EUROCONTROL

ATNP/WG3/IP **15 - 17**

12 January 1999

AERONAUTICAL TELECOMMUNICATION NETWORK PANEL

WORKING GROUP 3 (APPLICATIONS AND UPPER LAYERS)

Honolulu, USA, 19 - 22 January 1999

(Information paper)

Eurocontrol GACS Implementation and Validation

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SUMMARY

This paper provides the Working Group with information on a new Eurocontrol project to implement the draft Generic ATN Communication Service (GACS) SARPs. This will not only provide application developers with easy access to the full 7-layer ATN infrastructure, but will also validate the draft SARPs for GACS, the connectionless ATN upper layers and Dialogue Service (CLDS), and upper layer naming enhancements.

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1. INTRODUCTION

This paper provides information on a new Eurocontrol project to implement the draft Generic ATN Communication Service (GACS) SARPs. This will not only provide application developers with easy access to the full 7-layer ATN infrastructure, but will also validate the draft SARPs for GACS, the connectionless ATN upper layers and Dialogue Service (CLDS), and upper layer naming enhancements.

1.1. References

[1]	ATNP/WG3/WP4-13	Approach to Validation of CNS/ATM-1 Package SARPs
[2]	ATNP/WG3/WP9-25	Eurocontrol ATN Project Overview and Status
[3]	WG3 WP14-	GACS Benefits

The following documents form the technical baseline requirements for the GACS implementation:

[4]	DED6/TC6/T07/DEL/D05V0_F.doc	Specification for Generic ATN Communication Service
[5]	DED6/TC6/T07/DEL/D06V0_C.doc	GACS API Specification
[6]	ATNP/CCB/PDR 98100010	GACS AE Qualifier registration
[7]	WG3 WP14-11 (V0.B)	ATN Upper Layer Naming and Addressing Enhancements
[8]	WG3 WP14-27 (V0.1)	ATN Connectionless Upper Layer Communication Service
[9]	ISO/IEC 10035-1:1195/Amd.1:1997	Connectionless ACSE Amendment
[10]	ISO/IEC 9548-1:1996/Amd.1:1998 (submitted for fast-track)	Efficiency Enhanced Connectionless Session Protocol
[11]	ISO/IEC 9576-1:1995/Amd.1:1998 (submitted for fast-track)	Efficiency Enhanced Connectionless Presentation Protocol

2. GACS USE AND CAPABILITIES

The Generic ATN Communication service (GACS) allows a user of the service to transfer data transparently across the ATN to another user (or to multiple users). The user is able to specify the required quality of service (QoS) and recipient addressing parameters on a per-message basis.

The GACS specification is designed to optimise the use of communications bandwidth, and consequently uses the Dialogue Service defined in Sub-Volume 4 of ICAO Doc 9705, including extensions for unit data and presentation address handling services. The Dialogue Service in turn uses the ATN Transport service defined in Sub-Volume 5 of ICAO Doc 9705.

2.1. Building Block for new Applications and migration of existing Applications

The ADS Panel has defined Operational Requirements in the A/G and G/G domain for which the ATN Panel has developed the supporting ATN SARPs by means of the CNS/ATM-1 Package.

The development of Operational Requirements continues and after its next ADS Panel meeting, it can be expected that for a subset of these new Operational Requirements additional ATN application provisions need to be developed.

While the nature of these new ATS requirements is not exactly known today, the WG3 started to develop draft SARPs i.e. the GACS which is considered as one of the important enablers to realize these Operational Requirements in an ATN context.

The GACS can either be combined with specific Application Application Service Elements (ASE) or can be used as an Application Entity (AE). This choice can be made on a case by case basis depending on the characteristics of the specific operational, message transfer and communication requirements.

GACS also provides a mechanism by which existing pre-ATN communications may be migrated to the ATN by allowing current applications to exchange information using GACS as a standardised “enveloping” communications environment.

2.2. Building Block for AOC Applications

GACS also provides the ability for airlines to either migrate their existing pre-ATN AOC applications to the ATN or to develop new AOC applications in using either the ASE or AE approach. It should be clear that, by using GACS for AOC, there is no need to standardise or disclose externally what message formats are used.

2.3. Flexible use of ATN infrastructure

The GACS concept is fully compatible with the ATN communications concepts. By using GACS, ATC and AOC traffic can share the same communications links and infrastructure, without impairing the service offered to the safety-critical traffic.

GACS allows a user to concentrate on processing the operational aspects of a message exchange by making the user unaware of how the data is actually sent, whether a connectionless or connection oriented protocol is used or even whether a connection needs to be established before sending the data.

3. GACS GENERAL DESCRIPTION

The GACS user is able to select the required level of service, which in turn results in the use of either a connection-oriented (CO) or connectionless (CL) supporting protocol stack.

The GACS service provision as specified in [4] can be realised alternatively as an "Application Layer message protocol" or as a "simple generic service". The two approaches as illustrated in Figure 1 are very different and have different fields of applicability.

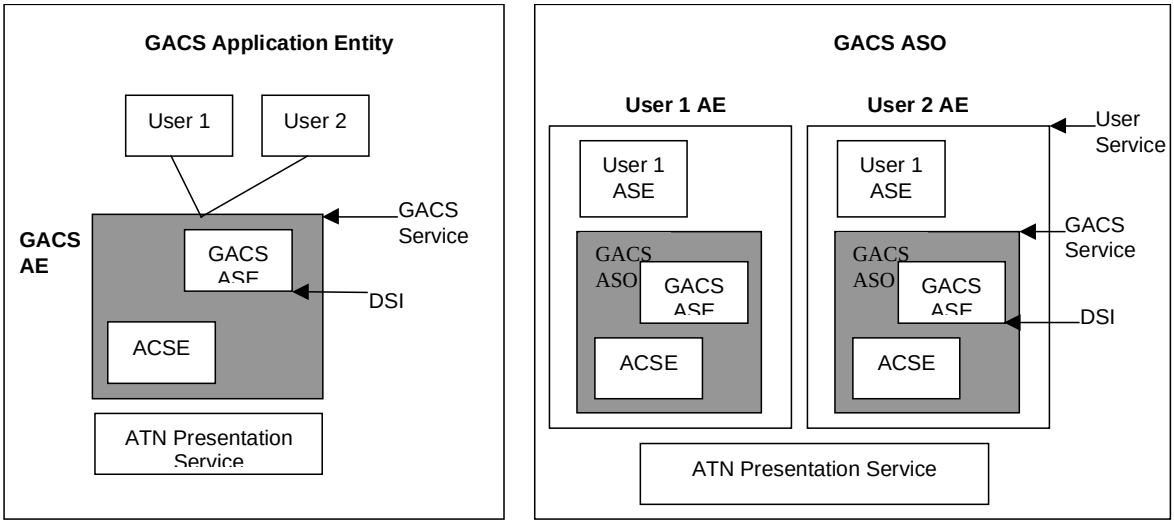

Figure 1. GACS Application versus GACS ASO

For the GACS implementation project, the **ATN Application Entity** (AE) approach is being adopted, as illustrated in the left-hand side of Figure 1. This provides an ATN access point to existing (e.g. ACARS-based) and future applications which are not specified as ASEs within the defined ATN upper layer architecture.

However, the GACS software will be designed to be modular, so that it could be adapted in the future to realise the alternative **ATN Application Service Object** (ASO) or "service" approach, as illustrated in the right-hand side of Figure 1. This would provide effectively an enhanced Dialogue Service to future air-ground and ground-ground ATN applications which are specified as ASEs (ATC and AOC).

The GACS AE approach is appropriate for the migration of existing applications. The GACS ASO (enhanced dialogue service) approach would be preferred for any new ATC or AOC application.

The GACS Application Entity will be a distinct ATN application installed in aircraft and ground systems acting as a point of access to the ATN. An ATN address will be allocated to the GACS AE. The existing CM Application can be used without modification to exchange the address and version number of the GACS application in the air-ground environment. The GACS application is identified by an OBJECT IDENTIFIER such as:

"iso(1) identified-organisation (3) icao (27) atn-end-system-air (1) 24-bit-address (x) ops (0) gacs (12)".

The GACS service will be exposed via an application programming interface (API), providing a communications interface to user applications.

Several GACS-Users will be able to use services from the same GACS Application. The GACS Application therefore multiplexes data supplied by GACS-Users over the same

dialogue when the intended recipient and the requested communication characteristics are identical.

GACS-Users in this approach are not considered as fully integrated ATN applications; they have no distinct ATN names and no ATN addresses. CM is not used to negotiate version numbers for the users. Specific mechanisms need to be implemented to switch the incoming data to the relevant GACS-User, based on the message-type field.

The GACS Application itself does not know anything about the user message contents, or the encoding rules for these messages. Typical communication functions, such as sequence numbering and request/reply correlation are entirely the responsibility of the GACS-User applications.

3.1. GACS Service Definition

The GACS software will provide the services listed in Table 1.

Table 1. Summary of GACS Service primitives

Service	Description
G-TRANSFER	This is an unconfirmed service used to transfer User-Data between communicating GACS-Users.
G-TRANSFER-CONFIRMED	This is a confirmed service used to transfer User-Data between communicating GACS-Users, and to provide the sender with confirmation that the data was received at the remote peer system(s).
G-END	This is an unconfirmed service used optionally to terminate an established communications relationship between communicating GACS-Users.
G-MULTICAST	This is an unconfirmed service used optionally to indicate whether a user wishes to receive messages sent to a particular group address.

For the basic G-TRANSFER and G-TRANSFER-CONFIRMED services, a number of options are defined, and these can be selected via the “Level Of Service” parameter:

a) Connectionless Mode. If the user does not require a resilient communications service (e.g. because the message is not mission-critical, or because the user application itself implements an error recovery protocol) then this can be requested per message. In this case, a connectionless (CL) protocol stack, if available, will be used to transfer the message, provided the size constraints of the CL stack are not exceeded.

b) Connection-Oriented Mode. If the user does require a resilient communications service (e.g. because the message is mission-critical, and the user application itself does not implement an error recovery protocol) then this can be requested per message. In this case, a connection-oriented (CO) protocol stack will be used to transfer the message.

c) Multi-shot Option. If the user intends to send multiple messages with the same Quality of Service (QoS) requirements to the same destination(s), then it can optionally request a “multi-shot” mode. This establishes and maintains a communication relationship with the specified peer(s), and provides an optimised use of the communications link, using a CO protocol stack. The G-END service is an optional service which allows a user of the multi-shot option to inform the GACS service that a communications relationship with the specified peer(s) is no longer required to be maintained. This allows an orderly freeing of

resources, and an assurance that there are no messages in transit to or from that particular peer(s). If G-END is not used, then any established communications relationship between two peers will automatically be ended by the GACS service on expiry of a configurable inactivity timer.

3.2. The G-TRANSFER service

The G-TRANSFER service enables the transparent transmission of data between GACS-Users.

G-TRANSFER is an unconfirmed service which is invoked by one GACS-User (the initiator) to send data to a peer GACS-User (or multiple peer users). G-TRANSFER request and indication service primitives are defined, as illustrated in Figure 2.

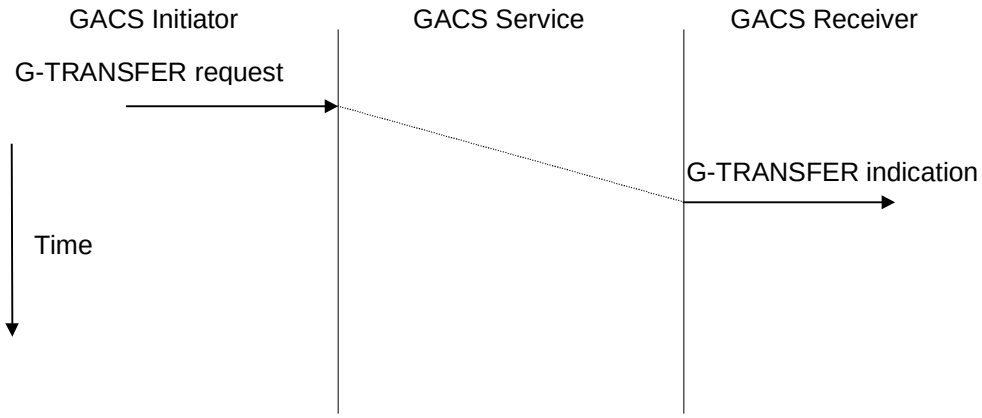

Figure 2. G-TRANSFER sequence diagram

The initiating GACS-User issues a G-TRANSFER request primitive. When the receiving GACS-User receives the G-TRANSFER indication primitive, the User Data is presented transparently to that user. It is a local matter to decide whether or not any reply is needed. Either GACS-User may issue a G-TRANSFER request at any time. Any sequencing constraints must be enforced by the GACS-Users themselves. The parameters of the G-TRANSFER primitives are shown in Table 2.

Table 2. G-TRANSFER parameters

Parameter Name	*Req*	*Ind*
Recipient List	*M*	
Sender	*U*	*C(=)*
Message Type	*U*	*C(=)*
Message Identifier	*U*	*C(=)*
Message Reference	*U*	*C(=)*
GACS-User Version Number	*U*	*C(=)*
Security Requirements	*U*	*C(=)*
Class of Communication	*M*	*M(=)*
Priority	*M*	*M(=)*
RER	*U*	*C(=)*
Requested Level of Service	*M*	*M(=)*
User Data	*U*	*C(=)*

3.3. The G-TRANSFER-CONFIRMED service

The G-TRANSFER-CONFIRMED enables the transparent transmission of data between GACS-Users, with confirmation of data delivery to the recipient system(s).

G-TRANSFER-CONFIRMED is a confirmed service which is invoked by one GACS-User (the initiator) to send data to one or more peer GACS-User(s). G-TRANSFER-CONFIRMED request, indication and confirmation service primitives are defined, as illustrated in Figure 3.

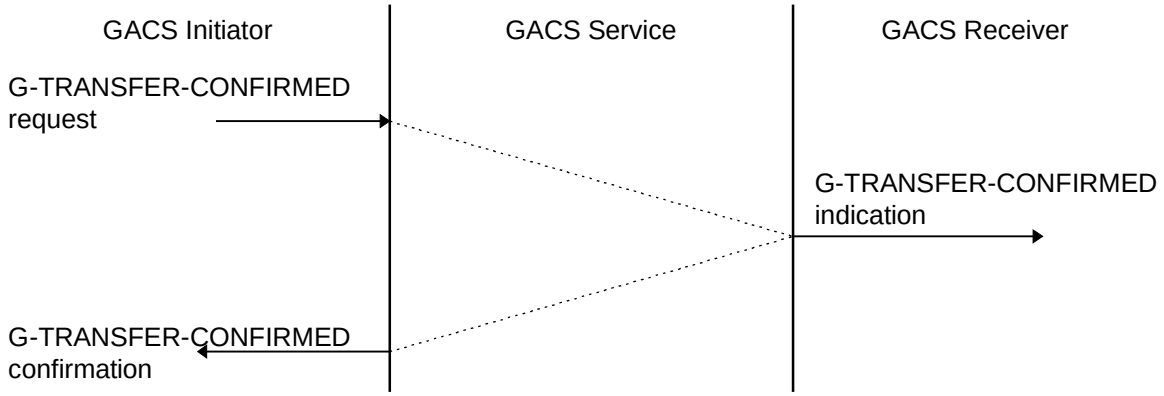

Figure 3. G-TRANSFER-CONFIRMED sequence diagram

The initiating GACS-User issues a G-TRANSFER-CONFIRMED request primitive. When the receiving GACS-User receives the G-TRANSFER-CONFIRMED indication primitive, the User Data is presented transparently to that user, and a G-TRANSFER-CONFIRMED confirmation primitive is automatically returned to the initiator. It is a local matter to decide whether or not any user reply to the indication primitive is needed. Either GACS-User may issue a G-TRANSFER-CONFIRMED request at any time. Any sequencing constraints must be enforced by the GACS-Users themselves. The parameters of the G-TRANSFER-CONFIRMED primitives are shown in Table 3.

Table 3. G-TRANSFER-CONFIRMED primitive parameters

Parameter Name	*Req*	*Ind*	*Cnf*
Recipient List	*M*		
Sender	*U*	*C(=)*	*M*
Message Type	*U*	*C(=)*	*C(=)*
Message Identifier	*M*	*M(=)*	
Message Reference	*U*	*C(=)*	*M*
GACS-User Version Number	*U*	*C(=)*	*C*
Security Requirements	*U*	*C(=)*	
Class of Communication	*M*	*M(=)*	
Priority	*M*	*M(=)*	
RER	*U*	*C(=)*	
Requested Level of Service	*M*	*M(=)*	
Result			*M*
User Data	*U*	*C(=)*	

3.4. The G-END service

The G-END service enables the orderly termination of a communications relationship between GACS-Users.

G-END is an unconfirmed service which is optionally invoked by one GACS-User (who is then the initiator) to terminate a communications relationship with one or more peer GACS-User(s). G-END request and indication service primitives are defined, as illustrated in Figure 4.

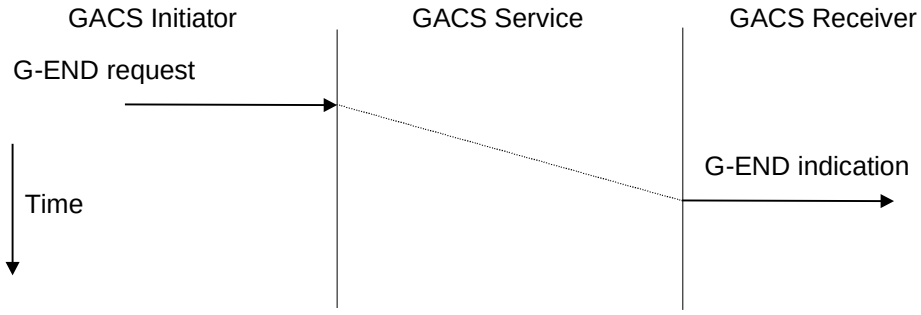

Figure 4. G-END sequence diagram

The initiating GACS-User issues a G-END request primitive at any time after using the G-TRANSFER or G-TRANSFER-CONFIRMED service with a multi-shot Level of Service. When the receiving GACS-User receives the G-END indication primitive, it knows that the current communications relationship with the peer is over. A new relationship may be established at any time. It is a local matter to decide whether or not any user reply is needed. Any sequencing constraints must be enforced by the GACS-Users themselves. The parameters of the G-END primitives are shown in Table 4.

Table 4. G-END parameters

Parameter Name	*Req*	*Ind*
Recipient List	*M*	
Sender		*M*
Message Type	*U*	*C(=)*
Message Reference	*U*	*C(=)*
User Data	*U*	*C(=)*

3.5. The G-MULTICAST service

The G-MULTICAST will enable or disable the receipt of messages addressed to a group address, when this is supported by the ATN lower layers.

G-MULTICAST is an unconfirmed service which is optionally invoked by a GACS-User to inform the local communications system whether that user wishes to receive messages sent to a particular group address. This service is only available when supported by a connectionless communications provider.

Only a G-MULTICAST request primitive is defined, as illustrated in Figure 5.

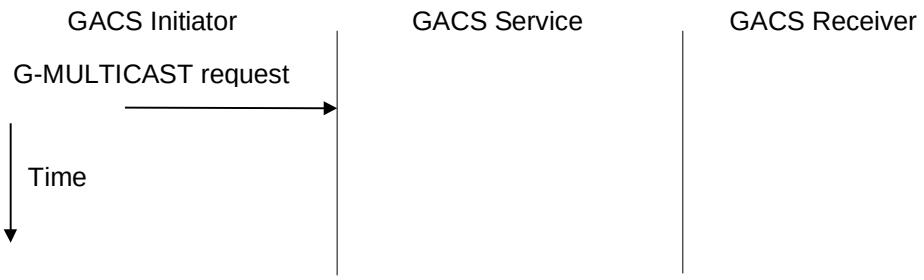

Figure 5. G-MULTICAST sequence diagram

The initiating GACS-User issues a G-MULTICAST request primitive at any time. The parameters of the G- MULTICAST primitives are shown in Table 5.

Table 5. G- MULTICAST parameters

Parameter Name	*Req*
Group Address	*M*
Toggle	*U*

4. CURRENT STATUS

The contract for the development of the GACS software has been let to the Irish company Airtel ATN. The contract was signed in November 1998.

The GACS project will produce independent software implementations of the following components:

- The ATN Connection-oriented Upper Layers (CO Session layer efficiency enhancement option, CO Presentation layer efficiency enhancement option, CO ACSE edition 2 and Control Function).
- The ATN Connectionless Upper Layers (CL Session layer efficiency enhancement option, CL Presentation layer efficiency enhancement option, CL ACSE edition 2 and Control Function).
- The Generic ATN Communications Service (GACS), providing a well-defined interface for applications to the full ATN protocol stack.

The project is scheduled for completion by the end of May 1999.

The GACS software will be made available free of charge to Eurocontrol Member States to assist in their ATN evaluation and trials activities.

5. FUTURE PLANS

Based on the results of the GACS implementation project, a validation report will be produced for GACS, the connectionless upper layers and the naming and addressing extensions, by the end of 1999. This report will be presented at the ATN Panel meeting in February 2000.

The GACS implementation project will consist of three phases:

I. The development of GACS software and the demonstration of its functionality

II. The integration of a PHARE EFMS application such as Trajectory Negotiation with GACS and its demonstration in a simulated environment

III. Possible flight trials of the application from Phase II.

The current contract only covers Phase I, with optional extensions to cover future developments.

6. CONCLUSIONS

The Eurocontrol GACS implementation project will play a major role in ATNP/3 SARPs validation as well as providing a migration path for non-ATN (e.g. ACARS-based) applications and a rapid prototyping platform for the development of ATM applications. It will be important for ATN trials and exploitation in the future and will be available for free distribution to Eurocontrol Member States.

This paper has provided the Working Group with a brief introduction to the GACS implementation project. Members are invited to contact the Eurocontrol ATN Project for further details and / or a demonstration.

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