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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 ongoing 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 papers presented at previous meetings of the Working Group which have described the overall concept, implementation approach and validation results obtained from the TES project (see list of references for details). It describes TES developments and plans since the previous report to the Working Group in October 1997.

A previous version of the TES software was demonstrated at the ATNP WG Langen meetings in June 1997.

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

1.1. References

[1] ATNP/WG3/WP4-13 Approach to Validation of CNS/ATM-1 Package SARPs

[2] ATNP/WG3/WP9-23 Results from Eurocontrol Application SARPs Validation

[3] ATNP/WG3/WP9-24 Implementation of Eurocontrol CNS/ATM-1 Trials End System (TES)

[4] ATNP/WG3/WP9-25 Eurocontrol ATN Project Overview and Status

[5] ATNP/WG3/WP10-23 Eurocontrol Trials End System (TES) - Status Update

[6] ATNP/WG3/WP11-21 Eurocontrol ATN Trials End System

[7] TES user documentation: ASI API Programmer's Guide, TES/DEL/ASIGV2_0

[8] TES user documentation: Introduction to TES Release B, DED6/TC5/T16/DEL/INTRO1_0.

2. BACKGROUND

2.1. What it is

The Eurocontrol Trials End System (TES) experimental software is an implementation of ATN applications conforming to the first wave of ATN specifications published by ICAO.

The TES software implements :

- The air-ground functionality of the Automatic Dependant Surveillance (ADS) application,
- The air-ground functionality of the Controller Pilot Data Link Communication (CPDLC) application,
- Both the air-ground and ground-ground functionality of the Context Management (CM) application,
- The ATN Upper Layers (Session layer efficiency enhancement option, Presentation layer efficiency enhancement option, ACSE edition 2 and Control Function).

These services are made available to user applications via exposed application programming interfaces (APIs), including an API at the Dialogue Service level.

The TES software relies on the transport services provided by the full ATN internet stack, the Eurocontrol TAR-TTS product. It can also use the X/Open XTI compliant Hewlett Packard OTS 9000 transport service.

Commercial off-the-shelf (COTS) tools are used for the purpose of controlling and monitoring the TES software (starting and stopping processes, setting up traces, etc.) and may also be used for developing and executing test scenarios at the API level.

It is emphasised that, although the TES development is referred to as "prototype", this is in the sense of being amongst the pioneering implementations of CNS/ATM SARPs, and is in no sense a "throw-away" piece of experimentation. The development approach is based on sound software engineering principles, rather than a "quick-and-dirty" rapid prototyping approach.

2.2. What it is NOT

The TES software provides access to the application services specified in the selected SARPs. It does NOT implement the "user part" of the application, and it does NOT include any end-user command-line or graphical interface.

The TES software does NOT implement the ATN internet communications service (ICS); it relies on the services of TAR-TTS or an alternative transport service provider for this. It does NOT implement the FIS (ATIS) air-ground application, nor the ATSMHS or AIDC ground-ground applications.

It does NOT allow an unlimited number of aircraft or ground systems to be simulated by a single user process. However, it can be configured to support multiple user processes.

It does NOT (currently) allow remote procedure call (RPC) access to the APIs; the user process must be co-located with the TES protocol stack.

3. CURRENT STATUS

TES Release B is currently being shipped to Eurocontrol member States who request it.

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.

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

A common set of source files is used on all supported platforms: HP-UX 9 and PC Solaris.

Delivery of this stage of the TES development was accepted in January 1998.

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.

3.1. Release Identification

The current release of TES to users is identified as “TES Release B” or simply “TES-B”.

The software and documentation are provided on a DAT tape in UNIX tar format.

3.2. What’s New in This Release

The initial TES release (Release A) was an implementation of the draft ICAO SARPs dated June 1996 (the so-called “Munich output” versions), together with some defect resolutions which were essential for the correct functioning of the software.

In Release B, the TES software has been updated to conform to the ICAO SARPs versions of March 1997 (the so-called “ICAO V1.1” or “Phuket output” versions). This is the version which was placed under formal change control by the ATN Panel.

Note that, because of the evolution of ICAO SARPs prior to formal publication, TES Release B is NOT in general capable of interworking with TES Release A. (Also, it is not capable of interworking with implementations which conform to the ICAO V2.2 SARPs).

With Release B, the TES software runs on a PC Platform in the SUN Solaris 2.5.1 environment in addition to running on a Hewlett-Packard 9000-series workstation with HP-UX 9.

Also new in Release B, a set of “Formatting / Unformatting Functions” is fully supported and documented for the first time, providing user-friendly access to the complex data structures at the TES APIs.

Finally, a small number of problems reported in the first release have been solved in the current release.

3.3. Use of the TES APIs

The TES software provides exposed C-language application programming interfaces (APIs) which correspond closely to the Abstract Service Interfaces (ASIs) defined in the air-ground application SARPs, and the Dialogue Service defined in the ULCS SARPs. Thus, user software written to use the services provided by the TES software is responsible for ensuring that the User Requirements specified in the SARPs are satisfied.

The TES APIs are mostly concerned with giving the user access to APDU formatting and sequencing functions. There are in fact two levels of API 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. The TES implementation avoids unnecessary copying of data, so once the API call is invoked, the user relinquishes control of any memory allocated for the data structures.

- 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.

When using the formatting functions, the underlying data structure is not visible to the API-user. All dynamic memory allocation is done by the formatting functions. The fields of the application message data structures are filled within these functions. Each message is

identified by a “Descriptor”. In general, the sequence to be performed by a user application is:

- Identify the type of message to format (FormattingStart procedure)
- Enter the message basic parameters (FormatBasicParameters procedures)
- For optional or multiple fields, call the specific formatting function as many times as required.
- Invoke the “raw” API call to send the formatted message.

Conversely, when receiving a message, the unformatting (or interpretation) functions may be used. When using these functions, the underlying data structure is again not visible to the API-user. Memory is released by these functions. In general, the sequence to be performed by a user application is:

- Wait for an input event
- Invoke the “raw” API call to receive the formatted message from the event buffer.
- Identify the type of message to interpret (InterpretationStart procedure)
- Interpret the message basic parameters (InterpBasicParameters procedures)
- For optional or multiple fields, call the specific interpretation function as many times as required.

4. DEVELOPMENTS AND EXPERIMENTS WITH TES

As reported in a previous Working Paper [6], there are several projects internationally which are utilising the TES software to provide rapid evaluation of and experimentation with ATN applications.

Current users include:

- SICTA (Italy)
- DFS (Germany)
- National Air Traffic Services - NATS (UK)
- Eurocontrol Experimental Centre (EEC) in Brétigny-sur-Orge
- FITAMS (Flight Trials of ATN / Mode S Subnetwork) project

5. FUTURE ENHANCEMENTS

The TES software is still undergoing a process of evolution. Items under active development for the next release include:

- Rationalisation of header files
- Provision of CPDLC RouteClearance and DepartureClearance formatting and unformatting functions (V1.1 SARPs versions).
- Portation to HP-UX 10 environment
- Increase in the maximum number of aircraft users to 200
- Improved compatibility with C++ compilers

- Modification of CPDLC formatting function ATCUp/DownlinkMessage to return a code indicating whether there are more elements to be retrieved, for compatibility with ADS and CM functions.
- Default for QoS parameter checking changes in entity configuration files, so that QoS checking is enabled by default.
- Correction to setting of Priority parameters when used with TAR-TTS
- Fixes for various problems as reported in Release B.

Items under consideration for the next release include:

- Conformance with ICAO V2.2 SARPs

A possible future enhancement is the provision of Remote Procedure Call (RPC) access to the TES APIs. When available, there will need to be a user guide describing the remote interface, instructions for registering with the RPC server, building the TES server, etc.

A common set of source files will be maintained for all supported platforms.

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 ongoing development as a major stepping stone to full ATN deployment.