CAR/SAM SEMINAR IN PREPARATION OF ELEVENTH AIR NAVIGATION CONFERENCE (AN-Conf/11)
(Lima, 18 to 22 August 2003)

(Presented by the United States of America)

SUMMARY

This paper is a cover page for some of the U.S. papers that will be presented at the upcoming ICAO Eleventh Air Navigation Conference (AN-Conf/11). These papers are included as attachments to this cover paper and represent areas where the U.S would like to focus discussion at this seminar in preparation for AN-Conf/11. This paper notes the titles of the papers that are being included as attachments, and the AN-Conf/11 agenda item where they will be discussed.

1. DISCUSSION

1.1 The following table denotes the papers that are included as attachments and are to be discussed during this meeting, CAR/SAM Seminar in Preparation for AN-Conf/11:

CAR/SAM Seminar AgendaItem	Title of Paper	ANConf/11 Agenda Item
1	U.S. Support of the ICAO Operational Concept	1.1
2	Elevating the Role of the Global Plan for CNS/ATM Systems	1.3
6	Performance-Based Navigation in the Future CNS/ATM System – Harmonizing the Transition to Area Navigation and Required Navigation Performance Operations	4.1
6	U.S. Air Traffic Control Capacity Enhancement – Traffic Flow Management (TFM) Real World Gains	4.2
8	Legal and Institutional Issues and the Status of CNS/ATM	6.1
8	Status of Wide Area Augmentation System (WAAS)	6.1
8	Status of Local Area Augmentation System (LAAS)	6.1
8	The Need for Reliable Free GNSS Service	6.4
9	NEXCOM (VDL Mode 3) Acquisition Status	7
10	* Global Aeronautical Information Management	1.2
10	* U.S. Endorsement of the ADS-B Concept of Use	1.2
10	* Initial Automatic Dependent Surveillance – Broadcast (ADS-B) Applications for Global Interoperability	1.2
10	* Safeflight 21: Alaska Capstone and Ohio River Valley *(ADS-B)*	1.2
10	* Strategy for Global Interoperability of ADS-B	7

* Note: Since there is no agenda item for the seminar that directly addresses the issues of Global Aeronautical Information Management or ADS-B, we have noted in the table above, our assumption that these would be discussed under agenda item 10.

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ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 1: Introduction and assessment of a global air traffic management operational concept

UNITED STATES SUPPORT OF THE ICAO GLOBAL AIR TRAFFIC MANAGEMENT (ATM) OPERATIONAL CONCEPT

(Presented by the United States of America)

SUMMARY

This paper presents the United States view on the global ATM operational concept, notes the consistency with the RTCA National Airspace System (NAS) Concept of Operation and Vision for the Future of Aviation approved by the RTCA Free Flight Steering Committee, expresses appreciation of the progress made by the Air Traffic Management Concept Panel (ATMCP) and recommends additional work to support the general use of the concept.

1. INTRODUCTION

1.1 The United States Federal Aviation Administration has worked closely with European and other member states in the ATM Operational Concept Panel (ATMCP) to develop the global operational concept presented in a WP/4 by the ICAO Secretariat. The document in WP/4 has been reviewed by the Panel, and the Air Navigation Commission, taking into account comments received from States, and is being presented to the Conference for assessment.

2. DISCUSSION

2.1 The global concept is a view of Air Traffic Management (ATM) in 2025 that draws upon established concept work done within the United States, EUROCONTROL and its member states, and other regions. This resultant global concept takes many of the ATM performance goals expressed in those concepts, extends those goals to 2025, and places the operational improvements into a context which supports modernization across all regions and traffic situations. The global concept describes a future ATM system that:

- Keeps safety first, with systems safety management as a foundation;
- Focuses on the delivery of service with an associated performance orientation;
- Recognizes that ATM is a set of interconnected operational processes that are at a minimum gate-to-gate in scope;
- Promotes the concept of ATM based on collaborative decision-making (CDM); and
- Has at its core the efficient use of information supported by a system-wide information management (SWIM) philosophy.

2.2 The RTCA National Airspace System (NAS) Concept of Operations and Vision for the Future of Aviation serves as a guiding document for the United States. Although the NAS Concept of Operations is both nearer term and more detailed, it is closely aligned to the global concept in vision and scope and incorporates some aspects of this global concept in the most recent update. There are no fundamental concept differences between the global concept and the RTCA NAS Concept of Operations.

2.3 The development of this initial global concept is completed. However, it is expected that this document will be subject to periodic updates to reflect changes in business climates and the potential use of technologies not foreseen to date. Further, although the framework for change has been established by the concept, additional work is required on the establishment and measurement of performance based on ATM delivery of service, the process for developing requirements from the concept, more detailed and tailored description of the concept through the development of supporting scenarios, and the development of transition paths to reach the vision

3. ACTION BY THE CONFERENCE

3.1 The conference is invited to agree on the following recommendation:

Recommendation 1/ - U.S. Support of the ICAO Global ATM Operational Concept

That ICAO:

a) Endorse the global ATM operational concept defined by the ATMCP and presented in WP/4.

b) Organize work to progress the supporting aspects of the concept including:
- Fuller development of the performance concept;
- Processes for using the concept in the development of SARPs;
- Delivery of concept scenarios to support tailoring of the concept for use in State and regional planning;
- Development of operational transitions; and
- Maintenance of the concept through periodic review and updates.

c) Encourage States to use the concept in support of their individual and regional planning.

ELEVENTH AIR NAVIGATION CONFERENCE
Montreal, 22 September to 3 October 2003

Agenda Item 1: Introduction and assessment of a global air traffic management (ATM) Operational concept
1.3 The need for a global air navigation plan

ELEVATING THE ROLE OF THE GLOBAL AIR NAVIGATION PLAN FOR CNS/ATM SYSTEMS

(Presented by the United States of America)

SUMMARY

In AN-Conf/11-WP/22, recommendations were made to first include the air traffic management (ATM) operational concept in the GLOBAL AIR NAVIGATION PLAN FOR CNS/ATM SYSTEMS (Global Plan – Doc 9750) and to reinforce the status of the Global Plan. The U.S. supports those recommendations and further recommends the Global Plan be elevated along the lines of Procedures for Air Navigation Services (PANS), with review, modifications and approval processes equivalent to those used for PANS.

REFERENCES:

AN-Conf/11-WP/22, "The Role and Function of the Global Air Navigation Plan for CNS/ATM systems"

1. INTRODUCTION

1.1 AN-Conf/11-WP/22 discusses the development of both the Global Plan and the Air Traffic Management (ATM) concept of operations. In addition it proposes the incorporation of the operational concept into the Global Plan and an increase in the status of the Global Plan. The United States supports those proposals.

2. ATM OPERATIONAL CONCEPT

2.1 In paragraph 1.4 of AN-Conf/11-WP/22, the Secretariat describes what the Global Plan, as a living document should contain; however, missing from that list is a vision of the future for CNS/ATM. The ATM concept of operations provides that vision and guidance, and further, it provides the rational and basis for the development of the technologies, processes and procedures defined in the Global Plan.

2.2 To further enhance the Global Plan, the ATM Concept Panel's work on the development of air traffic management requirements should be considered for inclusion at their maturity.

3. GLOBAL PLAN STATUS

3.1 The Global Plan is a significant component for the development of regional, national and local planning processes and therefore should be subjected to the same level of review and with a modification process similar to that of PANS. The Global Plan, with the inclusion of the ATM operational concept, should be considered as the architecture or roadmap for the future of international civil aviation.

3.2 The recommended role of the Global Plan is illustrated in Appendix A. The illustration is intended to show the interrelationship among various components necessary to produce globally and regionally focused strategic planning. The size and positioning of the Global Plan in the illustration is not intended to indicate relative importance.

4. SUGGESTED GLOBAL PLAN APPROVAL PROCESS

4.1 ICAO guidance is effective because there is an established process for review, modification and acceptance by the member States. For the Global Plan to be effective, it is important for it to undergo the same rigorous processes for review, modifications and acceptance as PANS.

4.2 The current version of the Global Plan has been discussed at ICAO worldwide meetings but it has never been circulated as a complete document to the States for comment. It is suggested that the document be offered for comment and subsequent approval by ICAO to establish its status.

5. ACTION BY THE CONFERENCE

5.1 The Conference is invited to agree on the following recommendations:

That ICAO:

a. Elevate the status of the Global Air Navigation Plan for CNS/ATM Systems to a level that will require review and agreement by the States

b. Urge states to adhere to the Global Plan when planning and implementing systems within their respective States

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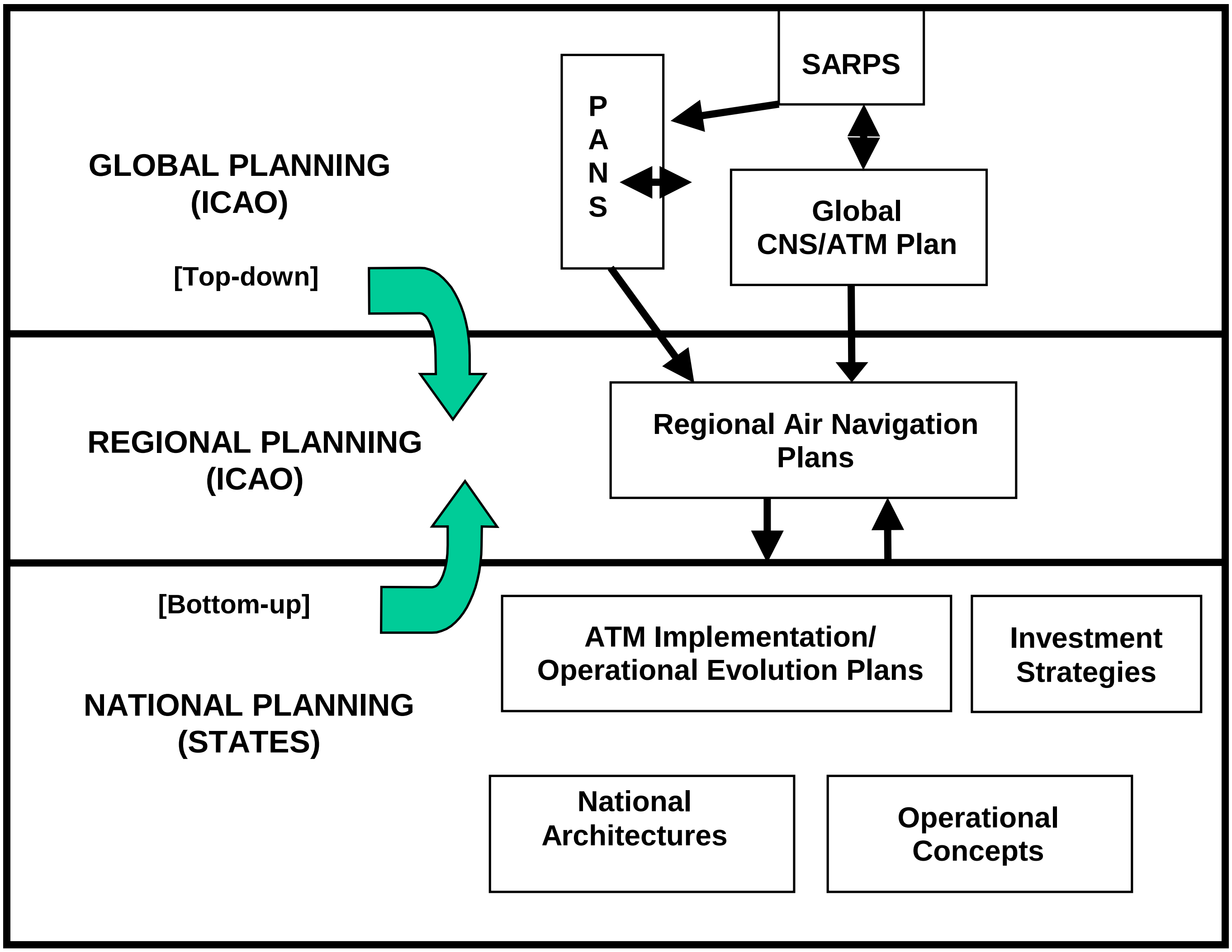
APPENDIX A

Illustration of the recommended role of the Global Plan



ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 4: Capacity-enhancement measures
4.2: Traffic Flow Management Real World Gains – Collaborative Decision Making (CDM) & Flight Schedule Monitor (FSM)

UNITED STATES (U.S.) ATC CAPACITY ENHANCEMENT – TRAFFIC FLOW MANAGEMENT (TFM) REAL WORLD GAINS

(Presented by the United States of America)

SUMMARY

This paper will discuss the U.S. approach to global Traffic Flow Management (TFM) and Collaborative Decision-Making (CDM) by presenting current and planned -government/industry initiatives. Global TFM will drive toward a seamless system that traverses international boundaries to share pertinent information and capitalize on benefits such as: enhanced security, improved effectiveness and hemispheric interaction. International collaboration is essential in order to build tools necessary to address this global direction and increased traffic demand expanding to new heights as we transition toward commercial space transportation.

Suggested actions by the Conference are located in paragraph 6.

REFERENCES

1. Collaborative Decision Making Process, 2003 briefing: Dialogue for the RTCA Meeting April 16, 2003: http://www.metronaviation.com/cdm
2. Collaborative Decision Making (CDM), 2003: Global II Air Traffic Flow Management Briefing: http://www.eurocontrol.int/eatmp/events/atfm.html
3. Operational Evolution Plan (OEP) Web Page: http://www1.faa.gov/programs/oep
4. National Airspace Redesign Web Page: http://www.faa.gov/ats/nar/
5. Flight Schedule Monitor (FSM) User Guide, Version 1.8.5, March 2003 : AUA-700/Metron Aviation
6. "Operational Evolution Plan Overview and Sample Results", ANConf/11-IP/XX

1. BACKGROUND

1.1 The U.S. Traffic Flow Management System mission is to balance air traffic demand with system capacity to ensure the maximum efficient utilization of the National Airspace System (NAS). A safe, orderly, and expeditious flow of traffic while minimizing delays is fostered through continued analysis, coordination, and dynamic utilization of Traffic Flow Management initiatives and programs.

1.2 The U.S. Federal Aviation Administration (FAA) Air Traffic Control System Command Center (ATCSCC) monitors and manages the flow of air traffic throughout the NAS, producing a safe, orderly, and expeditious flow of traffic while minimizing delays. U.S. TFM Units monitor and balance traffic flows within their areas of responsibility in accordance with traffic management directives. CDM is a joint FAA/industry initiative to develop new technology and procedures. CDM focuses on improving the efficiency of TFM initiatives through common situational awareness, increased predictability, and improved system planning. CDM has been in operation since 1998 and has demonstrated significant gains in NAS System efficiency.

1.3 The CDM concept is one of the five core technologies of Free Flight Phase I and has traversed international boundaries with acceptance in Canada, Japan, and Europe.

2. CONTEXT

2.1 Recent events have prompted intensification of aviation security procedures and processes. It is vital that cross border communication and coordination activities continue to be supported to maintain a safe, efficient and orderly aviation environment.

2.2 Closer coordination with neighboring flight information regions optimizes airspace, improves collaboration and coordination, and develops cooperative operational techniques in areas such as:

- North Atlantic Track System
- North American Route System
- North American Route Program

2.3 Agreements that are appended as Annexes to existing Memorandums of Cooperation and/or Understanding with other air traffic service providers or executive flow management units such as Japan's Fukuoko Air Traffic Flow Management Center, EUROCONTROL's Central Flow Management Unit (CFMU), and NAV Canada's National Operational Control Centre enhance international:

- data exchange between FAA's Enhanced Traffic Management System (ETMS) other air traffic service providers' automated data systems;
- airspace utilization;
- collaboration and coordination; and
- TFM tactical procedures and operations;

2.4 International/space flow management positions are needed for worldwide flow management coordination, collaboration and communication. As the aviation industry transitions to include commercial space vehicle operations, these positions will merge aviation and space transportation requirements. Proactively developing these positions will centralize hemispherical processes for international/space TFM collaboration.

3. COLLABORATIVE DECISION MAKING AT THE U.S. ATM NETWORK LEVEL

3.1 As a joint FAA/industry initiative, CDM focuses on common situational awareness, increased predictability, and improved system planning.

3.2 CDM is composed of three basic principles: 1) Establishment of *Common Situational Awareness* through data exchange. Shared information allows all parties to be aware of system demand and constraints. 2) Use of distributed *Planning* regarding the input of NAS stakeholders. NAS stakeholders provide input into traffic management decisions to ensure the limited resources are used in a manner that accommodates individual business needs collectively with system success. 3) Robust *Performance Analysis* to measure benefits and to further enhance system performance based on experience and expertise. Traffic Management tools are used to continually monitor initiative progress or decline and modified as necessary based on experience and expertise.

3.3 With stakeholders working together to provide training solutions and procedures, and integrated TFM tools/technologies, CDM increases system efficiency, safety and responsiveness. One method the FAA uses to compensate for reduced capacity at an airport is to delay flights arriving at that airport before those flights have departed. This is known as a Ground Delay Program. As part of the CDM effort, the FAA developed Flight Schedule Monitor (FSM) and deployed it at operational facilities including airline operations centers starting in 1998. Through FSM, the FAA and airline participants established common situational awareness and dramatically improved the efficiency of ground delay programs. Today, enhancements to FSM continue to improve the reliability, functionality and effectiveness of managing high-density traffic situations.

3.4 FSM creates a common situational awareness among all users and service providers in the NAS. Using real-time data culled from Enhanced Traffic Management System (ETMS), FSM presents a graphical and timeline presentation of airport demand and capacity information. Based on the FSM display, users can determine whether a demand/capacity imbalance exists and may choose to cancel, delay, or move flights around to keep traffic moving. Before users take any action on their flights, they can model several traffic management scenarios and view the results of the actions on their operation in a matter of seconds. FSM also contains powerful utilities for ground delay program (GDP) and ground stop management and analysis so all users can react quickly to NAS constraints. FSM allows air traffic service providers and airspace users to make better decisions resulting in more efficient operations.

4. ACCOMPLISHMENTS/BENEFITS

4.1 FAA conducted a TFM benefits assessment for the NAS in the spring 2003. Initial analysis shows that an estimated 13.7 million minutes- 21.7 million minutes of additional delay was avoided as a result of CDM tools and procedures in 2002. This translates to $341.5-542.5 million savings per year. Furthermore, improvements are projected to yield up to $365 million additional savings per year.

5. FUTURE PERSPECTIVES

5.1 To progress toward a global TFM system, we must balance technological advancement with efficiency while maintaining safety. Many new developing TFM projects have potential to elevate TFM techniques and procedures to astonishing levels. The following paragraphs outline some of FAA's new TFM projects:

5.2 The Free Flight Program was established in 1998 to implement specific enhancements to the NAS. CDM was one of the core capabilities recommended for implementation as part of these recommendations. As part of CDM, FSM continues to provide operational enhancements to the NAS User. Notable enhancements include:

1. Dynamic management of arrival flow through multi-fix ground delay programs;
2. Coordination of flow rates among airports using multi-airport ground delay programs; and
3. Dynamic management of unexpected demand.

5.3 Traffic Flow Management Modernization (TFM-M) - is the FAA multi-year plan to replace portions of the existing TFM automation systems with a modernized automation environment that supports both legacy and new functional capabilities. The automation systems to be modernized by the TFM-M program include the current TFM centralized processing capability located at the Volpe National Transportation Systems Center; the TFM subsystems located at the ATCSCC; and the TFM subsystems located at the various ATC facilities.

5.4 Operational Evaluation Program (OEP) - is the FAA's rolling ten-year plan providing the vision and road map for modernizing the NAS and influences the direction of CDM and TFM-M. OEP increases the capacity and efficiency of the NAS while enhancing safety and security. The OEP represents the agreements and commitments of FAA, Department of Defense (DOD), and the aviation community to modernize the NAS and solve problems in four core areas which are: Arrival/Departure Rates, En Route Congestion, Airport Weather Conditions, and En Route Severe Weather. Additional information on the OEP can be found in ANConf/11-IP/XX.

5.5 The National Airspace Redesign is the FAA’s continuing multi-year plan to review, redesign, and restructure the nation's airspace to meet the rapidly changing and increasing operational demands on the NAS. Similar to the OEP, the National Airspace Redesign will influence the direction of TFM and CDM development. The FAA is working with NAS users and service providers, using available airspace, facilities and equipment, and calculating future use of these resources to improve efficiency and reduce delays. As part of the redesign, the High Altitude Redesign program's focus is to develop and implement fundamental changes in navigation structure and operating methods for en route operations for the high altitude airspace environment. Required Navigational Performance, Area Navigation, and point-to-point navigation will incrementally replace the higher altitudes of the present jet-route structure. The process once developed will have a phased in implementation approach based on advanced technology as it becomes available in the cockpit and on the ground.

6. ACTION BY THE CONFERENCE

6.1 The Conference is invited to:

a) Note the collaborative planning approach adopted in the United States, Canada, Japan, and other Contracting States by air traffic service providers and airspace users.

b) Recommend that ICAO provide guidance to Contracting States to consider adopting a similar collaborative planning approach process, and sharing in the exchange of aviation information.

c) Recommend that ICAO continue efforts to support global TFM projects and activities and standardize TFM operating procedures globally. Ensure that worldwide air traffic service providers and airspace users are involved in the process.

d) Recommend ICAO support the development of TFM international/space processes and procedures.

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6: Aeronautical navigation issues
6.1: Global navigation satellite system (GNSS) development status based on reports from States, service providers and industry organizations

LEGAL AND INSTITUTIONAL ISSUES AND THE STATUS OF CNS/ATM

(Presented by the United States of America)

SUMMARY

ICAO has made excellent progress in implementation of CNS/ATM since the 10th Air Navigation Conference. Its economic, safety, and environmental benefits are already being felt around the globe. From a technical standpoint, no deficiencies in ICAO's legal framework (the Chicago Convention, its Annexes, and ICAO guidance materials) have been found to hinder implementation. Work on legal and institutional issues, which has continued alongside the technical work, should not be permitted to delay technical implementation. The Conference is invited to agree to these points.

1. INTRODUCTION

1.1 The Tenth Air Navigation Conference recommended that ICAO endorse the concept of CNS/ATM and the Eleventh Air Navigation Conference, with the benefit of a dozen years of experience in building the systems, offers a fine opportunity for assessing progress. This Conference is devoted to the details of implementation and other aspects of the future global ATM system. This paper will comment on the proposal made by European delegations in WP/__, GNSS Legal Framework, especially in light of the progress made in the implementation of CNS/ATM.

2. PROGRESS TOWARD CNS/ATM

2.1 The Tenth Conference conceived of CNS/ATM as a seamless global tool that Contracting States could use to carry out their responsibilities for the handling of international air operations (inter alia, under Article 28 of the Chicago Convention) using the most modern and efficient systems technology and relying on satellite-based platforms in all three principal areas—Communications, Navigation, and Surveillance. It was recognized at the time that CNS/ATM was ambitious and far-reaching. To achieve full implementation would require huge efforts from ICAO, Contracting States, regional organizations, and industry. It was impossible to know at the time what problems might be encountered, but the conferees had confidence in the institutional wherewithal of ICAO and its legal and administrative framework to provide the tools and facilitate the political will to get the job done.

2.2 The United States believes that substantial progress has been made. Strictly speaking, CNS/ATM will never be fully implemented, because technological breakthroughs seemingly always outpace the ability to exploit them. At the same time, there have been unexpected diversions and difficulties, not all fully resolved even now. For example, many States have delayed their initial ambitious schedules for phasing out redundant ground-based navigation aids over concerns about vulnerabilities of GNSS.

2.3 Nevertheless, great progress has been made worldwide in all areas of CNS/ATM, not just in the most highly developed States. Extensive use of satellite navigation systems is conducted in oceanic airspace as well as in large areas of domestic airspace. We are even moving rapidly in the implementation of non-precision approaches using satellite systems. We believe that the Conference should acknowledge that CNS/ATM implementation is well underway, and that the envisioned improvements in safety and efficiency are already being felt in large measure around the world.

3. LEGAL AND INSTITUTIONAL ISSUES

3.1 This juncture also provides the opportunity to assess the impact of legal and institutional concerns on CNS/ATM. ICAO has a long-term legal framework for its work, consisting of the Chicago Convention, its Annexes, and guidance materials, ranging from Council, Assembly, and Conference decisions, resolutions, and recommendations, to regional navigation plans, to a full range of manuals and other publications.

3.2 The power and flexibility of its legal tools (ICAO can issue Standards that are presumptively binding on Contracting States) has permitted the organization to adapt to technological, political, economic, and social developments that were far beyond the imaginations of the most visionary statesmen when the Chicago Convention was adopted in 1944. For example, the legal framework has adapted to the advent of the jet engine, radar, intercontinental-range navigation and communication aids, positive control, and all-weather en route navigation, approach, and landing, among many others—all without legal or institutional problems.

3.3 The vantage point of a dozen years of experience offers the opportunity to assess whether the long-term legal and institutional framework of ICAO continues to serve without major problems. Contracting States, service providers, and industry organizations have had every opportunity to identify deficiencies in the legal framework. The United States believes that the legal framework does offer continued serviceability and urges the Conference to recognize this fact accordingly. During the implementation of CNS/ATM, we have discovered no gaps in the legal framework; that is, we have found no problem that cannot be solved because of defects in the legal or institutional tools available to apply to it. Constraints have proved primarily to be of a technical nature or a matter of the lack of resources and political will, not due to a lack of law.

4. ICAO'S WORK ON LEGAL ISSUES CONCERNING CNS/ATM

4.1 For most of the past 12 years, ICAO has been at work on legal issues surrounding CNS/ATM. Most of the work has concerned GNSS, although some attention has lately been paid to legal aspects of communications, surveillance, and air traffic management. Interestingly, during this time, the Council dropped from the work program of the Legal Committee, consideration of a draft convention of air traffic control agency liability due to a lack of interest. From the outset, there have been proposals for changes to the legal framework involving new conventional law, first on the general responsibilities of States using this new navigation system, then more recently limited to liability aspects of GNSS. In the last few years, the Council has also expanded the work to include consideration of legal aspects of all of CNS/ATM, although the debate has continued to focus almost entirely on satellite-based navigation.

4.2 Legal issues have been discussed in the Council, at successive meetings of the Assembly, at the Worldwide CNS/ATM System Implementation Conference in Rio de Janeiro, with the Legal Committee, in a panel of legal and technical experts (known as LTEP), and for the last several years in a Secretariat Study Group. The Secretariat Study Group has made considerable progress in analyzing and identifying the issues. At no point, however, has any ICAO body achieved consensus on a proposal for a new global conventional law.

4.3 At the same time, every ICAO body which has considered legal issues surrounding CNS/ATM, including the FANS Committee, the Worldwide CNS/ATM System Implementation Conference, and the Tenth Air Navigation Conference, has been careful to retain the proviso: Work on legal issues must not be permitted to delay technical implementation of CNS/ATM. This Conference should declare the same proviso.

5. THE EUROPEAN REGIONAL CONTRACTUAL FRAMEWORK PROPOSAL

5.1 The European paper, WP/__, GNSS Legal Framework, describes a "contractual" framework that, because it involves the exchange among States of binding rights and obligations, has many of the hallmarks of a regional convention. It is noted that the same proposal has been made in ICAO's legal forums. The proposal is regional in nature and involves negotiation of many detailed agreements and the creation of large international bureaucracies.

5.2 The European paper, however, invites this Conference to "*agree* that this approach . . . could be used as a model for a possible *ICAO institutional framework* . . . and *recommend* that ICAO take these proposals into consideration when deciding on future work for a global GNSS legal framework." WP/__, para 10.1 (b)-(c) (emphasis added).

5.3 The United States believes that this conference should do no such thing, for both procedural and substantive reasons.

5.3.1 *Procedural Reasons that the Conference Should Not Endorse the European Regional Contractual Framework Proposal*.

5.3.2 The European paper invites technical delegations to make a judgment concerning the future of ICAO's long-term legal framework that has a potentially far-reaching legal, social, political, and economic impact. That invitation is far outside the mandate of this Conference.

5.3.3 The Air Navigation Conference is a technical—not a legal—body. It is inappropriate for it to make recommendations on the shape of a new legal framework. The agenda item under which this discussion is taking place is the "global navigation satellite system (GNSS) development status based on reports from States, service providers and industry organizations". Thus, it is entirely appropriate to assess whether there are any gaps in the legal framework that have hindered implementation from the technical standpoint, as this paper recommends. It is not appropriate to recommend highly speculative, far-reaching future changes to the long-term legal framework.

5.3.4 *Substantive Reasons that the Conference Should Not Endorse the European Regional Contractual Framework Proposal*.

5.3.5 The European Regional Contractual Framework Proposal may well prove to be an effective regional arrangement for the implementation of GNSS in Europe. It is impossible to know its value, however, until it is implemented there and working experience has accumulated. Europe does not need this conference's endorsement to construct its regional legal and institutional arrangements. When it has done so, it should return to ICAO and offer its experience. Contracting States will be in a much better position then to discern whether the European framework might be a suitable model for other regions.

5.3.6 Nevertheless, the European delegations are inviting the Conference to endorse the extension of the European Regional Contractual Framework Proposal, not only as a model for other regions, but also as a possible global framework. That is, even though we have no idea how well this concept may work in the *European regional context*, the Conference is being invited now to endorse it as a possible *global framework*.

5.3.7 Moreover, the European Regional Contractual Framework Proposal is a variation on other proposals for extensive, binding, legal and institutional arrangements that *have not attracted a consensus* in any of the many legal bodies that have considered them. Indeed, such proposals are still under active consideration in the Secretariat Study Group and the Council, and may be given to the Legal Committee for its next meeting.

6. ACTION BY THE CONFERENCE

6.1 The Conference is invited to agree:

(a) that implementation of CNS/ATM, as recommended by the 10th Air Navigation Conference, is well underway, notwithstanding that there is much left to be done,

(b) that the improvements in safety, efficiency, and environmental performance due to CNS/ATM envisioned by the 10th Air Navigation Conference are already being felt in large measure around the world

(c) that ICAO's long-term legal framework—the Chicago Convention, its Annexes, and ICAO guidance materials—offers continued serviceability and no deficiencies have been found to impede technical implementation of CNS/ATM, and

(d) that work on legal and institutional issues must not be permitted to delay technical implementation of CNS/ATM

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6: Aeronautical Navigation Issues

THE NEED FOR RELIABLE FREE GNSS SERVICE

(Presented by the United States of America and the 20 Member States of (COMESA) the Common Market for Eastern and Southern Africa)

SUMMARY

The introduction of Global Positioning System (GPS) service has led to its integration within the technical infrastructure of many of the developed States. The anticipated implementation of new Global Satellite Navigation System (GNSS) constellations and augmentation systems in the near future will greatly enhance this facility. This paper considers the needs of developing States for a variety of GNSS services and the responsibility of GNSS provider States to consider the needs of developing States by providing service free of direct user charges.

1. INTRODUCTION

1.1 At the ICAO 10th Air Navigation Conference and the 29th ICAO Assembly, the United States offered to make GPS service available for the foreseeable future on a continuous, worldwide basis free of direct user fees. The Russian Federation made a similar offer on behalf of GLONASS. During the next few years, several Satellite Based Augmentation System (SBAS)s will join the U. S. Wide Area Augmentation System (WAAS) in providing an important augmentation service for GPS capabilities and within the decade the Galileo constellation is expected to provide worldwide GNSS service.

1.2 It is important that the providers of satellite navigation services take into account the needs of developing States, which could derive great benefit from these services but cannot afford to pay for them.

2. DISCUSSION

2.1 The capabilities of existing and planned GNSS component systems provide a range of air navigation capabilities from enroute navigation to instrument approaches with vertical guidance. There are a number of States that have very limited air navigation infrastructure for which GNSS offers the prospect of major improvement in navigation services. There are States which have no means of providing instrument approaches with vertical guidance or that have great difficulty in maintaining such equipment. For regions having regular occurrences of Instrument Flight Rule (IFR) conditions, this can severely limit the utilization of air transportation, which will have a negative effect on economic development. Furthermore, there are many applications of GNSS outside of aviation that could have a beneficial effect on the economies of developing States. Applications of GNSS to surveying, mining, agriculture and other transportation modes can all have significant positive economic impact, particularly for developing countries.

2.2 GNSS should be considered a global utility from which many useful applications can be derived. In many cases, States with developing economies will have a great need for these applications and the provision of GNSS should be made to facilitate their access to these services.

3. The COMESA States: A Case in Point

3.1 The obstacles in implementing many of the CNS/ATM technologies are varied; ranging from political and financial, to technical and institutional ones. The Common Market for Eastern and Southern Africa (COMESA) has been working very hard to overcome these impediments, but the pace has been slow. Many of the benefits of these technologies have therefore been delayed or foregone. Enhancements in safety, increased airspace capacity, efficiency in aviation operations, and reductions in aircraft and passenger delays are being held hostage to these benefits and have become the price being paid for delayed implementation.

3.2 Implementation of GNSS procedures offers the fastest and most economical way for airspace users to realize the benefits of CNS/ATM technologies. COMESA's main objective with GNSS procedural implementation was to achieve internationally accepted GNSS procedures at airports that would significantly improve the effective use of airspace while providing operational and economical benefits to aircraft operators.

3.3 More than 300 GNSS Procedures have been developed for various African States and will be published for operational use during this year. Implementation of these GNSS Procedures will further provide reliable instrument arrivals, approaches and departure at 38 international airports. GNSS Procedures should also significantly reduce the potential for Controlled Flight Into Terrain (CFIT) at these airports. Safety was also greatly advanced by WGS-84 surveys and publication of current airport data and obstacles. The FAA has successfully provided Flight Verification for all the GNSS Procedures developed at the above-mentioned airports.

4. CONCLUSION

4.1 The United States, among others, will continue to provide GPS and its augmentations free of direct charges for the foreseeable future. This is very important for improving the safety and efficiency of States that have limited air navigation infrastructure. In addition, such States may also be in need of the many applications that can be derived from GNSS. Therefore, States should provide GNSS service free of direct user charges.

5. ACTION BY THE CONFERENCE

5.1 The Conference is invited to adopt the following recommendation:

Recommendation 6/ - The Need for Reliable Free GNSS Service

That ICAO:

a) Recommend that GNSS services be provided free of direct user charges.

ELEVENTH AIR NAVIGATION CONFERENCE
Montreal, 22 September to 3 October 2003

Agenda Item 7: Aeronautical air-ground and air-air communications

Status of the FAA's Next Generation Air/Ground Communications Program

(Presented by the United States of America)

SUMMARY

This paper provides the status of the FAA's development and acquisition of the Next Generation Air/Ground Communications (NEXCOM) program. NEXCOM is the FAA's implementation of the 1995 ICAO Special Communications Operational Division Meeting recommendation for a Time Division Multiple Access solution for the future VHF air/ground communications technology.

1 INTRODUCTION

1.1 This paper provides the status of the FAA Next Generation Air/Ground Communications (NEXCOM) Program. NEXCOM is the implementation of the ICAO VHF air-ground integrated voice and data link system recommended by the 1995 ICAO Special Communications/Operations Divisional Meeting.

2 DISCUSSION

2.1 The FAA acquisition program has been designed based upon the direction received during the following critical meetings and program milestones:

- **April 1995**: ICAO Special Communications/Operations Divisional Meeting
- **September 1995**: FAA approved a Mission Need Statement that served as the basis for the establishing of the Next Generation Air/Ground Communications (NEXCOM) Program.
- **May 1998:** FAA selected VHF Digital Link Mode 3 (VDL Mode 3) as the technology for NEXCOM.
- **1999:** ICAO/JCAB/Eurocontrol/UK/FRG/FAA complete VDL-3 SARPS validation
- **May 2000:** FAA restructured NEXCOM acquisition plan as a result of significant airspace user input to the program

2.2 This last meeting, known as the NEXCOM Aviation Rulemaking Committee (NARC), was convened at the request of the administrator to gain direct input from the airspace user community on the future US direction for aviation communications. The committee was comprised of members representing all segments of the aviation community. Anticipating a near-term spectrum depletion problem in the US and considering the long-term implications of any air/ground communications system decision on all segments of aviation, the group reached consensus on five major recommendations. Those recommendations are summarized below:

- Report annually on VHF spectrum saturation status
- Continue support for datalink development
- Expedite a system demonstration of a fully certified VDL-3 system
- Develop an alternative plan if VDL-3 proves untimely
- Develop globally interoperable next generation communications system

2.2.1 The FAA subsequently adopted these strategic recommendations and integrated them into its ongoing acquisition program.

2.3 The FAA's NEXCOM program, which implements these recommendations, is designed to meet several operational needs:

- Provide added spectrum capacity for both voice and data requirements within the assigned VHF ATC band, in light of projected spectrum depletion
- Replace and modernize the FAA's aging air/ground communication infrastructure
- Provide a high-integrity data path suitable for air traffic control, that meets the needs of all NAS users
- Reduce air/ground communications interference and provide security and channel control features to identify unauthorized users

2.3.1 The FAA selected VDL Mode 3 for NEXCOM based on its capability to fulfill these requirements, as well as provide safety/capacity enhancement voice channel features such as Controller Override and Anti-blocking.

2.4 The first phase of the NEXCOM program is the development of operational equipment for both ground and aircraft users. Final validation of the system-level requirements will be conducted from the perspective of the airborne users and operational organizations providing ATC service. This effort will result in appropriate, correct and complete requirements that form the basis of the subsequent full-scale production NEXCOM system. To achieve this first phase, the FAA's NEXCOM program is organized into four main efforts:

2.4.1 Multimode Digital Radio (MDR)

2.4.1.1 The FAA has contracted with ITT for a multi-mode digital radio. These ground-based multi-mode radios will provide air/ground communications for all air traffic control facilities in the NAS. These radios are capable of VDL Mode 3, 25 kHz DSB-AM and 8.33 kHz DSB-AM operation. In concert with the NARC recommendations, all modes of operation are undergoing full test and evaluation as part of the acquisition. Currently MDRs are installed at a key site in Florida and final operational approvals are in progress. These radios will first be deployed to replace current air/ground radios and will initially operate in 25kHz analog mode. The MDR's will be fully capable of transitioning to VDL Mode 3 pending the success of the avionics and ground system development activities described below.

2.4.2 Avionics Development

2.4.2.1 To assure interoperability, certification and commercial availability of the VDL Mode 3 capability, the FAA has initiated a cooperative avionics development effort. FAA has signed Government-Industry Agreements (GIA) with three manufacturers to develop the multimode avionics that will incorporate VDL Mode 3. Rockwell Collins and Honeywell are developing avionics for the commercial air transport market, while Avidyne is developing panel-mounted VDL 3 radios for the General Aviation market. The FAA also has an agreement in process that will begin the development of avionics for the business jet and commuter market.

2.4.2.2 The commercial air transport avionics are upgrades of the ARINC 750 VHF Digital Radios currently in production. The FAA is working with the Airline Electronic Engineering Committee (AEEC) in the development of needed documentation leading to adoption of characteristics for these new avionics. All technical work has been completed and is under review by the VDL subcommittee of the AEEC. Once complete, these technical packages and subsequent characteristics will be available to all manufacturers for use in developing VDL Mode 3 capable equipment.

2.4.2.3 Additionally, to support the certification of these avionics, RTCA SC-172 has developed and approved the Minimum Operational Performance Standards (MOPS). The FAA's Certification Branch is currently developing Technical Standard Orders based on the VDL Mode 3 MOPS and is working with avionics vendors and airlines to support the installation approval process required for full user operation.

2.4.2.4 The FAA and its industry partners are currently conducting interoperability testing between the pre-production avionics and the ground system test bed at the William J. Hughes Technical Center. In addition, selected units will be included in a NEXCOM System Demonstration scheduled for November of 2003. These radios are to be certified and available for purchase beginning in 2005.

2.4.3 Ground System Segment

2.4.3.1 To provide the ground half of the NEXCOM VDL 3 system, the FAA is in the process of developing the components necessary to enable provision of NEXCOM digital voice and data services. The NEXCOM ground system consists of two main components, the Radio Interface Unit (RIU), and the Ground Network Interface (GNI). The present phase of this development effort, known as the Rapid Preliminary Development Effort (RPDE), consists of a competitive requirements analysis and preliminary design effort. It also includes an Engineering Development Model that will demonstrate key FAA system requirements and the feasibility of each vendor's preliminary design. Contracts for RPDE have been awarded to two teams headed by Harris Corporation and ITT Corporation respectively. The System Requirements Review with each team has been completed.

2.4.3.2 Following the successful completion of the RPDE, the FAA will commence the Full Scale Development (FSD) of the ground system. This effort is scheduled to begin in early 2005 and continue through 2007, concluding in an Air Traffic Control Keysite Operational Test and Evaluation. Pending successful operational testing, full-scale system production and operational deployment will then begin, allowing for first implementation of a fully digital air/ground infrastructure in selected sectors by 2009.

2.4.4 NEXCOM System Demonstrations

2.4.4.1 In concert with the NARC recommendations, the FAA is conducting a series of three end-to-end operational system demonstrations. The first demonstration, conducted in October 2002, included a highly successful demonstration of the viability of the VDL-3 technology. The second demonstration will highlight the operation of pre-production avionics in October/November 2003. Certificated avionics and developmental ground systems providing NEXCOM services in an operational ATC environment will be the focus of the final demonstration, scheduled for the end of 2004.

2.4.4.2 To provide adequate time for both the system development and validation activities described above, as well as longer lead times for avionics equipage, the FAA is aggressively managing the existing 25 kHz spectrum. The FAA is dedicated to preserving the 25 kHz integrity of the VHF band, as this will allow the greatest flexibility for introduction of future digital services. Once the NEXCOM system development work is completed, the FAA will have several options available to begin the transition of the National Airspace System (NAS) to a fully digital infrastructure using VDL Mode 3. The final specific form of such an initial transition (en-route first, voice-only, data-only, voice and data simultaneously, broadcast or two-way services, etc.) is still being analyzed within the program. The cost and benefits to all users is a significant factor in determining the outcome of these deliberations.

3 CONCLUSION

3.1 The FAA is pursuing the development, validation, test, and certification of VDL Mode 3 as the potential basis for future NAS VHF communications. Fielding of the MDR ground radio component will begin shortly. The avionics and ground system development efforts are on or ahead of schedule. The FAA is aggressively managing its 25 kHz spectrum to provide time for successful development and validation of the VDL-3 technology and provide significant lead-time for user equipage. The final system operational deployment decision and the specific form of any digital transition are still under review within the FAA.

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ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 1: Introduction and assessment of a global Air Traffic Management (ATM) Operational Concept

GLOBAL AERONAUTICAL INFORMATION MANAGEMENT

(Presented by the United States of America)

SUMMARY

This Working Paper reflects the U.S. support of the ICAO Global ATM Operational Concept. To further support the Operational Concept and to assist in facilitating the transition to new global CNS/ATM systems, it is understood that systems supporting aeronautical information and charts must be further developed and oriented more toward global requirements. This should only be accomplished in a way that would safely increase efficiency and cost-effectiveness to users. The goal, therefore, is to create a new approach to support global air traffic management systems and their associated information systems. The U.S. supports the creation of a global aeronautical information management methodology that specifically highlights the need for the introduction and development of a conceptual information data model for the storage, retrieval and exchange of aeronautical data.

1. INTRODUCTION

1.1 All aeronautical information sub-systems (e.g., aeronautical information databases, on-board flight information databases, NOTAMs, obstruction evaluation databases, aeronautical charts, meteorological information, air traffic flow management information) are considered as elements of a total aeronautical information system (AIS). Managing all AIS to ensure that timely, interoperable, quality-assured and secure information is actually being provided and exchanged on a worldwide basis elevates AIS to a global aeronautical information management (AIM) concept. At its most basic foundation, AIM is needed to oversee a progressive migration from the publication of mostly paper-based products derived from mainly manual processes to the management of aeronautical information sub-systems in a globally exchangeable, electronic format.

1.2 It is envisioned by the Operational Concept that the global ATM system will require global aeronautical information of a specified quality. Thus, the ultimate goal of AIM would be to provide access to on-line, real-time, quality aeronautical information to any genuine user, any time, anywhere. To achieve this goal, aeronautical information must be provided and exchanged in electronic format based on a conceptually standardized data model. Strict quality control principles must be in place to ensure that aeronautical information is available, validated and secure to give the end-user the confidence in the correctness of the information received and assurance that it came from the correct source.

1.3 ICAO Annex 15, Aeronautical Information Services, emphasizes the aspects of data management, quality assurance and integrity with aeronautical information. The importance of aeronautical information is changing significantly with the implementation of area navigation (RNAV), required navigation performance (RNP), and airborne automated navigation systems. Together with the development of low-cost electronic data storage and retrieval systems the role of AIS (to include mapping) becomes more important.

2. DISCUSSION

2.1 Many users require that aeronautical data be held in a database. For example, flight management systems (FMS), flight-planning systems, air traffic control systems, ground proximity warning systems, simulators, procedure design systems and charting systems, all hold AIS-derived data in databases. The task of maintaining these databases and verifying and validating the data is currently time-consuming, costly and prone to error, because many of the changes are still made by manual input. Traditionally, independent and unique databases have been created and maintained for many of these aeronautical information sub-systems. Each database is maintained separately and few share data. Each database may hold different sub-sets of the data and may also have different requirements for accuracy, integrity and resolution. Furthermore, each system will probably provide different interface capabilities designed to meet the particular requirement of the user of that system. Notwithstanding this, there exists a large degree of commonality between the fundamental principles and data underlying the design of each system.

2.2 From the U.S. Federal Aviation Administration's (FAA's) perspective, there have been various computer system upgrades that have moved their aeronautical information system (AIS) data from their original (legacy) platforms to more modern architectures. The general issues are not unlike those in some other member States:

- The AIS data has been placed on modernized platforms;
- Modernization of legacy platforms still do not minimize the duplication of data or data discrepancies across lines of business and outside FAA;
- The real need to minimize AIS data duplication and discrepancies has not yet been met even with such modernization;
- All digital aeronautical cartographic and on-board AIS flight database products should be constructed and maintained using data derived from an authoritative AIS database.
- The most current data needed to maximize operational system capacity is still not readily available;
- All AIS information systems still need to be interoperable. They are not now without manual intervention; and,
- Most importantly, there still exists the need to automatically and accurately collect, validate, process, store, retrieve, maintain, analyze and disseminate AIS data with minimal human intervention.
- All AIS products should eventually be released in digital formats.

2.3 Having a common portal of AIS data from which everyone can access will derive specific benefits. One example would be a common digitized format for charts needed in the cockpit. By ensuring a central repository of digital datasets, there is a significant reduction in costs for maintenance of such charts and other associated products. This modeling methodology would, of course, be in compliance with ICAO's Annex 15, thus ensuring the goal of global harmonization.

2.4 This effort has already started within the FAA through a collaborative effort across functional lines such as AIS database management, aeronautical charting, airspace management, air traffic planning and procedures, flight procedures, and system engineering. The next step requires an Aeronautical Information Management (AIM) capability that would provide a formal framework for the information/data currently being collected, managed, analyzed and distributed by those involved with the FAA's AIS. AIM must have as its foundation a common data model.

2.5 The operational change that would go into effect throughout the FAA includes the life cycle role of AIS data – the convergence and ultimately the standardization of data; the automation of the processes for this convergence; the digital delivery of AIS data; and the harmonization of such data with that used by the international community.

2.6 Aeronautical Information Exchange Model (AIXM) is the only exchange model in operational use.

3. CONCLUSION

3.1 The FAA is interested in adopting the leading international aeronautical information model so that we can map our data and workflow processes within our AIS sub-systems and then upgrade these applications to take advantage of this new common data model. This adoption eliminates the need for each sub-system to negotiate their own data models with each other and then later be required to move to a different model based on international standards.

3.2 There are considerable benefits to be gained from placing AIS data under a common data exchange model, and thereby providing a single reference source for all AIS data around the globe under an aeronautical information management concept. For such a resource-intensive undertaking, the Conference may wish to consider those aeronautical information concept and data exchange models currently evolving on a worldwide basis. This activity will save years in the globalization of aeronautical data exchange.

4. ACTION BY THE CONFERENCE

4.1 The Conference is invited to agree on the following recommendation:

Recommendation 1/ – Global Aeronautical Information Management

That ICAO as a matter of priority:

a) Use the currently developed AICM/AIXM as the basis for a aeronautical information exchange; and,

b) Encourage states to use this model until such time as ICAO develops Annex material and Standard and Recommended Practices (SARPs) based on AIXM for the member states; and,

c) Amend specifications regarding the electronic storage, provision and interrogation of charts and aeronautical information contained in ICAO Annex 4 (Aeronautical Charts) and ICAO Annex 15 (AIS).

- END -

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 1.2: Enabling Concepts in Support of Global Air Traffic Management Operations

SAFE FLIGHT 21: ALASKA CAPSTONE AND THE OHIO RIVER VALLEY

(Presented by United States of America)

SUMMARY

This paper provides a status of the United States (U.S.) Federal Aviation Administration's (FAA) Safe Flight 21 programs in Alaska and the Ohio River Valley. Emphasis is on the operational aspects and real world applications, as well as accomplishments within the program to date.

1. INTRODUCTION

1.1 In recent years, the civil aviation community has recognized Automatic Dependent Surveillance Broadcast (ADS-B) as central to the future vision of free flight within a Communications, Navigation, and Surveillance - Air Traffic Management (CNS/ATM) system. ADS-B is the periodic broadcast of aircraft identification, position, velocity and intent information used by ground systems or proximate aircraft that allows both pilots and controllers to have a common situational awareness of all appropriately equipped users. ADS-B applications will enable new procedures (air to air, air to ground, ground to air, and on the airport surface) having the potential to increase safety and efficiency of the airspace system.

1.2 There are current activities ongoing within RTCA and the international community to further the development of technical and operational standards for ADS-B. Significant progress has been made in the U.S. to define ADS-B system level requirements and potential applications (RTCA DO-242A ADS-B Minimum Aviation System Performance Standards (MASPS) and on operational performance standards (RTCA DO-260A 1090 MHz ADS-B Minimum Operational Performance Specifications (MOPS), RTCA DO-282 Universal Access Transceiver ADS-B MOPS). Coordination is also underway to harmonize ADS-B applications internationally with EUROCONTROL and the European Organisation for Civil Aviation (EUROCAE) in the form of joint standards documents, and with the International Civil Aviation Organisation (ICAO) in the form of Standards of Recommended Practises (SARPs) and Manuals.

1.3 The FAA has been developing and conducting technical evaluations of ADS-B technologies since 1992 and has been operationally testing and evaluating related broadcast service applications since 1998. These more recent activities are organized under the Safe Flight 21(SF-21) program, formed to evaluate nine operational enhancements in which ADS-B is a key technology. The Alaska Capstone program is operationally evaluating a subset of the nine enhancements, as well as several other elements, to improve aviation safety in Alaska. To date, several of these enhancements have been fielded in the Alaskan region with full certification and operational approval in commercial revenue service.

2. U.S. STATUS – SF-21 AND CAPSTONE PROGRAMS

2.1 OHIO RIVER VALLEY

2.1.1 SF-21 is a cooperative government/industry effort to develop enhanced capabilities for free flight, based on evolving CNS technologies. The SF-21 program is demonstrating a cockpit display of traffic, weather, and terrain information for pilots, and will provide improved information for controllers, airlines, airport personnel and operations. The new technologies being used include the Global Positioning System (GPS), ADS-B, Flight Information Services-Broadcast (FIS-B), and Traffic Information Service–Broadcast (TIS-B), to integrate with enhanced pilot and controller information displays. SF-21 will evaluate the safety, efficiency, capacity, service, and procedure improvements these technologies make possible, and, in certain cases, will facilitate the certification of these technologies.

2.1.2 The primary objective of the SF-21 program is to enable and expedite implementation of the following nine operational enhancements:

1. Weather and other data to the cockpit
2. Affordable reduction of controlled flight into terrain (CFIT)
3. Improved low visibility approaches
4. Enhanced capability to see and avoid
5. Enhanced En Route Air-to-Air
6. Improved operations for surface surveillance and navigation for pilots
7. Enhanced controller management of surface traffic
8. Surveillance in non-radar airspace
9. Improved separation standards.

2.1.3 SF-21 has conducted several operational evaluations in conjunction with the Cargo Airline Association (CAA). Operational Evaluation-1 was conducted in July 1999 in Wilmington, Ohio. Twenty-four aircraft were fitted with a first generation ADS-B and cockpit display of traffic information (CDTI) suite. The aircraft demonstrated airborne “see and avoid” and “aid to visual acquisition” applications. Operational Evaluation-2 was conducted in October 2000 in the Louisville airport vicinity. This activity continued the development of ADS-B applications, to include airport surface situational awareness and initiated trials with Air Traffic call sign procedures to enhance visual acquisition and approaches. In 2002, test and evaluation activities were conducted in May at the Memphis International Airport (MEM). These tests included airport surface moving map and TIS-B trials to enhance ADS-B operations. The current testing emphasis for ADS-B is on evaluating Cockpit Display of Traffic Information Enhanced Flight Rules (CEFR) for visual situational awareness and separation applications under reduced visibility conditions. SF-21 is also exploring avionics development under a Test and Evaluation Surveillance Information System (TESIS) designed to evaluate alternative air carrier based avionics for ADS-B applications. Four avionics contractors are currently developing prototype units with a set of core capabilities. Each vendor is developing additional ADS-B applications.

2.2 ALASKA CAPSTONE

2.2.1 Current Capstone planning has focused on two regions of Alaska: Phase I addresses the Bethel/Yukon-Kuskokwim (Y-K) delta area and Phase II addresses the Juneau/Southeast (SE) Alaska area. Phase I planning in the Bethel area includes the installation of government-furnished Global Positioning System (GPS) driven avionics suites in up to 200 commercial aircraft serving this area, along with a supporting ground based infrastructure. Compatible data link transceivers installed at strategically located ground sites were designed to facilitate air traffic and flight monitoring/weather information services. January 2000, Capstone began operational use of ADS-B to provide Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) surveillance services in non-radar airspace in southwest Alaska. This event marked the beginning of Air Traffic Control (ATC) use of ADS-B for separation, vectoring, and sequencing aircraft. This ADS-B surveillance information is also being routed to airline operators for flight following and to assist in search and rescue.

2.2.2 Phase II of the Alaska Capstone Program will transition and begin in the Juneau area. The goal of this phase will be to incorporate technologies matured in the Phase I area, while building on lessons learned to provide a more useable IFR infrastructure. This will focus on navigational capabilities for lower en route altitudes, improved communications, weather information, surveillance, CFIT protection, and traffic awareness. On March 31, 2003, Capstone initiated enroute navigation using the world's first GPS/WAAS receiver certified for aviation use. Special Federal Aviation Regulation 97 provided authorization for trained pilots to use the GPS/WAAS receivers as the sole means for enroute navigation in Alaska. Already, this has produced an additional 41,000 feet of usable airspace along 1,521 nautical miles of the existing route structure in southeast Alaska. Approximately 200 aircraft (fix-wing and helicopter) will be fitted with upgraded and certified avionics. This next generation of avionics will include ADS-B and explore new capabilities, including WAAS capable GPS, see and avoid/traffic warning system, and enhanced awareness and avoidance. These avionics will be compatible with the ADS-B ground and airborne infrastructure. Both the ground and airborne segments will be upgraded to meet the RTCA Universal Access Transceiver MOPS.

2.2.3 Promising aviation safety improvement trends are documented in the Alaska Capstone region report "The Safety Impact of Capstone Phase I: An Interim Assessment of 2000-2001" (MP 02W0000150, MITRE Center for Advanced Aviation System Development, August 2002). Capstone equipped aircraft have had 40% fewer accidents than those not equipped. To determine whether this is a long-term trend, further data must be collected.

2.2.4 With the advent of ADS-B surveillance services in and around Bethel, Alaska there has been significant advancement of ADS-B implementation. All required operational evaluation and implementation activities were achieved and documented in the "Capstone Test and Evaluation Master Plan for Radar-Like Services" (Capstone Program Office, 30 January 2001). Although FAA Alaska Region implementation and refinements are still being made, this same process can be followed for both national and international ADS-B surveillance services.

3. SAFE FLIGHT 21 DEMONSTRATION AND EVALUATION ACTIVITIES

3.1 In 2001, the Safe Flight 21 program conducted an air traffic modernization forum in Memphis, Tennessee to demonstrate newly installed multilateration surveillance capabilities and on-board moving map displays for monitoring surface aircraft and vehicle movement. A multilateration infrastructure was also ordered for the Louisville, Kentucky test site. Other efforts included the award of four contracts for avionics development and evaluation, the development of a visual concept of use for surface moving map displays, and initial development of a surface moving map database to support this effort.

3.2 In 2002, the multilateration system was installed at Louisville, Kentucky, and a new automation platform for that facility to support ongoing ADS-B test and evaluation efforts is being procured. Development and evaluation is continuing on avionics and the procedural modifications needed to improve surface situational awareness and enhance existing surface surveillance using ADS-B. Interoperability and shakedown testing of avionics capable of transmitting and receiving ADS-B messages, receiving TIS-B messages, and displaying the combined ADS-B and TIS-B information to flight crews was conducted in April and May at Memphis International Airport. This data collection effort was designed to demonstrate the end-to-end functionality of the TIS-B infrastructure installed at Memphis, and provided data to assist in the validation of the avionics. Additionally, it provided an opportunity to document the air-to-air and air-to-ground surveillance performance of ADS-B in a light-to-moderate interference environment.

3.3 In 2003, demonstrations and evaluations include call sign procedure evaluation in Louisville and ADS-B/automation system integration and vehicle surface moving map testing at both Louisville and Memphis. In addition, east and west coast areas in the lower 48 states are being evaluated for potential use of ADS-B as a surveillance tool; these areas could offer opportunities for initial pockets of implementation.

4. CONCLUSION

4.1 Safe Flight developmental efforts are focused on the application of technology to meet user identified improvements that will provide significant safety, efficiency, and capacity benefits. Several of these are "near term" benefits that will be achievable in a relatively short time period with little or no changes to current ATC procedures. Equipment is provided as avionics in the aircraft and as infrastructure improvements (i.e., automation system upgrades, ground-based transceivers, etc.) on the ground. Test flight activities are prioritized to focus on the near term benefits, and are designed to focus on crew performance, operational procedures and benefits, and data link technical performance.

4.2 Demonstrations will be used to determine if these applications should be made operational on a national basis.

4.3 The 11th Air Navigation Conference participants are requested to consider the information presented in this paper and the applicability of our efforts to improve safety and efficiency for civil aviation operations in other regions of the world, particularly the Asia-Pacific Region. Members are also invited to visit the program websites at http://www.faa.gov/safeflight21 and http://www.alaska.faa.gov/capstone.

— END —

ELEVENTH AIR NAVIGATION CONFERENCE
Montreal, 22 September to 3 October 2003

Agenda Item 7: Aeronautical Air-Ground and Air-Air Communications

STRATEGY FOR GLOBAL INTEROPERABILITY OF AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B)

(Presented by the United States of America)

SUMMARY

This working paper proposes an approach for achieving globally interoperability in support of the early introduction of ADS-B enabled services.

1. INTRODUCTION

1.1 ADS-B technologies have been under development for more than a decade and the concepts for the initial use of ADS-B have begun to mature in some States and Regions over the past few years. Currently ICAO has Standards and Recommended Practices (SARPs) for two ADS-B link technologies and is developing the SARPs for a third. The United States of America Federal Aviation Administration (FAA) has conducted studies in cooperation with U.S. industry and has also supported cooperative activities with other States and Organizations that have attempted to assess the merits of each ADS-B link technology based on technical and economic factors. No single ADS-B link technology has emerged and been accepted by the international community as the sole long-term ADS-B solution. While recognizing that multiple ADS-B link technologies exist, a global strategy is needed to facilitate the early introduction of ADS-B capabilities.

1.2 In parallel with the link development activity, appropriate ICAO operational bodies should continue development of long-term operational requirements for ADS-B. This work should build on studies performed by regional technical bodies such as RTCA and EUROCAE with an eye towards global applications.

2. DISCUSSION

2.1 Over the past several years a number of States and organizations have participated in activities to develop and evaluate ADS-B technologies and the operational applications enabled by those ADS-B technologies. One of these efforts was a cooperative activity between the U.S. FAA and EUROCONTROL. This activity has included the evaluation of three candidate ADS-B link technologies (i.e., Mode S Extended Squitter, VHF Digital Link (VDL) Mode 4, and Universal Access Transceiver). The FAA has also conducted additional technical and economic studies that were focused on the use of ADS-B within the United States. Likewise, EUROCONTROL has sponsored additional studies focused on the European applications for ADS-B. In addition, the U.S. FAA and EUROCONTROL have jointly sponsored a number of flight evaluations that have utilized single and multiple ADS-B link technologies.

Other States, such as Australia and Sweden have conducted ADS-B evaluations using a single ADS-B link technology.

2.2 In July 2002 the U.S. FAA announced a decision on the ADS-B links for use within the United States for the initial introduction of ADS-B services. Under this decision 1090 MHz (i.e., Mode S) Extended Squitter is to be used for air transport and other high performance aircraft while Universal Access Transceiver (UAT) is to be used on the typical general aviation aircraft. No actions have been taken to require ADS-B equipage. The UAT is selected to provide ADS-B and associated services for the general aviation users because of its lower cost and greater uplink capacity, especially for Flight Information Services – Broadcast (FIS-B) services. If long range air-to-air applications are validated for use in the long-term that cannot be satisfied by 1090 ES alone, UAT would be a leading candidate to support these requirements. The U.S. supports progressing UAT ICAO SARPs so that UAT can be considered an international candidate for ADS-B. A number of technical, integration, and economic issues were identified with the VDL Mode 4 alternative, either by itself or in combination with another link, that precluded its consideration as part of the near-term U.S. ADS-B strategy.

2.3 The FAA and EUROCONTROL have each undertaken to coordinate strategies for the introduction of the initial ADS-B services within the U.S. and European airspace respectively. Common to both the U.S and the European strategies for the introduction of the initial ADS-B services is the use of Mode S Extended Squitter as a common link technology for achieving interoperability in support of near-term ADS-B applications. It must be recognized that currently Mode S Extended Squitter is the only ICAO standardized ADS-B link technology for which global radio frequency spectrum authorization currently exists.

2.4 Simulations for future Core Europe and future Los Angles operational environments suggest that Mode S Extended Squitter is expected to be capable of satisfying the initial requirements for ADS-B services for at least the next decade. There will likely be a point in time beyond which the current Mode S Extended Squitter system will need to be either augmented with a complementary second ADS-B link or replaced with a higher capacity alternative ADS-B link technology in order to fully satisfy the operational needs for ADS-B services in the most demanding operational environments. At what point in time the Mode S Extended Squitter technology will no longer be able to satisfy the ADS-B requirements is highly dependent on many factors including the ADS-B applications to be supported, the growth in air traffic and the evolution of the overall secondary surveillance radar environment as it impacts loading of the 1090 MHz channel. Given the many variables and the uncertainty associated with each, it is not possible today to estimate with any degree of certainty how long into the future the Mode S Extended Squitter technology alone will be able satisfy the operational needs. Therefore, though a second ADS-B link may be accommodated by both the U.S. and the proposed European strategies, it is the intent of both that international air carriers equipping with Mode S Extended Squitter would not also need to equip with a second ADS-B link in order to benefit from the initially offered ADS-B applications. It is recognized however, that as the requirements mature for the longer-term ADS-B applications, and as the demands placed on the 1090 MHz link increase over time, a point may be reached when the Mode S Extended Squitter technology may be unable to fully support the desired ADS-B capabilities. Therefore, air carriers may be encouraged to make provisions for the easy addition of a second ADS-B link in the future.

2.5 Both Airbus and Boeing have announced plans to equip new commercial air transport class aircraft with Mode S transponders supporting the transmission of Mode S Extended Squitter for ADS-B. The most recent generation of ACAS and Mode S equipment has incorporated support for Mode S Extended Squitter and given the global use of ACAS in air transport class aircraft the widespread availability of Mode S Extended Squitter based ADS-B services is becoming possible. The retrofit of commercial air transport aircraft with Mode S Extended Squitter capability for ADS-B has already begun by some commercial operators.

3. CONCLUSIONS

3.1 The. FAA and EUROCONTROL have coordinated on strategies for the introduction of the initial ADS-B services within the U.S. and European airspace respectively and both have identified the use of Mode S Extended Squitter as a common link technology for achieving interoperability in support of near-term ADS-B applications.

3.2 Mode S Extended Squitter is the only ICAO standardized ADS-B link technology for which global radio frequency spectrum allocation and global channel assignments currently exist.

3.3 Mode S Extended Squitter provides the most straightforward transition path to incorporate ADS-B within the ground ATS infrastructure and onboard air transport aircraft equipped with Mode S and ACAS avionics.

3.4 As a part of a global plan, in the near term, other link technologies supporting the initial introduction of ADS-B applications may optionally be used on a local or regional basis either in addition to Mode S Extended Squitter or in lieu of Mode S Extended Squitter (in support of local or regional operations).

a. The ground infrastructure intended to serve both international air transport operations as well as local domestic operations should support Mode S Extended Squitter and any additional ADS-B link technology authorized for use in IFR operations in that airspace.

b. Global, local or regional radio frequency spectrum authorization, as appropriate will be required for the additional ADS-B link(s) that are used.

3.5 In the longer-term, it is recognized that the current Mode S extended squitter technology may not be able to fully satisfy all of the requirements for ADS-B services in all airspace. It is therefore important to more fully define: the evolution of the operational requirements for ADS-B; the evolution of the air traffic environments in which ADS-B must operate; and the evolution of the use of the 1090 MHz channel. The long-term ADS-B solution will need to be integral with an overall long-term surveillance architecture that supports the Required Surveillance Performance (RSP) associated with a set of internationally standardized ATS applications

3.6 The long-term operational requirements will become the basis for an ICAO technical body to develop SARPs for an internationally standardized set of ADS-B applications, supporting both air-air and air-ground services. Further, the continued development within the appropriate ICAO technical body(ies) of alternative ADS-B link technologies is appropriate. However, it is premature to select any specific long-term ADS-B link architecture (i.e, either a single link or multi-link configuration) for the support of global aviation needs. Studies on such a long-term ADS-B link architecture must consider one alternative where the Mode S Extended Squitter technology continues to be used but is supplemented with a second ADS-B link specifically chosen to complement the capabilities of Mode S Extended Squitter. A second ADS-B link architecture that should be considered would be a high performance single global link solution that alone would be capable of satisfying the anticipated long-term global requirements for ADS-B. The two other ADS-B link technologies, the Universal Access Transceiver (UAT) and the VHF Data Link – Mode 4, should each be considered within the context of complementing Mode S Extended Squitter. However, technical, integration, and economic issues associated with VDL Mode 4 would need to be resolved before it could become a viable candidate as a complementary second ADS-B link. UAT SARPs will need to be finalized and integration issues addressed in order for UAT to be considered as a complementary second ADS-B link. In addition to considering UAT in combination with Mode S Extended Squitter, UAT should also be considered as a long-term candidate for serving as a single high performance ADS-B link. Other link technologies, or enhancements to existing ADS-B link technologies, may emerge and need to be considered before any ICAO decision on the preferred long-term ADS-B link architecture.

3.7 Any long-term solution for ADS-B must include radio frequency spectrum authorization for the ADS-B link or links involved. The economic factors associated with the alternative ADS-B link architectures would also need to be considered to ensure that any recommended long-term ADS-B configuration would be economically viable from both a ground infrastructure and airborne systems perspective.

4 ACTION BY THE CONFERENCE

4.1 The conference is invited to agree on the following recommendation:

Recommendation 7/ - Strategy for Global Interoperability of ADS-B

That ICAO:

a) Accept Mode S Extended Squitter as the ADS-B link technology for achieving global interoperability in support of the initial introduction of ADS-B enabled services.

b) Agree that as part of a global plan, for the near term, that other link technologies supporting the initial introduction of ADS-B applications may optionally be used on a local or regional basis either in addition to Mode S Extended Squitter or in lieu of Mode S Extended Squitter in support of local or regional operations.

c) Recognize that in the longer-term the current Mode S Extended Squitter technology may not be able to fully satisfy all of the requirements for ADS-B services in all airspace.

d) Continue development, within the appropriate ICAO operational bodies, of the long-term operational requirements for ADS-B. This work should build on studies performed by regional technical bodies such as RTCA and EUROCAE with an eye towards global applications.

e) Continue with the development of the technical standards for ADS-B link technologies since it is premature to make any decision on the preferred ADS-B link architecture to support the to be developed long-term ADS-B requirements.

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 1: Introduction and assessment of a global air traffic management (ATM) operational concept

1.2 : Enabling concepts in support of the global ATM operational concept

INITIAL AUTOMATIC DEPENDENT SURVEILLANCE — BROADCAST (ADS-B) APPLICATIONS FOR GLOBAL INTEROPERABILITY

(Presented by United States)

SUMMARY

This working paper proposes an approach for ICAO standardization and the global introduction of automatic dependent surveillance — broadcast (ADS-B) applications.

REFERENCES

1. "Strategy for global interoperability of automatic dependent surveillance broadcast (ADS-B)", working paper to the Eleventh Air Navigation Conference (AN-Conf/11), Agenda Item 7

2. Automatic dependent surveillance — broadcast (ADS-B) concept of use." ICAO Operational Data Link Panel (OPLINKP), AN-Conf/11-WP/6.

1. INTRODUCTION

1.1 The United States Federal Aviation Administration (FAA) and RTCA are working closely with the European States and organizations to define, develop and implement an initial set of ADS-B enabled operational applications. These ADS-B applications are proposed to serve as the basis for promoting global interoperability of ADS-B enabled operations for both the near-term and beyond. The proposed initial set of ADS-B applications is consistent with the draft "Automatic dependent surveillance broadcast (ADS-B) concept of use" developed by the ICAO Operational Data Link Panel (OPLINKP).

2. OVERVIEW OF THE UNITED STATES COORDINATION WITH EUROPEAN ACTIVITIES

2.1 The EUROCONTROL CARE/ASAS activity has identified an initial set of air-to-ground surveillance and air-to-air surveillance operational applications enabled by ADS-B, known as "Package-1." These applications are suitable for core European high-density traffic areas without excluding other areas, in line with the EUROCONTROL ATM 2000+ strategy and the expected operational improvements. These applications were also coordinated between the various European ADS-B related programs and projects through the Joint Coordination Board (JCB). Package-1 applications have acquired wide consensus and endorsement by the stakeholders. Significant international coordination of these applications has also occurred through the activities of the FAA/EUROCONTROL Research and Development Committee's Action Plans 1 and 10. Package-1 applications include the following:

2.2 Five ground surveillance applications:

a) ATC surveillance for en-route airspace;

b) ATC surveillance in terminal areas;

c) ATC surveillance in non-radar areas;

d) airport surface surveillance; and

e) aircraft derived data for ground tools.

2.3 Seven airborne surveillance applications:

a) enhanced traffic situational awareness on the airport surface;

b) enhanced traffic situational awareness during flight operations;

c) enhanced visual acquisition for see and avoid;

d) enhanced successive visual approaches;

e) enhanced sequencing and merging operations;

f) in-trail procedure in oceanic airspace; and

g) enhanced crossing and passing operations.

2.4 Note that these applications are also consistent with the United States National Airspace System (NAS) Concept of Operations, and do not fall outside the scope of near-term ADS-B capabilities as envisioned for implementation in the United States as described below.

3. OVERVIEW OF THE UNITED STATES ADS-B ACTIVITIES

3.1 The plan for implementing an initial package of ADS-B services in the United States NAS consists of two phases. Phase 1 concentrates on developing ADS-B applications and establishing pockets of implementation to enable initial operational use of ADS-B and stimulate user equipage. Phase 2 concentrates on the development and deployment of ADS-B ground infrastructure nationwide.

3.2 Phase 1 activities are built around pursuing those applications and benefits that are expected in the near term to stimulate user equipage with ADS-B avionics. Near-term initiatives are focused on aircraft-to-aircraft applications of ADS-B not requiring a NAS-wide ground ADS-B infrastructure, and on aircraft-to-ground applications of ADS-B where benefits can be achieved with a limited ground ADS-B infrastructure. Initial locations, or “pockets,” for this limited infrastructure include: Memphis, TN and Louisville, KY in the Ohio River Valley; southwestern Alaska in and around Bethel, AK; southeastern Alaska in and around Juneau, AK; Prescott, AZ and Daytona, FL training locations of Embry-Riddle Aeronautical University; and selected sites along the east coast of the United States. Applications to be supported in these pockets include (but are not limited to) air traffic control (ATC) surveillance in non-radar areas, ATC surveillance in terminal areas, enhanced traffic situational awareness on the airport surface, enhanced traffic situational awareness during flight operations, enhanced visual acquisition for see and avoid, and enhanced successive visual approaches.

3.3 Phase 2 consists of all the activities needed to achieve nationwide ADS-B capabilities. The operational and technical results of near-term initiatives will be leveraged to support investments and deployments for national use. The investment analyses for FAA-funded ADS-B ground infrastructure deployments will be conducted to determine overall system requirements, costs, and benefits of implementing ADS-B infrastructure nationwide, and ensuring interoperability with international ADS-B capabilities. Required automation changes and improvements, integration into the ATC system, and other issues will be examined carefully to ensure the successful implementation of ADS-B capabilities in the NAS.

3.4 The FAA and the United States aviation industry are supporting RTCA activities to develop the necessary standards associated with ADS-B. A number of such standards have already been published and work is progressing for the development of the standards associated with the initial ADS-B applications. RTCA is in close coordination with EUROCAE for much of their ADS-B standards work.

4. A UNITED STATES/EUROPEAN COORDINATED APPROACH FOR THE INTRODUCTION OF ADS-B ENABLED APPLICATIONS

4.1 Joint European/United States development and implementation of Package-1 applications plays a key role in the success of the United States plans for implementing ADS-B in the NAS. Most of the applications identified under the European defined Package-1 are already being developed and evaluated in the United States as part of the FAA's Safe Flight 21 program, and are crucial to the implementation of "pockets" of initial ADS-B capabilities; all Package-1 applications as well are consistent with both the European ATM 2000+ strategy and the United States NAS Concept of Operations. The United States FAA has agreed to adopt the terminology proposed by EUROCONTROL for the Package-1 set of ADS-B applications. Joint RTCA/EUROCAE development of technical standards in support of these applications is also underway. In addition, the FAA and EUROCONTROL, as well as the United States and European stakeholders, have identified/accepted 1090 MHz extended squitter as the common near-term ADS-B link to promote international interoperability; all Package-1 applications will be supported by this common link (see Reference 1) and airborne implementations are already underway.

5. ACTION BY THE CONFERENCE

5.1 The conference is invited to agree on the following recommendation:

Recommendation 1/ - Initial ADS-B applications for global interoperability

That ICAO:

a) Accept the Package-1 set of ADS-B applications, as being defined and validated by joint United States/European activities, to be used as the basis for ICAO activities to define the operational provisions for an initial global set of ADS-B applications; and

b) Accept the forthcoming joint RTCA and EUROCAE technical standards for the Package-1 ADS-B applications as the basis for the development of ICAO Standards and Recommended Practices (SARPs) and guidance material.

— END —

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 1: Introduction and assessment of a global air traffic management (ATM) operational concept
1.2: Enabling concepts in support of the global ATM operational concept

UNITED STATES ENDORSEMENT OF THE AUTOMATIC DEPENDENT SURVEILLANCE — BROADCAST (ADS-B) CONCEPT OF USE

(Presented by United States)

SUMMARY

This action/working paper proposes an approach toward developing global standards for ADS-B applications.

REFERENCES

“Automatic Dependent Surveillance — Broadcast Concept of Use” AN-Conf/11-WP/6
“Strategy for Global Interoperability of ADS-B”
“Initial ADS-B Application for Global Interoperability”, AN-Conf/11-WP/41

1. INTRODUCTION

1.1 The United States Federal Aviation Administration (FAA) through the Operational Data Link Panel (OPLINKP) along with the U.S. standards body RTCA are working closely with the member States of ICAO to define and develop a comprehensive concept of use for an initial set of the Automatic Dependent Surveillance — Broadcast (ADS-B) enabled operational applications. These ADS-B applications are proposed to serve as the basis for promoting global interoperability of ADS-B enabled operations for both the near term and beyond.

1.2 The ADS-B Concept of Use is being progressed by the ICAO OPLINK Panel. It describes the ADS-B system and its possible roles in the future communications, navigation, and surveillance/air traffic management (CNS/ATM) system. The OPLINK Panel will issue revised editions of the document as required to reflect any changes that occur.

2. DISCUSSION

2.1 In the early 1990's, ICAO approved the concept of Future Air Navigation System (FANS) based on satellite technology, which later evolved into CNS/ATM. The traditional air traffic control (ATC) surveillance system has limitations that constrained its capabilities in the current and future ATM environment. These limitations were detailed in the Draft Global Air Navigation Plan for CNS/ATM Systems (Chapter 1, Article 1.1) and include the following:

a) limited or no coverage, due to lack or limitations of the data sources (PSR, secondary surveillance radar (SSR). This includes non-equipped continental areas, low altitudes, non-continental areas, surface movements, silence cones, blind areas, antenna screening etc. In some cases (e.g. oceanic areas), this results in the need for procedural control, using voice reports;

b) mechanical rotation of the classical radar antennas, leading to inefficient scanning periods, impossibility of adapting the reporting rate to ATC needs etc. (Note: E-SCAN antennas may offer an alternative in this case);

c) garbling, fruit and splitting (resulting in false or lost targets);

d) unavailability of aircraft derived data, beyond the Mode A/C (i.e. Mode A identification and altitude);

e) non-homogeneous operation, caused by the current existence of a diversity of systems with different performance and capabilities;

f) in some regions the shortage of Mode A codes (only 4096 available) requiring frequent changes of code during the flight, which may also create identification ambiguities;

g) lack of capability to support future airborne situation awareness applications, because the corresponding surveillance data are not available to the aircrew; and

h) lack of capabilities to support airport surface Surveillance applications.

2.2 Due to constraints like these and cost, the necessary levels of capacity, flexibility and efficiency required to meet the future predicted air traffic growth could not be met by the existing surveillance systems. Various surveillance technologies have been developed to address these limitations. These include the SSR Mode S with enhanced services, ADS-Contract (ADS-C), and ADS-Broadcast (ADS-B).

3. CONCEPT OVERVIEW

3.1 The first meeting of the ICAO Air Traffic Management Concept Panel (ATMCP/1) defined the air traffic management operational concept as a description of the services that will be required to operate the global air traffic system up to and beyond 2025. The operational concept addresses **what** is needed to increase user flexibility and maximise operating efficiencies in order to increase system capacity and improve safety levels in the future air traffic management system. The extensive work which has taken place to date and that which is currently underway have convinced ICAO that ADS-B functionality has the potential to be one of the key elements necessary in achieving these operational concept goals.

3.2 The ADS-B Concept of Use describes ADS-B as one of the enablers of this future global CNS/ATM system. The description of ADS-B in this context is addressed to include functionality, the role of ADS-B in ATM, operational improvements, and typical applications. The applications are illustrated by use of various operational scenarios. These scenarios include all phases of flight in a gate-to-gate environment; contain certain aspects of the air-air, air-ground, ground-air and ground-ground interactions and the human and automated elements of the system. Finally, the concept addresses important issues for consideration by States while addressing implementation.

3.3 During the development of the ADS-B Concept of Use, considerations were made for other co-existing enablers (ADS-C, TIS-B[1], controller-pilot data link communications (CPDLC), etc.) in order to identify their complementary roles in the various operational scenarios.

3.4 The overall objective is to develop a common understanding of terms, definitions and possible uses of ADS-B in the future environment. A secondary objective is to do this early enough in the various stages of development to influence and facilitate that development.

3.5 The Automatic Dependent Surveillance — Broadcast (ADS-B) Concept of Use provides a description of the ADS-B system and its detailed role as an application enabling important changes in the future CNS/ATM system.

3.6 The description of the role of ADS-B takes into account the heterogeneous and evolving situation with respect to the available ground infrastructure, the aircraft capabilities, the airspace regimes etc. This considerably affects the transition from the current to the future system.

3.7 The ADS-B Concept of Use illustrates a number of typical operational scenarios. These scenarios describe the various possible flight phases in a gate-to-gate environment, i.e. including airport surveillance. They provide the description of the interactions between the airborne, ground, human and automated elements of the system. Furthermore, the scenarios describe a number of the supported applications and the role of ADS-B as an enabler in a mixed surveillance environment. These chosen scenarios were intended as illustrative examples and do not include all the possible uses of ADS-B.

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[1] TIS-B (Traffic Information Service – Broadcast) is a service, which enables position, and other data for non-ADS-B equipped aircraft to be broadcast via ADS-B. It is seen as an important means of supporting ADS-B services during the transition period when it is not feasible or cost-effective to equip all aircraft with ADS-B.

3.8 The ADS-B Concept of Use describes the role of ADS-B in supporting the future Surveillance service. This goes much beyond the current classical ground-based surveillance service and is extended to include air to air use as well as the capability to provide additional data such as state vector and trajectory intent. The levels of surveillance, which should be supported by ADS-B, are basic surveillance, enhanced surveillance (using state vector) and intent-based surveillance (using trajectory intent) on the ground and in the air, as applicable.

3.9 It should be noted that the ADS-B role, as detailed in the ADS-B Concept of Use, is complementary to other enablers such as SSR Mode A/C, SSR Mode S or ADS-C.

3.10 An analysis of the impact on various levels (operational, organizational etc.) stemming from the introduction of the ADS-B system is also presented in the ADS-B Concept of Use document.

3.11 A number of potential issues can be raised associated with the use of ADS-B. The operational concepts presented are at varying levels of maturity. We expect this concept for the operational use of ADS-B to evolve.

3.12 The technical aspects of the ADS-B Concept of Use should be coordinated with the appropriate ICAO technical panels to ensure consistency with ADS-B technical characteristics.

4. ACTION BY THE CONFERENCE

4.1 The conference is invited to agree on the following recommendation:

Recommendation 1/ - ICAO Activities on ADS-B Concept of Use

That ICAO:

a) adopt the initial ADS-B Concept of Use, as presented in ANConf/11-WP/6, as an ICAO operational “living” document;

b) assign the appropriate ICAO panel or study group to follow international research and development work in the area of ADS-B applications, and update / maintain the ADS-B Concept of Use document;

c) assign work to the appropriate Air Navigation Commission panels to work cooperatively to ensure that the ADS-B Concept of Use is properly aligned with existing operational and technical documents; and

d) utilize the ADS-B Concept of Use document, in its current form and as it matures, as a basis for development of potential standards and recommended practices (SARPs) and guidance material for air-to-air and air-to-ground surveillance applications.

— END —

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6: Aeronautical navigation issues

STATUS OF THE UNITED STATES LOCAL AREA AUGMENTATION SYSTEM (LAAS)

(Presented by the United States)

SUMMARY

This information paper provides the status of the United States Federal Aviation Administration's (FAA) Local Area Augmentation System (LAAS) and describes plans for its near term and future operational capability.

1. OBJECTIVE

1.1 LAAS is the ground-based augmentation system (GBAS) developed by the United States to provide precision approach capability and precise position, velocity, and time (PVT) data in the terminal area.[1] The objective of LAAS is to provide for all categories of precision approach (PA) and landings and surface operations to suitably equipped aircraft.

2. PROGRAM STATUS

2.1 The initial implementation of LAAS ground facilities will support both Category I instrument approaches and the GBAS positioning service at selected airports. The FAA awarded a contract in April 2003 for the design, development and production of the LAAS ground facility. This effort is divided into two distinct phases. The initial phase will focus on the development and design verification. At the successful conclusion of this phase a number of ground facilities will be built and deployed at selected United States airports.

[1] The latter functionality is defined in GNSS SARPs as GBAS positioning service.

(2 pages)

2.2 Research and development efforts advancing LAAS technology to support CAT II/III services is continuing. An evaluation of surface operations has also begun.

2.3 The development of terminal routings based on area navigation (RNAV) and required navigation performance (RNP) provides the potential for more efficient terminal operations and for multiple navigation services, including LAAS, to support the new routings. The LAAS data broadcast can be expanded to include terminal waypoint data to increase the flexibility of aircraft architectures capable of meeting the required performance. Efforts are under way to determine how to best support these applications using ground systems compliant with the existing, GBAS signal-in-space performance standards.

3. PLANNED LAAS IOC

3.1 LAAS IOC is expected by September 2006. After validating the system design, the FAA plans to install a number of ground systems at geographically diverse locations through out the United States National Airspace. These systems will support Category I PA and the GBAS Positioning Service. The FAA is currently coordinating with the aircraft operators to identify the procedures that will fully exploit the LAAS capabilities to improve airspace utilization and provide the lowest possible approach visibility minima.

4. EVOLUTION OF LAAS

4.1 The end state for LAAS is the provision of CAT II/III approach and landing service and most of the longer-term development efforts are aimed at achieving this goal. Near-term efforts are focused on achieving CAT III without the use of a second frequency in the airborne receiver. This will be followed by the incorporation of the benefits from GPS modernization, for example the additional frequency L5.

4.2 In addition, exploration of how LAAS can facilitate more efficient terminal area operations is expected to result in future LAAS applications such as guided departures, complex approach paths, guided missed approaches and surface movement guidance and control.

— END —

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

Agenda Item 6: Aeronautical navigation issues

STATUS OF THE UNITED STATES WIDE AREA AUGMENTATION SYSTEM (WAAS)

(Presented by the United States)

SUMMARY

This information paper provides the status of the United States Federal Aviation Administration's (FAA) wide area augmentation system (WAAS), and its current and future operational capability.

1. OBJECTIVE

1.1 The wide area augmentation system (WAAS) uses a network of ground reference stations (WRS), master stations (WMS), geostationary communication satellites (GEO), and GEO uplink stations (GUS) to improve the global positioning system (GPS) standard positioning service and provide increased accuracy, availability, integrity, and continuity of service to all properly equipped users in the United States National Airspace System (NAS). Using measurements of GPS error at reference stations throughout the United States, WAAS computes corrections as a function of latitude and longitude that are broadcast through the appropriate geostationary satellite. WAAS corrections are suitable for improved navigation capability including provision of instrument approach with vertical guidance service throughout most of North America.

2. COMMISSIONING OF THE WIDE AREA AUGMENTATION SYSTEM (WAAS)

2.1 WAAS was commissioned for use in all phases of air navigation in the United States NAS including one class of instrument approach with vertical guidance (LNAV/VNAV) on July 10, 2003. WAAS performance consistently demonstrates 1 m horizontal and 1.5 m vertical accuracy. WAAS Inter-governmental Oceanographic Commission (IOC) provides users with the capability to fly approaches with vertical guidance throughout the United States NAS. This initial WAAS capability also provides improved guidance to users in the en route and departure domains. LNAV/VNAV is an approach procedure with vertical guidance with nominal minimums of a 350 ft decision height and ½ mile visibility with appropriate lighting. Over 700 LNAV/VNAV procedures have been published for WAAS operations. The WAAS service area is the continental United States and portions of Alaska.

3. WAAS POST-IOC IMPROVEMENTS

3.1 Early next year, the FAA will improve the approach capability provided by WAAS through terminal instrument procedure optimization. This improvement will provide a new approach procedure with vertical guidance called LPV. LPV provides more lateral precision over LNAV/VNAV resulting in lower approach minima for most runways. LPV procedures have nominal minimums of a 250 ft decision height and ½ mile visibility with proper lighting.

3.2 LPV approaches, from a pilot's standpoint, will behave like an instrument landing system (ILS) approach and do not require any equipment beyond standard WAAS technical standard order (TSO) avionics. LPV will make the vertical guidance safety benefit accessible to the general aviation community, thus directly affecting the flying safety for general aviation aircraft and other WAAS users.

3.3 The FAA also plans to complete several other WAAS service/system enhancements in the post-IOC time frame. These system improvements are being made to increase the coverage area and to improve the availability of the signal in areas served by WAAS. These system enhancements include:

a) development and implementation of more efficient software monitor algorithms;

b) installation of additional WRSs to improve availability and coverage. Approximately 10 to 12 WRSs should be required. Discussions are underway with Mexico and Canada to determine the feasibility of installing some of the reference stations in those countries. The remaining WRS's are expected to be installed in Alaska;

c) procurement of additional GEO satellite communications links; and

d) equipment upgrades.

3.4 Due to the long lead-time necessary to plan for and secure GEO satellite services, the FAA has been working for several years to acquire redundant GEO signals in all areas served by WAAS. The initial goal is to provide a third GEO satellite on orbit as soon as possible after WAAS IOC to mitigate the single thread failure of the existing INMARSAT-III AOR-W and POR satellite solution. The FAA also wants to improve WAAS system availability (during GUS switchovers) and improve overall system coverage through more optimized GEO orbital locations.

3.5 WAAS FOC, with LPV capability throughout its service area, is expected by December 2007. WAAS GLS (GNSS landing system) capability, will await the availability of the second GPS aviation frequency, L5 (1 176.45 MHz). GLS is the Category I precision approach equivalent for GPS systems with aviation minimums of 200 ft decision height and ½ mile visibility (with proper lighting). The current plan is, by 2013, enough GPS satellites with L5 capability will be on orbit so as to be operationally usable by aviation. The FAA plans to upgrade WAAS to use L5 prior to this time.

— END —