CEC TEN-T ATM Task UK/96/94

ACCESS

ATN Compliant Communications European Strategy Study

Review/Update Interim Deliverable 1

Amendment to ACCESS Part 1 - Interim Deliverable 1: Proposed Network Architecture of the European ATN

Document Reference	: ACCESS/STNA/229/WPR/049
Author	: Stéphane Tamalet
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The work described herein has been undertaken by the author(s) as part of the European Community ACCESS project, within the framework of the TEN-T programme, with a financial contribution by the European Commission. The following companies and administrations are involved in the project: National Air Traffic Services (NATS), Deutsche Flugsicherung (DFS) and Service Technique de la Navigation Aerienne (STNA). The ACCESS final report has been synthesized from the original work packages developed during the ACCESS project.

EXECUTIVE SUMMARY

This document is an amendment to the ACCESS Interim Deliverable 1 ("Proposed network architecture of the European ATN" – ACCESS/STNA/208WPR/16), the synthesis report produced at the end of Network Architecture sub-phase of ACCESS phase 2 - Part 1, in July 1998.

This amendment provides an update of the ACCESS Interim Deliverable 1, taking into account the results obtained in the progression of the new set of Work Packages referenced in the ACCESS phase 2 – Part 1 under the heading of "Network Implementation Issues".

TABLE OF CONTENTS

1. Introduction

1.1 Scope

The objective of the ACCESS phase 2 - part 1 - Network Architecture sub-phase was to define the architecture of the Target European ATN of year 2010 in the geographical area covered by the ACCESS project. This subphase consisted of 8 Work Packages (see Table 1) and was completed with the production of its synthesis report, the Interim Deliverable 1 [A208], in July 1998:

Work Package Number	Work Package Title
WP201	Review of Current Communications Infrastructure
WP202	Definition of Area of Study and Services to be supported
WP203	Definition of Routing Architecture – Option 1
WP203A	Definition of Routing Architecture – Option 2
WP204	Choice of Ground Sub-networks
WP205	Choice of Air/Ground Sub-networks
WP206	Definition of Addressing Plan
WP207	Performance Analysis and Dimensioning

Table 1: Work Packages of the ACCESS Phase 2 - Part 1 - Network Architecture sub-phase

A meeting was subsequently held to enable ATN Routing experts to discuss the pro's and con's of each of the two proposed options for the routing architecture of the European ATN and select the preferred one. This meeting was held in the context of an additional Work Package (the WP209 – "Selection of Routing Architecture"), and its conclusions were recorded in [A209], a report issued in September 1998.

The ACCESS study went on with the "Network Implementation Issues" sub-phase, consisting of the 9 Work Packages listed in Table 2

Work Package Number	Work Package Title
220	Third Party Service Provision
220A	Deployment Scenarios for A/G Subnetworks
221	Operational Scenarios
222	Security Issues
223	Safety Assessment / Certification
224	Institutional Issues
225	Accommodation of FANS-1/A
226	Life Cycle Costs
227	Systems Management

Table 2: Work Packages of the ACCESS Phase 2 - Part 1 - Network Implementation Issues sub-phase

The results of this second subphase are synthesised in the ACCESS Interim Deliverable 2 [A228].

1.2 Purpose of this document

This document is an amendment to the ACCESS Interim Deliverable 1 [A208], the synthesis report produced at the end of Network Architecture sub-phase of ACCESS phase 2 - Part 1, In July 1998.

This amendment provides an update of the ACCESS Interim Deliverable 1, taking into account the results obtained in the course of the subsequent set of Work Packages referenced in the ACCESS phase 2 – Part 1 under the heading of "Network Implementation Issues".

1.3 References

ACCESS Reference	Title
[A208]	ACCESS/STNA/208/WPR/016 – Interim Deliverable 1 (Network Architecture) – Proposed Network Architecture of the European ATN – Issue 3.1 (19 November 1998)
[A209]	ACCESS/NATS/209/WPR/080 – Selection of Routing Architecture – Issue 3.0 (3 September 1998)
[A220A]	ACCESS/STNA/220A/WPR/038 – Deployment Scenarios for Air/Ground subnetworks – Issue 1.0 (2 October 1998)
[A228]	ACCESS/DFS/228/WPR/031 – Interim Deliverable 2 – Network implementation issues
[A240]	ACCESS/STNA/240/WPR/035 – Transition Planning – Transition planning and future evolution of the European ATN

2. Amendment to the ACCESS Interim Deliverable 1

2.1 Introduction

This section includes the updates to the chapter 2 of the Interim Deliverable 1.

The following table indicates for each main section of the Interim Deliverable 1, the corresponding update section (if any) within this amendment.

Title of the section in the Interim Deliverable 1	**Title and number of the associated update section within this document**
Current Communication Infrastructure	*No update*
Proposed D/L Services	Section 0 - 2.2 Proposed D/L Services
Routing Architecture	Section 0 - 2.3.1 Routing Architecture
Ground-ground subnetworks	Section 0 - 2.3.2 Ground-ground subnetworks
Air-ground subnetworks	Section 0 2.3.3 Air-ground subnetworks
Proposed addressing plan	*No Update*
Performance Analysis and Dimensioning of ATN Components	Section 0 - 2.4 Performance Analysis and Dimensioning of ATN Components

No update is provided on ID1 sections “Current Communication Infrastructure” and “Proposed addressing plan”. This is because the information elements provided in the ID1 on these subjects are still valid and do not require any update.

2.2 Proposed D/L Services

The Interim Deliverable 1 proposes a selection of air/ground and ground/ground ATC data link services candidate for implementation within the context of the target ACCESS ATN of year 2010.

In the course of the “Network Implementation Issues” sub-phase, no issue was raised which could invalidate the selection made in the Interim Deliverable 1. The proposed list of candidate services is therefore still considered relevant for the target ACCESS ATN of year 2010.

In the context of the ACCESS Work Package 240 on “Transition Issues”, further considerations have permitted to derive from this selection, the candidate air/ground and ground/ground data link services for **initial** implementation in the ACCESS area **in year 2005**. Details on this selection of initial ATN data link services are provided in [A240].

2.3 Proposed Topology of the ATN network

2.3.1 Routing Architecture

2.3.1.1 Introduction

As mentioned in introduction, a routing workshop was held at the end of the ACCESS Network Architecture sub-phase to discuss the pro’s and con’s of the two identified options for the routing architecture of the European ATN.

There was general consensus that there are many similarities between the two options with Option 1 being an ‘End State’ solution, and Option 2 being more evolutionary in nature, requiring modification as more users come ‘on line’.

This section provides a summary of the main issues raised during the Routing Workshop and deemed important to the selection procedure.

2.3.1.1.1 Definition Of The ATN Backbone.

In Option 1 the backbone will provide transit facilities for both routing information and data packets between islands, sub-islands and individual organisations. In Option 2 the backbone is primarily perceived as a route information pool, providing a default route for mobile users in the event that no other route is available; the backbone would not be implemented to provide ground-ground data transit services inter-organisations, but will be used for ground-ground communications with central pan-European facilities, such as CFMU, EAD, and other information pools which are expected to be implemented in the frame of advanced ATM concepts. This is considered to be the most likely initial deployment scenario for the ATN given the existing and proposed data communications infrastructure within the European region.

The choice of the routing architecture is therefore very dependent on the role that is expected to be played by the ATN backbone : Option 2 is not the most appropriate architecture, if the ATN backbone has to convey ground-ground data (production) traffic between organisations. Conversely, Option 1 is an over-dimensioned architecture if the role of the ATN backbone is limited to the provision of default (backup) routes for air-ground communications.

2.3.1.1.2 Cost Of Building A Transit Backbone

It may be difficult to justify the cost of building a transit backbone to enable ATN deployment within Europe. However, Option 1 would provide a suitable architecture for the States which already have access to a core network; this is the case for most of the States in the ACCESS Region (There are developments under way to provide connectivity between the European X.25 networks owned by ATSOs). Initially the routing and data traffic levels would not justify the route server architecture and only one or two backbone BISs would be required. It would be relatively easy to transition to the route server architecture as the number of BISs increases. Option 1 describes a target architecture for the European ATN of year 2010. Option 2 provides an appropriate architecture for States with limited existing data communications infrastructure, i.e. no access to a core transit network, and a first step in an evolutionary process towards Option 1 in those areas which choose to implement a core transit network for inter-organisation data exchange.

2.3.1.1.3 Development Of Route Server

The development of the route server option (Option 1) would require the IDRP NEXT HOP parameter to be mandated in a standard ATN air/ground router. This is the ‘next hop’ facility; it allows the route server to process only route selection and to not participate in the forwarding of data.

2.3.1.2 Conclusion

The results of the workshop concluded that Routing Option 1 is the recommended target architecture for the ACCESS region and Routing Option 2 could be an evolutionary first step towards this target architecture or provide an alternative approach where limited traffic requirements or communications infrastructure exist.

More specifically, it was concluded that:

1. Option 1 is a suitable ‘end state’ target architecture for the European region covered by the ACCESS study, provided that :
   - the traffic levels and user demand are sufficient, and
   - a common core transit network is available or being established.
2. The use of an architecture with smaller sub-islands and a route server in other parts of Europe needs to be validated.
3. Traffic levels and user demand permitting, Option 2 could be developed into the ‘end state’ architecture proposed in Option 1.
4. The transition issues raised from (1) and (2) above will be addressed in the ACCESS Transition work package.[1]

[1] Eventually, transition issues from (1) and (2) have not been addressed in the ACCESS Transition Work Package. This is because the purpose of the transition Work Package has been changed to focus only on the transition plan towards the “Initial” ACCESS ATN of year 2005.

5. Option 2 would be an appropriate architecture for States who have no requirement for a core ATN backbone supporting the exchange of production traffic.

6. There are currently plans to provide connectivity between X.25 networks owned by ATSOs, e.g. CAPSIN and RENAR. This has the potential to provide a common core subnetwork for the States in the ACCESS geographical area. This will 'tie in' with the architecture proposed by Option 1.

7. Agreement will need to be reached as to the status of the ATN Island backbone; is it a default route for mobile users or a core network forwarding routing and data packets ?

8. Both options require the backbone equipment i.e. route server (Option 1) and backbone BIS (Option 2) to have a very high availability.

2.3.1.3 Transition Issues

In the discussion of the two options, it became necessary to clarify the transition issues pertaining to the evolution of the European ATN from an Option 1 Routing Architecture initially deployed in the core ACCESS States, to the complete deployment of the ATN in the whole European Region. The concern was to demonstrate the extensibility of the routing Option 1 from the core ACCESS area to other parts of Europe.

Although these transition issues were initially foreseen to be considered in the scope of the Transition Work Package (WP240), it was felt useful to anticipate the answer to any possible questions on the applicability and suitability of the Option 1 routing architecture for the Northern and Eastern parts of Europe. Hence, complementary information on the Option 1 architecture addressing transition issues and extensibility of the proposed solutions to the whole European Region has been developed and the resulting material is provided in [A209] under the form of scenarios for the expansion of the European ATN.

2.3.2 Ground-ground subnetworks

2.3.2.1 General

ACCESS Interim Deliverable 1 recommends the use of the EAN (the European packet switching network, made of the interconnection of the different ATSOs' packet switching networks, and defined by the NSM-TF) as primary ground-ground subnetwork for supporting the ATN communication on the ground in the ACCESS area and time-frame.

This recommendation is still relevant and is currently enforced by the considerable progress being made by the NSM-TF in defining and implementing the common network infrastructure, and by new initiatives, such as the EAN-ATM project described in the next section, that is being launched for enhancing the EAN interconnection scheme.

2.3.2.2 The EAN-ATM project

EAN-ATM is a new TEN project, which purpose is to develop the standards, framework and management system for the operation of an ATM (Asynchronous Transfer Mode) European Backbone subnetwork that would enable greater integration and improved exchange of air traffic information between the states.

The main objectives of the projects are:

1. Examine the standards for the use of ATM and make proposals for their application to meet the requirements of a certifiable Pan European subnetwork for Air Traffic Management

2. Draft standards for Internetworking and connection and propose these standards for ECAC wide adoption

3. Develop concepts for validation of concepts and procedures

4. Develop and trial a network management system based on EATCHIP concepts.

NATS, DFS, AENA, ENAV, STNA, and Eurocontrol will be collaborative partners to this project.

NATS will be the project co-ordinator.

2.3.3 Air-ground subnetworks

The analysis conducted in the development of the Interim Deliverable 1 concludes that in the ACCESS time-frame (.i.e. up to 2010) the VDL Mode 2 subnetwork be integrated within the European ATN infrastructure as the primary means for the provision of air/ground services, and recommends that a further study be initiated to identify the optimal solution for a secondary back-up air/ground subnetwork.

On the other hand, the Interim Deliverable 1 does not provide any indication on the scenarios for the deployment of the ATN air/ground subnetworks in Europe. This is a missing input element to the definition of the European ATN architecture.

Consequently, in order to progress towards the proper completion of the main ACCESS part 1 objective, the ACCESS work Package 220A was created and dedicated to the identification of the most probable deployment scenarios for VDL Mode 2 and AMSS in terms of locations of ground stations and connectivity of these ground stations to ATN routers.

It must therefore be noted that complementary information on the future European ATN air/ground subnetworks infrastructure is provided in [A220A] and will be summarised in the ACCESS Interim Deliverable 2.

2.4 Performance Analysis and Dimensioning of ATN Components

2.4.1 General

The ACCESS Interim Deliverable 1 recognises that the final endorsement of a specific routing organisation requires to complement the analysis result by additional modelling studies. As a starting basis, it sets up a framework for analysing, predicting and planning the quantitative parameters of the network. The framework consists of a series of analytic and simulation activities to be carried out.

As a direct consequence of the ACCESS recommendations in this domain, a European project on the modelling and simulation of the European ATN is in the process of being launched. This project will comprise a set of analytic and simulation work packages related to the operation of the future European ATN. Some of the results of the ACCESS study will be used as an input to this project and it can be expected that a number of issues raised in the development of the ACCESS Interim Deliverable 1 will be solved.

The following section provides an overview of the objectives of this project.

2.4.1.1 Simulations to support the implementation of the European ATN

“Simulations to support the implementation of the European ATN” is the name of a new project launched by the Eurocontrol Agency, with the objective to consolidate the ATN design work being carried out by the ATN implementation Task Force and ACCESS. NATS and STNA will participate to the co-ordination of this project

The project is currently in the “Tender Phase”. In this phase the companies/consortia involved in preparing a response to the call for tender will analyse the project’s requirements for a Network Planning Tool and propose a suitable tool.

Once the contract will have been awarded, the project will be executed in five distinct phases as follows:

- Phase 1 - Simulation Specification: the objective is to develop a detailed specification of work for each of the subsequent project phases
- Phase 2 - Definition of Data Traffic Scenarios: in order to define a realistic framework within which the simulations are to be conducted, this phase of the project will determine the data traffic scenarios expected in the European ATN environment and describe the characteristics (i.e. data

volume, distribution, required QoS, time-frame etc.) of the data traffic generated by the applications communicating over the European ATN. The traffic scenarios will include communications induced by air/ground data-link services, and ground-ground communications.

- Phase 3 - Generic OPNET Simulations: this phase comprises five distinct simulations studies corresponding respectively to the following domains
  - the performances of the air/ground subnetworks,
  - the optimisation of the parameters of the Transport protocol,
  - the validation of the Route Server concept,
  - the identification of optimal limits in terms of number of systems in a routing domain,
  - a comparison of performance between the Option 1 and Option 2 routing architectures that have been defined in the scope of ACCESS..
- Phase 4 – Network Planning Tool (NPT) Simulation Model Development: the objective of this phase is to prepare for the use of the NPT in phase 5 by developing the necessary simulation models.
- Phase 5 - Assessment of Proposed ATN Topologies for Europe: the objective is to analyze the behaviour of the European ATN topologies developed in the contexts of ACCESS/ATNI-TF contexts, using the NPT and the associated models developed in phase 4.

3. Conclusion

In this first phase, the ACCESS project allowed to generate fundamental technical discussions on the architecture of the future European ATN between some of the main actors of the European ATC (NATS, DFS, STNA, Eurocontrol) and to build a number of concrete proposals as regards the design of the Target ACCESS ATN. As expected, and although it was difficult to get firm conclusion on every aspect, a consensus on open issues (e.g. routing organisation, possible VDL deployment scenarios) has been reached between ACCESS participants.

ACRONYMS

ACCESS	ATN Compliant Communications European Strategy Study
ATC	Air Traffic Control
ATM	Asynchronous Transfer Mode
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
CAA	Civil Aviation Authority
EAN	
PSN	Packet Switched Network
SARPs	Standard And Recommended Practices
VDL	VHF Digital Link
WAN	Wide Area Network