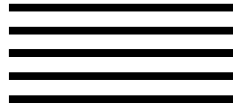


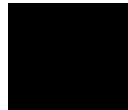
PROGRAMME FOR
HARMONISED AIR TRAFFIC
MANAGEMENT RESEARCH
IN EUROCONTROL



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EUROPEAN ORGANISATION FOR THE SAFETY OF AIR NAVIGATION, EUROCONTROL



PD/3 AHMI User Requirements Document

Final version 2.2



EUROCONTROL

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PHARE PD/3 PROJECT**PD/3 AHMI User Requirements Document**

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1. Scope of the document

This document defines the minimum User Requirements for the Airborne Human Machine Interface (AHMI) to be used in the Eurocontrol PD/3 Demonstration programme. The user will be the pilot operating the Experimental Flight Management System (EFMS), negotiating 4D clearances with ATC and monitoring the aircraft's progress relative to the clearance. The User Requirements will form the basis of the AHMI design, which will be specified in a separate document.

The AHMI project is part of the Eurocontrol PHARE (Programme for Harmonised ATM Research in Eurocontrol) programme, and is being carried out by the following PHARE partners:

DLR Braunschweig, Germany

DRA Bedford, UK

EEC Brétigny, France

NLR Amsterdam, Netherlands

2. INTRODUCTION

The PHARE programme is investigating a highly integrated airborne-ground ATM environment in which aircraft and ATC closely cooperate with each other using Data Link. In order to operate safely and economically within this 4D ATM system, the pilot needs an optimised Human Machine Interface for carrying out the necessary pilot tasks which include:

- 4D flight planning
- 4D flight negotiation
- 4D flight progress monitoring and alerting
- EFMS system control

The AHMI components will include a CDU (LCD flat-panel with touchscreen overlay) for EFMS control, and an EFIS Navigation Display (ND) using a cursor control device (rollerball or touchpad) to carry out route editing, display control and negotiation of 4D clearances. The following sections of this document specify the User Requirements for these cockpit devices.

3. GENERAL AHMI REQUIREMENTS

3.1 General requirements and basic assumptions

- 3.1.1 The Airborne Human Machine Interface (AHMI) needs to be designed with respect to the tasks a pilot has to perform in order to operate safely and effectively within the PHARE 4D ATM environment. Moreover, the AHMI must support all functionality required for the PD/3 aircraft flight operations and comply with the PD/3 Operational Scenarios.
- 3.1.2 The AHMI needs to be designed for the pre-departure as well as all phases of flight.
- 3.1.3 More specifically, the AHMI must provide support during the following pilot tasks:
- flight planning
 - flight negotiation
 - flight progress monitoring and alerting
 - EFMS system control
- 3.1.4 The AHMI shall be designed for real aircraft and for flight simulators.
- 3.1.5 The AHMI shall be based upon the Experimental Flight Management System (EFMS) functionality.
- 3.1.6 The AHMI design shall keep the pilot in the loop during ground and flight operations within the 4D ATM environment.
- 3.1.7 The AHMI shall include a Navigation Display (ND) and an EFMS Control and Display Unit (CDU).
- 3.1.8 The Navigation Display shall be an interactive display using a cursor, and the CDU display shall be an interactive display using a touch screen.
- 3.1.9 The AHMI shall be designed for one-man operation.
- 3.1.10 Although the AHMI implementation may differ for each participating site, the main functionality of the AHMI shall be the same for each site.
- 3.1.11 The Navigation Display shall be used primarily for functionality which requires graphical presentation and/or selection of information.

- 3.1.12 The CDU shall be used primarily for functionality which requires alphanumerical input.
- 3.1.13 The Navigation Display HMI and CDU Display HMI shall be functionally integrated.
- 3.1.14 The AHMI shall provide the pilot alerting/warning information.
- 3.1.15 The AHMI shall keep track of the position of the aircraft along the active 4D trajectory.
- 3.1.16 The CDU and ND display shall be linked to show similar information when in editing mode.

3.2 Functional requirements of the Navigation Display

3.2.1 The Navigation Display shall provide two modes of operation

- The MONITORING mode shall present a moving map around the fixed aircraft symbol. A compass arc at the top of the display shall indicate aircraft heading or track angle.
- The PLANNING mode shall present a map with a fixed north-up orientation, and shall allow the centre of the map to be controlled by the pilot.

3.2.2 The Navigation Display shall provide two modes of view

- The LATERAL mode presenting the lateral situation in a latitude/longitude frame.
- The VERTICAL mode presenting the vertical situation in an altitude/along track distance frame.

3.2.3 The Navigation Display shall provide the following Display Control functions:

- range selection
- mode selection
- view selection
- centre of map selection in PLANNING mode
- option selection for display of specific information

Note that, the display control functionality shall be implemented using either hardware buttons or using simulated buttons on the screen.

3.2.4 The Navigation Display shall provide the pilot with at least the following functions:

- Construction of a pilot constraint list
- Initiation of a 4D trajectory prediction.
- Support of the formalised clearance dialogue, and the strategic 4D negotiation dialogue.

- Activation of a negotiated tube.
- Activation of a proposed trajectory.

3.2.5 The Navigation display shall provide the following functionality:

- Insertion of a new or existing waypoint in the pilot constraint list
- Removal of one or more pilot constraint point(s)
- Modification of pilot constraint altitude attribute(s)
- Modification of pilot constraint time attribute(s)
- Planning of a diversion route
- Modification of the departure/arrival airport

During modification the pilot shall be able to cancel the current editing action.

3.2.6 The following functionality shall be provided on the Navigation Display:

- Go-direct from a/c position
 - ◇ to pilot constraint point
 - ◇ to waypoint not a member of pilot constraint list
 - ◇ to new cursor-defined point

3.2.7 The following information shall be provided on the Navigation Display:

- Navigation data base information (navaids, waypoints, airports)
- Pilot, proposed, active and ground (= ATC) constraint lists
- Proposed and active trajectories
- Proposed and active tubes
- Indication of path stretch points
- Indication of holding pattern point.
- 4D aircraft position

- Cursor position
- Magnetic/true heading
- Wind direction and wind speed
- Status of negotiation process

3.3 Functional requirements of the CDU display

3.3.1 In general, the CDU shall provide the pilot EFMS system control functions, trajectory planning functions and monitoring functions. Furthermore, the CDU shall inform the pilot about datalink related events.

3.3.2 The CDU display design will be pilot task oriented.

3.3.3 The CDU shall enable the pilot to carry out the following:

- Construction and modification of a constraint list and associated constraint attributes.
- Generation and negotiation of a trajectory.
- Initialisation of fuel and weight parameters.
- Initialisation of departure/arrival airport related information.
- Initialisation of EFMS position and EFMS time parameters.
- Modification of EFMS aircraft performance parameters.
- Modification of altitude and time constraints.
- Go-direct function.
- Access to a navigation database containing definitions of waypoints, navaids, route sectors (of types SID, STAR and EnRoute) and company routes
- Selection of company routes.

3.2.4 The CDU display shall support both the formalised clearance dialogue, and the strategic 4D negotiation dialogue functionality.

3.2.5 The CDU shall provide the following information to the pilot for flight monitoring and alerting purposes:

- Negotiation process status
- Datalink messages
- General trajectory information, such as:
 - ◇ takeoff time and arrival time

- ◇ takeoff weight and arrival weight
- ◇ cruise flight level
- Flight progress information, such as:
 - ◇ next waypoint identifier
 - ◇ distance to go
 - ◇ time to go
 - ◇ target altitude
 - ◇ target CAS
 - ◇ 4D aircraft position
 - ◇ 4D position error
 - ◇ fuel flow
 - ◇ wind direction and wind speed

4. References

- [1] EFMS PHASE 1b, User Requirements Document,
Part 2: Description of Initial CDU Page Layouts, DOC 94-70-25
- [2] AHMI Display Format Prototypes and Initial Evaluation Results, DOC 95-70-08
- [3] EFMS Phase 1B, Technical Reference Document, DOC 96-70-15
- [4] EFMS Phase 2, User Requirements Document,
EFMS and EFMS/AHMI Interface, DOC 96-70-19
- [5] PD/3 Operational Scenarios Document (Volume I) , DOC 97-70-04
- [6] PD/3 Operational Scenarios Document (Volume II), DOC 97-70-08

5. PHARE Glossary of terms

AHMI	Airborne Human Machine Interface project
ATC	Air Traffic Control
ATM	Air Traffic Management
CAA	Civil Aviation Authority
CAS	Calibrated Air Speed
CDU	Control and Display Unit
CENA	Centre d'Etudes de la Navigation Aérienne
CMS	Common Modular Simulator
CNS	Communication, Navigation and Surveillance
DLR	Deutsche Forschungsanstalt für Luft- und Raumfahrt Institut für Flugführung (Germany)
DRA	Defence Research Agency
EATCHIP	European ATC Harmonisation and Integration Programme
EATMS	European ATM System
EEC	Eurocontrol Experimental Centre
EFIS	Electronic Flight Instrument System
EFMS	Experimental Flight Management System
EHQ	Eurocontrol HeadQuarters
FMS	Flight Management System
GHMI	Ground Human Machine Interface project
HMI	Human Machine Interface
NLR	Nationaal Lucht - en Ruimtevaartlaboratorium (Netherlands)
ORG	Operational ORGanisation used as demonstration scenario
PATN	PHARE Aeronautical Telecommunication Network
PCC	PHARE Coordination Committee
PD/1	PHARE Demonstration 1
PD/2	PHARE Demonstration 2
PD/3	PHARE Demonstration 3
PHARE	Programme for Harmonised Air Traffic Management Research in Eurocontrol
PMB	PHARE Management Board
TMA	Terminal Manoeuvring Area