Final Project Report

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Abstract

Spectrum is a scarce and finite natural resource allocated through legally binding United Nations process.
Without appropriate spectrum, aviation's needs for ACNS systems cannot be met.

The 15.01.06 sets the bases of a new aviation spectrum management approach. To secure the long-term availability of suitable aeronautical radio spectrum a vision was adopted shared at SESAR, European and international level. To achieve the vision, the required short to long term strategies were developed together with best practices and guidance.

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Acronyms

Acronym	Definition
ACNS	Avionics, Communication, Navigation, Surveillance
ASBU	(ICAO) Aviation System Block Upgrade
ATM	Air Traffic Management
CNS	Communication, Navigation, Surveillance
CNS&S	Communication, Navigation, Surveillance & Spectrum
GANP	(ICAO) Global Air Navigation Plan
ICAO	International Civil Aviation Organisation
IMT	International Mobile Telecommunications
ITU	International Telecommunications Union
R&D	Research and Development
SESAR	Single European Sky ATM Research Programme
WRC	World Radiocommunication Conference

1 Project Overview

The overall aim of this project is to ensure the timely availability of adequate interference-free radio spectrum for aviation, an overarching SESAR Spectrum Vision and Strategy has been developed, which seeks to enhance current aeronautical spectrum management practices in Europe through an integrated strategic approach consistent with overall aviation plans.

1.1 Project progress and contribution to the Master Plan

The project created spectrum awareness; reflected in the Edition 2015 of the European AMT Master Plan.

It also introduced process to ensure that spectrum impacts are fully addressed in a timely manner. The application of the process will minimise risk to the development programme, and future system deployment, by:

- Ensuring sufficient and suitable spectrum availability;
- Promoting spectrum efficiency;
- Minimising the likelihood of incompatibility;
- Avoiding in-service interferences;
- Assessing the operational impact on other aeronautical systems;
- Making appropriate spectrum provisions through the ITU processes.

The primary intention is to apply the process to all new SESAR ACNS developments that have a dependency on radio spectrum but there is also the potential to address planned technical or operational changes to in-service systems.

It is intended that a validation and verification process is applied at strategic milestones during ACNS development programmes.

The validation and verification stage will:

- Initially, check whether sufficient data has been provided to fully conduct the assessment and take any necessary action to resolve deficiencies;
- Establish the level of compliance with the best practices as set out in the SESAR spectrum strategy. Particular attention will be given to spectrum efficiency and improvement targets;
- Establish whether there is sufficient spectrum to meet anticipated demand;
- Establish whether compatibility is assured between the SUE and existing aeronautical and non-aeronautical systems;
- Identify any operational limitations necessary to ensure compatibility;
- Establish the level of compliance with ITU Radio Regulations and ITU-R Recommendations;
- Check suitability and efficiency of the proposed frequency planning criteria and the likely impact on existing and planned systems;
- Check correctness and completeness of standards and specifications;
- Identify any misalignment with the strategic objectives of the Global Air Navigation Plan (GANP) and Aviation System Block Upgrade (ASBUs).
- Ensure the spectrum environment will support the optimum system performance necessary to deliver the operational requirement.

1.2 Project achievements

The project aimed at introducing significantly enhanced practices to deliver European aeronautical spectrum management, within the ITU and ICAO global institutional frameworks in:

- Providing a coordinated overall European spectrum strategy employed to create a sustainable environment for spectrum efficient aeronautical systems;
- Deploying improved processes for identifying, analysing, coordinating and promoting aviation's spectrum needs;
- Taking a longer-term view of aeronautical spectrum requirements.

The project introduced the importance of adopting a holistic Avionics, Communication, Navigation, Surveillance and Spectrum (ACNS&S) approach:

- Providing spectrum expertise for ACNS teams to ensure an inter-discipline approach to development, deployment and removal of outdated aeronautical systems;
- Promoting the development of spectrally efficient CNS systems to minimise the demand for additional spectrum to support future aviation growth;
- Promoting the withdrawal of obsolete and redundant systems in compliance with the future deployment programme.
- Inclusion of spectrum as a fundamental component within aviation's strategic programmes.
- A through-life approach to spectrum requirements, i.e. early internal engagement between all responsible parties coupled with an extended time frame beyond that of current strategic programmes.
- Close collaboration between ACNS teams, the deployment manager and spectrum experts during the development and deployment of ACNS systems.
- A performance-based approach to align spectrum with the functional needs of aviation systems and applications.
- Development of spectrum-agnostic and spectrally efficient ACNS systems that are fully interoperable in the global environment, but which can employ spectrum allocated on a regional or sub-regional basis.
- Ensuring cost effective technological evolutions;
- Minimising the impact and timescales of technological transitions.
- Ensure that the aviation spectrum strategy does not place financial burdens on the aviation industry.

The project prepared and presented Aeronautical Common Position for the International Telecommunication Union (ITU) WRC-12 and WRC-15; and succeeded to alleviate the International Mobile Telecommunications (IMT) threat.

1.3 Project Deliverables

The following table presents the relevant deliverables that have been produced by the project.

Reference	Title	Description
D01	Analysis of Aeronautical Spectrum Utilization and Impact Assessment	Assessment of aviation radio frequency bands that are allocated by the International

	[8]	Telecommunication Union (ITU). It comprises a detailed review of the regulatory provisions as provided by the ITU Radio Regulations and the Electronic Communications Committee of the European Conference of Postal and Telecommunications Administrations (CEPT). The assessment address: - the spectrum supply on the basis of the allocations of radio frequency spectrum for use by international civil aviation (radio communication and radio navigation) and the specific radio regulatory provisions. - The spectrum demand for the upcoming 20 years; - Means to meet spectrum demand and risk factors that may affect the availability of adequate spectrum.
D03	SESAR input to the European Aeronautical Spectrum Strategy [9]	The short term strategy based on ITU WRC cycle; aiming at preserving radio frequency spectrum necessary to support to the implementation of the European ATM Master Plan. Within the SESAR context, it presents the direction and scope of the short / medium term use for each portion of the aeronautical spectrum, the required spectrum resources, threats (risk factors) in meeting the spectrum requirements and steps to protect the aeronautical spectrum requirements.
D04-001	SESAR Aeronautical Spectrum Strategy and Vision [4]	Strategy and vision to secure the long-term availability of suitable radio spectrum to meet all of Europe's future objectives for aviation through cooperative engagement in the global spectrum environment. To introduce a culture where spectrum needs and spectrum efficiency are fully considered and analysed within ATM requirements, within the future CNS roadmap and in support to the SESAR Concepts. Identify the means by which aeronautical spectrum can be sustained over the medium and long-term periods and the spectrum availability for new technologies could be assured in anticipation of traffic growth and introduction of new vehicles and systems. Promote a cost effective development of the overall ATM system (including spectrum management)
D04-002	SESAR Spectrum Strategy Band by Band action plan [5]	The SESAR aeronautical spectrum strategy and vision Part 2. It supports 15.01.06 D04-01, by providing statements for each aeronautical frequency band, aimed at supporting the development of a spectrum action plan Where applicable, SESAR CNS enablers from the current Integrated Roadmap dataset (DS13 / DS14) are to be identified and given consideration in the strategy and vision statements. Deviations from the

		spectrum strategy statements in SESAR 15.01.06 D03 resulting from recent activities and the Agenda Items (AI) for the International Telecommunication Union (ITU) World Radiocommunication Conference (WRC) 15, have been identified where they occur
D05	SESAR Spectrum Strategy and Vision Implementation [7]	Roadmap for delivery of the key action steps contained in the SESAR spectrum strategy and vision Identify the steps to provide a roadmap for delivery of the key actions contained in the SESAR spectrum strategy and vision (D04-001), SESAR Spectrum Strategy Band by Band action plan (D04-002) and SESAR spectrum compliance process (D32).
D06; D07; D08-001 and D08-002	LDACS1&2 Compatibility Studies [10][11][12][13]	Those deliverables aim at checking the appropriateness for the future LDACS (L-band Digital Aeronautical Communication System) to share the 960-1164 MHz frequency band, considering interference and compatibility issues with the incumbent aeronautical systems already operating in the same band.
D11	Navigation Spectrum [14]	The document is based on the recommendations of the 15.01.06 D03 [9] SESAR Spectrum Strategy for an efficient spectrum use. Navigation systems operating in the VHF-Band, the L-Band, and GNSS are assessed.
D12 to D16	Spectrum needs for current and future Dependent Surveillance Systems [15][16][17][18][19]	Spectrum analysis performed by means of simulation to explore 1030/1090 MHz RF interference levels, spectrum utilisation, and SSR performance aspects in high density area of the years 2011 to 2030. Guidance to Surveillance experts operating in the 1030/1090 MHz frequency band.
D23	Briefing Material Report Deliverable WRC-2015 [20]	An overview of the importance of spectrum to aviation, including a brief description on the organisation of the ITU, the WRC process, and a summary of the ICAO and European Aviation Common positions in respect of WRC-15 Agenda Items which are important to aviation and SESAR.
D24	Report on WRC-2015 Outcome Deliverable [21]	Is a background brief on the results of the International Telecommunication Union (ITU) World Radiocommunication Conference 2015 (WRC-15); in relation to the ICAO and European Aviation Common Positions for WRC-15, together with a link to the Final Acts of WRC-15. It also includes the Agenda Items for WRC-19 and a particular highlight on the WRC-19 Agenda Item 1.10 addressing GADSS.
D27	Frequency Management Tools Deliverable [22]	A description of the current frequency management tools and their supporting processes, and the

		planned enhancement to those tools. It also analyses future requirements for frequency management tools that will emerge from new systems being developed in the SESAR framework and an evolving operational and regulatory environment. Recommendations are made for the development of new and enhancement of existing frequency management tools that will facilitate the seamless introduction of new aeronautical systems, deliver improved frequency planning and coordination processes, improve spectrum utilisation, minimise the likelihood of interference and monitor and measure spectrum usage.
D32	SESAR Spectrum Compliance process [6]	Guidance document for CNS and R&D experts to implement the spectrum strategy and reach the vision

1.4 Contribution to Standardisation

Aviation is a global industry; a European spectrum vision and strategy delivers real benefits only when adopted at worldwide level.

The SESAR Spectrum Vision and Strategy already adopted at European level is being integrated into the ICAO Handbook on Radio Frequency Spectrum Requirements for Civil Aviation; Volume I Second Edition; ICAO spectrum strategy, policy statements and related information.

The drafting of the above mentioned document started early 2016, and it is expected to be realised by the end of 2017.

1.5 Project Conclusion and Recommendations

Spectrum is a scarce and finite natural resource. Aviation spectrum allocations are under a global threat from other sectors that are seeking additional spectrum allocations. For this reason, it is vital that the aviation industry can demonstrate good governance; efficient use of spectrum allocated for aeronautical use and to take all necessary actions to minimise the impacts of spectrum shortages.

This project endeavoured to create awareness; the aviation sector has to address spectrum issues with priority. The increasing spectrum demand has changed the spectrum allocation environment, consequently aviation has to adapt to the new environment and adopt urgently the required actions to continue having access to a adequately protected spectrum to provide safety of life services.

The document D04-001 [4] suggests a proactive spectrum management approach and developed an aviation spectrum vision that was also accepted by ICAO and integrated into ICAO spectrum strategy document. Documents D04-002 [5], D05 [7] and D32 [6] are valuable tools for CNS and Spectrum experts to build on the aviation CNS & spectrum management. The D27 [22] bridges the aviation frequency management to the spectrum management. Frequency management and spectrum management are two different specialities, mixing them up ends by regrettable consequences; but there should be interconnections to allow spectrum managers to take required actions sufficient time in advance (order of magnitude 15 to 20 years) to address on time frequency shortages.

The project recommends aviation industry, in line with the D04 [4][5]; D05 [7]; D32 [6]; to urgently undertake the modernisation of the aviation CNS systems.

SESAR 2020 R&D activities have to adopt holistic ACNS&S approach and be consistent with the Spectrum Vision and Strategy [4].

Spectrum has to be recognised and has to be given the right priority in SESAR 2020.

The cost of losing spectrum by far exceeds the cost of the modernisation.

2 References

[1] SESAR Programme Management Plan, Edition 03.00.01

[2] European ATM Master Plan

[3] Multilateral Framework Agreement ("MFA") signed between the SJU, EUROCONTROL and its 15 selected members on August 11, 2009, amended on 14 June 2010, 19 October 2010 and 2 July 2012

[4] 15.01.06 D04-01: SESAR Spectrum Strategy & Vision Part 1

[5] 15.01.06 D04-02: SESAR Spectrum Strategy Part 2; Band-by-Band Action Plan

[6] 15.01.06 D32: SESAR Spectrum Compliance Process

[7] 15.01.06 D05: Summary of Spectrum Analysis Performed within SESAR1

[8] 15.01.06 D01: Report on Spectrum Utilisation Deliverable

[9] 15.01.06 D03: SESAR Spectrum Strategy Deliverable

[10] 15.01.06 D06: Scenario Description for LDACS1&2 Deliverable

[11] 15.01.06 D07: LDACS1&2 Compatibility Report Deliverable

[12] 15.01.06 D08-001: Final LDACS1&2 Compatibility Report Deliverable

[13] 15.01.06 D08-002: Final LDACS1&2 Compatibility Report Deliverable - Part 2

[14] 15.01.06 D11: Navigation Spectrum Report Deliverable

[15] 15.01.06 D12: 1030-1090 Scenario Description Deliverable

[16] 15.01.06 D13: 1030-1090 Simulation Model Description Deliverable

[17] 15.01.06 D14: 1030-1090 Interim Report

[18] 15.01.06 D15: 1030-1090 Final Evaluation Report Deliverable

[19] 15.01.06 D16: 1030-1090 Guidance Report Deliverable

[20] 15.01.06 D23: Briefing Material Report Deliverable WRC-2015

[21] 15.01.06 D24: Report on WRC-2015 Outcome Deliverable

[22] 15.01.06 D27: Frequency Management Tools Deliverable

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