ATN PROJECT

ATN IMPLEMENTATION TASK FORCE

ATN Administrative Structures and Institutional Issues

ATNP Ref. : EATMP/DIS/COM/ATNI-TF/DOC/51

Author : ATN Implementation Task Force

Rev. No. : Draft Issue 1.0

Date :11-Jun-99

Executive Summary

This report, produced by the EATMP ATN Implementation Task Force, identifies and proposes solutions to the institutional and administrative issues that need to be resolved in order to introduce the ATN into the operational European ATS communications infrastructure.

Overview and Approach

As a guiding principle the approach adopted by the Task Force was to build on previous work in the subject that had been conducted. At the ICAO level the initial work of the FANS II Committee and its subsequent processing by the ICAO ATN Panel in the area of institutional issues related to the ATN was taken into account. The European Commission has funded a number of studies which have addressed to varying degrees the institutional aspects related to ATN deployment, these being the CEC funded "COPICAT", "ACCESS" and last but not least the "ATN Institutional Issues" (ATNI2) studies. Account has also been taken of the ATN specific issues raised in EUROCONTROL's Study into the Institutional Issues related to use of the Aeronautical Mobile Satellite Service. The FAA draft guidelines supporting the certification of datalink-based systems and the recent report of the RTCA Task Force on Certification have also been taken into account. Joint FAA/Europe activities, i.e. the joint RTCA SC-189/Eurocae WG-53 committee developing guidelines for the safety assessment of data link based ATS environments and the "Common American European Reference ATN Facility" (CAERAF) project have also been considered.

Account was also taken of the FANS 1/A environment in the South Pacific and a number of issues/lessons learnt from that context have been found to be applicable in the context of the European ATN.

The Task Force also reviewed work in the area of GNSS at both the ICAO and European levels and identified a number of parallels in that environment that are equally applicable to the ATN environment, e.g. the proposal to establish a GNSS entity, the approach to liability determination.

Based on the existing work referred to above, the Task Force identified a number of issues that need to be resolved and, where possible, proposes resolutions to these issues in the form of recommendations. In some cases the proposed resolution is a solution to the problem, in other cases it proposes that further study be carried out by groups of dedicated experts.

Key Findings

The results of the recent European Commission funded ATN Institutional Issues ("ATNI2") have provided a major step forward in the identification and resolution of institutional, financial and administrative issues concerned with ATN service provision, specifically for the longer term, i.e. post 2010.

However, in the near term, i.e. the 2000 – 2010 timeframe, encompassing the foreseen Link2000+ timeframe, the regulatory environment is expected to comprise a disjoint set of resolutions, recommendations and requirements on service providers that are considered essential to facilitate the introduction of the service. The types of issues that are to be resolved include the approaches to safety assessment, certification, service level agreements, liability, support of AOC, use of air/ground service providers and financial arrangements such as funding and billing mechanisms. A number of issues, e.g. co-ordination of the regional deployment, development of regional safety assessments, regional infrastructure management will need to be handled at a regional level. Assignment of these types of responsibilities to a service provider independent entity, as in the case of the proposed "GNSS Entity", is considered to be the optimal means of achieving them. Such an entity has been referred to by the Task Force as the "European ATN Co-ordinating Entity" (EACE).

In the longer term, i.e. the Target Framework (2010 onwards) the Task Force agrees with the recommendations of the ATNI2 study whereby the regulatory environment be defined in the context of a single Regulatory Framework that encompasses all issues involved in the provision of the ATN service. This environment would include a "Regulator" to whom service providers will need to demonstrate their compliance with the applicable provisions of the Regulatory Framework. The provision of "common services" would be assigned by, what is referred to by the ATNI2 study as the European ATN Administrator (EATNA). The EATNA being a body which is funded by stakeholders and whose membership comprises these stakeholders. The EATNA would jointly agree the requirements for the common services and contract an independent entity (i.e. one with no vested interests in ATN service provision) to provide these common services.

Recommendations

This report concludes with a total of 17 specific recommendations that may be grouped and summarised as follows:

- **Institutional –** development of Safety Assessment, definition of data link Certification process and use of the CAERAF, definition of generic European Service Level Agreements (SLA), procedures for determination of Liability, support of Aeronautical Operational Control (AOC) communications, minimum performance, safety and interoperability requirements on air/ground service providers;

- **Organisational –** establishment of an ATN User forum**,** establishment of an European ATN Co-ordinating Entity (EACE);

- **Financial –** means to fund initial implementations, criteria for determining air/ground service usage charges**.**

- **Long Term** – supporting the recommendations of the ATNI2 study with respect to the development of a single Regulatory Framework that would ensure a fair and competitive service to all users and a level playing field between all service providers.

DOCUMENT CONTROL LOG

SECTION	DATE	REV. NO.	REASON FOR CHANGE OR REFERENCE TO CHANGE
ALL	11-Jun-99	Draft Issue 1.0	First Issue of Document following review at ATNI-TF/8, 27th – 28th May 1999.

DOCUMENT APPROVAL

AUTHORITY	NAME	SIGNATURE	DATE
ATN Implementation Task Force Chairman	H.J.Hof		
COM Team Chairman	E. Meyenberg		
Senior Director EATMP	W. Philipp		

TABLE OF CONTENTS

1. Introduction

The objective of this document is to identify and discuss the "administrative" and "institutional" and "financial" issues that must be addressed and resolved for an ATN compliant infrastructure to be:

- deployed in the EUR Region on an evolutionary basis and
- used as an integral component of the operational European ATM service.

1.1 Objectives

The objective of this report is, based on results of previous and current related activities, to identify, discuss and propose resolutions (where possible and feasible) to the administrative and institutional issues that need to be addressed for the initial implementation and operation of the ATN in Europe. Additionally, where considered necessary this report makes a number of recommendations to facilitate the resolution of those issues that cannot be solved within the context of the Task Force.

In developing this document the Task Force agreed a number of principles to guide its work in this area. These being:

- To define the "target" administrative and institutional environment within which the target ATN infrastructure will be deployed, operated and regulated;
- To focus on issues that require to be resolved in order to pave the way for initial ATN implementation and operational services (i.e. for Link2000+);
- To avoid "re-inventing the wheel" by analysing and adapting existing/proposed solutions from other domains within ATM (e.g. GNSS) and other telecommunications domains.

1.2 Scope

The scope of this document is restricted to addressing those issues that are specific to the deployment of the ATN components and applications covering airborne, air/ground and ground/ground aspects.

Institutional and administrative issues specific to the implementation, provision and management of the VDL, AMSS and Mode S air/ground subnetworks networks (e.g. frequency spectrum allocation) are outside the scope of this document.

Issues related to the transmission by the ATN of Aeronautical Passenger Communications (APC) and Aeronautical Administrative Communications (AAC) are also outside the direct scope of this document.

1.3 Structure of Document

Chapter 1 introduces this document and defines its scope, objectives and general principles that were adopted by the Task Force in its development.

Chapter 2 presents summary of all known related activities at the ICAO, Europe an US levels including the work of the FANS II Committee, the ATN Panel, the World-Wide CNS/ATM Implementation Conference, COPICAT study, the ATNI2 study, the ACCESS study, FAA Certification activities, RTCA/EUROCAE activities, FANS 1 experiences and GNSS. Attachment 1 provides further analysis and details of each of the initiatives identified.

Taking into account of the activities of related activities presented in Chapter 2, Chapter 3 discusses and presents recommendations related to institutional and administrative issue considered necessary for the introduction of the ATN in Europe. The Chapter considers these issues in two time frames, i.e. Interim Framework (2000 – 2010) and Target Framework (2010 – onwards).

Chapter 4, again taking into account results and recommendations of related activities in Chapter 2, discusses and presents recommendations on the financial arrangements considered necessary for the introduction of the ATN in Europe.

Chapter 5 presents a summary of the overall results and conclusions of the Task Force.

1.4 Why are these Issues Important ?

1.4.1 Context

The standardisation and validation of the ICAO SARPs for the ATN has been completed. Pre-operational trials (e.g. ADS Europe) have been completed and more are underway (e.g. PETAL IIe). However, in order for an ATN based datalink infrastructure to be introduced into the operational ATS environment there are a number of institutional, organisational and financial issues that must be addressed and resolved.

The technical infrastructure required to support the operational ATN communications service may be expected to comprise of a diverse set of components that may be owned/operated by multiple users and/or service providers:

- multiple ground/ground networks (e.g. X.25 links, LANS)
- multiple air/ground networks (e.g. VDL, AMSS)
- multiple airborne systems (e.g. FMS/CMUs)
- multiple ground host computer systems (e.g. FDPS, Airline AOC Hosts)
- a network/systems management function

The ground/ground networks may either be owned or leased by numerous ATSOs, AOs or communication service providers. The air/ground networks may be owned and operated by multiple service providers. The airborne and ground systems operated by the ATSOs, Airline Hosts and avionics are likely to be sourced from multiple suppliers.

The entire infrastructure will span international boundaries. Users (ATSOs, AOs) may need to depend on infrastructure not directly under their control (e.g. VDL stations in adjacent States) for the provision of their ATM service under certain conditions.

Certain elements of the infrastructure will need to be common to the entire set of infrastructure, e.g. the ATN backbone/Route Servers and Network/Systems Management.

The infrastructure may support both safety (ATS, AOC) and non-safety critical (AAC) type communications. This implies that it has to be assured that high priority safety critical communications are treated as such by the underlying architecture.

It may be necessary to introduce region wide software/hardware changes into the infrastructure to resolve identified faults or to introduce service enhancements.

It can be deduced from the above, that due to the complex, diverse, multi-national, multi-provider, multi-user and safety critical nature of the ATN, many issues beyond the technical

aspects that have been mostly addressed to date, will need to be addressed and resolved to enable the introduction of the ATN into the operational ATM environment.

1.4.2 Institutional Aspects

At the institutional level it will be necessary to address issues such as Safety Assessments, certification, liability and specification of service level agreements and promotion of competitive service provision.

The objective of the Safety Assessment will be to identify the safety objectives and requirements that need to be satisfied by the ATN as a whole, i.e. including systems, people and procedures. Due to the distributed nature of the ATN the Safety Assessment will need to be co-ordinated at the regional level in co-ordination with the safety regulation institutions of the participating States.

Being a distributed environment comprising elements from multiple suppliers (e.g. Routers from communications service providers, ATSOs, Airlines) how can it be assured that any new element introduced into the network will have no diverse effect on the operational network and will be capable of performing its intended function ? This point relates directly to the issue of certification and to what extent each of the elements in the end-to-end chain need to be certified. The validity of the current certification/operational approval process needs to be reviewed to take into account the characteristics of ATN datalink based systems. The need for “end-to-end” certification of each element in the path needs to be considered.

The issue of liability determination and its limits needs to be reviewed and resolved. The ATN will be a distributed infrastructure whose correct operation will depend upon the correct operation of these constituent elements. There may be situations where an ATS provider relies on the ATN infrastructure of an adjacent ATS provider to deliver its ATS. The issue of liability determination is not clear in the event of an air traffic incident due to a failure in the adjacent ATS providers’ infrastructure.

It is necessary to establish a means by which ATN communications service providers (ATS providers and commercial communications providers) should be contracted in a common manner across the region, i.e. through standardised Service Level Agreements.

An important institutional issue is to ensure avoidance of monopolistic situations whereby one or two communication service providers corner the market (and therefore dictate tariffs), i.e. it is essential to ensure competitive service provision and value for money.

1.4.3 Organisational Aspects

At the organisational level it is necessary to address issues such as overall regional project management of the infrastructure roll out. Negotiation of collective communications service provision contracts on behalf of participating ATSOs to ensure optimal arrangements. The establishment of an ATN Users Forum that will provide a platform for all players in the ATN to exchange information related to performance, faults, future enhancements etc. Overall co-ordination of the regional safety assessment needs to be organised in collaboration with safety institutions from the participating ATSOs. Consideration for the need to establish a regional accounting service will be necessary so as to avoid inefficient situations such as multiple billing for individual ATN service segments. The assignment and tracking of ATN addresses will need to be managed. Capacity planning of the infrastructure to meet forecast traffic demands will be an important organisational activity. Equally, configuration management of the regional infrastructure, provision of testing services and provision of regional network management services are organisational services that will be critical to the correct operation of the ATN.

1.4.4 Financial Aspects

At the financial level it is important to investigate potential methods and incentives to promote ATN implementation, e.g. use of public funds. Charging/billing criteria for air/ground services for ATS needs to be defined, e.g. charges based on usage or flat rate.

For the types of issues introduced above it is essential that the appropriate resolutions are in place well in advance of planned operational in-service dates so as to ensure the smooth and timely introduction of the ATN infrastructure. Delaying resolution of these types of issues will run the risk of delaying operational use of the infrastructure even if it has been deployed and is ready for use.

1.4.5 Summary

In summary, there is a number of significant issues that must be resolved in order to pave the way for the deployment and use of ATN based services in the operational ATS environment. The purpose of this report is to review these issues and, where feasible recommend appropriate courses of action.

The "**Institutional, Organisational and Financial**" environment in which solutions to these types of issues are resolved can be viewed as:

- That which will exist in the long term (i.e. 2010 onwards), i.e. the "**Target Framework**" as described in section 3.2 and

- That which will need to exist and evolve with the initial implementation (i.e. 2000 – 2010), i.e. the "**Interim Framework**" as described in section 3.1.

2. Related Studies/Initiatives

Whilst the majority of effort to date has been focused on the definition and validation of the technical aspects of the ATN there has only been a limited number of initiatives that have addressed the non-technical issues related to ATN implementation and operation. The most recent and applicable of which in the European context is the CEC sponsored "ATN Institutional Issues" ("ATNI2") Study which has produced two deliverables:

- Scenarios for the ATN: Non-Technical Implementation Issues [68] &

- The Introduction of ATN in Europe: A Regulatory Framework [89].

- Other initiatives and studies that have addressed the institutional and administrative aspects of CNS/ATM deployment include:

    - The work of the ICAO FANS II/4 Committee [69], which established a group to identify issues requiring global co-ordination for the operational deployment of the ATN. The Committee additionally endorsed a set of institutional guidelines and scenarios related to ATN implementation.

    - The ICAO Global Air Navigation Plan for CNS/ATM Systems [90], [91];

    - The work of the ICAO ATN Panel [80] which, inter alia, was tasked identify and propose solutions to institutional and administrative issues that face ATN deployment;

    - The "Rio" Global CNS/ATM Systems Implementation Conference [79] whose primary objective was to address the financial, economic and institutional issues facing CNS/ATM deployment;

- The CEC "COPICAT" Study [86] which contributed to the economic assessments and the organisational arrangements necessary for ATN deployment;

- The ACCESS Study which had Work Packages dedicated to issues surrounding the provision of ATN services by third party communications service providers [78] and Institutional Issues in general [121];

- The EATCHIP Ground/Ground Communications Network Service Management Task Force ([86], [87], [88], [116], [117]) which , inter alia, has been developing an agreement for the interconnection of ATSO networks, referred to as the "Interconnection Agreement";

- The EUROCONTROL Satellite Communications and GES Institutional Issues Study [76] and [77] which predominantly focused in issues related to GES deployment but additionally reviewed issues related to ATN deployment;

- The FAA Advisory Circular, Guidelines for the Approval of Aircraft Data Communications Systems [84], is intended to support the introduction of data communications applications for air traffic services;

- The FAA Advisory Circular, Initial Air Carrier Operational Approval for use of Digital Communications Systems [106], is intended to provide guidance on acceptable means for the "operational approval" to use digital communications systems for ATS;

- The RTCA SC-189/EUROCAE WG 53 is producing material to support CNS/ATM Safety Assessments ([81], [109], [110], [111], [112], [113], [114], [115]). The material addresses issues related to the institutional aspects of safety assessments and continued operational safety;

- ATN Systems Inc. have developed a Certification Approach [93] which defines the process for obtaining FAA approval for ATNSI products including the means by which ATNSI will show that the ATNSI products comply with FAA airworthiness requirements.

- The RTCA has convened a "Certification for CNS/ATM" Task Force whose objective is to "review the "certification" process employed "end-to-end" for advanced aviation systems. At the time of writing a draft report [105] of the Certification Task Force was available.

- The US Office of Inspector General (OIG) recently published its findings and recommendations following an audit of the FAA's progress and plans for the implementation of ATS data link [96].

In addition to the above work on ATN issues there has been a significant amount of work in ICAO, CEC and EUROCONTROL in the area of GNSS related administrative and institutional issues [73], [74], [75], [82] and [83]. The prime reason for the significant amount of attention on this subject is due to its reliance on the GPS and GLOSSNASS systems which are owned and operated by the US and Russian Federation governments respectively. However, many of the issues that have been identified are equally applicable in the provision of the global ATN service and the references have been analysed for applicable material and lessons that can be learnt from the GNSS community.

In addition to the above there are a number of relevant lessons of an administrative and institutional nature that have been gained from FANS 1/A operations in the South Pacific. These are documented in the Fans Interoperability Team (FIT) Report [92] and have been highlighted in this report.

In order to avoid unnecessary duplication of effort, the Task Force adopted the strategy to analyse and review the results of the above referenced studies in order to learn from and build on them. Due to its nature it has been widely accepted that ATN implementation will be evolutionary and will expand depending on accrued benefits. ATN implementation is expected to evolve from initially local implementations and/or the areas covered by pre-operational trials (e.g. PETAL II extension) to eventually cover the entire European region. The TF recognised the need to focus its attention on those administrative and institutional issues that require to be addressed and resolved for the initial implementation of the ATN and its use in the operational ATM environment. All recommendations in this report for future lines of action are focused on supporting and enabling initial implementation.

Attachment 1 provides an in-depth presentation of each of the objectives and conclusions, where applicable, of the related initiatives identified above.

3. Institutional and Administrative Structures for the ATN

Previous sections of this report and Attachment 1 have:

- highlighted the critical importance of resolving the key institutional and administrative issues to ensure the smooth and timely introduction of the ATN into the operational ATS service;

- introduced all known related studies that have previously addressed or have been related to these issues including those that have arisen in the FANS 1/A South Pacific environment;

- introduced the GNSS world to identify lessons that may be learnt from that environment which has many parallels to the ATN.

This objective of this section is to present and discuss of the specific issues that need to be addressed for the introduction of the ATN into the operational European ATS environment taking into account the previous sections of the report.

The Task Force endorses the need for an European “Regulatory Framework” for the ATN as recommended by the ATNI2 Study [89] as summarised in Attachment 1. However, it is recognised that process to establish such a framework is complex, political and therefore likely to take some considerable time to implement if accepted. Clearly ATN implementation cannot wait for such a framework to be in place. Section 3.1 discusses the specific points that need to be resolved for initial ATN deployment.

The Administrative and Institutional environment may therefore be classified as:

- Short/medium term, i.e. 2000 – 2010 time-frame, hereafter referred to as the “**Interim Framework**” and the

- Long term, i.e. 2010 onwards, hereafter referred to as the “**Target Framework**”.

3.1 Interim Framework

As indicated above this section identifies those issues that need to be resolved in the short term (2000 – 2010) to facilitate and enable the introduction of the ATN into the operational European ATS environment, and to ensure a clear path towards the Target Framework that is expected to exist post 2010. Given the operational context, the extent and type of ATN services foreseen to be deployed by the European ATN Implementation Plan [123] and ACCESS [124] it is clear that resolutions to a number of institutional, administrative and financial issues must be agreed.

3.1.1 Institutional Issues

The following sub-sections discuss the issues and possible resolutions to the following issues that are considered relevant for the interim framework:

- Regional Safety Assessment;
- Certification;
- Service Level Agreements;
- Liability;
- Support of AOC Communications;
- Use of Air/Ground communications service providers.

3.1.1.1 Regional Safety Assessment

As presented in Attachment 1 the joint RTCA SC-189/Euroce WG53 committee is currently developing guidance material to address the safety and inter-operability aspects of CNS/ATM systems. Specifically the committee is developing guidance related to conducting "Safety Assessments" of CNS/ATM environments, this process resulting in safety objectives and requirements to be satisfied by the various elements of the CNS/ATM environment. These safety objectives and requirements to be satisfied by an operational CNS/ATM system will result are subsequently allocated to parts of the system, procedures or airspace characteristics.

Due to the distributed nature of CNS/ATM systems, the Safety Assessment described in ([81], [109], [110], [111], [112], [113], [114], [115]) requires an assessment of the entire airspace system and is applicable to all elements of the operational environment including CNS services, ATM services, systems and procedures. The Safety Assessment is based on a description of the operational environment, referred to as the "Operational Environment Definition" (OED). The OED is a description of the total operational environment in which the CNS/ATM system will be deployed, will provide the basis for an assessment of failures, procedural errors and airspace characteristics from which to determine risk mitigation strategies that will be capable of protecting against identified hazards. An "Operational Environment" template [115] to facilitate the common definition of OEDs has been developed.

The CNS/ATM safety assessment spans from system planning, through development, to continued operational capability and is applicable to the entire CNS/ATM system and associated procedures that may span national boundaries.

The CNS/ATM safety assessment comprises:

- **Operational Safety Assessment (OSA)** – which establishes, validates and allocates the safety objectives and requirements through a co-operative effort from all the institutions[1] that control each of the elements of the operational environment. The OSA provides the basis for the safety assessment activities conducted by each of the institutions that control the development of the elements that comprise the operational environment. The OSA is separate from each of the institutional safety assessments in order to determine

[1] "Institutions" includes airspace planners, CNS/ATM system developers, ATS Providers, Communications Service Providers, flight crews, airline operations and State authorities responsible for the regulation, certification, approval and/or commissioning of any element of the CNS/ATM system, procedures or airspace.

the common safety objectives and requirements that require multi-institutional co-ordination;

- **Institutional Safety Assessments** – which ensure that the elements (and their development means and methods) of the operational environment satisfy the allocated safety objectives and requirements;

- **Operational Capability** – at entry into service is assured when all of the safety objectives and requirements have been assessed in the institutional safety assessments;

- **Continued Operational Safety** – ensuring that safety objectives and requirements are maintained throughout the systems service life. Activities such as operational monitoring and data collection should be initiated at entry into service. The OED and the OSA will provide the basis for determining the monitoring requirements and assessing the effects of any changes that may be introduced into the operational environment.

- **Co-ordination** – Co-ordination between planners, developers, implementers and users across all elements of the system facilitates the validation of safety objectives and requirements.

The results of the OSA, whose scope is determined by the OED, is to be endorsed by the system planners and implementers. The OSA includes two interrelated processes:

- **Operational Hazard Assessment (OHA)** – a qualitative assessment of the operational hazards associated with the OED. The OHA examines operational functions to identify and classify hazards (according to a scheme based on hazard severity) which may impair those functions. The OHA determines safety objectives and according to the hazard classification and determines related requirements.

- **Allocation of safety objectives and requirements** – this process allocates the safety objectives (high level requirements) and requirements to the various elements of the operational environment and identifies and validates the risk mitigation strategies that are shared across the involved institutions.

Given the multi-provider, supplier, user and distributed geographical scope of the ATN, it is clear that the regional Safety Assessment will need to be conducted by a central entity. Such an entity will need to co-ordinate the safety assessment process with each institution involved in the provision and use of the ATN service. The “European Co-ordinating Entity” as discussed in the COPICAT study [86] and further elaborated in section 3.1.2.2 would be an ideal candidate for undertaking such an activity.

Specifically, once the European ATN data link implementation plan (i.e. initial ATN infrastructure and operational services) has been defined, the central entity will, in accordance with the guidance developed by the joint RTCA/EUROCAE committee:

- Co-ordinate, with all institutions involved, the definition of the Operational Environment Definition (OED);

- Co-ordinate the execution of the Operational Safety Assessment (OSA) comprising the Operational Hazard Assessment (OHA) and allocation of safety objectives and requirements to the operational systems and procedures;

- Co-ordinate the “Institutional Safety Assessments” that are to be conducted by each institution addressing the elements of system and procedures under their jurisdiction;

- Co-ordinate the means and methods to assure the “Continued Operational Safety” of the system and procedures;

- Co-ordinate with all institutions to validate the safety objectives and requirements;

- Manage and co-ordinate changes introduced to the system through update of the OED and the OSA.

RECOMMENDATIONS:

Safety Assessment: Given the intended operational environment (i.e. location and type of data link services to be deployed) the Task Force recommends that a Safety Assessment, based on the guidance under development by the joint RTCA SC-189/Eurocae WG-53 committee is conducted in the context of the Link2000+ programme.

3.1.1.2 Certification

Traditionally only avionics have been subjected to a formal certification process. The means for operational approval of ground systems varies from ATS provider to ATS provider and is not subject to a formal certification process. The question is whether these current practices are suitable for data link based ATS services given that, in some respects, the ground and air/ground elements of the end-to-end service are as equally critical to message delivery as the avionics systems.

Whilst the current approach has proved satisfactory for the current infrastructure, its suitability to the ATN datalink environment needs to be re-visited. The ATN (end-to-end) communications service will be provided by a number of interconnected airborne and ground systems (Routers, End Systems) through a number of ground/ground and air/ground networks. It maybe argued that each element contributing to the end-to-end service is arguably equally critical in the delivery of ATS messages and should therefore be subject to uniform certification criteria.

As presented in Attachment 1 the current FAA "certification" approach for data link systems is:

- firstly "**design approval**" of aircraft data communications systems and applications based on guidance provided in the FAA's Advisory Circular [84];

- "**operational authorisation**" for commissioning ground or airborne segments of the end-to-end system based on guidance in the FAA's Advisory Circular [106].

It was the objective of the RTCA Certification Task Force to review and recommend improvements to the certification process in light of the advances in technology, i.e. CNS/ATM systems. The key recommendations to note, with respect to certification, from the draft report of the Certification Task Force are:

- **Recommendation 1**. An organisational focal point should be established by the authorities to provide *one stop service* to users, industry, and other governments in all matters related to advanced ground electronics and airborne avionics systems and related procedures. This function should have appropriate operational and technical expertise, and the authority and responsibility to develop and issue appropriate policy, certification, and related regulations and guidance materials

- **Recommendation 2**. The authorities should establish and maintain a systems engineering capability. This function should be used to establish overall performance requirements for all advanced systems and their subsystems, in conjunction with the user community. As part of this effort, the authorities should consider developing clear approval standards and processes for ground system elements that are integrated, to the degree necessary, with airborne system element certification.

- **Recommendation 4**. The importance of human performance considerations should be recognised by both the authorities and industry in reducing certification costs and improving the safety of the INAS. They should do so by introducing processes and written guidance that institutionalises *earlier* and *better* consideration of human

performance. This should be accomplished by providing certification credit for human performance where possible and by requiring consideration of human performance in accordance with specific standards for the certification of equipment, people, and procedures in advanced airborne and ground-based systems.

- **Recommendation 5.** The authorities should broadly implement a process where the regulators and applicants come to an early and clear agreement on their respective roles, responsibilities, expectations, schedules, and standards to be used in certification projects. The process should apply broadly across airborne and ground systems, allow non-applicant equipment suppliers to engage in certification programs, and provide greater opportunity to approve components or processes independent of the airplane.

- **Recommendation 7**. The early deployment of advanced systems should be encouraged by the authorities. This initiative would assure that prompt in-service experience can be obtained more quickly and incorporated into production systems. Improved feedback mechanisms would also assure that positive and negative experiences (especially human performance considerations) with operational systems and procedures are documented and analysed for future system *credit*, or for corrections to be applied based on lessons learned.

- **Recommendation 9**. The authorities should work with the rest of the aviation community to develop, co-ordinate, and apply a commonly agreed-upon concept of operations, including the development and application of certification policies.

Whilst it is recognised that the above recommendations are subject to approval of an international co-ordination process it is important to ensure that the approach proposed to support the certification of the ATN in Europe is consistent with these recommendations.

For the initial implementation of the ATN, within the context of the FAA's CPDLC programme, ATN Systems Inc. has defined a process and means [93] that it intends to follow in order to obtain FAA airworthiness approval for ATNSI products. Key aspects of the approach include:

- a Safety Assessment based on RTCA SC-189/EUROCAE WG53 guidance including the definition of an OED for the US domestic en route airspace.

- adoption of RTCA Doc 178B Level C as the basis of the product development;

- development of an independent Conformance Test Suite (CTS) as a means to test the ATN products;

- the involvement of FAA certification officials throughout the project.

- an ATNSI/FAA in-service operational evaluation (including trained pilots and controllers) of ATNSI products using various supporting ground infrastructure.

The issue then is to discuss the approach for certification that should be adopted in the European environment for the initial ATN Datalink implementation. The Task Force considers that it is essential that each element, at the level of subnetwork, router, end system and communications services, in the "end-to-end" chain[2] that contributes to the ATN communications service be subject to a "process" that verifies at least the following:

[2] A typical "end-to-end chain" would comprise the avionics end system, avionics subnetwork equipment, the air/ground subnetworks, the ground/ground subnetworks and the ground end systems (e.g. FDPS).

- all safety objectives and requirements allocated to the element in question have been satisfied as applicable through the design, development, commissioning and operational phases;

- that the introduction of the element and the element itself has no detrimental effect on the operational ATN service;

- that the element is compliant with all applicable technical provisions (e.g. ICAO SARPs compliance) and is capable of inter-operating with peer elements;

- that the element complies with its performance requirements and therefore, when introduced, will not compromise the required performance of the end-to-end system.

This approach is consistent with Recommendation 2 of the RTCA Certification Task Force. The results of this process may, in the long term, contribute to the issuance of a "certificate" confirming compliance of the element. This approach is consistent with that currently used for certifying avionics systems and could, in theory, readily be extended to ground systems such as FDPS in the future. The question of "certifying" communications service provider networks/services is one that requires further study as a longer-term issue but is one that has been recommended by ACCESS[3] [124].

It is with the above objectives of the in mind that the CAERAF has been specified. The CAERAF system will be capable of both supporting both laboratory testing and pre-operational evaluations involving real ground/ground networks, air/ground networks and real flights. The CAERAF is scheduled to be available by end 2000. The Task Force has noted that it will be necessary for the creation (by industry or otherwise) of a laboratory that offers comprehensive ATN testing services based on the CAERAF and that it be recognised/accredited by the approval/certification bodies. The availability of the CAERAF is consistent with t he first recommendation of the RTCA Certification Task Force which recommended the establishment of an organisational focal point providing a "one stop service" to users and suppliers on all matters related to ATN system, equipment and service testing.

Taking the above points into consideration it is considered that, for the initial deployment of the ATN in Europe, a "third party independent verification" process is formalised with the objective of assessing the capability of each element involved in the delivery of the end-to-end ATN communications service. Furthermore it is considered that the necessary steps be taken to ensure the establishment of a testing laboratory, independent of any regulatory function, offering testing services based on the CAERAF within the required timeframe for initial implementations.

RECOMMENDATIONS

Certification (1) – The Task Force recommends that each element in the "end-to-end" chain (at the component level, i.e. End System, subnetwork, Router) be subject to a process that verifies the ability of the component to fulfil its intended functions. *Note. - This process may later be formalised as the basis of the certification process for datalink based systems.*

Certification (2) – The Task Force recommends that the Common American European Reference (CAERAF) system, currently under development in collaboration with the FAA certification office, be promoted as the facility against which ATN compliant products and services are tested in order to gain certification credits.

[3] The ACCESS definition of the term "certification" when applied to ground based systems implies the formal approval, by the safety regulator, for the operational use of the ground based system.

Certification (3) – The Task Force recommends that the necessary steps are taken to ensure that a testing laboratory based on CAERAF services is established within the time frame required to support the testing of initial implementations, i.e. local implementation initiatives and Link 2000+ products and services.

3.1.1.3 Service Level Agreements

The overall ATN service in Europe is likely to be based on elements of infrastructure owned/contracted by a number of ATS providers, airlines and aeronautical communications service providers. In order to ensure availability of the regional ATN service each party needs to commit to ensuring its element of infrastructure complies with a minimal set of performance requirements.

All parties (e.g. ATS providers, Airlines) that own ATN infrastructure that is a component of the overall ATN service need to agree to binding agreements, (i.e. Service Level Agreements) defining requirements such as Availability, Reliability of their element of the service in order to ensure the overall ATN Service remains available. The net result of this process will be a "service delivery chain" that binds each participant in the chain to the requirements of its specific Service Level Agreement. A similar concept of service definition has been adopted in the GNSS world as presented in Attachment 1.

In practical terms the initial European ATN service will be comprised of service segments from:

- A number of ATS providers (e.g. States A, B and C);
- A number of Communications Service Providers (e.g. CSPs 1, 2 and 3).

In such an environment there are expected to exist service "boundaries" between:

- ATS Provider/ATS Provider – e.g. whereby an ATS provider provides transit service access to a back-up AMSS network and/or acts as a transit routing domain by offering back up alternative routes to a CSPs network;
- ATS Provider/Communications Service Provider – e.g. whereby a Communications Service provider provides the ATS Provider with a VDL service.

The means by which the level of service is specified, monitored and maintained are issues that will need to be solved for the initial ATN deployment. In general, the "Service Level Agreement" (SLA) is becoming the standard means by which services, such as telecommunications, are being agreed between users and suppliers and form the basis of contracts between parties. In the aeronautical telecommunications environment the SLA stipulate factors such as the required performance, reliability, monitoring, route advertisement and reporting requirements. The ACCESS project has conducted an in-depth study [78] into the issues surrounding the third party service provision of elements of the ATN communications service and recommends a comprehensive list of issues that ATN SLAs need to address. The study further recommended that the European Commission facilitate the establishment of a group of representative ATSOs, Communications Service Providers and airlines whose objective would be to develop a model SLA applicable to the European region that individual users (e.g. ATSOs) may use as a basis for their individual contracts.

Following the contracting of a service provider based on an SLA it is clearly necessary to have the ability to ensure that the service contracted is actually that which is being provided. The SLA should define the means by which the user can be assured the required service is being delivered. For example, the user may require the service provider to provide access points to the service provider's infrastructure from where the user is himself able to monitor in real time the service being delivered. The SLA will also need to define the procedures to be adopted in the event that the service provider continually fails to deliver the contracted service.

The main SLA issues identified by ACCESS [78] are:

- **Performance/Quality of Service Requirements**: It needs to be ensured that the performance/QoS requirements placed on the communications service are sufficient to meet its objectives, i.e. delivery of operational services and associated benefits. Where appropriate, these requirements should be defined in the context of maximum numbers of ground based and airborne users simultaneously using the system. The parameters to be used as the basis for defining the system performance/QoS requirements include Availability, Reliability, Integrity, Continuity, Throughput, Transit Delay, Maximum service outage, Geographical/Volume coverage**;**

- **SLA Performance Indicators**: Based on the performance/QoS requirements defined in the SLA, the SLA should identify a set of "Performance Indicators" which are used by both parties as part of the assessment to ensure that the SLA is being satisfied;

- **Minimum Performance Requirements for AMSS and VDL Service Providers**: It is expected that the airlines will determine which AMSS and/or VDL service provider they will use of AOC and therefore ATS communications. The ATSOs should publish a set of "minimum performance requirements" for the satellite service providers who, as a minimum, must be satisfied by any provider proposed by an airline, or otherwise, to be used for ATS communications.

- **Service Communications Profile**: The SLA should define a communications profile for the service being contracted which must tie down all options and recommendations defined in the applicable ATN and industry standards, e.g. use of Fast Select.

- **Service Access/Interconnection Requirements**: The SLA should define the physical means by which to access the communications service.

- **Certification**: The SLA should (1) require that the service offered has been "certified" and (2) that any changes to the infrastructure enabling the provision of the service require that it be re-certified based on an accordingly updated safety case. This certification is expected to be based on current practices whereby the applicant develops a safety case for the system in question.

- **Performance/QoS Monitoring**: The SLA should define the requirements on the CSP to monitor the performance of the service in real time. The methods and means by which the service will be monitored should be defined. In the case of AMSS this should include the monitoring of the GES operation. For initial operations and in order to acquire confidence in the service, users should consider the need for themselves to monitor the performance of the communications service.

- **Problem Reporting and Resolution**: The SLA should define the procedures to be followed in the event there are problems identified in the service either as a result of the performance monitoring function or feedback received from the service users. These should include a requirement on the Third Party CSP to immediately initiate actions to resolve the problem.

- **Infrastructure Enhancements**: Both the ADS Europe trial [108] and FANS 1/A [92] operations suffered from a degraded communications service as a result of the software upgrade introduced into the GES. These experiences highlight and reinforce the need for well defined and end User accepted procedures for:

    - Notifying all parties involved in the provision of elements of the end-to-end chain and users of (1) the type of change to be introduced, (2) the benefits of the change, (3) the date on which the change is to be introduced into the operational system and (4) the procedures to be followed in the event there is an adverse effect on the performance of the system following introduction of the change;

- Prior to operational introduction the testing of the change in an "off-line" environment (e.g. CAERAF) to ensure that (1) the system operates as specified and (2) there is no adverse affect on the communications service;

- Managing the introduction of changes into the infrastructure, e.g. in the case of AMSS the order of GES upgrades;

- Following introduction of the change into the operational system the testing of it and monitoring of the communications service to ensure its correct operation;

- The means to "roll-back" to previous versions of the infrastructure in the event of system malfunction and/or performance degradation following the introduction of a change.

- **Configuration Management**: As identified in both the FANS 1/A and ADS Europe environment it is essential to implement an effective configuration management system for all elements of the end-to-end chain. The SLA should define a requirement for the TPCSP to implement a configuration management system, which should, as a minimum, be capable of archiving all versions of the system so that it may be possible to roll back to any previous version if required. The configuration management system should additionally include all standards, design, development and test documentation that defines the functionality of the system.

- **Liability**: The SLA will clearly need to address the subject of liability and the extent, in financial terms, the TPCSP would be liable for in the event that it was demonstrated that it (i.e. the CSP) was negligent in providing the required communications service as specified in the SLA.

- **Charging Mechanism**: The SLA needs to define the methods and means by which the user will be charged for communications services used.

- **Billing**: The SLA needs to define issues related to billing in terms of frequency, breakdown of costs, information to be provided etc.

- **Help Desk**: The SLA should include a requirement whereby there is a continuous (24 hours a day, 365 days a year) help desk service available manned by experienced personnel.

It is recommended that a generic SLA (covering non commercial common issues) for European ATN services (covering both ATS Provider/ATS Provider and ATS Provider/Communications Service Provider relationships) is developed taking account of input from representative ATSOs, Communications Service Providers and Airlines.

RECOMMENDATIONS

Service Level Agreements (1) – The Task Force recommends that all entities, (whether they be commercial communications service providers, ATS providers or airlines), involved in the provision of any element of the ATN service are bound by a "Service Level Agreement" (SLA) that defines the service to be provided and their obligations in ensuring its continuous provision.

Service Level Agreements (2) – The Task Force recommends that in order to ensure uniformity of service, the development of a generic Service Level Agreement, covering non-commercial common issues for European ATN services, is assigned to a body comprising representation from the responsible personnel from representative ATS providers, communications service providers and airlines.

3.1.1.4 Liability

The resolution of the liability determination and limits issue has been considered as a major item necessary for the introduction of CNS/ATM. In addressing this issue one has to question what are the key differences between the current infrastructures and those that will exist in the future CNS/ATM environment.

For the communications element the main difference lies in the fact that in the current environment States typically own and operate all infrastructure that is required to deliver the operational Air Traffic Service. In the future environment States will need to rely on elements of infrastructure that belong to third parties (i.e. commercial communications service providers, ATS providers, airlines) in delivering an datalink based ATS service.

So the question then becomes how to determine liability in the event of an air traffic incident due to a failure in the distributed communications infrastructure. Assuming that all players contributing to the end-to-end service are bound by a Service Level Agreement based on the lines described in section 3.1.1.3 it should be possible to localise the segment of the chain that initially malfunctioned and was therefore the root cause of the incident. Once the fault has been localised it is clear that the party liable will be that which is responsible for providing that element of the end-to-end chain. This is the interim approach that has been adopted in the GNSS community as presented in Attachment 1.

The types of initial topologies foreseen for ATN deployment in Europe are expected to comprise:

- A limited number of ground/ground networks owned an operated by a number of ATSOs and communications service providers;
- Limited number of Back-bone and/or Route Servers;
- VDL Mode 2 air/ground networks operated by at least ARINC and SITA;
- AMSS air/ground network services offered by anyone of the three Satellite Service Providers (Satellite Aircom, Skyphone or Skyways Alliance)**.**

A scenario of where liability issue may arise is as follows. Assume that State “A” provides a data link service that relies on the correct functioning of an ATN Router in an adjacent State “B”. The situation may arise whereby State “A” is unable to communicate via data link with an aircraft under its control as a result of a malfunction of the Router in State “B”, e.g. whereby the State “B” router incorrectly advertises a route to the aircraft. Such a scenario may lead to an air traffic incident for which the determination of liability is not 100% clear in the event there are no or ill defined service contracts between States A and B. This example points to the need for all users to conclude appropriate service level contracts with ALL their providers (e.g. commercial service providers and ATSOs alike) which define precise service level clauses (e.g. advertisement of valid routes).

It is clearly inefficient from a management, administrative and consistency aspect for such service level contracts to be negotiated individually and between all users and service providers. The EACE as addressed in section 3.1.2.2 would be an ideal body to facilitate the drafting of service level contracts to ensure a consistent approach throughout the region.

The question then becomes the determination of the financial extent to which a service provider would be liable. According to the ATNI2 Study [89], and various European Directives referred to from that study, it is illegal for a service provider to limit its liability in cases where there is risk to bodily injury. Therefore a service provider is liable for potentially unlimited financial compensation in the event that it is proved it is liable for an air traffic incident.

However, it is unlikely that any service provider is willing to expose itself to such a risk and will seek to minimise its exposure by arranging insurance for itself. The insurance company,

however, is also unlikely to accept unlimited financial expose and will impose a "guarantee ceiling" which limits the amount to which it is exposed. Consequently there will be a shortfall between the unlimited financial exposure and the guarantee ceiling imposed by the insurance company. The ATNI2 Study [89] discusses this issue in depth and concluded that consideration be given to the establishment of a "Complementary Guarantee Fund" that will be required to satisfy claims beyond the guarantee ceiling. Such a fund is recommended to be funded 50% by the insurers and 50% by the service providers.

Whilst the Task Force appreciate the ultimate need for such a fund it is considered as a longer-term objective. When looking for near term solutions the Task Force investigated the approach adopted in the FANS 1 South Pacific operations but was unable to determine the approach to liability determination and limits due to the lack and confidentiality of information. If addressed, these issues are expected to be the subject of private contracts between the communications service providers and their clients.

Given the fact that it is not legal to limit one's liability in an environment where there is risk to bodily injury and assuming that communications service providers are unwilling to accept unlimited liability there appears to be no clear solution. The Task Force considers that the subject is studied further by a team including legal representation from ATSOs, Airlines and CSPs.

Consideration of arrangements in the FANS 1 environment (if any), ATS services based on ACARS and liability arrangements that ATS providers may have with ground/ground service providers for transmission of their safety critical ATS related traffic are taken into account.

RECOMMENDATIONS

Liability (1) – The Task Force recommends that the approach to liability determination is based on that adopted in the GNSS community, i.e. in the event of an incident to localise the segment of the end-to-end chain that was the root of the fault which would result in the identification of the liable service provider who was responsible for the operation of the faulty segment.

Liability (2) – The Task Force recommends that due to the fact that it is illegal for a service provider to limit its liability in environments where there is risk to bodily injury, and based on the assumption that service providers and their insurers are unlikely to be willing to accept unlimited liability, a group comprising the appropriate legal representation from the commercial service providers, ATS providers and airlines is established to develop proposals for solutions to this issue.

3.1.1.5 Support of AOC Communications

A key factor in the acceptance of the ATN by the airline community is due to its ability to handle AOC communications. In the context of the ACARS replacement (due to its foreseen inability to satisfy future AOC requirements) with VDL, a solution has been developed that introduces key elements of the ATN communications stack into the avionics. The ATNI2 study [89] summarised the situation by stating that there will be no ATN unless it supports AOC. A similar sentiment was expressed in the recommendations of the COPICAT Study [86].

In the mean time some ATSO's have stated concerns regarding the use of their private ATS networks to support AOC communications [89]. It is believed the foundation of these concerns relate to the impact of the AOC traffic on the overall quality of service of the ATS network and consequent impact on the ATS traffic. It is not essential to the operation of the ATN for these private ATSO networks to support transmission of AOC since this type of communications will typically be routed through CSP networks. However, the availability of private ATSO networks as secondary alternative routes for AOC communications is clearly desirable in order to increase the redundancy and consequent availability of the ATN service.

The Task Force supports the Agency's contract for the development of a Network Planning Tool [125] whose objective is to analyse and validate the various network designs proposed by ACCESS for the European ATN. It is understood that the study will develop realistic scenarios for both ATS and AOC communications traffic forecast to require ATN services. The Task Force recommends that the relevant ATSOs follow this study in order to acquire realistic estimates of the amount of traffic that their network could potentially handle. In addition to assessing traffic forecasts it may be necessary for ATSOs to consider additional issues such as competing with commercial service providers, liability issues and financial aspects (e.g. charging mechanisms).

RECOMMENDATIONS

Support of AOC – The Task Force recommends that ATS providers give due consideration to the issues involved in allowing their private ATS air/ground and ground/ground networks to transmit AOC traffic.

3.1.1.6 Air/Ground Service Providers

It is expected that airlines will, based on commercial reasons, contract one service provider or another for their air/ground AOC requirements. Assuming that AOC applications will be operational before ATS applications it is probable that the airlines will prefer (if not insist) on utilising their AOC service provider for ATS communications. The issue is whether such a situation is acceptable to the ATS providers. A major implication is that ATS providers will potentially need to arrange and manage service provision contracts with all service providers offering datalink coverage in their airspace.

The ATS provider essentially has two options. The first option is to accept the airline position and arrange service provision contracts with all service providers offering coverage in its airspace. However, for this option to be acceptable it will be necessary for all participating communications service providers to demonstrate compliance with a set of minimum safety, performance and inter-operability requirements.

The second option is for the ATSO to mandate a single service provider to be used for ATS data link in its airspace. Whilst this will simplify the work of the ATSO through only having to manage a single service provider, it is likely to be unpopular with the airlines who may have contracted another service provider for their AOC communications and such a mandate may have implications on their avionics fit. It is also likely to be unpopular with all those communications service providers not selected by the ATSO.

The TF considers that the first option will prevail and recommends that a set of "Minimum Performance, Safety and Inter-operability Requirements" for air/ground data communications services in support of ATS communications are developed and standardised for the European Region.

RECOMMENDATIONS

Air/Ground Service Providers –The Task Force recommends that a set of "Minimum Performance, Safety and Inter-operability Requirements" for air/ground data communications services in support of ATS communications are developed and standardised for the European Region.

3.1.2 Organisational Issues

The following sub-sections discuss the issues and possible resolutions to the following issues that are considered relevant for the interim framework:

- Establishment of an ATN User Forum
- Establishment of the European ATN Co-ordinating Entity (EACE)

3.1.2.1 ATN User Forum

Whilst users may be provided with performance information (as specified in the SLA) on the service provided by their contracted service provider, it would be desirable, if not essential, for users to be provided with performance statistics of the regional ATN as a whole. It is proposed that an "ATN User Forum" be established with this objective in mind. The forum would periodically collectively review performance of the system, analyse and discuss reported faults and resolutions. Most importantly, due to the wide membership of the forum, it will have the necessary "clout" to pressure communications service providers to resolve identified problems in a timely manner. In the context of the FANS 1/A operations in the South Pacific a " FANS Interoperability Team" and a "Central Reporting Agency" have been established to monitor FANS 1/A operations and performance. The CRA periodically collects and analyses fault reports which are disseminated to all users and providers in addition to publishing performance of the end-to-end system over pre-defined periods of time. So as to encourage the submission of fault reports all information reported by the CRA is de-identified prior to publication. The collective views of the CRA will exert greater pressure on the service providers to resolve reported problems.

It is considered that, once the initial ATN service is operational, a European "ATN User Forum" be established whereby users can jointly review, discuss and influence the performance of the contracted communications services, discuss identified problems and review proposed resolutions.

RECOMMENDATIONS

ATN User Forum – The Task Force recommends that based on the "FANS Interoperability Team" model adopted in the South Pacific in the context of FANS 1/A operations, an "ATN User Forum" is established following the introduction of the ATN into operational service.

3.1.2.2 European ATN Co-ordinating Entity (EACE)

How can it be assured that the ATN infrastructure provides and will continue to provide a guaranteed communications service that meets the operational requirements of the Air Traffic Service. As in the case of GNSS, it can be expected that a "contractual" chain needs to be established whereby each entity providing an element of the ATN communications service is bound by a contract (e.g. Service Level Agreement) that specifies the level of service required of them. In the GNSS world, due to the impracticability (i.e. in terms of administrative/management overhead and assurance of consistency) of all service providers to sign contracts with all potential users it has been decided to establish a "GNSS entity" in Europe. This entity will, inter alia, act as a focal point for overseeing the conclusion of service provision contracts with all suppliers to ensure a consistent level of regional service. The establishment of a similar body for the ATN, the "European ATN Co-ordinating Entity", as originally proposed by COPICAT [86], is considered essential for the timely and successful introduction of the ATN in Europe. The EACE, a common service provider organisation, would be responsible for issues such as provision of "common services" necessary for ATN operation, e.g. operations of Top Level backbone routers and/or Route Servers and management of the infrastructure at a regional level on whom the correct and efficient operation of the ATN will depend.

Consistent with the principle of separating service provision from regulation, the EACE will not be responsible for any aspect of regulation. It will, however, provide services (e.g. CAERAF based testing) that will contribute to cases made to safety regulatory bodies.

This section defines the scope, services and organisation of the European ATN Co-ordinating Entity (EACE) which, it is recommended be established in order to promote and, manage the implementation of the ATN in the EUR Region. The approach proposed here for the ATN can also be used for other Communication Infrastructure developments and has parallels with the proposed establishment of the GNSS Entity in terms of scope and responsibility.

Specifically the types of tasks and responsibilities that are suggested to be assigned to the EACE include as "core" (i.e. essential) tasks:

- **Regional Project Co-ordination** – overall co-ordination, monitoring and management of the regional implementation in accordance with the agreed implementation plan.

- **Common SLA Definition** – defining and maintaining common ATN SLA template to be used as basis for contracts between ATSOs and communications service providers.

- **Regional Network Management** - monitoring the performance (real time and off-line) of the overall regional ATN which will be enabled by the operation of a centralised European network management system infrastructure. The initial European ATN will be comprised of infrastructure elements that are owned/ operated or contracted to a third party by a number of ATSOs. It can be assumed that each ATSO will be responsible for managing his own element of the infrastructure. However, it needs to be determined whether this will be sufficient for managing the service at the regional level. Based on the reasonable assumption that it will not be sufficient the issue of a "European ATN Manager" who will be responsible for ensuring the European ATN service is maintained at the regional level needs to be addressed.

- **Escalation Procedures** – definition, management and oversight of escalation procedures in events of problems with service provision and/or mis-use.

- **Regional Safety Assessment** - Co-ordinating and maintaining the Safety Assessment including definition of the Operational Environment Definition, the Operational Safety Assessment and the Operational Hazard Analysis and overseeing the allocation of safety objectives and requirements to the various elements that comprise the European ATN. The activity will involve close liaison and collaboration with the safety regulatory bodies of the participating states.

- **ATN Address Allocation** – Maintaining central database of allocated ATN addresses. Each ground and airborne ATN system will be allocated an ATN address based on a convention defined in the ATN SARPs. Whilst the SARPs state that ICAO will be responsible for maintaining a record of assigned addresses it is proposed that such a role be undertaken by the EACE, in the context of the European implementation.

- **Regional Accounting Services** – providing "single point of billing" for communications service users (i.e. ATSOs or other communications service users), validating communications service provider invoices, maintaining billing statistics (i.e. invoicing users and paying service providers).

- **Capacity Planning** - continuous review of network dimensions to satisfy traffic demands. Ongoing analysis of forecast datalink traffic to ensure adequate and timely provision of additional network resources.

- **Regional Configuration Management** – configuration management of applicable documentation and software. Management of the introduction of infrastructure fixes or enhancements. In order to ensure continued operation of the infrastructure it will be necessary to maintain accurate configuration management records and archives of "baseline versions" of the operating environment so that it may be possible to roll back to pre-determined states in the event of catastrophic failures in the network service.

- **Operation of Top Level Backbone/Route Servers** – in order to operate as an efficient network (from a routing perspective) the ATN SARPs have defined the need for "ATN Backbones" and/or "Route Servers" whose functions are considered as "common" to the network as a whole. It is unlikely to be acceptable to the whole that any one ATSO or communications service provider takes on the provision of such a strategic and critical service. The EACE on the other hand, with its neutral status, is an ideal candidate for the provision of these types of services. It is therefore proposed that the EACE be

assigned the responsibility for the provision and operation of the European ATN Backbone/Route Servers.

- **Testing Services** - provision of CAERAF based testing services for ATN systems, equipment and communications services.

- **Help Desk** – provision of consultancy/advisory/training service to users, communications service suppliers on all matters related to ATN.

In addition to the above core services, the following list identifies areas that could optionally assigned to the EACE in the interests of efficiency:

- **Communications Service Contract Negotiation** – Negotiation of common communications service provision contracts on behalf of participating ATSOs.

- **Legal Services** – Provision of legal expertise to users (ATSOs, Airlines) specific to the aeronautical telecommunications environment.

- **ATN User Forums** – the EACE would provide the chair and secretariat for "ATN User Forum" meetings. The objective of these meetings would be to provide a platform for exchange of information (between the users (ATSOs, airlines) and communications service providers, the EACE and the safety regulators) on any issue involved in the use of the operational ATN service. Through the user forum the EACE will publish ATN service performance reports over periodical intervals, e.g. weekly. A similar entity to the User Forum, the "FANS Interoperability Team" [92] has been established in the context of the FANS 1/A operations in the South Pacific.

- **Common Equipment Specification and Procurement** – support development and acquisition of common ATN equipment, systems and communications service specifications on behalf of users.

- **External Co-ordination** – co-ordination with other administrations (e.g. FAA), international organisations (e.g. IATA, ICAO) on matters related to European ATN implementation, interconnection, performance, safety and inter-operability.

Consideration of the establishment of such an entity should include whether it is the responsibility of EUROCONTROL/EATMP or whether an independent entity be established.

Irrespective of whether the EACE is constituted inside or outside EUROCONTROL, it is further recommended that it reports to a body that comprises representatives from the stakeholder community (communications service providers, airlines, ATS providers). Such a body may be referred to as the an "EACE Management Council" (EMC). The EMC would oversee and direct the work of the EACE in order to ensure that it continually satisfies the common needs of the stakeholders.

RECOMMENDATIONS

European ATN Co-ordinating Entity – In order to co-ordinate the regional deployment of the European ATN and to undertake certain tasks that need to be undertaken at the regional level (as in the case of the proposed GNSS entity), the Task Force recommends that the appropriate steps are initiated for the creation of an independent entity, referred to in this document as the "European ATN Co-ordinating Entity". *Note. – The Task Force considers that the EACE will be necessary following the initial implementation which is expected to be co-ordinated by the Link2000+ programme.*

3.2 The Target Framework – A Regulatory Framework

3.2.1 The Need

The ATN is expected to play a pivotal role in the evolution of air traffic management in Europe. However, its deployment and future growth must respect certain rules if it is to fulfil its promises of safe, reliable and cost effective service provision. As can be seen from section 3.1 (Interim Framework) there are a multitude of rules that will need to be addressed for ATN deployment, many of them un-co-ordinated and in some cases may be conflicting. Furthermore, if ATN deployment is left uncontrolled, various scenarios are possible ranging from one extreme where a single communications service provider monopolises ATN service provision in Europe to one where the ATN simply does not get deployed due to lack of incentives.

3.2.2 The Current Regulatory Environment

The existing aeronautical regulatory environment is complex in that various aspects are the responsibility of a number of separate organisations e.g. JAA, national CAAs, ITU, CEC, Departments of Trade and Industry. Furthermore the Warsaw Convention and ICAO Chicago Convention imply certain regulatory aspects that are in some cases reflected in national laws. This existing framework has served the aeronautical community up to now. However, it is clear that with the introduction of CNS/ATM based systems, (which imply the integration of national and international, ground, air/ground and airborne technologies), this existing framework is in need of review to assess its ability to effectively regulate such new environments.

3.2.3 Benefits of a Regulatory Framework

A Regulatory Framework, along the lines proposed by ATNI2 [89] as summarised in Attachment 1, will recognise the need for the ATN, define rules to facilitate the deployment of the ATN, define the rules and regulations by which service providers must abide when providing ATN services. Such a framework is considered to provide a fair and non-discriminatory framework, which will allow the various stakeholders the means to develop their strategies knowing they are on par with all other stakeholders.

The framework proposed has been based on experiences gained in the telecommunications domain as well as from parts of air transport regulation. The framework will thus (1) contribute to the implementation of the ATN (including airline equipage) and (2) ensure a “level playing field” for all potential communications service suppliers to enter the market.

The Task Force considers the agreement of an approach based on a Regulatory Framework to be of a high priority, but, due to the political process that is implied for its acceptance recognises that it will take some considerable amount of time before it could be implemented.

3.2.4 Scope of the Regulatory Framework

The Regulatory Framework will comprise a number of rules and regulations with which ATN service providers must comply and satisfy. Additionally, in recognition of the air traffic congestion and associated congestion of R/T frequencies a key element of the framework will be to create and oversee the conditions (referred to as “Congestion Rules”) that will encourage the deployment of the ATN. For example, one possibility that has been discussed by ATNI2 is the imposition of a tax on those users that continue to use current communications means as opposed to migrating to the ATN.

The Regulatory Framework will include the rules related to managing and handling the issue of service provider liability. It will specify the obligations with which service provider must comply, e.g. mandatory insurance schemes covering up to a minimum guarantee ceiling that must be specified in the SLA. It was stated in section 3.1.1.4, that due to the fact it is not

possible to limit liability in situations where there is a risk of bodily injury, the ATNI2 study recommended the establishment of a complementary guarantee fund. Such a fund being proposed to be funded 50% by the service providers and 50% by the insurers. The Regulatory Framework would define the rules and regulations for the establishment and management of the fund.

The Regulatory Framework will include the rules and regulations applicable to the certification of ATN systems, equipment and services. It will additionally define the rules and regulations applicable to testing services such as those that will be offered by the CAERAF.

3.2.5 Common Service Provision

The provision of "common services", e.g. operation of the ATN backbone routers and regional network management are proposed, in the near term, to be the responsibility of a multi-stakeholder organisation such as the EACE. However, within the context of the proposed Regulatory Framework, the Task Force notes the ATNI2 proposal that suggests an alternative approach that is considered to be superior in the longer term. ATNI2 proposes the establishment of a body, referred to as the European ATN Administrator (EATNA), whose membership will comprise all players involved in the operation and use of the ATN service. The activities of the EATNA would be funded by its membership. The EATNA would identify and agree on all elements of the European ATN that are considered as being "common" and then contract the provision of these services to a third party. A key criterion for eligibility for the third party is that it must not have a vested interest in the provision of the operational ATN service. This proposal has been based on a solution that was adopted in the US for a similar problem related to number portability.

3.2.6 The Regulator

An independent "Regulator" (e.g. EUROCONTROL) will oversee compliance of the various organisations to the regulatory rules and regulations. The Regulator will be required to be totally and wholly independent from any entity involved, directly or indirectly, in the provision of ATN services.

Following an assessment of the communications service provider statement of compliance against the applicable rules and regulations, the Regulator will grant an "authorisation" or "licence" to the operator allowing him to offer his services. Authorised service providers would thereafter be required, on a periodic basis, to submit statements regarding their on-going compliance with the applicable regulatory requirements and may be subject to audits by the Regulator.

RECOMMENDATIONS

Regulatory Framework – The Task Force recommends that the Agency supports the European Commission in the consideration of the proposals and recommendations of the ATNI2 study which are concerned with the further investigation and definition and introduction of a Regulatory Framework in Europe. The objective of such a framework would be to govern the provision of ATN based services in Europe under a single cohesive set of regulations.

4. Financial Arrangements

The following sub-sections discuss the issues and possible resolutions to the following issues that are considered relevant for the interim framework:

- Provision of funds to bootstrap initial ATN implementation;
- Billing rules and mechanisms for ATN service provision.

4.1 Funding Initial Implementation

Due to the relatively large costs involved in deploying ATN, especially on aircraft and the projected lengthy return on investment it there is a natural reluctance from airlines and ATSOs to invest in ATN/datalink. A key issue therefore is to investigate the options that will "boot-strap" or "kick-start" the implementation.

Possible options are:

- Mandatory Equipage
- Public Funds
- Exclusive Benefits
- Cross Subsidisation

4.1.1 Mandatory Equipage

Historically, mandatory equipage is only an option in situations, which are directly related to safety of the air navigation system, e.g. TCAS. Consequently, for the initial deployment of the ATN it is unlikely that it would be acceptable to mandate equipage. However, in the longer term, when a critical mass of aircraft have equipped, the issue of mandating equipage for the remainder of the fleet may be an option. It is noted that the FAA [96] does not currently intend to mandate ATN in its airspace. The FAA is relying on the airline equipage to be driven by AOC needs due to the need to migrate to VDL from the saturated ACARS network. This approach has the major drawback that the time period before the full operational ATS benefits is protracted.

4.1.2 Public Funds

The utilisation of public monies to fund ATN implementation of operational ground and airborne ATN systems was considered by ATNI2 [89] to be very unlikely if not impossible. The primary reasons for this was due to the fact that it would distort the market and provide an unfair advantage to those that received funding. Also, such scenario would potentially lead to other projects (e.g. GNSS) claiming public funds considering themselves as higher priority activities.

However, the Task Force considers that it is valid to consider the initial implementation and use of the ATN as a pre-operational trial. It is understood that the possibility of public funding for pre-operational trials does exist and it is recommended that this option is further explored. Following a successful trial/pre-operational evaluation the system may evolve to an operational one. Should this be the case then consideration should be given to repayment of the public funds through financial savings made as a result of the ATN service.

4.1.3 Exclusive Benefits

One of the reasons that many airlines are reluctant to equip with ATN is due to the fact that it may not result in "exclusive benefits" to those that equip. For example, the situation will arise whereby those that do not equip will realise benefits resulting from reduced R/T congestion that results from competitors equipping with ATN.

The COPICAT study [86] recommended the creation of "ATN airspace corridors" which would only be available to ATN equipped aircraft. The ATIN2 Study [68] reported that some airlines expressed the view that a good ATN incentive would be the availability of direct routes, chosen flight profiles and priority clearances for those that have chosen to invest in ATN.

The Task Force is supportive of these types of benefit and recommends the subject of providing exclusive benefits for equipped aircraft needs to be studied further from an incentive perspective.

4.1.4 Cross Subsidisation

The option of cross subsidisation is where services whose use is discouraged (e.g. R/T) is taxed to fund equipage of aircraft with datalink. From all options considered this particular option was preferred by the ATNI2 Study [89]. The feasibility of introducing this type of system in the near term is questionable due to the fact that ATS charges in Europe are not currently broken down to reflect the individual elements of the ATS service thus making it impossible to fairly tax the discouraged services. However, in the long term, when it is expected that ATS providers will be required to unbundle their invoices for ATS services (e.g. for GNSS, for ATN, for R/T) the possibility of cross subsidy becomes possible. The question is of course whether it will be necessary in the long term as it is expected that the ATN implementation programme would already be underway.

For airline operator use of ATM applications, for which additional investments need to be justified, effective financial incentives are more difficult to implement. The main reason for this lies in the current mechanisms used in Europe to calculate en-route ATM service charges, which have no provision to take account of aircraft equipage and are, therefore, non-exclusive. Consideration of a type of cross subsidisation whereby a differential charging structure could be introduced to provide an immediate, exclusive, financial incentive that favours datalink equipped aircraft.

In the US and in the context of AOC, a form of cross subsidising to encourage migration to use VDL Mode 2 services is being discussed whereby the tariffs for the use of ACARS services will be increased artificially.

RECOMMENDATIONS

Funding Initial Implementations – The Task Force recommends that the use of public funds to bootstrap the initial avionics and ground systems implementations and operation, (which may be viewed as a pre-operational trial), is further investigated. (Section 4.1)

4.2 Billing Rules and Mechanisms

The key issues with respect to billing/charging of ATN services are:

- the criteria that should be applied by commercial communications service providers for determining their charges for ATS use of their air/ground services;
- the criteria that should be applied by ATSOs for determining their charges for ATS and AOC uses of their private networks by (1) other ATSOs (2) CSPs;

4.2.1 Charges for ATS Use of Air/Ground Services

Air/ground data communications costs are a major issue to be addressed. Of the $600M forecast to be spent by the FAA over the next 15 years on its data link implementation programme, $400M has been allocated to costs associated with use of VDL [96]. The FAA has taken an interim decision that it will itself pay the VDL service costs for the near term.

In Europe, due to the organisational differences (e.g. ATS service cost recovery through Route Charges), the question of who pays (ATSOs or airlines does not arise) as it will in all cases initially be the ATSOs. The key issue, however, is to determine the criteria for determining charges for ATS air/ground data communications (over VDL or AMSS), i.e. whether they should be based on a flat charge (i.e. independent of amount of traffic, similar to current R/T communications charges) or on a per usage charge (i.e. based on the amount

of traffic). Related to this issue it should be taken into account that a key institutional guidelines developed by the FANS II Committee was that "policies governing charges levied on users must not inhibit or compromise the use of satellite-based services". This implies that a flat rate approach to defining charging criteria should be adopted.

Given the safety critical nature of ATS communications it is essential to avoid the situation where there is a reluctance to use the ATN service due to cost considerations. To that end consideration should be given to the feasibility of the "flat charge" mechanism whereby there is a standard fixed periodical charge irrespective of the amount of use of the service. In order for the service providers to be able to commit to offering such terms it will clearly be necessary to forecasts on mean and peak usage levels. Such information will be used to dimension the service providers infrastructure which in turn will be a factor in the flat charge to be applied.

RECOMMENDATIONS

Charging Criteria – The Task Force recommends that the basis of charging for ATS air/ground services should be based on a "flat" charge basis in order to avoid situations whereby there is a reluctance to use the service due to cost considerations.

4.2.2 ATSO Charges

As noted in the first deliverable of the ATNI2 Study [68], some ATSOs may chose to offer the transit use of their private network to ATS and AOC traffic originating from and destined to third parties (i.e. other ATSOs, Communications Service Providers and Airlines). The issue to resolve is the criteria that ATSOs should apply in determining charges for the use of their network.

For ATS traffic a "contra" agreement, i.e. whereby ATSOs do not charge each other for use of each others networks, is considered the optimal solution and is consistent with the current practice. However, the costs of providing transit handling capacity for transit traffic between ATSOs will need to be addressed in the longer term.

For AOC traffic on the other hand it will be necessary, for each ATSO to determine accurate traffic forecasts of this type of traffic in order to determine the optimal strategy. For instance, there would hardly be in benefit in an ATSO implementing an AOC charges system when the amount of AOC traffic likely to transit its network is minimal.

For initial deployment it is recommended that transit AOC traffic is treated as ATS traffic, i.e. at no charge. In parallel it is recommended to develop accurate traffic forecasts for AOC traffic likely to be generated and identify realistic percentages of this traffic that is likely to transit ATS networks.

RECOMMENDATIONS

ATSO Charging AOC Traffic – The Task Force recommends that accurate forecasts of AOC traffic that may transit over ATS private networks are developed so as to provide an input to ATSOs when determining their own specific tariffs for the transmission this type of traffic. *Note. These traffic forecasts may also be the basis for an ATSO to make the principle decision whether it will allow for AOC transmission from a traffic volume and network capacity perspective.*

ATSO Charging ATSOs – For initial operational implementations, the Task Force recommends that ATSOs do not impose charges on the use of their networks by other ATSOs for transmission of ATS data and vice versa. *Note. In the longer term it will be necessary to develop mechanisms to ensure equitable distribution of traffic handling costs between ATS networks and with other third party service providers.*

5. Conclusions

The key conclusions that can be drawn from this report are that:

- The deployment and use of an operational ATS datalink based service must be in the context of an agreed regulatory (i.e. administrative and institutional) environment that is applicable to all suppliers involved in its provision;

- There has been a considerable amount of previous study into the institutional and administrative issues surrounding the deployment and use of CNS/ATM based systems. The majority of these previous studies, both at the ICAO and European level, have focused on GNSS provision due to the third party nature of GPS and GLOSNASS from which lessons may be learnt when considering related issues for ATN service provision. Preliminary work on ATN specific institutional issues was initiated in the context of the ICAO FANS II Committee and continued at the level of the ATN Panel. The results of the recent European Commission funded ATN Institutional Issues Study (ATNI2) have provided a major step forward in the identification and resolution of institutional, financial and administrative issues concerned with ATN service provision, specifically for the longer term, i.e. post 2010.

- However, in the near term, i.e. the 2000 – 2010 timeframe, encompassing the foreseen Link2000+ timeframe, the regulatory environment is expected to comprise a set of resolutions, recommendations and requirements on service providers that are considered essential to facilitate the introduction of the service. The types of issues that are to be resolved include the approaches to safety assessment, certification, service level agreements, liability, support of AOC, use of air/ground service providers and financial arrangements such as funding and billing mechanisms. A number of issues, e.g. co-ordination of the regional deployment, development of regional safety assessments, regional infrastructure management will need to be handled at a regional level. Assignment of these types of responsibilities to a service provider independent entity is considered to be the optimal means of achieving them. Such an entity has been referred to by the Task Force as the "European ATN Co-ordinating Entity" (EACE).

- In the longer term, i.e. the Target Framework (2010 onwards) the Task Force agrees with the recommendation of the ATNI2 study whereby the regulatory environment be defined in the context of a single Regulatory Framework that encompasses all issues involved in the provision of the ATN service. This environment would include a "Regulator" to whom service providers will need to demonstrate their compliance with the applicable provisions of the Regulatory Framework. The provision of "common services" would be assigned by, what is referred to by the ATNI2 study as the European ATN Administrator (EATNA). The EATNA being a body which is funded by stakeholders and whose membership comprises these stakeholders. The EATNA would jointly agree the requirements for the common services and contract an independent entity (i.e. one with no vested interests in ATN service provision) to provide these common services.

6. Recommendations

1. **Safety Assessment** - Given the intended operational environment (i.e. location and type of data link services to be deployed) the Task Force recommends that a Safety Assessment, based on the guidance under development by the joint RTCA SC-189/Eurocae WG-53 committee is conducted in the context of the Link2000+ programme. *Note. - The objective of the Safety Assessment being to identify, and review on a continuous basis, the safety objectives and requirements to be satisfied by the constituent components of the datalink environment which includes systems, procedures and people. (Section 3.1.1.1)*

2. **Certification (1)** – The Task Force recommends that each element in the "end-to-end" chain (at the component level, i.e. End System, subnetwork, Router) be subject to a process that verifies the ability of the component to fulfil its intended functions.

Note. - This process may later be formalised as the basis of the certification process for datalink based systems. (Section 3.1.1.2)

3. **Certification (2) –** The Task Force recommends that the Common American European Reference (CAERAF) system, currently under development in collaboration with the FAA certification office, be promoted as the facility against which ATN compliant products and services are tested in order to gain certification credits. (Section 3.1.1.2)

4. **Certification (3)** – The Task Force recommends that the necessary steps are taken to ensure that a testing laboratory based on CAERAF services is established within the time frame required to support the testing of initial implementations, i.e. local implementation initiatives and Link2000+ products and services. (Section 3.1.1.2)

5. **Service Level Agreements (1)** – The Task Force recommends that all entities, (whether they be commercial communications service providers, ATS providers or airlines), involved in the provision of any element of the ATN service are bound by a "Service Level Agreement" (SLA) that defines the service to be provided and their obligations in ensuring its continuous provision. (Section 3.1.1.3)

6. **Service Level Agreements (2)** – The Task Force recommends that in order to ensure uniformity of service, the development of a generic Service Level Agreement, covering non commercial technical issues for European ATN services, is assigned to a body comprising representation from the responsible personnel from representative ATS providers, communications service providers and airlines. (Section 3.1.1.3)

7. **Liability (1)** – The Task Force recommends that the approach to liability determination is based on that adopted in the GNSS community, i.e. in the event of an incident to localise the segment of the end-to-end chain that was the root of the fault which would result in the identification of the liable service provider who was responsible for the operation of the faulty segment. (Section 3.1.1.4)

8. **Liability (2)** – The Task Force recommends that due to the fact that it is illegal for a service provider to limit its liability in environments where there is risk to bodily injury, and based on the assumption that service providers and their insurers are unlikely to be willing to accept unlimited liability, a group comprising the appropriate legal representation from the commercial service providers, ATS providers and airlines is established to develop proposals for solutions to this issue. (Section 3.1.1.4)

9. **Support of AOC** – The Task Force recommends that ATS providers give due consideration to the issues involved in allowing their private ATS air/ground and ground/ground networks to transmit AOC traffic. (Section 3.1.1.5)

10. **Air/Ground Service Providers** – The Task Force recommends that a set of "Minimum Performance, Safety and Inter-operability Requirements" for air/ground data communications services in support of ATS communications are developed and standardised for the European Region. (Section 3.1.1.6) Note. – These requirements will be the benchmark against which SLAs are defined.

11. **ATN User Forum** – The Task Force recommends that based on the "FANS Interoperability Team" model adopted in the South Pacific in the context of FANS 1/A operations, an "ATN User Forum" is established following the introduction of the ATN into operational service. (Section 3.1.2.1)

12. **European ATN Co-ordinating Entity** – In order to co-ordinate the regional deployment of the European ATN and to undertake certain tasks that need to be undertaken at the regional level (as in the case of the proposed GNSS entity), the Task Force recommends that the appropriate steps are initiated for the creation of an independent entity, referred to in this document as the "European ATN Co-ordinating Entity". *Note. – The Task Force considers that the EACE will be necessary following*

the initial implementation which is expected to be co-ordinated by the Link2000+ programme. (Section 3.1.2.2)

13. **Regulatory Framework** – The Task Force recommends that the Agency supports the European Commission in the consideration of the proposals and recommendations of the ATNI2 study which are concerned with the further investigation and definition and introduction of a Regulatory Framework in Europe. The objective of such a framework would be to govern the provision of ATN based services in Europe under a single cohesive set of regulations. (Section 3.2)

14. **Funding Initial Implementations** – The Task Force recommends that the use of public funds to bootstrap the initial avionics and ground systems implementations and operation, (which may be viewed as a pre-operational trial), is further investigated. (Section 4.1)

15. **Charging Criteria** – The Task Force recommends that the basis of charging for ATS air/ground services should be based on a "flat" charge basis in order to avoid situations whereby there is a reluctance to use the service due to cost considerations. (Section 4.2.1)

16. **ATSO Charging AOC Traffic** – The Task Force recommends that accurate forecasts of AOC traffic that may transit over ATS private networks are developed so as to provide an input to ATSOs when determining their own specific tariffs for the transmission this type of traffic. (Section 4.2.2) *Note. These traffic forecasts may also be the basis for an ATSO to make the principle decision whether it will allow for AOC transmission from a traffic volume and network capacity perspective.*

17. **ATSO Charging ATSOs** – For initial operational implementations, the Task Force recommends that ATSOs do not impose charges on the use of their networks by other ATSOs for transmission of ATS data and vice versa. (Section 4.2.2) *Note. In the longer term it will be necessary to develop mechanisms to ensure equitable distribution of traffic handling costs between ATS networks and with other third party service providers.*

7. Reference List

Reference Number	Title
[1]	EATCHIP Communications Strategy - Volume 1 - Management Overview dated 08/04/98
[2]	EATCHIP Communications Strategy - Volume 2 - Technical Description, version 1.8 dated 08/04/98
[3]	Eurocontrol, COM.ET2.ST15:Analyse Options for Initial Air/Ground Data Networks - Executive Summary COM.ET2.ST15.0000, Edition 1.0 dated 15/10/98
[4]	ATN Implementation Task Force Strategic Business Analysis for the ATN, Issue 1.0 dated 11/06/99
[5]	Eurocontrol, analyse Options for Initial A/G Data Networks - Phase 2 Report: Criteria Selection and Options, EATCHIP COMP, COM.ET2.ST15, Edition 2.2 dated 15/05/96
[6]	Eurocontrol, Analyse Options for Initial A/G Data Networks - Phase 3 Report: Part 1, Tentative Implementation Plan by Horizon 2000 (ACARS Datalink), EATCHIP COMP, COM.ET2.ST15.3000-01, Edition 2.0 dated 15/07/98
[7]	Eurocontrol, European Network Operation Concept (ENOC) System Model, Draft 3.0 dated 03/06/94
[8]	Eurocontrol, STATFOR, Long-term Forecasts of Annual Number of IFR Flights per State until 2020, DED.4/STAT/PREV/378, January 98
[9]	Eurocontrol, Air Traffic Statistics and Forecasts - Number of Movements by Region 1974-1999, 2010 (Total Airspace), Ref Doc NO. 93.10.29, OPS/181/5 dated 30/4/93
[10]	ICAO, The ICAO CNS/ATM System: Coping with Air Traffic Demand, 1994
[11]	Report of the DLK users forum held Feb 3-4 1999 in Orlando, Florida, dated 26/02/99
[12]	EATCHIP ATN Implementation Task Force, Interim Report of the Implementation Task Force, DED/6/ATN/ATNI-TF/DOC/06, Issue 10.2 dated 22/01/98
[13]	EATCHIP COM-T Drafting Group, Report of the COM-T Drafting Group on the Feasibility of ATSO Data Network Integration, Version 2.0 dated 26/08/97
[14]	Eurocontrol, EATMS Operational Concept Document, EATCHIP FCOT, FCO.ET1.ST07.DEL01, Version 1.0 dated 01/03/97
[15]	Eurocontrol, ATM Strategy for 2000+, Doc no. FCO.ET1.ST07.DEL02 (Volumes I & II), Issue 4.0 dated November 1998
[16]	EATCHIP COM-T, Agreed Decisions of 11th meeting (10-11 February 1998)
[17]	Airports Council International, The World's Airports by 1996 - Airport Ranking by Aircraft Movements, ACI-Web page http://www.airports.org/
[18]	Flight International, Number 4617, Volume 153, 18-24 March 1998
[19]	Eurocontrol, EATMS Context and Scope Document (CSD), FCO.ET1.ST023.DEL01, Edition 1.0 dated 15/09/95
[20]	European Commission DGXII, COPICAT Economic Assessment and Proposed ATN Organisation, Edition 1.1 dated 22/11/96
[21]	Eurocontrol, Operational Requirements for Air Traffic Management (ATM)

Reference Number	Title
	Air/Ground Data Communications Services, Doc no. OPR.ET1.ST05.1000-ORD-01-00, Edition 1.0 dated 15/01/98
[22]	European Commission DGXIII, COPICAT User Requirements and Expectations, Edition 1.1 dated 22/11/96
[23]	Eurocontrol , Convergence and Implementation Programme - Status Report, Part 2 - April 1996, Edition 2.1
[24]	Airbus Industries, Global Market Forecast 1997-2016, March 1997
[25]	CEC DG XIII, Migration Strategy to a Future VHF Communication System, APAS 94 AT1003 Project NEWCOM, WP1
[26]	ATC News, DFS confirms three-centre plan, June 1997
[27]	Eurocontrol, Permanent Commission Measure No. Establishing a Central European Air Traffic Services (CEATS) Upper Area Control Centre, June 1997
[28]	Eurocontrol, FDPS Interoperability Study, Issue 1.0 dated 01/09/97
[29]	Lufthansa, Datalink for Communication, Navigation and Surveillance - The Experience so far, Presentation at Maastricht (Dr. Burkhart Wigger), dated 19/02/98
[30]	ESG, PROATN Traffic Volume and Data Rates, Technical Report prepared for DFS, Version 1.0 dated 23/06/97
[31]	ATN Implementation Task Force Work Programme and Planning Ref: DED6/ATN/ATNI-TF/DOC/01, Issue 3.0 dated 30/06/97
[32]	EATMS Mission, Objectives and Strategy Document, EATCHIP FCOT, Issue 1.3 dated 06/07/95
[33]	Capacity Shortfall in the ECAC Airspace through 2000-2015, Draft 3.1 dated 01/12/94
[34]	IATA Datalink Task Force Report, Issue 0.1 dated 04/02/97
[35]	Air Traffic Management for the North Atlantic to 2015, NATSPG/CADAG, Version 0.6 dated 01/10/97
[36]	IATA bemoans high charges, Jane's Airport Review, Volume 9, Issue 7
[37]	Eurocontrol ATNI-TF, ATN Scenario Definition, DED6/ATN/ATNI-TF/DOC/25, Version 2.1 dated 04/06/98
[38]	ICAO AHMS SARPS's, dated 14/03/97
[39]	Proposed ACARS Replacement Solutions written by Whyman & Adnams, Issue 1.2 dated 24/03/98
[40]	ATNP/2 Security Policy, ATNP/2 Report dated 01/11/96
[41]	Aeronautical satellite datalink study system, European Space Agency Final Report, ESTEC 11225/94/NL/Us, dated 01/10/95
[42]	An Initial Assessment of Possible ATC Datalink Technologies and their relative Costs, T. Latif, A. Orr, R. Bailey, E.J. Coulson, NATS Research & Development report 9626, dated 01/08/96
[43]	Overall EATCHIP CBA Scoping Study, EUROCONTROL, dated 01/09/97
[44]	Moving to a Digital Comms Net - Article in Air Traffic Management no5. 1/9/97, dated 01/09/97
[45]	Cost replaces benefits as ATN Buzzword – Estimated Cost of Customising a baseline Boeing 767-300ER to CNS/ATM, Article in ATC News, dated 07/04/97
[46]	Treaty 9 Study Report - CEC DGXIII, dated 01/06/98
[47]	ACCESS Work Package 201 - Current Communications infrastructure,

Reference Number	Title
	Version 3.0 dated 25/03/98
[48]	EUROCONTROL, EATCHIP 1370 Task 5, Inventory of Existing Ground Data Networks - Final Report, Issue 2.0 dated 01/04/93
[49]	EUROCONTROL, EATCHIP 2370 Task 5, Inventory of Planned Data Networks in the ECAC Area - Final Report, Issue 2.0 dated 01/03/94
[50]	EUROCONTROL, EUNIS WP1000 Report, Inventory of Ground Data Networks, Issue 2.0 dated 01/02/96
[51]	EUROCONTROL, EUNIS WP2000 Report, Inventory and Profile Description of Ground Data Applications, Issue 2.0 dated 01/02/96
[52]	EUROCONTROL, Overall CNS/TM Architecture for EATCHIP - Architecture Country Inventory Report, Document ASE.ET1.ST02-REP-02-00, Edition 1.0 dated 04/07/97
[53][4]	
[54]	ARINC Europe, Presentation by Robert Jefferson at GLOBALINK Service Launch Meeting – 1998
[55]	SAS Datalink Program - Presentation by Bjorn Syren at GLOBALINK Service Launch Meeting – 1998
[56]	SITA - Interview notes dated 17/04/97
[57]	The Business Side of CNS/ATM, David Allen – Boeing
[58]	Making Europe Fly - EUROCONTROL, 2 volumes - 1997
[59]	Lund E, North Sea ADS Programme, Information paper ATNP JWG/IP-2, ATNP JWG Redondo Beach, November 1997
[60]	EUROCONTROL, COM.ET2.ST15: Analyse Options for Initial Air/Ground Data Networks, Phase 3 Report: {art 2-1, COM.ET2.ST15.3000-REP-02-xx, Edition 1.0 dated 08/12/97
[61]	AEEC letter 98-096/DLK-825, report of the DLK Users Forum held June 3-4 1998 Brussels
[62]	Minutes of Network Service Management Task Force (1st meeting), 25-26 February 1998, Version 1.0 dated 24/03/98
[63]	IATA European Aircraft Forecast 1995-2000, dated 01/01/97
[64]	Free Flight: Preserving Airline Opportunity - Captain Russell G Chew, American Airlines, dated 22/09/97
[65]	ICAO Circular 270-AT/111 - Outlook for Air Transport to the Year 2005, 1997
[66]	ACCESS Work Package 202 - ATN Data Link Services in the ACCESS Area, Version 2.0 dated 05/03/98
[67]	ACCESS Work Package 206 - Addressing Plan of the European ATN Network, Version 1.0 dated 02/04/98
[68]	Report for the DG7, European Commission, Deliverable 1, Scenarios for the ATN, Non-technical Implementation Issues, Revision 1.2 dated 28/08/98
[69]	Report of FANS II/4, ICAO Document 9623 - year 1993
[70]	Report of the World Wide CNS/ATM systems Implementation conference, dated 15/05/98
[71]	A European Key View on Economic and Financial issues, World Wide CNS/ATM Systems Implementation Conference, ECAC Ref: WW/IMP-

[4] This reference has been left blank intentionally

Reference Number	Title
	WP/26
[72]	Information-Legal Aspects Implications of CNS/ATM, World Wide CNS/ATM Systems Implementation Conference, USA, ref: WW/IMP-WP/74
[73]	A European View on the Legal and Institutional Issues Relating to GNSS, World Wide CNS/ATM Systems Implementation Conference, ECAC, ref: WW/IMP-WP/12
[74]	Legal Aspects of Certification and Matters Relevant to GNSS Services, World Wide CNS/ATM Systems Implementation Conference, ICAO, ref: WW/IMP-WP/11
[75]	A Charter on the Rights and Obligations of States Relating to GNSS Services, World Wide CNS/ATM Systems Implementation Conference, ICAO, ref: WW/IMP-WP/10
[76]	ESG, Satellite Communications and Ground Earth Station Institutional Issues Study - Volume 1: Executive Summary - Doc, 1AK7-FR-01-GES, Version 1.0 dated 12/12/95
[77]	ESG, Satellite Communications and Ground Earth Station Institutional Issues Study - Volume 2: Final Report - Doc, 1AK7-FR-01-GES, Version 1.0 dated 12/12/95
[78]	ACCESS WP220, Third Party Service Provision, Issue 2.0 dated 22/01/99
[79]	Report of the World Wide CNS/ATM Systems Implementation Conference, Rio, dated 15/05/98
[80]	Report of the Second Meeting of the ICAO ATN Panel - Nov 96
[81]	CNS/ATM Safety Assessment, RTCA SC-189/EUROCAE WG 53, Revision 4 dated 22/04/98
[82]	Update on the GNSS Unit - GNSS - Roles and Responsibilities - Civil Aviation Requirements, AP/ACG/2/7, dated 13/05/98
[83]	Update on the GNSS Unit - The future role of EUROCONTROL in GNSS, AP/ACG/2/3
[84]	FAA Advisory Circular (No. 20-DC), Guidelines for the Design Approval of Aircraft Data Communications, Draft 1.6
[85]	Description of the FAA Avionics Certification Process, dated 23/04/97
[86]	Network Service Management Task Force (NSM-TF) Report, EATCHIP G/G Communications Subgroup, dated 28/04/98
[87]	Progress Report of Network Service Management Task Force (NSM-TF), EATCHIP G/G Communications Subgroup, dated 08/09/98
[88]	Minutes of Network Service Management Task Force (7th meeting), Version 2.0 dated 07/12/98
[89]	Report for the DG7, European Commission, Deliverable 2, The Introduction of ATN in Europe: A Regulatory Framework, Version 1.2 dated 26/02/99
[90]	Global Air Navigation Plan for CNS/ATM Systems, Volume 1: Operational Concept and General Planning Principles, ICAO, Version 1.0
[91]	Global Air Navigation Plan for CNS/ATM Systems, Volume 2 of the Global Plan, ICAO, Version 1
[92]	FANS Interoperability Team Report/2, dated 03/08/98
[93]	ATNSI Certification Approach - Aug 98, Version 98.1.2
[94]	RTCA Certification Task Force Terms of Reference
[95]	Report on Financial and Related Organisational and Managerial Aspects of GNSS Provision and Operation, ICAO Doc 9660 (developed by ICAO Air Navigation Services Economics Panel (ANSEP)

Reference Number	Title
[96]	ATA Data for IS cited in 'Economic Analysis of Datalink' - 1996 data
[97]	Atlanta Study' - Controller Evaluation of Initial Data Link En Route Air Traffic Control Services: ISSS Design Development Study 1, Report no: DOT/FAA/CT94/25, Air Traffic Data Link Validation Team, dated 01/05/94
[98][5]	
[99][6]	
[100]	C/AFT Datalink focus Group, Investment Analysis Results from All-Airline meeting November 18,1998, dated 18/11/98
[101]	Equipage rationale: A case study of the Atlanta Experiment from Datalink Investment Analysis, Issue 1.2 dated 15/10/98 - FAA
[102]	VDL-2/CPDLC & FAA Service Provider Costs from 15 Oct users meetings written by Joe Ladeluca, dated 15/10/98
[103]	1997 Aviation Capacity Enhancement Plan, FAA
[104]	FAA Controller Pilot Datalink Communication Benefits, FAA 1998
[105]	Final Report of RTCA Task Force 4, Certification, Working Draft Version 3.1, dated 01/02/99
[106]	FAA Advisory Circular, Initial Air Carrier Operational Approval for use of Digital Communications Systems, Draft dated 24/11/98
[107]	ATNI2 2nd Workshop Handout, dated 05/10/98
[108]	ADS Europe 97, Final Trials Report and Recommendations for Further Work, Issue 1.0 dated 01/02/98
[109]	RTCA SC-189/EUROCAE WG53, P-SG2-25, Guidance for the Application of CNS/ATM Safety Assessment, dated 14/12/98
[110]	RTCA SC-189/EUROCAE WG53, P-SG2-24, Guidance for the application of the OSA Process, dated 15/10/98
[111]	RTCA SC-189/EUROCAE WG53, P-SG2-11, Qualification of CNS/ATM Systems using Data Link, dated 29/04/98
[112]	RTCA SC-189/EUROCAE WG53, P-SG2-13, Common Safety objectives for ATS Systems using data link, dated 29/04/98
[113]	RTCA SC-189/EUROCAE WG53, P-SG2-27, Common Safety Elements for ATS that use data communications, dated 21/03/99
[114]	RTCA SC-189/EUROCAE WG53, G2-28, CNS/ATM Operational Environment for Air Traffic Services (ATS) that use data communications, dated 15/01/99
[115]	RTCA SC-189/EUROCAE WG53, P-PUB-16, Environment Template for capturing from PIRGs, initial information on their environment and operational concept, dated 24/10/97
[116]	Minutes of 8th NSM Task Force meeting 11/1 - 12/99, dated 14/01/99
[117]	Minutes of 9th NSM Task Force meeting 25/2-26/2/99, dated 08/03/99
[118]	C/AFT Presentation material from All Airline Meeting, dated 18/11/98
[119]	Presentation material from the FAA Datalink Investment Analysis users meeting, dated 15/10/98

[5] This reference has been left blank intentionally

[6] This reference has been left blank intentionally

Reference Number	Title
[120]	Office of Inspector General, Audit Report, FAA's Progress and Plans for Implementing Data Link for Controllers and Pilots Report no. AV-1999-057
[121]	ACCESS Institutional Issues WP224 ref:ACCESS/NATS/224/WPR/122, Issue 1.0 dated 05/03/99
[122]	CAERAF (Common American and European Reference ATN Facility) User Requirements document, dated 08/01/99
[123]	ATN Implementation Task Force Proposed European ATN Implementation Plan, Issue 1.0 dated 17/06/99
[124]	ACCESS (ATN Compliant Communications European Strategy Study) Study Final Report, Issue 1.0 dated 01/04/99
[125]	Technical Requirements Specification, Simulations to support Implementation of the European ATN, Issue 4.4 dated 30/07/88
[126]	ATN Implementation Task Force ATN Administrative Structures and Institutional Issues, Issue 1.0 dated 11/06/99
[127][7]	
[128]	ATNP WG1/WP1405, Report from members on ATN, Paul Hennig - January 1999
[129]	Air Group datalink DFS strategy, December 1998
[130]	Datalink investment analysis - ATS Data Link focus group CNS/ATM focused team, dated 09/04/99
[131]	EUROCONTROL ATN Workshop Report, ref: DED6/ATNIP/ATNI_TF/52, Issue 0.1 dated 20/08/98
[132]	EUROCONTROL/IATA common paper for EANPG/40 entitled Regional Planning for the Implementation of Data Link Services and the ATN - ATNI-TF/WP7/05 - EUR/IATA, dated 07/12/98

[7] This reference has been left blank intentionally

8. Glossary

4DTN	4D Trajectory Negotiation
A/G	Air/Ground
AAAV	Azienda Autonoma di Assistenza al Volo per il Traffico Aereo Generale
AAC	Airline Administrative Communications
ACA	Address Compression Algorithm
ACARS	Aircraft Communications Addressing and Reporting System
ACC	Area Control Centre
ACCESS	ATN Compliant Communications European Strategy Study
ACF	Airport Control Facility
ACG	ATS System Concept Working Group
ACI	ATN Communications Infrastructure
ACL	Altimeter Check Location (ICAO 8400/4)
ACM	ATC Communications Management
ACN	Austrian Communications Network
ACSP	Aeronautical Communications Service Provider
ADAP	Automated Downlink of Airborne Parameters
ADLP	Airborne Data Link Processor
ADNET	Administrative Network
ADS	Automatic Dependent Surveillance
ADS-C	Automatic Dependent Surveillance-Contract
AEEC	Airline Electronic Engineering Committee
Aena	Aeropuertos españoles y Navegación aérea (the Spanish CAA)
AES	Aircraft Earth Station
AES	Airborne Earth Station (AMSS)
AFI	ICAO African Region
AFS	Aeronautical Fixed Service
AFSG	Aeronautical Fixed Services Group
AFTN	Aeronautical Fixed Telecommunication Network
AIDC	Aeronautical Information Data Interchange
AIO	ATN Implementation Objective
AIS	Aeronautical Information Services
AMHS	Aeronautical Message Handling Service
AMS	Aeronautical Mobile Service
AMSS	Aeronautical Mobile Satellite Service
ANC	Air Navigation Commission (ICAO)
ANP	Air Navigation Plan
AO	Aircraft Operator
AOA	ACARS over AVLC
AOC	Aeronautical Operational Communications
APATSI	Airport/Air Traffic System Interface
APC	Aeronautical Public Correspondence
APO	Airport Operator
APR	Aircraft Parameter Reporting
APW	Area Proximity Warning
ASAS	Aircraft Separation Assurance System
ASD	Air Situation Display
ASM	Airspace Management
ATC	Air Traffic Control
ATCC	Air Traffic Control Centre
ATCO	Air Traffic Control Officer
ATFM	Air Traffic Flow Management
ATIF	ATN Trials Infrastructure
ATIS	Automated Terminal Information Service
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATNI	ATN Implementation
ATNII	ATN Institutional Issues

ATNI-TF	ATN Implementation Task Force
ATNP	ATN Project
ATNSI	ATN Systems Inc. (US)
ATS	Air Traffic Services
ATSC	Air Traffic Services Communications
ATSO	Air Traffic Service Organisation
ATSU	Air Traffic Service Unit
BA	British Airways
BB	Backbone
BIS	Boundary Intermediate System
BT	British Telecom
C/AFT	CNS/ATM Focus Team
CAA	Civil Aviation Authority
CADAG	Communications, Automation and Datalink Applications Group
CADS	Computer-Aided Departure Sequencing
CAERAF	Common American European Reference ATN Facility
CAM	Conflict Alert Message
CAMAL	Comprehensive ATN Manual
CAP	Controller Access Parameters
CAPSIN	CAA Packet Switched Integrated Network
CAR	Circonscription aéronautique régionale
CAUTRA	Coordinateur Automatique du Trafic Aérien
CBA	Cost Benefit Analysis
CBN	Common Backbone Network
CDG	Charles de Gaulle
CDM	Collaborative Decision Making
CDU	Control and Display Unit
CEC	Commission of the European Communities
CFMU	Central Flow Management Unit
CHG	Modification Message
CIC	Clearances and Information Communications
CIDIN	Common ICAO Data Interchange Network
CIP	Convergence and Implementation Programme
CIS	Commonwealth of Independent States
CLM	Clearance Modification Message
CLNP	Connection Less Network Protocol
CLTP	Connectionless Transport Protocol
CM	Context Management
CMU	Communication Management Unit
CNS	Communications, Navigation, Surveillance
COMT	Communications Team (EATCHIP)
COTP	Connection Oriented Transport Protocol
COTRAC	Common Trajectory Co-ordination
CPDLC	Controller Pilot Data Link Communications
CRA	Conflict Resolution Advisory (FAA)
CRCO	Central Route Charge Office
CSP	Common Service Provider
CTS	Conformance Test Suite
DBE	Data Base EUROCONTROL
DCF	Discounted Cash Flow
DCL	Departure Clearance
DEP	Departure Message
DEVNET	Development Network
D-FIS	Data Link Flight Information Services
DFS	Deutsche Flugsicherung
DGAC	Direction Generale de l'Aviation Civile
DLIC	Data Link Initiation Capability
DLTF	Data Link Task Force (IATA)
D-OTIS	Data Link Operational Terminal Information
DPN	Data Packet Network
D-RVR	Data Link Runway Visual Range

DSC	Downstream Clearance
DSP	Datalink Service Provider
DUC	Data Link Initiation Capability
DYNAV	Dynamic Route Availability
EACE	European ATN Co-ordinating Entity
EAD	European AIS Database
EAN	European ATSO Network
EANP	European Air Navigation Plan
EANPG	European Air Navigation Planning Group (ICAO)
EATCHIP	European Air Traffic Control Harmonisation and Implementation Programme
EATMP	European Air Traffic Management Programme
EATMS	European Air Traffic Management System
EATNA	European ATN Administrator
EBAA	European Business Aviation Association
ECAC	European Civil Aviation Conference
ECU	European Currency Unit
EFDP	European Flight Data Processor
ENAV	Italian CAA
ENOC	European Network Operating Concept
ENPRM	European Notice of Proposed Rule Making
EOLIA	European Pre-operational Data Link Applications
ES	End System
EU	European Union
EUR	European
EURO AG-DL	European Air/Ground Data Link
EUROCAE	European Organisation for Civil Aviation Electronics
EUROCONTROL	European Organisation for the Safety of Air Navigation
EuroVDL	European VHF Data Link
FAA	Federal Aviation Administration (US)
FANS	Future Air Navigation System
FANS1/A	Future Air Navigation System Version 1A
FATMI	Finnish Air Traffic Management Integration
FCOT	Future Concept Operation Team (EATCHIP)
FDDI	Fibre-Distributed Data Interface (LAN
FDPS	Flight Data Processing System
FEP	Front-end Processor
FFM	Free Flight Mode
FFS	Free Flight Airspace
FIR	Flight Information Region
FIS	Flight Information Services
FITAMS	Flight Trials of ATN and multiple Subnetworks
FIWs	Flight Plan Input Workstation
FLIPCY	Flight Plan Consistency
FMP	Flow Management Position
FMS	Flight Management System
FPS	Flight Plan Processing Systems
FUA	Flexible Use of Airspace
GDLP	Ground Data Link Processor (Mode S)
GES	Ground Earth Station (AMSS)
GLONASS	Global Navigation Satellite System
GNS	Global Navigation System
GNSS	Global Navigation Satellite System
GPWS	Ground-Proximity Warning System (avionics)
HF	High Frequencies
HFDL	High Frequency Data Link
HMI	Human Machine Interface
HTLA	High Traffic Level Area
IACSP	International Aeronautical Communications Service Provider
IAGDL	Intial Air/Ground Data Link
IAOPA	International Council of Aircraft Owner and Pilot Association

IATA	International Air Transport Association
IBERPAC	Spanish public packet switching network
ICAO	International Civil Aviation Organisation
ICC	Inter-Centre Communications
IDI	Initial Domain Identifier (ICAO Doc 9578-AN/935)
IDRP	Inter-Domain Rout[e]ing Protocol (ICAO Doc 9578-AN/935)
IEC	InterExchange Carrier
IFALPA	International Federation of Air Line Pilot Association
IFATCA	International Federation of Air Traffic Controllers Association
IFPS	Initial Flight Plan Processing System
IFR	Instrument Flight Rules (ICAO 8400/4)
IGA	International General Aviation (ICAO 8400/4)
INAS	International Airspace System
INTNET	Integration Network for Flight Data Exchange (EUROCONTROL)
IP	Internet Protocol
IPI	Initial Protocol Identifier
IRR	Internal Rate of Return
IS	Intermediate System
ISO	International Standards Organisation
ITU-T	International Telecommunications Union
JAA	Joint Aviation Authority
JRC	Joint Resources Council
KLM	Koninklijke Luchtvaart Maatschappij (NL)
LAAO	Large Aircraft Operator
LAAP	Large Airport
LAN	Local Area Network
LEO	Low Earth Orbit
LGS	Latvijas Gaisa Satiksme (Latvian Air Traffic Services Organisation)
LH	Lufthansa
LTLA	Low Traffic Level Area
LTLA-R	Low Traffic Level Area - Remote
MAAO	Major Aircraft Operator
MAAP	Major Airport
MANs	Multiple Area Network
MAS	Managed Airspace
MCDU	Multifunctional Control Display Unit
MEAO	Medium Aircraft Operator
MEAP	Medium Airport
MEO	Medium Earth Orbit
MET	Meteorological
METAR	Meteorological Aeronautical Report
MIB	Management Information Base
MMR	Multi-mode Radio
MOPS	Minimum Operational Performance Standards
MOTNE	Meteorological Operational Telecommunications Network Europe (ICAO 8400/4)
MSAW	Minimum Safe Altitude Warning
MTA	Message Transfer Agents
MTCD	Medium-Term Conflict Detection
MTOW	Maximum Take-off Weight
NAIS	Norwegian Aeronautical Information System
NAM	North America (ICAO Region)
NAS	National Airspace System (FAA)
NAT	North Atlantic
NATN	National Aeronautical Telecommunication Network
NATS	National Air Traffic Services
NATSPG	North Atlantic System Planning Group (ICAO)
Navcom	Navigation Communication
NEAN	Northern European Aeronautical Network
NEXCOM	Next Generations Communications

NLR	Nationaal Lucht- en Ruimtevaartlaboratorium (NL)
NMA	Network Management Agent
NMS	Network Management System
NOTAM	Notice to Airmen
NPV	Net Present Value
NSAP	Network Service Access Point
NSM	Network Service Management (COMT TF)
OACC	Oceanic Area Control Centre
OCD	Operational Concept Document (EATMS)
OCM	Oceanic Clearance
ODIAC	Operational Development of Integrated Air/Ground Data Communication and Surveillance (EATCHIP Subgroup)
ODT	Operational Requirements and Data Processing Team
OED	Operational Environment Definition
OHA	Operational Hazard Assessment
OIG	Office of Inspector General
OLDI	On-line Data Interchange
OPMET	Operational Meteorological Data
OPNET	Operational Network for ATS and System Management
ORD	Operational Requirements Document (ODIAC SG)
OSA	Operational Safety Assessment
PAC	Pre-Activation Message
PATA	Pacific Area Travel Association
PDC	Pre-departure Clearance
PDN	Public Data Network
PDU	Power Distribution Unit, or Power Drive Unit, or Protocol Data Unit (ICAO Doc 9578-AN/935)
PETAL	Preliminary Eurocontrol Test of Air/Ground Data Link
PETAL-IIe	Preliminary Eurocontrol Test of Air/Ground Data Link Extension
PPD	Pilot Preferences Downlink
ProATN	Prototype ATN
PSN	Packet Switching Network
PSTN	Public Switched Telephone Network (w. packet switching)
PTT	Post, Telephone and Telegraph (Administrations of various countries)
QA	Quality Audit
QoS	Quality of Service
R&D	Research and Development
RACF	Research and Development Programme in Advanced Communications Technologies for Europe
RAPNET	Regional ATS Packet Switched Network
RASA	Requirements Analysis and System Architecture (EATCHIP Subgroup)
RCC	Requirements Capture and Consolidation
RD	Routing Domain
RDC	Routing Domain Confederation
REDAN	Air Navigation Data Network
RENAR	Réseau de la Navigation Aérienne
RESEDA	French military X.25 network
RMCDE	Radar Message Conversion and Distribution Equipment
RNAV	Area Navigation
RRI	Router Reference Implementation
RTCA	Radio Technical Commission for Aeronautics
RTT	Radio Telemetering Theodolite
RVSM	Reduced Vertical Separation Minima
SADIS	Satellite Distribution System
SAM	Slot Allocation Message
SAP	System Access Parameters
SAR	Search And Rescue (ICAO 8400/4)
SARPs	Standards and Recommended Practices

SELCAL	Selective Calling System (ICAO 8400/4)
SG	Subgroup
SIGMET	Meteorological message
SITA	Société internationale de télécommunications aéronautiques
SLA	Service Level Agreement
SM	Suspense Message
SMAO	Small Aircraft Operator
SMAP	Small Airport
SMGCS	Surface Movement Guidance and Control System
SMGCS	Surface Movement Guidance and Control System
SNA	Systems Network Architecture
SNDCF	Subnetwork Dependent Convergence Facility (ICAO 9578-AN/935)
SSR	Secondary Surveillance Radar (ICAO 8400/4)
STATFOR	Statistic Forecast
STCA	Short Term Conflict Alert (ICAO 9578-AN/935)
STDMA	Self-organising time division multiple access
STNA	Service Technique de la Navigation Aerienne
SVC	Switched Virtual Circuit (X.25)
SYSCO	System Supported Co-ordination
TACT	Tactical Flow Management
TAF	Tactical Aeronautical Forecast
TAR	Trials ATN Router
TCAS	Traffic Alert and Collision-Avoidance System (US)
TCP	Transport Control Protocol
TCP/IP	Transmission Control Protocol/Internetwork Protocol
TEN-T	Trans-European Networks – Transport
TES	Trials End System
TF	Task Force
TIF	Traffic Information
TMA	Terminal Manoeuvering Area
TNP	Telematics Network Protocol
TOR	Terms of Reference
TPCSP	Third Party Communications Service Provider
TRANSPAC	French public X.25 network
TSAP	Transport Service Access Point
TTS	Transaction Tracking System
UAC	Upper Area Centres
UAL	United Airlines
UMAS	Unmanaged airspace
US	United States
VDL	VHF Data Link
VDR	VHF Digital Radio
VHF	Very High Frequencies
WAFC	World Area Forecast Centre (ICAO 8400/4)
WAN	Wide Area Network
WP	Work Package
XF	Exit Flight Level

Attachment 1 - Related Studies/Initiatives/Activities

On-going and past studies/initiatives and activities related to the institutional and administrative aspects of ATN implementation are reviewed in the following sub-sections based on the following categorisation:

- ICAO Activities (FANS II/4 Committee, ATN Panel);
- European Activities (COPICAT, ATNI2, Satellite Institutional Issues Study);
- USA Activities (FAA Certification Process, RTCA Certification Task Force, ATSI Certification Approach);
- Joint Europe/US Activities (RTCA SC-189/WG 53, CAERAF);
- FANS 1/A Operations;
- Related GNSS Activities (ICAO, Europe).

A.1 ICAO Activities

A.1.1 FANS II/4 Committee

A.1.1.1 Global Co-ordination

The ICAO FANS II/4 Committee developed a list of issues which were considered as requiring global co-ordination with respect to the ATN ([2, Appendix C to the Report on Agenda Item 4]). These issues being:

- Routing;
- QoS;
- Network Congestion/Network Flow Control;
- Network Monitoring;
- Problem Resolution;
- Technical Advice, educational service, and registry;
- product certification and conformance testing;
- security;
- accounting management and
- regulatory issues.

A.1.1.2 Institutional Guidelines

The FANS II/4 Committee additionally endorsed a set of institutional guidelines and scenarios for ATN service provision which were documented in the Global Co-ordinated Plan ([69], Appendix A to the Report on Agenda Item 8). These are intended to assist ATS providers and regional planning groups in the implementation of the aeronautical mobile satellite service (AMSS), the global navigation satellite system (GNSS) and the aeronautical telecommunications network (ATN). However, it is the responsibility of the States and the regional ATS organisations to define the institutional arrangements applicable to their region

and to develop the regional implementation strategy for the future CNS system along these arrangements.

In considering institutional arrangements necessary for the deployment and provision of the ICAO CNS/ATM system the FANS Committee best concluded that these could be best addressed by developing a number of institutional guidelines for use by States, service providers and users. Two types of guidelines (Attachment A) were developed:

- **General**, i.e. those applicable to all systems and
- **Specific**, i.e. those applicable to either communications or navigation systems.

A.1.2 ATN Panel

The ATN Panel was tasked to identify potential institutional issues relating to ATN implementation. In order to scope its work the Panel formulated the following definition of the term "Institutional Issue":

"Issues related to the ownership, control and responsibility for correct implementation and operation of systems which involve more than one State or organisation."

The ATNP reviewed the FANS II/4 list of guidelines and presented the results to ATNP/2. A number of issues were considered to be addressed by the provisions defined in the SARPs ([13, Appendix B to the Report on Agenda Item 4, ATNP/2 Report]) and a number of issues were identified as being beyond the responsibility of ATNP/2 ([13, Appendix C to the Report on Agenda Item 4, ATNP/2 Report]). Recommendation 4/3 b) of the ATNP/2 meeting recommended "*that ICAO expedite its work in resolving institutional issues, taking into consideration those included in Appendix C ...".* The issues listed in Appendix C were:

- arrangements should provide for the determination of liabilities;
- policies governing charges levied on users must not inhibit or compromise the use of satellite-based services;
- the issue of security administration must be addressed with regards to global implementation by the member states;
- the certification issues for systems management of the ATN and equipment is important and should be co-ordinated both regionally and inter-regionally;
- commercial service providers and their customers need to be able to define service level agreements and subsequently to meet contractual guarantees, quality of service (QoS) specifications and mechanisms to support these needs on a global basis.

A.1.3 World Wide CNS/ATM Implementation Conference

The World Wide CNS/ATM Implementation conference [79] was convened by ICAO with the primary objective of addressing the institutional and financial issues facing CNS/ATM deployment. Specific agenda items were assigned to the subjects of "Institutional Issues", "Financial Matters", "Legal Aspects" and "Training Needs. The 29th ICAO Assembly endorsed the recommendations of the conference and passed a resolution that States, as a matter of priority, enact the recommendations of the conference.

A.2 European Activities

A.2.1 COPICAT Study

The CEC sponsored COPICAT Study [86] identified a number of relevant issues:

- A general user consensus (Airlines, CAAs...) is that a single point of contact for the provision of the ATN communications services would be the preferred deployment solution. The ATN communication services should not be split up between different service providers. Therefore in order to optimise the investment, it is recommended that ATC and AOC applications be promoted on the same ATN components and networks.

- The Cost/Benefit analysis performed on the basis of a common ATC and AOC network deployment scenario concludes that the economic benefits of the project are significantly large to justify the investment and to generate a satisfactory return. The ATN is a profitable investment but should be considered as a long term infrastructure project (offering rates of return that vary between 16% and 42%) as suggested by the pay-back period ranging from 7 years to 10 years, depending on the assumptions chosen.

- Financing exclusively through the private sector does not look feasible in the medium term, but is plausible in the long term. Because the project carries with it a potential benefit from the public welfare perspective (reduction in air traffic congestion in Europe), mixed Private/Public financing is the best approach to take forward for the financing of the ATN project.

- The ATN implementation will not take place if a general consensus between all involved parties is not reached. The implementation has to be rapid in order to collect all potential benefits. This will require unifying guidance and driving force and needs to be focused on optimising the investment costs and operating costs. The creation of a « **Co-ordinating Entity (CE) »** to act as the body for the promotion, implementation, and control of ATN is required.

The following is a list of "institutional issue" related extracts from the main recommendations of the COPICAT study:

- The ATN Co-ordinating Entity needs to be formed and institutional issues clarified.

- The primary objective of the ATN has been to support the Air Traffic Services. The design of the European ATN must also include Airlines needs and must support AOC/AAC requirements.

- For a rapid implementation all necessary action needs to be taken towards promoting the use of the ATN through providing operational advantages. For example, ATN corridors could be created for sole use by ATN equipped aircraft.

A.2.2 CEC ATN Institutional Issues ("ATNI2") Study

The ATI2 study is the most relevant of studies focusing on institutional and administrative issues related to the deployment of the ATN in Europe. The aim of the study is to analyse the non technical obstacles which could affect the operational implementation of the ATN and to develop organisational, regulatory and institutional configurations capable of facilitating the implementation of the ATN.

The study was divided into two phases with a main deliverable report resulting from each phase:

- Phase 1 produced a report titled "Scenarios for the ATN: Non-technical Implementation Issues" [68] and

- Phase 2 produced a report titled "The Introduction of the ATN in Europe: A Regulatory Framework" [89].

A.2.2.1 Scenarios for the ATN: Non-technical Implementation Issues

The relevant key points and conclusions of this ATNI2 Report [68] follow:

A.2.2.1.1 Financial Aspects

From the Airline perspective some airlines expressed the view that a good ATN incentive would be the availability of direct routes, chosen flight profiles and priority for clearances for those that have chosen to invest in the ATN. Some airlines, on the other hand prefer that direct subsidies be made available based on the view that such subsidies will be in the public interest.

The study discussed various options for charging for ANS services from making them a function of demand on resource (e.g. airspace), to making them a function of avionics equipment fit, i.e. less charges for those airlines that have equipped with CNS/ATM equipment.

With respect to ATSO invoicing of ANS services the study identified a trend whereby ATSOs will be required to "unbundle" their services and invoice users based on specific services according to their actual costs incurred in providing these services.

The study concluded that the largest expense for ATN deployment would be due to the avionics costs. On the issue of providing public funds to equip aircraft, the study concluded that this would not be possible in light of competition regulation (i.e. for those carriers that did not qualify for funds). Additionally it was considered that there are additional/alternative CNS/ATM related technologies that could also lay claim to public funds.

A.2.2.1.2 Aeronautical Operational Control (AOC) Communications

The study noted that a strong driver for ATN is AOC communications which are becoming increasingly mission critical for many airlines. With AOC applications suffering from the saturation of the ACARS network the airlines, through the AEEC, have been looking at the various means to upgrade to the VHF Digital Link and believe that if an ATN solution is adopted then it must also support AOC. However, the study also noted that some ATSOs might be reluctant to offer their dedicated ATS networks to offer routes to AOC traffic.

A.2.2.1.3 Network Management

On the subject of network management the study concluded that EUROCONTROL, through the "European ATN Co-ordinating Entity" (EACE), is a suitable operator of common services such as Route Servers. With respect to management of the ATN infrastructure the study envisaged two possible solutions. The first a non-hierarchical, distributed solution whereby each administrative domain (e.g. a State) is responsible for the management of all elements that operate within its domain and interacts with adjacent administrative domains through sending/receiving data considered relevant. The second hierarchical, distributed solution whereby each administrative domain is responsible for the management of all elements that operate within that domain but, like all other domains, reports to a superior higher level entity. This higher level entity would have a total picture of the entire infrastructure.

A.2.2.1.4 Certification

On the subject of certification the study simply noted two possibilities for certifying systems. The first (the traditional method) whereby only the airborne part is certified through a global certification scheme. The second, whereby all elements in the end-to-end chain are subject to certification.

A.2.2.1.5 Regulation

The study reinforced the trend that operational services must be divorced from regulatory services and that a regulatory body should be envisaged for aeronautical telecommunications. The scope of such a body could clearly extend beyond the scope of the networks.

A.2.2.1.6 Service Level Agreements

The study expected that the elements of ATN communications services (e.g. ground/ground services offered by global operators) will need to be contracted and managed through strict Service Level Agreements.

A.2.2.1.7 Central Authority/Liability

The study expected that the central "ATN Regulating Authority" would define the legal catalogue of requirements that would form the basis of contractual regulation and individuation of contractual liability. The study referred to an "ATN Convention" to which each State would subscribe which would define common rules and legal, technical, financial requirements. The study noted that ATN operators and users will most likely define their relationships with different contractual agreements. Given this, it is necessary to solve the question whether the parties should be free to negotiate all of the terms of their contract or whether a minimum level of liability on the part of the service provider, as well as immunities from liability, should be prescribed by a mandatory rule defined by the Central Authority. In order to ensure that the ATN operators could bear the financial responsibility the study recommended that the Central Authority should define also the financial requirements that any ATN operator should possess.

A.2.2.1.8 Awareness

The study noted that, amongst European airlines, there was a general lack of awareness on ATN developments.

A.2.2.2 The Introduction of the ATN in Europe: A Regulatory Framework

The second deliverable of the ATNI2 study [89] proposes that a regulatory approach, i.e. through the definition of a "Regulatory Framework", is defined to facilitate the implementation and oversee operation of the ATN in Europe. The primary reason being that, given the significant impact and role that the ATN is expected to play in the future of European ATM, the possibility exists for the major stakeholders to influence its development in a manner that favours them at the expense of other stakeholders. This is considered completely contrary to the spirit and the letter of the Treaty of Rome. The report proposes a Regulatory Framework applying to aeronautical telecommunications rather than proposing limited and isolated measures. Such a framework is considered to provide a fair and non-discriminatory framework which will allow the various stakeholders the means to develop their strategies knowing they are on par with all other stakeholders. The framework proposed has been based on experiences gained in the telecommunications domain as well as from parts of air transport regulation. The report goes on to discuss at length the various issues that need to be defined within the context of a Regulatory framework, the most significant points being:

- **Harmonised Service Provision (HSP) Principles**: based on the need to respect "essential requirements" (which ensure optimal safety conditions in transport) and ensuring the freedom to services in order to make the best technical and economic solution.

- **Safety Rules**: Related to the management of the safety requirement focusing on:

  - The certification of systems and services**;**

  - The civil liability of service providers

  - The nature of contracts

- **Interconnection Rules**: Firstly, to ensure the effective "opening" of networks, their interoperability and the economic conditions to ensure that it is effective. Secondly to create a neutral entity which is responsible for providing the services of common interest. The study proposes that the stakeholders create an initial entity, the "European ATN Administrator" (EATNA). The EATNA would be responsible for contracting a second

neutral entity, the “European ATN Co-ordinating Entity” (EACE) with the task of providing all common services, e.g. provision of route servers.

- **Congestion Rules**: Given the forecast congestion in European airspace in the event that the ATM infrastructure does not adequately evolve, this element of the regulatory framework is concerned with defining rules to facilitate the economic emergence of the ATN. “They consist, according to different modalities, in favouring the users which use the ATN, by "taxing" those which do not.”

- **Authorisation/Licensing Rules**: In order to put into practice all of the measures mentioned above, the need to define an authorisation policy is proposed. Two types of policy are addressed. These being, licences (authorisations granted individually upon submission of a dossier, when they are limited in number), or general authorisations (granted automatically after verification of criteria).

- **The Regulator**: Finally the question of issues surrounding the regulator are addressed. The need for independence from service provision is stressed plus the fact that a regulator would be more efficient at an European level than a national one. EUROCONTROL is considered as a likely candidate with the proviso that there can be a clear distinction and separation between its regulatory and operational service functions.

A.2.2.3 ACCESS - Third Party Service Provision

The ACCESS project has conducted a Work Package focused on issues surrounding “Third Party Service Provision” [78]. The objective is to review and discuss the issues that ATSOs need to take into account when considering contracting out elements of the ATN service to third party communications service providers. The WP reinforces the ATNI2 view with respect to the use of strict SLA’s and provides detailed guidance on the issues that SLA’s need to address based on experiences acquired during the ADS Europe trial [108] and FANS 1/A operations in the South Pacific [92].

A.2.2.4 ACCESS – Institutional Issues

The ACCESS Work Package on Institutional Issues [121] used the first deliverable of the ATNI2 Study [68] as its basis. The WP reviewed the technical infrastructure proposed by ACCESS against the various institutional and administrative issues raised in the ATNI2 deliverable. The result of the review was that there are no conflicts or constraints identified in the ATNI2 study that would impact the ACCESS technical solution.

A.2.2.5 Network Service Management Task Force

The NSM Task Force of the EATCHIP Ground-Ground Subgroup is responsible for addressing and resolving the issues necessary for integrating a number of ATSO networks into an European ATSO Network (EAN). The institutional issues which arise when creating such a pan-European network are being addressed within the context of an “Interconnection Agreement”. The Task Force did not have the opportunity to review the draft agreement, as it had not been released for public review. However, based on a review of the NSM TF Minutes ([86], [87], [88], [116], [117]) it is understood that the Interconnection Agreement will address the following subject areas:

- Network Management Group Procedures
- Gateway Interface Specifications
- Network Service Levels
- Network Management System and Escalation Procedures
- Security Arrangements

- Network Costs Sharing Principles
- X.25 Service Description
- Frame Relay Service Description
- Internet IP Service Description
- X.28/X.3/X.29 Service Specification

A.2.3 Satellite Communications and GES Institutional Issues Study

The primary objective of the Satellite Communications and GES Institutional Issues study ([76], [77]) was to survey the institutional issues which will affect the provision and operation of a satellite communications service for ATS purposes within Europe. In particular, the study analysed how GESs supporting ATS services in the European airspace could be best organised, operated and managed and which requirements would be placed on the GES operator and the aeronautical satellite communications service provider. The study focused on the institutional, regulatory, and operational aspects and only subsequently on the procurement and implementation of such satellite ground earth stations.

The "*Key Institutional and Policy Issues" includes* a number of important institutional issues concerning the provision of the AMSS in the context of the Aeronautical Telecommunications Network (ATN). It highlights those ATN aspects which may have implications on the institutional arrangements for the AMSS in order to identify institutional arrangements for the AMSS that are still applicable and acceptable when transitioning to the ATN at a later stage.

There are seven major aspects concerning the definition of institutional arrangements when considering the AMSS in the context of the ATN. These are:

- accounting and charging management,
- GES selection,
- validity of advertised routing information,
- enforcement of service level agreements,
- access control,
- security, and
- organisational simplicity.

A.2.3.1 Accounting and Charging Management

In the ATN packets are routed on a hop-by-hop basis, each ATN router making an individual decision concerning the next hop router. As a consequence, there is no fixed path between the sending and the receiving entity, but subsequent packets may dynamically travel along different paths although belonging to the same sender/receiver pair. During their journey from the source to the sink the packets may pass through different ATN routers and subnetworks which may have different owners and/or operators and/or administrators. If these different paths each have different pricing structures and charging schemes too, accounting for the use of the (subnetwork) resources will be much more complex than in a simple topology where the users are directly connected to the uplink facility, e.g. GES, through a single ground network or access line.

The level of accounting complexity is increased by the fact that ATN routers have to support pass-through-traffic for another organisation, if the ATN router is located in a so-called transit

routing domain. ATN routers connected to an air/ground subnetwork, such as the AMSS subnetwork, will always be required to be part of a transit routing domain, unless the air/ground subnetwork will not be shared with traffic from outside the domain boundary.

In the case that charges are calculated on a per use basis, a sophisticated monitoring and accounting system will be required as well as a high degree of co-operation between the entities providing the communications services. A flat rate approach to charging may cause inequalities between the entities carrying the traffic, in particular as the ATN routing policies can be (ab)used to attract or block traffic to/from particular communications resources.

Accounting based on QoS needs to be considered in the internetwork environment because various subnetworks may support different levels of QoS. As the cost for the transfer across the air/ground link in general, and for the AMSS in particular, will clearly dominate the end-to-end communications cost, a simplified accounting scheme may be developed which is exclusively based on the air/ground subnetwork used for the information exchange between aircraft and ground facilities. In this case, the ground point of attachment of each subnetwork would be the only metering point within the network.

A.2.3.2 GES Selection

For ground-to-air communications neither the sending party nor the receiving airborne user can select the GES which is uplinking the messages. This is a problem which is currently experienced by aircraft operators in establishing voice calls to aircraft and it will likely be a problem for data communications in the ATN.

The routing in the ATN is distributed (i.e. the individual ATN routers make independent routing decisions) and based on connectivity, quality of service, traffic types and local policy. Routing is performed on the internetwork level, i.e. the underlying subnetworks are globally characterised by their performance figures, the individual structure within the subnetwork is transparent to the ATN routing process. The ATN Internet SARPs do not contain any provisions which allow the specification and selection of a particular GES in the routing process. Ground ATN routers which are directly attached to the AMSS subnetwork are in a position to select a particular GES, if several GESs are available, and may be configured through local policy to route data packets to a particular GES based on bilateral agreement with the particular GES operator. However, ground ATN routers which are several hops away from the AMSS subnetwork only have the global information that the air/ground router is offering a path to a given aircraft via the satellite system, but they have no means in selecting a specific GES, and are not in a position to consciously route data to a particular GES. This is likely to be a serious problem, as the data have to be directed to the log-on GES in order to be uplinked, given the current log-on limitations. Otherwise, the data will be discarded by the GES.

Even if the log-on capability will be enhanced this may cause a problem in the cases where:

- an air/ground router is simultaneously connected to an ATS GES and the GES of a third party CSP;

- a router receives reachability information from multiple routers each indicating a suitable route for ATSC via the AMSS subnetwork.

Unambiguous selection of the appropriate GES may be achieved by suitable network design, i.e. simple network topologies and appropriate routing policies within the ATN routers. For example, the routing policies implemented in an ATS air/ground router which is connected to an ATS GES and to a third party CSP GES for backup purposes may ensure that all packets are routed via the ATS GES unless a failure in this primary GES is identified.

An alternate solution to this problem may be that routing policy controls the distribution of routing information in the ground ATN in a way that one and only one route to an aircraft over the satellite subnetwork is advertised in the ATN. This route would follow a path which

contains the log-on GES of this aircraft and would ensure that the data forwarded to this GES will be uplinked to the aircraft.

A.2.3.3 Validity of Advertised Routing Information

ATN routers advertise routes (i.e. connectivity to end systems) which, in general, are based on routing information received from adjacent routers and on connectivity information received from attached subnetworks. As the route advertisement in the ATN beyond organisational and administrative boundaries is a distributed policy-controlled process, the advertised routing information must not be generated according to strict, standardised rules, but is within the authority of the advertising router or its administrator respectively. This tends to bear the inherent problem, that the advertised routing information may not correctly represent the current status of connectivity, and, for example, may indicate a path over the AMSS subnetwork which actually is not available.

In a competitive business environment, commercial CSPs may advertise routes to attract traffic on their networks although they do not have appropriate subnetwork connections available. The implication would be that traffic following such a route may be delivered via a subnetwork whose quality of service level is not compliant with the requirements of the traffic, or has to be re-routed with negative effects on the transit delay, or may even be discarded.

On the other side, AMSS providers may not advertise available routes over the AMSS subnetwork, in order to block some type of traffic from using their communications resources. Such a situation may be critical for safety communications, in particular for urgency and distress messages, if no alternate path to an aircraft exists.

From the above, it seems to be clear that, if the AMSS is integrated into the overall ATN, the correctness of the advertised connectivity information has to be ensured, and appropriate institutional procedures have to be defined to this end. Regulations concerning the application and use of (routing) policy in the ATN may be one element in this process.

A.2.3.4 Enforcement of Service Level Agreements

The routing information distributed in the ATN allows to differentiate routes to and from aircraft with respect to the mobile subnetwork type (e.g. AMSS, VDL, Mode S) a packet will pass over in following the route. ATN traffic may be qualified for a particular type of air/ground subnetwork only, or it may be routed using an ordered preference of different subnetwork types (e.g. try Mode S first, then VHF, then AMSS). No explicit information concerning the operator/administrative authority of this subnetwork is contained in the route. The implication of this is, that traffic may be forwarded along a path which uses the resources of a CSP that is not the CSP contracted by the sender/receiver of the message for delivery of its communications traffic. From this the question arises how to ensure that traffic is routed via the resources of the CSP, if a service level agreement (SLA) exists between this CSP and the sender/receiver of the traffic.

There are several potential solutions to this problem, including technical ones, institutional ones, and network design alternatives. However, there are no known activities which address this subject with respect to the future aeronautical communications system in due detail. The enforcement of SLAs is in particular an important issue for satellite communications, as such SLAs exist today (primarily for APC provision) in this domain, and are likely to exist in the future.

A.2.3.5 Access Control

In an internet environment, like the ATN, each subnetwork may establish and enforce policies for admitting and transmitting traffic in the form of access control. To provide global consistency, a commonalty of the access mechanism(s) is essential, and in addition, access control policies need to be established which are acceptable and uniform within a class of subnetworks.

A.2.3.6 Security

One of the strengths of the ATN is the ease with which the differing organisations can exchange and share information. On the other hand, ATS providers may be concerned about the security and privacy of their data, in particular if they are connected with third party CSPs through ATN routers. Potential issues include primarily the fear of unauthorised access to the ATS end systems and ATS applications through the ATN, as well as the exposure of sending information over the ATN. The associated risks may be mitigated through appropriate network design or organisational arrangements.

A.2.3.7 Organisational Simplicity

A complex organisational structure of the ATN (e.g. many States operating own Routing Domains and (air/ground) subnetworks) complicates the management and control of the network as well as the routing function to be provided in the airborne and ground-based systems. In its simplest form (i.e. a single centralised ATS connected to one air/ground router) only one router table entry would be required for all air/ground ATS Satcom. The maintenance of complex routing and policy information databases would not be needed.

Again, an appropriate network design in conjunction with suitable organisational and institutional arrangements for the shared use of the network resources will achieve a manageable and workable ATN in Europe.

A.3 USA Activities

In the USA there are a number of related activities devoted to the certification of ATN based systems, these being:

- The FAA's development of "Guidelines for Design Approval of Aircraft Data Communications Systems" to be published as an Advisory Circular [84];
- The FAA Advisory Circular, Initial Air Carrier Operational Approval for use of Digital Communications Systems [106], is intended to provide guidance on acceptable means for the "operational approval" to use digital communications systems for ATS;
- The ATN Systems Inc. "Certification Approach" [93];
- The RTCA has convened a "Certification for CNS/ATM" Task Force [105] whose objective is to "review the "certification" process employed "end-to-end" for advanced aviation systems.
- The US Office of Inspector General (OIG) recently published its findings and recommendations following an audit of the FAA's progress and plans for the implementation of ATS data link [96].

A.3.1 FAA Guidelines

The FAA is currently developing an Advisory Circular (AC 20-DC) [84] which will be issued in order to support the introduction of data communications for air traffic services (ATS). The AC provides guidelines for design approval of aircraft data communications systems and applications primarily used for ATS. The AC does not provide guidance on obtaining operational authorisation to use ATS data communications applications or for commissioning ground or airborne segments of the end-to-end system.

Current data communications systems and applications installed on aircraft have been approved on a non-essential equipment and shown not to interfere with the more critical functions on the aircraft. The AC states that this is unlikely to be the case with ATS use and that the failure of systems enabling ATS may contribute to conditions whose classification is more than severe. In order to adequately assess the effects of failures and design errors the AC describes a means, using the safety assessment, to identify safety requirements for the

operational environment in which the aircraft data communications and applications will operate. Also addressed are the requirements for interoperability with the air/ground subnetwork, ground data communication system and ground applications. The AC recognises that different parts of the data communications system and applications are controlled by different organisations. For example within the FAA the Aircraft Certification Service is responsible for design approval, whereas the Flight Standards Service is responsible for operational authorisation. The AC states that the FAA is co-ordinating the development of the guidelines with foreign CAA through the "International Co-ordination Panel for Navigation and Communication".

The process specified to facilitate design approval consists of a number of activities as follows:

- Conducting a safety assessment;
- Validating safety requirements established by the safety assessment;
- Validating the requirements for the aircraft data communications system and applications;
- Validating the inter-operability requirements;
- Ensuring that the implementations provided by the aircraft systems meet the requirements for the aircraft data communications system and applications.
- Evaluating flight crew operations and flight manual provisions.

With respect to related current activities the AC notes that the FAA Flight Standards Office is planning to issue Draft Order 8400.DL which will define the roles and responsibilities for FAA organisations involved in the implementation of data communications systems and applications for operational use.

The FAA Flight Standards Office has issued a draft Advisory Circular (AC-120) [106] whose objective is to describe the means by which air carriers may acquire "operational approval" for the use of digital voice and data communications system in support of ATS. Specifically, the AC describes the digital communications operational approval process, acceptable methods for training, acceptable programmes for maintenance, operational policies for use, appropriate actions in the event of an exceptional ATC digital communications event, and criteria for foreign operator use of digital communications in U.S. airspace.

A description of the FAAs avionics certification process is presented in [85].

A.3.2 ATNSI Certification Approach

The ATNSI Certification Approach [93] describes their process for obtaining FAA approval for ATNSI products including the means by which ATNSI will show that the ATNSI products comply with FAA airworthiness requirements.

ATNSI, within the context of a co-operative agreement with the FAA, is developing certifiable portable ATN software for both avionics and ground systems to support customisation and configuration programs that will result in the implementation of first production articles that use ATN products. ATNSI is developing the Router Reference Implementation (RRI), composed of a set of ATN Router and End System products, and the Conformance Test Suite (RRI) which will be used in the testing, acceptance and certification of the RRI software. The ATNSI approach is essentially based on the guidance provided in the FAA Advisory Circular AC-20-DC described above.

A.3.3 RTCA Task Force 4 - "Certification" for CNS/ATM

The following text is reproduced from the Executive Summary of the draft report of the Certification Task Force [105].

Historically, the Federal Aviation Administration and the respective international regulatory authorities have provided a regulatory framework, which has enhanced safety while simultaneously introducing new products and operational capabilities. However, during the last decade or so, the dynamic growth and globalization of aviation have outpaced the government's certification policies and regulatory oversight of Communications, Navigation, Surveillance / Air Traffic Management (CNS/ATM) systems, equipment and procedures. The time and cost of implementing new operational capabilities is increasing and is inhibiting the introduction of safety enhancements. The differences among various countries' certification processes and criteria add additional time, cost, and effort to obtaining the necessary approvals. Of note, the certification "cycle time" is now longer than the useful life of some components.

This situation has caused many in governments and industry to observe that the current certification process is too lengthy and too costly. In some instances elements of the certification process yield little or no "value added" from either aviation's or the public's perspective.

To address these and other challenges, in the Spring of 1998, FAA Administrator Jane Garvey asked RTCA, Inc. to convene a Task Force. The objective of this initiative was to "recommend what changes are needed as well as how and when any recommended changes should be implemented" to make the certification process more responsive to today's operational environment.

The terms of reference for the Task Force included:

"Task Force 4 is to review the "certification" process employed "end-to-end" for advanced aviation systems. Spurred by the recognized industry need to develop more responsive certification standards and processes for CNS/ATM and related systems on the ground and in the air, the Task Force is to review certification processes, recommend changes that would improve timeliness or reduce cost while maintaining the existing level of safety, or improve safety."

"It is intended that this activity will result in an internationally agreed road map for certification and operational authorization of CNS/ATM systems that will produce significant reductions in cost, more responsive certification services for CNS/ATM and related systems of the future, while significantly improving and at least maintaining levels of safety. The Task Force is not chartered to develop specific standards, methods, criteria, practices or new organizational structures."

The Task Force convened in June 1998. Participation was open to the public and everyone with an interest in the "aviation certification" process was encouraged to offer his or her views. Over 200 members of the international aviation community participated in the meetings of the Task Force, about 25% of who were members of FAA staff.

It readily became apparent that the review and approval system in place in the United States and throughout the world is very complex, that the various elements of the State's certification systems are not formally linked and that they often operate independently.

The Executive Summary of the draft Certification Task Force report [105] is reproduced at attachment 5.

A.4 Joint US/Europe Activities

There are currently two joint US/Europe activities that are relevant to this report:

- The joint RTCA SC-189/EUROCE WG-53 activity on Safety and Interoperability requirements for data link based air traffic services and the

- The development of the Common American European Reference ATN Facility (CAERAF) [122].

A.4.1 RTCA SC-189/EUROCE WG-53

The Terms of Reference of the joint committee are: "To advance Communication, Navigation, Surveillance/Air Traffic Management (CNS/ATM) concepts and support operational implementation, Special Committee (SC) 189/Working Group (WG) 53 shall develop guidance material to define the safety requirements and interoperability requirements for Air Traffic Services (ATS) supported by data communications."

Specifically, in addition to material supporting use of FANS/1 and ACARS for ATS purposes, the committee is tasked to produce the following material which is directly relevant to ATN implementation:

- Interoperability Requirements for ATS applications using ICAO ATN data communications; and

- CNS/ATM Safety Assessment Methodology; and

Work has recently been initiated on the development of the Interoperability Requirements material in the context of the Petal IIe trial. The Safety Assessment Methodology ([81], [109], [110], [111], [112], [113], [114], [115]) is considerably advanced and its key points are briefly presented in the following sub-section.

A.4.1.1 CNS/ATM Safety Assessment

This CNS/ATM Safety Assessment [81] material produced by the committee provides guidelines for performing CNS/ATM safety assessments for the purpose of qualifying air traffic services that are supported by data communications. The CNS/ATM safety assessment described is an assessment of the safety of the entire airspace system. The assessment should be applied to all elements of the operational environment, including communications, navigation, and surveillance (CNS) air traffic management (ATM) services, systems, and procedures. The CNS/ATM safety assessment includes an operational safety assessment, safety assessments made by individual institutions, and the continued operational safety. The material recommends that Safety assessment methods are used to establish safety objectives or high level requirements needed to attain a particular operational capability in a defined operational environment. Such requirements are allocated to parts of the system, procedures, or airspace characteristics. Qualification means are then applied to development activities to ensure that specific implementations satisfy these requirements with acceptable levels of confidence. In considering a multi-institutional system, the allocated requirements go beyond the control of any one State or organization.

A.4.2 Common American European Reference ATN Facility

Within the context of an agreement between the EUROCONTROL Agency and the FAA, the Agency has, in an agreement with ATNSI regarding the use of the CAERAF, let a contract for the development of a reference ATN facility referred to as the "Common American European Reference ATN Facility" (CAERAF). The objective of the CAERAF project is to deliver a system that will:

"Support the US and European approval, certification and commissioning process of operational ATN avionics and ground based ATN systems"

Through the provision of a comprehensive testing service. The CAERAF is scheduled to be delivered in November 2000. EUROCONTROL is investigating the possible options for the operational use of the CAERAF, e.g. as EUROCONTROL, US, industry etc.

A.5 FANS 1 South Pacific Operations

The FANS Interoperability Team (FIT) [92] was formed in 1996 with the objective of gathering, analysing and resolving problems associated with the operation of the FANS 1/A system in the South Pacific Region. The FIT established to oversee the monitoring process which ensures that the FANS 1/A system continues to meet its performance and interoperability requirements and that operations and procedures are working as planned. The FIT established a Central Reporting Agency (CRA) which acts as a clearing house for FANS related problem reports and monthly trend data. All information released by the CRA is de-identified. The FIT achieves its purpose by receiving from members monthly status reports that include system performance indicators and anomalies. The FIT consolidates reports produced and publishes the consolidated set of system performance indicators on the FIT web site.

A.6 GNSS

Due to its reliance on foreign states for navigation signals (i.e. US and Russia) and the fact their will be multiple suppliers contributing to the user service the GNSS faces a whole range of complex legal and institutional issues in the context of civil air navigation. These issues primarily relate to operating structures, liability and certification. In recognition of these types of issues ICAO has defined a “Charter on the Rights and Obligations of States relating to GNSS Services” and several recommendations relating to certification, liability, financing and future operating structures. In Europe, where the EGNOS system is foreseen for implementation by 2002 steps have been taken to define a regional framework.

A.6.1 ICAO

- **Draft Charter**

A Panel of Legal and Technical Experts on the Establishment of a Legal Framework with Regard to GNSS (LTEP) was established by the ICAO Council on 6 December 1995, with the mandate, *inter alia*, to consider different types and forms of the long-term legal framework for GNSS and to elaborate a legal framework which would respond to certain fundamental principles. The work of the Panel has resulted in the text of a Draft Charter on the Rights and Obligations of States Relating to GNSS Services (the “Draft Charter”), Attachment 3.

- **Legal Aspects**

The Panel of Legal and Technical Experts on the Establishment of a Legal Framework with Regard to GNSS (LTEP) has considered, in addition to the Draft Charter on the Rights and Obligations of States Relating to GNSS Services, the following legal issues related to GNSS:

- Certification
- Liability
- Administration, financing and cost recovery
- Future operating structures

A.6.1.1 Draft Charter

The Draft Charter embodies a number of fundamental principles applicable to the implementation and operation of GNSS, including:

- **Safety of International Civil Aviation**

The safety of international civil aviation is a paramount principle embodied in the Preamble and Article 44 (h) of the Chicago Convention. The Draft Charter reiterates this principle. Accordingly, the safety of international civil aviation should be fully safeguarded at all times in the operation of GNSS, including modifications to the system.

- **Universal Accessibility of GNSS Services**

Universal accessibility refers to the right of every State and aircraft of all States to have access to the services on a non-discriminatory basis under uniform conditions. This principle is incorporated into paragraph 2 of the Draft Charter.

- **Continuity, Availability, Integrity, Accuracy and Reliability**

When GNSS Services are provided, there is a need to ensure that the services are available on a continuous basis. Technical standards have to be complied with in order to ensure the integrity, accuracy and reliability of the services. Paragraph 4 of the Draft Charter addresses this matter.

- **Sovereignty**

The principle of complete and exclusive sovereignty of States over the airspace above their territory is reaffirmed in the Draft Charter. In accordance with this principle, every State may, among other things, preserve its authority and responsibility to control operations of aircraft and to enforce safety and other regulations within its sovereign airspace.

- **Compatibility with Global Planning and Implementation**

The implementation of CNS/ATM systems will require an unprecedented degree of international co-operation in the history of civil aviation. In order to achieve the global integration of the system, a well prepared global implementation plan is necessary.

Financial resources are limited and should be used to achieve optimum results. Duplication of efforts should be minimized and mutual interference prevented. In view of this, the Draft Charter provides that States shall be guided by the principle of co-operation and mutual assistance. Uniformity of GNSS services and compatibility of regional or sub-regional arrangements with the Charter and with the global planning and implementation process are emphasized in the Charter.

A.6.1.2 Legal Framework

The following legal issues related to GNSS have been addressed by the ICAO Panel of Legal and Technical experts:

(1) certification;

(2) liability;

(3) administration, financing and cost recovery; and

(4) future operating structures.

- **Certification**

Recommendations 1 to 8 put forward by LTEP are related to the legal aspects of certification. Attention has been given to the need for developing adequate safety standards for the use of GNSS, in the form of ICAO SARPs. The recommendations identify the role that States providing signals-in-space could play in the application of ongoing safety management processes. For instance, Recommendation 3 indicates that these States shall certify the signal-in-space by attesting that it is in conformity with SARPs. Further, it has been considered important to exchange information concerning the failure mode of the system. Accordingly, the ICAO forum referred to in Recommendation 8 would be used for this purpose.

- **Liability**

Issues related to liability have been discussed in the LTEP and are reflected in Recommendations 9 to 11. Since there is no unanimous conclusion at this stage with respect to these issues, the recommendations identify a number of concepts in relation to the liability regime for GNSS which should be further studied. For instance, further studies are necessary in order to determine whether the GNSS service providers could insert a disclaimer of liability into their service contracts as the providers of satellite telecommunication services have done.

- **Administration, Financing and Cost Recovery**

Recommendations 12 to 14 put forward by LTEP are related to the legal aspects of administration, financing and cost recovery of GNSS services. These recommendations refer to GNSS services as an international service for public use, identify the possible options for administrative mechanisms for GNSS, and consider the possible method of financing GNSS.

- **Future Operating Structures for GNSS**

The term "future operating structures" is related to long-term GNSS, rather than the existing systems. It is ICAO's established policy that GNSS should be implemented as an evolutionary progression from existing global navigation satellite systems, including the United States' global positioning system (GPS) and the Russian Federation's global orbiting navigation satellite system (GLONASS), towards an integrated GNSS over which Contracting States exercise a sufficient level of control on aspects related to its use by civil aviation. Recommendations 15 to 16 put forward by LTEP address the related issues. Recommendation 15 refers to the co-ordinating role for ICAO, the concept of civilian control over the future GNSS primary signals, and the optimum use of existing organizational structures. Recommendation 16 indicates the need to develop initially national and/or regional operating structures for GNSS, and identifies certain possible fields of international action.

A.6.2 Europe

The ECAC presented a paper [73] at the Rio World Wide Conference which outlined the European view on the legal and institutional issues relating to GNSS. The following is a summary of the key points from that paper.

A.6.2.1 GNSS Entity/Contractual Chain

At the EUROCONTROL level the need for an European entity, "GNSS Entity" has been identified which would be responsible for the organisation and co-ordination of the installation and operation of the satellite navigation infrastructure in Europe. Initially such an entity would support the EGNOS and subsequently the longer-term satellite navigation infrastructure (i.e. GNSS-2). A key responsibility of the GNSS unit would be to link the use of the infrastructure to the provision of air traffic services by a series of contractual arrangements. This introduces the concept of the "contractual chain" which would ensure that the overall infrastructure guarantees the delivery of the required signals which satisfy the requirements of the air traffic service providers with respect to integrity, accuracy, reliability and availability. At each stage of the chain, the contracts will define the performance guarantees, thereby identifying the extent of liability of the various actors. In this was liability would fall on the actor who committed the act/omission that caused the accident. It is envisaged that there will be contractual arrangements between the primary signal providers (e.g. US government for GPS) and the augmentation signal providers (e.g. EGNOS for Europe); between GNSS service providers and States, and between GNSS service providers and industry, which would provide for firm performance, service guarantees and determine liability. The GNSS entity would be the focal point for concluding the necessary contracts between the relevant actors in order to ensure an efficient, consistent and coherent set of contracts.

A.6.2.2 Liability

Liability resulting from any failure or malfunction of the augmentation systems is an important element of the European GNSS legal framework. Failures with respect to quality of information, or the monitoring and warning system may lead to catastrophic consequences. Such failures may arise from:

- Intrinsic defects in the system design;
- Failure with regard to the operation of the system, e.g. human error, inadequate error;
- External causes such as collisions in space;
- Military interference, hostile action;
- Denial of supply by owner of equipment.

Each of these events may lead to different kinds of liability. Legal liability (as opposed to criminal liability) can arise out of either a contractual or non-contractual situation. All entities involved in the provision of the service will be bound by contracts and their liabilities will be bound by these. Aviation users on the other hand would not be in any contractual relationship with the providers of the system and will therefore be obliged to rely on non-contractual liability. It is expected that liability resulting from GNSS related incidents with respect to the aviation users will be a shared liability involving several actors and States. In the absence of an international liability framework, GNSS accidents are likely to lead to numerous actions in several States as well as many third party actions. The ECAC view is that an international liability framework needs to be defined on order to facilitate an efficient procedure for resolution of liability claims. Such a framework is expected to take time and as an interim measure it is accepted that the contracts will need to define liability terms and conditions.

A.6.2.3 Safety Regulation

It is recognised that before GNSS can be used for safety critical ATS applications it must be approved by an appropriate body. EGNOS will need to be approved at the European level though, according to the ICAO convention, it will remain the responsibility of States to regulate within their territorial boundaries. The “Safety Case” approach for the entire EGNOS system is being considered as the means to satisfy the State’s regulators. The GNSS entity would have a key role in the safety case development. It would be responsible for the development of the Safety Case, ensuring safety requirements are satisfied by relevant parts of the system and maintaining the safety case. The entity would be expected to co-operate with the States and other bodies such as the JAA for the safety regulation of GNSS.

Attachment 2 – FANS II Committee Institutional Guidelines

General Guidelines

Guideline I-I: Universal accessibility to air navigation services must be available without discrimination.

Guideline I-2: The rights and responsibilities of States to control operations of aircraft and enforce safety regulations within their sovereign airspace must not be compromised.

Guideline I-3: Arrangements must preserve, facilitate and not inhibit ICAO responsibility for the establishment of appropriate Standards, Recommended Practices and procedures in accordance with Article 37 of the Convention on International Civil Aviation.

Guideline I-4: Arrangements must recognise State's responsibility and authority to enforce safety regulations.

Guideline I-5: Existing governmental or inter-governmental agencies need not be established if existing agencies in present or modified form can do the job satisfactorily.

Guideline I-6: Existing institutional arrangements and legal regulations should be preserved wherever practicable.

Guideline I-7: Arrangements should be made for determination of liabilities.

Guideline I-8: Adequate arrangements should be made for recovery in the event of a significant malfunction or catastrophic failure of the satellite system.

Guideline I-9: Arrangements must be adequately flexible to accommodate presently defined services and a range of future services.

Guideline I-10: Arrangements should allow the introduction of satellite services on an evolutionary growth basis.

Guideline I-11: Policies governing charges levied on users must not inhibit or compromise the use of satellite-based safety services.

Guideline I-12: Institutional arrangements should not prevent competition among different service providers that comply with the ICAO SARPs.

ATN Guidelines

Guideline IIa-1: Adequate arrangements should be made for service recovery in the event of a significant malfunction within the system. When failures occur the system design should allow for gradual degradation.

Guideline IIa-2: Arrangements should allow the introduction of services on an evolutionary growth basis.

Guideline IIa-3: Policies governing charges levied on users must not inhibit or compromise the use of services. Arrangements must ensure reasonable allocation of costs among States and other system users.

Guideline IIa-4: Arrangements must ensure guaranteed priority of safety communications over non safety and non ATS communications in accordance with ICAO SARPs.

Guideline IIa-5: Arrangements must retain air traffic services (ATS) authority to co-ordinate and maintain control over ATS communications.

Guideline IIa-6: Arrangements should not preclude the integration of existing communications networks and infrastructure into the ATN where these are adequate.

Guideline IIa-7: Arrangements must not interfere with State's regularity rights and responsibilities. States should make known any regulatory restrictions to facilitate other States' interconnection.

Guideline IIa-8: Arrangements must facilitate the certification by States of ATN services and equipment.

Guideline IIa-9: Arrangements and application of ATN Routing policies should preserve a State's ability to control the types of traffic on any subnetwork for which it is responsible.

Guideline IIa-10: Arrangements should not preclude that ATC, AOC, AAC and APC can be made available to the appropriate end-user.

Guideline IIa-11: Arrangements should be made to ensure security for the ATN is maintained in accordance with vulnerability analysis and risk assessments.

Attachment 3 - DRAFT CHARTER ON THE RIGHTS AND OBLIGATIONS OF STATES RELATING TO GNSS SERVICES

Whereas Article 44 of the *Convention on International Civil Aviation*, signed on 7 December 1944 (the "Chicago Convention"), mandates the International Civil Aviation Organization (ICAO) to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport;

Whereas the concept of the ICAO communications, navigation and surveillance/air traffic management (CNS/ATM) systems utilizing satellite-based technology was endorsed by States and international organizations at the ICAO Tenth Air Navigation Conference, and was approved by the 29th Session of the Assembly as the ICAO CNS/ATM systems;

Whereas the Global Navigation Satellite System (GNSS), as an important element of the CNS/ATM systems, is intended to provide worldwide coverage and is to be used for aircraft navigation;

Whereas GNSS shall be compatible with international law, including the Chicago Convention, its Annexes and the relevant rules applicable to outer space activities;

Whereas it is appropriate, taking into account current State practice, to establish and affirm the fundamental legal principles governing GNSS;

Whereas the integrity of any legal framework for the implementation and operation of GNSS requires observance of fundamental principles, which should be established in a Charter;

[*The Assembly solemnly declares*] [*States Parties recognize*] that the following principles of this Charter on the Rights and Obligations of States Relating to GNSS Services shall apply in the implementation and operation of GNSS:

1. States recognize that in the provision and use of GNSS services, the safety of international civil aviation shall be the paramount principle.

2. Every State and aircraft of all States shall have access, on a non-discriminatory basis under uniform conditions, to the use of GNSS services, including regional augmentation systems for aeronautical use within the area of coverage of such systems.

3. a) Every State preserves its authority and responsibility to control operations of aircraft and to enforce safety and other regulations within its sovereign airspace.

b) The implementation and operation of GNSS shall neither infringe nor impose restrictions upon States' sovereignty, authority or responsibility in the control of air navigation and the promulgation and enforcement of safety regulations. States' authority shall also be preserved in the co-ordination and control of communications and in the augmentation, as necessary, of satellite-based air navigation services.

4. Every State providing GNSS services, including signals, or under whose jurisdiction such services are provided, shall ensure the continuity, availability, integrity, accuracy and reliability of such services, including effective arrangements to minimize the operational impact of system malfunctions or failure, and to achieve expeditious service recovery. Such State shall ensure that the services are in accordance with ICAO Standards. States shall provide in due time aeronautical information on any modification of the GNSS services that may affect the provision of the services.

5. States shall co-operate to secure the highest practicable degree of uniformity in the provision and operation of GNSS services. States shall ensure that regional or subregional arrangements are compatible with the principles and rules set out in this Charter and with the global planning and implementation process for GNSS.

6. States recognize that any charges for GNSS services shall be made in accordance with Article 15 of the Chicago Convention [and shall be based on] [and should be based on] [noting] the principles set forth in the *Statements by the Council to Contracting States on Charges for Airports and Air Navigation Services*[, including the principle that it shall neither inhibit nor discourage the use of GNSS services. Such charges shall be apportioned in an equitable manner among all users of GNSS].

7. With a view to facilitating global planning and implementation of GNSS, States shall be guided by the principle of co-operation and mutual assistance whether on a bilateral or multilateral basis.

8. Every State shall conduct its GNSS activities with due regard for the interests of other States.

9. Nothing in this Charter shall prevent two or more States from jointly providing GNSS services.

Attachment 4 – GNSS Legal Framework

RECOMMENDATIONS

Adopted by the Panel of Legal and Technical Experts

on the Establishment of a Legal Framework with regard to GNSS (LTEP)

CERTIFICATION

Recommendation 1

ICAO SARPs on GNSS should cover the system performance criteria of relevant satellite components, signal-in-space, avionics, ground facilities, training and licensing requirements, and the system as a whole.

Such ICAO SARPs should contain adequate system performance and failure mode information to enable States to reasonably determine the safety impact on their air traffic service.

Recommendation 2

With respect to all ICAO SARPs on GNSS, signal-in-space provider States and provider international organizations should be involved in the proposed ICAO verification and validation process so that SARPs and supporting ICAO documentation will be of high integrity.

Recommendation 3

States providing signals-in-space, or under whose jurisdiction such signals are provided, shall certify the signal-in-space by attesting that it is in conformity with SARPs.

The State having jurisdiction under the Chicago Convention should ensure that avionics, ground facilities and training and licensing requirements comply with ICAO SARPs.

Recommendation 4

States providing signals-in-space, or under whose jurisdiction such signals are provided, should ensure application of ongoing safety management processes which demonstrate continued compliance with signal-in-space SARPs.

Recommendation 5

States providing signals-in-space, or under whose jurisdiction such signals are provided, should produce a safety management system document using the ICAO forum referred to in Recommendation 8 below. To the extent possible, such document should be consistent as regards format and content. ICAO should distribute such signal-in-space safety management system documentation.

Recommendation 6

Each State should define and ensure the application of safety regulations for the use of the signal-in-space as part of air traffic services in its own airspace.

Recommendation 7

For the purpose of authorization by a State of the use of the signal-in-space in its airspace, additional information which may be required for such authorization should be made available

and distributed through ICAO. Other sources for obtaining such information may be used, including, *inter alia*, bilateral and multilateral arrangements, Safety Case and NOTAMs.

Recommendation 8

States recognize the central role of ICAO in co-ordinating the global implementation of GNSS and in particular:

a) establishing appropriate Standards, Recommended Practices and procedures in accordance with Article 37 of the Chicago Convention in the implementation and operation of GNSS;

b) co-ordinating and monitoring the implementation of GNSS on a global basis, in accordance with ICAO's regional air navigation plans and global co-ordinated CNS/ATM systems plan;

c) facilitating the provision of assistance to States with regard to the technical, financial, managerial, legal and co-operative aspects of the implementation of GNSS;

d) co-ordinating with other organizations in any matter related to GNSS, including the use of frequency spectrum bands in which GNSS constituent elements operate in support of international civil aviation; and

e) carrying out any other function related to GNSS within the framework of the Chicago Convention, including functions under Chapter XV of the Convention.

More specifically, the ICAO forum for exchange of information on GNSS certification could have the following functions:

a) to provide liaison between State ATS providers, regulatory authorities, and signal-in-space providers;

b) to provide liaison between signal-in-space providers and other States with respect to the format and contents of safety management system documents;

c) to identify the failure modes of the signal-in-space and their impact on the safety of air traffic services nationally, and to refer them to an appropriate body as determined by the Council;

d) to identify what States require from signal-in-space providers in order to be confident that performance and risks associated with the signal-in-space are adequately managed over the life cycle of the system;

e) to facilitate information-sharing between signal-in-space providers and other States as to the continued compliance with the relevant SARPs, in order to maintain confidence in the reliability of the system.

LIABILITY

Recommendation 9

The following concepts, among other matters, should be considered in relation to the liability regime for GNSS which should be further studied:

a) Fair, prompt and adequate compensation;

b) Disclaimer of liability;

c) Sovereign immunity from jurisdiction;

d) Physical damage, economic loss, and mental injury;

e) Joint and several liability;

f) Recourse action mechanism;

g) Channelling of liability;

h) Creation of an international fund (as an additional possibility or an option);

i) The two-tier concept, namely strict liability up to a limit to be defined, and fault liability above the ceiling without numerical limits.

Recommendation 10

With regard to the fault liability portion, signals should be recorded for purposes of evidence in accordance with ICAO SARPs.

Recommendation 11

In conducting the studies on the liability regime for GNSS referred to in Recommendation 9, the following matters should, *inter alia*, be taken into account:

a) How liability provisions concerning the operation, provision and use of GNSS services should ensure that damage arising from such services will be compensated in an equitable manner;

b) The vital role of the signal transmitted by navigation satellites for the safety of international civil aviation could raise the question whether disclaimers of liability would be appropriate in the case of navigation satellites, particularly in cases involving accidental death or injury;

c) Having due regard to Principles 3 and 4 on the *Draft Charter on the Rights and Obligations of States Relating to GNSS Services*, whether the doctrine of sovereign immunity should be excluded in liability claims based on GNSS so as to ensure adequate allocation of liability;

d) The practical experience in the commercialization of GNSS services as they develop;

e) Appropriate methods of risk coverage should be utilized so as to prevent the frustration of legitimate claims;

f) Whether and to what extent liability provisions should reflect the joint liability of all parties involved in the operation, provision and use of GNSS services;

g) Liability provisions should have due regard to and, where necessary, should supplement existing principles and rules of international law, including air and space law.

ADMINISTRATION, FINANCING AND COST RECOVERY

Recommendation 12

GNSS services should be considered as an international service for public use with guarantees for accessibility, continuity and quality of the services.

The principle of co-operation and mutual assistance, as enunciated in the *Draft Charter on the Rights and Obligations of States Relating to GNSS Services*, should be applicable, *a fortiori*, to the cost recovery of GNSS.

Recommendation 13

In the absence of a competitive environment regarding the provision of GNSS services, consideration should be given as to whether mechanisms should be desirable to prevent abuse of monopoly power on the part of GNSS providers.

The administrative mechanisms for GNSS should be at multilateral, regional and national level. The Danish-Icelandic Joint Financing Agreement could be a model but this would not exclude the use of other types of mechanisms, including existing regional arrangements.

Cost recovery schemes, if any, should ensure the reasonable allocation of costs among civil aviation users themselves and among civil aviation users and other system users.

Recommendation 14

The aviation user charges which may be considered as possible methods for financing of GNSS include the following:

a) yearly subscription charges per using operator;

b) yearly subscription charges per using aircraft;

c) yearly/monthly licence fees;

d) charges per flight;

e) charges in respect of different phases of flight;

f) charges based on total passenger-kilometres and tonne-kilometres;

g) regular en-route charges; or

h) a combination of the above.

The principles recommended in the ANSEP Report and in the ICAO Guidelines should in any event be taken into account.

FUTURE OPERATING STRUCTURES

Recommendation 15

The future operating structures should include a co-ordinating role for ICAO with respect to the future GNSS, including the system providing the primary navigation signals in space.

The future GNSS primary signals in space should be civilian-controlled, with user States exercising an appropriate level of control over the administration and regulation of those aspects that relate to civil aviation.

To the extent practicable, the future systems should make optimum use of existing organizational structures, modified if necessary, and should be operated in accordance with existing institutional arrangements and legal regulations.

Recommendation 16

National and/or regional operating structures for GNSS should be developed initially. A single centralized operating structure does not appear to be needed at this stage but may be the subject of future study.

International co-ordination can be achieved through regional organizations operating under the umbrella of ICAO.

Possible fields of international action include:

a) International audit;

b) Monitoring of a seamless and universally accessible worldwide GNSS network;

c) Monitoring of the stable provision of the international GNSS signals-in-space;

d) Signal monitoring of the availability, continuity, accuracy and integrity of the GNSS signals-in-space.

The Panel recommends to the Council that:

- it should encourage the study of the concept of addressing liability through a chain of contracts between GNSS actors as an approach, in particular, at regional level;

- 'a model for the future contractual arrangements should embody results of the work done in applying Recommendations 9 and 11;

- the study and development, in the appropriate ICAO forum, of an instrument of international law in the context of the long term legal and institutional framework for GNSS should be initiated.

Attachment 5 – Conclusions and Recommendations of RTCA Certification Task Force

Opportunities to Reduce the Time, to Reduce the Cost, and to Provide Better Certification Service

Although the Task Force found few "silver bullets" that will produce rapid improvements in the certification process, it did identify many opportunities for improving the efficiency and effectiveness of the process.

The challenge for the group was to produce a manageable set of recommendations that addressed the concerns of the aviation community. The Task Force refined the agreed-to issues, problems and observations and then developed a small number of actionable items that could improve the certification process. While a rigorous cost / benefit analysis was not part of the Task Force activity, it is the opinion of the Task Force participants that most of these recommendations can be implemented at little or no added cost. In most cases, the recommendations call for an earlier and better exchange of information. It is also important to note that while the report focuses primarily on changes that are the domain of national authorities, it is also recognized that industry has an important role to play in improving the certification process.

Achieving Operational Benefits

The Task Force confirmed that the CNS/ATM capabilities of current aircraft installations are not being used; therefore, operational efficiency, capacity, and/or safety benefits are not being achieved. Hence, aircraft operators are reluctant to continue investing in new, more advanced systems because existing systems, such as Flight Management Systems that could provide major operational advantages, are not being used to their full operational capability. The reasons identified by the Task Force include:

- Ground systems do not provide the functionality required to exploit the advanced capability of certain deployed airborne systems in a timely manner, if at all.
- Instrument flight procedures are not implemented in a timely way to exploit current aircraft capabilities, such as RNAV, VNAV and RNP.
- The regulatory authorities often do not promptly authorize use of new functionality even when aircraft and operators are fully capable of beneficially using the new concepts and procedures
- Due consideration is not given to operational in-service experience and lessons learned in the development of procedures and criteria for design, training, qualification, and procedures.

Human Performance

The overall safety and efficiency of the aviation system depends on human operators as the ultimate integrators of the numerous NAS elements. This dependence is unlikely to decrease, and may even increase in unanticipated ways, as additional advanced technology is implemented. To a greater extent than ever before, understanding and accounting for the role of humans, including their positive and negative contributions, will be important to maintaining and improving safety while improving efficiency.

The Task Force identified several areas where there are insufficiencies in how human performance is addressed in certification processes. These include inconsistent evaluation of human-machine design, training, and procedures; inconsistent interpretation of existing criteria; inadequate regulatory and guidance material; and inadequate consideration of in-service experience. Too often, human performance and human-machine design issues are even less adequately addressed in modifications to legacy aircraft and ground system elements.

End-to-End Aviation Systems Considerations

The Task Force heard many concerns that systems were not being properly considered overall, or "from end to end." The introduction of new elements into the ground or airborne parts of the system are not generally preceded by appropriate systems engineering practices, including definition of operations concepts and requirements. It is clear that overall system performance is rarely specified and that authorities often do not take a structured approach to establishing the requirements for International Airspace System (INAS) systems and components. It is common for new ground or airborne components to have specifications or performance that are not matched to the other elements of the system with which they work to perform their function. One consequence may be that the new system element is over-specified, and therefore more expensive than it should be to achieve the incremental improvement in performance. Another possible consequence is that the new system element is not properly specified in light of the performance of other system elements, and the expected improvement in efficiency from the new system element is not attained.

Regulation, Policy, and Guidance Development

Generally, the authorities do not issue regulatory, policy, and guidance material in a timely manner. When the material is issued, it is often difficult to find and to obtain, especially for people who are new to the certification process, it is frequently subject to differing interpretations by various authorities, and is generally considered inadequate for the needs of the CNS/ATM users. In some cases, the policy or guidance material (or its application) is inappropriate, inconsistent with existing rules, misleading, or simply incorrect. For the long term, prolonged application of inappropriate rules and policies can have compounding adverse effects on CNS/ATM evolution, can provide significant disincentive for change, and can unnecessarily adversely affect entire aviation segments, beneficial technologies, or industries.

Authority Organization, Processes, and Industry Interface

During its deliberations, the Task Force identified the importance of clear lines of authority and accountability for projects designed to implement INAS changes. It also noted a need for better communication as well as a need for a smoother and more efficient functioning interface between the government authorities responsible for safety certification and operational approvals and the industry seeking to receive or implement those approvals. The Task force identified the following issues:

1. There is a need for better management and coordination within and among the authorities to implement needed INAS changes.

2. Insufficient working agreements and access to information between users and authorities inhibit efficient and effective certification.

3. Fear of retribution greatly reduces user feedback and makes appeals of authority decisions ineffective.

4. There are too many committees for which government and industry support is required.

Recommendations and Implementation Strategy of the Task Force

The Task Force agreed to focus on a relatively small number of recommendations, with the expectation that this focus will permit timely implementation of the suggested changes. Supporting rationale and amplifying materials for the following recommendations are included in the Certification Task Force Report.

The Certification Task Force report is not prescriptive nor was it intended to be so. Rather, the report represents a beginning--an outline of issues that are seen to introduce inefficiencies into the certification processes of aviation -- and offers recommendations for improving the certification process and making it more responsive to contemporary safety objectives and contemporary temporal and economic considerations. Given that the Task Force recommendations will require actions by both government and industry, it is clear that a strong and effective government/industry partnership is essential to successful implementation.

To that end, the Task Force also recommends that FAA facilitate the follow-on work by establishing a government/industry effort similar to that used to implement recommendations of the RTCA Task Force 3 on Free Flight. Such a public advisory group provides a useful reality check and to periodically (about three times per year) assess the progress of the community in meeting the intent of the recommendations. Such a government / industry group would also help the implementers identify needed resources or alternative means of progressing tasks that appear to be lagging.

The Task Force suggests that this approach is a useful model for facilitating the implementation of the recommendations of this report. The structure of RTCA, the organization to which the FAA turned to conduct this study, provides the Federal Advisory Committee framework necessary to comply with US law.

Recommendation 1. An organizational focal point should be established by the authorities to provide *one stop service* to users, industry, and other governments in all matters related to advanced ground electronics and airborne avionics systems and related procedures. This function should have appropriate operational and technical expertise, and the authority and responsibility to develop and issue appropriate policy, certification, and related regulations and guidance materials. (See Section 3.6 in the RTCA Certification ask Force Report)

Recommendation 2. The authorities should establish and maintain a systems engineering capability. This function should be used to establish overall performance requirements for all advanced systems and their subsystems, in conjunction with the user community. As part of this effort, the authorities should consider developing clear approval standards and processes for ground system elements that are integrated, to the degree necessary, with airborne system element certification. (Section 3.4)

Recommendation 3. Multi-tiered airworthiness requirements should be vigorously pursued by the authorities. (Section 3.5)

Recommendation 4. The importance of human performance considerations should be recognized by both the authorities and industry in reducing certification costs and improving the safety of the INAS. They should do so by introducing processes and written guidance that institutionalizes *earlier* and *better* consideration of human performance. This should be accomplished by providing certification credit for human performance where possible and by requiring consideration of human performance in accordance with specific standards for the certification of equipment, people, and procedures in advanced airborne and ground-based systems. (Section 3.3)

Recommendation 5. The authorities should broadly implement a process where the regulators and applicants come to an early and clear agreement on their respective roles, responsibilities, expectations, schedules, and standards to be used in certification projects. The process should apply broadly across airborne and ground systems, allow non-applicant equipment suppliers to engage in certification programs, and provide greater opportunity to approve components or processes independent of the airplane. (Section 3.6)

Recommendation 6. The authorities should enhance, expand upon, and standardize designee programs to improve timeliness of approvals. Promptly expand the concept of approving organizations, in addition to individuals, as is done in some cases in the Joint Aviation Authorities (JAA) and FAA. In addition to the traditional uses of delegated authority in the FAA and JAA, it is particularly important to also apply delegated approval authority to instrument flight procedures as soon as practical. (Section 3.6)

Recommendation 7. The early deployment of advanced systems should be encouraged by the authorities. This initiative would assure that prompt in-service experience can be obtained more quickly and incorporated into production systems. Improved feedback mechanisms would also assure that positive and negative experiences (especially human performance considerations) with operational systems and procedures are documented and analyzed for future system *credit*, or for corrections to be applied based on lessons learned. (Section 3.2)

Recommendation 8. The authorities should work with industry to accelerate the development of instrument flight procedures based on proven operational concepts, such as Required Navigation Performance/Area Navigation (RNP/RNAV), to exploit existing and anticipated aircraft system capabilities (e.g., Flight Management System(s) [FMSs]). (Section 3.2)

Recommendation 9. The authorities should work with the rest of the aviation community to develop, coordinate, and apply a commonly agreed-upon concept of operations, including the development and application of certification policies. (Section 3.4)

Recommendation 10. The number of committees should be reviewed and reduced by both the authorities and industry. Leverage successful activities (such as C/AFT, the JAA CNS/ATM Steering Committee) as means for users, industry, service providers, and regulators to discuss and reach general consensus before scarce resources are applied to additional forums. A specific effort to review and eliminate duplicate or ineffective implementation teams, committees, panels, etc., should be undertaken. (Sections 3.2 and 3.6)

Recommendation 11. The authorities should correct the improper application of rules, guidance, and policy by educating agency specialists about the conceptual basis for regulatory material. It is especially important to clarify the proper application of and relationship between airworthiness regulations and operating rules. An important aspect of this is to address or correct inappropriate use of certificate limitations, particularly when inappropriate limitations are proposed to address or correct perceived operational issues unrelated to basic airworthiness. (Section 3.5)

Recommendation 12. The authorities should work with industry to review the use of the TSO, STC (Amended TC in case of TC holders), or field approval processes when seeking airworthiness approval for an aircraft modification. Special focus should be placed on (1) providing the kind of self-certification of the manufacturing process for STC holders that is obtained by TSO holders, and (2) ensuring that human factors issues are appropriately addressed, regardless of which of these processes are followed. (Section 3.5)

Recommendation 13. To stop the ever-increasing number of rules that need harmonization, the authorities should ensure that no new regulations are proposed or promulgated unless they have been harmonized at least between the JAA and the FAA. This activity should begin at a specific date in the near future (say, one year), except in cases of overriding safety or statutory urgency. In the longer term, the ongoing efforts to harmonize existing rules should be completed. (Section 3.5)

Recommendation 14. The authorities should publicize how rules have been applied, thereby facilitating the standardization of regulatory interpretations. Making this information generally available, perhaps by Internet access, will ensure that those who are concerned with standardization are provided accurate information on the regulatory applications that

may be in need of better standardization. This is especially critical for timely granting of approvals by field offices. (Section 3.6)

Recommendation 15. The authorities should establish specific processes that will provide for feedback on actions that are perceived by users to be inappropriate for any reason. This must be conducted in a manner that users will have no fear of retribution.

(Section 3.6)