PRIORITY 4 - AERONAUTICS AND SPACE

ERASMUS

EXPERIMENTAL PLAN

ENVIRONEMENT BASELINE 2007 (FINALE EXPE-4)

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Contents

Executive summary

(1) The Experimental Plan defines the operational scenarios and methods to investigate the identified research questions. It represents the plan to conduct investigations in order to validate the hypothesis, to provide strong arguments and performance assessment, using a range of experimental techniques (modelling, simulation, clinical…).

(2) It describes:

- the objectives of the experiments,
- the operational context in term of airspace, traffic and scenarios,
- the technical context in term of platform and environment,
- the experimental design in term of experimental variables, simulation exercises plan, actors involved and roles, training…,
- the measurements specification in terms of methods and measurement instruments,
- the planning of the experiments.

(3) This Experimental Plan addresses the validation of the ERASMUS concept as described in the Concept of Operations version 2 according to the Baseline Scenario (2007). This experimental plan will be focused on the Air/Ground interactions and interferences from the pilot and cockpit side.

(4) The baseline scenario configuration will be an Executive Controller in a Controller Working Position current environment, and one pilot and a co-pilot in a cockpit simulator. There will be four different traffic samples representing the 2007 reference + 20% traffic increase taking place in the Aix-en-Provence sector (W). There will be 6 days duration simulation and 24 measured exercises.

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1 INTRODUCTION

(5) This ERASMUS EXPERIMENTAL PLAN (Expe-4) document is a dedicated for both ERASMUS Management and all other project stakeholders. It defines the experimental plan to conduct simulations activities in order to achieve assessment results regarding the performance of the SESAR concept and to develop arguments for the stakeholders and decision-makers.

(6) The Experimental Plan will be used to define and support the experiments to be conducted in the WP4.3.

(7) This document represents the ERASMUS project delivery **D 4.2.1** part of the WP4.2 as defined in [2].

1.1 Document Structure

(8) This document is structured in 6 main chapters:

- Chapter 1 introduces the document.
- Chapter 2 provides a general introduction into the ERASMUS context of the experiment
- Chapter 3 presents the simulation objectives
- Chapter 4 describes the experimental plan
- Chapter 5 describes the LOA in annex A
- Chapter 6 presents the traffic sample in annex B

1.2 Document evolution & approval

(9) The production and review cycles as defined in [4] are applied to produce this document.

1.3 Reference materials

(10) The documents referenced in this document include:

[1] The EC ERASMUS contract TREN/06/FP6AE/S07.58518/518276;

[2] The ERASMUS Description Of Work (Released version – ERASMUS annex 1 – DOW – V1.0 ed 10 03 2006.doc);

[3] The ERASMUS Consortium Agreement (Released version - ERASMUS - consortium agreement 1.2.doc);

[4] ERASMUS Project Management Plan.

[5] ERASMUS Concept of Operation – D2.2.1 (ERASMUS - WP22 - CONCEPT-OF-OPERATIONS - V1.4, 2007)

[6] ERASMUS Validation Plan – D4.1 (ERASMUS-WP4.1-VALIDATION-PLAN-V2.0, May 2007)

[7] ERASMUS Results analysis – Experiments II (ERASMUS-WP4 - D4.5.1, 2007)

[8] SESAR Definition Phase, Deliverable 1 (2006), *Air Transport Framework, The Current Situation*, DLM-0602-001-03-00, SESAR Consortium, Toulouse.

[9] SESAR Definition Phase, Task 2.1.2/D2 (2006), *Inventory of Existing Achievements and Ongoing Initiatives*, DLT-0607-212-ExecSum-00-04, SESAR Consortium, Toulouse.

[10] SESAR Airspace Users (2006), *Airspace User Operations, Vision Statements Document ATM 2020+,* AUO-VSD 1.0 (Mil Part 0.1), Version 1, Draft, SESAR Airspace Users Basic Consortium, Toulouse.

[11] SESAR Definition Phase, Task 2.2.2/D3 (November 2006), *SESAR Concept of Operations*, DLT0612-222-00-08, (Working draft), SESAR Consortium, Toulouse.

[12] SESAR Definition Phase (2006), Task 2.1.2 deliverable for SESAR D2 (17 November 2006), *Strategic Objectives Definition*, DLT-0607-212-01-02, SESAR Consortium, Toulouse.

[13] ERAMUS web site, www.atm-eramus.com

[14] SESAR Definition Phase (2006), Task 2.1.2 deliverable for SESAR D2 (17 November 2006), *Strategic Objectives Definition*, DLT-0607-212-01-02, SESAR Consortium, Toulouse.

[15] E-OCVM (2005), "European" Operational Concept Validation Methodology, E-OCVM, EC/EUROCONTROL, Joint programme Board, EUROCONTROL, Brussels/Brétigny.

1.4 Abbreviations and acronyms

ACC	Area Control Centre
ADS-B	Automatic Dependant Surveillance – Broadcast
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATCO	Air Traffic Controllers
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Ait Traffic Management
CD	Conflict Detection
CDTI	Cockpit Display of Traffic Information
COTRAC	Common Trajectory Coordination
CPDLC	Controller-Pilot Data Link Communication
CR	Conflict Resolution
CTO	Control Time Over
CWP	Control Working Position
DCL	Departure Clearance Service
DCS	Dowstream Clerance Service
DTI	Direction de la Technique et de l'Innovation
ERASMUS	En-Route Air Traffic Soft Management Ultimate System
ERATO	En Route Air Traffic Organiser
ETA	Estimated Times of Arrival
ETO	Estimated Times Over Point
FMS	Flight Management System
HF	Human Factors
HMI	Human Machine Interface
KPA	Key Performance Area
LOA	Letter of Agreement
NM	Nautical Miles
PC	Planner Controller
RTA	Required Time of Arrival
SAM	Simulateur Avion Modulaire: cockpit simulator
SESAR	Single European Sky Applied Research
TC	Tactical Controller

TP	Trajectory Prediction
TPS	Trajectory Prediction System (Ground)
TTA	Target Time of Arrival

Table 1: Acronyms and abbreviations

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2 CONTEXT TO THE EXPERIMENTS

2.1 Background

(11) The European Commission has funded ERASMUS, a 30 months project to look at ways to effectively integrate advanced automation concepts consistent with the SESAR framework []. This paper outlines an innovative concept of operations mixing human factors approach, automation technologies and their relationship to overall system performance.

(12) Within the SESAR ATM Target Concept that proposes a service-oriented approach based on a performance partnership amongst stakeholders, each single flight shall be performed according to the owner's request. This is the main driving principle for the ATM Target Concept, which is centred on the reality of the "business trajectory" representing the airspace users' intention with respect to a given flight. Business trajectories will be expressed in all 4 Dimensions (position and time) and flown with much higher precision than today, reducing uncertainty and allowing an increased reliance of airborne and ground-based automation. This will open innovative ways to envisage new separation modes to allow for increased capacity. SESAR has identified new separation modes as TC-SA (Trajectory Control by Speed Adjustment) that will use trajectory control and airborne separation systems to minimize potential conflicts and hence reduce controllers' interventions and workload.

(13) The ERASMUS Strategic De-Conflicting function aims at adjusting the 4D Business Trajectory in order to optimise the separation management with the provision of conflict free trajectory on short segment of 15 minutes, reducing controller's workload associated with routine monitoring and conflict detection as well as reducing the interventions of ATC in changing flight profiles to resolve potential conflicts. To adjust the 4D Business Trajectory, ERASMUS project investigates:

- A high-precision Trajectory Prediction performed by the FMS TP capabilities.
- A Trajectory Modification performing through minor speed adjustments (subliminal action) not directly perceivable by controllers and will not interfere with their own action and responsibility. ERASMUS estimates that the residual number of conflicts to be considered by controllers could therefore be significantly reduced (up to 80%). This subliminal control must be initiated in the sectors upstream (15 min ahead), in way to allow a sufficient adjustment of separations before the integration of the flights in the sector (-5% speed change during 15 minutes applied to pair of aircraft will increase their separation by 7 Nm). These operations are performed with 4D trajectory management and CTA/CTO guidance that could be sent by any elementary data-link.

(14) The ERASMUS project objective aims at designing, developing and assessing the ERASMUS Server corresponding to the strategic de-conflicting function and the Controller Working Position Toolkits corresponding to the separation provision function.

(15) The validation process will be based on an E-OCVM validation methodology. It will investigate two operational scenarios, a baseline scenario and a 2020 SESAR scenario corresponding to an IP2 SESAR deployment sequence.

2.2 Validation Plan Synthesis

(16) The Validation Plan, following the E-OCVM methodology, proposed a stepped based approach to validate the ERASMUS concept. Two operational scenarios will be explored:

- The **Baseline scenario** corresponding to the 2007 scenario (**reference scenario**);
- The **2020 scenario** corresponding to the IP2 SESAR scenario.

(17) While the technical component of the Baseline scenario will be investigated using fast-time simulations and mathematical modelling (WP1 activity), the human/machine articulation will be investigated with Human In The Loop (HITL) experimentations.

(18) The present Experimental Plan concerns the Baseline scenario addressing the human/machine articulation in term of consistency, robustness and performance.

(19) The following hypotheses, questions and indicators are extracted from the Validation Plan.

Note: Unlike other ERASMUS simulations, Experiment 5 is planned to be a demonstration and not an experiment. Experiment 5 is a proof of concept that aims at demonstrating the feasibility of the concept in a futuristic scenario. There will be research questions, but they will not be addressed in an experimental context (e.g. the data collected will not be statistically analysed).

Solutions to complexity problem	Hypotheses	Research Questions	Indicators
Act on traffic complexity delivered to controller (i.e. change traffic distribution)	Situations of "doubt" and "no doubt" do exist for the controller.	**R1** Are there doubt situations?	Risk perception, safety feeling, and difficulty feeling.
	Reducing controller uncertainty will conserve mental resources.	**R2** Does the reduction of doubt situations release the attention processes?	Compare number of aircraft considered with number of aircraft not considered whereas they should be (safety).
Improve traffic prediction information	Reducing controller uncertainty will conserve mental resources.	**R3** Does the reduction of doubt situations release the attention processes?	Risk perception, safety feeling, and difficulty feeling.
	Reducing number of conflicts will conserve mental resources.	**R4** Does the reduction of conflict release the attention processes?	Compare number of aircraft considered with number of aircraft not considered whereas they should be (safety).

Solutions to H–M interaction problem	Hypotheses	Research Questions	Indicators
Provide an autonomous system	ATCO will not be disturbed by the minor a/c speed variations computed by technical system	**R5** Is ATCO disturbed by modification of a/c trajectories?	Statement of dissatisfaction / frustration Excessive confidence or non confidence
		R6 Do modifications generate added communications between ATCO & pilot?	Nb of ATCO – Pilot communications
		R7 Do modifications create different understanding from ATCO & pilot?	Content of ATCO – Pilot communications
		R8 Are there interferences between TS strategy & operators' strategy?	Nb of technical system actions interrupted
Provide an efficient interactive system	A dedicated HMI can provide info to reduce doubt without disturbing ATCO task performance or	**R9** Does the HMI provide an efficient environment for the operators?	(Expe 5 To Be Defined)

	cognitive activities		
Assess impact on on-board side	ERASMUS integration into the cockpit is acceptable and will not overload the pilot	**R10** Is it acceptable for pilot to receive an order coming from a machine instead of an ATCO?	Rate of technical system actions carrying out by the pilot
		R11 Does the integration of ERASMUS in the cockpit overload the pilot? And are pilots disturbed by ERAMUS generated modifications?	Verbalisation (workload)
Address responsibility issue and Role change	ERASMUS needs to be certified to be acceptable to the operators	**R12** How to address the responsibility transfer and role change issues?	Paper Study

(20) The ERASMUS concept is built on a series of hypotheses that required to be validated step by step before jumping into a complete Air/Ground Human - Machine experiment. In consequence, a set of 4 Human In The Loop experiments have been carried out (expe-1, expe-2, expe-3, expe-X) in order to prepare the final Baseline scenario HITL experiment (expe-4). It is summarised in the following table:

Solutions to complexity problem	Hypotheses	Research Questions	Experiments
Act on traffic complexity delivered to controller (i.e. change traffic distribution)	Situations of "doubt" and "no doubt" do exist for the controller.	**R1** Are there doubt situations?	Expe2
	Reducing controller uncertainty will conserve mental resources.	**R2** Does the reduction of doubt situations release the attention processes?	Expe3 ExpeX
Improve traffic prediction information	Reducing controller uncertainty will conserve mental resources.	**R3** Does the reduction of doubt situations release the attention processes?	Expe5
	Reducing number of conflicts will conserve mental resources.	**R4** Does the reduction of conflict release the attention processes?	Expe5

Solutions to H–M interaction problem	Hypotheses	Research Questions	Indicators
Provide an autonomous system	ATCO will not be disturbed by the minor a/c speed variations computed by technical system	**R5** Is ATCO disturbed by modification of a/c trajectories?	Expe1 Expe3 ExpeX
		R6 Do modifications generate added communications between ATCO & pilot?	Expe5
		R7 Do modifications create different understanding from ATCO & pilot?	Expe5

		R8 Are there interferences between technical system's strategy & pilots' strategy?	Expe3 ExpeX Expe4
Provide an efficient interactive system	A dedicated HMI can provide info to reduce doubt without disturbing ATCO task performance or cognitive activities	**R9** Is the HMI provide an efficient environment for the operators?	Expe5
Assess impact on on-board side	ERASMUS integration into the cockpit is acceptable and will not adversely affect the pilot's performance.	**R10** Is it acceptable for pilot to receive an order coming from a machine instead of an ATCO? And does the integration of ERASMUS into the cockpit adversely affect the pilot's performance?	Expe4* Expe5
		R11 Does the integration of ERASMUS in the cockpit disturb the pilot?	Expe4 Expe5
Address responsibility issue and Role change	ERASMUS needs to be certified to be acceptable to the operators	**R12** How to address the responsibility transfer and role change issues?	Paper Study

(21) The research questions addressed by Experiment 4 are thus as follows:

- R8 - Are there interferences between technical system's strategy & pilots' strategy?
- R10 - Is it acceptable for the pilot to receive an order coming from a machine instead of a controller?
- R11 - Does the integration of ERASMUS in the cockpit overload the pilot? Are the pilots disturbed by ERAMUS generated modifications?

IMPORTANT: The Experimental Plan (called expe1, expe2, expe3, and expeX) are put in Annex for information. Theses documents are not contractual.

2.3 Related Experiments

(22) As described above, four previous experiments have been carried following this approach:

- The experiment 1 main objectives consisted in studying controller's perception of horizontal speed variation on managed aircraft.
- The experiment 2 purpose was to determine the effective action area of ERASMUS (i.e. "ideal" traffic configurations) and the relevant complexity criteria in the controller's perspective. It comprised two phases (cf. [7]):

* Transaction time under optimal conditions.

- The first phase (pre-survey) consisted in qualitatively defining the safety feeling, the difficulty feeling and workload feeling.
- The second phase (experiment) consisted in verifying whether the traffic distribution (according to the level of perceived conflicts) influenced the affective representation of the situation (in terms of safety, difficulty and workload feelings).

- The experiment 3 aimed at complementing the experiment 2 by using the relevant metrics assessed during the analysis. It was the first of the series to involve pilots, and thus enabling to evaluate the concept in a more realistic working environment.
- The experiment "X" took place between the experiment 3 and the experiment 4 (air –ground integration). It aimed at further assessing the effect of ERASMUS Server on the ground side (notably the effect on capacity) before investigating the concept in an integrated air – ground experimental environment.

2.3.1 ERASMUS experiments context

(23) The table below summarises the context of the ERASMUS previous and current experiments. It shows the research questions addressed through the validation exercises.

Environment	Research Questions	Indicators	Metrics
Experiment 1			
• Presentation to the controllers of a traffic replayed on radar image. • Wizard of Oz technique imitating ERASMUS actions.	• **R5** Is ATCO disturbed by modification of a/c trajectories?	• Statement of speed modification perception	• Information expressed by controllers about their feeling of speed modification and variation
Experiment 2			
• Presentation of traffic situation screenshots to the controllers with different traffic configurations. • No ERASMUS.	• **R1** Are there doubt situations?	• Risk perception • Safety feeling, Difficulty feeling, Workload feeling.	• Auto assessment of the feelings (feelings form) • Counting of a/c pairs belonging to different traffic configurations (conflict, doubt, no conflict) (Collective interview, Debriefing)
Experiment 3			
• RTS with 1 controller working position and 1 pseudo-pilot position • Comparison between ERASMUS On & Off. • Between-subjects design	• **R5** Is ATCO disturbed by modification of a/c trajectories? • **R1** Are there doubt situations? • **R8** Are there interferences between the technical system strategy & the operators' strategy? • **R2** Does the reduction of doubt situations release the attention processes?	• Statement of speed modification perception • Risk perception • Safety feeling, Difficulty feeling, Workload feeling. • Nb of technical system actions interrupted	• Workload (AIM ratings, NASA TLX, Feedback on workload issues) • Situational Awareness (SASHA ratings, Feedback on SA issues, SAGAT, debriefing) • Capacity (Nb of instructions, Duration of resolution loop with a/c)
Experiment X			
• RTS with 1 controller	• **R5** Is ATCO disturbed	• Statement of speed	• Workload (AIM

working position and 1 pseudo-pilot position. • Comparison between ERASMUS On & Off. • Within-subjects design	by modification of a/c trajectories? • **R1** Are there doubt situations? • **R8** Are there interferences between the technical system strategy & the operators' strategy? • **R2** Does the reduction of doubt situations release the attention processes?	modification perception • Risk perception • Safety feeling, Difficulty feeling, Workload feeling. • Nb of technical system actions interrupted	ratings, NASA TLX, Feedback on workload issues) • Situational Awareness (SASHA ratings, Feedback on SA issues, debriefing) • Capacity (Nb of instructions, Duration of resolution loop with a/c)
Experiment 4			
• RTS with pilots in a cockpit simulator and a controller working position.	• **R8** Are there interferences between the technical system strategy & the pilots' strategy? • **R10** Is it acceptable for pilot to receive an order coming from a machine instead of an ATCO? And does the integration of ERASMUS into the cockpit adversely affect the pilot's performance? • **R11** Does the integration of ERASMUS in the cockpit overload the pilot? Does the integration of ERASMUS in the cockpit disturb the pilot?	• Ratio between accepted and rejected messages • Feedback on magnitude of speed changes required by ERASMUS • Total Transaction Time • Message Frequency (rate) • Decision Time (measured from message access to CPDLC response) • Feedback on the conflicting traffic location • Perceived level of safety	• Acceptability/Comfort (Pre/post briefing discussion, On-line survey) • Response Time (Analysis, Literature Survey) • Situational Awareness (Post briefing questionnaire) • Safety / Security issues (Post briefing questionnaire)

(24) The table below summarises the context of the ERASMUS previous and current experiments concerning the actors involved (controllers, pilots, pseudo pilots), the location and the dates.

Controllers/Pilots	Location	Dates
Experiment 1		
Controllers Pseudo-Pilots	Aix en Provence ACC	Novembre 2006
Experiment 2		
Controllers Pseudo-Pilots	Aix en Provence Toulouse	January 2007 April 2007
Experiment 3		
Controllers Pseudo-Pilots	Aix en Provence	May 2007
Experiment X		
Controllers	Toulouse	February-March 2008

Pseudo-Pilots		
Experiment 4		
Pilots Feed controllers	Toulouse	June 2008

2.3.2 Previous experiments validation results

2.3.2.1 Experiment 1 validation results

(25) Experiment 1 took place at Marseille ACC from the 13th to 24th November 2006. The main objectives of the experiment consisted in studying controller's perception of horizontal speed variation on managed aircraft.

(26) The experimental task for controllers consisted in detecting horizontal speed variations for a traffic that was replayed on the radar image. The traffic development had been partly modified by an automated system which performed speed variations on certain aircraft. The controllers were also asked to detect conflicts as a secondary task corresponding to their usual traffic analysis.

(27) Each controller performed the two tasks under two situations: low traffic load and high traffic load.

(28) The main results of the experiment were as it follows:

- The controllers perceived that 34% of the aircraft had their speed automatically modified. Among these aircraft, 8% were actually not modified;
- The controllers did not perceive 64% of speed variations performed by the system.

(29) The maximum of (correct) speed variation perception was in low traffic load condition with speed reduction of -12% (i.e. 50 to 60 knots speed decrease), and when the speed modification occurred after the integration by the controller (within the managed sector).

(30) The speed variation was better perceived when applied to aircraft in conflict that is when the controller turns a particular attention to aircraft (speed being not a parameter specifically monitored).

2.3.2.2 Experiment 2 validation results

(31) The purpose of experiment 2 was to determine the effective action area of ERASMUS (i.e. "ideal" traffic configurations) and the relevant complexity criteria in the controller's perspective.

(32) The first phase of experiment 2 (pre-experiment) took place at Marseille ACC from the 31st January to the 1st February 2007. The main objectives of the pre-experiment consisted in qualitatively defining the safety feeling, the difficulty feeling and workload feeling.

(33) The controllers defined the workload feeling as resulting from the addition of the safety and difficulty feeling. The safety feeling was defined as depending on self-confidence, group pressure and personal state. The difficulty feeling was described regarding the problems configuration, the solutions and the room for manoeuvre.

(34) The main results of the pre-experiment showed that the controllers have difficulty to dissociate doubt on the conflict reality from doubt on the solution to carry out. The doubt removal process is a traffic management strategy that is considered as consuming resources and being marginally used and in case of low workload situations. On the contrary, the immediate traffic pre-categorisation is used as

resources self-management.

(35) The second phase of experiment 2 took place at Toulouse from the 16th January to the 20th April 2007. Its main objectives were to verify whether the traffic distribution (according to the level of perceived conflicts) influenced the affective representation of the situation (in terms of safety, difficulty and workload feelings). The controllers were placed in front of several traffic scenarios but did not handle the traffic. They had questionnaires to fulfil and participated to debriefings.

(36) The results showed that traffic situations involving conflicts required more attention resources than situations where the controllers could not immediately determine whether a situation was a potential conflict or not. The situation with conflicts had an impact rather on the safety feeling whereas the situation where the conflict was not certain had an impact rather on the workload feeling.

(37) The main criteria having an impact on the feelings degradation are the following:

- Available time to act
- Number of simultaneous conflicts
- Number of actions to be achieved
- Number of aircraft

(38) The safety feeling depends more on the available time to act whereas the difficulty feeling and the workload feeling depends more on the number of aircraft.

2.3.2.3 Experiment 3 validation results

(39) Experiment 3 will took place at Marseille ACC in May 2007.

(40) This experiment was set up to:

- Validate the thresholds identified in experiment 2 between the different buckets
- Gain insight on controllers practices to deal with conflict management and doubt management
- Test different configurations and different traffic samples
- Quantify the gain in controller performances of the subliminal application

(41) It aimed at testing the gain in resources provided by ERASMUS and at better defining the content and criterion of feelings elements introduced to qualify the traffic.

(42) It tried to answer the following research questions:

- Are there doubt situation?
- Does the reduction of doubt situation release the attention processes?

(43) The results showed a tendency for ERASMUS to save controllers resources.

(44) The gain delivered by ERASMUS did not seem to be in terms of absolute capacity or workload but more in terms of comfort, improvement of service delivered to aircraft and safety merging. The main results were on the improvement of safety critical situation with ERASMUS; reduction of potentially conflicting aircraft, increase separation for doubtful situation.

(45) The tendencies shown in the results suggested an effect of the composition of the traffic on the results. This impact was not only in terms of traffic load (number of aircraft) but also in term of traffic repartition. ERASMUS seemed to be efficient at a specific traffic load.

2.3.2.4 Experiment X validation results

(46) The experiment was carried out over two weeks in February and March 2008 at Toulouse with controllers from Aix ACC.

(47) The aim was to:

- Further investigate the tendencies observed.
- Demonstrate the shift from comfort to capacity (i.e. prove that capacity is increased).
- Improve the experimental protocol (i.e. more rigorous).
- Set up a smaller within-subjects design to ensure the effect of the independent variables can be measured.
- Minimise the breaking of ERASMUS actions.

(48) The preliminary results seem to confirm the potential of ERASMUS shown in Experiment 3

(49) The low traffic levels induce situations where controllers are more in a monitoring role and they are more likely to observe the ERASMUS actions. Still these actions seem not to disturb them, moreover the controllers feel comfortable to have a support for conflict resolution (i.e: some aircraft they identified as requiring an action ended with ERASMUS with larger separation and had just to be monitored).

(50) The controllers raised the concern of over trust in ERAMUS (i.e. potential tendency to believe it will solve all the conflict).

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3 SIMULATION OBJECTIVES

3.1 Validation Aims

(51) According to the Validation Plan (cf. [6]), this real-time simulation is intended to assess and demonstrate the following:

- The technical feasibility of Air-Ground architecture to use FMS TP capabilities.
- The modus operandi associated with the ERASMUS Server (i.e. subliminal control application).

(52) The focus of this experiment will be on the airborne side as no previous experiments have been carried out dealing with the airborne issues. It will focus on the following Research Questions:

R8 Are there interferences between technical system's strategy & pilots' strategy?

R10 Is it acceptable for pilot to receive an order coming from a machine instead of an ATCO? And does the integration of ERASMUS into the cockpit adversely affect the pilot's performance?

R11 Does the integration of ERASMUS in the cockpit disturb the pilot?

3.2 High-level Objectives

(53) The validation objectives can be grouped in three categories:

- **Technical feasibility**
  - To validate the functional requirements
- **Operational & Human Factors**
  - To assess the acceptability of the pilot interactions with the ERASMUS system from the pilot's perspective.
  - To evaluate the pilot working method associated with the ERASMUS Server.
  - To measure the acceptance from the pilots.
- **Safety issues**
  - To assess that the current safety levels are met or exceeded using the ERASMUS Server on board.
  - To assess the pilot perceived level of safety.

3.3 Low-level Objectives

(54) Each high-level objective that is addressed in the real-time simulation is broken down into low-level objectives.

3.3.1 Technical feasibility

(55) The associated low-level objectives are:

- Regarding **SAM** (Simulateur Avion Modulaire) flight simulator:
  - The suitability of currently available avionics (i.e., the MCDU and DCDU) to support ERASMUS/pilot communication and conflict management.
  - With FMS simulator to provide trajectory prediction.
- Regarding **ERASMUS Solver**:

- To send RTA usable by board side.
- To manage in computation nominal answers from board (i.e. Acceptance or Refusal of the RTA).

3.3.2 Operational & Human factors

(56) The associated low-level objectives are:

- Regarding the **pilot- ERASMUS interactions and methods** of work:
  - To assess the possible interferences between the technical system's strategy and the pilot's working methods.
  - To assess a pilot's ability to comply with ERASMUS clearances within the time period required by the Solver (e.g., 3 minute) (Average task duration times).
- Regarding the **acceptance from the pilots**:
  - To access the acceptability of ERASMUS clearances.
  - To assess the pilot's perception of the impact of the ERASMUS server on their workload*.

3.3.3 Safety

(57) As designed, the assessment will not be able to determine whether ERASMUS will meet of exceed current safety levels. In fact, the assessment will be able to produce information that will support further evaluation of the safety.

(58) The associated low-level objectives are:

- To gather information on the potential impact of the ERASMUS Server (subliminal control application) on risk of errors.
- To gather information on the potential impact of the ERASMUS Server on risk of any misunderstanding between Pilot and ATCO.
- To gather information on whether ERASMUS could lead up the Pilot to a state of uncertainty.
- To gather information on the ability of Pilot to react to an ambiguous situation is not compromised.

* The workload will not be gathered through objective measures during the simulation. Rather, pilots will be asked what they think about the workload issues during the debriefing session.

4 EXPERIMENTAL PLAN

4.1 Operational Context

4.1.1 Airspace

(59) The simulated sector is sector W2W3 (FL305 / FL660), and adjacent sectors when needed (Bordeaux sectors H & T, Aix sectors M, A and B).

(60) This work is focused on the En Route phase. The En Route simulations is based on Aix ACC airspace with a 2007 traffic level (or a traffic simulated corresponding to the controller load in operation on the sector) and using current concepts.

(61) The traffic selected from FPL routes has been modified to cope with the current LOA in Aix ACC for the W2W3 sector. The traffic constraint and working methods in operation in the selected sector have also been taken into account to choose the traffic simulated.

Note: The Letter Of Agreement (LOA) description is detailed in ANNEXE B (chapter 5).

4.1.2 Traffic

(62) The traffic samples are based upon a real Aix traffic. The traffic is 1.4 time the maximum today capacity of the W sector. Each simulation exercise is described in a specific file. Each file contains a list of the flights the controller will have to manage during the simulation. The conflict in which the "SAM" flight is involved is described in the list of flights and in the specific conflict description sheet (see ANNEX B chapter **Error! Reference source not found.** for a detailed description of the traffic samples and of the conflicts).

4.1.3 Layout

(63) There will be a pilot and a co-pilot in a cockpit simulator (SAM), in charge of one aircraft and applying the method of work they will be trained for to carry out the RTA.

(64) No pseudo pilot will be needed, as it is necessary to simulate air traffic control only to provide the pilots with a simulated environment.

(65) There will be one Executive Controller (or two, if a frequency change is simulated) using specific interface and tools:

- Radar picture (display of flight data)
- R/T for radio exchange simulation
- Message to be transmitted (Pilot or controller messages as first radio contact, requests from pilots, clearances from controller) They will be displayed on a specific device; pilot messages will be recorded and broadcasted on the frequency on the controller request, following a pre define plan.

(66) No paper strips, MTCD or telephone line will be necessary.

(67) The pilot and co-pilot in SAM cockpit will take in charge one aircraft in each simulation exercise. The aircraft the crew will manage will be part of a conflict situation and subject to an ERASMUS clearance.

(68) The conflict situations that are planned are the following:

- Catch up (once with and once without remaining risk).
- Crossing (once with a/c slowed down and once with a/c sped up by the Solver).

(69) Conflict with an evolving a/c will not be simulated.

(70) An RTA will be sent to the crew who will apply the procedure they will be trained for at the beginning of the experiment (cf. 4.1.4).

(71) The crew will be involved in secondary tasks so that they are busy enough and not only waiting for RTA (see below).

(72) The controllers will know which aircraft is taken in charge by the pilots in SAM cockpit. They will be told to act according to specific scenarios (e.g. do not interrupt a Solver action on the aircraft taken in charge by the crew in SAM cockpit by issuing an instruction).

(73) The scenarios will include the following events:

- RTA
- Frequency change

4.1.4 Procedure

(74) The experiments will last from 1 to 3 weeks depending on the number of participants recruited and their availability. Recruited pilots will be informed in advance about the experimental goals and ERASMUS concept, so they can build a picture about it. Introductory material (*draft name*) „Introduction to ERASMUS: Concept and Operation“ will be sent to participants one month before the experiments start probably via email.

(75) Participants will be given a detailed pre-experiment briefing on the content of ERASMUS RTA clearances and given training on the appropriate procedures. Participants will be introduced to the specific datalink messages (UM83) that will be used and made aware of the implications to the aircraft's planned route and performance[*]. Participants will be made aware of the implicit content of the message, instructed to view the whole RTA clearance and assess the impacts. Participants will also be given an opportunity to practice the procedures during a pre-experiment training session.

(76) Besides the information about the RTA, additional instructions will be given to the experimental subjects:

- **Pilots** will be asked to:
  1. follow their company constraints for the whole flight, especially when deciding whether to accept/reject ERASMUS clearance. (*If the pilot does not implement the clearance, the experimenter will pause the simulation and ask the pilot to explain their decision making process*).
  2. feel free to ask to stop the simulation and add any comments,
  3. be aware of the fact, that any clearance given by ATCo has priority over any ERASMUS message.
- **Controllers** have no idea about the message, which was generated and sent by ERASMUS.

[*] AT [postion] CLEARED [route clearance]

(77) One experimental day will consist of the following exercises: (for more detail description see Table 3).

9:15	Registration, invitation of the participant
9:30	Introduction of the experiment
	Introduction of ERASMUS concept
	Training including pre-test flight
10:30	Flight plan introduction
10:45	Break
11:00	Exercise I
11:45	Break
12:00	Exercise II
12:45	Lunch
14:15	Exercise III
15:00	Break
15:15	Exercise IV
16:00	Post briefing
17:00	Acknowledgement, end of the experimental day

Table 2 – Time table of the experimental day

(78) The duration of one experimental run within an exercise will be 10–15 minutes, followed by a short debriefing (10 minutes) and a break (10 minutes). 90 minutes is planned for lunch.

4.1.5 Experimental exercises

(79) As mentioned above, there will be 4 exercises, which will together create a complete 4 segments flight. The participant will be made aware of where he/she is flying, and will be responsible for performing communication and navigation tasks.

(80) Each exercise will present the pilot with one ERASMUS clearance that will require the participant to access the DCDU, read the datalink message, respond to the message, and program the FMC to obey the constraints transmitted in the clearance. Each exercise will be repeated twice. Several factors will remain the same within one exercise: the number and content of DATALINK clearances and the flight path of the exercise. While the time of the clearance's arrival on the flight deck will be varied between the first and second trials to reduce a learning effect, the content and timing of the messages will be previously prepared and fixed to make sure that all subjects will receive the same messages at the same time.

(81) The number and order of experimental trials will be based upon variations in the magnitude of the speed change required to comply with the ERASMUS clearances (e.g., small speed change vs. large speed change) (See section 4.3).

(82) During the exercise the subject will be required to perform additional tasks that are typically performed during normal en-route flight phase (e.g., initial contact, transfer of communications, report altitude

etc.[*]). There will be also other simulated DATALINK messages sent to the SAM (non-ERASMUS messages which appear to be from a human ATCo) and these will act as secondary tasks.

4.1.6 Presence and role of experimentators during exercises

(83) There will be a person from Honeywell acting as an observer during exercises. This observer will be responsible for taking notes and conducting question probes during the exercise. This person will be also responsible for collecting answers to questions during each short debriefing after each experimental run. The experimental run will be always stopped after the reply is downlinked to the last DATALINK clearance. The participant will be asked questions regarding the current exercise with the major focus placed on ERASMUS clearance. The participant will be also able to add any comments.

(84) This final session will be completed at the end of the experimental day. The goal is to identify issues connected with ERASMUS clearance. Items addressed in the debriefing phase will include:[*]

- How did you feel during the simulation? Did it at least remind you the real environment? Were the performed tasks common for you?
- Did you notice any changes in the workload (decrease/increase) in comparison to your routine flights?
- Did you always was aware what to do or were you confused by the tasks or anything else?
- How do you feel about the RTA clearances generated by a computer?
- Do the clearances make sense to you, were they reasonable from your point of view?
- What parameters did you consider when deciding whether to accept or reject the RTA clearance?
- What did make you to reject RTA clearance?
- (What changes would you recommend? What would you like to see done differently?)

4.1.7 Safety issues

(85) In the simulation, the safety will be assessed on the basis of the following data[*]:

- Perceived level of safety: the pilots will be asked to assess their perceived level of safety (i.e. safety feeling) during the measured simulation runs. In case there were any hazardous events during the simulation run, the pilots will be asked to assess the frequency of this event outside the simulation.

(86) Due to the fact that no abnormal events (faults injections) will be introduced during the simulation it is possible that in the majority of simulation runs no hazards will be observed. In this case, the pilots, exploiting the experience gained with the concept in RTS through several scenarios, will be asked to provide their feedback on potential impact of ERASMUS on risks of errors, as well as to identify potential hazardous events, possible operational effects and the associated severity.

(87) During the debriefing phase, additional safety related questions will be asked related to the evaluation of what happened and of what could happen if ... (e.g. the data availability or integrity is interrupted).

(88) The following safety related issues will also be addressed during the post-experiment briefing:

Ev#1: The pilot has received the ERASMUS instruction and has inserted the new RTA in the FMS (e.g.

[*] This will be specified later upon the SAM capabilities.

[*] Complete list of topics can be found in the ANNEX A.

[*] Complete list of topics can be found in the ANNEX A.

a RTA which foresees a speed increase or vice versa). While the flight is following the ERASMUS instruction, the controller issues a clearance instructing the pilot to modify the speed (e.g. speed reduction or vice versa). *Note*: The Controller instruction is contrary to ERASMUS instruction.

Ev#2: The pilot has received the ERASMUS instruction and has inserted the new RTA in the FMS (e.g. a RTA which foresees a speed increase or vice versa). While the flight is following the ERASMUS instruction, the controller issues a clearance instructing the pilot to modify the heading (e.g. vectoring instruction) and then to resume own navigation.

Ev#3: The pilot has received the ERASMUS instruction and has inserted the new RTA in the FMS (e.g. a RTA which foresees a speed increase or vice versa). While the flight is following the ERASMUS instruction, the controller issues a clearance instructing the pilot to go direct to a fix.

Ev#4: The pilot has received the ERASMUS instruction and has inserted the new RTA in the FMS (e.g. a RTA which foresees a speed increase or vice versa). While the flight is following the ERASMUS instruction, the controller issues a clearance instructing the pilot to change the Flight Level (e.g. climb to FL…).

Ev#5: The controller has issued a clearance instructing the pilot to modify the speed (e.g. speed increase or vice versa). While the flight is following the controller instruction, the pilot receives an ERASMUS instruction (e.g. a RTA which foresees a speed reduction or vice versa). *Note*: The ERASMUS instruction is contrary to Controller instruction.

4.1.8 Tasks to be performed

(89) Pilots flying SAM will follow common procedures and tasks in order to simulate common en-route phase of the flight in fidelity. SAM pilot tasks (scenarios) will be pre-prepared to reflect common tasks, which are performed by a pilot during en-route phase of the flight. There should be three different task scenarios prepared plus one training scenario; scenarios should be equal in difficulty and number of different tasks following the concept of routine tasks during en-route phase.

4.2 Technical Context

4.2.1 Simulation platform background

(90) During ERASMUS past experiments an end to end RTA process has been verified.

(91) Based on estimated trajectories (computed on ground or computed on board and transmit to ground) on conflict detection, RTA have been computed and sent to aircrafts to adjust trajectories.

(92) RTA has been transmitted in a subliminal mode for ground controllers.

(93) All actors from ground controller's simulated position, to different simulations for aircraft (FMS-RTA equipped, pseudo-pilot, cockpit simulator) connected together through a simulated data link, have been implemented in the experiments.

(94) The simulation platform used for these past experiments is re-used in experiment 4:

- to build the traffic environment;
- and partially to run the experiment.

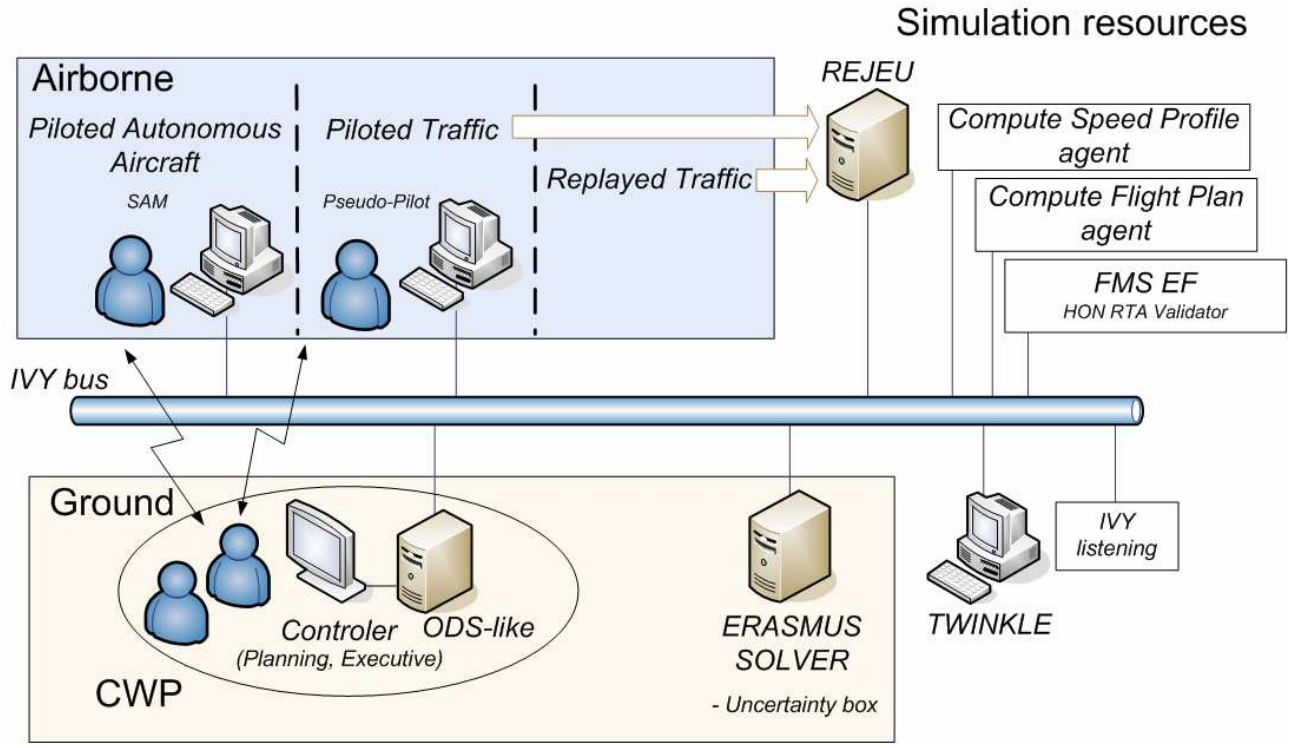


Figure 1: Overall platform architecture

4.2.1.1 Airborne traffic simulator and simulation resources

In order to have a realistic airborne context, a traffic simulator is used to replay flights from a real traffic situation.
Moreover the simulator accepts trajectory modification (from pseudo-pilots commands) for any flight and maintains the new trajectory.

Compute Speed Profile agent

This is the Ground Trajectory Prediction module used by the ERASMUS Solver to compute new trajectories constrained by speed adjustments.
Updated trajectories are maintained in REJEU.
Moreover the same algorithm is used by CATS (in ERASMUS Solver) during the conflict resolution process.

Compute Flight Plan agent

This module is used by the FMS EF (see below) to translate ground flight plan (REJEU data structure) to board flight plan (FMS EF data structure) in order to compute a Board Trajectory Prediction.

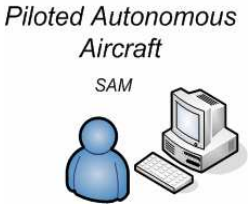
FMS EF
HON RTA Validator

The Flight Management System Enhanced Functions checks if an RTA request is achievable according to the Board Trajectory Prediction and aircraft performance.

4.2.1.2 Airborne actors

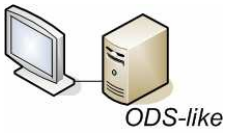
(95) Several simulation types are used to address the board domain.

Replayed Traffic — REJEU is configured with a data file containing flight plans and associated trajectories. When running the simulator replays the flights, providing aircraft positions on a simulated time base.



The cockpit simulator (SAM) is used to fly an autonomous flight in the traffic. It sends its position based on the REJEU clock.
It has its own Board Trajectory Prediction module and provides updated trajectory on requested from the Solver.

4.2.1.3 Ground actors



A ground controller position (executive) is simulated; enabling to visualize the traffic (radar image) and to give clearances to aircraft.

The ERASMUS Solver is aware of the airborne traffic (board or ground estimated trajectories).

It performs periodic potential aircraft conflicts detection and resolution, and sends speed or time constraints to concerned aircraft.

The light weight radar display simulator is used for development and integration purpose, to display the traffic (same as ODS Like) and to highlight (using colours) aircrafts involved by Solver time or speed constraints.

This application is used to monitor time or speed constraint messages sent by the solvers to concerned aircrafts.

4.2.1.4 Datalink

A unified media link used to interconnect the airborne and ground simulated domains, as well as the airborne traffic simulator and monitoring applications.

4.2.2 Platform workflow

(96) The simulation platform is used in two times. The first phase aims to generate the convenient traffic to be run during the second phase.

4.2.2.1 Experiment preamble: Traffic data preparation

(97) An existing traffic in REJEU is modified using the Twinkle tool to create the situation, in which the SOLVER will detect conflicts involving the SAM flight, and sent it an RTA. This traffic situation is logged to be used in experiments.

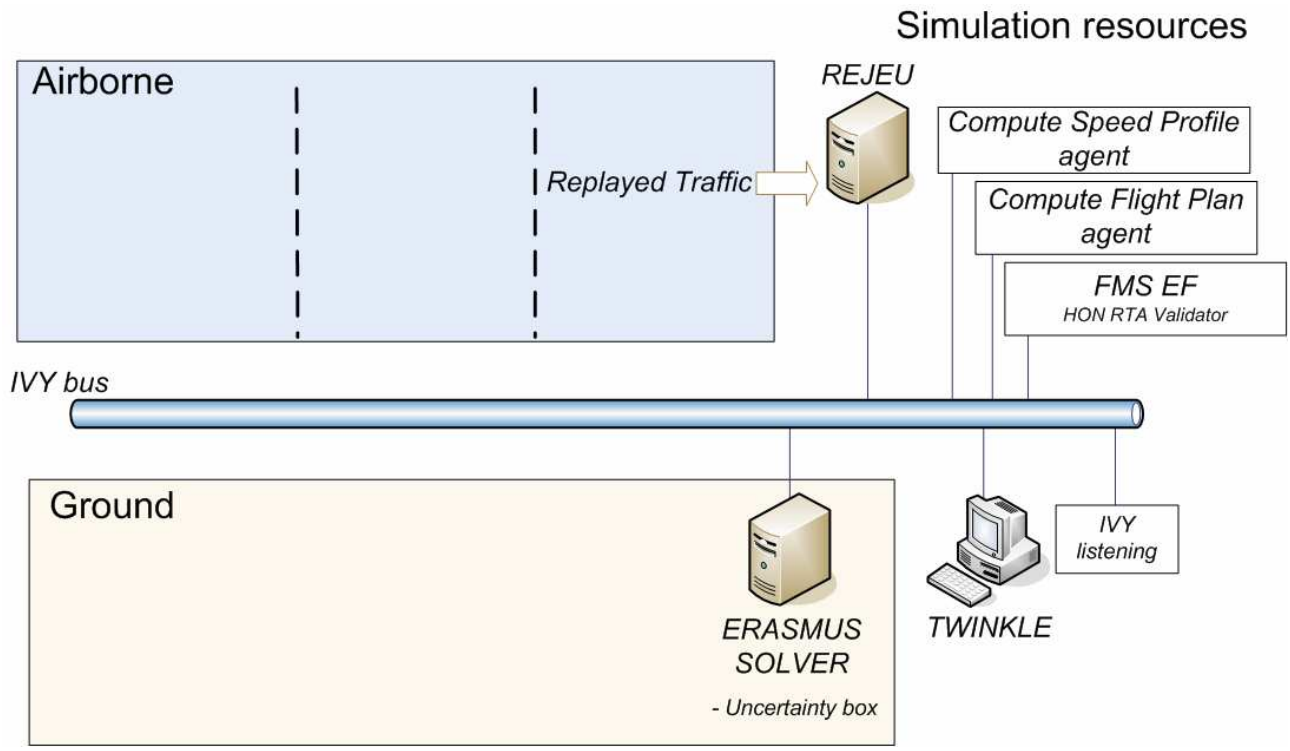


Figure 2: Overall platform architecture

4.2.2.2 Experiment run

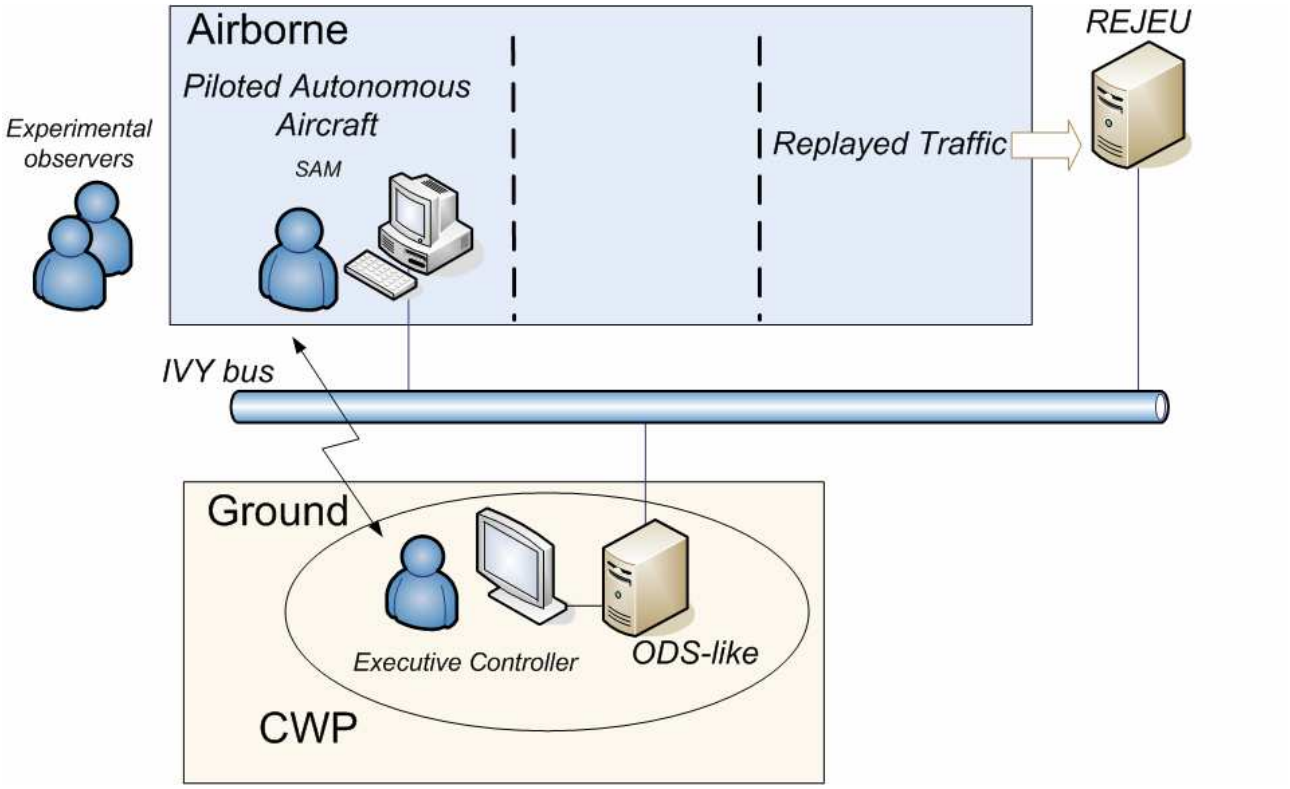


Figure 3: Run workflow

(98) SAM is a research part-task simulator, representative of a twin-engine glass cockpit. It includes EFIS, FCU, RMP, MCDU together with auto-pilot and simplified FMS capabilities.

(99) Running the prepared situation traffic, SAM will receive an RTA from the SOLVER that has to be managed by the crew through DCDU and MCDU.

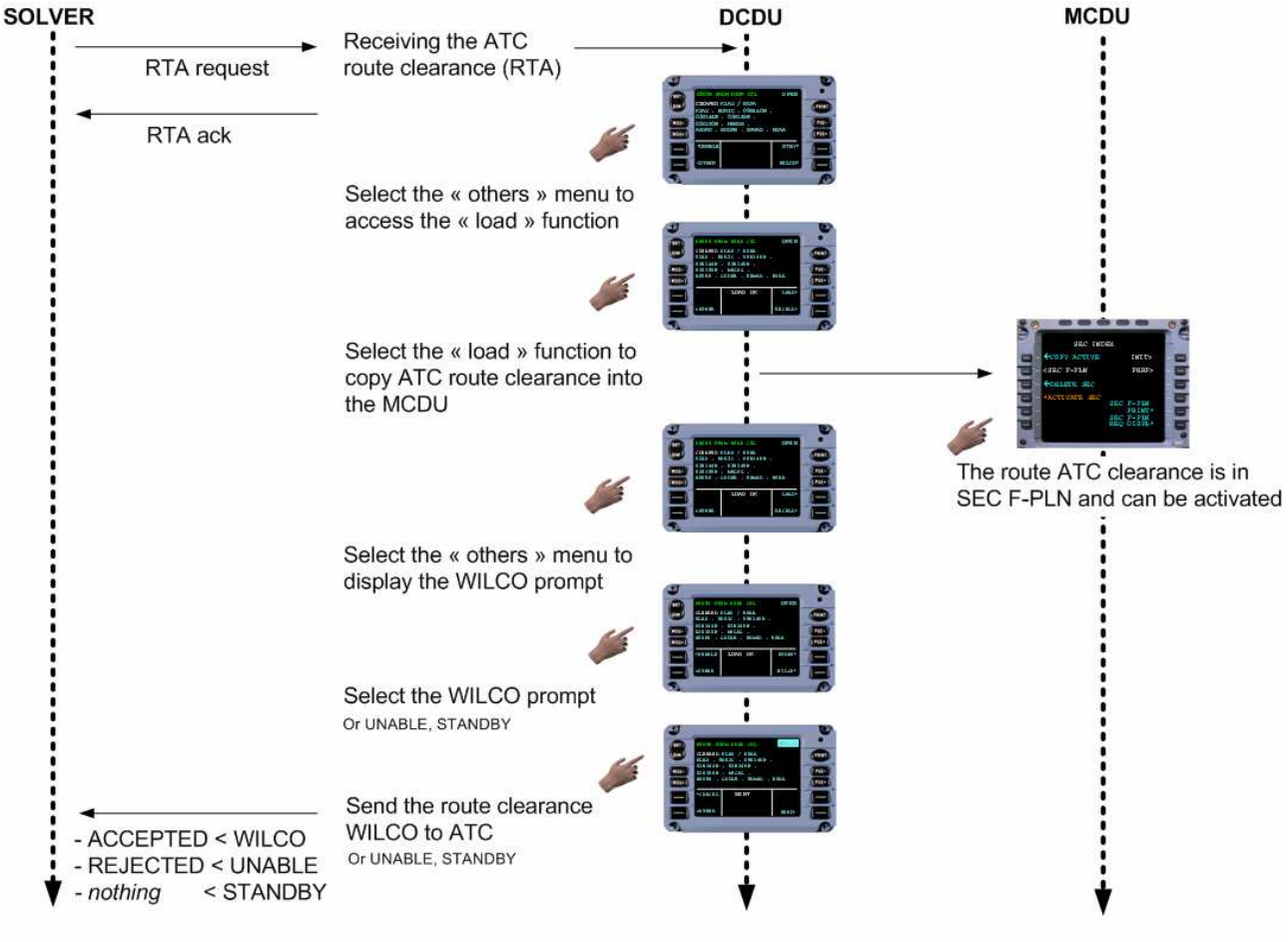


Figure 4: DCDU Process on RTA request

(100) The DCDU is the “mailbox” where the RTA request is received. On message reception, the “mailbox” automatically acknowledges the message if it is well formatted (i.e. CPDLC structure).

(101) The pilot can ask the DCDU to transmit the RTA to the FMS, to be converted and proposed as a secondary flight plan through the MCDU.

(102) Independently the pilot has to send (using the DCDU) an answer to the ground before the end of the 3 minutes timeout.

(103) By procedure, the pilot can send the answer before or after secondary flight plan being accepted and/or activated in the FMS.

4.3 Experimental Design

(104) The proposed experimental design can be found in the table below (Table 3). It requires the involvement of 2 pilots per day. There are 4 exercises reflecting 2 experimental conditions planned for each experimental subject. The current time-schedule is described in Table 2 under section 4.1.2.2.

Magnitude of speed change	Exercises

Normal - decrease	1
High – increase	2
Normal – increase	3
High – decrease	4

Table 3 – Experimental variables

(105) The reason for preparing 4 exercises is to gather as much data from pilot interactions with flight deck systems as possible. The magnitude of speed changes presented to the participant will be varied in different scenarios. Hence, the learning effect can be minimized.

(106) Besides the ERASMUS generated clearances, the participant will receive other DATALINK clearances which will appear to be sent from a human controller on the ground. These clearances will include free messages and will act as secondary tasks. There will be at least three additional DATALINK clearances in all exercises. These additional CPDLC messages will be uplinked to the SAM at fixed times throughout the exercises.

(107) The exercises will also examine differences in pilot response to the magnitude of speed change required by ERASMUS clearance. For the purposes of this assessment, a small speed change is defined as [-6%, +3%]. Large magnitude speed changes are the extreme values which can be initiated by ERASMUS, which means increase by +3% and decrease by -6%.

4.3.1 Actors involved and roles

(108) There will be 5 or more pilots (experimental subjects) involved in the assessment. Each subject will perform 4 exercises within 1 day; there will 5 or more experimental days altogether depending on the number of subjects recruited.

(109) The experimental subject will act as the Pilot Not Flying (PNF) and will be responsible for operating both the datalink system and the FMC during the experimental exercises. The Pilot Flying (PF) will be an experimental cohort and will be responsible for „flying“ the SAM. (*This person will likely be a member of DSNA's SAM implementation team)*.

(110) In order to minimize differences in skill and knowledge that could affect performance, subject recruited for the experiment should:

1. be current commercial Airbus transport pilots (have experience with flying A300 or higher)
2. be familiar with FMS and DATALINK
3. have operated flight within the European airspace
4. have a good knowledge of English flight communication

(111) Minimizing differences in subject skill sets will also minimize the amount of time needed during pre-experiment training.

(112) There will be one (or two) executive controller (DSNA). In addition to the messages exchanged with the crew in SAM cockpit via datalink or radio, he/she will manage replay of pilots - controller pre-recorded messages that will simulate surrounding traffic to the SAM cockpit crew.

4.3.2 Experimental management

(113) For the overall technical aspect, a technical manager and a computer engineer will be necessary to conduct the experiment. The technical manager will be responsible for the bench supervision while the computer engineer will be responsible for platform maintenance. There will be a SAM supervisor and a

SAM expert (participating to SAM training and flight briefings).

(114) In order to gather relevant data and follow-up the experiment, an observer (human factors and/or operational expert) and a pilot coordinator will be required and responsible to the experiment follow-up. One observer (human factors and/or operational expert) will be present in order to follow-up the experiment from the ATC side.

4.3.3 Training

4.3.3.1 Pilots training

(115) A training phase is planned for the pilots to get them used with SAM interfaces and be able to practice the RTA reception process.

(116) A training exercise will be prepared to train the pilots to the environment and the new procedure. This exercise will last 20 minutes.

(117) Training procedure will be following:

- There will be a brief introduction of ERASMUS concept incl. explanation of the content of the ERASMUS generated messages (HON);
- Introduction of tasks participants are expected to perform and explanation of participants role in the experiment (HON);
- Introduction of the SAM controls and environment (DSNA);
- Introduction of the SAM FMC and its operation (DSNA);
- Step-by-step explanation of dealing with an ERASMUS clearance (DSNA);
- Practice Session: CPDLC communication and FMC operation (DSNA);
- Time for questions (HON + DSNA).

(118) Before the exercise begins, it is crucial to make sure that pilots:

- are familiar with the aim of the project and ERASMUS concept;
- are familiar with the simulated environment (how to operate DCDU and FMS);
- understand the experimental procedure and tasks to be performed.

4.3.3.2 Controllers training

(119) No training period is planned as the controllers will work on their ODS like interface with the actual sector design and real traffic.

4.4 Measurements specification

(120) With regard to the Validation Plan, the following research questions were formulated:

Area of Human Performance Impact	Hypotheses	Research Questions	Indicators	Method and Remarks
Acceptability/Comfort	Pilots are comfortable with RTA clearances generated by ERASMUS.	Are pilots willing to accept RTA clearances generated by ERASMUS?	**Ratio** between accepted and rejected messages **Post-briefing** discussion about the conflict resolution by automation	**Pre/post-briefing phase**, discuss the issue of the relationship between human-automation. "How comfortable are pilots with RTA sent by automation?" and analyze changes before/after. **Analysis** of the reasons of rejection resp. acceptance of RTA clearances generated by ERASMUS, determining ratio between accepted/rejected ones. **Analysis** of the voice communication between ATCo and pilot. **On-line survey**
Acceptability/Comfort	Pilots are comfortable with **magnitude of speed changes** initiated by ERASMUS clearances.	Are pilots more likely to reject ERASMUS clearances that demand greater speed changes than those that require small speed changes?	Positive **feedback** on magnitude of speed changes required by ERASMUS during post-briefing phase **Experimental** – analysis of the ratio of accepted/rejected clearances due to magnitude of speed in experimental conditions focused on magnitude of speed change	**Post-briefing discussion** about the speed changes required by ERASMUS and rejected clearances **Analysis** – dependence of he acceptance of ERASMUS clearance and required speed change (increase/decrease) **Analysis** - correlation between clearance rejection and magnitude of speed change **On-line survey**
Acceptability/Comfort	Pilots are comfortable with the **uncertainty** of conflict prediction.	Are pilots comfortable with adjusting flight plans now, when the conflict is 20 minutes in the future?	Pre/post-briefing discussion about long-term conflict resolution **On-line survey** **Analysis** of the	Pre/post-briefing discussion about long-term conflict resolution, tracking possible attitude change after the exercise. Also include question „When you receive RTA would you like to see a where the conflicting traffic is as

Area of Human Performance Impact	Hypotheses	Research Questions	Indicators	Method and Remarks
			accepted/rejected ERASMUS messages with regard to the magnitude of speed change (basic assumption is, that pilots consider the greater the speed to be solving more immediate conflict, what makes the resolution more certain)	ERASMUS does? **On-line survey**
Response Time	Pilots will be able to comply with ERASMUS clearances within the time period required by the ERASMUS Server.	What is the average time required for pilots to notice, read, consider, and program the FMS?	Total Transaction Time Message Frequency (rate)	**Analysis** of time required to perform individual tasks when dealing with ERASMUS clearance **Identification** of the total transaction time **Analysis** of the transaction time in relation the magnitude of speed change requested
Response Time		How long does it take for pilots for deciding whether they accept or reject an ERASMUS clearance?	Decision Time (measured from message access to CPDLC response)	**Analysis** of the decision time **Analysis** of the possible connection of the decision time with amount of ERASMUS messages and magnitude of speed change initiated
Response Time		What are the components of the transaction sequence?		Literature Survey
Situational Awareness	Pilots are able to determine the location of conflicting aircraft.	Does ERASMUS degrade a pilot's ability to ascertain the location of nearby traffic? Does the magnitude of speed change makes pilots more able to determine, where the conflicting traffic is?	**Positive feedback** on the conflicting traffic location. Indicate the **ratio** of „correct" determination of conflicting traffic and its dependence on magnitude of speed change requested by ERASMUS.	**Experimental**

4.5 Simulation schedule

4.5.1 Pre-experiments

(121) The pre-experiment phase is planned during week 20 (between 16th and 20th May).

(122) These are organised prior to the real-time experiments to help with testing and calibrating initial scenarios in an environment close to the targeted one. In that respect, the pre-experiments will bring an essential feedback on the scenarios' design, the capacity to follow the scripts and provoke the events planned in the scenarios. Possibly all the scenarios will be played during one-day experiment.

(123) The testing aspects covered by the pre-experiments encompass:

- **Platform aspects**: the ability to run the scenarios in a targeted real-time simulations environment; the platform will also be assessed against realism.
- **Organisation aspects**: the capacity to plan and run exercises in a timely manner; the ability to execute the scenarios along the scripts as well as detecting software problems if any; these small scale experiments will also help in assessing whether the real-time simulation planning is realistic or not.
- **Scenarios aspects**: the ability to test the scenarios so as to modify them whenever necessary before the real-time experiments. Importance will be stressed on collecting feedback from the participants in order to refine the scenarios before the real-time experiments.
- Metrics / indicators aspects: the capacity to gather quantitative data.

4.5.2 Experiments

(124) Three weeks are available for Experiment 4 between 2nd and 20th June. This slot should allow having enough pilots for the purpose of the experiment.

(125) Days can be changed according to the pilots availability, but the exercises should be performed within one day.

	Monday	Tuesday	Wednesday	Thursday	Friday
Morning	SAM 1	SAM 2	SAM 3	SAM 4	SAM 5
	SAM 1	SAM 2	SAM 3	SAM 4	SAM 5
Afternoon	SAM 1	SAM 2	SAM 3	SAM 4	SAM 5
	SAM 1	SAM 2	SAM 3	SAM 4	SAM 5

4.6 Data log

4.6.1 Purpose of the data log

(126) The data logged on the SAM simulator during all exercises of the Experiment 4 will be used for data analysis and evaluation of the pilots' performance. We plan to use more sources of input data:

- IVY bus traffic (Messages sent over IVY bus can be easily stored)
- Video camera recording of the exercises (should be a part of the simulation environment)
- SAM events log
- Audio log

4.6.2 Scope of the SAM data log

(127) All exercises of the Experiment 4 run on the SAM are focused on the pilot behaviour and response to the RTA message sent via CPDLC. For this reason we are interested only in the period from the time when the RTA message is issued and sent over IVY bus to the SAM till the time when the message is accepted or rejected and send back to the Solver over IVY bus. Other events do not need to be logged.

4.7 Data analysis

To Be Defined

End of document

Annexes

ANNEX A - Post debriefing & pre-briefing phase questions

ANNEX A - 1. Questions for pilots

(128) We will be using 5 points scale for answering most of the questions. The scale will always use following scheme in dependence on the question asked:

Completely comfortable	1	2	3 Neutral	4	5	Completely uncomfortable
Extremely easy	1	2	3 Neutral	4	5	Extremely difficult
Completely unimportant	1	2	3 Neutral	4	5	Extremely important
Never	1	2	3 Neutral	4	5	Always

ANNEX A - 2. Pre-briefing phase questions

Q- PRE-BRIEF 1	**Hard data/data about participant** • What is your age? • What type of aircraft do you fly? • What is the total number of your flying hours? And % of that hours spent on FMS-equipped aircraft? • How often do you currently use CPDLC?How often do you encounter RTA in you current operations?
Q- PRE-BRIEF 2	**Questions concerning ERASMUS concept** • How comfortable are you with the ERASMUS concept on the basis of information provided? (scale) • How comfortable do you feel with the concept of RTA sent by automation? • With regard to information you have about ERASMUS, what do you expect? (describe) • In your estimation, how accurately could a computer predict if a conflict will occur 20 minutes in the future? (0 – 100% accurate)
Q- PRE-BRIEF 3	**Instruction before experiment start:** „You are a Pilot Not Flying, during a routine en-route phase of flight. There will be no takeoff or landing phase of flight. Please, perform all tasks as you are used to and apply all business constraints as you would in your real flight ops“.

ANNEX A - 3. Questions during exercise

(129) These questions will be asked after the operation with FMC dealing with ERASMUS clearance is finished.

Q-RUN 1	**Decision making** • What factors were you considering before rejecting ERASMUS clearance? (describe) **OR** • What factors were you considering before accepting ERASMUS clearance? (describe) • What were the most critical factors you have considered? (describe)
Q-RUN 2	**Uncertainty of conflict prediction** • When ERASMUS sent you an RTA, where you able to deduce the location of the other aircraft that were involved? (YES/NO) • Would you like to be able to see them (YES/NO) • If no, how important is it for you to know, where the conflicting traffic is? (scale)
Q-RUN 3	**Acceptance/comfort** • How comfortable do you feel about the magnitude of speed change requested by ERASMUS clearance? (scale) • How comfortable would you feel if the clearance was sent by a human ATCo? (scale)
Q-RUN 4	**Erasmus concept** • How comfortable are you with the fact, that you are not able to negotiate an aspect of ERASMUS clearance with human ATCo? (scale)
Q-RUN 5	**General/comments** • Do you have any comments about ERASMUS? (comment)

ANNEX A - 4. Post-briefing phase questions

Q-POST-BRIEF 1	**Questions concerning acceptance/comfort issues** ***- RTA clearances sent by automation/ERASMUS concept -*** • When facing the ERASMUS clearance, how comfortable are you with the fact, that it was generated by automation? (scale) • How comfortable would you be if the same clearance came to you from human controller rather than from an automated system? (scale) • How comfortable are you with the fact, that it is not possible ask human controller for any additional information about ERASMUS clearance as he/she is not aware of any clearances sent by ERASMUS? (scale) • How comfortable do you feel about not being able to negotiate an aspect of the clearance? (scale
Q-POST-BRIEF 2	**Questions concerning acceptance/comfort issues** ***- Magnitude of speed change requested by ERASMUS -*** • How comfortable did you feel about the magnitude of speed changes that resulted from complying with the ERASMUS clearances in this exercise? (scale)
Q-POST-BRIEF 3	**Questions concerning acceptance/comfort issues** ***- Volume of CPDLC -*** • How comfortable were you with the number of DATALINK clearances in this exercise? (scale) • If uncomfortable, what do you think about the volume of CPDLC? (describe – expected answer is „too many“ or equivalent
Q-POST-BRIEF 4	**Questions concerning acceptance/comfort issues** ***- Uncertainty of the conflict prediction/situation awareness -*** • How comfortable are you with the fact, that ERASMUS clearances address possible conflicts 20 minutes or even 2 sectors ahead? (scale) • Were you able to deduce where the conflicting traffic was? (YES/NO) • If not, how comfortable are you with not being aware where the conflict solved by ERASMUS was located? (scale) • How important would it be for you to „see“, where the conflicting traffic solved by ERASMUS clearance was located (e.g. as you are able to do on TCAS)? (scale)
Q- POST-BRIEF 5	**Questions concerning workload** • How difficult did you find tasks related to dealing with ERASMUS clearances? (scale) • Considering the fact, that ERASMUS clearances are sent to the aircraft during the en-route phase of the flight, how difficult it would be for pilots to deal with ERASMUS clearances? (scale)
Q- POST-BRIEF 6	**Decision making** • What did you consider or do you usually consider when deciding whether to accept/reject a RTA clearance? (describe)
Q- POST-BRIEF 7	**Other questions** • Do you perform tasks routinely? • Did ERASMUS behaviour meet your expectations? • Did you find ERASMUS messages intrusive, frustrating? • Was there in your opinion any contradiction in ERASMUS clearances?

(130) Based upon the documented (recorded) behaviour capturing the pilot accepting or rejecting a clearance, a pilot should be asked about the clearance and explain all aspects with regard to the specific clearance. Pilot will be provided with the documentation capturing the current situation the aircraft was in.

ANNEX A - 5. Questions concerning security issues

Q-SEC 1	Imagine ERASMUS specific/important data was interrupted so the data was not available during a significant time interval. What do you think about it? How severe would the consequences be? What would be, in your opinion, the main difference from a normal situation? How would it be solved? What do you think could be done to prevent this from happening?
Q-SEC 2	Imagine changed ERASMUS specific/important data, for instance order accelerate instead of decelerate (from the fake ground to the real air) or report an untruthful data about aircraft – its location or speed (from the fake air to the real ground). What do you think about it? How severe would the consequences be? What would be, in your opinion, the main difference from a normal situation? How would it be solved? What do you think could be done to prevent this from happening?
Q-SEC 3	How important is it to you to know that both the clearance and the data it was based upon came from an authorized source? Imagine that the uncertainty was keeping on a significant time interval. What do you think about it? How severe would the consequences be? What would be, in your opinion, the main difference from a normal situation? How would it be solved? What do you think could be done to prevent this from happening?
Q-SEC 4	Imagine that the data that ERASMUS uses to predict conflicts and calculate resolutions is freely available to anyone. Would this worry you? If so, why? How severe would the consequences be? What would be, in your opinion, the main difference from a normal situation? How would it be solved? What do you think could be done to prevent this from happening?

ANNEX A - 6. Questions concerning safety issues

Q-SAF 1	Hazardous situations • Describe any hazardous situations or abnormal events that happened or any other potential dangerous situations that may happen. • Which were the operational consequences (the effects on flight crew working conditions, on flight crew ability to cope with or to react to an ambiguous situation, physical distress/discomfort, workload, separation, etc..) and/or what else could happen? • How did you solve or recover from that hazardous situation? • Which factors do you think have led or could have led to these situations/events (e.g. procedure, training, etc..)?
Q-SAF 2	Perceived level of Safety • Does an high level of Safety have always been maintained during the simulation? • Possible answers: strongly agree; generally agree; not sure; disagree; strongly disagree. Why?
Q-SAF 3	Possible cases • How do you react if the controller issues an instruction (e.g. re-routing, heading, direct to), while the flight is implementing a RTA clearance? After implementation of the clearance issued by the controller, do you try to meet again the RTA provided by Erasmus? (Describe) • How do you react in case of reception of a RTA instruction by Erasmus, while the flight is carrying out a speed clearance issued by the controller? (Describe) • How do you react if the controller issues a new speed clearance while the flight is implementing a RTA clearance? (Describe)

ANNEX B – Traffic samples description

ANNEX B - 1. Exercise 1

Scenario

EXPE4 SCENARIO1			
CONTROL SECTORS	**H (LFBB UIR)W (LFMM UIR)**	**FL305 > FL660**	
START / STOP	**09 :55 :00 / 10 :18 :00**		
SAM FLIGHT	CALLSIGN	**CFG655**	
	AIRCRAFT TYPE	**B737/800**	
	FROM /TO	**LPFR EDDS**	
	FL	**360**	
	ROUTE in FRENCH AIRSPACE	**ZMR-DGO-PPN-LATEK-OBUTO-GONUP-TOU-GAI-GONIM-MEN-MEZIN-LATAM-ETREK-LUXAN-LTP-GIPNO-SOPLO-OMASI-MOSUL-SOSAL-KUDES**	
	POSITION AT START TIME	**10NM before TOU on the UN871**	Lat/long:
	COMM STATUS	**In contact with ATC, freq 132,910 (H sector channel)**	
CONFLICT	TYPE	**CROSSING**	
	CONFLICT IN SECTOR	**W**	
	POSITION	**ETREK**	
	DISTANCE MINI / AT	**10NM / 10 :18 :00**	
	WITH	CALLSIGN	**TOM058Q**
		AIRCRAFT TYPE	**A321**
		FROM /TO	**LEMH/EGCC**
		FL	**360**
		CONVERGING TRACK	**MTL ETREK**
RTA SAM		**SLOW DOWN ACTION**	

Flight list in H&W sectors

- Sequence beginning/end: 09h55 / 10h20
- Nb of flights: 31 + 2 (additional conflict)
- All aircraft are separated by 5Nm at least

CALLSIGN	DEP/DEST	SECTOR	ENTRY TIME	ENTRY FL	CONFLICT
AZA8578	LIRF LFBT	H	09 :55 :00	360	
MON264	EGKK LEAL	H	09 :55 :00	350	
GSOVA	EGKB LEMH	H	09 :55 :00	350	
EXS739	EGNH LEAL	H	09 :55 :00	330	
CFG655SAM	**LPFR EDDS**	H + W	09 :55 :00	360	Other aircraft: TOM058Q Crossing over ETREK Closest position at 10:18:00 Distance 10Nm
AEA1063	LPPT LIMC	H + W	09 :55 :00	340	
AEA1063	LPPT LIMC	H + W	09 :55 :30	340	
TOM622G	LEIB EGKK	H	09 :57 :30	360	
TOM184C	LEPA EGHH	H	09 :58 :00	340	
RAM840	GMMN EDDF	H + W	10 :00 :00	360	
BIE1259	LICC LFRS	H	10 :00 :00	320	
NJE6YP	EGLC LFMN	W	10 :00 :00	370	
BAW2486	EGKK LEBL	H	10 :01 :00	330	

JKK3194	EGNV LEIB	H	10 :01 :30	370	
FIN941	LPPT EFHK	H + W	10 :02 :00	360	
MYT826	LEMH EGNT	W	10 :02 :30	340	
TOM032C	LEPA EGKK	H	10 :03 :00	360	
DAH1048	DAAG LFQQ	W	10 :03 :00	360	
DAL32	KCVG LIRF	W	10 :05 :30	350	
BAW15HL	EGLL HLLT	H	10 :07 :00	350	
TOM058Q	**LEMH EGCC**	W	10 :07 :00	360	
EZY1BP	LEBL EGKK	H	10 :07 :30	340	
AFR976	LFPG FOOL	H	10 :08 :00	330	
TRA5061	EHRD LEGE	H	10 :08 :30	350	
IBE4432	LEBL LFPO	H	10 :09 :30	320	
AFR854	LFPG DNMM	H	10 :10 :30	350	
ELY032	KEWR LLBG	W	10 :13 :30	370	
AF570ZR	LFPO LFKJ	W	10 :14 :00	350	
BMA7656	LEPA EGKK	W	10 :17 :30	340	
N5736	LFRI LFKF	W	10 :22 :00	390	
N96JA	LFMN KPHL	W	10 :22 :00	400	

ADDITIONNAL CONFLICT			
CALLSIGN/AIRCRAFT TYPE	**FROM / TO**	**CONFLICT TYPE / POSITION / FL**	**MINIMUM DISTANCE AT TIME**
DAH1142 B737/800	DAAG / LFPO	CROSSING / ETREK / 340	1Nm at 10 :05 :20
ANE8656 CRJ1	LEMD / LFST		

Radio communications

- Beginning / end of sequence: 09h55 / 10h20

CALLSIGN	**DEP/DEST**	**TIME**	**CALL REASON**	**MESSAGES**
AZA8578	LIRF LFBT	09 :56 :00	TFR > H1	CTL: AZA8578 contact Bordeaux 124.08 PIL : Bordeaux 124.08 AZA8578
BAW2486	EGKK LEBL	09 :57 :30	First call	PIL: Bordeaux good morning BAW2486, FL330 CTL: bonjour BAW2486, maintain 330, to GAI, PUMAL PIL: 330, GAI, PUMAL, BAW2486
RAM840	GMMN EDDF	09 :58 :00	First call	PIL: Bordeaux god day, this is air maroc 840 CTL: bonjour 840, GAI, MEN ETREK PIL: GAI, MEN ETREK, 840
TOM622G	LEIB EGKK	09 :58 :30	First call	PIL : Bordeaux, this is thomson 622G, FL360 CTL: bonjour Thomson 622G, proceed to AGN PIL: to AGN 622G
MON264	EGKK LEAL	09:58:45	TFR	CTL: MON264 contact Barcelona 135.35 PIL: 135.35 MON264
TOM184C	LEPA EGHH	09:59:00	First call	PIL : Bordeaux, this is thomson 184C, FL340 CTL: bonjour Thomson 184C, proceed to AGN PIL: to AGN 184C
BIE1259	LICC LFRS	09:59:30	First call	PIL: Bordeaux bonjour, sky share 1259 CTL: bonjour 1259 GAI LACOU PIL: GAI LACOU 1259
FIN941	LPPT EFHK	10:00:00	First call	PIL: Bordeaux good morning FIN941, FL360 CTL: bonjour FIN 941, proceed FPL route
EXS739	EGNH LEAL	10:00:30	TFR	CTL: EXS739 contact Barcelona 135.35 PIL: 135.35 739 , Bye.
JKK3194	EGNV LEIB	10:01:00	First call	PIL: bonjour Bordeaux; spanair 3194 on course to GAI CTL: spanair 3194, proceed direct to PUMAL PIL: to PUMAL direct 3194, thank you
GSOVA	EGKB LEMH	10 :01 :15	TFR	CTL: GSOVA contact Barcelona 133.075 PIL: 133.075 GSOVA,Bye.
RYR9345	LEGE EGNT	10:01:30	TFR	CTL: Ryanair 3945, contact Bordeaux 132.335 PIL: 132.335 Ryanair 3945,Bye.

TOM032C	LEPA EGKK	10:02:00	First call	PIL: Bordeaux good morning, THOMSON 032 C CTL: bonjour 032C TOU CNA direct PIL: TOU CNA 032C
EZY1BP	LEBL EGKK	10 :04 :00	First call	PIL : Bordeaux Easy 1 BP bonjour CTL : bonjour BP, route to AGN PIL: to AGN 1 BP
IBE4432	LEBL LFPO	10:04:30	First call	PIL: Bordeaux this is Iberia 4432, level 320CTL: bonjour monsieur, proceed to AGNPIL: to AGN 4432
BAW15HL	EGLL HLLT	10:05:00	First call	PIL: Bordeaux good morning, speed bird 15 HL CTL: bonjour HL proceed to FJR PIL: to FJR, HL
TOM622G	LEIB EGKK	10:05:30	TFR	CTL: Thomson 622G contact bordeaux132.335, bye PIL: 132.335 622G, bye
TRA5061	EHRD LEGE	10:05:45	First call	PIL: Bordeaux this is transavia 5061, good morning CTL: bonjour monsieur, I call you back for descent PIL: roger, 5061
AFR976	LFPG FOOL	10:06:00	First call	PIL: Bordeaux, air france 9 76, niveau 330CTL : bonjour 9 76, direct FJRPIL : vers FJR 9 76
TOM184C	LEPA EGHH	10:06:15	TFR	CTL: Thomson 184C, contact Bordeaux 132.335 PI : 132.335 184C, bye CTL: good bye, sir.
AFR854	LFPG DNMM	10:07:00	First call	PIL: Bordeaux, air france 8 54, niveau 350, bonjour CTL : bonjour 8 54, direct KANIG PIL : direct KANIG 8 54
CFG655SAM	LPFR EDDS	10 :09 :00	TFR	CTL: CFG 655 Contact Marseille 132.255 PIL : ?????????? CTL : ??????????
CFG655SAM	LPFR EDDS		First call	PIL:???????????CTL: bonjour CFG 655 proceed LATAM ETREK, level 360. PIL: ???????????
NJE6YP	EGLC LFMN	10 :09 :30	TFR	CTL : 6 YP contact Marseille 134.260 PIL: 134.260 YP, bye CTL : bye
DAL32	KCVG LIRF	10:11:00	TFR	CTL: delta 32, contact Marseille 134.260 PIL: 134.260 delta 32
MYT826	LEMH EGNT	10 :11 :15	TFR	CTL: Kestrel 826, contact Marseille 118.880 PIL: 118.880 Kestrel 826, good bye
AF702MJ	LFPG LFMN	10:11:30	CLR	CTL: air France MJ, descendez niveau 320 PIL : quittons le 370 pour le 320 MJ
ELY032	KEWR LLBG	10 :11 :45	First call	PIL: Marseille, EL AL 032, good orning CTL: EL AL 032, bonjour, maintain level 370, flight plan route PIL: flight plan route, level 370, 032
AF570ZR	LFPO LFKJ	10:12:00	First call	PIL: bonjour Marseille, air france ZR CTL: bonjour Lonsieur 370, direct KURIR PIL : KURIR direct, ZR
DAH1048	DAAG LFQQ	10 :12 :30	TFR	CTL: air algérie 10 48, contactez Marseille 118.880 PIL: 118.880 pour air algérie 10 48. Au revoir.
BMA7656	LEPA EGKK	10 :15 :30	First call	PIL: Marseille bonjour, speed bird 7656, on course to MTL CTL: bonjour 7656, MTL ETREK PIL: MTL ETREK 7656
AEA1063	LPPT LIMC	10 :16 :00	First call	PIL: marseille, air europa 1063, bonjour CTL: air europa 1063 maintain level 340, flight plan route. PIL: flight plan route, 1063
TOM058Q	LEMH EGCC	10 :17 :00	TFR	CTL: Thomson058Q, contact Marseille 118.880 PIL: 118.880, thomson 058Q, bye
N5736	LFRI LFKF	10:18:00	First call	PIL: Marseille, N5736, level 390. CTL: N5736, maintain level 390, direct KURIR from position PIL : KURIR direct, 5736. Thank you
CFG655SAM	LPFR EDDS	10 :18 :30	TFR	CTL : CFG655, contact Marseille 128.780PIL :??????????????????CTL : ????????????????

ANNEX B - 2. Exercise 2

Scenario

EXPE4 SCENARIO2			
CONTROL SECTORS	**B,A,W (LFMM UIR)**	**FL305 > FL660**	
START / STOP	**10 :20 :00 / 10 :45 :00**		
SAM FLIGHT	CALLSIGN	**AZ644**	
	AIRCRAFT TYPE	**B737/300**	
	FROM /TO	**LIRF CYYZ**	
	FL	**320**	
	ROUTE in FRENCH AIRSPACE	**DOBIM AKUTI PIGOS BODRU KOTIT ETREK LERGA MALEB OBUBA FOUCO CNA LEBRI DESAB ERWAN RIVAK SIVIR**	
	POSITION AT START TIME	**1'30'' before PIGOS on UM616**	Lat/long:
	COMM STATUS	**In contact with ATC, freq 134.260 (A sector channel)**	
CONFLICT	TYPE	**CROSSING AZA02M PASSES BEHIND**	
	CONFLICT IN SECTOR	**W**	
	POSITION	**ETREK**	
	DISTANCE MINI / AT	**4NM / 10 :42 :15**	
	WITH	CALLSIGN	**AZA02M**
		AIRCRAFT TYPE	**B737 300**
		FROM /TO	**LPPR LIMC**
		FL	**320**
		CONVERGING TRACK	**MEN LATAM ETREK**
RTA SAM		**SPEED UP ACTION**	

Flight list in B&A&W sectors

- Sequence beginning/end: 10H20 / 10H45
- Nb of flights: 39
- All aircraft are separated by 5Nm at least (excepted AZA644 and AZA02M)

CALLSIGN	DEP/DEST	SECTOR	ENTRY TIME	ENTRY LEVEL	CONFLICT
NJE4QG	LFMN / EGLC	B	10 :20 :00	320	
DAL32	KCVG / LIRF	B	10 :20 :00	330	
TVS1056	LKPR / LEMD	B	10 :20 :00	390	
GWI75K	EDDH / LEPA	A	10 :20 :00	370	
AF 570 ZR	LFPO / LFKJ	A	10 :20 :00	350	
BMA7656	LEPA EGKK	W	10 :20 :00	340	
AEA1063	LPPT LIMC	W	10 :20 :00	340	
N96JA	LFMN KPHL	A	10 :20 :00	400	
ACA893	LIRF CYUL	B	10 :20 :00	320	
AZA644SAM	LIRF CYYZ	B	10 :20 :00	320	AZA02M / CROSSING at ETREK / FL 320/ DIST MIN = 4Nm at 10:42:15
AZA668	LIRF KEWR	W	10 :20 :30	400	
CSA688	LKPR / LEBL	A	10 :21 :00	370	
BOO937P	LFMN / EGLF	B	10 :22 :00	300↑380	
N5736	LFRI LFKF	W	10 :22 :00	390	
RAM840	GMMN EDDF	W	10 :22 :00	360	
AFR3382	LFLL DAAE	W	10 :22 :00	↑300	
FIN941	LPPT EFHK	W	10 :23 :00	360	
MHN82C	EGLF LIRN	W	10 :25 :00	390	

EZY4RB	LFQQ LFMN	W	10 :26 :30	310	
AEY208	LIPX / LEMD	B	10 :29 :00	350	
HLX49D	LPPR EDDK	W	10 :30 :00	380	
RYR6541	LFML EGSS	W	10 :30 :00	↑320	
SMJ984F	DNKN LFOK	W	10 :31 :00	400	
BLE451P	LIEA / LFPG	B	10 :32 :00	360	
AUA397U	LOWW / LEBL	B	10 :32 :00	350	
TOM352Q	LEMH EGGW	W	10 :32 :30	340	
GWI2605	GCTS / EDDF	W	10 :34 :00	340	
BER827C	LEMG EDDH	W	10 :34 :00	360	
GWI2605	GCTS EDDF	W	10 :34 :00	340	
AZA02M	LPFR LIMC	W	10 :36 :00	320	
DLH03F	EDDM / LEBL	B	10 :37 :00	350	
CC503 AH	LFKJ / LFPO	B	10 :37 :00	320	
FCA939D	LEMH / EGGP	W	10 :37 :00	340	
USA719	LIRF / KPHL	B	10 :38 :00	360	
JKK142	EDDM / LEVC	B	10 :39 :00	330	
AFL287	UUEE / LEBL	B	10 :41 :00	350	
IBE3464	GMMN LFST	W	10 :42 :00	340	
VPBAK	EGGD LFMD	W	10 :42 :00	370	
LBT3198	DTTJ / LFPG	B	10 :44 :00	340	

Radio communications

- Beginning / end of sequence: 10H20 / 10h45

CALLSIGN	DEP/DEST	TIME	CALL REASON	MESSAGES
NJE4QG	LFMN / EGLC	10:20:30	TRANSFER	CONT: fraction 4 Q G contact Marseille 132.005, good bye PIL: Marseille 132.005, 4 QG, bye
RAM840	GMMN / EDDF	10:22:00	FIRST CALL	PIL : Marseille this is air maroc 8 4 0 , level 360 , bonjour CONT: bonjour air maroc 8 4 0, maintain 360 direct to ETREK PIL: to ETREK direct 840
BOO937P	LFMN / EGLF	10 :22 :30	FIRST CALL	PIL: Marseille bonjour : BOO937P climbing level 300 CONT: bonjour 937P, climb level 380 PIL: up to level 380, 937P
FIN941	LPPT / EFHK	10:23:00	FIRST CALL	PIL: Marseille finnair 9 4 1 , level 380 , bonjour CONT: bonjour finnair 9 4 1, proceed direct to ETREK PIL: to ETREK direct finnair 941
MHN82C	EGLF / LIRN	10:23:30	FIRST CALL	PIL: Marseille , bonjour, manhattan 8 2 C level 390 CONT: bonjour 8 2C maintain level 390, flight plan route PIL: roger, 8 2 C
EZY4RB	LFQQ / LFMN	10:24:30	FIRST CALL	PIL: Marseille, easy 4 RB, flight level 310, bonjour CONT : bonjour easy 4 R B, proceed flight plan route PIL: FPL route 4 R B
AEA1063	LPPT / LIMC	10:25:00	TRANSFER	CONT: europa 1063, contact Marseille 133.425 PIL: 133.425 europa 1063, good bye
DAL32	KCVG / LIRF	10 :25 :15	TRANSFER	CONT: Delta 32, contact Marseille 133.760, bye PIL: 133.760 Delta 32
TVS1056	LKPR / LEMD	10 :25 :30	TRANSFER	CONT: T V S 1056 contact Marseille on 132.010 PIL: Marseille 132.010, TVS 1056, bye
AFR3382	LFLL / DAAE	10 :26 :00	TRANSFER	CONT: AIR France 33 82 , contactez Marseille 126.255 au revoir PIL: 126.255 air France 33 82 Au revoir
N5736	LFRI / LFKF	10 :26 :15	CLEARANCE	CONT: N5736, descent level 370 PIL : descending level 370 , N5736
BMA7656	LEPA / EGKK	10 :26 :45	TRANSFER	CONT : midland 7656, contact Marseille 133.235, bye PI : 133.235 midland 7656 good bye
GWI75K	EDDH / LEPA	10 :27 :00	TRANSFER	CONT: german, wings 75 K, keep present mach number and contact Marseille 133.880, bye PIL: 133.8800 with Marseille german wings 75K, bye
CSA688	LKPR / LEBL	10 :27 :15	TRANSFER	CONT: C S A 688, keep present mach number and contact Marseille 133.880, bye

				PIL: 133.880, with the same mach number CSA 688.
AF 570 ZR	LFPO / LFKJ	10 :28 :00	TRANSFER	CONT: air France ZR, contactez Marseille 133.760 PIL : avec Marseille 133.760, ZR au revoir
RAM840	GMMN / EDDF	10:28:30	TRANSFER	CONT: air maroc 840, contact Marseille 128.780 au revoir PIL : 128.780 air maroc 840 au revoir
FIN941	LPPT / EFHK	10 :29 :00	TRANSFER	CONT: Finnair 941, contact Marseille 128.780 , bye PIL: with Marseile 128.780 Finnair 941
HLX49D	LPPR / EDDK	10 :29 :15	FIRST CALL	PIL: Marseille, yellow cab 49D, bonjour CONT: bonjour yellow cab 49D, maintain level 380 to ETREK PIL: 380 ETREK yellow cab 49D
BOO937P	LFMN / EGLF	10:29:30	TRANSFER	CONT: contact Marseille on 128.780 PIL: 128.780, BOO937P
N96JA	LFMN / KPHL	10:29:45	TRANSFER	CONT: N96JA contact Bordeaux 132.335. PIL : Bordeaux 132.335 N96JA , bye
SMJ984F	DNKN / LFOK	10 :30 :00	FIRST CALL	PIL: Marseille, SMJ 984F level 400 , good morning CONT: Good morning SMJ 984 F, proceed direct to ETREK PIL: Direct ETREK, SMJ 984 F
AEY208	LIPX / LEMD	10:30:15	FIRST CALL	PIL: Marseille, AEY208, bonjour, level 350 CONT: bonjour AEY 208, proceed to KOLON PIL: on course to KOLON, AEY208
TOM352Q	LEMH / EGGW	10:30:30	FIRST CALL	PIL: Marseille, Thomson 352Q bonjour CONT: bonjour Thomson 352Q, proceed to ETREK direct PIL: on course to ETREK, 352Q
BLE451P	LIEA / LFPG	10:30:45	FIRST CALL	PIL : MarseilleBLE451P level 360 , good morning CONT: Good morning 451P, proceed direct to NEDRU PIL: Direct NEDRU, 451P
BER827C	LEJR / EDDH	10:31:00	FIRST CALL	PIL: Marseille, air berlin 827C , flight level 360 CONT: airberlin 827C maintain level 360 LATAM, ETREK PIL: 360 , LATAM, ETREK air berlin 827C
GWI2605	GCTS / EDDF	10 :31 :15	FIRST CALL	PIL: Marseille, german wings 2605 bonjour CONT: bonjour Thomson 352Q, proceed to ETREK direct PIL: on course to ETREK, 352Q
AUA397U	LOWW / LEBL	10 :31 :30	FIRST CALL	PIL: Marseille bonjour, austrian 397U, level 350 CONT: bonjour 397U, KOLON, GANGU PIL: KOLON, GANGU for austrian 397U
AZA02M	LEJR / EDDH	10 :34 :00	FIRST CALL	PIL: Marseille, alitalia 02M, flight level 320. CONT: bonjour alialia 02m, proceed to ETREK direct PIL: to ETREK direct, alitalia 02M
FCA939D	LEMH / EGGP	10 :34 :30	FIRST CALL	PIL: Marseille, FCA939D, level 340, good morning CONT: good morning 939D radar contact, proceed to ETREK direct PIL: to ETREK direct , 939D
DLH03F	EDDM / LEBL	10 :35 :00	FIRST CALL	PIL: Marseille, Lufthansa 03 F, bonjour CONT: bonjour Lufthansa 03 F, proceed to KOLON direct PIL: on course to KOLON, 03F
CC503 AH	LFKJ / LFPO	10:35:30	FIRST CALL	PIL: Marseille, corsair AH, PIGOS, niveau 320, bonjour CONT: bonjour monsieur, niveau 320 direct NEDRU de la position PIL : NEDRU de la position corsair AH
JKK142	EDDM / LEVC	10:35:15	FIRST CALL	PIL: Marseille ,spanair 142, flight level 330 CONT: bonjour spanair 142, maintain level 330 to KOLON, GANGU PIL: KOLON, GANGU, spanair 142, thank you
ACA893	LIRF / CYUL	10:35:45	TRANSFER	CONT: air Canada 893, contact Bordeaux 133.465 PIL: 133.465, air canada 893, au revoir CONT: au revoir monsieur
AZA668	LIRF / KEWR	10 : 36 :00	TRANSFER	CONT: Alitalia 668, turn to LERGA direct and contact Bordeaux on 132.335 PIL: To LERGA direct qnd Bordeaux 132.335. Good bye sir CONT: Good bye
RYR6541	LFML / EGSS	10 :36 :15	TRANSFER	CONT: ryanair 6541, contact Marseille 133.235, good bye PIL: 133.235, 6541, bye
HLX49D	LPPR / EDDK	10 :36 :30	TRANSFER	CONT: yellow cab 49D contact Marseille on 128.780 PIL : Marseille 128.780 , 49D, Bye
USA719	LIRF / KPHL	10:36:45	FIRST CALL	PIL: Marseille US air 719 flight level 360 CONT: US air 719 maintain level 360 and proceed NEDRU direct PIL: direct NEDRU, US air 719
VPBAK	DGGD / LFMD	10:38:00	FIRST CALL	PIL: Marseille VPBAK, reaching LERGA level 370 CONT: VPBAK, proceed direct MTL, I call you back for descent

				PIL: direct MTL , VPBAK
EZY4RB	LFQQ / LFMN	10:38:30	TRANSFER	CONT: easy 4 RB, for futher descent, contact Marseille 131.005, good bye PIL: 131.005 easy 4 RB, bye
AFL287	UUEE / LEBL	10:39:00	FIRST CALL	PIL: Marseille, Aeroflot 287, bonjour CONT: bonjour Aeroflot 287, proceed direct KOLON, then GANGU PIL: KOLON, GANGU, aeroflot287
BER827C	LEJR / EDDH	10 :40 :00	TRANSFER	CONT: air berlin 827C contact Marseille 128.780 PIL: Marseille 128.780, berlin 827 C
IBE3464	LEMD / LSZH	10 :40 :15	FIRST CALL	PIL: Marseille IBE3464, level 340, bonjour CONT: IBE3464, proceed direct ETREK , maintain level 340 PIL: direct ETREK, level 340, IBE3464
GWI2605	GCTS / EDDF	10:40:30	TRANSFER	CONT: german wings 2605 contact Marseille 132.005 PIL: Marseille 132.005, german wings 2605
AEY208	LIPX / LEMD	10:41:00	TRANSFER	CONT: AEY 208 contact Marseille on 127.840 , bye PIL: 127.840 AEY208, bye
LBT3198	DTTJ / LFPG	10:42:00	FIRST CALL	PIL: marseille, tunisair 3198, 340 on corse to PIGOS, bonjour CONT: bonjour tunisair 3198, proceed flight plan route PIL: flight plan route, 3198
MHN82C	EGLF / LIRN	10:43:00	TRANSFER	CONT: Manhattan 82C contact Marseille 127.180 PIL : 127.180 Manhattan 82C, Bye CONT: bye sir
AZA644	LEJR / EDDH	10:43:30	TRANSFER	CONT: AZA644 contact bordeaux 133.465, bye PIL: bordeaux 133.465, good bye sir
AZA02M	LEJR / EDDH	10:43:35	TRANSFER	CONT: AZA02M contact marseille132.005, bye PIL: marseille132.005, good bye sir

ANNEX B - 3. Exercise 3

Scenario

EXPE4 SCENARIO3			
CONTROL SECTORS	**T (LFBB UIR) then W (LFMM UIR)**	**FL305 > FL660**	
START / STOP	**10 :30 :00 / 10 :45 :00**		
SAM FLIGHT	CALLSIGN	**EZY6117**	
	AIRCRAFT TYPE	**B737/800**	
	FROM /TO	**EGAA / LFMN**	
	FL	**390 then 370 then 330**	
	ROUTE in FRENCH AIRSPACE	**VEULE / REMSI / KOTAP / KETEX / KOTIS / KUKOR / LERGA / LATAM / MTL / GIROL / MEDOK / AMFOU / TIPIK / MUS**	
	POSITION AT START TIME	**1 Min to KUKOR on UM728 (34.5Nm behind VPBAK)**	Lat/long:
	COMM STATUS	**In radio contact with T sector (LFBB)**	
CONFLICT	TYPE	**OVERTAKING**	
	CONFLICT IN SECTOR	**T&W**	
	POSITION	**ALL ROUTE LONG UNTIL INITIAL DESCENT OF VPBAK (10:48:00)**	
	DISTANCE MINI / AT	**6.54Nm at 10:48:00**	
	WITH	CALLSIGN	**VPBAK**
		AIRCRAFT TYPE	**C550**
		FROM /TO	**EGGD / LFMD**
		FL	**370 then 320**
		CONVERGING TRACK	**Same route**
RTA SAM	**SLOW DOWN**		

Flight list in T&W sectors

- Sequence beginning/end: 10H30 / 10H45
- Nb of flights simulated: 22 + EZY6117+VPBAK (17 in T and 5 in W when EZY6117 in crossing these sectors)
- All aircraft are separated by 5Nm at least

CALLSIGN	DEP/DEST	SECTOR	ENTRY TIME	ENTRY LEVEL	CONFLICT
EZY6117 SAM	EGAA / LFMN	T	10 :30 :00	370	OVERTAKING VPBAK (GS# = 90kts): 34.5Nm behind VPBAK at 10:30:00 / 6.54Nm at 10:48:00 Due to destination, the two aircraft have to enter W sector at FL370, and live it at FL320.
VPBAK	EGGD LFMD	T	10 :30 :00	370	
LTU152	EDDL / LEIB	T	10 :30 :00	330	
AF680ZA	LFPG / LFMT	T	10 :30 :00	310	
DAL83	LFMN / KJFK	T	10 :30 :00	320	
BER49Z	EDLP / LEPA	T	10 :30 :00	350	
N96JA	LFMN KPHL	T	10 :30 :00	400	
DLH11F	EDDM / LEMD	T	10 :32 :00	350	
AFR3178	LFRS / LIMC	T	10 :37:00	310	
JKK164	LOWW / LEMD	T	10 :37 :00	350	
RYR6541	LFML / EGSS	W	10 :35 :00	□340	
BAW354N	EGLL / LFMN	T	10 :37 :00	370	
JKK164	LOWW / LEMD	T	10 :37 :00	350	

ACA893	LIRF CYUL	T	10 :38 :00	320	
NJE5RH	EGLF / LFMN	T	10 :39 :00	370	
DLH64Y	EDDH / EDDL	T	10 :40 :00	330	
AZA668	LIRF KEWR	T	10 :40 :00	400	
AZA644	LIRF CYYZ	W	10 :40 :00	320	
BMI1995	EGBB / LFML	T	10 :40 :00	350	
BER37H	EDDG / LEPA	T	10 :41 :00	370	
IBE3464	LEMD / LSZH	W	10 :42 :00	340	
DLH92A	LEMD / EDDL	W	10 :45 :00	340	
AZA02M	LPPR / LIMC	W	10 :36 :00	320	
BER37H	EDDG / LEPA	T	10 :41 :00	370	

Radio communications

- Beginning / end of sequence: 10H30 / 10H45
- EZY6117 (SAM) in contact with sector T at 10H30 and will contact sector W at 10H42.

CALLSIGN	DEP/DEST	TIME	CALL REASON	MESSAGES
DLH11F	EDDM / LEMD	10 :30 :30	FIRST CALL	PIL: Bordeaux, Lufthansa 11 F, good morning CONT: Lufthansa 11 F good morning, maintain level 350 to LERGA, OLRAK. PIL: 350, LERGA, OLRAK , Lufthansa 11F.
LTU152	EDDL / LEIB	10 :31 :00	TRANSFER	CONT: L T U 152, contact bordeaux 134.61, bye PIL: bordeaux 134.61, LTU152, Bye.
N96JA	LFMN KPHL	10 :31 :30	CLEARANCE	CONT: N 96JA, proceed direct to Cognac PIL: direct to Cognac, thank you , N96JA
DAL83	LFMN / KJFK	10 :32 :00	CLEARANCE	CONT: delta 83, proceed direct to Limoges PIL: direct to Limoges, delta 83.
AF680ZA	LFPG / LFMT	10 :33 :00	TRANSFER	CONT: Air France ZA, contactez bordeaux 124.075 PIL: 124.075, air France ZA , au revoir CONT: au revoir ZA
DAL83	LFMN / KJFK	10 :34 :00	TRANSFER	CONT: delta 83, contact bordeaux 135.24, au revoir PIL: bordeaux 135.24 delta 83, good bye.
JKK164	LOWW / LEMD	10:34:30	FIRST CALL	PIL: Bordeaux bonjour, this is Spanair 164, level 350. CONT: bonjour Spanair 164, proceed LERGA, OLRAK. PIL: LERGA , OLRAK, spanair 164.
BAW354N	EGLL / LFMN	10:35:00	FIRST CALL	PIL: Bordeaux, speed bird 354N, level 370 CONT: speed bird 354N, maintain level 370 to LERGA , LATAM PIL: LERGA, LATAM for speed bird 354N
ACA893	LIRF CYUL	10:35:30	FIRST CALL	PIL: Bordeaux, Air Canada 893, good morning CONT: Air Canada 893 good morning , maintain level 320 , proceed flight plan route PIL: level 320 , flight plan route , 893
DLH11F	EDDM / LEMD	10: 36:00	CLEARANCE	CONT: Lufthansa 11F, for radar spacing, continue on present heading PIL: we continue on heading 247, Lufthansa 11F
BER49Z	EDLP / LEPA	10:36:30	CLEARANCE	CONT: air berlin 49Z, for radar spacing, continue on present heading PIL: we keep heading 175, air berlin 49Z
AFR3178	LFRS / LIMC	10:37:00	FIRST CALL	PIL: bordeaux, air France 31 78, bonjour CONT: bonjour 31 78, 3 10, VALKU, MADOT PIL: VALKU, MADOT, 31 78.
NJE5RH	EGLF / LFMN	10 :37 :45	FIRST CALL	PIL: Bordeaux, fraction 5 RH, level 370 CONT: fraction 5 RH, maintain level 370 to LERGA , LATAM PIL: level 370, LERGA, LATAM , fraction 5 RH
AZA668	LIRF KEWR	10:38:00	FIRST CALL	PIL: Bordeaux, Alitalia 668, level 400, bonjour CONT: bonjour Alitalia 668, maintain level 400 direct to FOUCO PIL: direct to FOUCO , Alitalia 668
N96JA	LFMN KPHL	10 :38 :15	TRANSFER	CONT: N96JA, contact bordeaux 133.230 PIL: 133.230, N96JA, good bye CONT: good bye , sir
DLH64Y	EDDH / EDDL	10 :38 :30	FIRST CALL	PIL: bordeaux, lufthansa 64Y, level 330

				CONT: bonjour lufthansa 64Y, proceed to VALKU, OLRAK PIL: to VALKU and OLRAK, Lufthansa 64Y
BER37H	EDDG / LEPA	10:39:30	FIRST CALL	PIL: Bordeaux, air berlin 37H, level 370 CONT: bonjour air berlin 37H, proceed to VALKU, OLRAK PIL: VALKU , OLRAK, air berlin 37H
VPBAK	EGGD LFMD	10 :40 :00	TRANSFER	CONT: VPBAK contact marseille 132.255 PIL: 132.255, VPBAK, Good bye CONT: good bye , sir
BER49Z	EDLP / LEPA	10 :41 :30	TRANSFER	CONT : air berlin 49Z, resume own navigation to GONIM and contact Bordeaux channel 132.910 PIL : to GONIM and 132.910, air berlin 49Z
DLH11F	EDDM / LEMD	10:42:00	TRANSFER	CONT: Lufthansa 11F, resume own navigation direct to Agen, and contact Bordeaux on 122.415, Bye PIL: direct Agen , and with Bordeaux 122.415, Lufthansa 11F, Bye.
EZY6117 SAM	EGAA / LFMN	10 :42 :15	TRANSFER	CONT: Easy 6117, contact marseille 132.255, good bye. PIL: ????????????
EZY6117 SAM	EGAA / LFMN	10 :42 :30	FIRST CALL	PIL : ?????????????????? CONT : bonjour easy 6117, maintain level 370, proceed flight plan route PIL: ????????????????
DLH92A	LEMD / EDDL	10:43:00	FIRST CALL	PIL: Marseille , bonjour, Lufthansa 92 A, level 340. CONT: Bonjour Lufthansa 92 A, proceed direct ETREK PIL: direct to ETREK, 92A
AZA02M	LPPR / LIMC	10:43:15	TRANSFER	CONT: alitalia 02M, resume own navigation to LTP and contact Marseille 132.005 PIL: to LTP , and with Marseille 132.005, alitalia 02M, Bye CONT: good bye, sir
AZA644	LIRF CYYZ	10 :43 :30	TRANSFER	CONT: alitalia 644, proceed to LERGA from position and contact Bordeaux 133.465. PIL: to LERGA and 133.465, alitalia 644.
IBE3464	LEMD / LSZH	10:44:00	CLEARANCE	CONT: Iberia 3464, what is your mach number? PIL: mach 0 7 7, Iberia 3464 CONT: roger, maintain point 7 7 as minimum PIL: point 77 as minimum, 3464.
DLH92A	LEMD / EDDL	10:44:15	CLEARANCE	CONT: Lufthansa 92 A, say your mach number? PIL: mach 0 7 7, Lufthansa 92 A CONT: roger, maintain point 7 7 as maximum PIL: point 77 as maximum, Lufthansa 92 A

ANNEX B - 4. Exercise 4

Scenario

EXPE4 SCENARIO4			
CONTROL SECTORS	**M+W (LFMM UIR)**	**FL305 > FL660**	
START / STOP	**09h00 / 09h15**		
SAM FLIGHT	CALLSIGN	**BMA7638**	
	AIRCRAFT TYPE	**A321**	
	FROM /TO	**LEPA / EGMH**	
	FL	**340**	
	ROUTE in FRENCH AIRSPACE	**LUMAS/SOSUR/MRM/MTL ETREK/MADOT ATN/AVLON/OKRIX/BRYCLM/UTELA/KOPOR/KOMEL/ABSUD/GUBAR**	
	POSITION AT START TIME	**14Nm before MRM on UM976**	Lat/long:
	COMM STATUS	**In contact with M sector (LFMM)**	
CONFLICT	TYPE	**OVERTAKING**	
	CONFLICT IN SECTOR	**M&W**	
	POSITION	**ALL ROUTE LONG**	
	DISTANCE MINI / AT	**10Nm 09h16:30**	
	WITH	CALLSIGN	**JXX1291**
		AIRCRAFT TYPE	**HS25B**
		FROM /TO	**LEPA / BIKF**
		FL	**340**
		CONVERGING TRACK	**Same route**
RTA SAM			

Flight list in (M+W) sectors

- Sequence beginning/end: 09h00 / 09h17
- Nb of flights: 30
- All aircraft are separated by 5Nm at least

CALLSIGN	DEP/DEST	SECTOR	ENTRY TIME	ENTRY LEVEL	CONFLICT
BMA7638 SAM	LEPA EGMH	M+W	09 :00 :00	340	450kts / Overtaking JXX1291 / 10Nm 09 :16 :30
JXX1291	LEPA BIKF	M+W	09 :00 :00	340	430kts
JKK027	LEMD / EKCH	M+W	09 :00 :00	320	
BZ747VV	LFRN / LFMN	M+W	09 :00 :00	320	
AZA611	KJFK / LIRF	M+W	09 :00 :00	350	
N1GN					
	KEWR / LLBG	M+W	09 :00 :00	410	
AEAE518	EDDN / LEPA	M+W	09 :00 :00	370	
TCX235L	LEMH / EGKK	M+W	09 :00 :00	360	
AZA3R6	LIMC / LEMG	M+W	09 :00 :00	330	
MSR996	CYUL / HECA	M+W	09 :02 :00	370	
JAF904	LEMG / EBBR	M+W	09 :02 :00	320	
GWI2522	EDDS / LEBL	M+W	09 :02 :00	350	
NJE7GZ	EGLC / LIEO	M+W	09 :03 :00	410	
TCX959L	LEIB / EGKK	M+W	09 :03 :00	380	
AFR238G	LFPG / DTTA	M+W	09 :04 :00	370	
TSO9130	LPFR / UUDD	M+W	09 :05 :00	360	
XLA587	LEMH / EGKK	M+W	09 :09 :00	320	
TSC418	CYUL / LIRF	M+W	09 :10 :00	350	

COA40	KEWR / LIRF	M+W	09 :11 :00	370	
ACL9351	LFBT / LIME	M+W	09 :11 :00	350	
MON471	LEMH / EGBB	M+W	09 :11 :00	340	
NJE798G	EDDM / LEIB	M+W	09 :11 :00	410	
AF3244	LFBO / LIMC	M+W	09 :12 :00	320	
MON3125	LEMH / EGCC	M+W	09 :13 :00	360	
HLX8PE	EDJA / LEPA	M+W	09 :13 :00	390	
MYT194	LEMH / EGCC	M+W	09 :15 :00	360	
NRD516	EDDM / LEPA	M+W	09 :16 :00	330	
EZY4PN	LFPO / LFMN	M+W	09 :17 :00	370	
MPJ9951	EIDW / LICC	M+W	09 :17 :00	330	
N606AT	LEPA / EIDW	M+W	09 :18 :00	400	

Radio communications

- Beginning / end of sequence: 09h00 / 09h17

CALLSIGN	DEP/DEST	TIME	CALL REASON	MESSAGES
TCX959L	LEIB / EGKK	09:00:30	FIRST CALL	PIL: Marseille, top jet 959L, level 380, bonjour CONT : bonjour top jet 959L, proceed MRM , ETREK PIL: MRM , ETREK , top jet 959L
BZ747VV	LFRN / LFMN	09:01:00	TRANSFER	CONT: britair V deux fois, maintenez 320 et contactez Marseille 134.26. PIL: Marseille 134.26 , V deux fois , au revoir. CONT : au revoir Monsieur.
AZA611	KJFK / LIRF	09 :01 :15	TRANSFER	CONT: Alitalia 611 contact Marseille 134.26 Bye PIL: 134.26 Alitalia 611, Bye.
JKK027	LEMD / EKCH	09 :01 :30	TRANSFER	CONT: spanair 027, with marseille 132.005 PIL: marseille 132.005, spanair 027
MSR996	CYUL / HECA	09 :01 :45	FIRST CALL	PIL: Marseille, egyptair 996, level 370 CONT: egyptair 996, proceed flight plan route PIL: flight plan route for egyptair 996
NJE7GZ	EGLC / LIEO	09:02:00	FIRST CALL	PIL bonjour Marseille, fraction 7 GZ, level 410 CONT : bonjour fraction 7 GZ, proceed to KURIR PIL : to KURIR direct , fraction 7 GZ
JAF904	LEMG / EBBR	09 :02 :30	FIRST CALL	PIL : Marseille, J A F 904, level 320 on course to LATAM CONT : bonjour 904, proceed to ETREK direct PIL: direct to ETREK, 904
GWI2522	EDDS / LEBL	09:02:45	FIRST CALL	PIL: Marseille, this is German wings 2522, bonjour CONT: bonjour 2522b flight plan route, I call you back for descent PIL: standing by for descent 2522
AFR238G	LFPG / DTTA	09:03:00	FIRST CALL	PIL: Marseille, air France 238 G bonjour , niveau 370 CONT : bonjour 238G, direct DIVKO BALOK PIL : roger, DIVKO, BALOK de la position 238 G
N1GN	KEWR / LLBG	09 :03 :30	TRANSFER	CONT : N1GN, contact Marseille 135.29, bye. PIL : 135.29 N1GN, Bye.
TSO9130	LPFR / UUDD	09 :04 :00	FIRST CALL	PIL : Marseille, tourismo 9130, good day CONT good day Tourismo 9130, proceed direct ETREK PIL: direct ETREK 9130
MSR996	CYUL / HECA	09:06:00	TRANSFER	CONT: egyptair 996, contact Marseille 135.29 PIL: maresille 135.29, egyptair 996
XLA587	LEMH / EGKK	09 :07 :00	FIRST CALL	PIL : marseille EXPO 587, bonjour, level 320 CONT : bonjour EXPO 587, MRM, ETREK direct PIL : to MRM then E RTREK EXPO 587
TSC418	CYUL / LIRF	09:07:45	FIRST CALL	PIL: Marseille air transat 418 , Bonjour. CONT : bonjour 418 proceed flight plan route PIL: 418
COA40	KEWR / LIRF	09:08:00	FIRST CALL	PIL : Marseille continental 40 flight level 370 to LERGA CONT : continental 40, after LERGA proceed KURIR direct

				PIL: LERGA , KURIR for continental 40
ACL9351	LFBT / LIME	09:08:30	FIRST CALL	PIL: Marseille bonjour, A C L 9351 CONT : 9351, bonjour, proceed PIGOS direct PIL : direct to PIGOS 9351
AF3244	LFBO / LIMC	09:09:00	FIRST CALL	PIL: Marseille, air france 32 44 niveau 320, bonjour CONT : bonjour air France 32 44, maintenez 320, direct ETREK PIL : direct ETREK air France 32 44
JAF904	LEMG / EBBR	09 :09 :30	TRANSFER	CONT : JAF 904, contact marseille 132.005 PIL : 132.005, JAF 904
NJE7GZ	EGLC / LIEO	09 :10 :00	TRANSFER	CONT : fraction 7 GZ, contact Marseille 135.29 PIL : 135.29, fraction 7 GZ, bye CONT : bye
MON471	LEMH / EGBB	09 :10 :30	FIRST CALL	PIL : marseille, monarch 471, bonjour CONT : bonjour Monarch 471, proceed MRM, ETREK direct PIL : MRM , ETREK direct, monarch 471
MON3125	LEMH / EGCC	09 :11 :00	FIRST CALL	PIL : marseille, monarch 3125, bonjour, level 360 CONT : bonjour Monarch 3125, proceed MRM, ETREK direct PIL: MRM then ETREK direct, monarch 3125
TSO9130	LPFR / UUDD	09:11:15	TRANSFER	CONT: tourismo 9130, contact Marseille 128.78 PIL: 128.78, tourismo 9130, good bye.
HLX8PE	EDJA / LEPA	09:11:30	FIRST CALL	PIL: Marseille yellow cab 8 PE flight level 390 CONT : bonjour yellow cab 8 PE, you may turn to MAMES direct PIL: to MAMES direct , yellow cab 8 PE, thank you
TCX235L	LEMH / EGKK	09:12:00	TRANSFER	CONT: top jet 235 l , contact Marseille 118.880 PIL : 118.880, top jet 235L, Bye
AEA518	EDDN / LEPA	09 :12 :15	TRANSFER	CONT : Europa 518, contact barcelona 133.075 , bye PIL : with Barcelona on 133.075, Bye.
GWI2522	EDDS / LEBL	09:12:30	CLEARANCE	CONT: German wings 2522, descent level 290 PIL: descending level 290 German wings2522
TCX235L	LEMH / EGKK	09:12:45	TRANSFER	CONT: top jet 235 L, contact Marseille 118.880, Bye PIL : marseille 118.880, Bye.
MYT194	LEMH / EGCC	09:13:00	FIRST CALL	PIL: Marseille, kestrel 194, , flight level 360 CONT: bonjour kestrel 194, proceed flight plan route PIL: roger, flight plan route for kestrel 194
AZA3R6	LIMC / LEMG	09:13:30	TRANSFER	CONT: alitalia 3 R6, contact Barcelona 133.075 Bye PIL: Barcelona, 133.075, Bye.
EZY4PN	LFPO / LFMN	09:14:00	FIRST CALL	PIL: Marseille, easy 4 PN, reaching LERGA CONT: easy 4 PN , LERGA MTL, I call you back for descent PIL: LERGA , MTL easy 4 PN
NRD516	EDDM / LEPA	09:14:30	FIRST CALL	PIL: Marseille, good morning, this is North Rider 516 CONT: good morning North rider 516 maintain level 330 to MTG, MAMES PIL MTG, MAMES for North Rider 516
N606AT	LEPA / EIDW	09:15:00	FIRST CALL	PIL: Marseille, N606AT , flight level 400 to SOSUR CONT: bonjour N606AT, proceed flight plan route PIL: roger, flight plan route 606 AT
GWI2522	EDDS / LEBL	09:15:30	TRANSFER	CONT: german wings 2522, maintain 290 and contact barcelona 133.025 PIL: with Barcelona 1133.025, german wings 2522
JXX1291	LEPA BIKF	09:16:00	TRANSFER	CONT : jet X 1291, contact marseille 133.235 PIL : marseille 133.235, jet X 1291 , good bye CONT : good bye Sir.
BMA7638	LEPA / EGMH	09 :16 :15	TRANSFER	CONT : midland 7638, contact Marseille 133.235 , good bye PIL: ??????????

End of annexes