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Model of the ADS SARPs

INFORMATION PAPER

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SUMMARY

This paper describes a model of the ADS application produced in SDL on the GEODE tool as part of the Eurocontrol CNS/ATM-1 validation effort.

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1. INTRODUCTION

1.1 Scope

Eurocontrol is involved in a number of validation activities. This paper is a short report on the status of one of those activity threads - the simulation of the ADS protocol through the use of the "GEODE" simulation tool.

The ATNP/WG3/SG2 (Air subgroup) within ICAO has produced draft SARPs for a number of air-ground applications for the CNS/ATM-1 Package [1], one of which is the Automatic Dependent Surveillance (ADS) application. As part of the validation of that SARPs, a model of the protocol machine has been produced on behalf of Eurocontrol by Verilog in SDL (Structured Design Language) using the GEODE tool.

1.2 Validation of the ADS Protocol

The ADS protocol is described in chapter 5 of the draft ADS SARPs, and this functionality is also represented as a set of state tables in appendix A of that document. Validation of the protocol will ensure that:

- the SARPs text allows all acceptable behaviour (as defined by the service definition in chapter 3, and the sequence diagrams in chapter 5);
- the SARPs text disallows all unacceptable behaviour;
- there are no states that application can get into, but not get out of (deadlocks);
- there are no groups of states that the application can get into, but cannot get out of into the other states (livelocks).

1.3 Modelling the ADS Protocol

In order to validate the ADS protocol, Eurocontrol contracted Verilog to create a model of the protocol written in a formal definition language, SDL (Specification and Design Language) on their modelling tool GEODE. In order to ensure that the model is an exact mirror of the state machine described in the draft SARPs text, the author of the SDL model copied the text of the draft SARPs, and translated it line by line into SDL. This was done without any attempt to understand the protocol as a whole, thus ensuring that the SDL is an exact portrayal of the text, rather than an interpretation of it.

Modelling the application protocol using SDL and the GEODE tool will allow the sections in the draft SARPs, that describe the protocol machine, to be validated. The work done so far has already validated that the text itself is consistent (this is analogous to having removed compilation errors from a computer program). Future work will validate that the protocol, as described, does what it is intended to do (this is analogous to testing a program once the compilation errors have been removed).

1.4 References

1. Draft ADS SARPs for the ATN CNS/ATM-1 Package. Version 1, dated 6th October 1995.
2. Defect Reports (as provided by Verilog) dated 2nd January 1996.
3. Verilog's GEODE documentation set

1.5 Abbreviations

ADS	Automatic Dependent Surveillance
ASE	Application Service Element

ATN	Aeronautical Telecommunications Network
CF	Control Function
CNS/ATM	Communications, Navigation and Surveillance / Air Traffic Management
GEODE	SDL editor and simulation tool, manufactured by Verilog
ICAO	International Civil Aviation Organisation
SARPs	Standards and Recommended Practices
SDL	Specification and Description Language

2. MODEL DESIGN

The model of the ADS application describes the following components:

- ADS-air ASE;
- ADS-air User;
- ADS-ground ASE;
- ADS-ground User.

In order to allow the model to simulate two ADS ASEs communicating with each other, the model also includes that part of the Dialogue service which is used by the ADS ASEs. This accepts Dialogue service primitives invoked by one ASE and invokes Dialogue service primitives at the other (and vice versa). It can also simulate communications failure and recovery.

Thus, the working model contains two ASE modules, each with its own lower and upper interface processes, as well as a single “Control Function” module, with its Dialogue service process, and an air-user module. The main signals between the different processes map directly onto the service primitives.

The model is presented in full in Annex B.

3. DEFECTS

The SDL model of the draft ADS SARPs protocol V1.0 has been completed and delivered to Eurocontrol.

During the development of the model, a number of defect reports were raised, identifying 38 typographical errors in version 1.0 (mostly in the protocol chapter and the state tables). All these have been corrected in version 1.1. It is expected that, during the ongoing simulation activities, other defects will be discovered.

At the current stage of development, problems still exist within certain parts of the model.

All defects are reported in full in Annex A.

4. FUTURE WORK

Having developed the model, the simulation activities are now progressing. Each of the valid sequences of events will be simulated individually, to ensure that they are all possible. Then random, and finally exhaustive simulation will be performed to ensure that no problems occur when the valid sequences of events are mixed. Exhaustive simulation will ensure that all possible scenarios are tested.

ANNEX A - DEFECT REPORTS

To be provided.

ANNEX B - UPPER LAYERS MODEL

The following pages are the output from the GEODE tool. They are the model of the ADS application, written in SDL and presented in the SDL graphical format.