EUROPEAN ORGANISATION FOR THE SAFETY OF AIR NAVIGATION

EUROCONTROL

EATCHIP COMMUNICATIONS STRATEGY - VOLUME 1 - MANAGEMENT OVERVIEW

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Abstract

This document represents the Management Overview of the EATCHIP Communications Strategy, as endorsed by the Twelfth Meeting of the EATCHIP COM Team, held on 3/4 June 1998.

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The following table identifies all management authorities who have successively approved the present issue of this document.

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DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION	DATE	REASON FOR CHANGE	SECTIONS PAGES AFFECTED
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0.C	04.12.97	Expanded outline with text and diagrams incorporated.	All
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1. INTRODUCTION

1.1 Business Context

Since 1987 the demand for air transport has continued to expand, resulting in a traffic increase of approximately 6% per year, and a forecasted doubling of traffic levels before 2015 when compared to those experienced in 1997. This demand requires a substantial increase in capacity and productivity. From the airlines perspective there is also a desire for more efficient routings, and there is an overall requirement for cost containment.

The current operating concepts will not meet these future requirements. Consequently, new concepts are being developed which use greater automation and require real-time access to or distribution of information. Cost containment may be achieved by the use of new communications technologies and by optimising the communication system design.

The EATCHIP communications strategy (COM Strategy) sets out a roadmap for the introduction and deployment of these new technological solutions to meet the requirements of Air Traffic Services Organisations (ATSOs) and airspace users (airlines, general aviation and the military) in the ECAC area.

1.2 Structure and Usage

The strategy is presented in three volumes, the first two of which state the policy:

- Volume 1: Communications Strategy (Management Overview) It provides an overview, from a business perspective, of the business drivers, guiding principles, technical approach and timescales of the strategy.
- Volume 2: Communications Strategy (Technical Description) It provides a greater level of detail of requirements, opportunities and constraints, and the technical implications of the strategy, together with a glossary of terms.
- Volume 3: Communications Strategy (Background) It contains material which was considered during the development of the strategy, and the possible architectural direction for realisation.

It is intended that the strategy will be used by the aeronautical community and industry for planning transition and migration towards the identified strategic communications solutions.

The Agency and the COM Team will use this document as the basis for developing the work programme and ATSOs will use it for the development of national strategies.

1.3 Development

The development of the COM Strategy has been influenced by many factors, including: institutional issues, global interoperability, differences between states, technology opportunities, transition issues, business considerations etc. It is recognised that communications should be treated from an overall system viewpoint, rather than as a collection of independent air-ground and ground-ground components.

The COM Strategy foresees that there must be an evolution of the existing communications infrastructure, in order to support new requirements emerging from future ATM concepts. The COM Strategy describes the main actions required to support this evolution.

Communications is an enabling service, providing the means by which user requirements for interchange of information are met. Accordingly, the COM Strategy has been developed by means of a requirements driven process.

2. DESCRIPTION OF THE STRATEGY

2.1 Objectives

The business drivers for the COM Strategy correspond to the "Major Objectives" identified in the ATM 2000+ strategy, namely:

1. Safety - to deploy in a timely manner communications services and infrastructure which are reliable, secure and consistent with the new functionality required to support the new operating concepts which are necessary to achieve the overall safety targets.
2. Capacity - to improve use of communications resources and support new operating concepts which are dependent on increased use of data rather than voice, and interoperability between distributed systems components.
3. Flight Effectiveness - to provide improved air-ground communication, and to facilitate ATS/AOC collaboration in flight planning and decision making.
4. Economics (Cost Effectiveness) - to adopt communications techniques that reflect the best business practices and utilise appropriate technical solutions for best use of resources. (Business efficiency and airline competitiveness makes it essential that services are provided in the most economic manner.)
5. Environment - to provide better communications as an enabler to improved flight planning, thereby achieving environmental benefits through improved flight effectiveness.
6. National Security and Defence Requirements - to ensure interoperability and integration of civil and military ATM while preserving the confidentiality of sensitive data.
7. Uniformity - to ensure that common standards are adopted and implemented globally for aeronautical communications, and to continue the harmonisation and integration of the communications infrastructure throughout the ECAC area.

The primary goal of the COM Strategy is therefore to develop a safe, efficient and cost-effective set of communications solutions which support, in a globally compatible manner and with due regard for backward compatibility, the evolution of European Air Traffic Management (ATM) and other identified air navigation services for the ECAC area to the year 2015.

The strategy also recognises that co-ordination will be necessary with external bodies (EU, ICAO, FAA, JAA etc.).

2.2 Guiding Principles

The following principles have guided the development of the strategy.

2.2.1 Deriving benefit from the communications world

The strategy is to minimise the realisation costs through the adoption of an "Open Equipment and Service Provision" approach. This implies the use of commercial industry standards wherever possible, permitting the use of Commercial Off-The-Shelf equipment and easy access to commercial network services. Also, harmonisation of ATM systems specifications will create a larger market for standard aviation-specific equipment and competitive provision of services.

2.2.2 Service Level Management

The communications services described in the strategy need to be provided to meet specific service level requirements. The strategy is to agree internationally the service

levels that users of aeronautical communications services and infrastructure will be offered, and the systems network management means by which delivery of that service is monitored and achieved.

2.2.3 Deriving maximum benefit from investments

The strategy is to capitalise on existing investments made by both air space users and Air Traffic Services Organisations through appropriate coexistence coupled with evolutionary transition plans. Economies of scale can be achieved through the use of new (lower cost) services, and the use of Commercial Off-The-Shelf products. The return on investment in new technical solutions will be maximised through the common usage of such equipment and services for many different purposes, e.g. ATS, AOC and APC using shared resources.

2.2.4 Global Interoperability

The strategy is that communications services shall be available in a consistent manner across Europe. To achieve global interoperability it is necessary to develop and apply internationally accepted standards. This includes

- Standards specifically developed for the Aeronautical community
- Standards developed by ISO and ITU
- De-facto and consensus standards

2.2.5 Technology

The strategy recognises that the evolution of new technology and technical solutions may bring opportunities to reduce costs, or increase performance and reliability, or both. Alignment with industry development trends and adoption of commercially successful products and standards will reduce development costs. Techniques will be adopted that optimise the use of resources, e.g. networking in place of point-to-point circuits, use of digital transmission, switching, signalling and compression for efficient use of bandwidth/spectrum. The strategy is to exploit the benefits of new technologies as they become available, in the most cost-effective way.

2.2.6 Security

The strategy recognises the need to protect safety-critical communications from malicious or accidental interference or disruption, through agreement on a common ECAC-wide approach to security provision across the aeronautical communications services and networks.

2.2.7 Coexistence, transition and migration

The strategy recognises the need to have the flexibility to include, in due time, the necessary enhancements as a result of the anticipated future requirements. It recognises the necessity to maintain communications service levels in a changing environment, and the need to be able to introduce new solutions in an evolutionary fashion. New solutions need to be introduced in a way which retains backward compatibility with existing (“legacy”) solutions, using gateways where necessary, to allow a planned transition over an agreed period of time.

2.2.8 National Requirements and capabilities

The strategy recognises that different states have different national requirements and capabilities, because of:

- operational differences (traffic levels, oceanic or continental operation, fall-back arrangements etc.)

- regulatory differences (relationships with military, relationships with Public Network Operators)
- functionality and characteristics of legacy systems
- budget constraints.

In consequence, not all elements of the strategy have to be implemented in all states, nor does the timing of introduction of new solutions necessarily have to be synchronised.

2.3 Impact and Risks

2.3.1 Consequences of Institutional Issues

Institutional issues present a potential risk to the realisation of those communication projects involving a number of states. Hence, at an early stage in such a project, the impact of institutional issues should be evaluated and action taken to reduce the risk; it being understood that such action may modify the proposed technical solution.

2.3.2 Other Risks

A number of other risks may prevent or delay the realisation of the strategic actions:

- Technical risks - studies and trials may reveal that some of the new proposed solutions are ineffective or impracticable
- Certification problems - the means to achieve safety certification across multiple distributed systems elements has not been fully resolved, and there has to be specific accountability for actions when higher (distributed) technical functionality is applied
- The market place - market forces may press for solutions other than those preferred in the strategy, by providing cheap off-the-shelf (but different functionality) alternative solutions
- Global acceptability of solutions - the preferred solutions for an ECAC area may fail to find favour or support in other regions, and competing solutions may be put forward.
- Competition for resources - increased competition for limited communication resources, such as frequency spectrum, may constrain the options available to the aeronautical community.
- Cost overruns - high complexity and underestimation of required resources has led to ATS projects world-wide suffering from overrunning costs and schedules. This history may discourage users from innovative technical solutions and lead to a simpler approach that does not fully achieve the strategic objectives.

The strategy recognises that these risks exist, and that the strategy itself will need to be adjusted in the future to mitigate particular eventualities that may arise.

2.3.3 Impact on airspace users

To cater for the requirements of airlines, general aviation and the military, the strategy leads to a well defined process of communication service provision. The strategy takes into account the considerable investment, the long planning lead times, the cost of retrofits, short times for return of benefit, competitive communication market, etc.

3. COMPONENTS OF THE STRATEGY

The communication strategy addresses communication services, subdivided into:

- Data communications services, providing end-to-end connectivity (application to application) and broadcast capability for air-ground, air-air, and ground-ground application purposes.
- Voice communications services, providing the end-to-end and broadcast voice capability for air-ground, air-air and ground-ground purposes.

and the supporting network services, subdivided into:

- The Pan-European Fixed Network Services, (PENS) providing the international ground telecommunications infrastructure by the interconnection of national infrastructures for voice and data, including network systems management, end-to-end voice and data integrity, switching and routing, multiplexing and message handling.
- The Mobile Network Services, (MNS) providing the communications links between mobiles (aircraft or vehicles) and between mobiles and ground elements, for voice and data over wireless links (radio, satellite and other), including network systems management..

3.1 Data communications services

The business objectives for higher levels of automation, better utilisation of resources and increased safety levels demand an increased use of data communications services in the future. Data communications between distributed automation components allows better co-ordination, both in the air-ground and ground-ground context. Data communications also presents a lower cost, higher integrity alternative to voice communications for non-time-critical information exchanges, with less scope for misinterpretation of the message.

In the medium and long term the evolving ATM concepts, based largely on optimised capacity management and increased ATC automation, will generate requirements for an improved "new generation" data communications service. In addition to the increased need for ATC automation there is a parallel requirement from Airlines arising from evolving user needs for AOC / AAC / APC applications and the inability of the present ACARS systems to meet those needs. A single communications service architecture must be crafted to satisfy all aeronautical data communications needs.

The current ATS and AOC/AAC/APC data communications infrastructure has been developed in an ad-hoc manner without a consistent architecture and supports many different Legacy applications. The new data communications architecture must allow for the continued operation of the Legacy systems by defining "Legacy adaptation interfaces" between them and the new architecture. New applications will be defined with "Standard application" interfaces from the beginning and will gradually replace the Legacy units.

The new data communications service architecture will provide a single vehicle for the operation of Legacy systems, the introduction of new concepts and applications whilst allowing the addition of new technology for ground-ground and air-ground sub-networks via "Standard sub-network plugs". The adoption of such a model will protect the investment of ATSO and Airlines by offering data communications service users a safe and reliable data communications services over market leading sub-networks offered by industry.

3.1.1 Air-ground

Air -ground data communications provide information exchange between aircraft and ground facilities The strategy is that air-ground data services to internationally agreed standards will be introduced to meet the ECAC operational requirements. These operational requirements, together with their Required Communications Performances (RCP), are being defined in the operational domain, and address such applications as ATC Clearances, Trajectory Negotiation, Downlink of Aircraft Parameters and Flight Plan Consistency Verification. The currently identified communications services to support

these applications are Automatic Dependent Surveillance (ADS), Controller-Pilot Data Link Communications (CPDLC) and Flight Information Services (FIS).

A transition plan is needed to enable existing ACARS-based AOC applications to make use of the new higher performance mobile network services.

3.1.2 Air-air

Air-air is seen as a future means to improve air situation awareness, enhance flight efficiency, leading towards "free flight". The requirements for air-air data communications services are at a very embryonic stage, but are expected to evolve during the lifetime of this strategy.

3.1.3 Ground-Ground

Ground-ground communications are the means for improving information flows between ATC centres, and to national, central or regional organisations such as Met, Military, CFMU, CRCO and EGNOS. Inter-centre data communications such as OLDI are already in use in many European countries. In the future, data volumes will increase with increased automation and in support of higher levels of co-ordination. The drivers for these new services arise from the operational domain. In particular, new data services are foreseen in support of distributed databases (e.g. European AIS Database (EAD)), Flight Data Processing System interoperability, and Collaborative Decision Making. In order to derive maximum benefit from the underlying data network services, the strategy envisages sharing resources for both operational and administrative data communications purposes.

3.1.4 Ground Mobile

Ground mobile communications is seen as the means for improving aircraft and vehicle management at airports, in support of the 'Gate to Gate' concept. This includes the requirement to address the pre-departure and post-flight phases, and surface movement co-ordination requirements. The communications services necessary to support this domain will be determined, specified, validated and implemented.

3.2 Voice communications services

3.2.1 Air-ground

End-to-end voice communications between pilots and controllers is central to the ATS strategy for the short and medium term. In the longer term, increasing use of datalinks will mean that voice traffic is reduced for routine ATC communications, however, voice will remain the primary mechanism for emergency and critical safety related exchanges. This may require that the ground station component of air/ground has access to a switched ground infrastructure. This will necessitate the provision of addressing and signalling protocols to enable radio communications to be carried over the ground network.

The key element is for controllers and pilots to have (virtually) immediate access to radio channels when needed for the communication of safety messages between them. Today this is achieved primarily by VHF radio between ATSOs and pilots by use of routine pre-determined channels which are continually monitored in the air and by ground stations. There are, however, problems of congestion and the availability of channels in the VHF band.

With traffic growth, there will be a need to move to more effective use of existing communications media, and possible use of other communications paths such as satellite. At the same time, the increased use of datalink services may act to suppress the growth of voice communications requirements. Dialogue management will be required to ensure that voice and data communications are synchronised.

It is assumed that the anticipated increase in air traffic will mean that on balance voice traffic will not reduce. The balance and impact of these opposing influences will be analysed to determine the future air-ground voice service requirements.

3.2.2 Air-air

Air-air voice communication is already in use, for example for co-ordination and relaying purposes. The requirements for air-air voice communications are expected to evolve during the lifetime of this strategy.

3.2.3 Ground-ground

Ground-ground Voice Communication Systems (VCS) currently serve users in the ATS, ATFM and ASM environment. Services include conferencing, recording, call queuing and pre-emption, call diversion and common directories.

The current ATS telephone network relies heavily on point-to-point circuits between centres. Cost reductions can be achieved through the use of digital switched voice network services, but these require that the VCSs are also digital, operating to the same common standards as offered by the digital networks.

To improve the interoperability of the VCSs across countries, migration from the current mix of installed VCSs to systems using common signalling and interfaces is required. The migration from analogue to digital technology will provide opportunities for increased functionality and efficiency improvements. However because of the level of investment in the currently installed systems, and the relatively high replacement costs, these improvements have to be planned as part of ATSO's ongoing replacement programs.

Intercom systems between remote ATS facilities (APP and Tower, or where intercom traffic operates remotely via a central switch) should provide the same quality of service and access as local systems.

3.3 Pan European Fixed Network Service (PENS)

The voice and data services described earlier require a cost-effective and uniform fixed network. The Pan-European Fixed Network Service (PENS) is foreseen as the strategic ground telecommunications infrastructure for voice and data transmission and switching for the aeronautical community.

The various constituents of PENS fulfil the business requirements and guiding principles for increasing communications traffic, safety, cost-reduction, reuse of existing resources, common use of resources and delivery of agreed levels of service.

PENS includes:

- The network services, which provide switched communications paths,
- Network systems management to monitor and control service delivery.
- The switching fabric, which can deliver connectivity to support the network services (some of these provide a network service in their own right, others are used as enablers for more feature-rich network services).
- The bearers appropriate to the provision of the circuit level connectivity between fixed locations.

Figure 1 shows the expected deployment of PENS constituents.

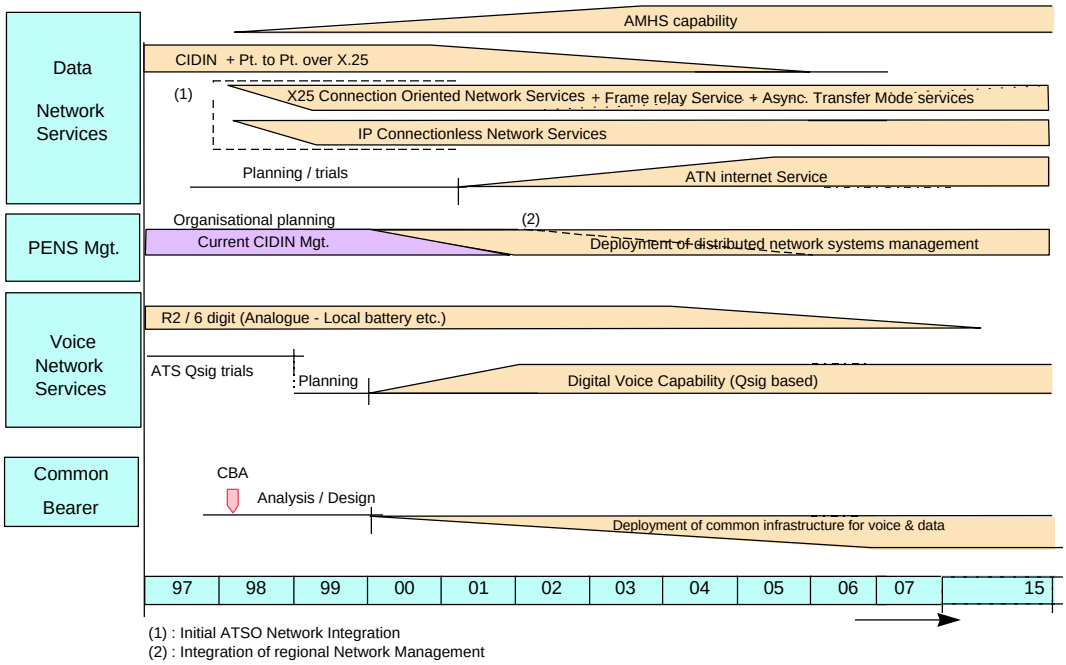


Figure 1 PENS Deployment

Key Features:

Data Networking: AFTN and CIDIN will continue to be used, but gradually be replaced by AMHS services. The existing ATSO data networks will be integrated and enhanced as the basis of the Pan European Fixed Network Service, providing connection-oriented (X.25 and/or Frame Relay) and connection-less (IP) services, potentially leading to Asynchronous Transfer Mode services in the future. The ATN internet will provide service levels and additional functionality (mobile routing, policy-based routing) necessary for high integrity, safety-critical data communications.

Voice Networking: The existing MFC/R2 analogue signalling will migrate to a "Qsig"-based digital voice capability.

Common bearers: Due to advances in technology, economic benefits will be achievable by the use of common bearers for integrated voice and data communication.

Network Systems Management: A key feature for the effective provision of PENS is the distributed network systems management, whereby the overall service delivery can be monitored and co-ordinated, through regional and national managers.

Figure 2 illustrates this concept.

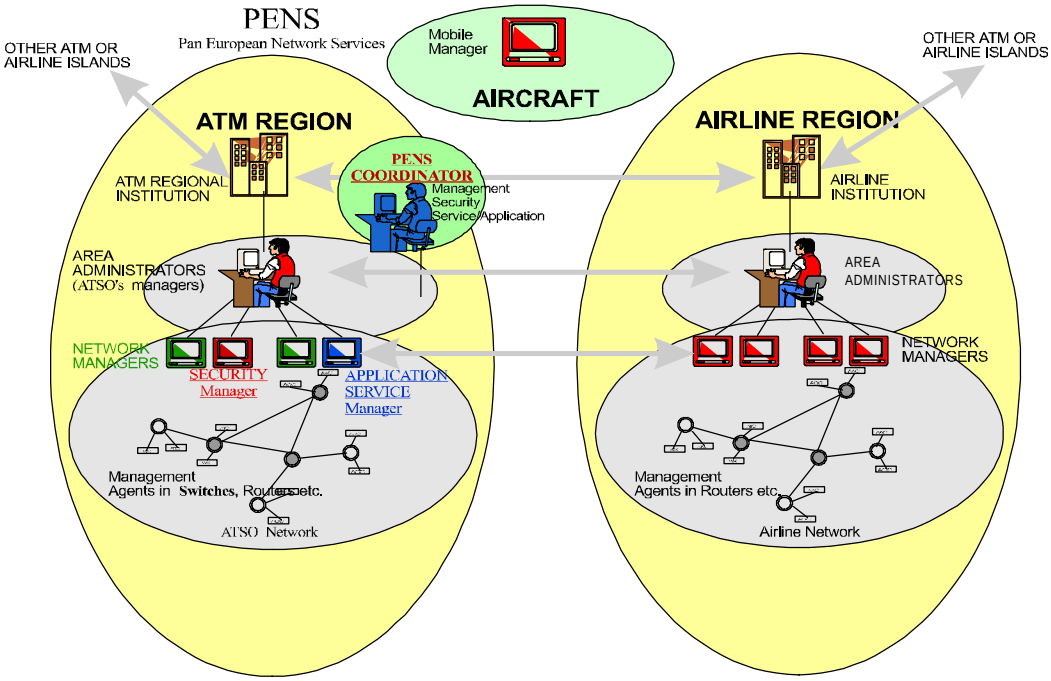


Figure 2 Distributed Network Systems Management

In the long term, the expectation is that a seamless (single image) Network Systems Management approach will be implemented, which incorporates both air and ground management entities.

3.4 Mobile Network Service (MNS)

The air-ground voice and data services described earlier require a supporting mobile network infrastructure which can deliver the required quality of service to meet operational requirements. The Mobile Network Service, (MNS) is foreseen as the communications infrastructure between mobiles (aircraft and vehicles) and between mobiles and ground elements, over wireless links (radio, satellite and or other), including network systems management.

The Mobile Network Services are described in terms of:

- The network services, which provide switched communications paths,
- The protocols for carrying voice and/or data over the mobile carriers
- The carrier functionality (radio etc.) appropriate for providing circuit level connectivity for mobiles.

Figure 3 illustrates the timescales for the MNS elements.

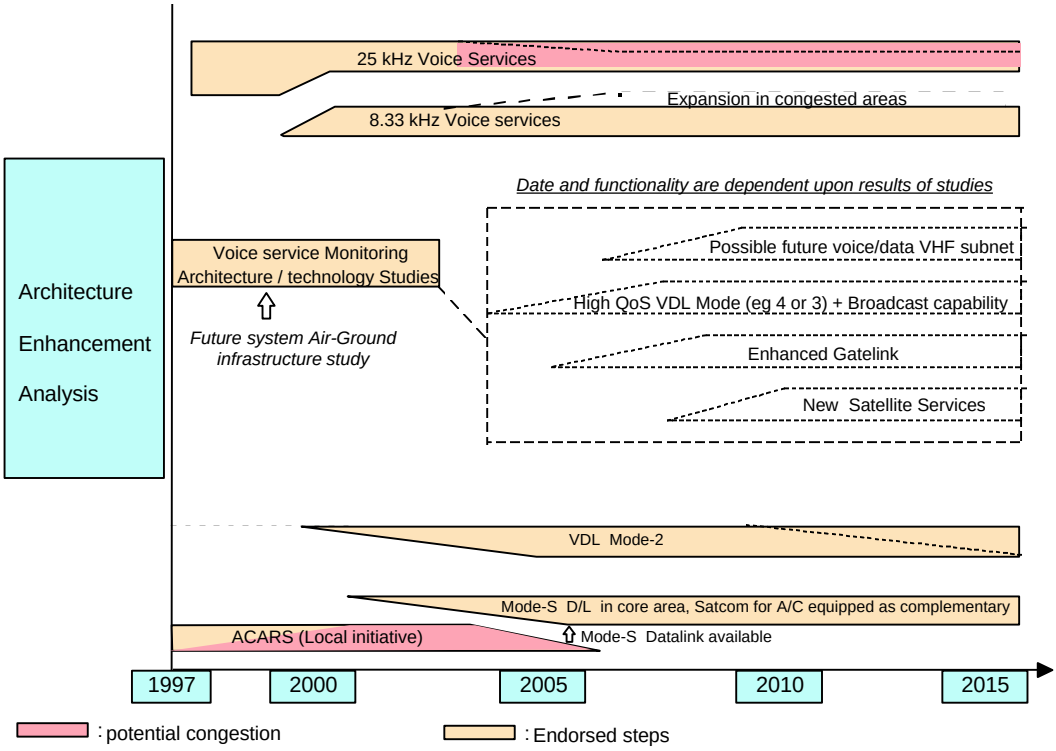


Figure 3 MNS Deployment

Key Features

Coexistence and migration for FANS1/A equipped aircraft: The transition from ACARS-based (FANS1/A) communications to the strategic ATN-based solution needs to be carefully co-ordinated with all interested parties.

ATN sub-networks: Use of the ATN internet protocols on the air-ground links is important if communications resources are to be shared between ATS and AOC usage. The strategy is to adopt ATN internet sub-network protocols for all strategic data link technologies.

Initial air-ground data links: VDL Mode 2 will be deployed as the first air-ground sub-network to support the ATN, with Satellite data for aircraft already equipped for airline

traffic and Mode S where implemented for surveillance purposes providing complementary sub-networks.

Future air-ground data links: Other VDL data modes offer the possibilities of higher quality of service, which may be essential to meet the required communications performance of some new operational applications. Such modes may also offer cost savings through combining digitised voice and data on the same channel. New satellite systems may offer cost reduction opportunities with increased performance and availability.

Air-ground voice: Analogue voice over 25kHz channels will continue to be the main air-ground voice link to serve the needs of controller pilot communication in the short and medium term. In the short term, the adoption of 8.33kHz channel spacing is seen as an essential measure to increase channel availability in congested air space of the ECAC region.

Wireless ground mobile data links: Wireless airport communications based upon internationally agreed standards are foreseen to improve ground co-ordination and to support communications at the gate.

Spectrum Protection: The ICAO CNS-ATM strategy requires for each of its constituting elements Communication, Navigation and Surveillance sufficient and sufficiently protected radio spectrum. Increasing (commercial) pressure from telecommunication service providers on spectrum allocation in ITU and CEPT fora necessitates a strong defence of existing aeronautical allocations and a co-ordinated effort to ensure of spectrum availability for future aeronautical applications.

4. ACTIONS AND ROADMAP

The main strategic actions resulting from the strategy are listed below. The bold text in brackets indicates the primary ATM 2000 Plus business drivers (major objectives).

A. To specify and implement new data communication services (e.g. CPDLC) and voice communication services (e.g. air-air), based on new operational concepts. **(Capacity; Flight effectiveness)**

B. To implement 8.33 kHz channel spacing in the upper airspace of the 8.33 states, from 1999. The necessity and feasibility for an expansion of 8.33 kHz channel spacing in congested areas will be determined as soon as possible. **(Capacity)**

C. To implement a VDL-Mode 2 air-ground sub-network as the first ATN sub-network, for operation commencing in 2000. On an opportunity basis, complementary ATN datalink services may also be provided by Mode S in the states implementing Mode S stations for enhanced surveillance purposes, and SATCOM for the aircraft already equipped. **(Safety; Capacity; Environment)**

D. To study the requirements for future air-ground sub-networks, in order to identify candidate solutions for beyond 2005 (including VDL Mode 4, VDL Mode 3, new satellite generation, Enhanced Gate Link, future VHF, HF datalink). **(Safety; Capacity; Environment)**

E. To support ongoing improvements in the management of frequency spectrum for aeronautical purposes. The interests of the aeronautical community will be promoted at the appropriate international fora. **(Safety; Capacity)**

F. To implement an ATN Internet to support air-ground communications, with appropriate ground network support. Early air-ground operations are expected from 2000 onwards and full deployment of the ATN is planned for 2005 onwards. **(Safety; Uniformity)**

G. To implement network systems management in support of network services on an international basis and in an evolutionary way. **(Cost effectiveness; Uniformity)**

H. To implement an international Aeronautical Message Handling Service (AMHS), as an X.400 based replacement to the existing AFTN application, which will be phased out of operation from 2004. Gateways between the AFTN and the AMHS are already in operation. International operations are foreseen to commence in 2002. **(Flight effectiveness; Cost effectiveness)**

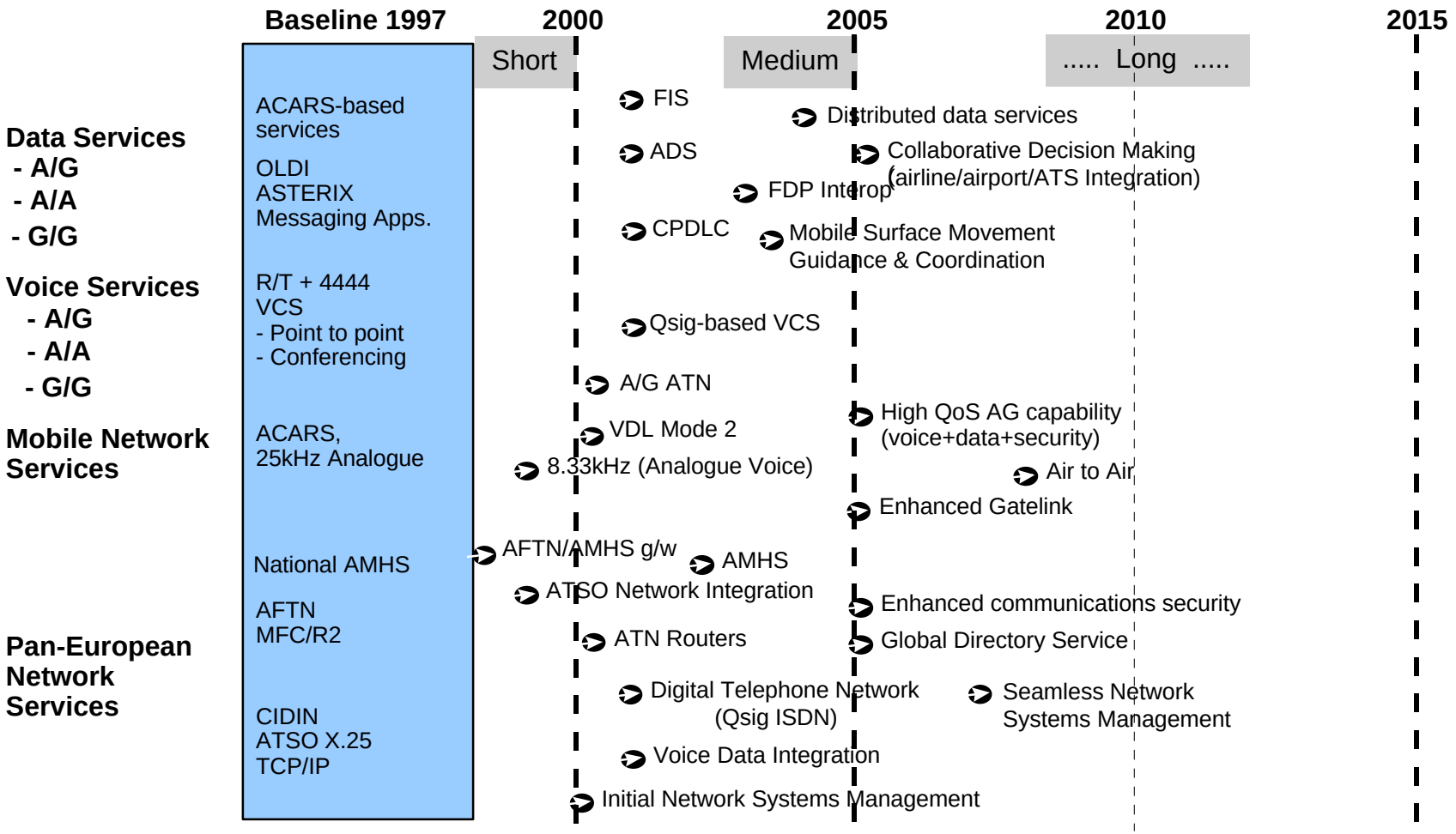
I. To implement an improved digital signalling system (ATS Qsig) for ground-ground voice communications, as a replacement to existing analogue signalling systems (e.g. MFC-R2). **(Cost effectiveness; Uniformity)**

J. To provide circuit level integration for international voice and data traffic, using common, interoperable standards, service levels and physical representation. **(Safety; Cost effectiveness; Uniformity)**

K. To integrate existing and planned national networks, based on the coexistence of industry and international standards (e.g. ISO ICAO/ATN) to support current and future application requirements (e.g. EAD, EGNOS, CRCO, CFMU, eFDP, OLDI, AMHS, Radar data distribution). **(Cost effectiveness; Uniformity)**

L. To conduct a study to specify and standardise ECAC-wide security mechanisms (both technical and procedural) to protect information flows using the ground-ground or air-ground communications infrastructure. **(Safety; National Security)**

Roadmap - The expected initial deployment timetable is illustrated in Figure 4.



Indicates “Start of service” dates

Figure 4 Communications Strategy Timescale