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EUROCONTROL Guidelines

EUROCONTROL Guidelines on Minimum CNS Infrastructure and Avionics Equipage for the Support of OAT Harmonisation

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Abstract

The EUROCONTROL Agency has acknowledged the need to identify the Communications, Navigation and Surveillance (CNS) resources, in the ground and airborne, which are the minimum required to enable Pan-European Operational Air Traffic (OAT) operations when harmonised European OAT Rules (EUROAT) and related service/system supporting OAT transit are in place.

For that purpose the EUROCONTROL Directorate Civil-Military ATM Co-ordination (DCMAC) promoted through the Civil-Military CNS Focus Group the development of the present document describing the CNS requirements considered applicable for the handling of State aircraft operating as OAT. The requirements contained herewith shall not replace the provisions laid down in civil and military AIPs. It rather constitutes guidance for the ATM planners and procurement branches.

The requirements contained herein seek a longer term convergence with the Civil-Military CNS/ATM Interoperability Roadmap and SESAR Technology Assessment.

The document has the status of EUROCONTROL Guidelines and has been submitted and endorsed by the Civil-Military Interface Standing Committee (CMIC).

Keywords

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CNS Requirements	Civil-Military	Infrastructure	Interoperability

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Contents

Executive Summary

This document defines a set of Communications, Navigation and Surveillance (CNS) requirements identified as the "Minimum CNS Infrastructure and Avionics Equipage for the Support of OAT Harmonisation". These requirements will enable the implementation of the concepts and procedures envisaged for Pan-European Operational Air Traffic (OAT) operations under harmonised European OAT Rules (EUROAT) and OATTS: a related service supporting OAT transit.

The need to delineate such list of CNS requirements has been acknowledged by the EUROCONTROL Agency that tasked the Civil-Military CNS Focus Group (CNS FG) to develop the present document.

The basic references used for this work were the deliverables of the HORGI TF, the CNS FG "Civil-Military CNS/ATM Interoperability Roadmap", SESAR Technology Assessment and a number of known military requirements.

The present CNS requirements cover both the ground and airborne sides as required for the handling of State aircraft when operating as OAT. These provisions aim at offering suitable guidance for the civil and military stakeholders.

Such requirements have been developed in the form of an underlying set of CNS ground infrastructure elements and airborne equipage fits. These latest were organised as baseline requirements, valid for 01 January 2008, transitional capabilities to be considered in the short to medium timeframe (2008-2013)* and long term targets for 2013+. Some of the transitional requirements and the long term ones are consistent with the "Civil-Military CNS/ATM Interoperability Roadmap" to ensure not only the handling of State aircraft within GAT structures but also to improve interoperability and civil-military system convergence. SESAR Technology Assessment options were also taken into account.

The airborne requirements identified for OAT in the present document comprise:

Air/Ground Voice Communications:

- UHF COM 25 kHz Transceiver;
- VHF COM 8.33 kHz Transceiver (En-Route);
- VHF COM 25 kHz Transceiver Off-Route and where UHF and 8.33 kHz is not available;

Navigation:

- TACAN and/or available GPS/INS (later GNSS) in 2008-2013;
- GPS/INS (later GNSS) in 2013+;
- Multi-Mode Receiver (ILS, MLS and DGPS) sustaining PAR during transition.

Surveillance:

- SSR Mode A+C Airborne Transponder;
- SSR Mode S ELS/EHS Airborne Transponder from 31 March 2009.

The abovementioned baseline and transition requirements might not match available ground infrastructure in certain geographical locations. Additionally, the divergent capabilities of some legacy military fleets might entail the recourse to a number of transitional provisions described in this document.

*- These dates are indicative only and must be reniewed when considered in the context of the SESAR Master Plan

1. Introduction

1.1 Foreword

The EUROCONTROL HORGI Task Force has been multiplying the efforts towards the Pan-European Harmonisation of OAT Rules and its GAT Interface. In parallel a "Civil-Military CNS/ATM Interoperability Roadmap" has been developed by the CNS Focus Group and was approved by the Military Team in December 2005.

That roadmap has not extensively addressed the applicability of CNS requirements for the support of OAT (and the OAT/GAT interface). However, it is widely accepted that a number of civil-military interoperability recommendations applicable to GAT may possibly also be relevant to facilitate OAT operations.

During the first half of 2006, the CMIC reiterated the support to further work in the area of CNS requirements' definition for OAT and for OAT/GAT. It was agreed to task the CNS FG to actively support the work of the HORGI TF, namely by determining the "Minimum CNS Infrastructure and Avionics Equipage for the Support of OAT Harmonisation".

In line with the operational improvements foreseen in the EUROCONTROL ATM Strategy for the Years 2000+, the HORGI TF is progressing with the harmonisation of the European OAT Rules (EUROAT) and the delineation of an OAT Transit Service (OATTS). A critical precondition for the complete definition of the EUROAT and OATTS is the identification of the CNS infrastructure on the ground, and consistent airborne avionics fittings, that need to be in place to support OAT operations performed by State aircraft.

It is against this background that a set of CNS requirements for OAT needs to be identified. Known military CNS requirements supporting ATM functions will be taken as the basis. Some GAT provisions will be added or adapted as applicable to complement the envisaged system support. The result shall be a minimum set of requirements to support harmonised OAT operations in a flexible way optimising the use of existing resources.

The infrastructure and avionics fittings, determined as necessary to support OAT harmonisation, shall take due account of the fragmented civil and military ATS provision in Europe, the type of civil-military ATM organisation (separated, co-located or integrated), the geographical areas/airspace where GAT mandates are applicable and the transitional exemption policies applicable to State aircraft.

The determination of the requirements started with the identification of the available civil and military ground infrastructure that might be used to support OAT (including its interface with GAT). The next step was to determine the level of onboard equipage taking into account the typical CNS avionics suite installed in modern military aircraft together with some provisions to accommodate legacy military aircraft with lower capability.

In parallel, the future evolution of the identified requirements will be forecasted with the objective of migrating towards improved civil-military interoperability, reduced requirement for exemptions, rationalisation of civil and military infrastructures and long term system integration.

The adherence to performance-based principles rather than the carriage of particular equipments shall be pursued as necessary to enable OAT operations, within all civil and military segments of the European ATM Network (EATMN) including those regularly used to handle GAT traffic.

The technologies being envisaged during the SESAR Definition Phase cover also civil-military interoperability requirements and target the 2020 timeframe. The requirements applicable to OAT shall facilitate also the convergence to SESAR Technology Assessment.

1.2 Objective

This document intends to describe the minimum ground-based and airborne CNS requirements to support harmonised Pan-European OAT (and OAT/GAT interface) operations conducted by State aircraft. The CNS enablers shall be identified in relation to their area of applicability, specific conditions for its consideration, for State aircraft flying under OAT status and when reverting to GAT structures, its criticality and expected evolution to improve interoperability and to implement performance-oriented solutions.

1.3 Scope

Such a list of CNS requirements is intended to serve as expert level guidance material to ATM and CNS planners and procurement agencies and shall be considered as supplementary to the defined EUROAT and OATTS and other relevant deliverables of the HORGI TF. This document is neither describing the operational environment and the procedures for the use of the CNS resources, nor the relevance of the same resources for strict military wartime functions.

The information provided in this document pursues harmonisation objectives and does not replace, in any way, the provisions included in national civil and military Aeronautical Information Publications (AIP) and other national regulations and, thus, shall not be used as the basis for military air operations planning and tasking activities.

Other aspects that are also excluded from the scope of this deliverable are the associated institutional and regulatory impacts, including the mechanisms for certification or verification of compliance, and the CNS support of UAV operations.

The document has the status of EUROCONTROL Guidelines and has been developed by the CNS Focus Group, subject of positive strategic advice from the Military Harmonisation Group (MILHAG) and endorsed by the Civil-Military Interface Standing Committee (CMIC).

1.4 Acronyms

ACAS	Airborne Collision Avoidance System
AFTN	Aeronautical Fixed Telecommunications Network
AIS	Aeronautical Information Services
ATFCM	Air Traffic Flow and Capacity Management
B-RNAV	Basic RNAV
CNS	Communications, Navigation and Surveillance
CPDLC	Controller-Pilot Data Link Communications
DME	Distance Measuring Equipment
ELS	Elementary Surveillance (Mode S)
EHS	Enhanced Surveillance (Mode S)
EUROAT	EUROCONTROL Harmonized Rules for Operational Air Traffic
GAT	General Air Traffic
GBAS	Ground-Based Augmentation System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
HORGI	Harmonisation of OAT Rules and GAT Interface
IFF	Identification Friend or Foe
ILS	Instrument Landing System
INS	Inertial Navigation System
JAA	Joint Aviation Authority
MLS	Microwave Landing System
MMR	Multimode Receiver
NATO	North Atlantic Treaty Organisation
NDB	Non-Directional Beacon
OAT	Operational Air Traffic
OATTS	OAT Transit Service
P-RNAV	Precision RNAV
PSR	Primary Surveillance Radar
RAIM	Receiver Autonomous Integrity Monitoring
RNAV	Area Navigation
RNP	Required Navigation Performance
RVSM	Reduced Vertical Separation Minima
SBAS	Space-Based Augmentation System
SSR	Secondary Surveillance Radar
TACAN	(UHF) Tactical Air Navigation Aid
TMA	Terminal Manoeuvring Area
VOR	VHF Omni-directional Radio Range
VORTAC	VOR associated with TACAN for civil usage

2. Harmonisation of OAT and CNS Requirements

2.1 EUROAT and OATTS Development

The EUROCONTROL ATM Strategy for the Years 2000+ states that military and civil users must be accommodated within European airspace by appropriate means of co-ordination. This, together with the implementation of the Single European Sky, justifies not only the harmonisation of service provision regulations to GAT but also challenges the European military community to overcome the present national fragmentation in regard to OAT and harmonise relevant arrangements at European level, in order to maintain, and potentially enhance, the level of military requirement facilitation.

The EUROCONTROL Agency, responding to such challenge, is currently developing deliverables to accomplish this task with a 3-step approach (OAT regulatory harmonisation, OAT Transit Service development, Pan-European military training area use-strategy with CBO/CBA[1]).

2.1.1 HARMONISATION OF OAT RULES AND ITS GAT INTERFACE

Air operations related to the training and exercising of military forces ensuring the readiness and standards to discharge National Defence and Security functions and project air power, as required for State sovereignty missions, are mainly conducted as OAT.

Military OAT flight operations require skills and capabilities outside the scope of civil aviation, and consequently are not sufficiently supported by those rules, procedures and ATM arrangements as detailed by ICAO, EU and/or national authorities for GAT flights.

Therefore, it was recognised that in order to appropriately facilitate OAT and its interface with GAT within the Single European Sky environment, relevant national OAT rules should be harmonised and standardised amongst the EUROCONTROL Member States.

The “EUROCONTROL Specification of Operational Air Traffic under Instrument Flight Rules (IFR) inside controlled Airspace in the ECAC Area (EUROAT)” are designed to provide this harmonised and standardised framework for OAT flights and to appropriately facilitate the interface between OAT and GAT. This will be done through the application, whenever possible, of the ICAO rules defined for GAT flights with additional rules that deviate from ICAO provisions, being considered when operations so require.

2.1.2 ECAC-WIDE OAT-IFR TRANSIT SERVICE (OATTS)

Since OAT should not be imposed with restrictions in regard to aircraft equipage, flow management measures and other ATM arrangements for GAT, the establishment of an ECAC-wide OATTS is required to maintain sufficient military operational flexibility within the future SES environment.

Initially the OATTS will be defined as the connection of national structures, under the framework of the EUROAT, as required to enable:

- missions to be properly planned by the military airspace users independently of whether States provide flexible or static OAT route options;
- air navigation services to be appropriately provided for OAT by the States irrespectively of the provider being military, joint civil-military or civil units;

1- CBO=Cross Border Operation; CBA=Cross Border Area

- the possibility for States to fully integrate OAT into the GAT route structure, as long as the EUROAT is applied to the extent required and no ATFCM measures are imposed.

It remains a strict military requirement that military airspace users need for their operations, exercise and training unhindered access to airspace when it is required and timely and flexible availability of routing options. Within the context of SES, other activities that are essential drivers for OAT harmonisation are Functional Airspace Blocks (FAB) projects and ongoing definition of CBO/CBAs structures and procedures. OAT harmonisation it is equally an important contributor for the establishment of FABs.

2.2 Context of CNS Requirements

The harmonisation efforts pursued through the EUROAT and OATTS developments are somewhat constrained by the national fragmentation of today's OAT arrangements. This entails the need to assess how we ensure the appropriate support in terms of flight planning, airspace management, certification of service provision, training/licensing of ATCOs and determination of the CNS enabler infrastructure (ground-based and airborne).

The identification of the aircraft CNS equipage required to sustain OAT operations must take into account the capabilities presently available in most military airframes, and the migration to a harmonised target configuration.

However, such configuration has to be consistent with the ground infrastructure available at each particular State, and even with the nature of the ATS unit or service provider (civil or military). That might imply that, in some areas and to some extent, the CNS equipage applicable to OAT might be affected by requirements mandated for GAT as well.

As dictated by the level of flexibility inherent to the OATTS, the CNS requirements for OAT shall take into account the need for ATM functions and military warfare requirements to co-exist. It is desirable that military operational avionics features be utilized to reach a level of performance required for ATM purposes.

To ensure a transition from the current situation to that of a harmonised environment in terms of CNS support for OAT, the differences in terms of enforced mandates and capabilities available might have to be temporarily mitigated through the retention of some local special handling procedures, exemption-based accommodation of State aircraft, or through transitional provisions as described in paragraph 4.2.

Once regulations and procedures for OAT within Europe are fully harmonized, a subset of the civil-military CNS interoperability requirements already identified for GAT might be extracted for OAT applicability. One can anticipate that, for the longer term, OAT procedures and rules will not be dramatically different from those applicable for GAT. This indicates that a long-term goal shall be the convergence of the infrastructure elements described in this document with GAT requirements listed in the "Civil-Military CNS/ATM Interoperability Roadmap" and with those foreseen by the SESAR Master Plan.

The regulatory context is outside the scope of this document. However, the airworthiness standards and other applicable guidance material that makes possible a certain CNS capability should be highlighted as a means of compliance to attain a certain level of ATM performance. This is particularly relevant in terms of SES and SESAR developments.

2.3 Principles of CNS Requirements

When determining and implementing the CNS requirements applicable to State aircraft operating within the OATTS and observing the conditions established by the EUROAT the following principles shall be respected:

- OATTS will not be able to sustain a sanctuary for military aircraft with insufficient CNS equipment for more than a defined transition period within the SES environment,
- The level of military CNS harmonization required to enable an ECAC-wide use of OATTS must be ensured taking into account any local specificities,
- Military operational CNS equipment designed to meet military wartime requirements should be used to the maximum extent possible to meet civil CNS performance requirements,
- Bearing in mind the SES regulatory trends, a performance-based equivalence between civil and military standards and specifications supporting certification or verification of compliance, shall be pursued. That must allow the mapping of military CNS capabilities against civil CNS performance levels and capabilities linked to ATM services,
- Synergies must be created to enable the use of civil CNS terminal and en-route infrastructure when investments to maintain ageing military infrastructure are prohibitive,
- Services to be provided within the OATTS are critically dependent on the seamless information exchange in the ground environment, throughout civil and military networks, and between the air and ground segments.

3. Description of CNS Requirements

3.1 Methodology

The methodology for the development of the "Minimum CNS Infrastructure and Avionics Equipage for the Support of OAT Harmonisation" includes:

- The definition of a baseline, comprising requirements considered valid on 01 January 2008;
- The description of the requirements needed to cope with the expected evolution in the foreseeable future (short to medium term: 2008-2013 and long-term: 2013+);
- The reference to, and alignment with, the existing "Civil-Military CNS/ATM Interoperability Roadmap", SESAR and relevant national military documents describing ATM-related military requirements;
- To the extent applicable, the consideration of the fragmented situation in terms of European ATS provision and lack of proper equipage available in many legacy military aircraft[2].
- The consideration of the timeframes and specific provisions agreed in terms of OAT Rules and OATTS as decided within HORGI TF.
- The differentiation between ESSENTIAL and RECOMMENDED requirements.
- An effort towards rationalisation of the CNS assets identifying ways to make best use of what is available without creating new overwhelming requirements. This can be done by either retaining special handling for particular conditions or by taking advantage of backwards compatibility with legacy systems and by pursuing the notion of performance-based equivalent compliance.

The determined requirements are discussed in the text and listed in accordance with that methodology in the Annexes "A" and "B". Paragraph 4.2 addresses the transition method.

The next paragraphs detail the conditions for the selection and application of the relevant capabilities in terms of ground infrastructure and airborne equipage.

2- Sometimes proper attention has to be paid to the type of State aircraft or nature of military ATS unit considered (fighters, transport-type or military ATC, Air Defence), area of applicability (airspace, en-route, TMAs, approach and landing) and local arrangements (different infrastructure at different States).

3.2 Ground Infrastructure

It is assumed that an initial core infrastructure is available, either civil or military. A number of existing infrastructure elements will have to be considered to support the essential CNS capabilities described in this document.

Communications

- Ground communication networks and interfaces as required for the exchange of flight data (including flight plans), aeronautical information, meteorology data and surveillance data as required to ensure safe and efficient OAT operations. This information shall be transferred in a way that becomes available for or from military ATS or Air Defence Units, Airbase Wing Operations or Squadron Operations Centres.

- The infrastructure used in the exchange of Flight Plans and AIS data is normally the AFTN/CIDIN international network with remote terminals available in military ATS or AD units constituting extensions of the ANSP local networks. These networks will migrate to Aeronautical Message Handling Services (AMHS) supported by IP-based networks that will replace X.25 circuits reaching its end of life cycle.

- Point to point bilateral circuits based on the protocol X.25 support Flight Data (FMTP/OLDI, ADEXP) transfers between ACCs (including military ACCs). Also here the migration to IP standards will have to occur[3].

- Dedicated or public switched telephone networks (PSTN) need to be available for inter-centre voice coordination between civil and military ATS units.

- Ground-based radio receiver sites provide UHF and/or VHF (25 kHz and/or 8.33 kHz) to support air-ground voice ATC communications within a certain portion of airspace or in the vicinity of an aerodrome, including the airfield services (APP, TWR, FIS, etc.). HF sites exist for beyond line-of-sight communications.

- VHF 25 kHz channels in the band 138-156 MHz are available for military off-route OAT operations in most NATO States.

- In some States, civil ANSPs are not providing UHF support (e.g. Austria, Sweden, some Eastern European States).

Surveillance

- Within Europe various ground radar stations exist for airfield, terminal or en-route surveillance, either independent or dependent of airborne transmissions in the form of Primary Surveillance Radar (PSR) or Secondary Surveillance Radar (SSR). A mixture of civil and military sensors exists including, as a norm at civil side, PSR in TMAs and double SSR extended to the en-route segment. On the military side, there is a wide availability of Primary Radar coverage but this not always used for ATC purposes.

- The ground-based surveillance infrastructure is presently characterised by overlapping radar coverage in certain areas and some gaps in terms of independent means in the en-route part. Nevertheless, for the specific support of OAT operations it is important to ensure the continuous ground system support for the critical functions of ATC handling of flights, its identification and separation of traffic in the en-route and terminal environment.

3- A separated category of interoperability requirements related with ATS systems (ATC applications and systems) will be vital for the success of OAT Harmonisation but are left outside the scope of this document.

- For OAT purposes it is assumed that, based on current overprovision of radar coverage in Europe, for en-route and terminal airspace, PSR and/or SSR will always be available. Possible existence of airborne transponders non compliant with Annex 10 or with anomalies has to be monitored.

- When operating as OAT without re-using any GAT structure the reliance on airfield surveillance facilities complemented by communications capabilities might be used to support most of the applicable OAT rules in the vicinity of military airfields. In the "en-route" environment SUR assets are fundamental to assist in the separation with civil traffic.

- When and where other SUR techniques like Multilateration or ADS-B are introduced their impact on the continuous support of OAT operations shall be assessed and, when required, special handling procedures or interoperability actions might have to be undertaken.

Navigation

- In spite of the plans to rationalise the existing NAVAID infrastructure which comprises a multitude of ground-based beacons such as NDB, VOR, DME, TACAN, VORTAC, ILS, MLS and PAR, the migration to a more intensive use of satellite-based navigation (including its augmentation systems) will take still some time, particularly at civil side, with some uncertainty remaining on its possible classification as the "sole means" of navigation.

- A simplified perspective shall be considered in respect to the selection of NAV enablers considered for the support of OAT. Ideally the airborne self-contained NAV avionics shall suffice for the NAV support of OAT flights. These avionics might typically include Inertial Navigation System (INS) with GPS (later GNSS) updates to support pilots with positioning and bearing information as well as for approach and landing.

- Consequently, ground NAVAIDS (e.g. TACAN, VOR/DME, DME/DME and PAR in military airfields) might be used during a transition or as a backup when matching airborne fitting.

- In most military airfields approach and landing is supported with Ground Controlled Approach/Precision Approach Radar (PAR). A long-term solution, consistent with NATO PALS, will derive from the availability of Multi-Mode Receiver (MMR), which includes ILS, MLS and DGPS capabilities.

- Local requirements, when higher NAV performance is applicable at a certain civil airport, terminal area or in the en-route environment, might dictate the need to follow special handling arrangements until performance based navigation (PBN) requirements[4] enable the re-use of equivalent military means.

A seamless support of OAT operations will largely depend on future synergies between civil and military CNS infrastructures leading to appropriate civil-military system interoperability improvements. A long-term target shall be to converge to the "Civil-Military CNS/ATM Interoperability Roadmap" and SESAR.

Annex "A" details the ground infrastructure requirements for OAT.

4- PBN concept is under development at ICAO level (ICAO document 9613)

3.3 Air/Ground Communications

Baseline Requirement (from 2008)	Transition Requirement (2008-2013)	Long-term Requirement (2013+)
❑ UHF COM 25 kHz Transceiver ❑ VHF COM 8.33 kHz Transceiver (En-Route)	❑ VHF COM 25 kHz Transceiver (En-Route and Off-Route)	❑ UHF COM 25 kHz Transceiver ❑ VHF COM 8.33 kHz Transceiver (En-Route) ❑ Future Radio System (2025+, TBD)
See details in Annex B – Avionics Fittings - Communications		

3.3.1 AIR/GROUND VOICE COMMUNICATIONS

OAT configuration

Current ATC concepts are intensively based on air/ground voice communication interaction between pilots and controllers.

Military air/ground mobile communications are required to exchange voice and data in support of Air Operations. The use of HF for long range beyond line-of-sight communications is not seen as relevant for OAT harmonisation. The existing standards that can be used to enable ATC air/ground voice communications supporting military OAT operations include:

- **UHF AM line-of-sight (225-399.9 MHz)** using multi-channel transceivers with 25 kHz channel spacing, is an essential requirement for military tactical communications including air/ground, air/air and UAV operations. Such requirements include the use of UHF to support ATC functions and shall be considered an essential capability to enable OAT operations. This is justified by the high airborne equipage rate as the vast majority of NATO nations and a number of Partnership for Peace (PfP) States have their military aircraft fitted with UHF-capable radios.

  There are still a number of legacy aircraft in Eastern European States that are only equipped with VHF radios. UHF frequencies have traditionally been lent to civil ANSPs to be implemented in support of ATC services provided to military aircraft which are not VHF capable. Hence, UHF provision is available at military ATS units and civil ACCs but such coverage is not yet universally available or comprehensive in all European States.

- **VHF AM line-of-sight Off Route (OR) (138-144 MHz)** is generally available in VHF radio sets with 25 kHz channel spacing and wide tuning range. It supports the handling of military aircraft flying as OAT and some airfield services. In some countries the full range up to 150 or 160 MHz is used for military A/G/A requirements. Cooperation between NATO and non-NATO air forces relies heavily on the availability of this military band. In the context of OAT harmonisation, it shall be considered as supplementary to UHF or VHF 8.33 kHz when required to match the airborne fitting with the available ground infrastructure.

- **VHF DSB AM line-of-sight Route (R) (118-137 MHz)** is a civil ATC voice communications band highly congested in much of Europe. In order to cope with this situation, ICAO and EUROCONTROL have promoted a new standard based on 8.33 kHz channel spacing and the area where the carriage of 8.33 kHz capable radios is mandatory is being constantly expanded.

  This has an impact on military operations when State aircraft that are non-8.33 kHz capable have to fly as GAT.

For the sake of the end goal of convergence with the civil side and interoperability imperatives, Military Authorities have been urged to make efforts to migrate towards VHF 8.33 kHz. Considering the fast increase of equipage rates of military airframes with VHF 8.33 kHz radios and after a certain transition, VHF 8.33 kHz equipage will facilitate OAT flying when State aircraft have no option other than to re-use the GAT structures to accomplish their missions. In that sense, VHF (R) 8.33 kHz shall also be considered the long term essential requirement to support OAT harmonization. In some States where UHF is not available or when dictated by the aircraft fitting VHF (R) channels with 25 kHz spacing might have to be used as a supplementary capability.

In conclusion, the standard used to support OAT air/ground voice communications shall consider as the baseline requirement either UHF and VHF (En-Route and Off-Route) and missions will be prepared by selecting the available ground infrastructure (civil or military ATS) that matches the airborne equipage. VHF 25 kHz in the civil ATC band (118-137 MHz) will serve only as a transition where State aircraft cannot be handled in UHF or VHF 8.33 kHz. Long-term target is to use available UHF provision together with VHF 8.33 kHz as the enabler of civil-military interoperability.

Reversion to GAT considerations

The carriage and operation of 8.33 kHz VHF channel spacing radio communication equipment became mandatory in the ICAO EUR Region in October 1999 for operations above Flight Level (FL) 245. Today, State aircraft which are non-8.33 kHz capable are allowed to operate as GAT within 8.33 kHz airspace, above FL195, providing they are UHF equipped and remain within the capacity limits of the ATM system. However, in some States, the UHF coverage provided by civil ANSPs is limited or not available and non-8.33 State aircraft are handled on remaining VHF 25 kHz assignments.

On 15 March 2007 carriage of 8.33 kHz capable radios became mandatory above FL195 in the ICAO EUR Region. EUROCONTROL was seeking to secure agreement to a revised policy for the handling of non-8.33 kHz equipped State aircraft, taking due account of special considerations pertaining to the military environment but also aiming to maximize the 8.33 equipage of State aircraft in order to alleviate the VHF spectrum problems.

That proposed revised policy has undergone subsequent further review and was taken into account in the work done on the SES interoperability mandate on Air-Ground Voice Channel Spacing. The proposed revised 8.33 kHz policy for State aircraft was included in the Implementing Rule and focuses on the effort to equip mainly 'transport-type' aircraft. This policy is intended to apply to State aircraft conducting IFR flights as GAT in the airspace of 8.33 kHz enforced mandatory carriage in the ICAO EUR Region (i.e. above FL195 since 15 March 2007).

The flights of remaining non-8.33 kHz equipped State aircraft that cannot be retrofitted for a justified compelling reason will be accommodated by the civil ACCs, provided that they can be safely handled within the capacity limits of the ATM system on UHF or 25 kHz VHF assignments.

The UHF infrastructure supporting State aircraft flying GAT should be available in the conditions stated in the Commission Regulation (EC) No 1265/2007 of 26 October 2007 laying down requirements on air-ground voice channel spacing for the Single European Sky.

That regulation envisages in its article 5 that "Air traffic service providers shall ensure that the State aircraft not equipped with radio equipment with 8.33 kHz channel spacing capability can be accommodated, provided that they can be safely handled within the capacity limits of the air traffic management system on UHF or 25 kHz assignments". Possible synergies with military UHF infrastructure might be considered. In addition, military UHF infrastructure will continue to support OAT operations.

Further phases of vertical expansion below FL195 are also under consideration, which adds to the incentive for State aircraft to be equipped with 8.33 kHz radios.

3.3.2 AIR/GROUND DATA COMMUNICATIONS

In the context of minimum capabilities for OAT, air/ground data link communications are not envisaged as an essential requirement to support ATM functions. This matter might have some relevance for State aircraft frequently operating as GAT that might voluntarily equip to avoid reduction of the CPDLC service received. This is not considered a requirement specific of OAT and is only mentioned in this document for the sake of completeness.

On the civil side, the operational improvements introduced to the European ATM Network include the progressive implementation of Controller-Pilot Data Link Communications (CPDLC), through the EUROCONTROL LINK 2000+ Programme, which is driving the introduction of CPDLC for non-time-critical air-ground communications, replacing some voice exchanges in support of an increased level of automation in routine tasks (such as ATC clearances). It is expected that the exemption of State aircraft from a future Link 2000+ mandate will be retained, and that they will be handled with VHF voice radios when operating as GAT within the airspace designated for LINK 2000+ operations. Follow-on data link services will be implemented at a later stage, around 2012, as part of CASCADE activities to complement CPDLC applications (e.g. ADS-B data link to transmit aircraft-derived data for ATC purposes).

As the implementation of ATC data link communications during the coming decade will increase it may have an impact on military ability to operate as GAT when military aircraft have to fly through designated airspace. The full implications of civil data link developments, including the lack of interoperability with military data links should be the subject of a further assessment. A voluntary and phased introduction of early CPDLC capability to a restricted community of large «transport-type» military aircraft frequently operating as GAT might be considered to ensure the same level of service as offered to civil traffic.

A longer term Future Radio System (FRS) resulting from the EUROCONTROL/FAA coordinated efforts (with ICAO) to identify the technology and requirements that will replace analogue voice and data communications by a single digital system is not likely to be available before 2025+.

Annex “B” details the air-ground communication infrastructure requirements for OAT.

3.4 Navigation Avionics Requirements[5]

Baseline Requirement (from 2008)	Transition Requirement (2008-2013)	Long-term Requirement (2013+)
❑ TACAN sustained until 2013 ❑ GPS/INS (later GNSS), Initial availability ❑ Multi-Mode Receiver (ILS, MLS and DGPS)	❑ TACAN complemented by available GPS/INS (later GNSS) ❑ PAR and MMR sustained until PALS	❑ GPS/GNSS+INS (part of ABAS in SESAR), ❑ Multi-Mode Receiver ❑ PALS
See details in Annex B – Avionics Fittings - Navigation		

3.4.1 ALL WEATHER EN-ROUTE NAVIGATION

OAT Configuration

Current NATO doctrine states that allied military aircraft/platforms, in any kind of operation, must be able to operate in all-weather conditions, day or night, or even at low level and also without support from ground-based navigation aids, either as GAT or OAT within controlled airspace, at civil airports or military airfields.

Therefore, the initial baseline airborne equipage that needs to be available in military airframes performing harmonised OAT operations shall, to a great extent, rely on self-contained position fixing and direction capability but, in certain circumstances might have to consider also an external reference. Consequently, the consistency with the available ground navigation aids cannot be ignored in certain States or to certain legacy aircraft with lower navigation capabilities. A conventional ground-based NAV infrastructure, civil and military, including TACAN, VORTAC, VOR/DME and DME/DME will be retained for quite a while to support operations initially as primary means and later as a backup aid of space-based systems.

An initial harmonisation effort should take advantage of available GPS and integrated/hybrid GPS/INS installations on military aircraft. In the timeframe (2008-2013) it is expected that GPS/INS (and GNSS when operational) becomes available in modern military platforms although it must be recognised that some transitional measures have to be considered to accommodate legacy aircraft. This will entail the retention of TACAN still as the primary navigation aid, temporarily, until full GPS/INS capability is achieved.

Consequently, military aircraft operating as OAT need to consider a baseline requirement comprising, as a minimum, an initial transition for the accommodation of legacy aircraft using TACAN together with the gradual availability of more inertial navigation system (INS) with GPS (or GNSS) updates, which is expected to become the primary source of NAV support from 2013.

The harmonisation efforts in this area shall include the promotion of compliance of military GPS equipment with instrument navigation standards and the recognition of the GPS Precise Positioning Service (PPS).

5- Options consistent with the "NATO Strategic Plan for Joint Navigation and Landing Systems".

Reversion to GAT considerations

During the conduct of military training or operations in parallel with civil traffic, within GAT structures, a certain level of compliance or interoperability between the navigation capabilities of military systems and those mandated for the civil GAT airspace uses might be necessary.

The navigation applications requiring a certain navigation performance of the system in terms of accuracy, integrity, availability and continuity of service in certain airspaces, namely Area Navigation (RNAV) or Required Navigation Performance (RNP), at different levels, might have to be demonstrated by a State aircraft that needs to revert to GAT status. The preferred method is to undergo a verification of compliance based on a performance-level approach to prove that equivalent values and functional criteria can be achieved when considering different equipments or sensors that typically equip military airframes.

Long term convergence of civil and military navigation capabilities shall be based on the ICAO endorsed concept of Performance Based Navigation (PBN), as part of the ICAO Global ATM Concept, and proper consideration for the migration to satellite-base navigation as the "sole means" which will achieve 4D RNP RNAV levels and introduce greater flexibility to military operations especially when conducted within GAT structures.

However, as identified in the Interoperability Roadmap, actions need to be taken and processes to be identified to make sure that State aircraft with divergent navigation avionics are accepted as compliant to civil RNAV or RNP requirements provided that it is proved that military systems offer an equivalent or better level of navigation performance.

3.4.2 TERMINAL AIRSPACE NAVIGATION

OAT Configuration

When operating under OAT status within terminal airspace (which may be not well defined in the vicinity of military airfields), in the approach phase, military aircraft will follow procedures that are not very different from the OAT en-route environment and thus Category I or even non-precision approaches are acceptable for that particular phase of flight.

Reversion to GAT considerations

When State aircraft flying as OAT need to revert to GAT within (civil) terminal and approach areas, where stringent civil requirements normally apply (B-RNAV, P-RNAV), special handling of State aircraft with lower navigation capability might be required.

The cockpit HMI used for NAV settings, including those applicable within terminal airspace in the vicinity of civil airports, shall allow a flexible and manual introduction of navigation settings (e.g. "way points" when supported) and supplementary functions when the airborne FMS computer does not exist or does not support the automatic loading of navigation data base information. Consequently, proper actions are required to enable State aircraft operating as GAT to fly SIDs and STARs with requirements different than those prescribed by JAA TGL 10, where the automated availability of a proper database is required.

Also in that TMA context the re-use of different equipage fits that can frequently be found in military aircraft shall also be enabled by the determination of a performance based verification of compliance. That does not exclude, for the medium/longer term, that the advent of GNSS solutions and its augmentations (e.g. SBAS/EGNOS, GBAS, DGPS) is not used in military airframes as a means to improve the operational performance.

3.4.3 APPROACH AND LANDING

OAT Configuration

Operating as OAT, approach and landing at military aerodromes is frequently supported by a Ground Controlled Approach (GCA)/Military Approach (APP) enabled by a Precision Approach Radar (PAR), which does not require any particular equipage on the airborne side. In the medium term (2008-2013) PAR capability has to be sustained at least until the arrival of a single system after the PALS transition. In this period Multi Mode Receiver (MMR) integration in some military aircraft will still be ongoing in order to fulfil interoperability requirements.

In the longer term (2013+) the foreseeable evolution in the civil aviation community will dictate the technology selected for PALS. The fast introduction of MMR in military aircraft, with the availability of ILS, MLS and DGPS, will facilitate a smooth transition until the determination of a long-term solution and will suffice for operation within OAT structures.

Reversion to GAT considerations

The main driver of future (military) PALS will be the need for commonality with civil satellite-based GNSS infrastructure. The implementation of MMR will ensure, to a certain extent, civil-military interoperability in terms of landing capability. The development of common standards and equivalent verification of compliance might be required to ensure the compatibility between military GPS (DGPS) receivers and civil Ground–Based Augmentation Systems (GBAS).

Annex “B” details the navigation infrastructure requirements for OAT.

3.5 Surveillance Avionics Requirements

Baseline Requirement (from 2008)	Transition Requirement (2008-2013)	Long-term Requirement (2013+)
❑ SSR Mode A+C Airborne Transponder	❑ SSR Mode A+C Airborne Transponder ❑ SSR Mode S Airborne Transponder from 31 March 2009	❑ SSR Mode S Airborne Transponder from 31 March 2009 ❑ Advanced SUR techniques (TBD)
See details in Annex B – Avionics Fittings - Surveillance		

OAT Configuration

The availability of a an airborne transponder in military aircraft conducting OAT operations is critical to ensure that they are visible to the ground-based surveillance system in a way that enables civil or military ATC to perform the appropriate traffic separation functions.

For the foreseeable future, SSR Mode S will be the main operational improvement of the en-route surveillance infrastructure being implemented within core Europe as dictated by the need to cope with the shortage of Mode A codes. Mode S is intended to alleviate the RF pollution and garbling, introduce selective identification of flights and use a set of downlink airborne parameters (DAPs) to enhance ATC functions.

State aircraft will have to be equipped with ICAO Annex 10 Mode S transponders by 31 March 2009 as determined by the harmonised Mode S Transition Arrangements for State aircraft as supported by the EUROCONTROL Provisional Council. All State aircraft flying in Mode S Elementary Surveillance (ELS) designated airspace will have to be ELS compliant. Most transport-type State aircraft will have to comply with additional Mode S Enhanced Surveillance (EHS) requirements in the Mode S EHS designated airspace.

Considering the huge military fleets and the difficulties in retrofitting all aircraft by the agreed date in face of procurement or end-of-service constraints, access to the Mode S (designated) airspace after the final compliance date will be granted by the Regulatory Authorities whenever possible but only to those State aircraft operators who submitted their Mode S airborne equipage plans to them for approval. A procedure to support access to Mode S airspace will be developed for this end. State aircraft operators are encouraged to equip their fleet intending to use the airspace of the Mode S implementing States. It should be noted that a large number of States neighbouring the Mode S area are installing Mode S radars as well and will probably become part of Mode S airspace in the medium term.

From 31 March 2009 the widespread use of Mode S airborne transponders dictated by IFR/GAT requirements can be used in the OAT context as an excellent means to ensure compatibility with available legacy ground infrastructure, even outside the Mode S area[6], due to the backwards compatibility with Mode 3/A and, at the same time, ensure compliance to modern Mode S interrogators where available. An important aspect is to ensure the permanent availability of SSR codes taking into account ORCAM/CCAMS developments.

Airborne surveillance/identification requirements dictated by military wartime requirements, like IFF Mode 5, are not considered in the peacetime ATM context of OAT although such transponders should be backwards compatible/interoperable with civil SSR Mode 3/A and Mode S.

Reversion to GAT considerations

For the longer term when State aircraft operate within GAT structures it might need to be taken into consideration that State aircraft will operate within a highly automated environment. Here multiple surveillance techniques will coexist (e. g. Multilateration, PSR, SSR, ADS-B, TIS-B) and then aircraft frequently operating as GAT might consider the need to equip with airborne data link, CDTI or other avionics required to support advance surveillance features like ADS-B. For the moment possible impacts of such developments are not considered in respect to OATTS.

Annex “B” details the surveillance infrastructure requirements for OAT.

6- ELS - Belgium, France, Germany, Luxembourg, the Netherlands, Switzerland and the United Kingdom. EHS - France, Germany and the United Kingdom.

3.6 Other Requirements

A number of other civil avionics requirements exist within the ICAO or EUROCONTROL frameworks. They are not considered as baseline requirements for harmonised OAT operations because for all these requirements there might exist alternative or fall back features that allow the dispensation of such requirements.

However, some of these avionics might impact the operation of State aircraft when operating as GAT, when landing at civil airports or when mixed mode operations oblige to consider them because of safety assurance reasons. Civil-military interoperability criteria have not been defined in the Roadmap in relation to this outstanding set of requirements.

Consequently, the national regulations in force shall be consulted each time the mission is planned in a way that status of the flight, airspace/routes or airports considered may suffer a constraint or impact by any mandate in this area.

The following avionics requirements are considered to be included in this category:

- **Airborne Collision Avoidance System (ACAS)** – In addition to TCAS interactivity (RA) many military airframes have alternative means to get equivalent situational awareness;
- **FM Immunity** of VOR and ILS receivers and other VHF avionics – wide introduction of filters and Multi-Mode Receivers (MMR) are expected as the mitigating measure;
- **Reduced Vertical Separation Minima (RVSM)** – Exemption for State aircraft in place;
- **Enhanced Ground Proximity Warning System** – Applicability to State aircraft not defined;
- **Flight Data Monitoring** - Applicability to State aircraft not defined;
- **Emergency Locator** - Applicability to State aircraft not defined.

4. Transitional Provisions

4.1 General

Considering that the present requirements are applicable in the support of the harmonisation efforts to implement a set of Pan-European rules for OAT and a seamless OAT Transit System they will have to be considered in parallel with related developments within the EUROCONTROL HORGI Task Force.

For that reason it was considered appropriate that the following timescales* apply:

- Baseline requirements - those to be considered from 01 January 2008;
- Short to medium-term requirements - those to be in place in the timeframe 2008 to 2013;
- Long-term requirements - those applicable from 2013 onwards.

2008

In the beginning of 2008 the situation in Europe, respecting ATS provision, will still remain highly fragmented on the civil and military side. The infrastructure available to support ATM services will still be not homogeneous within the region and the organizations/structures in place to ensure civil-military coordination will vary from State to State comprising various arrangements like fully integrated civil-military ATS, civil ATS comprising a co-located military position or separated provision of civil and military ATS.

For the time being it has to be accepted that the ground CNS infrastructure differs from State to State and that the handling of OAT traffic can only be ensured by verifying in the national Aeronautical Information Publications (AIPs) which resources are available in a certain geographical area and whether they match the particular avionics suite of a State aircraft.

2008 - 2013

Until at least 2013 some sort of “country chapters” may have to be derived from States’ AIPs as required to support transitional aspects of ground infrastructure and military aircraft equipage to cope with different infrastructures available in different States.

No immediate retrofit actions (additional to those already ongoing: 8.33 kHz and Mode S) are due to be considered as a direct consequence of the requirements foreseen in this document. Alternatively, aircraft with lower capability will be handled on the basis of special handling, exemptions or other mitigating measures at least until 2013.

However, modern military aircraft are supposed to be initially equipped, as a minimum, with the baseline requirements identified for OAT while certain transitional capabilities are to be considered as described earlier in this document.

2013+

For the longer term it is expected that the harmonisation provisions contained in this document and in the “Civil-Military CNS/ATM Interoperability Roadmap” and SESAR Technology Assessment will contribute to rationalise the ground infrastructure and to create synergies and complementarities between the civil and military resources. Therefore, for beyond 2013 it should be possible to benefit from a reasonably harmonised seamless infrastructure on the ground with ATS provision being ensured by either civil or military units.

*- These dates are just indicative and must be reniewed when considered in the context of the SESAR Master Plan

On the airborne side, the main transitional difficulties will relate to the different levels of avionics equipage that characterise different military fleets. Until the completion of most actions required to raise civil-military interoperability as foreseen in the roadmap, it will be necessary to verify whether legacy aircraft are equipped in a way that enable its accommodation with the available level of ATS service.

When reverting to GAT operation and for the introduction of long-term civil-military interoperability measures it is considered appropriate to observe the contents of the "Civil-Military CNS/ATM Interoperability Roadmap", SESAR requirements and follow on implementation details.

4.2 Information Supporting Transition/Way Ahead

The contents of national civil and military AIPs or other national official documents are the source to be considered for determining the information required to ensure the appropriate selection of the CNS infrastructure option suitable to accommodate military OAT operations within each State and for each particular type of military airframe.

The development and maintenance of "country chapters" might be required until all baseline and short to medium term avionics requirements and consistent ground infrastructure elements are achieved. A new supporting document, entitled "States Information Supporting CNS Requirements for OAT", with such national details will have to be elaborated as a follow up of the present document.

This information will be collected from national Military Authorities concerned or by collating the information available in AIPs when required to support the practical implementation of the mechanisms enabling seamless Pan-European operations.

The development of such "country chapters" is, for the moment, left outside the scope of the present document and shall be considered as a CNS-related support measure.

Those "country chapters" shall be consistent with the principles and concept contained in this document and shall describe for each ECAC State the availability (civil and military) of all the ground infrastructure elements listed before in terms of its geographical location, coverage and ATC use,

Another stand alone follow on action is a generic survey of the levels of CNS equipage of the main State aircraft fleets. It shall be conducted to assess gaps in terms of avionics capability.

5. Conclusions and Recommendations

Supporting the HORGI Task Force harmonisation efforts to develop Pan-European rules for OAT and a seamless OAT Transit System implies for ATM and CNS planners and procurement organisations the close consideration of the minimum CNS infrastructure required to be in place by a certain timeframe.

They should be able to mitigate, to the extent possible, the fragmented situation in terms of European ATS provision and lack of proper equipage available in legacy military aircraft.

The guidance contained in this document is proposed as a reference to be used to facilitate convergence with the Civil-Military CNS/ATM Interoperability Roadmap and with the SESAR Technology Assessment.

Annexes

Annex A

Ground Infrastructure

Capability	Capability	Fragmentation Considerations	Evolution Roadmap
Ground-ground COM (Flight Data, FPL, AIS, Meteo)	AFTN/CIDIN Terminals and X.25 inter-centre point to point circuits	Civil ANSPs networks provide AFTN/CIDIN remote terminals to military ATS and AD units. Inter-centre Flight Data supported with X.25	From 2009 AMHS over IP networks and replacement of X.25 by IP (as mandated by FMTP SES IR)
Ground-ground COM (Inter-centre voice)	Dedicated or PSTN telephony circuits	Civil ANSPs implementing R2, ATS/QSIG or VoIP.	Long term: Voice over IP
Air-Ground Voice (Ground radio sites)	Civil or military radio sites (VHF and UHF)	Civil ANSPs provide VHF 8.33 kHz as the ICAO standard. Civil and military ANSPs of NATO western States retain UHF provision. Some civil ANSPs do not provide UHF but keep VHF 25 kHz channels to handle non 8.33 kHz State aircraft. Military ATS units provide VHF 25 kHz (off-route) channels to support OAT.	VHF 8.33 kHz expanded and implemented by civil ANSPs (from 2007 above FL195) Residual UHF and VHF 25 kHz kept
SUR Infrastructure	PSR and/or SSR	Aerodrome Surveillance Radars (PSR) and SSR in most military airbases. Military en-route PSR widely available. Mode S being introduced in the core area. Civil provision including PSR and SSR for TMAs and double SSR for en-route. Mode S introduced in the core area.	Radar, including Mode S, will remain the primary means Other techniques introduced (Multilateration, ADS-B)
En-Route NAV Infrastructure	Increasing GNSS capability and ground NAVAIDS (TACAN, VOR/DME, DME/DME)	Airborne self-contained NAV features (INS+GNSS/GPS) have to be used based on equivalent performance levels. Ground NAVAIDS are backup when matching airborne fittings (TACAN, MMR).	From 2013 performance-based RNP RNAV based on GNSS/GPS solutions with fall back options
Approach and Landing	PAR and Ground NAVAIDS (supplementary)	GCA/PAR in military airfields as NATO interim precision approach system. Military use of GPS/PPS and MMR (ILS, MLS, DGPS). Mix of ILS, MLS and DGPS/GBAS/SBAS at civil and military airfields.	From 2013 Cat I GNSS/GPS solutions (including augmentations) Future NATO PALS (MLS, DGPS)

Annex B

Avionics Fittings - Communications

Capability	Baseline Requirement (01JAN2008)	Area of Applicability	Handling of State aircraft with the Requirement	Criticality of the Requirement	Evolution Roadmap
UHF Com. 25 kHz (Off and En Route)	Multichannel transceiver in accordance with adequate specification	Wherever provided by civil or military ATS	To be used when handling OAT flights or GAT flights conducted by non-8.33 kHz State aircraft within the area of 8.33 kHz mandatory carriage	Essential	Retained while it remains a military standard to support ATC and as needed to accommodate non-8.33 kHz military airframes
VHF Com. 8.33 kHz	2 Sets of AM DSB VHF transceivers - 8.33 KHZ channel spacing	Above FL 195 in most ECAC States from 15 March 2007	UHF-equipped State aircraft not equipped with an 8.33 kHz channel spacing capable radio will still be allowed to operate as GAT in the airspace designated for 8.33 kHz channel spacing operations	Essential	It will be the long term ICAO standard likely to be further expanded below FL195. It will serve as the civil-military interoperability enabler.
VHF Com. 25 kHz (En Route)	2 Sets of AM DSB VHF transceivers - 25 KHZ channel spacing (Note 1)	Below FL195 and elsewhere not covered by UHF or 8.33 KHZ	To supplement UHF or VHF 8.33 when suitable infrastructure is not available or when State aircraft are not equipped	Recommended	To be progressively reduced as 8.33 kHz expands
VHF Com. 25 kHz (Off Route)	Multichannel transceiver in accordance with adequate specification	To support OAT provision by military ATS and at military airfields	To supplement UHF when suitable infrastructure is not available or when State aircraft are not equipped and for airfield services	Recommended	No plans are known

Avionics Fittings - Navigation

Capability	Baseline Requirement (01JAN2008)	Area of Applicability	Handling of State aircraft with the Requirement	Criticality of the Requirement	Evolution Roadmap
All Weather En-Route Operations - Conventional or RNAV-RNP.	TACAN/VORTAC	Where available in the support of military ATS	In some States TACAN routes can be used as required to handle OAT flights of State aircraft not yet equipped with INS/GPS	Recommended	Transitional capability until wide availability of INS/GPS in military aircraft.
	Inertial Navigation System (INS) with GPS (or GNSS) updates ABAS in SESAR	Independent from local infrastructure	Self-contained feature that enable operational flexibility when operating as OAT although compliance with additional provisions might be required when operating as GAT	Essential	Expected to become primary navigational aid for NATO as from 2013+ Equivalent compliance with civil navigation performance to be pursued

Capability	Baseline Requirement (01JAN2008)	Area of Applicability	Handling of State aircraft with the Requirement	Criticality of the Requirement	Evolution Roadmap
Terminal Airspace (TMA) (Arrival/ Departure)	Way Points/ Conventional SID and STARs	Civil TMAs	Special handling with available avionics and later equivalent performance.	Recommended	Migrate to Performance-Based Navigation
	RNAV-RNP SIDs and STARs	Civil TMAs	Special handling with available avionics and later equivalent performance.	Recommended	Migrate to Performance-Based Navigation
Approach and Landing	Approaches with GCA/PAR	Military airfields	No airborne avionics required	Recommended	Transition to future PALS
	Multi-Mode Receiver (MMR) (ILS, MLS, DGPS)	Civil and military airfields	Seamless OAT operations and compliance with ILS, MLS or GBAS requirements at civil airports	Essential	Single system to be determined in the context of future PALS

Avionics Fittings - Surveillance

Capability	Baseline Requirement (01JAN2008)	Area of Applicability	Handling of State aircraft with the Requirement	Criticality of the Requirement	Evolution Roadmap
SSR Mode A+C (Surveillance with altitude reporting)	Airborne transponder in accordance with ICAO Annex 10.	For IFR/ GAT, and for VFR/OAT in “designated national airs-pace”	State aircraft are to be mandatory equipped	Essential	Transition to a full Mode S environment
SSR Mode S (Elementary Surveillance)	Airborne transponder in accordance with ICAO Annex 10 Amendment 77.	Within Mode S ELS designated airspace of the imple-menting States	Applicable to all State aircraft by 31 March 2009 operating as OAT and/or GAT in accordan-ce with EUROCONTROL “Harmonisation of the Transition Arrangements for State Aircraft”	Essential	It will become the primary civil SUR requirement. To be considered in conjunction with the military standard IFF Mode 5.
SSR Mode S (Enhanced Surveillance)	Airborne transponder in accordance with ICAO Annex 10 Amendment 77.	Within Mode S EHS designated airspace of the imple-menting States	Applicable to DAP capable transport-type State aircraft by 31 March 2009 operating as GAT/ IFR in accordance with EUROCONTROL “Harmonisation of the Transition Arrangements for State Aircraft”	Essential	

Notes: (1) The VHF (R) and VHF (OR) Bands are generally operated by the same radio set.