form ICAO's membership and Assembly have established the SARPs for airlines around the world. The Standard is a specification that is necessary for the safety or regularity of international civil air navigation. The Recommended Practice is a specification that is desirable in the interest of safety, regularity, or efficiency of international civil aviation. At present, there are eighteen Annexes to the Convention on International Civil Aviation; seventeen of these are within the air navigation field.

In addition to SARPs, ICAO also formulates Procedures for Air Navigation Services (PANS), which do not have the same status as the SARPs. The various PANS are developed by the Air Navigation Commission or its designated panel or working group, on the basis of proposals coming from the same sources as for SARPs. Following consultation with all Contracting States and interested international organisations, they are approved by the Council and recommended to Contracting States for world-wide application. The PANS comprise, for the most part, operating practices as well as material considered too detailed for SARPs. PANS often amplify the basic principles in the corresponding SARPs to assist in the application of those SARPs. The PANS become applicable on a date set by the Council. Because PANS have a different status from SARPs, Contracting States do not have to notify differences in case of non-implementation.

In addition to SARPs and PANS, ICAO develops Regional Supplementary Procedures (SUPPs). These form part of the Air Navigation Plan (agreed by Regional Air Navigation meetings) to meet the needs of specific geographical areas that are not covered by the world-wide provisions. The Regional Supplementary Procedures are developed, approved by the Council and recommended to Contracting States for application in the flight information regions to which they are relevant. These procedures may indicate modes of implementing procedural provisions in SARPs and PANS, specify detailed procedural options for regional application or promulgate a procedure of justifiable operational significance, additional to, but not in conflict with, existing provisions in the Annexes or PANS.

To facilitate the implementation by States and to promote the uniform application of SARPs and PANS, technical manuals and guidance material in other forms are issued by the Organisation under the authority of the Secretary General. At the present time there are more than 40 such publications.

The ICAO Council is purposely organised in a manner that allows for equitable consideration of all member states regardless of size or viability of their air commerce. Similarly, ICAO policy states that the standards adopted by ICAO will consider the impacts to all parties regardless of size.

While acceptance of ICAO standards is not mandatory, they are generally implemented by most Member States. Because ICAO standards are international in scope and deal specifically with ATM issues, they have a direct effect on European (and other nations)

ATM standards and regulations. European aviation interests are explicitly accounted for, particularly in the areas of interoperability and harmonisation.

A.2 RTCA Incorporated

RTCA is a private, not-for-profit organisation that addresses requirements and technical concepts for aviation. RTCA was organised as the Radio Technical Commission for Aeronautics in 1935 and reorganised in 1991, incorporating and shortening the name to RTCA, Inc.

The principal mission of RTCA is to provide a forum where government and industry representatives gather to address aviation issues related to electronics technology, and to develop consensus-based recommendations.

As a private, not-for-profit entity, consensus remains the foundation upon which RTCA initiatives are based. RTCA's recommendations are often the basis for many government policy decisions — US and international — at which point they may become legally binding and enforceable.

The RTCA's activities are primarily carried out via the Technical Management Committee. The committee includes representatives from member organisations. Special committees may be formed based on consensus by the Technical Management Committee to consider specific topics and recommend minimum operational performance standards or appropriate technical guidance documents. These special committees are open to public participation to all interested parties.

A.2.1   Standardisation Instruments

RTCA's principal instruments (or products) are recommended practice documents prepared by the Technical Committees after broad consensus is achieved. In addition to preparing recommended operational performance standards and technical guidance documents, RTCA also develops consensus regarding the implementation of new communications, navigation and surveillance concepts for aviation. For example, following the 10th Air Navigation Conference endorsement of the Future Air Navigation System/Global Navigation Satellite System concept, the FAA Administrator asked RTCA to develop recommendations as to how and when the transition to satellite navigation should occur. The resulting GNSS Task Force Report helped provide the foundation for many ongoing satellite-based navigation initiatives that will "significantly improve the efficiency, capacity and safety of air transportation well into the 21st century", according to RTCA.

As a product, RTCA develops Minimum Operational Performance Standards (MOPS) in addition to other documents. The MOPS are based on ICAO SARPs, but define to a lower level the necessary performance of avionics systems. As a standalone document, MOPS are voluntary in nature. However, most MOPS are referenced by the FAA in Technical Standard Orders (TSOs), which then make them mandatory, unless a manufacturer can prove similar or better performance. Generally, manufacturers

choose the easier route of mandatory conformance to the MOPS (which they have probably helped to develop in the RTCA process anyway).

While the RTCA works primarily on US aviation issues, international co-ordination is accomplished via international membership in the various RTCA steering committees. The recommendations and standards developed by the RTCA are primarily aimed at US aviation, although members of the European aviation community attend some of the consensus bodies.

Note that the development of RTCA specifications occurs with significant input and support of industry. The subsequent adoption of these standards by the FAA through, amongst others, the TSO process provides greater market entry potential for those who have participated in their development. The large size of the US market, and the fact that FAA TSO certification is generally recognised world-wide by other aviation administrations and regulatory bodies, means that RTCA indirectly and directly greatly influence the global market.

A.3 European Organisation for Civil Aviation Equipment (EUROCAE)

The European Organisation for Civil Aviation Equipment (EUROCAE) is a non-profit making European Association established in 1963, with members from National Aviation Authorities, equipment manufacturers, airlines, and engine and airframe manufacturers. One of its main tasks is the development of minimum performance specifications (MPSs) for civil aviation equipment. EUROCAE specifications are harmonised as far as possible with the equivalent MPS developed by the RTCA in the USA (normally referred to as Minimum Operational Performance Specifications - MOPS, or Minimum Aviation System Performance Specifications - MASPS). Membership fees represent 90% of the funding for EUROCAE's activities. The other 10% come from the sales of their specifications.

EUROCAE has close working relationship with the JAA and with the national administrations. EUROCAE is a voluntary organisation that works by consensus. It develops technical specifications that, although useful as common references, have no binding authority. However, the specifications, once developed, are often accepted by JAA and national aviation authorities and integrated into the various air safety regulations. In particular, JAA is able to incorporate EUROCAE specifications in JARs and introduce these as regulations through Regulation 3922/91. The States can incorporate the specifications in their own legislation, although they are under no obligation to do so and could easily use their own specification or adopt those of another organisation such as the RTCA.

A.3.1   Standardisation Instruments

The specifications and reports produced by EUROCAE are classified under several main headings:

- •Minimum performance specification (MPS),

- •Minimum operational performance standard (MOPS),

- •Minimum operational performance requirement (MOPR), and

- •Minimum aviation system performance specification (MASPS).

If the document has an addition classification of the form DO-xxxZ, it has been developed jointly with RTCA, the DO reference being the RTCA classification.

EUROCAE MPSs are intended to be used by national aviation authorities for the type approval of equipment. The MPSs contain bench testing specifications for that purpose and when used as intended, they approach the objective of a full process of standardisation and certification, albeit without labelling.

A.4 Airlines Electronic Engineering Committee (AEEC)

The Airlines Electronic Engineering Committee (AEEC) is an international body of airline representatives. AEEC sets the standards for avionics equipment used on the world's commercial air transport aircraft. AEEC standards are co-ordinated with many airline, Federal regulatory, and standards organisations including the International Civil Aviation Organisation (ICAO).

AEEC sets the standards defining form, fit, function, and interface for avionics equipment used on the world's commercial air transport aircraft. The mission leads to five basic AEEC goals:

- Promote industry competition via avionics standards,

- Improve product reliability via market pressures,

- Design aircraft concurrent with avionics,

- Promote safety with reasonable Federal regulations, and

- Promote more effective certification procedures.

AEEC was established in 1949. Falling under the authority of the ARINC Board of Directors, the AEEC is an international body of airline representatives. The AEEC is subject to the ARINC Board of Directors, which is itself an international organisation.

AEEC is an international body of airline representatives. It is composed of representatives from 10 North American airlines, 6 European airlines, 1 Asian airline, 3 special interest groups, the US Air Force (the single largest operator of aircraft in the world), and 4 ARINC organisations.

A.4.1 Standardisation Instruments

AEEC prepares industry standards for avionics in the form of "Grey Cover" Characteristics, Specifications, and Reports. Characteristics provide form, fit, and function definitions for avionics equipment. Specifications and Reports address physical and electrical interfaces as well as functional performance at a system level, including:

- packaging,

- racking,

- electrical, and

- General design and maintenance techniques.

The roles of the AEEC are changing to accommodate a systems approach to avionics performance rather than a hardware-based approach. This has adjusted the focus of its standards development to concentrate on the overall system design. The AEEC is

migrating toward an approach based on the Open System Interconnection (OSI) Model. Proposals for a new or modified standard can be submitted from a number of sources such as the airlines, airframe manufacturers, avionics manufacturers, or service providers. Upon review, a recommendation is made from AEEC whether or not to begin the standardisation process based on three basic criteria:

- a standard must provide realisable benefit to the industry,

- the effort must fit into the AEEC's work program, and

- A simple majority of AEEC members must be in favour of establishing a standard in the particular area.

A draft is then developed from a number of sources, depending on the appropriateness and existence of the information. Data can be drawn from manufacturer equipment specifications, existing ARINC standards, other standards, and new material. A draft standard circulation and comment revision process proceeds until the subcommittee determines that the formal draft is mature.

A vote is taken at an AEEC general session (with a minimum 50% attendance), with a $\frac{2}{3}$ majority approval required for acceptance of the standard. Mail ballots are occasionally used when adoption is critical and not enough time exists for a general session. The standard is given a title and then published for distribution following a 30-day final review before sending to ARINC for publication.

The AEEC works closely with external organisations in developing standards. RTCA, EUROCAE and other organisations are often involved to minimise duplicate efforts and to ensure that final documents are complementary between the organisations. The differences between the ICAO SARPs and AEEC standards are subtle. When the AEEC prepares ARINC standards, they adhere to the respective ICAO SARPs. The airlines, however, often start new system designs prior to the initiation of the ICAO SARPs activity. ARINC standards have been used in the ICAO forum to help ICAO participants address avionics functions defined in the SARPs. Representatives from ARINC generally participate in ICAO meetings.

The AEEC is subject to ARINC, and maintains a small membership that includes international representatives. The representatives establish working groups to address various aviation electronics issues (such at ATM standards). In addition, the AEEC works closely with other organisations such as the RTCA and ICAO in developing standards.

A.5 Aeronautical Radio Incorporated (ARINC)

ARINC Incorporated is a company that serves customers in aviation, government, and other industries. It was founded in 1929 and is owned by US (as well as international) airlines and aircraft operators.

ARINC's activities have two major thrusts:

- Communications and information processing services for the aviation and travel industries, and

- Systems engineering, development, and integration for government and industry.

ARINC is a private company funded and owned by (US and international) airlines and aircraft operators. ARINC's membership includes all the airlines and aircraft operators that fund its operations.

A.5.1   Standardisation Instruments

Most of the forums discussed previously are principally involved in providing services to government and industry. ARINC participates in these areas by providing guidance for establishing avionics and other technical standards for the global air transportation industry and represents the aviation industry in international forums.

ARINC is owned by a group of international airlines and aircraft operators. ARINC's primary function is systems. The AEEC, which is subject to ARINC's board of directors, develops various standards for the aviation community and publishes them through ARINC.