RTCA SC-189/EUROCAE WG-53 Position Paper
Air Traffic Services Safety and Interoperability Requirements

General Information

Position Paper Number:	Revision: e.g. A	Date: e.g. 11 Nov 94	Comments Due:
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Author/Fax/Internet:
Steve Paasch
Internet: steve.paasch@certification.com
FAX: 425-881-0398

Send Comments to (Include Name/Address/Fax/Voice/Internet):
Author

Position Paper Title:
Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications

Abstract:
This position paper is used to develop and track the changes of ED/DO-GUID publication, Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications. This publication will contain the guidance material being produced by the sub-groups.

It is the intent of PUB to combine all guidance material into one document. As a result, ED/DO-METH, currently in P-Pub-20-C2, has been incorporated into ED/DO-GUID, which is contained in this position paper. Therefore, P-Pub-20-C2 is considered obsolete and will no longer be maintained.

Also, subgroups will no longer maintain position papers containing guidance material and all new guidance material provided by subgroups should be developed as a comment paper to this position paper and provided to the name shown above.

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Name	***Org***	***Internet***	***Fax***
Serge Bagieu	Aerospatiale	Serge.Bagieu@Avions.Aerospatiale.Fr	+33-5-61-93-80-90
Tom Kraft	FAA	Tom.Kraft@FAA.DOT.Gov	+01-425-227-1181
Will Struck	FAA	Will.Struck@FAA.DOT.Gov	+01-425-227-1100
Rob Mead, SG-1	Eurocontrol	Rob.Mead@Eurocontrol.be	+32-2-729-9087
Tony Martin SG-1	AJM Cnslt	AJMartin@Accessone.Com	+01- 425-868-7297
Gary Morton SG-2	CAA SRG	gary.morton@srg.caa.co.uk	+011-44-293-57-39-74
Mark Joseph SG-2	MITRE	MJ@MITRE.Org	+01-703-883-1330
Elbert Henry - SG-3	FAA-AAR	elbert.henry@faa.dot.gov	+01-202 493 0711-
Marc Barrere - SG-3	Aerospatiale	Marc.Barrere@avions.aerospatiale.fr	+33-5-61-93-07-29
Gregg Anderson	FAA	Gregg.Anderson@FAA.Gov	+01-202 366 1806
Danny Bharj	Eurocontrol	Danny.Bharj@eurocontrol.be	

RTCA SC-189/EUROCAE WG-53 Comment

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Author/Fax/Internet:	Send Comments to (Include Name/Address/Fax/Voice/Internet):
Steve Paasch Internet: steve.paasch@certification.com FAX: 425-881-0398	Author

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EUROCAE
17 Rue Hamelin
75783 PARIS Cedex 16
FRANCE

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Copies of this document may be obtained from

EUROCAE
17 Rue Hamelin
75783 PARIS Cedex 16
FRANCE

Telephone: 33-(0)1 45 05 71 88
Facsimile: 33-(0)1 45 05 72 30
Internet: eurocae@compuserve.com

Please contact EUROCAE for price and ordering information.

FOREWORD

1. The development of these guidelines was jointly accomplished by RTCA SC-189 and the European Organisation for Civil Aviation Equipment (EUROCAE) WG-53 through a consensus process. It was accepted by the Council of EUROCAE on (TBD) and RTCA Program Management Committee on (TBD).

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- developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation, and
- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunications Union and other appropriate international organizations can be based.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders.

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RTCA, Incorporated
1140 Connecticut Avenue, N. W., Suite 1020
Washington, DC 20036

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Copies of this document may be obtained from

RTCA, Incorporated
1140 Connecticut Avenue, Northwest, Suite 1020
Washington, D.C. 20036-4001 U.S.A.

Telephone: 202-833-9339
Facsimile: 202-833-9434
Internet: www.rtca.org

Please contact RTCA for price and ordering information.

FOREWORD

This guidance document was jointly prepared by Special Committee 189 (SC-189) and the European Organisation for Civil Aviation Equipment (EUROCAE) Working Group 53 (WG-53) and approved by the RTCA Program Management Committee (PMC) on _____.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal Advisory Committee and develops consensus based on recommendations on contemporary aviation issues. RTCA's objectives include, but are not limited to:

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1 Introduction

The International Civil Aviation Organization (ICAO) has introduced the communication, navigation, and surveillance/air traffic management (CNS/ATM) system. The CNS/ATM system applies modern technologies to air traffic services (ATS) to improve air traffic management operations. These air traffic services are intended to offer operators greater flexibility to meet changing needs, accommodate the projected growth in civil air transportation, and minimize operating costs for operators and air traffic service providers worldwide. Some of the air traffic services that use the CNS/ATM system require data communications between the aircraft and the air traffic service providers. These air traffic services will require an allocation of functions and performance requirements between the aircraft and the ATS provider. Also, the integrated system in its operating environment will need to be qualified for approval to ensure that the system performs as intended and is safe with an acceptable level of confidence.

The use of CNS/ATM systems to advance air traffic services (ATS) has resulted in a need for government/industry-accepted guidance material for coordinating air and ground approvals. The provision of ATS using data communication requires compatibility between air and ground systems.

This guidance material is intended for stakeholders involved in the implementation of air traffic services supported by data communications. Stakeholders include those States and organizations that are in control of the establishment of the requirements for the air traffic service and the assurances related to the implementation of those requirements. Stakeholders include airspace planners, air traffic service providers, ATS system manufacturers, communication service providers, aircraft and equipment manufacturers, operators, and approval authorities.

This guidance material comprises objective criteria in clear and concise format to enable consistent and repeatable results in its application throughout the world.

The guidance material was developed jointly by RTCA, Inc. and the European Organisation for Civil Aviation Equipment (EUROCAE) in consideration of the International Civil Aviation Organization (ICAO) activities and in cooperation with governments worldwide.

1.1 Purpose

This guidance material provides minimum acceptable criteria for approving the provision and use of an air traffic service supported by data communications. The criteria are in the form of objectives and evidence:

“Approval” denotes those activities related to aircraft certification, ATS provider operational approval, operator operational approval, and in some cases, airspace approval. These separate and distinct approvals collectively define the conceptual “end-to-end approval.” In cases for which there is no regulatory basis for an element of ATS supported by data communication, “approval” denotes the activities which takes place to show compliance with the requirements allocated to that element. See **Figure 1-1**.

INSERT FIGURE 1-1 FROM 22Gfigs.ppt HERE

Figure 1-1: Generic regulatory framework for approval.

1.2 Scope

This document includes the means to establish the safety, performance, and interoperability requirements and to qualify air traffic services supported by data communications.

The guidance material is a single source document for approval aspects related to planning, requirements determination, qualification, entry into service and operations of ATS supported by data communications where coordination across institutions or approvals is necessary.

The term 'operational' is used in various forms to imply a scope of the guidance material that includes approvals for elements of the air traffic service that have the potential to affect the safety, performance, and interoperability of flight operations. This involves ground-based and satellite elements, operational procedures (including human elements), and the aircraft.

The term 'operational' excludes assessments not directly affecting the approval of ATS flight operations. Some examples of assessments that are out of scope for this document include:

a) Safety assessments related to the disposal of hazardous materials used in test and evaluation, or in system construction.

b) Performance assessments related to establishing requirements for optimizing efficiency for air traffic management.

c) Interoperability assessments related to data communications between two air traffic service units.

However, States and organizations that perform such assessments can conduct them in concert with the activities related to the operational assessments to which this guidance material relates.

Other RTCA special committees and EUROCAE working groups may provide guidance material related to human factors, software integrity assurance, and security. This document includes a framework to accommodate such future guidance material.

1.3 How to use the guidance material and related standards

This section provides an overview of the guidance material, related standards, and how they are used to produce the evidence for approval of the provision and use of specific operational implementations.

1.3.1 Guidance material

The ***guidance material*** is intended for the aviation community. To aid such use, references to specific national regulations and procedures are minimized. Instead, generic terms are used. For example, the term "approval authority" is used to mean the organization or person granting approval on behalf of the State responsible for approval. Where a second State or a group of States validates or participates in approval, this document may be used with due recognition

given to bilateral and multilateral agreements or memoranda of understanding between the States and/or organizations involved.

The ***guidance material*** is not mandated by law, but represents a consensus of the aviation community. It also recognizes that alternative means may be available to the applicant. To aid the use of alternative means, the ***guidance material*** uses the word "should."

The ***guidance material*** is a single document and may be revised as experienced is gained in using the document.

1.3.1.1 Structure

Figure 1-2 provides an overview of the structure of the ***guidance material***. The ***guidance material*** is structured along the life cycle for air traffic services, which is described in Chapter 2, and the approvals for the provision and use of the air traffic services, which are described in Chapter 6. The parts of the life cycle considered within this document are planning, requirements determination, qualification, entry into service, and operations (including changes to the environment and decommissioning). The approval categories are ATS provider operational approval, operator approval, aircraft certification, and, in some cases, airspace approval.

INSERT FIGURE 1-2 FROM 22Gfigs.ppt HERE

Figure 1-2: *Guidance material structure.*

For each part of the life cycle and for each approval category, compliance objectives are provided. The compliance objectives are the minimum acceptance criteria for showing that each part of the lifecycle has been satisfactorily completed. The compliance objectives allow for flexibility in the planning, requirements determination, qualification, entry into service, and operations of air traffic services. Guidance is also provided on the evidence to be produced in support of an operational implementation. The evidence is associated with satisfying the compliance objectives and will be used to coordinate approval with the approval authority.

Chapter 2 describes the life cycle for air traffic services supported by data communications. The life cycle presented in this document is for the purpose of providing a framework and terminology for the guidance material, which is contained in subsequent chapters in the document. This life cycle should not be misconstrued with the life cycle used for a specific operational implementation. However, the parts of the life cycle described in this chapter correlate to the parts of the life cycle used for the specific operational implementation. For example, "qualification" in this document's life cycle can be mapped to the "development" or "design" or "verification" or "supporting processes" part of the life cycle for the specific operational implementation depending on which life cycle is used and where the compliance objectives are satisfied.

The compliance objectives to be satisfied prior to entry into service are provided in chapters 3 through 5. Chapter 7 provides compliance objectives to be satisfied during operations and are related to maintenance, monitoring, and follow-on modification for technical and operational

changes that are made after entry into service. Each compliance objective in this document is assigned a specific reference designator to facilitate compliance during approval.

Compliance objectives are different than operational, safety, performance, and interoperability objectives, which are established by the requirements determination process described in section 2.2. The objectives established from requirements determination are intended for the air traffic service itself and are used as the basis for establishing the requirements allocated to the different institutions and approvals. Operational, safety, performance, and interoperability objectives and related requirements are provided in standards, referred to as the ***safety and performance requirements (SPR)*** standard for selected air traffic service(s) and operating context(s) and the ***interoperability requirements (INTEROP)*** standard for selected technologies. The SPR standard and INTEROP standard are used as the basis for qualification, which is the process for showing that the operational implementation for the air traffic service satisfies the operational, safety, performance, and interoperability objectives and requirements.

1.3.1.2 Other considerations using the guidance material

These points need to be noted when using guidance material:

a) *Annexes* are normative parts of this document. *Appendices* are informative parts of this document.

b) Explanatory text is included to aid the reader in understanding the topic under discussion. For example, the guidance material provides an overview of life cycle for air traffic services.

c) Notes are used in this document to provide explanatory material, emphasize a point, or draw attention to related items, which are not entirely within context. Notes do not contain guidance material.

d) In cases where examples are used to indicate how the guidance material might be applied, either graphically or through narrative, the examples are not to be interpreted as the preferred method.

e) A list of items does not imply the list is all-inclusive.

1.3.2 Related Standards

1.3.2.1 Safety and performance requirements (SPR) standard

A SPR standard is used to provide the objectives and requirements for the qualification activities throughout the life cycle of the implementation for all of the different approval processes. The SPR standard is based on the air traffic service description(s) and operating context(s) that are defined in an operational environment definition (OED). It includes a source trace from each requirement through the operational safety assessment (OSA), operational performance assessment (OPA), the operational environment definition (OED). The OED, OSA, and OPA are included in the SPR standard for each service/operating context. The SPR standard can be tailored to a planner's specific requirements. Planners can:

Select the services and operating contexts appropriate for their particular operational implementation from the service descriptions and the operating contexts. Implementers need to qualify only to those requirements that trace to the services selected for the particular operational implementation.

Use the source trace to assess the impact in the event the services selected for the operational implementation can not be shown to meet the safety and performance requirements contained in the SPR standard.

Negotiate with approval authorities any deviations, additions, clarifications of the SPR standard via the approval plan. These items would be provided as evidence.

Use the SPR standard to determine the basis for what to monitor during operations.

If a SPR standard does not exist as an industry standard, the system requirements for the specific element of the operational implementation need to incorporate the safety and performance requirements and the allocation to other elements of the operational implementation with which it interfaces. In the interest of achieving global harmonization, this approach is not recommended.

1.3.2.2 Interoperability requirements standard

The interoperability requirements standard is the technical, functional, and interface requirements standard for the aircraft system, the ATS provider systems, and the communication service provider systems to support air traffic services in a defined operational environment.

A new air traffic service element can be classified as interoperable with the existing service if it can be operationally approved without change to any pre-existing hardware or software.

Differences that can be accommodated by operational procedure changes may be acceptable and still be considered interoperable. There may be limits in the number of such procedural changes due to operational or safety considerations.

1.3.2.3 Other standards

Minimum operational performance standards (MOPS) and minimum aviation system performance standards (MASPS) provide performance requirements for specific technologies based on the technology. These standards can be used to assess the feasibility of a particular technology to meet the minimum operational safety and performance requirements determined by a top-down assessment of safety and performance for a defined operational objective and provided in the SPR standard.

1.3.3 Relationships among the guidance material, standards, and evidence

Figure 1-3 provides an overview of the ***guidance material***, the ***SPR*** standard, the ***INTEROP*** standard, and evidence of planning and qualification to the standards. The evidence for a specific operational implementation is produced to show compliance to the ***SPR*** standard and the ***INTEROP*** standard.

The ***guidance material*** provides guidance on establishing;

- the ***safety and performance requirements (SPR)*** standard for selected air traffic service(s) and operating context(s)
- the ***interoperability requirements (INTEROP)*** standard for selected technology(ies)
- the evidence for approval of a specific operational implementation

The SPR standard and INTEROP standard are considered evidence of the requirements determination process and may be applied to different operational implementation throughout the world, provided the implementations are shown to meet the requirements provided by the SPR standard and the INTEROP standard. The SPR standard can be used in conjunction with different INTEROP standards provided the technology and technical functions provided by the INTEROP standard can be shown to meet the operational safety and performance requirements provided in the SPR standard.

INSERT FIGURE 1-3 FROM 22Gfigs.ppt HERE

Figure 1-3: *Relationship of guidance material to standards and evidence.*

Multiple ***SPR*** standards and ***INTEROP*** standards may be developed over time. As air traffic service providers and operators intend to provide and use new or modified air traffic services or use an existing air traffic service(s) differently than its original intent, the guidance material is used to develop a new ***SPR*** standard or revise an existing ***SPR*** standard. As new technologies are intended for use or existing technologies are modified, the guidance material is used to develop a new ***INTEROP*** standard or revise an existing ***INTEROP*** standard.

The requirements provided in the SPR standard and INTEROP standard are validated during the development of the standards. The validation includes a check for consistency between the requirements specified in the INTEROP standard and the SPR standard. To support this validation, these standards are typically developed during the initial operational implementation of an air traffic service supported by data communications or the initial use of a technology.

The ***SPR*** and ***INTEROP*** standards are used to establish the basis for developing and evaluating evidence produced in support of a specific operational implementation. This evidence includes the approval plan(s), system requirements, qualification data, and the accomplishment summary(ies).

2 Life cycle for air traffic services

This chapter describes the life cycle for air traffic services supported by data communications and is shown in **Figure 2-1**. The life cycle in this document consists of planning, requirements determination, qualification, entry into service and operations.

INSERT FIGURE 2-1 FROM 22Gfigs.ppt HERE

Figure 2-1: *Relationship of guidance material to planning, requirements determination, qualification, and operation*

2.1 Planning

Planning includes the process to identify the stakeholders and establish the operational objectives and schedule for the implementation and approval of a new or modified air traffic service as it relates to approval. Planning provides early involvement and commitment of all the stakeholders to agree on the approach for meeting the objectives and evidence criteria required by this guidance material. It is intended to formalize the agreements among and between those provisioning for the Air Traffic Service, those who will use the service, and the approval authorities.

For follow-on implementations of the same service in a different area/region of the world, *cross-regional planning* considers the work that was originally done in order to reduce the effort related to the approvals for the air traffic service. In these cases, the ***safety and performance requirements***, ***interoperability requirements,*** and the ***evidence of completion/provisions for entry into service*** from the initial implementation will provide the basis for approval of the follow-on implementation.

As an output of the Planning process, ***Approval plan(s)*** (see chapter 3) provide(s) agreed approach(es) for showing that the operational implementation complies with applicable requirements and ensures consistency of all the plans for the operational implementation.

Refer to Chapter 3 for compliance objectives and guidance on evidence of completing planning activities.

2.2 Requirements determination

Requirements determination is the process whereby stakeholders coordinate, establish, validate, and allocate safety, performance, and interoperability objectives and requirements to elements of an air traffic service. Requirements determination uses a top-down approach to establish requirements based on operational capability and environmental considerations. The top-down approach complements a bottom-up approach, which determines the feasibility of a particular technology's performance and capability to meet operational safety and performance requirements.

INSERT FIGURE 2-2 FROM 22Gfigs.ppt HERE

Figure 2-2: *Overview of requirements determination.*

Figure 2-2 provides an overview of the activities during requirements determination. Requirements determination uses a total systems approach to coordinate and determine the requirements allocated to the different institutions in control of some aspect of the system. Requirements determination includes:

- Safety and performance requirements (SPR), based on operational assessments, provides the safety and performance objectives and requirements for defined operational objectives and allocation of requirements to different institutions and approvals. Refer to Annex A for developing the SPR.

- *Operational Environment Definition (OED)*. The OED includes the air traffic service(s) descriptions and characterizes its(their) operating environment to support operational assessments. The OED is intended to be based on regional/State-specific operating concepts for a specific region or State airspace, and the OED specifies the characteristics of those operating concepts that are significant to the operational safety, performance, and interoperability assessments. The OED serves as the basis for the operational safety assessment (OSA), the operational performance assessment (OPA), and the technology choice.

- *Operational Safety Assessment (OSA)*. The OSA includes an operational hazard assessment (OHA), which evaluates the operational capabilities and related air traffic services described within the OED to identify operational hazards and classify them according to a globally standardized hazard classification scheme. Based on the hazard classification and the substantiation for the hazard class, risk mitigation strategies are developed and safety objectives and requirements are allocated to different parts of the air traffic service.

- *Operational Performance Assessment (OPA)*. Operational performance assessment includes the determination of an appropriate RCP, which is based on the ICAO definition. Once determined the RCP becomes the design requirement for the airspace or a capability within a defined airspace and related air traffic services described within the OED. Based on the overall RCP, performance requirements are allocated to RCTP and human performance. RCP specifies the minimum operational performance to meet specific goals for air traffic management efficiency and specifies minimum performance requirements allocated by the OSA. Having developed RCTP the operational performance assessment should allocate the performance to the three domains (Aircraft, Network, ATS).
  RCTP and the allocated RCTP should be used as the base of technical qualification and RCP should be used as the base of operational approval.

- Interoperability requirements, based on technology, provides the technical, functional, and interface requirements for defined technology and allocation of requirements to different institutions and approvals. Refer to Annex B for developing the INTEROP.

  - *Interoperability Assessment (IA)*. The interoperability assessment determines the interoperability requirements for the selected technology and related functions required to support the Air Traffic Services and operating contexts described within the OED. The allocation of these interoperability requirements enables different institutions to provide different parts of the system with assurance that they are compatible.

- *Coordination* includes coordinating the activities of all stakeholders through the appropriate operational assessment activities (i.e., requirements determination) to assess all requirements that may affect safety, performance, or interoperability. Coordination facilitates validation of the safety, performance, and interoperability objectives and requirements allocated to the elements of the operational environment.

- *Allocation of requirements*. The requirements for safety, performance, and interoperability are allocated to the different institutions in control of qualifying the system to the requirement and the appropriate approval.

Safety and performance requirements (SPR) for the operational capabilities and the ***interoperability requirements*** for the technology and related functions provide the agreed to requirements for qualification and operations.

Refer to Chapter 4 for compliance objectives and guidance on evidence of completing requirements determination activities.

2.3 Qualification

Qualification occurs during development and prior to entry into service. Qualification comprises that which is done by each of the institutions to ensure that their part of the air traffic service satisfies the ***safety and performance requirements***, and ***interoperability requirements***. Qualification activities affecting more than one institution need to be coordinated through the coordination process established during requirements determination. Qualification considers all the elements of the air traffic service in its operating context and includes:

- *Institutional safety assessments (ISAs)*. The institutional safety assessments ensure that each element of the environment for which that institution is responsible satisfies the safety objectives and requirements that have been allocated by the OSA. The institutional safety assessments allow the institutions flexibility in allocating lower level requirements to satisfy the safety objectives allocated by the OSA. An institution's ISA may also address or define safety requirements that are beyond the scope of the OSA.

- *Installed communication performance (ICP)*. The Installed Communication Performance (ICP) is a statement of performance for a given communication path which reflects the technology used. ICP excludes human factor time and is used to qualify against a given RCTP. For operational approval a total ICP is qualified against a total RCTP. For qualification or type approval the ICP component determined or measured for each domain is qualified against its respective allocated RCTP. ICP is expressed in the same parameters as RCTP. The total ICP that is achievable would vary depending on the combination of airborne system, air/ground sub-network used, service providers and ATS service provider.

- *Human performance*. Human contribution in terms of communication performance is included in the transaction delay, availability, transaction continuity and transaction integrity. This Human contribution embraces shared language abstractions, information processing and all of the confounding influences of fatigue, attitude, attention, training, aptitude, circadian rhythms, workload, distractions, and others. Its measurement differs individually from day to day and session to session. It also varies between equally trained individuals. Nonetheless, it is important to measure this integral element of the communication process – human information processing – in RCP.

- *Achieved communication performance (ACP)* The Achieved Communication Performance (ACP) is the dynamic measure of the operational performance of the communication path, with human factor included in the measure. The ACP is expressed in the same terms and parameters as RCP, but at any instant may vary, depending on environmental,

communication, and failure conditions. ACP is considered against RCP. ACP is a transaction measurement and cannot be allocated. In the case where ACP does not meet a specified RCP level, an annunciation may be required. ACP will be used to support operational approval and real-time monitoring but in any case constitute a requirement.

- *Interoperability*. Qualification for interoperability requires that all interoperability requirements for a particular operational implementation are verified at the function level. Additional interface tests between all elements of the end to end system are also required.

Requirements, ***design data***, ***verification and validation coverage analysis***, and ***assurance data*** provide the definition and means to manage the configuration of the implementation (the physical part of the system of which the institution is in control).

Refer to Chapter 5 for compliance objectives and guidance on evidence of completing qualification activities.

2.4 Entry into service

Operational capability at entry into service is ensured when the approval authorities have accepted the evidence. Approvals should be coordinated across institutions to ensure that validation is completed before entry into service.

Upon completion of the validation process, operational approval is granted to the operator and ATS providers.

Institutional approvals are issued when appropriate safety, performance and interoperability requirements have been finalized and approved.

Refer to Chapter 6 for compliance objectives and guidance on evidence for entry into service.

2.5 Operations

Operations include the process to ensure that the safety, performance, and interoperability objectives and requirements for the operational capability are maintained throughout its service life. (Ed note: define in glossary.) Operations include:

- *Maintenance* ensures that the system continues to function in its original state.

- *Monitoring* provides creditable operational data to determine that safety objectives continue to be satisfied, ACP continues to meet the RCP, and interoperability is not compromised by changes. Monitoring includes continued operational safety (COS), achieved communication performance (ACP), and change/configuration management.

- *Follow-on modification* includes re-qualification when the original operational capability and/or related safety, performance, and interoperability requirements change. Changes to the ATS system can include changes in procedures, changes to the environment, and decommissioning

Refer to Chapter 7 for compliance objectives and guidance on evidence of completing operations activities.

3 Planning

Planning minimizes the risk of issues related to approval of the air traffic service arising prior to entry into service. The overall approval for provision and use of the air traffic service is achieved by different approvals, i.e., requirements determination, airspace approval, aircraft certification, ATS provider operational approval, operator operational approval and network operational approval. The plans for each of the approvals need to be coordinated as part of the planning activities.

3.1 Objectives

The evidence associated with each approval plan should satisfy the following objectives:

a) Identify the stakeholders.

b) Identify the air traffic service(s), the operating context(s), and the candidate technologies.

c) Identify the applicable approval processes and related airworthiness, operational, and ATS provision requirements.

d) Describe the means to establish the safety, performance (i.e. RCP), and interoperability requirements.

e) Describe the means to qualify the implementation to the requirements.

f) Describe the means of monitoring for safety, performance (i.e. ACP), and interoperability as well as managing the configuration of the system during operations.

g) Ensure consistency among related approval plans.

h) Identify the schedule for operational implementation.

i) Obtain agreement with the approval authorities on the approval plans.

3.2 Evidence

This section describes the evidence associated with showing that the operational implementation satisfies the objectives for planning. This section uses the appropriate term for the “approval plan” typically used within each institution.

3.2.1 Requirements determination plan

Ed. Note. This section will need further work. Text below is for information only and gives an idea of what is intended. Section 3.2.1 is a placeholder for planning information for things above any one institution.

a) Operational Safety Assessment Plan, including:

(1) The activities that need to be performed for the safety assessment;

(2) The means that may be used to perform those activities;

(3) The institutions that should be involved in the activities.

(4) The procedures by which the OSA activities should be performed.

(5) The means by which the configuration management of the OSA will be ensured:

(i) environment configuration is identified,

(ii) changes are controlled,

(iii) problems are reported,

(iv) changes are reviewed and agreed, documents are archived, retrieved and released.

b) Operational Objectives Identification Plan, including:

(1) The activities that need to be performed for objectives identification;

(2) The means that may be used to perform those activities;

(3) The institutions that should be involved in the activities;

(4) The procedures by which the activities should be performed;

(5) The means by which the configuration management will be ensured:

(i) environment configuration is identified,

(ii) changes are controlled,

(iii) problems are reported,

(iv) changes are received and agreed, documents are archived, retrieved and released.

3.2.2 Airspace approval plan

The applicant should provide the following information for airspace approval:

a) Description. Describe the operational concept of the airspace to be approved.

b) Approval basis. Describe the approval basis. Include applicable regulatory requirements and other related regulatory material.

c) Safety assessment. Define the safety assessment activity and its interrelationship with other activities within the approval process.

d) Human Factors Requirements. Describe and identify any human factors/human engineering issues that may affect operational use of the airspace.

e) Validation of requirements. Describe the means for validating requirements for the airspace and for the operational environment.

f) Development assurance for airspace. Describe the means for ensuring that the airspace satisfies the allocated requirements.

(1) Development environment. Define the development processes, including validation, verification, configuration management, process assurance, and the interrelationships among processes. If tools are to be used for verification and/or validation credit, define the means by which tools will be certified.

(2) Standards and guidelines. Specify international, national or corporate, standards that will be used to support the selection of valid functional requirements and verifiable design implementations.

(3) Consideration of design errors. Define the methods used for considering errors in the airspace design.

g) Airspace approval data. Define the means for providing evidence showing that the airspace system complies with approval requirements. Describe how approval data will be packaged, in what form, and how approval data are made available to the approval authority.

h) Approval co-ordination. Describe the involvement of the approval authority that is necessary to ensure that the approval plan complies with the guidelines contained herein and that the actual processes comply with the approval.

i) Schedule. Provide a schedule that indicates the interaction between the applicant and the approval authority.

3.2.3 ATS provider operational approval plan

The applicant should provide the following information for Air Traffic Services (ATS) approval:

a) Description. Describe the operational concept of the Air Traffic Service to be provided. Describe the ATS data communications system and the interface with other systems and functions of the existing Air Traffic Service.

b) Other approvals. Identify related approval plans. Describe the relationship of this approval to others approvals required for provision and use of the Air Traffic Services (ATS).

c) Approval basis. Describe the approval basis. Include applicable regulatory requirements and other related regulatory material, industry guidelines and standards or other documents.

d) Safety assessment. Define the safety assessment activities and their interrelationships with other activities within the approval process.

e) Performance assessment. Define the performance assessment activities and their interrelationships with other activities within the approval process.

f) Safety, performance and interoperability requirements. Define the means to identify safety, performance requirements for the Air Traffic Service and for the operational environment and the interoperability requirements.

g) Training Program. Describe the training program and procedures that will be implemented to train and qualify appropriate Air Traffic Service employees (ATCOs, ATSAs, and other support personnel).

h) Human Factors Requirements. Describe and identify any human factors/human engineering issues that may affect operational use of the data communications system and proposed methods to eliminate or mitigate errors such as; slips or mistakes when using the data communications system.

i) Maintenance Program. Describe additional maintenance program changes that are required to support the initial and continued Air Traffic Service requirements for the data communications system.

j) Validation of requirements. Describe the means for validating requirements for the Air Traffic Service and for the operational environment.

k) Development assurance for the Air Traffic Service Systems. Describe the means for ensuring that the ATS Systems satisfy the allocated requirements.

   (1) Development environment. Define the development processes, including validation, verification, configuration management, process assurance, and the interrelationships among processes. If tools are to be used for verification and/or validation credit, define the means by which tools will be certified.

   (2) Standards and guidelines. Specify international, national, corporate, or project standards that will be used to support the selection of valid functional requirements and verifiable design implementations.

   (3) Consideration of design errors. Define the methods used for considering errors in the Air Traffic Services design (for example, architectural means, safety directed life cycle, systematic approach to systems development, exhaustive input testing, service experience). Define the acceptance criteria for each of the techniques used. Define the means that will protect the more critical functions from the malfunction or failure of less critical functions.

   (4) Consideration of random failures. Define the methods used to allocate the reliability requirements to the various parts of the Air Traffic System. The methods used for meeting those requirements should also be defined (for example, probability analysis of failure rates).

(5) User-modifiable, option-selectable functions. If the Air Traffic Systems are designed to be modified (e.g., user-selectable options or partitioned user-modifiable software) without a re-evaluation for approval, then define the means (for example, processes, design features, environment, tools, approval data) by which the safety requirements, as determined by the safety assessment, will be ensured throughout the service life of the system. Include the means by which the configuration of these features will be managed.

(6) Consideration of operational performance. Define the methods used for consideration of realistic Air Traffic Controller performance, including the effect of error.

l) Air Traffic Service approval data. Define the means for providing evidence showing that the Air Traffic Service data communications system and applications comply with approval requirements. Describe how approval data will be packaged, in what form, and how approval data are made available to the approval authority.

m) Approval co-ordination. Describe the involvement of the approval authority that is necessary to ensure that the approval plan complies with the guidelines contained herein and that the actual processes comply with the approval.

n) Schedule. Provide a schedule that indicates the interaction between the applicant and the approval authority.

o) Flight and ground tests and Manual of Air Traffic Services provisions. Define the objectives and acceptance criteria for flight and ground tests. The flight and ground tests include tests to validate the data communications system and applications in the context of the safety and interoperability requirements and to check for adverse effects on other aircraft systems and functions. Provide a proposed MATS supplement.

3.2.4 Aircraft certification plan

When planning for aircraft certification, the applicant should provide the following:

a) Description. Describe the aircraft data communications system, the applications, and their interface with other systems and functions on the aircraft. Describe the operation (e.g., human/machine interface) and the flight deck arrangement.

b) Other approvals. Identify related approval plans. Describe the relationship of the aircraft certification to other approvals required for provision and use of the air traffic service.

c) Certification basis. Describe the certification basis. Include applicable airworthiness requirements and other related regulatory material, industry guidelines and standards or other documents.

d) Safety assessment. Define the safety assessment activities and their interrelationships with other activities within the design approval process.

e) Performance assessment. Define the performance assessment activities and their interrelationships with other activities within the design approval process.

f) Safety, performance, and interoperability requirements. Define the means to identify safety and performance requirements for the aircraft systems and for the operational environment and the interoperability requirements.

Note: To facilitate the coordination process, the applicant is encouraged to submit the safety and interoperability requirements in electronic media format acceptable to the approval authority. The approval authority will need to coordinate the safety and interoperability requirements prior to aircraft certification.

g) Validation of requirements. Describe the means for validating the requirements for the aircraft and for the operational environment.

h) Development assurance for aircraft systems. Describe the means for ensuring that the aircraft satisfies its allocated requirements.

(1) Development environment. Define the development processes, including validation, verification, configuration management, process assurance, and the interrelationships among processes. If tools are to be used for verification and/or validation credit, define the means by which tools will be qualified.

(2) Standards and guidelines. Specify international, national, corporate, or project standards that will be used to support the selection of valid functional requirements and verifiable design implementations.

(3) Consideration of design errors. Define the methods used for considering errors in the aircraft system design (for example, architectural means, safety directed life cycle, systematic approach to systems development, exhaustive input testing, service experience). Also, define the acceptance criteria for each of the techniques used. Define the means that will protect the more critical functions from the malfunction or failure of less critical functions.

(4) Consideration of random failures. Define the methods used to allocate the reliability requirements to the various parts of the aircraft systems. The methods used for meeting those requirements should also be defined (for example, probability analysis of failure rates).

(5) User-modifiable, option-selectable functions. If the aircraft systems are designed to be modified (e.g., user-selectable options or partitioned user-modifiable software) without a re-evaluation for airworthiness, then define the means (for example, processes, design features, environment, tools, certification data) by which the safety requirements, as determined by the safety assessment, will be ensured throughout the service life of the system. Include the means by which the configuration of these features will be managed.

(6) Consideration of operational performance. Define the methods used for consideration of realistic operator performance, including the effect of error

i) Aircraft certification data. Define the means for providing evidence showing that the aircraft data communications system and applications comply with airworthiness

requirements. Describe how certification data will be packaged, in what form, and how certification data are made available to the certification authority.

j) Certification coordination. Describe the involvement of the approval authority that is necessary to ensure that the certification plan complies with the guidelines contained herein and that the actual processes comply with the certification.

k) Schedule. Provide a schedule that indicates the interaction between the applicant and the approval authority.

l) Flight and ground tests and flight manual provisions. Define the objectives and acceptance criteria for flight and ground tests. The flight and ground tests should include tests to validate the aircraft data communications system and applications in the context of the safety, performance and interoperability requirements and to check for adverse effects on other aircraft systems and functions. Provide a proposed flight manual or flight manual supplement.

3.2.5 Operator operational approval plan

When developing a plan for operational approval, the operator should initially provide a letter of intent to the approval authority. The letter of intent should provide an overview of the intended operation, operating environment, aircraft , and communications equipment and capabilities. A proposed approval plan should be submitted separately or as an attachment to the letter of intent. The operational approval plan should include the following information:

a) Description. Describe the operating environment, coordination with other regulatory authorities, and the operations that will be conducted. Describe the aircraft data communications system, the applications, and their interface with other systems and functions on the aircraft. Describe the operation (e.g., human/machine interface) and the flight deck arrangement. Describe the communications network that will be used, e.g.; Conduct CPDLC using RC-9000 VDL-2 VHF data link radios and ARINC as the communications service provider.

b) Schedule. Provide a schedule indicating interaction between the applicant and the approval authority. . This schedule should include; the names, experience and qualifications of operator personnel that are participating in the operational approval process; and aircraft, simulators, and/or training devices that will be used during qualification and validation tests.

c) Flight and ground tests. Define the objectives and acceptance criteria for evaluating the performance of operator personnel during flight and ground tests.

d) Certification basis. Describe the certification basis. Include applicable airworthiness requirements and other related regulatory material, industry guidelines and standards or other documents. Provide a copy of the AFM(S) section(s) that describe any procedures and/or limitations specific to the installed communications system that the operator is proposing to use.

e) Aircraft certification data. Provide evidence showing that the aircraft data communications system and applications are installed and certified for the intended functions.

f) Training program. Describe the training program and procedures that will be implemented to train and qualify appropriate operator employees (pilots, dispatchers, maintenance, and other support personnel).

g) Human factors requirements. Describe and identify any human factors/human engineering issues that may affect operational use of the communications system and proposed methods to eliminate or mitigate errors such as; slips or mistakes when using the communications system.

h) Maintenance program. Describe any additional maintenance program changes that are required to support the initial and continued airworthiness requirements for the installed communications system.

i) Approval authority. If applicable, describe the involvement of any personnel designated by the approval authority that will be acting as representatives of the approval authority and providing operational approval to the operator.

j) Validation of requirements. Describe the means for validating that the training, operational, airworthiness, safety, performance, and interoperability objectives and requirements resulting from installation and operation of the communications system are met. Validation includes ensuring that the implementations provided by the aircraft avionics satisfy the communication system capabilities and operating environment requirements.

3.2.6 Network operational approval plan

When developing a plan for operational approval, the following network aspects should be addressed:

a) Description

b) Safety assessment

c) Performance assessment. Define the performance assessment activities and their interrelationships with other activities within the design approval process.

d) Interoperability assessment

The expectation is that network approval will be part of ATS / Operator operational approval process.

4 Requirements determination

This section describes the objectives and the related evidence when developing requirements for air traffic services supported by data communications that are planned, built, and operated by different States and/or organizations.

All safety, performance, and interoperability requirements identified are provided in SPR and INTEROP standards.

4.1 Operational environment definition

This section describes the objectives and evidence for characterizing the operational environment.

4.1.1 Objectives for operational environment definition

The objective for the OED is to collect and present all of the characteristics of the operational environment needed to complete the Safety and Performance Requirements (SPR), and Interoperability Requirements (INTEROP). The OED provides the basis for:

- Safety assessment,
- Performance assessment,
- Interoperability assessment.

The OED provides performance information to be used within the OPA to assess performance requirements for the end to end data link path in any communication environment. Objectives for the OED should include:

a) Identification of air traffic services,

b) Identification of operating contexts,

c) Provide the basis for conducting operational assessments for performance and safety requirements,

d) Provide the basis for specification of candidate technologies for interoperability requirements.

4.1.2 Evidence of operational environment definition

The evidence of the OED shall comprise the ATC operation including interoperability, safety and performance constraints, the ICAO Regional classification and the physical systems present and/or proposed. The evidence should include:

a) Airspace Characteristic Description

b) Separation Minima

c) Route Configuration and Complexity

d) Type of Control

e) Airspace Class

f) Traffic Characteristic Description

g) Traffic Rates

h) Aircraft Mix

i) Description of Operations

j) Service Descriptions

k) Operational Scenarios

l) Functional Characteristics

m) Communication

n) Navigation

o) Surveillance

4.2 Safety requirements determination

This section describes the objectives satisfied and the evidence produced when developing safety requirements for air traffic services supported by data communications.

4.2.1 Objectives for operational safety assessment

This section provides the objectives for the operational safety assessment as they relate to the operational hazard assessment and the allocation of safety objectives to requirements.

4.2.1.1 Objectives for operational hazard assessment (OHA)

The OHA is a qualitative assessment of the operational hazards associated with the Operational Environment Definition (OED). For the OHA, operational functions should be examined to identify and classify hazards which may potentially impair those functions. Hazards should be classified according to a classification scheme based on hazard severity. Safety objectives should be determined according to hazard classification. The OHA is developed early in the airspace planning process and is updated as functions are modified or operational hazards are identified. The objectives of the OHA are as follows:

a) All characteristics of the operational environment as defined by the OED that may cause a hazard or to which a hazard is related should be identified.

b) All operational hazards should be identified.

c) The effects of each operational hazard should be identified using **Figure 4-1**.

d) Each operational hazard should be classified according to the severity of its identified effects per a common hazard classification scheme of **Figure 4-1**.

e) The effects and classifications of operational hazards should be traced to the environment definition.

f) Safety objectives based on the operational hazard classifications should be established according to **Figure 4-2**.

Figure 4-1: *Operational Safety Assessment Hazard Classification Matrix.*

Hazard Class	1 (most severe)	2	3	4	5 (least severe)
Effect on Operations	Normally with hull loss. Total loss of flight control, mid-air collision, flight into terrain or high speed surface movement collision.	Large reduction in safety margins or aircraft functional capabilities.	Significant reduction in safety margins or aircraft functional capabilities.	Slight reduction in safety margins or aircraft functional capabilities.	No effect on operational capabilities or safety
Effect on Occupants	Multiple fatalities.	Serious or fatal injury to a small number of passengers or cabin crew..	Physical distress, possibly including injuries.	Physical discomfort.	Inconvenience.
Effect on Air crew	Fatalities or incapacitation.	Physical distress or excessive workload impairs ability to perform tasks	Physical discomfort, possibly including injuries or significant increase in workload.	Slight increase in workload.	No effect on flight crew.
Effect on Air Traffic Service	Total loss of separation.	Large reduction in separation or a total loss of air traffic control for a significant period of time	Significant reduction in separation or significant reduction in air traffic control capability.	Slight reduction in separation or slight reduction in air traffic control capability. Significant increase in air traffic controller workload.	Slight increase in air traffic controller workload.

Note: This table is recommended for use in classifying hazards identified during the OHA. This OSA classification can then be translated into the institution's own safety assessment methodologies. A safety hazard is classified by reviewing the text in each of the matrix cells and finding a failure or event description that best matches the hazard. Greater safety objectives and more rigorous assessment, assurance and qualification processes apply as hazard severity increases. The least severe hazards, once identified as such, require minimal assessment, assurance, and qualification.

INSERT FIGURE 4-2 FROM 22Gfigs.ppt HERE

Figure 4-2: *Hazard Classification/Safety Objectives Relationship*

4.2.1.2

Objectives for allocating safety objectives and requirements (ASOR)

This process allocates the safety objectives and related requirements, and identifies and validates the risk mitigation strategies that are shared by multiple institutions. Understanding the dynamic interplay or interaction among operational functions, ATS procedures, and airspace characteristics will assist in the identification of failures, errors, and/or combinations thereof that contribute significantly to the hazards identified in the OHA. The allocation must be updated throughout the development activities. Allocations must be updated when an institution fails to meet its requirements. Guidance for allocating safety objectives and requirements is as follows:

a) Identify and assess the relationships of system failures, procedural errors, combinations thereof, and the effects on air traffic services based on the CNS/ATM architecture and the procedural requirements provided in the OED.

b) Common cause failures or errors occurring across institutional boundaries should be identified and requirements for their elimination or mitigation should be established.

c) All considerations and assumptions of the assessment should be identified and validated. Examples of such considerations and assumptions include, but are not restricted to:

   (1) Mitigating human actions or responses should be reasonably expected to occur as assumed.

   (2) Design-induced human errors leading to operational hazards should be identified, assessed, and eliminated or controlled.

   (3) Assumptions about independence should be validated.

   (4) Failures caused by external events, such as environmental conditions, atmospheric disturbances, etc., should be accounted for.

d) All operational safety objectives and requirements should be allocated to institutions and/or institutional components and elements of the operational environment.

e) Shared safety objectives and requirements should be coordinated across institutional boundaries.

f) Safety objectives and requirements should be validated.

g) The OSA results should be traced to each operational capability provided in the OED.

h) Coordinate the OSA with other operational assessments (e.g., security, efficiency, performance, and interoperability).

i) Ensure the correctness and completeness of the safety objectives and requirements.

4.2.2 Evidence of safety requirements determination

The following data items should be produced during the OSA:

Ed Note: Text is provided here as information and needs to be integrated. G2 will submit a comment on Revision G to incorporate text.

a) Operational Hazard Assessment Results, including:

(1) Identified operational services, capabilities, and functions from the OED

(2) Identified operational hazards related to the identified operational services, capabilities, and functions

(3) Identified effects of each operational hazard

(4) Classification of each operational hazard as to the severity of its effects

(5) Identification of the safety objective related to each operational hazard

(6) Mitigating and contributing factors for each operational hazard from the OED

(7) Candidate safety requirements, including both system requirements and procedural requirements

b) Allocation of Safety Objectives and Requirements Results, including:

(1) Identification of system and procedural elements contributing to each operational hazard, and their relationships (e.g., fault tree or Markov analysis of failures and errors causing the operational hazard)

(2) Common Cause Analysis

(3) Safety objectives and requirements allocated to each contributing factor

(4) Proposed allocation of identified safety objectives and requirements to developing and implementing institutions

4.3 Performance requirements determination

This section describes the objectives satisfied and the evidence produced when developing performance requirements for air traffic services supported by data communications.
Objectives for operational performance assessment (OPA)

This section provides the objectives for the operational performance assessment as they relate to the required operational performance and the allocation of performance objectives.

4.3.1 Objectives for operational performance assessment (OPA)

4.3.1.1 Objectives for RCP assessment

The assessment will establish a particular RCP, which will enable specific operational benefits to be achieved. RCP will then be published for a given airspace and for an intended service. The RCP provides a quantitative measure of the Communication portion of the CNS concept.

4.3.1.2 Objectives for RCTP assessment

The objective of the RCTP assessment is to allocate the RCP between technical and human factors and to establish the technical system performance requirements. The RTCP will be used to qualify systems. A further objective of the RCTP assessment is to determine the domain performance allocation between aircraft, network and ATS systems.

4.3.1.3 Objectives for ICP assessment

The objective of the ICP assessment is to determine the installed performance of the domains. ICP will be compared to RCTP.

4.3.1.4 Objectives for ACP assessment

The objective of the ACP assessment is to compare the measured operational performance level to RCP, in order to determine operational approval and monitor performance.

INSERT FIGURE 4-3 FROM 22Gfigs.ppt HERE

Figure 4-3: *Summary of the Relationships Among RCP, RCTP, ICP and ACP Within the OPA Process*

4.3.1.5 Objectives for required surveillance performance (RSP)

Ed Note: text is needed from SG3.

4.3.2 Evidence of performance requirements determination

Ed Note: text is needed from SG3.

4.3.2.1 Evidence for communication performance requirements

The following data items should be produced during the OPA:

a) Identify RCP type

b) Allocated RCP to RCTP and human performance

c) Allocated RCTP to the aircraft, network and ATS domains

4.3.2.2 Evidence for RSP

Ed Note: text is needed from SG3.

4.4 Interoperability requirements determination

The IA should define the interoperability requirements and their allocation across institutions.

4.4.1 Objectives for interoperability

The interoperability assessment should document and allocate the requirements, basic rules, and constraints that are necessary for interoperability. This assessment provides a means for verification of interoperability after changes to the air traffic service and provide a set of recommended verification tests to ensure interoperability for any new or modified part or procedure.

Interoperability requirements should include the technical requirements for institution and system end-to-end compatibility. The interoperability standards should reference international standards whenever available, and should define the additional requirements, including message subsets, changes or deviations from existing standards, selected options, dynamic behavior, and limitations necessary to achieve interoperability of the system in the operational environment defined in the OED. Interoperability requirements should also be allocated to the applicable institutions or stakeholders.

The interoperability requirements should be documented in the format defined in Interoperability Requirements template in Annex D.

4.4.2 Evidence of interoperability

Interoperability is proved through exhaustive, multi-leveled interoperability testing at the component, institutional interface, and end system -to-end system levels. Specifically, interoperability is validated through:

a) Evidence of institutional test and verification of interoperability requirements allocated solely within the institution

b) Evidence of institution – institution test and verification of interoperability requirements allocated across that institutional boundary interface

c) Evidence of multi-institution test and verification of interoperability requirements allocated across those institutional boundary interfaces

d) Evidence of application–to-application automation test and verification of system interoperability requirements

e) Evidence of pilot-to-controller (human in the loop) test and verification of system interoperability

Evidence is usually comprised of test plans, test results, and test reports. Testing should be conducted within an environment which employs configuration management.

4.5 Requirements Coordination

This section describes the objectives that should be satisfied and the related data items that should be produced when coordinating safety, performance, and interoperability requirements. The safety, performance and interoperability requirements may be determined independently. Approval criteria will be based on the safety, and performance requirements for the intended uses and interoperability requirements for the candidate technologies. In order to proceed into the development phase, it is important to compare requirements and check for inconsistencies and conflicts. Requirements in the SPR and the INTEROP are allocated to the institution(s) and system elements they apply. Requirements for each institution should be captured in one place and should identify the source document (SPR or INTEROP) to allow traceability.

4.5.1 Objectives for requirements coordination

The first step in requirements integration is assembly of safety, performance, and interoperability requirements. The evidence of the safety requirements determination (OSA results), operational requirements determination (OPA results), and interoperability requirements determination (interoperability specification) will provide the source of requirements for integration.

The second step in requirements integration is organization of requirements by institution of control. Requirements may be associated with more than one institution. Institutions will likely have a combination of safety, performance and interoperability requirements which they control.

The next step is a comparison of requirements. The comparison is a check for inconsistencies and conflicts between requirements.

Resolve conflicts and inconsistencies between requirements.

The interdependencies and interactions between fields of responsibility require extensive coordination to perform the operational safety assessment. The goal of this coordination and associated common work is:

a) to achieve mutual understanding on all safety-related issues for a correct definition of the interface and the nature of common work to be carried out to establish appropriate safety requirements.

b) to build up confidence and consistency in hypotheses and assumptions made about the functions and operations of each field of responsibility.

c) to ensure that the adequate level of safety assessment activity will be conducted in each field of responsibility, agree on the way to do it, propose a plan for discussion, followed by approval of the safety assessment work by competent authorities.

For the implementation of ATS applications and services supported by data communications, safety assessments and analysis of different natures will certainly be conducted separately with specific methods by different institutions. Coordination between all those institutions is one of the major issues of the OSA.

Hence, it is highly recommended that the institution in charge of the coordination of the OSA involve all the institutions potentially affected by the OSA. It is also highly recommended that the OSA takes into account as inputs all the existing safety assessments made by the various institutions. Those safety assessments, if existing, should be identified in the OSA plan.

4.5.2 Evidence of requirements coordination

Includes source trace for each requirement – defines the rationale and indicates impact

Ed Note Source trace in SPR should include INTEROP as a source.)

5 Qualification

This section includes the objectives and evidence for qualification of project implementations to the safety, performance, and interoperability requirements established during requirements determination. Qualification of each institution requires documented evidence of conformance to plans identified in Section 3, and to the safety, performance, and interoperability requirements in Section 4. The qualification process verifies that all requirements including Safety, Performance and Interoperability requirements allocated to the institution have been satisfactorily met by the institution. The qualification process may be unique and specific to each institution; indeed it may be unique and specific to each instantiation of institutional processes. For example, at the aircraft level, the qualification process is commonly called the airworthiness certification process.

The qualification evidence is a comprehensive set of all the requirements and any documentation necessary to show that the requirements have been met. This documentation may include institutional assessments and mitigation means, system, procedural and human factor requirements; detailed design requirements, verification plans and results; and qualification test plans and results. This documentation should include requirements traceability throughout. The institution and the approval authority should agree to the exact set of evidence as a part of the qualification plan.

Ed note. Make the introduction consistent with introduction of section 3 and 4) Ed note. PUB goal is to consolidate this section into a common list of objectives that could be used for safety, interoperability, and performance, as well as aircraft and ATS provider systems. Ed note: text to be considered: " Development assurance levels based on the operational hazard classifications should be identified according to **Figure 4-2**." Development assurance level is determined by the institution responsible for the development of that element of air traffic service based on the safety objectives and requirements allocated to the institution.

5.1 Airspace

Ed note: assign to SG4.

5.1.1 Objectives

5.1.2 Evidence

5.2 ATS provider

We should introduce an Ed note to indicate what and from who we are expecting, shouldn't we? Perhaps the top level Ed note is enough. Suggest that this section be assigned to each of the subgroups SG1, SG2, SG3, & SG4 for their qualification criteria.

Note from SG4: Appropriate resources to develop text for this section of the document are not available to complete prior to due date. SG4 proposes that the section be removed until such time as appropriate resources become available

5.2.1 Objectives

5.2.1.1 Performance

The performance assessment will establish the RCTP appropriate to the ATS provider institutional domain. Qualification requires the provider to demonstrate that the ICP for the ATS domain satisfy the RCTP allocated to the ATS domain by the OPA. Qualification will also require the ATS provider to demonstrate a mechanism for monitoring ACP, comparing it to the RCP, and taking action should RCP not be achieved.

5.2.2 Evidence

5.2.2.1 Performance

The ATS provider shall demonstrate by analysis or systems test that ICP criteria for the ATS domain meets the applicable RCTP.

The ATS provider shall detail an ACP monitoring system and procedures to be implemented once failure to meet the RCP has been detected.

5.3 Communication Service Provider

Ed note: This section will provide criteria, however, it should be applied to either the qualification activities for the Air Traffic Service Provider or the qualification activities for the Operator.

Requirements allocated to the communication provider are assumed to be placed under the responsibility of the ATS providers. Indeed current schemes work that way (ATS being responsible for provision of Annex 11 services, using GG and A/G com services from external suppliers. This still allows for the aircraft/operator institutions to be responsible for meeting the requirement to carry/operate peer airborne equipment according to OSA results.

5.3.1 Objectives

5.3.1.1 Performance

The performance assessment will establish the RCTP appropriate to the communication provider institutional domain. Qualification requires the provider to demonstrate that the ICP for the network domain satisfy the RCTP allocated to the network domain by the OPA.

5.3.2 Evidence

5.3.2.1 Performance

The communication provider shall demonstrate by analysis or end to end tests that ICP criteria for the network domain meets the applicable RCTP.

5.4 Aircraft

Editorial note: the main input of this chapter come from PSG2-21; there is missing element from SG1 & 3 (tbc).

5.4.1 Objectives

5.4.1.1 Safety

The institutional safety assessments ensure that each element of the operational environment for which the airborne institution is responsible satisfies the safety objectives and requirements that have been allocated by the OSA.

a) All of the safety objectives and requirements that have been allocated by the ASOR are covered by the ISAs.

b) The OSA and the ISAs satisfy the completion criteria established during the OSA planning process.

c) Traceability between the hazard effects, the classification of operational hazards and the operational environment is documented per the established guidelines.

5.4.1.2 Performance

The performance assessment will establish the RCTP appropriate to the aircraft institutional domain. Qualification requires the aircraft manufacturer to demonstrate that the ICP for the aircraft domain satisfy the RCTP allocated to the aircraft domain by the OPA.

5.4.1.3 Interoperability

Ed note: Refer to text section 7 of Pu-23-B2.

5.4.2 Evidence

5.4.2.1 Safety

Ed note: Assign to SG2. Refer to other evidence sections for ideas on content and level of detail.

5.4.2.3 Performance

The aircraft manufacturer shall demonstrate by analysis or laboratory or flight-test that ICP criteria for the aircraft domain meets the applicable RCTP.

5.4.2.3 Interoperability

Ed note: Assign to SG1. Refer to other evidence sections for ideas on content and level of detail.

5.5 Operator

Operator qualification requirements will depend on the operating rules or requirements that each operator is conducting operations under. In some cases, the qualification requirements may be more stringent for air carrier operators than general aviation operators.

5.5.1 Objectives

The approval authority should review and evaluate the objectives and evidence for qualification that the Operator has provided in the operational approval plan. The objectives are defined in the description section of the operational approval plan outlined in paragraph 3.2.3 of this guidance. The evidence required from the Operator to meet the qualification requirements will depend on the proposed operating environment and the complexity of the Operator's objective(s).

5.5.2 Evidence

The Operator should provide at least the following minimum evidence to the approval authority:

a) copies of aircraft flight manual or flight manual supplement with appropriate conditions and limitations for use of the data communications system;

b) copies of the training and maintenance programs and documentation that ground, dispatch, and flight crew personnel have successfully completed the applicable parts of the revised training and maintenance programs;

c) verification that applicable human factors issues have been identified and resolved,

d) verification that appropriate procedures and normal/abnormal/emergency checklists have been revised and approved by the approval authority;

e) verification that appropriate changes have been made to aircraft minimum equipment lists and aircraft configuration deviation lists;

f) verification that applicable operating rules and procedures are met.

5.5.2.2 Safety

The assurance that operational safety objectives and requirements for the Operator are met should occur during a flight operations validation test. The flight operations validation test may

or may not include an actual aircraft flight and may be combined with the airworthiness certification validation test. This test should provide verification that all safety, performance, and interoperability requirements necessary for operational implementation and approval to use the data communications system in a specific operating environment are met.

5.5.2.2 Performance

The assurance that operational performance objectives and requirements for the Operator are met will require the operator to demonstrate that its aircraft have the proper RCTP qualification, that the crews will operate within the allocated human factor budget and that the communication configuration is appropriate.

6 Entry into service

Ed note: Assign to PUB. CAG to review

6.1 Airspace

6.2 ATS Provider

The designated authority should develop, alter, test, and evaluate systems, procedures, facilities, and devices, and define their performance characteristics, to meet the needs for safe and efficient navigation and traffic control of civil and military aviation.

The essence of technical certification is the periodic verification and validation that the advertised quality and scope of services, or the capability of providing those services, are being provided to the users. The basis of technical certification is the verification that the system or equipment in question is providing (or capable of providing, e.g., standby equipment), the advertised service to the user within the prescribed handbook tolerances and limits.

The following is the lifecycle for generation of a service for the air traffic service provider:

1) Existing Standards such as Standards and Recommended Practices (SARPS), Minimum Operational Performance Standards (MOPS) and Regulations
2) ATSO develops equipment specification
3) Industry builds equipment
4) ATSO factory tests equipment
5) Equipment installed into the ATSO
6) ATSO site tests equipment
7) ATSO or independent regulator certifies equipment
8) ATSO or independent regulator certifies service
9) ATSO provides to users

6.3 Aircraft

6.4 Operator

Operational Approval for an Operator is complete when the approval authority and the Operator agree that all the criteria defined in the Operator's operational approval plan are met and validated. The approval authority should issue approval to the Operator with appropriate conditions and limitations on a form and in a manner consistent with the approval authority administrative procedures.

7 Operations

7.1 Continued operation

7.1.1 Continued operational safety

After the qualification of a system in accordance with the safety objectives and requirements derived by the Operational Safety Assessment (OSA) and allocated to each of the system segments, there is the need to ensure that environment changes implemented as ATS operations evolve do not degrade the desired safety performance. Continued Operational Safety includes monitoring the environment characteristics for changes that affect the safety of flight operations. The monitoring requirements are determined by the cross-referencing within the OSA of the environment characteristics, documented in the Operational Environment Description (OED), to the allocated safety objectives and requirements, which result from the OSA. This process includes change management, continued verification, configuration management, and organizational monitoring, and maintenance requirements.

INSERT FIGURE 7-1 FROM 22Gfigs.ppt HERE

Figure 7-1: *OED characteristics called out in the OSA are monitored in operations for changes so that, if necessary, alternative mitigation can be provided.*

Any change to a characteristic of the environment utilized as a rationale or as mitigating a risk identified in the OSA should be monitored and assessed for its effect on the associated safety objectives or requirements. In particular, airspace characteristics, operations changes, functional characteristics, and system technical characteristics, as depicted in **Figure 7-1**, should be monitored. Objectives related to continued operational safety include:

a) Airspace characteristics utilized as rationale, or as mitigating a risk identified in the OSA should be monitored for changes which affect the associated safety objectives or requirements.

b) Operations descriptive characteristics such as risk mitigating procedures should not be eliminated or changed without providing alternate forms of risk mitigation, or assuring that the changes in the OED that affect Operational Safety must be configuration managed and evaluated in the OSA to ensure mitigation is adequate.

c) Functional characteristics, whether capability or performance characteristics which are called out in the OSA as mitigating risk, should not be changed without providing an alternate form of risk mitigation. The effect of a change in a functional characteristic on inter-segment assumptions, deviations from interface standards, or functional allocation to segment as identified in the OSA should be assessed. For example, a particular developmental assurance level may be called out as a safety requirement within the OSA. Change management would ensure that development assurance levels and associated control data level identified for changes to the system functional characteristics are consistent with development assurance levels associated with that function or operational capability.

d) System technical characteristics which are called out in the OSA as mitigating risk, or which are required for the implementation of procedures which enable separation minima reductions, should be monitored for changes which affect the safety of flight operations. These may be performance characteristics or functional characteristics implemented on an end-to-end basis.

e) The introduction of different aircraft types with different capabilities may require that the OSA or portions thereof be revisited to account for safety impact.

f) Continued verification of allocated safety objectives and requirements should be facilitated through the use of appropriate techniques, including problem reporting methods and reliability histories in each segment and in operations. As part of this process, assumption violations should be explicitly identified. Problem reports, reports of operational errors or deviations which can be related to identified safety objectives and requirements, or which would indicate the need for additional requirements should be referred to the ongoing OSA maintenance activity.

g) The environment characteristics assumed for the purpose of the OSA should be configuration managed such that reliability histories, and problem reports identified as operational safety related within continued verification can be associated unambiguously with a given configuration.

h) Organizational changes which reallocate responsibilities within an FIR, or domain, should be monitored to assure that coverage of OSA derived safety objectives is not interrupted. Organizational changes may have the effect of leaving a safety objective uncovered, or unmonitored. **Figure 7-2** depicts the four aspects of continued operational safety as they relate to the OSA and to the operational usage of each system increment.

i) Where safety objectives are met by the implementation of maintenance practices, then these should be subject to configuration management procedures.

INSERT FIGURE 7-2 FROM 22Gfigs.ppt HERE

Figure 7-2: *Aspects of Continued Operational Safety. OSA allocated objectives are ensured through monitoring.*

7.1.2 Continued operational performance

The performance monitoring requirements are determined by the OPA. The key element is the monitoring of the ACP and in particular the performance of the network domain. In addition there is the need to ensure that environment changes do not degrade the desired performance. There is also an expectation that pilots and controllers will monitor the performance and take action if the transaction expiration time (see OPA for definition) is exceeded.

7.1.3 Continued operational interoperability

Any new institution, or new or modified system or functional element added to an existing operational environment should be first verified at the system/function level and then subjected to appropriate interoperability tests as defined in Section 4.0.

7.2 Follow-on approval

Once initial operational approval is provided no additional approval is needed as long as the kind of operation, services, and equipment have not changed since the original approval. When a change in the operating environment, kind of operation, services, or communications equipment occurs, re-qualification and/or revalidation may be necessary. When it is necessary, the applicant should submit a new operational approval plan. The complexity of this plan will vary, based on the operational and equipment changes.

Ed note: This section is intended to provide guidance on the extent to which one would have to re-qualify when changes are made to the operation, aircraft, ATS service, or airspace. Each of the subgroups G1, G2, G3, & G4 should look at re-qualification activities from each of the perspectives: operational, safety, performance, and interoperability.

7.2.1 Airspace

Ed note. Something needs to go here from SG4?

7.2.2 ATS Provider

The objective of Equipment certification is to make an independent determination as to when a system/subsystem/equipment should be continued in, restored to, or removed from service.

The service capability is the end product delivered to the ATSO operator that is the product of an appropriate combination of services/procedures/systems/subsystems/equipment.

Service certification is the verification that an appropriate combination of services/procedures/systems/subsystems/equipment, as advertised to the user, has been certified as being capable of providing the functions necessary to the user. The certifying official uses personal knowledge, technical determination, observations, and inputs from other certified personnel to accomplish certification.

ATSO's identify capabilities requiring certification within the parameters specified for their system elements. The choice of methods used for certification determination is left to the professional judgement of the certifying official. The official may use one, several, or a

combination of the certifying methods to determine that a system is providing the advertised user service. Generally, performance of the prescribed system periodic maintenance tasks will provide the necessary information for this determination.

Specific maintenance procedures for a particular system may be found in maintenance technical handbooks, instruction books, or other technical documentation. Other maintenance methods available to support a certification determination are:

a) Direct measurement of certification parameters. Officially waivered values, where issued, shall be used in place of directive values.

b) Monitor indications. These should include the satisfactory operation of both the control and remote indications.

c) By recording and analysis of required information on technical performance forms.

d) By performing a comparative analysis of flight inspection data with previous.

e) Visual and aural observations, such as meter readings, plan position indicator (PPI) data, pilot light indications, and absence of extraneous noises, excessive heat, or questionable odors.

f) User (pilot) report of satisfactory operations, as with a voice communication check on remote air to ground equipment.

g) By the completion of local or remotely conducted hardware or software diagnostic tests, where that capability exists.

Normal and maximum periodic certification intervals are established, based upon the criticality of user service and performance stability of the system in question. Normal certification interval is the periodicity to be used on a routine basis. This interval reflects the period a system can be expected to perform reliably without further maintenance attention. Maximum certification interval is that beyond which a reliable system performance can no longer be assured without verification.

7.2.3 Aircraft

Ed note. Something needs to go here from SG4?

7.2.4 Operator

Once initial operational approval is provided to an operator, no additional approval is needed as long as the kind of operation, aircraft, and equipment have not changed since original operational approval. When a change in the operating environment, kind of operation (e.g. domestic en route, oceanic en-route, terminal area, approach) or communications equipment occurs, requalification and/or revalidation may be necessary. When requalification or revalidation is necessary, the operator should submit a new operational approval plan to the approval authority. The complexity of this plan will vary, based on the operational and equipment changes.

EDITOR'S NOTE: APPENDICES AND ANNEXES WILL BE FOUND IN SEPARATE FILES FOR ATTACHMENT HERE. SEE FILE PUB22GA.DOC OR PUB22GA6.DOC FOR WORD 6 VERSION. GLOSSARY CAN BE FOUND IN P22GLO-G.DOC AND 22GLOGW6.DOC FOR WORD 6 VERSION. FIGURES CAN BE FOUND IN POWER POINT 4.0 FILE 22GFIGS.PPT.