



# EUROCONTROL ATN Project Overview and Status

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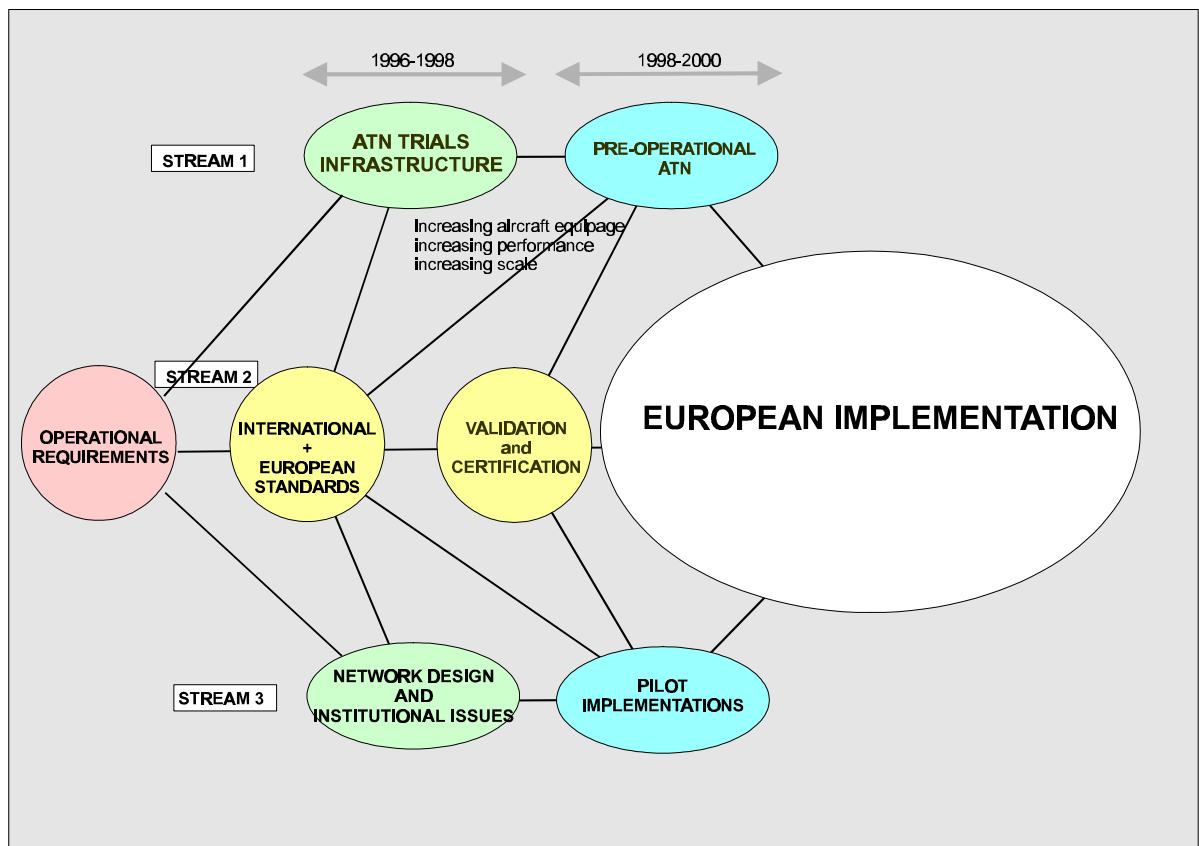
## 1. Introduction

The objective of this paper is to give an overview of the EUROCONTROL ATN project and to present the current status.

The ATN project, as part of EATCHIP (European ATC Harmonisation and Integration Programme), is focused on the European implementation of the ATN. The activities of the project include, support to standardisation, validation, trials, development of trials and pre-operational systems and implementation planning.

## 2. Overview of the ATN Project

The strategy which is followed by the ATN Project is presented in the figure below. The National Administrations, the EUROCONTROL Agency, the European Commission and Industry are working closely together on the ATN. Besides making for valuable synergy, this partnership has reduced unnecessary duplication of work and effort.



**Figure 1 - The ATN Strategy**

The strategy has been divided into three streams of activities. The **first stream** is the development of a European ATN Trials Infrastructure. Not only are ATN standards being validated to ensure that they are complete and correct, but they are also being tested in operational environments. A topical example of this is the UK/France/European Commission ADS Europe Project in which commercial aircraft are using the ATN for ADS.

The next phase in this stream is the development of Pre-operational ATN implementations. EUROCONTROL is contributing to the funding and is also actively participating in two programmes (Pro-ATN and EOLIA) being run by the European Commission and European Industry. These programmes will develop, implement, demonstrate and evaluate a complete pre-operational environment which includes the ATN and User Selected Air Traffic Services (ATS) data-link services, based on ICAO standards.

The **second stream** deals with the support to the ATN standardisation process in ICAO and Europe. It is concerned with the validation of standards and the development of tools for certification. The EUROCONTROL Agency and its Member States have successfully completed an extensive co-operative validation programme. Results show that the ATN standards are mature; that they meet the requirements and that they form a good basis for the independent development of interoperable systems. At a recently held meeting of the ICAO ATN Panel all ATN standards were endorsed on the basis of the positive results of the validation programme. The availability of stable global ICAO ATN standards will accelerate the global implementation of the ATN on the ground and in the air.

EUROCONTROL has initiated the development of the Common American European Reference ATN Facility (CAERAF). The intention is to make the facility available to States and the Aeronautical Industry for testing in the context of certification, commissioning and acceptance of operational ATN systems.

The **third stream** consists of implementation-related activities, incorporating the design of the European ATN, the identification and discussion of Institutional Issues and a detailed Cost-Benefit analysis. The stream also includes Pilot Implementations which are operational implementations on a limited scale. The European ATN Implementation Task Force has been established to co-ordinate the implementation of the ATN.

## 3. European Trials and Pre-operational systems

### 3.1 ATN Trials Infrastructure (ATIF)

#### 3.1.1 Introduction

The development of the early ATN Infrastructure (ATIF) in Europe has come to a point where experimental ICAO SARPS compliant ATN system elements are available and widely deployed. Complementary ATN components like the Trials End System (TES), the Trials ATN Router and Transport Server (TAR-TTS), and the Mode S Ground Data Link Processor etc., have been integrated into a distributed European ATN Trials Infrastructure which is being extended to other regions (e.g. the U.S. and Australia)

ATIF Users are given TAR, TTS and TES which are the first 7 layer ICAO CNS/ATM-1 Package compliant systems offering ATN communications services anywhere.

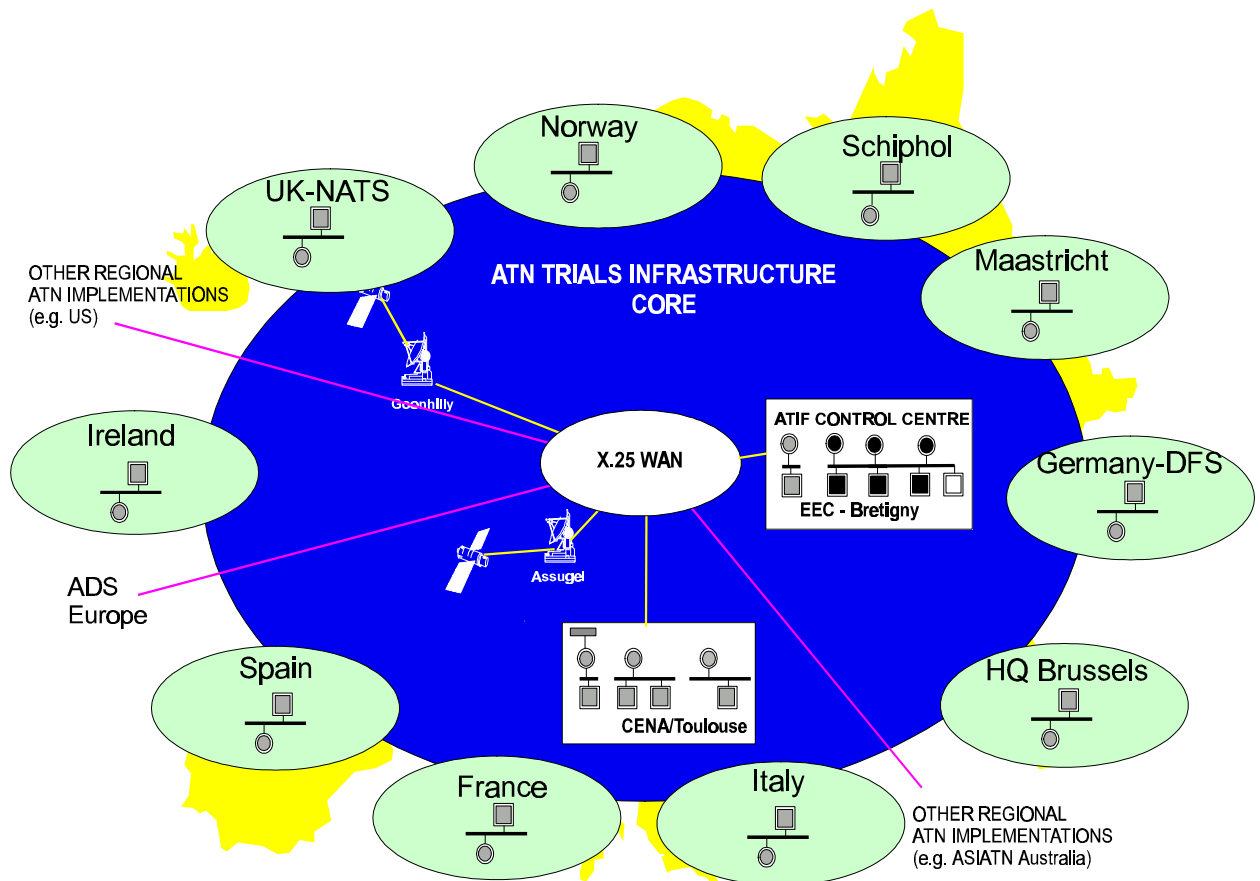
The Airborne side has now also been addressed and experimental compliant systems are available on the PC platform. Flight trials with 7 layer ATN and multiple subnetworks exercising a subset of the ADS and CPDLC SARPs will be conducted in early 98.

The philosophy of the project has been to develop ICAO compliant ATN systems as quickly as possible and to distribute them as widely as possible at low cost to member states for ATN Trials, whilst providing support and training. The concept is one of "service provision" to individual States in support of national or multi-national trials rather than "organisation of States internal

trials”, whilst initiating Eurocontrol internal trials activities such as Flight Trials of ATN and Mode S (FITAMS).

### 3.1.2 Objectives

There has been a large investment by European institutions (CEC and EUROCONTROL) and European industry in the development of an experimental ATN infrastructure. There is a need to exploit this investment to promote the ATN in the time before operational systems come on line. ATN systems will be supplied by the ATN Trials Infrastructure project (ATIF) and put in place at low cost for the convenience of users.



**Figure 2 - ATN Trials Infrastructure**

The ATN Trials Infrastructure project has created a managed environment to service the requirements of these users and to promote the use of the ATN in the core area of Europe and beyond.

The “core” infrastructure has been kept as simple as possible but “peripheral” end users may be added by the provision of ATN access nodes at remote sites (e.g. to provide ADS data to users in Southern Europe). New users are being added all the time.

The specific objectives achieved are:

- The delivery of a distributed environment comprising CNS/ATM-1 Package compliant systems for the purpose of trials and demonstration,
- Continuing European ICAO SARPs validation,
- The provision of Standard Interfaces as “ATN plugs” for potential users of the ATN for trials and experiments such that new or existing applications may use the infrastructure,

There is a continuing need to attract further CAA and Airline participation to stimulate investment in implementation programmes by showing potential benefits.

### 3.1.3 ATIF Components and Current Status

#### 3.1.3.1 TAR-TTS - The ICAO SARPS Compliant Internet

The TAR-TTS product comprises the ATN Internet functionality and as such is the most complex ATN component providing configurable Mobile and Ground ATN Routers.

ATIF Users will be given TAR-TTS release D which is the first ICAO CNS/ATM-1 Package compliant system offering ATN Internet communications services anywhere.

Further releases of TAR-TTS will be developed when rapid-prototyping activity is required for new functionality (e.g. new subnetworks, multi-cast etc.)

TAR-TTS now has a large installed user community administered from Brétigny including Maastricht, ADS Europe, NATS, Irish CAA, SICTA - Italy, LVB - Holland, DFS - Germany, TELNOR - Norway, AENA - Spain and CENA - Toulouse, JAPAN.

**Availability: Release D - Now**

#### 3.1.3.2 Airborne TAR-TTS

Portation to a PC UNIX environment has been completed. Airborne TAR-TTS supports an interface to ARINC 429 - the aircraft standard bus. It will allow the product to fly in experimental aircraft supporting mobile subnetworks (Mode S, VHF, Satcom).

**Availability: Now**

#### 3.1.3.3 TES - The ICAO SARPS Compliant Applications/Upper Layers

The Trials End System (TES) product comprises the ATN upper layers and ADS (Automatic Dependent Surveillance), CPDLC (Controller-Pilot DataLink Communication) and CM (Context Management) applications. These upper layers are integrated with TAR/TTS on the same platform using the transport service interface.

The integration of TES with TAR-TTS on a single platform is a configuration option, which gives ATIF the first complete end to end seven-layer ICAO-compliant implementation on the ground and in the air.

Portation to a PC UNIX environment has been completed.

**Availability: Release B - Now**

### 3.1.3.4 Network Management Centre (NMC)

The NMC development is a toolset that will configure and control distributed ATIF systems to create an integrated and flexible network for trials and demonstration purposes. The objectives of the NMC development are as follows:

- to provide a tool to the ATN Trials Infrastructure project and to support continuing ATN Validation configuring the first known CNS/ATM-1 Package compliant internetwork,
- to be extensible to configure and control ATN applications and upper layer experiments/validation developed elsewhere and ported to the ATIF systems,
- to allow flexible use of ATIF experimental resources and systems in support of applications for trials and demonstrations,
- acquire early experience in the configuration and operation of an ATN end to end service for trials purposes and to help specify requirements for operational Management systems.

This tool will be designed for platform independence such that it can be adapted to all major UNIX platforms.

**Availability: Now**

### 3.1.3.5 Mobile Subnetworks

The TAR-TTS will interface to the **Mode S** T-GDLP developed by Eurocontrol. The airborne router interface to the ADLP (Williamsburg and ARINC 429) was implemented when TAR-TTS was ported to the PC environment intended for avionics use.

**Availability: T-GDLP/ADLP now, flight trials underway**

The TAR-TTS interfaces to the **Satellite subnetwork** in ADS Europe on the ground and is operational now. The airborne router interface to the SDU (Williamsburg and ARINC 429) was implemented when TAR-TTS was ported to the PC environment intended for avionics use.

**Availability: Now (used in ADS Europe and FITAMS sub-project)**

The TAR-TTS does not currently interface to the **VDL Mode 2 subnetwork** equipment but provides SARPs compliant interfaces to enable this - there is no anticipated problem - it just has not been done yet. UK NATS wish to join the FITAMS projects and want to collaborate to add VHF.

Discussions have been held with Sweden with a view to the integration of **VDL Mode 4** into ATIF.

Also planned for 98 are interfaces to LEO systems (e.g. Iridium).

### 3.1.3.6 Local and Wide Area Subnetworks

The TAR-TTS can operate over Ethernet and FDDI LANs and offers X25 WAN access.

**Availability: Now**

An SNDCF specification for the integration of Asynchronous Transfer Mode to ATIF is ready and will be incorporated in TAR-TTS.

### 3.1.3.7 PROATN

See later below on the PROATN project which develops pre-operational and pre-industrial prototype ATN systems. These systems, equivalent in functionality to TAR-TTS-TES but built to higher levels of quality and reliability will be integrated into ATIF as they become available.

**Availability: Integration expected end 98.**

### 3.1.4 Relation to States Trials Programmes

As stated in the introduction: "The concept is one of "service provision" to individual States in support of national or multi-national trials rather than "organisation of States internal trials". Co-ordination with individual States has been conducted on a bi-lateral basis rather than in large groups because it has become evident that this is the best way to progress - ATIF can concentrate in a particular State's individual needs. States discuss key issues and plans much more freely in that environment.

To date the major States with which bi-lateral discussion have taken place and with whom active trials programmes are being pursued are:

- UK NATS,
- GERMANY DFS,
- ITALY SICTA,
- IAA IRELAND.

For each there is a detailed work plan under the responsibility of the State.

The FAA are the most recent members and they will take delivery of TAR-TTS for their trials program.

JAPAN, AUSTRALIA and THAILAND have active programmes in ASIA and Australia have already connected to ATIF.

### 3.1.5 Relation to CEC Projects

Within the 4<sup>th</sup> Framework Programme of the CEC there are projects related to the development of Pre-operational ATN implementations. EUROCONTROL is contributing to the funding and is also actively participating in two programmes (Pro-ATN and EOLIA) being run by the European Commission and European Industry. These programmes will develop, implement, demonstrate and evaluate a complete pre-operational environment which includes the ATN and User Selected Air Traffic Services (ATS) data-link services, based on ICAO standards.

ATIF promotes and deploys experimental rapid prototypes of ATN systems before PROATN Pre-operational systems become available. ATIF will have been in operation for several years by the time PROATN comes on line and can be used as a "benchmark reference" to test the new systems.

### 3.1.6 ATIF Internal Sub-projects

#### 3.1.6.1 FITAMS

The FITAMS activity is well advanced, it has been proposed to meet foreseen requirements for short term ATN/data link flight trials, from EUROCONTROL Divisions DED/3 and DED/6. FITAMS will mount the first ever demonstration of ICAO SARPs compliant end to end (7 layer)

datalink via multiple mobile subnetworks with live experimental aircraft. All the major components of the ATN have either been developed, or else are in the final stages of preparation. These components include the Trials ATN Router (TAR), the Transport layer (TTS), and the Trials End-System (TES). Division DED/3 require that the Mode S datalink be validated in the context of the ATN using the T-GDLP and T-ADLP developed by Eurocontrol.

The DERA BAC1-11 aircraft has been chosen for FITAMS, it is the only experimental aircraft currently equipped with Mode S level 4 transponder and Data 3 Satellite subnetwork equipment as required by FITAMS and is a well proven trials environment.

The French Mode S facilities will be used in FITAMS and UK NATS have now shown interest in extending the BAC1-11 flight hours and adding their Mode S facilities to the trial.

**Status: Successful flight trials have demonstrated ADS and CPDLC over the ATN Internet. March 12 1998 saw the first ever 7 layer ATN end to end trial over multiple subnetworks (Mode S and Satcom).**

For the future it is planned to add VDL Mode 2 and LEO satellite subnetworks to the trial.

### 3.1.6.2 PETAL II ATN Operations

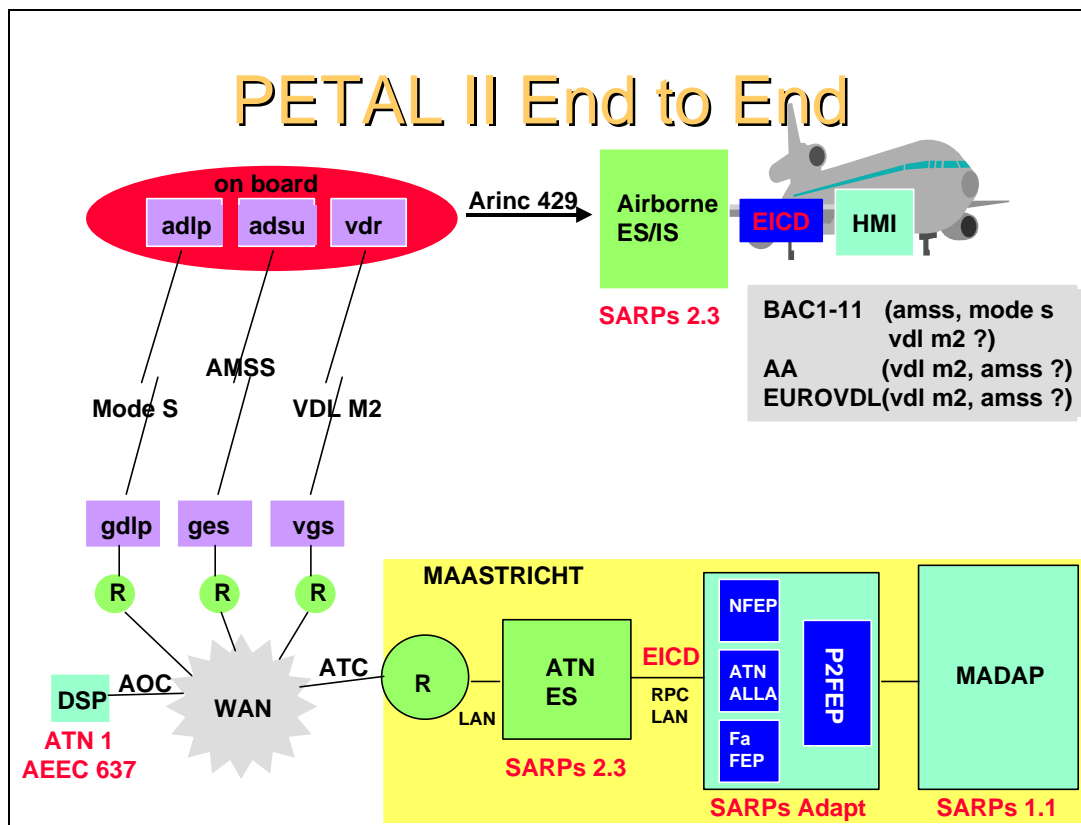


Figure 3 – Petal II Architecture

Building upon the success of FITAMS, the DERA BAC1-11 and the ATN infrastructure will now be upgraded and deployed in Maastricht to support the PETAL II trial extension using ATN and the VDL Mode 2 subnetwork.

PETAL II implements 8 operational services and approximately 65 supporting CPDLC messages. These services and supporting messages are viewed by operational trials participants (i.e. the controllers and aircrews) as sufficient for the operational objectives of the trials and the busy continental en-route ATC environment involved, at least in the initial period of datalink operations.

An important distinction between PETAL II and previous ATIF activities is that commercial aircraft, pilots and controllers at an operational centre are in the loop. American Airlines is committed to provide 4 PETAL II/ATN equipped aircraft, ARINC will provide the VDL Mode 2 infrastructure and ATIF will provide ATN connectivity at Maastricht. There is an active link with FAA CPDLC implementation project.

**Status: The Petal II extension is approved and the Petal II integration team has been created to manage the necessary airborne, ground and subnetwork deployment. First experimental flights with BAC1-11 planned 1Q 99, full operation with commercial aircraft planned end 2Q 99.**

### 3.1.6.3 ADS/ATN Upgrades

The ADS/ATN upgrades will allow the further exploitation of the air-ground infrastructure developed in the ADS Europe initiative. In ADS Europe UK NATS and STNA in France provided the ground part of the infrastructure whilst the airborne part was hosted on 11 commercial aircraft from BA, KLM, Lufthansa and Air France. The use of commercial aircraft gives the unique benefit of daily flight for a long term appraisal of ADS and ATN network operation by Member States and Airlines. Investigations have shown that the continued operation of the whole ADS Europe infrastructure with the fleet of 11 aircraft would be prohibitively expensive. Therefore, a subset of the infrastructure using EEC Brétigny, the UK NATS facilities on the ground and the BA and KLM aircraft has been identified for further upgrade.

The upgraded ADS/ATN environment will utilise Eurocontrol's TAR/TTS development providing Member States with the opportunity to access ADS data via an ATN compliant Internet flown on commercial aircraft for the first time.

**Status: Project started 3<sup>rd</sup> upgrade planned for quarter 98. This will be the first ATN compliant Internet (it includes IDRP) flying on commercial aircraft anywhere. It will operate until end 1<sup>st</sup> quarter 99.**

### 3.1.7 Relation to Trials/Validation Programmes

The following activities are either already ATIF users, require connectivity with ATIF or have a potential relation to ATIF.

	Program or State	Activity and Relation to ATIF
1.	EUROCONTROL - PETAL II	A very important trials program involving commercial aircraft that will validate the operational concept, requirements and operational procedures for En route air/ground datalink.  It will also progress the implementation of air/ground data link functions at the Maastricht UAC toward an operational system, and provide an EATCHIP model of such system for

	<b>Program or State</b>	<b>Activity and Relation to ATIF</b>
		<p>use in Europe.</p> <p>The first phase of PETAL II will use an ICAO compliant ADS/CPDLC message set over the STDMA subnetwork. Phase 2 will use ICAO ATN compliant communications as provided by the ATIF project.</p>
2.	EUROCONTROL - FITAMS	<p>The TAR/TTS/TES will be used in an ATIF sub-project "Flight Trials of ATN and Mode S" - FITAMS planned for 97. These trials will involve the BAC 1-11 and will make use of the Eurocontrol T-GDLP and ADLP developments. There is obviously a dependency on the availability of ground Mode S stations. The French station is likely to be the first available for use.</p> <p>UK NATS now wish to collaborate in FITAMS to provide early validation of their EOLIA developments.</p>
3.	ADS EUROPE	<p>The original ADS Europe contract with the CEC has ended but Eurocontrol has a new contract with the consortium to continue operations for one more year. The major partners in ADS Europe are France (STNA/DGAC) and UK (NATS).</p> <p>ADS Europe currently uses the TAR router, the UK ADS End System is likely to be upgraded to use the TAR-TTS. This project has operational aircraft and represents a major opportunity to extend the current ADS Trials which are not ICAO compliant to ICAO compliant ADS and CPDLC trials using ATIF equipment.</p>
4.	ARTAS	The use of ATIF to inter-connect ARTAS experimental sites in 5 countries is under evaluation and study.
5.	ASIATN	<p>The Australian Trials programme has 2 phases:</p> <p>In the first phase, the platform will be capable of inter-operation with ADS-Europe systems in order to support ATN trials in the Asia/Pacific as soon as possible. They have requested ADS Europe to provide addresses on the aircraft for their use. They base themselves on EURATN systems and have a contract with Thomson for this.</p> <p>The objective of the second phase is to upgrade the platform to comply with the CNS/ATM-1 Package SARPs. With a few exceptions, the aim is to comply with the version of SARPs as presented to ATNP/2. This would require an upgrade to the ADS Europe aircraft or the provision of new aircraft.</p> <p>They seek a link with FAA and European activities.</p>
6.	DFS - GERMANY	<p>Joint Air Navigation Experiments (JANE), a prototype CNS/ATM Demonstrator program is under preparation but early ATN trials already being conducted.</p> <p>Major ATIF partner. DFS are very active users of TAR/TTS/TES. They had a mandate to demonstrate ATN with a real world application and air-ground datalink in 97. Mode S trials with the Gotzenheim station may be linked to the FITAMS project when the station is ready.</p>

	<b>Program or State</b>	<b>Activity and Relation to ATIF</b>
7.	EUROCONTROL - GROUND-GROUND EXPERIMENTS.	The TAR/TTS will be used in experiments for ground-ground messaging in support of AIDC and other applications. A layer for switching application context in "hot standby" redundant mode will be ported on top of the Transport interface.
8.	EUROCONTROL PD3 PHARE - PATN	PHARE is a research programme investigating the concept of an integrated air/ground ATM system for 2005+. It is a collaborative programme with the prime research centres of Europe, i.e. NATS/DRA, NLR, DLR, CENA, EEC, with 50% funding from Eurocontrol. It has developed 'tools' for both air and ground components in support of this concept, namely:  Air: Experimental 4D FMS and HMI  Ground: Trajectory Predictor, Conflict Probe, Flight Path Monitor, Negotiation Manager, Arrivals Manager, Departure manager, etc. and HMI.  PHARE uses SATCOM and the P-ATN network of EURATN based systems.
9.	EUROCONTROL/CEC - PROATN-EOLIA	These are projects co-funded by Eurocontrol, the CEC and industry, their purpose is to produce the certifiable and pre-operational systems that will supersede the experimental ATIF ATN systems in operational air-ground and ground-ground environments after mid-98. ATIF will be used for early integration and inter-operability tests with these systems.
10.	FAA ATN TRIALS	Major ATIF partner. Users of TAR-TTS for experimental evaluation and support of application development. Co-operation will also take place on the development of Systems Management facilities.
11.	FRANCE - STNA	Major ATIF partner. France and STNA/CENA/SOFRÉAVIA are the main users and developers of EURATN systems. STNA are formulating a trials program and are interested in participating in ATIF. They are the second major partner in ADS Europe. CENA are developers of the ATIF NMC and are already connected to ATIF.
12.	IRELAND	Major ATIF partner. Users of TAR/TTS/TES for early ATN experiments and experience in house, plans include ADS, CPDLC and ground-ground (OLDI). They would like to connect to ADS Europe.
13.	JAPAN	Users of TAR/TTS/TES for early ATN experiments with an active ATN programme in Asia. Planned inter-connection with ATIF in mid 98.
14.	LVB/ EUROCONTROL PROCESSED RADAR DATA EXCHANGE TRIALS	Ground-ground ATN tests exchanging processed radar data between RMCDEs located in Maastricht and Schiphol via two TAR (Trials ATN Router) systems connected by RADNET. This is the same configuration that was used in ATC 97 at Maastricht. The tests were completely successful by Jan 97. There are plans to extend the tests to other member states

	Program or State	Activity and Relation to ATIF
		(e.g. DFS).
15.	NEAN/NEAP	A CEC DG VII project. These are trials aimed at the use of the STDMA and ADSB, they will equip Lufthansa, SAS and ALITALIA aircraft – NEAN provides the infrastructure and NEAP the applications. Relation to ATN discussed but ATIF will wait and integrate VDL Mode 4 rather than STDMA..
16.	SICTA - ITALY	Major ATIF partner. Users of TAR/TTS/TES for early ATN experiments and experience in house plans include ADS, CPDLC and ground-ground database exchange in the future. Already connected to ATIF and very active.
17.	SITA-AMERICAN AIRLINES VHF TRIALS	More information required but these tests involve VHF Mode 2 datalink and ATN Routers (the SITA on the ground). VDL Joint Validation Program (JVP) and other VDL validation activities that have been undertaken between American Airlines, Rockwell Collins and SITA.
18.	SPAIN - AENA	TAR/TTS users started the connection with ATIF in 1st of May/97. This implies that ADS End System (ECA) will be developed and tested against a simulator of ARINC 745-2 for ADS application only. Already connected to ATIF and connected to ADS Europe.
19.	TELNOR - NORWAY	Users of TAR/TTS and EURATN for ATN operations in the context of the North Sea Helicopter ADS Trials. Future plans include the use of PROATN systems.
20.	THAILAND	Major Asian State with implementation plans for ATN. They may soon request connection to ATIF.
21.	UK NATS	Major ATIF partner. They are the UK ADS national trials which have been linked to the ADS Europe project in previous phases. They now plan to take the TAR IDR software and implement this on a British Airways 747 aircraft (Phase 1-C). The TAR-TTS will be also ported to 4 commercial ADS Europe aircraft (2 BA and 2 KLM).  TAR/TTS/TES used internally in NATS simulation, pre-operational projects and in preparation for FDPS2 project.

## 3.2 Trials End System

### 3.2.1 Introduction

The ATN End Systems task within the Communications division of Eurocontrol embraces the delivery of Air-Ground and Mobile services with the ATN as the prime communications infrastructure. The project focuses on the delivery of ATM services throughout the entire flight cycle, from the pre-departure stage, using fixed or radio links at the gate, through the taxiing, takeoff, climb, en-route, descent, approach and landing, culminating with the arrival at the destination gate.

Within this task, the Trials End System (TES) project has been involved in a number of activities in support of the development and validation of the ICAO standards and recommended practices

(SARPs) for Air-Ground applications and supporting ATN Upper Layers. These activities have included requirements analysis, formal modelling of the applications, and the production of prototype software realisations of the applications specified in SARPs.

The TES software has been further developed as a component of the Eurocontrol ATN Trials Infrastructure (ATIF).

### 3.2.2 Objectives

The objectives of the TES may be summarised as:

- Validation of the ATN Air-Ground applications and Upper Layer SARPs.

This has been fully achieved with the publication by ICAO of the technical provisions for ATN. The TES contractor independently analysed the draft SARPs, produced functional and design specifications based on the draft SARPs and implemented the software realisations. The TES software was then used to test the functionality, interoperability and performance of the draft SARPs.

- Production of corresponding prototypes and simulation models.

This is achieved by the availability of the TES software and its continuing development, enhancement and support. Also available are simulations of the ADS application and ATN Upper Layer protocol, modelled using the formal language SDL.

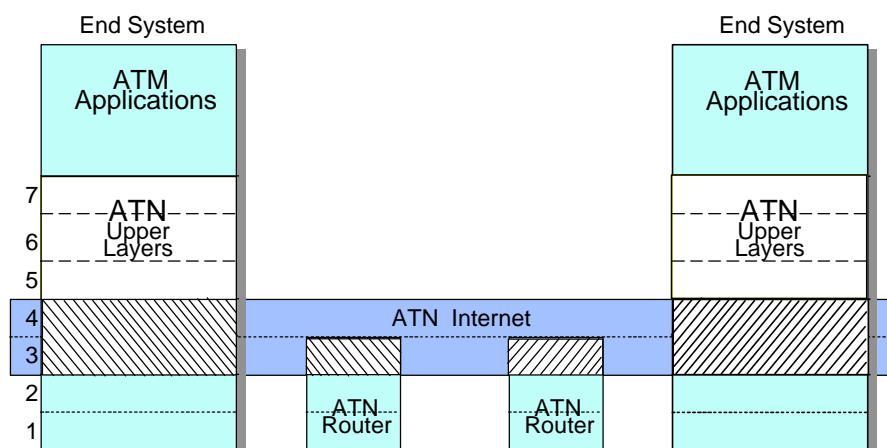
- Use of TES in ATN experimentation programmes.

Ongoing, with the provision of the TES software to assist member Administrations in their ATN experimentation, use in internal Eurocontrol experiments and interoperability testing.

### 3.2.3 TES Architecture

The TES software implements an OSI telecommunication stack based on an environment from ATOS called C-OSIAM. The architecture of TES is closely related to the C-OSIAM approach for building a telecommunication stack.

The ATN Upper Layers ensure the end-to-end communication between the two end systems over a number of ATN routers connected via ATN compatible subnetworks as illustrated in Figure 4.



### Figure 4: ATN End Systems Model

The two end systems communicate via a standard transport service interface. This point is important since one objective of the TES software was to validate the SARPs for ATM applications and ATN upper layers, and not the ATN Internet.

Each of the different TES communication infrastructure configurations is accessible from the TES platform, a Hewlett-Packard workstation running the HP-UX operating system. The default configuration, supplied to users, is to use the TAR-TTS to provide a complete ATN protocol stack.

## 3.2.4 TES Components

The TES software implements the following air-ground ATN applications as published by ICAO:

- The air-ground functionality of the **Automatic Dependant Surveillance (ADS)** application (excluding the ADS Report Forwarding functionality)
- The air-ground functionality of the **Controller Pilot DataLink Communication (CPDLC)** application
- Both the air-ground and ground-ground functionality of the **Context Management (CM)** application
- The **ATN Upper Layers** (efficiency enhancement option Session Layer, efficiency enhancement option Presentation Layer, Association Control Service Element (ACSE) edition 2 and Control Function (CF)).

The TES software also implements a flexible Addressing Database (ADB) which provides a repository for the information exchanged by the CM application, and makes this information available to other applications and systems management.

Each of the TES software implementations includes both the airborne and the ground based end system components.

The TES system also includes a COTS test harness which allows test data to be input into the applications individually or concurrently. The test harness may be used to test both normal and abnormal events through the TES APIs. This was used to validate the behaviour of the TES prototype and the draft SARPs.

### 3.2.4.1 TES Interfaces

The TES software uses the transport layer interface to provide access to ATN Internet. Different communications infrastructure configurations can be “plugged in” beneath the transport interface, including:

- TAR-TTS, complete CNS/ATM-1 Package ATN Internet protocol stack;
- commercial off-the-shelf (COTS) lower layers (H-P OTS-9000 product).

Fundamental to the implementation approach is the definition of a set of Application Programming Interfaces (APIs), enabling a modular approach to be taken. There is no requirement for such interfaces to be standardised as SARPs, but it could be beneficial to share the interface definitions with other States and Organisations, to encourage the development of

portable applications and therefore potentially decrease costs by maximising the market relevance of products developed to work within the global ATN environment.

The TES software provides exposed C-language APIs which correspond closely to the abstract service interfaces (ASIs) defined in the air-ground application SARPs.

The TES APIs are mostly concerned with giving the user access to data formatting and sequencing functions. Two levels of API are provided:

- The “raw” API corresponds closely to the ASI defined in the SARPs. It requires the API-user to initialise complex C data structures, allocating dynamic memory as necessary for the data buffers. In fact, these structures have been automatically generated by an ASN.1 compiler, so are not necessarily as user-friendly as possible.
- To provide a more user-friendly interface, each API call has associated with it one or more formatting or unformatting functions. These functions hide the complexity of the underlying C data structures from the API-user, and provide instead a “flattened” parameter list, enabling the user simply to supply the values for the function call parameters.

### 3.2.4.2 Limitations

The TES implementation satisfies the functional requirements in the air-ground SARPs - the “User Requirements” specified in SARPs are explicitly excluded. Thus, any software accessing the TES software must ensure that the user requirements are observed.

The air-ground SARPs also define interworking possibilities in terms of valid subsets of each application. The TES software is not configurable in terms of the subsets defined in SARPs; rather, it conforms to just one of the defined subsets.

The TES software does not include any End-User interface (such as a pilot display or controller workstation simulation). It does include a licensable COTS test harness to simulate the functions of such interfaces, and well-defined APIs to allow integration with end-user applications.

### 3.2.5 Current Status

The TES software was originally developed in order to validate the draft ICAO SARPs known as the “Munich output” (June 1996 versions). It has since been upgraded to conform firstly to the SARPs versions approved in March 1997 (ICAO Version 1.1 - “post-Phuket” SARPs) and subsequently to the version published by ICAO in Doc 9705 (August 1998). At the same time, various usability enhancements have been implemented.

It is available for free issue for experimental purposes to Eurocontrol Member Administrations. A four-day training course has been developed to assist users to exploit the TES software.

**Availability: Now.**

The TES software also runs on a PC platform running SUN Solaris 2.5.1 /x86, and on HP-UX 10 in addition to the original HP-UX 9 platform.

**Availability: Now.**

## 3.2.6 Future Developments

Future developments of the TES implementation include:

**SARPs tracking.** As SARPs changes are approved by ICAO, they will continue to be evaluated for their effect on TES functionality and interoperability.

**Remote Access.** Currently, the TES user process must be co-hosted with the TES stack. An enhancement to allow access via standard remote procedure call (RPC) mechanisms is being implemented.

**Other Platforms.** The portation of TES software to other software environments and platforms according to user requirements is under continual review. Other users are evaluating DEC Alpha platforms.

## 3.2.7 Relation to Other Projects

As already mentioned in the ATIF description, TES is being used as component of the ATN Trials Infrastructure, and so has a relationship with a number of ongoing ATN experimentation activities, including:

- ProATN - this project will benefit from the TES software development and interface definitions.
- DFS- Germany
- Eurocontrol - FITAMS
- FAA ATN Trials
- SICTA - Italy
- NATS - UK.

## 3.3 Generic ATN Communication Service (GACS)

### 3.3.1 Introduction

In order to simplify the development of future ATN applications and to facilitate the migration of non-ATN (e.g. ACARS-based) applications to an ATN infrastructure, a simple generic messaging service has been defined. This would be capable of carrying future (yet to be defined) information structures reliably and securely between communicating partners, in the context of the Aeronautical Telecommunication Network. Such a service could be used by future free-standing applications, or alternatively, embedded into these new applications. The service is known as the "Generic ATN Communication Service" (GACS).

The initial ATN application SARPs specify a number of communicating data services for both air-ground and ground-ground applicability. These specifications include protocol control information, the user information semantics and the user information encoding appropriate to the application. However, the process for arriving at these SARPs has been quite protracted, and now that the first versions have stabilised, the change process to introduce new features is also lengthy.

GACS provides an alternative approach to the specification and subsequent implementation of information interchange requirements for aeronautical applicability, based on a more formalised separation of the information semantic definitions from the communications protocol specification.

### 3.3.2 Requirements

There are three main areas of requirement that drive the need for a GACS solution:

1. Future air-ground information exchange requirements in support of new or evolving operational concepts such as flexible use of airspace and free flight.
2. Future ground-ground information exchange requirements to enhance the co-operation and co-ordination capabilities between ATSOs, or between ATSOs and regional flight management co-ordination units, or for use between ATSOs and AOC for Collaborative Decision Making purposes
3. Migration and transition of existing (ACARS-based) AOC and ATC communication (e.g. pre-departure clearance) to the ATN infrastructure.

In all these areas, there are business and/or operational requirements for information exchange between elements of automation in distributed systems. Some of these requirements are already addressed by the initial ICAO SARPs. Others, particularly ground-ground, can be handled through use of the store-and-forward Aeronautical Message Handling Service (AMHS). However, there is a substantial category of information which requires a more "real time" transfer service than AMHS, both in the air-ground and in the ground-ground context.

It is these types of information exchange that GACS is intended to address. GACS is based on the existing ATN standards to provide the following type of communication services :

1. addressing of any message to any air or ground destination on a point-to-point (and possibly multi-point) basis
2. unambiguous (authenticated) identification of sender and recipient (in user-friendly nomenclature)
3. means of uniquely identifying messages (both the "type" and "instance"), for subsequent reference or for correlating requests with replies
4. user-requested quality of service, relating to "Required Communications Performance"
5. security mechanisms to protect against unauthorised interference with the message content
6. service version number negotiation
7. prioritisation e.g. for display purposes
8. unconstrained message content and length.

### 3.3.3 Functionality

The GACS service can be provided at a number of levels to meet different needs of the communicating partners, as described below. The following basic functionality is defined:

1. **Connection-oriented service.** A persistent connection can be established for a period of time between the communicating partners, over which a number of message exchanges can take place reliably and efficiently.
2. **Connectionless service.** Each message is a discrete instance of communication. There is no connection overhead between the parties, and in consequence there is no guarantee that any loss of messages will be detected.
3. **Multi-point service.** Allows a sender to specify direct (as opposed to store-and-forward) information distribution to a defined list of recipient systems.
4. **Multicast service.** A recipient user can register to receive any message addressed to a specific group address, on a connectionless basis.
5. **Secure dialogue service.** (Future enhancement). A secure persistent connection is established between the communicating partners.
6. **Semantic interpretation and response.** (Future enhancement). This would allow some pre-defined semantics (e.g. "reply request", "confirm action") and their associated responses to be incorporated in the service, rather than being part of the user application.

### 3.3.4 GACS Benefits

#### 3.3.4.1 Flexible use of ATN infrastructure

The GACS concept is fully compatible with other ATN communications concepts. Airlines may use GACS as a long term solution for AOC traffic, obviating any need to standardise or disclose externally what message formats are used. By using GACS, AOC and ATC traffic can share the same communications links and infrastructure, without impairing the service offered to the safety-critical ATC traffic.

#### 3.3.4.2 Locally defined information formats

A major benefit that GACS brings is the ability for ATSOs, regional bodies, airlines and others to specify and implement new air-ground and/or ground-ground information exchanges which can be carried over the ATN without the need for protracted specification, co-ordination and standardisation activities. Such formats could be deployed on a national, regional or airline-specific basis.

#### 3.3.4.3 Standardisation of new applications

The use of GACS provides a clear split in the responsibilities for developing and standardising the operational information specifications and the communication specifications. The benefits of this approach to standardisation are:

1. a potential increase in the speed of standardisation, allowing operational concepts to be developed into standards in a shorter timeframe than current practices
2. the possibility of changing message sets in line with evolving requirements without the need to change the communication standards
3. an efficient method for validating concepts and requirements early in the standardisation lifecycle

4. the ability to upgrade applications without the need to upgrade the communications service (and vice versa).

### 3.3.4.4 Embedded Applications

It is possible with the GACS concept to specify applications which are close coupled to the communications protocols. By using the GACS specifications as a basis for these close-coupled application specifications, there are savings in specification and validation time, because the communications portion of the application specification is based on well established and validated text.

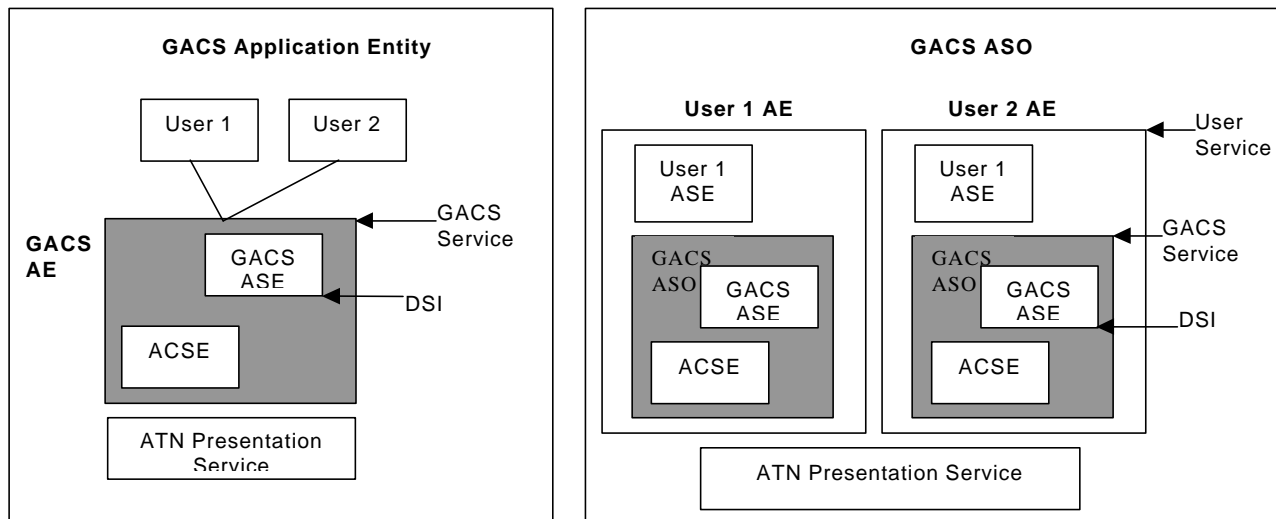
These savings ripple through to the implementation, where existing code can be reused in the development of the new application.

### 3.3.5 GACS Realisation

The GACS service provision can be realised alternatively as an "Application Layer message protocol" or as a "simple generic service". The two approaches are very different and have different fields of applicability.

- a) GACS can be realised as an **ATN Application Entity (AE)** providing an ATN access point to existing (e.g. ACARS-based) and future applications which are not specified to use the defined ATN upper layer architecture.
- b) GACS can be realised as an **ATN Application Service Object (ASO)** or "service" providing an enhanced dialogue service in the ATN Upper Layer Architecture to future air-ground and ground-ground ATN applications (ATC and AOC).

The two architectures are illustrated in the following figure.



#### GACS Application versus GACS ASO

The GACS AE approach is appropriate for the migration of existing applications. However, this approach is not the only approach for applications to use the ATN. The GACS ASO (enhanced dialogue service) approach would be preferred for any new ATC or AOC application.

### 3.3.5.1 The GACS Application Entity

This would be a distinct ATN application installed in aircraft and ground systems acting as a point of access to the ATN. An ATN address is allocated to the GACS AE. The GACS application itself is an addressable entity identified by an Object Identifier.

It would be natural to implement the GACS service as an application programming interface (API), providing a communications interface to user applications.

Several GACS-Users could use services from the same GACS Application. The GACS Application therefore multiplexes data supplied by GACS-Users over the same dialogue when the intended recipient and the requested communication characteristics are identical.

GACS-Users in this approach are not considered as fully integrated ATN applications; they have no distinct ATN names and no ATN addresses. Specific mechanisms need to be implemented to switch the incoming data to the relevant GACS-User, based on the message-type field.

The GACS Application itself does not know anything about the message contents, or the encoding rules for these messages. Typical communication functions, such as sequence numbering and request/reply correlation are entirely the responsibility of the GACS-User applications.

### 3.3.5.2 The GACS Application Service Object

The GACS ASO is defined to provide new application ASEs with an enhanced service within the AE. New ASEs can be developed over either the Dialogue service or the GACS service, depending upon their requirements.

In this framework, any new application is considered as a fully integrated ATN application identified by a specific ATN address and an Object Identifier. GACS itself is not identified as an ATN application. This architecture is completely in line with the ATN ULA..

ASEs can be privately defined. The ASE protocol and the format of the data exchanged by the AOC ASEs does not need to be standardised by ICAO or disclosed externally. These ASEs are "black boxes" for the ATN (in the same way that CM, CPDLC and ADS are considered as "black boxes" by the ULCS architecture).

### 3.3.5.3 GACS Interfaces

The implementation of GACS could be expected to offer an API at the GACS service boundary. The communications functionality would be implemented behind this API. An operational application, embodying the understanding of message semantics and encoding, would be developed for each application which wishes to make use of the GACS service. Industrial groups may wish to standardise an API, based on the GACS service specification, as an "exposed interface" for use by new aeronautical applications or migration of existing applications (e.g. AOC).

### 3.3.5.4 Validation

It would be possible to complete the validation of GACS through a pilot implementation, to ensure that the GACS specification, when correctly implemented, is capable of delivering the appropriate communications services to the GACS user applications.

### 3.3.6 Current Status

Eurocontrol has developed draft SARPs for GACS, and these are being progressed within ICAO ATNP working groups. Eurocontrol has also developed a draft API specification, allowing draft GACS-user applications to be developed immediately.

A Call for Tender has been launched for the development of software which will flexibly provide the GACS service to user applications, thereby providing entry-level user access to the full ATN infrastructure.

**Availability: Late 1998.**

## 3.4 Prototype Aeronautical Telecommunications Network (PROATN)

PROATN is part of CEC DGXIII's ATC related 4th Framework Programme in which EUROCONTROL has a specific interest. Co-funding arrangements have therefore been made between EUROCONTROL, the CEC and industry.

The Committee of Management in its 180th authorised the Director General to let a contract with the PROATN Consortium for the supply of a deployed pre-operational Aeronautical Telecommunications Network (ATN) infrastructure.

The project has two distinct parts.

Part 1 is the development of the ATN prototype. Its duration is about 2.5 years till mid 1998.

Part 2 is the verification, validation and demonstration phase. It starts in 1998 and will last about 1.5 years.

The project objectives are:

- to produce a deployed ATN infrastructure which allows the validation and demonstration of the ATN related issues of the ICAO CNS/ATM concept before it is implemented for operational use in the Member States.
- It will be developed as a pre-operational and pre-industrial prototype ATN of which the key elements are certifiable on an end-to-end basis.
- It will conform to the draft Standard and Recommended Practices (SARPs) and Guidance Material (GM) as being developed by the International Civil Aviation Organisation (ICAO).
- It will closely co-ordinate its activities with those of the European pre-Operational Data Link Applications (EOLIA) project, the objectives of which are to develop and evaluate several user-oriented ATC data link applications (including ADS - Automatic Dependent Surveillance) in the European environment.
- The development and validation of the PROATN will take into account both technical and operational inputs provided by the User Forums of both the PROATN and the EOLIA projects.

- The development of the PROATN will in particular include the ground End Systems and Routers, the airborne End Systems and Routers, the single-domain and multi-domain Network Management stations and the air-ground subnetworks (VHF, Satellite, Mode S).
- It will be validated by using network test tools as developed in PROATN and the Air Traffic Management (ATM) applications as developed in the EOLIA project.
- After its development and the integration of the ATM applications as defined by the User Forums, the PROATN will be deployed at 8 ground sites, and will be installed in both experimental aircraft and a “grounded” airline aircraft (i.e. a real Airbus aircraft fuselage with a real cockpit of an aircraft, however without engines).
- In the second part of the project the airborne systems will be officially integrated into the experimental aircraft and in a test airline aircraft (i.e. an airline type Airbus aircraft, however used for testing). The resulting ATN prototype will subsequently be used to contribute to the validation of the ATN and the ICAO CNS/ATM concept, and will be used to demonstrate the capabilities and benefits of the ATN to its user community.

**STATUS: Started Feb 96, planned completion of Phase 1 in mid 98. Currently in an advanced system integration stage. Phase 2 is approved by the European Commission and the associated contract with Eurocontrol will be concluded in August 98.**

The PROATN products are anticipated to be integrated into the ATN Trials Infrastructure as they become available from mid-98 onwards.

## 3.5 EOLIA

### 3.5.1 Introduction

EOLIA (European pre-Operational data Link Applications) is a European Commission (EC) sponsored project which has the objective to develop and evaluate a set of user-oriented ATN compliant, pre-operational ATC data link services in the European environment to enable the improvement of Air Traffic Management (ATM) taking into account the interests of the users and the European Industry.

Eurocontrol concluded a contract with the EOLIA consortium to develop extensions in the following areas :

1. Implementation of Additional Data Link Services and cross integration of existing services.
2. Stand-alone data link systems and Integration of Data Link services
3. Interworking trials with the **Eurocontrol UAC Maastricht**, which will control data link equipped aircraft in its live sectors to support the evaluation of the EOLIA services in an operational context.

The **Eurocontrol Experimental Centre in Brétigny** will provide a data link capable airborne and ground simulation capability to support the EOLIA evaluations and demonstrations.

These are detailed in the following paragraphs:

### 3.5.2 Down Stream Clearance (DSC)

The DSC service is based on the DSC communication services provided by the ICAO CNS/ATM Package-1 CPDLC application. The task involves the development of a common functional specification, a technical specification and the implementation of DSC on the NATS ATC platforms and the NLR aircraft. The DSC specification includes the definition of the DSC service layer. For the airborne software development, Aérospatiale is assisting NLR to integrate the software developed within the NLR aircraft.

One possible demonstration scenario is that the NLR test aircraft will take off from Amsterdam and will log on using DLIC to both the Dutch ATSU and the UK's ATSU. The aircraft will then undertake various tests to demonstrate the services hosted on it. This will include the passing of a DSC from the UK ATSU.

### 3.5.3 ATIS

The ATIS service is based on the CNS/ATM-1 package FIS application. When developing the functional specification of the service, the ATIS service description as provided by Eurocontrol's ODIAC Task Force is used.

This task involves the development of a common functional specification, technical specifications and the implementations which are specific to the EOLIA FIS platform, operated by Sofréavia/STNA, as well as the NLR aircraft. Sofréavia/STNA will develop the ATIS service in co-operation with Thomson with the objective of being able to connect to their pre-operational system at one of the French airports. Some adaptation of the existing digitised ATIS French system will be done by Sofréavia/STNA; the ATN FIS data-link system will be developed by Thomson.

Once the ATIS service has been implemented in the EOLIA end systems, local testing, interoperability testing and demonstrations/evaluations will be performed. For the airborne software development, Aérospatiale will assist NLR to integrate the software developed within the NLR ATSU. During the evaluation, Sofréavia/STNA will also carry out a technical comparison between this ATN-based ATIS service and the one based on ACARS.

The system will be designed as a pre-operational system taking into account the experience of the current ISATIS pre-operational use of data-link ATIS.

### 3.5.4 Safety Analysis

A safety analysis of the ATIS and DSC services has been undertaken. The analysis is based on a hazard identification and a fault tree analysis. The report concluded that there are potentially wide-ranging safety benefits relative to current procedures, principally by largely eliminating errors such as callsign confusion and mishearings between aircrew and controller, by more efficient transmission of data, avoiding hazards due to R/T congestion, and by providing an alternative means of communication and additional systems safeguards against error.

However, a number of areas were identified in which risks could increase, or for which the change in risk was uncertain. Recommendations for further risk assessment and risk management activities in these areas were made. The main areas of uncertainty are: the operational context for DSC, the HMI for the two services (since at the time of producing the analysis, no HMI has been developed), and the interaction between these two services and other parts of the ATN.

The safety analysis will be provided as input to any studies that aim at producing a safety analysis for a wider context, such as the whole of the ATN. It will also be used as potential input to ODIAC and the COM team

### 3.5.5 Cost Benefit Analysis.

A cost benefit analysis of the two services, DSC and D-OTIS (ATIS) has been performed. The analysis was done in the following steps:

- Definition of a proper system of reference
- Definition of the "do nothing case"
- Definition of the generic cost for the services
- Description of the benefits
- Computation of the costs and benefits

The D-OTIS service was found not financially profitable for the ATS providers because most of the benefits are qualitative rather than quantitative, and the quantitative benefits do not offset the costs the providers incur. Nevertheless, it may be that the providers are willing to pay for the qualitative benefits that they obtain.

The DSC service, on the other hand, was shown to have quantitative benefits that overpass the cost of the DSC service provisions, as well as providing qualitative benefits. The benefits are mostly realised in savings in controller workload.

Conclusions from this cost benefit analysis of just two ATN services can only be fully justified in the context of a cost benefit analysis of the whole of the ATN. For example, it may be that when viewed as a marginal cost, the provision of D-OTIS may yield a quantitative benefit. Thus the analysis will be used as input to any studies looking at the wider context of cost benefit for the whole of the ATN. The report will also be used as input to ODIAC and the COM team.

### 3.5.6 Stand-alone Data Link Systems.

This task supports the objective of enabling Eurocontrol and its Member States to acquire experience with ATN-based data link services, using the ProATN infrastructure; together with the provision of an appropriate mechanism to ease the integration of these data link services in Member States' ATC environments. The feasibility of such an integration is demonstrated by applying this mechanisms on a real ATC Centre environment based on the UK NATS development environment.

The Thomson/CSF AGAPES (Air Ground Applications Processing End System) which is being developed within the EC EOLIA project will be made more robust, so that it will be possible to export it to ECAC parties for trials and experimentation's purposes.

AGAPES will simulate an ATC "datalink only" controller position, allowing the test and evaluation of Air-Ground services capabilities. A typical use of this system could be the installation of this position in an ATC en-route operational centre with a standalone ATC position from which it will be possible to test datalink services with EOLIA equipped aircraft.

### 3.5.7 Integration of Data Link Services

The objective of the EOLIA/Pro-ATN demonstrator, to be provided by NATS, is to integrate initial data link services, based upon the Thomson Pro-ATN platform, into an operational ATC environment. It is the aim of the Air Traffic Management Development Centre (ATMDC, NATS) at Bournemouth to develop an initial operational data link service HMI upon its PEACH (Prototyping Environment for ATC HMI) platform. This platform will integrate the data link service HMI with the NERC (New En-Route Centre) ATC HMI with the Thomson Pro-ATN platform providing live data link communication with one or more suitably equipped trials aircraft in an operational ATC environment.

This work will be a significant step forward in achieving the EOLIA objectives of Eurocontrol, the EC and NATS. One of the aims of this Eurocontrol project is to demonstrate the feasibility of introducing an "off-the-shelf" modular data link service solution into an operational ATC environment. NATS is also currently contracted by the EC to provide input into EOLIA for work packages involving Ground End System (ES) Communication Integration and Ground ES Site Integration and Validation. Finally NATS, as an operational ATC organisation, is very keen to see the theoretical and research elements of data linking transferred into an operational environment, particularly with the ongoing development of FDPS2 for ScOACC. Producing this demonstrator will thus provide considerable benefits to all parties in terms of the experiences gained and lessons learned from both operational ATC and systems and communications engineering viewpoints.

With the exposure that NATS can give this demonstrator to operational controllers, this work will potentially pave the way for the introduction of data link services not just upon a NERC HMI based demonstrator but into NERC itself. A significant part of the forthcoming upgrade of the MSS (Multi-sector Suite) simulation facility at the ATMDC is to introduce PEACH-based NERC HMI. Using PEACH and the NERC HMI for this demonstrator will thus also provide future potential for performing large scale simulated (and even mixed live and simulated) trials of data link services within a representative operations room.

### 3.5.8 Cross Integration of FLIPCY and DYNAV

The FLIPCY (Flight Plan Consistency) and DYNAV (Dynamic Navigation) services are being developed for the EC on the NLR aircraft and the Aérospatiale Iron Bird. Eurocontrol is funding the portation of the implemented services from one air platform to the other. Thus, both platforms will have the same set of services.

### 3.5.9 Integration with Maastricht UAC

As part of the PETAL II programme, Maastricht UAC will have developed CNS/ATM-1 systems based on the same ODIAC Services as EOLIA are developing. Interoperability trials and demonstrations will be performed between the flying NLR aircraft and Maastricht UAC systems.

**STATUS: The project started in Feb 96, planned completion of the Eurocontrol contract is in early 1999. Phase 2 is approved by the EC and the associated contract with Eurocontrol is currently under negotiation.**

## 4. European ATN Implementation

### 4.1 Introduction

The ICAO Standards and Recommended Practices (SARPs) for the ATN and associated air/ground subnetwork technologies have been completed and validated on a world-wide basis. The various ICAO Regional Planning Groups are now responsible for the development of regional ATN implementation plans which will be part of the overall CNS/ATM implementation plans for a given region.

Pre-operational systems are currently being developed within the context of European and American projects. In parallel implementation plans are developed and non-technical implementation issues are addressed.

The implementation process is complex for the following reasons:

- The implementation must be driven by clear and accepted 'benefit drivers'.
- The implementation requires review of operational approval/qualification procedures.
- Institutional issues related to the implementation and operation of the ATN need to be solved.
- Evolutionary transition is required.
- Implementation requires global co-ordination.

The implementation strategy has to take the above issues into account. An additional level of complexity is the choice of Mobile Subnetwork. Whereas the ATN enables to integrate many different subnetwork technologies, it is in the interest of aircraft operators to minimise the unnecessary proliferation of different types of subnetworks. This will enable them to use systems as widely as possible and will reduce the cost of implementation.

### 4.2 ATN Implementation Task Force

The ATN Implementation Task Force (ATNI-TF) was established under the auspices of the EATCHIP Programme in order to identify, document and where appropriate resolve the issues related to the deployment of the ATN in Europe. Amongst other deliverables, the ATNI-TF is expected to prepare a Draft ATN Implementation Plan and a set of recommendations that will facilitate the implementation of the ATN in the EUR Region. This Draft ATN Implementation Plan will be presented to the European Air Navigation Planning Group (EANPG) which has the final authority for the adoption of the European ATN Implementation Plan.

Membership of the ATNI-TF includes representatives from States, IATA, NATO and Industry. In principle all Stake Holders are invited to participate in and contribute to the ATN Implementation Task Force.

Based upon its terms of reference (TOR) the Task Force will:

- identify and document a consolidated set of high level requirements on the ATN in general, and on ATN implementation in particular;

- conduct a quantitative cost and qualitative benefit analysis for ATN deployment in the European Region;
- identify institutional, legal and procedural issues related to ATN deployment and operation;
- identify and resolve issues related to the design of the European ATN;
- develop an implementation plan for the European ATN;
- implement a marketing strategy related to increasing the awareness of the aeronautical community on the subject of the ATN.

In achieving the above, the Task Force developed a Work Programme that comprises a set of defined work packages:

<b>Work Packages</b>	<b>Deliverables</b>
Requirements Capture and Consolidation	Consolidated set of high level ATN service and communication requirements
Business Case Development	Business Case for the ATN in the EUR Region
Marketing Strategy	Inventory and analysis of ATN related press articles  Set of publications promoting ATN implementation
Institutional, Legal and Procedural Issues	Compilation of identified issues including assessment and proposed resolution  ATN implementation and operation procedures
Design and Implementation Planning	Draft ATN Implementation Plan  Proposed Transition Strategy  Proposed CIP Implementation Objectives

The deliverables defined above will be an integral part of the Final ATNI-TF Report and will be presented in the form of attachments to this Final Report to ease future maintenance and update.

The European Commission has launched the ATN Compliant Communications European Strategy Study (ACCESS) project in which UK, Germany and France co-operate. The deliverables of this project form together a network design for the European ATN. The results of this project will be input for the European implementation plan which will be produced by the ATN Implementation Task Force.

The input on Institutional, Legal and Procedural issues will be produced by the ATN Implementation Issues project of the European Commission. This project will also investigate the various alternatives for financing the required investments and for establishing a European ATN

Co-ordinating Entity . The European Co-ordinating Entity is a proposed facility which will be responsible for tasks like network management and accounting.

## 4.3 Implementation Trends

Although there is no firm European ATN Implementation plan, a number of trends are already visible.

The ATN will be implemented in the ground communication infrastructure. Routers will be deployed to interconnect national subnetworks. The communication infrastructure within centres, which are typically TCP/IP environments, are connected via Gateways to the international infrastructure. The next phase may consist of the implementation of a European backbone subnetwork to interconnect the national routers. The infrastructure will become more common i.e. serving more types of users in the aeronautical domain. This will increase the cost/effectiveness of the infrastructure.

ACARS will be replaced with an ATN compliant implementation of VDL Mode 2. This will be the basis for AOC and AAC communication.

On a local scale datalink services may be provided to datalink equipped aircraft. Candidate services are for example Pre-departure clearance and ATIS. Experience and familiarisation will be gained through implementation of CPDLC in en-route airspace. Initial implementations of the ATN in Europe are foreseen around the year 2000.

**Status: The development of an European ATN Implementation plan is well underway. It is being developed in a complementary and collaborative way involving, Member States, Industry and Users. An ATN Implementation scenario has been developed which is used as the basis for the Business Case and the Implementation Plan. The development of the Business Case and the Implementation Plan is well underway.**

## 4.4 Common American European Reference ATN Facility

The objective of the Common American European Reference ATN Facility (CAERAF) is to provide a test facility to test operational ATN systems prior to deployment in the operational environment. Testing will be required in the context of recognised safety assessment, certification and operational approval processes.

The CAERAF project is a joint project between the FAA and ATN Systems, INC. on one side and EUROCONTROL on the other side. ATN Systems, INC, an 11 airline owned and FAA supported company, is developing a Conformance Test Suite which will be integrated in the CAERAF in the context of a EUROCONTROL sponsored contract.

The benefits of CAERAF can be summarised as follows:

- CAERAF will reduce the overall costs of ATN implementation.
- CAERAF will increase the safety of the operational ATN.

The ATN will be a global network infrastructure for mobile and fixed aeronautical data communication. This infrastructure will be used for non-safety and safety critical data transmission.

The ATN infrastructure is expected to be gradually implemented. A typical operational implementation will consist of different types of airborne and ground based components from potentially different manufactures.

The components of the ATN communicate with each other, for example, to ensure that messages can successfully be routed to mobile systems in accordance with safety and policy requirements. A system that does not properly interoperate with the other systems can cause severe problems in the network and, depending upon the safety criticality of the data being transmitted by the infrastructure, may even result in a safety hazard. It is therefore of paramount importance to adequately test systems to ensure correct behaviour before they are operationally deployed.

It is an option that systems may be tested on a bi-lateral basis. This would ultimately imply that all systems have to be tested with all systems. The systems also have to be tested under exceptional conditions. Testing a system will become cumbersome and very expensive or, when the cost are not acceptable, may be limited in scope. It also has the potential to lead to disputes between vendors as to which implementation is "correct". Reduced testing will constrain the operational usability of the ATN.

The CAERAF approach is based on the principle that all systems are to be tested against the same reference implementation, i.e. the CAERAF platform. This ultimately results in a more cost/effective approach from a total system perspective. It also increases the confidence in the deployed systems to carry safety critical data. Furthermore the CAERAF will enable systems to be tested under exceptional conditions which may not otherwise be the case.

In October 1996 a contract was let with IBM for the development of the User Requirements Document. The contract includes an extensive User Requirements Capture process. Requirements of potential users (Administrations, Industry, Service Providers) were captured by means of Workshops, interviews and analysis of documents. The captured requirements have been consolidated in the User Requirement Document.

During the User Requirements phase the following disciplines were consulted:

- Regulatory experts
- Testing experts in and outside the aeronautical domain
- Avionics and aircraft Manufactures
- Airlines
- Administrations

The current scope of the CAERAF includes interoperability, stress, robustness. conformance and performance testing.

The User Requirements Phase has been completed in June 1997. The CAERAF is planned to be available in 2000.

Currently, a number of institutional issues related to the CAERAF are being discussed. It is for example necessary to establish an institutional context in which the CAERAF and the results obtained by using CAERAF are recognised by the Regulatory Bodies.

**STATUS: Contract signature is planned for November 1998.**

## 5. Points of contact

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