

# White paper on performance-based certification of military airborne systems to meet civil ATM/CNS requirements

**Civil-military ATM coordination division**  
**Communications-Navigation-Surveillance unit**


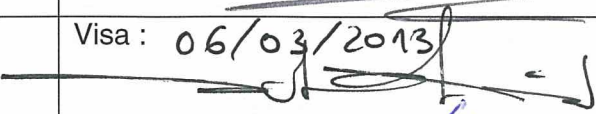



**WHITE PAPER ON  
PERFORMANCE-BASED CERTIFICATION OF MILITARY  
AIRBORNE SYSTEMS TO MEET CIVIL ATM/CNS  
REQUIREMENTS**

Civil-military ATM coordination unit / Communications-Navigation-Surveillance unit

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## EXECUTIVE SUMMARY

Certification is one of the processes used to manage and ensure common and harmonised safety levels in aviation.

In the Single European Sky (SES) regulatory framework, systems have to be certified to be deemed interoperable.

In most countries, the military have the power to certify their systems in their own certification environment. The military processes are mostly unknown to the wider international civil aviation community, they suffer from a lack of consistency/harmonisation between the various military authorities, and documentation is sometimes restricted in nature. Because of these issues, this situation results in uncertainty about the validity of these processes when considered at the civil regulator's side.

In addition, SES interoperability requirements are sometimes not covering specific military requirements because of a lack of coordination between civil and military authorities during the drafting phase of the regulations.

Where such a situation occurs, it ultimately leads to a loss of air operations effectiveness and to shortcomings in terms of capacity, performance and safety.

Several previous documents, statements and studies pointed out the need for a certification environment based on performance levels for military aviation to comply with civil ATM/CNS requirements. In this document, performance means "the manner in which something reacts or fulfils its intended purpose"<sup>1</sup>. It does not refer to any economic efficiency unlike it is nowadays often used in new ATM regulation.

The objectives of this *White paper on performance-based certification of military systems to meet civil ATM/CNS requirements* are:

- To contribute to the development of national certification processes which will use technical performance levels as a basis
- To propose an alternative to equipage derogations or exemptions as regards ATM/CNS compliance which result in reduced airspace capacity for all airspace users
- To provide additional options for military operations planners generated by aircraft certified in a way which meets ATM/CNS requirements
- To provide a common and harmonised process for performance-based certification

In this document, the performance-based certification (PBC) concept addresses the requirements for the certification of airborne systems.

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<sup>1</sup> Webster's encyclopaedic unabridged dictionary of the English language (1993), p 1439

## 1. INTRODUCTION

### 1.1 Background

Military aviation needs to have unrestricted access to controlled airspace where mixed mode operations occur on a permanent basis, in peace time and in times of crisis or conflict, sometimes in very dense civil traffic areas. The trend towards a decrease in military flights is offset by the increase in civil traffic in Europe, despite the economic downturn, and the need for less numerous but larger military training areas.

Flying in a mixed-mode environment alongside civil airspace users in controlled airspace is becoming more and more difficult for State aircraft, which are not able to prove their compliance with the civil regulations. Such compliance is demonstrated through a certification process which encompasses operational approval and a technical compliance assessment.

Safety of flight operations is always a concern for civil and military authorities. Civil airspace users and air navigation service providers (ANSPs), together with manufacturers of civil aviation products and maintenance organisations, must apply strict regulations and certification processes to achieve a high level of safety in aviation operations. In this context, the military authorities apply the same principles which have guided civil aviation for decades. Certification is required for several ATM/CNS-mandated equipments, constituents or systems. All airspace users have to prove that they are and will remain compliant with the applicable regulations; in this way, the competent supervisory authorities can be sure that the safety objectives<sup>2</sup> are met in designated airspace volumes for any aerial-related activity.

Certification is a very common process used in many civil activities to prove safety or operational capability. It is also very common in civil aviation that some requirements are met by civil aircraft or airspace users, and this is demonstrated through certificates issued by a competent authority for the system, the crew or the component after undergoing a process known, understood and recognised by all the actors. In certain cases, regulations may allow delegation of the ability to sign certificates to recognised organisations<sup>3</sup>.

Military aviation has acknowledged the importance of certification for more than a decade, and is building up and refining national and/or common processes in order to prove – to the national Ministries of Defence and to the whole aviation community - that their flying activity is safe. Even where they seem similar to civil flights, military missions encompass a large variety of operations. Specific conditions of operation impose a specific design for military systems.

Military aircraft use systems which are often subject to security measures or may have no equivalent in civil aviation. For airborne systems, vibrations, aggressive environments or high “g” constraints, together with the need for specific standardisation materials, sometimes prevent constructors from using commercial off-the-shelf equipment or architecture. It is therefore very difficult for the military to make their case and to prove compliance by using civil means or processes which show that their systems meet civil requirements, even though they are safe for other airspace users and meet the required performance.

Some military functionalities or mission requirements are unknown to civil aviation and they are intertwined with the communication and navigation system architecture. The required performance of a military ATM/CNS system might match the required civil performance, but the way it is designed is so different from the civil architecture – and some parts may be

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<sup>2</sup> E.g. pursuant to AMC in EASA CS§25.1309 for large aeroplanes.

<sup>3</sup> E.g. in the EASA regulatory framework, approved design organisations (DOA) may enjoy the privilege of directly approving minor changes, while holders of ETSO authorisation may place a label and sign ‘form 1’, which is a declaration of conformity, whenever they dispatch an aircraft part.

subject to security measures – that some civil requirements are simply not applicable to those systems, especially those relating to the system architecture.

The way of reconciling civil ATM/CNS safety requirements and military mission requirements is sometimes summarised by “as civil as possible, as military as necessary”. This pragmatic approach is not designed to get rid of the safety objectives, but to state that military aviation has a number of specific characteristics that must be taken into account, especially when certification is involved.

Training flights and military operations conducted by State aircraft and the airframes used for them are outside the scope of the Chicago Convention<sup>4</sup> and, in the European Union, outside the scope of the EASA<sup>5</sup> certification processes. In most European States national legislation grants military authorities the privilege of certifying their systems according to their own rules and processes.

The military processes are mostly unknown on the civil side, they suffer from a lack of consistency/harmonisation between the various national military authorities and technical documentation is sometimes classified. Certification processes are also in most cases not open or published. Because of such issues, this situation creates uncertainty and does not promote trust from the civil side as to the validity of these processes from their perspective. Military certificates are sometimes not fully trusted by the civil players not because their legal basis is questioned but because of a lack of trust.

In addition, civil mandated ATM/CNS systems are sometimes not possible to implement by the military because of technical mismatches or an initial lack of coordination between civil and military authorities during the drafting phase of the regulations when these are prepared without extensive military consultation. A recurrent consequence of this situation is the need for the civil ANSPs to handle State aircraft under general air traffic (GAT) rules, applying “exemption policies” and derogations with all the problems this creates in terms of increased ATC workload, capacity reductions and safety concerns.

SESAR, the ATM infrastructure modernisation programme of the Single European Sky, aims to provide the technical and operational options for the implementation of the future Single European Sky to the whole community of users, including military aircraft operators. For the implementation of the selected options, technical standards will have to be created or updated. They will form one of the bases for SES interoperability which is made possible through the certification of systems.

ATM/CNS systems will have to follow these standards, specifications or requirements to meet the objectives of time-based and trajectory-based operations. But the evolution of military systems is costly and sometimes impossible because of the high integration of mission functionalities at system level.

The military certification processes are now deemed mature enough to avoid “exemption policies” as the first option when meeting future ATM/CNS requirements. Certification focusing on the actual performance levels required by a regulation is to be explored as a solid alternative to the current situation.

## **1.2 Purpose and scope of the document**

The Civil-Military Air Traffic Management Coordination Division (CMAC) within EUROCONTROL Directorate Single Sky (DSS) is responsible for proposing solutions supporting civil-military interoperability. CMAC is developing a certification framework concept which is intended to provide guidance to the national military aviation authorities proposing ways to certify their systems against ATM/CNS regulations for mandated systems.

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<sup>4</sup> Article 3 thereof.

<sup>5</sup> Article 1.2 of EC Regulation 216/2008, most recently amended by Regulation 1108/2009.

That guidance gives precedence to the performance of existing military systems, paying less consideration to the required equipment and to the system architecture as required in some civil regulations or prescriptive standards.

In this document, *performance-based certification* (PBC) refers to such certification processes.

The objectives are:

- To contribute to the development of certification processes which use performance as a basis for certification
- To propose an alternative to derogations or exemptions, which reduce airspace capacity for all airspace users and have a detrimental effect on safety
- To provide additional options for military operations planners generated by certified aircraft
- To provide/propose a common and harmonised process for performance-based certification

This document does not deal with certification based on *performance standards and regulations*. Its goal is to contribute to the provision of an alternative means of certifying in certain cases against civil regulations or prescriptive technical ATM/CNS standards where some of their technical requirements are not strictly followed but performance and safety levels are.

The concept described in this document applies to airborne systems. The systems or functions which do not have either EASA 'Form 1'<sup>6</sup> or a DoC (declaration of conformity) provided by the manufacturer and those which are not covered by the conformity assessment guidance material<sup>7</sup> published by EUROCONTROL are within the scope of this document.

As stated in EASA's Basic Regulation 216/2008, amended by Regulation 1108/2009, although this Regulation does not apply to military aircraft when carrying out a military activity (Article 1<sup>8</sup>), "*Member states shall undertake to ensure that such activities or services have due regard as far as practicable to the objectives of this Regulation*". Two of the objectives defined in Article 2 of this Regulation are to promote a uniform level of safety and cost-efficient certification processes<sup>9</sup>.

This white paper is proposed as a performance-based certification concept supporting a uniform level of safety vis-à-vis civil-military ATM/CNS mandated systems applied to military aviation; it will address the implementation of such certification by the competent national certification authorities for military systems. It defines a conceptual approach for a harmonised performance-based certification.

The present white paper does not question the States' prerogative to carry out certification or conformity assessment activities. Its goal is to ensure progress on an action identified in many European documents and studies but still outstanding.

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<sup>6</sup> Article 6a (alternative verification of compliance) of Regulation (EC) 552/2004 establishes that a certificate issued in accordance with Regulation (EC) No 216/2008, where it applies to constituents or systems, shall be considered, for the purposes of Articles 5 and 6 of Regulation 552/2004, as an EC declaration of conformity or suitability for use, or as an EC declaration of verification, if it includes a demonstration of compliance with the essential requirements of Regulation 552/2004 and the relevant implementing rules for interoperability.

<sup>7</sup> EUROCONTROL guidelines on conformity assessment for the interoperability Regulation of the single European sky (EUROCONTROL-GUID-137 edition 3.0 20/02/2012)

<sup>8</sup> This Regulation (216/2008 amended 1108/2009) shall not apply to: (a) products, parts, appliances, personnel and organisations referred to in paragraph 1(a) and (b) while carrying out military, ... activities or services. (c) ATM/ANS, including systems and constituents, personnel and organisations, referred to in paragraph 1(e) and (f), which are provided or made available by the military.

<sup>9</sup> Article 2 Objectives 1. The principal objective of this Regulation is to establish and maintain a high uniform level of civil aviation safety in Europe. 2 (c) to promote cost-efficiency in the regulatory and certification processes and to avoid duplication at national and European level;

Due to the nature of the present document, it was decided to consider it as a non-ERAF (EUROCONTROL Regulatory Advisory Framework) document. The specific format and non-consultation options derive from this non-ERAF nature. It is published without prejudice to its perusal by military organisations.

### 1.3 Acronyms

Acronym	Description
AD	airworthiness directive
AMC	acceptable means of compliance
ANSP	air navigation service provider
ATC	air traffic control
ATM/CNS	air traffic management / communications navigation surveillance
CMAC	Civil-Military ATM Coordination Division
CS	certification specification
CAMO	continuing airworthiness maintenance organisation
DoC	declaration of conformity
DSS	Directorate Single Sky
EASA	European Aviation Safety Organisation
ERAF	European regulatory and advisory framework
ETSO	European Technical Standard Order
FAA	Federal Aviation Administration
FRD	functional requirements document
GAT	general air traffic
GPS	global positioning system
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
MASPS	minimum aircraft systems performance specification
MoC	means of compliance
MoD	Ministry of Defence
NSA	national supervisory authority
OAT	operational air traffic
PBC	performance-based certification
PPS	precise positioning signal
R&D	research and development
RVSM	reduced vertical separation minima
QRA	quick reaction alert
SAR	search and rescue
SES	single European sky
SESAR	SES ATM Research
STC	supplemental type certificate
TC	type certificate
TGL	temporary guidance leaflet

### 1.4 Supporting documents

Many previous documents and studies pointed out the need for certification based on performance for military aviation:

**“Civil military CNS/ATM interoperability roadmap ed. 1.0” (EUROCONTROL 2006)**

The civil-military CNS/ATM interoperability roadmap (being updated at the moment) is intended to contribute to improve the effectiveness of existing and new mechanisms, criteria and structures for enhancing civil-military cooperation and coordination.

Civil-military interoperability requires some form of harmonized approach rather than purely national ones.

Within the EUROCONTROL institutional framework, a civil-military regulatory initiative is required in order to put in place the mechanisms to run a certification process, or equivalent, for military systems, with a view to obtain the recognition of some level of ICAO/MASPS capability. The level of accuracy should be expressed in terms of performance capability independently of supporting avionics or ground infrastructure.

**“Proposals for the improvement of European civil/military ATM cooperation under the SES” (DG TREN 2008)**

Equipping State aircraft with additional avionics is very costly for the military and even infeasible due to payload or cockpit restrictions. Many airborne and ground based CNS/ATM systems can achieve equal or superior performance to civil systems, and it is the performance requirement that should be emphasised in the standard or specification, not the particular piece or type of equipment.

**“Minimum CNS infrastructure and avionics equipage for the support of OAT harmonisation” (EUROCONTROL 2008)**

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.

**“Feasibility studies on the integration of military ground and aircraft systems in the context of the SESAR concept and architecture” (ALTRAN 2008)**

(The studies) concluded that there is a lack of interoperability between military avionics and SESAR infrastructure due to the fact that military combat aircraft are essentially weapon platforms whose equipage priorities are decided in accordance with specific military mission requirements. The consequence is an evident capability mismatch that needs to be overtaken ... by following a performance-based approach that enables available military systems to be re-used to support SESAR ATM functions.

**“Deliverable D5: Report on the case study – EUROFIGHTER TYPHOON and Airbus A400M” (FDC 2008)**

The common application of civil AMC and military requirements creates difficulties in... areas which are fundamental for PBN<sup>10</sup>:

Sensors: the civil navigation framework logically restricts the eligible sensors to those in use on civil aircraft. Military specific sensors cannot be used for civil navigation since there is no military AMC or standard proving their equivalency to civil eligible sensors in terms of performance, functions and safety.

... (For A400M) Despite its efficiency with regard to civil certification and military qualification, the segregation of both types of GPS seems complex and likely adds to costs. Such complexity could be avoided if it has been possible to get a civil approval of a GPS PPS receiver for IFR flight possibly through Equivalent Safety Findings part of the aircraft civil certification basis.

**“Initial study to determine feasibility of navigation equivalent verification of compliance for State aircraft against ATM navigation standards” (FDC 2009)**

It is noticeable that regarding the navigation function there is no military equivalent to the TGL or AMC to support the certification of military navigation systems. When compliance with civil navigation functions is requested, the regulations recommend the use of EUROCAE

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<sup>10</sup> Performance-based navigation

and RTCA standards although the applicability of such standards to military specific equipment is in the vast majority of cases impossible. In the area of regulatory material and processes for civil-equivalent military certification, the demonstration of equivalent compliance to civil requirements for safety and performance should be investigated.

**“Outcome of the Global Air Traffic Management Forum on civil/military cooperation in Montréal 19-21 October 2009” (ICAO 2009)**

*The participants in the Forum, both civil and military, achieved a clear consensus expressing a desire to work together for the mutual benefit of all airspace users through a process of cooperation, collaboration, commitment and trust. Maintaining the level of safety and security in the airspace is the basis for this cooperation. The military expressed that they preferred performance requirements over equipage requirements. It was concluded that civil and military requirements can meet provided there existed a will and mutual understanding between both communities.*

**“Task force for supporting the Commission in defining a deployment strategy for the SES technological pillar” (European Commission 2011)**

*The standards are also a key input to the certification process, which has to be based on performance of the equipment and not on the equipment itself. With this approach it would be much easier and less costly to integrate the military, as their equipment might provide an equivalent level of performance, and the production of standards would be enhanced if civil and military standards were harmonized at the earliest opportunity.*

**“Civil-military cooperation in Air Traffic Management” (ICAO circular 330 March 2011)**

*Existing civil standards and specifications are adequate to support technical compliance of civil CNS/ATM systems but tend to overlook the specific characteristics of available military CNS/ATM systems. To enable solutions that would promote civil/military interoperability, States should ensure that such specifications respond to the fulfilment of defined performance levels, using multiple means of compliance, rather than mandating particular equipage fits.*

In addition, ICAO Circular 330 promotes the idea that military systems do not necessarily comply with the equipage fit requirements which are mandatory for civil aviation. They then need to develop appropriate means of compliance which demonstrate fulfilment of the performance required by the standards and specifications.

This white paper will support those requests until such time as the standards and specifications in aviation take into account both civil and military requirements or until ATM/CNS requirements are based solely on performance.

In this document, “Certification” also covers operational approvals, which are equally the responsibility of the competent military authorities.

## 2 INTRODUCTION TO THE *PERFORMANCE-BASED CERTIFICATION CONCEPT*

### 2.1 Background

#### **Definition of performance in this document**

In this document, performance means “the manner in which something reacts or fulfils its intended purpose”. It does not refer to any economic efficiency unlike it is nowadays often used in new ATM regulation.

Focus is given to technical performance which must be understood in a wide sense.

Technical performance encompasses (non-exhaustive list):

- functionality
- accuracy
- integrity
- continuity
- availability
- latency
- safety targets

#### **State aircraft**

“State aircraft” is an international term designating “*aircraft used in military, customs and police services*”<sup>11</sup>. Moreover, “*the contracting States undertake, when issuing regulations for their state aircraft, that they will have due regard for the safety of navigation of civil aircraft*”<sup>12</sup>.

In the European Union the same principle is established by Art. 1.2 of the EASA Basic Regulation. It should be noted that even if an aircraft is on the civil register and/or operated by a civil operator, when its flight services are contracted by a military or governmental (public) non-military entity (e.g. civil protection or police), the aircraft becomes a State aircraft during the related missions.

Some State aircraft airframes are in fact type certified or even registered as civil airframes. In this case they are designed, equipped and maintained<sup>13</sup> just like any other civil aircraft, but other civil regulations (e.g. relating to the aircraft operator) may not apply.

Therefore, these aircraft usually have a type certificate from the competent civil authority<sup>14</sup> and are initially considered as civil aircraft from the certification point of view even though the operator is military and during the flight the aircraft becomes a State aircraft. In order to maintain continuous airworthiness, the military must use the required service bulletins, airworthiness directives (AD), etc. under their authority.

The military should be aware that modified civil types must be certified as such through the appropriate procedures, including the publication of supplemental type certificates (STC) or changes to the TC whenever necessary.

But most State aircraft - particularly military aircraft – are not designed by reference to civil airworthiness codes, certification specifications or ETSO standards. They are primarily designed to perform State missions in an operational environment that is fundamentally different from the civil aviation environment; they have secure and highly integrated systems meeting war theatre requirements. As a consequence, the evolution of these systems is

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<sup>11</sup> Chicago Convention, Article 3 Section (b)

<sup>12</sup> Chicago Convention, Article 3 Section (d)

<sup>13</sup> The maintenance of such airframes is usually outsourced.

<sup>14</sup> e.g. the restricted type certificate (RTC) for the Airbus A400M aircraft, issued on 3 May 2012 by the European Aviation Safety Agency (EASA)

expensive and complex. In addition, the application of civil regulations to some military aircraft is sometimes impossible because of the system architecture. The timeframe required by military aviation to retrofit their aircraft is sometimes not compatible with the civil aviation roadmaps.

However, the avionics architecture in civil aviation is normally left to the designer and not mandated by specific rules. On the other hand, military aircraft, even if not carrying too much equipment for ATM/CNS functionalities as mandated for civil aviation, are nevertheless capable of navigating with certain levels of accuracy and integrity, and of exchanging digital information with ground stations.

### **Notion of certification environment**

Many States have initiated or already have in place a certification environment for their military State aircraft. Sometimes governmental non-military aircraft are subject to safety oversight by the competent civil authority, even if specific rules exist in this respect.

The military certification process is sometimes not appropriately recognised by the civil certification authorities:

- The military processes are fragmented and there is no common framework for the initial and continuous airworthiness of State aircraft
- Separation between the regulatory, certification and operation functions needs to be improved or explained outside the military organisation
- Certification processes are insufficiently documented
- Cultural differences towards the approach on safety between military aviation and civil aviation.
- Lack of common civil-military regulations, specifications or standards.
- Institutional gap preventing the civil authorities from efficiently interacting with their military counterparts.

Each State defines how and by whom their State aircraft are certified. There is no harmonisation in Europe on the certification of State (military or non-military) aircraft.

For military aircraft, most of the time, one or several dedicated military structures within the military organisation are nominated as *certification authorities*.

Certification activities for systems are mainly separated into:

- technical certification, ensuring that the aircraft meet the technical requirements set out in the regulations;
- operational approval, which is the official declaration that the aircraft is authorised to operate in a regulated airspace. Operational approval relies on technical certification and on various additional requirements, i.e. procedures, training, monitoring deriving from the regulations.

They are supplemented by licences and certificates for organisation and personnel (e.g. continuing airworthiness maintenance organisation (CAMO), pilot licences, PART 66 licences, etc.).

The technical codes used for the design and airworthiness of the military aircraft are different to those for civil aviation for several reasons, one being that the civil technical or airworthiness codes do not take into account military aircraft mission conditions.

Technical solutions used in a military aircraft are driven by mission requirements or integration constraints specific to the military platforms. This gives the wrong impression that military aircraft design follows its own set of rules independently of any civil regulations, certification processes or guidance material.

But most military certification environments are now comprehensive and reliable, although there is still a lack of uniformity across Europe.

### **Certification of State aircraft by reference to civil ATM/CNS mandates**

Regulating access to airspace indirectly impacts military aircraft even when the regulations are allegedly not applicable: ICAO and SES regulations do not apply to military aircraft because ICAO does not have the power to regulate on them, while such aircraft are outside the scope of the EASA Basic Regulation (with the caveat on safety mentioned above) and there is no European-wide organisation which has full military regulatory competence. But to a certain extent civil regulations may apply to military airspace users when military systems are operated in a civil regulated airspace and ATS cannot accommodate them or when the military want to comply with civil rules, or governmental non-military organisations impose, through contracts, compliance with civil regulations on their contractors.

Military aircraft must then be certified to fly without restrictions in the airspace regulated by civil authorities<sup>15</sup>.

Derogations and exemptions are sometimes granted to allow military aircraft to fly in regulated airspace. This procedure is useful but is in fact unsatisfactory for all parties. It leads to a reduction in airspace capacity and triggers safety constraints and ATC workload considerations and unpredictability for military flights as the objective of SES is to increase capacity, reduce segregation and promote the interoperability of systems for the benefit of all airspace users. Some high-priority military missions are protected (QRA, SAR, etc.) but, in some States, many military flights flying as GAT may be treated as scheduled commercial flights.

Civil regulations ensure that if a certified operator or manufacturer follows approved certification specifications and accepted means of compliance (MoC), the required safety level will be achieved.

This does not prevent the applicants from using different means to achieve that safety level, but evidence must then be produced to support that claim. Safety cases are designed to provide such evidence. Alternative MoCs increase the cost of implementation and are not the preferred approach for civil stakeholders. But because of:

- the institutional separation of the civil and military certification authorities added to major differences in system design;
- a lack of initial coordination between the civil and military certification authorities,

this kind of process must often be used by the military authorities to certify that they have met civil ATM/CNS requirements for mandatory airborne systems.

Lack of knowledge on the part of the civil regulator and military certification authority regarding military certification structures and processes, together with the diversity across military organisations, does not help the civil counterparts to have a clear understanding of the way certifications and operational approvals are granted.

Although they are the result of legitimate military certification processes, the certificates are sometimes considered questionable by the civil authorities. Nonetheless, military authorities and operators already provide a number of fully “recognised” approvals (e.g. RVSM).

### **Validity of certificates and licences emanating from a State aircraft certification environment**

The Chicago Convention (ICAO) is the basis of the international validation of aviation certificates. The notion of recognition is defined in Article 33: *“certificates of Airworthiness, certificates of competency and licences issued or validated by the state in which the aircraft is registered, shall be recognised as valid by other states. The requirements for issue of those Certificates or Airworthiness, certificates of competency or licences must be equal to or above the minimum standards established by the Convention”*.

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<sup>15</sup> i.e. controlled airspace classes A to E and uncontrolled airspace classes F and G, as standardised in ICAO Annex 11, within which rules of the air and other operational rules for civil aviation and GAT are established by the competent civil authority.

This implies that the ICAO Contracting States are deemed to be all equal and trustworthy provided they comply with the minimum standards for proper certification established by the Annexes to the said Convention. Their certificates have the same value regardless of origin and they do not have to be verified by a higher authority. The certification environment merely has to prove that it is trustworthy.

Although State aircraft are excluded from the application of ICAO Convention, they are registered in a State aircraft register and their certification environment is endorsed by the States on a national basis. The State aircraft certification system provides therefore the same level of confidence as the civil international system, although it is handled entirely at national level.

There is currently no international certification system for State aircraft because of the special nature of the missions performed by such aircraft.

There is no legitimacy in a formal process whereby a civil authority could endorse the military certificates.

Recognising State aircraft certification originating from a competent military authority is in the spirit of the international recognition system promoted by ICAO based on national and mutually agreed responsibility<sup>16</sup>.

The situation in Europe today may seem to be complex. It comes from a geographical and regulatory mismatch between the European civil certification system, which is handled at regional level, and the State (military and non-military) aircraft certification system, which is implemented at national level by the States. In other parts of the world such confusion does not exist since civil and State aircraft certification geographically match and are handled under the umbrella of a single administrative structure. Nonetheless, each State is responsible for its State-registered aircraft vis-à-vis the international community in the same way as for the civil registered aircraft.

EASA provides a comprehensive and common certification regulatory framework for civil registered aircraft in Europe. For State aircraft, the certification environments are national. This does not prevent each European State from certifying its State-registered aircraft on the basis of the regulation they intend to apply in the same way as in the United States, for example. Nor does it prevent a manufacturer of an aircraft for a government customer from applying to EASA to obtain a civil TC (e.g. as was done for the Airbus A400M). Certificates issued by an European authority with jurisdiction over State aircraft intrinsically have the same value as a certificate issued by the US Department of Defense where the State aircraft certification environment provides the same level of confidence as the civil one.

Nevertheless, there is still room for improvement in the way the civil certification world sees State aircraft certification. State aircraft certification environments are fragmented and often deemed not transparent enough.

Performance-based certification processes can provide solutions by:

- improving transparency in the military certification process
- clarifying the specifications the aircraft is certified against
- providing adequate documentation in support of certification and operational approvals.

The progress made by the military in the field of airworthiness in the last five years will directly benefit ATM/CNS certification because it has introduced the civil safety approach in the military and has created links between civil and military certification authorities.

But it is obviously insufficient because it has not yet created the formal institutional bridges between the civil and military certification environments which are required for the future challenges to SES interoperability implementation.

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<sup>16</sup> This might imply that it is part of the ICAO universal safety oversight audit programme (USOAP) - <http://www2.icao.int/en/usoap/Pages/default.aspx>

An innovative strategy must be put in place to match the legal civil requirements to the military certification processes, bearing in mind that the civil regulations cover:

- administrative regulations relating to the process (e.g. part 21 for initial airworthiness);
- airworthiness codes and certification specifications for which alternative MoCs are usually possible; and
- legal provisions or bilateral/multilateral agreements for mutual recognition<sup>17</sup> or reciprocal acceptance<sup>18</sup> of certificates.

Performance-based certification is an alternative process from an already existing comprehensive, legal and trustworthy certification environment which consists of checking that a system meets the technical performance requirements deriving from a regulation, with the possibility of meeting some of the requirements by other means while ensuring that the safety levels are equal to or better than the required safety objective and making explicit the set of requirements the system is certified against and the mitigation measures taken.

Performance-based certification could contribute to building a trusting and fruitful relationship between civil and military aviation as regards ICAO and SES requirements for mandatory airborne systems. It is intended to introduce a concrete process supporting the slogan “as civil as possible, as military as necessary”.

### **2.1.1 Driver and benefits**

Implementation of performance-based certification could help in:

- providing a common framework for military authorities to certify their systems by reference to ATM/CNS mandates
- harmonising the macro-processes used by the military to certify their systems
- fostering the acceptance of military certification by other countries on sound, shared and common grounds
- allowing both civil and military organisations to optimise airspace capacity and mission effectiveness through military system certification
- avoiding unnecessary forward fits or retrofits in order to comply with operational improvement-related ICAO MASPS, EC regulations or EASA MoCs, AMCs and CS.

### **2.1.2 Intended audience and stakeholders**

The intended audience is:

- All military airspace users in Europe, systems operators and air navigation service providers;
- The national military certification authorities;
- The competent civil aviation authorities at national level;
- The military regulators for operations and other aviation domains.

The additional stakeholders are:

- The European Commission and the European Defence Agency;
- EUROCONTROL
- The ANSPs that will deal with the military aircraft flying in the airspace they are responsible for with no exemption of accommodation.

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<sup>17</sup> Article 11 of the EASA Basic Regulation

<sup>18</sup> For instance, the reciprocal acceptance of certificates between EASA and FAA is not only based on compliance with the minimum ICAO standards, but is covered by a bilateral agreement signed by the European Commission: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:291:0003:0044:EN:PDF>

- The CON, NAV and SUR service providers which exchange information with aircraft;
- EASA as the European agency responsible for safety in civil aviation
- Where applicable, monitoring units which collect and monitor the operational approvals and are able to check on the actual performance data.

## 2.2 Performance-based certification concept

State aircraft are outside the scope of the Chicago Convention (ICAO). Therefore all subsequent regulations, documents or specifications are not directly imposed on State aircraft and their requirements are not taken into account in the drafting phase. Unfortunately, this means that the military have no say in the early stages of the drafting of the civil regulations or means of compliance developed to satisfy this regulatory framework.

State aircraft therefore follow national regulations issued by national State aircraft aviation authorities. There is a large variety of regulatory frameworks, even if these are all closely related to the civil regulations.

Performance-based certification aims to achieve the level of safety within European airspace vis-à-vis the regulatory and certification powers of the civil aviation and State aircraft aviation authorities.

Performance-based certification must be designed to minimise the cost of certification activities and to build trust between military and civil aviation by providing comprehensive and sound processes and documentation supporting certification.

There are usually two kinds of ATM/CNS requirements:

- **System-related**
  - Performance
  - Architecture
  - Safety
  - Interoperability
- **Environment-related**
  - Airworthiness
  - Procedures
  - Training

Performance-based certification focuses on the technical performance of a system, but in the context of its integration into a network of systems. Therefore, it might include additional interfaces with other systems introduced by a different technical architecture.

The main challenge with the performance approach is first to precisely define “equivalence” and second to be able to demonstrate it: The definition of the performance requirements to be certified against and the means used to demonstrate them must be precisely and extensively documented.

Equivalence of performance should be demonstrated at least in relation to those functions and mitigation measures that demonstrate safety levels to be equal or better.

Equivalence of performance includes measurable (e.g. with metrics deriving from the regulation) and non-measurable requirements (e.g. procedures or technical architecture).

For communication and surveillance systems, in addition to safety, interoperability also has to be demonstrated, via alternative means of compliance, where appropriate and if the equipment mandated for civil aviation is not installed on military aircraft.

## **2.2.1 Principles of the performance-based certification concept**

### **1- Safety is at the heart of the performance-based certification concept**

In the framework of an operational improvement or function to be implemented, aircraft, systems or equipment are certified against a set of system requirements and procedures deriving from an extensive and comprehensive set of studies proving that the required safety objective has been achieved.

In a multi-systems interactive environment, the same level of safety must be guaranteed by every system. If just one of the systems fails to perform as well as all the other systems, the overall safety level falls dramatically. This explains why system certification and performance monitoring are bound to CNS/ATM mandates in regulated airspace.

Any certification process must ensure that the required safety level is achieved for all the other airspace users. This principle applies also to military certification processes.

### **2- The competent certification authority is the national military aviation authority or another one mandated by the military**

A certification environment encompasses:

- the legal framework of certification, including recognition/acceptance of certificates by other authorities,
- the requirements, standards, means of compliance and guidance material,
- the accountable individuals,
- the set of certification processes,
- the certified systems and spare parts,
- the certificates, licences and labels,
- an appropriate system to maintain records.

The military certification environment is fragmented at European level and suffers from a lack of regional consistency. There is a military certification environment for each State. While in many States it is already very comprehensive and robust, some environments are still under development. Individually, the military certification environments are indeed very similar to the civil certification environment provided under the EASA umbrella. They all comply with common basic principles such as competency and independence<sup>19</sup>. They encompass all the elements of the civil certification environment, including authorities, regulations, means of compliance, certification processes and guidance material, certificates, licences and labels.

The differences between the civil and military certification environments are due not to the willingness to achieve different levels of safety, but to the nature of the stakeholders and the legal responsibilities of the States. Those differences do not create a gap justifying the fact that military certificates do not have the same level of international validity.

The military certification environment is indeed the legal framework for the certification of military systems. The decisions and certificates of the military authority do not have to be endorsed by any civil counterpart. Otherwise, this would imply that military authorities are somehow subordinate to the civil authorities. There is no legal basis for this, unless it is imposed by law. Responsibility lies with the military authority, and the accountable managers are also clearly identified in the military certification environment.

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<sup>19</sup> The notion of independence of the military authority is sometimes misunderstood by the civil bodies because of a misleading perception of the role of the military ranking system and chain of command. It is commonly agreed that a military authority reporting at Ministry of Defence (MoD) level provides a sufficient level of independence even though its members are individuals who originate from the operators. Other models can also provide sufficient confidence in their independence, depending of the structure of the MoD. Actual practices and behaviours witnessed in real situations are the genuine proof of independence of an authority, regardless of the certification environment, as demonstrated in recent events in civil industrial domains (oil, railways, etc.).

Provided the requirements are met and the means of compliance demonstrate those requirements, the way of achieving them in a consistent and comprehensive legal framework and accountability system can differ. This implies that certification decisions are backed by robust certification processes and strong technical evidence.

**3- The concept of performance-based certification is designed to focus on the technical performance of the system rather than its architecture or components, and is thus intended to define tailored means of compliance in support of the certification activity**

This is a key issue in building trust between the authorities.

Primarily, in ATM/CNS mandates, the systems requirements focus on technical performance. Several additional requirements are added in order to ensure that performance is maintained over time and that the actions of the human operator will not hamper the level of safety that can be attained with regard to the technical requirements. A safety case wraps up all the claims and evidence and ultimately proves that the safety level objective has been met.

In some regulatory documents, technical performance levels are often supplemented by requirements relating to system architecture, equipage or even procedures. These requirements play a significant role in the calculation of the safety level provided by the compliant system. They may also act as a guideline for the aircraft manufacturers and operators when designing such systems. Part of the regulation is then indeed an acceptable mean of compliance.

A system architecture/equipage requirement does not by its nature follow the widely accepted principle of alternate means of compliance since it excludes all systems achieving the performance level by other means.

Where the system architecture/equipage requirements can be mitigated by alternate architecture/equipage procedures and proven by ad-hoc safety cases, the certification authority is entitled to question such requirements and to certify the system anyway. In this case, it must be clearly stated against which requirements the system has been certified.

All requirements must therefore be grouped in a functional requirements document (FRD) which will be the certification basis for the alternate system.

**2.2.2 Conditions for proper use of PBC**

PBC is designed to be a substitute certification process in cases where conventional certification cannot be achieved or there is an advantage in not using it.

Some conditions need to be met for proper and reliable use of PBC.

**1- The labels and certificates issued by the certification authority using PBC must provide at least the same level of confidence as those issued using different certification techniques.**

This implies that the certification authority must be

- granted the appropriate powers and responsibilities by the State
- independent from manufacturers and operators (this includes technical decisions)
- impartial
- adequately funded
- manned with competent expertise and appropriate management
- in possession of the appropriate technical guidance and equipped with documented processes

in order to achieve, without unlawful reservation

- open access to documents and non-discrimination; nonetheless, restricted information may be safeguarded by waivers within a scope which is limited, justified and documented
- credibility built on (non-exhaustive list)
  - o transparency
  - o freedom from conflicts of interest
  - o participation and acceptability to interested parties
  - o non-deceptiveness
  - o reliability and independent assessment
- use of
  - o objective and measurable criteria
  - o recognised standards

The certification authority using PBC is subject to oversight by an independent and accredited external body with a view to supporting the abovementioned claims.

**2- The environment for maintenance of performance-based certification should be as reliable as that referred to in the EASA implementing rules and FAA FARs or similar certification environments.**

Organisations maintaining PBC must be certified, and manned by trained and competent personnel. Responsibilities must be clearly documented.

This is linked to the credibility of the military certification environment and processes.

The basic certification regulation must be given the appropriate legal level. Acceptable means of compliance, guidance and training material and procedures must be extensively documented.

**3- Using PBC does not create a specific environment for certification**

PBC certifies the performance of a system in the existing, stable, well known and well managed military certification environment. Since the certification environment does not fundamentally change (authority, regulations procedures for performing the certification activity), a specific certification environment is not created.

PBC should be seen as a modality of the regular certification environment. Certificates and labels issued will be valid without any reservations.

**4- Performance-based certification must be supported by appropriate safety cases.**

A valid MoC requires a clear demonstration that the safety level objective for the operational function has been achieved when the performance is attained. MoCs are designed and supported by the organisation seeking certification. Available civil-military standards would facilitate the recognition of MoCs.

Where at least one of the requirements of the civil regulatory package is not met in the required way, demonstration of compliance is necessarily different to that published in support of that regulatory package.

A safety case will demonstrate that despite the difference, the system is able to cope with the safety level objective. This safety case also highlights specific situations in which the appropriate procedures must be conducted by the aircraft operator, other airspace users and the airspace controller and specific training must be provided.

PBC is also beneficial in certifying the use of other techniques in order to achieve a given function or service outcome. But because of all the technical differences, no software

application based on the substituted techniques can claim validation based on the original safety case. Dedicated safety cases must therefore be developed to certify such applications.

Safety also addresses the interactions between components which are only certified individually. Co-existence of multiple individual components each carrying a valid certificate may be declared as not in accordance with defined safety levels due to the mutual effects of impacts from the surrounding environment.

**5- Performance-based certification requirements must be grouped in a specific functional requirements document when deviating from the initial set of requirements**

The FRD is an official military authority document which mirrors the civil regulatory document. It must clearly describe the whole set of requirements against which the military system has been certified. It must be endorsed by the appropriate authority and certification activities must be conducted in accordance with the FRD provisions.

**6- Restricted information on technical components or functions must be assessed to be kept minimal**

Information waivers must be limited to those items of technical, procedural or operational information which must remain classified, safeguarded and cannot be disclosed. And even then, a minimum of information should be available. Certification documentation does not have to be openly published but it needs to be accessible at short notice to whoever has the appropriate authority to request it (e.g. RVSM ops approvals).

### 3 CONCLUSION

Performance-based certification, for military airborne systems, does not imply a need to create a specific certification environment.

It is recommended in most circumstances to avoid the retrofit of military platforms only for the sake of compliance with civil ATM/CNS requirements where performance-based alternatives exist.

Nonetheless, as the common understanding between the certification authorities is a matter of trust and transparency, using PBC means following a strict but flexible methodology, including the ability to provide the necessary documentation and to participate in civil monitoring programmes if required.

Sound organisation and a solid set of responsibilities in the military will encourage trust between the latter and the authorities in charge of operational improvement on the civil side. Therefore the military certification authorities must pursue their efforts to create a reliable certification environment with a high level of confidence, in accordance with the powers entrusted to them by law.

The more the military authorities apply a comprehensive and common process for certification, the more accepted their certificates will be. Civil and military certification processes are not in opposition, but there is an institutional barrier that can be overcome by concrete actions and transparent processes. Performance-based certification could be one such process.

Implementing PBC at national level could, in the medium/long term, also pave the way towards:

- Harmonisation of the regulatory approach to non-military State aircraft across Europe;
- Bilateral/multilateral agreements between military and civil certification authorities;
- Harmonisation of certification rules for State military aircraft at European level.



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