Episode 3

Single European Sky Implementation support through Validation

Document information	
Programme	Sixth framework programme Priority 1.4 Aeronautics and Space
Project title	Episode 3
Project N°	037106
Project Coordinator	EUROCONTROL Experimental Centre
Deliverable Name	Detailed Operational Description - Network Management in the Execution Phase - E4
Deliverable ID	D2.2-046
Version	3.00
Owner	
Rosalind Eveleigh	EUROCONTROL
Contributing partners	

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

- This page is intentionally blank -

DOCUMENT CONTROL

Approval

Role	Organisation	Name
Document owner	EUROCONTROL	Rosalind Eveleigh
Technical approver	EUROCONTROL	Giuseppe Murgese
Quality approver	EUROCONTROL	Frederique Senechal
Project coordinator	EUROCONTROL	Philippe Leplae

Version history

Version	Date	Status	Author(s)	Justification - Could be a reference to a review form or a comment sheet
1.00	19-11-2009	Approved	Sönke Mahlich Serge Manchon	Approval of the document by the Episode 3 Consortium.
2.00	01-02-2010	Approved	Ros Eveleigh	Alignment with ATM Process Model.
3.00	15-04-2010	Approved	Ros Eveleigh	Alignment with DOD. Approval of the document by the Episode 3 Consortium.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

TABLE OF CONTENTS

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The SESAR Detailed Operational Description (DOD) is composed of nine main documents. Each document is mapped on:

- A specific operational phase:
  - Long-term planning;
  - Medium/short-term planning;
  - Execution.
- A specific operational layer:
  - Network management: sub-regional and regional;
  - Airspace management: civil/military;
  - Airport airside operations: runway, apron and taxiway management;
  - Conflict management: terminal and en-route airspace;
  - Airspace user operations: trajectory management.

The DOD addressed by the present document focuses on the operating principles relevant to the Execution Phase for:

- Network management;
- Airspace management;
- Airspace user operations, when interacting with the network management function.

Airport operations and ATC operations are covered by separate documents. Airports are nonetheless scoped by this DOD when regarded as network nodes and not as local resources to manage. Likewise, the relationship between network and ATC operations is also analysed.

From a network perspective, the Network Operations Plan developed in the mid/short-term is managed on the day of operation: the capacity plan is activated and the trajectories are progressively executed. The NOP is continuously updated with real-time information, derived from onboard or ground data, so as to accurately reflect the current situation and provide all ATM Stakeholders with a common, high-fidelity picture of actual operations allowing them to react to operational deviations

From the perspective of an individual flight, **the Execution Phase begins with the instantiation of the flight Reference Business / Mission Trajectory**, and terminates after execution of the flight trajectory.

The RBT underpins the NOP integrity in operation: The Airspace User agrees to fly the RBT and the ANSP and the airport agree to facilitate execution of the same RBT.

The Network Management function, embodied in the Sub-Regional and Regional Network Managers, operates seamlessly to manage operations from a network viewpoint in order to maximise the overall capacity available to Airspace Users, while preserving the forecast net return of the individual which would be a priori achieved through execution of the originally agreed RBT.

During flight execution, the RBT Revision mechanism is triggered whenever new constraints[1] arise in the network and have to be met by the trajectory. The Revision takes the form of

[1]A constraint is a factor which must be taken into account by the user when constructing the Business or Mission Trajectory, or which might occur during execution and in this case would lead to a revision of

either a CDM process involving the Airspace User (trajectory owner), and the interested parties (RBT revision becomes effective through RBT update, after validation[2] by the Regional Network Manager) or tactical interventions of the Controller (described in DOD E6).

Sub-Regional Network Managers cope with the activated resources[3] they are in charge of. The airspace configuration is dynamically adjusted whereas the traffic flows are locally optimised in a collaborative manner through 1) strategic de-confliction when RBTs are accurate and predictable enough, 2) dynamic demand / capacity balancing by controlling traffic density or traffic complexity, 3) integration of DCB with ASM, 4) and by smoothing real-time transitions during airspace re-configurations for the continuity of operations. Dynamic DCB Solutions based on traffic demand or/and capacity scenarios are also increasingly used. They result from post ops analysis.

The Regional Network Manager acts as a synchroniser and integrator of DCB Solutions, through the NOP, so as to create network-wide synergies, avoid counterproductive actions, harness capacity opportunities, harmonise operations and make them a continuum throughout the Region – and on its boundaries as well (ECAC inbound and outbound flows). The Regional Network Manager is also the one to secure or/and recover network stability in the face of contingencies (unexpected events).

The end-goal of network management at the local level is met when trajectories approach the long-term planning[4] horizon of the controller. **The Local DCB Complexity manager** acts as an interface between DCB and ATC. The Local DCB Complexity manager works at preventing overloads by delivering to ATC traffic they can handle safely i.e. with an acceptable density and/or DCB complexity[5], and at reducing the tactical interventions needed for separation provision. Conflict management is eased by strategic de-confliction, while traffic synchronisation is eased by the pre-sequencing operated by DCB queue management measures. The airspace organisation can be dynamically fine-tuned either through airspace re-configuration and/or re-sectorisation and/or by applying a temporary airspace structure e.g. a temporary local route network. In any case, RBT are collaboratively revised when needed.

When the day of operation is over and trajectories have been executed, the Network Management function has delivered a Service which has to be aligned with the Target Performance Levels of the Established Performance Framework[6]. **Post ops analysis** provides the feedback and support needed to assess conformance of passed operations in order to improve the performance of future operations.

---

the RBT/RMT. To the broadest sense, the constraint might result from an unexpected event (e.g. system failure) to the tactical intervention of a controller.

[2] Note that the Regional Network Manager may arbitrate decision making in order to react timely.

[3] Dynamic sectorisation, active configuration, route structure, where needed; military areas activated whatever the type, and airport configuration.

[4] This is an enlarged time horizon for the purpose of ATC e.g. the time horizon relevant to multi-sector planning. 15 min to 30 min seems to be a sensible order of magnitude.

[5] ATC Complexity is different from DCB Complexity. The DCB complexity indicator is based on a probabilistic model. It allows activities such as dynamic route allocation and as such is an input to strategic de-confliction. ATC complexity is an input to flight de-confliction. Complexity management is the interface between dynamic DCB and long-term ATC planning.

[6] Refer to Long Term Planning (DOD L).

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

1 INTRODUCTION

1.1 PURPOSE OF THE DOCUMENT

This document provides a refined description of the SESAR concept of operations regarding operational processes taking place at the airspace and network levels during the execution phase. Referred as "Network Management in the Execution Phase – E4", this document is part of a set of Detailed Operational Description (DOD) documents which refine and clarify the high level SESAR ConOps concept description in order to support the Episode 3 exercises, which have the objective of developing a better understanding of the SESAR Concept. This set of DODs can be considered as step 0.2 of E-OCVM [1] - i.e. the description of the ATM Operational Concept(s). The DOD document structure and content is derived from the one of the OSED (Operational Service and Environment Definition) described by the ED-78A guidelines [2]. According to the ED-78A: "*the OSED identifies the Air Traffic Services supported by data communications and their intended operational environment and includes the operational performances expectations, functions and selected technologies of the related CNS/ATM system*". The structure of the DOD has been defined considering the level of details that can be provided at this stage – i.e. the nature and maturity of the concept areas being developed.

The complete detailed description of the mode of operations is composed of 10 documents according to the main phases defined by SESAR – i.e. Long-term Planning phase, Medium/Short-term Planning and Execution Phase (the complete set of documents is available from the Episode 3 portal home page [3]):

- The General DOD (G DOD) [4];
- The Long-term Network Planning DOD (L DOD) [5];
- The Collaborative Airport Planning DOD (M1 DOD) [6];
- The Medium & Short-term Network Planning DOD (M2 DOD) [7];
- The Runway Management DOD (E1 DOD) [8];
- The Apron & Taxiways Management DOD (E2/3 DOD) [9];
- The Network Management in the Execution Phase DOD (E4 DOD), this document;
- The Conflict Management in Arrival & Departure High & Medium/Low Density Operations DOD (E5 DOD) [11];
- The Conflict Management in En-Route High & Medium/Low Density operations DOD (E6 DOD) [12];
- The Episode 3 Lexicon (Glossary of Terms and Definitions) [13].

1.2 INTENDED AUDIENCE

The intended audience includes:

- Episode 3 partners;
- The SESAR community.

1.3 DOCUMENT STRUCTURE

The structure of the document is as follows:

- §2 of this document provides an overview of the functions addressed in this document;

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

- §3 provides a description of how today's operation will be changed with the implementation of the concept area under analysis;
- §4 gives a description of the future operating principles. It details the benefits, the constraints, the human factors aspects, the enablers, the actors and the operating methods;
- §5 gives environment constraints of interest to the DOD (a general document provides this information at the global level);
- §6 lists roles and responsibilities applicable to this concept area;
- Annex A provides the list of the various scenarios relevant to this document;
- Annex B provides the summary of the Use Cases defined in this document;
- Annex C contains the traceability table of the SESAR Operational Improvement (OI) steps addressed by this document.

1.4 BACKGROUND

The Episode 3 project, also called "Single European Sky Implementation Support Through Validation", was signed on 18th April 2007 between the European Community and EUROCONTROL under the contract N° TREN/07/FP6AE/S07.70057/037106. The European Community has agreed to grant a financial contribution to this project equivalent to about 50% of the cost of the project.

The project is carried out by a consortium composed of EUROCONTROL, Entidad Publica Empresarial Aeropuertos Espanõles y Navegacion Aérea (AENA); AIRBUS France SAS (Airbus); DFS Deutsche Flugsicherung GmbH (DFS); NATS (EN Route) Public Limited Company (NERL); Deutsches Zentrum für Luft und Raumfahrt e.V.(DLR); Stichting Nationaal Lucht en Ruimtevaartlaboratorium (NLR); The Ministère des Transports, de l'Equipement, du Tourisme et de la Mer de la République Française represented by the Direction des Services de la Navigation Aérienne (DSNA); ENAV S.p.A. (ENAV); Ingenieria y Economia del Transporte S.A (INECO) ISA Software Ltd(ISA); Ingeneria de Sistemas para la Defensa de Espana S.A (Isdefe); Luftfartsverket (LFV); Sistemi Innovativi per il Controllo del Traffico Aereo (SICTA); THALES Avionics SA (THAV); THALES AIR SYSTEMS S.A (TR6); Queen's University of Belfast (QUB); The Air Traffic Management Bureau of the General Administration of Civil Aviation of China (ATMB); The Center of Aviation Safety Technology of General Administration of Civil Aviation of China (CAST); Austro Control (ACG); Luchtverkeersleiding Nederland (LVNL). This consortium works under the co-ordination of EUROCONTROL.

With a view to supporting SESAR Development Phase activities whilst ensuring preparation for partners SESAR JU activities, Episode 3 focuses on:

- Detailing key concept elements in SESAR;
- Initial operability through focussed prototyping exercises and performance assessment of those key concepts;
- Initial supporting technical needs impact assessment;
- Analysis of the available tools and gaps for SESAR concept validation; and
- Reporting on the validation methodology used in assessing the concept.

The main SESAR inputs to this work are:

- The SESAR Concept of Operations (ConOps): T222 [81];
- The description of scenarios developed: T223 [75] & [80];

- The list of Operational Improvements allowing to transition to the final concept: T224 [79][79];
- The definition of the implementation packages: T333 [79] & [78];
- The list of performance assessments exercises to be carried out to validate that the concept delivers the required level of performance: T232 [82];
- The ATM performance framework, the list of Key Performance Indicators, and an initial set of performance targets: T212 [76].

The objective of detailing the operational concept [86] is achieved through the development of the DODs. These documents are available for the SESAR development phase and are produced through the System Consistency work package of Episode 3. The life cycle of the DOD documents is defined through three main steps:

- Initial DODs provided as the first inputs to the Episode 3 project;
- Interim DODs containing first refinement and consolidation from Episode 3 partners aligned to the prototyping/evaluation work, provided by mid-project duration;
- Final DODs updated by the findings and reports produced by the prototyping/evaluation activities, provided at the end of the project.

1.5 GLOSSARY OF TERMS

The Episode 3 Lexicon contains lists of agreed acronyms and definitions [13].

2 OPERATING CONCEPT-CONTEXT AND SCOPE

2.1 SESAR CONCEPT FOR NETWORK MANAGEMENT IN THE EXECUTION PHASE

In the current ATM system (reference year 2008), Air Traffic Flow and Capacity Management (*ATFCM)* manages flights within the pre-tactical time horizon until a time parameter of approximately 30mn before Off-Block time (depending on the airfield). Once the flight started taxiing, it got outside the ATFCM process and could then be managed by ATC only. This resulted in unnecessary ATFCM measures since the ATM situation could have significantly changed once the flight arrived by the capacity constraint.

Furthermore, the poor accuracy of the available flight data, in particular during the pre-flight phase, limited their use for purposes other than planning. Trajectory prediction after take-off, suffered from uncoordinated ATC processes and insufficient information flows. Trajectory changes were not systematically and instantaneously downloaded but determined mainly triggered by ATC systems events such as First System Activation messages, Departure Planning Information coming from CDM airports, and through basic vertical and longitudinal uncertainty management.

According to the SESAR Operational Concept for 2020, updated flight trajectory data will be available through the Network Operations Plan (NOP) to which all authorized Actors (inc. Airspace Users) have access to.

Shared Business Trajectories (SBT) will be subject to continuous optimisation triggered by the latest information on airspace resource constraints and/or the aircraft operational requirements.

The Business/Mission Trajectory expresses the specific needs of Airspace Users:

"*The trajectories represent the business/mission intentions of the airspace users. Airlines, Business, General Aviation and the Military all have 'business' or 'mission' intentions, even if the terminology is different and their specific trajectories have different characteristics. The trajectory is always associated with all the other data needed to describe the flight".*

Business / Mission Trajectories will be managed uniquely through a common operational object, the Network Operations Plan, NOP, accessible to all ATM Stakeholders via SWIM. Protection of secure and sensitive military data will be assured.

The NOP will be providing a set of collaborative applications to access to traffic demand, airspace and airport capacity, constraints, and pre-defined solutions to assist in managing diverse events. The planning phase ends with the publication of the Reference Business / Mission Trajectory (RBT) in the NOP, once the SBT stabilizes. This is the step that characterises the transition from time uncritical CDM enabled planning and optimisation towards a process that concentrates on the execution of the plan and the management of imponderability. The principle enabler for the network performance in the execution phase is the commitment of the various actors to the plan:

- Airspace users are committed to fly the RBT;
- ANSPs are committed to facilitate the RBT.

Another major evolution provided by SESAR is the notion of the rolling plan which allows a smooth transition from the planning to the execution phase monitored, facilitated, and orchestrated by a regional and sub-regional network management functions.

The **Sub-Regional Network Management** together with the **Civil / Military Airspace Manager** takes most of the initiative in this phase assuring the efficiency and timeliness of operations.

Close co-operation with military authorities assures smooth transition to/from periods of airspace reservation with as much prior notice as possible (**Advanced FUA**) so that any opportunities for efficiency can be fully exploited. In addition, military areas are much more flexible.

The **Regional Network Manager** coordinates the ASM/DCB Solutions selected, refined or elaborated by the Sub-Regional Network Managers and/or at Airport Level. The Regional Network Management also assures stability of the whole network and works at ensuring the best user business outcome for individual flights and to maximise overall network performance.

Dynamic configuration of airspace volumes adapted to changing traffic patterns will make best use of the available ANSP resources.

If airspace reconfiguration measures are insufficient to cope with the traffic demand then **Dynamic Demand Capacity Balancing (DCB)** is applied to identify the most user friendly adaptation of the traffic demand to solve the problem. This process foresees the network management function to inform the airspace user on the constraint by sending a **Target Time Over (TTO)** the entry point in the critical airspace volume. The Airspace User in return evaluates the new situation and proposes an RBT update that complies with the constraint. There are multiple possibilities for DCB measures to meet the TTO such as: ground delay, extended taxiing, en-route speed reduction, re-routeing, and DCB queue.

A **DCB queue process**, in support of managing arrivals, can be used as a pre-sequencer in favour of an AMAN or as a pseudo AMAN in case no AMAN is available. Such queue could be managed locally and synchronized at regional level.

2D and 3D route allocation imposed by network management function should be exceptional since the SESAR concept is based on a free route structure. Nevertheless, **strategic de-confliction**[7] of individual flights can be applied temporary for departures and arrivals from/to large TMAs, or to go through a very busy airspace volume, in order to reduce the need for tactical intervention on individual aircraft.

Experts' knowledge of the traffic patterns and of the available resources allows opportunities for improvements to be easily identified. But, complex DCB/ASM solution like airspace structure activation requires being pre-defined in order to be timely implemented. On that purpose, SESAR foresees the extensive use of a **catalogue of pre-defined DCB/ASM solutions** (refer to section **4.1.4.4 - Select/Refine/Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2)**) elaborated during the long-term planning phase, updated when required (including during the execution phase), and accessible in the NOP.

2.2 SCOPE OF THE DOCUMENT

The document addresses the network management processes relevant to the Execution Phase, in relation to the operational improvements targeted by SESAR for 2020. For those processes, the document describes what the improvements will change to the current operating method, what will enable those changes, what are the expected benefits/anticipated constraints/transition issues and how the improvements, through the processes, will influence the SESAR performance framework.

The document is entitled Network Management in the Execution Phase (E4). Indeed, it endeavours to detail the operational description of the Execution Phase at network level, as well as sub-regional level. Airport and ATC processes are addressed in separate documents, unless they are network-related.

[7] The term Strategic De-confliction is used in this context to mean actions taken when the take-off time is known with sufficient accuracy – i.e. after push-back, or even after the flight is airborne - i.e. [15 min, 40 min] for ATC planning conflict management and 40 min and more for complexity management and dynamic DCB, before entry in high-density areas, to be validated. The related DCB measures exclude tactical instructions and clearances that need an immediate response, but include activities such as dynamic route allocation.

This Detailed Operational Description intends to scope the following elements:

- Dynamic Demand and Capacity Balancing i.e. involving trajectories for which the RBT has already been published - i.e. around departure clearance until their execution reaches the long-term planning horizon of the controller[8];
- Dynamic DCB Solutions, predefined or ad-hoc, from elaboration to application through validation with network impact assessment;
- Network integration of Dynamic Airspace/Airport DCB Solutions, synchronisation of Dynamic DCB Solutions;
- Dynamic airspace organisation including re-configurations, re-sectorisations, temporary route structures, airspace reservations;
- Coordination between DCB and ASM on the day of operation, for the management of changing airspace requirements;
- CDM processes between Airspace Users and other ATM Stakeholders including RBT revisions;
- Monitoring of real-time operations through 4D trajectory updates;
- Management of the NOP in execution inc. reaction to operational disturbances.

2.3 ATM PROCESSES DESCRIBED IN THE DOCUMENT

The SESAR Concept of Operations is process orientated. Each process is triggered by a particular situation and has a goal to achieve, in interaction with its environment and with other processes. Each SESAR phase is structured around a number of processes and is carried out through their implementation.

Network Management in the Execution Phase is focused on, two high-level processes, highlighted on Figure 1:

[8] Note that Demand / Capacity Balancing, as a planning process, is addressed in DOD M2, whilst Dynamic Demand / Capacity Balancing during execution of operations is addressed in this DOD.

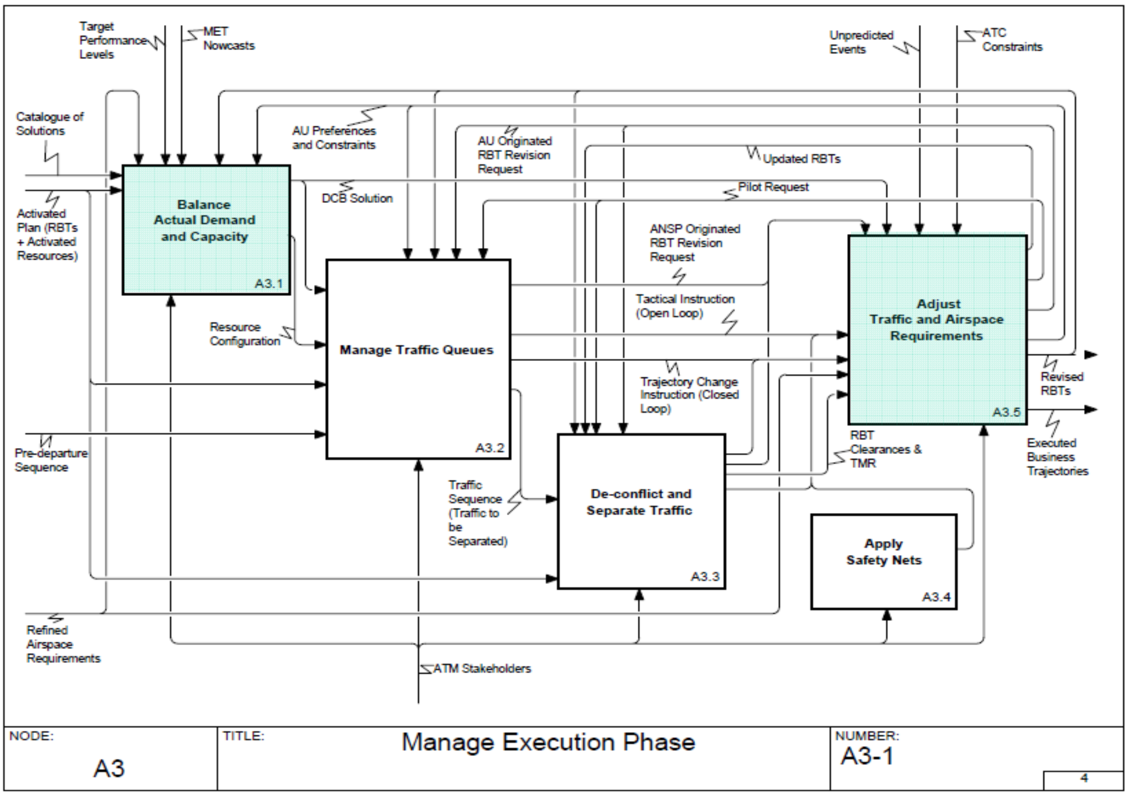

Figure 1: High-level processes scoped by E4

- A3.1: Balance Actual Demand and Capacity;

  Missions: Monitor Airspace Load/Density, Balance Demand and Capacity, Assess and Manage DCB Complexity, Optimise Resource Usage accordingly, taking into account Airspace Requirements as well as other constraints.

- A3.5: Adjust Traffic and Airspace Requirements.

  Missions: Adjust Airspace Requirements to satisfy users' needs, and Revise RBT (at the owner's initiative; or not), Update RBT.

A3.2 – Manage Traffic Queues is part of Aerodrome Operations and Traffic Synchronisation, which possibly follow the action of (Dynamic) DCB[9]: the process is addressed in DOD E1, E2/3 and E5

A3.3 – De-conflict and Separate Traffic and A3.4 – Apply Safety Nets are part of Conflict Management: the process is addressed in DOD E1, E2/3, E5, and E6.

Each high-level process breaks into mid-level processes (Figure 2 and Figure 3) down to low-level processes. The low-level processes addressed in this document are listed in Table 1.

[9] A (Dynamic) DCB solution can be a DCB queue. A DCB queue, generally applied to pre-sequence a heavy traffic demand in favour of an AMAN, is not an ordered flight list just like the one the AMAN will implement. This is a pre-sequenced flight list over a constraint point that has a longer time horizon and that will be an input to the AMAN. A DCB queue does not intend to order actual flights (contrary to the arrival sequence established by the AMAN). It only intends to balance demand and capacity on arrival.

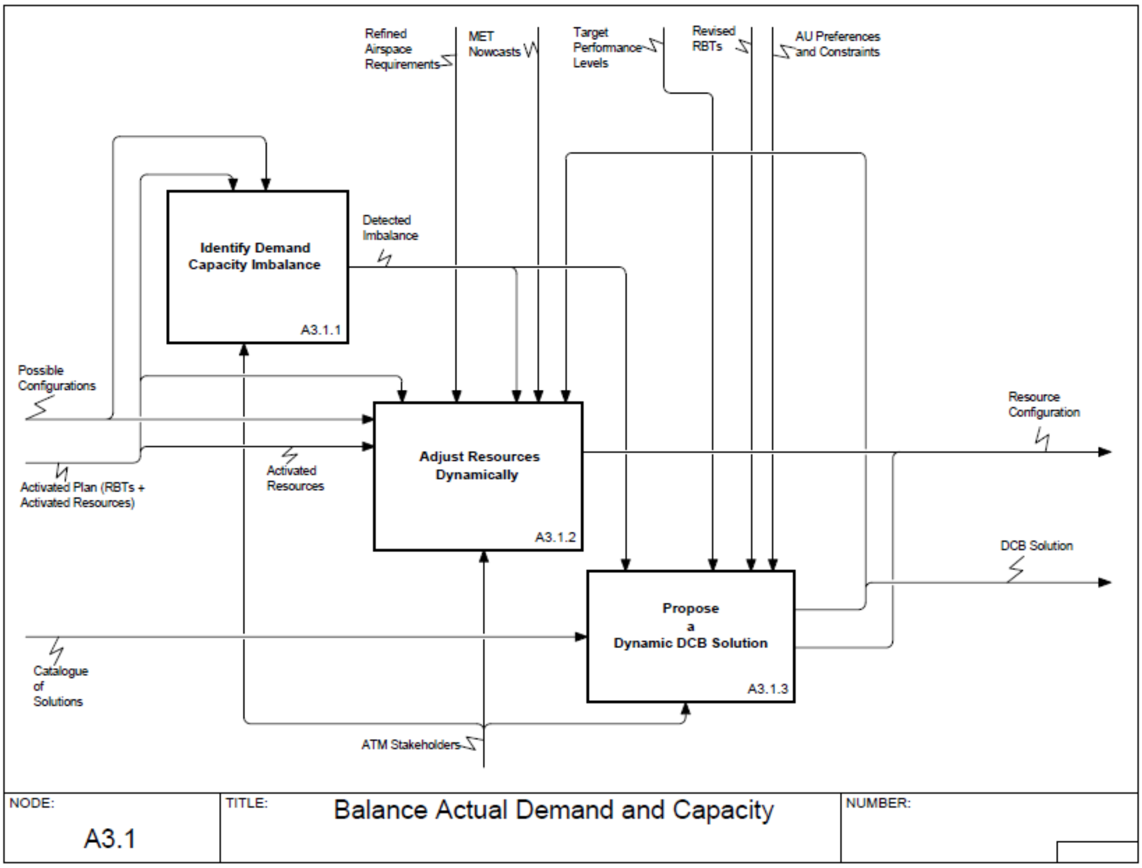

Figure 2: Mid-level processes scoped by E4 (for A3.1)

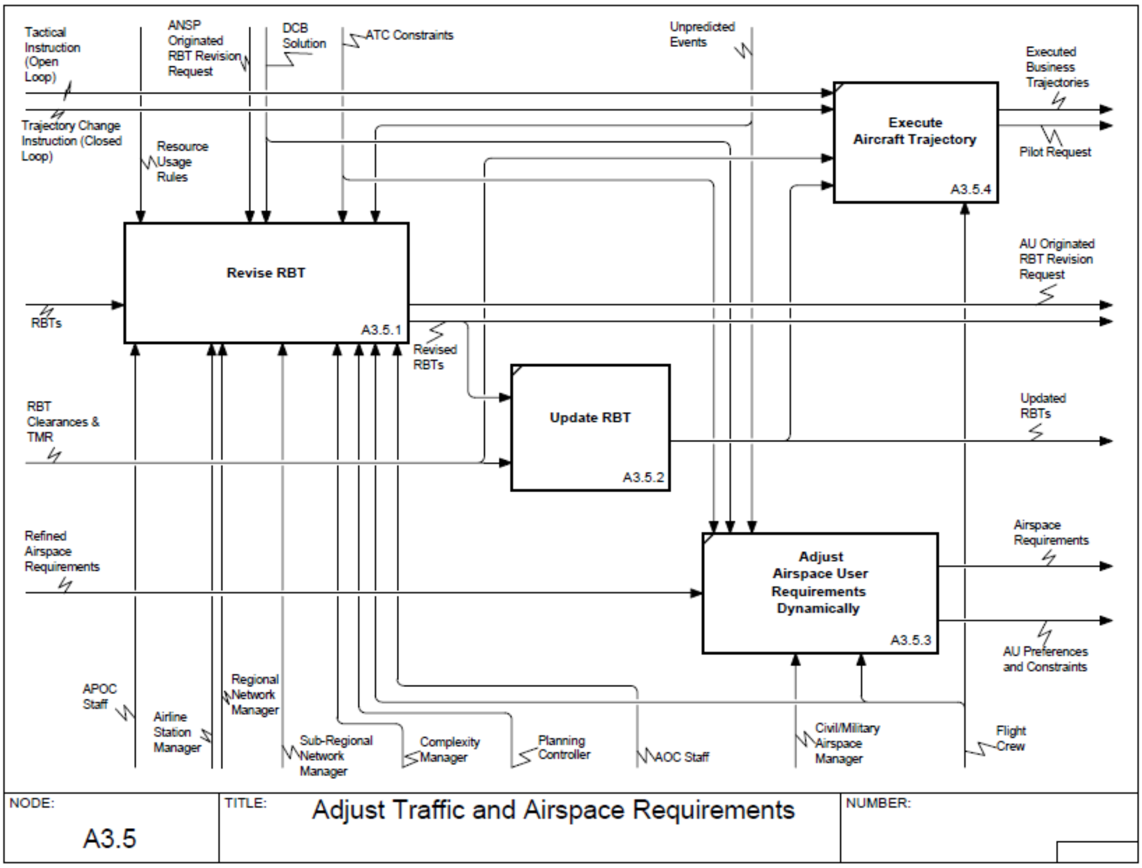

Figure 3: Mid-level processes scoped by E4 (for A3.5)

Code[10]	ATM Process	Description	SESAR ConOps References
A3.1.1.1.2	Assess Airspace Capacity Load	This process describes how the capacity load of airspace element is monitored. This will be done according to an instant permissible density with a look-ahead time horizon of around 40 minutes or more. In case of overload or if capacity opportunity is detected, a DCB solution might be negotiated with all concerned actors.	F.2.6.3, F.2.6.4, F.2.6.5, F.2.6.5.2, F.3, F.5.1.1, F.5.1.2, F.5.1.4, F.5.2
A3.1.1.2	Assess DCB Complexity	This process will allow the Local DCB Complexity Manager to assess the DCB Complexity of an airspace volume. It allows activities such as dynamic route allocation. This is an input to strategic de-confliction.	F.3.1, F.3.2, F.3.2.1, F.3.2.2, F.3.3, F.3.4, F.3.5
A.3.1.2.3	Adjust Airspace Resources Dynamically	This process is run to coordinate last-minute airspace resource operating rules change such as airspace volume closure/availability due to unpredicted event, activation of a temporary route structure…	F.2.6.3, F.2.6.4, F.3, F.3.1, F.3.2, F.3.2.1, F.3.3, F.3.4, F.3.5, F.3.7

[10] This refers to the code associated to the process in the ATM Process Model SADT diagrams.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

Code[10]	ATM Process	Description	SESAR ConOps References
A3.1.3.1.2	Select/Refine/Elaborate a Dynamic DCB Solution at Network Level	This process will allow proposing a DCB/ASM solution in response to a detected imbalance, at the sub-regional level. If the solution selected in the catalogue is likely to have impact on the network, then the solution will be activated by the regional network manager. Thus the solution can be selected and applied as-is, or modified, or elaborated and integrated in the catalogue of solutions.	F.2.6.2, F.2.6.3, F.2.6.4, F.3
A3.1.3.2.1	Assess Network Impact of the Dynamic DCB Solution	This process describes how the Regional Network Manager assesses the network impact of a DCB solution (possibly made of several DCB measures). Network impact assessment during the execution phase will be necessary for ad-hoc Dynamic DCB solutions, since they will be defined most of the time at the local level. Distant network impact cannot be detected at sub-regional/local level.	F.2.6.2, F.2.6.4
A3.1.3.2.2	Apply the Dynamic DCB Solution	This process describes how the System applies a Dynamic DCB Solution that has been activated after assessment by a Local/Sub-Regional Network Manager or by a Regional Network Manager (refer to A3.1.3.2.1).	F.2.6.2, F.2.6.4
A3.5.1.1	Adjust RBT	This process aims at: 1) Re-scheduling flights in en-route and arrival queues, during the execution phase, i.e. the RBT has already been published and the aircraft may be already airborne. The airspace users may be themselves requesting the re-scheduling or may have to accommodate it in the case it is requested by the: APOC Staff or the Sub-Regional Network Manager. 2) Adjusting flight trajectories during the execution phase, i.e. the RBT has already been published and the aircraft may be already airborne. Most of the time, the airspace users will themselves request the trajectory modification or may have to accommodate it in the case it is requested by another stakeholder (e.g. Sub-Regional/Regional Network Manager) due to a residual high-density area/high DCB Complexity area or on the contrary due to a capacity opportunity. CDM process at system/user initiative if time permits.	F.1, F.2.2, F.2.3, F.2.3.3, F.2.6.1, F.2.6.4, F.2.6.5.3, F.2.6.6, F.3.1, F.3.2, F.4.1, F.4.3

Code[10]	ATM Process	Description	SESAR ConOps References
A3.5.1.2	Validate RBT Changes	This process will allow the Regional Network Manager to validate at the network level the proposed RBT changes (re-scheduling and/or trajectory adjustment). This "validation" relates to the assessment of the induced impact of the RBT changes on the network.	F.1, F.2.2, F.2.3, F.2.3.3, F.2.6.2, F.2.6.4, F.2.6.6, F.3.1, F.3.2
A3.5.2	Update RBT	The RBT can be updated either after the "A3.5.1 Revise RBT" activity, or through automatic update triggered when the current predicted trajectory differs from the previously down linked predicted trajectory by more than pre-defined thresholds indicated in TMR.	F.2.3, F.2.3.3
A3.5.3	Adjust Airspace User Requirements Dynamically	This process is twofold: 1) It will enable real time adjustments of flexible airspace structures. 2) All users will be able to express their preferences and constraints.	F.3.7
A3.5.4	Execute Aircraft Trajectory	This is the process that explains how the RBT is physically executed i.e. this process takes flight instructions and the RBT as inputs to perform the aircraft flight, producing the Executed Business / Mission Trajectory.	F.2.3, F.2.3.3, F.2.3.4, F.4

Table 1: Low-level processes scoped by E4

2.4 Related SESAR Operational Improvements (OI's)

A table listing the SESAR Operational Improvements steps that are relevant to this DOD, and the associated processes, is provided in Annex C (refer to §11).

2.5 Related SESAR Performance Requirements

SESAR has defined several Key Performance Areas (KPAs) and Performance Requirements (objectives, indicators and targets) which are defining system wide effectiveness and thus, for most of them, affect the various components of the future 2020 ATM target system. The table below shows a list of those Key Performance Indicators (KPIs) which are directly or indirectly affected by Network Management in the Execution Phase. The KPIs are organised by KPA and performance requirements as defined by SESAR:

Key Performance Area (KPA)	Description
Access & Equity	Access: This Focus Area covers the segregation issue: whether or not access rights to airspace and airports are solely based on the class of airspace user. In other words, is shared use by classes of airspace user allowed, and how much advance notice of this accessibility is provided. Shared use of airspace by different classes of airspace users should be significantly improved (classes defined by type of user, type of aircraft, type of flight rule). Where shared use is conflicting with other performance expectations (safety, security, capacity, etc.), viable airspace alternatives will be provided to satisfy the airspace users' needs, in consultation with all affected stakeholder.

Key Performance Area (KPA)	Description
	No indicators defined yet. Equity: The scope covers the subject of equitable access, i.e. the prioritisation issue: under shared use conditions (i.e. access is possible), to what extent is access priority based on the class of airspace user. No indicators defined yet.
Capacity	This KPA addresses the ability of the ATM system to cope with air traffic demand (in number and distribution through time and space). The challenge in terms of capacity in the airspace environment is to meet the traffic growth demand and to limit the en-route delay. The strategy aims at widening the current notion of Traffic Flow and Capacity Management from the mere allocation of slots to the optimisation of traffic patterns and capacity management with the emphasis on optimising the network capacity through collaborative decision-making processes. KPIs affected by Network Management: • Annual growth rate for the number of IFR flights that can be accommodated in Europe **CAP.3.OBJ1.IND2** • Annual number of IFR flights that can be accommodated in Europe: The European ATM system will need to be able to handle 70% more flights per year than in 2005 **CAP.3.OBJ1.IND1** • The daily number of IFR flights that can be accommodated in Europe should be 49 000 flights **CAP.3.OBJ1.IND3**. • Daily number of IFR movements (departures plus arrivals) **CAP.2.OBJ1.IND2** • Hourly number of IFR movements (departures plus arrivals) **CAP.2.OBJ1.IND1** • Annual number of IFR flights able to enter the airspace volume **CAP.1.OBJ1.IND2** • Hourly number of IFR flights able to enter the airspace volume **CAP.1.OBJ1.IND1**
Cost Effectiveness	This KPA addresses the cost of gate-to-gate ATM in relation to the volume of air traffic that is managed. In line with the political vision and goal, the working assumption for Cost Effectiveness design target is to halve the total direct European gate-to-gate ATM costs from 800 €/flight to 400 €/flight, in 2020 (2005 Euros). KPIs affected by Network Management: • Average cost per flight, at European annual level: halve the direct European gate-to-gate ATM costs through progressive reduction **CEF1.OBJ1.IND1** • Average indirect cost per flight, at European annual level (The scope covers the extra costs incurred by airspace users through non-optimum performance in the Efficiency, Flexibility and Predictability KPAs) **CEF2.OBJ1.IND1**
Efficiency	This KPA addresses the actually flown 4D trajectories of aircraft in relationship to their initial Shared Business Trajectory The efficiency of individual flight operations has to be improved such that: • At least 98% of flights depart on time (punctuality with respect to a 3

Key Performance Area (KPA)	Description
	minutes tolerance window around off-block departure), the average departure delay of delayed flights does not exceed 10 minutes; • The flight duration is “normal” (with respect to a 3 minutes tolerance window around block-to-block time) more than 95% of the time, the average flight duration extension of flights does not exceed 10 minutes; • Less than 5% of flights suffer additional fuel consumption of more than 2.5%, for flights suffering additional fuel consumption of more than 2.5%, the average fuel consumption does not exceed 5%. KPIs affected by Network Management: <u>Fuel Efficiency:</u> Conform to the recalculated Initial Shared Business Trajectory (= initial SBT corrected for actual weather) Fuel consumption to the greatest extent : • Occurrence: % of flights with additional fuel consumption of more than 2.5% of intended consumption **EFF.2.OBJ1.IND1** • Severity: Average fuel deviation of deviated flights **EFF.2.OBJ1.IND2** <u>Mission efficiency:</u> Following military trajectory models focus is to reflect the economic impact of transit times associated with military training activities. • Impact of Airspace Location on Training **EFF.3.OBJ2.IND1** (Provides a measurement of the time spent actually in the designated operating area, achieving the mission training objectives, compared with the total time airborne) • Economic impact of Transit **EFF.3.OBJ1.IND1** (Provides a measurement of the economic cost of the time spent by aircraft flying from their bases into their designated operating area and returning at the end of the exercise) <u>Temporal efficiency **EFF.1**</u> : This Focus Area covers the magnitude and causes of deviations from planned (on-time) departure time and deviations from Shared Business Trajectory durations): • Occurrence: % of flights with a normal flight duration **EFF.1.OBJ2.IND1** • Severity: the average flight duration extension of flights with an extended flight duration **EFF.1.OBJ2.IND2** Continually reduce the departure delay due to ATM **EFF.1.OBJ1** (Only primary delay due to ATM in nominal conditions is considered (Flights delayed for non ATM reasons are excluded but would be considered against flexibility performance): • Occurrence (Punctuality): 98% or more of flights departing on-time **EFF.1.OBJ1.IND1** • Severity (Delays): the average departure delay of delayed flights **EFF.1.OBJ1.IND2**
Environmental Sustainability	This KPA addresses the role of ATM in the management and control of environmental impacts. The aims are to reduce adverse environmental impacts (average per flight); to ensure that air traffic related environmental constraints are respected; and, that as far as possible new environmentally driven non-optimal operations and constraints are avoided or optimised as far as possible. This focus on environment must take place within a wider “sustainability” scope that takes account of socio-economic effects and the synergies and trade-offs between different sustainability impacts.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

Key Performance Area (KPA)	Description
	KPIs affected by Network Management: • Amount of CO_2, H_2O, NO_x emissions which is attributable to inefficiencies in ATM service provision: The average CO_2 emission per flight as a result of ATM improvements will be decrease by 10% compared to 2005. **ENV.4.OBJ1.IND1-4** • Percentage of cases in which local environmental rules affecting ATM are respected **ENV.3.OBJ1.IND1** • Percentage of cases in which the best alternative solution from a European Sustainability perspective is adopted **ENV.1.OBJ2.IND1** No indicators on noise emissions yet defined.
Flexibility	This KPA addresses the ability of the ATM system and airports to respond to "sudden" changes in demand and capacity: rapid changes in traffic patterns, last minute notifications or cancellations of flights, changes to the Reference Business Trajectory (pre-departure changes as well as in-flight changes, with or without diversion), late aircraft substitutions, sudden airport capacity changes, late airspace segregation requests, weather, crisis situations, etc. Allow Airspace Users translating in time their Business Trajectory to the greatest extent **FLX.1.OBJ1** : • Flexibility demand: % of flights requesting time translation from initial RBT **FLX.1.OBJ1.IND3** • Frequency: % of Business Trajectory delayed more than 3 minutes as a consequence of a 4D Trajectory time translation **FLX.1.OBJ1.IND1** • Lead time is the time difference between the time request and the earliest time constraint (e.g. gate, de-icing, departure runway, weather…) **FLX.1.OBJ1.IND4** • Severity: Average delay of delayed flights as a consequence of a 4D Trajectory time translation **FLX.1.OBJ1.IND2** Allow Airspace Users updating their Business Trajectory for a full redefinition to the greatest extent: • Flexibility demand: % of flights requesting BT redefinition from initial RBT **FLX.1.OBJ2.IND4** • Frequency: % of Business Trajectory delayed more than 3 minutes as a consequence of the Business Trajectory full re-definition **FLX.1.OBJ2.IND2** • Frequency: % of Business Trajectory update accepted possibly with time penalty as a consequence of the Business Trajectory full re-definition: At least 95% (European-wide annual average) of the (valid) requests for full RBT redefinition of scheduled and non-scheduled flights will be accommodated, albeit possibly with a time penalty. **FLX.1.OBJ2.IND1** • Lead time is the average time difference between the time request and the earliest time constraint (e.g. gate, de-icing, departure runway, weather…) **FLX.1.OBJ2.IND5** • At least 98% (European-wide annual average) of the VFR-IFR change requests will be accommodated without penalties **FLX2.OBJ2.IND1** • Severity: Average delay of delayed flights as a consequence of the Business Trajectory full re-definition **FLX.1.OBJ2.IND3** Accommodate non-scheduled flight departures **FLX.2.OBJ1:**

<table>
<tr><th>Key Performance Area (KPA)</th><th>Description</th></tr>
<tr><td></td><td>% of non-scheduled flights delayed more than 3 minutes FLX.2.OBJ1.IND1
Average delay of delayed non-scheduled flights FLX.2.OBJ1.IND2
Suitability for military requirements FLX.4
(Focus is to reflect the suitability of the ATM System for military requirements related to the flexibility in the use of airspace and reaction to short-notice changes.)
Adherence to optimum Airspace Dimension FLX.4.OBJ2.IND1</td></tr>
<tr><td>Participation</td><td>At the level of overall ATM performance, the KPA “Participation by the ATM Community” covers quite a diversity of objectives and involvement levels. Participation by the ATM community can be considered in the following dimensions:

a) Separate involvement issues and approaches apply for each of the ATM lifecycle phases: planning, development, deployment, operation and evaluation/improvement of the system.

b) “Meeting the (sometimes conflicting) expectations of the community” implies that participation and involvement should be explicitly pursued for each of the other Key Performance Areas: access and equity, capacity, cost effectiveness, efficiency, environment, flexibility, global interoperability, predictability, safety, security.

c) Involvement should be monitored and managed per segment of the ATM community.

The three dimensions serve as a framework for focused tracking of the various participation and involvement initiatives, assessment of the actual level of involvement against the desired level, and identification of weaknesses and improvement opportunities.

The aim is to achieve a balanced approach to ATM community involvement.

Different methods and levels of involvement are possible:
Informing the community;
Obtaining feedback and advice from the community;
Collaborative decision making; and
Consensus building.
No indicators defined yet.</td></tr>
</table>

Key Performance Area (KPA)	Description
Predictability	This KPA addresses the ability of the ATM system to ensure a reliable and consistent level of 4D trajectory performance. In other words: across many flights, the ability to control the variability of the deviation between the actually flown 4D trajectories of aircraft in relationship to the Reference Business Trajectory. The predictability of individual flight operations has to be improved such that: • Less than 5% of flights suffer arrival delay of more than 3 minutes; • The average delay of delayed flights (with a delay penalty of more than 3 minutes) will be less than 10 minutes; • Variability of flight duration (block to block) is 0.015 (meaning for a 100-minute flight duration, more than 95% flights arrives on-time, according to arrival punctuality target); • Reactionary delays are reduced by 50% by 2020 compared to 2010 baseline. <u>KPI concerning Knock-on Effect:</u> • Number of cancelled flights **PRD.3.OBJ1.IND2** • Reactionary delay **PRD.3.OBJ1.IND1** <u>KPI concerning On Time Operation:</u> • Arrival punctuality: % of flights with an arrival delay of more than 3 minutes **PRD.1.OBJ1.IND1** • Arrival punctuality: Average arrival delay of delayed flights **PRD.1.OBJ1.IND2** • The coefficient of variation of gate to gate time intervals **PRD.1.OBJ2.IND1** <u>KPI concerning Service Disruption:</u> • Number of cancelled flights per type of disruption **PRD2.OBJ1.IND1** • Number of diverted flights per type of disruption **PRD2.OBJ1.IND2** • Total delay due to disruption per type of disruption **PRD2.OBJ1.IND3**
Safety	This KPA addresses the risk, the prevention and the occurrence and mitigation of air traffic accidents. The number of ATM induced accidents and serious or risk bearing incidents do not have to increase and, where possible, have to decrease, as a result of the introduction of SESAR. Considering the anticipated increase in the European annual traffic volume, the overall safety level would gradually have to improve, so as to reach an improvement factor 3 in order to meet the safety objective in 2020. This is based on the assumption that safety needs to improve with the square of traffic volume increase, in order to maintain a constant accident rate. KPI concerning Network Management: • Safety level, Accident probability per operation or flight hour, relative to the 2005 baseline **SAF.1.OBJ1.IND1** • Severe DCB/Complexity issues not detected/unsolved during Network Management **SAF.1OBJ1.IND2**

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

Key Performance Area (KPA)	Description
Security	This KPA covers a subset of aviation security. It addresses the risk, the prevention, the occurrence and mitigation of unlawful interference with flight operations of civil aircraft and other critical performance aspects of the ATM system. This includes attempts to use aircraft as weapons and to degrade air transport services. Unlawful interference can occur via direct interference with aircraft, or indirectly through interference with ATM service provision (e.g. via attacks compromising the integrity of ATM data or services). ATM security also includes the prevention of unauthorised access to and disclosure of ATM information. No indicators defined yet.

Table 2: Key Performance Areas scoped by E4

3 CURRENT OPERATING METHOD AND MAIN CHANGES

3.1 ASPECTS OF TODAY'S OPERATIONS THAT WILL REMAIN

Today's operations that will remain are presented below:

- Network Management monitoring the execution phase to support the processes detailed in short-term planning;
- Detection of imbalances based on traffic load monitoring: from hourly capacity use to airspace volume occupancy counts monitoring;
- Dynamic airspace volume re-configuration as a means to adjust resources in execution;
- Airspace requirements confirmed at short notice.

3.2 ASPECTS OF TODAY'S OPERATIONS THAT WILL CHANGE

The expected changes are described below:

- Monitoring of real-time operations based on 4D trajectory updates;
- Detection of imbalances based on traffic load monitoring will be complemented with density monitoring for the earliest dynamic DCB measures (between one and two hours before, to be validated) and with complexity assessment for those applied with a shorter time horizon (40 min to 60 min, to be validated);
- Airborne actions possible for the purpose of DCB, mostly by activation of predefined solutions agreed during the planning phase;
- Dynamic resource adjustments based on a more flexible airspace organisation – e.g. re-sectorisation, temporary route structure;
- Dynamic resource adjustments based on a more flexible use of airspace either by civilians or by MIL Authorities (e.g. ability to segregate an airspace volume, to implement modular/dynamic areas);
- Strategic De-confliction and Complexity management processes enabled by the quality/accuracy of flight data (trajectory DCB containment could be of ±5 min, i.e. ±50 NM and time drift ranging between -3 min and +2 min, TBC during validation exercises), as well as the flexibility of airspace organisation, and intended to reduce the need for tactical intervention on individual aircraft;
- Queue management as a means to sequence aircraft approaching a constrained resource, mainly arrivals at busy airports (pre-sequencing);
- RBT Revision, a CDM process allowing the trajectory owner to decide on how to meet new constraints arising in the network.

3.3 ASPECTS OF TODAY'S OPERATIONS THAT WILL DISAPPEAR

The aspects that disappear are described below:

- Monitoring of real-time operations based on "conventional" flight updates – e.g. CPR, DPI;
- Ground delays as imposed today on Airspace Users (ATFM slots attributed centrally 2 hours before departure time) for Demand and Capacity Balancing.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

4 PROPOSED OPERATING PRINCIPLES

Network Management in the Execution Phase is focused on two high-level processes:

- A3.1: Balance Actual Demand and Capacity.

  Missions: Monitor Airspace Load/Density, Balance Demand and Capacity, Assess and Manage DCB Complexity, Optimise Resource Usage accordingly, taking into account Airspace Requirements as well as other constraints.

- A3.5: Adjust Traffic and Airspace Requirements.

  Missions: Adjust Airspace Requirements to satisfy users' needs, and Revise RBT (at the owner's initiative; or not), Update RBT.

A3.1 and A3.5 sub-processes will be presented in the next pages. Links with OI Steps (see ANNEX C: OI Steps Traceability Table) are provided along the text as hyperlinks, except for OI Step DCB-0103 "SWIM enabled NOP" which is applicable to all sub-processes.

4.1 NETWORK SUPPORT TO BALANCE ACTUAL DEMAND AND CAPACITY (A3.1)

4.1.1 Scope and Objectives

4.1.1.1 Foreword

Balance Actual Demand and Capacity is the process through which traffic demand and activated resources capacity are dynamically balanced.

Dynamic DCB - i.e. DCB during the execution phase, takes over from short-term DCB (please refer to DOD M2 process "Balance Planned Demand and Capacity"). This means that, for example, a DCB queue is shared by short-term DCB and dynamic DCB.

Dynamic DCB is herein described at the airspace/airport level from a network management perspective. Dynamic DCB at the airport level is an open question, the discussion is provided in the G DOD.

Sub-Regional Network Managers are pivotal to Dynamic DCB, which operates as follows:

- The situation ahead is assessed by Network Managers. For each airspace element (airspace volume, route segment…) the upcoming load is assessed. The granularity of traffic demand analysis can be the density or the complexity, depending on the look-ahead time horizon: from a couple of hours[11] down to 40 minutes[12];
- On that basis, the Sub-Regional Network Manager makes a decision on whether there is an imbalance to solve, triggering the next step of the process;
- Whenever possible, the situation is rebalanced through a dynamic adjustment of the available resources, if necessary in cooperation with the Civil/Military Airspace Manager. This may imply changes in:
  - o The operational rules in application for resource usage that are defined during the Long-term Capacity Planning Phase. They are continuously refined according to specific events, and are available in the NOP;
  - o The active airspace configuration.

[11] It is estimated that 95% of the SBTs are known 2 hours before OBT.

[12] Corresponding to the maximum time horizon of long-term ATC planning.

- If after all possible capacity adjustments there is still an imbalance, a Dynamic DCB Solution implying traffic demand adjustment is implemented at the airspace level from a network perspective;
- Network-wise aspects are worked out in cooperation with the Regional Network Manager, possibly in coordination with other Sub-Regional Network Managers;
- The application of the Dynamic DCB Solution triggers process "Network support to Adjust Traffic and Airspace Requirements (A3.5)" with Airspace Users pivotal to it;
- DCB is completed when the imbalance is solved.

Airspace Users are fully involved in the collaborative Dynamic DCB processes during the agreements on how traffic demand or individual trajectories will be adjusted if ANSPs and airports cannot provide sufficient capacity:

- Airspace Users will give their preferences when time permits, e.g. the SBTs (see DOD M2) and the RBTs (this DOD) to be subject to a trajectory revision. The new trajectories will be validated according to the ATC constraints to be put in place;
- But also participate to the short-term and dynamic DCB solution selection, elaboration or refinement, whenever possible.

The end of Dynamic DCB overlaps the beginning of complexity management (refer to section 4.1.2), which is at a crossroads between DCB and ATC Planning. Traffic complexity (related to the interactions between trajectories, aircraft attitude and proximate pairs) is assessed by the Local DCB Complexity Manager when the look-ahead time horizon becomes relevant to it (around 40 min or less). To lower complexity and hence alleviate the controller's workload, the Local DCB Complexity Manager may decide to:

- Optimise the airspace organisation through dynamic airspace volume re-configuration or/and the activation of a temporary route structure;
- Request BT changes in accordance with the resource adjustments - e.g. a temporary route structure activation.

The Local DCB Complexity Manager coordinates with the ATC Planning Controller, the Network Management function and, possibly the Civil/Military Airspace Manager.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

4.1.2 Assumptions

Note: The working assumptions made herein are subject to the approval of the interested parties since they are not made explicit in the SESAR ConOps.

Assumption 1

Dynamic DCB operates within the [2 h[13]; 40 min] timeframe, regarding the look-ahead to a detected imbalance.

Indeed, Dynamic DCB addresses trajectories being executed in a majority[14], namely:

- Related to airborne flights;
- Or at least published RBTs with a stable and precise[15] off-block time.

Assumption 2

A look-ahead of around 40 min time or more is relevant to DCB Complexity.

Assumption 3

A look-ahead of [15 min, 30 min] time is relevant to ATC planning - e.g. multi sector planning based on ATC Complexity or on Conflict Management, since flights presumably enter the time horizon of the controller's decision-making support systems - e.g. case of an extended arrival manager.

Consequence of assumptions 1, 2 & 3

Approximately 30 to 40 min before execution of the RBT segment, the three operational layers (Dynamic DCB, Complexity Management, and ATC Planning) somewhat overlap, hence the underlying coordination between the Sub-Regional/Regional Network Managers, the Local DCB Complexity Manager and the Planning Controller, and the need to prioritise their actions.

4.1.3 Expected Benefits, Issues and Constraints

The current ATFM system is rigid and does not allow pro-activity in the execution phase because it hardwires service delivery to a predicted traffic demand and airspace use plan that finally do not exactly occur.

The open-loop application of departure slot allocation almost irreversibly generates delays, quite often unnecessarily, due to poor information quality. This also generates additional unpredictability to TTAs.

The Proposed Dynamic DCB operating principles will allow taking very precise last-minute decisions through a CDM mechanism that could be applied even when the aircraft is airborne. In addition, quality of decision data is improved through the optimisation of SBTs and the commitment of both ATM and AUs on the RBT.

The accuracy of traffic demand data in particular will enable Demand and Capacity Balance monitoring at the scale of density down to complexity.

---

[13] On average. The actual look-ahead will depend on the distance between the departure aerodrome(s) and the airspace element subject to Dynamic DCB.

[14] Hence making up a flow-like entity which is markedly more predictable than the one addressed by Short-term DCB, which is made of SBTs in a majority: a number of flights, departing notably from close aerodromes, are supposedly not in execution when the time horizon is larger than 2 hours.

[15] [-x min, +y min] to be validated. Please refer to DOD L, "Prioritisation rules" in §4.3.4.3.

The implementation of Dynamic DCB requires updated information available through the NOP and development of standard interfaces and access services that will allow CDM between an enlarged set of types of actors, even if the number of contributors should be reduced most of the time, through an extended use of predefined DCB Solutions.

4.1.4 Overview of Operating Method

Figure 4 gives an overview of the process sequences and information flows required to *balance actual demand and capacity* in the execution phase.

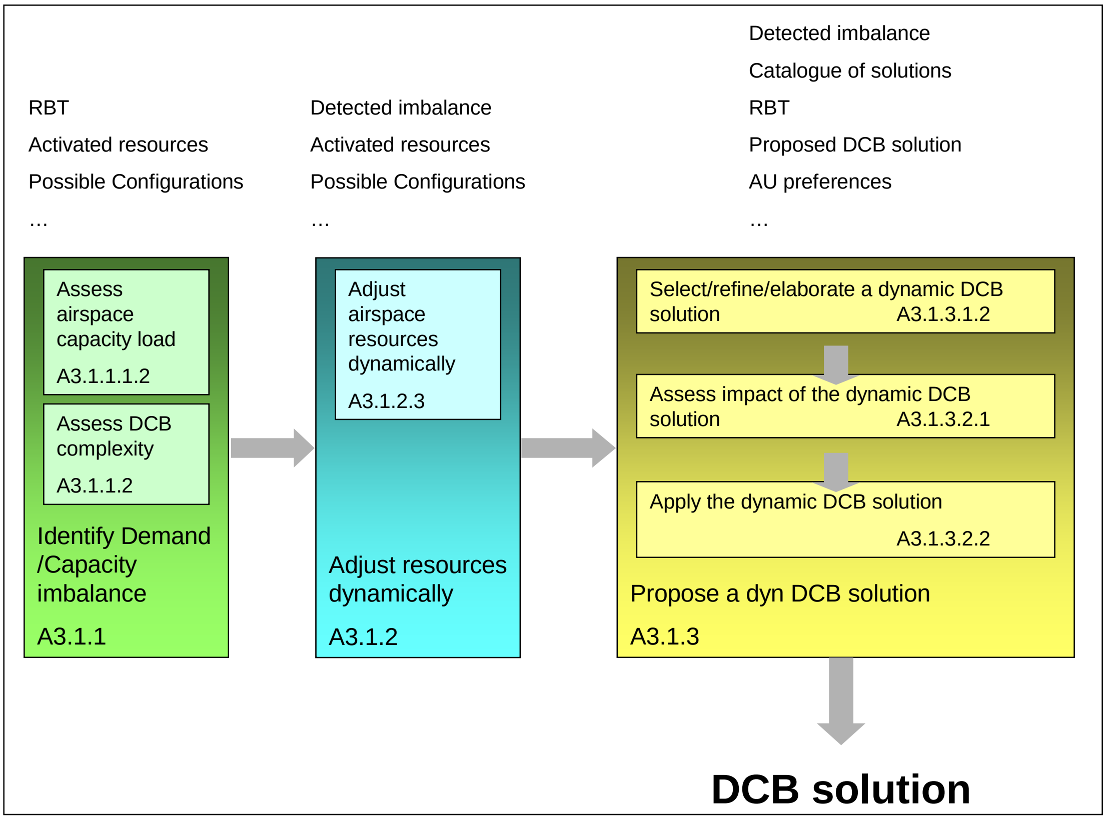

Figure 4: A3.1 Network Support to balance actual demand and capacity

Dynamic demand capacity balancing is a revolving process that continuously monitors the demand / capacity balance, identifies local capacity/complexity overloads (A3.1.1), adjusts airspace resources dynamically to accommodate the demand whenever possible (A3.1.2) and proposes a dynamic DCB solution to solve persisting problems with minimum implication on the airspace users proposed business/mission trajectory.

In detail this process evolves along the following five steps:

STEP 1: Depending on the look-ahead time horizon and on flight status (SBT, RBT), the monitoring activity can be managed at two levels:

- Traffic density (sub-process A3.1.1.1.2, § 4.1.4.1) for the long-term detection (up to 2 h);
- Traffic complexity (sub-process A3.1.1.2, § 4.1.4.2) for a look-ahead time horizon of around 40 mn.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

STEP 2: The monitoring activity can trigger adjustment of resource like dynamic airspace volume reconfiguration by "Adjust Airspace Resources Dynamically " (sub-process A3.1.2.3, § 4.1.4.3).

STEP 3: In the case where resource reconfiguration does not entirely solve the detected imbalance, then the sub-regional manager selects or refines a DCB/ASM solution in the catalogue of pre-defined solutions, or elaborates one, possibly through a CDM session with other sub-regional managers and with Airspace Users (sub-process A3.1.3.1.2, § 4.1.4.4).

STEP 4: Sub-process A3.1.3.2.1 (§ 4.1.4.5) describes how the Network Manager assesses the network impact of DCB/ASM solution in particular for an ad-hoc solution.

STEP 5: Sub-process A3.1.3.2.2 (§ 4.1.4.6) describes how the System applies a Dynamic DCB/ASM Solution that has been activated.

4.1.4.1 Assess Airspace Capacity Load (A3.1.1.1.2)

This process describes how the capacity load of airspace element is monitored so as to identify capacity opportunities [DCB-0208]. The capacity load is an indicator [CM-0302], still to be precisely defined, that will measure the magnitude of imbalance between demand and capacity. This will be done according to an instant permissible density with a look-ahead time horizon of around 40 minutes or more. In case of overload or if capacity opportunity is detected, a DCB solution might be negotiated with all concerned actors.

The main drivers related to this process are the following:

- Inputs[16]:
  - None.
- Constraints/Triggers:
  - Activated Plan (RBTs + Activated Resources);
  - Possible Airspace Configurations.
- Human Actors:
  - Sub-Regional Network Manager;
  - Regional Network Manager.
- Outputs:
  - Capacity Over/Under Load, based on the instant permissible density.

Through this process, the anticipated load of traffic is assessed by the Sub-Regional and Regional Network Manager, given:

- The resource which is monitored (typically an airspace volume);
- The operational status of the resource (including operational rules, configuration and capacity), as contained in the Activated Plan;
- The trajectories intending to use the resource;
- The look-ahead time defining the prediction horizon, possibly ranging from 40 min to 2 hours.

Forthcoming overloads are therefore detected by the Sub-Regional and/or Regional Network Manager.

[16] An input refers to information that is *modified* by the process. Information that is used by the process, but *not modified by it*, is a constraint or trigger.

In addition to capacity load monitoring, complexity assessment may in return trigger airspace reorganisation through dynamic re-sectorisation – i.e. Process A3.1.2 Adjust Resources Dynamically, or/and a DCB Solution – i.e. Process A3.1.3.1 Select/Refine/Elaborate a Dynamic DCB Solution, or/and RBT revisions – i.e. Process A3.5.1.1 Adjust RBT, in coordination with the Planning Controllers, the Sub-Regional/Regional Network Managers, the Civil/Military Airspace Manager.

The following Use Case has been identified for Assess Airspace Capacity Load process:

Use Case	Description
Assess Airspace Capacity Load	This UC describes how the Regional Network Manager and Sub-Regional Network Manager assess the capacity load of airspace element, in order to put in place a DCB solution when needed. Capacity load assessment will be done according to an instant permissible density with a look-ahead of around 40 minutes and more (to be validated).

Table 3: Use Case for Assess Airspace Capacity Load

4.1.4.2 Assess DCB Complexity (A3.1.1.2)

This process will allow the Local DCB Complexity Manager to assess the DCB Complexity of an airspace volume. It allows activities such as dynamic route allocation. This is an input to strategic de-confliction. Both DCB complexity and ATC complexity are calculated on the basis of SBTs and RBTs:

- **The DCB complexity indicator** integrates uncertainty and correlative statistical deviations. It addresses the **density**, conflicting **flows**, and other **structural causes** of complexity (everything that is less sensitive to the uncertainty of that time horizon). Such an indicator should be based on a probabilistic model. Alleviation strategies would ideally try to separate conflicting flows, introduce de-conflicting airspace structures or balance complexities over multiple sectors.
- **The ATC complexity indicator** operates at a much shorter time horizon (<40min). It is addressing the conflict probability between **individual flights** and other aspects relevant to required controller and pilot/pilot interaction, based on a forecast of concrete tasks and events. Alleviation strategies would ideally address the aircraft with the highest marginal cost (workload) first.

DCB Complexity and ATC Complexity can be introduced as two filters (among several others) operating at different ATM layers, DCB being at a higher level of abstraction and in the longer term compared to ATC. [CM-0302]

The main drivers related to this process are the following:

- Inputs:
  - o None[17].
- Constraints/Triggers:
  - o Activated Plan (RBTs + Activated Resources).
- Human Actors:
  - o Local DCB Complexity Manager.
- Outputs:
  - o DCB complexity Indicator.

[17] An input refers to information that is *modified* by the process. Information that is used by the process, but *not modified by it*, is a constraint or trigger.

Through this process, the DCB complexity is assessed by the Local DCB Complexity Manager, given:

- The airspace volume which is monitored;
- The operational status of the airspace volume (inc. operational rules, configuration and capacity), as contained in the Activated Plan;
- The trajectories intending to use the airspace volume;
- The look-ahead time defining the prediction horizon, possibly ranging from 20 to 40min.

The DCB complexity is a probabilistic model based on an uncertainty envelope centred on the expected aircraft position. The main objective of complexity monitoring is to maintain the ATCo workload under a predefined threshold, not only for one ATCo but also for all ATCos working on the same family of sectors.

In addition ATCO **workload** is derived from complexity as an aggregated figure provided to Local DCB Complexity Managers.

A simplified ATCO Workload function consists of:

- The number of aircraft and time needed by the associated ATC task for routeing through the airspace volume;
- The number of flights in vertical evolution and the duration of climb/descent management task;
- The number of conflict pairs and the duration of conflict resolution task.

Typically, a maximal workload would be calculated according to a time step of 10 min (TBV) to anticipate the evolution as an input to resource and configuration management.

Experts have elaborated the following more comprehensive list of indicators to be considered for the development of more advanced workload models:

- Number of vertical movements;
- Number of potential conflicts;
- Interval between ATC instructions;
- Number of commands (voice or data messages) sent per hour;
- Number of flights controlled by one controller per hour;
- Number of flight level change instructions;
- Average time for each possible action;
- Number of co-ordination discussions with adjacent agencies;
- Radiotelephony frequencies occupancy;
- Number of heading instructions.

In addition, the experts highlighted others parameters not directly related to the air traffic flow but having impact on the subjective component such as:

- Time of working for every controller one day;
- Controller alternating time.

The workload of a controller is determined by three aspects: an intrinsic complexity related to the air traffic structure, a subjective component related to the controller him/herself (cognitive strategies and individual characteristics) and the available supporting tools.

The subjective range cannot be measured, but can be taken into account during the calibration procedure of complexity measurement tools or can be considered during description of threshold values. The main point is that workload depends on local environments, procedures, methods and that is why approach CM air management can differ from the ATM environment. Measuring workload is quite complicated, but the objective is to have the capability to predict complexity in order to react so that it is possible to reduce the overall ATCo workload.

It is assumed that airspace volumes having similar DCB complexity should have the same macroscopic workload model.

The assessment of DCB complexity may trigger:

- Airspace reorganisation through dynamic re-sectorisation or/and activation of a pre-defined route structure (A3.1.2 Adjust Resources Dynamically);
- Any other DCB Solution (A3.1.3.1 Select/Refine/Elaborate a Dynamic DCB Solution);
- RBT revisions (A3.5.1.2 Adjust RBT) in coordination with the Planning Controllers, the Sub-Regional/Regional Network Managers, and the Civil/Military Airspace Manager.

For example, complexity analysis could highlight that trajectory patterns in the next 45 min will result in a complex area (dynamic sector) for which any other configuration can be applied. A specific route pattern will be used in order to split traffic demand and have it distributed between to sectors, off-loading the busy one.

The following Use Case has been identified for Assess DCB Complexity process:

Use Case	Description
Assess DCB Complexity	This UC describes how the Local DCB Complexity Manager assesses the DCB complexity of every busy airspace element to reconfigure the airspace volume or/and define individual DCB solutions to be applied on the most constraining flights.

Table 4: Use Case for Assess DCB Complexity

4.1.4.3 Adjust Airspace Resources Dynamically (A3.1.2.3)

This process is run to coordinate **last-minute airspace resources operating rules change** (see [AOM-0204], [AOM-0206] and [AOM-0208]) such as:

- Airspace volume closure due to unpredicted event;
- Airspace volume availability due to planned activity cancel such as military area relocation due to weather constraints;
- Anticipatory deactivation of a TSA;
- Airspace resource configuration;
- Activation of a temporary route structure in a medium/high density area [AOM-0403], [AOM-0501], [AOM-0502].

The resulting effects might propagate all over the network, but also up to the short-term planning phase - e.g. DCB Queue creation and modification, routing advisories triggering SBT/RBT revisions.

The main drivers related to this process are the following:

- Inputs:
    - o Activated (airspace) resources;

  - Possible Airspace Configurations.
- Constraints/Triggers:
  - Complexity;
  - MET Nowcasts;
  - Constraints on Resources;
  - Unpredicted Events;
  - DCB Solution;
  - Detected Imbalance;
  - Refined Airspace Requirements;
  - Activated Plan (RBTs + Activated Resources).
- Human Actors:
  - Local ASM (or Civil/ Military Airspace Manager if required);
  - Local DCB Complexity Manager;
  - Sub-regional Network Manager (as alternate to Local DCB Complexity Manager);
  - Regional Network Manager.
- Output:
  - (Airspace) Resources Configuration.

Adjust Airspace Resources Dynamically is the process through which an airspace element (airspace volume, military area, temporary route structure …) transitions in real-time from one operating mode to another, for example a Military Area is released because of weather conditions.

From the side of DCB, the transition is decided on the basis of DCB complexity requiring traffic flows analysis, and operated by the Sub-Regional Network Manager, in coordination with the Civil/Military Airspace Manager and possibly the Local DCB Complexity Manager who knows best the available resources and their effectiveness, under the supervision of the Regional Network Manager should several changes need being coordinated, and in any case to assess impact on the network.

If the concerned airspace resource is such that changing its operating mode does not propagate outside the resource, the adjustment will be managed locally by civil and military Actors, under the supervision of the Sub-Regional Network Manager and by the Civil/ Military Airspace Manager.

From the side of ATC, similar process will be performed on the basis of ATC complexity (see “Complexity Management” in DOD E6) applied in a Multi-Sector Planning environment, on the basis of individual flights [CM-0302].

This process aims to dynamically optimise resource usage in order to:

- Adapt to contingencies - e.g. convective weather, technical failure;
- Adapt to unforeseen Resource Availability;
- Satisfy airspace requirements given at short notice - i.e. when they have an impact on flights already airborne;

- React to a forthcoming imbalance. In that case the process can be triggered by the implementation of a Dynamic DCB/ASM Solution. The new operational rules may be part of the solution, if predefined;
- Lower complexity by means of some airspace reconfiguration.

The optimisation of resource usage may be achieved through changes in:

- Dynamic sectorisation (dynamic structures that will adapt to trajectories in order to keep the situation manageable by the Controller while keeping the RBTs unchanged);
- Resource configuration;
- Resource usage rules (activation/deactivation of an Airspace Reservation or a local route network, interface between MIL mission trajectories with Business Trajectories).

Such changes aim to act on the resource capacity, and/or on the load of traffic and/or on the traffic complexity.

The impact of the new resource configuration/status/rules, which makes the “operational rules”, may be tested (through a simulation of the process) before they become applicable - e.g. to check that an imbalance is solved, through feedback to Assess Airspace Capacity Load and Assess Traffic Complexity processes.

Once applicable, they are recorded in the NOP with all relevant information (e.g. period of application) and notified to the interested parties, notably all ATM Stakeholders impacted at (very) short notice: the controllers in charge of the airspace element, the AOC Staff, and Flight Crews of the incoming flights.

Note that the conformance to new operational rules may imply RBT revisions i.e. Process A3.5.1.1 (Adjust RBT).

The following Use Cases have been identified for "Adjust Airspace Resources Dynamically " process:

Use Case	Description
Switch Airspace Operational Rules	This UC describes how, according to known SBTs and RBTs a specific airspace volume can be operated a different way, for example in case a TSA is de-activated with anticipation, or when a medium density area requires during a time period being structured i.e. when a change of real-time operation rules is necessary.
Coordinate Temporary Airspace Closure	This UC describes how a Regional Network Manager and/or Sub-Regional Network Manager and/or Civil/Military Airspace Manager can perform a coordination on an airspace volume closure, in order to use this resource safely or not to use it during a time period, during the short-term planning and the execution phases.

Table 5: Use Cases for Adjust Airspace Resources Dynamically process

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

4.1.4.4 Select/Refine/Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2)

This process will allow proposing a DCB solution in response to the detected imbalance [DCB-0208], [CM-0302]. It will allow both selection and refinement of an existing solution from the DCB (including ASM, see [AOM-0204] and [AOM-0206]) catalogue of solutions or to elaborate a new solution. This proposed DCB solution will complement the catalogue of solutions, if new or modified.

The Flight Crew/AOC Staff will participate directly to the Select/Refine/Elaborate a DCB Solution process. SBT/RBT compliance with network usage rules will be assessed within this process, and not during the assessment of the dynamic DCB Solution at network level (process A3.1.3.2.1).

The **main drivers** related to this process are the following:

- Inputs:
    - Proposed DCB Solution;
    - Catalogue of Solutions.
- Constraints/Triggers:
    - Detected Imbalance;
    - Cancelled DCB Solution.
- Human Actors:
    - Regional Network Manager;
    - Sub-Regional Network Manager;
    - Civil/Military Airspace Manager;
    - Flight Crew;
    - AOC Staff.
- Outputs:
    - Catalogue of solutions;
    - Proposed DCB Solution.

The **portfolio of possible DCB Solutions** consists of:

- Basic DCB Solutions:
    - Airspace configuration inc. temporary reserved airspace;
    - Strategic De-confliction measures[18]: temporary route structure activation in the terminal area, flight level capping, advisory routing, dynamic route assignment, definition of interface between MIL Mission Trajectories with Business Trajectories [AOM-0304], pre-defined ATS routes definition, use of free route [AOM-0403], [AOM-0501], [AOM-0502];

[18] Strategic De-confliction is used to apply actions that can be taken when the take-off time is known with sufficient accuracy, or even after the flight is airborne. The related DCB measures exclude tactical instructions and clearances that need an immediate response. Strategic de-confliction is applied in order to reduce the need for tactical intervention on individual aircraft.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

  - Queue management.
- Pre-defined DCB Solutions, made of basic DCB Solutions, characterised by:
  - The definition of the ATM situation that triggers its application;
  - The expected result;
  - A modus operandi including:
    - The list of actors that will take part to the negotiation process prior to pre-defined DCB Solution implementation during the Medium-term or Short-term Planning Phase, and their roles;
    - The selected procedures and/or DCB measures, which defines the network use to treat the ATM situation.

Predefined DCB Solutions are agreed between partners through CDM sessions and will be refined during the medium and short-term planning phases, through simulations.

If a particular ATM situation cannot be solved by the application of a predefined DCB Solution, an ad-hoc DCB Solution will be built upon the basic DCB Solutions thus upon the available resources.

The **implementation of a Dynamic DCB Solution** is prepared by the Sub-Regional Network Manager when a situation of imbalance is identified at Airspace Level during the execution phase - i.e. from 2 hours to 40 minutes ahead:, on the basis of Business / Mission Trajectory (see [DCB-0208]).

- In case of the imbalance being on the load of traffic: such an imbalance is either a residual situation left by the planning phase of DCB (due to uncertainties) or a developing situation confirmed in execution (due to contingencies and/or to the flexibility given to real-time operations). In both cases, the magnitude of the imbalance should remain limited - e.g. 110% of the airspace volume capacity;
- In case of the imbalance being on traffic complexity: it could not be assessed during the planning phase.

Therefore a Dynamic DCB Solution is intended to:

- Offload congested areas and possibly use capacity opportunities;
- Prevent controllers from overloads and/or highly complex traffic patterns;
- Increase predictability allowing the AO taking the right decision (turn-around management);
- Avoid capacity wastes.

To achieve it, a Dynamic DCB Solution, when active, operates via:

- First, a dynamic adjustment of the resource through changes in operational rules and configurations (refer to section 4.1.4.3);
- Second and maybe consecutive to resource adjustment, a dynamic adjustment of the demand through requests for a revision of trajectories and/or airspace requirements[19]. The intent may be to re-assign some traffic (for the purpose of strategic de-confliction, segregation/desegregation …) or to meter / pre-sequence traffic in favour of an AMAN (queue management in execution or adjustment of a planned queue – refer to DOD M2 for more information about queues) through individual RBT revisions.

All along this process, the Regional Network Manager coordinates the Dynamic DCB Solutions selected, refined or elaborated at Airspace Level (by the Sub-Regional Network Managers) and/or at Airport Level (by the APOC Staff).

Because the implementation of Dynamic DCB Solutions must be timely, most of them will be predefined (possibly in the form of a Scenario) and selected as such in the Catalogue[20] or with minor refinements.

Since they have been previously validated and provided no modification is applied now, the Sub-Regional Network Manager is allowed to skip the network assessment phase and jump from selection to application at once (provided a GO for activation has been sent by every concerned Sub-Regional Network Manager), almost shortcutting all coordination with the Regional Network Manager.

Such predefined solutions may be tailored to address operation recurrent issues, affecting well-identified flow patterns with a known and circumscribed network effect i.e. contained within the Airspace volume in which the DCB solution is applied.

Conversely, the elaboration of a new, ad-hoc Dynamic DCB Solution will be subject to network effect assessment, with possible iterations if the solution is not validated as such. There is a risk for the CDM process to lag, leading to an untimely implementation of the solution. Such solutions should be limited in scope and occurrence, and be prepared at network level straight away to include network effect assessment.

If a particular ATM situation cannot be solved by the application of a predefined DCB Solution, an ad-hoc DCB Solution will be built upon the basic DCB Solutions contained in the Catalogue. Basic DCB Solutions may consist of configuration inc. military activity, temporary route structure, flight level capping, advisory routing, queue management and Strategic De-confliction measures. This task will be orchestrated by the Regional Network Manager. All required actors will be involved in the process.

A network-wide impact assessment may be required prior to implementing a solution when:

- The same imbalance faces more than one DCB actor - e.g. the Sub-Regional Network Managers of adjacent airspace areas or the APOC Staff of neighbouring airports;
- The network stability is at stake, due to the magnitude of the imbalance;
- The resolution of the imbalance is prone to some adverse network effect and must be prepared network-wide to speed up the implementation (notably if the time horizon is short).

[19] This may in return trigger a dynamic adjustment of the resource (through the activation or deactivation of the airspace reservation fulfilling the requirements of the user).

[20] The Catalogue of Solutions is elaborated during the Long Term and Medium/Short-term Planning Phase. It includes Dynamic DCB Solutions, either basic or predefined (refer to section “4.1.4.4 Select/Refine/Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2)”).

The coordination work is more of a routine task, performed by the Regional Network Manager who embraces the entire NOP and is therefore in a position to synchronise Dynamic DCB Solutions, so that they are constructive and create synergies to the benefit of the whole network.

Such a coordination is necessary, at least to avoid inefficiencies, even if the solutions do not impact adversely on each other.

Regional Network Management aims to explicitly:

- Ease the CDM process between sub-regional Network Managers when necessary;
- Synchronise DCB measures to be put in place with DCB measures already activated;
- Be the honest broker i.e. decision maker of last resort if needed (no agreement found between parties engaged in the CDM process), in order to maintain the network stability.

Network coordination can also be performed implicitly through NOP/SWIM:

Assume, for instance, that a pool of aircraft are queued on departure (e.g. metering constraint on a terminal area exit point) and on arrival - e.g. metering constraint on a terminal area entry point. Both queues are different DCB Solutions, remotely prepared by different actors (APOC Staff on departure and Sub-Regional Network Manager on arrival) to solve different issues - e.g. adverse weather on departure and airspace congestion on arrival. However they do bear “common-modes” - i.e. have trajectories in common. Inevitably, some kind of coordination will occur[21] to check the consistency of both queues, make sure that they work in synch and reconcile them if need be, until the departure queue is implemented.

DCB Queues

The next paragraphs attempt to propose basic operating principles for DCB queue management in the context of execution phase.

- A DCB queue is a DCB Solution applied when every other capacity optimisation, alone or in combination with others, has been tested and does not solve the imbalance(s). Hence, queue management is a complementary means to guarantee network balance from minor time shifts up to its ultimate of grounding aircraft (e.g. in case of critical events);
- A DCB queue is defined by a maximum throughput regardless of individual order;
- The **First Come/First Served** principle over a capacity constraint (e.g. a TMA entry point) is applied in the active DCB area whether the flight is airborne or not. When several flights have identical ETA/TTA, then those airborne have priority over those still on the ground. Those having a RBT have priority over those having a SBT;
- A DCB Queue Management process only provides a TTA[22] if the flight has reached a time horizon of 2 h (TBV) before ETA. This DCB Queue active horizon parameter

---

[21] Possibly initiated during the planning phase. See sister process A2.3.2.1.3 Select/Refine/Elaborate a DCB Solution at Network Level, DOD M2 Medium/Short-term Network Planning.

[22] ETA/ETO estimates are not constraints for the flight crew. However, when estimates change, there must be an update of the RBT. An estimate is a time that is not considered in the actions of the air and ground and if it cannot be achieved, the RBT is automatically updated.

TTA/TTO Target Times are loose constraints and typically reserve an approximate place in a queue for a constrained resource. The aim with computing a Target Time is to prepare the assignment of a controlled time while uncertainty is such that the allocation of a more precise data would be irrelevant (layered approach). Air and ground make best efforts to respect a target time and if it cannot be results from a trade-off: the earlier a flight receives a TTA, the better but the more risky it is the ATM situation has changed, and the TTA will have had unnecessarily constrained the flight;

- It is up to the airspace user to decide on how to meet the TTA: by 1) Adjusting speed 2) By changing FL even if not longer optimal 3) By changing the 2D route;
- A tolerance window [-3 min; +3 min] (TBV) is defined around the TTA;
- Once having reached the AMAN active horizon (40 min TBV), the flight does not receive any more TTA from the DCB Queue process, but a CTA from the AMAN.

DCB departure queue

- DCB departure queues are regarded as airport DCB solutions, addressed in DOD M1.

DCB arrival queue

- DCB arrival queues are regarded as network DCB solutions;
- Arrival queuing aims:
  - o At preparing flights in order to make it easier sequencing of arrivals during peak periods that cannot be handled by the AMAN alone;
  - o Or at acting as a basic sequencer for non-AMAN-equipped airfields;
  - o Or at equity between flights inside or outside the active AMAN horizon. If no DCB arrival queue is implemented then flights outside the AMAN horizon would not be submitted to any pre-sequencing.
- Arrival queues are planned by the Sub-Regional Network Manager at the request and in coordination with the APOC Staff;
- Arrival queue management operates as follows, and involves multiple time horizons, as shown by Figure 5.

achieved the RBT needs to be revised, which could require some negotiation and wider changes to the plan.

CTO/CTA constraints are mandatory: if the aircraft cannot meet a constraint, the flight crew must propose a revision to the RBT that respects the constraint in another way (different route, level etc). Constraint conformance will be continuously monitored by Air and Ground.

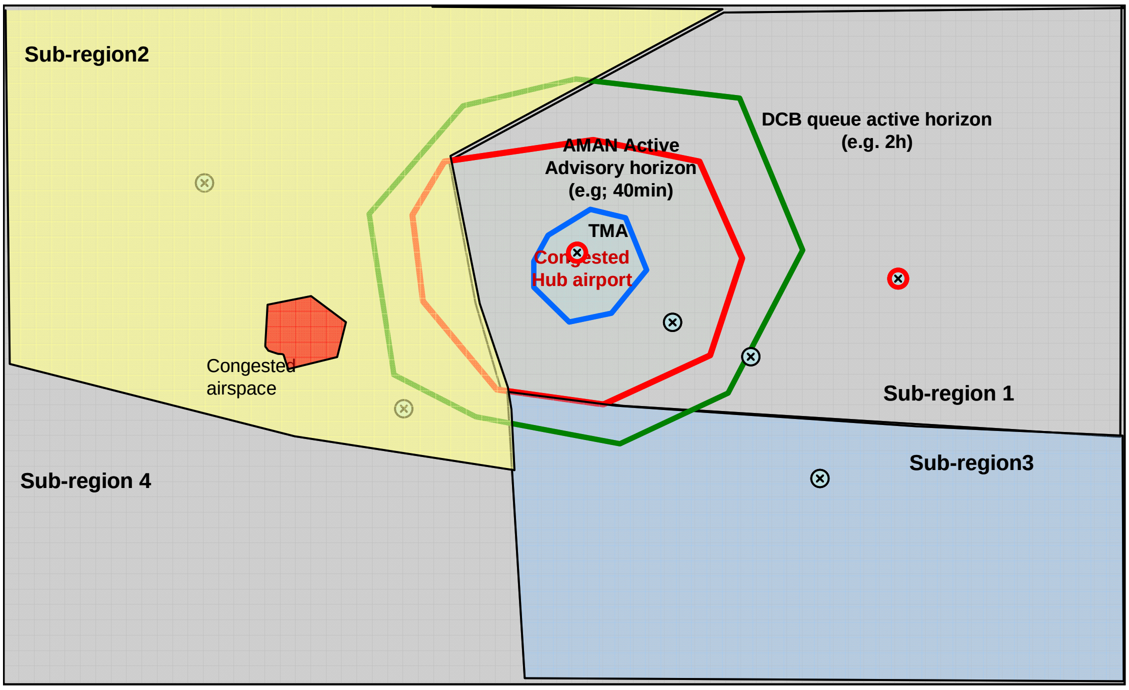

Figure 5: Time horizon of an arrival queue

The APOC Staff decides to plan an arrival queue:

- No active AMAN: the flight is assigned a TTA on the basis of its current SBT/RBT and according to the queue throughput. Flights can be either on the ground or airborne; or
- Active AMAN: the flights that are outside the active AMAN active horizon (40mn TBV) are assigned at TTA like in 1). When reaching the AMAN horizon, the TTA turns into a CTA of higher accuracy. The CTA is calculated by the AMAN and is as close as possible to the TTA. The flights that are within the active AMAN horizon are allocated a TTA converted to a CTA as soon as the aircraft departs.

The Airspace User can modify the SBT through a CDM process (Optimise SBT) in order to both achieve the TTA but also maximise the flight revenue according to his/her business model.

For flights also submitted to DMAN, the TTA and the TTOT will be made compatible on the basis of the business trajectory through an iterative process relying on the NOP.

DCB en-route queue

When exceptionally an en-route high-density area is not anticipated on time, an en-route queue can be requested by the Sub-Regional Network Manager or suggested by the Regional Network Manager. In this case, flights, whether airborne or not, are assigned a TTA - i.e. a Target Time of Arrival in the high-density area[23]. The Airspace User modifies the SBT/RBT through a CDM process (Optimise SBT or Revise RBT) in order to both achieve the TTA but also maximise the flight revenue according to its business model. Depending on the high density area location the Airspace User might decide to elaborate a 4D trajectory that matches the TTA but also the planned time of arrival at destination.

[23] One could consider the TTA as a Target Time Over an entry point (not necessarily a waypoint) in the high-density area, and consequently call it a TTO.

The following Use Case has been identified for Select/Refine/Elaborate a Dynamic DCB Solution at Network Level process:

Use Case	Description
Select/Refine/Elaborate a Dynamic DCB Solution at Network Level	This Use Case describes how either a Regional or a Sub-Regional Network Manager selects / refines / elaborates then implements a DCB solution in order to maintain the Traffic Demand and capacity balanced in the concerned area (an airspace area or an airport or group of airports). Implementation may be possible at local level if, by DCB solution definition, it is known to have local impact only. Otherwise, explicit co-ordination with the Regional Network Manager is required. The solution will be in any case broadcast for confirmation to the concerned sub-regional actors (including APOC staff) who are the only ones that know precisely the available resource. Nonetheless, in case a side-effect is generated by a set of "local" DCB solutions, then implementation at the regional level must be considered as a last-resort decision making aiming at maintaining the required level of safety.

Table 6: Use Case for Select/Refine/Elaborate a Dynamic DCB Solution at Network Level

4.1.4.5 Assess Network Impact of the Dynamic DCB Solution (A3.1.3.2.1)

This process describes how the Regional Network Manager assesses the network impact of a DCB solution (possibly made of several DCB measures). Network impact assessment during the execution phase will be necessary for ad-hoc Dynamic DCB solutions, since they will be defined most of the time at the local level. Distant network impact cannot be detected at sub-regional/local level. This is the most efficient as assessment is performed on the basis of RBT or a significant proportion of [DCB-0208].

The Actors that participate to the assessment of the Dynamic DCB Solution, are:

- One or several Sub-Regional Network Managers that attended the negotiation:
  - The Requester for the application of the DCB Solution;
  - The Providers;
- The Regional Network Manager (honest broker).

These Actors can output a GO or a NOGO for the activation of the Soluton according to the network impact that would result from the application of the DCB Solution (*what-if*).

The main drivers related to this process are the following:

- Inputs:
  - Proposed DCB Solution.
- Constraints/Triggers:
  - None.
- Human Actors:
  - Regional Network Manager;
  - Sub-regional Network Manager.
- Outputs:
  - Activated DCB Solution, i.e. a DCB Solution having a *GO* for application through the NOP/SWIM;

- o Non-applicable DCB Solution, i.e. Cancelled DCB Solution and *NOGO* for application through the NOP/SWIM.

Through this process, the network impact of a Dynamic DCB Solution is assessed if:

- The solution is not part of the Catalogue of Solutions (the catalogue of solutions only contains validated DCB solutions);
- The solution has been cancelled or modified.

The assessment is either conducted at local level or by the Sub-Regional or the Regional Network Manager depending on the part of the network which is impacted by the Solution:

- If the local manager[24] considers that the solution should be local and if the Sub-Regional Network Manager agrees, at least by default while duly informed (as in the case of a predefined solution), the local solution is implemented;
- Otherwise if the Sub-Regional Network Manager considers that the solution should be of sub-regional nature and if the Regional Network Manager agrees, at least by default while duly informed (as in the case of a predefined solution), the Sub-Regional solution is implemented;
- Otherwise a Regional solution is implemented by the Regional Network Manager.

The outcome of the assessment is:

- Either an activation: a GO for application is sent to the provider of the proposed solution, who activates the DCB solution as required;
- Or a cancellation: a NOGO for application is sent to the provider of the proposed solution, APOC Staff or Sub-Regional Network Manager, who then submits a reworked solution.

Note however, that this iterative process will be far less elaborated than in the planning phase given the time to react to the detected imbalance. Most issues will be solved by predefined solutions picked out of the catalogue by the interested parties. This means that combination of basic DCB Solutions will not be applied for safety issues because all combined measures implementation might abort.

The following Use Case has been identified for Assess Network Impact of the Dynamic DCB Solution process:

Use Case	Description
Assess Network Impact of the dynamic DCB Solution	This UC describes how the network impact of a proposed DCB solution is performed. If the network impact is significant, the DCB solution must be refined or changed for a more efficient one. Network impact assessment must be considered as a background activity handled by every actor and by the regional level in particular, knowing that most of the DCB solutions that can be applied during the execution phase have to be accepted for local implementation i.e. without explicit co-ordination with the regional level, in order to speed up the decision making process and find timely response to DCB imbalances.

Table 7: Use Case for Assess Network Impact of the Dynamic DCB Solution

[24] Either the Complexity Manager (case of an airspace DCB solution) or the APOC Staff (case of an airport DCB solution).

4.1.4.6 Apply the Dynamic DCB Solution (A3.1.3.2.2)

This process describes how the System applies a Dynamic DCB Solution that has been activated after assessment by a Local/Sub-Regional Network Manager or by a Regional Network Manager (refer to A3.1.3.2.1and to [DCB-0208]).

The main drivers related to this process are the following:

- Inputs:
  - Activated DCB Solution.
- Constraints/Triggers:
  - Revised RBTs;
  - AU Preferences and Constraints.
- Human Actors:
  - Sub-Regional Network Manager;
  - Regional Network Manager;
  - APOC Staff.
- Outputs:
  - DCB Solution published in the NOP through SWIM.

The following Use Case has been identified for Apply the Dynamic DCB Solution process:

Use Case	Description
Apply the Dynamic DCB Solution	This UC describes how the System applies a Dynamic DCB Solution that has been activated after assessment by a Local/Sub-Regional Network Manager or by a Regional Network Manager.

Table 8: Use Case for Apply the Dynamic DCB Solution

4.1.5 Enablers

The implementation of Dynamic DCB requires updated information available through the NOP/SWIM and development of standard interfaces and access services that will allow CDM between an enlarged set of types of actors, even if the number of contributors should be reduced most of the time (through an extended use of pre-defined DCB Solutions).

4.1.6 Transition issues

The next two requirements are foreseen:

- The deployment of NOP/SWIM;
- In the case of DCB Solutions implemented at very short notice (-40min to be validated), acceptance by the controllers to execute RBT changes in favour of a downstream control working position.

4.2 Network support to Adjust Traffic and Airspace Requirements (A3.5)

4.2.1 Scope and Objectives

Adjust traffic and airspace requirements is the process through which 1) The Airspace Requirements received, changed, or cancelled on the day of operation are handled by the

Civil/Military Airspace Manager in cooperation with the Sub-Regional and Regional Network Managers; 2) The actual traffic demand (made of RBTs) is adjusted by the Airspace Users during the Execution Phase, having a potential impact on other SBTs:

- Either on Airspace Users' own initiative;
- Or at the request of third parties, for the needs of DCB (inc. airspace, airport and network resources management) or ATC (for the purpose of de-confliction and separation assurance).

Therefore the process can be triggered by a great variety of events (military areas shift, military area cancel, flight cancel, and flight extra-mileage for the sake of AU's flight schedule re-synchronisation…). Depending on the nature of the trigger, on the time horizon of the issue and on the latency time of the response:

- The magnitude of the response will differ, e.g. a de-confliction manoeuvre and the application of DCB Solution will not imply the same number of revisions;
- The timing of the response elaboration and the number of actors involved will differ. Some actions will be carefully negotiated if not too time-sensitive; whereas CDM sessions will be shortcut by time-critical actions, for the sake of safety.

Network support to this process mainly scopes:

- The demand adjustments triggered for the purpose of Dynamic DCB (refer to section 4.1);
- The demand adjustments which may have implications for the network and the way it is managed (even if those adjustments are initially very specific).

Demand adjustments either result from a modification of:

- Trajectories through RBT updates, possibly consecutive to RBT revisions;
- Airspace Requirements.

Trajectories may be adjusted at the level of:

- Flight operations, i.e. in respect of a particular trajectory;
- Airline operations, i.e. in respect of the trajectories owned by the same Airspace User;
- Airspace Users Operations, i.e. in respect of the trajectories owned by different Airspace Users.

4.2.2 Assumptions

- Airlines have access to a complete situation of their own schedule whatever the look-ahead horizon;
- It is expected that RBTs are stable and accurate, which should improve predictability of traffic demand/capacity imbalance, of complex traffic patterns detection, and of TTA.

Defining the look-ahead time horizon of dynamic DCB is a trade-off between:

- Maximising network effectiveness; and
- Reducing the risk for unnecessary trajectory modification;

If DCB or dynamic DCB catches the flight too early: it is efficient in terms of time recovery of operational disturbances (at take-off in particular), but the ATM situation may change and measures already applied useless.

If DCB or dynamic DCB catches the flight too lately: the DCB's pre-sequencing effect of arrivals will be inefficient.[25]

Hence, we consider that an AMAN with a -40 min look-ahead could be convenient together with a DCB look-ahead of -40 min and a active time limit of -120 min.

4.2.3 Expected Benefits, Issues and Constraints

It is expected that RBTs are stable and accurate, which should, improve predictability of traffic demand/capacity imbalance, of complex traffic patterns detection, and of TTA.

Positive side effects on the SBTs themselves should improve the short-term planning layer output.

Better knowledge of Airspace Requirements should improve use of the airspace available capacity.

Finally, a more dynamic use of airspace through activation of adjustable airspace volumes/profiles (inc. military area) will maximise satisfaction of Airspace Users, both for Civilians (more direct routes) and for Military Users (more adequate military areas adapted to training exercises requirements).

4.2.4 Overview of Operating Method

Figure 5 gives an overview of the process sequences and information flows required to *adjust traffic and (Users) airspace requirements* in the context of network management in the execution phase.

---

[25] On the basis of:

- An average flight duration in the ECAC area is around 1H20;
- A TTA drift due to operational disturbances estimated to -/+3 min;
- An AMAN look-ahead of 40 min.

The remaining en-route flight duration is around 1H, hence a max of -2 min can be applied simply by adjusting speed.

The uncertainty on the TOT could be -3/+3 min. An AMAN with a 40 min look-ahead could manage 5 to 6 min comparable to a -5 min (-3-2) and +3 min error.

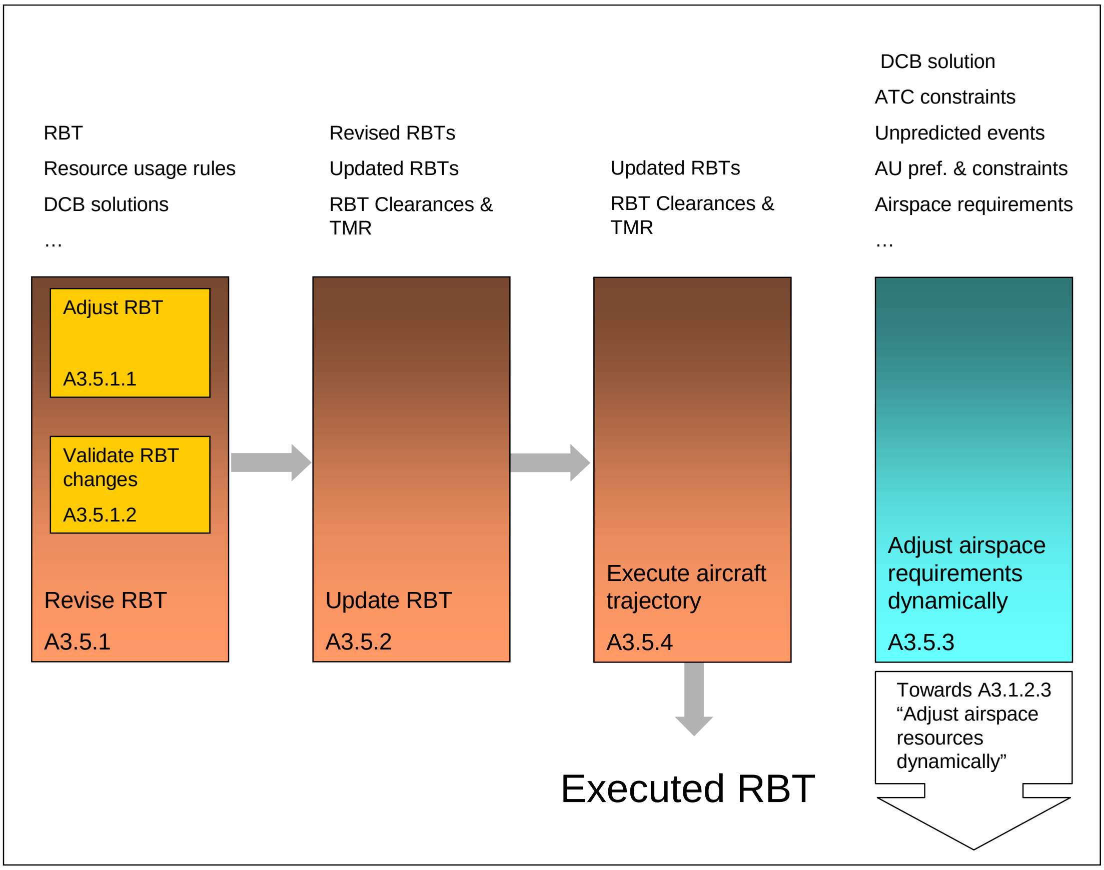

Figure 6: A3.5 Network Support to Adjust Traffic and (User) Airspace Requirements

Due to the different nature, the process of updating traffic requirements (orange) is different to the one dealing with the adjustment of airspace requirements (blue). In detail the process evolve along the following steps:

The revision of the RBT consists of "Adjust RBT" and "Validate RBT changes" sub-processes.

Revision of the RBT:

- Is triggered at air or ground initiative when route, altitude and/or time constraints are to be changed (due to weather hazards or a constraint that cannot be respected or due to queue or conflict management);
- Is also triggered after any RBT update in order to check whether a revision of the RBT is needed or not;
- Revision of the RBT is performed to the best possible outcome for the user.

A.3.5.1.1: "Adjust RBT" sub-process describes how a RBT can be adjusted either at user initiative for operational reason, or by an ATC controller for separation management reasons, or by the Local DCB Complexity Manager aiming at strategic de-confliction, or by the Sub regional / Regional network manager in the context of a DCB/ASM solution.

This process also checks whether a RBT update implies a RBT revision.

A.3.5.1.2: "Validate RBT changes" sub-process (§ 4.2.4.2) allows the Regional Network Manager to check if the new RBT is compliant with the airspace usage rules in place along the trajectory, and has no adverse impact on the network.

A3.5.2: "Update RBT" process (§4.2.4.3) can be activated either by the System when the current predicted trajectory differs from the previously predicted trajectory by more than a pre-defined threshold, or by the A3.5.1 "Revise RBT process" (cf. STEPS 6 and 7 here above).

A3.5.4: "Execute aircraft trajectory" (§ 4.2.4.5) describes how the RBT is physically executed according to mainly tactical instructions and updated RBTs.

A3.5.3: "Adjust airspace requirements dynamically" (§ 4.2.4.4) enables users to manage the flexible use of airspace, and also to express their preferences and constraints (facing for example an unpredicted event). This process links the global demand/capacity balancing activity to RBT management.

4.2.4.1 Adjust RBT (A3.5.1.1)

This process aims at:

- Re-scheduling flights in en-route and arrival queues, during the execution phase, i.e. the RBT has already been published and the aircraft may be already airborne. The airspace users may be themselves requesting the re-scheduling or may have to accommodate it in the case it is requested by the APOC Staff or the Sub-Regional Network Manager;
- Adjusting flight trajectories [CM-0501], [AUO-0303] during the execution phase [AOM-0403], [AOM-0501], [AOM-0502] i.e. the RBT has already been published and the aircraft may be already airborne. Most of the time, the airspace users will themselves request the trajectory modification or may have to accommodate it in the case it is requested by another stakeholder (e.g. Sub-Regional/Regional Network Manager) due to a residual high-density area/high DCB Complexity area [CM-0302]or on the contrary due to a capacity opportunity - i.e. the application of a DCB solution [AOM-0204];
- Checking whether a RBT update implies a RBT revision;
- Interfacing MIL mission trajectories with Business Trajectories [AOM-0304].

The main drivers related to this process are the following:

- Inputs:
  - RBTs.
- Constraints/Triggers:
  - Resource Usage Rules;
  - DCB Solution;
  - Unpredicted Events like convective weather area, temporary airspace closure…;
  - ANSP originated RBT revision request;
  - ATC Constraints.
- Human Actors:
  - AOC Staff;
  - Sub-Regional Network Manager;
  - Flight Crew;
  - Regional Network Manager;
  - Local DCB Complexity Manager;
  - Planning Controller;
  - APOC Staff;

- Airline Station Manager.
- Outputs:
    - AU originated RBT revision request;
    - Changed RBTs.

At the level of DCB, Adjust RBT is the process through which a new RBT is proposed, agreed and validated up to 40 min in advance:

- With the objective of responding to airspace user requests and requirements, MET constraints…
- Or because a constraint cannot be met by the (possibly updated) RBT;
- Or because a constraint is revised, added or removed, as a result of:
    - Demand and Capacity Balancing (triggered by the Sub-Regional Network Manager or the APOC Staff), consecutive to the application of a Dynamic DCB Solution;
    - Strategic De-confliction (triggered by the Controller, the Local DCB Complexity Manager or the Sub-Regional Network Manager);
    - Complexity Management (triggered by the Local DCB Complexity Manager).

This matches [AOM-0206] OI.

In order to limit the impact of an airspace exclusion, Dynamic Mobile Areas and other more or less dynamic airspace volumes, have been designed (see [AOM-0208] and section 4.2.4.1 “Refine/Define Airspace Reservation Demand (A2.1.1)” in DOD M2 [7]).

Also, the route network will evolve to a reduced set of pre-defined routes not impacted by airspace boundaries (See [AOM-0403]).

If not initiated by the Airspace User (AOC Staff, Flight Crew or Airline Station Manager), a revision may be requested by the APOC Staff, the Sub-Regional/Regional Network Manager, the Local DCB Complexity Manager or the Planning Controller, propagating all information needed to evaluate the desired outcome of the RBT adjustment, optionally with the proposal for the RBT adjustment.

The request is acknowledged by the Airspace User, who provides in return a revision proposal.

The other parties either accept the proposal, or propose amendments until everybody agrees on the new RBT, which is then submitted to the Regional Network Manager for validation (refer to section 4.2.4.2).

The following Use Cases have been identified for Adjust RBT process:

Use Case	Description
Re-Schedule Flights (by User)	This UC describes how an Airspace User can re-schedule his flight taking into account airspace/ground constraints in order to match a TTO (a TTOT if the a/c is still on the ground with an already agreed SBT, in this case the RBT may return to a SBT) or for his business needs.
Re-Schedule Flights (by System)	This UC describes how the Regional Network Manager, a sub-regional manager, or any planning actor can ask a User, through the NOP, for re-scheduling his flight due to unforeseen constraint, in order to match a TTO or a TTOT if the a/c is still on the ground, with an already agreed SBT. In this case the RBT may return to a SBT.

Use Case	Description
Adjust Flight Route (by User)	This UC describes how an Airspace User can ask for a RBT modification in order to fulfil his business needs.
Adjust Flight Route (by System)	This UC describes how the Regional Network Manager, a sub-regional manager, or any planning actor can ask a User, through the NOP, to modify his/her RBT for safety reasons i.e. in order to avoid directly or indirectly a too dense airspace volume.

Table 9: Use Cases for Adjust RBT

4.2.4.2 Validate RBT Changes (A3.5.1.2)

This process will allow the Regional Network Manager to validate at the network level the proposed RBT changes (re-scheduling and/or trajectory adjustment and/or interface between MIL Mission Trajectory with Business Trajectory [AOM-0304]) in order to smooth traffic flows and de-conflict flights through complexity management [CM-0302] [CM-0501]. This "validation" relates to the assessment of the induced impact of the RBT changes on the network.

The main drivers related to this process are the following:

- Inputs:
  - None.
- Constraints/Triggers:
  - Changed RBTs.
- Human Actors:
  - Regional Network Manager (possibly substituted by the related NOP service).
- Outputs:
  - Revised RBTs.

Validating a (changed) RBT aims at:

- Verifying that the 4D profile is compatible with the airspace resources to be activated at the moment the flight will be using it. Nevertheless, for long haul flights, this checking will be conducted the following way:
  - If the flight is more than 3 hours (a parameter to be validated) away from destination airport, then the flight/AOC will be simply informed of the planned mismatch (the planned available/unavailable resources may change);
  - If the flight is less than 3 hours (to be validated) away from destination airport then the flight/AOC will be warned and requested to provide a relevant RBT. In case of a late answer or no answer at all, then the Regional Network Manager will work out an adequate 4D trajectory.
- Finally making sure the (new) RBT has no adverse impact on the network.

The (revised) RBT will be shared in the NOP and notified by the System to both the ground and onboard equipment provided the aircraft is of the required ATM Service Capability [AUO-0303] Anyway, the RBT will be transmitted to the AOC.

The following Use Case has been identified for Validate RBT Changes process:

Use Case	Description
Validate RBT Changes	This UC describes how the Regional Network Management function through the NOP services, checks compliance of a changed RBT with the airspace use and with the airspace usage rules.

Table 10: Use Case for Validate RBT Changes

4.2.4.3 Update RBT (A3.5.2)

The RBT is updated automatically[26] when the current predicted trajectory differs from the previously down linked predicted trajectory by more than pre-defined thresholds indicated in TMR.

Any update of the RBT will directly trigger "De-conflict and Separate Traffic" for safety purpose and "Revise RBT" to check whether a revision of the RBT is needed or not (see [AOM-0304], [CM-0302] and [CM-0501]).

The main drivers related to this process are the following:

- Inputs:
  - RBTs.
- Constraints/Triggers:
  - RBT Clearances & TMR.
- Human Actors:
  - None.
- Outputs:
  - Updated RBTs.

Update RBT is the process through which the RBT is replaced by:

- A Revised RBT: this alternative is straightforward and is the natural outcome of a revision, provided that it is validated (refer to section 4.2.4.2);
- The current PT[27]: this alternative is not straightforward and is detailed hereunder.

The process is triggered when the deviation of the PT from the RBT is greater than a delta specified in the TMR. This can be done as a result of the achievement of Operational Improvement [IS-0305], which supposes achievements of OI [IS-0302] and of [IS-0303]. Both OIs aim at improving ground prediction by using airborne data. Use of MET data is also a very important issue [IS-0501].

When the Update RBT process is triggered, the latest PT update becomes the new reference i.e. the new RBT: the RBT is updated. Thus, the PT is the airside 4D trajectory predicted and updated continuously, while the RBT is the shared predicted 4D trajectory .

The update process for the RBT will depend on the current clearance given to the flight as there will be different rules for open-loop clearances and closed-loop clearances.

This TMR is adjusted so that onboard data are only disseminated when they are relevant to other ATM stakeholders, in order to:

[26] This requires ATM Service Level 3 operations capable aircraft.

[27] The PT is the airborne predicted trajectory. It is continuously computed/updated on-board (in aircraft fitted with FMS or similar equipment) and corresponds to what the aircraft is predicted to fly

- Achieve a minimum level of stability regarding the information of reference;
- Streamline the utilisation of the SWIM network to avoid overloads consequential to massive information exchanges.

The following Use Case has been identified for Update RBT process:

Use Case	Description
Update RBT	This UC describes how the RBT can be updated either after the "A3.5.1 Revise RBT" activity, or through automatic update triggered when the current predicted trajectory differs from the previously down linked predicted trajectory by more than pre-defined thresholds indicated in TMR.

Table 11: Use Case for Update RBT

4.2.4.4 Adjust Airspace Requirements Dynamically (A3.5.3)

Process "Adjust Airspace Requirements Dynamically" is twofold:

- It will enable real time adjustments of flexible airspace structures [AOM-0206];
- All users will be able to express their preferences and constraints [AOM-0204].

The main drivers related to this process are the following:

- Inputs:
    - Refined Airspace Requirements.
- Constraints/Triggers:
    - DCB Solution;
    - Unpredicted Events;
    - ATC Constraints.
- Human Actors:
    - Civil/Military Airspace Manager;
    - Exercise Director (or the responsible military planner);
    - Flight crew.
- Outputs:
    - Airspace Requirements
    - Airspace User Preferences & Constraints.

Adjust (User) Airspace Requirements Dynamically is the process through which Airspace Requirements are submitted or revised in execution [AOM-0206]. Revisions may be initiated:

- By the Airspace User because of new intentions;
- By the Civil/Military Airspace Manager, consecutive to the application of a DCB Solution by the Sub-Regional Network Manager.

Revised Airspace Requirements are proposed and negotiated between the interested parties until they reach an agreement.

The Civil/Military Airspace Manager, cooperating with the Sub-Regional Network Manager and the Airspace User, works to find a compromise (see [AOM-0208]):

- Fulfilling the user's requirements as much as possible;

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

- Minimising impact on demand (business trajectories, especially those in execution) and capacity (airspace resource).

Dynamic DCB is impacted as follows:

- Revised Airspace Requirements trigger an adjustment of the Airspace Reservation coordinated by the Civil/Military Airspace Manager and the Sub-Regional Network Manager through process A3.1.2.3 Adjust Airspace Resources Dynamically (refer to section 4.1.4.3);
- A Dynamic DCB Solution is applied at Airspace or Network Level, if need be to:
    - Reconcile trajectories so that they are compatible with the Airspace Reservation (no interference);
    - Resolve an airspace imbalance possibly created by the reconciliation.

The following Use Case has been identified for Adjust Airspace Requirements Dynamically process:

Use Case	Description
Adjust Airspace Requirements Dynamically	This UC aims at adjusting airspace requirements in real time for flexible airspace structures.

Table 12: Use Case for Adjust Airspace Requirements Dynamically

4.2.4.5 Execute Aircraft Trajectory (A3.5.4)

This is the process that explains how the RBT is physically executed i.e. this process takes flight instructions and the RBT as inputs to perform the aircraft flight, producing the Executed Business Trajectory (see [CM-0501]).

The main drivers related to this process are the following:

- Inputs:
    - Tactical Instruction (open loop);
    - Trajectory Change Instruction (Closed loop);
    - RBT Clearances & TMR;
    - Revised RBTs;
    - RBT.
- Constraints/Triggers:
    - None.
- Human Actors:
    - Flight Crew.
- Outputs:
    - Pilot Request;
    - Executed Business Trajectories.

The following Use Case has been identified for Execute Aircraft Trajectory process:

Use Case	Description
Execute Aircraft Trajectory	This Use-Case describes how the Flight Crew takes flight instructions and the RBT as inputs to perform the aircraft flight, producing the Executed Business Trajectory.

Table 13: Use Case for Execute Aircraft Trajectory

4.2.5 Enablers

Proportion of ATM-3 capable aircraft, consistent with the deployment of SESAR IP2, capable in particular of full 4D trajectory management (through flight updates, data-link communications) including:

- Data sharing;
- Ground broadcast of uplink of AIMS/Meteo data (wind grids);
- Auto taxi (optimising speed adjustment according to the cleared taxi route);
- Multiple Controlled Times of Over-fly (CTOs, in addition to CTA): time constraint management on several point of the trajectory.

4.2.6 Transition issues

The expected transition issues are the following:

- Availability of technology;
- Cost of equipage.

5 ENVIRONMENT DEFINITION

5.1 AIRSPACE CHARACTERISTICS

This section is covered by the General DOD [4].

5.2 TRAFFIC CHARACTERISTICS

This section is covered by the General DOD [4].

6 ROLES AND RESPONSIBILITIES

The section addresses the roles and responsibilities of organisations and human actors in the context of network management in the execution phase.

6.1 MAIN ROLES AND RESPONSIBILITIES

Network Management during the Execution Phase interface actors from all the operational layers:

- Airspace User Operations with involvement of the AOC Staff, the Flight Crew and the Airline Station Manager;
- Demand and Capacity Balancing with involvement of the Regional Network Manager and the Sub-Regional Network Manager;
- Airspace Organisation and Management with involvement of the Civil/Military Airspace Manager;
- Aerodrome Operations with involvement of the APOC Staff;
- Traffic Synchronisation and Conflict Management with involvement of the Planning Controller.

The **Regional Network Manager** is responsible for the ECAC-wide network planning, i.e. for all network aspects beyond the range of Sub-Regional Network Managers. In particular, the network as a whole is entrusted to them. They envision it, monitor it, bring it under control and keep it under control.

The Regional Network Manager integrates sub-regional contributions to the NOP.

The Regional Network Manager closely cooperates with the Sub-Regional Network Managers, to leverage their action and balance demand and capacity at the regional level through:

- Support: Facilitate co-ordination with the Sub-Regional Network Managers, particularly in the elaboration of network DCB Solutions;
- Validation: network effect assessment of new and sensitive airspace/airport DCB Solutions;
- Coordination: integration/synchronisation of a set of airspace/airport DCB Solutions such as queues.

He/She is the recipient of the Airspace Users intentions, validate them and provide assistance to flight planning.

The User Driven Prioritisation Process, UDPP, will not be implemented during the execution phase regarding the extreme difficulty negotiation between Airspace Users/AO would be. UDPP will be applied during the short-term planning phase (refer to DOD M2). Nevertheless, procedures like slot swapping could be applied to arrivals through bi-lateral agreement between AOCs and after network impact assessment.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

Sub-Regional Network Managers are responsible for sub-regional network planning and the resolution of imbalances, whenever it can be done at their level. They:

- Define and refine the airspace available capacity plan, in cooperation with the Civil/Military Airspace Manager;
- Identify imbalances at local / FAB level (possibly advised by the Regional Network Manager);
- Implement DCB Solutions developed at local / FAB level, after regional validation if need be: DCB solutions are developed in cooperation with Civil/Military Airspace Managers to take into account Airspace Requests and Requirements, and find an acceptable trade-off. DCB Solutions are also developed in co-operation with Airspace Users, especially when the UDPP is enabled.

The sub-regional network manager works at local/ACC level or at FAB level:

- If the scope of the Sub-Regional Network Manager covers one ACC only, he/she will act at the local level, like an advanced FMP. He/She behaves like a **Local DCB Complexity Manager**;
- Otherwise, the Sub-Regional Network Manager covers several ACCs grouped as a FAB:
    - He/She is supplemented by the local DCB Complexity Managers being networked to him/her;
    - He/She animates internal to FAB CDM session internal FAB to collate and analyse local needs versus resources availability;
    - He/She takes part to any CDM session at sub-regional and regional levels for consistency check;
    - He/She participates at local plans integration into a coherent network plan.

Local DCB Complexity Managers work locally:

- They are the best placed to know the available ACC resources (including roster) and related capacity. They also know which DCB solutions would the best suit (at least, locally) airspace use;
- They participate to refinement of resource usage (including military activity), to the adjustment of traffic demand and military activity, and coordinate with other DCB Managers as well as adjacent Sub-Regional Network Managers;
- They co-ordinate with other local DCB Managers and with local ASM;
- They have to participate to the local solutions integration managed by the Sub-Regional Network Manager.

The **Civil/Military Airspace Manager** works at the level of a sub-region. The related civil military unit is called the Airspace Management Cell (AMC) is responsible for the tactical management of airspace.

The Civil/Military Airspace Manager is responsible for the planning of military airspace requirements in close coordination with the military Exercise Director(s) (or the responsible military planner) and the Sub-Regional Network Manager. He/She organises and manages the airspace to accommodate predicted traffic demand and coordinates airspace reservations (location, type, size, time) with military units, the sub-regional network manager and with the neighbouring FABs in order to keep the impact on civil air traffic to a minimum.

The **AOC Staff** manages the Airspace User operations i.e. a collection of flights in relation to each other, some of them being executed, some of them being planned. To maximise net return, they implement the Flight Programme according to schedule or find the optimum trade-off when it cannot be achieved, through Flight Dispatch and Prioritisation. Consequently, they represent the interests of the Airspace User and are the focal point for all CDM aspects.

In particular, they negotiate RBT Revisions whenever possible. RBT Revisions are negotiated:

- Internally, i.e. with the relevant actors inside the Airspace User Organisation: Flight Crew(s) and Airline Station Manager(s);
- Externally, i.e. with the relevant actors outside the Airspace User Organisation: Regional and Sub-Regional Network Manager(s), APOC Staff, other AOC Staff.

The AOC Staff is central for all RBT Revisions requested because of constraints arising in the network, possibly imposed by the application of a Dynamic DCB Solution. They decide on how to meet the constraint. Real-time coordination between the AOC Staff of different airlines is foreseen in order to favour high-priority flight.

The **Flight Crew** remains ultimately responsible for the safe and orderly operation of the flight in compliance with the ICAO Rules of the Air, other relevant ICAO and CAA/JAA provisions, and within airline standard operating procedures. It ensures that the aircraft operates in accordance with ATC clearances and the agreed Air-Ground Reference Business / Mission Trajectory (RBT).

The Flight Crew will be supported by the airborne system concerning automatic monitoring of trajectory management, automatic execution of spacing/S&M or separation/C&P, conflict detection and resolution and execution of the self separation manoeuvre.

Main interactions of the Flight Crew are with the Airline Operations Control Centre within the domain of Airspace Users Operations and with Air Traffic Control. With respect to network management in the execution phase, the Flight Crew interfaces with all relevant ATM Stakeholders insofar as the aircraft becomes an active node of the SWIM-enabled network.

The **APOC Staff**, the **Airline Station Manager** as well as the **Planning Controller**, are central figures in the Detailed Airport Operations Descriptions.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

6.2 ACTORS' RESPONSIBILITIES IN THE ATM PROCESS MODEL

The following table summarizes the main actors and roles contributing to network management in the execution phase:

Organisation/Unit	Individual Actor	Related Process(es)	Main Role(s) & Responsibilities
Regional Network Management Unit	**Regional Network Manager**	A3.1.3.1.2 Select/Refine/Elaborate a Dynamic DCB Solution at Network Level A3.1.3.2.1 Assess Network Impact of the Dynamic DCB Solution A3.1.3.2.2 Apply the Dynamic DCB Solution A3.5.1.1 Adjust RBT A3.5.1.2 Validate RBT Changes	The Regional Network Manager manages the execution of network operations: • Executes the NOP (through region-wide actions) and has it executed (through the coordination of sub-region-wide actions); • Permanently monitors the network situation ahead to assess network stability and regain if instabilities develop; • Ensures the continuity of operations throughout the network, so that it is smoothly and evenly operated in order maximise efficiency and avoid capacity wastes, notably when opportunities are created in real-time; • Supports Dynamic DCB through the validation and coordination of Dynamic DCB Solutions when necessary; • Implement Dynamic DCB Solutions, whenever the regional approach is more relevant, because the problem is time-critical or is unmanageable sub-regionally; • Arbitrates to broker a deal while preserving equity, whenever a CDM negotiation reaches gridlock and a timely response must be provided.
Sub-Regional Network Management Unit	**Sub-Regional Network Manager**	A3.1.1.1.2 Assess Airspace Capacity Load A3.1.2.3 Adjust Airspace Resources Dynamically A3.1.3.1.2 Select/Refine/Elaborate a Dynamic DCB Solution	The Sub-Regional Network Managers are collectively responsible for the execution of network operations: • Assess the developing situation permanently and check whether it is in line with the Network Operations Plan at the sub-regional level; • Optimise the developing situation whenever possible on the basis of the most up-to-date information regarding activated resources, flights in execution (inc. agreed RBTs, revised RBTs, updated RBTs, prioritised RBTs…) and possibly flights still in the planning phase. The optimisation may be obtained through the dynamic adjustment of the resources (e.g. activation of a temporary route structure in terminal airspace during the high-complexity operations) or the negotiation of RBTs Revisions (via CDM processes); • React to the developing situation, whenever necessary to correct it or take advantage of it, through Demand Capacity Balancing;

Organisation/Unit	Individual Actor	Related Process(es)	Main Role(s) & Responsibilities
		A3.1.3.2.2 Apply the Dynamic DCB Solution A3.5.1.1 Adjust RBT	• Act as the manager of resource and thereby cooperate with all the actors interested in the resource: the Civil/Military Manager, the AOC Staff, the Regional Network Manager and their neighbouring counterparts, the Local DCB Complexity Manager, the Planning Controller. The Sub-Regional Network Manager can be envisaged as a **local DCB Actor** or as a sub-regional actor, depending on the area of responsibility i.e. local/ACC or FAB. The local activity is more related to dynamic resource management and preparation and implementation of dynamic DCB solutions, while the sub-regional actor works more at refining and integrating the dynamic DCB solutions and the coordination with local actors, the neighbouring sub-regions and the regional network manager.
Airspace Management Cell Civil Military Unit	**Civil/Military Airspace Manager**	A3.1.2.3 Adjust Airspace Resources Dynamically A3.5.3 Adjust Airspace Requirements Dynamically A3.1.3.1.2 Select/Refine/Elaborate a Dynamic DCB Solution at Network Level	The Civil/Military Airspace Manager is responsible for the tactical management of airspace, that is: • The implementation of the published Airspace Use Plan; • The dynamic adjustment of Airspace Requirements, when requests are made, changed or removed at the last minute; • The update of the Airspace Use Plan, in accordance with these adjustments; • The notification of these adjustments to the Sub-Regional and Regional Network Managers, so that the possible impact on networks operations can be assessed. E.g. if some airspace is released, network management is given the opportunity to use extra capacity and can seize it, if need be, through dynamic resource adjustments and rerouting proposals (in the form of RBT Revisions requests); • The implementation of these adjustments, to adapt operational rules and coordinate the activation or deactivation accordingly; • The real-time management of airspace inc. transitions, with activation and deactivation of Airspace Reservations, from Modular Temporary Airspace Structures to Dynamic Mobile Areas through Flexible Military Airspace Structures incl. airspace monitoring inc. conformance monitoring. The Civil Military Airspace Manager can be envisaged as a local ASM Actor or as a sub-regional actor, depending on the size and complexity of the area of responsibility. The Civil/Military Airspace Manager during the Execution Phase cooperates: • Inside ASM - i.e. with their neighbouring counterparts to facilitate cross-border operations, notably in the frame of a shared use of airspace;

Organisation/Unit	Individual Actor	Related Process(es)	Main Role(s) & Responsibilities
			• Outside ASM, for the purpose of ASM/DCB coordination, with the Exercise Director, the Sub-regional Network Manager and the Regional Network Manager. The Exercise Director (or the responsible military planner) is: • Responsible for scheduling the military needs in terms of airspace reservation and time slot at any time; • The focal point for all MIL Actors, and for the Airspace Management Cell.
Air Navigation Service Provider	**Local DCB Complexity Manager**	A3.1.1.2 Assess DCB Complexity A3.5.1.1 Adjust RBT	The Local DCB Complexity Manager ensures that traffic complexity remains within the limits the controllers can cope with safely. This process supports an efficient provision of Separation Services in that it detects zones/volumes of high complexity and takes mitigation measures against overloads of Controllers. The tasks of the Local DCB Complexity Manager are to: • Monitor the levels of complexity of traffic; • Forecast traffic patterns; • Assure the provision of information on upcoming congestions; • Initiate CDM processes to find solutions to reduce complexity when needed; • Verify applicability of proposed solutions of airspace users. The main interactions of the Local DCB Complexity Manager are with Planning Controllers and Supervisor and with Sub-regional Network Manager, Airspace Users (AOCC), Airport Operations (APOC) and Airspace Manager.
Airline Operations Centre	**AOC Staff**	A3.5.1.1 Adjust RBT A3.5.3 Adjust Airspace Requirements Dynamically A3.1.3.1.2 Select/Refine/Elaborate a Dynamic DCB Solution at Network Level	The AOC is an organisational unit of an airspace user and is normally run by a variety of professionals from different areas. It is hosting the roles of Flight Dispatch, TTA/TTO Management and Strategic & CDM Management thereby managing the operations of the airspace user and implementing the flight programme. AOC Staff main responsibility is to maintain the integrity of the scheduled Flight Programme and to take in real time the necessary decisions in order to manage all the flights within the airspace user network. Thereby AOC Staff is responsible for: • Improving airline network performance (integrity); • Optimisation of the SBT (prior to departure) and providing recommendations/proposed changes to the RBT (execution phase) to the Flight Crew to ensure the users' business objectives for a flight are met; • Devising solutions for constraints arising from the NOP;

Organisation/Unit	Individual Actor	Related Process(es)	Main Role(s) & Responsibilities
			• Deciding on the need to create, cancel, delay, reroute flights/passengers and change Aircraft in response to operating needs. Where this affects other stakeholders, the AOC Staff will publish the corresponding data and, where necessary, will negotiate and take decisions via a CDM process; • Developing "arrival and departure priority proposals" (slot swapping and inbound priority sequencing) and negotiating solutions on behalf of the aircraft operator.
Airline, BA, GA, Military	**Flight Crew/Pilot**	A3.5.11 Adjust RBT A3.5.4 Execute Aircraft Trajectory A3.1.3.1.2 Select/Refine/Elaborate a Dynamic DCB Solution at Network Level	The Flight Crew remains ultimately responsible for the safe and orderly operation of the flight in compliance with the ICAO Rules of the Air, other relevant ICAO and CAA/JAA provisions, and within airline standard operating procedures. It ensures that the aircraft operates in accordance with ATC clearances and the agreed Air-Ground Reference Business/Mission Trajectory (RBT). Main interactions of the Flight Crew are with the Airline Operations Control Centre within the domain of Airspace Users Operations and with Air Traffic Control. In summary, the main role of the Flight Crew is to: • Conduct flight according to RBT and applicable rules; • Revise RBT, if required; • Assure separation, if Separator; • Avoid collisions; • Optimise queuing.
Air Navigation Service Provider/ En-Route (civil & military)	**Planning Controller**	A3.5.1.1 Adjust RBT	The principal tasks of the Planning Controller are to check the planned trajectory of aircraft intending to enter the sector for potential separation risk, and to co-ordinate entry/exit conditions leading to conflict free trajectories. The main interactions of the Planning Controller are with adjacent Planning Controllers and the appropriate Executive Controllers and also with the Local DCB Complexity Managers within the domain of Air Traffic Control. In summary, the main tasks of the Planning Controller are to: • Facilitate Flight according to RBT and applicable rules; • Coordinate sector entry/exit conditions, Flight Crew requests with adjacent sectors; • Optimise Queuing.

Organisation/Unit	Individual Actor	Related Process(es)	Main Role(s) & Responsibilities
Airport Operations Centre	**APOC Staff**	A3.1.3.2.2 Apply the Dynamic DCB Solution A3.5.1.1 Adjust RBT	The Airport Operations Centre (APOC) is the central organisational unit responsible for airport airside operations. The APOC Staff has the various roles of Resource Management, Flight Operations Management and Environment Management and is responsible for CDM with all relevant stakeholders. Main interactions of the APOC Staff are with the Apron/Ground Controller within the domain of Airport Operations and with Airspace User Operations. In summary, the main tasks of the APOC Staff are to: • Set up Departure Queue; • Manage Airport Resources; • Manage Environmental issues; • Manage Flight Data.
Airline, BA, Third Party	**Airline Station Manager**	A3.5.1.1 Adjust RBT	The Airline Station Manager is responsible for the aircraft turn-round in order to manage the aircraft procedures on the ground safely, securely and efficiently. Depending on the Airspace User organization, some of these tasks may be carried out by or delegated to Ground Handling Agents. The Airline Station Manager needs to inform the AOC timely on the status of the turn-round and in, case of exceptional events, needs to take part in or be informed about CDM processes and/or decisions. In summary, the main task of the Airline Station Manager is to manage Turn-round of aircraft.

Table 14: Actors Scoped by E4, Roles & Responsibilities

7 HOT TOPICS

The hot topics come from two sources:

- The review room;
- The expert group sessions following the validation exercises 3.3.2 and 3.3.3, and the expert group 4.3.1.1.1.

Hot topics deal with concept fine-tuning and with incompatible opinions between Experts. In all cases, after analysis of the problem, DOD scribes will take the final decision.

The mentioned exercises confirm a significant number of the assumptions included essentially in DODs M2 "Medium/Short-Term network planning" and E4 "Network Management in the Execution phase"), and also in the operational scenario OS-11 "Non-severe capacity shortfalls impacting arrivals in the Short-term" related to business trajectory management and dynamic DCB in the context of arrival traffic management.

The exercise allowed also refining some elements and identifying open issues to be added in the list of "hot topics":

Border-line between DCB and dynamic DCB

Regarding the planning processes contributing to the management of arrivals in the day of operation, three layers are referred to:

- A DCB layer working uniquely on flights in the planning phase;
- A dynamic DCB layer working with a time horizon ranging from 40 minutes to 2 hours ahead of the congested area and managing both flights in short-term planning phase and execution phase (with a focus on flights in execution phase);
- The "AMAN" process.

The exercise highlighted the fact that the border-line between Dynamic DCB and DCB is not necessarily a "line"! During the simulations, the actors tended to use the possibility to extend the planning horizon of Dynamic DCB in function of the severity of the congestion and thus to overlap significantly with the DCB process, switching from the concept of "border-line" to the concept of "interfacing".

Conclusion from Exercise: The time parameters of 2 hours and 40 min only serve as starting values for process optimisation purposes. The final trigger between the three processes mentioned above will not be a standard fix time parameter but an individual one reflecting local particularities, ground/airport infrastructure, arrival/departure traffic pattern.

Alternative Viewpoint: Some experts expressed the need to have a clear time or distance based process trigger to avoid synchronisation issues.

Transition from SBT to RBT

There were lively discussions on the trigger and time horizon for the transition from SBT to RBT:

Conclusion from the Experts: While elaborating on the operational scenario and refining the simulation platform requirements, experts agreed that the transition from SBT to RBT was in fact defined as:

- In a CDM airport when the event 'Delivery of start up approval' (triggered by the User's Request) occurs, if all the prerequisite actions[28] on the SBT are complete including compliance with ATM constraints;
- In a non-CDM airport, the equivalent event is the delivery of the departure clearance, following the user's request for a departure clearance.

Alternative Viewpoints: The transition from SBT to RBT takes place as soon as the flight enters the pre-departure sequence (DCB standpoint) or latest at a fixed time trigger such as 5min before push back.

Business Trajectory Management

There were two approaches concerning the business trajectory process sequencing discussed in preparation of the validation exercise.

The Interpretation used in the Exercise: There was consensus amongst ATM service providers that the first proposal for a business trajectory compliant to network constraints should come from the ATM service provider who is best suited to suggest a solution. Then this trajectory would be transmitted to the Airspace User. If the trajectory proves not convenient to the Airspace User, he/she will use the proposal as a baseline for a modification and submit the user preferred 4D trajectory to the network manager for validation and publication. This solution is considered to be the most efficient in conditions of high dependence of multiple constraints.

Note: the gaming exercise with focus on arrival management confirmed the advantages of starting the process with a feasible solution to reduce the number of iterations in the trajectory development process.

Alternative Viewpoint supported by some airlines: The ATM service providers communicate only the constraints subject to the flight and the airspace users in return provide their proposal compliant to the constraints. This solution is considered to be most efficient in conditions of reasonably few interdependent constraints as it is projected by SESAR 2020.

[28] If the departure airport is within the AMAN horizon of the destination airport, a TTA for the IAF will be allocated which may include the allocation of an appropriate pre-defined arrival route. The principle is "first requested, first served".

8 REFERENCES AND APPLICABLE DOCUMENTS

8.1 REFERENCES

[1] **E-OCVM** E-OCVM version 2, EUROCONTROL, March 2007.

[2] Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by Data Communications, EUROCAE ED-78A, December 2000.

[3] **Episode 3** Single European Sky Implementation support through Validation portal, www.episode3.aero.

[4] **Episode 3** SESAR DOD G - General Detailed Operational Description, D2.2-040.

[5] **Episode 3** SESAR DOD L - Long-term Network Planning Detailed Operational Description, D2.2-041.

[6] **Episode 3** SESAR DOD M1 - Collaborative Airport Planning Detailed Operational Description, D2.2-042.

[7] **Episode 3** SESAR DOD M2 - Medium/Short-term Network Planning Detailed Operational Description, D2.2-043.

[8] **Episode 3** SESAR DOD E1 - Runway Management Detailed Operational Description, D2.2-044.

[9] **Episode 3** SESAR DOD E2/3 - Apron and Taxiways Management Detailed Operational Description, D2.2-045.

[10] **Episode 3** SESAR DOD E4 - Network Management in the Execution Phase Detailed Operational Description, D2.2-046.

[11] **Episode 3** SESAR DOD E5 - Conflict Management in Arrival and Departure High & Medium/Low Density Operations Detailed Operational Description, D2.2-047.

[12] **Episode 3** SESAR DOD E6 - Conflict Management in En-Route High & Medium/Low Density Operations Detailed Operational Description, D2.2-048.

[13] **Episode 3** SESAR DOD Lexicon - Glossary of Terms and Definitions, D2.2-049, January 2009.

[14] **Episode 3** SESAR/Episode 3 Information Navigator, 25 March 2009.

[15] ATFCM Users Manual, EUROCONTROL CFMU, Edition 12.0, September 2007 (http://www.cfmu.eurocontrol.int).

[16] **SESAR** Description of Responsibility, DLT-0612-242-00-09 (draft), July 2007.

[17] **SESAR** The European Air Traffic Management Master Plan Portal, www.atmmasterplan.eu.

[18] **Episode 3** Performance Framework cycle 1, E3-D2.0-03-V2.2, April 2008.

[19] **SWIM SUIT** Information Content and Service Requirements, D1.2.1 v1.0 (final), January 2008.

[20] **SES II** Single SKY II - Functional Airspace Blocks: A necessary step ec.europa.eu/transport/air_portal/traffic_management/ses2/index_en.htm

[21] EUROCONTROL Long-Term Forecast of Flights (2004-2025), v1.0, December 2004.

[22] EUROCONTROL Long-Term Forecast: IFR Flight Movements 2006-2025, v1.0, December 2006.

[23] Challenges to Growth Report 2004, CTG04, v1.0 December 2004.

[24] EUROCONTROL Military Statistics, Edition 2008.

[25] Episode 3 Analysis of 2006 to 2020 samples, E3-WP2-I0025-WKP-V2.0, May 2008.

[26] ICAO Doc 4444-ATM/501, Procedures for Air Navigation Services, Air Traffic Management, Fourteenth Edition, 2001.

[27] EUROCAE ED-110A – Interoperability Requirements Standard For ATN Baseline 1, August 2004.

[28] ICAO ANNEX 10 - Aeronautical Telecommunications – Volume III, Part I (Digital Data Communication Systems) First Edition, July 1995 – amended by Amendment 76 (01/11/2001).

[29] Navigation Strategy for ECAC, NAV.ET1.ST16-001, v2.1, March 1999.

[30] Transition Plan for the Implementation of the Navigation Strategy in ECAC 2000 -2015, NAV.ET1.ST16-002, v3.0, May 2000.

[31] Performance Based Navigation Manual, volume 1, ICAO draft 5.1 Final, March 2007.

[32] EMMA2 A-SMGCS Services, Procedures and Operational Requirements (SPOR).

[33] Episode 3 OS-11, Non-Severe (No UDPP) Capacity Shortfalls impacting Arrivals in the Short-Term, v0.6, December 2008.

[34] Episode 3 OS-12, Landing & Taxi to Stand, v0.40,December 2008.

[35] Episode 3 OS-13, Taxi-out and Take-off, v0.50, December 2008.

[36] Episode 3 OS-14, Long Term capacity planning, v1.65, September 2008.

[37] Episode 3 OS-15, Airport Operational Plan Lifecycle for Long-term Phase, v0.20, September 2008.

[38] Episode 3 OS-16, Turn-round Management, v0.30, October 2008.

[39] Episode 3 OS-17, Solve Hazardous Situations during Taxiing, v0.30, December 2008.

[40] Episode 3 OS-18, Airport Operational Plan Lifecycle for Medium/Short/Execution phases, v0.30, October 2008.

[41] Episode 3 OS-19, Severe (UDPP) Capacity Shortfalls impacting Departures in the Short-Term, v0.50, November 2008.

[42] Episode 3 OS-20, Airport Capacity Shortfalls in the Medium-Term, v0.30, October 2008.

[43] Episode 3 OS-21, Departure from non Standard Runway, v0.30, December 2008.

[44] Episode 3 OS-22, Life Cycle of the 4D Trajectory, v0.1, December 2008.

[45] Episode 3 OS-26, Non-Severe (No UDPP) Capacity Shortfalls impacting Departures in the Short-Term, v0.20, October 2008.

[46] Episode 3 OS-27, Allocation of Departure Profile, v0.30, December 2008.

[47] Episode 3 OS-28, Allocation of Departure Route, v0.30, December 2008.

[48] Episode 3 OS-29, Closely Spaced Parallel Operations in IMC, v0.30, December 2008.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

[49] Episode 3 OS-30, Handle Planned Closure of an Airport Airside Resource, v0.30, December 2008.

[50] Episode 3 OS-31, Handle Unexpected Closure of an Airport Airside Resource, v0.30, December 2008.

[51] Episode 3 OS-32, Management of Vehicles on Manoeuvring Area, v0.20, November 2008.

[52] Episode 3 OS-33, Negotiating a proposed ATC revision to the RBT due to queue management, v0.50, December 2008.

[53] Episode 3 OS-34, Military collaboration in the Medium-Short Term, v0.20, December 2008.

[54] Episode 3 OS-35, High density TMA Arrival - Flying CDA merging, v0.10, November 2008.

[55] Episode 3 OS-36, Non-Severe (No UDPP) Capacity Shortfalls impacting Multiple Nodes of the Network in the Short-Term, v0.11, December 2008.

[56] Episode 3 OS-37, Business Development Trajectory Creation, v0.11, December 2008.

[57] Episode 3 OS-38, Flights in the Execution Phase in a 4D environment, v0.03, December 2008.

[58] Episode 3 OS-39, Aborted Take-off, v0.21, January 2009.

[59] Episode 3 OS-40, Traffic complexity assessment & application of dynamic-DCB solutions, v0.31, March 2009.

[60] Episode 3 UC-03, Identify Flight Before Taxi-Out, v0.30, August 2008.

[61] Episode 3 UC-05, Handle Aircraft Landing, v0.20, December 2008.

[62] Episode 3 UC-08, Ensure Taxi-Out, v0.40, December 2008.

[63] Episode 3 UC-12, Ensure Taxi-In, v0.40, December 2008.

[64] Episode 3 UC-17, Modify Departure Sequence by Tower Runway Controller, v0.30, December 2008.

[65] Episode 3 UC-22, Obtain Flight Briefing, v0.30, October 2008.

[66] Episode 3 UC-23, Change of Runway Configuration, v0.20, July 2008.

[67] Episode 3 UC-31, Refine a Target Off-Block Time, v0.30, July 2008.

[68] Episode 3 UC-33, Refine De-Icing Capacity, v0.20, September 2008.

[69] Episode 3 UC-35, Determine-Revise Stand Load Schedule, v0.30, December 2008.

[70] Episode 3 UC-38, Handle Aircraft Take-off, v0.20, June 2008.

[71] Episode 3 UC-44, Merge Arrival Flows using ASPA SM, v0.50, December 2008.

[72] Episode 3 UC-45, Refine the Airport Operational Plan, v0.50, December 2008.

[73] Episode 3 UC-46, Identify a Long Term Demand Capacity Imbalance, v0.60, December 2008.

[74] Episode 3 Project Lessons Learnt, Support to Episode 3 WP2.3, TRS-08-222764-T-WP3-D3.3-V0.1, v0.1, October 2009.

8.2 APPLICABLE DOCUMENTS

[75] SESAR Operational Scenarios and Explanations – Network Airline Scheduled Operation, v0.6, November 2007.

[76] SESAR The Performance Target (D2), DLM-0607-001-02-00a (approved), December 2006.

[77] SESAR The ATM Target Concept (D3), DLM-0612-001-02-00a (approved), September 2007.

[78] SESAR The ATM Deployment Sequence (D4), DLM-0706-001-02-00 (approved), January 2008.

[79] SESAR The ATM Master Plan (D5), DLM-0710-001-02-00 (approved), April 2008.

[80] SESAR WP2.2.3 D3, DLT-0707-008-01-00 v1.0, July 2007.

[81] SESAR Concept of Operations, WP2.2.2 D3, DLT-0612-222-02-00 v2.0 (validated), October 2007.

[82] SESAR Investigate Needs for New Appropriate Modelling and Validation Tools and Methodologies, DLT-0710-232-00-01 v0.01, May 2008.

[83] SESAR Implementation Package 1 taskforce report.

[84] SESAR Initial SESAR Concept Story Board.

[85] SESAR Report Performance Objectives and Targets RPT-0708-001-01-02.

[86] Episode 3 Description Of Work (DOW), v3.1, July 2009.

[87] Episode 3 D2.4.1-04 - Performance Framework.

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

9 ANNEX A: OPERATIONAL SCENARIOS

The detailed description of those scenarios will be provided through individual files - i.e. one per identified scenario.

The following table summarises the dedicated scenarios for Network Management in Execution. This list could be refined according to the specific needs of Network Management in Execution exercises.

Some of these scenarios address both the short-term and the execution phases. When it is the case, this is mentioned in the scenario summary header.

Scenario	Summary	Status
Non-Severe (No UDPP) Capacity Shortfalls impacting Arrivals in the Short-Term	Operational scenario OS11 is of interest both for the Medium/Short-term planning phase (DOD M2) and for the execution phase (DOD E4). This OS will be used for the validation of dynamic DCB. Dynamic DCB aims at filling the gap between planning DCB and ATC. This OS describes the resolution of a local imbalance facing a European airport in 2020 on the day of operations that is to say during the short-term planning phase and the execution phase. The imbalance is subsequent to a capacity shortfall resulting from sudden adverse weather conditions. The imbalance, albeit non-critical, is identified at short notice and occurs during a busy time period. Being non-severe, the capacity short-fall can be solved without UDPP during the planning phase (UDPP is not applicable during the execution phase). Severity can be defined as a maximal capacity overload (for example 20%) or as a maximal overload during a time period (for example, 3 hours in a row with a 10% capacity overload), or as a maximal admissible delay per flight, Therefore, actions have to be taken to rebalance the situation at the airport and in the vicinity i.e. terminal airspace. Actions are performed to flights already airborne or not in the DCB arrival queue horizon or not, or in the AMAN horizon or not. Those actions result from the application of predefined DCB Solutions, primarily impacting arrivals and taking the form of a queue management process. Those actions are described, together with the operational events they respond to. The processes relevant to it are addressed in the Detailed Operational Description related to network management on the day of operations.	**Produced (OS-11)**

Scenario	Summary	Status
Non-severe (no UDPP) capacity shortfalls impacting multiple nodes of the network in the short-term	Operational scenario OS36 is of interest both for the Medium/Short-term planning phase (DOD M2) and for the execution phase (DOD E4). This OS will be used for the validation of dynamic DCB. Dynamic DCB aims at filling the gap between planning DCB and ATC. Network stability is also treated. This operational scenario describes the resolution of 3 local imbalances facing 2 European airports and an en-route sector, in 2020 on the day of operations (that is to say during the short-term planning phase and execution phase). Just like for OS11, capacity shortfalls are of an acceptable magnitude i.e. non-severe (please, cf. OS11 here before). The 3 nodes, belonging to the same FAB (Beach FAB), are strongly connected through trajectories. Therefore the resolution of the 3 imbalances is prone to network effect – meaning that a DCB Solution applied on one node may have an impact on another node. As a consequence, local actors have to coordinate at the sub-regional level, so as to find compatible DCB Solutions.	**Produced (OS-36)**
Traffic complexity assessment and application of dynamic DCB solutions	Air Traffic Complexity Management Service (ATCM) represents a dynamic, real time, automated service which applies a complexity function within a defined airspace of operation (called “Sector Family’’), in order to predict future controller workload within up to approximately 90 - 30 min. look ahead time horizon. ATCM Service integrates the following processes: complexity management, queue management and conflict management. Air Traffic Complexity Management Service is directly dependant on trajectory prediction (TP) accuracy and level of capability and interoperability of ATM systems and tools. The ATCM has the following high level objectives: • NOP stability needs to be supported; • Operator costs need to be minimised; • The RBTs need to be changed as little as possible; • ATCO workloads need to be kept at an acceptable level. The Operational Scenario is broken down into 4 sub-scenarios (for ATC Capability Levels 2 to 4) describing the processes and interactions among actors involved in ATCM within the context of SESAR concept of	**Produced (OS-40)**

Scenario	Summary	Status
	operations: • ATCM in an ATC Capability Level 2 environment; • ATCM in an ATC Capability Level 3 environment – Dynamic Resectorization; • ATCM in an ATC Capability Level 3 environment – Traffic Flows Re-routing; • ATCM in an ATC Capability Level 4 environment. For ATC Capability Level 2, basic automated support for Complexity Assessment is available – i.e. Basic Traffic Complexity Management Tool (Basic TCM). Single CTO uplink assists in Complexity Management processes or is used for the purposes of AMAN tool. 2D-PTC is deployed based on pre-defined ATC routes. For ATC Capability Level 3, full set of complexity management tools with capabilities to share trajectory data with aircraft, assign targets for airborne separation (pairs of aircraft) and balance aircraft operator preferences and ATCO workload with automated assistance are provided. Multiple CTOs uplink is used for the purpose of queue and complexity management processes. 2D-PTC is deployed on user preferred trajectories and 3D-PTC on pre-defined ATC routes. Free routing is applied from ToC to ToD, without the need to adhere to fixed route structure. Fixed route structures are deployed only in situations when traffic complexity requires their use and in areas close to major busiest hubs. Dynamic resectorization and traffic flow re-routing are detailed in this scenario. For ATC Capability Level 4, the full implementation of enhanced trajectory management through 3D-PTC on user preferred trajectories and delegation of separation responsibility to the flight crew for crossing and passing manoeuvres relative to designated aircraft, through the deployment of airborne separation crossing and passing applications (ASEP C&P).	
Negotiating a proposed ATC revision to the RBT due to queue management	As the traffic complexity is constantly monitored by the ground ATM system, a complex situation has been predicted by the Multi-Sector Planner on the W en route sector. It results from an increase in demand. The complexity is predicted to increase within 15 [29] minutes and a solution to reduce the level of complexity will be found by organizing the flow of aircraft entering W sector using Queue Management techniques. Action taken to reduce the predicted complexity is to regulate the number of aircraft entering the sector W. So,	**Produced (OS-33)**

[29] It is considered that 15 min is the minimum time necessary to the MSP to elaborate and implement a sequencing solution. Time can be possible beyond 15 min.

Scenario	Summary	Status
	aircraft will be subject to a Controlled Time Over (CTO) suitable waypoints prior to enter the sector W. The result will be a sequencing that leads to a lower complexity in sector W, even if there is potential for any additional conflict due to the CTO. This scenario describes how the MSP can request individual RBT adjustments on a group of aircraft in order to regulate the flow of aircraft entering the sector W. The RBT revision process will not include a UDPP process or a CDM process with the airspace users as this adjustment will have no impact outside the MSP responsibility area (group of sectors of the ACC) and because of the delay is too short to extend the negotiation. In the scenario, the MSP decides to request the controllers to instruct the flight crews because the CTOs induce significant speed changes in a short time with the potential for one additional conflict. If it was not the case, the MSP could directly instruct the flight crews using data link capabilities and the controllers will be informed on CTO. The scope of this scenario is the Team Resource Management (TRM) (i.e. MSP and all the sectors controllers of the ACC). Scenario Objective The current situation is a complex situation due to a traffic overload expected within 15 minutes in the sector W. This scenario aims to evaluate benefit of the role of the MSP for de-complexification purposes and to show how the MSP will elaborate a solution: That reduces the complexity in W sector by regulating the number of aircraft entering this sector (respect of traffic capacity) keeping the complexity at an acceptable level in the others Agreed by all the involved controllers before implementation In order to evaluate several tasks the MSP will have to assume during his “de complexification” activity, the selected solution, despite it keeps the complexity in sector W at an acceptable level, will involve conflicts to solve. This scenario will propose the use of several tools, and allow the observation of coordination tasks between the MSP and the involved control sectors, in order to obtain the agreement of all on an acceptable solution before its implementation.	

Table 14: Operational Scenarios identified for Network Management in Execution

10 ANNEX B: DETAILED USE CASE

The detailed description of those Use Cases will be provided through individual files - i.e. one per identified Use Case.

Use Case	Status
Assess Airspace Capacity Load	**Not Planned within Episode 3**
Assess DCB Complexity	**Not Planned within Episode 3**
Switch Airspace Operational Rules	**Not Planned within Episode 3**
Coordinate Temporary Airspace Closure	**Not Planned within Episode 3**
Select/Refine/Elaborate a Dynamic DCB Solution at Network Level	**Not Planned within Episode 3**
Assess Network Impact of the Dynamic DCB Solution	**Not Planned within Episode 3**
Apply the Dynamic DCB Solution	**Not Planned within Episode 3**
Re-Schedule Flights (by User)	**Not Planned within Episode 3**
Re-Schedule Flights (by System)	**Not Planned within Episode 3**
Adjust Flight Route (by User)	**Not Planned within Episode 3**
Adjust Flight Route (by System)	**Not Planned within Episode 3**
Validate RBT Changes	**Not Planned within Episode 3**
Update RBT	**Not Planned within Episode 3**
Adjust Airspace Requirements Dynamically	**Not Planned within Episode 3**
Execute Aircraft Business / Mission Trajectory	**Not Planned within Episode 3**

Table 15: Use Case summary

Issued by the Episode 3 consortium for the Episode 3 project co-funded by the European Commission and Episode 3 consortium.

11 ANNEX C: OI STEPS TRACEABILITY TABLE

The following table captures the SESAR Operational Improvements (OIs/OI Steps) addressed by the airspace and network management during the execution phase. Although most of the OI Steps should be IP2, some of them might be IP1 (if their implementation is still part of the target system context) or IP3 (if their implementation starts in 2020).

OI Step	Description	Rationale	Related ATM Model Processes
Airspace User Data to Improve Ground Tools Performance *[L01-05]*			
Use of Aircraft Derived Data (ADD) to Enhance ATM Ground System Performance [IS-0302]	Continued improvement of ground TP accuracy using ADD (state vector, weight, wind, and then intent data - next N waypoints) subject to quick variations and/or frequent updates.	The objective is to improve ATC decision support tools and especially ground based safety nets performance.	Update RBT (A3.5.2)
Use of Predicted Trajectory (PT) to Enhance ATM Ground System Performance [IS-0303]	The trajectory sharing process is automatic and transparent to the crew and the controller unless the update results in a new interaction for the aircraft. RBT revision is triggered at air or ground initiative when constraints are to be changed (modified by ATC, or cannot be achieved by a/c)	The objective is to improve ground trajectory prediction by use of airborne data.	Update RBT (A3.5.2)
Automatic RBT Update through TMR [IS-0305] Takes over IS-0302 and IS-0303	The event-based Trajectory Management Requirements (TMR) logic is specified by the ground systems on the basis of required time interval and delta of current PT versus previously downlinked PT. TMR parameters can be static/globally defined or dynamic/flight-specific. This process is transparent to ATCOs and pilots (deviation alerts that are relevant for the ATCO should be associated with larger tolerance than ground-managed TMR).	The objective is to improve ground trajectory prediction by use of airborne data while optimising the communication bandwidth. The improvement may be in several steps starting with fixed/pre-defined periodic downlink (possibly varying according to airspace and/or phase of flight), then event-based ground-managed TMR, then static airborne-managed TMR parameters (the detection of deviation being performed by airborne systems), then dynamic airborne-managed TMR parameters (defined on the ground and uplinked as appropriate).	Update RBT (A3.5.2)

OI Step	Description	Rationale	Related ATM Model Processes
Weather Information for ATM Planning and Execution ***[L01-06]***			
Use of Airborne Weather Data by Meteorological Service to Enhance Weather Forecast [IS-0501]	Specified weather data are captured by airborne aircraft and downlinked to the meteorological service in support of forecasting, significant weather reporting and data collection. (This may be "contract" or "event" driven).	The objective is the provision of meteorological products which are more informed and accurate.	All
From FUA to Advanced FUA ***[L02-03]***			
Europe-wide Shared Use of Military Training Areas [AOM-0204]	TSA/TRA sharing concepts - including cross-border operations (CBO) and cross-border areas (CBA) - are extended at European level subject to political endorsement, especially in regard to the dependency on other States (e.g. reciprocity of training opportunities, need to identify and mitigate regulatory and procedural differences).	This improvement refers mainly to the multilateral/European/FAB dimension.The objective is to overcome existing national fragmentation in view of the Single European Sky implementation, and the expected harmonisation of airspace design and use at European level and to facilitate military-military cooperation between Armed Forces;	Adjust Airspace (User) Requirements Dynamically (A3.5.3) Adjust RBT (A3.5.1.1) Adjust Airspace Resources Dynamically (A3.1.2.3) Select./ Refine/ Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2)
Flexible Military Airspace Structures [AOM-0206]	The possibility for ad-hoc structure delineation at short notice is offered to respond to short-term airspace users' requirements not covered by pre-defined structures and/or scenarios. Changes in the airspace status are up-linked to the pilot by the system.	The objective is to better respond to military airspace requirements and/or meteorological constraints while giving more freedom to GAT flights to select the preferred route trajectories and to achieve more flexibility from both civil and military partners.	Adjust Airspace (User) Requirements Dynamically (A3.5.3) Adjust RBT (A3.5.1.1) Adjust Airspace Resources Dynamically (A3.1.2.3) Select./ Refine/ Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2)

OI Step	Description	Rationale	Related ATM Model Processes
Dynamic Mobile Areas (DMA) [AOM-0208]	DMA are temporary mobile airspace exclusion areas. The size and duration of the volumes of airspace will be kept to the absolute minimum required.	The intent is to limit the impact of airspace exclusion to the minimum while allowing the users to be separated from this moving volume.	Adjust Airspace (User) Requirements Dynamically (A3.5.3) Adjust RBT (A3.5.1.1) Adjust Airspace Resources Dynamically (A3.1.2.3) Select./ Refine/ Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2)
Facilitating OAT Transit ***[L02-04]***			
OAT Trajectories [AOM-0304]	Interfacing Military Mission Trajectories with Business Trajectories		Adjust RBT (A3.5.1.1) Validate RBT changes (A3.5.1.2) Update RBT (A3.5.2) Adjust Airspace Resources Dynamically (A3.1.2.3) Select./ Refine/ Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2)
Use of Free Routes / 4D Trajectories ***[L02-06]***			
Pre-defined ATS Routes Only When and Where Required [AOM-0403] Takes over AOM-0501 and AOM-0502	The route network will evolve to fewer pre-defined routes with the exploitation of advanced navigation capabilities and generalisation of FABs not constrained by FIR boundaries, allowing for more direct routes and free routing. Route constraints are removed along with the development of 4DT based	Cf SESAR Concept of Operations.	Adjust RBT (A3.5.1.1) Adjust Airspace Resources Dynamically (A3.1.2.3) Select./ Refine/ Elaborate a Dynamic

OI Step	Description	Rationale	Related ATM Model Processes
	operations. However, it is assumed that some form of route network will be retained to cater for specific requirements (e.g. non capable aircraft, transition of medium complexity operations to/from TMA lower airspace, segregation between managed and unmanaged airspace, military flight planning, etc.).		DCB Solution at Network Level (A3.1.3.1.2)
Use of Free Routing for Flight in Cruise Inside FAB Above Level XXX [AOM-0501]	The goal is to allow free routing inside FAB independent from route network in cruise above level XXX.	The intent is to alleviate airspace constraints	Adjust RBT (A3.5.1.1) Adjust Airspace Resources Dynamically (A3.1.2.3) Select./ Refine/ Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2)
Use of Free Routing from ToC to ToD [AOM-0502]	The free routing is from Top Of Climb to Top Of Descent.	The intent is to alleviate airspace constraints	Adjust RBT (A3.5.1.1) Adjust Airspace Resources Dynamically (A3.1.2.3) Select./ Refine/ Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2)

OI Step	Description	Rationale	Related ATM Model Processes
Enlarging ATC Planning Horizon ***[L05-03]***			
Ground based Automated Support for Managing Traffic Complexity Across Several Sectors [CM-0302]	The system provides support for smoothing flows of traffic and de-conflicting flights in a multi-sector/multi-unit environment. Controllers are assisted in alleviating traffic complexity, traffic density, and traffic flow problems.	Currently, there is a gap between the management of traffic flows at European level and the control of flights in individual sectors. The objective is to provide support to the Multi Sector Planner on performing the planning of individual trajectories using advanced planning tools and consequently reducing complexity in his extended planning horizon (across several sectors)	Assess Airspace Capacity *(A3.1.1.1.2)* Assess DCB complexity *(A3.1.1.2)* Adjust Airspace Resources Dynamically *(A3.1.2.3)* Select/Refine/Elaborate a dynamic DCB solution at network level *(A3.1.3.1.2)* Adjust RBT *(A3.5.1.1)* Validate RBT changes *(A3.5.1.2)* Adjust airspace requirements dynamically *(A3.5.3)*
4D Contract ***[L08-01]***			
4D Contract for Equipped Aircraft with Extended Clearance PTC-4D [CM-0501]	A 4D Contract is a clearance that prescribes the containment of the trajectory in all 4 dimensions for the period of the contract. The goal of a 4D Contract is to ensure separation between: • 4DC capable aircraft, • 4DC aircraft and dynamic special use airspace for a segment of the business trajectory in en-route airspace.	Need to take into account the mixed mode (conventional and PTC-4D)	Adjust RBT *(A3.5.1.1)* Validate RBT changes *(A3.5.1.2)* Update RBT *(A3.5.2)* Execute aircraft trajectory *(A3.5.4)*

OI Step	Description	Rationale	Related ATM Model Processes
Collaborative Layered Planning Supported by Network Operations Plan *[L03-01]*			
SWIM enabled NOP [DCB-0103]	The NOP is in fact a 4 dimensional virtual model of the European ATM environment. It is a dynamic, rolling picture that provides a relational image of the state of the ATM environment for past, present and future. The user, via the appropriate applications, is able to view this image, moving the window along the timeline and focusing on any particular aspect or aspects he or she is interested in.	The plan itself is the result of the complex interactions between the trajectories shared into the system, the capacity being offered, the actual and forecast MET conditions, resource availability, etc. and the automatic and manual negotiations that have been carried out. While a user will only need to see the part of the picture he is concerned with together with its broader implications in order to carry out an action on and with the plan, the applications themselves always use the totality of the information available in the SWIM environment.	All
Improving Network Capacity Management Processes *[L04-01]*			
Dynamic ATFCM using RBT [DCB-0208]	Use of 4D trajectory updates in the ATFCM process in order to optimise the network usage.	Dynamic ATFCM management objective is to take benefit of the 4D trajectory updates for using capacity opportunities and for supporting the queue management and the achievement of the CTA.	Assess Airspace Capacity Load (A3.1.1.1.2) Select/ Refine/ Elaborate a Dynamic DCB Solution at Network Level (A3.1.3.1.2) Assess Network Impact of the Dynamic DCB Solution (A3.1.3.2.1) Apply the Dynamic DCB Solution (A3.1.3.2.2)

OI Step	Description	Rationale	Related ATM Model Processes
Management / Revision of Reference Business Trajectory (RBT) ***[L05-01]***			
Revision of Reference Business / Mission Trajectory (RBT) using Datalink [AUO-0303]	The pilot is automatically notified by datalink of trajectory change proposals (route including taxi route, altitude, time and associated performance requirements as needed) resulting from ATM constraints arising from, for example, ad hoc airspace restrictions or closing of a runway. ATM constraints may also be expressed in terms of requests such as RTA in support of AMAN operation or runway exit in support of BTV operation. On the other hand, the controller is notified by datalink of aircraft preferences in terms of STAR, ETA, ETA min/max, runway exit, etc.	This improvement may be in two steps starting with the uplink of simple flight specific constraints displayed on a dedicated cockpit screen as any datalink message. In a next stage, more complex constraints can be automatically generated by ground tools (incl. MTCD, AMAN, DMAN) and proposed to the controller for approval; on the cockpit side, the agreed constraints may be automatically loaded into the FMS, leading to a new trajectory computed and proposed to the flight crew.	Adjust RBT (A3.5.1.1) Validate RBT Changes (A3.5.1.2)

Table 16: Operational Improvements addressed

END OF DOCUMENT