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WORKING GROUP 3 (APPLICATIONS AND UPPER LAYERS)
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Eurocontrol ATN Trials End System

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SUMMARY

This paper presents the current state of development and deployment of the Eurocontrol Trials End System (TES), an implementation of the CNS/ATM-1 Package ATN upper layers, ADS, CM and CPDLC applications. TES is a component of the Eurocontrol ATN Trials Infrastructure (ATIF).

The Working Group is invited to note this important development as a major stepping stone to full ATN deployment.

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1. INTRODUCTION

This paper presents the current status of the Eurocontrol ATN Trials End System (TES), an implementation of the CNS/ATM-1 Package ATN upper layers and ADS, CM and CPDLC applications.

This is an update to previous papers describing the overall concept, implementation approach and validation results obtained from the TES project (see list of references for details). It describes TES developments since the demonstrations which were presented at the ATNP WG Langen meetings in June 1997.

TES is a component of the Eurocontrol ATN Trials Infrastructure (ATIF).

1.1. Acknowledgements

Thanks are expressed to SICTA in Italy and DFS in Germany for sharing the results of their TES deployments to date.

1.2. References

ATNP/WG3/WP4-13	Approach to Validation of CNS/ATM-1 Package SARPs
ATNP/WG3/WP9-23	Results from Eurocontrol Application SARPs Validation
ATNP/WG3/WP9-24 (TES)	Implementation of Eurocontrol CNS/ATM-1 Trials End System
ATNP/WG3/WP9-25	Eurocontrol ATN Project Overview and Status
ATNP/WG3/WP10-23	Eurocontrol Trials End System (TES) - Status Update

2. BACKGROUND

The Eurocontrol Trials End System (TES) project has been involved in a number of activities in support of the validation of the draft ICAO Air-Ground SARPs and supporting ATN Upper Layers. A major activity was the production of prototype software realisations of the SARPs.

The TES software implements :

- The air-ground functionality of the Automatic Dependant Surveillance (ADS) application SARPs (excluding the ADS Report Forwarding functionality)

- The air-ground functionality of the Controller Pilot DataLink Communication (CPDLC) application SARPs

- Both the air-ground and ground-ground functionality of the Context Management (CM) application SARPs

- The ATN Upper Layer SARPs (efficiency enhancement option session, efficiency enhancement option presentation, ACSE edition 2 and Control Function).

In each case, the functionality referred to is that of the Application Entity (in OSI terminology), i.e. that part of the application which is concerned with communication aspects.

The TES implementation satisfies the functional requirements in chapters 2 to 6 of the air-ground SARPs - the user requirements in chapter 7 are explicitly <u>excluded</u>. Thus, any software accessing the TES software must ensure that the user requirements are observed.

Chapter 8 of each air-ground SARPs defines interworking possibilities in terms of valid subsets of the application. The TES software is <u>not</u> configurable in terms of the subsets defined in SARPs chapter 8; rather, it conforms to just one of the defined subsets.

To give a rough indication of the SARPs functionality excluded from TES, the number of User Requirements as a proportion of the total number of requirements in each of the application SARPs is:

CM	21%
CPDLC	48%
ADS	27%

Fundamental to the implementation approach is the definition of a set of programming interfaces 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 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 TES software is implemented over the OSI transport service, which is provided either by the OTS 9000 product from Hewlett Packard, or by the Internet SARPs-compliant TAR/TTS system which has been developed within Eurocontrol.

3. CURRENT STATUS

The TES prototype software has now been upgraded so that it conforms to the SARPs versions approved at the ATNP Working Group of the Whole meeting in March 1997 (ICAO Version 1.1 - post-Phuket SARPs). This was done in order to:

    a) keep the software current,

    b) update the upper layers to conform to the final versions of the ISO standards,

    c) validate approved SARPs changes since June 1996,

    d) facilitate interoperability with other implementations.

This stage of the TES development is close to final acceptance.

The TES software has been ported onto a PC platform running SUN Solaris 2.5.1 /x86, in preparation for in-flight trials.

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

4. NEXT STEPS

Future highlights of the TES implementation include:

- Additional Interoperability testing

  IOP testing with other independent implementations of ATN applications and upper layers is an important goal of the TES project. This not only increases confidence in the SARPs themselves but ensures that global interworking is indeed feasible. The earlier IOP testing of the CM application between TES and a US implementation will shortly be extended to include the ADS and CPDLC applications.

- API enhancements

  The current TES interfaces were designed as engineering interfaces to allow testing to be performed. The next release of TES will present a more user-friendly set of interfaces to the outside world.

- SARPs tracking

  As SARPs changes are approved by the ATNP CCB, they will be evaluated for their effect on TES functionality and interoperability. It is likely that an upgrade of TES will be performed when the SARPs baseline stabilises (e.g. by ATNP/3).

- 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 under investigation.

5. DEVELOPMENTS AND EXPERIMENTS WITH TES

This section outlines some of the projects which are utilising the TES software to provide rapid evaluation of and experimentation with ATN applications.

5.1. SICTA (Italy)

5.1.1. Introduction

In the framework of their ATN research activities SICTA plan to use Eurocontrol TES products, together with TAR-TTS products, in two projects:

- ADS, CPDLC, CM Trials
- AISAS Flight Information System Trials.

5.1.2. ADS, CPDLC, CM Trials

SICTA have in progress integration of ATN into their existing ADS environment. This currently consists of:

- a DEC Alpha hosting ADS, CPDLC and CM applications and an ADS Track generation function,
- a PC (called Assistant) hosting ground HMI for ADS, CPDLC and CM,

- a PC hosted ADSU (simulator of a number of aircraft with HMI, ADS, CMA and CPDLC capability),

- a system hosting a Data Fusion function of ADS and Radar data, and

- a Controller Working Position (with display for radar and pseudo-radar, for ADS, tracks).

The intention is to fly the ADSU in a modified form and use Eurocontrol TES-TTS-TAR products in the Airborne and Ground systems to form the ATN datalink.

The trials will be conducted in 2 phases:

Phase 1 - integration on the ground with mobile subnetwork simulated through a X.25 link.

Phase 2 - as phase 1 but with the addition of the already available experimental VDL Mode 1 data-link, first in the laboratory and then on a Citation III aircraft for flight trials. In the future, different mobile data-links will be used.

5.1.3. AISAS Flight Information System Trials

AISAS is the ENAV's (the Italian Agency for Air Traffic Control) AIS Automated System and SICTA would like to introduce ATN communications to the existing application using Eurocontrol TES-TTS-TAR products in the Airborne and Ground systems. This would lead to the demonstration of air-ground NOTAM communication between the mainframe database on the ground and the pilot. This service is not currently covered by the ICAO FIS SARPs and the trial may lead to new SARPs being proposed.

For this service SICTA aim to implement a new FIS/NOTAM Application Entity in the TES product.

The trials will be conducted in 2 phases:

Phase 1 - integration on the ground with mobile subnetwork simulated through a X25 link.

Phase 2 - as phase 1 but with the addition of the already available experimental VDL Mode 1 data-link, first in the laboratory and then on a Citation III aircraft for flight trials. In the future, different mobile data-links will be used.

5.2. DFS (Germany)

All systems currently used by DFS in its Demonstrator and ATN Research Testbed (DART) are TAR-TTS systems developed by Vertel under a Eurocontrol contract, and are based on HP 9000 work stations.

In the scope of Satcom subnetwork integration in the end of 1997, as well as for Mode S subnetwork integration in the beginning of 1998, combined air/ground BISs, based on a PC TAR, will be installed in the airborne laboratory (simulator) of DART.

Another combined BIS/End System, a combination of TAR-TTS and TES, is already in use.

Beyond this, work has started to connect the ATN environment with the ATC simulator in Langen. This will optimise further trials and investigations with respect to realistic surroundings. This complex research system will obtain a "real" ATC environment.

The planned infrastructure of the DART is illustrated in Figure 1, where the TES end systems are shown circled.
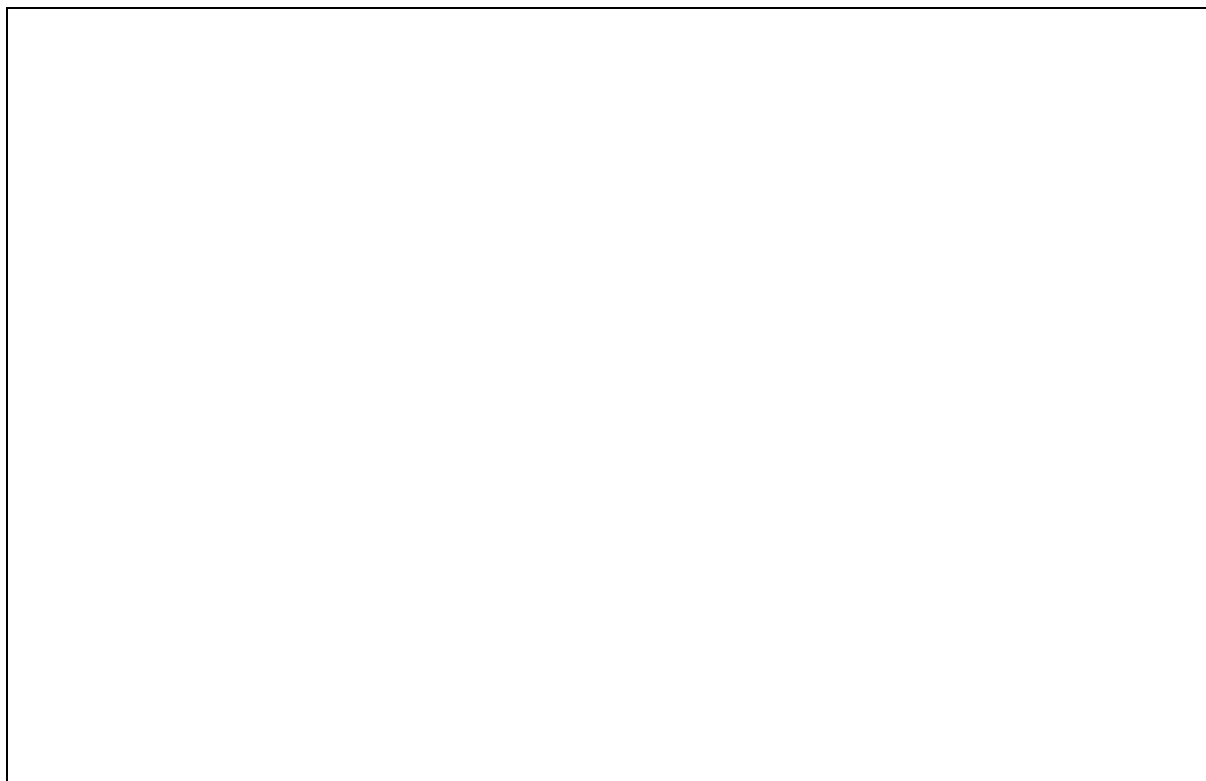
◯ = Trials End System (TES)

Figure 1. Planned infrastructure of the Demonstrator and ATN Research Testbed (DART)

5.3.   NATS

National Air Traffic Services (NATS) UK are using TES as part of their prototype development environment. The environment is used to build prototype air traffic control systems, in order to support development of the operational systems of the future. The prototype systems include both the human-machine interface (HMI) for controller positions and the back-end support systems.

TES will be used in this environment to act as the prototype back-end service for data link applications. An HMI prototype will then be developed to support the controller side of a number of services based on CPDLC and ADS.

5.4.   EEC

The Eurocontrol Experimental Centre in Brétigny-sur-Orge near Paris has successfully achieved the first part of the integration of the ATN/TES software with the air server and ground server of its simulation environment. This integration has been completed for the CNS/ATM-1 Package CM application.   It is one of the first systems where an ATN application works on an end-to-end basis and the results from this experience will be very valuable for similar projects in the Member States.

A complete CM Logon "handshake" has been implemented between the air server and the ground server. A complete Logon Request consisting of ground and air applications and class specifications was successfully formatted, ASN.1 encoded and sent.

The ground system then successfully received, ASN.1 decoded and correctly interpreted this incoming Logon Indication and a complete Logon Response, also consisting of a complete set of ground and air applications, was successfully formatted, encoded and sent back to the air system which had initiated the Logon.

The air system successfully received, ASN.1 decoded and correctly interpreted the incoming Logon Response.

The scope of the EOLIA-PETAL II project in Brétigny embraces the integration of the CNS/ATM-1 Package (upper and lower layers) into the *Eurocontrol Simulation Capability And Platform for Experimentation* (ESCAPE).

The CNS/ATM-1 Package datalink services interfaces are already implemented in the TES. The TES ATM applications are further subdivided into the EOLIA datalink services with the following properties:

CPDLC:

ACL	The ATC Clearance service provides air-ground data communication procedures for aircrew's clearance requests (speed, altitude and heading) and controller's clearance deliveries (speed, altitude and heading)
ACM	The ATC Communications Management provides automatic assistance to the aircrew and next controllers for conducting a transfer of ATC communications (voice channel and data communications channel) from a Ground System to another Ground System (transfer from a Transferring ATSU to a Receiving ATSU).
Dynav (DRA)	The Dynamic Route Availability proposes an improved route due to a change in the airspace constraints to the pilot. *Note: This service is linked to the FPC service which ensures the consistency between air/ground flight plans, and warns the controller against this change.*

ADS:

APR	The Automatic Processing Report visualises the air situation.
Flipcy (FPC)	The Flight Plan Consistency checks that the flight plan stored in the aircraft navigation systems are identical to ATC ground system's one. *Note: For this service, a flight plan database has to be managed.*

CM:

DLIC	The Data Link Initiation Capability supports addressing requirements for the other Air traffic services and the possibility to update information on the supported applications. *Note: Ground forwarding will not be implemented.*

Other, PETAL II related sub-services will be added during the project.

These services will be implemented and integrated into the simulator facility, as illustrated in Figure 2.

The objective for EEC is to have a CNS/ATM-1 Package SARPs compliant simulator up and running before the end of EOLIA Phase 1, in July 98, and to make a feasibility study before this milestone, so that cost-benefit and safety benefit studies can be proposed for EOLIA Phase 2.
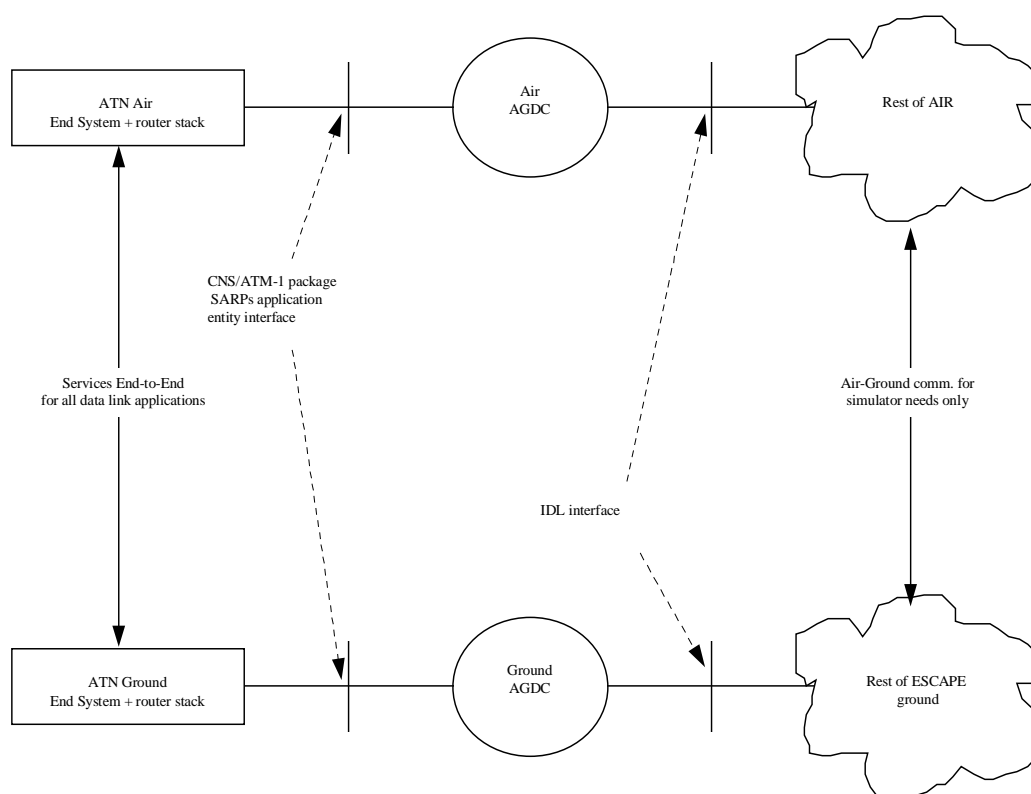
Figure 2. Overview of integration into EEC Simulator facility

The objectives and deliverables of the EEC are:

- Integrate CNS/ATM-1 Package data link services into the EEC simulator, and have a first simulation to prove the feasibility of the project goals in ~ March 98.

- AIR part of the simulator with multiple air ATN telecommunication stack to be delivered to EOLIA consortium in ~July 97.

- Ground HMI with CNS/ATM-1 package to be delivered to Maastricht UACC (TBC).

5.5.   FITAMS

The FITAMS (Flight Trials of ATN / Mode S Subnetwork) activity is being undertaken to meet foreseen requirements for short term ATN / datalink flight trials, prior to the end of 1997, from Eurocontrol Divisions DED/3 and DED/6.

The ATN Trials Infrastructure (ATIF) project in Division DED/6 requires to mount a demonstration of ICAO SARPs-compliant end to end (7 layer) datalink via multiple mobile subnetworks with live experimental aircraft. This is required in the short term prior to ProATN trials scheduled for 1998.

Division DED/3 require that the Mode S datalink be validated in the context of ATN and are already involved in flight trials of Automatic Downlink of Aircraft Parameters (ADAP) within the framework of Mode S Enhanced Surveillance. Aircraft will be equipped to participate in trials involving French Mode S Ground Stations, but would benefit from the availability of data from an additional aircraft that could be provided by FITAMS, also showing ADAP via ATN.

TES is being used, together with Trials ATN Router (TAR) and Trials Transport Service (TTS) components, to provide a complete CNS/ATM-1 implementation which will undergo flight trials as part of the FITAMS project. This will provide the first ever demonstration of ICAO SARPs compliant end-to-end (7 layer) datalink via multiple mobile subnetworks with live experimental aircraft, featuring integration with an airborne system on an experimental BAC 1-11

The ADS and CPDLC applications are important components of the FITAMS trials, as are both satellite and Mode S subnetworks.

5.6. Others

- Integration into ATC centres / simulators

  Investigations are under way into the integration of the TES software with other experimental ATC systems and air and ground simulators. Candidates for these activities are the Upper Air Centre in Maastricht and the simulators at the Eurocontrol Experimental Centre. A feasibility study has also been performed into integration with the "Rapid Prototyping Facility" for controller workstations within Eurocontrol HQ.

- Possible ATN demonstrator

  An ATN demonstrator, including realistic end-user interfaces, may be produced by the Eurocontrol Institute in Luxembourg, using TES software for the ATN upper layers and applications.

6. CONCLUSIONS

The Eurocontrol TES software played a major role in CNS/ATM-1 package SARPs validation and continues to be important for ATN trials and exploitation. It is available for free distribution to Eurocontrol Member States.

This paper has provided the Working Group with a brief update of the status of the TES implementation. Members are invited to contact the Eurocontrol ATN Project for further details and / or a demonstration.

The Working Group is invited to note this important development as a major stepping stone to full ATN deployment.