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# The case for a Simple ATN Messaging Service

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**SUMMARY**

CNS/ATM Package 1 provides data link services closely modelled in many cases on voice mode of operation, and initial ground-ground information interchange solutions. Meanwhile work continues on defining data link services between automated ATM elements, and enhanced ground co-ordination.

Therefore ATNP has to anticipate a new approach, both for air-ground and ground-ground. This paper presents the justification for ICAO ATNP WG3 to consider developing a Simple ATN Messaging service specification.

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# 1. INTRODUCTION AND OBJECTIVES

The CNS/ATM-1 package ATN 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.

This paper proposes a revised 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. Such an approach has the potential to reduce significantly the message specification and validation timescale, thereby allowing future aeronautical applications to be standardised (if appropriate) and published much more quickly than has been possible to date.

The proposed approach is to define and specify a simple generic messaging service which 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. In the following sections, such a service is described as the "Simple ATN Messaging" (SAM) service.

# 2. REQUIREMENTS

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

- Future air-ground information exchange requirements in support of new or evolving operational concepts such as flexible use of airspace and free flight.
- 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
- Migration and transition of existing (ACARS-based) AOC and non-safety-critical ATC communication (e.g. pre-departure clearance) from pre-ATN carriers into the ATN.

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 package 1 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, both in the air-ground and in the ground-ground context.

It is these information exchanges that SAM is intended to address. SAM can be based on the existing ATN standards to provide the following type of communication services :

- addressing of any message to any air or ground destination on a point-to-point (and possibly multi-point) basis
- unambiguous (authenticated) identification of sender and recipient (in user-friendly nomenclature)
- means of uniquely identifying messages (both the "type" and "instance"), for subsequent reference or for correlating requests with replies

- user-requested quality of service, relating to "Required Communications Performance"
- security mechanisms to protect against unauthorised interference with the message content
- service version number negotiation
- prioritisation e.g. for display purposes
- no constraints on message content or length.

# 3. FUNCTIONALITY

An initial analysis of the three areas of requirement has shown that the SAM service should be provided at a number of levels to meet different needs of the communicating partners, as described below.

## 3.1 Basic Services

The basic level of SAM would provide the following variants as options:

- Connection-oriented service - in this variant a persistent connection is established for a period of time between the communicating partners, over which a number of message exchanges can take place.
- Connectionless service - in this variant each message is a discrete instance of communication. There is no persistent connection between the parties, and in consequence there is no guarantee that the message will actually get through to its intended destination.
- Secure dialogue service - in this variant a secure persistent connection is established between the communicating partners.
- Multi-cast service - in this variant a recipient user can register to receive any message addressed to a specific group address, on a connectionless basis.

## 3.2 Enhanced Services

Future enhancements may be incorporated as later variants of SAM:

- Multi-point service - this variant would allow a sender to specify direct (as opposed to store and forward) information distribution to a defined list of recipient systems.
- Semantic interpretation and response - this variant would allow some pre-defined semantics, such as "reply request", "confirm action", and their associated responses to be incorporated in the service, rather than being part of the user application.

# 4. SAM BENEFITS

## 4.1 Flexible use of ATN infrastructure

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

## 4.2 Locally defined information formats

A major benefit that SAM 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.

## 4.3 Standardisation of new applications

The use of SAM 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:

- an increase in the speed of the standardisation process, allowing operational concepts to be developed into standards in a much shorter timeframe than current practices
- the possibility of changing the message set in line with evolving requirements without the need to change the communication standards
- an efficient method for validating concepts and requirements early in the standardisation lifecycle
- the ability to upgrade the application without the need to upgrade the communications service (and vice versa).

## 4.4 Embedded Applications

It is still possible with the SAM concept to specify applications which are close coupled to the communications protocols. By using the SAM 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.

# 5. POSSIBLE APPROACHES

## 5.1 Division of Work between ICAO Panels

The SAM approach maps well onto the current allocation of responsibilities between ICAO panels:

- an operational panel would continue to develop operational requirements
- the operational panel would develop message set requirements, potentially with some technical assistance
- a technical panel would develop standards for the SAM capability.

Any changes to the operational requirements would not require major changes to SAM, - only to the message set requirements.

## 5.2 Standardisation in the ATN Panel

The basic SAM services described earlier relate closely to the work already being undertaken by WG3 SG3 on the Dialogue Service Interface (DSI) in the evolution of the Upper Layer Communications Service (ULCS) SARPs.

These basic SAM service levels can be achieved simply by exposing the dialogue service interface for the dialogue service functionality being described in the current (Package 2) ULCS SARPs development. SAM would thus be standardised as an ASE in accordance with the requirements of Sub-Volume 4.

## 5.3 Implementation

The implementation of SAM could be expected to offer an API at the SAM 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 SAM service. Industrial groups may wish to standardise an API, based on the SAM service specification, as an "exposed interface" for use by new aeronautical applications or migration of existing applications (e.g. AOC).

## 5.4 Validation

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

## 5.5 Certification

It should be possible to obtain certification of the SAM implementation to the API, at a level which will satisfy the requirements of safety-critical ATC communications. It is then possible to use that implementation either for future ATC applications, or as a component in a less critical administrative communication application.

# 6. CONCLUSIONS

CNS/ATM-1 is now stable, and provides the solid basis for a range of services now being implemented. However, requirements are already emerging which need new information exchanges which are not specified in current or emerging SARPs. As we move into the stage of developing solutions to meet new operational concepts and procedures, if we are to avoid the extended timescales that have been experienced in the past, a new approach is needed.

The proposed approach separates the operational requirements definition from the technical communications standardisation processes. The communications standardisation should be based on a generic message service (SAM) which can be standardised now in preparation for new (as yet incompletely specified) application requirements.

The ICAO ATN panel WGs are invited to endorse this approach, thereby enabling the appropriate technical panel to develop a generic messaging application with an agreed approach.

# 7. RECOMMENDATIONS

## 7.1 Recommendations for ATNP WG1

It is recommended that the strategic proposals made in this paper be reviewed by ATNP WG1, with the objective of including the requirements of a Simple ATN Messaging (SAM) specification into the work programme, as a strategic solution for the implementation of future operational application requirements.

## 7.2 Recommendations for ATNP WG3

1. It is recommended that the technical proposals made in this paper be reviewed by ATNP WG3, with the objective of including the development of a Simple ATN Messaging (SAM) specification into the work programme, as a strategic solution for the implementation of future operational application requirements.
2. It is recommended that an early target be set for the development and validation of SARPs to support SAM.
3. It is recommended that WG3 assign SG3 (or other appropriate subgroup or task force) to assess technical solutions for the realisation of a SAM service.
4. It is recommended that WG3 assign SG2 (or other appropriate subgroup or task force) to assess the potential impact on future air-ground standardisation.
5. It is recommended that WG3 assign SG1 (or other appropriate subgroup or task force) to assess the potential impact on future ground-ground application standards.