Contextual note – SESAR Solution description form for deployment planning

Purpose:

This contextual note (CN) introduces the SESAR PJ-16-04-01 Solution which focusses on Multi-Touch Inputs (MTI) for the Human Machine Interface (HMI) of the Controller Working Position (CWP). The solution will develop guidance and assessment methods regarding HMI, investigated new HMI needs and interaction modes in relation with SESAR solutions (including new user interface technologies such as speech recognition, multi-touch, and gaze detection). The project focused on MTI technologies and MTI interaction mode that is now regarded as sufficiently mature also in the ATC (Air Traffic Control) environment.

This document provides to any interested reader (external and internal to the SESAR programme) an introduction to this SESAR Solution in terms of scope, main operational and performance benefits, relevant system impacts as well as additional activities to be conducted during the industrialization phase. This contextual note complements the technical data pack comprising the SESAR deliverables required for further industrialization.

Improvements in Air Traffic Management (ATM)

Despite different concepts of operations across Europe, all Air Traffic Controllers must at some point input data into their systems to maintain an up to date picture of the air traffic situation. In many cases this could be as simple as entering the last cleared flight level or speed orders given to an aircraft. It could be giving a 'direct to' order in response to an aircraft's request to re-route slightly.

But increasingly, Radar technologies are built with more complex and sophisticated tools to help support decision making and allow for controllers to move more traffic at reduced separations. The data input mechanisms for these tools – whether they are electronic co-ordinations with other sectors or probing and decision support tools can be cumbersome using traditional input methods like mouse clicks or keyboard strokes.

The rise of multi-touch technology such as tablets or smart phones has heralded a new form of data input technologies which are now becoming second nature to, and in some cases preferred to traditional input methods. This technology has been demonstrated to provide much faster input methods including methods such as 'one-touch' cleared flight levels or graphical routing via touch opportunities. The technology also allows for the exploitation of even more complex and useful tools such as map manipulation directly via touch inspired by mobile mapping apps and gestures recognition for tactical inputs in order to enhance usability and controller productivity.

Touch technology already exists in some forms across a few domains in ATC, however multi-touch will be able to be deployed into all domains, expanding the capabilities of particularly the Approach and En-Route environments.

Operational Improvement Steps (OIs) & Enablers

PJ.16-04 solution Controller Working Position (with the MTI activity) is an enabling solution in the SESAR 2020 framework. It has the OI-step POI-0003-SDM "Improving controller productivity by introducing new methods of controller interaction." MTI activity defined the Enabler ER APP ATC 181 "Controller productivity enhancements by Multi-Touch Input at the ER/APP CWP/HMI" in EATMA (DS19).

The new functional block "Multi Touch Input" consists of "Touch Input" as described in EATMA according to the NSV-4 view of dataset 19 and the TRL4 TS/IRS.

Background and validation process

In SESAR 1, project 10.10.02 (CWP Human Factors Design) ran an extensive analysis of new technology to support and release the air traffic controller. The results were published in a series of deliverables "Available Technology Screening Document" (D02), "Innovation Analysis Report 2013" (D93) and "Innovation Analysis Report 2014" (D96). The former two innovation analyses investigated the potential of multi-touch technology, while the latter included multi-touch technology in the scope of the discussion on potential multi-modal interaction concepts. Taken together, the results of these analyses can be used as starting point for the analysis of the multi-touch technology in project PJ.16.

In addition, the SESAR project 10.10.02 concluded that "multi-touch devices, both in the form of standard displays with multi-touch functionality, and handheld or tablet devices, such as the Apple iPad or other tablets, are technically mature enough to be used in the ATC/ATM environment". The activity encompasses almost the whole chain of aircraft flight phases comprising Approach and En-Route environments with respective Controller Working Positions (CWP). The CWP is augmented with a multi-touch device.

Three exercises and one technical demonstration, with air traffic controller involvement, were conducted to shed light on different aspects of multi-touch inputs in Air Traffic Control (ATC) connected to SESAR ATM Master plan's flight and control phases.

Results and performance achievements

Multi-Touch Inputs (MTI) is one of several technologies of SESAR2020 PJ.16-04. Some previous works were done in the 10.10.2 project of SESAR 1. PJ.16-04-01 is the successor of those works.

During this TRL4 phase, the effort invested by all contributors has been mainly focused on:

- the development of MTI prototypes for TRL4 validations and one demonstration,
- the execution of TRL4 exercises and one demonstration,
- the analysis of validation results and its documentation, and

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- the production of data pack 2.

Regarding the objectives from the Project Management Plan, especially objectives 1 and 2 (listed in the following) were achieved:

- Objective 1 - To deliver a set of workstation solutions following a user centred approach, to demonstrate an improvement to productivity (based on measurement of human performance).
- Objective 2 - Early definition and evaluation of the Controller Productivity Solutions with the Operational Users in an operationally representative environment ensures the project delivers solutions taking into consideration human limitations and beliefs.
- Objective 4 - To provide a process for requirements derivation for Controllers HMI and CWP software based lessons learnt and industry best practice both internal and external to ATM.

Recommendations and Additional activities

As the validation results are positive and consistent across the exercises, it is considered that no further research is needed. In addition, no technical blocking point has been identified which could jeopardize the industrialisation of the MTI. So there is a possibility to proceed with an industrialisation of the MTI.

A CR is currently drafted (CR 03781 Create Solution for Multi-Touch Inputs).

However, some aspects need to be scrutinized when achieving the industrialization:

- The solution needs to be assessed with a wider number of ATCos.

- The training should be carefully considered, and time should be given for the end-users to adapt their way of working to the MTI.

- Close the gap on safety elements. Safety has not been evaluated in abnormal conditions. SARs are based on expert judgement only.

- The reported effect of technology costs reduction in PAGAR (Table 23) needs to be updated. Introduction of ASR systems as an additional sensor will increase the technology costs of a CWP, but it is expected that ATCo's costs are reduced, because ATCo's productivity is expected to increase.

Recommendation with respect to program view

- Integration of different activities of PJ.16-04 (MTI, ASR, AG and UPMS) into one exercise;

Actors impacted by the SESAR Solution

- TMA and ACC ATC units with their air traffic (planning and executive) controllers (due to some new HMI elements)
- ANSPs (due to CWP system changes)
- ATM system providers (due to implementing new functionalities)

Impact on Aircraft System

SESAR PJ.16-04-01 Solution focusses on the improvement of the Controller Working Position (CWP) by the implementation of the multi-touch technology, so no impact on Aircraft System is foreseen.

Impact on Ground Systems

The Data Pack for MTI related to TRL4 include a Technical Specification document. However, according to the TS-IRS included in this Data Pack, the MTI System offers a new functionality, therefore the following Functional Block has been created:

- **Multi Touch Input**: The Multi-Touch Input device functional block uses a touch input device (a trackpad or touch screen) as a new interaction means with the Air Situation Display of the CWP (e.g. replace the keyboard with a virtual keyboard, new HMI concept with touch events and gesture...). By using this Functional block, data inputs into the system by the controller shall be faster, more efficient and without increasing the failure rate

Regulatory Framework Considerations

The use of MTI supports/influences the Safety Management System of each ANSP. Therefore, the EASA AMC needs to be considered.

Standardization Framework Considerations

No ideas for standardisation have been sketched.

Considerations of Regulatory Oversight and Certification Activities

As MTI represents a technological enabler and as a supplement or replacement to existing controller input devices (like keyboard, mouse or trackball) there is no need to adapt procedures as such.

Operations in general will remain the same.

On the TS IRS Operational, Safety, performance and interoperability requirements are addressed.

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Solution Data pack

The Data pack for this solution includes the following documents *(all of them received the version number 02.00.00 for conformity reasons being based on the latest final version)*:

- PJ.16-04-01 TRL4 AN MTI, Edition 02.00.00 ("SJU approved")
- PJ.16-04-01 TRL4 TS/IRS MTI, Edition 02.00.00 (30.09.2019)
- PJ.16-04-01 TRL4 TVALR MTI, Edition 02.00.00 (30.09.2019)
  with PJ.16-04-01 TRL4 TVALR MTI, Appendix E Safety Assessment Report, Edition 02.00.00 (11.07.2019, v01.00.00 "SJU approved")

Intellectual Property Rights (foreground)

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