Final Report

AIR

ATM-CNS

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EXECUTIVE SUMMARY

1. The increased integration of airspace management and navigation service provision underscores the need to improve interoperability of equipment and procedures. At the same time it is necessary to support the adoption of new technology based on a wide range of technologies developed by equipment manufacturers, airspace users and service providers, and to provide for its co-ordinated introduction.

To fulfil this need, the European Commission proposes a standardisation legislation defining a first layer of high-level essential interoperability requirements, to be refined as necessary into a second layer of binding Implementing Rules for key elements of interoperability and supported by a third layer of voluntary standards denoted as Community Specifications.

2. The main objectives of this study, based on an analysis of existing and planned regulations, rules, standards and system qualification and operation practices, are:

- to define a generic layout and a set of guidelines for the production of implementation rules,
- to identify priorities and propose a work programme to develop a complete interoperability in the Single European Sky (SES) by 2012, as required by the draft SES regulation.

3. After describing the background and the objectives of the study, we dedicate the first part of this report to a critical review of the regulatory material already available for organising the SES rule-making process, including the relevant international standardisation material and the General European Legislation.

Our main conclusions are:

a) The wide scope of the SES “interoperability regulation” has to be understood to prevent misunderstandings. A great part of the regulation is linked with the definition of the services, performances and quality of service of the ATM/CNS network elements, but on many aspects go beyond pure interoperability.

b) Sufficient regulatory material is needed to allow the use of the regulation in the transition period, from one and a half year after the entry in force of the regulation. In particular, the definition of the presumed means of conformity and the specific conformity assessment including the definition of the tasks for notified bodies has to be defined shortly for systems and constituents.

c) Implementing rules should cover two aspects, an operational one dealing with responsibilities, operational procedures and another one more technical, this corresponding to the two kinds of community specifications. The Implementing Rules derived from the IOP regulation can also have links with Service provision and airspace regulation.

   To the operational and technical rules could be added the “administrative” rules giving more requirements to the rule-making process (definition of the phases, identification of the stakeholders, coordination with other regulation processes, coordination IR-CS, easy access…) and to the content and presentation of the regulatory material, or defining of common terminology (for example definition of traffic characteristics to support the definition of performances) or methodology. Relevant Community specifications can also be established (standard template, use of current standardisation process…). We give first elements on this subject in the report.

d) Considering that several problems are linked to the conformity assessment process, we point out the need to develop an (administrative) implementing rule defining more precisely the means of conformity (including the modules to be applied, the supplementary requirements that are necessary and the tasks of the notified bodies), according to the type and characteristics of the procedures, systems and constituents to be regulated. This should be made consistent with

requirements concerning safety: inter-operability implementing rules should take into account the impact of safety requirements on the inter-operability of systems. In the report, we study how the existing modules can be used associated to different categories of constituents/systems and we suggest some new modules to address the specifics of the ATM/CNS field, in particular dealing with the safety requirement.

e) Implementing rules should not contradict ICAO Standards but could use them as a valuable input and refer to them when and only when necessary. While OACI Standards have a mandatory nature for the sake of world-wide inter-operability between aircraft and ATM/CNS systems, the technical standards of the SES regulation will be voluntary instruments adopted after an industry consensus. The technical details of a regulation should normally belong to standards. The Implementing rules say what you must do; the community specifications how you can do.

f) Some elements issued from EUROCONTROL activities (European Convergence Implementation Plan (ECIP), ATC IOP Concept of operations, Interoperability Requirements Documents (IRDs)), will be useful in the Implementing rules definition, development and planning. We underline the need of a commonly accepted logical architecture thus setting a reference framework for the constituents of the ATM/CNS network, and the services and interfaces they provide. The Overall Architecture OATA completed by some layered model for Communication seems a good basis to cover this point.

4. Taking into account the lessons learnt from the review of existing Interoperability Regulatory material, we begin the second part of the document by giving a number of recommendations and heuristic principles to future developers of Implementing Rules to delineate what future IRs should be and should not be. We identify issues to be addressed in making the implementing rules and developed initial principles for their elaboration. We define a generic format and a set of guidelines for drafting and checking implementation rules taking into account the practices of other organisms but also the specific requirements laid out in the SES regulation, such as the stakeholders' consultation. We think that a docket management system should be created and be accessible using the Internet. A docket should be created for each rule, with the information concerning the rule, including the status, results, and comments of the NPRM process. (This constitutes a first approach to the administrative implementing rule and community specification we suggest). We give in an annex a number of examples, trying to pint out useful "tips" about what developers of Implementing Rules should take care of.

5. Then we define the method used to trigger and structure the definition of the Implementing rules. An important criterion, as said before, is the usability of the essential requirements in the transition period. Another one is the already defined planning of existing systems improvement and development of new concepts which must be encouraged through regulatory materials. Priority in the development can proceed from a pragmatic analysis of IOP problems, study of the risks, and maturity of the solutions. For a better identification of IOP problems and IR/CS classification, we define, from the SES regulation, 4 levels of IOP objectives (European harmonisation of services of the same nature, European interconnectivity of services of the same nature, European CNS/ATM systems interactivity, Interactivity with users and extern environment).

Due to the complexity of the ATM/CNS interconnections, implementing rules can cover several domains. In some cases, it would be more efficient to consider "IOP subjects" rather than domains to define implementing rules and a pure top down starting from the domains is not optimum.

We estimate the time required by the different phases of the rule-making process. It appears that 2 or 3 years are necessary to complete the process leading to the adoption of some implementing rules, depending on the complexity of the task, the degree of maturity of the possible solutions, the involvement of the stakeholders, the gap perceived between already existing material and the work to be done. This duration is that commonly noticed for other regulations.

6. Using the criteria we have defined, we examine then domain by domain the issues that could lead to regulations and characterised their importance and the urgency to find solutions. Estimating the time required to produce inter-operability rules in each particular case, and taking into account the time where the new functions/systems/procedures are planned to be implemented, we then develop a roadmap for solving the problems pointed out before. We propose having four sets of regulation packages, corresponding to the urgency of the problems and the degree of maturity of the solutions, each package lasting 2 or 3 years, the first one being launched at the beginning of 2004, the second in 2006, the third in 2008 and the last one in 2010, in a consistent way with the ECIP. The corresponding community specifications could be defined in parallel, one year late.

7. The objective of the first package will be chiefly to have sufficient material to apply the regulation from mid 2005. One conclusion of our study is that in many cases, minimum standards of performance have to be given in some implementing rules, more detailed elements being given in community specifications. This first package can also complete the Essential Requirements on some more technical issues, for which the preliminary material is already available. We indicate in the report the technical documents already available to support these developments.

For the first package, we suggest the development of the implementing rules and community standards presented next page.

This work plan has now to be discussed with the stakeholders.

8. We gather in annexes a list of constituents that could be subject to the regulation, the justification of the development of the Implementing Rules and Community Specifications for the 4 packages and other documents detailing some aspects of our study.

Domain (s)	IR and CS
ADMINISTRATIVE	IR_ADM_1.1: method: refinement of the regulated process and results IR_ADM_1.2: means of conformity (including the modules to be applied, the supplementary requirements that are necessary and the tasks of the notified bodies according to the types of elements to be regulated; links with safety regulation; verification of complex systems including datalink) CS_ADM_1.1: standard for the content, presentation, diffusion of the regulatory material CS_ADM_1.2: integration of RTCA SC-179/EUROCAE WG-53 in the SES regulatory material CS_ADM_1.3: means of conformity for ground-ground systems
GENERAL	CS_GEN_1.1: “define a general functional framework and logical architecture available for 2005 ATM/CNS systems and constituents”. CS_GEN_1.2: definition of standard configurations necessary to define performances of systems (traffic load, runways configuration, concept of operations…) IR_GEN_1.1 (CS_GEN_1.1): complement the ESARRs relatively to the general requirement about safety (to be more thoroughly investigated)
COM	IR_COM_1.1: radio spectrum management and frequency allocation for CNS IR_COM_1.2: co-ordination framework for Channel sharing agreements CS_COM_1.1: functional specifications and performances of G/G Com
NAV	IR_NAV_1.1: required navigation performances
SUR (SDPS included)	IR_SUR_1.1: overall Surveillance Service Performance Requirements
ASM	IR_ASM_1.1: Modalities for synchronised procedures and systems adaptations to Airspace classification changes in the upper airspace IR_ASM_1.2: Modalities for synchronised procedures and systems adaptations to ATS routes changes in the upper airspace IR_ASM_1.3: Modalities for synchronised procedures and systems adaptations to sectors design changes in the upper airspace
ATFM	IR_ATFM_1.1: Minimum mandatory data provision between ATM services within the current ATFM structure for assuring 1) access of the whole set of data necessary for deciding of the ATFM measures to apply, 2) diffusion of the decision terms to all impacted parties, 3) access to the data necessary to assess conformity to the ATFM measures IR_ATFM_1.2: Adoption of common data exchange formats for ATFM-relevant information provision CS_ATFM_1.1: Providing the technical details of the data exchange standard to be used (ADEXP format) and potential associated intern systems enhancement
ATS	IR_ATS_1.1: Minimum requirements for inter-FDPS interconnectivity; IR_ATS_1.2: adoption of common data exchange formats for ground-ground inter-FDPS- data exchanges associated with a CS providing the technical details of the data exchange standard to be used IR_ATS_1.3: minimum FDPS processing performance and mandatory set of core functions to achieve such performance, in particular regarding inter-FDPS data consistency, accuracy, and error tolerance IR_ATS_1.4: Minimum requirements for ATS staff working environment for 2005 in all specific operational environment IR_ATS_1.5: standard ergonomic principles for the design, development and implementation of HMI with ATS staff working environment
AIS	IR_AIS_1.1 specifying the AIS data integrity levels & assurance procedures based on the material provided by the RU on the subject of end-to-end Aeronautical data integrity IR_AIS_1.2: electronic support for Aeronautical information diffusion making it mandatory the use of an electronic-AIP standard (CS - Industry standard based on the EUROCONTROL e-AIS specimen) IR_AIS_1.3: reaffirming all the mandatory assurance quality procedures for the production, design, storage and provision of Aeronautical information for local AIS specifying in particular the sanction regime for the non- Adherence to AIRAC cycle
MET	IR_MET_1.1: mandatory MET data provision to all interested party (ATFM, ATS, airports), specifying the required MET forecast availability and accuracy at different time horizons aimed at defining common MET data set to be provided SES-wide

1 INTRODUCTION

1.1 Purpose of the document

The purpose of this document is to describe the objectives and results of ATM/CNS Interoperability Roadmap Study.

1.2 Intended audience

The European Commission DG TREN.

1.3 Document structure

Following an executive summary and this section 1 “introduction”, the document is divided into two parts.

In the first part, we review the existing material.

- Section 2 presents the statement of the work: background, objectives, general approach of the study.
- Section 3 describes the Single European Sky Legislation.
- Section 4reviews International Interoperability framework (Chicago Convention, International Standardisation System, General European Legislation).
- Section 5 describes some IOP material that will be useful for the rule-making.
- Section 6 reviews existing rules or standards from ICAO, EUROCONTROL, EUROCAE…

In the second part, we give a general layout and a set of guidelines for the production of the rules and the roadmap for their development.

- Section 7 presents guidelines for the production of implementing rules.
- Section 8 proposes IR documentation template
- Section 9 defines rule-making criteria, examines the phases of the rule-making process and proposes a roadmap in four steps.
- Section 10 presents the implementing rules and community specifications are necessary to be developed.

Annexes give some more details.

- Annex A gives a first list of ATM/CNS constituents.
- Annex B gives a list of question allowing the identification of Implementing Rules.
- Annex C gives examples of IR and tips for their writing.
- Annex D details the need for having rules and specifications, domain by domain.
- Annex E makes clear Radio spectrum Management & Frequency Allocation.

For practical reasons, the Annexes are presented in a separated file.

The details of the survey of the existing interoperability regulation (ICAO, EUROCONTROL, EUROCAE, etc.) are produced as an EXCEL external file.

1.4 Applicable and reference documents

[A1] EC Contract B2002/B2-7040B

[A2] European Commission Invitation to Tender n°/F2/17-2002

[A3] Sofréavia technical proposal ref. ATM/P7901/PR02059T_10 dated 16/09/02

[R1] Sofréavia's Quality Manual.

[R2] Sofréavia's QA procedures n°14 – "Management de projet"; n°18 – "Réalisation des études de conseil"; n°26 – "Maîtrise des documents du dossier d'affaire".

[R3] Draft Regulation of the European Parliament and of the Council laying down the framework for the creation of the Single European Sky (16/12/2002) (SES regulation 2001/0060)

[R4] Draft regulation on the interoperability of the European ATM Network (16/12/2002) (SES regulation 2001/0237)

[R5] Draft regulation on the organisation and use of airspace in the Single European Sky (16/12/2002) (SES regulation 2001/0236)

[R6] Draft regulation on the provision of air navigation services in the Single European Sky (16/12/2002) (SES regulation 2001/0235)

[R7] Decision 93/465/EEC of 22/07/1993 – OJL 220, 30.8.1993, p23

[R8] Study on institutional issues concerning joint developments in the field of Flight Data processing (produced by Sofréavia – 06/02)

1.5 External Documentation

1.5.1 EUROCONTROL Documentation

Documents available on the Web site (documents from FDM Group, ITDF, OATA, …).

Documents produced for the RC meetings.

1.5.2 General Documentation

Documents available on Web sites (FAA, JAA, EASA, CENELEC, etc).

1.6 Terminology

ACC	Area Control Centre
AECMA	Association européenne des constructeurs de matériel aérospatial
AFTN	Aeronautical Fixed Telecommunication Network
AIS	Aeronautical Information Service
ANP	Air Navigation Plan
ANS	Air Navigation Service
AOC	Airline Operational Cells (flight planning or dispatch activities)

ASM	Airspace Management
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATS	Air Traffic Services
CAA	Civil Aviation Authority
CDM	Collaborative Decision Making
CEN	Comité Européen de Normalisation
CENELEC	Comité Européen de Normalisation Electrotechnique
CFMU	Central Flow Management Unit
EC	European Commission
ENPRM	EUROCONTROL Notice of Proposed Rulemaking
EOTC	European Organisation for Conformity Assessment
ESARR	EUROCONTROL Safety Regulatory Requirements
ETSI	Institut européen de normalisation des télécommunications
EU	European Union
FDP	Flight Data Processing
FIS	Flight Information Service
FMP	Flow Management Position
FUA	Flexible Use of Airspace
GNSS	Global Navigation Satellite System
HMIS	Human Machine Interface System
IAS	International Accounting Standards
ICAO	International
ITU	International Telecommunication Union
NPRM	Notice of Proposed Rule-Making
PANS	Procedure for Air Navigation Service
PRC/PRU	Performance Review Commission/Unit
QOS	Quality of Service
RC/RU	Regulatory Committee/Unit
RDPS	Radar Data Processing System
SARP	Standards and Recommended Practices
SDPS	Surveillance Data Processing System
SES	Single European Sky
SRC/SRU	Safety Regulation Commission/Unit
SUPP	(regional) Supplementary Document (to SARPS)
UTC/IAT	Universal Time Coordinates / International Atomic Time
UTE	Union technique de l'électricité
WP	Work Package
WRC	World Radio Conference

2 STATEMENT OF WORK

2.1 Background of the study

The Community does not have a long tradition of dealing with air traffic management. For a variety of reasons – sovereignty and military considerations, the existence of intergovernmental cooperation through EUROCONTROL – Member States preferred to handle these issues outside the Community framework.

Following the extensive delays experienced during summer 1999, the Commission has made a reform of European air traffic management into one of its priorities. A High Level group composed of senior representatives of civilian and military air traffic management organisations agreed at the end of 2000 on the main elements of this reform. These orientations were supported by the European Council, and the Commission followed suit with comprehensive legislative proposals for a reform of the organisation of air traffic management in Europe, so as to improve the efficiency and safety of the system.

Care was taken from the outset to launch this initiative in close cooperation with European non-Member States, who are associated either as part of the enlargement process, through aviation agreements with the Community (Norway, Switzerland) or through their membership of EUROCONTROL. The Community is also in the process of joining that organisation so as to embed its action in a pan-European context.

The Commission likewise elaborated a platform for industrial and professional stakeholders and for the social partners to participate in the discussion. This led to the development of a promising social dialogue at European level.

The key objectives of this reform are the reduction of fragmentation of airspace, organisations and systems and the development of Community added value through political decision-making and through the formulation of a regulatory framework that binds Member States as well as airlines, equipment manufacturers and air navigation service providers. The principal components of the Community's initiative relate to:

- Integration of airspace, in order to move away from the current patchwork of different approaches to airspace classification and to enable the organisation of airspace as a function of operational requirements rather than national borders. The main instruments of this approach are:
  - The harmonisation of airspace classification and the establishment of a European Upper Flight Information Region,
  - The establishment of (cross-border) functional blocks of airspace, which would lead to the establishment of optimised control areas and creating opportunities for rationalisation of the air traffic control infrastructure,
  - The improvement of civil-military coordination through the systematic application and improvement of the concept of flexible use of airspace, so as to enable fluid management of military requirements for airspace, and
  - More pro-active management of air traffic flows.
- The core air traffic control service continues to operate under natural monopoly conditions, and Member States retain their freedom to designate the operators concerned.
  - However, the move towards functional blocks of airspace will lead to the increasing provision of services across borders, requiring harmonisation of service provision through the formulation of common requirements for the organisations providing air navigation services. Furthermore there is scope for the supply of supporting services by several providers, increasing the choice available to airspace users and air traffic control organisations.

  - Such a system of certification requires the active involvement of regulators with sufficient resources to guarantee arms' length relations and the effective oversight of service providers.
  - The cost recovery principle has not been able to generate sufficient impetus for improvement of air navigation services and adjustment to the requirements of airspace users. Furthermore the current traffic downturn exposes the vulnerability of air navigation service providers. Improvements to the charging mechanisms are therefore urgently required.

- The increased integration of airspace and service provision underscores the need to improve interoperability of equipment. At the same time it is necessary to support the adoption of new technology based on wide support of technology choices by equipment manufacturers, airspace users and service providers, and its coordinated introduction on the basis, if appropriate, of mandated equipage. The 2000 High Level Group report emphasised the need to accelerate the development and implementation of new concepts, tools and procedures, based on a partnership between all stakeholders driven by systematic high-level industry consultation[1]. The report underlined the need for an open standardisation process.

Our study is mainly focused on this last point (interoperability).

The expected benefits for European industry from the Commission proposed approach are:

- firstly by streamlining European decision-making, it will become easier for manufacturers and purchasers to synchronise investment and procurement cycles.
- secondly manufacturing industry will take profit of a more open European market. The fragmentation of the air traffic control equipment market leads to high development costs which hamper interoperability but also don't make much business sense.
- thirdly to help European industry on the world scene, including its ability to set worldwide standards. A strong standardisation effort will help Europe to convert its drawback of not having a single procurement authority to a big advantage. A system developed in Europe in accordance with interoperability standards will be a serious candidate for many countries worldwide.

This initiative has led to a draft set of regulations which are the starting point of this study: they consist of a general framework 2001/0060 and 3 inter-related pieces of legislation:

- 2001/0235 on the provision of Air Navigation Services,
- 2001/0236 on the organisation and use of the airspace,
- 2001/0237 on the interoperability of the European ATM network.

[1] Points 2 and 4 of the introduction of the SES Interoperability Regulation 2001/0237:
"The report of the High Level Group on the Single European Sky has confirmed the need to establish technical regulation on the basis of the "new approach" in accordance with the Council resolution of 7 May 1985 on a new approach to technical harmonisation and standards [1] where essential requirements, rules and standards are complementary and consistent."
"The report of the High Level Group has confirmed that even though progress has been realised during the last few years towards a seamless operation of the air traffic management network in Europe, the situation still remains unsatisfactory with a low level of integration between national air traffic management systems and a slow pace in the introduction of new concepts of operation and technology necessary to deliver the additional required capacity."

2.2 Objectives of the study

The focus of this study is the development of implementation rules for the interoperability of ATM-CNS services. Directly linked with the SES regulation for interoperability, this study is also connected to the other regulations when they impact interoperability.

The main objectives of this study, based on an analysis of existing and planned regulations, rules standards and system qualification and operation practices, are:

- to define a generic layout and a set of guidelines for the production of implementation rules,
- to define and prioritise the functional domains where implementation rules are required to meet the essential interoperability requirements laid out in the draft regulation, so as to allow the European Commission to set up a co-ordinated work programme for EUROCONTROL expert groups and other technical standardisation bodies early enough to meet the 2012 target date for interoperability.

The key issues raised by the terms of reference of the study are:

- The need to take into account both the general mechanisms of the European Union for developing requirements, rules and standards and the existence of aviation-specific mechanisms embodied by ICAO and EUROCONTROL, especially regarding the procedural dimension of the specifications produced;
- The novelty of the new layered approach (essential requirements, implementation rules, European specifications) in the field of ATM/CNS systems and procedures;
- The need to agree criteria for selecting and prioritising the tasks with all the parties involved into the development of the new approach;
- The development of a comprehensive roadmap applying the proposed criteria into all the functional domains identified at Annex I of the Draft Regulation, in the context of pre-existing specifications and standards.

2.3 The general architecture of ATM/CNS

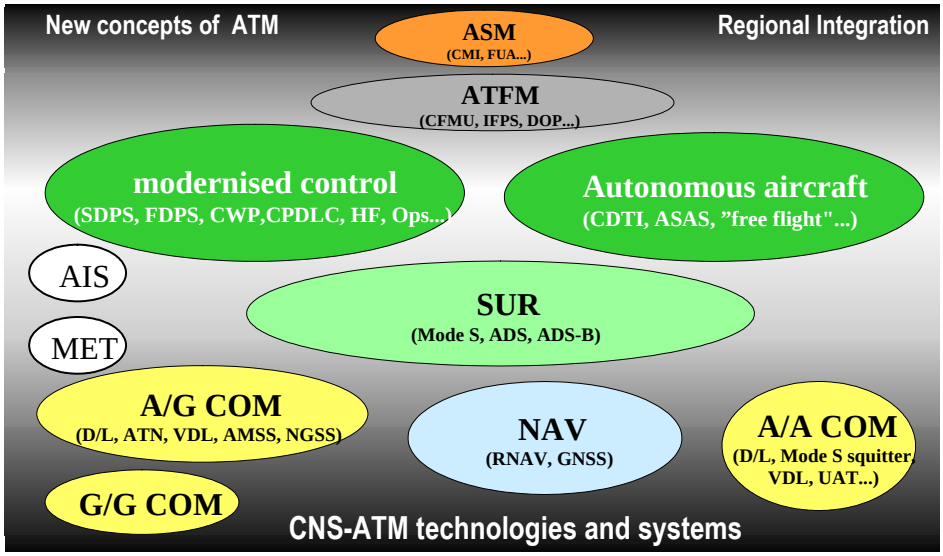

Figure 2.1: general architecture of ATM/CNS

The slow-evolving ATM/CNS system consists of all the supporting systems and services, and the way they are used by the human actors of ATM operations, to establish and maintain a safe and efficient operational environment for Civil Aviation. The Figure 2.1 summarises the overall shape of ATM/CNS and the way its various sub-systems are related to each other.

On this diagram, the most operational-procedural and larger scale functions (ASM, ATFM) are located at the top, while the supporting CNS technologies and systems are at the bottom. The mix of data integrating systems and procedures that constitutes ground-based ATC and the emerging paradigm of aircraft autonomy sits in the middle. This representation captures 3 important notions:

- CNS systems are enablers that can serve different operational purposes in ATC,
- the modernisation of ATC and the development of aircraft autonomy are complementary and share the same set of CNS enablers,
- from the standpoint of inter-operability specification, the higher parts of the diagram are the most directly operational areas where the influence of ATS providers and airspace users is dominant, while the lower parts are the technological areas where the influence of manufacturing industry is dominant.

2.4 Approach

The first task to be undertaken is to conduct a review of existing material, especially the draft set of Single European Sky regulations, so as to identify all the constraints imposed by the EU approach on the development of implementation rules and subsequent technical specifications.

Another important aspect of that task is to clarify the terminology by mapping all the various ICAO and EUROCONTROL terms (SARPs, standards, recommended practices, guidance material, guidelines, manuals, bulletins…) into the new framework.

The second task to be undertaken is to assess where the current rules and specifications sit in relation to the new framework. All of the existing ICAO, EUROCONTROL, EU and other IOP "standards" will have to be reviewed and mapped in terms of:

- their domain of application (according to the system breakdown of Interoperability Regulation Annex I, refined into sub-systems as deemed necessary),
- their scope,
- their application.

The third task to be undertaken is divided into two parts:

- characterisation of implementing rules so as to provide a sort of high level User Guide for the participants to the rule-making work programme. In particular, it is important to define the content of a rule comparatively to the community specifications' one and the conditions which underpin the realisation of a rule,
- definition of a common description format for the specification of implementation rules, together with examples and recommendations about how to best formulate implementation rules (and also how not to, as negative examples are frequently better than positive ones from a pedagogical standpoint).

The fourth task consists in establishing a methodology to identify the areas / systems that should be regulated. We propose to use a methodology adapted to the two problems: have sufficient material from mid 2005 to apply the regulation, go with the improvement of systems and new concepts introduction from 2005 to 2015.

The fifth task is the identification of these areas / systems and the characterisation of the problems to be solved, based on the methodology identified above.

The sixth task consists in developing an outline Work Program for the definition of implementation rules covering the 8 domains, broken down into relevant sub-domains. The proposed roadmap reflects the relative priorities through a Gantt chart with dependency links noted on it, and it points at the existing entities, rules and standards that the participants into the rule-making process will have to draw from.

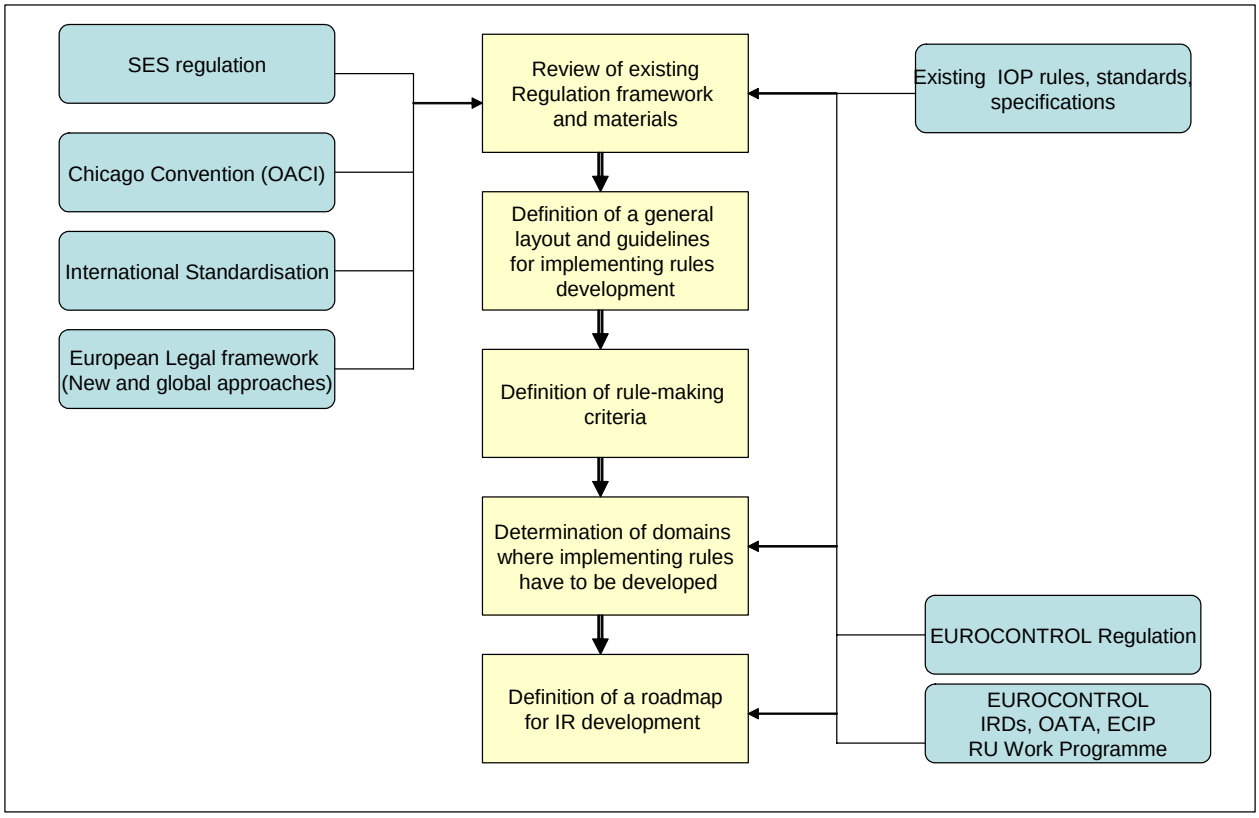

Figure 2.2: the study approach

Most of the tasks are led in parallel and take profit of the results of the others.

On this basis, we have broken down the work into 6 technical Work Packages:

- WP1: Review of International and Single Sky Interoperability Regulation Framework
- WP2: Review of Existing Rules and Specifications
- WP3: Definition of Rule-Making Criteria
- WP4: Identification of Priority Areas
- WP5: Layout and Guidelines for Implementation Rules
- WP6: Interoperability Rule-Making Roadmap.

The overall objective of the approach is that the introductory guidance resulting from WP3, plus the presentation model, examples and recommendations resulting from WP5 will constitute sufficient guidance for the subsequent inter-operability rule-making process starting from the WP6 roadmap.

The document structure is presented according these work packages with the exception that the layout and guidelines for the Implementation Rules document are presented before the definition of Rule-making criteria.

3 CONTEXT OF SINGLE EUROPEAN SKY IOP REGULATION

3.1 Objectives of the chapter

The objective of the chapter is to identify all the constraints imposed by the EU approach on the development of implementation rules and subsequent technical specifications.

Before examining the SES IOP regulation 2001/0237, we analyse how the 3 other SES regulations are related to the interoperability regulation.

3.2 Relations between the different SES regulations concerning interoperability

3.2.1 Framework Regulation (2001/0060)

This regulation gives the background and the framework of the Single European Sky regulation and introduces the three regulation documents about airspace management, service provisions and interoperability.

It introduces the notion of implementing rules (IR) for the three regulations.

IR are to be defined by EUROCONTROL under a Commission mandate: this is done normally – when the subject is not within their remits – in application of the advisory procedure of EU Comitology; if that approach does not work, the SES Committee will apply the management procedure of the Comitology and may take other alternative measures for developing any IR it needs [2].

It indicates the implication of the stakeholders in the regulation process3. To be accepted, such a process must be transparent and reasonably assess the merits and drawbacks of introducing a regulation, through a wide and open consultation of the stakeholders. This is the only way to convince every stakeholder and to inject a strong legitimacy into the new regulation and a high level of confidence in the expected results. The NPRM (Notice of proposed rule-making) process or the well-established procedures of the Standardisation Organisations observes a number of basic principles supporting these ideas: transparency, openness, impartiality, efficiency, public access to specifications.

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[2] *"In the process of creating the Single European Sky, the Community should, where appropriate, develop the highest level of cooperation with EUROCONTROL in order in particular to ensure regulatory synergies and consistent approaches, and to avoid any duplication between the two organisations." (SES Framework 2001/0060 recital 15).*
"In accordance with the conclusions of the High Level Group, EUROCONTROL is the body that has the appropriate expertise to support the Community in its role as regulator. Accordingly, implementing rules should be developed, for matters falling within the remits of EUROCONTROL, as a result of mandates to that organisation, subject to the conditions to be included in a framework of cooperation between the Commission and EUROCONTROL." (idem – recital 16).

This is repeated in Article 8.a point 1.
"For the development of implementing rules pursuant to Article 3 of this Regulation which fall within the remit of EUROCONTROL, the Commission shall issue mandates to EUROCONTROL setting out the tasks to be performed and the timetable therefore. The Commission shall act in accordance with the procedure referred to in Article 7(2)[that is the advisory procedure]".
"If EUROCONTROL cannot accept a mandate that was issued to it under paragraph 1, or if the Commission, in consultation with the Single Sky Committee, considers that:
a) the work carried out on the basis of such mandate is not progressing satisfactorily given the timetable set, or
b) the results of the work carried out are not adequate,
the Commission may adopt, acting in accordance with the procedure referred to in Article 7(3), [That is the regulatory procedure] alternative measures to achieve the objectives of the mandate concerned."

[3] *The Member States, acting in accordance with their national legislation and the Commission shall establish effective consultation mechanisms for appropriate involvement of stakeholders in the implementation of the Single European Sky.*
Such stakeholders may include air navigation service providers, airspace users, airports, manufacturing industry and professional staff representative bodies.
Consultation of stakeholders shall cover, in particular, the development and introduction of new concepts and technologies in the European air traffic management network (Article 9).

This regulation contains a definition of interoperability (cf. 3.3.1) and a definition of systems and constituents.

3.2.2 Systems and constituents

Systems "*encompass ground-based and airborne constituents as well as space-based equipment, and provide support for ANS for all phases of flight*", where constituents "means *"tangible objects such as hardware and intangible objects such as software upon which the interoperability of the European ATM network depend*". (SES Framework regulation- Article 2)

In line with the SES regulation, a constituent is any element produced by a manufacturer which is minimal for the definition of interoperability conformity specifications and tests.

A system is any aggregation of constituents with an identifiable functionality at the level of the ATM/CNS network and put into service by an ANS provider which is minimal for the definition of interoperability compliance specifications and tests.

Remarks:

Annex III of the Interoperability Regulation says that "*the constituents [concerned by a rule] will be identified in the implementing rules …*". The list of the constituents of the ATM/CNS network is not given in the SES regulation as it is something which would be modified along the time.

To avoid ambiguity in the definition of rules and standards when a constituent is named, it is necessary to adopt a common target logical architecture which identifies:

- the logical building blocks that form the overall ATM/CNS system,
- the services and interfaces they provide.

The constituents are these logical building blocks.

This architecture must be able to support centralised or distributed systems (or constituents), the choice being organisational (structure of airspace, definition of responsibility areas) or technical.

The systems/constituents identified in the implementing rules are logical whereas the systems/constituents concerned by verification are physical ones. A physical constituent can correspond to several logical constituents or parts of a logical constituent. For example, a FDP system can integrate the Correlation Manager or the Arrival Manager and Communications constituents. This fact has to be taken into account when defining the rules and their conformity assessment.

3.2.3 Airspace Management (2001/0236)

The most relevant elements are article 10 (FUA) and article 13 (ATFM) that specify requirements on service implementation, that have necessarily an impact on ASM and ATFM constituents and systems interoperability.

3.2.4 Service Provision (2001/0235)

The most relevant elements are Article 6a (common requirements for ANS, including the notion of "quality of services") and Article 12 (Access to and protection of data) that provides a high level interpretation of data interoperability between ANS Providers broader than the merely technical feasibility of data interchange.

This Draft regulation defines a two-tiered regime for the regulation of ANS provision in the European Union:

- a set of core operational ATS (traffic information and control services), which can be considered as a natural monopoly (in the sense that a single service provider has to be in charge of those services for any given portion of airspace) and which is to be regulated through a state-managed authorisation and oversight regime; authorisations are explicitly

limited to specific airspace blocks by the concerned State(s) and are valid for a limited period of time (designation process);

- a set of more "peripheral" services, which is considered as non-monopolistic, and which is also regulated through a state-managed authorisation and oversight regime, the key difference with the core set is that the granting of an authorisation by any national authority is to be automatically recognised by other national authorities, the service providers being merely expected to notify to all relevant authorities the airspace blocks where they intend to offer their services, without any further ado.

In practice, well-defined inter-operability rules (and associated Community Specifications) are especially important for that second set of services, especially for facilitating the specification of service contracts at the interface between the core service provider and its peripheral service providers when a service unbundling approach is taken.

Considering safety*, the Commission shall (…), identify and adopt the EUROCONTROL Safety Regulatory Requirements (ESARRs) and subsequent amendments to those requirements within the scope of this Regulation, that shall be made mandatory under Community law."* (Article 5).

As the objectives of the interoperability regulation encompasses a notion of "safe operation" of the European Air Traffic Management Network, the potential impact of making the ESARRs mandatory into Community law must be taken into account when defining Implementing Rules for inter-operability. ESARRs define obligations of ATS providers in relation to safety assurance processes (in particular the production of safety indicators) and they do not sit exactly as the same level as the Inter-operability rules and related specifications that are the subject of this study[4].

We can see a potential impact of ESARRs on inter-operability issues as providing a set of "meta-rules", and as such these "meta-rules" may have an influence on the allocation of responsibilities for certain high level rules, for example, so as to adopt verification patterns and identify roles that are congruent with arrangements made in the field of safety assurance.

Future ESARRs (e.g. the planned ESARR 6 on software system engineering) may also have an impact on the definition of the conformity verification regime to be attached to the inter-operability rules, as ESARR requirements may influence the choice of certain combinations of conformity verification modules and/or the content of their customisation.

As regards the interaction between ESARRs and the interoperability regulation what can be said is:

- Currently existing ESARR are not expected to have an impact on the definition of inter-operability rules,
- When new ESARRs are introduced to regulate aspects of ATM/CNS safety such as methodological requirements on the design, production and operation of systems and constituents, then the provisions of those new ESARR should be kept coherent with the conformity verification regime applicable to the systems and constituents submitted to the inter-operability regulation.

3.3 Interoperability regulation (2001/0237)

This section describes the "Core Regulation" for managing interoperability issues.

3.3.1 Definition of interoperability

The definition given in the SES regulation is the following:

[4] Those ESARRs provide for a set of harmonised safety regulatory requirements, to be used as inputs to the national safety rules against which ANSPs, the ATM System they operate and ATM staff must be regulated; some of those ESARRs also include requirements bearing on the safety regulators when verifying compliance with related safety rules applicable to ANSPs, the ATM System they operate and ATM staff.

"Interoperability" means a set of functional, technical and operational properties required of the systems and constituents of the European air traffic management network and of the procedures for its operation, in order to enable its safe, seamless and efficient operation. It is achieved by making the systems and constituents compliant with the essential requirements (SES Regulation Framework 2001/0060).

Usual Interoperability Definitions

1. *"The ability of two or more systems or components to exchange information and to use the information that has been exchanged"* [IEEE 90].

2. *"The ability of systems to provide services to and accept services from other systems and to use the services so exchanged to enable them to operate effectively together."* ISO TC 204 Document N271 (Adoption Proposed by ITS America)

In these definitions, the notion of system has to be understood in a broad sense. It can be extended to other entities such as organisations. The interoperability between the end-users (human) and the systems (machines) has also to be considered.

The definition of interoperability given by the SES regulation is wider that the definitions usually found elsewhere. This is reflected in the Essential Requirements.

Interoperability in its usual narrower is strongly connected with seamlessness, yet it is only one of the contributing factors safety and efficiency in the E-ATM network (For example, the redundancy of systems, which is a key point for safety, has nothing to do with the usual definition of interoperability; the introduction of new concepts, key point to improve efficiency, is not directly linked with interoperability in the usual definition of the term).

These remarks are important to understand the scope of the regulation, the perimeter of the regulatory material to be developed and to avoid misinterpretation.

3.3.2 Domains to be considered

Annex I of the Interoperability Regulation says: "For the purpose of this regulation the European air traffic management network is subdivided into eight systems[5]" that are reminded here.

- ASM: systems and procedures for ASM
- ATFM: systems and procedures for ATFM (including Flight Planning activities)
- ATS: systems and procedures for ATS (ATC and FIS), in particular: FDPS, surveillance DPS, HMIS
- COM: Communications systems and procedures: G/G, A/G, A/A
- NAV: Navigation systems and procedures,
- SUR: Surveillance systems and procedures,
- AIS: systems and procedures for AIS,
- MET: systems and procedures for the use of MET information.

We shall use that list as the starting point of our own analyses for the sake of traceability. We will refer to the functional domains such as ASM, ATFM… (or sub-domains: COM G/G, ATS/HMIS) in the rule-making process.

[5] The word "system" used here has not to be understood as a system whose compliance could be verified in the sense of Annex IV of the Interoperability Regulation. We will use the word "domain" to avoid ambiguity.

3.3.3 The three layers of the regulation

The Interoperability Regulation is organised in 3 layers:

- Essential Requirements (ER). ER are part of the regulation itself, that is the highest level of legislation;
- Implementing Rules (IR). The aim of an IR is: a) to refine and interpret Essential Requirements[6], and b) to give a reference to which systems, constituents and associated procedures shall comply with.
- Community Specifications (CS). This third layer is outside the mandatory part of the regulatory material.

In the Service provision regulation, the Safety requirements are equivalent to the Essential requirements (but do not cover all the scope of this regulation).

3.3.4 Essential Requirements

The ERs are listed at Annex II of the Interoperability Regulation. They are structured into 2 sets: general requirements that apply to all the systems and system-specific requirements.

3.3.4.1 General requirements

Seven items have been identified: Seamless operation, Support to new concepts of operation, Safety, Civil-Military co-ordination, Environmental constraints, Logical architecture principles, System construction principles.

That means that the Air traffic management systems and their constituents, shall be designed, built, maintained and operating, using the appropriate procedures in such a way:

- to ensure the seamless operation of the EATM network at all times and for all phases of the flight,
- to support new concepts of operation improving the quality and effectiveness of Air navigation services, in particular in terms of safety and capacity,
- to achieve agreed high levels of safety,
- to support civil/military co-ordination,
- to take into account the need to minimise environmental impact,
- to achieve a coherent, harmonised, evolutionary, validated logical architecture,
- and based on the grounds of sound engineering principles (modularity, interchangeability, availability, redundancy and fault tolerance).

The regulation gives some hints concerning the characteristics of the systems/constituents to assure these requirements:

a) Seamless operation is expressed in terms of: information sharing, common understanding of information, comparable processing performances.

b) Support to new concepts of operation would take benefit from the examination of the potential such as CDM, increasing automation and alternative methods of separation responsibility

c) Safety is expressed in terms of performance characteristics, freedom from harmful interference, and compatibility with human capabilities.

d) Civil-military co-ordination concerns mainly ASM and ATFM through the application of the FUA concept. It is expressed in terms of a correct and timely sharing of information.

[6] SES Regulation 2001/0237 Article 3 – point 3

3.3.4.2 Specific requirements

The regulation gives some more specific and detailed requirements in some domains. It addresses seamless operation and support to new concepts.

Most of the specific requirements concerning seamless operation are relative to:

- The performance and quality of service of the systems (accuracy, reliability of the results,…)[7],
- The quality of the information (correctness, consistency, relevance),
- The sharing of information in a timely way,
- The access to the information.

System performances are defined according to known traffic characteristics and an environment exploited under an agreed and validated operational concept.

Most of the specific requirements to "Support to new concepts" ask for the accommodation of the systems to new concepts of operation.

Domain	Seamless operation	Support to new concepts of operation
Airspace management	Provision of pre-tactical and tactical aspects of airspace availability (taking into account national security requirements)	
Air Traffic Flow Management	Sharing of coherent strategic, pre-tactical and tactical Flight information. Dialogue capabilities for an optimised use of airspace.	
Air Traffic services – FDP	To assure a coherent and consistent planning process and resource-efficient tactical co-ordination during all phases of flight, to ensure a safe, smooth and expeditious processing: Timely sharing and understanding of correct and consistent information. Equivalent FD processing performances (accuracy, error tolerance) in a given environment	Accommodation to new concepts of operation. Use of automation-intensive tools. Timely sharing and understanding of correct and consistent information (for airborne and ground systems)
Air Traffic services – Surveillance DP	Provision of the required performance and quality of service within a given environment (surface, terminal manoeuvring area, en-route) in particular in terms of accuracy and reliability of computed results, correctness, integrity, availability, continuity and timeliness of information at the control position. Timely sharing of relevant, accurate, consistent and coherent information	Accommodation to new sources of surveillance information
Air Traffic services – HMI systems	Provision of an harmonised working environment to all control staff, including functions and ergonomics, meeting the required performance for a given environment	Accommodation to new concepts of operation and increased automation
COM (G-G,A-G,A-A)	Systems: Achievement of the required performances within a given volume of airspace or for a specific application, in particular in terms of communication processing time, integrity, availability and continuity of function. Network: Meet the requirements of quality of service, coverage and redundancy	Accommodation to new concepts of operation
NAV	Achievement of the required horizontal and vertical navigation performance, in particular in terms of accuracy and functional capability for a given environment (surface, terminal manoeuvring area, en-route)	

[7] ISO 13236 "Quality of Service Framework concepts and terminology" that defines 8 potential QOS characteristics (time, coherence, capacity, integrity, safety, security, reliability, priority) could be useful to specify the performance of the services provided by the systems and therefore interoperability.

Domain	Seamless operation	Support to new concepts of operation
Surveillance	Systems: Provision of the required performance applicable in a given environment (surface, terminal manoeuvring area, en-route) in particular in terms of accuracy, coverage, range and quality of service. Network: meet the requirements of accuracy, timeliness, coverage and redundancy. Enable surveillance data to be shared.	
AIS	Accurate, timely and consistent aeronautical Provision of the information in an electronic form, based on a commonly agreed and standardised data set. Accurate and consistent aeronautical information, in particular concerning airborne and ground-based constituents or systems, shall be made available in a timely manner.	Increasingly accurate, complete and up-to-date aeronautical information shall be made available and used in a timely manner.
MET	Systems and procedures for the use of meteorological information shall improve the consistency and timeliness of its provision and the quality of its presentation, using an agreed data set.	Improvement of the promptness of the availability and the speed with which met information may be used.

Comments:

Six out of the seven Essential requirements are closely linked with the definition of services and with the ability of systems to provide services to and accept services from other systems (the usual narrow meaning of “interoperability”):

a) For the first requirement (seamlessness), domain-specific requirements detail the needs concerning the definition, performance and quality of the service, the access to the service.

b) The introduction of new concepts may lead to the definition of new or modified responsibilities between the stakeholders, and therefore to the definition or modification of the services provided by the systems through some new contributions of the others. This is also true for many improvements of the systems (in seamlessness, safety…).

c) The need for high levels of safety must be reflected into the design of the systems, the functionality of the services they provide

d) Further to a problem of responsibilities and organisation, the civil-military co-ordination is a special case of service provision.

e) An appropriate open architecture and f) sound engineering principles participate to the production of safe and efficient interoperability.

3.3.5 Implementing rules

The Interoperability SES regulation 2001/0235 says (Article 3) that implementing rules for interoperability shall be drawn “whenever necessary” to achieve in a coherent way the objectives of this regulation, in particular to complement or further refine the essential requirements, namely in term of safety, seamless operation, performances, introduction of validated concepts of operation or technologies.

Such rules determine, where appropriate, the constituents concerned by the regulation and the specific conformity assessment procedures:

- based on the modules defined in Decision 93/465/EEC to be used to assess either the conformity or the suitability for use of constituents as well as the verification of systems, and
- involving notified bodies (defined in Article 8).

The implementing rules specify the conditions of implementation including, where appropriate, the date by which all relevant stakeholders have to comply with it.

A Cost-Benefit Analysis must be made to assess the interest of the rule:

"The preparation, adoption and review of implementing rules for interoperability shall take into account the estimated cost and benefits of technical solutions by which they may be met, with a view to defining the most viable solution, with due regard to the maintenance of an agreed high level of safety. An assessment of the costs and benefits of those solutions for all stakeholders concerned shall be attached to each draft implementing rule for interoperability" (SES Interoperability Regulation 2001/0237 Article 3 point 4).

it must be noted that in some domains (ASM, ATFM), the implementing rules (and community specifications) defined for constituents, systems and procedures have to be built taking into account the essential requirements provided for in Regulations Airspace and Service Provision.

3.3.6 Community specifications

"*The development and adoption of Community specifications concerning the European air traffic management network, its systems and constituents and associated procedures is an appropriate means of defining the technical and operational conditions necessary to meet the essential requirements and relevant implementing rules for interoperability; compliance with published Community specifications, which remains voluntary, creates a presumption of conformity with the essential requirements and the relevant implementing rules for interoperability*" (SES IOP Regulation 2001/0237 Introduction point 12)

CS must be established by the European standardisation bodies (CEN/CENELEC/ETSI) in conjunction with EUROCAE and by EUROCONTROL in accordance with general Community standardisation procedures (Interoperability Regulation Annex paragraph 13); albeit they are voluntary rather than mandatory standards, their use creates presumption of conformity for systems and constituents to ER and IR, which means that industry and service providers should easily adhere to such standards.

The role of EUROCAE, EUROCONTROL in the Community Specifications development is given in the SES IOP Regulation (Article 4 point 1) with details on the nature of Community Specifications.

"Such specifications can be:
a) European standards for systems or constituents, together with the relevant procedures, drawn up by the European standardisation bodies in co-operation with EUROCAE, on a mandate from the Commission in accordance with the provisions of Article 6(4) of Directive 98/34/EC and pursuant to the general guidelines on co-operation between the Commission and the standardisation bodies signed on the 13th of November 1984,
or
b) specifications drawn up by EUROCONTROL on matters of operational co-ordination between air navigation service providers, on request of the Commission in accordance with the procedure referred to in Article 7(2) of Regulation (EC) No XXX/XX [framework]."

Comments and recommendations:

According to the SES regulation, there are 2 types of standards, technical standards for systems and constituents, that are to be developed in the CEN/CENELEC/ETSI framework in co-operation with EUROCONTROL and EUROCAE, and operational standards that deal with ATS service provision issues and that are to be developed by EUROCONTROL.

Based on this distinction it is reasonable to assume that two main types of IR should emerge:

- IR defining responsibilities, common operational procedures and performance requirements for addressing inter-operability issues at the level of Air Traffic Services;
- IR defining services, performance and quality of services requirements at the level of technical systems and constituents.

It should be noted that the functionality and performance of technical IR must be defined so as to meet the higher level operational requirements in the context of a given overall system architecture. Many ATM inter-operability rules should bear on service providers operating at different levels of service integration

rather than on equipment manufacturers, especially in those areas where a good traceability towards safety concerns has to be provided.

3.3.7 Verification of compliance – Transitional arrangements

a) Verification of conformity or suitability for use of constituents

When developing a constituent, a manufacturer shall ensure and declare by means of the EC declaration of conformity or suitability for use of constituents that he has applied the provisions laid down in the essential requirements and in the relevant implementing rules for interoperability (Article 5).

The EC declaration cover either the assessment of the intrinsic conformity of a constituent, considered in isolation to the Community specifications to be met; or the assessment/judgement of the suitability for use of a constituent, considered within its air traffic management environment (Annexe III).

b) Verification of compliance of systems

Prior to the putting into service of a system; the relevant air navigation service provider shall establish an EC declaration of verification, confirming compliance with the essential requirements and implementing rules and shall submit it to the national supervisory authority together with a technical file (Article 6).

The system is checked for each of the following aspects: overall design; development and integration of the system, including in particular constituent assembly and overall adjustments; operational system integration; specific system maintenance provisions if applicable.

The relevant implementing rules for interoperability shall identify where appropriate the tasks pertaining to the conformity of constituents and verification of systems to be carried out by the “notified bodies “.

c) The verification of conformity of constituents and compliance of systems should be based on the use of modules covered by Council Decision 93/465/EEC (recital 14 and Article 3.3.d). As far as necessary these modules should be expanded to cover specific requirements of the industries concerned. (Recital 14). One of the objectives of this study is to check that the existing modules are sufficient for the purpose of ATM inter-operability testing or to propose additional modules. This point is discussed at section 4.

d) The fact that ATM products do not address the mass market and are not intended for use by the general public makes it unnecessary to have CE markings affixed to them (Recital 15). However markings imposed by other regulations should be maintained. For example, a Controller Working Position is physically a computer connected to a large CRT and those constituents are submitted to general CEN/CENELEC requirements regarding such electric equipment (e.g. protection by fuse against shortcuts etc.). The CE marking affixed on the relevant components will serve to testify that electrical standards are complied with, while other higher level aspects of HMIS interoperability as the surveillance or flight data processing capacity of the HMIS will be addressed separately. In this study, we shall deal only with ATM-specific aspects of interoperability. This does not mean that we exclude completely low level issues of physical inter-operability: if it is found, for example, that existing electrical insulation standards are not sufficient, then specific rules and standards should be defined.

It must be noted that the preamble of the Interoperability Regulation insists on electromagnetic compatibility, the protection of Safety of Life services from harmful interference and the efficient use of aviation-allocated frequencies. These aspects belong to what we describe as the physical inter-operability level.

e) Article 10 of the SES IOP Regulation 2001/0237 gives the transitional arrangements with two important dates, one for new systems put into service (beginning or mid 2005), and the other for all the systems (beginning or mid 2012)[8].

Comments: The regulatory material must be rapidly "operational" to allow development and verification of the systems put into service after beginning-mid 2005.

In particular, it is necessary to define the presumed means of conformity and the specific conformity assessment (including the definition of the tasks for notified bodies) for each constituent and system that will be put into service when the essential requirements shall apply. Verification of compliance cannot leave room for interpretation. The process must be clear, unambiguous and comprehensive to guarantee equal treatment among manufacturers and ANS providers by the notified bodies and the regulatory authorities.

Concerning performance, the essential requirements are only qualitative[9]. Implementing rules or community specifications will be necessary to define quantitatively performance characteristics, unless already specified by internationally agreed standards (e.g. in ICAO SARP) in order to allow for the verification of compliance.

Considering that the ATM products/systems/services have to comply with a complex relevant requirement baseline (e.g. ICAO SARPs, EUROCONTROL Rules / Standards, EU regulations, etc.), a global and homogenous approach is to be applied by the "users" of the regulation (manufacturers, ANS providers…).

Systems will be designed and developed taking into account safety, performance, interoperability, security or quality of service requirements. We assume that, for those sufficiently mature technologies that are the subject of the inter-operability regulation, the corresponding inter-operability rules and specifications will be based on the results of pre-existing safety studies, leading to a consensus on the necessary functionality, the applicable operational constraints, and the allocation of performance requirements amongst system constituents.

Those aspects of safety certification should be covered by specific documents (Safety Cases, Contingency Plans…) to be developed by ATS/ANS providers submitted to the Service Provision regulation regime of 2001/235 and they are not considered within the scope of this study.

Knowing that the ATM/CNS systems are continuously updated with new versions and modifications, another point to be clarified is at which conditions a new verification of conformity is necessary.

An implementing rule may address the definition and/or the deployment plan of an operational concept, the distribution of responsibilities between service providers, or the application of specific operational

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[8] "Starting from 1½ years after the entry into force of this Regulation, the essential requirements shall apply to the putting into service of systems and constituents of the European air traffic management network, if not otherwise specified by the relevant implementing rules for interoperability.
Compliance with the essential requirements shall be required for all systems and constituents currently in operation by 8½ years after the entry into force of this Regulation, if not otherwise specified by the relevant implementing rules for interoperability.
Where systems of the European air traffic management network have been ordered or binding contracts to that effect have been signed:
- before the entry into force of this Regulation,
or, where appropriate,
- before the entry into force of one or more relevant implementing rules for interoperability,
so that compliance with the essential requirements and/or the relevant implementing rules for interoperability cannot be guaranteed within the time limits mentioned in paragraph 1, the Member State concerned shall communicate to the Commission detailed information on the essential requirements and/or implementing rules for interoperability where uncertainty of compliance has been identified."

9 For example : "Surveillance data processing systems shall be designed, built, maintained and operated, using the appropriate and validated procedures, in such a way so as to provide the required performance and quality of service within a given environment (surface, terminal manoeuvring area, en-route) with known traffic characteristics, in particular in terms of accuracy and reliability of computed results, correctness, integrity, availability, continuity and timeliness of information at the control position.

Surveillance data processing systems shall accommodate the timely sharing of relevant, accurate, consistent and coherent information between them to ensure optimised operations through different parts of the network."

procedures without direct links to systems and constituents. In those cases, it would be irrelevant to expect the development of Community Specifications against which a presumption of conformity could be assessed, and ad hoc conformity assessment procedures should be defined on the basis of written declarations made by ANS and ATS providers near the relevant authorities in charge of supervising their operations (those cases can be considered as a special case of the manufacturer's self-declaration of conformity as described in module A of Decision 93/465)

The use of existing modules described in Decision 93/465 and the definition of additional mechanisms and/or new modules we propose at chapter 4 have to be assessed by the stakeholders and the Regulation Authorities.

Thus, we suggest that a task force involving representation from all relevant stakeholders should be created in order to examine conformity assessment procedures in more details. This could be done as part of the drafting process for the Implementing rule dedicated to this subject.

3.4 Determining SES IOP objectives: interpretation of the Essential Requirements

Interoperability is justified by a wish of achieving greater *integration* between entities sharing a common "general objective" (here the provision of a safe and efficient European Air Transport) but which were "historically" operating in relative isolation one from another. Achieving a certain level of integration basically determines interoperability objective to be set for non-integrated systems.

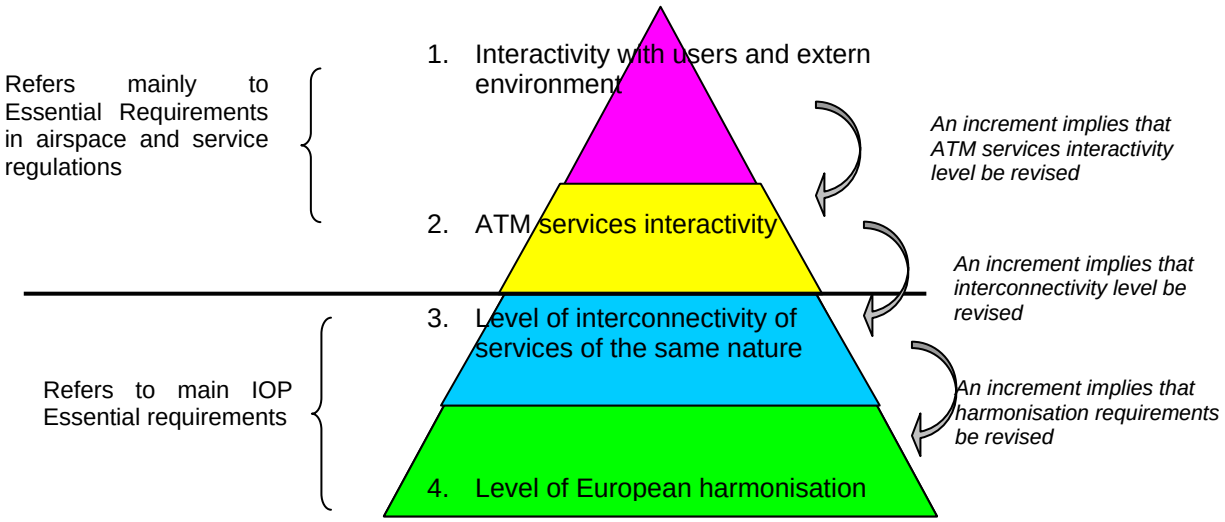
To our understanding of the SES regulatory texts, four integration "levels" may be at stake:

1) European harmonisation of the structural characteristics of services providing the same type of service so that free movements of workers and products can be achieved from one place to another within the Single Sky

2) European interconnectivity of the mosaic of services providing the same ATM functions in the Single Sky at different places so that despite that tessellated structure, seamless operations are achieved while moving throughout the European airspace

3) European interactivity between all ATM functions within the Single Sky providing different services so that a robust, consistent and efficient functioning of the ATM system as a whole can be achieved.

4) Interactivity with ATM service users and externalised elements of the Single Sky.



All these objectives are inter-linked by means a cascade of incremental adaptations. Indeed enhancing the level of interactivity of the ATM system with the Single European sky users and more generally the integration within the extern environment, potentially implies that ATM services interactivity be enhanced, which then may require that larger operational scope for achieving seamless operations be considered, all this shall finally lead to local enhancement solutions featuring a minimum of common characteristics so that free movements of products and workers be achieved within the Single Sky.

⇨ Interoperability improvement cascade:

(Modification of the ATM service to users or the interaction with extern environment ⇒ revision of the ATM services and their interactivity ⇒ revision of the interconnectivity scope of the services providing the same service ⇒ harmonised enhancement of the intern structure of the services providing the same service)

For example, the Essential Requirement dealing with the FUA can be interpreted as a wish to providing new routing options to civil aviation through the opening of military airspace to civil aviation. It is a *4th level IOP objective* – improved interactivity with users. Achieving it requires enhancing simultaneously ASM, ATFM and AIS services activity (and interactivity) *3rd level IOP objectives*, that derives into implementing a system-wide architecture with local & central functions assuring European consistency – *2nd level IOP objective*, and harmonised systems & procedures enabling the service to be provided in all European ATS – *1st level IOP objective*. All these objectives are specified in a single consistent document, EUROCONTROL "ASM Handbook – FUA".

Satisfying the essential requirements does not necessarily lead to develop new specific objectives at all the levels. Indeed many ES already specify objectives of lower level than the 4th level. However developing the basis of the pyramid shall remain any time required since one of the most fundamental essential requirement of the IOP regulation focuses on the two IOP objective levels at the basis of the pyramid, still notwithstanding that the upper ones are punctually scoped in the IOP but are mainly specified in the other SES Regulations (essentially SES Regulation 0236 _ Airspace).

In this scheme Implementing Rules serve to specify at any step of the process, the mandatory requirements that any service has to meet to satisfy the Essential Requirements (including the modality of conformity assessment), while Community Specifications offer the complements describing any technical / operational solutions by which this shall be achieved (including solutions for conformity assessment).

It is therefore important to determine which level every essential requirement sits at so as to identify the relevant portions of the inter-operability cascade, by which actual satisfaction of the essential requirement can be achieved. It is thus an important driver for defining of the IR/CS development program. Depending on the level, IR and CS shall address different problems, provide different nature of requirements and scope different "elements to be certified". The following array provides the results of a first attempt to classify / identify them.

IOP objective	Characterisation of the Interoperability requirement
Level of European harmonisation of services of the same nature	Standard characteristics of components enabling the service provision respecting the required nature and quality of service of services providing the same ATM/CNS function in the Single Sky
	Standard characteristics of components assuring inter- connections between services providing the same ATM/CNS function in the Single Sky
Level of seamlessness between services of the same nature	Common nature and quality of service of services providing the same functions in the Single Sky
	Nature and level of service exchange between services providing the same function in the Single Sky
ATM services interactivity	Nature and quality of service of an ATM/CNS service consistent with other services' nature and QoS to assure the provision of the required ATM/CNS system service to users and conditions of integration with extern environment within the Single Sky
	Nature and level of Interactivity between ATM services within the Single Sky
Interactivity with users and extern environment	Nature and quality of the ATM/CNS system service to users within the Single Sky
	Conditions of the ATM/CNS system interaction with extern environment within the Single Sky

3.5 Conclusions

In this chapter, we describe how the SES regulations are related to the interoperability regulation whose main features were pointed out. We indicate that the implementing rules should cover two aspects, one operational dealing with responsibilities, operational procedures and another one more technical, corresponding to the two kinds of community specifications.

We point at the SES wide interpretation of "interoperability". We underline the interest of having a commonly accepted logical architecture thus setting a reference framework for the constituents of the ATM/CNS network, and the services and interfaces they provide.

We take account of the constraint to have sufficient regulatory material to allow the use of the regulation during the transition period, starting 1 and a half year after the entry in force of the regulation. In particular, the definition of the presumed means of conformity and the specific conformity assessment including the definition of the tasks for notified bodies has to be defined shortly for systems and constituents.

Considering that several problems are linked to the conformity assessment process, we point out the need to define an implementing rule defining more precisely, according to the type and characteristics, of procedures, systems and constituents to be regulated, these means of conformity and we support EUROCONTROL idea concerning the creation of a task force to examine the problem of certification in more details. A framework for dealing with those issues is provided in the next chapter.

Finally, we define 4 levels of IOP objectives (degree of integration) which allow an identification of the IOP problems and a classification of the future IR/CS. This structure will be used in the rule-making.

4 REVIEW OF THE SES INTEROPERABILITY FRAMEWORK

4.1 Objectives of the chapter

The objective of this chapter is to analyse the International and European regulatory tools in order to describe the mechanisms and constraints applicable to the Single European Sky rule-making process.

We consider successively:

- the international context of Civil Aviation Legislation (ICAO, International Standardisation System),
- the general European Legislation (EU treaty, Harmonisation and Common Market, The Global Approach for Conformity Assessment and CE marking).

In particular, we analyse the usability of "modules" defined by the European Legislation for the certification process and we propose some other modules to be more compliant with the certification needs of the ATM/CNS network.

Lessons learnt for the SES rule-making process are given at the end of each section.

4.2 Chicago Convention

This section recalls how interoperability is organised at ICAO level:

- on a worldwide basis through SARPs and PANS,
- on a regional basis through EUR level SUPPs Documents, and regional and national ANPs and AIPs,

We analyse the implication of this regulation on the SES rule-making process.

4.2.1 ICAO global standards

The ICAO principles for the establishment and enforcement of inter-operability standards are:

- It is the power (and duty) of individual Member States to develop and enforce rules with respect to operation and navigation of aircraft; this includes various prerogatives such as the definition and operation of services provided, the designation of flight routes and the publication of airspace restrictions;
- National laws should be aligned on regulations established under the Convention (article 12);
- Standards adopted by ICAO must be enforced by States, unless they have notified deviations (Article 38); notification is mandatory10, which makes a strong case for adopting a very strict interpretation of the mandatory character of the standards, in the absence of such prior notification of deviation. But there is no regime of sanctions against non-compliance to the Standards.

By Article 38 of the Convention, each Contracting States is obliged to notify ICAO of any differences between their national regulations and practices and the international Standards contained in the Annexes and any amendments thereto. Contracting States are also invited to extend such notification to any differences from the Recommended Practices contained in the Annex and any amendment thereto, when the notification of such differences is important for the safety of air navigation.

[10] Contracting States are also invited to extend such notification to any differences from the Recommended Practices contained in the Annex and any amendment thereto, when the notification of such differences is important for the safety of air navigation.

Standards and Recommended Practices (SARPs) are adopted through a mandate granted by the Convention to the ICAO Council (Article 37) and they are published by the Air Navigation Commission (ANC); in a number of areas, technical provisions make reference to other standards of world-wide application which are adopted at the level of ITU, and updated every three years by the World Radio Conferences (WRC).

- "Standard: any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognised as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention; in the event of impossibility of compliance, notification to the Council is compulsory under Article 38."
- "Recommended Practices: any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognised as desirable in the interest of the safety, regularity or efficiency of international air navigation and to which Contracting States will endeavour to conform in accordance with the Convention."
- The following editorial practice has been adhered to in order to indicate at a glance the status of each statement. Standards have been printed in light-face roman, and using the operative verb "shall". Recommended Practices have been printed in light-face italics, the status been indicated by the prefix "Recommendation" and the operative verb "should".
- Note that efficiency is only considered through recommended practices; it is not the case in the SES regulation where effectiveness can be the objective of mandatory requirements.

SARPS are contained in a set of 18 Annexes to the Chicago Convention.

The annexes of most relevance to this study are:

- Annex 10 (Aeronautical Telecommunications, a matter that concerns also radar surveillance and navigation aids) for CNS standards;
- Annex 11 (Air Traffic Services) for ATFM, ATS and FIS procedures;
- Annex 2 (rules of the air) for ASM;
- Annex 3 for Meteo;
- Annex 15 for AIS.

SARPS are primarily aimed at ensuring the operational and technical inter-operability of aircraft CNS equipment and also of ATC and FIS terminology and procedures on a worldwide basis, so that an ILS receiver or a VHF or radar transceiver, for example, when fitted onto an aircraft can work properly with the corresponding ground equipment anywhere in the world.

ICAO SARPS are limited in their scope to aircraft-bound or inter-ANSP co-ordination issues that are of world-wide relevance as of their potential impact for the safety and expeditiousness of international flights.

Technical issues such as, for example, the data exchange protocols and formats used for the ground-ground interconnection of surveillance radars with Surveillance Data Processing Systems (SDPS) are considered as "local issues" and left open in the SARPS.

On the operational plane, another type of document exists, denoted as Procedures for Air Navigation Services (PANS) and which may be published separately; they are approved by the ICAO Council for worldwide application. Rules for adoption and compliance with PANS are similar to the SARPS ones.

"They contain, for the most part, operating procedures regarded as not yet having attained a sufficient degree of maturity for adoption as International Standards and Recommended Practices, as well as

material of a more permanent character which is considered too detailed for incorporation in an Annex, or is susceptible to frequent amendment, for which the processes of the Convention would be too cumbersome."

ICAO annexes may contain a mix of SARPS and PANS (e.g. volume I of Annex 10 contains SARPS while volume II includes aeronautical communication procedures that have the status of PANS document).

A more detailed review of SARPS is provided in the following chapter of this report.

4.2.2 ICAO Regional Standards – Technical Manuals – ANP

In Europe, the ICAO EUR Regional Office may prepare additional standardisation documents addressing ANS operations and denoted as SUPPs (Regional Supplementary Procedures). SUPPs are of the same nature as PANS, except that their scope of application is regional instead of global (they are approved by the Council). ICAO EUR does not publish technical standards refining or supplementing SARPS: when such standards are deemed necessary, they are developed by EUROCONTROL.

Technical Manuals provide guidance and information in amplification of the International Standards, recommended practices and PANS.

Air navigation Plans detail requirements for facilities and services for international air navigation in the respective ICAO regions. They are produced at the national level and consolidated on a regional level under the authority of the Secretary General.

ANP describe the concrete implementing measures taken by states and co-ordinated within the region, but do not specify new standards, although they may mention occasional deviations from the international standards, e.g. taking stock of national specificity regarding the use of radio-frequencies).

4.2.3 Links with the Single European Sky rule-making process

For the purpose of this study we shall assume that the hierarchy between International Standards and European ones is respected, but also that ICAO SARPS shall not be unnecessarily referred to in the Implementing Rules for the Single European Sky. Here is an overview of the impact of existing ICAO standards on the development of Interoperability rules:

- ICAO global and regional standards are expected to be applied by all EU states (who are also ICAO States) and therefore compliance with those standards should not be contradicted by EU law and regulations unless differences have been formally notified by the concerned states to ICAO; one of the missions assigned to the entities in charge of producing those rules shall be that no such contradiction crops up;
- Implementing Rules should also make due reference to any applicable ICAO standards of relevance to the area they address, and require compliance with those standards, insofar as they can be considered as a pre-requisite to further Community Specifications (for example, if an Implementing Rule is developed for establishing a common time reference for flight data should make reference to the UTC/TAI standard which is mandated by ICAO);
- Implementing Rules need not make reference to ICAO Standards in areas where compliance with those standards is not directly relevant to the object of the rule (for example if an EU standard is developed for addressing radar-RDPS interconnections, then any reference to SSR SARPS at Annex 10 are relevant to that purpose; those SARPS may be mentioned, in order to provide advisory elements of context, but their content needs not be repeated);
- the EU may impose onto its members additional measures such as specific requirements on acceptable means of conformity, or tighter/more sophisticated requirements than basic ICAO ones, as necessitated by an efficient implementation of the Single European Sky.
- If an implementing rule is envisaged that falls at odds with an existing ICAO standard, two solutions may be envisaged: the concerned States (possibly through EUROCONTROL coordination.) to the ICAO Air Navigation Commission through the ICAO Secretariat, or b)

Europe initiates a co-operative work to modify the ICAO standard (and defer the entry into force of the rule till the moment the new standard is available.)

4.3 International Standardisation system

4.3.1 Definition and presentation of the organisms

Standard Definition (ISO/IEC Guide 2:1996)

"Document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at achievement of the optimum degree of order in a given context."

"*Standardisation is commonly understood as the process in which agreements between interested parties are made and established (in a standard). These agreements are often of a technical nature. The intention and expectation of the establishment of theses agreements is that they are used repeatedly."* (This definition is proposed by the Dutch Standardisation Institute).

Generally, standards are developed according to the following principles:

- consensus: the view of all interests are taken into account,
- industry-wide: global solutions to satisfy industries and customers,
- voluntary: standardisation is market-driven and therefore based on voluntary involvement of all interests in the market-place.

The following table gives a current view of the International Standardisation System:

Scope	General standards for industry	Mandatory rules for radio spectrum allocation and assignment	Aeronautical Standards
International	ISO/CEI/CCITT BIPM (metrology) IRTF (geodesy)	ITU	ICAO SARPS
European	CEN/CENELEC/ETSI (recognised European Standardisation Organisations)	CEPT	ICAO EUR Documents EUROCONTROL EUROCAE
National	ANSI, AFNOR, BSI, DIN	ANFR	RCTA, national ANP & AIP

Three types of standards can be defined, according to their use in a programme[11]:

- Administrative standards grouping:
  - standards which are common to all domains of activities and dealing mostly with terminology, metrology, statistics, agreement and symbols (ex for aviation: JAR 1).
  - organisational standards: standards on processes for global management of the programme (ex: JAR 11).

[11] From « Les Normes dans le domaine aéronautique et spatial (DGA, DGAC, CNES, GIFAS) – April 93 », and NATO standardisation. In the first document, "Technical standards" are divided into "System standards" and "Technology standards". "Operational standards" are not defined. Technical standards are called materiel standards in NATO.

- Operational standards: standards which affect current practice and procedures such as concepts, organisations, training, logistics.
- Technical standards are those standards which affect the characteristics of future and/or current materiel to include telecommunications, data processing and distribution. They may cover production codes of practice as well as materiel specifications. Materiel includes complete systems, sub-systems, assemblies, components, spare parts and materials.

Operational and technical standardization are inter-dependent. Standardization in key operational areas, such as operational concepts and procedures and mission requirements, facilitate the standardization of equipment and systems supporting those concepts and procedures. In turn, new technology may require the reformulation of operational concepts and will often results in changes to operational procedures.

In practice, standards often refer to "industry standards" which are applied on a voluntary basis. In the ATM field, specific mention must be made of ICAO and (former) EUROCONTROL standards[12], which are by definition binding requirements. Such requirements of a mandatory nature need often to be completed by lower level material describing in a sufficiently detailed way means of compliance to the rules.

(Former) EUROCONTROL Standards are binding for the EUROCONTROL States, but:

- they do not comply with the non ambiguous conformity assessment requirement of SES regulation,
- they do not comply with the stakeholders' consultation requirement (the ENPRM process has been implemented only recently),
- there is no supra-national imposition regime for ensuring compliance with those standards.

Links with the Single European Sky rule-making process

The approach of the SES IOP Regulation is to rely on the three recognised European Standardisation Organisations to publish European Standards, these organisations being invited to cooperate with EUROCAE (Article 4 point 1a).

In the IOP regulation, standards are only considered as voluntary instruments presuming compliance to the essential requirements or the implementing rules. This attitude is in the spirit of the standardisation process in the so called "new approach" and "global approach"(outlined at section 4.4.2.)

Normally, the technical details of the mechanisms supporting inter-operability will remain at the level of voluntary standards but there could be cases when, for the very sake of interoperability, the detailed technical solutions will have to be imposed, and therefore incorporated directly into the Implementing Rules.

The obvious risk of having the technical details of inter-operability being left voluntary is that inter-operability may be jeopardised by the emergence of several alternative standards.

n a very competitive and challenging economical environment, the risk that several alternative solutions emerge and evolve into several competing "de facto" standards is very small, and that risk is even smaller in the context of air traffic management services, with its long history of global co-operation and co-ordination. Once a Community Specification will have been published, since compliance with it will create a presumption of conformity with the corresponding rule, making the pursuit of alternative paths is even less attractive for constituent and system manufacturers.

[12] "Former" EUROCONTROL standards contain a mandatory part and a voluntary part (Ex: OLDI contains 5 mandatory pages out of 85). EUROCONTROL had issued the "Directives for EUROCONTROL Standardisation" document, based upon comparable directives applied in different international organisations aiming at producing international standards (ICAO, ISO, CEN/CENELEC/ETSI, IEC), notably presenting editorial practices for "Normative Elements" and "Recommended Elements" similar to the ICAO practices for "Standards" and "Recommended Practices".

We also think that in those cases when one single technical solution would have to be imposed, it is not adequate to mandate a standard by reference in a rule[13], except if this standard is extremely stable (metrology, electro-magnetic interface…). The reason is that if the standard evolves, the rule is no more pertinent. In that case, it would be necessary to put the content of the standard (or part thereof) inside the rule itself.

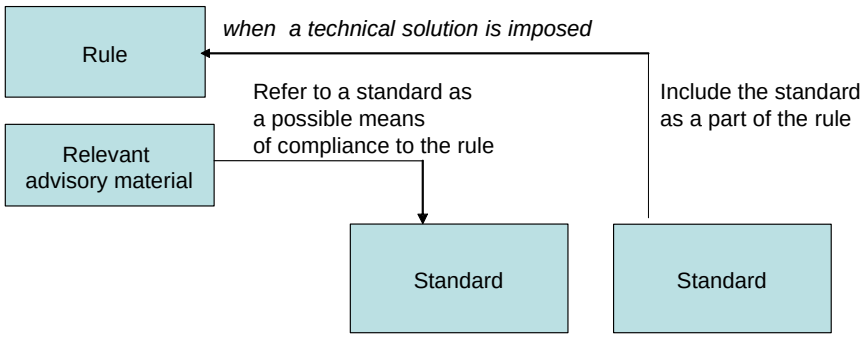


Figure 4.1: Reference to standards in the rules

Therefore, unless is it explicitly mandated by a rule, a standard remains a voluntary instrument, even if widespread adhesion is expected.

Based on the same arguments as exposed for ICAO SARPs, we assume that existing International and European Standards shall not be unnecessarily referred nor repeated in the Implementing Rules for the Single European Sky, nor in the Community Specifications.

Considering the different types of standards which have been evoked, we can supplement our typology of implementing rules with the notion of “administrative rules”:

- for the clarification of the regulatory process (method), (cf JAR11)
- for the definition of common terminology, common characterisation of the environment (for example definition of traffic characteristics to support the definition of performances),
- common methodology (conformity assessment, safety management).

We will propose some administrative rules in this document.

[13] The opposite position is taken in JAA. For example, in EASA, IR 21 says that “the applicable requirement” is CS 25.

4.4 General European Legislation of relevance to the SES regulation

In this section, we discuss salient elements of European legislation of relevance to the SES regulation, that is:

- The EU Treaty,
- The concept of the New Approach for technical harmonisation and its implementation,
- The concept of the Global Approach for conformity assessment and its implementation,

For each element we discuss their potential impact on the implementation of SES Regulation.

4.4.1 EU Treaty

This section discusses only those elements referred to in the Draft SES Regulations, especially article 5 of the European Union Treaty.

Article 5 states that:

"*The Community shall act within the limits of the powers conferred upon it by this Treaty and of the objectives assigned to it therein.*

In areas which do not fall within its exclusive competence, the Community shall take action, in accordance with the principle of subsidiarity, only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States and can therefore, by reason of the scale or effects of the proposed action, be better achieved by the Community.

Any action by the Community shall not go beyond what is necessary to achieve the objectives of this Treaty."

Recital 23 of the Framework Regulation justifies the intervention of the Community in establishing the Single Sky, "*while allowing for detailed implementing rules that take account of specific local conditions".*

Links with the Single European Sky rule-making process

The single most important point here for our study is the requirement that implementing rules should take due account of specific local conditions. Since a wide consultation of stakeholders must take place before any implementing rule is adopted, it can be expected that any issues connected with specific local conditions would be raised at the latest during that consultation process.

Leaving room for subsidiarity may be achieved, at the level of SES Implementing Rules, in two (non exclusive) ways:

- developing IR sufficiently detailed so as to identify all of those specific local conditions that need to be addressed, grouping them into ad hoc categories, and proposing an implementation variant for each category;
- developing IR containing only the common core requirements, and deferring the definition of further details to relevant local authorities while specifying what sort of additional local rule should be defined, and imposing a finite (and preferably small) set of acceptable options, in order to have inter-operability combinations still manageable.

4.4.2 Harmonisation and Single Market (Directive 98/34/EC)

The so-called New Approach was defined in the context of the creation of the Single Market, on the 31st of December 1992.

The European Union Treaty, as consistently interpreted by case law of the European Court of Justice, implies that:

- Products manufactured or marketed in one country should be able to move freely within the whole Community,
- Restrictions to trade may be imposed by national measures only when:
  - They derive from safety or other public protection requirements (environment, health, etc.),
  - They serve a legitimate purpose (in a way that respects the principle of proportionality of the means employed to the ends pursued).

An important technical limitation to the free movement of goods across national boundaries within the Community has been the existence of diverging national technical regulations and standards that would have maintained a fragmented market, despite the formal removal of all other legal and regulatory barriers, since it could always be argued that technical harmonisation is a legitimate purpose.

Directive 98/34/EC (amended by Directive 98/48/EC) obliges Member States to notify any draft technical regulations developed at the national level, and defines a “standstill period” of 3 months before their adoption, so as to provide the Commission and other Member States with some time to analyse the proposed document and react to it (if objections are raised, the standstill period is prolonged by 3 additional months, and in the case when a directive is being elaborated, the standstill period is of 12 months, so as to avoid that the late introduction of new national regulations create problem with an emerging Directive).

Yet it was not sufficient to avoid the continued proliferation of national standards, and the efficient implementation of the Single Market obviously called for the development of Community-wide technical harmonisation. Therefore, the same Directive 98/34/EC gives the possibility to the Commission to consult Member States on the opportunity of elaborating European standards.

The so-called New Approach to technical harmonisation and standardisation was adopted as a Council Decision of 1985, and its interpretation has evolved as it was put to the test in various fields of application. In particular, the notion of Implementing Rules as a mandatory refinement of Essential Requirements was introduced recently.

However, the 4 basic principles of the New Approach remain the same:

1. Legislative level harmonisation is limited to essential requirements; any products meeting those essential requirements should enjoy free movement within the Community,
2. The technical specification of such products are described in harmonised standards, which are published in the Official Journal, and that are presumed to be in conformity with the essential requirements,
3. The application of those standards remain voluntary and every manufacturer remains free to apply other technical specifications meeting the same essential requirements (yet it may become harder for him to demonstrate conformity with those requirements),
4. Compliance with harmonised standards creates a presumption of conformity with the corresponding essential requirements.

As discussed in the corresponding section, the set of draft SES regulations was developed according to the principles of the New Approach.

4.4.3 The Global Approach for Conformity Assessment and CE marking (Dec 93/465/EEC)

For the New Approach to work properly, a guaranteed and homogeneous degree of protection with respect to the essential requirements must be attained, under the responsibility of national authorities.

In particular, a safeguard clause must be included in every directives or regulations laying out essential requirements, so as to allow national authorities to discharge their responsibility, in the case when overriding safety or security concerns appear, and also in situations when those harmonised standards that create a presumption of conformity are discovered to be erroneous or inadequate. (for example, article 12 of Draft Regulation 2001/0060 provides safeguards relating to national security and defence issues, and similarly Article 7 of Draft Regulation 2001/0237 provides safeguards relating to the imposition of restrictions or prohibitions on systems and constituents.)

The salient features of the so-called Global Approach are:

1. When a directive or regulation defines essential requirements it must also specify a conformity assessment procedure, which is to be applied by the manufacturer before the product may be put on the market, and this is materialised by a CE marking (however some directives and regulations do not require a CE marking, and this is the case of Draft Regulation 2001/237)
2. When some third party assessment is required by the assessment procedures, it is conducted by Notified Bodies that have been designated by Member States and the directive or regulation must also define the requirements applicable to such bodies.

So far, some 30 directives and regulations addressing various technical areas have been adopted or are in preparation according to the principles of the New Approach and the Global Approach.

The next section analyses the different modules introduced in relation to CE marking, and discusses their respective applicability to SES interoperability, in the light of the EOTC implementation guidelines for the “New Approach” and the “Global Approach”.

We will also discuss some examples of conformity assessment procedures that have been defined in fields of some relevance to SES inter-operability regulation (electromagnetic compatibility, radio telecommunication terminal equipment).

4.4.4 SES context for conformity assessment procedures

Conformity assessment procedures derived from Decision 93/465/EEC are mentioned in the SES inter-operability regulation (2001/0237 article 3 (d)) as having to be introduced at the level of to-be-defined Implementing Rules.

Therefore, when an Implementing Rule is developed, it should contain a description of acceptable means of compliance and in particular the type of compliance verification mechanism that is required.

Wherever notified bodies are tasked with conformity and suitability assessment, such bodies may be notified by States specifically for inter-operability verification purposes (article 8.1 and 8.2 and Annex V of regulation 2001/0237) or may be already identified as recognised organisations tasked with inspections and surveys of ANS providers (article 4 and Annex I of regulation 2001/0236).

Our interpretation of the criteria for the selection of notified bodies is that it might be more adequate to have the same bodies capable of conducting ANS supervision also in charge of conducting inter-operability assessment when operational procedures have to be dealt with, rather than mere technical systems interfaces.

Council Decision 93/465/EEC provides strict guidelines for any future directives or regulations defining conformity verification procedures for industrial products. “*These procedures may only depart from the modules when the specific circumstances of a particular sector or directive so warrant. Such departures*

from the modules must be limited in extent and must be explicitly justified in the relevant directive" (this quotation is from article 1.1 of the Decision).

Recital (15) of Regulation 2001/0237 indicates a number of potential causes of deviation from standard CE marking regulations and practices primarily focused at mass market products: "*the market concerned is of small size and consists of systems and constituents of an almost exclusive use to ATM purposes and not destined to the general public*".

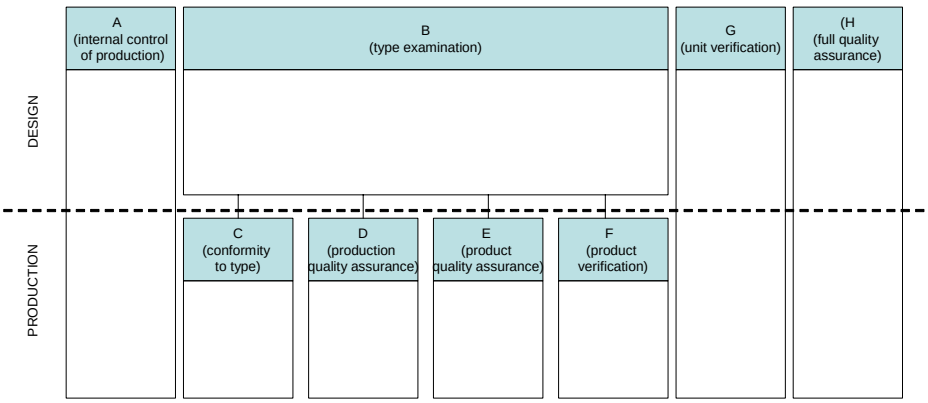
4.4.5 The modules of Dec 93/465/EEC

The text of this decision refers only to Directives, which were at the time the Decision was taken the main legal instrument available for producing binding rules. However, we can consider that the same principles apply also to other binding rules contained either in primary regulations or in secondary regulations such as the foreseen Implementation Rules. Therefore we have replaced the word "directive" by the word "regulatory text" in this section, where we mean by regulatory text either a directive, or a regulation or an implementing rule.

The list of modules is provided as an Annex to the Decision, together with a list of clarifying comments and additional recommendations:

- the main focus is the health and safety of users and consumers,
- different modules may be used for the design phase and for the production phase,
- the regulatory text must define precisely which modules (or combination whereof) are acceptable, and should leave as wide a possible a choice to manufacturer while avoiding to impose unnecessary modules that create an economic burden on operators (in the same spirit, notified bodies should be encouraged to make an economical application of the modules, and co-operate so as to ensure consistent technical application across Member States),
- the sub-contracting of conformity assessment work must be regulated on the basis of conformity with EN 45000 standards.

There are 8 generic modules, with some variants. The following table gives the scope of each module.



a) Module A, denoted as Internal Production Control, makes the manufacturer responsible for:

- establishing a declaration of conformity in writing,

- keeping (or at least 10 years after the end of production, (this is a default value that may be modified in the regulatory text) the technical documentation (design, production and operation) available for inspection by national authorities,
- taking measures to ensure that the production process ensure compliance with the applicable requirements and the technical documentation.

Variant Aa of module A adds the following constraint:

Certain tests (to be specified in the regulatory text) must be carried out on each product by the manufacturer or on his behalf, supervised by an identified notified body chosen by the manufacturer, or product checks are conducted at random intervals directly by that notified body.

b) Module B, denoted as Type Examination, makes the manufacturer responsible for:

- applying, near one (and only one) notified body, for an examination of conformity to the provisions of the regulatory text be undergone by a specimen,
- attaching the technical documentation (design, production and operation) of the product to the application,
- ensuring that the technical documentation enables the conformity,
- providing one or more specimen as requested by the notified body for undertaking tests,
- applying for additional approval when modifications are made to the product that may affect its conformity,
- keeping for at least 10 years after the end of production (this is a default value that may be modified in the regulatory text) the type certificates and related documentation.

The notified body is responsible for:

- Checking that the standards said to have been applied by the manufacturer have indeed been applied,
- Agreeing with the applicant where the necessary examinations and tests will take place
- Issuing a type certificate (including a complete identification of the examined type and its documentation) if the outcome of the conformity assessment is positive, or providing detailed reasons if the outcome is negative,
- Keeping a copy of the documentation and certificate (potentially available for other notified bodies)
- Notifying to other notified bodies the relevant information regarding the certificates it has issued, their additions and withdrawals.

c) Module C, denoted as Conformity to type, is to be applied as a follow-up to module B; it makes the manufacturer responsible for:

- Verifying that the manufacturing process assures compliance of the product with the type,
- Producing a written statement of conformity to type (and keeping it for 10 years after production stops).

Variants for that module may add similar constraints as module Aa in relation with module A (tests conducted by the manufacturer or by a notified body at random interval)

d) Module D, denoted as production quality assurance, is the same as modules A and C in terms of verification regime for the product (the manufacturer is responsible for checking conformity and providing for the corresponding written statement), with the additional constraint that he must operate an approved quality system for production (ISO 9002, supplemented by any additional requirements derived from the regulatory text), final product inspection and testing, which must be periodically audited by a notified body.

Module D may be combined with modules B and C, to implement a production quality assurance policy in the context of a type approval.

e) Module E, denoted as Product Quality Insurance, associates the Quality Assurance characteristics of module D with the technical description of specific products (ISO 9003, supplemented by any additional requirements derived from the regulatory text), submitted to an audit by a notified body and followed by regular surveillance (inspection of production and storage sites, quality system documentation and test records etc…)

f) Module F, denoted as Product Verification, "externalise" to a notified body the task of carrying out conformity tests (either on every or on a statistical basis where sampling criteria have to be defined in the regulatory text), and delivering the corresponding certificate.

Module F can be combined with B and C in the context of type approval.

g) Module G, denoted as unit verification is the same as module F except that an individual verification of each product is mandated, while in module F, this was an option left to the manufacturer.

h) Module H, denoted as Full Quality Assurance, generalises the approach of module D to cover the whole lifecycle of the product, including design (ISO 9001, supplemented by any additional requirements derived from the regulatory text).

An important variant of H that we can denote as Hda, includes a design approval process conducted by a notified entity.

It should be noted that the distinction established between Production QA (module D), Product QA (module E) and Full QA (module H) by reference to the distinction existing between ISO 9002, ISO 9003 and ISO 9001, respectively, will become obsolete at the end of 2003, as the new ISO 9001:2000 standard will supersede the previous 9001/2/3:1994 series (and former ISO 9000 certificates will no longer be valid).

In the foreword of EN ISO 9001:2000, a note explains the relationship between those 93/465 modules that refer to a certifiable Quality Management System (these are modules D, E and H) and the new ISO 9001:2000 standard.

First, certain aspects of that new standard cannot be related to the scope of modules D, E and H, and would create problems for maintaining an objective certification basis; these are the notions of "customer satisfaction" and "continuous improvement".

EN ISO 9001:2000 stipulates that failing to meet requirements of ISO EN 9001:2000 about these notions, has no impact on the presumption of conformity for modules D, E and H.

Module D does not encompass design and development activities and module E does not encompass design and production processes but only final verification. The corresponding requirements can be omitted without losing the presumption of conformity.

Therefore if we identify as ISO:9001:2000-X the subset of ISO 9001:2000 that does not address customer satisfaction and continuous improvement issues, meeting the requirements of this subset creates a presumption of conformity in respect of module H, meeting those requirements minus paragraph 7.3 (denoted as minus Y below) still creates a presumption of conformity in respect of module D, and meeting those requirements minus paragraphs 7.1, 7.2.3, 7.3, 7.4 and 7.5.1-3 (denoted as minus Z below) still creates a presumption of conformity in respect of module E.

The following comparative table summarises the key differences between the different modules:

Modules	Notion of type approval	Quality Assurance certification	Conformity certificate by a notified entity	Product testing by a notified entity
A	No	No	No	No
Aa	No	No	No	Possible (supervision of manufacturer tests or own random testing)
B+C	Yes	No	Yes (type level + product level)	Possible in a variant for C (supervision of manufacturer tests or own random testing)
D	Possible	Yes (ISO 9001:2000-X-Y)	No	No
E	Possible	Yes (ISO 9001:2000-X-Z)	No	No
F	Possible	No	Yes	Yes (systematic or statistical, on request by manufacturer)
G	No	No	Yes	Yes (systematic)
H	No	Yes (ISO 9000:2000-X)	No	No
Hd	Possible	Yes (ISO 9001 +)	Yes (design approval variant)	No (only review of design tests done by the manufacturer)

4.4.6 Examples of applications outside ATM

A number of industrial products have already experienced the use of the New Approach and Global Approach. We describe below a sample of applications that are of some relevance to ATM/CNS systems and constituents in the sense that:

Certain directives and the associated compliance verification regimes are of direct relevance to some ATM/CNS equipment in a very generic way (directive on Electro-Magnetic Compatibility, directive on low voltage electrical equipment)

Certain ATM/CNS constituents are similar to already harmonised industry products (directives on the compatibility of telecommunication terminals, radio-telecommunication terminals and satellite earth stations)

The heart of the problem for the development of ATM/CNS inter-operability is the harmonisation of integrated functional services, and therefore the relevance of constituent level conformity assessment procedures employed in other areas should not be overestimated.

However these examples illustrate how the assessment conformity modules are used in other sectors of industry and thus they may provide an empirical rationale for choosing those modules that should be reasonably applicable to ATM/CNS constituents:

Directive	Subject	Modules	Comment
73/23/EEC	Low voltage electrical equipment	A	Voltage up to 1000 V AC, 1500 V DC
89/336/EC	Electromagnetic compatibility (EMC) for radio transmitters	B + C	Type examination + declaration of conformity to type
89/336/EC	EMC for other equipment fully applying harmonised standards	A	Self-certification
89/336/EC	EMC for other equipment	N/A	Manufacturer technical construction file + report or certificate by competent body
99/5/EC	Radio and telecommunication terminal equipment (receivers)		Manufacturer's choice
	Radio and telecom terminal equipment (except emitters using terrestrial/space radio spectrum) with harmonised standards	Aa or H	Aa: internal control of production and specific apparatus tests
	Radio and telecom equipment without harmonised standards	A or Aa+ or H	Aa +: Aa + examination of technical file
98/13/EC	Telecommunication terminal equipment and satellite earth station equipment	H or B + Cbis2 or B + D	Cbis2: type conformity declaration + product checks conducted by notified body

4.4.7 Applicability to ATM systems and constituents

The users of ATM systems and constituents are not consumers from the General Public, but only specialised Air Navigation Service providers, and conformity can be appreciated at 2 levels: technical conformance (system verification and/or certification) and operational conformance (operational approval).

In Recitals 14, 15 and 16, and in Articles 3, 5 and 6, Regulation 2001/0237 describes the principles to be applied for the verification of compliance with essential requirements and implementing rules:

- the conformity and suitability for use of constituents in respect of inter-operability rules should be declared by the manufacturer,
- the compliance verification and suitability for operation of systems shall be confirmed by the relevant ANS provider through a written statement near their national regulator.

Starting from those principles, two issues must be addressed:

- The complexity and heterogeneity of ATM/CNS systems,
- The evolution of these systems and their continuity of service, which are key aspects of their safe and efficient inter-operability.

4.4.7.1 ATM/CNS system complexity issue

ATM/CNS systems are complex (and may be logically and/or geographically distributed) and this has to be taken into account into this assessment.

Although some systems may be straightforwardly identified with a single physical “box” (usually a computer and its software) fed by means of various interface, most systems are compound entities resulting from the assembly and integration of different types of components. For example, a Surveillance service is provided through a combination of an SDPS connected to various remote sensors by means of telecom lines that may be leased from a generic provider.

For the purpose of this analysis, 3 main types of components can be identified:

- constituents in the sense of the IOP regulation, which are components designed and produced under the responsibility of a manufacturer, then installed and put into service under the responsibility of an ANS provider ;
- ANS-developed components (e.g. system operation procedures, ad hoc integration software) which are designed and produced by the ANS provider, that fulfils the role of manufacturer, as far as conformity assessment is concerned ;
- Generic services procured near non-ANS service providers (e.g. a standard point-to-point communication line leased near a telecom service provider). For that last category of component, we need to interpret the inter-operability regulation since the generic telecom service provider cannot be considered as an ANS provider nor as a constituent manufacturer.

Since the performance requirements set on the service are defined by the ANS provider as part of the overall architecture of the surveillance network, it seems logical for the purpose of that regulation to treat the verification of non-ANS services embedded into the operation of an ANS system in the following way:

- The non-ANS service provider is expected to make a written statement of compliance with those requirements that are applicable to the service it provides (that statement may be merely the technical annex to the service contract signed with the ANS provider and that should specify a number of technical performance requirements regarding the availability, reliability, integrity, throughput of the provided communication service) ; the ANS provider is responsible for defining those requirements, through the application of the relevant implementing rules (that may specify, for example, the list of performance metrics to be applied to the communication of surveillance data).
- The ANS provider is also responsible for setting those requirements into the context of the overall system so as to demonstrate that, combined with the requirements applicable to other constituents (sensors, RDPS) the requirements he has passed onto the telecom service provider allow the global surveillance system to operate safely.

That interpretation of the regulation means that the responsibility for the demonstration of conformity would remain with the ANS provider which is consistent with the notion that the declaration of suitability for operation of the system as a whole is made by the ANS provider. As the suitability for operation of externally procured services can be demonstrated only when the system as a whole is put into service, it is logical to ascribe that responsibility to the ANS provider.

It must be noted that this problem does not exist for the conformity assessment of products in other domains because these products are entirely “self-contained”: their operation may occasionally depend on some external input from the environment: satellite antennas or lifts need a electric power source, but its specifications (e.g. 380 V tri-phase, 50 Hz alternative current, together with certain voltage and frequency stability requirements) are already standardised and can be easily included in the specification of the product itself, which is not so easy for ANS systems.

ANS systems may be “non-connex” in the sense that intermediate non-ANS services may be included as non-terminal links in a chain of interoperable components, and we propose to solve that particular problem by assigning the setting the conformity verification of such links at the same level as for the whole system.

Another issue to be clarified is the distribution of responsibilities between an ANS provider and the ATS provider in the case when the ATS provider procures some services near the ANS provider (and possibly combines them with ad hoc components procured elsewhere or resulting from in-house development, so as to provide the complete service he needs for his operations.

In that case, the same approach as discussed above should be taken, leading to consider the ANS provider service as a sub-system and the conformity validation of the complete system being done under the responsibility of the ATS provider.

The ANS provider of the sub-system service would then make a statement of conformity against inter-operability rules that would then be complemented by a verification of compliance and a declaration of suitability for use made by the ATS provider.

Here the potential difficulty is that in a given operational context an ANS service may correspond to a "self-contained" functional system delivering an "end user service" and in another context it has to be supplemented by additional constituents installed and verified under the responsibility of an ATS provider.

For example, a GBAS station for navigation would be a constituent providing a service enhancing locally a more basic GNSS service. When the station is put into service, it is the responsibility of the ATS provider to verify that:

- the GBAS station does indeed meet the interoperability rules for his environment (GBAS interoperability rules may include restrictions (e.g. absence of interference with other radio-electrical equipment) that can be verified only on the site of deployment, while compliance with the technical performance requirements of the constituent will be declared at the manufacturer level)
- the more global GNSS service (the availability of which is a pre-requisite to the correct operation of the GBAS station) is indeed available at the site of deployment of the station, and that service is delivered at the level of performance specified in the design documentation of the station.

Discussing whether those providers of more global GNSS signal-in-space should be treated as ANS service providers or as non-ANS service providers is yet another issue. For the purpose of conformity verification, it does not impact the approach we propose to clarify the responsibilities between different layers of service provision and the corresponding sets of sub-systems and constituents.

4.4.7.2 Evolution and continuity of service issues

In the field of ATM/CNS there are 3 main types of constituents and systems:

- aeronautical-specific equipment that are predominantly based on mature and non-specific hardware and software technologies routinely used in non-aeronautical industrial production (telecommunication routers and multiplexers, VHF stations, radars, VOR/DME); there is a somewhat larger number of such pieces of equipment;
- complex software-intensive constituents and systems (such as ATC support tools, FDPS, SDPS, HMIS) where operational procedures, the organisation of operations and maintenance processes, and the functional evolution of constituents play a key role in the assessment of suitability for use; also a small number (a few dozens) of such systems and constituents are deployed in the EU and customisation will continue to take place and ANS providers have a major role to play in assessing the suitability for use;
- safety-critical constituents and systems such as precision landing equipment or safety telephone lines; this type of equipment is not customised and, like the first category, it is deployed in small quantities, with a high responsibility bearing on the ATS providers regarding the assessment of operational suitability (site approval procedures etc.).

For all these types of constituents and systems the number of manufacturers is limited, as these systems are aviation-specific, and are only a set of niche markets.

The following table summarises the characteristics of these 3 categories of equipment:

Categories Characteristics	I: Mature CNS equipment	II: Software-intensive tools and systems	III: Safety-critical equipment
Customisation issues	NO	YES	NO
Evolution issues	NO	YES	NO
ANS Operational issues	NO	YES	YES
Market Size	SMALL	VERY SMALL	VERY SMALL
Unit Cost	MEDIUM – LOW	HIGH – VERY HIGH	MEDIUM

A very important point for ATM systems operation is that conformity verification conducted under the modules of Decision 93/465 stops at the delivery, integration and final checking conducted at the premises of the manufacturers and/or on the site of operation.

Our perception is that there may be a need to refine these modules, and to define the way they are interpreted or introduce additional modules, in two areas:

- The treatment of constituent/system modifications, especially regarding the maintenance and evolution of software-intensive systems (for example, FDPS software is upgraded every 6 months or every year, and each upgrade includes modifications of functionality and from time to time the integration of new constituents)
- The continuous or periodic verification of conformity of the service provided by some systems of constituents, especially the most critical from a safety standpoint (controller-pilot communication system, surveillance system, navigation equipment and services). This is all the more important that, as described in the previous section, certain sub-system or embedded services will not be submitted to the inter-operability regulation as they will be procured near non-ANS service in a “black-box” fashion with little or no potential for verifying the design, production and operation of the internal structure of those sub-systems or embedded services.

This analysis points at the need to define administrative rules in 2 areas:

- for treating evolution and maintenance issues, a rule should provide general criteria for discriminating between minor modifications and major ones (this is in line with conformity verification processes in other areas, e.g. in JAR codes) ; minor modifications (e.g. patching a bug) could be left to a manufacturer declaration that the modification does not alter, while major modification would require that the ANS (or ATS provider) reiterates a statement of suitability for use, subsequent to system verifications undertaken under his responsibility ; typically, any modification of the functionality (other than correcting a defect preventing the use of some functionality in certain circumstances) should qualify as major modifications ; in particular, that rule should require the verification by the ANS provider that the performance of pre-existing functionality still meets the requirements, when operated in conjunction with the new functionality ;
- for treating the periodic/continuous verification of conformity, a rule defining the systems and constituents for which specific procedures may be needed for undertaking more or less continuous conformity verifications after their entry into service ; the functional domains of application of that rule should be the pilot-controller communication system, the surveillance system and the navigation systems (both GNSS and classical navaids) ; the aircraft side counterparts of those systems (e.g. the radar transponder for surveillance) may also be submitted to the same verifications if they may create a potential loss of service.

4.4.7.3 Framework for using the conformity verification modules

The potential impact of the preceding analysis in terms of conformity verification modules depends in part on the interpretation of other elements of regulation.

For maintenance and evolution issues, if ESARR level existing and planned regulation is deemed to provide a sufficient general framework for regulating ANS system maintenance activities, then existing modules may suffice, provided their interpretation is uniformly regulated by the administrative rule outlined above.

If it is found necessary to develop a specific conformity verification regime for the maintenance of ANS systems and constituents, then a module M (for maintenance of constituents and/or systems,) including provisions on the availability and qualification of maintenance personnel, the clear definition of scheduled maintenance procedures, the optional introduction of non-stop maintenance procedure for 24H/24 systems, and also options for distinguishing minor routine activities (first level maintenance, conducted on-site under the responsibility of the user) and major scheduled or unscheduled activities (second level maintenance conducted under the responsibility of the manufacturer, and done exclusively by manufacturer staff or sub-contractors answering to the manufacturers) may have to be introduced

As regards the more or less continuous assessment of conformity for systems and constituents, if the provisions of existing modules deemed applicable at the entry into service can be interpreted as applicable periodically to provide for a periodic revision procedure, in order to check that the systems in operation still satisfy the inter-operability conditions that were verified at its entry into service otherwise a new module R (for revision) could be introduced several options can be defined, depending on whether that periodic verification should/may be conducted by the manufacturer, the operator, or a notified body.

As regards the notion of continuous verification of conformity, it should be treated first at the level of the design and production of the constituents and systems, so that they provide appropriate input-testing and self-testing functionality and/or deliver user alerting signals at their output interface, by design, and these aspects may be verified by relying on existing conformity modules ; therefore a corollary to the administrative rule listing the systems and constituents concerned by this issue of continuous conformity is that the domain-specific implementing rules applicable to these constituents and systems should describe the type of real-time monitoring and alerting functionality to be provided and its performance.

Once the manufacturer of the constituent/system has delivered a conformant product, it is the responsibility of the ANS provider to ensure adequate integration with other systems, supported by operational procedures (distribution of alerts signalling a loss of conformity to other systems and human operators, manning of a central monitoring position by a properly trained supervisor etc.) and to make a declaration of suitability for use covering also those aspects.

Like is the case for evolution and maintenance issues, for addressing those more operational aspects, two different approaches are possible:

- the provisions of ESARRs regarding ATS operation and the training of personnel, used in conjunctions with domain-specific rules specifying requirements on the treatment of loss of conformity signals by the ANS providers using those systems and constituents, are deemed sufficient, or
- a variant of module M evoked above, defining generic procedures for the continuous verification of conformity at the level of the ANS is defined.

In either case, the distinction we have introduced between what can be taken care of at the level of design and production of the systems/constituents and what can be addressed only at the level of the ANS provider remains valid and reflects the distinction introduced in the regulation between the declaration of conformity and the declaration of suitability for use.

The following table summarises our approach of the scope of conformity verification responsibilities for the different participants to the development and operation of systems and constituents.

On this table, the lines are the different aspects to be covered, the columns reflect the different types of components that have been identified in this discussion, plus the system that may integrate various

components from the other columns, and the acronym at the intersection denotes whether the responsibility is ascribed to the manufacturer (M) the service provider (S) or the ANS provider (A) which is the operational users in the cases when it need to be distinguished from a lower level service provider (who may be either an ANS provider himself or a non-ANS provider, depending on the column):

Design	Constituent	Non-ANS service	ANS-developed component	Intermediate ANS service	System
Design	M	Not applicable	A (acting as M)	M	M
Production	M	Not applicable	A (acting as M)	M	M
Entry in service	A	A	A	S	A
Modifications to a system in operation	M (minor) A (major)	A	A (acting as M)	S (minor) A (major)	M (minor) A (major)
Operational continuity of conformity	A	A	A	A	A

In our approach, an intermediate level ANS service that contributes to the function of another system is treated like a constituent. The main difference with a non-ANS service is that the underlying system need not be treated as a “black box”, and fall within the scope of the interoperability regulation concerning the design and production phases.

To facilitate the selection of modules to be applied, we recommend the following approach:

Develop a complete categorisation of systems and constituents based on the Categories I, II and III that we have already introduced (that categorisation could be reflected into a third administrative rule).

In order to properly check the inter-operability of those different types of constituents and systems throughout their lifecycle while avoiding to put too much of a burden onto both manufacturers and ANS providers we recommend the following approach (we have not included in this table the envisaged extension modules M and R as discussed in our analysis, if necessary, they should be introduced in the last column of the table):

	Manufacturer	**ANS provider**	**Manufacturer or ANS provider or third party**
	Design and Production Conformity	Initial operational suitability and after a major modification	Post-maintenance verification and continuous verification of conformity
Category I	Module A based on a specified set of performance tests + module D (production quality assurance) for complex constituents/systems	Module Aa (with unit testing option) based on a specified checklist of conditions of operation	Specific provisions in the implementing rules and/or
Category II	Module Aa (with unit testing option) based on a specified set of interface and performance tests + module H	Module Aa (with unit testing option) based on a specified checklist of conditions of operation	Specific provisions in the implementing rules
Category III	Module A + module G or Module Aa + module H	Module A + Module G (unit testing conducted under the responsibility of a notified body) Or Module Aa + Module H	Specific provisions in the implementing rules + module G (post-maintenance unit testing conducted under the responsibility of a notified body)

It should be noted here that imposing the additional burden of modules D or H to manufacturers is not much of an issue, as a vast majority of manufacturers of aeronautical equipment and systems are already ISO 9001 certified (which is not yet the case with ANS providers).

For the most critical constituents and systems, supplementing module A by module G looks an acceptable alternative for those manufacturers and operators that would not be ISO 9001 certified.

The above table could also be included in the administrative rule defining the categorisation, after a discussion with manufacturers, ANS providers and EUROCONTROL has allowed consolidating the suggested categories and the associated combinations of modules.

In the case when none of the 3 categories described above is adequate for a specific system/constituent, then a specific combination of modules may still be defined at the level of any individual implementing rule, provided a justification is provided for not using one of the reference combinations proposed in the table.

4.4.8 Conformity assessment procedures for aircraft products and appliance

Regulation 2002/1592 establishing the EASA does not make reference to the modules of Decision 93/465/EEC. That regulation will replace pre-existing instruments recognising at the level of the European Community the role played by the JAA for producing Aviation Safety requirements. Those requirements and the associated means of conformity have been developed as JAR codes over a period of 20 years, and they are already harmonised with American CFR codes to a large degree.

4.5 Conclusion

The salient elements that we can retain from our assessment of conformity assessment issues are:

- the integration of non-ANS services and/or of intermediate layers of ANS services is a factor of complexity for certain ANS system ; according to our analysis, that complexity may be adequately dealt with by clarifying the responsibilities of the different actors in the context of the regulation ;
- to provide for safe inter-operability, the verification of conformity should deal with two ATM/CNS specific issues: the frequent evolution of systems/constituents, and the need for periodic or continuous verifications of service performance for systems already in operation ;
- those two issues require the definition of general implementing rules interpreting the regulation respectively for distinguishing system/constituent maintenance from evolution, and for identifying those systems/constituents for which the periodic or continuous verification of performance should be applied ;
- those issues may also lead to the introduction of new conformity verification modules, in the case when a combination of higher level safety assurance regulation (ESARR) with domain-specific implementing rules is found insufficient
- for selecting combinations of conformity verification modules, we propose a framework associating reference combinations of modules associated to different categories of constituents/systems, and we recommend to consolidate that table through consultation with manufacturers, ANS providers and EUROCONTROL then including it into an administrative rule.
- any system - or constituent- specific deviations from the options proposed in that table would then have to be justified on a case by case basis.

5 IOP MATERIAL

5.1 Objectives

The objective of this chapter is to collect material which would be useful for the IOP rule-making apart from the regulatory process definition material which has already been considered.

After a short presentation of the material, we indicate how it can be use in the SES IOP rule-making.

The main sources of data come naturally from the EUROCONTROL Agency. Most of the regulations prepared by the EUROCONTROL/RU will normally be based on work undertaken by various parts of this entity (e.g. EATMP, CFMU, CRCO).

The various Agency Units already contribute to inter-operability regulation:

- convergence management of national plans through the ECIP process,
- technical co-ordination of expert groups producing European specifications, in conjunction with EUROCAE,
- management of European-wide development projects for homogenising services and systems (ARTAS, CFMU, Mode S, RVSM, 8.33, EAD, ETFMS…).

5.2 ECIP Process

The European Convergence and Implementation Plan (ECIP) is a key element in the overall planning process for improving European Air Traffic Management (ATM). It describes the commonly agreed actions to be taken by the EUROCONTROL States and other ECAC States participating in the European Air Traffic Management Programme (EATMP) to meet the strategic principles and objectives set out in the EUROCONTROL ATM 2000+ Strategy.

ECIP provides an ECAC-wide, common medium-term Implementation Plan for Europe for improving ATM performance over the next 5 to 7 years. It takes account of the aviation community's future needs and is driven by clearly defined requirements and ATM PerformanceTargets.

ECIP Implementation Objectives and Stakeholder Lines of Action (SloAs) describe the actions that need to be taken by each of the aviation stakeholders and specify a target date.

In order to implement those actions properly in each State, a local adaptation of the ECIP is required – the LCIP: Local Convergence and Implementation Plan.

Consequences for SES IOP rule-making:

The European Convergence and Implementation Plan is of great interest for this SES study as it gives the list of the new functions / systems with planned and accepted implementation dates. Therefore this document is a guide to select the areas where implementing rules could be necessary and to determine when they would be necessary.

In the future, the ECIP would have to be checked for consistency with the date of applicability of the implementing rules.

5.3 FD Management Sub-group

Flight Data Processing Systems Interoperability is a major stake for the improvements of the ATM network.

Concerning this subject, the Agency has established a multi-domain working arrangement known as the Flight Data Management Sub-Group (FDM SG), reporting to the ODT. The FDM SG has:

a. Quantified and assessed the significance and causes of stakeholder problems with inconsistent flight data by means of several studies.

b. Started production of a set of Interoperability Requirements Documents which describe the flight data exchange requirements of all stakeholders.

c. Started production of a Flight Data Management Master Plan, giving an overview of all flight data interoperability activities in the ECAC area.

a. Classified recommendations on flight data management improvements into those which should be implemented in the Short-, Medium- and Long-Term.

b. Developed an FDM Concept, which has been reviewed and supported in principle by the ODT, to enable improved operational efficiency and dynamic airspace management as proposed in the EATMP ATM Strategy for 2000+.

Further work is planned to build on the results obtained so far, in order to:

- facilitate the implementation of Short- and Medium-term improvements, based on recommendations from the FDM SG studies, by means of standards for flight data interoperability developed in cooperation with EUROCAE, the CFMU and other stakeholders,
- refine the FDM Concept with feasibility investigations, a business case and a safety case.

The FDM SG has close working relationships with the Airports Team (through the Collaborative Decision Making Task Force, CDM TF), the CFMU (through the Systems Sub Group), the AIS AHEAD Programme and the Overall ATM/CNS Target Architecture (OATA) Project. The OATA Project has identified the Flight Manager as one of the key cross-domain Architectural Components, and has delegated the definition and refinement of this Component to the Flight Data Management activity.

To ensure that all the Agency's flight data interoperability activities are brought together under a single management, the former Operational Interoperability Task Force and OLDI Task Force have both been terminated and their functions have been taken over by a single Interoperability Development Task Force (IDTF), which reports to the FDM SG. The IDTF is responsible to the FDM SG for definition of interoperability requirements and maintenance of the OLDI standard.

One on-going activity is the production of a proposed standard for a Flight Data Model, in close cooperation with EUROCAE WG59, the CFMU and other stakeholders. This Model is intended to ensure interoperability between the new Flight Data Processing System developments being conducted by iTEC-FDP, eFDP/FI and Maastricht UAC. A joint agreement has been reached with EUROCAE WG59 by which the FDM SG will launch an activity to prepare a draft proposal for the standard and submit it to WG59. No real date is known about the results of WG59.

5.4 Results of the Interoperability Development Task Force (IDTF)

5.4.1 IRD development programme

The Operational Interoperability Task Force was established to identify inter-operability requirements at an operational level in support of the development of new flight data processing systems being procured by a number of European service providers. The work was based on the Procurement Specification for

eFDP compliant systems and other EATMP documents. The work was partitioned first into 12 items (now 17) and an Interoperability Requirement or Analysis Document (IRD or IAD) prepared for each. In addition an ATC Interoperability Concept of Operations was developed and a report on interoperability facilities that could be introduced using current infrastructure – the so-called 'Quick Wins Report'.

The ODT at its 20th Meeting established the Interoperability Development Task Force-IDTF, which is to follow up on the work of OITF and OLDI TF and will report to the Flight Data Management Sub-Group (FDMSG).

The ATC Interoperability Concept of Operations is the conceptual level document. Detailed inter-operability requirement documents (IRD's) describe the need at a lower level. Interoperability can be achieved by the use of differing techniques appropriate to the operational need, e.g. message exchange, replication mechanisms and data sharing. The IRD's identify functions and data in order that such design decisions can be taken. In particular the need for data to be shared or exchanged between a number of actors, particularly with airport and aircraft operators, supports the information management concepts advanced in ATM Strategy 2000+. At an engineering level, data exchange formats should be open to facility interoperability.

Considering the subdivisions of ATM and the surrounding ATM entities of ATM (Military ATC services, ATFM, Aircraft operators, Airport operations, Aircraft, Air Defence agencies, Airspace management cells, IFPS), interoperability subjects have been classified into 17 items :

Air/ground Co-operative ATS	Recovery Support
Traffic Management	Ground – Ground Situational Awareness
Aircraft Operators-Civil ATS	Trajectory Negotiation & Accuracy
Airport Operations-Civil ATS	Aircraft Operators to Airport Operations
Air Traffic Flow Management &Flight Plan Distribution – Civil ATS	Air Traffic Flow Management & Flight Plan Distribution- Military ATS
Co-ordination and Transfer	Oceanic Air Traffic Services Providers
Correlation of Surveillance and Flight Data	Air Traffic Flow Management & Flight Plan Distribution- Airport Operations
Facilitate Optimum Route	
Medium Term Conflict detection & Resolution	Air Traffic Flow Management & Flight Plan Distribution- Aircraft Operators

"The objectives are to provide an overview of all identified functions which require a system to utilise flight data received from a source external to the unit concerned and/or make available flight data to an external unit or agency."

The IRD development programme has identified and elaborated the following:

1. The ATM services involved in an IOP subject;
2. The conceptual data exchanges that will be necessary between the various collaborating services;
3. The processing upgrades that will be necessary within a service to support the IOP facilities;
4. The quality of service attributes for all data to be exchanged.[14]

[14] The data flows documented in section 6.1.1 of the IRDs are conceptual flows between services and are not intended to imply real physical flows between actual systems. The QOS attributes specified in the IRDs are not therefore specified as mandatory system to system attributes. They are provided only as guidance, to give a top level indication of the type of service that will

The data needs are expressed in a conceptual form, with an emphasis on operational needs. The data exchanges are expressed on a service to service level, with a deliberate disregard to how the data is exchanged. For example TSA status is needed from a TSA Authority for use by ATS. How the data is actually transferred and the route it takes is not of interest.

Subsequent work will need to progress the IOP needs further within the framework of logical and physical models complete with detailed interface specifications and precise data formats[15].

Similar documents exist for other parts of the ATM/CNS system within EUROCONTROL: ATFM/CFMU, Surveillance…

The opinion of the Task Force concerning these requirements relatively to regulation is: *"The implementation of the interoperability requirements is not mandatory unless specified otherwise in EUROCONTROL Standard documents or by European legislation. The exchange of data not so mandated is subject to bilaterally agreement and is to be based on the data flows described in the IRD's and the associated data dictionary."* (IOP Concept of Operations)

Example:

Extract of the ATC Interoperability Concept of Operations:

"Flight Profile

The efficiency of ATFM achieved by the CFMU is dependent on the quality of the trajectory data within the ATFM systems, therefore the trajectories held in the CFMU should be consistent with those within the ATSU's and it is one objective of interoperability to achieve this consistency. It is also essential that this common flight profile is consistent with that to be flown by the aircraft.

Similarly, the flight profile calculated in IFPS must be of sufficient quality to ensure correct distribution of flight plan data, particularly in the climb phase.

Measures are therefore necessary to ensure that the profiles used by ATC, ATFM, IFPS and the aircraft are consistent.

Within the ATM domain, trajectories are calculated taking into account constraints such as ATC procedures and practice, not all of which are published. Aircraft operators are able to provide information which can render more accurate such calculations. The provision of data from aircraft operators to the ATM domain, both in the form of performance related and trajectory data will facilitate improved accuracy and consequently the efficiency of all functions that utilise it."

Extract of one of the IOP requirement documents:

"eTWRA_036: A calculated time of arrival shall be made available to the destination airport operator, when the flight is a parameter distance or time from the arrival runway on final approach where an interface definition, has been established."

5.4.2 EATMP Consolidated Interoperability Summary

The "Quick Win Report" has been extended and is known now as the EATMP Consolidated Interoperability Summary (CIS).

have to be provided for each of the data entities to be exchanged. Subsequent phases of work will need to partition these attributes and assign more detailed QOS attributes to the physical interfaces involved. These attributes do not take account of any engineering concerns that may subsequently dictate higher levels of availability, performance and security.

[15] To date all IRDs concerning ATC interoperability have been completely modelled in UML class sand sequence diagrams, using Rational Rose.

This document makes recommendations for the implementation of EATMP interoperability data-flows identified by the OITF/IDTF and for the resolution of data consistency issues identified by the FDM Sub-group. It provides the results of supporting assessments based on:

- operational readiness for standardisation and the benefits to be gained by implementation. The readiness assessment includes aspects such operational status, concept maturity and the probability of institutional agreement for the provision and exchange of data.
- technical and architectural considerations, including the availability of the data and infrastructure to support its capture and exchange,
- the availability and status of any existing and applicable standards.

A responsible party has been assigned for each of these three assessment sections. EUROCAE WG59 is in charge of the technical/architectural assessment, ITDF and CFMU of the other parts. The document has identified recommendations for new data flows introduction. These data flows refer to the IRDs. Priorities have been given for such introduction: before end 2004, end 2007, after 2007.

The document considers now various FDM-SG issues concerning data exchanges and consistency between 3rd party services that do not involve ATC ("Wider scope data exchange").

5.4.3 Consequences for the SES Rule-making process

Considering ATC and Flight Data, the ATC Interoperability Concept of Operations, the Interoperability Requirements Documents, the EATMP CIS seem a sound basis:

- to classify and investigate the subjects where interoperability has to be regulated (cf. the 17 items),
- to assign priorities to interoperability issues,
- to set a framework and an indicative level of granularity for the rules,
- to provide potential references for the rules
- to provide sound basis for the contents of rules and community specifications.

5.5 Overall ATM/CNS Target Architecture (OATA)

5.5.1 Description

The overall ATM/CNS Target Architecture represents the high level design of an integrated ATM "system of systems" across all ECAC states, towards which the current collection of individual national systems will evolve. It provides a technical framework that identifies the dependencies between system services. It further provides the framework for the standards and guidelines that enable the components (= the logical building blocks that form the overall ATM system) to inter-operate.

Its scope is broader than that encompassed by ATM/CNS, as it covers ground planning, airspace planning and tactical activities in which airport, Airline Operations and Aircraft are directly involved.

The goals of the OATA are primarily:

- To define and maintain an architecture that is accepted as a target throughout the EUROCONTROL organisation and as widely as possible through their ATM stakeholders, users and industry.

- To contribute to the future of European-wide processes for the industry-standardisation of ATM system components[16], and to feedback the results of that process into the maintained baseline,

and secondarily,

- To achieve alignment between the EUROCONTROL OATA and those of the FAA and other ICAO Member States outside Europe, in particular with respect to common interfaces to stakeholders (including aircraft).

The initial straw man for this target architecture is component-based with uniformly and unambiguously defined Services and Functions as well as interfaces and semantics of information exchanges specified with Interface Definition Language (IDL). This model uses concepts and notations from UML (Universal modelling language).

The current phase of the project (Phase 2) consolidates the high level architecture, identifies Middleware requirements, develops a plan for evolution reflecting operational needs of systems for 2011, having a clear evolution path to meet the needs of 2020, develops example Stakeholder Transition Plans as test cases. Future phases will support development of a wider set of Stakeholder Transition Plans and address standardisation and regulatory issues.

As a consequence, its architecture model is not finalised and/or widely agreed yet and could evolve during the next stages of the project.

OATA domains

The OATA is segmented into “domains” that correspond to stakeholders’ activities. Domains covered by the architecture are:

- ATM/CNS, covering ATC, ATFM and CNS functions
- Airports (air side)
- Aircraft (avionics)
- Airline Operational Cells (flight planning or dispatch activities)

Component-based architecture

A component[17] is “a coherent package of functionality that can be considered as an independent logical unit, and that has defined interfaces by which it provides and uses services to/from other components. There is a very sharp distinction between the external interfaces and its internal design and implementation”. (Project Management Plan 27/09/2002).

Components implement formally defined interfaces. This reflects that the component satisfies certain contractual obligations. These ensure that independently developed components can interact in predictable ways. The process of extending systems by adding components, irrespective of origin of manufacture is greatly simplified. Systems can be rapidly built from components sourced from multiple suppliers.

Components that use a service are connected to components that provide the service. Components that are capable of consuming events are connected to components capable of publishing/emitting events. The component is responsible for the set of services it offers and for the main data items that it owns. The same function can be accomplished by several components operating in different work-spaces and exchanging information and actions (The components are said federated).

[16] A component is “a coherent package of functionality that can be considered as an independent logical unit, and that has defined interfaces by which it provides and uses services to/from other components. There is a very sharp distinction between the external interfaces and its internal design and implementation”. (Project Management Plan 27/09/2002)

[17] To avoid confusion with “CORBA components”, it seems that the new spelling will be ”modules” like in the AVENUE project.

The dialog between two entities is the confluence of two services (ex: proposition of a initial flight plan from an aircraft operator, validation of the initial flight plan by ATFM).

This concept is very important: it is possible to define a service without knowing who the users are, allowing thus a great flexibility. One can define a service between ATC systems which will be used later by an ATFM system for example.

To the services are attached the notion of performance and quality of services, naturally considered as a part of interoperability.

Clusters of components

The architecture allocates "clusters" of components to domains. Those clusters contain specific components and instances of "cross-domain components".

The "cross domain components" are the components that are subject to various allocation schemes to stakeholders' systems. If such components are replicated, they need to be synchronised to avoid data inconsistencies[18]. These components are:

- The "Flight Manager" (FM), which is responsible for provision of a validated, accurate and up-to-date view of flight information.
- The "Environment Manager" (EM), responsible for both the periodic production of aeronautical information and the real time access to those data. Main data items: geographical data, airspace organisation, sectorisation data, aircraft performance, and meteorological data.
- The "Configuration Manager" (CM), in charge of providing the current ATM configuration (actual state of dynamic airspace items, sectorisation) and the workload of the sectors.
- The "Aircraft Derived Data Manager" (AM), which is a utility component that collects and maintains the navigation state vector and other airborne parameters for the benefit of other components.

In comparison with the functional domains defined by the EC regulation, we can note that:

- Surveillance data processing is considered as part of surveillance and not of ATC, (the fact that SDPS is considered in ATC in the SES regulation reflects the fact that it is not considered as a unbundling services unlike the other parts of surveillance).
- There is no component for HMIs (The Controller Workstation Manager which appears in the first versions has been withdrawn in version 1.4 – 21/05/2002).
- Middleware and Communication are considered as the backbone of the system but have not been much detailed.

[18] Problem of cross-domain components:
The concept of cross-domain component is neither so clear nor accepted by the community. Instead of accepting that the systems deviate and try to correct the deviations afterwards, the cross-domain synchronisation will make sure pro-actively that all actors have the same data. This assurance that all the systems will share the same data (such as airborne and ground flight plan) is key point on the safety aspect in OATA. In AVENUE, this role is cast to specific modules (one for air-ground collaboration), one for ground-ground communication.
The problem of interoperability is crucial for a good integration between similar functions between functional domains as well as inside a functional domain. Furthermore, the similar functions are only "similar" but not identical. The best example is the Flight data manager which exists in aircraft, ATFM, in each ATC Centre. The Flight Manager has specific activities in the ATC centres that are not realised in the other domains (SSR code allocation, Flight Path monitoring…).The concept of cross-domain hides an important part of the complexity of interoperability.
The impact of the cross-domain component is not only an open technical issue but also an economic one. It could imply the development of new on-board material or software for the stakeholders, whose costs and benefits must be compared with regard to the improvement of safety and capacity it provides.

5.5.2 Consequences for the SES Rule-making process

1. We support the idea that reference architecture is needed in the definition of the SES regulation, especially when designing rules and specifications to be applied at the level of constituents. It is necessary to have an unambiguous reference for the definition of the actors and their responsibilities, the functional domains, the components and the services provided by the components (with both a static and dynamic view). It is necessary to have a global view giving a common understanding of information and events, a common convergence target for systems integration. Without such a reference architecture, a patchy case by case approach would prevail and a consistent set of regulatory products would be nearly impossible to achieve.

   This is consistent with the 6th Essential requirement of the SES regulation (Interoperability): *"Systems shall be designed and progressively integrated with the objective of achieving a coherent and increasingly harmonised, evolutionary and validated logical architecture within the European air traffic management network."*

2. While the SES regulation considers only physical systems or constituents when considering validation, the implementing rules and community specifications, in many cases, will have to refer to this logical architecture which is an abstract view of physical systems implementation.

   The systems/constituents identified in the implementing rules are logical whereas the systems/constituents concerned by verification are physical ones. A physical constituent can correspond to several logical constituents or parts of a logical constituent. For example, a FDP system can integrate the Correlation Manager or the Arrival Manager and Communications constituents.

   The architecture must be able to support centralised or distributed systems (or constituents), the choice being organisational (structure of airspace, definition of responsibility areas) or technical or a mix of both.

3. Reference to OATA

   The OATA is the only existing architecture modelling the CNS/ATM system. Its maintenance and evolution are assured (defined in its goals, with the adequate budget and organisation).

   The OATA is currently reviewed by the involved stakeholders (ATS providers, regulators, Industry). Following that review process, it is expected that the OATA will be a widely accepted reference model of ATM architecture. Furthermore to the problems linked to the cross-domains components related before, the architecture has to take into account "old" systems (which do not implement Overall Architecture features) and "new" systems.

   We can hope that further developments will lead to an architecture that will point out the whole set of interoperability issues.

   It is why we recommend using OATA as a starting point for developing SES regulation material, especially for the definition of ATC systems and constituents and their interfaces.

4. Organisation of the domains

   Annex I of the Interoperability regulation reads "ATS: systems and procedures for ATS (ATC and FIS), in particular: FDPS, surveillance DPS, HMIs". Annex II gives specific requirements on FDPS, Surveillance DPS and HMI systems in the ATS domain.

   It is understandable that the regulation insists on FDPS in ATS, even if other FDP functions exist in other domains (ATFM systems). It could be accepted that HMI systems – which exists physically – could be considered even if they are not defined in the logical architecture.

   Another difficulty is the Surveillance DPS considered in ATS in SES regulation and in Surveillance (CNS) in OATA (SDPS is not an unbundling service).

5. The modelling of ATM systems relies on accepted operational concepts. To reference the procedures that will be defined in the SES regulation, it is also necessary to define a common

operational concept model of the ATM/CNS system. OATA refers to EUROCONTROL ATM Strategy 2000+ and EATMS operational concept.

6. The problem to use OATA as a reference in the SES regulation is the fact that this architecture is always evolving.

   To preserve the consistency when OATA and the operational Concept will evolve, to minimise the dependence of the rules to the environment, we recommend making reference to these documents only in the advisory part of the rules. When the mandatory part of a rule needs to make reference to an acronym of a technical definition found in OATA documents, then it should do so in the “acronyms and definitions” section appended to the text of the rule.

7. Communication aspects are of particular relevance when it comes to consider interoperability issues. They also correspond to a fundamental, transverse/underlying component of the OATA architecture model. Despite this very fact, as discussed below, the latter, at least in its first phase, does not describe its “Communications” component in as detailed a way as it does for the rest of the logical architecture components.

   Moreover, the identification of interoperability issues in the COM domain will require an examination at the various service interfaces in the frame of a “layered” model. We propose below a complementary framework that will allow us to cover the COM functional domain in the course of the present study.

8. OATA gives a list of components for the ATM-CNS systems that could be a solid basis for the identification of the components concerned by the IOP regulation. We propose a list of components in Annex A. We have however a problem of classification as the eight “systems” defined by the regulations do not correspond to the users domains of OATA.

5.6 Conclusions

Different elements can be used:

- to identify, structure and prioritise interoperability issues,
- to classify the implementing rules,
- to give advisory elements to complement the rules that will be defined.

The interoperability issues have to be considered inside and between the domains defined by the regulation.

These elements are:

- The European Convergence and Implementation Plan (ECIP) document,
- the IRDs documents relative to flight data in ATM, the EATMP Consolidated Interoperability Summary,
- the OATA architecture.

These documents should being used for the definition of the roadmap in the course of our study but also in future rules developments.

6 REVIEW OF EXISTING RULES AND SPECIFICATIONS

6.1 Objective

The objective of this chapter is to provide a complete picture of all the existing regulatory material. To facilitate the investigation, it is structured after the functional domains identified at section 3.5.3, on the one hand, and the different organisations that may have produced relevant standards and rules on the other hand.

6.2 The different organisations

6.2.1 ITU (International Telecommunication Union)

In its role as global spectrum co-ordinator, the ITU develops and adopts the Radio Regulations, a set of rules which serve as a **binding** international treaty governing the assignment, allocation and use of the radio spectrum.

Moreover, ITU make recommendations which are approved by ITU Member States: their implementation is not **mandatory**. However, as they are developed by experts from administrations, operators, industry and other organisations dealing with radio-communication matters from all over the world, they enjoy a high reputation and are implemented world-wide on a voluntary basis. The corresponding regional body is CEPT in Europe.

The co-ordination of assignment for those portions of the spectrum allocated to Civil Aviation is managed by ICAO.

6.2.2 WMO

The World Meteorological Organisation manages the WEDIS and other global meteo systems that produce MET information fed into the AFTN and other data distribution systems.

6.2.3 ISO

International Standard Organisation standards are documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose: all these documents are non-mandatory and to be voluntary applied.

A number of other standardisation bodies are recognised as sister organisations by ISO in specific fields (e.g. BIPM in metrology, IRTF in geodesy etc.).

6.2.4 ICAO

Cf 4.2

6.2.5 EU

EU produces directives, regulations and decisions; all those types of regulatory material are mandatory and binding on EU Member States and also to third parties, as required.

6.2.6 ETSI

ETSI has different mandates from the European Commission to develop harmonised European standards. Equipment manufactured according to these standards will be presumed to comply with the non-binding essential requirements.

ETSI is working on the following elements of the mandate M/239 on air traffic management and systems:

- a European Standard for VHF Digital Link, mode 2;
- a European Standard for Ground-to-ground voice communication – digital signalling in ATS telephone links;
- a study on the feasibility of standardising Self-organising Time-Division Multiple Access (STDMA) system requirements;
- a European Standard for Gatelink, an aircraft to ground system data link interface based on radio LAN technology.

Following on from M/239, ETSI, together with CEN and CENELEC, has received mandate M/318 for the standardisation of VDL mode 4 and for a study on the application of VDL Mode 4 to the local component of Galileo.

ETSI work in the field of civil aviation is carried out in co-operation with EUROCAE. Under the terms of the co-operation agreement (this agreement is under renegociations), EUROCAE produce Minimum Operational Performance Specifications for airborne equipment. ETSI produce European Standards and other deliverables for ground-based equipment.

6.2.7 EUROCONTROL

6.2.8 EUROCONTROL Convention

EUROCONTROL revised Convention, signed in 1997, reconfirms and strengthens the Organisation's authority in the taking of binding regulatory decisions. Article 2.1 (I) stipulates that the Organisation will "develop proposals for the harmonisation of air traffic services regulations". Annex I further stipulates that "the Director General shall draw up and submit for the Council's approval the rules and procedures applicable to standards, specifications and practices for air traffic management and services".

Indeed, when EUROCONTROL issues regulatory material, its Member States are obliged to implement it in order to have a common set of European ATM regulations, applicable in all Contracting Parties.

The Single European Sky initiative and the accession of the European Community to EUROCONTROL make particularly important the co-ordination of regulatory activities of both organisations. EUROCONTROL will notably contribute to the implementation of the SES through the development of implementing rules which will complement the high level regulations.

6.2.9 EUROCONTROL Regulatory bodies

In recent years, EUROCONTROL has created 2 entities dealing with the definition of regulatory measures and related compliance and performance monitoring:

- The SRC (Safety Regulation Commission)(supported by the SRU : Safety Regulation Unit) that develops safety-oriented regulatory material (ESARR) and that monitors globally safety performance,
- The RC (Regulation Commission) (supported by the RU: Regulation Unit) that addresses those areas of regulatory intervention necessary for an efficient implementation of the agreed evolution of the ATM system. If RU cover other areas than safety (performance, inter-operability, security, common airspace design, harmonised airspace structure, etc.),

it cannot be said that the scope of its activity is “non-safety related”. Most of the regulatory material which will be prepared will indeed have safety implications[19].

The Ministers of the European Civil Aviation Conference (ECAC) decided in 1997 to establish a formal mechanism in Europe for the multilateral development and harmonisation of an ATM safety regulatory regime, separate from service provision, within a total aviation safety system approach.

EUROCONTROL Commission, under the early implementation of the EUROCONTROL Revised Convention, has established the Safety Regulation Commission (SRC) as an independent body to the EUROCONTROL Agency to provide advice in order to ensure consistent high levels of safety in air traffic management (ATM) within the ECAC area. The SRC reports to the EUROCONTROL Commission through the Provisional Council on all matters relating to the safety regulation of Air Traffic Management, including recommendations for improvement of ATM safety.

The SRC undertakes EUROCONTROL work in the field of ATM Safety Regulation across the whole ECAC area and is composed of senior executives from within organisations responsible for ATM Safety Regulation at national level.

SRC is responsible for the development and uniform implementation of harmonised safety regulatory objectives and requirements for the European Air Traffic Management, and ensuring their effectiveness through measurement of safety performance. In its role, the SRC also handles the working interfaces with other aviation bodies and interested parties.

The RC is a High Level Committee of senior aviation experts who provide advice through the Provisional Council to EUROCONTROL Permanent Commission on ATM Regulations. The formal regulatory function, i.e. the taking of decisions that bind EUROCONTROL Member States (including oversight and enforcement) is the exclusive preserve of EUROCONTROL Permanent Commission. Note that a big difference between the SRC and the RC is that the first one is composed by a representative of each state. The smooth functioning of the regulatory process would benefit from nominated States focal points.

The RU – established 1/1/2002 – falls under the responsibility of EUROCONTROL Director General and is functionally separated from the rest of the Agency. This kind of organisational structure was adopted so as to ensure the complete separation of the regulatory function within EUROCONTROL and therefore to increase transparency, clarify accountabilities and avoid any risk of conflict of interest.

The main activities and functions of the RU cover:

- The elaboration of mandatory and, when appropriate, non-mandatory material,
- The support to the RC,
- The drafting of the EUROCONTROL Regulatory Work Programme,
- The management of the ENPRM process,
- The monitoring of the implementation of EUROCONTROL regulations by the contracting parties.
- The SRU will deal with the safety aspects of the subjects addressed by the RU.

NB: The PRC (Performance Regulation Committee) (supported by the PRU: Performance Regulation Unit) is dedicated to performance monitoring only and is not a regulation body.

6.2.10 EUROCAE

The main European administrations and the main aircraft and equipment manufacturers are members of EUROCAE and actively participate in the Working Groups, which prepare voluntary specification documents. The primary task of Working Groups is to prepare performance specifications and similar

[19] The terms of reference of the SRU and RU are somewhat ambiguous. Only practise could clarify the subject. It is clear that the new structure has to find its place relatively to the existing Agency Units. The idea of regulation needs time to make its way.

documents, which may be referenced by the Aviation Authorities in Europe. They are most frequently Minimum Operational Performance Specifications (MOPS) or Minimum Aviation System Performance Specifications (MASPS), derived from ICAO SARPS most of the time, and defining **voluntary** industry standards. These performance specifications are intended to be adapted as regulatory documents by European authorities.

EUROCAE works in close cooperation with its American counterparts RTCA and SAE, with the permanent objectives of publishing compatible documents and supporting the interests of manufacturers and users worldwide.

In 2001, the EUROCAE Council has approved and initiated working groups in the following areas:

- Passenger Electronic Devices (WG-58)
- Interoperability of European Flight Data Processing Systems (WG-59)

  WG-59 clearly depends on EUROCONTROL Operational Interoperability task Force (OITF) which provides the operational requirements. It also relates to wider studies conducted by EUROCONTROL such as CFD SG and CNS/ATM Overall architecture.
- Modular avionics (WG-60)
- ATC Open Architecture (WG-61). This group is preparing standards of an open Architecture for Future European interoperable ATC systems.

  WG-61 will cooperate with the EUROCONTROL Overall CNS/ATM Target Architecture Project (OATA), which is expected to be a major source of input, and with the EUROCONTROL Consistent Flight Data task force. Close co-operation is also planned with EUROCAE WG-59 concerning FDP Interoperability.
- Galileo (WG-62)

It should be noted that the only regime that associates a regime of sanctions against non-compliance is the EU. For all the other organisations the principle of national sovereignty implies that non-compliance is dealt with only by means of peer pressure. In principle, EUROCONTROL has arbitration procedures, but not with the strength of these of the EC.

6.3 Detailed results

The results of the review of existing rules and standards for each organisation, in each functional domain are detailed in an annexed file. The position of the rules and standards is assessed in terms of technical scope, level of enforcement, conformance criteria.

6.4 Synthesis of the results

The following matrix shows, for each organisation and for each domain, if mandatory rules (M) or voluntary specifications (V) have been defined and for which type of rules: Administrative (A), Operational (O), technical (T).

This table is explained in the following paragraphs.

	WMO		ITU		ISO		ICAO		ETSI		EUROCONTROL		EUROCAE	
ASM							**M**	**T O**			**M**	**O**		
ATFM							**M**	**T O**			**M**	**T O**		
ATC & FIS							**M** V	**T O** O			**M** V	**O** **T O**	V	T
ATC/FDPS							**M**	**T O**			**M**	**T**		
ATC/SDPS											**M**	**T**		
ATC/HMIS					V	T					**M**	**T**		
G/G COM					**V**	**T**	**V**	**T**	**V**	**T**	**M**	**T O**	**V**	**T**
A/G COM			**M** **V**	**T** **T**	**V**	**T**	**M** **V**	**T O** **T O**	**V**	**T**	**V**	**T O**	**V**	**T**
A/A COM			**M** V	**T** T			**M** V	**T O** T O	**V**	**T**			**V**	**T**
NAV			**M** V	**T** T			**M** V	**T O** T O			**M**	**T O**	V	T
SUR			**M** V	**T** T			**M** V	**T O** T O			**M**	**T O**	V	T
AIS					V	**A**	**A**	**T O A**			**M**	**T O A**	V	T
MET	**M**[20] V	**O** T O			V	**A**	**M**	**T O A**						

Table 6.1: Regulatory documents analysis

6.4.1 Analysis per organisation

- The WMO standards are of relevance only to MET, and are mainly voluntary or good practices: the only mandatory document has been developed in co-operation with ICAO. All these documents concern principally Information and Operation interoperability.
- The ITU allocation scheme and related regional and national assignment plans for of radio-frequencies are quite important for all types of radio equipment emitting and receiving signals in the COM, NAV and SUR domains: they define mandatory Radio Regulations and voluntary Recommendations mainly linked with Hardware (frequencies) and corresponding Performances. G/G COM may also be marginally impacted in case ground-ground radio-communications are used, but this recommendation has not been identified.
- The ISO standards of most relevance are in the fields of data processing and communication. Therefore, the ISO documents are voluntary standards dealing with G/G and A/G COM.
- In OACI, except in Annex 10, there is very little material of direct relevance to system level interoperability: indeed, the main focus of ICAO rules and standards is to ensure a minimum level of operational interoperability. ICAO defines mandatory standards and recommendations for almost all the functional domains (except SDPS, HMIS).

[20] Mandatory through cooperation with ICAO.

- Referring to a standard made by another organisation, OACI can make it mandatory for certain applications (such as ISO 9001).
- The main EU sources of interoperability regulation have been identified in previous sections, and not approached here.
- ETSI, working in co-operation with the European Union, defines Information voluntary documents concerning communications (A/A, A/G and G/G COMs).
- EUROCONTROL standards and recommendations and regional ICAO EUR documents are of relevance to almost all the domains. They are most of the time binding for the concerned states, but EUROCONTROL has no legal possibility to guarantee assessment to the defined standards. It is also interesting to highlight the fact that, concerning the CFMU management (ATFM), the documents are contractual: they are agreed upon by the different ATCCs through signed letters acting as contracts.
- EUROCAE material exists in the Data Processing and CNS areas: these are voluntary documents defining technical specifications for industrial interoperability.

6.4.2 Analysis per Functional Domain

Those different functional domains have the following characteristics, which explain the structure of the above matrix:

- The A/G COM, G/G COM and A/A COM are standardised and defined by numerous documents, by different organisations: ITU, ISO, ICAO, ETSI, EUROCONTROL, EUROCAE. In fact, there is plenty of materials concerning communication interoperability, as this part of the system must be uniformed for it to operate correctly. Some documents have several parts, some mandatory, and some voluntary.
- In the same optic, the NAV and SUR domains are also standardised by mandatory documents and voluntary recommendations by ITU, ICAO, EUROCONTROL and EUROCAE.
- The Data Processing systems (FDPS, SDPS, HMIS) interoperability are also copiously defined by mandatory standardisation documents from ICAO and EUROCONTROL and some voluntary standards by ISO and EUROCAE.
- Flight Management (ATFM and ASM) is standardised by mandatory documents published by ICAO and EUROCONTROL.
- AIS is standardised by ICAO and EUROCONTROL through mandatory documents, whereas only the ICAO is defining binding rules concerning the MET domain, with some WMO publications to be applied on a voluntary basis.

6.4.3 Analysis per types of standards

Technical standards

- The production of technical standards is shared by all organisations and constitutes the most important part of the standards developed.

Operational standards

- Operational standards are delivered by ICAO and EUROCONTROL mainly, and WMO for MET, the other standardisation bodies being industry-oriented hence having no direct interest/role in the operational field. Very often Technical standards are associated with Operational standards in the documentation delivered.

Administrative standards

- Administrative standards are only punctually provided when generic standard organisational models may gain been used at a service scale – in the AIS and MET domains exclusively.

6.4.4 Conformance Assessment

Only ETSI defines extensive compliance assessment procedures in its documents with guidelines for physical testing. EUROCONTROL only explicitly presents conformity assessment for G/G COM (OLDI and FDE-ICD); for the Conformity and Implementations Plans, the States are considered as responsible for conformance, with CIP progress reviews punctually organised to assess the conformance with the documents.

There are only very few EUROCAE documents describing acceptable means of demonstrating compliance. However EUROCAE documents can be considered as means of compliance for other regulations.

Therefore only a small portion of all the standards and recommendations are foreseen conformity assessment procedures.

6.5 Conclusion

OACI and EUROCONTROL are currently the main contributors for the regulation of the ATM/CNS network; they cover the various types of standards. The COM domain is regulated by most of the organisations we have studied. ATM domains are cover almost only by OACI and EUROCONTROL whose regulation materials are binding for the States. ITU defines specific mandatory regulations in the Radio frequency domain. Conformity assessment procedures are not frequent.

7 GUIDELINES FOR THE PRODUCTION OF ATM/CNS IMPLEMENTING RULES

7.1 Objectives of this chapter

The objective of this chapter is to provide a number of recommendations and heuristic principles to future developers of Implementing Rules (IR) that have emerged through discussion within the AIR Team when trying to delineate more clearly what future IR should be and should not be.

As it is intended to be used as a preliminary “IR Developer’s Guide” it is written as to be as much stand-alone a part of the AIR Final Report as possible and for that reason it may repeat certain explanations and suggestions already provided in previous chapters.

To maximise the pedagogical value of these guidelines we have deliberately presented them as explanatory answers to a set of frequently asked questions by those people in EUROCONTROL and elsewhere that have started discussing the subject.

By the way, this chapter gives also sound principles for the IOP rule-making criteria.

Obviously, we do not expect this document to be the last work on this complex subject, but we hope it will provide useful insights into a number of aspects of the IR production process.

7.2 Frequently asked questions and tentative answers

7.2.1 What regulatory requirements apply to Implementing Rules?

The starting point for defining Implementing Rules (IR) is the need to clarify/interpret Essential Requirements and to provide pointers to existing or planned Community Specifications (CS).

The definition of Implementing Rules is submitted to a number of explicit requirements that can be found in SES Regulation 2002/0237. Each of the most salient requirements listed below is followed by a reference to the relevant article of that regulation:

- systems, constituents and associated procedures shall comply with IR throughout their entire lifecycle (art. 3.2) (this means that conformity assessment procedures should cover the entire lifecycle, as discussed earlier in this report);
- the proposed IR shall be introduced as a complement or a refinement of some Essential Requirement(s) (art. 3.3.a), and/or to facilitate the introduction of new, agreed and validated concepts of operation or technologies (art. 3.3.b);
- a cost-benefit analysis for all stakeholders concerned shall be provided, assessing the possible technical solutions (art. 4);
- IR shall be developed with due regard to the maintenance of an agreed high level of safety (art. 4);
- conformity assessment procedures derived from EC 93/465 shall be established (art. 3.3 d);
- the systems and/or constituents that constitute the scope of application of the rule shall be defined (art. 3.3 b);
- IR should rely on rules and standards developed by international organisations such as EUROCONTROL or ICAO (recital 10).

As IR must serve to bridge the gap between ER and CS, they should be represented in a format that supports both a top-down ER-to-IR justification and a bottom-up CS-to-IR consolidation.

Also, since any IR must be able to support a formal certification process, it must also define acceptable means of conformity (expressed in part through the identification of some existing or to be defined CS creating a presumption of conformity,) and of acceptable methods of demonstration (to be based on the modules derived from Decision 93/465/EEC).

7.2.2 Should Implementing Rules be ascribed to specific functional domains?

The lists of Essential Requirements annexed to the inter-operability regulation are of 2 types: some of them are general requirements, while others are domain-specific requirements. Therefore it should be expected that some Implementing Rules would apply only within one domain, while other rules would apply within 2 or more (even all) functional domains.

By their very nature, some rules may have a broad scope of application while other rules would be more domain-specific. For example, we discuss in Annex C a possible example of Implementing Rule setting accuracy requirements in relation to the ICAO UTC timing standard; such a rule is of relevance to any systems and constituents that manipulate timestamps when processing real-time ATM/CNS information, be they identified as communication, navigation, surveillance or flight data processing systems. By nature, open architecture requirements have also a broad scope of application.

We have also identified “rules of the rules” that we have denoted as administrative rules.

7.2.3 Should existing ICAO, EUROCONTROL and other international rules be transformed into IR?

Most of the time, existing rules and mandatory technical standards are already widely applied by industry and ATS providers, in order to ensure world-wide inter-operability, especially in relation to aircraft equipment and ATC procedures that need a minimum level of inter-operability between aircraft/pilots and ground systems/controllers to be guaranteed everywhere.

For example, there is certainly no need to define Implementing Rules just for repeating the catalogue of ICAO phraseology or detailing the structure of VDL and other telecom protocols. And when there is no reason to believe that the enforcement an existing ICAO or EUROCONTROL rule need to be improved by turning it into a piece of European legislation, then it need not be repeated in full as an SES IR.

When existing rules and mandatory standards have to be supplemented by EU-specific provisions to meet some Essential Requirement(s) or when the current regime of state-enforced compliance is found insufficient, then one or more IR should be drafted, and the already existing international rule that they reinforce/supplement should be explicitly pointed at, so as to avoid repeating a lot of technical details that have already been agreed at ICAO or EUROCONTROL level.

Also, if an IR is defined to enhance or supplement an existing regulation dealing with functionality or performance issues, then the description of the IR should make an explicit reference to that regulation, so as to provide adequate traceability, especially for allowing any interested party to be convinced that the proposed IR is not in contradiction with that pre-existing regulation.

By the same token, other rules that are not specifically aeronautical, like the radio regulations produced at ITU need not be systematically reflected in IR, but they should be mentioned as a starting point in any IR setting additional requirements.

For example, because of the high density of aeronautical radio-communication equipment in Europe, it might be envisaged to set more stringent constraints on the level of noise produced by some ground emitters than what is allowed by existing ICAO regulation.

This could be feasible through an IR (and providing it does not prevent the concerned equipment from meeting its operational requirements) but setting European constraints looser than the already internationally agreed regulations would not be acceptable (at least until a request for changing that international regulation has been accepted by the relevant international regulatory body.)

7.2.4 Should all domains be entirely covered by inter-operability rules?

The introduction of IR in each of the 8 domains identified in the SES regulation is probably necessary, as many of the Essential Requirements are very high level and need to be translated into a language more directly focused at the inter-operability problems of specific ATM/CNS functions and systems. The desirable end state if therefore that each system and component of the ATM/CNS network should be regulated (definition of all service characteristics) in order to suppress any ambiguity, and to allow for consistent means of conformity assessment. Following this approach, and considering the huge scope of the essential requirements, this leads to developing a complete description of ATM/CNS procedures, systems and constituents through implementing rules or specifications.

In those areas such as air-ground or air-air communications where the ground systems are tightly coupled with the aircraft side, one should be careful not to overstep the ICAO standardisation process by imposing technical requirements on the ground side that would lead to incompatibilities with ICAO standards defined on the aircraft side.

For example, it is perfectly understandable and indeed commendable that IR be developed for defining EU-wide constraints on the ground part of the VDL system architecture (e.g. a global addressing plan, performance requirements on ground stations, a VDL channel sharing policy, service level commitment by VDL network operators etc.) but any requirements on the ground system should remain compatible with the aircraft VDR functions and performance requirements as standardised at ICAO.

If the work done in Europe leads to the identification of additional requirements regarding the functionality and/or the performance of aircraft equipment, then those new requirements should be injected into the ICAO SARPs revision process and adopted by ICAO before they may be mandated in the context of a European regulation.

So the complete answer to the question of coverage completeness is that:

- IR should not be developed in areas were Essential Requirements by themselves are deemed sufficiently explicit and where existing voluntary specifications are widely accepted and can meet those requirements without further ado;
- IR should be developed in every domains to address all unsolved inter-operability issues, providing that they do not raise conflicts with ICAO processes;
- In the long term, as overall ATM integration increases and technology evolves, it is likely that new IR will have to be developed to address new interoperability issues where no need is currently perceived.

7.2.5 Should an IR make reference to some specific operational concept?

Whenever possible, an IR should not impose a whole specific operational concept as a pre-requisite: it is desirable to have an IR that remains valid even if certain aspects of the operational concept are modified.

What is important is to be able to identify those aspects of the operational concept that are of direct relevance to the IR. Also, in the technical and economical rationale associated to the IR, making reference to certain elements of the current or future operational concept may provide a justification for the introduction of a rule.

7.2.6 Should an IR make reference to some specific architecture model?

, An IR may address either procedural/operational or technical aspects. Also the scope of an IR may be either a distributed (sub-)function or a physical system or constituent.

To facilitate a common interpretation of the scope of an IR by all the parties concerned, especially when an IR needs to identify a specific logical constituent, it may be useful to make reference to a widely shared understanding of the functional breakdown of the system.

The answer is therefore similar to the answer provided vis-à-vis the operational concept: what is important is to identify those logical articulations of the architecture model that are of relevance to the interpretation of the technical scope of the rule, but adopting a single model should not be seen as a pre-requisite to the formulation, adoption and discussion of an IR.

7.2.7 Can/should an IR make reference to other IRs?

Most of the time, an IR will not be created in isolation, but as part of a reflection about all inter-operability problems in one or more functional domains, and the likely result will be a set of IR addressing the different inter-operability problems identified.

As the IR are focused at (sub-)functions and/or physical constituents rather than at the problems themselves, one should not expect a one-to-one correspondence between an IR and an identified problem. However, when several IR jointly contribute to the solution of a problem, it is certainly interesting to signal in the rationale associated to every IR which other IRs are of relevance to the problem addressed by a given IR.

An IR should be interpretable as a stand-alone requirement to the largest possible extent, however it may be sometimes useful to put a general IR “in common factor” for several less general IR.

If the case arises that a genuine mutual dependence appears between 2 rules, then it would be better to merge them into a single rule.

7.2.8 When and how should an IR be revised?

An IR (or more frequently a group of IR relative to a given domain) should be revised when:

- the elements of operational concept on which it is based are evolving,
- the technological assumptions on which it was based are becoming obsolete,
- the ICAO SARPs (or other international rules) of relevance to the rule have evolved,
- new voluntary standards have emerged that make it desirable to modify the scope of the rule and/or the conformity assessment regime,
- new inter-operability problems have been discovered (which may lead to revise existing rules and/or to create new ones)

7.2.9 What is/should be the relationship between inter-operability rules and safety requirements?

Different entities already exist, some of them completely dedicated to safety, and we have seen also that the definition of inter-operability used in the Draft SES regulation is much wider than the ability to exchange information at system/constituent interface, and makes reference to safety and efficiency issues.

We must note also that the conformity assessment modules of Decision 93/465 are used in other fields of technical harmonisation primarily to maker sure that the products put onto the Single Market are safe (be they lifts, explosives for civil uses, pressure equipment, medical devices etc.)

Because those modules do not cover the complete operational lifecycle of the systems and constituents, they may need to be supplemented by some additional processes and/or rules of interpretation.

Another issue is that safety assessment problems can be mastered only when a complete picture of service integration has been established. An important assumption here is that the performance

allocation policies applied to systems and constituents when setting inter-operability requirements must have been validated by upstream safety studies (or through empirical evidence for those constituents and technologies that have been in use for a long time.)

An overall safety assessment methodology is being developed by EUROCAE as ED-78A (in co-ordination with RTCA DO-264). It provides a suitable overall framework for defining consistent requirements across a whole set of systems and constituents that provide end-to-end application services across a communication data link, and as such would constitute a sound basis for consolidating the safe inter-operability of distributed systems.

The approach we recommend is to define an articulation between overall safety management processes and requirements that are applied to ANS providers and regulated by the provisions of draft regulation 2001/235, and the safe inter-operability of systems/constituents that is the scope of draft regulation 2001/237.

This does not preclude the imposition by the supervisory authorities of additional safety requirements going much beyond system inter-operability aspects (e.g. the definition of back-up means and an operational contingency plan) and that would have to be detailed in an overall safety file submitted separately from the inter-operability technical file.

Along the same line of thought inter-operability rules could be discussed from a security standpoint, and we would recommend a similar approach:

- Develop if found necessary additional security-oriented rules, mechanisms and processes for conducting the secure inter-operability assessment, and clarify the distribution of responsibilities between manufacturers and ANS providers
- For checking systems against security inter-operability implementing rules, limit the scope of the security conformity assessment to those aspects that are directly related to the functionality or performance of the systems and constituents under evaluation, and leave it to security authorities to impose any additional requirements of a more global nature, that would apply only to ANS providers and would fall within the scope of draft regulation 2001/235

7.2.10 Should IR and CS be produced hand in hand?

As already discussed, high level IR may exist where evidence of conformity may be provided without resorting to detailed technical specification (e.g. if an IR requires the implementation of a strategic co-ordination mechanism between certain parties, keeping a record of the co-ordination meetings having taken place may suffice to demonstrate conformity).

Similarly, if the concerned industry actors are sufficiently proactive, Community Specifications may be developed without resorting to IR to mandate their implementation.

Yet in many cases, IR should be associated to the observance of certain Community Specifications that will create a presumption of conformity.

In principle, considering only those areas where both types of material are deemed necessary, Implementing Rules and Community Specifications should be developed in parallel by different bodies, and they might theoretically be published completely separately. In practice, to maximise the efficiency of the new approach, the publication of IR and CS should be reasonably synchronous:

- If an IR is published too long before the corresponding CS are available, then no straightforward reference framework exists for conducting the conformity assessment and everybody (the manufacturers, the ATS operators, the supervisory authorities and the notified bodies) will be in trouble for validating/certifying constituents or systems: enormous amounts of efforts may be spent without much guarantee that a good level of inter-operability is attained.
- If CS are published too long before the corresponding IR are available, then they might be considered as useless and remain unimplemented (as IR are being developed

precisely because CS alone do not suffice), or worse, they could start becoming obsolete by the time the IR finally appears.

Obviously, it is not possible nor desirable for the sake of flexibility to guarantee that IR and CS will be approved and issued simultaneously, and some ad hoc mechanism should be provided for advertising advisory updates regarding the availability of a new CS within the ATM/CNS community, separately from the IR production and revision process itself.

This approach would allow the EC and EUROCONTROL to manage a looser synchronisation constraint between the CS drafting process and the IR drafting process. If the CS are not yet available for publication when the IR is ready, then the CS drafting process may only be alluded to in the first version of the Guidance material associated to the IR. At the time when the relevant CS is officially published, a Guidance Leaflet (GL) may be issued, indicating that the duly referenced CS is now available in relation to that IR.

This mechanism could also be used to solve the problem of updating the reference version of the CS (that is expected to evolve faster than the IR) without going through the process of revising and reissuing the complete IR.

8 PROPOSED IR DOCUMENTATION TEMPLATE

8.1 Objectives of the chapter and general comments

This chapter presents the proposed template for documenting Implementing rules.

The proposed template reflects the SES requirements identified at section 7.2.1, regarding the need to justify the creation of a rule and to undertake a stakeholder consultation process before adopting it. Part of this material (in particular the justification RIA – Regulatory Impact Assessment – and the additional Guidance Material) need not be part of the official publication, yet it should be made available for consultation and comments throughout and after the preparation of the rule. A docket management system should be created and be accessible using the Internet. A docket should be created for each rule; with the information concerning the rule, including the status, results and comments of the consultation process.

Therefore we propose to break down the documentation into 4 parts:

1. A lifecycle management table,
2. The implementing rule itself, **mandatory.**
3. The Regulatory Impact Assessment (RIA), that provides all sorts of justification for imposing the rule; this section is mandatory in the sense that a rule cannot be adopted if a convincing RIA is not provided, but it is only a rationale, which is not part of the regulatory substance of the rule: the content **IS NOT mandatory**.
4. Guidance Material aimed at facilitating the implementation and conformity assessment of the rule by system/constituent manufacturers and/or operators and their regulatory authorities. That last section is merely **advisory**.

We suggest hereafter to refine, complete and regulate this work by an adapted regulation (see10.2).

Annex C gives examples of Implementing Rules.

8.2 Lifecycle management table

The life-cycle management table should list the main steps of the production-consultation-publication process, keeping a historical record of the modifications made until the rule is finally published. In that table, the successive modifications can be described only summarily, but the complete set of successive draft versions should be archived for reference to detailed modifications. In the case when the organisation and/or contact point changes, the whole set of earlier versions of the document should be transferred to the new entity/person in charge, so that the complete work history is properly maintained.

The minimum sets of steps that ought to be recorded in that table are:

1. the initial proposal,
2. the first complete draft version circulated for consultation,
3. the consolidated version established at the end of the consultation process,
4. the final version adopted (the last date in the table is expected to be the OJEC publication date if the rule is adopted.)

Other intermediate steps may be also noted in that table, so as to reflect significant change of content and/or advancement status. It may also happen that the elaboration of the rule is interrupted at some point and that it never reaches the publication stage (e.g. the outcome of the consultation process may be that no implementing rule is really needed).

The following data should be listed:

- A version date

- A status (initial proposal, discussion draft, final draft for review, reviewed draft proposed for adoption, adopted rule ready for publication, published rule already in force)
- An entity/person taking responsibility for the redaction and distribution of the document in its current status.

8.3 Implementing Rule

The implementing rule itself should consist of:

- A title reflecting its content,
- A unique IR identifier for information management purpose,
- The references to the Essential requirements that are concerned by the rule,
- The text of the regulation [21], including any limits regarding the applicability of the rule or particular parts of it[22]
- Definitions of terms or abbreviations/acronyms used in the text of the regulation,
- References that are necessary to interpret/apply the rule, possibly including references to some other implementing rules, or to existing international rules and standards (references of an advisory nature should be put in the Guidance Material section, not in this section). If the management of a reference creates a problem then the complete text should be inserted.
- The conformity verification regime that is applicable for that rule.
- The mandated conformity verification test suite.
- Detailed Technical provisions: there should be the possibility for detailed technical provisions to be contained only in annexes. Annexes to the rule should contain only mandatory elements.

8.3.1 Rule Title

The title should be carefully chosen so as to reflect the subject of the rule.

To the greatest extent possible, the name of the rule should allow its reader to identify:

- the domain/systems/components that the rule addresses,
- the underlying problem that the rule is addressing,
- the nature of the rule (i.e. if the rule is focused at organisational/human responsibilities and the operational processes and procedures to be implemented to fulfil those responsibilities, or if it specifies functional/logical/physical interface requirements and/or performance requirements, or if it addresses other issues); the proposed HIPO characterisation can be used as a heuristic to identify the nature of the rule (knowing that certain rules may combine performance aspects with operational aspects or system interface aspects, and that hardware-related issues may correspond to a wide range of physical implementation concerns, not only signal-in-space characterisation, even if electromagnetic signals and interference are a key element of inter-operability)

One of the responsibility of the body in charge of redacting the Implementing Rules should be to establish a homogeneous nomenclature, including a reference list of keywords to be used in a systematic way when devising the names of the rules, so as to avoid terminological variations that do

[21] (according to Article 3.3 a and b SES Interoperability Regulation 2001/0237)

[22] (according to Article 3.3 e Interoperability Regulation 2001/0237: “specify the conditions of implementation”)

not reflect real differences (e.g. avoid that certain rules call “performance metrics” what other rules would call “performance parameters”).

Similarly, within each domain, an agreement should be established on the terminology adopted to identify the relevant systems and constituents (e.g. adopting the terminology of the OATA architecture supplemented as necessary to identify additional aspects; in the last section of this chapter we propose an approach for supplementing the OATA model in relation to the COM domain).

Obtaining a relatively long name should not be a deterrent to precision:

- For example the name of a rule setting a common timing accuracy tolerance for all ATM/CNS systems producing timestamps with respect to the UTC standard should be something like:
  - “Harmonised ATM/CNS timestamp precision”, or
  - “Common maximum tolerance on UTC accuracy for ATM/CNS timestamps”.

The second name is somewhat longer than the first one, but is also more precise (obviously here, as all the parties concerned by the rule know that the ATM time standard is UTC, the second name may sound a bit too much).

Both names convey the key message that:

- the rule addresses all the time-stamping (sub)-system (scope of the rule)
- it is a technical performance requirement specification rule (nature of the rule)
- it aims at creating a common harmonised requirement on the precision of timestamps (the problem addressed by the rule is the time uncertainty of data/events circulated/recorded across the whole system),

which is what is really important. Eventually choosing between “accuracy” and “precision” is a matter to be solved owing to the detailed terminological guidelines to be established before developing the rules.

8.3.2 Rule identifier

The rule identifier should be such that every rule may be uniquely identified through that item. Ideally, if carefully chosen, the title should be sufficient. However, since it is likely that many domain-specific activities will be undertaken in parallel, it is prudent to create an identifier reflecting:

- The functional domain(s) and/or sub-domain(s) for which the rule is developed,
- A unique serial number for each rule in the domain (centrally allocated at domain level),
- The most salient words of the rule title (for ease of reference to the subject of the rule).

Therefore we recommend the following structure for the identification of rules:

<Domain(s)> <serial number> <rule subject> [<version number>]

If successive versions are stored and/or distributed as distinct logical objects, the identifier should be suffixed with the version number.

Additionally a full-fledge indexing system could be used to sort and/or filter out rules according to various criteria.

8.3.3 Text of the rule

The text of the rule must be a list of short and unambiguous “shall” sentences, each of them being individually numbered for ease of reference (the exact way the different “shall” clauses are sequentially numbered should be harmonised before starting the drafting of the rules, so that every implementing rules be presented with the same “look and feel”).

Applicability clauses indicating any limits or variants of the rule (for example, a rule may be applicable only to large airports or it may request some supplementary functionality to be provided for operations in relation to certain airspace classes etc…) must also be part of the text.

Final provisions concerning the date of entry into force of a rule should be included[23], in the Decision of the Single Sky Committee approving the rule for publication and not in the body of the attached rule.

As an adequate period for transposition and a sufficient allowance for transition to the new provisions[24] must be provided, a certain lead time should frequently be included between the publication and the entry into force, and the definition of this lead time should also be a key aspect of the industry consultation process.

Therefore, during the consultation process, the date of entry into force should be expressed as a maximum delay starting at the date of publication in the Official Journal (if some additional delay is foreseen before the entry into force of some variants, it must be indicated too.)

In the example part of this chapter, we try and provide some additional guidelines on the way the implementing rules should be written.

8.3.4 Definitions, abbreviations, acronyms and references

As the text of the rule may make use some definitions or acronyms, those items should be listed and described after the text of the rule itself. In particular, when certain words are used with a specialised technical meaning, that meaning should be carefully defined. If a definition is quoted from some reference document, the precise original source of the quotation (author, title, page, paragraph) should be mentioned.

For example, if the acronym “UTC” is used in the text of a rule, is should be developed and explained, including an explicit reference to the international standard UTC/TAI (used by ICAO, but maintained by Bureau International des Poids et Mesures (BIPM)).

This is in line with the idea that Implementing Rules “should rely on rules and standards developed by international organisations such as EUROCONTROL or ICAO” (recital 10 of the Inter-operability regulation).

In the same spirit, recital (19a) of the Framework SES Regulation 2001/0060 makes reference to the principles of EUROCONTROL’s document 99.60.01/01 of 1st August 1999 for determining route facility charges and calculating unit rates.

However, Community Specifications (voluntary standards) should not be referenced in the Implementing Rule itself (but they may be mentioned in the advisory part) as it would indirectly grant technical standardisation bodies the right to make EU legislation evolve.

For the same reason, if some pre-existing technical standard that may evolve outside the control of European Community bodies and procedures had to be referenced in an IR, it would be better to copy all those elements of the standard that are of relevance to the level of abstraction of that IR and to paste them into the text of the IR, which does not preclude making reference to the complete original standard in the Guidance Material section (in the final section of this section, we provide a few examples of how to select those elements from existing standards that could/should be put into the corresponding IR).

As already discussed at section, it may be also necessary for an IR to make reference to some other IR that provides elements for interpreting it correctly.

However, only those other IRs that are absolutely necessary to understand and apply correctly that IR should be referenced here (other IRs references that just help understand the overall context should be put in the Guidance material section).

[23] (according to Article 3.3.e Interoperability Regulation 2002/0203)
[24] (according to recital 17)

8.3.5 Conformity verification regime and associated certification tests

The conformity verification regime identifies the general requirements that apply to the conformity verification process and in particular the formal steps to be taken before making a declaration of conformity or suitability for use[25], in particular:

- The relevant IR(s) shall identify, where appropriate, the tasks pertaining to the assessment of conformity or suitability for use of constituents to be carried out by notified bodies[26].
- The relevant IR(s) shall identify where appropriate the tasks pertaining to the verification of systems to be carried out by notified bodies[27],

The intent of the "conformity verification regime" section is to identify:

- the constituents and the systems impacted by the rules[28],
- what type of assessment of conformity and suitability for use is to be conducted for the constituents and the systems.

Those aspects that are not generic but that depend on the functional nature of a given system or constituent shall be listed in the "conformity certification test" section.

This approach allows to define general patterns for the certification process (e.g. a verification of design and implementation documents by a notified body) then to provide a detailed specification of the tests to be passed by the constituent or system under scrutiny.

That detailed specification may determine what elements are mandated for inclusion in the technical file submitted to the regulator and/or what technical evidence supporting the assessment of conformity by the notified bodies are demanded.

It should preferably be presented as a logical sequence of tests to be passed.

As regards the distinction between inter-operability and other certification issues, since safety certification, security certification and other issues are addressed through distinct requirements, specific criteria, and (for the time being) separate processes, further investigation has to be made.

8.4 Regulatory Impact Assessment (RIA)

The RIA section should contain the following descriptive material:

- The problem that the rule intends to address,
- The objective of the proposal, in connection with the Essential Requirements which are explicitly addressed by that rule,
- The existing international standards and/or CS and/or system engineering practices which have been taken into account in the definition the rule,
- A description of perceived risks[29], including safety impacts[30], environment and energy impacts, both for introducing the regulation and for failing to introduce it,

[25] (according to Article 5 and 6 SES Interoperability Regulation 2001/0237)
[26] (according to Article 5.4 and ANNEX III article 1 SES Interoperability Regulation 2001/0237)
[27] (according to Article 6.3 SES Interoperability Regulation 2001/0237)
[28] (according to Article 3.3 c Interoperability Regulation 2001/0237)
[29] According to US legislation, the FAA considers also 1) the flexibility of the rule concerning the scale of business, organisations subject to the regulation 2) The international Trade Impact (not to create unnecessary obstacles to the foreign commerce of the US) 3) unfunded mandates 4) federalism 5) information collection 6) environment analysis 7) energy impact 8) affect on intrastate aviation in Alaska 9) plain language (to communicate clearly with the public). It is why we have add some assessments not directly driven by the SES regulation.
[30] (according to Article 3.4 Interoperability Regulation 2001/0237)

- The identification of alternative options, explaining why the proposed rule is deemed the best option,
- The identification and quantification of the benefits for the various categories of concerned stakeholders,
- An estimate of compliance costs[31], based on a) the conformity verification regime applied, b) the mandated test suite and c) the identification of European Specifications and other standards creating a presumption of conformity,
- The verification of compatibility with international rules and standards[32],
- An assessment of the clarity of the rule (plain language),
- A detailed historical record of the consultation phase (gathering the various opinions collected during that phase).

If a large amount of supporting material is associated to some sections of the RIA, it should be organised as a set of annexes to the body of the main document.

8.5 Guidance material

As implied by the name of that section, the guidance material associated to the IR is only of an advisory nature: it should gather all the additional material (references to European and non-European practices, lessons learnt from (pre-)operational experiments, problem-solving tips…) and in particular any reference to Community Specifications or other voluntary standards of relevance to the implementation of the rule.

8.6 General Principles for the drafting of rules

These principles are coming from lessons learnt by the review of existing regulatory material and procedures (JAA, FAA, etc).

Rules should be drafted such that, in principle, their elements are self-sufficient to achieve the policy objective of the rule and avoid divergence of implementation.

Wherever practicable, rules should be drafted such that they identify responsibilities within a given process and/or specify performance to be attained: they should not be directly prescriptive about the technical solutions to be adopted (that may be referred to in the Guidance section of the rule).

The regulatory elements must be clear, non ambiguous, in order that verification of conformity could be done without interpretation, all the participants being treated equally.

In the case of amendments to rules, the rule maker should consider that amending existing rules might be quicker and easier than drafting a completely new rule. Every amendment of a rule should be clearly expressed and should take the form of a text to be inserted in the rule to be amended. Where applicable, new or amended rules should expressly repeal obsolete rules or provisions rendered inapplicable or redundant by virtue of the new rule.

In drafting rules, the content of the provisions should:

- be as homogenous as possible;
- avoid complicated sentences and the excessive use of abbreviations;
- avoid cryptic, convoluted or unnecessary wording;
- achieve brevity in section, paragraph and sentence content;
- make extensive use of subject headings.

[31] Idem

[32] (according to consideration (10) Interoperability Regulation 2002/0203 : “these implementing rules for interoperability should rely on rules and standards developed by international organisations such as EUROCONTROL or ICAO.”)

During rule development and particularly during formal consultation, care should be taken to identify whether draft texts might need simplification/clarification. This may become apparent where, for example, there are frequent requests for clarification and/or where a variety of different interpretations are made by the readers.

It is important to master the time of development of the rule.

The means of compliance relative to one rule must not be scattered in several elements.

The evolution of regulatory elements according to the time must be mastered in order to guarantee the same treatments for all competitors.

9 COMPLEMENT TO THE RULE-MAKING PROCESS

9.1 Objectives of the chapter

The objectives of the chapter are:

- to define a sound methodology which could be used for the identification of the implementing rules and community specifications that are necessary to be developed.

  The TOR of the study gives the following requirements:

  – The starting basis for such methodology would be the essential requirements in Annex II of the interoperability regulation.

  – The methodology would develop the means and logical links to trace such requirements down into implementing rules (where necessary).

  – Relevant mature material available at EUROCONTROL level would be used to complement such work.

- to present the different phases of the rule-making process and estimates the time required to produce inter-operability rules covering all of the essential and specific requirements,
- to introduce the different packages of regulation.

9.2 Description of the method for identification of the regulatory material to be developed

9.2.1 Defining the objective of the IR/CS development program:

The contribution of IR and CS in the regulation is defined as follows: to refine and complete general and domain-specific essential requirements “when necessary”. That means whenever mandatory procedures and voluntary standards would help in the definition of concepts and procedures, and in the definition, development, improvement or maintenance of systems and constituents, in the verification of the conformity to such systems and components in order to assure the seamlessness, safety and efficiency of the ATM/CNS system.

This appropriateness of the regulatory material to the needs should be maintained all along the life of the system. It must take into account, manage or and go with the improvements of the procedures, systems and constituents.

The important point is that the objective that shall be pursued in the IR/CS development program is therefore twofold:

- to have a sufficient basis applicable from mid 2005, at the date when verification of conformity will become applicable,
- to go with the future developments from 2005 onwards.

(We can consider that the specifications of systems put into service in 2005 will be very close to those of the current systems)

These could be considered as two different problems, the first one being the most urgent.

9.2.2 Defining the constraints to take account of in the IR/CS development program

As argued in chapter 3, the evolutions of the current system promoted by the EC for the Single European Sky are significant and almost all of them (even those not mentioned in Regulation 2001/0236_*Airspace*) may impact systems and procedures design. In addition, these may correspond to objectives of various levels – see section 3.4 for the definition of such objectives levels -, sometimes dealing with standardising a set of characteristics of current existing systems and procedures so that a common baseline is shared; but some other times dealing with revisiting the functional role of a whole service (e.g. CDM implementation).

There is therefore a need to distinguish between the EC objectives for the Single European Sky (in the broadest sense), those which directly but also those which indirectly shall affect the nature of the systems and procedures currently used in each domain and at what moment there will be a chance that the material necessary to understand how such systems and procedures would be impacted be available. The most important existing European source for estimating the dates of availability is EUROCONTROL through the strategic documentation it delivers (ECIP in particular).

Provided such constraints, the IR/CS development program was built first by distinguishing which requirements correspond to which objective and provided the dual objective of the program, which shall be included in the developments for 2005 (first IR/CS development phase), which for the developments for 2005 onwards (next IR/CS development phases).

9.2.3 The proposed approach for both IR/CS development program objectives

We describe more practically below the approach taken to answer to the problem of 1) having a solid basis of regulation for mid 2005 and 2) boosting and going with the planned developments of the ATM/CNS network. In fact we distinguish two methods that we have applied to answer to these two problems. The results of this approach are given in chapter 10.

The starting point to identify the Implementing Rules that are necessary is the list of Essential Requirements given by the regulation (SES IOP regulation but also the other SES regulations when they impact the interoperability of systems) and also the classification of the levels of integration that we have proposed in section 3.

The definition of the content of the Implementing Rules comes from the explicit requirements given in 7.2.1.

A difficulty of the rule-making process is to define to which level a regulatory material is necessary, as it is not possible and desirable to consider all the usual specifications of the systems as elements of the SES regulation.

There may be different priorities between domains (or IOP subjects, cf. 7.2.2) and within a given domain (or group thereof) certain issues are more urgent than others. The work should start with those domains and global inter-operability problems that really demand an early attention.

Certain issues are also more serious than others. High level problem should be addressed first, before scavenging into the internal structure of each domain. For example, it is certainly important to have an IR for setting functional and performance requirement at the level of FDPS-FDPS interactions, while lower level IR addressing the internal structure of FDP functional constituents and their interfaces are certainly a longer term issue.

9.2.3.1 A sufficient basis for 2005

9.2.3.1.1 Approach

In this first development phase, we have to apply a top down approach starting from the general and domain-specific requirements and to examine for each domain and IOP subjects (cf 7.2.2) whether IR

or CS derived from Essential requirements would help the verification of conformity of systems and constituents. The services provided, their performance and QOS are perhaps not explicit, but they are not new

The successive phases of the approach are the following:

a) We have to consider that the essential requirements can lead to regulatory material applicable to all the domains or applicable to one or a set of functional domains only.

The requirements covering the achievement of a logical architecture (ER6) and engineering principles (ER7) are naturally leading to general implementing rules or community specifications. Safety requirement (ER3) leads also to general recommendations. We have to consider if the essential requirements are sufficient for the current or near to be implemented systems. These rules plead for progressive enhancements.

b) We have then to consider if the general and the domain-specific requirements are sufficient. We retain to solve the problem this basis question: do they allow a harmonised verification of conformity for systems and constituents?

That means:

- are the procedures/systems/constituents to be verified sufficiently identified ?
- are their characteristics (performance, QOS) and also the services themselves sufficiently defined ?
- are the means of conformity defined ?

To cover the first point, we recommend developing a community specification giving a framework reference to the functions and constituents available in 2005 (cf. 10.3).

To cover the third point, we recommend having an outline rule, giving answers for the different types of constituents, this rule being detailed for each particular case if necessary, as we will present below (cf. 10.2.).

c) To analyse the services, we have to consider each domain or rather “IOP subjects” trying to cover the whole functional scope of the ATM/CNS network.

As said in 7.2.2, we propose to use the idea developed in the IRD development programme (cf.5.4.1): “bring together concepts known to require or affect interoperability of ATC systems and between such systems and those of other actors and to identify the interoperability requirements” and enlarge its scope to the ATM/CNS network. We suggest, by an examination of all the services of the ATM/CNS network and the consideration of its subdivisions and the surrounding entities, defining “IOP subjects” covering all IOP problematic.

For example, ATFM would not be examined “alone” but through the study of “ATFM and FP distribution – Civil ATS”, “ATFM and FP distribution– Airport operations” and “ATFM and FP distribution – Aircraft operators”. Another example: for communication, we choose to use a layered-model completing the traditional A/A, A/G, G/G cutting.

An IOP subject can be relative to services provided in only one domain (such as “co-ordination-transfer”).

d) To allow the analysis to be conducted, we must consider, for each “IOP subject” (as realised in the IRD programme):

- the Air Traffic Services (actors) involved in the IOP subject,
- the definition of the service, including the conceptual data exchanges that are necessary between the various collaborating actors,
- the accessibility, performance and quality of the service,
- the regulatory elements existing for this subject (ICAO, EUROCONTROL…) and their degree of application.

e) We have then, using expertise of competent people for each subject, to answer to the “basic” question, considering the requirements provided by the regulation. The result of our study is that in many cases, minimum standards of performance have to be given in some implementing rules, more detailed elements being given in community specifications.

9.2.3.1.2 Example of derivation of IR from the ER

In the surveillance domain, there is a requirement on the surveillance network to meet requirements of “accuracy, timeliness, coverage and redundancy”. This requirement should be reformulated and detailed in a more technical language through an implementing rule identifying carefully:

- the constituents of the “surveillance network”: sensors (radars, ADS stations, multilateration systems) ground links towards the SDPS for merging the different sources, plus possibly inter-SDPS links for additional robustness
- the functionality of the surveillance data provision service, what are the features of the service access protocol (possibly including features such as a negotiation of the Quality of Service, client authentication etc.) and what elements of information are provided at the service interface
- the overall performance requirements to be set on the surveillance data provision service at the service interface of the SDPS towards other functional systems (horizontal and vertical accuracy, minimum detection altitude, timing accuracy, maximum age of data, integrity, capacity, probability of surveillance message loss, service availability etc.); the performance levels are likely to be different in different portions of airspace, leading to the identification of operational performance categories (notion of RSP) associated with phases of flight or airspace segments (en route, TMA, airport surface) and possibly refined according to additional sub-categories (e.g. depending on applicable separation minima)
- the apportionment of performance requirements (e.g. global integrity results from the convolution of sensor integrity with link integrity and SDPS integrity) on the different constituents of the surveillance network, based on explicit assumptions made on coverage and link redundancy (for the sake of consistency, the same categories identified for performance minima should be used for describing the redundancy assumption).
- That IR need not mandate any specific data transfer protocol within the network, nor a common data representation format at the external service interface: it is sufficient to provide a semantic definition of the data set to be delivered (however, it can be expected that adopting some ASTERIX-derived data structure for delivering the surveillance data will be identified in the advisory part of the rule as creating a presumption of conformity, so as to favour the convergence towards a common voluntary standard).
- That IR could also be split in 2: one IR addressing the surveillance data service provision itself (functionality and performance of the global service provided), and a second IR gathering the assumptions and requirements on the internal structure of the surveillance network.
- If necessary, lower level rules could be adopted for individual components (e.g. an interoperability rules defining the functionality and performance of one or more classes of radar sensor). Whenever necessary, constituent level rules should make reference to the relevant system level rule (e.g. if a radar performance rule has to be defined separately from the performance apportionment rule defined for the whole surveillance network, then the lower level rule should point to the higher level one (that need to develop several IR in the same domain may arise for organisational reasons only, like allowing two distinct expert groups to be loosely synchronised rather than having to organise joint meetings).

9.2.3.2 Improvement of systems and introduction of new concepts

9.2.3.2.1 Identification and prioritisation

For broadening the scope of IR and CS in relation with future development, an important aspect of the regulation lies in the definition of new services and in the improvement of their provision (performances, QOS). The main added value of the regulation in this case is to boot up and boost the adoption of harmonised solutions and to limit risks, which may be of a technical, economical, or organisational nature. In order to determine the level of detail of relevance for the regulation and also to assign relative priorities within the domains to be regulated first, we can consider current issues or risks associated with future developments that have already been planned or at least identified in "strategic" documents, such as ECIP, and more generally the ATM2000+ strategy.

Enabling the implementation of the Single European Sky would hardly be achieved at the same time, be it for financial reasons. The implementation shall be stepped based on a consistent strategy of implementation.

Many problems of interoperability (in the broad sense) have been already identified. In the ATM community, many questions raised by Essential Requirements, such as questions of the European airspace organisation harmonisation or how to achieve seamless operations have been studied. The improvement of procedures and systems have been described and planned along with the introduction of new concepts in the European Convergence and Implementation Plan (ECIP). The prioritisation of these activities is the main objective of the analysis of the ECIP, where currently existing harmonisation material is described as well as prioritised into 7 years implementation plans. The corresponding actions are commonly agreed by the stakeholders. Other "strategic" documents can also to be considered (Mode S implementation Plan…).

These documents are therefore essential supports for the definition of implementing rules and community specifications that can boot these activities.

However the SES regulation introduces new aspects, such as how to move towards "Functional Airspace Blocks".

The maturity of the solutions has to be considered. In some areas, it may be imprudent to develop IR before an experimentally validated concept of operations supported by a first batch of procedural and technical draft standards has emerged.

For example, experiments are under way in the field of ATFM to assess the contribution of airport CDM techniques, but it is probably too soon to develop an IR in that area (although the need for developing CDM-focused IR in the future can be already identified).

Some other issues requiring a focused regulatory intervention through an IR can be:

- insufficient services or quality of service provided by the actors or the ATM-CNS systems,
- insufficient definition of services preventing new access to the ATM/CNS network,
- inadequate or insufficient application of some pre-existing existing rule or standard,
- insufficient involvement of ATS providers relatively to the implementation of new concepts, systems, and technologies.

The starting point for the creation of Implementing Rules is not a blank piece of paper: for many years groups of experts have worked at the international and regional levels to develop inter-operability standards in various areas of Civil Aviation, as shown by the assessment of existing material presented at chapter 4. As stated in recital 10 of 2001/0237: "implementing rules for inter-operability should rely on rules and standards developed by international organisations such as EUROCONTROL and ICAO". So a first important point to develop Implementing Rules in areas where international rules and standards already exist is to appreciate whether it is useful or necessary to give a stronger regulatory status at EU level to those existing rules and standards.

A second point is to ascertain whether there are any specific problems with the way current standards are applied, that would lead to a lack of efficiency. In some cases, solutions have already been found to existing interoperability problems. However, in situations where no directly perceivable incentive exists to make compliance attractive or when different stakeholder groups have utterly diverging interests, imposing a rule may be the only way forward to improve the situation from a global standpoint.

Therefore, the objective an implementing rule should be to help solving pending inter-operability issues or to accelerate the implementation of solutions, for example:

- by boosting solutions that are important at the Community level (for example by defining a service or a date of implementation or means of compliance to a rule),
- by defining a trade-off baseline between different (sometimes) contradictory opinions or solutions,
- by giving a mandatory status to an existing rule inadequately implemented.

The methodology to be applied for the development of regulatory material dealing with future developments is therefore different from the preceding one: the definition of the Implementing rules results more from a top down approach starting the essential requirements and the levels of integration we have defined, but the identification of priorities in and across the domains (IOP subjects) to be regulated must be derived from pragmatic analysis of known IOP problems so as to focus the regulatory effort at areas where:

- European regulation and standardisation would bring the more tangible benefits,
- the subject is sufficiently mature.

9.2.3.2.2 List of questions

a) The first step remains the identification of domains or IOP subjects to be analysed and the identification of the Essential Requirements that are relative to these domains.

The functional view and the architecture logical view are necessary to identify this subject. We can use documents already mentioned and coming from EUROCONTROL. The completeness and validation of these documents are not achieved. The reader should note that the development of the rules is more demanding than the mere identification of subjects to be regulated; stable, validated and consistent references should be mentioned in the rule or specification.

b) To select and prioritize the domains where implementing rules are needed, we propose examining at a high level the set of questions which are given in Annex B.

9.3 Phases and delays of the rule-making process

We assume that, as the European Commission will give a mandate to EUROCONTROL for developing Implementing Rules, the EUROCONTROL Notice of Proposed Rule-Making (ENPRM) process will be applied in its main lines, as the ENPRM structure is compatible with the requirements laid out in the Draft Regulations of the Single Sky (especially regarding the consultation of stakeholders).

We are not considering here the situation where another procedure would be applied to define the Implementing Rules. Since the mandate to EUROCONTROL is the default option, any other approach would take much more time (if only because it would be started only in case of failure of the initial process based on the mandate given to EUROCONTROL.)

The ENPRM regulatory process consists of 6 steps: Initiation, Drafting, Consultation, Review of comments, Adoption/approval, Publication.

However, we also assume that every instantiation of ENPRM in that context of IR production for the Single Sky will be encapsulated by European Commission activities related to a) the definition and approval of the mandate proposed to EUROCONTROL by the Single Sky Committee, and b) by the final approval and publication of the resulting regulation(s).

In practice, the Single Sky mandate, once endorsed by EUROCONTROL, should lead to a parallel approval of technically identical implementing rules by the Single Sky Committee on the EU side and by the EUROCONTROL Provisional Council on the EUROCONTROL side.

It can therefore be expected that the 2 final steps of ENPRM (approval and publication) shall be conducted in close co-ordination between EUROCONTROL and the Commission, as a quasi-simultaneous approval and publication is certainly of much benefit to the regulation concerned.

However, some clarification on the respective roles of the different entities involved is needed to prevent those final steps of the process from occurring in sequence rather that in parallel in each organisation.

That process of joint EU-EUROCONTROL rule-making can be the object of an (organisational) IR (cf JAR 11 that provides an overall rule-making framework for the other JAR codes) but such a rule can only be designed when the necessary institutional arrangements are in place.

The ENPRM process has in particular an initiation phase and a drafting phase. At the end of the initiation phase, a formal evaluation of the proposal for regulation is made to determine whether regulatory action is justified. The result of this evaluation is presented to the Regulatory Committee for review prior to the notification to the Provisional Council. The initiation phase can rely on an early consultation with key stakeholders to review possible implications (Advanced-ENPRM).

The mandate given by the EC should take account of the possibility to stop the regulatory process at the end of the initiation phase. Our assessment of the duration determines the total delay necessary, supposing that the initial phase is concluded successfully.

We recommend to cover the broadest possible set of functional systems and constituents within the framework of a single ATM/CNS inter-operability regulation mandate, setting different target dates for different “packages” as discussed in this roadmap (adopting a policy of one-package-one-mandate, each mandate with its own management process would lead to additional mandate management complexity, and would lose the sense of overall system integration issues.)

As the development of Implementing Rules is both a new task and a new way of working together for the Commission and EUROCONTROL, it also seems prudent to include a yearly revision clause in the definition of that mandate.

This approach would also provide a reasonably flexible way of tackling unforeseen problems and/or shifts in inter-operability priorities.

To the largest possible extent, that single revisable EC mandate and the Regulatory Work Programme approved by the Provisional Council of EUROCONTROL should feature the same priorities and the same agenda.

Also we do not analyse in this document the process to be followed for a revision of an already existing Implementing Rules. Although it can be expected that revising an existing piece of regulation should take significantly less time than starting from scratch, there are some stakeholder-consultation and comment-integration delays that cannot be significantly shortened, while the adoption/approval and publication phases would also be submitted to the same constraints as the initial approval and publication; therefore only the drafting phase could be really much shorter.

We have described separately a mechanism for publishing advisory updates so as to allow for a light-handed re-synchronisation of conformity assessment guidance material in Implementing Rules with newly published Community Specifications, but this type of mechanism applies only to the updating of guidance material and cannot be used as a fast track substitute of a full-fledge ENPRM when the rule itself is to be modified.

Once the first set of Implementing Rules has been adopted, we recommend discussing the introduction of a “fast track” revision variation in the ENPRM, if the initial process is found too slow and too cumbersome.

9.3.1 Initiation phase

9.3.2 Origination

The purpose of this sub-phase to the Commission is to prepare the mandate that would be given to EUROCONTROL.

This phase will be done for a set of well-identified packages of functions or sub-domains, with a clear identification of priorities reflected in target dates.

During this phase, the European Commission will have to carry out a basic Regulatory Impact Assessment (RIA) on the basis of readily available guidance and advice; this should ideally outline costs, benefits, who/what will be affected and why non-regulatory action is not sufficient.

This document is probably unnecessary if EUROCONTROL has already taken up the identified issue and produced a similar set of justification.

The European Commission would also indicate for each function or sub-domain the objective-date for completion. They can indicate if they consider regulating such function or sub-domain is a core or exploratory activity.

Duration: 2 months

9.3.3 Receipt and acceptance of the mandate

This preliminary RIA should be the basis for a discussion between EUROCONTROL and EC to come to an agreement on the mission definition. (We don’t see the interest the Commission would have to present to the Single Sky Committee something which would not have been accepted by EUROCONTROL DG).

During this phase EUROCONTROL would verify that:

- there is sufficient justification for EUROCONTROL action,
- the mission is consistent with its strategic objectives and already planned regulation activities (in term of contents as well of delays),
- the mission is acceptable taking into account the available resources and budget.

During this phase, EUROCONTROL can establish a first development plan, perhaps for the initiation phase only, with the definition of the experts and the project leader who will be involved.

Considering the “go/nogo” milestone at the end of the initiation phase, knowing also that part of the tasks depend on the stakeholders’ implication, plus the novelty of the approach, we don’t see how EUROCONTROL can really commit itself for an end date for the regulation process; they can just propose a planning for the task.

Duration: 2 months, partly in parallel with the preceding one.

9.3.4 Single Sky Committee Approval

The mission planned for EUROCONTROL is presented and accepted by the Single Sky Committee from the RIA and the description of the mission discussed with EUROCONTROL.

This phase is submitted to the frequency of the Single Sky Committee meetings.

Duration: difficult to determine. The following phase could take place in parallel with the following one.

9.3.5 Proposal evaluation

The proposal for regulation is evaluated to ensure that there is sufficient justification to proceed with regulatory action and, if so, to further decide the appropriate regulatory action. A more detailed RIA will be produced. The outcome may result in regulatory or non-regulatory approaches. A detailed roadmap for the production of the regulatory package may also be defined (Tasks, composition of the team, working methods, timescales).

The result of EUROCONTROL evaluation could be presented to the Regulatory Committee for review.

As said before an advanced consultation process can take place during this phase. The content of the A-ENPRM document shall discuss only proposed regulatory changes and policy intention at a sufficient level of detail to gain the necessary feedback. Such a process needs 2 months more for the preparation, 2 to 3 months for the consultation, 2 to 3 months more for the answers to comments and preparation of the evaluation.

Duration: 5 months (-2,+4) without A-ENPRM, 12 months (-2,+4) with A-ENPRM.

9.3.6 Total duration of the initiation phase

Until all parties agree on the content of the mandate the regulatory team is constituted: 4 (-1,+2) months.

From acceptance: 5 (-2,+4) months without A-ENPRM, 12 (-2,+4) months with A-ENPRM

Total duration of the initiation phase: 9 (-3,+6) months without A-ENPRM, 16 (-3,+6) months with A-ENPRM.

9.3.7 Drafting Phase

Drafting must take into account the following principles:

- systematic consideration of ICAO SARPS;
- Harmonisation with other authorities and International Organisations in compliance with SES policies (JAA, EASA…);
- Systematic consideration of an implementation programme defining a transition period;
- Consistency with SES material;
- Systematic definition of conformity assessment and other assessments including CBA as defined in SES interoperability Regulation 2001/0237.
- This drafting is made by the working team who take advices from experts as necessary.

The definition of the scope to be regulated has to be shaped in order not to have a too long drafting process.

When several rules will have to be considered in the same domain, the first ones will be more difficult to define then the other ones.

The drafting phase could be shorter when an A-ENPRM has taken place:

Duration: 6 (-2, +6) without A-ENPRM in the initiation phase, 6 (-2,+2) with A-ENPRM in the initiation phase.

9.3.8 Formal consultation phase

Consultation in order to elicit comments must be made.

An RIA and a project of rule are proposed for comments.

The responsibility for the decision that the NPRM is mature for consultation has to be clarified.

Duration: 3 (-1,+1) months.

9.3.9 Review of comments phase

A Comment/response Document has to be produced. If the result of the review is that the final text is significantly different from that circulated, another consultation process must be considered.

Duration: 3 months

9.3.10 Adoption/ approval phase

By RC, Provisional Council, Single Sky Committee

Duration: 3 months

9.3.11 Publication phase

Duration: maximum 3 months

(JAR 11 says that publication shall take place within 3 months after adoption)

Let us take 1 month.

9.3.12 Total duration

Before the drafting phase: 9 (-3,+6) months without A-ENPRM, 16 (-3,+6) months with A- ENPRM.

Drafting phase + Formal consultation + Review of comments + Approval + Publication: 16(-3,+7) without A-ENPRM, 16 (-3,+4) with A-ENPRM.

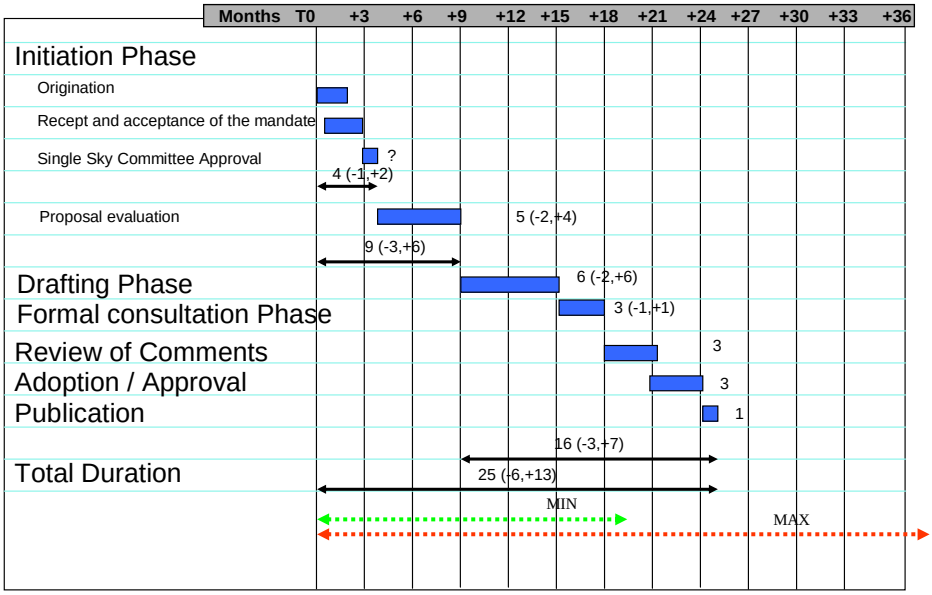
The total duration of the process is therefore:

- without an A-ENPRM: 25 (-6,+13)
- with an A-ENPRM: 32(- 6,+10)

We can retain as a rule-of-thumb: that the production of Implementing Rules would take 2 to 3 years in general, minus or plus 6 months for easiest or most difficult cases.

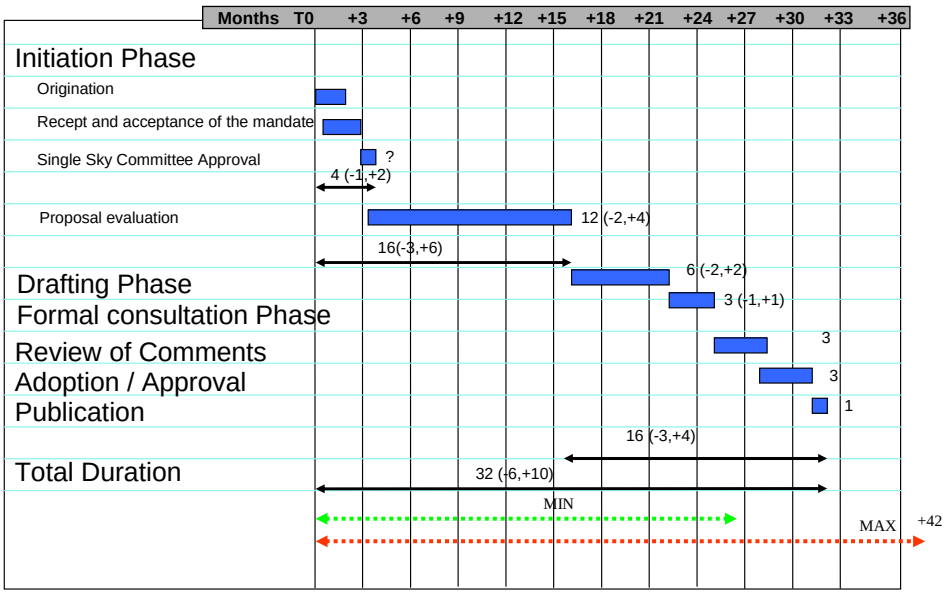
To be applied, systems and procedures have to be adapted. For ground systems, it does not seem possible to aim at an application of the rule before a two-year period. For airborne systems, some rules implicating modification in airborne equipment are not applicable before a period of seven years.

This is illustrated in the following figures.



DURATION OF THE RULE-MAKING PROCESS WITHOUT A-ENPRM

Figure 9.1



DURATION OF THE RULE-MAKING PROCESS WITH A-ENPRM

Figure 9.2

9.3.13 Calibration of the delays

The duration of the phases of the rule-making process is highly dependent on the type (safety, interoperability, performance, QOS…) and complexity of the issue to be solved and on the motivation of the stakeholders to find and accept a common solution.

The delays depend on the numbers and types of stakeholders involved, the numbers of systems concerned, the maturity of the concept or function to be regulated, the maturity of the possible technical solutions, the urgency of the problem, the way to verify the regulation, the fact that the solution implies the modification of organisation or responsibilities, etc…

We can say that probably issues impacting the aircraft side (from the standpoint of either equipment or procedures) would be more difficult to be solved that issues of relevance to ground systems only.

9.4 Definition of a roadmap for rule-making

Considering the description of the domains where implementing rules seem necessary, and the priorities in their development given in the preceding chapter, we consider that the production of implementing rules can be broken down in four packages:

The first package corresponds to the rules which seem the most urgent and need an immediate action for a development in 2004-2005, possibly 2006. They can be relative to current problems or to systems/functions that can be implemented towards 2006-2008.

The second package corresponds to less urgent rules relative to systems/functions that could be implemented in 2009-2012. Their development can begin in 2006-2007 for a period of two or three years.

The third and forth packages correspond to longer term issues for functions or procedures implemented after 2010 and 2015; the implementing rules development can begin in 2008 for the first ones, 2010 for the others.

The first package answers in priority to the need of having sufficient basis for the application of the SES regulation from mid 2005.

10 EXAMINATION OF THE NEED TO CREAT E IMPLEMENTING RULES

10.1 Objective of the chapter

The objective of the chapter is to define in which domain, for which purposes, and under which scheduling, it is necessary to develop implementing rules and community specifications.

For each domain, we present:

- the essential requirements relative to the domain,
- how the methodology defined in the preceding chapter is used.
- the regulatory material that should be developed for each of the four packages outlined in the preceding chapter.

To make this main document more compact, the details of the analysis and the Gantt Chart of the development program are presented at Annex D.

Implementing rules and Community specifications to be developed in the first package have been given an individual identifier.

The general syntax proposed is IR_DDDD_P.N where DDDD is the domain (e.g. ATFM or SUR), P the package number, and N the individual number in the package.

The estimation of the duration of the tasks is based on the gap perceived between already existing material, the maturity/stability of the concept and of possible solutions, the safety criticality, the motivation of the stakeholders.

The start date takes into account the urgency/priority of the corresponding issue, in particular taking into account the need for sufficient material for the transition phase and using the implementation dates of new functions or improvements of systems when they are defined in the ECIP process.

10.2 Administrative rules and specifications

A) We suggest first, considering the SES regulation itself as an “essential requirement” to refine the regulatory process and its results and completing the work we have done in 8, we think it should be suitable to define:

- **IR_ADM_1.1**: An (administrative) implementing rule, consistent with the EC procedures, detailing SES regulation relatively :
  - to the rule-making process:
    - involvement of the stakeholders in the consultation process (for implementing rules and community specifications making) (ex: nature of the stakeholders to be consulted, possibility to consult the stakeholders in several steps, role of social partners, request from a stakeholder for a rule),
    - definition of the different phases of the rules making (we suggest to use the ENPRM principles as a start point), including the approval by the authorities and the conditions of transition from one phase to another,
    - access to the information/documentation,
    - coordination with other regulation processes[33], including safety regulation,

[33] “The ENPRM process requires that the closest contact should be maintained with the EC to ensure the necessary compatibility/consistency with their regulatory process and to achieve efficient synchronisation of the parallel rule-making processes. (…)The detailed procedural aspects have yet to be elaborated and this is the subject of ongoing discussion between

- coordination IR-CS,

- to the identification, content and possibly presentation of the implementing rules and community specifications (ex: traceability ER-IR-CS; definition of level of granularity; record of the various versions of the different materials; reference to existing normative documents).

- **CS_ADM_1.1**: a community specification giving means of conformity of that rule:
  - reference to (or parts of) ENPRM (EUROCONTROL Notice of Proposed Rulemaking), and to EUROCAE procedures if compatible,
  - organisation of a web site for supporting the process,
  - standard of presentation and content of the Implementing rules docket and possibly community specifications docket (to be consolidated into a European rule documentation standard) including the Regulatory Impact Assessment Document presentation and content.

B) As said before, the generic framework proposed at chapter 4 for establishing means of conformity will have to be discussed and consolidated with the stakeholders and the regulatory Authorities. IOnce this is done, an **IR_ADM_1.2** could define:

- 1) the additional mechanisms, verification processes and/or new modules which are necessary to fully address the complexity of ATM/CNS systems,
- 2) the criteria to be applied for selecting those modules to be applied (preferably as a small generic set of system/constituent categories as proposed),
- 3) the supplementary requirements that are necessary,
- 4) the level of intervention of notified bodies,
- 5) the relevance of other elements of safety regulation (ESARRs in particular) on the conformity verification regime,

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The methodological principles defined in RTCA SC-179/EUROCAE WG-53 in the SES regulatory material could be expanded so as to provide a methodology for validating all ATM/CNS system and could then be consolidated into a Community Specification: **CS_ADM_1.2**.

Another community specification should be developed so as to provide a synthesis of recognised best practices regarding the development and application of tests procedures and the sound exploitation of their results, for the various types of systems and constituents found in a ground-ground environment: **CS_ADM_1.3**.

10.3 General

a) Common framework

The identification of the IOP subjects where a regulation is desirable derives from different views of the ATM/CNS system:

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the Agency and the EC. However, the aim will be to achieve a set of binding EUROCONTROL provisions that can be readily transposed into the EC legal order." (3rd RC meeting – 04/02/03).

The progress is dependent on the validation of the MOU between the EC and the Agency which prescribes programmes of co-operation carried out on a yearly or multi-annual basis.

- We can consider the multi-domains view (where is investigated all elements contributing to interoperability: missions, services, operational functions, actors' role. Ideally a complete picture of the operational functions and interfaces would be necessary.
- We have also the logical architecture's view which gives a list of constituents.
- Another point of view is relative to isolated elements (sensors/providers) (radio communications, radio navigation…).

The implementing rules and the community specifications rely on such operational concepts, functional definitions and logical architecture: a sufficient and commonly accepted identification and definition of systems and constituents (relationships, services supplied, information needed) is necessary to impose rules about their properties.

In this report, we suggest to use and make reference to existing documents (IRD, OATA model, albeit not completely validated, …). However, these documents do not cover now all the scope of the IOP regulation (for example, the IRD deal only with flight data) and also their objective is to provide a convergence point for the systems for the year 2010 and above. So, it is not so sure that a sufficiently stable and clear framework, limited to the services of the "current" systems and to the current constituents, is available for the first phase of the implementation of the IOP regulation.

We recommend examining this point in more details and we suggest a community specification **CS_GEN_1.1**: "define 1) a general functional framework and 2) a logical architecture available for 2005 ATM/CNS systems and constituents considered as a reference for the description of the rules and community standard".

b) As regards the need ,expressed in the SES regulation, to establish a "calibrated" environment, it could be useful to define class of "traffic characteristics", "agreed and validated operational concept", "level of safety", perhaps runway configurations, etc.

CS_GEN_1.2: definition of standard configurations necessary to define typical performances of ATM/CNS systems (traffic load, runways configuration, concept of operations…).

c) Following the work made by EUROCAE WG 61 in the definition of an open architecture (ER 6), a community specification will be interesting as a mean of conformity of the essential requirement concerning architecture principles. The requirement asking for an increasingly harmonised, evolutionary and validated architecture, and the result of the working group not being ready before several months, we suggest to retain this community specification in the work programme for package 2.

d) "Systems construction principles" (ER 7) is a requirement which is reported in the majority of each system requirements and we don't see any urgency to complete it with an implementing rule. It is possible that ESARR6 relative to the development of systems when considering safety could be extended to cover interoperability aspects.

e) Safety

The SES regulation requests "agreed safety management, "reporting methodologies", "a harmonised set of safety requirements for the design, implementation and operations of systems and their constituents, both for nominal and degraded modes of operation". An implementing rule **IR_GEN_1.1** could be developed to supplement the regulatory ESARR package for ATM/CNS systems in relation to SES IOP requirements. Some Community specifications could be necessary to give examples or standards for the content and presentation of the documents. This subject has to be discussed with EUROCONTROL SRU.

10.4 Domain COM

10.4.1 Specific Essential Requirements

The Essential Requirements specific to "Communications systems and procedures for ground-to-ground, air-to-ground and air-to-air communications" are dealing with seamless operations and support to new concepts of operation.

Concerning seamless operations, it is stated that the communication systems have to achieve the required performances (communication processing time, integrity, availability, and continuity of function), and that the communication network has to achieve appropriate QoS, coverage and redundancy.

It is stated that communication systems shall support the implementation of advanced, agreed and validated concepts of operation for all phases of flight.

10.4.2 COM Modelling

In the OATA programme, the Communication component is included in a transversal layer named "Middleware and Communication Components" connected to the interfaces of most of the other components of the model, therefore constituting the information backbone of the system. To our judgement, this representation does not provide a sufficient level of architectural detail on communication systems and constituents

The communication system and the constituents of the network have to be characterised more precisely in terms of service layers. Subsequently to that characterisation, it will become possible to allocate at each layer a level of performance and to assess the performance of the whole system, so as to be compliant with the Communication specific Essential Requirements.

The figure below illustrates such a layer-based architecture.

It also describes the way common representations of the COM domain on the one hand, and the OATA logical architecture representation on the other hand, can fit together. It becomes necessary at this stage to clearly identify discrepancies, or gaps between these representations, because they may help anticipate on framework-related weaknesses in the overall process of assessment of interoperability issues, and as such, could lead to consider additional candidate Implementing Rules.

There is an overlap between the COM functional domain and all communicating components in the OATA architecture (not only the middleware and communications components). As far as the COM functional domain is concerned, the layered model proposed as a framework shall be used for the identification and structuring of interoperability issues, instead of directly relying on the components characterisation as currently proposed by OATA (not yet detailed enough in this area).

The following diagram details the resulting mapping between OATA, the functional COM domain and the layered model:

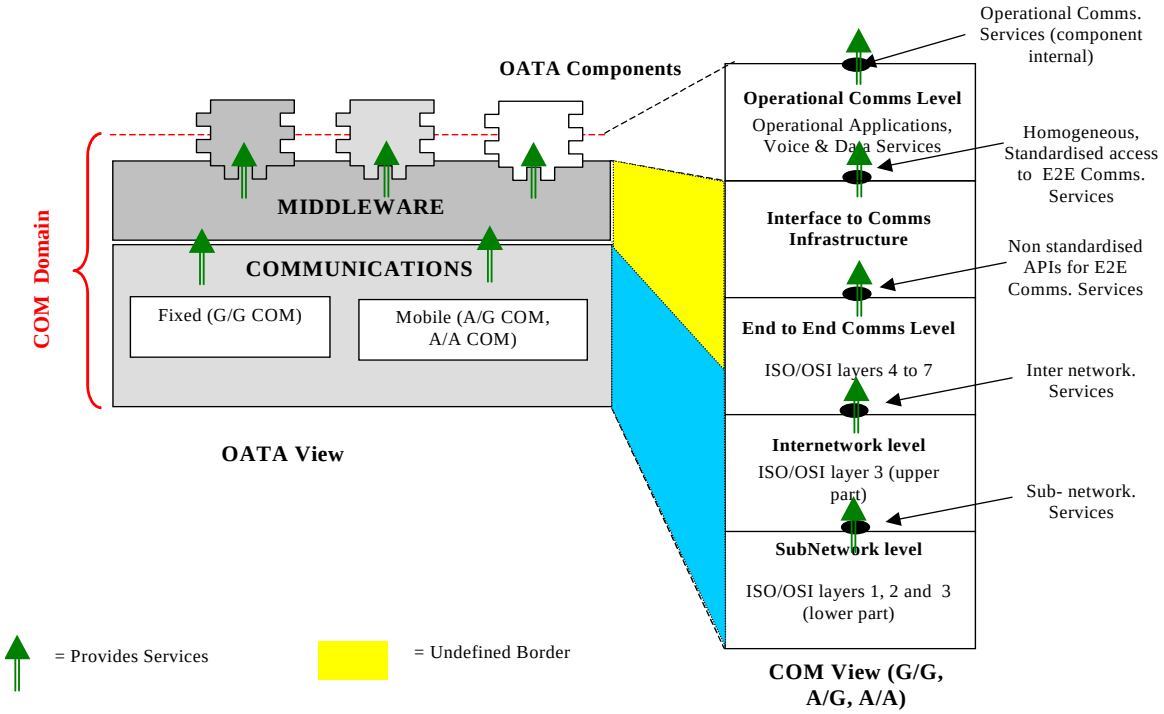


Figure 10.1

The following table summarises the proposed layered logical model to be considered for the entire COM domain:

Level		Scope		Certifiable Constituents
Operational		Operational (Communicating) Applications		Operation Manuals, HMIs (interface to comms)
		Voice services	Data services (D/L services, D/L applications)	
"INTERFACE TO COMMS INFRASTRUCTURE"		Standardised Interface to the Application layer APIs		Piece(s) of Software providing a standard and homogeneous interface to the underlying communication layers
INFRASTRUCTURE	**End to End and upper layers**	ISO/OSI model layers: 7 → Application 6→ Presentation 5→ Session 4→ Transport		**INFRASTRUCTURE**
	Inter network	ISO/OSI model layer 3 (Network), upper sub-layers		

Level		Scope	Certifiable Constituents
	Sub-networks	Ground, Air and Air-Ground sub-networks – ISO/OSI model layers: 3→ Network (lower sub-layer) 2→ Data Link 1→ Physical	

Table 10.1

Considering this model, the need for interoperability regulatory documents to precise the Essential Requirements, that is to say to allow the communication system to achieve appropriate level of performances, seems twofold:

- Intra-layer: within one layer of the hierarchy, the performances have to be assessed; there are interoperability issue that need to be regulated and documented, for instance the inter-network addressing plan;
- Inter-layer: at the interface between the different layers, defined notably by an exchange of information with given characteristics (of quality of service for example), regulation documents have to be defined to qualify these characteristics, e.g. concerning the communication data performances at the end user level.

10.4.3 Need for Implementing Rules

Thus, there seems to be an important need for Implementing Rules, which roles are to clarify the performance requirements for every part of the communication model.

The classes of performances required by the Essential Requirements need to be qualified.

Implementing rules shall of course not conflict with ICAO SARPS or question these documents due to their very nature of world-wide established standards; neither shall they repeat ICAO rules or specifications (ICAO standards have precedence over EU rules in the ATM domain). However, the specific European context generates the need to complement and/or refine the content of the ICAO documents through Implementing Rules.

Therefore, Implementing Rules are necessary for every layer of the communication model for the definition of the classes of performances required in the Specific Essential Requirements:

- Sub-networks:
  - Air/Ground and Ground/Ground infrastructure performances
  - Datalink layer performances
  - Network layer performances
- Inter-network performances
- Operational level:
  - Datalink performances
  - Voice performances

Concerning the Essential Requirement requiring "support to new concepts of operation", a unique Implementing Rule dealing with Air/Air Communication operations shall be written in complement to the Essential Requirement.

10.4.4 Implementing Rules Roadmap

Considering the needs for Implementing Rules detailed above, a prioritisation extracted from EUROCONTROL works (Communication Strategy in particular) and the estimated urgency of the issues, the following roadmap can be drawn:

- The first package of regulatory material, i.e. of priority 1, is detailing the "Seamless Operation" specific Essential Requirement for the Air-to-Ground sub-network layer of the model. The physical and datalink layers performances need to be standardised, leading to two different Implementing Rules:
  - **IR_COM_1.1:** concerning the Air/ground physical layer performances, and particularly the frequency management and allocation, directly related to the Quality of Service available on the link considered;
  - The next layer of the model shall also be standardised so that the ER requirements can be answered: **IR_COM_1.2** concerning the datalink layer characteristics have to be written, focusing on the datalink layer channel sharing enabling required performance to be provided.
- In the first package, there should be no need to regulate the functional specifications and the performances of the G/G COM domain. There could nevertheless be Community Specifications (CSs) concerning G/G COM general architecture (**CS_COM_1.1**). These documents could promote a unified standard for Ground-to-Ground Communication Network, based on EUROCONTROL current works for instance (seamlessness).
- The second package of regulatory material is a set of rules concerning the "Seamless Operation" specific Essential Requirement that concerns all the layers of the COM model, from the sub-network to the operational level, through the inter-network layer. The following rules shall be addressed:
  - An **IR** concerning the Ground/ground physical layer functions and performances;
  - A generic **IR** concerning A/G sub-network connected service performances, that has to be detailed for each A/G sub-network technologies through appropriate industrial voluntary standards;
  - Voluntary **Community Specification** defining network architecture options and assessing the inter-network layer performances, standardising for instance inter-network addressing plan or sharing agreements among the different actors, so that seamless performances can be guarantied throughout the whole COM system;
  - An **Implementing Rule and a voluntary Community Specification** defining Datalink services operational characteristics and performances, based current documentation but putting the emphasis on Quality of Service requirements for each datalink service;
  - An **Implementing Rule** acting as a symmetric standard of the previous IR, but in the framework of voice services performances. Adjacent Community Specifications concerning digital voice equipment could support the central IR.
- A last package including a single rule is addressing the "Support to new concepts of operation" specific Essential Requirement. This long-term IR deals with ASAS operations: actually, it seems necessary to complete the Essential Requirement on this subject, and to support the industrial standards in development. It would be completed by a voluntary Community Specification.

10.5 Domain SUR

Surveillance is basically the ability of the whole ATM system (ground- and airborne-based) to identify each aircraft and to determine its accurate position. The purpose is to contribute to the improvement of the capacity whilst maintaining, or improving, the present level of safety.

10.5.1 Specific Essential Requirements

In the Interoperability Regulation the surveillance domain is split in two pieces:

- Surveillance systems and procedures: surveillance system and surveillance network are differentiated here;
- Surveillance data processing systems.

Specific Essential Requirements are defined for both pieces.

10.5.2 Seamless Operations

Surveillance systems should achieve "required performance […] in particular in terms of accuracy, coverage, range and quality of service."

"The surveillance network […] shall be such as to meet the requirements of accuracy, timeliness, coverage and redundancy", and to ease the surveillance data sharing.

Surveillance data processing systems shall achieve "required performance and quality of service […] in particular in terms of accuracy and reliability of computed results, correctness, integrity, availability, continuity and timeliness of information at the control position." It "shall accommodate the timely sharing of relevant, accurate, consistent and coherent information" among the surveillance network.

10.5.3 Support to new concepts of operation

Surveillance data processing systems "accommodate the progressive availability of new sources of surveillance information in such a way as to improve the overall quality of service."

10.5.4 SUR Modelling

The approach here is to define surveillance functions as parts of a unified domain with different layers presenting different characteristics.

10.5.5 Surveillance Component Functional Architecture according to OATA document

The Surveillance Functional Architecture (SFA) is currently under review. The review is being conducted under the responsibility of the Surveillance Architecture Focus Group and within the scope of the Overall ATM/CNS Target Architecture (OATA) programme.

Nevertheless, according to OATA programme, two clusters mainly constitute the Surveillance component:

- Air Surveillance Cluster: Air Data Acquisition and Air Surveillance Data Processing & Distribution (SDPD)
- Ground Surveillance Cluster: Ground Data Acquisition, Target Report Servers and Ground SDPD.

The Data Acquisitions (Air and Ground) boxes are fed by surveillance information provided by surveillance infrastructure:

- PSR, SSR and Mode-S Radar for Air Surveillance (En-Route, TMA and Approach);

- ADS-B for Air and Ground Surveillance;
- Multi-lateration Sensors and ASDE for Ground Surveillance.

Finally, all the surveillance information issued by this structure is allocated to Surveillance Applications Users.

10.5.6 Hierarchical Architecture of the Surveillance within Air Traffic Management

The Surveillance component structure can also be described following a hierarchical model in three layers:

- The **physical infrastructure** at the bottom level supplies data services to the ATM system. Physical communications system supports the transfer of digital COMmunications, NAVigation and SURveillance information. Within the SUR domain, Radars Sensors are required to acquire the information from suitably equipped aircraft.
- **System Support** functions process the data into smooth and filtered information. At System level, a range of DPS (Data Processing System) functions process the COM, NAV and SUR data. The SDPS (Surveillance Data Processing System) is used to interpret the surveillance information and distribute it through a ground network to its final users.
- **Users** are provided with a service (**Service Provision**) at the highest level, which is used to support critical functions in ASM (Air Space Management) for instance. Suitable aircraft information, presented in a form that a controller can use to make decisions or recommendations generated from functions at the underlying System Support level.

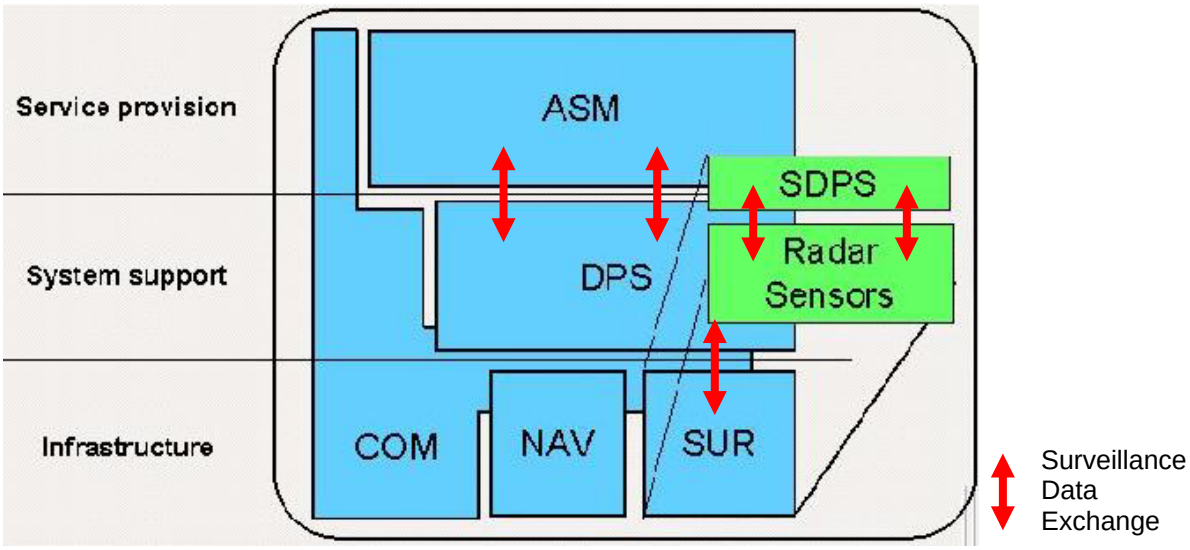


Figure 10.1: Surveillance Domain Hierarchical Model

10.5.7 Functional vs. Hierarchical Structure

Both the approaches, functional and hierarchical are largely compatible. Each surveillance technology, technique, system or application can be fit to both these architectures. Therefore, we will rather refer to the hierarchical architecture in the following surveillance domain analysis to identify the IR propositions.

The mapping of the levels of interoperability onto the hierarchical structure seems quite straightforward:

- The technical standards mainly concern the surveillance physical infrastructure of the hierarchy - surveillance sensors (Radars, airborne equipment…), distribution

network… - and the protocol and data exchange functions of the system - that is to say the SDPS mainly. But the system support can also define hardware interoperability aspects (processing units…).

- The operational standards mainly concern the service provided to the surveillance data users, that is to say the service provision level of the architecture, but also the operations of the other layers.

This mapping can be used to identify the correspondence between the documents identified in the WP2 and classified according to the different types of standards, and the hierarchical structure.

Indeed, when identifying the interoperability issues in the Surveillance domain, the best approach is to consider each level of the hierarchical model, as well as the interfaces between the layers, and to characterise them with appropriate standards.

The need for interoperability regulatory documents is therefore twofold:

- Intra-layer: within one layer of the hierarchy, there are interoperability issue that need to be regulated and documented, for instance the surveillance servers addressing plan;
- Inter-layer: at the interface between the different layers, defined notably by an exchange of information with given characteristics (of quality of service for example), regulatory documents have to be defined, e.g. concerning the surveillance data performances at the end users level.

The approach defined here can combine:

- the bottom-up approach, based on existing standards;
- the top-down approach, based on the hierarchical structure presented previously and on the identification of potential interoperability issues, layer per layer (at the same time intra- and inter-layer).

When reducing the scope to the surveillance infrastructure for instance, the main documents to be taken into consideration are ICAO SARPS, grouped in Volume III, Part 1 of ICAO Annex 10, complemented by ICAO technical Manuals, ETSI standards for ground equipment, and EUROCAE/RTCA MOPS for airborne equipment.

10.5.8 Need for Implementing Rules

Based on the previous Surveillance system model, the rules have to address the specific Essential Requirements at each level of the layered model. Indeed, it is the performance of each layer that needs to be clearly defined:

- General Performances at the User level (Service Provision);
- System Support layer performances:
  - seamless data transfer;
  - surveillance model conformity rule;
- Infrastructure performances, in particular concerning Mode-S;
- Operational surveillance applications performances, and also support to new surveillance operational concepts.

10.5.9 Implementing Rules Roadmap

The previous remarks concerning the needs for Implementing Rules should be complemented by domain strategies and planning (for instance EUROCONTROL Surveillance Strategy) in order to define different work-packages for the standardisation work.

1. The first package of standards, i.e. of priority 1, including a single rule **IR_SUR_1.1** is addressing the "Seamless Operation" specific Essential Requirement at the Service Provision layer of the Surveillance Model. In fact, it shall define precise performance characteristics at the general surveillance level, in particular in terms of accuracy, coverage, QoS…; it corresponds to the expression of surveillance performance integrating the contribution of all of the underlying constituents, reflecting the service provided at the output of the SDPS.

2. The second package of standards, with a lower priority, is a set of rules concerning the "Seamless Operation" and "Support to new concepts of operation" specific Essential Requirements.
   - The performances of the System Support and Infrastructure layers have to be standardised. The following elements should be developed:
     - A **Community Specification** concerning the Seamless Data Transfer performances, considering ATERIX standard as main reference for the definition of a common data format for the information circulated across the surveillance network
     - A**n Implementing Rule** addressing Surveillance Model Conformity issues for deriving surveillance distribution needs and requirements, and defining a unified surveillance architecture (based on ARTAS architecture) that shall allow to reach the required performances for the future unified surveillance network;
     - An **Implementing Rule** concerning Mode-S Stations Addressing Plan. It shall define the Mode-S stations codes allocation procedures to be used at the European level.
   - Concerning new surveillance operational concepts, the rules shall address the two types of Essential Requirements at the same time, namely defining application performances and making the evolution to these new concepts easier:
     - Safety Nets operations and applications shall be described in an **IR** defining their associated performances and systems;
     - An **IR** defining ADS Operational Applications performances and procedures and required Architecture shall be written;
     - An **IR** defining ground surveillance Operational enhancements shall be defined: it shall describe procedures and systems to be used in order to deploy Collision Avoidance services, and Taxiway and Runway intrusion services.

10.6 Domain NAV

10.6.1 Specific Essential Requirements

The Essential Requirement specific to "Navigation systems and procedures" is mainly dealing with seamless operation. It states that the navigation system should be able "to achieve the required horizontal and vertical navigation performance, in particular in terms of accuracy and functional capability".

10.6.2 NAV Modelling

In the OATA programme, the Navigation system is not considered as an independent domain, but rather as a set of data provided by different sources (navigation aids, aircraft…), centralised within the "Avionics Cluster" and transmitted to the whole ATM system through the Middleware layer.

This vision seems to be satisfying for the Essential Requirement to be appropriately applied to the Navigation system and eventually specified.

10.6.3 Need for Implementing Rules

The Essential Requirement itself, in parallel with the appropriate standards, seems sufficient to characterise the performances of the different types of navigation information sources.

It could nevertheless be complemented by Implementing Rules detailing the concept of horizontal and vertical performance at the operational level for the en-route and approach phases of flight. These rules are indeed required to detail the means of conformance of the different sensors and other systems to the Essential Requirement. These IRs shall be available as soon as possible.

An Implementing Rule concerning Global Navigation Satellite Service could eventually be useful to characterise the operations and the performances of this future navigation sole data source. This rule will act as the common base of performance requirements for all industrial standards dealing with GNSS.

10.6.4 Implementing Rules Roadmap

In order to complete the "Seamless Operation" Essential Requirement for Navigation systems, two packages of Implementing Rules shall be identified.

- The first package consists in an **IR** (**IR_NAV_1.1)** directly detailing the navigation performance requirements of the Essential Requirement and that has to be ruled in short-term. It shall detail the navigation horizontal and vertical separation standards and performance concepts in the different airspace.
- The second package of rules, for a longer term (package 4) is twofold:
    - An **IR** completing the Essential Requirement in the scope of precision approach. It shall detail the horizontal and vertical navigation performances particular to this phase of flight.
    - An **IR** characterising the operations and the performances inherent to the Global Navigation Satellite System shall be written.

There is no need for complementary Community Specifications, as all the sensors used in navigation to guaranty the performances required in the Essential Requirement are already defined in industrial standards with adequate details.

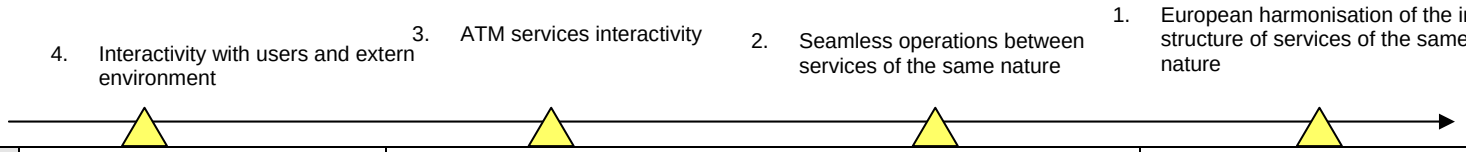
10.7 Domain ATM

Since it is necessary that the Implementing Rules development program be consistent between all four Regulations composing the Single European Sky Regulatory package, and since the essential requirements provided for in Regulations 2001/0236_Airspace and 2001/0235_Service Provision, determine the strategic changes for ASM, ATFM, and ANS, thus could hardly be ignored to build our assumptions on the required systems interoperability levels to support such changes, IR/CS themes for systems interoperability are analysed referring to essential requirements of any of these SES Regulations in a non-discriminatory manner, whenever felt of relevance on interoperability matters.

The following matrix provides an overview of the series of operational Requirements for the creation of the Single European Sky impacting any of the ATM domains, ASM, ATFM, ATS, AIS and MET, classified with respect to the levels of IOP objectives they correspond to, as defined in section 3. This classification serves to determine for each domain all the EC requirements which could be of relevance for all these ATM domains.

All three SES regulations (2001/0235, /0236, /0237) were explored in depth to build the list of Essential Requirements of this matrix. To distinguish their origin on the matrix, requirements extracted from SES Regulation 2001/0236_Airspace are marked with a single asterisk, requirements extracted from SES Regulation 2001/0235_Service Provision are marked with a double asterisk.

This classification in particular helped us determining a specific strategy for the development of relevant IR/CS and especially their prioritisation into a consistent development program. The strategy for each domain is described in the next sections organised per domain.



Generic ***Safety provision in the Single European Sky***	Agreed high levels of safety provided to users	Agreed sets of safety requirements for the entire European air traffic management network		Adoption of ESSARs * Systems and procedures compatible with human capabilities and assuring protection from harmful interference
Generic ***Rules for Provision of Air Navigation services***		Formalised working relationships, setting out the specific duties and functions assumed by the providers to other service providers *	Common requirements for the provision of air navigation services *	
Generic ***Rules for Data exchanges***	Access to relevant data shall be granted between airspace users, certified air navigation service providers and airport for operational purposes only *		Standard conditions of access to relevant operational data between service providers, airspace users and airports approved by supervisory authorities *	
Generic ***New concepts of operation***	Enhanced interactivity with users: CDM, ASAS		Harmonised enhanced Levels of Automation of services	
Generic ***Civil/military collaboration in the Single European Sky***	Improved service to users: more flexible use of airspace ** Civil/military co-ordination **	Timely sharing of correct and consistent information between civil and military counterparts	Uniform application of the FUA concept **	
Generic ***Environmental constraints***	Minimise Environmental impact in accordance with applicable community specifications			
Generic ***Systems logical architecture principles***		Coherent and increasingly harmonised, evolutionary and validated logical architecture within the ATM network		
Generic ***Systems construction principles***				Design, building and maintain of systems on sound engineering principles

Generic ATFM ***New organisation and use of airspace in the Single European Sky***	Support operational decisions between airports, ANSP and airspace users ** Revision of priority rules regarding access to airspace ** Provision of options for diversion of general traffic from congested areas **		Creation of a single publication for routes and traffic orientation **	
Generic ATFM ***New organisation and use of airspace in the Single European Sky***		Optimised capacities within the use of airspace **	Rules of transparency and efficiency ensuring that capacity is provided in a flexible and timely manner ** Improved ATFM processes **	
Generic ASM ***New organisation and use of airspace in the Single European Sky***		Creation of the European Upper Flight Information Region ** Reconfiguration of the upper airspace: Creation of functional airspace blocks **		Common principles for the design of routes and sectors ** Common airspace classification **
Specific ATS **FDPS**		Coherent and consistent planning process Resource-efficient tactical co-ordination	Interoperable FDPS: timely sharing of information, common operational understanding of the information Equivalent Flight Data processing performance and appropriate for a given environment	Common application of an agreed and validated operational concept to achieve sufficient performance in terms of accuracy and error tolerance of processing results
	Support to new concepts of operation Delegation of responsibility to pilots (ASAS concept)		Support to new concepts of operation Automation-intensive tools introduction	
Specific ATS **HMI**		Accommodation of HMI to new concepts of operations and increased automation Compatibility with human capabilities	Common HMI characteristics, aimed at Progressively harmonising the working environment for all control staff, including functions and ergonomics	
Generic AIS ***New organisation and use of airspace in the Single European Sky***		Creation of a single aeronautical publication for the EUIR **		

Specific ATFM -IOP	Offer dialogue capabilities in a view of an optimised use of airspace	Support the sharing of correct coherent and relevant strategic, pre-tactical and tactical flight information		
Specific ASM-IOP	Information relating to pre-tactical and tactical aspects of airspace availability provided to whomever concerned in a correct and timely way			
Specific AIS IOP	Provision of accurate and consistent information in particular concerning airborne and ground based constituents made available in a timely manner Progressive improvement of the accuracy and completeness of aeronautical information to support the continuous improvement of the efficiency of airspace and airport use		Aeronautical information provision in an electronic form	Common standard data set
Specific MET IOP		Provision of an agreed data set of MET information to users Support to new concepts of operations: Improved MET info provision to support a continuous improvement of the efficiency of airspace and airport use	Improve consistency and timeliness of MET information provision Improve quality of its presentation Support to new concepts Improve promptness of availability and speed with which it may be used	

10.8 ASM domain

10.8.1 Essential Requirements of relevance for the ASM domain (and corresponding IOP objective level)

The SES requirements of relevance for ASM are twofold:

1. the achievement of great strategic airspace management changes, including the creation of the EUIR, the adoption of common principles for boundary-free optimised routes and sectors, the introduction of "functional airspace blocks, 3rd- 4th level IOP objectives.
2. the recognition of the potential of achieving efficient civil/military collaboration, in particular through the implementation of the FUA concept. This corresponds to a 1st level IOP objective but progress in this frame is important.

Both Airspace and Interoperability related Requirements are considered.

10.8.2 IR/CS development strategy for ASM

Provided our interpretation of EC requirements for ASM in the Single European Sky, our strategy for Interoperability IR/CS developments is based on the following principles:

(a) the creation of the Single European Sky which generates fundamental strategic changes of the Upper airspace structure, based on IR developed in the field of SES Regulation 2001/0236_*Airspace,* may gain be associated with IR specifying the Modalities for the synchronisation of all ATM systems and procedures updates as well as users Flight Planning & Flight Management Systems at the time when airspace structures evolutions are targeted. The IOP-IR development rhythm may follow the associated airspace IR development (first package). The issue of introducing "functional airspace blocks" providing its difficulty, shall be addressed apart, in a single package joined to Regulation 2001/0236_*Airspace*

(b) when the ASM interoperability subject is specifically addressed, it is the consolidation of ASM-related airspace access information in the pre-tactical and tactical phases which is exclusively scoped, with particular emphasis put on achieving the most efficient collaboration between civil and military users. This basically deals with achieving full implementation of the FUA concept. The SES Regulatory text is clear about the EC requirement for effective application of the FUA concept in the Single European Sky. However, the Commission does not directly request for the development of a FUA-specific implementing rule but only warns on the possibility of enforcing one if progress for implementing FUA is not stated from member States. *"Member States shall report annually to the Commission on the application, in the context of the common transport policy, of the concept of Flexible Use of Airspace in respect of the airspace under their responsibility"' 'Where, in particular following the reports submitted by Member States, it becomes necessary to reinforce and harmonise the application of the concept of Flexible Use of Airspace within the Single European Sky, implementing rules within the context of the common transport policy shall be adopted (…)".'*Any FUA-oriented implementing rules developments were therefore considered provisional, depending on the conclusions of the EC review on States progress in this field.

(c) Now in Regulation 2001/0237_*Interoperability,* civil/military collaboration might go beyond the implementation of the FUA concept *"The European air traffic management network, its systems and their constituents shall support the progressive implementation of civil/military co-ordination,* ***to the extent necessary*** *for an effective airspace management and air traffic flow management".* Among the most relevant civil/military collaboration enhancement projects currently involving both military and civil aviation authorities, one should consider the EUROCONTROL Agency attempts:

   1. for establishing rules for consolidated civil and military airspace planning, however with no systems interoperability issues at stake
   2. for harmonising GAT/OAT handling procedures. In this field, the Agency is proposing that an endorsement be established by the ICAO and NATO but also by the European Commission.

This shall be approved and adopted at least as an IOP "Community Specification", the development of which shall still be postponed on package 2 or 3.

(d) Only upper airspace restructuring is targeted in the SES regulation, the policy for the lower airspace might be established depending on the results of an EC study on the potential extension of Regulation 2001/0236_*Airspace* principles for the lower airspace. Thus IR/CS developments for the lower airspace shall be only provisional, in particular those aimed at the extension / enhancement of the FUA to the lower airspace.

10.8.3 Implementing Rules Roadmap

Considering the principles detailed above, the following IR/CS development program was drawn:

- In a first package, IOP-related IR accompanying strategic airspace management changes may be developed in the following fields:
  - **IR_ASM_1.1:** Modalities for synchronised procedures and systems adaptations to Airspace classification changes in the upper airspace,
  - **IR_ASM_1.2:** Modalities for synchronised procedures and systems adaptations to ATS routes changes in the upper airspace,
  - **IR_ASM_1.3**: Modalities for synchronised procedures and systems adaptations to sectors design changes in the upper airspace.
- In a second package,
  - **IR_ASM_2.1**: European obligations for the effective implementation of the FUA concept but only provisional, if no progress is achieved on the implementation of the FUA,
  - **IR_ASM_2.2**: common procedures for OAT/GAT handling compatibility.
- In a third package,
  - **IR/CS developments relating to the EC policy for the lower airspace that might follow for the extension of upper airspace principles to the lower airspace.**

10.9 ATFM domain

10.9.1 Essential Requirements of relevance for the ATFM domain (and corresponding IOP objective level)

The main requirements for the Single European Sky ATFM system as provided for in the SES regulation correspond to the following different IOP objective levels:

(a) a revision of the ATFM service to users is aimed and is oriented towards increased collaborative decision making with airspace users and airports with regards to flight planning within the accessible airspace. This constitutes a 4th level IOP objective, which requires that interactivity of the ATFM services with airport-based services and airspace users be firmly established.

(b) a revision of the ATFM service interactivity with ATS is aimed, to assure more optimum ATC capacities assignments, in order that the available ATC capacity be provided considering airspace users needs, needs that the ATFM system is in charge of estimating. This constitutes a 3rd level IOP objective that requires that interactivity between intern functions of the ATM system be enhanced.

(c) in parallel Regulation 2001/0236 *_Airspace* provides for fundamental changes into the decision-making structure of the ATFM service, (revision of ATFM priority rules, Single, consistent EUIR-wide traffic orientation scheme publication, etc), 3rd-4th level IOP objective.

(d) still when the ATFM interoperability subject is specifically addressed, it is the consolidation of ATFM-related flight information flows, which is exclusively scoped, 2nd level IOP objective.

Provided the levels and associated difficulty of achieving such objectives, our conclusions regarding IOP-related IR and CS development program are the followings:

1) EC requirements for the ATFM decision-making pole address both decision-making structures and information management. However, as specified in point (d), IR and CS developments in the field of regulation 2001/0237*_Interoperability* shall mainly aim at addressing ATFM-related information management, potential IR developments on decision-making structures being rather established within other SES regulations frame, as stated in point (c).
   - ⇨ IR/CS developments shall therefore aim at specifying all ATFM-related information flows transiting in the ATM network so as to enable increasingly efficient functioning of ATFM in the Single European Sky. Such IR shall:
     - ⇨ clearly specify the minimum mandatory ATFM-related information provision between all ATM services involved, including the nature and quality of information to exchange, assuring the good diffusion of information, including 1) access of the whole set of data necessary for deciding of the ATFM measures to apply, 2) diffusion of the decision terms to all impacted parties, 3) access to the data necessary to assess conformity to the ATFM measures.
     - ⇨ refer to European standards for ATFM-relevant data exchanges, at least based on the currently existing ADEXP format specified by the Central Flow Management Unit. Provided that flight information flows are numerous and useful for a great number of systems and services, the idea of grouping all the information on flights transiting in the ATM network in a single information-rich package (the flight object) is currently raising. Before such a standard is available, at least current (potentially enhanced) standards shall be recognised as the baseline in the first regulatory material delivery date.
     - ⇨ Technical details on the standards might be provided in an associated CS.
2) However such requirements are expected to evolve with the ATFM service enhancements provided for in points (a) and (b). These would necessitate an important restructuring of the ATFM service and of its relation with the other ATM services.

This fundamental restructuring is currently under study in the ATM community. Among the material of most relevance in this field, one shall consider the attempt of implementing CDM principles at airports – point (a), and the initiative of the CFMU to establish the concept of ATFCM (Air Traffic Flow and Capacity Management) – point (b). Achieving an acceptable conceptual baseline is certainly a difficult task requiring live testing campaigns. It would therefore certainly be premature to consider that sufficiently stable material be available in 2005, at the first IOP regulation enforcement date. From the estimates of the EUROCONTROL harmonisation program and the ECIP plan, stable results are not expected before 2008-2010 (corresponds to our third work-package development program). Still it may not be unrealistic fore-planning the development of complete mandatory IOP IR material in our third IR/CS development work package.

- ⇨ IR/CS IOP-related developments shall therefore take into account the need of introducing new information flows, which will become necessary to enable both CDM at airports and Air Traffic Flow and Capacity Management be implemented. Such IR shall:
  - ⇨ clearly specify the minimum mandatory ATFM-related information provision between all former and newly ATM and non-ATM services involved, including the nature and quality of information to exchange,
  - ⇨ In particular
    - ⇨ for CDM at airport, specify airport-based, Aircraft Operators, ATFM and ATS services responsibility with regards to the provision of CDM information for flight planning
    - ⇨ for capacity management, specify the new information flows at stake especially regarding ATS capacity information exchange, that as provided for in Regulation 2001/0236_*Airspace* shall be granted on transparency principles
  - ⇨ CS developments may usefully precede IR developments as soon as mature support tools prototypes are available in the community. These shall be introduced as non-mandatory but "good" practices to pave the way towards full/mandatory implementation of such concepts. In particular technical standards on CDM products might be made available as soon as possible for industry prior to mandatory implementation.

3) However first systems enhancements investments, not aiming at complete but at least at partial implementation of such information flows, might certainly be achieved rather soon. These would aim at paving the way towards full information exchanges between services that will be of relevance for future ATFM structures enhancements. The upgrading of such information flows is currently studied at EUROCONTROL in the FDM department. Information flows enhancements are decomposed into "IOP subjects" and implementation target dates depending on the difficulty of achieving them are estimated. From this analysis "quick wins" are determine. These shall constitute the baseline for the development of ATFM-related IR for the first SES regulation enforcement date.

10.9.2 Implementing Rules Roadmap

Considering the needs for Implementing Rules detailed above, the prioritisation based on current levels of achievement of the series of SES objectives for ATFM, the following IR/CS development program was drawn:

- In a first package, IR specifying how to guarantee "Seamless Operation" within the current ATFM system structure shall be developed and may be decomposed in two different IRs:
  - **IR_ATFM_1.1**: Minimum mandatory data provision between ATM services within the current ATFM structure for assuring 1) access of the whole set of data necessary for deciding of the ATFM measures to apply, 2) diffusion of the decision terms to all impacted parties, 3) access to the data necessary to assess conformity to the ATFM measures;
  - **IR_ATFM_1.2** adoption of common data exchange formats for ATFM-relevant information provision
  - A **CS** providing the technical details of the data exchange standard to be used (ADEXP format) and potential associated intern systems enhancements.

Such a material shall provide a stable baseline for the next structural enhancements of the ATFM system.

- In a second package, to pave the way towards CDM implementation and capacity management in ATFM, but providing that conceptual maturity may not be so soon achieved, at least shall CS be developed, to launch industrial developments and encourage first implementations, in the following fields:
  - For capacity optimisation purposes,
    - A **CS** developed as a "good practice" specifying the roles of each service in flow and capacity information exchanges and the associated strategic, pre-tactical and tactical procedures enabling the decision-making;
  - For CDM implementation purposes;
    - A **CS** describing the minimum technical requirements for airport CDM
  - In parallel shall the development of the "flight object" standard be started and delivered as a **CS** first;
- In a third package, the delivery of the mandatory material for CDM implementation and capacity optimisation might become realisable, these shall specify
  - The revised structure of ATFM-related information exchanges between ATM services and their responsibility with regards to airspace users, in terms of support for flight planning mainly.
  - The capacity information exchange structure enabling common air traffic and capacity information management at Single European Sky scale.
  - The adoption of the "flight object" as the standard format for flight information exchange within the SES ATM network.

10.10 ATS domain

10.10.1 Essential Requirements of relevance for the ATS domain (and corresponding IOP objective level)

The main requirements for the Single European Sky ATS are numerous since ATS are the cornerstone of the ATM system. In particular, these are also involved in series of SES objectives defined in the field of ATFM or ASM. Our interpretation is that all the above SES objectives may be considered of relevance for ATS, these are classified as follows depending on the level of the objective to achieve:

(a) 4th level objective: Establish stronger air/ground systems connectivity for enabling increased co-operation with airspace users,

(b) 4th to 3rd objectives: Increased interactivity between ATS services and other ATM services to achieve optimised airspace structures design and capacity management throughout the whole Single European Sky. In this field, the achievement of resource efficient tactical co-ordination is particularly targeted as well as improving planning processes.

(c) when the ATS interoperability subject is specifically addressed, essential requirements are defined for FDPS, SDPS and HMI.

(d) Concerning FDPS, emphasis is put on achieving:

(e) 2nd level objectives: efficient interconnections between all local FDPS systems, this in a view of assuring:

- equivalent FDPS performance throughout the Single European Sky adapted to each given environment (en-route, TMA),

- a timely sharing of information and a common understanding of that information

(f) 1st level objectives: similar FDPS design characteristics –, based on the application of a common operational concept assuring that the required FDPS processing performance is reachable

(g) in relation with the 4th level objective (a): the introduction of the new concept of operation, based on ASAS with increased connection with airborne systems

(h) Concerning HMI, 1st level objective: the implementation of “similar” working environments for controllers SES-wide is targeted so that no local particularity makes it difficult for ATS staff to move from one place to another within the Single European Sky.

(i) Considering 1st - 2nd level objectives for rapid and harmonised automation of the working environment, with particular emphasis put on impeding risks that such automation-intensive tools do not match with human capabilities.

(j) SDPS is not addressed in this section but in the SUR related section since many of the requirements on this topic are directly related to the global surveillance system

10.10.2 Proposed strategy of IR/CS developments in ATS

Provided the levels and associated difficulty of achieving such objectives, our conclusions regarding IOP-related IR and CS development program is basically that:

1) at the first regulation enforcement date in 2005 at least 2nd and 1st levels objectives shall be addressed in priority. These deal with achieving basic seamlessness of local FDPS systems – objective (e) and (f) and ATC staff working environment harmonisation – objective (h), with potential postponing of IR/CS readjustments taking into account future ATS systems enhancements – 3rd and 4th objectives achievements.

- ⇨ IR developments for objective (e) would gain in using the IDTF work on enhancing inter-ACC and ACC-airports, ACC-ATFM information flows. The upgrading of such information flows is currently studied at EUROCONTROL by the IDTF task force, formerly in charge of the maintenance of the OLDI inter-ACC data exchange format. Information flows enhancements are decomposed into "IOP subjects" and implementation target dates depending on the difficulty of achieving them are estimated. From this analysis "quick wins" are determined. These shall constitute the baseline for the development of FDPS-related IR for the first SES regulation enforcement date.
- ⇨ IR developments for objective (f) could be pursuant to the current EUROCONTROL/EUROCAE WG59 work, and the attempt for specifying the technical characteristics of future FDPS
- ⇨ Such IR shall:
  - ⇨ Address the FDPS processing performance requirements
  - ⇨ Provide technical guidelines on FDPS data processing aimed at assuring that
    1) the required processing performance quality is reachable
    2) assuring that consistency between all data stored in each FDPS is assured, taking into account the possibility of centralising some functions
  - ⇨ clearly specify the mandatory data flows exchanges between ATS services, associated with the corresponding data quality information
  - ⇨ refer to European standards for all-relevant data exchanges, at least based on the currently existing OLDI format. Provided that flight information flows are numerous and useful for a great number of systems and services, the idea of grouping all the information on flights transiting in the ATM network in a single information-rich package (the flight object) is currently raising. Before such a standard is available, at least current (potentially enhanced) standards shall be recognised as the baseline in the first regulatory material delivery date.
  - ⇨ Technical details on the standards might be provided in an associated CS.

2) targeting the harmonisation of all ATS staff working environments, especially through the development of clear rules for HMI developments and the control of automation within the existing operational context taking as much as possible account of future working environment enhancements. Such IR shall clearly specify
   - ⇨ the minimum features of ATC staff working environment for a given operational environment
   - ⇨ the common characteristics of all current HMI (flight information provision systems, radar information provision systems) addressing in particular the package of automatic functions and associated ergonomic rules
   - ⇨ additional community specifications shall be provided to assist industry in the development of HMI for control staff respecting such requirements
3) In parallel the development of community specifications orienting industrial developments for new systems developments enabling the achievement of objectives (a), (b) and (i) such as AMAN, DMAN, EMAN, the MTCD family and ASAS related tools aiming at increased sophistication of the service may be developed as soon as stable prototypes are available in the market. The development of mandatory material in this field shall be postponed in a third work-package aiming at clearly specifying the mandatory ATS systems requirements based on accepted and tested services enhancements. From the estimates of the EUROCONTROL harmonisation program and the ECIP plan, stable results are not expected before 2008-2010 (corresponds to our third work-package development program)

10.10.3 Implementing Rules Roadmap

Considering the needs for Implementing Rules detailed above, the prioritisation based on current levels of achievement of the series of SES objectives for ATS, the following IR/CS development program was drawn:

- In a first package, IR specifying the minimum requirements for FDPS system at the 2005 target date, decomposed in two different IRs:
  - **IR_ATS_1.1**: Minimum requirements for inter-FDPS interconnectivity;
  - **IR_ATS_1.2:** adoption of common data exchange formats for ground-ground inter-FDPS-data exchanges associated with a **CS** providing the technical details of the data exchange standard to be used
  - **IR_ATS_1.3:** minimum FDPS processing performance and mandatory set of core functions to achieve such performance, in particular regarding inter-FDPS data consistency, accuracy, and error tolerance
  - **IR_ATS_1.4**: Minimum requirements for ATS staff working environment for 2005 in all specific operational environment
  - **IR_ATS_1.5:** standard ergonomic principles for the design, development and implementation of HMI with ATS staff working environment

Such a material shall provide a stable baseline for the next structural enhancements of the ATS systems.

- In a second package, to pave the way towards enhanced ATS systems efficiency in terms of automation and interactivity between ACC and other ATM services, but providing that conceptual maturity may not be so soon achieved, at least shall CS be developed, to launch industrial developments and encourage first implementations, in the following fields:
  - **IR_ATS_2.1**: EC Requirements for FDP enhanced core-functions (enabling the introduction of new concepts such as full FUA, dynamic sectors sizing, ASAS, CDM etc…)
  - associated industry standards whose prototyping is expected to be achieved
    - **CS** specifying the procedures for the use and the technical specification for the design, development implementation and maintain of the MTCD;
    - **CS** specifying the procedures for the use and the technical specification for the design, development implementation and maintain of the AMAN and DMAN tools;
  - In parallel shall the development of the “flight object” standard be started and delivered as a **CS** that shall enable increased interactivity with ATFM, ASM and Airspace users be achieved thus enabling increasingly efficient flight and capacity planning
  - **CS**: common principles for the implementation of advanced automated tools in ATS staff working environment
- In a third package,
  - **IR_ATS_3.1**: EC Requirements for air-ground data-link integration in ATS for the implementation of the air/ground delegation of responsibility concepts.
  - **IR_ATS_3.2**: The adoption of the “flight object” as the standard format for flight information exchange within the SES ATM network within FDPS
  - **IR_ATS_3.3:** translation into mandatory rules for the implementation of advanced automated tools in ATS staff working environment throughout the SES
  - associated industry standards whose prototyping is expected to be achieved eg CS-ATS: specifying the procedures for the use and the technical specification for the design, development implementation and maintain of the Integrated manager tool, conflict resolution support tool, etc

10.11 AIS domain

10.11.1 Essential Requirements of relevance for the AIS domain (and corresponding IOP objective level)

The SES requirements of relevance for AIS deal with:

(a) the 4th-3rd level objective of achieving a complete, accurate and consistent aeronautical flight information package including expectable introduction of increasingly rich and critical information, in particular in the field of SUR and NAV equipment both at airports, TMA and en-route,

(b) the 2nd level objective of achieving fully electronic support for Aeronautical information flows,

(c) the 1st level objective of creating a single aeronautical information publication for the EUIR.

10.11.2 IR/CS development strategy for AIS

Provided the level of maturity of the harmonisation program for AIS managed by EUROCONTROL, IR/CS developments for AIS shall be rather soon started. Provided this our conclusions for IR/CS developments are the following:

1) The objective of publishing a single aeronautical information package would certainly be enabled using the European Aeronautical Database as focal point for the collection of national data and common publication centre. In this field no particular complement of the regulatory text would be required to achieve such an objective

2) Further investments on local AIS Systems and procedures enhancements are still required and would certainly need enforcement to achieve objective (a) and (b). This shall consist in

   ⇨ reaffirming adherence to ICAO rules (and in particular to AIRAC cycle for provision of AIS publication) for AIS services

   ⇨ associating service quality management processes to guarantee positive human interference with the data production, transfer and maintain

   ⇨ achieving common high information quality targets, assured from data originator to final data user, defined in such a way that current and future needs are met.

Such IR/CS developments shall begin soon provided that the EUROCONTROL Agency and in particular the Regulatory Unit are currently working on the subject.

10.11.3 Implementing Rules Roadmap

Considering the needs for Implementing Rules detailed above, the prioritisation based on current levels of achievement of the series of SES objectives for ATFM, the following IR/CS development program was drawn:

- In a first package, IR specifying how to guarantee AIS data quality from originator to end user decomposed in three different IRs:
  - **IR_AIS_1.1** specifying the AIS data integrity levels & assurance procedures based on the material provided by the RU on the subject of end-to-end Aeronautical data integrity
  - **IR- AIS_1.2**: electronic support for Aeronautical information diffusion making it mandatory the use of an electronic-AIP standard (CS - Industry standard based on the EUROCONTROL e-AIS specimen)
  - **IR- AIS_1.3**: reaffirming all the mandatory assurance quality procedures for the production, design, storage and provision of Aeronautical information for local AIS specifying in particular the sanction regime for the non- Adherence to AIRAC cycle

10.12 MET domain

10.12.1 Essential Requirements of relevance for the MET domain (and corresponding IOP objective level)

The SES requirements of relevance for MET deal with:

a) A 3rd level objective aimed at defining the nature of the data set that all MET services throughout the Single European Sky shall provide to all MET data users within the ATM network,

b) A 3rd level objective of improving the quality of the presentation of MET information,

c) A 2nd level objective of achieving enhanced quality of MET data provided by all MET services working for the SES ATM service,

d) A 3rd longest term level objective of accompanying ATM systems enhancements with increasingly accessible and sophisticated MET information provisions.

10.12.2 IR/CS development strategy for MET

Provided the great divergences between local MET information use and provision and the increasingly wide scope of MET data users within the ATM, our conclusions for IR/CS developments are the following:

1) IR developments aiming at specifying the nature of the requirements for the provision of MET data to all interested party (ATFM, ATS, airports), including the required MET forecast availability and accuracy at different time horizons shall be started in priority (package 1) aiming at preparing the necessary basic IR/CS material for the first regulation enforcement date in 2005

   ⇨ These shall lead to the development of the common MET data set to be provided to all users

2) IR developments aiming at harmonising the presentation of MET data information using more sophisticated support systems than currently existing. Provided the absence of agreed standards or well-known prototypes in this field, such a process may take time be achieved. At least shall such efforts be based on “best practices” and lead first to the development of Community Specifications for industrial development purposes.

3) A revision of the regulatory material on the nature and quality of the common MET data set to provide to users shall be envisaged but certainly in a 3rd package for 2010-onward IOP rules enforcement.

10.12.3 Implementing Rules Roadmap

Considering the needs for Implementing Rules detailed above, the prioritisation based on current levels of achievement of the series of SES objectives for MET, the following IR/CS development program was drawn:

- In a first package, IR specifying the basic minimum MET data nature & quality provision for all interested parties:
  - **IR_MET_1.1**: mandatory MET data provision to all interested party (ATFM, ATS, airports), specifying the required MET forecast availability and accuracy at different time horizons aimed at defining common MET data set to be provided SES-wide
- In a second work package,
  - **IR_MET_2.1**: common specification of MET information presentation and integration into ATM staff working environment
  - **CS_MET**: technical specification for the development of improved MET data information presentation tools
- In a third work package, **IR/CS_MET**: revised, enhanced version of IR_MET integrating new MET data quality needs from users.

10.13 Coverage of the ERs

In the following tables, we present the relation between the essential requirements and the implementing rules whose development is proposed.

We consider first the Implementing Rules and Community Specifications proposed for package 1.and secondly for the other packages.

	Seamless operation	Support to new concepts of operation	Safety	Civil/military co-ordination	Environmental constraints	Systems logical architecture principles	Systems construction principles	Airspace Regulation
General			IR					
ASM								IR
ATFM	IR, CS							
ATS	IR CS							
COM (general)	IR	IR						
G/G COM	CS		CS					
A/G COM	IR	IR						
A/A COM								
NAV	IR		IR					
SUR (including SDPS)	IR		IR					
AIS	IR							
MET	IR							

Table 10.1: IR and CS for package 1

	Seamless operation	Support to new concepts of operation	Safety	Civil/military co-ordination	Environmental constraints	Systems logical architecture principles	Systems construction principles	Airspace Regulation
General						CS		
ASM		IR		IR				IR
ATFM		CS						
ATS	IR, CS	IR, CS						
COM (general)								
G/G COM								
A/G COM	IR, CS	IR, CS	IR, CS			CS		
A/A COM	IR, CS	IR	IR, CS					
NAV	IR	IR	IR					
SUR (including SDPS)	IR, CS	IR, CS				IR, CS		
AIS								
MET	IR CS							

Table 10.2: IR and CS for the 3 last packages

10.14 Conclusions

10.14.1 CNS

The first package of Implementing Rules can roughly be split into two different types of documents, whatever the CNS domain:

- A first set of rules focuses on the definition of common performances for each domain. This type of rules has the objective to unify the different requirements (in NAV, SUR and COM) and to simplify the global definition of the different systems, based on these requirements. The necessity for a common Radio Spectrum Management policy fits for instance into this type of IRs.
- The second set of rules deals with more technical issues, for which the preliminary material is already available and the work can start shortly. This is the case of the Channel Sharing procedure in the A/G COM sub-domain.

There is no particular CNS technology that needs to be regulated in priority 1, but rather general technical frameworks that have to be defined to guaranty interoperability (frequency management, CNS performances…).

The IR package 2 is focused on the enhancement of Air/Ground Datalink services and supporting network and the enhancement of Surveillance services, with the introduction of ADS operational applications and the improvement safety nets, in line with corresponding ATM2000+ Operational Improvements.

In the third package starting in 2010, Air/Air Datalink communications have to be addressed, in parallel with Airborne Separation concepts and airborne equipment (CDTI). The enhancement of the surveillance system has also to be continued by the introduction of common terminology and new concepts for collision avoidance.

Finally, in the long term, new navigation technologies should be subject to regulation, in a fourth package of Implementing Rules. These are not only technical enablers, but mostly operational concepts designed to improve the navigation system. The writing of these IRs is subject to previous improvements and studies on the satellite-based systems and their actual performances. Once this has been assessed, it shall be possible to regulate satellite-based precision approach procedures and navigation sole service.

10.14.2 ATM

The analysis of the SES regulation led us to identify different nature of objectives with various difficulty levels. The creation of the Single European Sky is indeed expected to bring about series of fundamental changes in the way the ATM domains are currently structured, their responsibility sharing within the ATM system in a whole and with regards to “customers”, the most important of which being the internalisation of several decision-making poles in the airspace, capacity & traffic management – airports, military & civil airspace users, and its “Europeanisation”. The consequence for interoperability is far from negligible since the introduction of new players in the “optimisation effort” associated with its “Europeanisation” mean that new information flows and data exchanges need to be assured. In parallel the other objective is to achieve a consistent and harmonised frame of systems and procedures throughout the Single European Sky so as to make it appears as a uniform structure and facilitates the movements of products and workers within it.

Targeting all these objectives at the same time appeared to us rather difficult and hardly achievable at the first SES regulation enforcement date in 2005. The IR/CS development program we propose is thus based on the following strategy: aiming in priority at controlling the development of a harmonised frame of systems and procedures throughout the Single European Sky based on currently existing ATM domains function/responsibility within the ATM system and with regards to users, with particular focus put on efficient information exchanges. This shall constitute the baseline on which ATM services enhancements shall be granted. The corresponding IR/CS development shall thus be started in the next work-packages, provided the availability of stable and mature conceptual material for their development. In this field, the provision of Community Specifications may advantageously proceed the provision of the associated IR whenever possible, be it to orient industrial developments prior to the corresponding rules enforcement.

This led us to determine the following IR/CS development work program:

- for ASM, work-package 1 shall aim at defining all the technical obligations of ANSP accompanying the effort of airspace re-structuring, provided for in regulation 2001/0236_Airspace apart from the implementation of “functional blocks of airspace”, while the second work-package shall focus on achieving enhanced civil/military collaboration and the third work-package on (potentially) extending the rules to the lower airspace.
- for ATFM, work-package 1 shall aim at defining EC rules for the provision of all the data necessary for the ATFM service to assure its current role, including the adoption of common data exchange formats, work-package 2 shall then be dedicated to the introduction of the newly available concepts assuring the enhancements of the ATFM service – airport CDM and capacity optimisation, in the form of CS first then translated into firm IR in work-package 3. In parallel the “flight object standard” collecting all the useful information on a flight into a Single package shall show progress throughout the development program and aim at final adoption at the end of the IR/CS development program for ATFM.

- for ATS, work-package 1 shall aim at 1) specifying IR for inter-FDPS connectivity, and intra-FDPS core-functions & processing performance, 2) defining the minimum common requirements of ATS staff working environment, including ergonomic principles, applicable in 2005 provided the current role of ATS providers within the system, work-package 2 developments shall address the introduction of new concepts of operation including 1) the enhancement of FDPS core-functions, and inter-networking 2) the provision of Community Specifications for industry on all new promising products aimed at enhancing ATC productivity (AMAN, DMAN, MTCD, etc). Finally Work-package 3 shall aim at the translation into mandatory rules of all the concepts stable at the 2008-2010 horizon. In parallel the “flight object standard” shall show progress throughout the development program and aim at final adoption at the end of the IR/CS development program for ATS.
- for AIS, the development effort shall concentrate on work-package 1, IR developments shall address AIS data integrity rules, the use of electronic support and service quality assurance processes.
- in the MET domain, work package 1 shall aim at clearly specifying the nature and quality of the MET data set to be provided to each MET data user provided current needs, work-package 2 shall be focused on achieving common requirements for the presentation of MET data within ATM staff working environment, while in work-package 3 the issue of enhancing the quality and availability of MET information in support to new needs shall be addressed.

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