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AERONAUTICAL TELECOMMUNICATIONS NETWORK PANEL
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EUROCONTROL ATN Project Overview and Status

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Summary

This document presents the status of the EUROCONTROL ATN Project.



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.

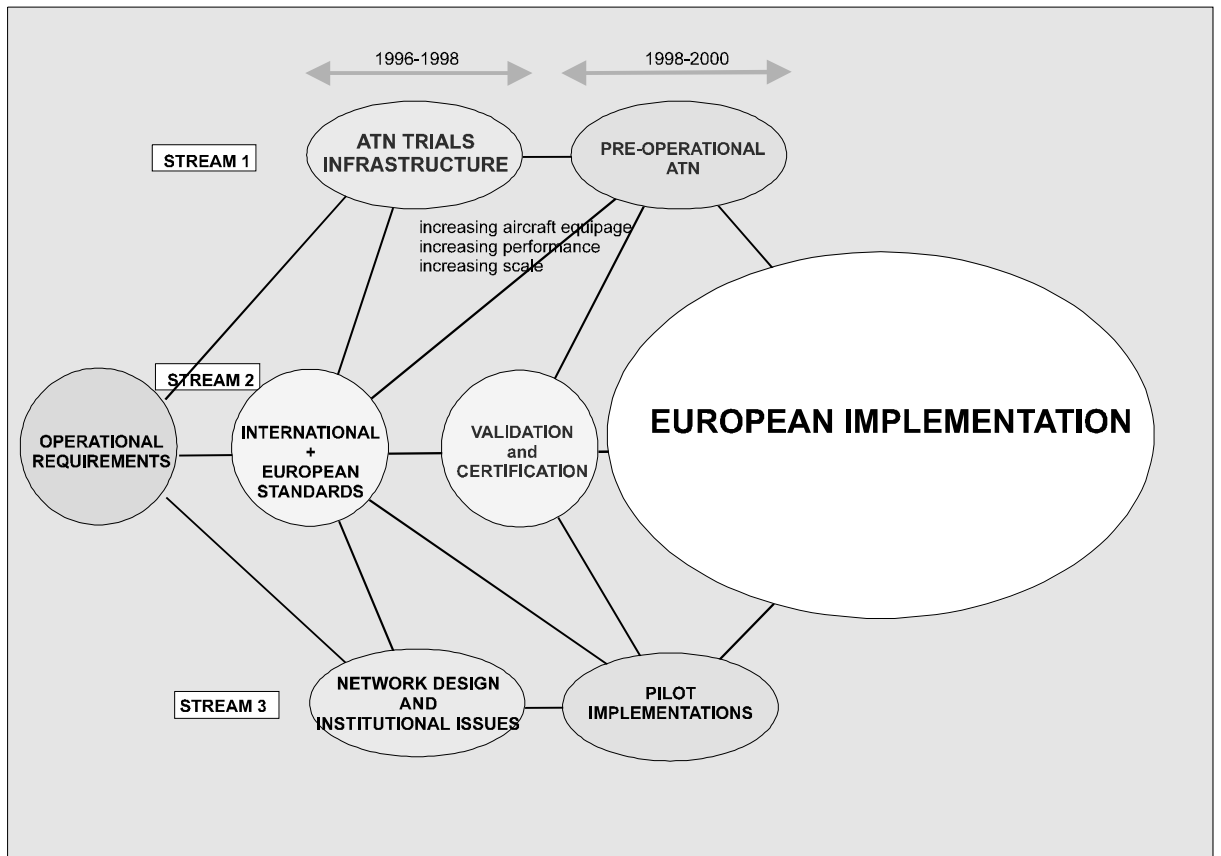


Figure 1 - The ATN Strategy

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 is currently managing the User Requirements phase for the development of a Reference ATN Facility (RAF). The contract for this phase was awarded to IBM Belgium. 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. A European ATN Implementation Task Force will be 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 in Europe has come to point where experimental ATN system elements are becoming available from a number of sources. Early testing at the communications level in limited local configurations is already underway.

With the deployment of the experimental systems, the planned availability of complementary ATN components like the Trials End System (TES), the Mode S Ground Data Link Processor, the Trials ATN Router (TAR), etc. at various European sites, a distributed European ATN Trials Infrastructure is being created.

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. For the ground this objective is nearing completion. The airborne side is now being addressed, compliant systems should be

available by July 97. The concept is one of “service provision” in support of national or multi-national trials rather than “co-ordination and organisation of operational trials”.

3.1.2 Objectives

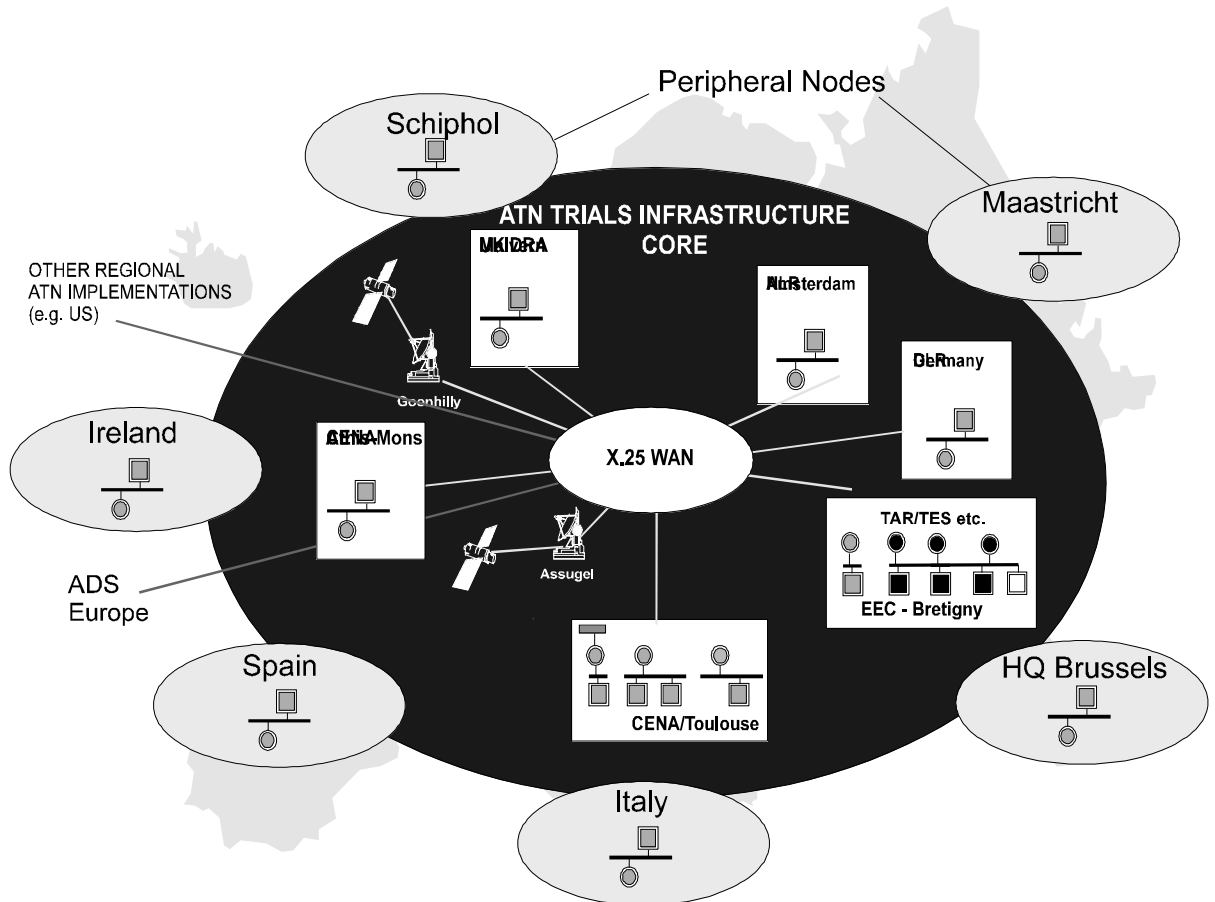


Figure 2 - ATN Trials Infrastructure

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.

The ATN Trials Infrastructure project creates 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 will be 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).

The ATN needs to be marketed to attract further CAA and Airline participation to stimulate investment in implementation programmes by showing potential benefits in the field.

The specific objectives are:

- The delivery of a distributed environment comprising the distributed CNS/ATM-1 Package compliant European ATN Trials Infrastructure (ATIF) consisting of the experimental CNS/ATM-1 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,
- 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

ATIF Users will be given TAR-TTS release B which is the first ICAO CNS/ATM-1 Package compliant system offering ATN Internet communications services anywhere. Release B has been the subject of the course given was delivered in mid-Nov 96, there will be a Release C by end of April. 97 which will include enhancements for:

- Routing policy language and aggregation,
- Mode S T-GDLP interface,
- Remote TCP/IP access to the Transport interface,

No further releases are planned but defects will be corrected when necessary.

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 and AENA - Spain).

Availability: Release B - now, Release C - April 97

3.1.3.2 Airborne TAR-TTS

Portation to a PC UNIX environment is planned for July 97, this version will also support an interface to ARINC 429 - the commercial aircraft standard bus. This will allow the product to fly in experimental aircraft.

Availability: August 97

3.1.3.3 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.

A contract has been let for this work and delivery is planned for August 97. This tool will be designed for platform independence such that it can adapted to all major UNIX platforms.

Availability: August 97

3.1.3.4 TES - The ICAO SARPS Compliant Applications/Upper Layers

The Trials End System (TES) project is developing ICAO SARPs compliant upper layers and applications for ADS (automatic dependent surveillance), CPDLC (controller/pilot datalink communications) and CMA (the context management application). These are being developed on the HP9000 platform and as such can be integrated with TAR/TTS on the same platform using the transport service interface.

The integration of TES with TAR-TTS in a single platform is planned for April 97. ATIF will then have the first complete end to end ICAO SARPs compliant implementation.

The Network Management Tool (ATIF-NMC) will be extended to include configuration and monitoring of the TES product co-located with TAR-TTS in the same platform.

When the TAR-TTS is ported to new environments (e.g. PC UNIX for aircraft) the TES products will also be ported.

Availability: Integrated with TAR-TTS in March 97, for external distribution after tests (e.g. with FAA implementation) June 97.

3.1.3.5 EURATN

The original objective of ATIF was to have two independently developed CNS/ATM-1 compatible systems (EURATN/DEMISIS and TAR/TTS) for the execution of trials. However, at this time it has not been possible to upgrade EURATN due to time and cost constraints.

CENA/SOFRÉAVIA plan to use the existing EURATN systems for the Norwegian ADS and ASIATN programmes, it is anticipated that portation to the Solaris operating system and upgrade will take place in the short term. In any case EURATN will inter-work with TAR-TTS and can be considered part of ATIF deployments.

Availability - now, although only on SUN O/S not Solaris (not fully CNS/ATM-1 compatible). Portation, upgrade and Solaris version planned for use in ATIF.

3.1.3.6 Mobile Subnetworks

The TAR-TTS will interface to the Mode S T-GDLP developed by Eurocontrol by April 97 trials are planned. The airborne router interface to the ADLP (Williamsburg and ARINC 429) will be implemented when TAR-TTS is ported to the PC environment intended for avionics use.

Availability: T-GDLP/ADLP now, flight trials planned

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) will be implemented when TAR-TTS is ported to the PC environment intended for avionics use.

Availability: Now

The TAR-TTS does not currently interface to the VHF subnetwork equipment but provides SARPs compliant interfaces to enable this - there is no anticipated problem - it just has not been done yet. The airborne router interface to the airborne VDL unit (Williamsburg and ARINC 429) will be implemented when TAR-TTS is ported to the PC environment intended for avionics use.

3.1.3.7 Fixed Subnetworks

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

Availability: Now

Future plans are for Frame Relay and Asynchronous Transfer Mode interfaces.

3.1.4 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. | 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> |
| 2. | 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> |
| 3. | DFS - JANE | <p>Joint Air Navigation Experiments (JANE), a prototype CNS/ATM Demonstrator program is under preparation. There is an interest to develop the Pre-departure Clearance application.</p> <p>DFS are users of TAR/TTS and will also request TES software. They have 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 Eurocontrol Mode S trials when the station is ready.</p> |

| | Program or State | Activity and Relation to ATIF |
|-----|--|--|
| 4. | 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. |
| 5. | Eurocontrol - Mode S | The TAR/TTS/TES will be used in flight trials planned for 97. These trials will involve the BAC 111 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 the likely to be the first available for use. |
| 6. | Eurocontrol - PETAL II | This trials program will validate the operational concept, requirements and operational procedures for air/ground datalink in EATCHIP-III and transition to EATMS; 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 use in Europe. 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 if sufficient commercial aircraft can be equipped suitably. Upgraded ADS Europe aircraft would be an option. |
| 7. | 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. |
| 8. | 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. |
| 9. | FAA ATN Trials | ?? More information required. Current plans are to inter-connect the US Upper Layer and Application development to the European TAR/TTS/TES to conduct inter-operability tests. |
| 10. | France - STNA | 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. |
| 11. | Ireland | Users of TAR/TTS for early ATN experiments and experience in house, plans include ADS, CPDLC and |

| | Program or State | Activity and Relation to ATIF |
|-----|---|---|
| | | ground-ground (OLDI). Connection to public X25 Jan 97, connection to ATIF Feb 97. They would like to connect to ADS Europe. |
| 12. | LVB/ Eurocontrol Processed Radar data Exchange Trials | Ground-ground ATN tests exchanging processed radar data between RMCDEs located in Maastricht and Schipol via two TAR (Trials ATN Router) systems connected by RADNET. This is the same configuration that will be 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 (e.g. DFS). |
| 13. | 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. Currently no relation to ATN. |
| 14. | SICTA - Italy | Users of TAR/TTS for early ATN experiments and experience in house plans include ADS, CPDLC and ground-ground database exchange in the future. September connection to ATIF for international trials to be specified. |
| 15. | 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. |
| 16. | SPAIN - AENA | TAR/TTS users ready to start the connection with ATIF from 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. The first End to End trials should be carried out no later than 1st of July/97. They want to connect to ADS Europe. |
| 17. | TELNOR - Norway | Users of TAR/TTS and EURATN for early ATN experiments and in the context of the North Sea Helicopter ADS Trials. Future plans include the continued use of experimental systems before the introduction of PROATN operational systems. |
| 18. | UK NATS ADS Europe and Phase 1-C | NATS is a major partner in ADS Europe. 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 in a British Airways 747 aircraft (Phase 1-C). This will be the first airborne implementation of IDR and it will communicate via SATCOM with the TAR/TTS on the ground via the Goonhilly ground earth station. |

3.2 Trials End System

3.2.1 Objectives

The objectives of the TES project are:

- the validation of the ATN Air-Ground applications and Upper Layer SARPs,
- the production of corresponding prototypes and simulation models, and
- free issue of the software to member Administrations.

The TES is currently being procured by Eurocontrol for the ATN End System task (FCO.ET3.STO4).

3.2.2 Architecture

The TES is a set of capabilities; hardware, base software and custom software, which will be used initially primarily for the validation of the ICAO draft SARPs for the ATN Upper Layers and Air-Ground ATM applications. The TES environment consists of two major components, the air-based end system and the ground-based end system. The ATN Upper Layers rely on the services provided by the ATN Internet, and provide communication services to the ATM applications. 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 3.

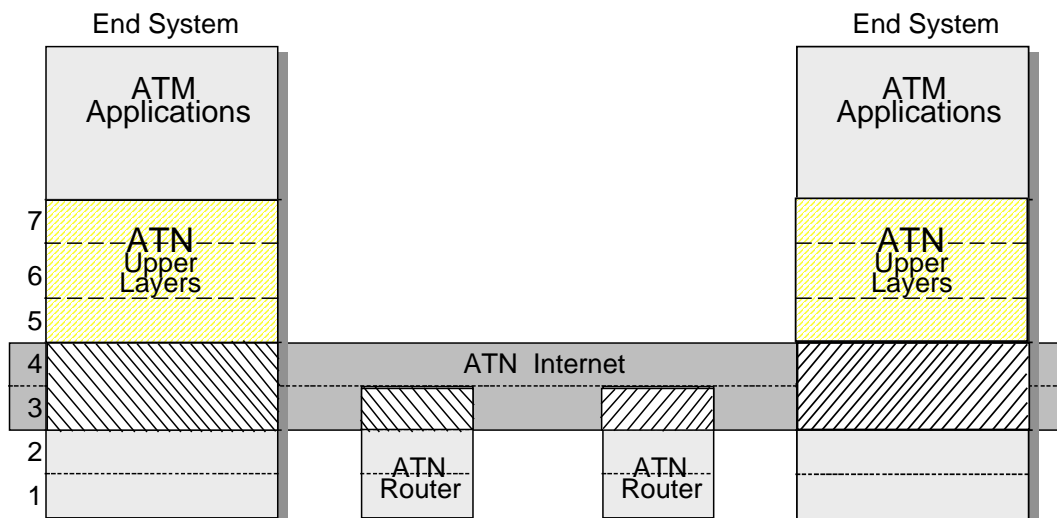


Figure 3: ATN End Systems Model

For the TES, these two systems shall communicate by a lower layer protocol stack which can be used in a variety of configurations, in place of the ATN Internet. This latter point is important since the objective of the TES is to validate the SARPs for ATM applications and ATN upper layers and not the ATN Internet.

The TES prototype software shall use the transport layer interface, to provide access to ATN Internet, which will be replaced with a connection-oriented Class 4 transport protocol

to the communication infrastructure. For the TES, different communications infrastructure configurations can be “plugged in” beneath the transport interface, including at least the following:

- inter-process communication (single machine);
- TCP/IP communication;
- ATN simulation (i.e. software which simulates the anticipated behaviour of the various subnetworks of the ATN Internet);
- in the future, complete CNS/ATM-1 Package ATN Internet protocol stack;
- commercial off-the-shelf (COTS) lower layers.

Each of the different TES communication infrastructure configurations will be accessible from the TES platform, an HP-725 running a POSIX and XPG/4 conformant environment.

3.2.3 Trials End System Prototype

The TES prototype will include software implementations of the following ATM SARPs:

- Automatic Dependent Surveillance (ADS);
- Context Management (CM) Application;
- Controller-Pilot datalink communication (CPDLC);
- Common Upper Layer Architecture and protocols.

Each of the TES prototype software implementations of the ATM applications will include the air and the ground based end system components. The TES does not include the validation of the Flight Information Services SARPs, which is also part of the CNS/ATM-1 Package.

The TES prototype will be developed by the contractor, selected to supply the TES, who will independently analyse the draft SARPs, produce functional and design specifications based on the draft SARPs and implement the software realisations. The TES prototype will then be used to test the functionality, interoperability and performance of the draft SARPs

The TES prototype will use the defined End System Interfaces. The End System Interfaces provide a common interface which will allow simulation and test tools to be developed separately from the TES prototype.

The TES prototype will include a user interface simulation to allow data to be input into the prototype applications individually or concurrently. The TES prototype user interface simulation will be used to test and record the behaviour of the ATN components developed using the draft SARPs. The general model for the TES is illustrated in Figure 4.

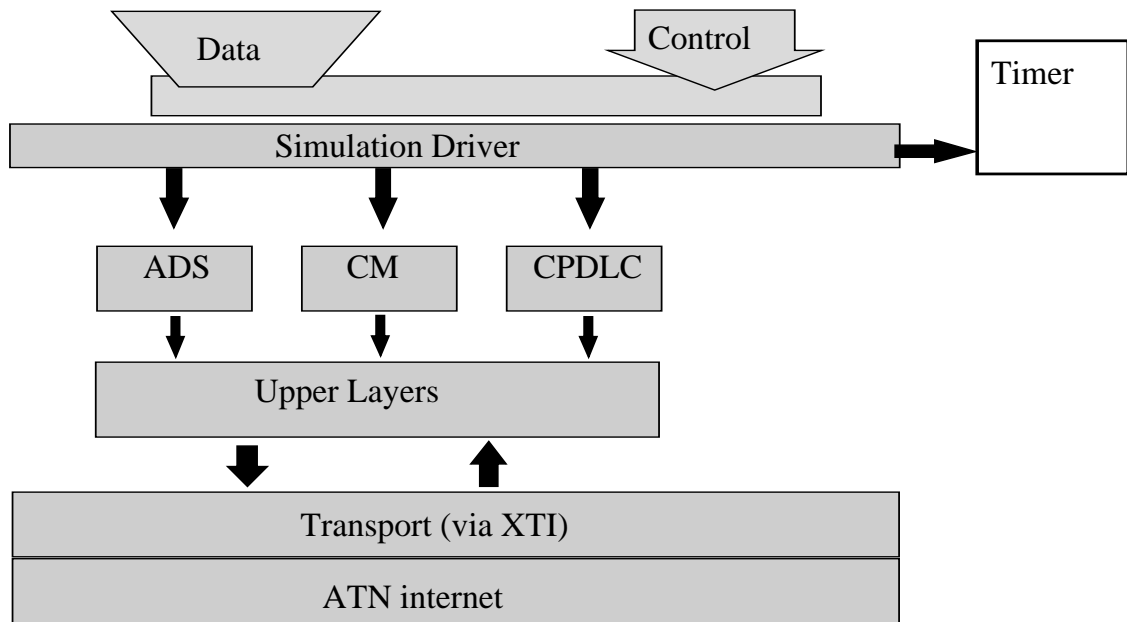


Figure 4: Trials End System ATN SARPs validation model

The TES prototype user interface simulation will use tables as a source of data, which where possible will be based on samples of real data, and control sequences which can utilise the tabular data to produce what-if scenarios.

The TES prototype user interface simulation will be used to test both normal and abnormal events into the TES prototype through the End System Interfaces. The test scenarios will be based upon real-life situations, including time based events, single instance of a flight and summation of all flights. These will be used to check the behaviour of the TES prototype and the draft SARPs.

Both the TES prototype user interface simulation and End System interfaces are aimed at the validation of the SARPs and would not necessarily be used in an operational environment.

The TES and its components will support a number of configurations on the user side or Human Computer Interface (HCI), which will allow it to be used beyond the initial SARPs validation. These user configurations will include:

- the validation environment;
- a demonstration environment, with user interfaces possibly based on Eurocontrol Brétigny HCIs;
- future experiments based on CNS/ATM-1 Package SARPs;

It is intended that the TES prototype system and its hosted applications will evolve into an ATN Application Reference System, providing a stable implementation of the CNS/ATM-1 Package SARPs once validation is complete, against which other implementations can be tested.

Thus, future uses foreseen for the TES prototypes include:

- Further SARPs evaluation and experimentation

- Integration with end-user (HMI) software
- Use in operational simulations
- Use in pre-operational trials.

3.3 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 Tele-communications 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 System Design stage

The PROATN products are anticipated to replace the ATN Trials Infrastructure products TAR/TTS/TES etc. as they become available from mid-98 onwards.

3.4 EOLIA

3.4.1 Introduction

EOLIA (European pre-Operational data Link Applications) is a European Commission 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. The project is closely related to the Prototype Aeronautical Telecommunications Network (PROATN) project which develops the pre-operational and certifiable ATN, used by the EOLIA project as communication infrastructure.

EOLIA makes use of a user forum which is consulted in order to discuss the requirements for the different services which are implemented, and to prioritise them. The developed requirements are consistent with the requirements defined by the ODIAC (Operational Development of Initial Air/ground data Communications) group at Eurocontrol.

The work is broken down into the following work packages:

- WP1 - Project Management
- WP2 - User Forum
- WP3 - Systems engineering and prototype integration
- WP4 - Airborne development and integration
- WP5 - Ground development and integration
- WP6 - Evaluation

The project plans to deliver software and final reports to Eurocontrol by the end of 1998, including a demonstration of the services in operation.

The EOLIA project provides an additional layer of functionality on top of the CNS-ATM-1 air-ground applications. The EOLIA software will make use of the CM (Context Management), ADS (Automatic Dependent Surveillance), CPDLC (Controller Pilot DataLink Communications) and FIS (Flight Information Services) applications being developed as part of the ProATN (Prototype Aeronautical Telecommunications Network) project.

Figure 4 shows the structure of the systems being developed. The ProATN software will provide the functionality of CM, ADS, CPDLC and FIS as defined in the SARPs (Standards and Recommended Practices). The EOLIA service layer will add value to this functionality.

A series of services will be implemented that provide functionality more closely coupled to typical operational procedures.

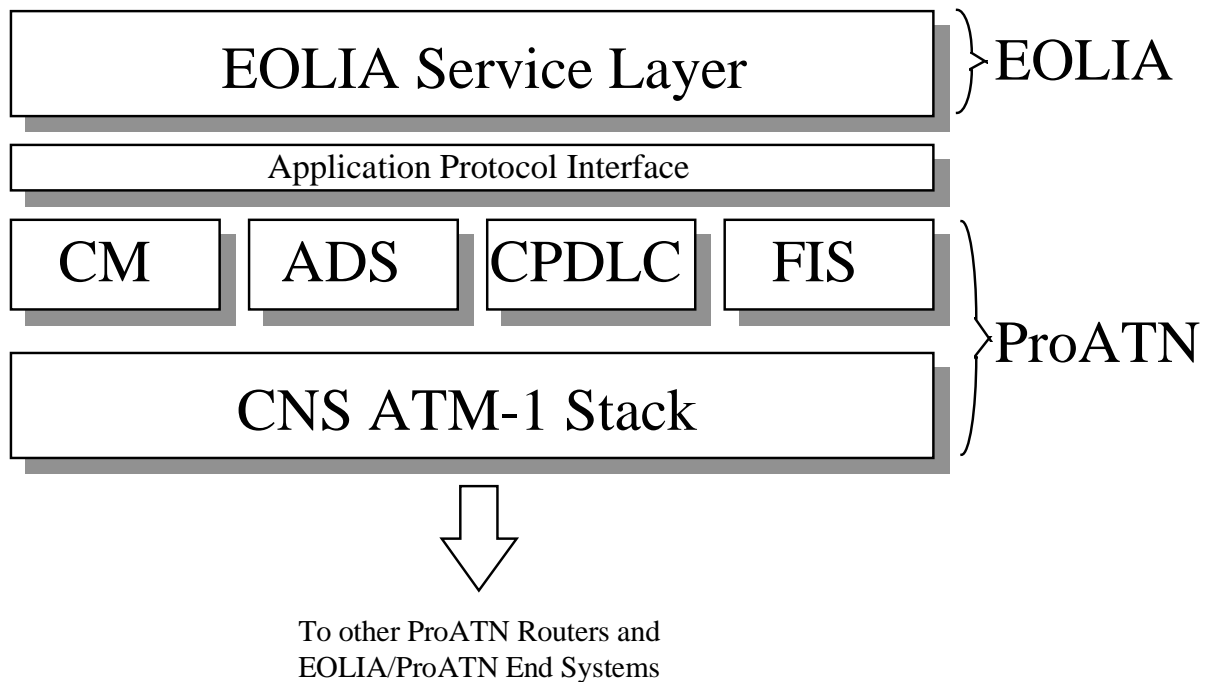


Figure 4: The structure of the EOLIA Software

3.4.2 Stand-Alone Data Link System

The services developed in the EOLIA project will be integrated into a stand-alone datalink-only controller position, allowing the testing and evaluation of datalink services. 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.

The system will be highly modular in its construction, with a well-defined API (Application Programmer Interface) between the EOLIA services and the user interface. The user interface will be focused on datalink services only, and will allow customisation of the presentation of the data.

In order to be a fully functional controller position, a mock-up of a flight data processing system will be created so that the EOLIA service layer can get flight plan information. Again, this will be accessed through a well defined API.

The system will be implemented with the DLIC, APR, ACL, ACM and FLIPCY services. If funding permits the DYNNAV service will also be implemented.

3.4.3 Integration of Datalink Services

3.4.3.1 PEACH

An objective of the project is to integrate datalink services into an operational ATC environment. It is the aim of the Air Traffic Management Development Centre in the UK, to

develop an initial operational data link service with a user interface, upon its PEACH (Prototyping Environment for ATC HMI) platform. This will provide live datalink communication with one or more suitably equipped trial aircraft in an operational ATC environment.

This work will result in a live demonstration of the datalink services within a realistic ATC environment.

3.4.3.2 Cross Integration

The air-borne service software is being developed by Aerospatiale and NLR, and will be integrated by them into their own aircraft platforms. Thus, those services developed by Aerospatiale will be implemented on Aerospatiale's aircraft platform, and those services developed by NLR will be implemented in NLR's aircraft platform.

In order to ensure that all aircraft platforms have the same functionality, the task of porting the developed services from one platform to the other will be undertaken. This process is known as cross integration. The resulting aircraft platforms will thus have the full range of services implemented.

Cross integration of the DYNAV and FLIPCY services will be performed under Eurocontrol funding. Cross integration of APR, ACL, ACM and DLIC will be performed as part of the EC sponsored project.

3.4.4 UAC Maastricht

Eurocontrol operates the UAC (Upper Area Control) centre at Maastricht in the Netherlands. One of the objectives of the project is the integration of the UAC into the EOLIA topology, and the end-to-end testing of the UAC with the EOLIA services. The scope of the end-to-end testing covers both those services funded by the EEC and those funded by Eurocontrol.

This task should result in a demonstration of the EOLIA services running between UAC and both a ground simulation of an aircraft and a flying aircraft.

4. European ATN Implementation

4.1 Approach

Pre-operational systems are currently being developed within the context of European 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 a/c 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.

A European ATN Implementation Task Force is being established with the objective to produce a credible European ATN Implementation Plan. The Task Force will amongst others initiate Cost Benefit Analysis studies to evaluate different implementation options and will also address the institutional issues.

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.

To support the operational implementation the need for the following two tools has been identified:

- Reference ATN Facility (RAF): A facility which will be used to test operational airborne and ground systems prior to operational deployment,
- Network Design Tool: A simulation facility for the dimensioning, planning and evaluation of ATN infrastructures.

The Network Design Tool Project is still in a project initiation phase.

4.2 Implementation trends

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

The ATN will first 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.

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. The main benefits

will be derived from datalink applications supporting improved Air Traffic Management. An example is the trajectory negotiation application.

The first area of ATN implementation is likely to be the North Atlantic Region. The introduction of ADS and CPDLC in combination with the introduction of improved navigation and new operational concepts is likely to result in benefits. The time scale for implementation is around the year 2000 whereas the first implementations of ATN in the European airspace are foreseen for 2003 - 2005.

4.3 Reference ATN Facility

The objective of the Reference ATN Facility (RAF) 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 benefits of RAF can be summarised as follows:

- RAF will potentially reduce the overall costs of ATN implementation.
- RAF will potentially 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 be 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 RAF approach is based on the principle that all systems are to be tested against the same reference implementation, i.e. the RAF 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 RAF 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 will be 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 RAF has been reduced to interoperability, stress, robustness and performance testing. Although pure conformance testing is not within the scope of RAF, the facility will be capable to test conformance to the ATN SARPs.

The User Requirements Phase will be completed in July 1997. Following approval for the development phase , EUROCONTROL will launch a competitive call for tender for the next phase. The planned availability date for RAF is 1999.

Currently, a number of institutional issues related to the RAF are being discussed. It is for example necessary to establish an institutional context in which the RAF and the results obtained by using RAF are recognised by the Regulatory Bodies. Also being considered are the various options to provide the RAF service and the relation to the ATN Systems Inc CTS project.

5. Points of contact

For more information on the EUROCONTROL ATN Activities you may contact the following persons:

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