



# Final Project Report

## Document information

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Project Manager	Indra
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## Abstract

P10.10.02 is a technical project which has been focussed on the definition of technical requirements and guidelines (HMI and HF) for an En-Route and TMA CWP as well assessments of innovative HMI technologies to support CWP evolution from SESAR 1 concepts in the operational thread of SESAR Programme. This is achieved through an iterative process made up of several assessment and review cycles, which leads to the consolidation of a set of P10.10.02 HMI Requirements coming both from the consolidated HMI requirements already produced by the WP10 projects and from the proposals made by P10.10.02 to fill the gaps at requirements level, where needed.

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Rational for rejection	
None.	

## Document History

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Edition	Date	Status	Author	Justification
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01.00.00	04/04/2016	Final		Final version updated after SJU, external and internal comments

## Intellectual Property Rights (foreground)

This deliverable consists of SJU foreground.

## Acronyms

Acronym	Definition
ACC	Area Control Centre
ATCO	Air Traffic Controller
ATM	Air Traffic Management
CHMI	Controller Human Machine Interface Management [Functional Block]
CWP	Controller Working Position
HF	Human Factors
HMI	Human Machine Interface
NFC	Near-field Communication
OFA	Operational Focus Area
OSD	Operational Service and Environment Description
SESAR	Single European Sky ATM Research Programme)
SJU	SESAR Joint Undertaking (Agency of the European Commission)
TMA	Terminal Manoeuvring Area

# 1 Project Overview

P10.10.02 is a technical project which has been focussed on the definition of technical requirements and guidelines (HMI and HF) for an En-Route and TMA CWP as well assessments of innovative HMI technologies to support CWP evolution.

The innovative HMI technologies analysed to support CWP were:

- Cycle 2013: Multi-Touch Devices, Eye Tracker and Handwriting Recognition.
- Cycle 2014: Complementary Technologies (Motion Caption, Mobility and Near-field Communication), Eye Tracker improvement and Future Multimodal CWP.

## 1.1 Project progress and contribution to the Master Plan

P10.10.02 is a technical project which has been focussed on the definition of technical requirements and guidelines (HMI and HF) for an En-Route and TMA CWP to support validation activities in the operational thread of SESAR Programme.

The process was iterative (top-down approach): several cycles of assessment of the Technical Specifications produced were carried out, until the final delivery of the Technical Notes. Each iteration of this process was structured along six main phases:

- Analysis of existing P10.0y.0z technical specifications produced or updated during the cycle: to detect if the defined functional requirements had an HMI impact:

Cycle 2013:

P10.02.01 - D14-001 - ATC TM System Requirements Step 2 v2 [23]

P10.03.02 - D33 - System Requirements Phase 2 Consolidation [24]

P10.04.01 - D06 - Conflict Detection and Resolution requirements definition - Step 1 [25]

P10.04.02 - D06 - Conformance Monitoring System Requirements Phase 1 [26]

P10.04.03 - D20 - Preliminary Definition Report for Phase 2 (Enhance Safety Nets) [27]

P10.04.03 - D39 - Preliminary Technical Specifications for Phase 2 (Enhance Safety Nets and RADP) [28]

P10.04.04 - D02 - System Requirements [29]

P10.09.01 - D09 - D10.9.1 - Phase 2 - System requirement - Step 2 [30]

P10.09.02 - D16 - 10.9.2-D16-System requirement - Phase B [31]

P10.09.04 - D10 - System requirements definition for ATC support to CDA-CCD - Phase 1 [32]

Cycle 2014:

P10.02.05 – D34 - (VP-714) IOP ATC System Requirements (IOP-TS) [33]

P10.02.05 – D36 - (VP-711) IOP ATC System Requirements (IOP-TS) [34]

P10.04.01 – D18 - Conflict Detection and Resolution Tools System Requirements - Phase 2 [35]

P10.04.04 – D18 - System Requirements finalized [36]

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P10.07.01 – D87 - D10.7.1-1 – AGDL System Requirements Update 1 [37]

Cycle 2015:

P10.02.01 – D86 Updated Step 1ATC TM System Requirements - Cycle 1 [38]

P10.02.01 – D87 Updated Step 1ATC TM System Requirements - Cycle 3 [39]

P10.02.01 – D14-001 - ATC TM System Requirements step2 [40]

P10.02.02 – D10 Consolidated Specification of SESAR Trajectory Management Exchange Formats and TM process modelling and design [41]

P10.02.05 – D45 (VP-030) IOP ATC System Requirements (IOP-TS) [42]

P10.02.05 – D52 (VP799) IOP ATC System Requirements (IOP-TS) [43]

P10.04.01 – D33 - Conflict Detection and Resolution Tools System Requirements - Phase 3 [44]

P10.04.02 – D07 - Conformance monitoring system requirements phase 2 [45]

P10.04.02 – D08 - Conformance monitoring system requirements phase 3 [46]

P10.04.03 – D20 - Conformance monitoring system requirements phase 2 [47]

P10.07.01 – D75 - D10.7.1 - AGDL System Requirements - TS 2015 [48]

P10.09.01 – D09 - Phase 2 - System requirement - Step 2 [49]

P10.09.02 - D55 - Step 1 Technical Specification [50]

P07.05.04 – D49 Technical specification Step 1-V3 v1.0 [51]

- Analysis of existing HMI requirements in the Technical Specifications listed in the previous bullet: to highlight gaps, overlaps and inconsistencies among the different Technical Specifications produced by the technical projects;
- Analysis of existing HMI operational requirements (CHMI tagged by the "ATC System Specification" project) whose OSEDs were used as inputs for the technical projects: to highlight gaps, overlaps and inconsistencies among the different Technical Specifications produced by the technical projects:

Cycle 2015:

P04.07.02 – D20 - SPR\_2 [45]

P05.07.02 – D77 - Preliminary V2 OSED for Step 1 [45]

P05.06.01 – M196 – Step\_1 SPR - Iteration 3 [54]

P04.07.03 – D02 – Preliminary OSED-SPR and Interoperability report [55]

P04.05 – D823 - TMF INTEROP for Step 1 Initial Release [56]

- Analysis of the identified HMI gaps with respect to the functional requirements specified in each Technical Specifications document (listed in the first bullet);
- Proposal of a solution for HMI requirements gap-filling, to be provided to the relevant technical projects for review and integration into the following issue of their Technical Specifications, where applicable;
- Early coordination with the project in charge of CWP development and integration (P10.10.03) to share the final solution for HMI requirements in order to be aware in advance of any potential gap to be filled or inconsistency to be solved at implementation level.

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Any gap, overlap and inconsistency detected in the functional requirements were documented, along with recommendations to solve them, in order to trigger update of related documentation by interested projects. In addition, P10.10.02 did a tracing to ensure the technical projects took into account the recommendations proposed to complete HMI functionality (to reach the success of the validation exercise from the CWP point of view).

Taking into account the role of P10.10.02 within the OFA06.02.01 "CWP En-Route and TMA", the work done by P10.10.02 in the development of the HMI&HF guidance's (and the way to provide support) were fully considered at OFA06.02.01 level and integrated with P05.09 activities. In this sense, P05.09 acted as OFA06.02.01 coordinator where both operation and technical projects cooperated to ensure consistency and coherency of produced guidelines and recommendations. In particular, the process foresaw P05.09 input analysis for P10.10.02, P10.10.02 provided HMI baseline for P10.10.03 and shared teams worked together to ensure mutual feedback.

In terms of Master Plan, the project did not contribute to the implementation of any enabler, as defined in Dataset 14 [18] (maturity assessment is based on Release 5 Plan [12]), as P10.10.02 was a horizontal project giving support to the technical projects and the responsibility of the HM requirements belonged to these technical projects.

## 1.2 Project achievements

With the goal of validating some of the concepts described before, P10.10.02 worked:

- To provide a strong support to the technical projects to define all technical requirements related to HMI/HF in a Controller Working Position in En-Route and TMA environment. This allowed to define a clear and complete set of HMI/HF requirements agreed with all the technical projects and to avoid gaps and overlaps between the projects.
- This project produced a set of harmonized HMI/HF requirements and guidelines that any Industry in Europe could use as a reference for evolving their current CWP into a more Advance CWP (SESAR functionally).
- This set of HMI/HF requirements collected in a Technical Note was delivered by P10.10.02 to the project in charge of CWP development and integration (P10.10.03) with the aim of implementing an advance CWP and to be aware in advance of any potential gap to be filled or inconsistency to be solved at implementation level. This avoided to rework in the most cases.
- Although each SESAR project has validated within their projects part of HMI/HF requirements, none of them could analyse the complete impact for controllers as these new SESAR functionalities are dramatically changing the way that the controller interact and obtain information from its CWP. For that reason, P10.10.02 became into a transversal project.
- An important achievement was the evaluation of multi-touch technology integrated in the CWP with real ATCOs. The overall assessment of the investigation comparing multi-touch vs. mouse revealed a trend that further developing of controller working positions with multi-touch interaction philosophy is worth to follow up. Two proposals were evaluated. The technology was found to be quick and efficient. The results offered a valuable baseline for further developments.
- Other achievement related to the innovative technologies was the technical evaluation of attention guidance technology (eyetracking) and speech recognition. Some technical tests were executed, which can be taken as a starting point for future research and improvements.

In addition, a workshop to discuss future scenarios for the work of TMA/ACC controllers at a multimodal CWP was performed by September 2014 (conclusions can be found in ref. [8]).

Due to the closure of P10.10.02 there is no gap expected within the programme, since P10.10.02 provided support to write HMI requirements and guidelines after the R5 validations.

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## 1.3 Project Deliverables

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

Reference	Title	Description
D93	Innovation Analysis Report 2013 (ref. [15])	This document provides an analysis of innovative technologies or HMIs that could be used to improve the usability and performance of the interactions. The document addresses the following technologies: Multi-Touch screens, Eye tracking, Handwriting. These technologies has been analysed and experimented. Benefits, recommendations and guidelines are provided
D96	Innovation Analysis Report 2014 (ref. [8])	This document provides an analysis of innovative technologies or HMIs that could be used to improve the usability and performance of human-machine interactions at the CWP. The document addresses the following technologies: Motion Caption / Sense technology, mobility, NFC and eye tracking. These technologies have been analysed and experimented. Benefits, recommendations and guidelines are provided. Moreover, the discussion results of a project workshop on a concept for a potential multimodal future CWP are provided.
D97	HMI & HF Guideline Document 2015 (ref. [9])	This document summarizes the guidance material required to support P10.0y.0z in 2015 during the production of HMIs and in regards to questions related to HF aspects. To do this updating, the material produced by P10.10.02 during the Step 1 was reviewed, as well as the relevant material produced by P16.05.03 [19] and P05.09 [20] projects.
D98	Technical Note 2015 (ref. [10])	This Document provides the results of the P10.10.02 analysis of the WP10 System Requirements dealing with the Human Machine Interface (HMI) for both the En-Route and TMA environments in 2015. The analysis aims at identifying gaps, overlaps and inconsistencies among the WP10 system requirements and provides recommendations (rewording the requirements, adding new requirements or deleted some of them) and HMI solutions to solve the critical issues.
D02	Available Technology Screening Document (ref. [4])	This document contains a list of available / new technologies for monitors, touch displays and interaction modules. The technologies are described and specifications are listed. Their potential use within a future TMA/ACC ICWP were analyzed and technologies showing high potential were selected for a more thorough examination including feedback obtained from user tests.



D04	Human Factors Design Document for TMA-ACC – STEP 2 (ref. [5])	<p>This document provides the Human Factors requirements, which support the prototype development taking into account following aspects:</p> <p>Human Machine Interface Aspects</p> <p>Ergonomic Aspects</p> <p>Environmental Aspects</p> <p>Social Factors Aspects</p> <p>Safety Aspects</p>
D06	User Interface Design Document for TMA-ACC – STEP 2 (ref. [6])	<p>This document focuses on the definition of the Controller User Interface design for TMA/ACC environment, which defines where the data are presented and managed on the HMI, providing high-level user interface requirements for each defined HMI component which needs to be designed.</p>
D08	TMA-ACC specific Style Guide – STEP 2 (ref. [7])	<p>This document refines the Generic SESAR Information Presentation Guide coming from P16.05.03 [19] with the specifics of the TMA/En-Route environment. The intention of the guidance and requirements material created within this document supported the SESAR goal of a harmonized HMI. Within this document common features which are important to ensure the common HMI baseline and a standardized/harmonized layout and interactions are described. The limitation to only describe the most important features supported the SESAR goal by giving the industry partners still enough freedom to differentiate from each other and to achieve a company identity.</p>

## 1.4 Contribution to Standardisation

This Project has not made any contribution to Standardization due to its aforementioned Transversal Role and no direct participation on the concept validation activities.

## 1.5 Project Conclusion and Recommendations

The analysis of the HMI requirements showed several types of issues related to the process for getting inputs. P10.10.02 didn't analyze all OSEDs for HMI requirements (out of P10.10.02 scope), but relied on the identification of them in documents produced by other WP10 projects. Two different approaches were followed:

- Technical Specifications produced by WP10 primary projects. Some of them didn't consider HMI functionality as part of their scope.
- Technical Architecture Document produced by P10.01.07, which included the allocation of operational requirements from OSED/SPR/INTEROP documents to Functional Blocks.

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Nevertheless, this allocation activity started late, and was done only when other WP10 projects needed to deliver a prototype for supporting an exercise.

It must be noted that, when P10.10.02 was not informed about CHMI functionality through an external Technical Specification or Technical Architecture Document, the functionality was not covered by P10.10.02 analysis, and a gap could exist (P10.10.02 is not aware of any example). It is clear that a single and systematic approach for CHMI requirements, shared, known and applied by all projects, would have been beneficial to guarantee full coverage of all CHMI aspects.

At OFA06.02.01 level, the project P05.09 worked in close coordination with P10.10.02 by providing input for the technical analysis and with P10.10.03, providing the HMI baseline to be developed and integrated into CWP. Shared teams worked together to ensure mutual feedback. This approach in addition to the cyclical process is recommended in order to take advantage of operational and technical knowledge where the operational aspects and technical feasibility constraints drive the improvement process of ATM system. In addition, P05.09 and P10.10.02 projects have taken into account documents produced in the WP16.

Regarding the new technologies assessed, the most important conclusions defined were:

- Controllers are nowadays already complaining about the differences when installed at their CWP, so ergonomic aspects as intuitiveness are rather important.
- Voice communication can be always used as fall back technology, when either MT, ASR or ET fails.
- The mobility during work may be increased by using smartphones and tablets. This may have positive effects on the body posture as well as enabling flexible, almost location-independent working environments.
- Set a focus to controller training and better tools, the handling has to meet the complexity level, non-complex interactions for non-complex tasks.
- Design automation systems and HMI together so that it helps controllers

In order to improve and increase the efficiency of using the CWP HMI in the future, it's recommended, taking as starting point the analysis of the innovative technologies done in P10.10.02, to investigate new HMI needs and user interaction modes. SESAR 2020 can be a good opportunity to carry out these improvements by exploiting the latest mature technologies.

## 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] P10.10.02 – D02 - Available Technology Screening Document, Edition 00.01.00, 21/02/2011
- [5] P10.10.02 – D04 - Human Factors Design Document TMA/En-Route, Edition 00.01.00, 10/01/2013
- [6] P10.10.02 – D06 - User Interface Design Document for TMA-ACC – STEP 2, Edition 00.02.00, 19/12/2012
- [7] P10.10.02 – D08 - TMA/En-route specific style guide, Edition 00.01.01, 15/01/2013
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- [11] Final Project Report Template, Edition 03.00.04, 27/01/2016
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- [16] P10.10.02 – D94 – HMI & HF Guideline Document 2014, Edition 00.01.01, 28/01/2015
- [17] P10.10.02 – D95 - Technical Note 2014, Edition 00.01.02, 16/01/2015
- [18] Integrated Roadmap, Dataset DS14
- [19] P16.05.03 – D05 - Generic SESAR Information Presentation Guide, Edition 00.01.00, 04/11/2012
- [20] P05.09 – M197 - 2015 Technical Note, Edition 00.00.03, 03/06/2015
- [21] P10.10.02 – D01 - User Interface Design Process, Edition 00.01.00, 14/10/2010
- [22] P10.10.02 – D03 - HF Baseline Requirements Document, Edition 00.01.00, 13/12/2010
- [23] P10.02.01 - D14-001 - ATC TM System Requirements Step 2 v2
- [24] P10.03.02 - D33 - System Requirements Phase 2 Consolidation
- [25] P10.04.01 - D06 - Conflict Detection and Resolution requirements definition - Step 1
- [26] P10.04.02 - D06 - Conformance Monitoring System Requirements Phase 1
- [27] P10.04.03 - D20 - Preliminary Definition Report for Phase 2 (Enhance Safety Nets)
- [28] P10.04.03 - D39 - Preliminary Technical Specifications for Phase 2 (Enhance Safety Nets and RADP)
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- [47] P10.04.03 - D20 - Conformance monitoring system requirements phase 2
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- [49] P10.09.01 – D09 – Phase 2 - System requirement development - Step 2
- [50] P10.09.02 - D55 - Step 1 Technical Specification, Edition 00.04.00 30/09/2015
- [51] P07.05.04 – D49 Technical specification Step 1-V3, Edition 1.0, 31/07/2015
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