

**FAA/EUROCONTROL Cooperative Efforts
on
Research & Development Programs**

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Abstract

As Europe implements its European ATC Harmonisation and Integration Programme (EATCHIP) which contributes to the design of a uniform European Air Traffic Management system and the U.S. moves toward a system of free flight in the context of a modern system architecture, it is crucial that joint efforts are in place to ensure that these future systems are both complimentary and compatible. Our challenge is to determine how to best harness the existing and evolving technology to build an overall system that fosters the realization of a harmonized global communications, navigation, surveillance, and air traffic management system (CNS/ATM). Achievement of this goal not only requires a common understanding of the nature of the drivers that will heavily influence the possible solutions in different countries, but also cooperation during the formative stages of new systems in order to ensure interoperability through the development of compatible solutions with common standards. This paper provides an overview of the effective framework in which the Federal Aviation Administration (FAA) and the European Organisation for the Safety of Air Navigation (EUROCONTROL) along with many of its member States are cooperating in R&D towards this end and highlights the progress that has been realized in the past three years as a result of this framework.

Background

In 1995, FAA and the EUROCONTROL Organisation decided to focus their co-operation existing under the joint Memorandum of Co-operation already in place and to re-assign priorities. The first FAA/EUROCONTROL Research and Development (R&D) Symposium was held in Luxembourg in April 1995. At this meeting there was a high level exchange of R&D information which lead to a greater common understanding of the European and FAA plans for the future Communications, Navigation, Surveillance/Air Traffic Management (CNS/ATM) systems and the related research programs that are either being conducted or planned by the individual agencies. As a result of this mutually beneficial information exchange, an agreement was reached to conduct a second symposium with the objective of cooperating further.

The second FAA/EUROCONTROL R&D Symposium was held in Denver, Colorado in December 1995. The objective of this meeting was to identify areas of mutual interest where FAA, the EUROCONTROL Agency, and its PHARE partners (France, Germany, Netherlands, United Kingdom, and the European Commission) could effectively leverage limited resources and work together in R&D that will lead to a global, seamless CNS/ATM system

for the 21st Century. The meeting resulted in the definition of several R&D Cooperative Tasks and assignment of FAA and EUROCONTROL points of contact to lead each task.

During the eight months following the Denver Symposium, varying degrees of progress were made towards the development of action plans for accomplishing each of the defined R&D tasks. To reaffirm the commitment made in Denver and to ensure the full development of all action plans, FAA managers and engineers met with their EUROCONTROL Agency counterparts in September 1996 at EUROCONTROL headquarters in Brussels, Belgium. This meeting resulted in a refinement of the task action plans (including a consolidation of tightly coupled tasks and definitions of deliverables and milestones), a determination of the impact of the action plans on the FAA/EUROCONTROL Memorandum of Cooperation (MOC) and an agreement to conduct an executive steering committee meeting by year end in order to formally approve and commit resources for progressing the action plans.

Establishment of FAA/EUROCONTROL R&D Committee

In December 1996 key R&D decision makers from the FAA and the EUROCONTROL Organization met in Washington, DC to officially form the FAA/EUROCONTROL R&D Committee. The FAA/EUROCONTROL R&D Committee recognized that more than an exchange of information would be required to achieve CNS/ATM harmonization between the U.S. and Europe. The Committee identified the need for active cooperation at the program level in order to leverage increasingly scarce R&D resources and to ensure timely implementation of new capabilities. To this end, the Committee updated the nomination of the points of contact from both the FAA and EUROCONTROL for each defined R&D cooperative task and committed to provide management oversight and the guidance necessary for progressing these R&D cooperative tasks. The Committee is responsible for monitoring the milestones set forth within each of the approved R&D task action plans, reviewing the progress of the tasks, recommending strategies and priorities for continuing productive progress, recommending future

steps, recommitting resources and considering the addition as well as the discontinuance of cooperative R&D activities. The Committee officially convenes quarterly to conduct reviews of the progress of action plans alternating meetings and video-conferences. Between these reviews continuous communication is strongly encouraged between the FAA and EUROCONTROL in order to ensure steady completion of milestones.

Framework of FAA/EUROCONTROL Cooperative R&D

There are presently eight cooperative R&D tasks defined under the management of the FAA/EUROCONTROL R&D Committee. These tasks focus on specific technologies under which cooperation would likely produce benefits to both FAA and EUROCONTROL R&D programs. Over the past two years, the action plans for these tasks have undergone critical refinement, reflecting the collaboration and agreement to combine specific elements of individual tasks into work more representative of current R&D technology requirements. In addition, the action plans have been assessed and agreed upon by both management and engineering staff of FAA and EUROCONTROL, and perspectives of R&D cooperative efforts and potential benefits are more completely reflected in the plans. The assessment process served to drive out the lower priority activities, and provided a much stronger signal on the higher priority issues. These assessments also identified overlaps between working groups and between individual tasks. For the most part, these redundancies have been eliminated, except in limited areas where independent research, for the time being, is still desirable.

It is the intention of the participants of the cooperative efforts that the defined action plans remain "living documents"; that is, they will be reviewed periodically to re-affirm or modify specific activities, schedules, and objectives, based on achieved objectives and Status of on-going activity.

In summary, the introduction of a more structured approach to conducting cooperative R&D through the development of specialized action plans, and more importantly, the engagement of senior management and the engineering staff who will participate directly

in accomplishing the actions, has led to a greater understanding.

FAA/EUROCONTROL Cooperative R&D Tasks

Airborne Separation Concepts

Objective

Cooperative work in this domain was initiated in order to:

- ❖ Promote a mutual understanding of U.S. and European visions of future operational concepts for uses and integration of airborne avionics with ATM decision support systems and operations,
- ❖ Identify areas for practical cooperation on CNS/ATM matters which can be achieved in the short term, and promote understanding
- ❖ Examine longer range opportunities for advances in integrated CNS/ATM and flight management system (FMS) avionics capabilities for separation assurance.

Background

From the U.S. perspective, the advent of free flight within the FAA and North American user community has raised many challenges and opportunities for significant cost benefits to both providers and users in the airspace. These benefits are more likely to be realized if there can be full integration of the airborne avionics and the ground-based ATM decision support systems. Operational concepts being considered on both sides of the Atlantic should be shared and understood as the procedures are developed that will enable air traffic control (ATC) to handle increased levels of air traffic more efficiently, while maintaining agreed safety levels.

From the European perspective, the European Air Traffic Management System (EATMS) operational concept is being defined with the objective to accommodate the future traffic demand in a safe and cost effective manner. The CNS/ATM systems concept provides the basis for global improvements in ATM through an internationally standardized package of air-ground data link applications.

In the longer term, early cooperative efforts toward understanding and exploitation of European CNS/ATM experiment results, and integration with advanced flight management systems for airborne separation assurance, will benefit both parties. This will provide the basis for ultimately developing concepts to exploit these evolving technologies, and defining and validating revised and new procedures. The leadership exhibited by EUROCONTROL in contributing and participating in major European CNS/ATM activities will contribute to the ultimate objective to develop and validate a global end-to-end CNS/ATM system.

Scope

The scope of work within this area focuses on Traffic Alert and Collision Avoidance System (TCAS), Automatic Dependent Surveillance (ADS), Automatic Dependent Surveillance Broadcast (ADS-B) and Airborne Separation Assurance System (ASAS). With regard to TCAS, there is an agreement to exchange relevant data on TCAS version 7 and TCAS RF spectrum interference reduction on 1030/1090 MHz. There is also an agreement to exchange relevant data and assess current efforts to exploit the use of ADS and ADS-B in support of future CNS/ATM roles, including, but not limited to air-to-air surveillance, low cost general aviation CDTI and ASAS, airport surface and remote area surveillance. In general, all advanced CNS capabilities for airborne separation assurance will be explored.

Status

Significant coordination and exchange of information has resulted between the FAA and EUROCONTROL with regard to standards for next generation air/ground voice communications and ASAS/ADS-B. Various issues raised as a result of this cooperative effort have been presented for consideration by RTCA and EUROCAE. Coordination on TCAS Version 7 and the establishment of a FAA technical standard order (TSO) is ongoing.

Air Traffic Operational Concepts

Objective

The intention of this cooperative effort is not only to build a mutual understanding of U.S. and European traffic environments, issues and solutions, but also,

through more detailed analysis of key concept issues, to contribute to the production of a common global operational concept. Specifically, the objectives of cooperation are:

- ❖ To make aviation increasingly more global and to make international operating environments increasingly less disjoint by providing detailed insight, to all parties, into the various current and future operational concepts in existence for US and European environments.
- ❖ To normalize the vocabulary of operational concepts by identifying their differences, and comparing and contrasting these differences in relation to the external environmental constraints - city pair locations, national boundaries, terrain, etc.
- ❖ To highlight and, in turn, mitigate the associated risk of the communities not having fully compatible solutions by identifying the dissimilarities in context and requirements within the operational concepts.
- ❖ Finally, to identify areas for cooperative development and develop a methodology for tracking and resolving issues and changes in operational concepts.

Background

The initial cooperative work in this research area commenced in February 1996 and was completed less than one year later. An extension to this effort was agreed upon and begun in December 1997.

From the US perspective, the advent of Free Flight as a driving force within the FAA and the US user community has raised issues as to whether there is a fork in the road between future technology implementation and procedural development of the US and the European community. It has also led to considerable introspection within the FAA as to the role of operational concepts in planning and maintaining alternative approaches to providing service.

Within the FAA both the Office of System Architecture and Investment Analysis (ASD) and the Air Traffic Requirements (ATR) organizations are

developing operational concepts for current and future services. The ATR effort includes a comprehensive survey of all “operational concepts” and a compilation of both their scope and depth. This initial effort was scheduled to be completed in 1997. The full scope of the effort is to develop Level 1 operational concepts - the services that are required irrespective of the provider and method. The Level 1 description is the immutable basis for development. Level 2 - the information required to provide the services and alternative assignments of the service responsibilities. Level 3 - detailed scenarios of how the various agents interact in operations.

From the European perspective, an EATMS Operational Concept has been defined with the objective to accommodate the future traffic demand in a safe and cost-effective way and to realize a uniform European ATM System. As one of its principles, this represents a European deployment of the ICAO global CNS/ATM systems concept. This simple statement is, however, not enough, neither to define how the future system would work and deliver the expected performance, nor to ensure practical global consistency for aviation users.

This work is an integral part of the development of a gate-to-gate ATM Strategy for the years 2000+ that the ECAC Transport Ministers requested to develop, and which is planned to be approved in the beginning of 1999. The Strategy will, in particular, be based on agreed performance targets and describe the roadmap of changes required through time.

The development of the EATMS operational concept is aimed at providing a reply to the above issues. It follows a top-down approach made of the following steps:

- define the mission and identify the user requirements.
- assess the potential performance shortfalls and identify the need for change.
- understand the invariant services which have to be provided by ATM.
- identify the possible options, analyze them, narrow down their range and select the most promising ones.
- assemble them into coherent descriptions, addressing by whom, how, where and when services will be provided.

- get support from R&D for the above analyses and to validate possible concepts.
- identify the main operational changes through time to ensure that performance targets are met and consistently lead to the future ATM system.

This is an iterative and incremental process to make sure that transition is possible and affordable and that benefits can be delivered, in particular with respect to additional capacity in high traffic density airspace.

Both approaches to operational concepts share the progressive development of future concepts from invariant processes/services, with, in parallel, a compilation of ideas, leading to the definition of roles and responsibilities and finally detailed scenarios of operations. The processes are similar and early cooperative efforts are needed to reduce divergence in results.

Scope

The agreed upon scope of work in this task includes:

- Identification of the Level 1 operational concept and reach agreement on the services to be investigated and time horizon to be considered. The latter should not extend beyond the year 2020.
- Joint work to develop well understood Level 2 alternative allocations. Particular attention should be paid to the feasibility of a continuous transition from current systems.
- Depending on interest in the alternative, assignment of joint or singular responsibility to develop the detail scenarios associated with the alternatives.
- Investigation of, using and updating the scenarios, through joint or singular efforts the operational, technical and human impacts of the Level 2 alternatives.
- Development of a common framework for identifying, discussing and investigating alternatives to provide the basis and audit trail for both internal and global investigation of these advanced alternatives and their costs and benefits. This will allow the parties to reach common method and/or understanding in meeting

the mutually agreed to services detailed in the operational concepts.

- Development of a common vocabulary to make certain that the terminology used in the US and in Europe is well understood. In particular, when identifying “new concepts” it must be ascertained that no mis- or over-interpretation is then given to these new ideas.

Status

Although the initial work defined for this cooperation had the modest ambition not to produce a common operational concept, but simply to build a mutual understanding of the traffic environments, issues and solutions and to identify further steps of cooperation, notable progress towards a common global operational concept has resulted from two FAA/EUROCONTROL Working Conferences.

The first conference held from 30 June to 2 July 1997 compared the U.S. and European ATM environments and current and future ATM operations. Differences were felt less important than initially expected even in the environment aspects. The weight of the past, in particular on systems in place; the overall traffic volume; and the number of runways at an airport were felt major areas of difference, but not to the point that they would impact the discussion and lead to necessarily different solutions. The main conclusions from the conference concerning a possible follow-up were the need to continue working on clarification of concepts and the formulation of the problems as well as to describe an international common concept and road map of change, starting first by selected aspects, which could form the purpose of other, more detailed, joint discussions and analyses.

The second conference was held 9-11 June 1998. It should be noted, as it was in the meeting, that the exchange of documentation and associated discourse has been a major positive result of the action plan. The FAA has used the ATM 2000+ Strategy documents and the ARDEP R&D documents in the FAA RE&D program formulation. NATS documents, as well as CENA’s document on Optimization of Airspace Operations, have been used as source documents by the FAA’s Separation Integrated Requirements Team. Undoubtedly, the free

exchange of ideas has improved the level of analysis on both sides. The conference concluded with the following points:

- ❖ The original task was to agree what is meant by performance in the context of each component and establish an outline set of common performance statements and, where possible, performance metrics and future targets. In this respect a vigorous discourse was undertaken on the subject of performance measurement and the availability of supporting data. It was quickly determined that there are serious data unavailability issues for many of the invariant processes, especially their constituent mechanisms. It was also clear that this will require an iterative process of gathering, analyzing and hypothesizing as we move forward on performance and measurement. Agreement was reached that metrics come in three flavors – descriptive, diagnostic and prescriptive. The descriptive metrics allow for an understanding of the processes, the diagnostic indicate when the processes need adjustment and change, and the prescriptive are used in validation and development to assure that what is being produced (whether ideas or systems) meet the prescribed operational need.
- ❖ ICAO has formed an operational concepts panel. Several of the members of the panel are members of the working group. The rest of our action plan group members are alternates or close to the panel members. Our efforts will be input to the panel. As we analyze the comparability of our individual concepts we are determining their extendibility to a global CNS/ATM concept. This action will be complete with first meeting of the panel.
- ❖ Europe's ATM 2000+ strategy and the FAA's CONOPS and Architecture lay out the initial current plans for implementation of the concepts. These plans lay out the expected system enablers to achieving these concepts. The effort underway should provide additional justification or changes to these plans. Need to emphasize that the approach we are taking is modest in its goals and is related to the availability of data.

In summary, the comparison of concepts and data at the June 1997 conference encouragement that there were similar operations in Europe and the US. The same analysis showed that several future concepts such as multi-sector operations were held in common. Efforts to work the comparisons at a more detailed level have proven more difficult. It is clear that neither the FAA or EUROCONTROL, individually, have the information – detailed processes, descriptions, data, etc. - to build complete baselines of the invariant processes to do their own current versus future comparisons.

Air Traffic Modeling for Separation Standards

Objective

This cooperative effort seeks to:

- ❖ To foster worldwide cooperation on Air Traffic Modeling for separation standards and the joint development and use of these capabilities to support the efforts in operational concepts, procedure development, and system architecture.
- ❖ To initially focus on an area of mutual need – the development of common models for safety analysis, especially in the areas of separation standards and collision risk.

Background

The original cooperative work outlined for this research which commenced in October 1996 and was completed in October 1997 called for:

- Identification of a core group of responsible individuals, analysts and model developers in the areas of separation standards and collision risk within the FAA and the European aviation community, development of a joint concept paper that provides the framework of critical assumptions and definitions, defines basic relationships and critical parameters, and identifies basic modeling needs.
- Identification of sub-groups to work on the subject matter issues on a continuing basis to assess the present level of safety and develop methods for assessing safety implications arising from future options for operations.
- Identification of modeling needs and development of a plan for cooperation to meet these needs.

The extension now defined for this effort outlines the work to be performed from 1998 through 2001.

The joint perspective is that several questions arise in the advent of various new technologies such as satellite navigation, flight management systems, and data link, and the new emphasis on user preferred routings either as contract or in Free Flight. Chief among the questions concerns methods for assuring separation safety when changing separation standards or ATM/ATC procedures. Couple this quest with the relaxation of assigned directional altitudes to the ultimate – cruise climb – and collision risk becomes a significant analytic requirement. Add to this new automation techniques to aid the controller and safety prediction becomes an important consideration. All of these are areas where significant improvements need to be made to validate capabilities and speed implementation.

This area of research is still in its infancy, and is ripe for cooperative development to ensure both consistency of measure as well as ensuring complementary rather than parallel development increasing the net leverage of resources.

Scope

The current scope of work within this cooperative effort includes:

- Establishment of Separation Safety Metrics (12/1998)- Appropriate metrics must be selected to quantify the risks perceived by aircraft operators, passengers, ATM service providers, Flight Standards organizations, and the general public. The metrics must assist senior ATS Flight Standards Managers as they review and "sign off" on specific ATM system changes. The identification of suitable risk metrics will require the joint involvement of operational and technical experts on both sides of the Atlantic.
- Modeling of Aircraft Collision and Wake Turbulence Induced Risk (12/2001) - The ATM scenarios to be modeled will be identified and will include scenarios developed both by FAA and EUROCONTROL. A toolkit of aircraft collision risk assessment techniques will be assembled that can provide risk descriptions and

advice to AT and Flight Standards managers. Human performance (controller and pilot) will occupy a significant role in the analyses.

A wake turbulence-induced risk assessment model will be developed that draws on the available techniques and data. This wake turbulence work is ambitious, and the likelihood exists that the physics of wake turbulence will not be sufficiently understood for reliable and accurate estimates of risk to be developed for all scenarios. Nevertheless, the need is significant, and any progress in this area will be valuable.

The collision and wake turbulence-induced risk assessment techniques must be validated to the extent feasible, to assure integrity and credibility. The tools will be validated by a review of model logic and assumptions, and conformance with input data reflecting current conditions.

- Development of a Separation Safety Monitoring Process (12/2001) - It is necessary to develop and have in place a system for monitoring the safety of the airspace after implementation of new operational concepts, separation minima, ATC procedures, and/or technologies. The monitoring process should examine separation safety trends, and encourage the reporting of all serious concerns and unexpected events. This effort will be closely integrated with the divisions, offices and other groups with safety responsibilities within FAA and EUROCONTROL.

Status

Under the initial milestones within this research area, a concept paper was completed and provided the basis for progressing the current scope of work.

Initial discussions have taken place in EUROCONTROL among operational and technical staff concerning establishment of safety metrics. Several alternative potential safety metrics have been identified. FAA has yet to identify the operational FAA staff who will participate in the establishment of safety metrics. When these FAA staff have been identified, joint consultations will be undertaken and the safety metrics established.

Initial modeling efforts are also being undertaken. FAA has contracted with VPI to conduct some safety modeling work. EUROCONTROL is undertaking some safety modeling work with NLR and DNV Technica. When these efforts are at a mature stage, they will be circulated to partners in Europe and North America for review and discussion.

Evolution of ATS System Architecture

Objective

This cooperative effort seeks to identify, define, compare, and evaluate requirements and the architecture developed to satisfy these requirements between the FAA and EUROCONTROL.

Specifically, the objectives of cooperation include:

- ❖ Achievement of a common understanding of both operational and business concepts.
- ❖ Documentation and evaluation of EUROCONTROL and FAA Architectures and their respective evolutionary processes.
- ❖ Determination of the impact of new concepts, e.g. Free Flight, and of modern avionics on current architecture.
- ❖ Execution of related cost/benefit studies pertaining to the impact of specific evolutionary changes to the architecture.
- ❖ Assessment and agreement of the level of Validation and Verification Strategy for the architectures, considering common aviation standards.
- ❖ Co-operation in the R&D efforts being performed by each organization related to architecture.
- ❖ Agreement on the modeling approach and tools to be used for architecture representation and comparison.

Background

From the U.S. perspective, the advent of free flight within the FAA and U.S. user community has raised many challenges and opportunities for significant cost benefits to both providers and users of the airspace.

From the European perspective, the EATMS operational concept is being defined with the objective to accommodate the future traffic demand in a safe and cost-effective way. As one of its principles, EATMS represents a European deployment of the ICAO global CNS/ATM systems concept. This simple statement is, however, not

sufficient to define how the future system will work and deliver the expected performance, nor to ensure practical global consistency for aviation users. It also does not define the complex transition steps concerned. Although the development of the EATMS operational concept is being addressed in another area of cooperation, the development of the EATMS technical concept must proceed in a corresponding and iterative manner.

The joint perspective is that to ensure the implementation of new and emerging concepts will support the realization of the full potential of new concepts. It is essential that the architecture is gate-to-gate and provides seamless interoperability on an international basis. Architecture concepts being considered on both sides of the Atlantic should be shared and understood as the technology is developed so that increased levels of air traffic can be handled more efficiently, while maintaining and possibly enhancing the current levels of safety. These architectures shall consider airborne components of the overall system.

Scope

The scope of work outlined is intended to advance the study of global CNS/ATM system architectures and to lay the foundation for future compatibility of architecture requirements. Specific activities defined within this area of cooperation are:

- Review the available EUROCONTROL and FAA Architectures with the intent to ensure adequate commonality in the approach and end goals of a common harmonized architecture.
- Determine if the architectures can meet the current and future requirements of the providers and the users of the airspace.
- Derive requirements for automation and interoperability based on the approved operational concept(s) and “the architecture” via a study of the concepts and operational processes, including software simulations and modeling as well as a common definition of subsystems, interfaces and standards.
- The application of Validation and Verification Strategy to the architectures in accordance with separate area of cooperation in this area.
- Conduct related cost/benefit studies pertaining to the impact of specific evolutionary change(s) on the architecture on the separate environments.

- Co-operate in R&D on architecture.
- Develop a common vocabulary.

Status

The following short term objectives defined in the scope of work for this cooperative research have been accomplished:

- A comparative analysis of the FAA and European architecture documentation has been performed by Germany's DFS
- An Architecture Collaboration Workshop was held in June 1998 with representation from CNS domains.
- There has been an initiation of discussions on Information Architecture/Information Management.

Based on the above accomplishments, the activities within this cooperative work have been extended to include involvement of and coordination with Vertical Domains, establishment of an appropriate collaboration framework, maintenance of comparative study work by establishment of an appropriate framework, further development of the Architecture vision document establishing architecture principles and evolution scenarios, and consideration of information security issues and (any) impact on safety.

Validation and Verification Strategy

Objective

The objective of this cooperative work is to determine a strategy for validating and verifying the performance, reliability, and safety of ATM systems and procedures and their possible relations to certification. The term "performance" includes benefits such as capacity gain, cost effectiveness, and environmental issues. The strategy is should to allow for the validation and verification during the phases of research and development and implementation of airborne and ground-based ATM sub-systems in relation to current and future operational context.

Background

This area of cooperation has two drivers. First, the present activities of both parties in the definition of the emerging future ATM system concepts. Second, the desire to narrow the R&D scope to allow more expeditious and targeted progress towards an early implementation and realization of immediate benefits to the airspace users from available technology. This is in line with the objective of the December 1995 Denver R&D Symposium on benefits in reducing R&D costs by finding more efficient ways to design feasible, safe, and operationally beneficial ATM systems. As an example, the possibility of automated ATM operations enabled by GPS and future communications and computing technologies might offer significant benefits to both providers and users of the airspace. To realize these potentials, it is essential that strategies for validating and verifying the correct and safe functioning of these airborne and ground-based ATM sub-systems are defined, including corresponding operational procedures and possible relations to certification.

Scope

This cooperative work is proposed to focus on early benefits and will proceed as follows:

- Exchange of experiences and "lessons learned" from previous projects.
- Mutual presentation of relevant current activities including experiments and trials with regard to emerging future concepts.
- Establishment of a common vocabulary covering the relevant validation and verification concepts/activities in relation to each other.
- Mutually present plans for future validation and verification activities including experiments and trials.
- Identify, based on the results of the above mentioned activities, the most promising areas for common efforts, exchange results and define plans for follow up work.

It is planned that related activities of all organizations such as EUROCONTROL, FAA, MITRE/CAASD, NASA, civil aviation authorities, research establishments including academia and industry should participate in this work.

Status

The FAA and EUROCONTROL validation organizations are in a formative state.

EUROCONTROL and the FAA have exchanged the “EATMS Validation Strategy Document 1.0” and the “Draft Operational Concept Validation Process” description respectively. The EATMS document was reviewed by several concerned bodies (e.g., FAA Traffic Services R&D Subcommittee, the FAA Technical Center, NASA, Boeing and MITRE). It serves as background material in the establishment of the FAA Concept Validation approach.

A September 1998 coordination meeting resulted in a consensus of the meeting participants that attempting to establish Phase 3 activities is premature. Until both parties have more mature plans and have established their activity schedules, they cannot establish cooperative experiments. The review of Phase 1 and Phase 2 showed the benefit of a more modest, but useful set of milestones and joint activities:

- 1) Continue the exchange of information on validation and verification activities including planned experiments, analysis studies and metrics development.
- 2) Hold annual workshops at research facilities focusing on ongoing validation activities. The scope of the workshop will be on the experimental plan, lessons learned, performance and metrics. The focus is on the process and methodologies, not necessarily results. The purpose is to further develop our knowledge of validation techniques and potential experimental problems. *Future cooperative effort will be revisited/discussed at the workshops.*
- 3) Both EUROCONTROL and the FAA have embarked on prototype data repository activities. While it is premature to consider data repositories as an activity for joint collaboration, the exchange of information on the prototype development is important and points of contact have been established to maintain that information link.

As individual plans and activities mature, annual workshops are planned in order to provide a forum for a re-examination of potential Phase 3 activities – that is co-operative efforts in validation. It is the participants’ expectations that this is a course of action that is not only likely but also desirable. The first workshop should be held mid-year 1999 and a

review of potential Phase 3 activities would be a major workshop agenda.

Air/Ground Information Requirements & Air Traffic Management Decision Support Tools

Objective

The overall objective of this task is continued cooperation on research and development of air traffic management decision support tools and resultant requirements for air/ground data exchange, leading to the realization of a harmonized air traffic management system. This will be achieved through the following objectives:

- ❖ To promote a mutual understanding of the role of decision support systems and tools in an evolving international air traffic management system. Continued emphasis will be given to defining the need for equivalent functional capabilities to support operations of the international air transport community flying across the airspace boundaries of various ATM authorities.
- ❖ To share information, experience and expertise that has been gained by each participant during research, development and implementation activities in the U.S. and Europe. Emphasis will be given to the exchange of information that will aid in planning for cooperative research programs and harmonization of plans and activities, while also minimizing future duplication of efforts.
- ❖ To collaborate on the development, evaluation and validation of decision support tools that will be implemented to achieve evolutionary improvements in efficiency and capacity throughout all segments of the airspace system.

Background

In the U.S., the aviation industry has defined a strategy for achieving increased user flexibility and operating efficiencies by progressively removing restrictions to airspace operations, through modifications to procedures and implementation of new capabilities and technologies. The goal of this strategy is to strive towards an ATM system that best utilizes ground and airborne capabilities and systems in a cooperative fashion, providing users with the

flexibility to fly routes that better meet their dynamic operational requirements, categorized as free flight.

Industry consensus for modernizing the U.S. National Airspace System is evolving towards implementing core ATM decision support system capabilities at selected field sites under a program termed as Free Flight Phase 1 (FFP1), as well as understanding and mitigating the CNS risks under a changed Flight 2000 program. The capabilities to be deployed under FFP1 program are:

- User Request Evaluation Tool (URET) - inter and intra facility
- Controller Pilot Data Link Communication (CPDLC) Build 1 – NOW applications
- Collaborative Decision Making - Select Applications
- Traffic Management Advisory (TMA) - Single Center
- Passive Final Approach Spacing Tool (pFAST)
- Surface Movement Advisory (SMA)

Central to the evolution of the ATM system and Free Flight implementation strategy is the development and implementation of decision support tools, or computerized aids to the ATM work force.

The FAA in concert with MITRE/CAASD, is conducting research, development and implementation activities on various decision support tools in all operational domains consisting of the en route, terminal, oceanic, airport surface, and traffic flow management environments. Additionally, the FAA and NASA have combined their respective ATM R&D programs into an integrated national program for ATM R&D, encompassing the development of decision support tools within the free flight operational concept.

In Europe, ATM harmonization is addressed in EATCHIP for the nineties and the new ATM strategy for 2000+. EATCHIP Phase III covers the time-scale until 2005, following which EATCHIP IV and the associated EATMS concept will, in an evolutionary fashion, complete the harmonization and integration processes. Implementation throughout Europe is aligned through the European “Convergence and Implementation Plan”. The EATMS is currently embedded in a comprehensive, uniform, gate to gate oriented ATM strategy for the year 2000+, which will create the basis for the

development of ATM in Europe in the early part of the next century. The ATM 2000+ is structured on a top-down and performance driven approach. It incorporates the identification and prioritization of those measures which will deliver early benefits for the airspace users.

The EATCHIP III operational concept describes the ATC tools which are expected to bring benefits in capacity. They comprise:

- Communications and surveillance requirements encompassing air/ground data link requirements
- Flight data processing and distribution
- ATM added functions: Monitoring Aids (MONA), Safety Nets (SNET), Sequencing and Metering (Arrival Management AMAN & Departure Management DMAN), Medium Term Conflict Detection (MTCDD), support and supervisory functions, airspace management and data processing, and ATS environment data processing.

The EATCHIP Phase III Operational Concept has been agreed by the National Administrations. The Operational Concept is being detailed in a series of Operational Requirements documents for each element listed. Following international approval, the operational requirements will be further detailed in generic data processing specifications.

Scope

Collaboration shall be achieved through information sharing in the following areas:

- Operating Concepts for Advanced Air Traffic Control and Traffic Flow Management Decision Support Tools
- Specific Decision Support Tools for Advanced ATM
- Human Centered Approach to Automation
- Air/Ground Information Exchange for evolving ATM System Operations

Information will be shared in the form of available documentation such as briefings, reports and papers, as well as specific algorithms and documentation software. Additional information will be shared during technical interchange meetings. In all cases, evaluations on the applicability of information exchanged to plan research and products being

developed will be conducted and shared by both parties.

Status

Over the past year, the FAA participated in PHARE PD3 simulations and analysis of expected service improvements. The FAA's participation was organized as follows:

1. at the EUROCONTROL Experimental Centre, Bretigny :
 - one controller for 6 months detachment
 - one human factors expert/analyst for 3 months
 - two controllers for two periods (training 1 week and simulation 3 weeks)
2. at CENA, France :
 - two controllers for two periods (training 2 weeks and simulation 3 weeks)
3. at NLR, Netherlands :
 - two controllers for two weeks training

Concerning service improvements, the participants gained information on :

- conflict probe,
- applied 4D trajectory and trajectory negotiation,
- multi sector planning and its effect on planning and tactical control
- the ERATO planning and conflict handling tool of CENA,
- the PHARE Arrival Management concepts of the NLR.

Most of the FAA participants are involved in FAA system upgrade projects, for which the experience gained was considered very useful. Further exchange of staff might be envisaged in the PD/3 continuation trials contracted to NLR.

American Airlines has confirmed their intention to equip part of their fleet to be compatible with the PETAL (Preliminary EUROCONTROL Trials on Air-Ground Data Link) implementation of Air-Ground Data Communications Services as defined in ODIAC (Operational Development of Integrated

Surveillance and Air/Ground Data Communications). The message exchange will be using an ATN compliant air/ground communications infrastructure. To this effect AAL has just started to upgrade their Airline Operations Communications avionics suite, to which the ATS Data Communications can be added without major risk.

EUROCONTROL and FAA have started collaboration in the PETAL Integration Team (PIT), which had a first meeting at Washington DC in July and a second meeting at Maastricht UAC in September. PIT 3 is planned for early November in Seattle.

It is foreseen that the initial FAA-EUROCONTROL collaboration for PETAL will be followed by in a separate project, under the umbrella of Action Plan 6. A roadmap for early European Data link Implementation will be defined by end Sept. 98, for liaison with internal EUROCONTROL bodies, the FAA, Airlines, and Service Providers.

The PETAL II extension with the participation of the FAA, a Commercial Airline (AAL), a VDL Mode 2 service provider and Maastricht UAC as the operational centre is seen as a major opportunity to leverage operational CNS/ATM-1 implementation. Apart from the US participation in PETAL it is equally important to reinforce EUROCONTROL Member State involvement and support which will be addressed in the EUROCONTROL/EATCHIP Operational Requirements/Data Processing and the Communications Teams, and to get European airline involvement.

The Technical Interchange Meetings (TIM) conducted and planned within the scope of this area of cooperation have attracted many more participants and generated more international interest than originally expected. The first in a series of planned TIMs was held in June 1997 and served as the first in a series of seminars to create/reinforce working and personal relationships between leading experts and researchers in the ATM R&D community and to reach consensus on major ATM issues. The second TIM was held in March 1998 and focused on Air/Ground Information Requirements. The next TIM was held in November 1998 and focused on the Surface Management domain. The TIM (ATM-98)

for which this paper has been prepared is the second in the series of annual ATM R&D seminars and is proof of the success of the FAA/EUROCONTROL R&D cooperation. There is a Human Centered Approach to Automation TIM planned for early 1999 and a Conflict Detection TIM planned for mid 1999.

ATC Procedures

Objective

This high priority objectives in this area are:

❖ Development of a Global RTF Phraseology -

The group will compile, analyze and rationalize differences of ATC RTF Phraseologies currently in use in the FAA (USA), NAVCanada and European operational environments. Safety related differences isolated during this process will be addressed on a top priority basis in the form of either changes to the ATC operational manuals of the FAA and/or NAVCanada or in the form of proposals for amendment to the relevant ICAO Documents

A global RTF Phraseology will subsequently be developed with due consideration for the important safety related requirement for a RTF Phraseology which is harmonized so as to be suitable for global promulgation and application

❖ Co-ordination of the development of a proposal(s) for amendment to the existing ICAO Provisions on flight-planning (including RPLs) –

Work currently underway within EUROCONTROL, addressing the updating of those provisions for the purpose of keeping pace with evolving technologies and airspace requirements based on strict COM/NAV/SUR equipment fits, will be co-ordinated with the FAA, NAVCanada and the ICAO Air Navigation Bureau, ATM Section, for the purpose of ensuring a product suitable for global application into the foreseeable future. Specifically, the provisions related to the filing of information relevant to Item 10 of the current ICAO Flight Plan Format will be addressed initially as an issue requiring urgent attention.

Background

The working group formed under this area of cooperation has adopted the name Multi-Agency

ATS Procedures Co-Ordination Group (MAPCOG). The terms of reference (ToRs) for this group are defined by Annex 12 to the Memorandum of Cooperation between the FAA and EUROCONTROL. NAVCanada, the Canadian ATS Service Provider, is as well providing representation to the group in the context of the existing Memorandum of Understanding between EUROCONTROL and Transport Canada.

Scope

The scope of work of the MAPCOG includes the:

- review of ATS Procedures as published in the relevant ICAO Documents,
- formulation of revised ATS procedures, where required, for eventual incorporation into ICAO Documents,
- assessment of operational requirements for new ATS procedures as required by evolving technologies
- development of new ATS procedures compatible with the other components of ATM, ASM and ATFM
- validation of newly developed ATS procedures
- consolidation of new ATS procedures
- formulation of proposals for amendment to ICAO PANS-RAC and/or ICAO SARPS required to support the implementation of new or revised ATS procedures

Status

MAPCOG recognizes the relevance and importance of its RTF phraseology work in relation to the "ICAO Action Plan for Global Aviation Safety" endorsed by the 151st Session of the ICAO Council, which identified this aspect of the work of MAPCOG as a major contributing element. In this regard, the group will seek to submit to the ICAO Air Navigation Bureau, a proposal for a Global RTF Phraseology by October 1999. In addition, MAPCOG intends to submit a comprehensive proposal for amendment to the PANS-RAC Flight Planning Provisions in October 1999.

Parallel to, and in support of, the actions outlined above, EUROCONTROL undertook a major process of compiling a comprehensive comparative study of existing ATS Definitions and RTF Phraseologies as applied in the operational ATC environments of Canada, the USA and Europe. Such compilation

serves as the basis for the action outlined under the first objective defined above. This task was completed by EUROCONTROL in June 1998.

The rationalization of selected differences associated with the Definitions of Terms used in the provision of ATS, will be undertaken on a priority basis whenever required for the facilitation of the work of RTF phraseology objective above. The eventual development of a comprehensive, harmonized set of Definitions of ATS Terms for global promulgation and application is reserved for future work of MAPCOG.

Digital Voice Telecommunications Network

Objective

The goals for this domain are:

- ❖ To identify and define the requirements of the FAA and EUROCONTROL to establish a method of cooperation in the development, evaluation and implementation of a digital Aeronautical Voice Telecommunication Network (VTN).
- ❖ To develop VTN Technical Provision Document that will be prepared in a format compliant with ICAO and submitted to the “ATS Voice Switching and Signaling Study Group” (AVSSSG) and ICAO Regional Offices, with the aim of proceeding towards international standardization in digital voice telecommunications.
- ❖ Provide AVSSSG and ICAO Regional Offices with the results of the cooperative evaluation activities performed under the action plan for this work in order to support the validation of the developed Technical Provision Document and Guidance Material.
- ❖ To achieve the early validation of the VTN concept.

Background

From the US perspective, the National Airspace System (NAS) Baseline Architecture identifies and plans for growth to a fully digital communications system. Efforts are currently ongoing within the FAA to develop digital voice interface standards and

implementation for inter-facility communications within US.

The US understands that for economic purposes and to enhance and modernize services, ICAO member states are currently taking steps to implement digital voice networks. For this reason, the US has interest in development of a standard for a digital Aeronautical VTN so that the US can assure compatibility of its Aeronautical VTN with the other member states.

The FAA recognizes that in the context of Transatlantic Air Traffic Control, NAVCanada is a vital player. A significant portion of voice traffic is routed via NAVCanada to Europe. NAVCanada’s concerns, participation and cooperation are required to develop and implement the oceanic communication gateway.

From the European perspective, a digital signaling specification has been developed. Trials are underway at the moment between EUROCONTROL sites. The work has been done within the framework of the European Harmonization and Integration Program (EATCHIP). The aim is to develop a digital European network for Air Traffic Management.

From EUROCONTROL’s point of view a common digital interface which is adopted by all ICAO regions is highly desirable.

Additionally in February 1998, the ICAO Secretariat proposed that a study group (AVSSSG) be established to update provisions related to air traffic services voice switching and signaling systems. The results of this cooperative work will be offered to ICAO in support of the AVSSSG.

Scope

The scope of this cooperative work has been segmented into three phases:

- Phase 1 – Compilation and documentation of operational functionalities particular to each participant country.
- Phase 2 – Agreement on a common protocol definition for signaling system, an addressing and numbering scheme, and the voice compression algorithm to be used.
- Phase 3 – Development of the Aeronautical VTN Technical Provision Document and Guidance

Material within the framework of international standards. Development of an interface control document to serve as a guideline to validate these documents

Status

Agreement has been reached to conduct an Oceanic Gateway project which will initially be a test bed ATS-QSIG (PSS1) network between FAA, EUROCONTROL, and NAVCanada nodes and should focus on technical trials and validation activities. This project and the results derived will support the promotion of an international digital signaling standard. In mid October 1998 NAVCanada hosted a coordination planning meeting in order to reach agreement on the way to move forward among all planned participants in the Oceanic Gateway.

CONCLUSION

The management and engineers of the FAA and EUROCONTROL are highly motivated to progress the eight tasks currently defined within the scope of the FAA/EUROCONTROL R&D Committee. This is evidenced in the fact that three of the eight task action plans have already been completed and extended to a second phase of cooperation within one year.

As a result of the relationships that have been developed through the FAA/EUROCONTROL R&D Committee and the notable effectiveness of the joint R&D work within its framework, the FAA and the EUROCONTROL Organization (including partners as well as associated European civil aviation universities and organizations) have engaged in the technical exchange of several research engineers. The FAA has hosted engineers from DFS (Germany), CENA (France), CIRA (Italy) and the EUROCONTROL Experimental Center (France) and has sponsored a one year assignment at the EUROCONTROL Experimental Center of a FAA TCAS expert to assist EUROCONTROL with the implementation of Airborne Collision Avoidance System (ACAS) and a six month assignment of a Fast-Time Simulation engineer. Additional technical exchanges continue to be introduced and several are in the planning stages.