SESAR Concept of Operations Step 1

Document information	
Project title	Concept of Operation
Project N°	B4.2
Project Manager	DFS
Deliverable Name	Concept of Operations Step1
Deliverable ID	D65-011
Edition	01.00.00

Please complete the advanced properties of the document

Abstract

The SESAR Concept Of Operations (CONOPS) Step 1 document provides the top level guidance and serves as the main common reference for all operationally related SESAR tasks. This document may evolve and refinements will be necessary as validation of concept elements is assessed with respect to the delivery of expected performance. The document describes the ATM operation envisaged in Europe so that civil and military Airspace Users, Service Providers, Airports, Aviation and ATM industries and SESAR Programme tasks gain common understanding of the operational characteristics of ATM in the first step of SESAR development and the main changes they imply in operating practices along with the capabilities they require.

CONOPS Step 1 represents the end state for Step 1.

Authoring & Approval

Prepared By		
Name & company	Position / Title	Date
Elke Groeneveld DFS		2012-03-27
Christian Bousmanne EUROCONTROL		2012-03-27
Hugues Rocher EUROCONTROL		2012-03-27
Daniel Nelson NATS		2012-03-27
Samuel Crompton NATS		2012-03-27
Antonio Obis AENA		2012-03-27
Andrea Ranieri Indra		2012-03-27
Philippe Trouslard DSNA		2012-03-27
Nicolas Hinchliffe ATCEUC		2012-03-27
Michel Le Toullec Airbus		2012-03-27
Michael Watson Thales		2012-03-27
Cedric D-Silva Thales		2012-03-27
Thorsten Astheimer Fraport		2012-03-27
Beata Myhrer Noracon		2012-03-27
Lars Stridsman Noracon		2012-03-27
Frank Sandeloev SAS		2012-03-27
Mihail Genchev EUROCONTROL		2012-03-27

Reviewed By		
Name & company	Position / Title	Date
WP 4.2		February 2012
WP 5.2		February 2012
WP 6.2		February 2012
WP 7.2		February 2012
WP 8		February 2012
WP 13		February 2012
WP 14		February 2012
Military ANSP and users		February 2012
Civil airspace Users		February 2012
B4.2		February 2012
B4.3		February 2012
SJU		February 2012

Approved By		
Name & company	Position / Title	Date
AENA	Antonio Obis	2012-03-27
AIRBUS	Michel Le Toullec	2012-03-29
DFS	Gabriele Zaki	2012-03-27
DSNA	Philippe Trouslard	2012-04-02

EUROCONTROL	Christian Bousmanne	2012-03-29
INDRA	Andrea Ranieri	2012-03-29
NATS	Daniel Nelson	2012-03-27
NORACON	Lars Stridsmann	2012-03-29
THALES	Jean-Francois Grout	2012-03-29

Document History

Edition	Date	Status	Author	Justification
00.00.01	05.10.2011	Draft	Lars Stridsman	New Document
00.00.02	11.10.2011	Draft	Lars Stridsman	Document structure update after CONOPS Webex
00.00.03	13.10.2011	Draft	Lars Stridsman	Document structure correction
00.00.04	18.10.2011	Draft	Lars Stridsman	Document structure after Webex 17/10
00.00.05	25.10.2011	Draft	Lars Stridsman	Document with initial draft text
00.00.06	31.10.2011	Draft	Lars Stridsman	Document updated after team Webex
00.00.07	18.11.2011	Draft	Lars Stridsman	Document updated after team Webex
00.00.08	21.11.2011	Draft	Lars Stridsman	Document updated after team Webex
00.00.09	28.11.2011	Draft	Lars Stridsman	Document updated after team F2F
00.00.10	06.12.2011	Draft	Lars Stridsman	Document updated before first external review
00.00.11	12.01.04	Draft	Lars Stridsman	Document updated before team webex
00.00.12	12.01.12	Draft	Lars Stridsman	Document updated before team webex
00.00.13	12.01.19	Draft	Lars Stridsman	Document updated before external review #2
00.00.20	12.02.19	Draft	Lars Stridsman	Document updated after external review #2
00.00.30	14.03.19	Draft	Lars Stridsman	Document updated after external review #2
00.00.31	19.03.2012	Draft	Lars Stridsman	Document updated after external review #2
00.00.32	19.03.2012	Draft	Lars Stridsman	Update of the document after Quality Assurance review
00.00.40	23.03.2012	Draft	Lars Stridsman	Final editing of the document after Quality Assurance review
00.00.50	27.03.2012	Draft	Lars Stridsman	Final version submitted to PM B4.2
01.00.00	09.05.2012	Final	Lars Stridsman	Final version

Table of Contents

List of tables

List of figures

Executive summary

Context and objective

The SESAR Concept Of Operations (CONOPS) Step 1 document provides the top level guidance and serves as the main common reference for all operationally related SESAR tasks. The objective is to describe the ATM operation envisaged so that civil and military Airspace Users, Service Providers, Airports, Aviation and ATM industries and SESAR Programme tasks gain common understanding of the operational characteristics of ATM in the first step of SESAR development and the main changes they imply in operating practices along with the support they require. At the same time, the Concept recognizes the continued important role of humans in the future system. Procedures will change significantly and future situational awareness needs will differ from today.

The SESAR CONOPS can be seen as a specific application of the ICAO Global Air Traffic Management Operational Concept, adapted and interpreted for Europe with due regard to the need for global interoperability. The CONOPS also aims at describing the SESAR (European) input to the Aviation System Block Upgrades" describing a set of Air Traffic Management solutions.

The document has been created by SESAR WP B4.2. The ambition has been to create a document that is structured for ease of use both on the management and expert level.

Overview and Structure

The CONOPS Step 1 document describes Time Based Operations, the first step of 3 in a layered approach, step by step achieving the full performance of the European ATM System. It covers the complete ATM process from early planning through flight execution to post flight activities.

Part 1 addresses the new operating methods brought by SESAR. This part is structured around Operational Sub Packages (OSP) describing the operational concept on a high level. Part 2 addresses the applicable operational environment where the elements of the operational concept apply. Part 3 describes a nominal high level scenario covering the full scope of step 1. Part 1 and 2 provides the expert perspective and use of the document- Part 3 represents the management view where the concept is illustrated through an example scenario.

Main changes of ATM Operation

Moving from Airspace to Trajectory Management

The central pillar of SESAR is the management of aircraft trajectories from planning through execution gate to gate. Trajectories will be expressed in all 4 dimensions (4D) and flown with significantly higher accuracy than today.

In Step 1 User preferred routeing, without pre-defined routes, is applicable in low and medium complex airspace within a single FAB. More detailed information about the flight is available for network planning through the use of the Operational Flight Plan and improved OAT Flight Plan. The onboard trajectory is shared with the ground system to feed the ground tools. This improves predictability and consistency between air and ground trajectories.

ASAS spacing supports tactical actions to achieve an optimum arrival sequence or to ensure longitudinal spacing of "same route" departures. It can also be used for or en-route spacing.

Enhanced accuracy of ground-based trajectory prediction improves the performance of Controller support tools. Strategic conflict management is achieved through the integrated operation of airspace organisation and management of demand and capacity balancing and of queue management based on more accurate 4D trajectories.

Airborne Collision Avoidance (ACAS) and Short Term Conflict Alert (STCA) play a major role in maintaining the required level of safety. STCA is adapted to TMA operations. ACAS is improved via automation in the execution of the Resolution Advisory (RA) and the reduction of abusive RA alerts occurring during level off.

End to End Traffic Synchronisation

AMAN is extended to support the management of arrival flows further out from the destination airport. DMAN servicing multiple airports enable a constant delivery of flights from multiple airports merging into the en-route phase of flight.

AMAN and DMAN are synchronised by including the operations of close proximity airports in the Arrival metering before departure towards constrained destination airports.
Controlled Time of Arrival (CTA) is proposed by AMAN, implemented by Controllers and met by aircraft with high accuracy, improving the performance and reliability of arrival sequencing.
More information is available to Controller and Flight Crews to ensure a safe, expeditious and efficient movement on the ground. The coordination of AMAN/DMAN with surface management operations supports efficient mixed mode operations on a single runway.

Integrated and Collaborative Network Management
Airport Collaborative Decision Making (A-CDM) processes progressively build the Airport Operations Plan (AOP) and Network Operation Plan (NOP) through the sharing of more and more up-to-date and precise data as the day of operations approaches.
User Driven Prioritisation Process (UDPP) is first used to address reduced airports capacity, with a primary focus on addressing departure congestion.
Management of Target Time Over/Arrival (TTO/TTA) improves the effectiveness and the smoothing effect of regulations on the demand in congested airports and areas.
Flexible Military Airspace ensures that military airspace requirements are met and at the same time giving more freedom to GAT flights to select their preferred route.
Dynamic DCB / Short-Term ATFCM Measures manage traffic peaks and complexity, to smooth ATC workload through the application of fine-tuned measures close to the real time operations.
AOP and NOP ensure the best overall system outcome. A-CDM is extended to include interconnected regional airports and affects all IFR flights.
Complexity management simplifies the ATM situation, while human interventions still ensure the provision of separation when necessary.

Efficient and Green Terminal Airspace Operations
An efficient fixed airspace structure combined with advanced airborne and ground system capabilities is deployed.
TMAs are optimised through Performance Based Navigation (PBN) using Advanced RNP. The aim is to generate route structures in lateral dimensions (2D), while the vertical dimensions of the flight remains managed tactically managed by Controller.
Continuous Climb Departures (CCD) and Continuous Descent Approaches (CDA) can be accommodated on a tactical basis, improving the flight efficiency and reducing, among other things fuel burn and CO2 emissions and noise.

Increased Runway and Airport Throughput
Flight Crew Enhanced Vision provides a clearer vision of landing and ground operations in Low Visibility Conditions. Low Visibility Procedures and Precision Approaches using initial CAT II/III GBAS are more systematically used.
Airport surface safety is enhanced thanks to increased situation awareness and to the introduction of conflict detection tools and alerting systems for Controller, aircrew and vehicle drivers.
Time based Separation (TBS) dynamically adapted to the dissolving of wake vortex on final approach, so as to aid towards consistent and accurate delivery between arrival aircraft.

Remote Tower with AFIS
Remotely Operated Aerodrome Control is provided from a remote location, significantly reducing the costs of infrastructure by joint tower installations for a number of airports centralized at a single site.

1.Introduction

1.1.Purpose of the document

The Concept of Operations (CONOPS) document in SESAR is a document describing the operational concept, answering the question “what?” and also describing the way this concept shall be applied, answering the question “how?” thereby providing the overall concept level guidance to ensure consistent development of the operational details.

The CONOPS document is the main common reference for all operationally related SESAR tasks. This document may evolve and refinements will be necessary as validation of concept elements is assessed with respect to the delivery of expected performance.

1.2.Scope

The Concept of Operations covers the three operational steps defined by the SESAR Concept Story Board, introducing an incremental approach to concept development, validation and deployment that is aligned with the SESAR definition Phase Service Levels 2, 3 and 4.

The objective of the operational steps is to identify manageable, implementable collections of ATM Operational Improvements that brings the expected benefits to the ATM community.

SESAR Step 1 Concept of Operations (CONOPS) describes in sufficient detail the ATM operation envisaged in Europe so that civil and military Airspace Users, Service Providers, Airports, Aviation and ATM industries and SESAR Programme tasks gain common understanding of the operational characteristics of ATM in the first step of SESAR development and the main changes they imply in operating practices along with the capabilities they require.

The CONOPS covers the complete air traffic management process from early planning through flight execution to post flight activities.

CONOPS Step 1 represents the end state for Step 1. Intermediate steps, such as operational improvements that are superseded by other operational improvements within Step 1 are therefore not described in this document.

The target audience of this document are twofold. Primary SESAR Joint Undertaking partners and stakeholders involved in the development and validation of the SESAR concept. Secondly, the global ATM community are invited to read this document in order to learn about how Europe intends to develop and implement the ATM System to meet the overarching goals of the aviation industry.

1.3.Limitations to the Concept

It should be noted that operational working methods must be defined taking into account the level of equipped aircraft, as well as the ground support tools and infrastructure needed to deliver the expected benefits. It should be noted as well that this takes place in a mixed environment, with equipped and non-equipped aircraft, different aircraft performance levels and with different levels of ground support tools and infrastructure.

1.4.Structure

The document has three main chapters addressing the Concept, how it is applied and the operational environment it pertains to. It is structured for ease of use both on the management and expert level. Part 1 and 2 provides the expert perspective and use of the document- Part 3 represents the management view where the concept is illustrated through an example scenario.

Part 1 – Operational Concept Description addressing the new operating methods brought by SESAR. The chapter is structured around Operational Sub Packages (OSP) describing the operational concept on a high level down to the granularity of concept element details at the level of the Operational Focus Areas (OFA).

Part 2 - Operational Environment addressing the applicable operational environments where the elements of the operational concept are available. It is detailed in chapter4.

Part 3 – Operational Scenario presenting a high level scenario covering the full scope of step 1, addressing a nominal case where all relevant OI steps are covered. It is detailed in chapter 5.

Annexes –
A – Reference List

B – Mapping of SESAR Packages, Sub Packages and OFA to ICAO ASBU

C – List of Operational improvement steps

.

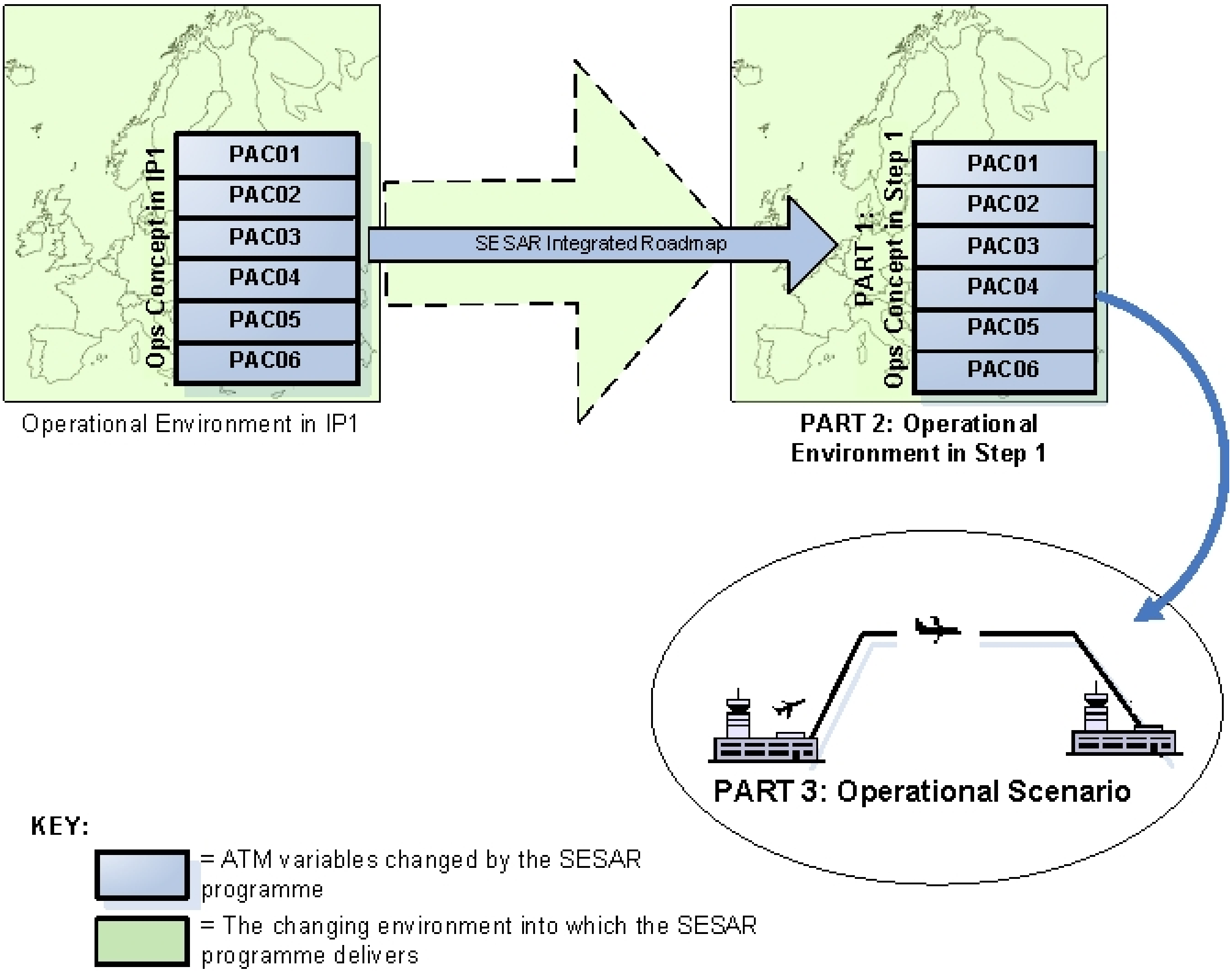

Figure 1 Document Structure

Figure 1 reflects the structure of the document and its relation to precursory work.

The green elements in Figure 1 represent the changing environment in which ATM operates; its status in SESAR Step 1 is described in Part 2 of this document.

The blue elements in Figure 1 represent the changes to ATM delivered through the SESAR programme. Changes made by Step 1 of the SESAR programme result in a new concept of operation, which is described in Part 1 of this document. The concept of operation is described top-down: first as a SESAR-wide summary view and then sub-divided by Operational Sub-Packages with a level of detail consistent with that in the Operational Focus Areas (OFA). This structure enables a simple comparison to be made between the SESAR programme of change and the operational outcomes.

The Operational Scenario provided in Part 3 is based on the Operational Concept described in Part 1. However, instead of being structured according to the SESAR Operational Sub-Packages, it describes the scenario per ATM phase. The scenarios therefore provide an additional layer of detail for the concept describing the outcome of the OI Steps.

1.5.Background

During the SESAR Definition phase, series of documents were developed to map the future of the European ATM to the whole SESAR program. The work was a common endeavour to which all European Stakeholders participated: They all agreed to the result.

The core document from that work is the document describing the operational concept - DLT-0612-222-02-00_D3_Concept of Operations.

The Operational Improvement steps (OI) being referred to are strictly referencing the Integrated Roadmap Version V1.03b. Changes and updates to the Operational Improvement steps will be reflected in later editions of this document.

In SESAR Development phase this document is now being further developed and updated as a result of more detailed concept work and results from validations carried out in the SESAR programme.

1.6.Relation to ICAO initiatives

The International Civil Aviation Organization (ICAO) has developed the Global ATM Concept Document [ref ICAO Global ATM Concept Document, Doc 9854] describing the future ATM concept applicable on a global basis.

The SESAR Concept of Operation is developed with reference to the ICAO Concept Document. The former, however, details the concept to a level where it can be validated and implemented in European operational environments.

In parallel ICAO has initiated the “Aviation System Block Upgrades” (ASBU) initiative as a programmatic framework that develops a set of air traffic management (ATM) solutions or upgrades that takes advantage of current equipage, establishes a transition plan, and enables global interoperability.

ASBU comprise a suite of modules, organized into flexible and scalable building blocks. Block upgrades describe a way to apply the concepts defined in the ICAO Global Air Navigation Plan (Doc 9750) with the goal of implementing regional performance improvements. It includes the development of technology roadmaps, to ensure that standards are mature and to facilitate the synchronisation between air and ground systems, as well as between regions. The ultimate goal is to achieve global interoperability.

The following block upgrades have been defined:

- Block 0: available now
- Block 1: available to be deployed globally from 2018
- Block 2: available to be deployed globally from 2023
- Block 3: available to be deployed globally from 2028

SESAR Concept of Operations relates mainly to ASBU blocks 1&2.

The ASBU are not a universal reference for SESAR. The CONOPS rather intends to describe the SESAR (European) input to the ASBU structure.

Annex A contains a mapping between SESAR CONOPS Step 1 Operational Packages (PAC), Operational Sub Packages (OSP) and Operational Focus Areas (OFA) to ICAO ASBU.

1.7.Relation to Performance Framework

The starting point for the cascade and allocation of validation targets is the setting of strategic targets contained in the European ATM Master Plan - Edition 1, published March 2009.

In response to the ATM challenge, the European Commission (EC) launched the SESAR programme, with the objectives, as expressed by Vice-President Jacques Barrot, to achieve a future European ATM System for 2020 and beyond, which can, relative to today's [2005] performance:

- Enable a 3-fold increase in capacity which will also reduce delays, both on the ground and in the air,
- improve the safety performance by a factor of 10,
- enable a 10% reduction in the effects flights have on the environment and
- provide ATM services at a cost to the airspace users which are at least 50% less.

From these high level targets, more detailed targets have been allocated to relevant Concept Roadmap elements, i.e. Operational Packages (PAC), Operational Sub-Packages (OSP) and Operational Focus Areas (OFA) for six Key Performance Areas (KPA: airspace capacity, airport capacity, safety, environment / fuel efficiency, cost effectiveness, predictability) based on a set of Influence Diagrams developed and described by SESAR Project B4.1 [see References].

These targets are delivered through the SESAR Deployment Packages and Scenarios per OFA and Operational Environment, providing performance improvements that becomes manifest in the Concept of Operations. Therefore, each element of the CONOPS (in Part 1 of this document) identifies the affected KPA.

1.8.Relation to Deployment Baseline

Operational Improvements from the Deployment baseline may be important enablers for subsequent improvements in SESAR Step 1 and beyond, but for the purpose of describing SESAR Concept of Operations it is assumed that the Deployment Baseline is already implemented or under deployment.

This document does not include any comparison of performance between Deployment Baseline and SESAR Step 1.

1.9.Glossary and definition of terms

Glossary and definition of terms are assembled in the document SESAR Lexicon but for the sake of readability this document contains all acronyms and definition of terms used in the document.

1.9.1.Glossary

Term	Explanation
4DT	4D Trajectory
A-CDA	Advanced Continuous Descent Approach
A-CCD	Advanced Continuous Climb Departure
A-CDM	Airport Collaborative Decision Making
A-ICWP	Advanced-Integrated Controller Working Position
A-RNP	Advanced RNP
ACARS	Aircraft Communications Addressing and Reporting System
ACAS	Airborne Collision and Avoidance Systems
ADD	Aircraft Derived Data
ADR	Airspace Data Repository
ADS-B	Automatic Dependant Surveillance - Broadcast
ADS-C	Automatic Dependant Surveillance - Contract
ADS-C EPP	ADS-C Extended Projected Profile
ADEP	Aerodrome of Departure
ADES	Aerodrome of Destination
AEW	Airborne Early Warning
AFIS	Aerodrome Flight Information Service
AFISO	Aerodrome Flight Information Officer
AFUA	Advanced Flexible Use of Airspace
AIS	Aeronautical Information Service
AMAN	Arrival Manager
AMC	Airspace Management Cell
ANSP	Air Navigation Services Provider
AOCC	Airlines Operations and Control Centre
AOP	Airport Operations Plan
APOC	Airport Operations Centre
APP	Approach Control
APW	Area proximity warning
ARES	Airspace Reservation/Restriction
ARN	ATS Routes Network
ASM	Airspace Management
ASAS	Airborne Separation Assistance Systems
ASAS-S&M	ASAS Sequencing and Merging
ASBU	Aviation Service Block Upgrade (ICAO)
ASEP	Airborne Separation
A-SMGCS	Advanced Surface Movement Guidance and Control System
ASPA	Airborne Spacing
ASPA S&M	Airborne Spacing Sequencing and Merging
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATN	Aeronautical Telecommunications Network

Term	Explanation
ATOT	Actual Take Off Time
ATS	Air Traffic Services
ATSA-ITP	Airborne Traffic Situational Awareness - In-Trail Procedure
ATSA –VSA	Airborne Traffic Situational Awareness – Enhanced Visual Separation on Approach
ATSAW	Airborne Traffic Situational Awareness
ATSU	Air Traffic Services Unit
AU	Airspace User
AUP	Airspace Use Plan
AWACS	Airborne Warning and Control System
BDT	Business Development Trajectory
BT	Business Trajectory
CAT	Category
CBA	Cross Border Area
CBO	Cross Border Operations
CCD	Continuous Climb Departure
CDA	Continuous Descent Approach
CDM	Collaborative Decision Making
CDO	Continuous Descent Operations (defined by ICAO)
CDTI	Cockpit Display of Traffic Information
CFIT	Controlled Flight Into Terrain
CORA	Conflict Resolution Assistant
CPDLC	Controller Pilot Data Link Communication
CSAR	Combat Search and Rescue
CTA	Controlled Time of Arrival
CTO	Controlled Time Over
CWP	Controller Working Position
DAP	Down-linked Aircraft Parameters
DCB	Demand and Capacity Balancing
dDCB	Dynamic Demand and Capacity Balancing
DOD	Detailed Operational Description
D-OTIS	Data Link Operational Terminal Information Service
D-TAXI	Taxi services via data link
DCB	Demand and Capacity Balancing
DMAN	Departure Manager
DPI	Departure Planning Information
EASA	European Aviation Safety Agency
ECAC	European Civil Aviation Conference
EIBT	Estimated In Block Time
EOBT	Estimated Off Block Time
EPP	Extended Project Profile
ET	Estimated Time
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure

Term	Explanation
ETMA	Extended Terminal Manoeuvring Area
ETO	Estimated Time Over
EUROCAE	European Organization for Civil Aviation Equipment
FAA	Federal Aviation Administration
FAB	Functional Airspace Block
FAF	Final Approach Fix
FDPS	Flight Data Processing System
FIS	Flight Information Service
FMS	Flight Management System
FMP	Flow Management Position
FO	Flight Object
FOC	Flight Operational Control / Flight Operations Centre
FRA	Free Route Airspace
FPL	Filed Flight Plan
FRT	Fixed Radius Transition
FUA	Flexible Use of Airspace
FUM	Flight Update Messages
GA	General Aviation
GANIS	Global Air Navigation Industry Symposium
GA/R	General Aviation & Rotorcraft
GAT	General Aviation Traffic
GBAS	Ground-Based Augmentation System
GNSS	Global Network Satellite System
HLAPB	High Level Airspace Policy Body
HMI	Human Machine Interface
I4D	Initial 4D
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organization
ICAO OPLINK	ICAO Operational Data Link panel
IFPS	Integrated Initial Flight Plan Processing System
INTEROP	Interoperability Requirements
IOP	Interoperability (between ground systems)
ITP	In Trail Procedure
KPA	Key Performance Area
LPV	Localizer Precision approach with Vertical guidance
LTM	Local Traffic Management role
LVO	Low Visibility Operations
LVP	Low Visibility Procedures
MASPS	Minimum Aviation System Performance Standards
MDI	Minimum Distance Interval
MDT	Mission Development Trajectory
METAR	Meteorological Aerodrome Report
MIDS	Multifunctional Information Distribution System (Link 16). A military data link system.

Term	Explanation
MIP	Merge Initiation Point
MMS	Mission Management System
MSP	Multi Sector Planner/Planning
MSPSR	Multi-Static Primary Surveillance Radar
MTCD	Medium Term Conflict Detection
MTF	Medium Term Forecast
NEXTGEN	Next Generation Air Transportation System (FAA)
NOP	Network Operations Plan
NOTAM	Notice to Airmen
OAT	Operational Air Traffic
OCE	Operational Concept Element
OI step	Operational Improvement Step
PA	Precision Approach
PBN	Performance Based Navigation
PO-ASAS	Principles of Operation for the use of ASAS, FAA/EUROCONTROL
P-RNAV	Precision Area Navigation
PSR	Primary Surveillance Radar
PT	Predicted Trajectory
PTC	Precision Trajectory Clearances
RA	Resolution Advisory
R&D	Research and Development
RBT	Reference Business Trajectory
ReqMT	Requested Mission Trajectory
RNP	Required Navigation Performance
RNP APCH	RNP Approach
RMT	Reference Mission Trajectory
ROT	Runway Occupancy Time
R/T	Radio Telephony
RTA	Required Time of Arrival
RTCA	Radio Technical Commission for Aeronautics
SBAS	Satellite-Based Augmentation System
SBT	Shared Business Trajectory
SES	Single European Sky
SESAR	Single European Sky ATM Research
SID	Standard Instrument Departure (Route)
SIGMET	Significant Meteorological Information
SMAN	Surface Manager
SMT	Shared Mission Trajectory
SOP	Standard Operational Procedures
SPR	Safety and Performance Requirements
STAM	Short Term ATFCM Measures
STAR	Standard Terminal Arrival Route
STCA	Short Term Conflict Alert

Term	Explanation
SWIM	System Wide Information Management
SYSCO	System Supported Coordination
TAF	Terminal Aerodrome Forecast
TAWS	Terrain Avoidance Warning System
TBS	Time Based Separation (Wake Vortex)
TCM	Traffic Complexity Manager
TC-SA	Trajectory Control by Ground Based Speed Adjustments
TCT	Tactical Controller Tool
TMA	Terminal Area
TMR	Trajectory Management Requirement
TOBT	Target Off Block Time
TOC	Top of Climb
TOD	Top of Descent
TP	Trajectory Predictor
TRA	Temporary Reserved Airspace
TS	Traffic Synchronisation
TSA	Temporary Segregated Area
TSAT	Target Start-up Approval Time
TTA	Target Time of Arrival
TTO	Target Time Over (a fix, waypoint,)
TTOT	Target Take Off Time
TWR	Control Tower
UAS	Unmanned Aircraft System
UDPP	User Driven Prioritisation Process
UP4DT	User preferred 4D Trajectory
UPR	User Preferred Route
UPT	User Preferred Trajectory
UUP	Updated Use Plan
VLJ	Very Light Jet
VoIP	Voice over Internet Protocol
VNAV	Vertical Navigation
VPA	Variable Profile Area
VRNP	Vertical Required Navigation Performance
VTT	Variable Taxi Times
WAM	Wide Area Multi-lateration
WG	Working Group
WOC	Wing Operation Centre

1.9.2.Definitions

When the following terms are used in this document, they will have the meaning as specified below. As indicated in the Source column below, some definitions have been developed by the B4.2 team that produced this document. These definitions will be aligned with SESAR Lexicon.

Term	Definition	Source
A-CDM	Airport Collaborative Decision Making (CDM) is a concept which aims at improving Air Traffic Flow and Capacity Management (ATFCM) at airports by reducing delays, improving the predictability of events and optimising the utilisation of resources. Implementation of Airport CDM allows each Airport CDM Partner to optimise their decisions in collaboration with other Airport CDM Partners, knowing their preferences and constraints and the actual and predicted situation. The decision making by the Airport CDM Partners is facilitated by the sharing of accurate and timely information and by adapted procedures, mechanisms and tools. The Airport CDM concept is divided in the following Elements: • Airport CDM Information Sharing • CDM Turn-round Process – Milestones Approach • Variable Taxi Time Calculation • Collaborative Management of Flight Updates • Collaborative Pre-departure Sequence • CDM in Adverse Conditions • Advanced CDM	Airport CDM Operational Concept Document Ver. 3.0
ADS-C application	ADS-C application is designed to give automatic reports from an aircraft to a ground system, according to a contract type: on demand, on a periodic basis, or when triggered by an event (e.g. change of waypoints and/or constraints, deviation of estimates more than defined thresholds, etc.).	B4.2
ADS-C EPP report	ADS-C EPP (Extended Projected Profile) report is the ADS-C report containing the sequence of 1 to 128 waypoints or pseudo waypoints with associated constraints and/or estimates (altitude, time, speed, etc.), gross mass and min/max speed schedule, etc. as defined in WG78/SC214 standards	SESAR, document WP 5 Project D01 05.05.01 - Step 1 TMA Trajectory Management Framework
ADS-C ETA min/max report	ADS-C ETA min/max report is the ADS-C report containing the earliest and latest values of ETA computed by the aircraft system on the point specified by ATC (e.g. IAF).	B4.2
Advanced Continuous Descent Approach (A-CDA)	Advanced Continuous Descent Approach involves the progressive implementation of harmonised procedures for CDA in higher density traffic. Continuous descent approaches are optimised for each airport arrival procedure. New Controller tools and 3D trajectory management enable aircraft to fly, as far as possible, their individual optimum descent profile.	OI AOM-0702
Advanced Continuous Climb Departure (A-CCD)	Advanced Continuous Climb Departure in higher density traffic enabled by system support to trajectory management.	OI AOM-0705
Aircraft intent	Information on planned future aircraft behaviour, which can be obtained from the aircraft systems (avionics). It is associated with the commanded trajectory and will enhance airborne functions. The aircraft intent data correspond either to aircraft trajectory data that directly relate to the future aircraft trajectory as programmed inside the avionics, or the aircraft control parameters as managed by the automatic flight control system. These aircraft control parameters could either be entered by Flight Crew or automatically derived by the flight management system.	ICAO Doc 9854
Airport Operations Plan (AOP)	A single, common and collaboratively agreed rolling plan available to all airport stakeholders whose purpose is to provide common situational awareness and to form the basis upon which stakeholder decisions relating to process optimisation can be made. As well as timely and accurate information, the AOP also contains a robust performance monitoring capability which allows the airport processes to be efficiently managed in real-time. Through its 'rolling' nature, the AOP will ensure that mitigation actions taken by each stakeholder will be based on accurate information with the result of their actions being reflected directly back into the AOP	6.2 DOD Ver. 00.03.00
Airspace Reservation / Restriction	Airspace Reservation means a defined volume of airspace temporarily reserved for exclusive or specific use by categories of users (TSA, TRA, CBA) and Airspace Restriction designates Danger, Restricted and Prohibited Areas.	EC Regulation n°2150/2005
Arrival Manager	Arrival Manager is a planning system to improve arrival flows at one or more airports by calculating the optimised approach / landing sequence and Target Landing Times (TLDT) and, where needed, times for specific fixes for each	SESAR Airports Definition Team

Term	Definition	Source
	flight, taking multiple constraints and preferences into account.	
ASAS Spacing	An ASAS separation provision mode in which the separation responsibility remains with the ground controller and the aircrew are instructed to maintain a specified time or distance from a designated aircraft, usually the preceding aircraft in the arrival or departure stream.	SESAR Consortium (2007) CONOPS Acronyms and Definitions, Task 2.2.2 - Milestone 3
ATC Clearance	Authorization for an aircraft to proceed under conditions specified by an air traffic control unit.	ICAO Doc 4444
ATC Instruction	Directives issued by air traffic control for the purpose of requiring a Flight Crew to take a specific action.	ICAO Doc 4444
ATS Route Segment	A portion of an Air Traffic Service (ATS) route to be flown between two consecutive significant points.	Aeronautical Information Feature Data Dictionary (AIFDD)
Business or Mission Development Trajectory	The Business or Mission Development Trajectory (BDT/MDT) is the trajectory initially planned by the Airspace User to be shared with the wider aviation community only once the corporate plans are sufficiently mature.	SESAR, document WP 5 Project D01 05.05.01 - Step 1 TMA Trajectory Management Framework
Business or Mission Trajectory	The Business or Mission Trajectory (BT/MT) is a trajectory which expresses the business or mission intentions of the Airspace User (respectively mainlines, regional, business, general aviation or military aviation). It includes both surface and airborne segments and is built from, and updated with the most timely and accurate data available in the Network Operation Plan (NOP), including turn-around elements. Mission Trajectory may additionally include specific airspace reservations when such airspace structure is needed.	SESAR, WP 05.05.01 D01 - Step 1 TMA Trajectory Management Framework
Clearance	See ATC Clearance	ICAO Doc 4444
Closed loop clearance	A closed loop clearance is a clearance resulting in a revision of one portion of the RBT/RMT, e.g. a direct route from a point of the original RBT/RMT to another point of the original RBT/RMT.	SESAR, WP 05.05.01 D01 - Step 1 TMA Trajectory Management Framework
Complexity Management	Complexity Management is a service that manages, balances, individual Controller (or sector Controller team) workload at local level - ATSU environment to achieve the goal of maximising the throughput of the ATM system by not wasting, or leaving unused, any latent capacity and reduces safety risks related to workload variations.	New
Continuous Climb Departure	an optimised departure from an airport to a defined point or level without intermediate level offs	New
Continuous Descent Approach	an optimised decent and approach to an airport from a defined point without intermediate level offs	New
Controlled Time of Arrival	An ATM imposed time constraint on a defined merging point associated to an arrival runway.	SESAR Def. Phase
Departure Manager	Departure Manager is a planning system to improve departure flows at one or more airports by calculating the Target Take Off Time (TTOT) and Target Start-up Approval Time (TSAT) for each flight, taking multiple constraints and preferences into account.	EUROCONTROL (2008) Airport CDM Implementation Manual
Estimated Time	An information on Estimated Time, subject to variation, neither a Controlled Time (time constraint) nor a Target Time (planned time)	New
ETA min/max	ETA min/max is the earliest/latest ETA at a waypoint, provided the aircraft flies the 4D trajectory at its max/min allowable speed, wind/temp error is also taken into account, in order to guarantee that any CTA defined within associated ETA min/max interval will be satisfied with high probability.	New
Estimated In-Block Time	Estimated In-Block Time, the estimated time that an aircraft will arrive in block. (Equivalent to Airline/Handler ETA – Estimated Time of Arrival).	A-CDM Manual
Flight intent	The future aircraft trajectory expressed as a 4-D profile until destination (taking account of aircraft performance, weather, terrain, and ATM service constraints), calculated and “owned” by the aircraft flight management system, and agreed by the pilot.	ICAO Doc 9854
Flight Object	The system instance view of a flight. It is the flight object that is shared between the IOP stakeholders.	EUROCAE (2009), Flight Object

Term	Definition	Source
		Interoperability Specification, ED-133
Improved OAT Flight Plan	A flight plan based on the ICAO 2012 FPL format, improved with initial Mission Trajectory data and harmonised military information items, managed centrally at European level and used by military organisations operating IFR in European airspace	SESAR WP 7.6.2
Local Traffic Management role	The Local Traffic Management role lies in between the Flow Management and (multi)-sector planning roles, taking a wider view over a group of multi sector areas and/or sectors (potentially a complete ACC) and any Airfield Towers that fall within the Local Traffic Management's area of responsibility. The associated actor provides the coordinating link between the ANSP, sub-regional and regional flow and airspace management. In case of an imbalance, the responsibility is to identify the adequate measures to be taken, in coordination with the appropriate partners (that could include Network management, Flow Management, other Local Traffic Management and the Airspace Users). The Local Traffic Management actor is likely to be either a Supervisor, or report to one, and as such will retain local safety accountability. Any ATFCM initiatives will have to be approved by him.	SESAR WP 4.2
Managed Airspace	Airspace in which all traffic and its intent is known to the Air Traffic System.	SESAR Def. Phase
Network Operations Plan	The Network Operations Plan is a set of information and actions derived and reached collaboratively both relevant to, and serving as a reference for, the management of the Pan-European network in different timeframes for all ATM stakeholders, which includes, but is not limited to, targets, objectives, how to achieve them, anticipated impact.	SESAR NOP Project Team
Open Loop Instruction	An open-loop instruction is an ATC instruction that does not include a specified or implied point where the restriction on the trajectory ends and does not include a specified or implied return path to a downstream computed, known or expected trajectory.	SESAR Trajectory Management Document
Operational Flight Plan	The operational flight plan provided to Flight Crew before departure is more detailed than the ATC flight plan and consists of the detailed list of the waypoints of the route, with their associated altitude, speed, time and fuel estimates. [1]	New
Operational Focus Area	A limited set of dependent operational and technical improvements related to an Operational sub-package, comprising specific interrelated OIs designed to meet specific performance expectations of the ATM Performance Partnership.	SESAR SJU, "Operational Focus Area Programme Guidance - Executive Summary" Edition 02.00.00
Operational Package	1. A deployment focused grouping of performance driven operational changes and associated technical and procedural enablers 2. A (very) high level grouping of (related) Operational Improvement Steps for the purpose of (very) high level communication	SESAR SJU, "Operational Focus Area Programme Guidance - Executive Summary" Edition 02.00.00
Operational Scenarios	Within the context of an operational concept scenarios are a description of how a future system could work. Each scenario describes the behaviour of users and the future system, interaction between the two, and the wider context of use. From a detailed scenario the ATM Stakeholders should be able to identify user requirements and potential business cases.	New
Operational Sub-Packages	A sub-grouping of connected operational and technical improvements related to the Operational Package with closely related operational focus, designed to meet performance expectations of the ATM Performance Partnership.	SESAR Joint Undertaking (2010), Release 1 Plan v1.0
Predefined Route	A predefined route is based on published waypoints (ICAO). These waypoints are inputs inserted in the FMS (among other elements) for trajectory computation.	New.2
Reference Business Trajectory	The business trajectory which the airspace user agrees to fly and the ANSP and Airports agree to facilitate (subject to separation provision).	SESAR Consortium (2007) CONOPS Acronyms and Definitions, Task 2.2.2 - Milestone 3

[1] Note that The ATM Lexicon includes an ICAO definition of Operational Flight Plan strictly for helicopter operations.

Term	Definition	Source
Reference Business or Mission Trajectory	The Reference Business or Mission Trajectory (RBT/RMT) is created from the last version of the SBT/SMT. It is the trajectory that the Airspace User agrees to fly and that the ANSP and Airport agree to facilitate. It is associated to the filed flight plan and includes both air and ground segments. It consists of 2D routes (based on published way points and/or pseudo waypoints computed by air or ground tools to build the lateral transitions and vertical profiles); altitude and time constraints where and when required; altitude, time and speed estimates at waypoints, etc. When an RBT/RMT is agreed a NOP update is triggered.	SESAR Def. Phase
Required Time of Arrival	In this document refers only to the aircraft FMS RTA function, enabling the onboard management of CTA instruction.	New
Revision of the Reference Business or Mission Trajectory	The revision of the Reference Business or Mission Trajectory (RBT/RMT) is triggered at Controller or Flight Crew initiative when there is the need to change the route and/or altitude constraints and/or time constraints, mainly due to hazards (traffic, weather), fine sequencing (CTA or CTO allocation) or inability for the aircraft system to meet a constraint (CTA missed).	SESAR Def. Phase
Update of the Reference Business or Mission Trajectory	The update of the Reference Business or Mission Trajectory (RBT/RMT) is automatically triggered when the trajectory predictions continuously computed by the aircraft system, differ from the previously shared trajectory predictions more than the delta defined by ATC in Trajectory Management Requirements (TMR). The update of the RBT/RMT can also be triggered on request or periodically.	SESAR Def. Phase
Shared Business or Mission Trajectory	The Shared Business or Mission Trajectory (SBT/SMT) is the trajectory published by the Airspace User that is available for collaborative ATM planning purposes. The refinement of the SBT/SMT is an iterative process. The final form of the SBT/SMT becomes the Reference Business or Mission Trajectory (RBT/RMT) and is part of the filed flight plan.	SESAR Consortium (2007) CONOPS Acronyms and Definitions, Task 2.2.2 - Milestone 3
Tailored Arrival	Tailored arrival procedures are defined from Top of Descent to Initial Approach Fix (IAF) or to runway taking in account the other traffic and constraints, to optimize the descent. The concept is based on the downlink to the ANSP of actual aircraft information (like weight, speed, weather etc.) and the uplink of cleared route (STAR) calculated by the ANSP.	OI AOM-0704 New
Target Time of Arrival	An ATM computed arrival time. It is not a constraint but a progressively refined planning time that is used to coordinate between arrival and departure management applications.	SESAR Consortium (2007) CONOPS Acronyms and Definitions, Task 2.2.2 - Milestone 3
Target Time Over	An ATM computed over-flight time. It is a progressively refined planning time that is used as an indication for flight planning and execution to coordinate at network level and enhance the effectiveness of the ATFCM measures.	WP7.2 Detailed Operational Description
Trajectory	The description of movement of an aircraft both in the air and on the ground including position, time, and at least via calculation, speed and acceleration.	ICAO (2003) AN-CONF/11-WP/4 The Global ATM Operational Concept
Trajectory (4D)	The 4D trajectory is a set of consecutive segments linking published waypoints and/or pseudo waypoints computed by air or ground tools (airline pseudo FMS, aircraft FMS, ground Trajectory Predictor) to build the lateral transitions and the vertical profiles. Each point is defined by a longitude, latitude, a level and a time with associated constraints where and when required.	New
Trajectory management (4D)	Trajectory management is the process by which the Business or Mission Trajectory of the aircraft is planned, agreed, updated and revised. It is achieved through Collaborative Decision Making (CDM) processes between Airspace users (Airspace Users) and ATM Service Providers (ANSP, Airports, Network Manager) or directly between Flight Crew and Controller during the execution phase when time does not permit CDM.	New
Trajectory Management Requirement	Trajectory Management Requirement (TMR) specifies the requirement on the aircraft to share the updated trajectory in the event that the flight detects a 'delta' from previously shared predictions or on a cyclical basis. The TMR specify the lateral, vertical or time parameters that will trigger the update process. The TMR specify the other event driven and periodic trajectory sharing requirements. The TMR will specify the data content required and the allowable tolerances of selected time/speed and altitude.	New
User Preferred 4D Trajectory	The User Preferred 4D Trajectory (UP4DT), or from a Military perspective the Requested Mission Trajectory (ReqMT), is the user preferred 4D trajectory integrating the known ATM constraints, Airspace User agree to fly and ANSPs & Airports will strive to facilitate; it corresponds to the operational flight plan	New

Term	Definition	Source
	currently provided by Airspace User to Flight Crew that has been shared with ATM actors to take into account static and known dynamic constraints in ATM system (airspace reservations, capacity short falls, weather, etc.); it represents the initial step toward the Shared Business / Mission Trajectory (SBT) and the Reference Business / Mission Trajectory (RBT).	
User Preferred Route	A user preferred route may include published as well as non-published points defined in latitude/longitude or point bearing/distance. Such waypoints are inserted in the FMS for trajectory computation	New
User Preferred Trajectory	The user preferred trajectory is the set of consecutive segments linking waypoints and additional pseudo waypoints computed by the FMS to build the vertical profiles and lateral transitions	New

Part 1
Operational Concept

2. SESAR Operational Concept Step 1: Time Based Operations

"Time Based Operations" is the first building block for the implementation of the SESAR 2020 concept and is focused on flight efficiency, predictability and environment (identified as Key Performance Indicators). It follows on from SESAR Definition Phase IP1(now Deployment Baseline) service levels 0 and 1"Time Based Operations" and encompasses SESAR Definition Phase Service Level 2.

The goal in step 1 is to build a time synchronised and predictable European ATM system, where partners are aware of business and operational situations and collaborate to optimise the network.

This first step initiates time prioritisation for arriving aircraft together with wide use of data-link and the deployment of initial trajectory based operations. When and where required, Controlled Time of Arrival (CTA) is used to sequence traffic managing queues and/or Controlled Time Over (CTO) for En route traffic synchronization or to control airspace reservation/restriction activation for military, as required.

In particular:

- Arrival Management and Departure Management are synchronised and the overall efficiency is additionally improved by including Multi-airport operations in the arrival and departure metering.
- Prioritisation of arrival time is achieved through the consideration of arrival times from planning phase to execution phase. Departure times are defined so as to enable the aircraft to meet the Target Time of Arrival/Target Time Over (TTA/TTO).
- Arrival Management is extended to support the management of arrival flows further out from the destination airport.
- The allocation of CTA, flown with high accuracy, improves the performance and reliability of Arrival Management.
- Delegation to Flight Crew of the task of spacing from a designated target aircraft improves airspace throughput. The spacing parameter expressed to Flight Crew may be in distance or preferably in time.
- The allocation of Controlled Time Over (CTO), flown with high accuracy to sequence traffic or control Airspace Reservation (ARES) activation, improves the performance and reliability of Airspace Management.

Traditional flight planning is complemented by more detailed information from the airspace users. The airline operational flight plan and the onboard trajectory information are used to feed the ground tools and thereby improve the operational predictability of trajectories. Network operations are supported by initial Ground-Ground system wide information, only partially implemented in Step 1, and by improved consistency between air and ground trajectories through down-linked trajectory data. Improvement in the accuracy of ground-based trajectory prediction leads to improved performance of Controller support tools and reduced controller task load per flight. Sectorisation is dynamic and civil/military coordination is improved. Shared airspace is managed via Variable Profile Areas, which offer several combinations to allocate the requested volume of airspace.

A coordinated process is used for Air Traffic Flow and Capacity Management (ATFCM), Airspace Management and Airport CDM in the Network Operations. Dynamic Demand & Capacity Balancing, including Short-Term ATFCM Measures (STAM) provide dynamic co-ordination between ATFCM and ATC. Automated tools allow a continuous monitoring of traffic demand and evaluation of traffic complexity, through occupancy and ATC Workload assessment. Complexity assessment activities ensure consistency between Network Management functions and ATC without any disruption.

The airport becomes an integral part of ATM and airspace users participate in ATM business decisions through User Driven Prioritisation Process (UDPP), directly linked to slot allocations in the Network Operations planning during periods of reduced capacity.

Performance Based Navigation, based on RNP values is used to systemise/optimise route structures and procedures. Flight Crews, Controllers and operations planners have automation support and management tools bringing safety, environmental and flight efficiency improvements. TMA route networks are optimised using Advanced RNP with Continuous Descent Operations (CDO) and Continuous Climb Departures (CCD) in high complexity TMA. In En-route, route networks are also optimised using Advanced RNP. Airspace Users can also, within a FAB, route freely without reference to the ATS route network above a certain level.

The extended use of the automated execution of the Resolution Advisory (RA) generated by Airborne Collision Avoidance and the reduction of abusive RA alerts occurring during level off as well as the adaptation of STCA to TMA operations play a major role in helping to ensure maintenance of the required level of safety.

Runway throughput is enhanced through weather dependent separation based on wake vortex dynamic information. Reduced Runway Occupancy Time (ROT) is achieved thanks to coordination between Flight Crew and ATC on a runway exit, commensurate with taxi plan and aircraft capabilities. Enhanced Tower equipage increases robustness of ROT reduction under all weather conditions.

Airport surface operations are optimised with the integration and exploitation of new ATC functions such as planning and routing tools and the implementation of ATM related airport turn-around processes which significantly improve planning and predictability of flight movements on the airport surface. Collaborative decision making is improved and the situational awareness of all mobile units (aircraft and vehicles either self-moving or moved with assistance) is increased on the airport surface. Surface Management is integrated with Arrival and Departure Management integrated in surface planning constraints. Low Visibility Procedures and Precision Approaches using e.g. initial GBAS CAT II/III are more systematically used.

Joint tower installations for a number of airports centralized at a single site, result in more efficient use of the personnel required to handle ATC service.

3.Operational Concept Description

3.1.Moving from Airspace to Trajectory Management

3.1.1. 4D Trajectory Management

<table>
<tr><th colspan="2">Summary</th></tr>
<tr><td>Most Significant changes</td><td>The use of the Operational Flight Plan and improved OAT Flight Plan integrated in IFPS

The possibility for Airspace Users to fly preferred route without reference to the ATS route network~~,~~

The sharing of onboard trajectory to feed the ground tools and thereby improve predictability and consistency between air and ground trajectories.</td></tr>
<tr><td>Operational Focus Areas

& contribution to Performance</td><td>Trajectory Management Framework
• Flexibility: Definition of Trajectory Management Services permitting the safe and efficient creation, amendment and distribution of trajectory data leading to enhanced airspace utilisation, flexibility and predictability.
• Cost effectiveness: Support for 4D trajectory management allowing more optimised flight trajectories, thus reducing ATM related costs.

Free Routing
▪ Efficiency: Free Routing directly lead to improved flight efficiency in both fuel efficiency and business/mission effectiveness.
▪ Flexibility: Free Routing offers the airspace users the possibility to plan their flight trajectories as they see fit with multiple options.
▪ Environment/Fuel Efficiency: By enabling airspace users to fly their preferred trajectories and reducing distance flown, Free Routing has a significant positive impact on environment by reducing flight emissions and fuel burnt.

Business and Mission Trajectory
• Capacity: Collaborative refinement of 4D trajectories provides more detailed information on the intended profile of the aircraft and allows more optimised use of airspace.
• Cost effectiveness: The use of more optimised flight trajectories leads to improved cost effectiveness.

Cruise climb

• Environment/Fuel Efficiency: Reduce environmental impact through increased flight efficiency

System Interoperability with air and ground data sharing
• Predictability: Improved predictability through data sharing.
• Safety: Improved flight safety based on data sharing (e.g. hazardous weather conditions).</td></tr>
<tr><td>Applicable Operational Improvement Steps</td><td>AOM-0304-A, AOM-0501, AUO-0203-A, AUO-0204-A, AUO-0302-A, AUO-0303-A, AUO-0304, IS-0302, IS-0301, IS-0303-A</td></tr>
<tr><td>Primary Key Performance Areas (Improvement)</td><td>Environment/Fuel-Efficiency (Medium); Airspace Capacity (Low); Predictability (Medium); Cost Effectiveness (Low); Safety (Medium)</td></tr>
</table>

Domain / Flight Phases	En Route, Terminal Area, Airport / Planning and Execution Phase

The Trajectory Management concept entails the systematic sharing of aircraft trajectories between various participants in the ATM process to ensure that all partners have a common view of a flight and have access to the most up-to-date data available to perform their tasks.

This concept enables the dynamic adjustment of airspace characteristics to meet predicted demand with distortions to the business/mission trajectories kept to the absolute minimum. Whenever possible, the necessary tactical interventions are considered at the gate to gate trajectory level and not only at sector level, taking due account of the wider impact on the trajectories concerned as well as on the network.

The optimisation of the ATM network, leading to minimal distortions of the trajectories, is achieved through an extensive iteration process based on the exchange of accurate data and refined estimates of all involved actors.

In Step 1, the trajectory management concept does not reach its full maturity mainly due to technical and equipage limitations. In order to enable early ATM improvement and to accommodate the transition towards this concept, an initial trajectory based operational concept is developed.

Business and Mission Trajectory
Initial trajectory based operation in step 1 reflects the development of a User Preferred 4D Trajectory (UP 4DT), or from a Military perspective the Requested Mission Trajectory (ReqMT), from long term planning through all phases of flight until reaching the stand after landing. It is an intermediate step towards 4D Trajectory Operations that encompasses the sharing of air and ground trajectory data driving safe and predictable operations with improved situational awareness amongst actors as well as the possibility during execution phase to impose a single time constraint at a time over a defined fix to a flight.

The application of initial 4D trajectory operations is improved by the use of the Airline operational flight plan and its equivalent for OAT (see chapter 1.9.2 for the definition) which are more detailed than the ATC flight plan and require pre-planning and prior knowledge of flight intent as well as static and dynamic constraints in the ATM system (airspace reservations, capacity short falls, weather, etc.).
During the execution phase, equipped aircraft are able to share their onboard trajectory according to contract terms specified by ATC (e.g. ADS-C EPP) to feed the ground tools, including the trajectory prediction and thereby improve accuracy and predictability.

Where and when required, single time constraints (Controlled Time Over, Controlled Time of Arrival (CTO/CTA) may be allocated to equipped aircraft on the basis of the estimated time window computed onboard the aircraft for the metering fix specified by ATC, supported –for CTA- by AMAN using air ground data link.

Situational awareness and predictability are progressively improved thanks to the exchange of information between ATC facilities, which include the Network Management trajectory related information.

Initial trajectory based operation focuses predominantly on the flight phases when the aircraft is within the AMAN horizon, i.e. the last part of the cruise phase before Top of Descent and the descent phase. However Network Management and ATS Units having data exchange in earlier flight phases have synchronised the air ground view and are already beginning to sequence traffic through metering points ensuring orderly flows that facilitates the use of CTO or CTA.

For military flights from/to military airfields not subject to capacity issues, the use of CTA is not crucial. Nevertheless, the use of CTO at entry/exit points of airspace reservation/restriction (ARES) facilitates the accuracy of their real-time activation/deactivation, and consequently improves Network performance through better management of static constraints.

The 4D operations concept is based on two distinct elements:

- Synchronisation between air and ground 4D trajectory which is addressed here in the context of this operational package “moving from airspace to trajectory management”
- Strategic metering and sequencing of flights using CTO or CTA when and where required (e.g. in constrained airspace) which is addressed further in the document in the operational sub-package “end to end traffic synchronisation”.

The Trajectory does not yet contain all the necessary elements to enable the implementation of the Shared and Reference Business or Mission Trajectories (SBT/RBT and RBT/RMT) that will be in use during step 2. Among others:

- Ground routing is not an integrated part of the trajectory although related ground (A-CDM) timings such as Target Start-up Approval Time (TSAT), based on individual Variable Taxi Times (VTT) are already used.
- Although the trajectory computed onboard may be made available through data link all along the flight, only equipped ANSP are able to use it in complement to the flight data available on ground, supported by ground trajectory prediction.
- Airspace Reservation is expected to be an integrated part of the mission trajectory description though target time over entry or exit point and duration of area activation integrated in the improved OAT Flight plan.
- SWIM is not expected to be in place yet at regional level.

System Interoperability with air and ground data sharing

The ATM system relies on all actors having a shared view of the situation; it is therefore essential that the trajectory held on the ground in the ground trajectory prediction tools, in the Flight Data Processing Systems (FDPS) and in the wider Network systems is as close as possible to the trajectory held in the aircraft Flight Management System (FMS).

Improved consistency between air and ground trajectories through down linked trajectory data enhances the overall performance of decision support tools. Congestion can be more precisely anticipated, allowing better adaptation to real traffic situation and therefore reducing the need for tactical intervention. Before departure, the Airspace User, having provided its operational flight plan, refines, in coordination with the Network Management, the trajectory to be flown, taking due consideration of all the known constraints affecting the flight. For flights entering the ECAC airspace, this coordination may be conducted the traditional way through the issuing of ATC clearances.

In the execution phase, the predicted trajectory can be synchronised according to the contract terms specified by ATC (e.g. ADS-C EPP) allowing the automatic downlink of trajectory data between equipped aircraft and the ANSP that are able to incorporate these data in their system.

Improved interoperability between the ground systems of adjacent ATSU enables better exchange of the trajectory data with enhanced accuracy, at an earlier stage than today, supporting better coordination between centres, extending the horizon of the ground trajectory prediction tools.

The down linked trajectory data consists of the Extended Projected Profile (EPP) which include:

- The Flight Intent (input to aircraft FMS) i.e. the waypoints of the routes and associated altitude, possible time and/or speed constraints agreed between ATM actors.
- The Predicted Trajectory (output from aircraft FMS) i.e. the Flight Intent augmented with intermediate waypoints and associated altitude, time and speed estimates computed by aircraft FMS to build the lateral transitions and vertical profiles.

- Aircraft derived parameters e.g. gross weight, speed min/max, etc.

The trajectory data are automatically down linked according to the datalink contract terms:

- On event (e.g.: in case of change of predicted trajectory versus previously shared predicted trajectory more than the thresholds specified by ANSP))
- On request
- On a periodic basis.

These updates of the trajectory are automatically performed from the aircraft system to the ANSP system according to the contract terms. They feed the ground tools, increasing the accuracy of the ground computed trajectory and allow potential conflicts within a medium-term time horizon to be identified and resolved earlier thus reducing the risk of unexpected events.

During the execution phase, the trajectory may be revised at controller or Flight Crew initiative (e.g. due to traffic or weather hazards, for fine sequencing using CTO/CTA or due to aircraft inability to meet a constraint). Each revision of the trajectory triggers a trajectory update message (e.g. ADS-C EPP) enabling a re-synchronisation of the trajectories held in the air and on the ground.
This “trajectory revision” consists of a “closed loop” in that the ATC instruction revising the trajectory modifies the route and/or associated constraints in a closed manner, e.g. a direct from a point of the trajectory to another point of the trajectory.

“Open-loop” instructions are still used by Controller in time critical situations e.g. to ensure immediate separation of the aircraft versus conflicting traffic or to avoid adverse weather (CBs). These “open loop” instructions do not provide Flight Crew with instructions on how to return to the initial trajectory. Neither do they contain instructions on how to proceed with another trajectory enabling him to complete his flight. After an open-loop instruction the adherence to the initial trajectory is suspended onboard until a new instruction is given to resume a “closed loop” trajectory. The reduction of tactical open-loop interventions is one of the advertised benefits of trajectory operations. It should be achieved thanks to better sharing of up-to-date and precise data among all stakeholders enabling anticipation of the problems followed by the implementation of collaborative solutions.

Limitations
Whenever automatic sharing of onboard trajectory data (e.g. via ADS-C) cannot be used for trajectory synchronisation, the ANSP may be able to use the limited information sent through the Aircraft Derived Data[2] (e.g. via ADS-B) for improvement of ground trajectory prediction.

Human Aspects

Flight Crew
In step 1, 4D traffic management does not induce any fundamental change in the role and responsibilities of Flight Crew but there will be more and more automation to support him in the execution of the today’s four main tasks:

- **Fly:** today, Flight Crew must concentrate on flying the aircraft (capture and maintain the desired guidance targets on the lateral and vertical flight paths, while in parallel monitoring the flight parameters and preventing deviations); in step 1, Flight Crew is expected to fly a trajectory agreed and shared with ATM actors in managed mode (i.e. to be achieved by the aircraft flight management and guidance system).
- **Navigate:** today, Flight Crew has to clearly know where the aircraft is, where it should be and avoid severe weather, terrain and obstacles; in step 1, all these aspects are still valid but mainly in the context of the agreed trajectory, shared with ATM actors.

[2] ADS-B out allows the aircraft to broadcast position, speed, altitude, flight ID, Wake Vortex category, etc. Gross weight and min/max speed schedule will require a new standard available in a further step than step 1. It should however be noted that gross weight and min/max speed schedule are part of ADS-C EPP in step 1.

- **Communicate:** today, communication allows sharing of goals and intentions, thereby enhancing Flight Crew's situational awareness. In step1, as data link replaces R/T more and more, there is less room for erroneous interpretation but the lack of "party line", i.e. the possibility for Flight Crews to hear the communication between Controller and the other traffic makes it more difficult for Flight Crew to build a mental picture of the surrounding traffic, which can decrease situation awareness; therefore the display of the traffic in the cockpit (e.g. CDTI and ATSAW) counterbalances this effect to a certain extent
- **Manage:** today, Flight Crew has to manage the continuation of the flight including monitoring of the aircraft systems and performing applicable procedures. In step 1, more and more automated functions support Flight Crew (e.g. to meet a time constraint on a specified fix or a spacing in time versus a designated target). Considering this, any additional task delegated to Flight Crew has to be compensated by automation to avoid increasing Flight Crew workload.

Controller

In the context of increased sharing of data between air and ground, the tasks and responsibilities distribution in ATC have to be clearly defined. Controller may be burdened by new or additional tasks and functions, and therefore his/her task load inevitably increases. Procedures must therefore be developed to support the new functions/tasks to ensure that Controller workload is kept at an acceptable level. If necessary dedicated tools have to be implemented.

The broad introduction of data link has a profound impact on communication and team interaction. Data exchanges between air and ground are increasingly performed via data link, while voice remains the primary means of communication in time critical circumstances. While this relieves congested R/T channels and reduces misunderstandings, it might simply change the nature of the errors, (e.g. typos could replace mishearing).

Furthermore sharing of information and tasks between executive and planning Controller could be affected by data link communications. Specific procedures might be needed to foster shared situational awareness of the team.

3.1.2. Airborne Spacing and Separation

Summary	
Most Significant changes	Delegation to Flight Crew the spacing in time with reference to a designated target aircraft to optimise sequencing
Operational Focus Areas & contribution to Performance	**ASPA S&M (Airborne Spacing - Sequencing & Merging)** • Environment/Fuel efficiency: Support CDO implementation and so contribute to reducing aviation environmental impact. • Cost Effectiveness: Allow better adherence to optimum spacing operations among aircraft resulting in less aircraft delay, more optimum trajectory profile to the touchdown and reduced flight time/distance. • Predictability: Improve landing time predictability under all wind conditions through close adherence to time based spacing on final approach. • Safety: The possibility for an aircraft system to automatically maintain a relative spacing contributes to improving safety.
Applicable Operational Improvement Steps	TS-0105, TS-0107
Primary Key Performance Areas (*Improvement*)	Predictability (Low); Cost Effectiveness (Low); Safety (Low)
Domain / Flight Phases	En Route and Terminal Area / Planning and Execution Phase

Airborne Spacing applications

The aim is to achieve the fine spacing required to optimise runway utilisation. ASAS Spacing supports tactical actions to achieve the optimum arrival sequence or for the longitudinal spacing of same route departures or even en-route spacing. This aim is complementary to the one pursued with the implementation of ATSA-ITP for oceanic flights.

ASAS Spacing application requires Flight Crew to achieve and maintain a given spacing, preferably in time, with a designated aircraft, as specified in a specific ATC instruction. Although Flight Crew is given a new task, separation provision is still Controller responsibility and applicable separation minima are unchanged.

ASAS Spacing is used for instance in Approach to Merge and Sequence arrival streams (ASAS-S&M). Before reaching the merge initiation point (e.g. an Initial Approach Fix (IAF) on which a Controlled time Of Arrival (CTA) may have been set for initial traffic synchronisation in absolute time), Controller requests Flight Crew to identify the target aircraft (preceding aircraft in the landing sequence) and gives an ATC instruction for an ASPA manoeuvre (e.g. “Remain behind” or “Merge, then Remain behind” the target with the required time spacing as specified by the Arrival Manager)- This manoeuvre must be agreed by Flight Crew (as soon as agreed the CTA is abrogated). The aim is to allow fine sequencing in relative time and thereby optimizing runway throughput. The objective, for the instructed aircraft, is to achieve and maintain an assigned interval relatively to another (target aircraft).

Human Aspects

ASAS Spacing is expected to decrease both Flight Crew and Controller workload in the achievement of merging traffic flows, while time based spacing on final approach is expected to deliver increased resilient runway throughput in all wind conditions. The issue of controller and flight crew workload will however need to be properly addressed in order to achieve those objectives.

Controllers

The temporary delegation of spacing responsibility to Flight Crew under certain circumstances or for defined segments of the flight in ASAS spacing applications is a fundamental change in the responsibilities of Controller. In step 1 this delegation is limited to the execution of the ASAS sequencing & merging task where Controller has delegated the execution of the spacing task to Flight Crew while remaining responsible for the separation.
The overlapping of different spacing tasks and separation responsibilities in the same airspace (even if Controller remains responsible of the separation) could be challenging and require additional vigilance for Controller to maintain the traffic picture. Switching between spacing tasks from Controller to Flight Crew and back again could also increase the necessary alertness for Controller. Therefore the effects on safety, workload and situational awareness need to be analysed thoroughly for ASAS applications. The necessary procedures need to be developed in detail to ensure optimal use of this concept.
Specific functions and HMI may be needed to allow Controller to use ASAS applications (specific colour, use of vectors, monitoring aids with alerts). This will have to be studied and validated.

Flight Crew
The delegation of a manoeuvre is not really a new principle for Flight Crew, as such a delegation already exists when a visual separation is accepted by Flight Crew. However, ASAS applications give the possibility for Controller to delegate to Flight Crew the execution of a spacing task in step 1 (ASAS Spacing).
Even if the responsibility for the separation remains with Controller in Step 1, a view towards the transition of this responsibility in step 2 with ASAS Separation has to be kept in mind. Mixing different types of delegations could be confusing for Flight Crew. It is therefore essential that Flight Crew is clearly informed of the type of delegation in Step 1 (spacing task) and well aware of the context of the delegation (a single target). Moreover, any additional task delegated to Flight Crew will have to be compensated by automation to avoid increasing Flight Crew workload.
The choice of the separation mode must address the issue of its respective management on board and on the ground. While Flight Crew is executing time-based spacing, Controller is working according to distance-based separation through radar surveillance. Therefore any accelerating or decelerating action must be considered in this environment.

3.1.3. Conflict Management and support tools

Summary	
Most Significant changes	Enhanced accuracy of ground-based trajectory prediction leads to improved performance of Controller support tools and reduced Controller task load per flight
Operational Focus Areas & contribution to Performance	**Conflict detection, Resolution and monitoring** • Airspace Capacity: Support ATC Controllers then increasing the number of controlled aircraft per controller, thus increasing airspace capacity. • Safety: The tool effectively monitors the ATM system thus preventing human error and therefore maintain or improve current level of safety • Cost effectiveness: Reduce the cost per flight by increasing capacity. **Enhanced Decision Support Tools and Performance Based Navigation** • Airspace Capacity: Tools support ATC Controllers. This optimises the ratio of controlled aircraft per controller which increases airspace capacity. • Safety: The precise management of trajectories supports a high degree of strategic deconfliction in congested airspace (2D-RNP and 3D route structures) therefore safety will be increased. • Cost effectiveness: Reduce the cost per flight by increasing capacity. **Sector team operations** • Cost effectiveness: Optimize the ratio number of controlled aircraft per controller, potentially reducing the number of controllers required per watch and thereby potentially reducing the Gate-to-Gate costs. • Airspace Capacity: Contribute to increase airspace capacity through reduced Controller workload and better use of Controller work force.
Applicable Operational Improvement Steps	CM-0204, CM-0301, CM-0405, CM-0406, CM-0601, SDM-0203
Primary Key Performance Areas (*Improvement*)	Environment/Fuel-Efficiency (*Low*); Airspace Capacity (*High)*; Predictability (*Low*); Cost Effectiveness (*High*); Safety (*Low*)
Domain / Flight Phases	En Route and Terminal Area / Execution Phase – Planning Phase

Conflict Management
In the ICAO scope, the function of conflict management is to limit, to an acceptable level, the risk of collision between aircraft and hazards. Conflict management is applied in three layers:

- Strategic conflict management
- Separation provision
- Collision avoidance (covered in 3.1.4 Air Safety Nets)

The conflict management process can be applied to a trajectory at any point, from the earliest business/mission sharing phase to real time in the execution phase.

Support tools
Conflict management support tools are able to predict conflicts with sufficient accuracy and look-ahead time to allow Controller to handle traffic.

A progressive improvement in the accuracy of ground-based trajectory prediction takes place in step 1 leading to improved performance of Controller support tools (greater accuracy and longer prediction horizons) and hence leading to reduced Controller task load per flight (more long duration clearances and increased dependence on the tools to monitor compliance and to check the progression potential conflicts).

Medium Term Conflict Detection (MTCD) tools and, among them, those to be studied in the MSP frame (see the related Human aspects below) specifically benefit from this improvement in the accuracy.

In addition, due to common information held by each sub region, conflict prediction is possible over a much longer time frame and wider area than is currently possible.

Ground-based trajectory prediction tools supports conflict detection, conformance monitoring and queue management, making use of operational flight plan data and aircraft performance tables, meteorological forecasts, surveillance data and additional trajectory and performance data from the Flight Operation Centre (e.g. new trajectory data from ground flight dispatcher in case of weather data implying need for rerouting). That data, together with limited down-linked intent data (e.g. pilot selected level) and down-linked aircraft parameters (DAP) or down linked trajectory data for equipped ANSP (see 3.1.1 4D trajectory management) also allow basic intent monitoring functions to be introduced.

An MTCD-based tool is required to assist in the efficient utilisation of pre-defined arrival and departure routes (2D and 3D) in TMA and is required to allocate flights to routes in real time ensuring that each flight remains conflict-free.

MTCD in Step 1 needs to clearly identify Controller tasks in conflict resolutions. In Step 1 the accuracy of a MTCD must be aligned with the following CORA[3] 1 target: the system identifies conflicts and Controller solves (display of detailed and filtered conflict data and provision of what-if-probing). A coherent involvement of the human in the loop (Controller and Flight Crew) must be achieved.

In Step 1 the variable level of accuracy of the ground based trajectory prediction impacts the quality of the information delivered by any conflict detection tool. This also impacts the look-ahead time envisaged for the tool. The difference between MTCD and TCT (Tactical Controller Tool) must therefore be clearly made.
MTCD must be considered as an automated decision-support tool that detects conflicts between aircraft trajectories around up to 20 minutes in advance. Due to the trajectory uncertainty occurring within the MTCD longer conflict look-ahead time, false conflicts and missed conflicts are expected in step 1.
Tactical Controller Tool (TCT) is an automated tool that allows the tactical controller (Radar/Executive) to detect and resolve conflicts around up to 8 minutes in advance. In addition, the TCT also features Critical Manoeuvre Alert function which indicates situations to the Tactical controller where a flight may enter into conflict should it fail to carry out a pending manoeuvre (turn / level-off).[4]

Strategic conflict management

- Strategic conflict management aims at reducing the need to apply separation provision to an appropriate level, thereby reducing Controller workload. This aim must be balanced with the need to preserve the optimal business/mission trajectory.

[3] Conflict Resolution Assistant defined with 3 Steps

CORA-1: the system identifies conflicts and Controller solves (display of detailed and filtered conflict data and provide what-if-probing)

CORA-2: the system provides advisories to Controller to solve the conflict

CORA-3: the system solves the conflict [use of trajectory negotiation capabilities (ground-ground and air-ground) for optimum resolutions and implementation of the resolutions, decisions in the cockpit

[4] The same look-ahead time span can sometimes be used for MTCD and TCT, which has led to the appearance of the CDT (Conflict Detection Tool). It is, however, preferable to distinguish MTCD and TCT.

Strategic conflict management is achieved through the integrated operation of airspace organisation and management, demand and capacity balancing and queue management based on more accurate 4D trajectory data provided by the Airspace Users. This integrated operation is reflected in trajectory based collaborative layered planning and the application of conflict management and separation, as described here above.

The elaboration of the user preferred trajectory integrating known ATM constraints may result from a certain level of strategic conflict management (the trajectory may include pre-deconflicted 3D routes) and from initial traffic synchronisation for planning purposes (Target Time Over or Target Time of Arrival (TTO/TTA)), with dynamic refinement or adjustment during flight through e.g. the allocation of a Precision Trajectory Clearance based on 2D predefined route in step 1 (2D PTC) leading to the revision of the onboard trajectory.

Separation provision

The concept of separation provision contains new elements, which are all compliant with the ICAO separation provision component while also reflecting the trajectory managed environment of SESAR. Separation minima have not been established, but it is understood that such minima have to be developed and agreed for each separation mode. For that reason the area of conflict management and support tools has a strong linkage with Safety Nets. But the independence of Safety Nets still remains a core requirement.

Separation Provision by Controller is supported by advanced tools for conflict detection and resolution, featuring “what if” scenario probes, and conformance monitoring tools, including MTCD and (TCT, as well as ground conformance monitoring tools and deviation alerting tools.

Multi-sector Planning[5]

As soon as Controllers are informed of a flight (through the radar display or through electronic strips), they process the flight. Each information, (e.g.: initial flight processing) which is not managed automatically, must be processed by Controller. This uses some of Controller’s global mental resource. It increases Controller’s workload and finally has an impact on the capacity.

Automation has, since the 1980s, reduced the allocated time for initial processing. Therefore the time left for the executive controller to visualise the flight on his screen, along with the time spent by the planning controller to analyse the track of the aircraft in his own sector have been reduced. Automated exchanges between Controller units have also reduced the notice time that was previously used by Controller to integrate the incoming traffic. This evolution has allowed capacity to be increased while accelerating the process of the traffic integration.

During the past few years, Controllers have been compelled to change their working methods, adapting them to new system capabilities, while giving a new dimension to the role of the Planning Controller, thereby providing for increased capacity.

With free routing this previous observation comes into its own due to the fact that the free routing environment is, by definition less predictable than a conventional network:

- the initial integration process is more demanding for Controllers,
- reverting to longer notice time allocated to each CWP to process a flight would not be an option as it would demand greater amount of resources and therefore would reduce the capacity of the sector.

To accommodate free routing in Step 1, Controllers may rely even more on the support of new integration tools and methods. In that context, a Multi Sector Planner, may integrate a

[5] Note: The following only refers to Conflict Management and Support tools. The link with Dynamic DCB (dDCB) and Short Term ATFCM Measures (STAM) will be detailed in chapter 3.3 Integrated and Collaborative Network Management. The concept must, however be integrated in a global view, including particularly, LTM and Flow Manager.

flight in its area of responsibility, and is capable of taking early conflict management decisions. An extended view of the airspace under the MSP responsibility allows a wider visibility of the problems/conflicts and the resulting solutions. This facilitates the MSP to take early conflict management decisions and to optimise complexity resolution measures, in close coordination with the LTM so that any resulting actions won't interfere with the full picture of DCB.

Such MSP capabilities also apply to a conventional environment confronted with increased traffic demand with more conflicts. The MSP may also improve the capacity of the control units that form part of its area of responsibility.

Limitations

Electronic coordination capabilities are needed to further automate Controllers' tasks. In order to alleviate Controller's workload (associated with coordination, integration and identification tasks) the system:

- should allow Controllers to conduct screen to screen coordination between adjacent ATSU/sectors,
- has to support coordination dialogue between Controllers and transfer of flights between ATSU, and therefore facilitates early resolution of conflicts through inter ATSU/sector coordination. taking care of the availability of traffic information inside a common area of interest.

The context of dialogue/coordination between En-route & ETMA/TMA ATSU/sectors has to be considered according to the needs depending on the complexity of the traffic.

Here must be highlighted the increased difficulty to safely manage evolving flights in MTCD. This must be particularly checked and validated at system level.

Human Aspects

The support tools must assist both Flight Crew and Controller in the management of uncontrolled airspace or at the boundary between controlled (managed) and uncontrolled airspace. It cannot be assumed that all future airspace will be class A (and therefore with a restricted access). Safety improvements therefore need to be established for all categories of airspace.

Strategy to reduce Controller task load

To address Controller task load issue, without incurring a significant increase in ANSP costs, 3 lines of action are included in the concept:

- automation for the routine Controller task load supported by better methods of data input and improved data management (e.g. through screen to screen coordination),
- automation support to conflict/interaction detection and situation monitoring and conflict resolution (taking into account the impact of more accurate trajectory information resulting in reduced false conflicts),
- a significant reduction in the need for Controller tactical intervention (reduction of the number of potential conflicts via a range of de-confliction methods).

3.1.4.Air Safety Nets

Summary	
Most Significant changes	The dual layer safety afforded by enhanced ACAS and STCA plays a major role in maintaining the required level of safety.
Operational Focus Areas & contribution to Performance	**Enhanced STCA** • Safety: Increases safety, reducing the number of ATM related accidents and incidents. **Enhanced ACAS** • Safety: Increase safety, reducing the number of ATM related accidents and incidents
Operational Focus Areas	Enhanced STCA Enhanced ACAS
Applicable Operational Improvement Steps	CM-0406, CM-0811, CM-0803[6]
Primary Key Performance Areas (*Improvement*)	Safety (*High*)
Domain / Flight Phases	En Route and Terminal Area / Execution Phase

Air Safety Nets are ground-based and airborne functionalities that have the sole purpose of monitoring the environment of operations, during airborne phases of flight, in order to provide timely alerts of an increased risk to flight safety that may include resolution advice. Air safety nets are essential contributors to safety and will remain so. Several elements contribute to the improvement of the Airborne Safety Nets in Step 1.

A core requirement for a safety net is that it must work independently from other parts of the system, on the ground or in the air; this is to ensure that reduced system availability or common mode failure (where a single data error may invalidate several safety layers) does not prevent the safety net from achieving its Safety objectives.

In SESAR, the dual safety layer afforded by independent airborne and ground based safety nets (ACAS and STCA) play a major role in helping to ensure maintenance of the required level of safety.

Ground Based Safety Nets
Ground system situation monitoring, conflict detection and resolution support are deployed to ensure safety and assist with task management in Terminal Area operations. Even if conflict-free route allocation is deployed, there are still circumstances when flights have to deviate from their clearance or in busy airspace where route and profile interaction is inevitable (e.g. multi airport TMAs). This tool assists Controller in detecting and assessing the impact of such interactions or deviations.

In step 1, STCA is adapted to specific TMA operations. New or modified existing functionalities provide automated alerting of conflicts to terminal Controller workstations whilst avoiding false alerts (adapted for the specific TMA operating modes and separation standards).

Airborne Safety Nets
Airborne Collision Avoidance (ACAS) has been introduced onboard in order to reduce the risks associated with mid-air collision threats, but yet incidents do still occur e.g. due to late reactions and overreactions from Flight Crew to Resolution Advisories (RA), mainly caused amongst other reasons by the surprise and stress created by the aural RA alert requiring the

[6] CM-0803 will be moved from Deployment baselineto Step 1

immediate execution of the RA, to be performed manually by Flight Crew based on cockpit indication.

Airborne Collision Avoidance is improved in step 1[7] thanks to the automation of the execution of the RA. The ACAS is combined with autopilot (automatic control of aircraft) or the Flight Director (display of commands to assist Flight Crew in controlling the aircraft) in order to provide a vertical speed guidance using ACAS target. This generates an automatic manoeuvre if the autopilot is on or a manual manoeuvre through flight director cues if autopilot is off. Monitoring is ensured through the display of the vertical speed indicator. At any moment Flight Crew can override the automatic manoeuvre.

Airborne Collision Avoidance is also improved by implementing TCAS Alert Prevention to reduce the number of abusive RA alerts occurring during level off by introducing new altitude capture laws taking into account TCAS triggering thresholds.

Human aspects

The occurrence of an RA fundamentally changes Flight Crew and Controller tasks. When an RA is issued, Flight Crew is required to follow the RA and to disregard any ATC instructions. Controller can only be informed of the occurrence of an RA by Flight Crew by voice in step 1, as no automated reporting procedure exist.

[7]Even if improved ACAS (e.g. combined with AP/FD) has been implemented on Airbus A380, the benefits brought by an implementation to the entire fleet have not yet been validated, reason why, this OI validation is part of step 1 core activity

3.2.End to End Traffic Synchronisation

3.2.1.Traffic Synchronisation

Summary	
Most Significant changes	AMAN extended to support the management of arrival flows further out from the destination airport Multiple airports DMAN enabling a consistent delivery into the en-route phase of flight... Integration of AMAN and DMAN by including the operations of close airports in the Arrival metering before departure CTA allocated by AMAN and met by aircraft with high accuracy improves the performance and reliability of arrival sequencing
Operational Focus Areas & contribution to Performance	**AMAN and Extended AMAN horizon** • Fuel-Efficiency. Reduce fuel emissions per flight by reducing arrival delay. • Cost Effectiveness. Improve cost effectiveness as a consequence of reduction in fuel emission. • Predictability. Improve predictability of Landing Times through extending the AMAN horizon into En-Route DMAN Multiple Airports • Fuel-Efficiency. Reduce fuel emissions per flight by reducing overall arrival and departure delay. • Cost effectiveness. Improve cost effectiveness as a consequence of reduction in fuel emission. • Predictability. Improve predictability of Take-off and Landing Times within the planning horizon of AMAN and DMAN • Cost effectiveness. Increase efficiency of aircraft operations through a better balancing between arrival and departure delay **i4D + CTA** • Predictability. Increase predictability due to CTA operations • Environment/Fuel- Efficiency. Increase efficiency through a better delay management • Environment. Reduce environmental impact of ATM Operations • Airspace capacity. Increase interoperability due to a higher integration of air and ground systems – sharing of information between air aircraft and ground systems **Integrated AMAN DMAN** • Fuel-Efficiency. Reduce fuel emissions per flight by reducing overall arrival and departure delay.

	•Cost effectiveness. Improve cost effectiveness as a consequence of reduction in fuel emission. • Predictability. Improve predictability of Take-off and Landing Times within the planning horizon of AMAN and DMAN • Cost effectiveness. Increase efficiency of aircraft operations through a better balancing between arrival and departure delay
Operational Focus Areas	AMAN and Extended AMAN horizon DMAN Multiple Airports i4D + CTA Integrated AMAN DMAN
Applicable Operational Improvement Steps	TS-0103, TS-0104, TS-0203, TS-0303, TS-0304, TS-0305, TS-0306, TS-0308, TS-0202, TS-0302
Primary Key Performance Areas (*Improvement*)	Environment/Fuel-Efficiency (*High*); Airspace Capacity (*Low*); Airport Capacity (*High*); Predictability (*Low*); Cost Effectiveness (*Low*)
Domain / Flight Phases	En Route, Terminal Area, Airport / Planning and Execution Phase

Traffic Synchronisation refers to the tactical establishment and maintenance of a safe, orderly and efficient flow of air traffic.

It concerns the management and execution of 4D trajectories based on constraints combined with integrated queue management and handling both in the air and on the ground. It operates on individual flights but for the overall ATM network benefit and it is also closely related to Separation Provision process. It aims to facilitate the highest achievable capacity of the ATM System and to manage delays in a fuel-efficient and environmentally acceptable manner.

The Traffic Synchronisation concept is to be seen in the context of the ATM Network Management processes. Network Management ensures the balance between capacity and demand of the traffic flow, resulting in the Network Operations Plan, whereas Traffic Synchronisations is about fine-tuning the position of an individual aircraft into a stream that optimises the utilisation of a constrained resource, hence improving the overall outcome of the process.

The system provides support to departure metering and coordination of traffic flows from multiple airports to enable a constant delivery into the en-route phase. When basic departure management focuses only on the distribution of initial departure routes, departure traffic flows must be considered into the en-route environment, interacting with other traffic flows.

The system provides support to coordination of traffic flows into multiple airports close to one another to enable a smooth delivery to the runways. Assistance to multiple airport arrival management in the terminal area environment is becoming increasingly necessary especially in view of the emerging use of secondary airports which are located in close proximity to major airport hubs. In a complex terminal airspace environment there may be significant interaction between traffic flows flying into a number of these airports. The interaction of such traffic flows in relation to arrival management must be analysed.

Integration of AMAN and DMAN with the A-CDM processes

Integration of Arrival Management/Departure Management (AMAN/DMAN) is especially relevant between airports with interferences and airport pairs Origin-Destination. The effectiveness of AMAN-DMAN is improved by interfacing the Network Operation Plan (NOP) and the AOP. Issued Target Time of Arrival (TTA) to inbound flights are visible in the destination AMAN facilitating airport planning of ground operations and pre-departures sequence. A-CDM operations can start Target Off Block Time (TOBT) and Target Start-up Approval Time (TSAT) process with enhanced time margins and interacting with the arrival sequence. DMAN sequence can then deliver performance benefits from a constantly updated arrival sequence well before the beginning of the outbound operation.

AMAN and Extended AMAN horizon

AMAN functionality is extended to support the management of arrival flows further out from the destination airport. The AMAN process is, by its nature, a process that starts from a first come-first served unbiased sequence. As the sequencing algorithm progresses, the optimisation of the natural sequence is adapted in order to maximise the throughput in the constrained environment.

The sequencing algorithms of the system may include generic functions for optimising the runway throughput, such as wake vortex class, approach speed categories and runway occupancy times.

The Controlled Time Of Arrival (CTA) is an ATM imposed time constraint on a defined metering point associated to an arrival runway. It is generally calculated after the flight is airborne and is used by the relevant Controllers and Flight Crews. For a short flight the CTA should be very close to the pre-take-off TTA. For longer flights the CTA must be available well before planned Top-Of-Descent and is calculated when the flight passes inside the AMAN sequencing horizon.

The introduction of aircraft capable of flying highly accurate 4D trajectories, thus being able to meet a CTA with high accuracy, improves the performance and reliability of the AMAN system. This gives better performance in the sequencing and scheduling of the arrival stream as well as higher potential for the aircraft to fly optimised trajectories at speeds and descent rates that will save fuel (near idle profile integrating CTA), reduce noise and at the same time provide all stakeholders with higher predictability. The capable aircraft affected by a constraint receives a CTA in the En Route phase of flight, thereby being able to adjust its trajectory in the most efficient way up to the CTA metering point, while passing through several ATC sectors/units.

In those ATS Units where the precision trajectory, as sent by the properly equipped aircraft according to contract terms (e.g. through ADS-C EPP) can be processed and when the level of saturation requires the implementation of constraints, the AMAN system computes and allocates CTA to capable aircraft on the basis of the ETA min/max provided by the aircraft on ATC request e.g. through ADS-C ETA min/max report, using the process described in the scenario (ref Ch. 5 High Level Scenario).

Through ground-ground coordination all concerned ATS Units have previously been informed, for complexity and occupancy management analysis[8], on the trajectory change that would be generated[9] when imposing a CTA to the flight. Controller currently responsible for the flight, after having checked and agreed to perform the action, up links the CTA to Flight Crew (e.g. via CPDLC). When accepted by Flight Crew, all concerned ATS Units through ground-ground coordination, are made aware of the CTA constraint implementation.

AMAN also calculates target (approach) times (applicable to non-I4D/CTA capable aircraft), ensuring the implementation of an efficient sequence of arrival to the entire traffic flow (which may be merging via multiple converging routes). AMAN calculated times are presented to Controller, who assesses the possibilities to accommodate the delay/part of delay in his sector through speed change/track extension or early descend. If no possibility to

[8] The capability for concerned (intermediate) ATS units to analyse and agree on the trajectory change proposal is under validation

[9] the capability for the AMAN or associated ground predictor tool to compute the anticipated effect of a CTA on the trajectory in the upstream ATS Units is under validation.

accommodate delay, the flight is managed by downstream sectors and/or through holding instructions.

It should be noted that ICAO basic rules for prioritisation of individual flights are always respected by the Arrival Management System (aircraft in distress and emergency, ambulance flights, state VIP flights, military flights on air defence mission).

DMAN Multiple Airports
Multiple airport DMAN support departure metering and coordination of traffic flows from multiple airports, metering departing traffic to fixes where multiple streams of traffic converge, e.g. from closely-located airfields to a point on the TMA boundary.

Departure traffic flows into the en-route environment and interactions with other traffic flows must be considered.

DMAN uses TOBT (the estimated time when the aircraft is ready to go Off Block and/or Start Up) to calculate the:

- TTOT (based on the overall traffic situation) and verifies that it is the “slot” window,
- TSAT (the time when the flight should go Off Block and/or Start Up), using the Variable Taxi Time information where available.

All actors are informed about the DMAN system generated TSAT.

Initial 4D operation (I4D) and CTA
The avionics function, Required Time of Arrival (RTA), can be exploited by En-route Controllers for demand/capacity balancing, complexity management and metering of flows through the assignment of Controlled Time over (CTO) as well as by TMA Controller for arrival management through the assignment of CTA. CTO/CTA allocation should however remain restricted to capacity constrained environments and only when the traffic situation calls for constraints.

By metering aircraft at an earlier stage of their flight i.e. well before TOD, the impact of the constraint is minimised, allowing the aircraft system to compute the preferred vertical profile integrating the new time constraint before starting the descent. This allows ATC to accommodate a maximum of traffic considering the available capacity in particular when limited whilst reducing the complexity to ensure the human capabilities are not exceeded. Reduction of ATC tactical interventions through early planning of traffic in en-route and in arrival management phase avoids severe and costly sequencing measures.

This process enhances aircraft profile optimisation, flight predictability and allows improvements in the stability and reliability of the sequence built by ATC.

CTO or CTA allocation consists in a synchronisation or sequencing using absolute time constraints by Controller for spacing between aircraft and may be followed at the metering point by ASAS spacing which corresponds to the delegation to Flight Crew of the spacing task versus a designated target aircraft and so consists in a synchronisation using relative time.

Limitation
It should be noted that in step 1, only one constraint at a time can be managed by avionics, allowing e.g. first a CTO assignment for en route synchronisation and then, only after having passed the CTO point, can a subsequent CTA be assigned and managed by avionics for fine spacing at an arrival fix.

Human Aspects
The main aspects for Human Factors assessment are consequences of the following changes associated with step 1:

- Increased use of data-link to exchange clearances and data between different ground and airborne actors, partly in an automatic manner.

- Flight Crews, Controllers and operation planners have automation support and management tools (e.g. FMS RTA function for Flight Crews, A-SMGCS, DMAN, AMAN, MTCD for Controllers)

Flight Crew

- Every revision of the trajectory to be flown (e.g. due to new STAR and/or CTA allocation) shall be clearly explained or justified to avoid uncertainties and additional exchange between Flight Crew and Controller e.g. for optimisation of the arrival sequence.
- Flight Crew shall be made aware of the start of initial 4D operations (e.g. at AMAN horizon) namely in step 1 when the full concept of gate to gate 4D trajectory management is not implemented.
- Flight Crew shall be supported by onboard automation (air ground data link, CTA management by avionics) to avoid increasing Flight Crew workload.

Controller and Flight Crew

- A flow of many types of information from many sources to support the human-automation control is introduced through automation. Therefore the issues of human-human and human-system communication are critical and should be carefully analysed, paying specific attention to the how and when to feed the system with data (operator inputs).

3.2.2.Integrated Surface Management

Summary	
Most Significant changes	Increased situational awareness of Controllers, Flight Crews and vehicle Drivers. Integration and exploitation of new ATC functions such routing, guidance, AMAN / DMAN integration in surface planning and managing of alerts. Integrations of environmental constraints in the surface trajectory planning
Operational Focus Areas & contribution to Performance	**Surface Planning and Routing** • Predictability. Increase predictability and airport efficiency • Airport capacity. Optimise departure sequencing at the airport, thus increasing runway throughput • Airport capacity. Maintain airport throughput during adverse conditions • Environment/Fuel-Efficiency. Increase of efficiency and reduction of fuel consumption through the reduction of taxi deviations **Surface management Integrated with Arrival & Departure Management** • Predictability. Increase predictability and airport efficiency, ensuring the integration of airport operations and surface management with AMAN and DMAN. •Environment: Improved departure sequencing at the airport, thus reducing delays and environmental impact thanks to integration of AMAN and DMAN information into surface management. •Airport Capacity. Optimise runway throughput. **Guidance assistance to aircraft and vehicles** • Safety. Increase airport safety • Predictability. Increase predictability and airport efficiency • Airport Capacity. Maintain airport throughput during adverse conditions
Applicable Operational Improvement Steps	AO-0205, AO-0206, AO-0207, AUO-0602, AUO-0603[10], TS-0104, TS-0202, TS-0203, TS-0306 ,
Primary Key Performance Areas (*Improvement*)	Environment/Fuel-Efficiency (*Low*); Airport Capacity (*Low*); Predictability (*High*); Safety (*Low*)
Domain / Flight Phases	Airport/Medium to Short Term Planning Phases, Execution Phase

The importance of moving aircraft on the airport surface from stand to runway and vice versa in a safe, controlled and organised manner is paramount for airports and even more when capacity restrictions depending on weather, or other circumstances affect operations. In step 1, optimum management of surface traffic flow not only increases efficiency, predictability and capacity during the ground movement phase but also has a positive impact on the environment. The planning of surface routes may consider constraints imposed by the need

[10] AUO-0603 full capability might not be available within Step 1 (Status of runways and taxiways).

to minimise the environmental impact especially surface holding or the need to avoid braking or changes in engine thrust levels as the aircraft moves from the runway to the stand or vice versa.

Surface Planning and Routing
During the Short Term planning phases of the flight, the system provides Controller with a calculated route based on criteria like planning (delay reduction) and ground rules, while minimizing potential conflicting situations with other mobile units. Once that trajectory is calculated and during execution, the system informs the ground Controller of any deviation from route or previous planned surface trajectory it might detect, using conformance monitoring function.

Guidance assistance to aircraft and vehicles
The objective of capacity increments and efficient guidance of movement has to be reached with the same or even higher safety levels than operations nowadays. The increase of the situational awareness for all stakeholders is a major contribution to achieve these levels. The system displays dynamic traffic context information including status of runways and taxiways, obstacles, route to runway or stand. Ground signs (stop bars, centreline lights, etc.) are triggered automatically according to the route issued by ATC. More information is available to Controller and Flight Crews onboard to ensure a safe expeditious and efficient movement on the ground. A-SMGCS allows accurate surveillance, while providing guidance and situational awareness to Flight Crews and vehicle drivers. Information regarding the surrounding traffic[11] during taxi and runway operations is displayed in the aircraft cockpit as well as the taxi clearance sent by data link for equipped aircraft. In addition, alerts related to traffic at proximity of the runway are automatically generated onboard by the aircraft system. Associated human machine interfaces improve Controller situational awareness, allowing enhanced traffic control, especially in Low Visibility Conditions. The system also displays dynamic traffic context information including status of runways and taxiways, obstacles, and an airport moving map. The Guidance Assistance also provides airport vehicle drivers with an airport moving map showing taxiways, runways, fixed obstacles, and their own position. The main goals of this area of improvement are to increase efficiency, predictability and safety and maintain a good airport throughput during low visibility conditions.

Surface management Integrated with Arrival & Departure Management
The taxiing process is considered as an integral part of the process chain from arrival to departure and AMAN/DMAN is integrated with A-CDM processes between airport operator, Airspace Users and Air Traffic Service Providers at the same airport, thus improving predictability of the airport processes and ground handling activities. In addition, operational integration of DMAN functions into the surface management is done by taking into account the collaborative pre-departure sequence, off-block information, actual traffic on the surface and constraints related to ATFM slot, runway, taxiway and environment, providing more stable and predictable departure sequence thanks to a better awareness of traffic situation on the ground. The AMAN metering arrival function is integrated into the airport operational data that feeds the surface management system. Therefore, the operational integration of AMAN/DMAN with surface management operations addresses the issue of dependency between arrivals and departures on a runway and especially in mixed mode operations in order to minimise or better manage delays.
The combination of this integrated approach of managing and synchronising surface operations with arrival and departures is aimed also to take into account the noise mitigation needs around the airport, by integrating stand management and arrival routes that best match the optimum taxi route to stand. In addition, this directly affects the aircraft fuel use and emissions at and around airports by electing the best balanced options between airport throughput and environmentally sustainable operations.

[11] The term traffic designates here either a ground vehicle or an aircraft. The validation results of the involved projects will however, have to confirm whether airport ground vehicles shall appear or not.

Human Aspects

An increased situational awareness induces increased available information. It might cause an overload of information to Controller and Flight Crew. The definition of the optimum set of available information to ensure the safest operation without overloading Controller and/or Flight Crew is the main aspect to be treated in the field of human factors. The problem can be stated like how to manage this new available information in the most efficient manner in order to improve general airport surface and runway throughput without compromising safety or hindering human interaction at different operational functions and levels.

Controller

- Expected change: The integration and exploitation of new ATC functions such as routing, guidance, alerts with current elements as surveillance and Electronics Flight Strips into an Advanced-Integrated Controller Working Position (A-ICWP),
- new implementation of procedures and technology applicable for ATC functions, cockpit crew and vehicle drivers have to be assessed carefully,
- as workload is already a critical factor in ground operations any new implementation has to be a balanced process not compromising controlling the aircraft or a specific vehicle.

Flight crew

- Expected change: The display in the cockpit of the taxi clearance, airport layout and surrounding traffic presented in the moving map, as well as the alerts related to traffic at proximity of the runway automatically generated onboard during operations on surface airport have to be assessed carefully,
- specific attention should be paid to a possible degradation of flight safety by even small changes bringing workload above a critical point due to, for example :
  - false alerts during the surface routing,
  - the use of air ground data link (e.g. CPDLC) for issuing Taxi instructions due to Flight Crew Head down decreasing situational awareness has also to be assessed carefully.

3.3. Integrated and Collaborative Network Management

3.3.1. Demand and Capacity Balancing Airport & En-Route

Summary	
Most Significant changes	Enriched flight planning, Management of TTA/TTO for smoothing constraints Dynamic Sectorisation and Improved Civil/Military Coordination Enhanced ATFCM Airport CDM integrated in the Network Operations
Operational Focus Areas & contribution to Performance	**Airport Operations Planning and A-CDM** • Predictability: Increase predictability and required flexibility of airport operations (integration of airport operations within the network) due to elimination of inconsistencies of information and late responsiveness. Pro-active management of predicted impacts to normal operations due to Airport CDM Information Sharing Element, Collaborative Management of Flight Updates and CDM Turn-around Process. • Environment/Fuel-Efficiency: Contributes to increment flight efficiency due to better planning of stands, de-icing operations and optimised calculation of Variable Taxi Times, • Airport Capacity: Better use of existing airport capacity and delivery of latent capacity increments through information sharing and CDM in Adverse Conditions. Quicker recovery to normal operations from predicted or unpredicted adverse operating conditions due to improved flow of proper relevant information in CDM in adverse conditions facilitated by Airport Information Sharing. **Dynamic Sectorisation and Constraint management** Safety: The sharing of the airspace planning and the real status will provide common situation awareness to all ATM actors. Environment/Fuel Efficiency: The flexibility provided by the implementation of modular areas offers more plan able airspace. It will contribute to reduce emissions through the use of more optimum trajectories. Airspace Capacity: Facilitating the sharing of use of military training areas increases the capacity when and where needed for the benefit of civil airspace users. The ARES will be more easily adapted to the real need providing additional airspace for the other airspace users. Airspace Capacity: The military have the real volume of airspace needed for each of their missions. Defining the segregated areas based on mission requirements will provide more airspace available for the other airspace users and more options for optimal routings. Financial and operational benefits to the airspace users. Flexibility: The implementation of VPA offers several combinations to allocate the requested volume of airspace. It should facilitate the negotiation process to allocate ARES. **Environmental sustainability** • Environment/Fuel-efficiency: Contributes to environmental strategic objectives of SESAR Programme **Network Operations Planning** •Predictability: Increased predictability of individual flights and network performance through integration of Airport Operations into the Network, collaborative planning and information sharing

	through the NOP/AOP. • Environment/Fuel-Efficiency: Facilitation of more direct routing made possible by providing a better knowledge of the actual Network capability and so will have a direct impact on both predictability and Fuel efficiency •Airspace/Airport Capacity: Better use of existing Network capacity by the achieved improvement in predictability and the support it provides to the management and monitoring of the network effects. **UDPP** • Cost-Effectiveness: Financial and operational benefits to the airspace users. • Flexibility: Enhanced flexibility, improving the management of unexpected traffic demand/capacity imbalance. **Enhanced ATFCM processes** • Airspace/Airport Capacity: Smooth peak demand and reduce complexity allowing the capacity to be used more consistently. • Environment/Fuel-Efficiency: Increased efficiency enabling optimised flight trajectories and profiles with the end result being reduced fuel burn, noise and CO2 emissions •Predictability: Improve the predictability in managing time deviation. • Safety: Improve safety in better anticipating and managing potential overloads **Airspace Management and AFUA** Safety: The sharing of the airspace planning and the real status provide common situation awareness to all ATM actors. Environmental Efficiency: The flexibility provided by the implementation of modular areas offer more plan able airspace. It contributes to reduce emissions through the use of more optimum trajectories. Airspace Capacity: Facilitating the sharing of use of military training areas will increase the capacity when and where needed for the benefit of civil airspace users. The ARES will be more easily adapted to the real need providing additional airspace for the other airspace users. Environmental/Fuel-Efficiency: The military will have the real volume of airspace needed for each of their missions. Defining the segregated areas based on mission requirements will provide more airspace available for the other airspace users and more options for optimal routings. Financial and operational benefits to the airspace users. Airspace Capacity: The implementation of VPA will offer several combinations to allocate the requested volume of airspace. It should facilitate the negotiation process to allocate ARES.
Applicable Operational Improvement Steps	CM-0102-A, CM-0103, AUO-0102, AUO-0103, DCB-0103, DCB-0305, AUO-0801, DCB-0304, AUO-0101
Primary Key Performance Areas (*Improvement*)	Access & Equity; Environment/Fuel-Efficiency (*High*); Airspace Capacity (*Low*); Airport Capacity (Low); Predictability (*Medium*); Cost Effectiveness (*Low*); Safety (*Medium*)

Domain / Flight Phases	Airport/, Network, En-Route /Long Term Planning Phase, Medium to Short Term Planning Phase, Execution Phase.

Network Operations Planning

The Network Management function assesses the evolution of traffic and airspace demand, identifies any capacity / traffic imbalances, develops ATFCM scenarios for capacity shortfalls through a CDM process involving all concerned sectors and records the agreed scenarios in the Network Operation Plan (NOP). When necessary, modified routes are proposed to the Airspace Users based on the published alternative routes. The Airspace Users submit the revised user preferred trajectories integrating the ATM constraints.

ATFCM/ASM planning and Demand Capacity Balancing are iterative processes, which progressively generate and detail the NOP. They are developed in a CDM approach involving local (including Airports), sub-regional and regional actors and Airspace Users. Processes are initiated several months ahead, on a rolling pattern, and are progressively refined until and during the execution phase. NOP and Airport Operations Plan AOP are updated accordingly.

This linking of AOP/NOP parameters optimise the network and airport management by timely and simultaneously updating AOP and NOP via SWIM, providing all concerned actors, which include the Network and Airport Managers with a commonly updated, consistent and accurate Plan. The NOP becomes the network information delivery service unit for all planning units in the Network: Airport Operators, ANSP, FAB, Airspace Users and Network Manager.

Throughout the lifecycle of a flight, a layered and collaborative planning consists of successive planning phases from long term to medium and short term, involving all ATM stakeholders in Collaborative Decision Making (CDM) processes to progressively build the NOP through the sharing of more and more up to date and precise data once the day of operations approaches.

As the day of operation approaches, the Airspace User's plans and the details regarding airspace management become richer in detail and less subject to variation. For military flights, if a specific airspace structure is needed as a demand parameter of the trajectory, it is fully integrated into the trajectory definition and description.

A collaborative planning process is applied to the trajectory in a number of iterations, refined through the inclusion of potential constraints arising from updated and more accurate information. These constraints may be as a consequence of time, altitude or routings required in some airspace according to the level of demand as well as ground capacity restrictions. If ATM constraints have to be applied, the preferred way to integrate them is achieved through a collaborative process with the Airspace Users in order to achieve the best business or mission outcome.

Initial UDPP Process

User Driven Prioritisation Process (UDPP) serves as a common baseline enabling each partner to react on the situation on an individual basis to improve its own net return. In the context of the UDPP, the users are responsible to respond in a collaborative manner to the Network Management Function.

The aim of UDPP is to provide Airspace Users with more flexibility to re-arrange their schedule through AU driven prioritisation in the Step1 environment following the SESAR Story Board step-wise evolution of the operational environment. The UDPP process includes the following features (but not limited to):

- AU prioritise their own flights (within existing commercial agreements)
- Network Management Function/Airport propose target times to AU optimising throughput
- AU may negotiate between themselves, subject to final agreement of all actors

UDPP is available in any normal situation, and particularly appropriate in case of capacity constraints on departure and arrival, and even en-route. These situations may be tactical (e.g. weather deterioration), pre-tactical (weather forecast, industrial action, maintenance, crisis etc.), and strategic (Olympic Games etc.). The decision making on how to resolve these in a SESAR step-wise operational environment is focused on Airspace User needs. UDPP formalise the set of "rules" that enables decision making and reflects trade-offs. This process can be initiated by AUs and/or the Network Manager (at network or airport level) and it is supported by the Network Management Function. The final decision is the result of a collaborative process involving all actors (Airspace Users, Network Management Function, Airports, Flow Managers, Air Traffic Control).

UDPP is first used to address reduced airport capacity, with a primary focus on departure congestion (local demand management). The CDM process mainly relies on the existing system (Slot Swapping) using current techniques adapted to SWIM-compliant information sharing. UDPP Step 1 therefore addresses exchange within and between Airspace Users of flights on Departure from a CDM-Airport. It builds on the A-CDM concept for regulated and non-regulated flights and extends the scope of the existing ATFM Slot Swapping procedure for regulated flights. With UDPP Step 1, the Airspace Users make their prioritisation according to their business needs. They can initiate a UDPP exchange within their own company or with another AU. The Airport Management or the Network Management Function can also initiate UDPP through the Airport Operations Centre (APOC). In such cases, the Network Management Function/Airport Management proposes the initial set of measures as a basis to begin negotiations amongst affected users.

In all cases, Network Management Function assesses the impact of the User's UDPP proposals on the network, makes sure that all concerned parties are aware of them and can react with new measures in order to minimise the impact of the User's proposal on the network stability.The Network Management Function therefore permanently monitors the process. Two roles are defined in UDPP Step 1:

- UDPP-Arbitration at Airport level: In case of departures from the same airport, Network Management Function delegates to the Airport the responsibility to make sure that the agreed UDPP rules are respected and that an acceptable solution is available in due time.
- UDPP Referee at Network level: It publishes the results and facilitates collaborative dialogue to resolve traffic demand and capacity balancing issues. In particular, it records the results of UDPP requests over time, in accordance to the UDPP principles and rules.

Enriched Flight Planning

Improved interoperability between airspace users and network management systems enables enrichment of FPL data by operational flight plans including flight performance parameters. The Network Management Systems also receives the Improved OAT FPL, which includes the references to ARES. The scope of Step1 for the Network Management Systems is to receive the user preferred trajectory, computed by the AOCC, that corresponds to the operational FPL taking into account ATFCM/ASM constraints.

Management of Target Time Over/Arrival (TTO/TTA)

The objective is to answer the business need of the User whilst improving the effectiveness and the smoothing effect of regulations on the demand in congested airports and areas by enabling the adherence to the target time (TTO/TTA). The CTOT are defined so as to enable the aircraft to meet the TTO/TTA target at the destination airport, whilst adhering to other possible constraints (e.g. en route). During the CTOT assignement process, the AOCC has the possibility to adjust its operational flight plan so as to enable the flight to meet the TTA whilst flying closely to its optimum business flight profile.

Once the CTOT is specified, the Target Take Off Time (TTOT) is assigned to the flight by the DMAN within the CTOT tolerance window. The Network Manager notes the target time entry in the congested area before take-off and, during the execution, the detected deviations between the planned profile and the actual profile phase. Airport Operators can access the

TTA information (Settings, updates, etc.) well in advance prior to flight arrival to the AMAN Horizon and use this parameter to plan airport operations like stand management, taxi routing, pre-departure sequence and DMAN management.

The destination airport can react to TTA messages sent by the Network manager to the inbound flight before its departure by assessing the arrival impact on the next departure. It can also assess its impact as in the arrival management procedures thus reducing the potential knock-on effects in the airport activities and on subsequent departures.

Flight Crew may be informed through the AOCC of the TTA at destination, when this limitation is the most penalising one of his flight. This information is expected to help it to manage and adjust his flight in the most economical way.

The Airport Operator, through the AOP, as a subset of information parameters of the NOP, is alerted of any inbound traffic deviation from its scheduled TTA. This information can then be used to update airport operations on the ground, feeding the A-CDM processes with more information, to ensure that subsequent outcomes from airport operations decisions are reflected back to the NOP.

Civil Military co-ordination

Flexible Military Airspace: 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 for both civil and military partners

Before Day of operations: Local, national and Sub-regional actors in close coordination **with Network Manager assess the impact of mission trajectories on airspace demand and** develop solutions to optimise network, regional and local capacity.

Day of Operations: Deviations from the Network operations plan are coordinated and thereby permit quick decisions, thus exploiting the airspace in a dynamic manner minimising the impact of any disruptions and taking benefit of any opportunity. Military priority missions (air defence flights/renegade) exceptionally performed are integrated without any constraints, even in a complex environment if needed.

Dynamic sectorisation

Improving predictability of Sector Capacities: ANSP define and share sector capacities in a more pro-active reliable manner improving the predictability of capacity and network planning and the effectiveness of short term ATFCM measures

Allocation of Airspace/Route structure though dynamic management: The system provides support to decision making based on pre-defined sector sizing and constraint management in order to pre-deconflict traffic and to optimise the use of Controller work force.

Flexible Sectorisation Management: Sector configuration management is improved as a function of airspace management to ensure balance between traffic / airspace demand and capacity at European network level

Enhanced ATFCM Processes

Sector supervision and configuration management systems are sufficiently flexible to support different sector configurations as required by ANSP when needed, after coordination through ATFCM process to ensure consistency with the Network situation.

Interactive Network Capacity Planning offers an interactive support to stakeholders in the development of medium-term plans. Latent capacity is used to relieve bottlenecks through consolidated capacity planning process based on coordination and network synchronisation of ANSP/airports enabling the adaptation of the capacity delivery where and when required. Better knowledge of TTA Data at airports also improves the airport capacity management process and thus improves the overall network performance by improving traffic evolution monitoring, providing more accurate airport capacity and demand data to the Network manager. Actions can then be triggered to bring traffic demand as close as possible to the initially planned capacity. Adequate use of that information allows the airport to move from reactive management to proactive management by feeding back new messages to the Network Manager with the TTA impact on the airport.

Enhanced ATFCM/ASM/ATS coordinated process optimises the utilisation of the available capacity based on the continuous assessment of network impact of the expected airspace allocations through collaborative activities within the planning and execution phases between ASM and ATFCM.

Dynamic DCB / Short-Term ATFCM Measures constitute a step forward to close the gap between ATFCM and ATC. The objective is to anticipate and manage traffic peaks and complexity, to smooth ATC workload through the application of fine-tuned measures e.g. Short Term ATFCM Measures (STAM) close to the real time operations, providing significant improvements in overall Network capacity and efficiency, with minimum curtailing for the Airspace Users.

In order to do so, workload calculation and monitoring is improved and procedures to support the process are developed that require dynamic coordination between Local Traffic Managers, Airspace Users and the Network level (through CDM).

STAM consist of measures like minor ground delays, appropriate flight level capping, exiguous rerouting etc., applied on a limited number of flights after coordination, with direct effect on workload/complexity resolution and/or delay reduction.

This process complements current global hour-based capacity management with much more focused minute-based activity at sector level. It will connect ATFCM planning activities with tactical ATFCM interventions up to the ATC working horizon: in that timescale, LTM and MSP actors will work closely to identify, agree and implement dynamic DCB initiatives as operationally appropriate.

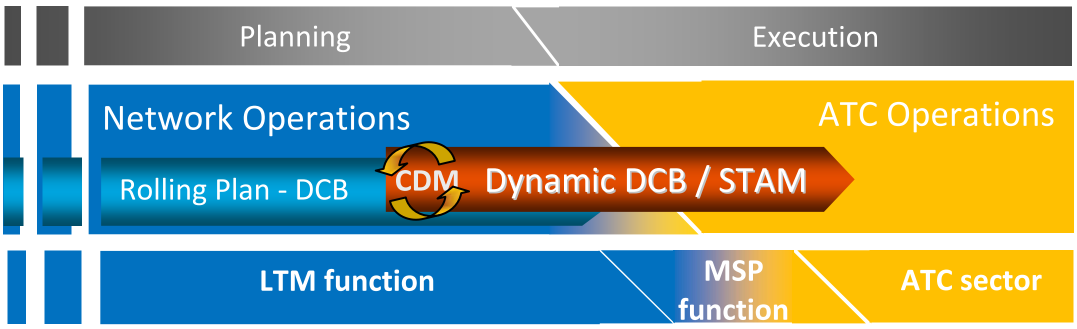

Figure 2 DCB evolution in SESAR

Airport Operations Planning and Airport Collaborative Decision Making (A-CDM)

The integration of Airport Operations into the Network Operations is the paramount improvement of the Demand and Capacity balancing procedures. The link between air trajectory and ground trajectory with its related processes identifies the milestones and events that can increase benefits for both Network and Airport DCB procedures. The objective of this integrated process is to reduce delays, improving the predictability of events and optimising the utilisation of resources of Airport CDM Partners (Airport Operators, Ground handlers, Airspace Users, De-Icing Companies, ANSPs, Network Manager and Support Airport Services i.e. Police, Customs, Emergency, Immigration, etc.)

The main actor in this coordination role from the airport perspective is the APOC (Airport Operations Centre) providing monitoring, diagnosis and decision support capabilities and implements mutual agreed actions, updating the Airport Operations Plan (AOP). APOC continuously checks the progress/evolution of the plan. It detects and identifies deviations from the plan, assesses the impact on KPIs and processes and triggers alerts & warnings if necessary.

Information sharing between AOP and NOP ensures the best overall system outcome while taking due account of the needs of the airport, of the individual Airspace Users as well as those of the Network as a whole. During the planning (often short term) these flights evolve into trajectories where they fit into the airspace user's schedule and in the airport / network resources availability planning (landing slots, high-level parking/stands availability). The AOP during Medium Term Planning includes information on the critical events that have an impact on capacity, traffic demand or airport operational performance, such as regular adverse weather conditions, industrial actions, maintenance or special events. This guarantees a similar scope of the airport segment for all airports and generates as well a partial information overlap of AOP and NOP, bringing full consistency. Short term planning and operational execution coordination are done through the exchange and update of A-CDM milestones for each trajectory (normally executed by the same airframe especially in scale operations) and these outcomes are reflected back into the AOP by the APOC.

A-CDM is extended to include interconnected regional airports and affects all IFR flights regulated or non-regulated. Relevant A-CDM airports at regional level and the Network Manager exchange information through AOP/NOP, sending updates to flight milestones times through Flight Updates messages (FUM) and Departure Planning Information (DPI). This enriches communication and situational awareness, especially in support of the improvement of the estimated time of arrival for all flights to/from the region. UDPP Process (Slot Swapping in a SWIM environment) is activated if constraints into the airport are needed during high congestion periods.

Human Aspects

Working environment: changes are identified for the enhancement of the traffic prediction tool set. An associated HMI in support of the enhanced tool set should be created and evaluated.

Procedures, roles and responsibilities: increased coordination takes place between the Network Manager and the Local traffic manager, TWR/ACC Supervisor and APOC. This might induce higher workload. However, this improves traffic and workload predictions, leading to a better predictability of capacity, and allows the supervisor to have a better overview of the traffic. This results in a more efficient and precise opening and closing of sectors.

Improved occupancy forecasts and associated workload assessments are expected to lead to an increased level of safety and operational productivity. This allows a better management of resource at Network and ATSU level.

In terms of civil-military coordination, real time changes are possible at short notice because of the ad-hoc structure delineation. Their impact shall be assessed.

Some GA flight operations, helicopter operations and leisure flight operations in particular must be handled as a real time change due to their naturally very short term planning of operations. The impact of those operations on working practices and methods shall be properly assessed.

Training and development: Controllers and supervisors will need to be trained on the procedure and the HMI.

3.3.2.Complexity Management

Summary	
Most Significant changes	Automated tools allow a continuous monitoring of traffic demand and evaluation of traffic complexity. Complexity assessment activities are consistent between Network Management functions and ATC without any disruption.
Operational Focus Areas & contribution to Performance	**Complexity Assessment and Resolution** • Airspace Capacity: Smooth peak demand and reduce complexity allowing the capacity to be used more consistently. • Environment/Fuel-Efficiency and Cost-Effectiveness: Increased efficiency enabling optimised flight trajectories and profiles with the end result being reduced fuel burn, noise and CO2 emissions •Predictability: Improved predictability by managing time deviation from prediction and time accuracy at CTA/CTO
Applicable Operational Improvement Steps	CM-0104
Primary Key Performance Areas (*Improvement*)	Access & Equity; Environment/Fuel-Efficiency (*Low*); Airspace Capacity (*Low*); Cost Effectiveness (*Medium*)
Domain / Flight Phases	En Route and Terminal Area / Planning and Execution Phase

Complexity management aims at simplifying the ATM situation so that Separation Provision can be efficiently provided by human intervention. Complexity management begins with the detection of zones/volumes of high complexity to enable the following processes to ensure the safe and orderly management of air traffic:

- safe transition from free route operations to route based operations,
- definition of the optimum sector organisation to provide the most efficient service, using, when possible Dynamic sector configurations and multi sector planning,
- modification of individual trajectories to reduce complexity when needed,
- implementation of measures on traffic flows in order to react to specific ATC constraints (e.g. availability of airspace -due to weather, special use of airspace-, availability of ATC sector capacity, etc.).

Complexity measurement is an essential input for workload assessment in DCB and dynamic DCB activities.

Complexity characteristics
Complexity is a generic term, often used to describe the difficulty for an Air Traffic Controller to handle the traffic under his/her responsibility. It is, in fact the result of several factors acting at the same time. From a general point of view, the main contributing factors are traffic demand and airspace characteristics. But aircraft performance diversity must also be seen as a contributor. More precisely, complexity is, for any given airspace volume, a determinant (mathematical) of the airspace architecture, the phase of flight and of the number of aircraft flying through. (Good airspace architecture design incorporating RNP can therefore strategically reduce complexity). Meteorological events (i.e. winds, a line of thunderstorms), constitute the last contributing factor to complexity, as they introduce unpredictability, randomness, the need for tactical management.

Complexity has temporal as well as geographical dimensions. There are times of the day when airspace could feature high-complexity operations and appropriate procedures would apply while at other times procedures applicable to medium or low complexity operations would be used. The requirement is that the periods during which the different procedures are in force must be clearly defined and controlled: users and ANSP need certainty with regard to the procedures in use.

Complexity and Workload Assessment
Complexity assessment relevant for network management is an activity based upon likely interactions of traffic flows, traffic pattern and airspace demand on traffic load and Controller workload. Complexity assessment is sensitive to specific geographical parameters and consequently, relies on local knowledge and experience. Local complexity assessments form an essential part of the network view.

Factors that affect the complexity assessment include: Quality and granularity of trajectory data, current operational conformance, airspace reservation/restriction activation conformance, (Is the network performing in an expected manner?) and probability of non-nominal weather occurrence, integration of unscheduled operations (GA/R, Business Aviation).

Complexity and Workload assessment is an on-going process carried out by the Network Manager, Flow Manager and Local Traffic Manager. At a basic level, it is achieved by monitoring the deviation of the current traffic picture compared to the planned traffic demand, and continuously measuring traffic load and complexities.

Complexity and workload assessment provides traffic updates to the NOP, and is input to the DCB process.

Automated tools
Automated tools are needed to manage complexity. They have to:

- support traffic load management per network node (e.g. sector, waypoint, route, route-segment, etc.) according to declared capacities. The aim is to assure that Controller's workload limits are not exceeded,
- continuously monitor and evaluate traffic complexity (in a certain airspace volume) according to a predetermined scale (e.g. high-medium-low) facilitating information on upcoming congestions and allowing switching to the correspondent "airspace sub-category" and applicable operating procedures,
- support decision-making processes related to Airspace management (transition between airspace sub-categories),
- cope with the tasks of a Complexity Manager (e.g. MSP, LTM) which are to evaluate the complexity across the sectors and its impact on controller workload and resulting measures to recognise and circumvent forthcoming separation complexities while balancing workload, forecasting traffic patterns, assuring the provision of information on upcoming congestions, initiating CDM processes to find solutions to reduce complexity when needed and verifying applicability of proposed solutions of airspace users etc.

Complexity Management – Operation in complex environments
To ensure an efficient complexity management, all critical factors (e.g. timeframe, geographical dimensions, etc.) that influence the complexity prediction and the measures to react, have to be taken into consideration. Complexity is a constantly evolving factor, and the level of accuracy of its prediction varies during all the planning phases, even until the very day of operations. This generates, in turn, changing requirements for the supporting tools and therefore, for the actions taken by the actors in the process of complexity management. (Examples of key elements affecting traffic complexity are; airspace characteristics and environmental aspects; traffic demand; all other factors relevant to specific situations…all elements liable to change rapidly and at the last minute).

Complexity Management begins when traffic complexity is assessed and managed as a precursor to the Separation Management Process. Forecasted complexity, coupled with demand enables ATFCM and ASM to take timely action to adjust capacity, airspace configuration or demand profiles through various means, in collaboration with ATC and Airspace Users. Complexity management therefore supports, among other things:

- the research of appropriate strategies to solve imbalances between demand and capacity,
- the research of appropriate airspace configuration: transition from free route to route based operations,
- the determination of the optimum sector organisation, or airspace reservation/restriction partitions and activation timeframe,
- the modification of trajectories by route, level or timing.

Dedicated monitoring tools are shared with ATC to ensure full consistency between complexity assessment activities, Network Management functions and ATC.

The resolution of air traffic complexity problems may be constrained by:

- airspace availability limitations (due to weather, special use of airspace, etc.),
- ATC sector capacity,
- operator preferences (i.e. preferred flight profiles),
- air traffic queue management targets (e.g. target times, levels and speeds,),
- network stability requirements,
- 4D trajectory update rules.

The balancing methods usually used, within the Air Traffic Service Units (ATSU), to manage complexity can be applied at a wider scale to a number of ATC sectors. They aim first, at using all of the available ATC capacity and then, at adjusting air traffic. They include (by order of preference):

- flexible re-deployment of human resources,
- dynamic sectorisation based on predefined sector configurations,
- redistribution of individual 4D trajectories within multi-sector ATSU,
- re-direction of air traffic flows to ensure that high levels of efficiency are sustained,
- adjustments to trajectory parameters (target times and/or levels).

High Complexity Terminal Operations

In Europe high complexity operations would routinely occur in terminal areas but may occur in other airspace. This issue therefore primarily relates to enhanced route structure, and is further addressed in chapter 3.4.1.

En-Route High Complexity Operations

Situations of high complex also occur in en-route airspace where appropriate solutions need to be applied. Depending on the airspace and operational environment, 2D routes may be fixed or defined as temporary

User preferred routing may be suspended when analysis of the pending trajectories determines areas of high potential complexity (for example if an active TSA leads to restricted airspace availability with consequent traffic congestion). These volumes have both geographical and temporal dimensions and are visible via the Network Operation Plan along with route structures that are used.

Medium/Low Complexity Operations

Medium/low complexity en-route and terminal area operations prevail in managed airspace outside areas and times of high complexity. For these operations the goal is to provide sufficient capacity to meet demand without resorting to a structured route network.

In step 1, free route operations are limited to low/medium traffic complexity airspace. They are basically limited to traffic up to a certain complexity allowing controllers to detect and resolve conflicts, thanks to automation support while fully remaining in the loop. In addition, operational constraints may, locally and on an ad hoc basis, lead to temporarily activate a limited predefined route network within free route airspace (this back up network solution could be required to enable a more efficient management of traffic situation of high complexity).

The adherence principle to the agreed UP4DT/ReqMT remains within Free Route Airspace (FRA). As far as possible the modifications during the execution phase have to be limited to face unforeseen events. Deviations to achieve separation from other flights or for arrival management needs may also occur. GA/R and Business Aviation flights are part of these operations. The objective is also to facilitate their integration.

Certain military operations have to be performed in an airspace volume within which free routing is permitted. Although it is not systematically a problem, some operations could generate constraints for both civilian and military users, or impose segregation between both types of air traffic. Consequently, the selection of airspace where free routing and military operation are permitted should be assessed and validated using the complexity and workload assessment tools.

Finally, in a medium/low complexity terminal area, aircraft, fly, as far as possible, their individual optimum climb or descent profiles. Continuous Climb Departure (CCD) or a Continuous Descent Approach (CDA) with curved segments are required for fuel/emissions saving and noise abatement (CDA/CCD are also possible in high complexity en-route and terminal area depending on the period and the traffic configuration).

Human Aspects

Previous Experimentations have shown that Free Route operations basically generate a Controller workload increase (due to the management of "random" instead of usual predictable points, and unusual traffic patterns). An appropriate level of ATC automation is needed. New or adapted ATC support tools have to be studied, in order to support an easy situation awareness building, sharing and maintenance within the sector team:

- Conflict Detection tools
- Monitoring Aids
- System supported coordination
- What if tools

The studies of en route complexity management must include the studies on free routing which have to especially focus on:

- management of transitioning (climbing/descending) flights,
- confliction between transitioning flights and cruising flights in free routing,
- sectorisation review to accommodate the changes in traffic flows,
- definition of the capacity / workload,
- circumnavigation of airspace reservation/restriction when mandatory.

A specific training has to be developed for Controllers (new working methods and tools).

Free Route operations may generate additional Network Operations Planning issues (airspace management, complexity management, traffic synchronization). A dedicated validation exercise is needed to address this issue.

New or enhanced support tools are therefore to be studied for:

- airspace Management (ASM & AFUA, network management),
- complexity management (including sectorisation).

IOP is highly required, as a support for coordination between ATSUs due to:

- no more defined coordination points,
- more variable transfer geometry.

Controller

An operator adapts his performance level according to the perceived level of risk. The operator area of performance is characterized by silent areas (areas of safe driving, where the subject thinks he has control of the situation to the level of performance), and "turbulent" areas when he is close to losing control of the situation (the subject receives cognitive alarms informing him of the increasing risk of loss of control for this level of performance). Those signals are essential, and should be used to manage complexity

The awareness of complexity management measures that have to be performed prior to the provision of actual separation must be underlined: most significantly controllers working practice can be considerably enhanced by the complexity management processes. Feedback is needed for fine-tuning of the tools and the complexity algorithm itself (particularly for the tuning stage prior to deployment for a particular airspace).

3.4.Efficient and Green Terminal Airspace Operations

The particular challenge for terminal area operations is to increase the overall capacity such that closely located airports can operate at maximum capacity with a reasonable level of over-flying traffic accommodated. This must be ensured while respecting more stringent noise abatement procedures and providing more efficient flight profiles for arriving and departing aircraft.

3.4.1.Enhanced Route Structures

Summary	
Most Significant changes	TMA route networks are optimised using Advanced RNP
Operational Focus Areas & contribution to Performance	**Optimised RNP Structures** • Airspace Capacity: Full P-RNAV implementation pursues the elimination of radar vectoring based procedures by allowing the aircraft to fly defined precision SIDs and STARs, thus minimizing the variability of the flown trajectory. • Environment/Fuel Efficiency: Reduction of fuel consumption, and associated cost reduction, due to the reduction of Airborne and Ground Holdings and optimisation of flight profiles. • Predictability: Increased predictability through situational awareness. **Point Merge in Complex TMA** • Airspace Capacity Minimizing the variability of the flown trajectory. • Environment/Fuel Efficiency: Reduction of fuel consumption, and associated cost reduction, due to the optimisation of flight profiles. • Predictability: Increased predictability through situational awareness. • Safety: Increased safety with higher trajectory accuracy and less open loop clearances.
Applicable Operational Improvement Steps	AOM-0404, AOM-0603
Primary Key Performance Areas (*Improvement*)	Environment/Fuel-Efficiency (*Low*); Airspace Capacity (*Low*); Airport Capacity (*Low*); Cost Effectiveness (*Low)*
Domain / Flight Phases	Terminal Manoeuvring Area / Planning Phase

For high-complexity operations, an efficient fixed airspace structure combined with advanced airborne and ground system capabilities is deployed to deliver the necessary capacity whilst ensuring that separation is maintained. The concept recognises that when traffic complexity is high, the required capacity can only be achieved at the cost of some constraint on individual optimum trajectories (e.g. the allocation of a Controlled Time Of Arrival (CTA) in the context of Initial 4D operation leads to reduction in efficiency of the vertical profile).

Controller task-load per flight is a major factor in airspace capacity. The SESAR concept improves complexity management and increases capacity by reducing the requirement for tactical intervention. In highly congested areas dominated by climbing and descending traffic flows, this is achieved by deploying route structures that provide a greater degree of strategic de-confliction and procedures that capitalise on the greater accuracy of aircraft navigation. The greater accuracy of aircraft navigation improves situational awareness for Controller, reducing workload and enabling more efficient flight profiles to be provided. For example, Point Merge Systems use RNP capabilities to improve traffic sequencing with reduced Controller workload.

It should be noted that TMA task-load can also be managed by the use of Controlled Time Of Arrival (CTA) for Traffic Synchronisation which helps manage complexity by controlling the flow of traffic on/into the fixed route structures, (see chapter 3.2.1 Traffic synchronisation: I4D and CTA).

Although TMAs are still reliant on fixed route structures, they are optimised through Performance Based Navigation (PBN)[12] using Advanced RNP. Advanced RNP is proposed as an ECAC-wide navigation specification to be used in En-route as well as Terminal airspace and to cover all phases of flight. This overarches the separate elements of P-RNAV and RNP APCH and is supported by a new EASA AMC (Acceptable Means of Compliance (for airworthiness of products, parts and appliances) for Advanced RNP. Advanced RNP capabilities corresponds to the “PBN IR” mandate (drafting in progress) i.e. the capability for the aircraft to fly in a more deterministic way Fixed Radius Transition (FRT) and with scalable RNP fixed value defined per segment leg i.e. RNP1 in En Route and RNP0.5 in TMA for step 1.

In Step 1, the focus is on generating route structures in lateral dimensions (2D), with the vertical dimensions of the flight managed tactically by Controller to maintain separation whilst optimising the vertical profile as far as possible.

Because RNP routes are not constrained by ground-based navigation aids, they are designed to optimise flight efficiency improvements (i.e. fuel burn and CO_2) where this can be reasonably traded-off against capacity improvements.

What is more, RNP-capable aircraft have greater predictability of relative positioning. Situational awareness for both Flight Crew and ATC is therefore improved, giving a safety benefit derived from the human factor issues that this addresses.

Human Aspects

The introduction of Enhanced Route Structures will not change the fundamental responsibilities of either Controller or Flight Crew. The design of TMA airspace using an RNP-based route structure simplifies procedures and increases the predictability of air traffic position and direction.

However, due to the introduction of new procedures, tasks and operating methods will change. There will be a cultural impact to Controller where closed-loop control will become more frequently used (e.g. clearance to a pre-defined waypoint/route) and open-loop control will become less frequently used (e.g. continue on heading).

[12] ICAO Document 9613 provides guidance on PBN implementation.

3.4.2. Improved Vertical Profiles

Summary	
Most Significant changes	Continuous Descent Operations (CDO) and Continuous Climb Operations (CCO) in high complexity TMA
Operational Focus Areas & contribution to Performance	**Approach Procedures with Vertical Guidance** • Environment/Fuel Efficiency: Reduction of fuel consumption and noise footprint on the surrounding of the airports. • Airspace Capacity: Contribution to increment efficiency • Safety: reduction in CFIT. **Continuous Climb Departure (CCD)** • Environment/Fuel Efficiency: Reduction of fuel consumption and noise footprint on the surrounding of the airports. • Predictability: Contribution to increment of predictability • Safety: Contribute to flight safety with less altitude penetrations **Continuous Descent Approach (CDA)** • Environment/Fuel Efficiency: Reduction of fuel consumption and noise footprint on the surrounding of the airports. • Predictability: Contribution to increment of predictability • Safety: Contribute to flight safety with less altitude penetrations
Applicable Operational Improvement Steps	AOM-0702 , AOM-0705, AOM-0704
Primary Key Performance Areas (*Improvement*)	Environment/Fuel-Efficiency *(Medium);* Predictability (*Low*); Safety (*High*)
Domain / Flight Phases	Terminal Manoeuvring Area / Planning & Execution Phases

The vertical profile element of climbing and descending traffic needs to be considered to deliver the improvements needed to flight efficiency (i.e. fuel burn and CO2) and other environmental factors such as noise.

Continuous Descent Approach (CDA) should be considered as part of Continuous Descent Operations (CDO), which is defined in ICAO Document 9931. The GANIS working document on ICAO Aviation System Block Upgrades identifies and highlights the need for cooperation between the airborne and ground actors to achieve efficient CDO[13].

In current-day operations a CDA is only applied from the Initial Approach Fix (IAF) to runway threshold. As part of SESAR Step 1, in alignment with CDO, the continuous descent should be executed as early as possible, where capacity allows, ideally from top-of-descent.

This improved management of the vertical profiles on descent, together with the use of Performance Based Navigation to improve situation awareness, also delivers safety benefits with respect to avoidance of Controlled Flight into Terrain (CFIT) on final approach. Note that improved situational awareness is the most important factor in avoiding CFIT. CCD is also enabled by airspace design, procedure design and facilitation by ATC. In this case, the aim is to prevent any levelling during the climb phase, allowing departing aircraft to climb to their optimal cruise altitude, at their optimal rate of ascent to minimise fuel burn.

[13] *CDO is enabled by airspace design, procedure design and facilitation by ATC, in which an arriving aircraft descends continuously, to the greatest possible extent, by employing minimum engine thrust, ideally in a low drag configuration, prior to the final approach fix/final approach point (FAF/FAP). An optimum CDO starts from the top-of-descent (TOD) and uses descent profiles that reduce controller-pilot communications and segments of level flight.*

In Step 1, the airspace design is formed by lateral (RNP) route structures. Although separation should be primarily ensured by airspace and procedure design, separation between flows (arrivals versus arrivals or arrivals versus departures) may require level-offs, depending on the traffic density/complexity. If the departures can be designed to out-climb the arrivals then this ensures maximum opportunity for CCD application and minimises the need for support by computer-generated vertical flight paths. Where there is a potential impact on the optimal descent profiles for arrivals, the flight efficiency trade-off is optimised according to local parameters. This also enables the TMA Controller to minimise their workload with respect to the departing traffic.

With RNP routes deconflicted (e.g. laterally via 2D RNP and vertically via altitude constraints/windows), speed constraints are only used where capacity constraints dictate the need to maintain in-trail spacing between flights on any specific route or to manage sequencing and merging between routes within closed loop procedures. Where in-flight constraints are necessary, they are set in such a way that the aircraft will be able to fly at or above clean speeds through the entire approach or departure (under nominal conditions)

The operational procedures are designed such that, when traffic density permits, CDA and CCD can be accommodated on a tactical basis. Dependent on the traffic density/complexity level-offs may be required to provide separation between flows (arrivals versus arrivals or arrivals versus departures).

With the application of continuous climb and continuous descent (CCD or CDA), intermediate altitude clearances (level-off segments) are no longer applied. This reduces the cockpit workload and the risk of misinterpretation of clearance, which consequently reduces the risk of altitude penetrations creating potentially hazardous situations.

Tailored arrival

Tailored arrival procedures are defined on a per flight basis from Top Of Descent (TOD) to Initial Approach Fix (IAF) or to runway taking in account other traffic and constraints, to optimize the descent and minimise the need for low level airborne holding. It is based on the downlink to the ANSP of actual Aircraft Derived Data (like weight, speed, etc.)[14] and the uplink of the assigned route (STAR) as calculated by the ANSP.

Limitations

The chapter assumes that aircraft and ground systems are equipped to facilitate downlinked ADD (wind and temperature are specifically important) and uplinked route data, e.g. via ADS-C EPP and CPDLC. Such data sharing enables more efficient profiles to be provided and makes tactical provision of CDAs more efficient and more likely, but does not preclude the implementation of CDAs and CCDs.

Human Aspects

The introduction of Improved Vertical Profiles will not change the fundamental responsibilities of either Controller or Flight Crew. However, due to the introduction of new procedures, tasks and operating methods will change: one key example of is the management of the Top of Descent in En route airspace which is now an event well defined by the process of the Continuous Descent Operations: to achieve CDA Controller cannot manage this Top of Descent while only considering the aspects of conflict management. Instead, tactical updates/revisions to the trajectory need to be coordinated between En-Route and Terminal control.

[14] ADS-B out allows the aircraft to broadcast position, speed, altitude, flight ID, Wake Vortex category, etc. Gross weight and min/max speed schedule will require a new standard available in a further step than step 1; it should however be noted that gross weight and min/max speed schedule are part of ADS-C EPP in step 1

3.5.Increased Runway and Airport Throughput

3.5.1.Weather resilience

Summary	
Most Significant changes	Systematic collaborative Low Visibility Procedure development for similar airports Use of interim GLS applications (only GPS) Use of GBAS Cat II/III based on GPS L1 for Precision Approaches Equivalent Vision of landing and ground operations in Low Visibility Conditions
Operational Focus Areas & contribution to Performance	**Low Visibility Procedures using GBAS** • Safety: Increased safety, reducing the number of potential CFIT incidents / accidents. • Airport capacity: Maintain airport throughput during low visibility conditions. • Environment/Fuel-Efficiency: Reduction of fuel and noise footprint. Provide a flexible use of the airspace improving airports traffic capacity and environmental constraints. **Pilot Enhanced Vision** • Safety: Increasing of the aircraft safety on the airport surface, the better situational awareness provided by vision systems in low visibility conditions will reduce the probability of occurrence of hazardous situations. •Airport Capacity: Maintain airport throughput during low visibility conditions. •Environment/Fuel-Efficiency: Reduction of fuel and noise impact.
Applicable Operational Improvement Steps	AO-0505, AUO-0403
Primary Key Performance Areas (*Improvement*)	Airport Capacity (*Low*); Cost Effectiveness (*Low*); Safety (*High*)
Domain / Flight Phases	Airport/ Medium to Short Term Planning Phases, Execution Phase

Bad weather conditions are a great factor for causing delays, restrictions to some operations and even closing of some airports. Adverse weather conditions can have a negative impact on the ground handling of an aircraft. Thunderstorm conditions near or at/above the airport will result in a halt of the ground handling activities due to safety regulations. The SESAR programme aims to develop systems and practices to cope with these disruption events and to achieve an operational degree close or even equal to normal weather conditions.

The Low Visibility Condition declared over an airport affects dramatically the airport throughput and cause knock on delays in the network.

Flight Crew Enhanced Vision
Equivalent vision of landing and ground operations in Low Visibility Conditions, head up and head down, allows lowering approach limits, improving taxi time efficiency and increasing safety margins. Enhanced vision of external environment is also combined with Advanced Localizer Precision with Vertical guidance approach based on SBAS (A-LPV/SBAS).

Low Visibility Procedures using GBAS
To cope with these problems in Step 1, Low Visibility Procedures are collaboratively developed and implemented at applicable airports that share with similar weather conditions or operate with similar Low Visibility Conditions characteristics, ensuring in particular harmonised procedures across airports and the use of optimised separation criteria.

In step 1, Low Visibility Procedures and Precision Approaches using initial CAT II/III GBAS[15] are more systematically used.

[15] Based on today's GPS L1 in step 1 and on dual GNSS in a later step.

3.5.2.Airport Safety

Summary	
Most Significant changes	Wide implementation of European Action Plan for the Prevention of Runway Incursions Increased situational awareness of all mobile units (aircraft and vehicles) in the airport surface
Operational Focus Areas & contribution to Performance	**Airport safety nets** • Safety: Increase airport safety through the implementations of European Action Plan. **Enhanced situational awareness** • Safety: Increase airport safety through enhancing situational awareness for pilots, vehicles and controllers under normal or degraded visibility conditions.
Applicable Operational Improvement Steps	AO-0104, AO-0204, AUO-0605
Primary Key Performance Areas (*Improvement*)	Airport Capacity (*Low*); Safety (*High*)
Domain / Flight Phases	Airport/ Long Term Planning Phase, Medium to Short Term Planning Phases, Execution Phase

As it is recognised in the ATM world, airports are becoming an identified bottleneck for network capacity. Within the SESAR environment, various stakeholders will use different ways to enhance capacity, improving predictability and increasing airport throughput.

But increasing runway throughput and runway utilization, taxiways and apron capacity has to be achieved within the SESAR safety goals. The number of ATM induced accidents and serious or risk bearing incidents must not increase and where possible decrease as a result of the introduction of SESAR concepts.

Surface movement capacity is therefore to be increased without increasing the risk of runway incursions and taxing and apron incidents and/or accidents. To achieve this objective, a range of actions need to be taken, to maintain or even improve safety levels. Better situational awareness both for Controller, Flight Crew and vehicle drivers including conflict detection and alerting systems enhances airport surface safety but creates also room for increasing surface movement capacity.

Safety Nets

ECAC airports and Aircraft Operators must develop procedures and apply the recommendations contained in the European Action Plan for the prevention of runway incursions. Among those:

- compliance of infrastructure with ICAO provisions,
- best practices on Flight Crew procedures for runway crossing and while taxiing,
- assessment for Flight Crews regarding aerodrome signage, markings and lighting.

During Step 1 the system begins to detect conflicts and infringements of some crucial ATC instructions or rules involving aircraft and/or vehicles on runways, and provides Controller with appropriate alerts. Whereas conflict detection identifies a possible collision between aircraft and/or vehicles, the system now also focuses on dangerous situations arising whenever one or more mobile unit infringes ATC instructions or rules. This improvement also addresses aircraft incursions into an area where the presence of an aircraft (or vehicle) is temporarily restricted or forbidden.[16]

The system provides Controller with the position and automatic identity of all relevant mobiles on the movement area, with the exception of vehicles on the apron. The system detects potential conflicting situations/incursions involving mobile and stationary units on runways, taxiways and in the apron/stand/gate area. Appropriate alerts are provided to Controllers, Flight Crew and also to the relevant ground vehicle drivers[17]. Potential resolution advisories are provided to Controllers/Pilots/Vehicle Drivers depending on the complexity of resolution possibilities[18]. Controller can also be alerted by the system in case of unauthorized / unidentified traffic. Besides, the aircraft system generates its own traffic alert during operation on airport surface e.g. in case of traffic at proximity of the runway.

Enhanced Situational awareness

A-SMGCS allows accurate surveillance and precise control of traffic on the surface. System features includes traffic advisories and alarms to Controllers to reduce the risk of runway incursions and ground collisions.

On top of those new tools, existing procedures are improved and new ones are set:

Information regarding surrounding traffic (including both aircraft and airport vehicles) during taxi and runway operations is displayed in the aircraft cockpit superimposed onto the airport layout on a moving map and in the vehicles as well.

Human Aspects

The availability of surrounding traffic information can increase Flight Crew workload when taxiing through the airport. The effect of interfacing with this safety information has to be studied. The presentation of the information is a crucial issue, this alone can lead to increase or decrease in safety levels.

[16] (E.g. closed taxiway, critical area, etc).

[17] There is a request for changing AUO-0605: forwarding ground generated alert to Flight Crew via data link does not appear appropriate from an operational perspective, flight crew expects instruction (e.g. stop immediately) rather than an alert from ATC (e.g. runway incursion), via voice rather than data link due to time critical situation."

[18] This specific feature is envisaged for Step 1 but it is currently under operational feasibility study.

3.5.3. Enhanced runway throughput

Summary	
Most Significant changes	Weather dependent separation based on wake vortex dynamic information Reducing Runway Occupancy Time (ROT) by improving Flight Crew's awareness of ROT techniques Optimised braking to vacate at the runway exit coordinated between Flight crew and ATC to reduce the ROT
Operational Focus Areas & contribution to Performance	**Time Based Separation** • Airport/Airspace Capacity: Increasing runway and airspace throughput reducing landing and departure wake turbulence separation. **Dynamic Vortex Separation** • Airport/Airspace Capacity: Increasing runway and airspace throughput reducing landing and departure wake turbulence separation. • Predictability: Increase predictability of flights due to a time based management of separation. •Environment/Fuel-Efficiency: Reduction of fuel consumption, thus increasing environmental sustainability. **Runway Occupancy Time Management** • Airport Capacity: Increasing runway throughput through the reduction of runway occupancy times •Predictability: Increase predictability through integration of runway exit with taxi to stand routing. •Environment/Fuel-Efficiency: Reduction of fuel consumption, thus increasing environmental sustainability
Applicable Operational Improvement Steps	AO-0303, AO-0304, AUO-0702, AUO-0703
Primary Key Performance Areas (*Improvement*)	Environment/Fuel-Efficiency (*Low*); Airport Capacity (*High*); Predictability (*Medium*); Cost Effectiveness (*Low*); Safety (*Low*)
Domain / Flight Phases	Airport/ Medium to Short Term Planning Phase, Execution Phase

The development and implementation of techniques and procedures to increase runway throughput and reduce separation distances must take into account Wake Vortex encounters. Those techniques include reduced spacing between departure, reduction of the time interval between two successive departures and arrivals, etc.

Runway throughput must be optimised at congested airports. A range of technical and procedural solutions, both ground and airborne, support the safe and efficient management of the runway in all weather conditions, achieving throughput rates, equal to or close to nominal throughput rates achievable in good weather conditions, with a homogeneous aircraft traffic sequence. This requires a spectrum of measures included in these main areas:

- Real-time demand and capacity balancing
- Sequencing and metering
- Time-based separation
- Wake vortex detection
- Runway occupancy improvements

Time based operations, wake vortex detection and dynamic meteorological influences
One of the biggest changes in step 1 is the application of time based wake turbulence radar separation rules on final approach (TBS), which aims at stabilising the overall time spacing between arrival aircraft. The Final Approach Controller and the Tower Runway Controller are provided with the necessary TBS management tools. They enable an accurate delivery on final approach consistent with TBS rules. Minimum radar separation and runway related spacing constraints must still be respected when applying the TBS rules.

The impact of weather conditions is dynamically integrated in the sequence of arrivals and departures thanks to the application of weather dependent separation (WDS). This covers arrivals on final approach and departures on the initial common departure path. It allows the reduction or the suspension of the wake turbulence separation, during a specific amount of time, in stable forecasted weather conditions. In this case, conditions should either ensure transport of the wake turbulence out of the path of the following aircraft, or ensure that, because of the wake turbulence decay it is no longer a hazard to the following aircraft. These measures are also applied to departures but considering different wake vortex behaviour and aircraft operation.

The objective is to enable a tactical increase in the achieved arrival and departure capacity in favourable weather conditions. This helps dealing more efficiently with the fluctuations in arrival and departure demand with a positive effect on runway queuing related delays.

Knowledge of the existence and behaviour of wake vortices must be accompanied by procedures and regulatory standards.

Optimised braking
The objective is to optimise the braking in order to vacate at the runway exit previously coordinated between Flight Crew and Controller in order to reduce the Runway Occupancy Time (ROT). The runway exit and ROT is coordinated, by voice or datalink, between Flight Crew and Controller depending on system capability. It is consistent with the taxi plan, the weather conditions and the aircraft capabilities. Braking is performed either manually or for equipped aircraft, by avionics that controls the deceleration scheme of the aircraft to reach a predetermined speed at the selected exit. This procedure allows for early use of available data by ATC and is applicable for non-data link capable aircraft. The accurate ROT is used to sequence arrivals and improve runway management; the reliable runway exit and predicted time at the exit completes the link between airborne and ground trajectories. This also facilitates surface routing from runway exit to stand. Assisting Flight Crew in achieving optimal final aircraft configuration and braking techniques results in lower ROTs and thus maintain or increase throughput and capacity.

Human Aspects
The automated exit capability will most likely have to be linked to the Auto Land function to optimize the system use. There is an inherent risk that automated braking if paired with Auto land function most likely will deteriorate Flight Crew skills making a positive outcome of critical situations more doubtful when an automated system takes care of the normal landing operations, and Flight Crew only train their skills in adverse environments when system capability no longer is able to cope with the situation. This is potentially hazardous as this gradually will lower Flight Crew skills where an additional factor may be late detection of auto brake failure due to the engine reverse which is most effective at high speed. Experience has shown this to be a contributing factor in several accidents and incidents.

3.6. Cooperative Asset Management

3.6.1. Remote Tower with AFIS

Summary	
Most Significant changes	Joint tower installations for a number of airports centralized at a single site. More efficient use of the personnel required to handle this entire service.
Operational Focus Areas & contribution to Performance	**Remote Tower** • Cost Effectiveness: ATC services will be more cost-effective to provide, regardless of time and place, by using information collected from remote tower sensor systems (without the need to build a tower) • Safety: Vision and ATM situational awareness are improved by using enhanced camera technology and modern surveillance technology and therefore safe operations could be performed with high reliability.
Operational Focus Areas	Remote Tower
Applicable Operational Improvement Steps	SDM-0201
Primary Key Performance Areas (*Improvement*)	Cost Effectiveness (*tbd*), Safety (tbd)
Domain / Flight Phases	Airport / Execution Phase (Descent, Climb Out)

Remotely Operated Aerodrome Control is provided from a remote location, i.e. not from a control tower which is local to the aerodrome itself and can be applied for a single aerodrome. Controller (or AFISO) in this facility performs the remote ATS for the concerned aerodrome.

The remote tower concept is not intended to be implemented at airports with a significant traffic volume and a certain complexity but at airports with intermittent traffic. The thresholds have yet to be defined by the local authority.

The concept of remotely provided aerodrome control service applies at aerodromes where the service provider has determined that this is feasible, that the site and techniques to be used are proven to meet all appropriate safety requirements and where/ when this is cost-effective.

A main driver for the implementation of Remotely Operated Aerodrome Control is the potential of significantly reducing the costs of infrastructure by joint tower installations for a number of airports centralized at a single site. Considerable gains in productivity are achieved due to more efficient use of the personnel required to handle this entire service.

A second driver is safety. By using enhanced modern camera technology supporting improved vision and ATM situational awareness (also in low visibility conditions), safe operations can be performed with high reliability. The availability of modern surveillance technologies (e.g. multilateration, ADS-B) can further enhance those benefits.

The concept does not seek to change the air traffic services provided to airspace users or change the levels of those services. It changes the way those same services will be provided through the introduction of new technologies and working methods.

The current source for getting visual information, the direct Out The Window view is replaced by other information sources relayed to the remote facility e.g. visual reproduction via cameras, virtual reproduction using surveillance information and/or synthetic models etc.

3.7.Information management

3.7.1.SWIM

Summary	
Most Significant changes	Ground to Ground only Improved collaborative decision making and situational awareness. Separation of information provision / consumption
Operational Focus Areas & contribution to Performance	**SWIM** • Cost Effectiveness: data sharing through common systems provides economies of scale. • Safety: Reduced misinterpretation due to shared data; improved awareness of weather hazards (e.g. thunderstorm activity), mitigating risk of traffic overloads. • Environment/Fuel Efficiency: Enhanced accuracy and resolution of met data will allow each aircraft to fly closer to its optimum profile thanks to better predictions. • Airspace Capacity: reduced uncertainty of weather events, mitigating unforeseen loss of capacity.
Applicable Operational Improvement Steps	IS-0402, IS-0501, IS-0701, IS-0702, IS-0703, IS-0704, IS-0705
Primary Key Performance Areas (*Improvement*)	Cost Effectiveness (*High*)
Domain / Flight Phases	All phases, all domains (except airports, airlines, military)

The concept of SWIM – System Wide Information Management - covers a complete change in paradigm of how information is managed along its full lifecycle and across the whole European Ground ATM system. The implementation of the SWIM concept enables direct ATM business benefits to be generated by ensuring the provision of commonly understood quality information delivered to the right people at the right time delivered at the right place - the Operational Temporality of information. This improves ATM Ground to Ground real-time collaborative decision making process and situational awareness across all ATM stakeholders sharing the same information. SWIM improves the ATM information management. This implies possible changes to separation of concerns for each actor, which at the end may impact on roles and associated liabilities.

Given the transversal nature of SWIM, which is to go across all ATM systems, data domains, business trajectory phases and the wide range of ATM stakeholders, it is not expected that one solution and certainly not one single technology fits all. Nevertheless it is recognised that global interoperability through standardisation is essential. SWIM is an important driver for new and updated standards.

SWIM as paradigm change in the information sharing and will enable the concept of net-centric ATM operation. This paradigm change in information sharing is shown in figures 3 (sharing information today) and 4 (sharing information tomorrow) [19].

[19] ATC clearance exchanges (CPDLC) will be still point to point between Controller and Flight Crew and 4D trajectory data will be automatically down linked according to the contract terms specified by ANSP (e.g. ADS-C EPP) whereas AIS/MET data will be shared via Air Ground SWIM in step 2.

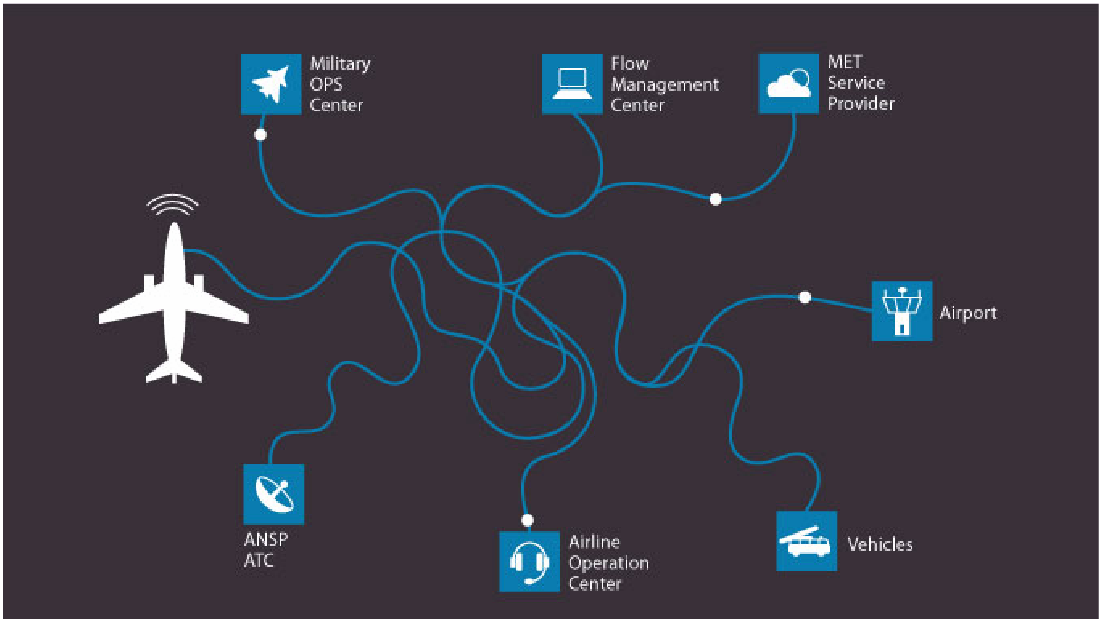

Figure 3 Sharing information today

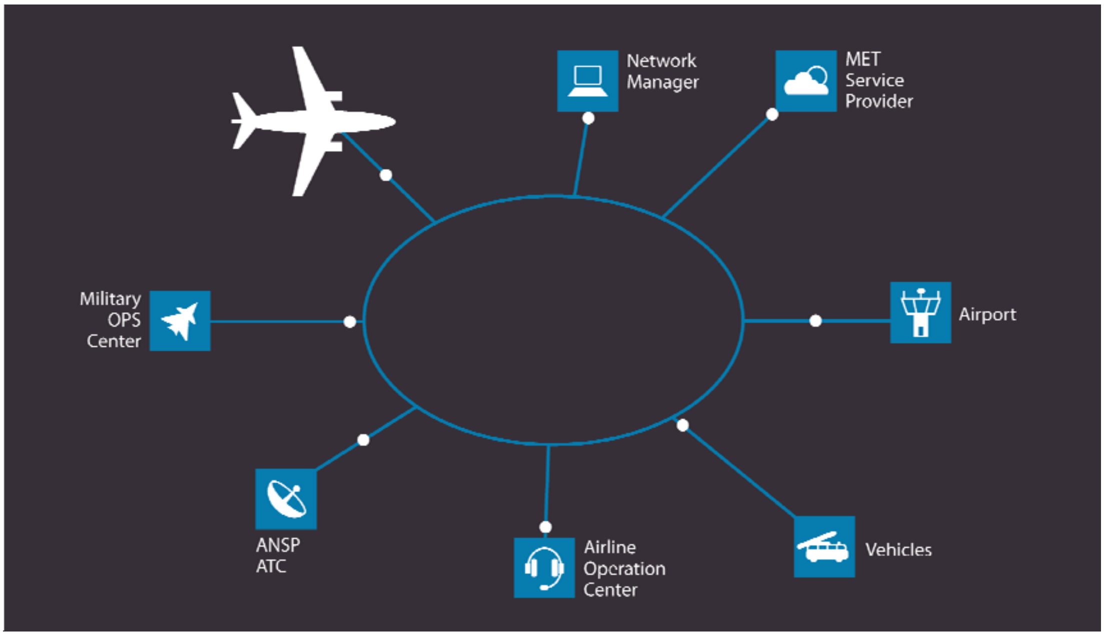

Figure 4 Sharing information tomorrow

SWIM separates the information provision from the information consumption. In the ATM network, almost every participant is a producer as well as a consumer of information. It is not ideal to decide in advance who will need what information, obtained from whom and when. SWIM decouples producers of information from the possible consumers in such a way that the number and nature of the consumers can evolve through time as shown in figure 3 (Net centric information viewpoint). Information sharing is enabled by SWIM adopting a service oriented approach where interoperable services can be used in a flexible way within multiple separate systems from several business domains.

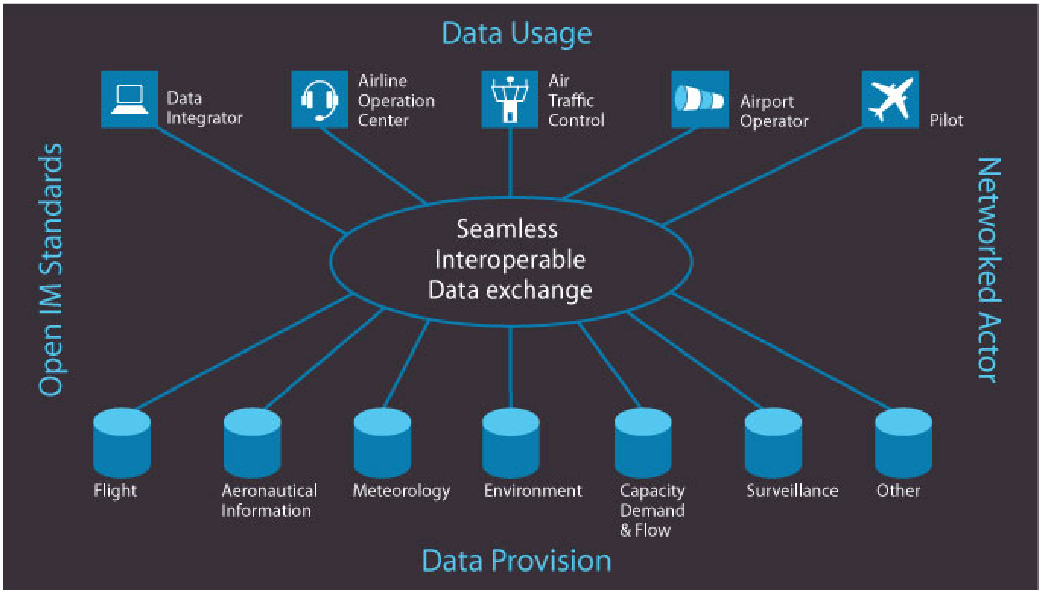

Figure 5 Net centric information viewpoint

SWIM supports the initial SESAR Trajectory Management concept by ensuring that all partners have a common view of a flight and have access to the most up to date data available to perform their tasks. By sharing the Flight Object, SWIM enables extensive iteration process based on the exchange of accurate flight information & refined estimates between ANSPs. Thus necessary tactical interventions are considered at the trajectory level and not only at the immediate aircraft level, taking account of the wider impact on the trajectories concerned as well as on the network.

SWIM supports the Traffic Synchronisation concept in the context of the integrated and collaborative ATM Network Management processes. By providing easy access to Network Operation Plan (NOP) information services and making digital the AIS information, SWIM enables extensive collaborative decision making process for ensuring the balance between capacity and demand of the traffic flow, resulting in the Network Operations Plan.

Part 2
Operational Environment

4.Operational Environment

4.1.Operational characteristics

4.1.1.Traffic Characteristics

This chapter has been developed according to the EUROCONTROL STATFOR Medium term forecast (MTF), February 2011. The MTF considers the development of air traffic in Europe over 7 years (2011 to 2017) and is developed by growing baseline traffic (all IFR flight movements for the whole of 2010) taking into account factors such as economic growth, past patterns of supply, the growth of low-cost carriers and the influence of high-speed trains. The routing between airports pairs is modelled both on the patterns observed in the baseline year, and recent trends in how these patterns are changing. However, no account of future route network changes is made.

Three ‘scenarios’ are used to capture the likely range of growth of flight movements. They comprise: the low-growth and high-growth scenario which vary economic growth, load factors and other variables in order to capture the most-likely range; and the baseline forecast which is a guidance figure within this range.

The traffic forecast is for 11.6 million IFR movements in Europe in 2017, 22% more than in 2010 (The average European growth rate over the 7 years (2011-2017) is for 2.9% per year.

In this forecast all IFR flights, including military and general aviation flights operating under GAT IFR rules, are included.

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	AAGR 2017/ 2010
IFR Flights Movements (Thousands)	H						10,007	10,433	10,846	11,258	11,676	12,120	12,490	4,0%
	B	9,561	10,043	10,083	9,413	9,493	9,902	10,240	10,479	10,760	11,045	11,337	11,571	2,9%
	L						9,813	10,100	10,238	10,435	10,643	10,861	11,004	2,1%
Annual Growth (compared to previous year)	H						5,4%	4,3%	4,0%	3,8%	3,7%	3,8%	3,1%	4,0%
	B		5,0%	0,4%	6,6%	0,8%	4,3%	3,4%	2,3%	2,7%	2,7%	2,6%	2,1%	2,9%
	L						3,4%	2,9%	1,4%	4,9%	2,0%	2,1%	1,3%	2,1%

Table 1: IFR movements Medium Term Forecast

The forecast is constrained by annual airport capacities which impose limitation on the growth factors. In the baseline scenario in 2017, around 100,000 departures cannot be accommodated according to the forecast due to airport congestion (mainly in UK, Turkey and France).

	Change in IFR Departures							Percentage Change						
	2011	2012	2013	2014	2015	2016	2017	2011	2012	2013	2014	2015	2016	2017
High	16.6	25.3	36.5	65.7	91.8	127.6	202	0.2%	0.2%	0.3%	0.6%	0.8%	1.0%	1.6%
Base	12.3	23.2	30.2	40.3	47.8	69.3	100.5	0.1%	0.2%	0.3%	0.4%	0.4%	0.6%	0.8%
Low	11.4	17.5	22.4	30.7	33.4	42.6	77.4	0.1%	0.2%	0.2%	0.3%	0.3%	0.4%	0.7%

Table 2 Impact of airport constraints on traffic growth in the forecast

Airport capacity is the key challenge in the SESAR timeframe. The range of operational and technical solutions implemented during Step 1 contributes to loosen these constraints, by increasing airport capacity both under nominal and bad weather conditions (see chapter 3.1.3).

The traffic growth rate for 2013 is expected to be lower than in 2012 with a value of 2.3% (±1.5%). This is mainly due to the removal of the 2012 effects (leap-year and major events) but is also explained by the increasing weight of the capacity constraints at major airports (30,000 departures will not be accommodated across the European network in 2013).

From 2014, the growth rate is expected to remain stable around 2.7% until 2016 — another leap year — and then to drop slightly in 2017 (leap-year effect withdrawn and capacity constraints removing 100,000 departures to the European network).

The growth is not uniform across Europe. Of the 5,000 or more additional daily flights that are forecast, domestic traffic in Turkey is one of the main sources of growth, as well as the flow between Turkey and Former CIS region (former Soviet Republics). Most of the busiest European States (Germany, UK, Italy and France) will also see their domestic traffic expanding, even if growth in each State only represents a quarter of Turkish internal growth. It is still these big States that will see the greatest number of additional movements between 2011 and 2017. The flow between France and North-Africa region is also expected to develop quite significantly by 2017.

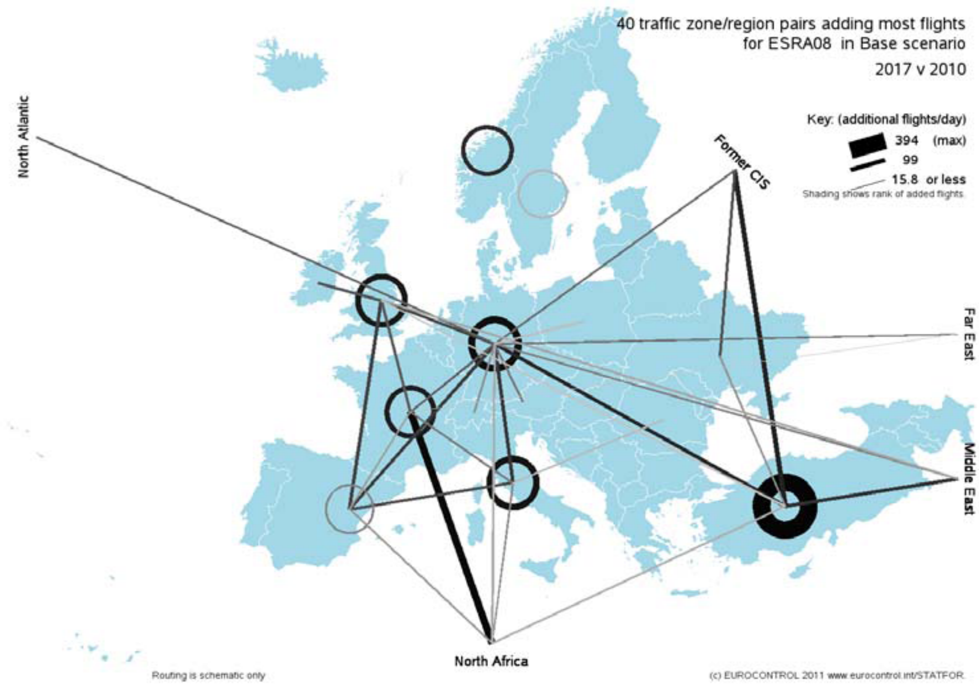

Figure 6: Map of the top 40 traffic growth flows (2017 v 2010).

It is important to highlight that these forecasts take into account some special events and trends (e.g. Olympic games, EU accession leading to market liberalisation, adoption of EU visa-free measures, etc.), while other more uncertain factors potentially influencing traffic growth or patterns have not been accounted for (e.g. opening of the Siberia route leading to more direct flights between Europe and far-east, new combination of engine/aircraft, new fuel concepts)

Forecast traffic and growth per areas illustrates the imbalance in growth. FAB EC which adds the most flights (near 3,000 more movements a day) only increases by about 20% between 2010 and 2017. Baltic and Danube will see over 35% more flights in 2017 than they had in 2010, each adding some 700 flights a day. Blue Med which for the first time in 2010 saw more flights than UK-Ireland outpaces their growth by more than 1% per year on average and finishes more than 10% above the UK-Ireland levels in 2017 reaching close to 8,000 flights a day. For Further information on FAB, please refer to chapter 4.1.2.2.

Figure 7 illustrates the traffic distribution taking 2010 as reference year. The market share for low-cost carriers climbed to 22.1% of all flights, driving the overall growth with respect to the previous year. Business aviation and all-cargo also contributed strongly to growth. Nevertheless all-cargo has a limited impact on overall growth as this segment remains small in terms of number of flights. The scheduled traffic segment slightly declined, still representing the main share of traffic. The rest of traffic, mostly general aviation, remained stable at around 2.8%.

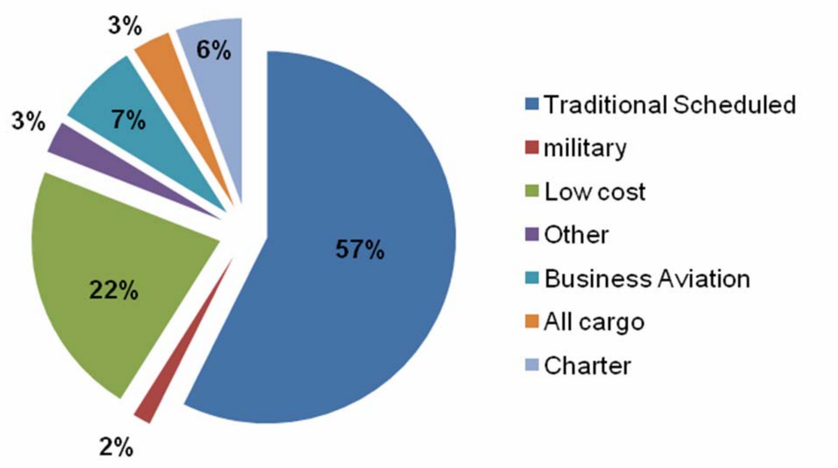

Figure 7: IFR Traffic distribution 2010

Regarding the GAT Military flight, the statistics from STATFOR can be used. Complementary information[20] from the Civil-Military ATM Coordination Directorate gives the split by flight level of the military GAT as shown in following figure:

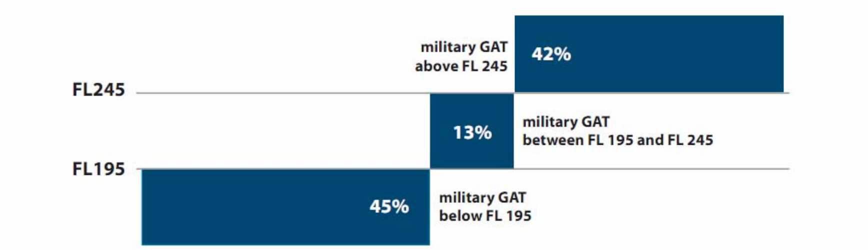

Figure 8: Military GAT per Flight Level

The relative contribution of GAT Military flights to the overall global traffic is expected to remain unchanged by 2015. The average contribution of military OAT/IFR to the overall traffic will remain between 1, 5 and 2% with local various at State level.

To be noted that if the number of GAT Military flights is expected to remain unchanged in comparison with growing GAT civil flights, the percentage of the global traffic they represent will necessarily decrease. The impact will remain very low.

Nevertheless, the Military flights executed in specific airspace reservation/restriction and much more demanding in terms of airspace volumes represent one of the most impacting

[20] Data collected from Directorate Single Sky Civil-Military ATM Co-ordination Division (DSS/CM), Military Statistics, Edition 2011

factors for the Network, and it cannot only be assessed in terms of number of flights but rather in terms of impact they globally have on other airspace users operations.

4.1.1.1.Mix of aviation types and equipage

The current mix of aircraft types, operating characteristics and pattern are not expected to significantly change before 2015. There is no information available on fleet renewal according to environmental pressure or oil price and balance between turbo prop, jet. In the longer term, aircraft will adhere more closely, i.e. more accurate horizontal and vertical adherence, to the planned 4D trajectory.

The ECAC fleet can be characterised by a mix of aircraft types and performance, mixed equipage and mixed navigation capability. The overall, aircraft performance, including aircraft navigation capability, is expected to improve.

Airbus A318/A319/A320/A321 represent 12,5% of aircraft and 27,3% of flights in Europe, operated by around 100 operators but 60% with less than 5 aircraft; Boeing B737/100-200/Classic/NG represent 10,8% of aircraft and 22,2% of flights in Europe. Initial Operational Capabilities step 1 plus 3 to 10 years depending on the complexity of new functions and on publication or not of mandates will be required to get a significant percentage of equipped aircraft.

Unmanned Aerial Vehicles are expected to become significant airspace users UAV operations outside segregated airspace are expected to become more common at all flight levels.

The sector of business aviation, performed by jet and non-jet traffic, and including Very Light Jets (VLJ) is expected to grow more rapidly than the main scheduled/charter passenger market, particularly for the next years as the market rebuilds itself after the financial crisis (see figure below). What with in the medium-term, with an expectation of economies continuing to be relatively weak, medium term forecast do not announce a return to pre-crisis growth rates.

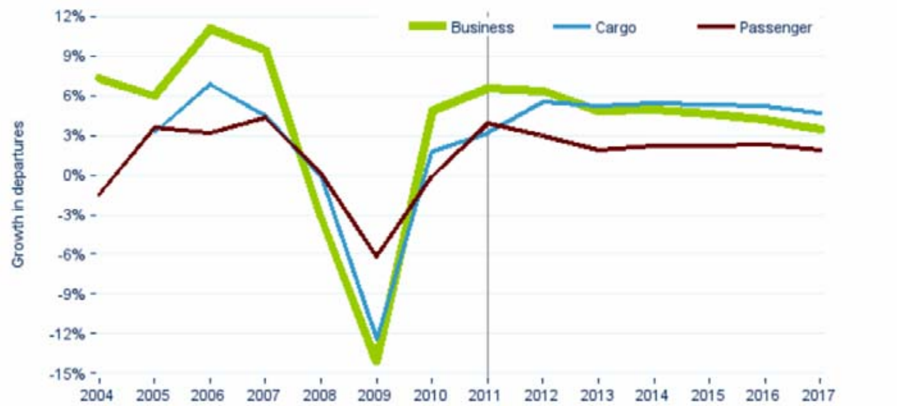

Figure 9: 2011-2017 growth forecast by category

4.1.1.2.Airport traffic mix

The percentage distribution between the three aircraft ICAO wake turbulence categories (Heavy/Medium/Light) will be different for every airport and in fact will only have an impact if the airport will operate at, or close to, runway capacity. This distribution in fact determines the minimum time between flights to be used on the approach, landing, take-off and climb phases in order to minimise wake vortex incidents. Although to be applied for safety reasons it does not determine the practical capacity limit of an airport with a demand less than 50% of its maximal theoretical capacity.

An approximate indication can be given on traffic volume and traffic mix. This must be considered as purely indicative since deviations from this categorisation will exit.

Airport Category	Annual Movements	Example of Airport (IATA code)	Heavy-Medium-Light mix
Intercontinental Hub	300.000 +	MAD, FCO, LHR, AMS, CDG, FRA, LGW, MUC ZRH	>15% Heavy <1% Light
European Hub	150.000-300.000	MXP, ARN, BRU, CPH, PMI, HEL, VIE, PMI, BCN, ORY, OSL, PRG	<15% Heavy 10-20% Light
Primary Node	75.000-150.000	STN, PRG, DUS, LYS ATH, HAM, WAW, TXL, LIS, STR, BUD, VLC	<5% Heavy 20-30% Light
Secondary Node	30.000-75.000	LTN, LIN, LCY,CGN, SXF, FNC, LBA, HAJ, NUE, GOT, BGY, CIA, SOF, BUH, LUX, CRL, HHN, OPO	<1% Heavy >30% Light
Tertiary Node	<30.000	DTM, AAR, RTM, GRO, BRE, LJU	No heavy >40% Light
General/ Business Aviation	A few hundred-80.000	RKE, LBG, BRN, FAB, QEF	No heavy >90% Light
Military/ Civil Mixed Ops	<30.000	EIN, TOJ	>50% military ops

Table 3 Traffic Volume and Traffic Mix for Different Categories of Airport

Besides the traffic levels, the Airport operational environment is determined by a combination of influencing factors; these key features can be used to classify airports in Europe:

- the function of the airport within the European Network (e.g. hub, node, etc.),
- the physical layout of the airport (i.e. the runway-taxiway topology),
- the utilisation of available capacity (i.e. vulnerable to disruptions),
- the impact of external influences (e.g. geographical, weather and political constraints).

A detailed description of the Airport operational environment can be found in the Airport Detailed Operational Description (6.2 DOD v00.03.00)

4.1.2. Airspace and Network Management

In order to face traffic increase and additional diversity and complexity in the airspace user requirements, the ECAC airspace will still need to become more flexible and adaptable, allowing an effective balance between capacity, mission effectiveness, flight efficiency and environmental requirements, while maintaining or improving the safety of operations.

4.1.2.1.ICAO ATS airspace classifications

During the time frame of SESAR Step 1 the future European airspace organisation will initially be based on current ICAO ATS airspace classifications, regulations and applicable rules, including Visual Flight Rules (VFR) and Instrument Flight Rules (IFR).

Classifications and rules will be adopted consistently by all States, thus ensuring uniformity of their application and a simplification of airspace organization throughout the whole ECAC region.

This will provide a progress towards, but not the achievement in Step 1, of an airspace continuum where the only distinction is between two Airspace classes (i.e. Managed and Unmanaged Airspace), which will not be achieved in in the first step of SESAR development.

4.1.2.2.Functional Airspace Blocks

Within the SES framework, Member States of the European Union (EU) are required to establish Functional Airspace Blocks (FAB) by 4 December 2012, i.e. volumes of Airspace based on operational requirements and established regardless of State boundaries, where the provision of air navigation services and related functions are performance-driven and optimized with a view to introducing, in each functional airspace block, enhanced cooperation among air navigation service providers or, where appropriate, an integrated provider.

The development of FABs will lead to less fragmentation and to the harmonization of the various rules associated with airspace utilisation, thanks to a more integrated management of the airspace within the FAB. The relaxation of constraints implied by national or service provision boundaries will enable cross-border operations and the use of cross border areas.

Nine FAB initiatives existed in 2011:

- Baltic FAB: Lithuania and Poland
- Danish - Swedish FAB: Denmark and Sweden
- North European FAB (NEFAB): Estonia, Finland, Iceland, Latvia, Norway
- FAB UK-Ireland: United Kingdom and Ireland
- FAB Europe Central (FABEC): Belgium, France, Germany, Luxembourg, Netherlands, Switzerland and EUROCONTROL Maastricht
- FAB Central Europe (FAB-CE): Austria, Bosnia & Herzegovina, Croatia, Czech Republic, Hungary, Slovak Republic and Slovenia
- Danube FAB: Bulgaria and Romania
- South West FAB: Portugal and Spain
- FAB Blue MED: Cyprus, Greece, Italy and Malta. (Albania, Egypt and Tunisia, as associate partners. Kingdom of Jordan and Lebanon as observers

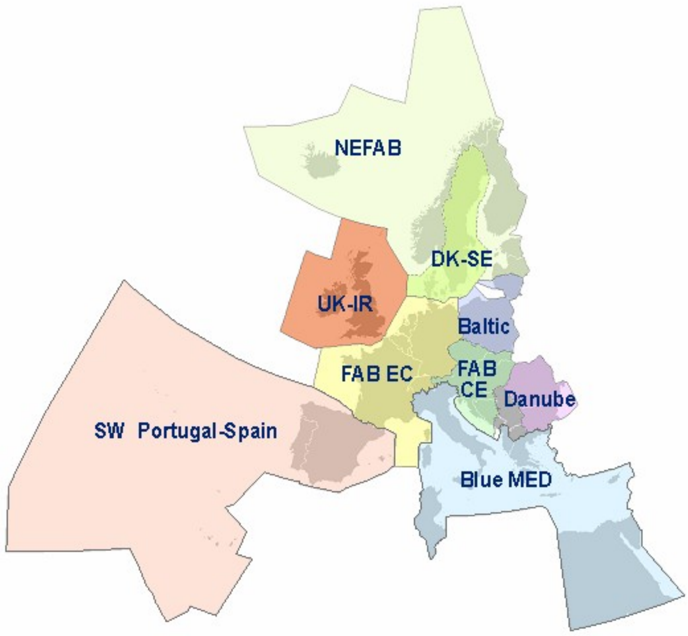

Figure 10 Functional Airspace Block Initiatives (2011)

As of 2011 it appears that the potential risk of not meeting the December 2012 deadline is high in the case of NEFAB, medium in the case of Baltic, while for Blue MED and SW Portugal-Spain, there is not enough information available to estimate the level of risk.
It is interesting to note that no FAB or FAB initiative has yet introduced cooperation mechanisms with neighbouring FABs, hence FAB initiatives remain focused on intra-FAB arrangements with no concrete initiatives for FAB interfaces at State level.

4.1.2.3.Route Network

ATS routes of the ATS Routes Network (ARN) continue to characterize the airspace for the most part. Improvements in the strategic design, planning and management of these routes will improve the predictability of the route options and reduce the need for tactical re-routeing by Air Traffic Controllers.

The ARN Version-7 is the reference. It is based on a European wide collaborative process by which the major traffic flows, combined with major airspace constraints (airports, airspace reservation/restriction etc.) are translated into a basic route structure. Built upon agreed planning principles, the resultant structure provides the basis for more detailed development by States at national or regional/FAB level.

The overall European Network Consistency is assured across through the consolidated development of a network scheme which considers the ECAC airspace in its totality, independent of FIR boundaries. Co-ordination and consolidation of airspace design, planning and implementation are achieved through Collaborative Decision Making (CDM) at European network level.

The main characteristics of the ATS Routes of the ARN Version-7 are:

- More routeing options offered to the Airspace Users. These routes are designed using principles and sectorisation independent from national boundaries, adapted to main traffic flows
- An airspace structure on the basis of an ATS route network and Free Route Operations, capable of being managed in a more flexible manner so as to allow operators to choose from several strategically designed airspace structures (ATS routes and Free Route operations).

Improvements in the strategic design, planning and management of these two components improve predictability of the route options.

The progressive introduction of more advanced navigation applications both on the ground and onboard, allows the implementation of Advanced RNP routes. As a result, spacing between routes can be reduced. Moreover, in areas where the spacing between Advanced RNP routes is not reduced, A-RNP capable aircraft can be directed to fly parallel to the flight planned route using the parallel offset function.

The requirements of GAT and OAT are accommodated by integrating these into the strategic ARN developments. As a consequence, deviations from ARN developments are kept to a minimum.

ATS Routes (permanent or conditional) are managed in a consistent manner. More ATS routes become conditional, to cope with new airspace configurations. The establishment of permanent routes now needs to be soundly justified. Conditional becomes the preferred option.

Operations along optimum trajectories are possible in defined airspace volumes at particular times. This is considered as a necessary step towards trajectory based operations.

4.1.2.4.Free Route Airspace Operations

In alignment with ICAO aviation system block upgrades, (the Framework for global harmonization, working document for GANIS), free routing corresponds to the ability for flights to file a flight plan with at least a significant part of the intended route which is not defined according to published route segments but specified by the airspace users. It is a user-preferred route, not necessarily a direct route, but the flight is supposed to be executed along the direct route between any way-point specified by the airspace user (published or not). Free Route operations could only be performed within a Free Route Airspace.

Free Route Airspace (FRA) is a specified airspace within which users may freely plan a route between a defined entry point and a defined exit point with the possibility to route via intermediate way points without ref. to the ATS route network, subject to airspace availability. The FRA is a fully managed airspace within which flights remain subject to ATC.
In Step 1, within a given FAB (Functional Airspace Block), the Free Route Airspace extends laterally to the FIR's limits of the belonging States, and vertically from a base level (specifically defined within each FAB.

Free Route operations concern flights in cruise or vertically evolving within this airspace. The user preferred route 2D design will be based on published Entry and Exit points of the free route airspace. The publication of a constellation of published reference waypoints may be studied. Airspace users can freely define additional intermediate waypoints, by using Latitude/longitude coordinates (Entry and Exit points excluded, a user preferred route may be entirely defined via non published waypoints).

The mandatory Entry and Exit points are defined in order to ensure a safe transition between Free Route and predefined route constrained environments, so a lateral or vertical connection between the user preferred route and the adjacent/subjacent ATS Route Network. This has been also facilitated via ARN design refinement.
Every Airspace user defines its user preferred trajectory according to its business intentions, which will strongly differ according to the operator type and business model (e.g. low cost airline or business aviation company) , and even according to the air link for a same operator (e.g. market competition & cost index, route charges, yield management).

According to the situation, the performance target and the associated design criterion will not be the same:

- time saving,
- distance flown reduction,
- fuel consumption reduction,
- yield management (e.g. hub management, flight crew turnover).

Consequently, the preferred route design may strongly vary. The UP4DT consists of:

- a single direct segment linking an entry point to an exit point (i.e. route length reduction), or
- a set of successive direct segments freely (still defined between two published Entry and Exit points), linking published or non-published (computed) waypoints (e.g. flight management using wind benefits). There is no limitation, every published or non-published (computed) waypoint may be directly linked to any other one, within the FAB Free Route Airspace.

As already mentioned, a fixed route network may locally and temporarily be activated within the Free Route Airspace, due to major operational constraint. Therefore the UP4DT may occasionally contain predefined route based chapter(s).

In the context of the studies some questions will have to be answered:

- If a published waypoints constellation is considered to be used, will it only consist of the already known published waypoints of the ATS route network within the FAB upper airspace (below the base FRA FL)? Plus additional ones? Or will it be a specific published constellation?
- Could Free Route operations be performed in Step 1 through several FABs (Multi FABs free trajectory design), or should the user preferred trajectory design contain a published Exit/Entry point to be overflown when passing from one FAB to the following one ?

- Continuous Descent Arrivals have to be performed. Their compliance with the Free Route operations has to be confirmed.
- How will be applied the Flight Level Orientation Scheme within FRA?

The use of Free Routing for flight in cruise will be progressively introduced inside FAB above a certain level.

4.1.2.5.Terminal Airspace Routes

Within Terminal Airspace, traffic is increasingly metered from entry/arrival gates into the terminal route system using arrival managers where required. Departure managers may also be used to improve metering of traffic from terminal to en route airspace, or to smooth the delivery of traffic from multiple departure points that converge into en route sectors. This further increases reliance on ATC support tools.

Traffic into terminal airspace is increasingly managed along ATS routes and metered in time. The use of Advanced RNP 1 terminal routes (including A-RNP1 SIDs and STARs) and RNP-based instrument procedures with vertical guidance enhances safety and capacity.

4.1.2.6.Airspace Configurations

An Airspace Configuration refers to the pre-defined and co-ordinated organisation of ATS Routes of the ARN and/or Terminal Routes and their associated airspace structures (including temporary airspace reservations/restrictions, if appropriate) and ATC sectorisation, aimed at balancing performance driven strategic objectives (capacity, flexibility, flight efficiency, environmental) at all levels, i.e. network, sub-regional and local.

Airspace Configurations are an extension of the notion of Airspace Scenarios and provide for a more integrated approach between airspace structures (including optimum trajectories and Terminal Airspace) and airspace network management with more flexibility in the latter.

Compared to Airspace Scenarios, which by their nature are fixed and static solutions enabling demand and capacity balancing, Airspace Configurations will enable flexible solutions as a function of changes that have occurred or are anticipated to occur.

Under particular Airspace Configurations, temporary airspace reservation/restriction may be activated and de-activated close to real time (Airspace Management). They can vary in size, location and time (to accommodate airspace user requirements)

A coordinated and systematic approach will be needed to select and change Airspace Configurations across the European ATM System, supported by a European Airspace Development plan (Advanced Airspace Scheme Route Network) deployed through successive ARN versions. This will be achieved through the Airspace Network Management function.

Until such time when Airspace Configurations will become completely dynamic, the majority of them are expected to be pre-defined strategically. Each configuration comprises a set of pre-defined fixed and flexible routing options (or optimised trajectories) and optimum ATC sectorisation, meeting civil and military air traffic demand, including environmental constraints if so determined. They will be capable of being dynamically adaptable to traffic demand so that they can respond flexibly to different performance objectives which vary in time and place. Using modular design techniques, sectors will be more and more adaptable in shape and size (pre-defined) in response to variations in demand and airspace availability.

The management of the notification of Airspace Configurations will be based on automatic flows of information between a centralised Airspace Data Repository (ADR) and the different stakeholders through defined services (Business to Business or Business to Customer)) provided by the Network Manager Function and made available through SWIM. Business to Business service will allow stakeholders to query the system according to their needs while

Business to Customer service will provide data to the stakeholders through an automated push mechanism. NOP portal will continue to be used to retrieve data by those stakeholders not subscribing to any specific service agreement.

4.1.2.7.Advance Flexible Use of Airspace (AFUA)

The concept of AFUA intends to provide more flexibility by allowing dynamic airspace management in all phases of the operations, from initial planning to the execution phase, taking into account local traffic characteristics.

AFUA structures are designed to fulfil military needs and better share the constraints with other airspace users.

A modular design of airspace reservation/restriction, Variable Profile Areas (VPA) for new airspace requirements is introduced to enable sub-divisions, new areas or revised airspace requirements closer to air bases (≤100 NM radius) and define different airspace scenarios to address local, sub-regional and network impact. A VPA can be any type of airspace reservation or restriction consisting of either individual or a combination of volumes / modules.

The basic unit volume of a VPA will be defined by the HLAPB according to the following principles:

- the construction of the VPA shall allow the maximum of flexibility and offer several combinations that can fit the airspace users' needs,
- smaller basic unit volume provide more flexibility, particularly interesting in a high density traffic area e.g. 10x10 NM,
- vertical limits shall be adaptable depending on the mission type, mission objectives, aircraft capabilities, etc.,
- any combination of basic volume is possible,
- the status (TRA, TSA, D or R) shall be adapted to the mission,
- the route network associated with the VPA has been taken into account in the area design to enable capacity optimization and different airspace allocation and rerouting scenarios.

For specific missions and under certain circumstances, fixed airspace structures will remain, including ATS Route, CDR and ARES due to safety, security, environmental or legal constraints.

Airspace reservations are fully embedded in the trajectory and negotiated through collaborative decision making process (A-CDM), limited to the individual operational need by the implantation of modular areas. The possibility to design 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 uplinked to the pilot and shared with all other concerned airspace users by the system. GAT crossing are possible in all type of airspace structures, after coordination or under specific permanent agreements, depending on the nature of the airspace. Nevertheless the penetration into a TSA-type or Prohibited-type of Airspace, shall only be intended to cover urgent situations and not as a common authorisation.

The continuous sharing of airspace planning and status between all ATM actors should limit the number of unnecessary constraints.

Automated processes are in place at ground and airborne levels (Wing Ops, Air Traffic Control (ATC) Systems, Airspace management Cell (AMC), Air defence Centres, Aircraft Equipage, etc.) in order to make the Mission Trajectory execution consistent with airspace allocation process (ARES activation/deactivation displayed in real time on CWP displays.

Figure 11 shows an airspace configuration supported by sub-division of military training areas (TSA/TRA/CBA), increasing number of conditional routes and facilitated by A-RNP1 route network

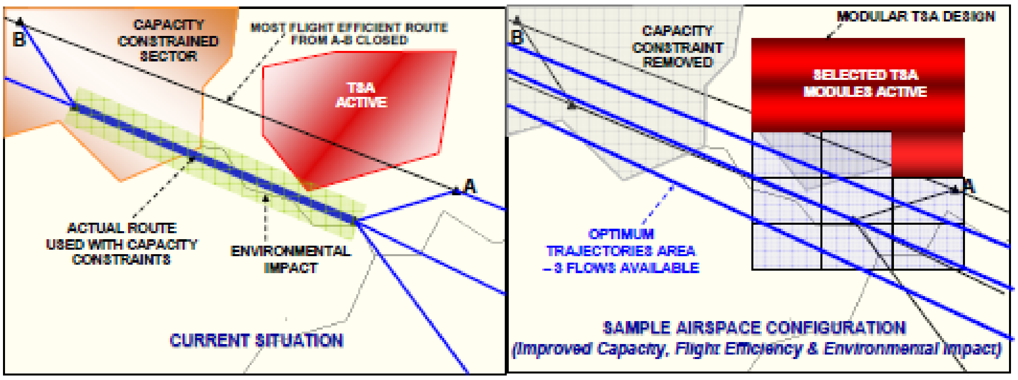

Figure 11 Current Situation & Sample Airspace Configuration

4.1.2.8.Airspace Planning

The Airspace planning and execution levels will closely interact at national, sub-regional and European level through a Network Operations Plan (NOP).The NOP will provide an overview of the ECAC airspace situation allowing for accessing and extraction of data, including traffic demand, airspace and airport capacity, constraints and airspace configurations.

Both at long and medium/short term planning levels, Airspace Network Management is achieved through Collaborative Decision Making (A-CDM) process linked with User Driven Prioritization Process (UDPP) and involving all participants (civil and military). It will be performed at European, sub-regional (e.g. FAB) and national level.

As a consequence, there will be a more efficient use of available airspace and/or capacity. Network Management will be undertaken giving consideration to the Civil and Military airspace user requirements and will involve the Network Manager and the coordinated functions of the ASM and ATFCM.

4.1.2.9.Information needs and management

Network Operations Plan (NOP)

The first steps of the interactive Rolling NOP were already implemented through the deployment of the NOP web portal. It provided an overview of the ATFCM situation from strategic planning to real time operations with ever increasing accuracy up to and including the day of operations. The data was accessible online by stakeholders for consultation and update as and when needed, subject to access and security controls.

Further systems and tools are integrated in Step 1 to support the interactive approach to the NOP, whose final aim is to facilitate the processes needed to reach agreement on demand and capacity. It is a set of collaborative applications providing access to traffic demand, airspace capacity, constraints and scenarios to assist in managing diverse events. The NOP integration with the AOP permits to also take into account airport capacity and constraints, thus constituting a single portal for all stakeholders to access 4D real time representation of the European ATM environment. The NOP is continually accessible to ATM partners and evolves during the planning and execution phase though iterative and collaborative processes.

The plan itself is the result of the complex interactions between the trajectories shared in the system (the demand), the capacity being offered, the actual and forecast MET conditions and resource availability. The NOP draws on the latest available information shared in the system. It includes scenarios to assist in managing diverse events that may threaten the network in order to restore stability of operation as quickly as possible. . It should provide as well projections of the expected performance considering the expected operational context and agreed solutions.

Swim

The System Wide Information Management is defined at an overall system level, rather than individually at each major subsystem one. This responds to the need of an integration of the ATM network from the information perspective, rather than from a technical system one. This fundamental change of paradigm forms the basis for the migration from one-to-one data exchanges to a many-to-many collaborative and geographically dispersed information distribution model.

SWIM enables the provision of commonly understood quality information delivered to the right people at the right time delivered at the right place - the Operational Temporality of information – to whole ATM Ground stakeholders.

The ATM information that is shared, is provided from technical systems to the SWIM technical infrastructure, and enabled through services. All information exchanges between the participants' technical systems will be performed using services, which may vary from support services completely isolated from legacy applications (e.g. core infrastructure services such as authentication, supervision, etc.) to services tightly integrated with the legacy applications.

The SWIM technical infrastructure promotes re-use of existing services and the consolidated infrastructure (such as existing Network Management Information Services). This generates cost savings, mitigates much of the integration technology risk, and provides a point of control for implementing guidance and integration.

During step 1 the ground-ground information exchanges, usually supported by point to point messages, and are progressively provided through the following services:

- Ground-ground flight coordination and transfer functions between en-route systems based on ED-133 Flight Object concept (ATC 2 ATC profile),
- business to Business services to share traffic flow management information (including the capability to fill and validate flight plans) between the Regional Network Management Function / Airspace Manager and APOC, FOC (Network Management Function, Business to Business Profile),
- business to Business services to share Aeronautical information between the EAD (as part of Regional Network Management Function / Airspace Manager) and ER-APP-ATC, Airport Airside Operations, FOC/WOC (EAD Business to Business Profile).

Two main models constitute the reference to guarantee the interoperability and usability of information by all the different ATM partners: AIRM and ISRM.

ATM Information Reference Model – AIRM

ATM Information Reference Model (AIRM) provides an implementation neutral definition of all ATM information, through harmonised conceptual and logical data models. It will contain well-known elements such as Aerodrome, ATS Route, Airspace, Flight procedure and a common definition of fundamental modelling concepts including time and geometry.

Information Service Reference Model – ISRM

Information Service Reference Model (ISRM) provides the logical breakdown of required information services and their behavioural patterns. Working towards service implementation specifications, it will include the details of services' payload, pattern of exchange, quality of service (QoS), and binding to the system-of-system data exchange infrastructure, also known as the SWIM infrastructure.

Information Management Functions (including Governance)

To achieve a common and transparent net-centric collaboration, there is a need to enforce governance on the resources made available on the SWIM network. The Information Management functions will establish the governance framework in terms of regulatory and support functions needed to perform system-wide information sharing. These functions include user identity management, discoverability of resources, security aspects such as authentication, encryption and authorisation, notification services, registration need to be defined to support information sharing. SWIM governance affects almost all the roles and their interactions within the ATM system. In addition, the management of information requires that policies related to the access and uses of information are developed. Rules, roles and responsibilities need to be defined, per stakeholder, taking into account the functional criticality of the information they handle. Data ownership, data provision and data usage rules will need to be redefined and possibly harmonised. Issues such as liability, charging and copyright principles should be proactively managed. To preserve Airspace Users' privacy of data, the level of disclosure of sensitive data has to be determined and evaluated against existing legal framework. In all circumstances, there is an increasing requirement for the definition and application of Service Level Agreements (SLA) between the different parties.

System Wide Information Management (SWIM) Security

SWIM might become an extremely attractive target for cyber-attacks (not necessarily carried out by terrorists or individual hackers exclusively, but other sources as well i.e. competitor States sponsoring cyber-attacks, hidden behind the difficulty of attribution of a cyber-attack). Attackers can get extremely robust capabilities at a considerably low cost.

In this context, appropriate levels of security are crucial to ensure real-time information exchange guaranteeing confidentiality, integrity and availability (CIA) of ATM data. SWIM and its information exchange requirements demands a robust security policy and security solutions to enable and protect the expected SES performance.

4.1.2.10.CNS Capabilities

Aircraft CNS capabilities

Aircraft CNS capabilities progressively available in step 1 are summarized here below. They are mainly driven by main airlines and commercial aviation.

Military transport-type aircraft follow same rules as Commercial aircraft (with adapted schedule) whereas other aircraft types follow specific rules (e.g. fighters are not concerned by CNS capabilities required for TMA and airport operations as their use of civil airports is not significant). When possible, military specific capabilities are re-used for ATM purpose, e.g. MIDS/L16 for ATM air-ground data link, Mode S/Mode 5 transponders for ADS-B in and out, military GNSS signals.

Regional/Business aviation may have some limitation linked to legacy interfaces (e.g. limited or no integration of ATN/VDL2 with other onboard functions) and key assumption is enhanced vision of external environment combined with Advanced Localizer Precision with Vertical guidance approach based on SBAS to operate CATII approaches.

General aviation has important limitations i.e. VFR GA mainly equipped with ADS-B[21], IFR GA-VLJ-Helicopter with ADS-B IN, SBAS and enhanced final approach and landing.

[21] There is an initiative for a Fit low power SSR transponder to equip small aircraft operating within identified TMA (only those not already normal transponder equipped) but there may be no standard according to EASA

Capabilities Available in Step 1	
COM	Automatic downlink of 4D trajectory according to contract terms dynamically specified during flight by ATC (e.g. ADS-C EPP). Automatic downlink of ETA min/max on the point specified in ATC request (e.g. ADS-C ETA min/max report). Data link exchange of clearance or instruction between ATC and Flight Crew i.e. Departure Clearance, D-TAXI, Clearances in TMA, for vacating at a specified runway exit, CTA/CTO, ASAS Spacing and ATSA ITP (CPDLC). Data link exchange of AIS/MET data (D-OTIS).
NAV	Onboard management of a single time constraint (CTA or CTO) with a required accuracy (+/-30'' or +/-10'' 95% of time). Onboard management of ASAS Spacing manoeuvres delegated to Flight Crew (e.g. “Remain behind” and “Merge then remain behind”). Onboard management of RNP transition to XLS (x = ILS, MLS, GLS) / LPV Precision Approach[22]. Onboard management and guidance of CAT II/III Precision Approach based on Ground Based Augmentation System (via GPS L1 or equivalent military GPS encrypted signal). Optimised Braking and Onboard management of taxi route and graphical display on moving map
SUR	Onboard generated alerts related to traffic at proximity of runway during operations at surface displayed on moving map presenting surrounding traffic (ATSA-SURF). Equivalent vision of landing and ground operations in Low Visibility Condition

[22] No OI associated to RNP transition to XLS/LPV PA but the enabler is step 1 and addressed by 9.09 PP

Ground CNS capabilities

Capabilities Available in Step 1	
COM	Air ground communication is achieved preferably by data link for equipped Aircraft and ATCU, excepted by voice in time critical situation requiring immediate action with widespread use of 8.33 kHz channel spacing below FL195. CPDLC[23] which started with the Link 2000+ program in En route is extended to Terminal Area and Surface operations as well as initial use of WiFi[24] for Surface operation. Ground-ground flight data processing exchanges usually supported by point to point messages[25] are progressively using initial SWIM services i.e.: • Services to share Flight Object information between ER-APP-ATC systems • Business to Business services to share traffic flow management information (including flight plans) between the the Regional Network Management, Airport Operations (APOC) and Users Operations (AOCC) • Business to Business services to share Aeronautical Information between EAD (Regional Network Management Function/Airspace Manager), ER/APP ATC, Airport Operations and User Operations (AOCC). For ground telephony needs, Voice Internet Protocol is available.
NAV	The Performance Based navigation (PBN) concept represents a shift from sensor-based to performance-based navigation. The primarily role of the Navigation Infrastructure is to support the Navigation Applications, used by all Airspace Users including Military. It includes all existing conventional means (VOR, NDB, DME, TACAN, ILS,) and GNSS-based means (GPS L1, GBAS, SBAS/EGNOS). As an alternative to ILS CAT I, GBAS CAT I and SBAS (EGNOS) operations are progressively installed at many European airports. GBAS CAT I ground stations have been installed in some ECAC countries, operational approvals for public use have been made. For the CAT II/III operations, GBAS CAT II/III is progressively installed when an alternative for the ILS is required.

[23] Based on VDL mode 2/ATN technology

[24] Based on AEROMACS technology

[25] Based on SYSCO/OLDI technology

SUR	Surveillance is foreseen to remain a mix of: SSR Mode S and Wide Area Multi-lateration as independent cooperative surveillance ADS-B Out for dependent surveillance PSR to support independent non-cooperative surveillance needs including for safety and security reasons. In the longer term, PSR is to be replaced by a more efficient technology like the multi-static primary surveillance radar (MSPSR). Air Navigation Service providers have a flexible choice of technologies depending on the respective operational requirements, geographic location and cost efficiency decisions.

4.1.3.Environment

4.1.3.1.Weather

The main weather conditions affecting airports and network performances are poor visibility, freezing conditions, strong winds and convective weather. These factors have an adverse impact on predictability of operations and on system capacity, due to higher uncertainty margins around trajectory predictions and in order to guarantee safety. Sensitivity of different Airspace Users to weather conditions can considerable vary depending on the type of aircraft operated (type of airframe, on-board equipment, etc.).

The arrival and departure airport capacity often drops in adverse weather conditions, requiring the application of ATFM regulations and the consequent generation of delay on flights. En-route capacity can also be affected by weather phenomena, e.g. due to the presence of cumulonimbus associated with thunderstorms or of ash clouds limiting the airspace access and determining flight re-routings or cancellations. This was the case in April 2010, when the eruption of Eyjafjallajokull volcano in Iceland had a major impact on European civil aviation, mainly through cancelled flights. Apart capacity, other impacts of adverse weather conditions on en-route operations include trajectory changes, inability to respect a time constraint, ground trajectory predictions degradation, less accuracy of controller support tools, conflict and/or complexity resolution solutions non applicable, work load increase, aircraft diversion etc.

Figure 13 illustrates the impact of weather on ATFM delays in Europe in 2010.

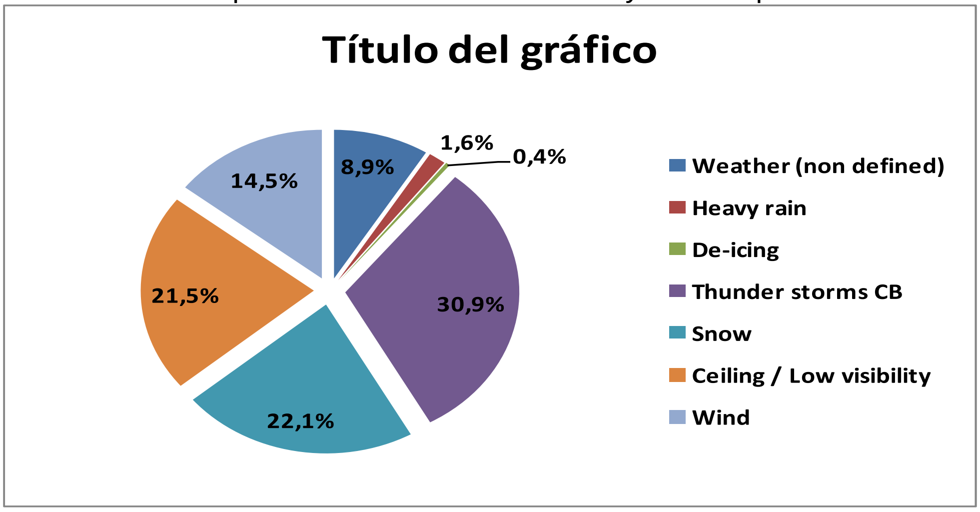

Figure 12 Impact of weather phenomena on ATFM delays (PRR 2010)

The following three basic weather categories can be distinguished for an airport:

- **Nominal** weather conditions, which are the conditions in which the airport operates in more than 90% of time and where the declared capacity for scheduling purposes is based on. Nominal conditions translate in conditions like no wind (or light wind under a certain threshold), no snow, no visibility constraints etc.
- **Adverse,** degraded, weather conditions, within the operational envelope of the airport, which have a significant negative impact on operations unless an appropriate response is organised; Adverse weather conditions may be reduced visibility conditions (e.g. Cat 2) conditions or strong and gusting wind.
- **Disruptive** weather, adverse conditions which are very unlikely to occur and would have a severe impact on airport performance but the airport cannot be expected to provide resources to mitigate the condition like snow at a Mediterranean airport.

Table 4 gives the characteristics for the categories of **Nominal** and the **Typical Adverse** conditions which have a negative impact on operations at airports.

Weather Constraint	Nominal Conditions	Typical Adverse Conditions	Comments
Visibility	More than 1,500 m	Less than 550 m	Visibility Condition 2[?]
Cloud Base	More than 1,500 ft	Less than 200 ft	
Wind Intensity and Direction	Less than 15 kt	More than: •15 kt head •30 kt cross	Head winds reduce the arrivals stream capacity for distance based separation. The limits on tail winds will depend on runway length
Wind gusts	No gusting	Gusting	Cross wind gust characteristics impact runway use (runway selection, in-trial separations)
Icing conditions	Above +3deg C, no moisture	Below +3deg C, close to dew point	Clear ice condition may be different from what is stated here
Precipitation	No precipitation, No standing water on runaway	Heavy rain, standing water on runway	
Snow/slush	No snow or slush on runaway	Snow or slush on runaway	
Braking conditions	Good	Medium to poor	Braking conditions are the determined by weather conditions rather than weather conditions themselves.
Duration of weather events	Less than 15 minutes	15 minutes or more	
Thunderstorm / lightning	No occurrence	Within 5km of airport or on arrival/ departure paths	Within 5 km of airport may result in the temporary halt of aircraft handing (e.g. fuelling) at the aircraft stand. On arrival/departure path may result in runway changes or temporary halt of runway operations

Table 4 Weather Categories

A further specification to characterise visibility might be applicable where Runway Visible Range is used as the metric.

Category	Landing Decision height (SDH)	Runway Visual Range
1	DH>200ft	>550m
2	100ft<DH<200ft	>300m
3a	0 ft<DH 100ft	>200m
3b	0 ft<DH <50ft	>200m
3C	DH = 0 ft	0m

Table 5 Low Visibility Landing Minima

Specific operating techniques and operational recommendations for specific types of operations usually supplement the Standard Operating Procedures in such cases as adverse weather, thus decreasing predictability to guarantee safety.

The provision through the Airport Operations Plan (AOP) of early information regarding the status of airport infrastructure and movement areas, combined with effective Collaborative Decision Making (CDM) and enhanced meteorological forecasts permits to mitigate the impact of adverse weather conditions.
Time-based separation dynamically adjusted according to weather conditions improves the management of arrivals in strong wind conditions.

The link of AOP to Network operations Planning (NOP) allows the system to become more predictable, while the co-operative trajectory management permits to minimize the impact on Airspace Users operations thanks to specific process such as the User Defined Prioritisation Process (UDPP) and the early available information.

4.1.3.2.Environmental constraints

The main impact of aviation on climate are emissions of carbon dioxide (CO2), contrails and cirrus clouds (H2O), oxides of nitrogen (NOx), oxides of sulphur (SOx) and soot.

CO2 can remain in the atmosphere for over 100 years and is considered to be the most important greenhouse gas (GHG) with the largest cumulative impact on climate. Aviation accounts for approximately 3.5% of total CO2 emissions in Europe, which is a relatively small share. However in view of the forecast traffic growth and the environmental and economic benefits, the aviation industry has a responsibility to minimise its impact on climate by further improving aviation efficiency.
At its 37th Assembly in October 2010, ICAO achieved the adoption of the first global governmental agreement, through which the aviation sector commits to reducing its greenhouse emissions (-2% per year until 2020).

Although the main contribution to the reduction of aviation CO2 emissions is expected to come from fleet renewal, technology developments and low carbon fuels, ANS has its role to play as well.

The ANS-related impact on climate change is closely linked to operational performance which is largely driven by inefficiencies (flight and temporal) and associated fuel burn. In Step 1 a more integrated approach to the management of traffic combines and coordinates different flow and queue management techniques in the air and on the ground together with green terminal operations, improved network design and free routing. All these improvements are aimed to reduce fuel burn, emissions and delays fostering the efficient utilisation of available en-route and airport capacity.

Some trade-offs are inevitable when the environmental impact of air traffic is constrained by other factors: safety limitations, noise limitations, capacity constraints, etc.

Aircraft noise at airports is a factor influencing people health, quality of life and other factors such as housing values. The measures for noise containment and their application are usually under the responsibility of Airport operators, depending on the local restrictions imposed by Governments or Planning Authorities.

The long term environmental objectives of SESAR are:

- To improve the role of ATM in enforcing local environmental rules by ensuring that flight operations fully comply with aircraft type restrictions, night movement bans, noise routes, noise quotas, etc.
- To improve the management of noise emissions and their impacts through better flight paths, or optimised climb and descent solutions; and,
- To improve the role of ATM in developing environmental rules by assessing the ecological impact of ATM constraints, and, following this assessment, adopting the best alternative solutions from a European sustainability perspective

For information, a number of existing legislations are noted at this stage:

Directive title	Description
Noise	
Limitation of noise **89/629/EEC**	This Directive sets stricter rules with regard to the limitation of noise emissions from civil subsonic jet aeroplanes. It does not apply to aeroplanes with a maximum take-off mass of up to 34,000 kg, and a

	capacity of up to 19 seats.
Operations of aeroplanes **2006/93/EC**	It requires Member States to ensure that all civil subsonic jet aeroplanes operating from airports situated in their territory comply with the standards specified in Part II, Chapter 3, and Volume 1 of Annex 16 ICAO.
Introduction of noise-related restrictions **2002/30/EC**	It requires the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports. This restriction is based on the ICAO 'Balanced Approach' and it specifies the overall approach to airport noise management in Europe.
Environmental noise directive **2002/49/EC**	It provides guidance for Member States on the assessment and management of environmental noise using harmonised noise metrics and subsequent publishing of noise management plans. It requires competent authorities in Member States to draw up "strategic noise maps" (i.e. noise contours) for major roads, railways, airports and agglomerations, using harmonised noise indicators and to draw up action plans to reduce noise where necessary.
Environmental	
European Trading Scheme **2008/101/EC**	According to Directive 2003/87/EC and subsequent amendments, Airspace Users will be obliged to surrender "allowances" for virtually all commercial flights with a take-off weight of 5.7t or above, landing at and departing from any airport in the EU as from 2012. Domestic aviation will be subject to the same rules as international air traffic. Airspace Users with a relatively low number of flights have been exempted to avoid excessive administrative cost burden. The so-called "de minimis" clause excludes operators with fewer than 243 flights per 4-months period for three consecutive 4 months periods was added to the directive
Directive **2008/50/**EC on ambient air quality and cleaner air for Europe	It sets clear standards and requires Member States to stay within set limits for these pollutants

Table 6 Environmental constraints

4.2.Roles and Responsibilities

The following list includes the key roles within different stakeholders' organizations and the main changes foreseen in their responsibilities in Step 1. For the complete list of Actors, Roles and Responsibilities, please refer to Appendix D.

Airline Operations Centre (or Flight Operation Center)

Flight Crew

Flight Support and Technical Officer

Wing Operations

Network Manager

new roles in ATM layered planning:

- "ATC Sector Planner"
- "Multi-sector Planner"
- "Complexity Manager"

Executive Controller

Tower Ground Controller

APOC Supervisor

Part 3
Operational Scenario

5.High Level Operational Scenario

5.1.Operational Scenario for step 1

5.1.1.Long Term Planning

The Long Term Planning Phase provides the ATM context for the Airspace Users to commence planning of the flight and the development of the Trajectory (it will become the B/MDT "Business/Mission Development Trajectory" in step 2).

At this stage, the declared resources available to the ATM System (e.g. airport capacity figures, taking into account airport emissions plans [AUO-0801]) are compared with the known demand to create the initial demand/capacity balancing (DCB). The Network Manager elaborates the Demand Forecast (traffic and airspace demand) and Capacity Forecast in close coordination with his partners (that includes civil and military Airspace Users, Local Capacity Managers and the Airport Operations Centres). This information allows creating a plan including measures that can be prepared and possibly applied in order to minimize the impact of ATM on Airspace users' performance.

In order to identify where capacity may not meet the demand profile or efficiency goals and why, Network Operations in the Long-Term Planning phase provides a clear view of Traffic demand and Airspace demand forecast, as well as understanding of infrastructure capacity, development needs and deliveries. This work is supported by modelled mitigation solutions, agreed with all aviation partners, and aligned to performance criteria. The results are incrementally published through the Network Strategic Plan.

The Airspace Users, at this relatively early stage in the planning of the flight are aware of the constraints that could be imposed on the flight (e.g. routing limitations due to a major Military exercise).

The Airport Operator of the departing airport allocates all agreed departure slots to all concerned parties through the Network Operations Plan (NOP), which is an output of the Long-Term Planning phase.

The Airport Operator of the arriving airport allocates all agreed arrival slots to all concerned parties through the NOP, which is enabled by initial SWIM and thus made available to all subscribers to the system [DCB-0103].

At the same time the Airport Operator develops the seasonal stand plan.

Military aspects
For military operations, Long Term Planning represents the origin of planned missions known by military actors as e.g. Combined/Joint Forces Staff Headquarters, NATO Commands, Air operations centres, etc…At this stage, most information on long-term planning of major exercises or events can be shared and de-conflicted with other events.

The recurrent daily training of combat and reconnaissance squadrons and Flight Crew training schools, military air transport (including air-to-air refuelling, airborne early warning system parachuting), Special Operations, test flights, UAS operations, and special events are considered.

In order to facilitate the elaboration of the Demand Forecast by the Network Manager the data should be preferably labelled by the degree of maturity:

- Planned exercises (dates, number of expected sorties per day, impacted FIR/UIR, concerned airspace portions/volumes (high, medium, low altitude), planned general time slots (summer or winter time tables) etc.,

- the volume of flights expected for each military platform, relying upon previous year statistics and on the annual plans: number of flights and distribution between VFR and IFR, number of hours of flight in High Altitude/Medium Altitude/Low Altitude,
- high visibility events for which military aerial units are committed (e.g. protection of International Conference Summits, protection of World Championship, Olympic Games, Air shows).

All relevant information having an interest for the ATM Network and allowing a better planning is shared through the NOP [AOM-0304a].

5.1.2.Medium/Short Term Planning

The Airspace User publishes its proposed flight schedules based on the allocated arrival and departure slots [DCB-0103]. The schedules are elaborated with the Airspace User's preferred trajectories and may include free route airspace based on the planned aircraft type plus any known ATM constraints such as possible airspace volume reservation and are then, individually instantiated as the User Preferred 4D Trajectories / Request Mission Trajectories (UP4DT/ReqMT) which are published to all concerned parties through the NOP (it will become the SB/MT "Shared Business/Mission Trajectories" in step 2).

Early available information about flight intentions are collected by the system (Schedule data, Allocated airport slot data, standard preferred routes ...), as a first milestone in the UP4DT development.

The Network Manager elaborates, maintains, and makes accessible, enhanced forecast of Traffic Demand used to support the Medium/short Term planning phase, when detailed information about traffic demand derived from flight plans is not yet available.

The Airport Operator in an A-CDM process prepares an initial stand allocation based on published flight schedules one day prior to operations.

Local Capacity Managers define and share sectors capacities in a pro-active manner improving the predictability of capacity. The Network Manager captures, maintains, and makes accessible on a need to know basis, the published sector capacities needed to build the Network Operations Plan in a CDM approach.

Resources and capabilities available at all levels (from sector to Network level) are managed to provide a clear description of the available capacity for a given time period. Up-to-date and comprehensive capacity data and information from ANSPs and airports are made available supporting stakeholders in the development of medium to short term plans, in particular for the Demand Capacity Balancing activity.

The allocation of airspace taking into account civil and military users' needs (Flexible Use of Airspace concept) is a rolling activity carried out through a CDM process in order to elaborate an optimum solution for the civil/military airspace sharing and to reach a collegial agreement.

ATFCM/ASM planning and DCB activities are iterative processes, which progressively generate and detail the Network Operation Plan (NOP). Processes are initiated several months ahead, on a rolling pattern, and are progressively refined till during the execution phase.

The Network Management function develops DCB solutions for expected capacity shortfalls. CDM processes with all concerned actors (local, sub-regional and regional levels, AUs) allow the building of catalogues of DCB solutions that could be used depending on the situations and the environment contexts.

Following the analysis of the demand and resources and capabilities, the Network Management function (at local, sub-regional and regional level) identify the areas/flows/sectors/points… where a DCB problem is anticipated and may need the implementation of a solution to minimize the impact of the detected bottlenecks.

The implementation of DCB measures to solve a DCB problem is also subject to CDM processes. It includes optimum Airspace Configurations measures (e.g. sectors configurations, airspace allocation), ATFCM scenarios, alternative routes proposed to the Airspace Users based on the Airspace users' preferred trajectories, dynamic DCB measures, ATFCM regulations. It is supported by the assessment of the impact of the solutions on the different levels of the network (regional/sub-regional/local).

The Network Management function monitors the situation and may use fast time simulations to re-assess the evolution of traffic demand, the airspace re-configuration and the impact of any DCB measures.

Resolving identified capacity/demand imbalances is iterative throughout the Medium/Short Term Planning and execution phases; DCB and dynamic DCB solutions may be implemented and fine-tuned all the way through these phases.

The Network Manager records the agreed measures in the System (NOP). The ATM System always makes available the updated NOP to all interested actors.

Updates to the airspace planning by the Local Traffic Manager, the Flow Manager or the Airspace Manager are also recorded in the NOP.

The Airspace User submits the revised UP4DT integrating the known ATM constraints and airspace volumes (iterative UP4DT/ReqMT) to the ATM System [AUO-0203-A]).

The Tower Supervisor in an A-CDM process with the Airport Operator provides information on Airport capacity capabilities that may include short of staff and equipment that will limit airport capacity to the System which updates the NOP.

The Airspace User refines the UP4DT for the flight based on the Airspace Use Plan (which gives the airspace configuration/availability) and files the ATC flight plan for the day of operation to the Network Management function.

In case of ATM constraints, the UDPP process may be activated to take into account Airspace Users priorities and swaps according to their business needs [AUO-0101, AUO-0102]. The Network Manager facilitates its implementation by assessing the impact of such process on the Network [DCB-0305].

Military aspects

In the short and medium term planning, it is essential that the airspace management process is consistent with the trajectory management process in order to ensure allocation of specific training areas at the appropriate time. In Step 1, when Airspace Reservation/Restriction (ARES) is needed, it is part of the Mission Trajectory description. The improved OAT Flight Plan will contain the agreed ARES [AOM-0304-A].

Missions Trajectories covered by Step 1 Trajectory management and AFUA

Daily training is generally composed of single missions and small exercises including possible air-to-air refuelling phases and Airborne Warning & Control System operations (AWACS).

For a complete joint exercise comprising multiple flights departing from multiple aerodromes, and including air-to-air refuelling phases, formation of Composite Air Operation (COMAO), transiting phases, high-low-high profiles flights, air combat phases, AWACS operations, parachuting phases, UAS operations, Combat Search and Rescue (CSAR) operations, Combat helicopters operations etc., the shared information on all ReqMTs would be much more complex. Mission trajectories will create a more complex environment for the system(s) and for the other users. Trajectory management in step 1 does not aim to cope with such complex operations.

Such exercises are relatively infrequent but a high level of flights synchronisation is required. As a result, every MT must obtain a high level of priority, determined during anticipated CDM processes, in order not to be constrained by the validation process within the ATM system and to keep the planned flight synchronisation intact. In other words, such ReqMT will probably not be published in the NOP, the system may identify potential constraints through pre-defined and non-predefined airspace structure reservation/restriction only and propose adjustments as a remedy to non-participant airspace users only (both civil and military) [AOM-0205].

Business, General and Rotorcraft aviation

Short-notice flight needs are accommodated within the daily plan through UP4DT with limited information due to detailed needs unknown. UP4DT trajectories may be defined by handing agents or pilots on behalf of smaller airlines, business aviation, general aviation and rotorcraft flights, or by the ANSP if required (e.g. on behalf of the GA).

5.1.3.Pre-Departure

Based on the last iteration of the UP4DT / ReqMT, the Airspace User produces the operational flight plan which corresponds to the trajectory the Airspace User will fly and the ANSP & Airport will strive to facilitate.

This trajectory does not contain all the necessary elements to enable the implementation of the “Reference Business/Mission Trajectories” which is foreseen in step 2 [AUO-0204-A]), in particular ground routing is not an integrated part of the airborne trajectory although related ground (A-CDM) timings such as Target Start-up Time (TSAT), based on individual Variable Taxi Times (VTT) will be used.

If the flight is subject to an ATFCM regulation, the Airspace User will be notified of a CTOT and a Target Time over the congested area protected by the regulation. The Target Time can be a Target Time of Arrival (TTA) or a Target Time Over (TTO). The objective is to increase the effectiveness of the Network by improving the awareness of the TTA/TTO needed for ensuring the smoothing effect of regulations on the demand.

The Airspace User in coordination with Flight Crew (or alternatively the Ground Handler) provides the Target Off-Block Time (TOBT) to the System, which is a time estimate of the aircraft ready, all doors closed, boarding bridge removed, push back vehicle available and ready to start up / push back immediately upon reception of clearance from the Tower Controller. The TOBT is maintained updated through the A-CDM process.

The System issues a Target Take-Off Time (TTOT) based on the filed flight plan / UP4DT. Amongst other parameters, the TTOT takes into consideration the TOBT, the TTA at the destination airport (when available) and the departure runway in use. Furthermore with knowledge of the TTA, the elapsed time derived from the UP4DT, the departure and arrival demand for the runway(s) and the dependent departure route demand from adjacent airports, the local departure management process will calculate the associated start-up/ push-back time and taxi route [TS-0306].

The System issues the TSAT that will match the TTOT, taking into account the TOBT and taxi route from the flight’s stand to the holding point and the associated taxi time.

Flight Crew has received the pre-flight information briefing (e.g. NOTAMs, Weather forecasts, etc.) concerning the flight.

Once onboard, Flight Crew sends a notification to the first ANSP[26] to provide aircraft address and data link capabilities (e.g. CPDLC, ADS-C, FIS / D-OTIS via ATN). Once the log on is completed, Flight Crew automatically receives from the ATM system the TSAT and the

[26] Flight Crew notifies the first ANSP and the connexions with the next ANSPS are transparent.

planned (computed) taxi-out route information from the stand to the departure runway [AUO-0302-A].

Flight Crew uploads into the aircraft system (manually or automatically if received via data link) the operational flight plan (routes and constraints constituting the UP4DT/ReqMT) and all other relevant data according to Company's Standard Operational Procedures (e.g. zero fuel weight and fuel uplift, cost index, wind/temperature data etc.). ATM systems being capable of initial Trajectory Based Operation automatically transmits a contract related to the provision of trajectory data (e.g. ADS-C EPP Extended Projected Profile) to the aircraft capable of initial Trajectory Based Operation. 4D trajectory data computed by the aircraft systems are automatically down linked to the ATM system in accordance with the rules set in the contract. The objective is to feed ATC tools with more precise data so as to improve their prediction capabilities [IS-0303a].

Although user's preferences and limitations have been taken into account in the UP4DT/ReqMT Flight Crew may revise them for take-off to take into account last minute change due to operational reason including weather degradation [AUO-0303a]. When air and ground capabilities permit these changes, they are down-linked via data link [IS-0303a]. These changes are taken into account by the ATM System.

Any update of the ground routing and/or TSAT is communicated to Flight Crew via data link.

Tower Ground Controller uses the DMAN System to determine push-back and taxiing priorities (parameters for prioritisation determined locally) in order to optimise runway throughput. To improve the aerodrome throughput, Departure and Arrival Management are very closely related and coordinated functional entities, themselves closely linked to the surface movement entity. The taxiing process is an integral part of the process chain of DMAN-to-SMAN-to-AMAN with A-CDM processes between the Airport operator, TWR and Airspace Users [AO-0207]. The Network Manager uses the information as a TTOT reference.

Flight Crew requests "Departure Clearance" through the System via data link [AUO-0302-A]. The Tower Ground Controller issues the "Departure Clearance" including updated TSAT via data link. Flight Crew acknowledges receipt of the clearance using the System.

Flight Crew requests the "Start Up" and Push Back" from the Tower Controller via data link. The Tower Ground Controller uses the DMAN information to determine time to issue "Start Up and Push Back Approval". He also verifies that the aircraft will comply with its CTOT window prior to providing the Start Up approval and pushback instruction to Flight Crew.

The Tower Ground Controller (or Apron Manager) provides the Start Up approval/Push-back instruction via data link [AUO-0302a]. Flight Crew gives instructions for the push back procedure to the Ground Handling Agent. The Ground Handling Agent, after checking the Traffic Situational Awareness display [AO-0204] and visually verifying that there are no vehicles or other objects in proximity, commences the aircraft push-back

Flight Crew starts up the engines in accordance with Airport procedures. Departure information (AOBT) is made available by the System which recognises the event from the A-SMGCS data through flight plan and surveillance correlation. This event updates the DMAN and if necessary changes the departure sequence [TS-0202] [TS-0203].

All the above procedures may change depending on Airport regulation and Company's Standard Operational Procedures (SOP).

Military aspects (only differences to the above-description) when ARES is used.
Contrary to transport aircraft, air ground data link (e.g. CPDLC) is not considered for Combat aircraft in Step 1 (the possible use of MIDS/L16 for ATM purposes must be assessed).

For flights making use of an ARES the TTOT takes into consideration the Target Time Over (TTO) at the ARES entry and/or exit points instead of TTA [AOM-304-A].

Flight Crew uploads into the MMS (Mission Management System) the operational flight plan (routes and constraints constituting the ReqMT) and all other relevant data according to the Mission Procedures (e.g. aircraft configuration and wind/temperature data, etc.).Flight Crew may manually revise any preference or limitation to take into account last minute change.

Any update of the ground routing, TSAT, "departure clearance" elements are communicated to Flight Crew via voice communication.

Aircraft Formations are considered as a single flight and managed by Leader pilot who is in charge to coordinate all information related to the mission with "wingmen".

Specific to UAS, to be noted that due to a lack of pertinent regulations the majority of UAS operations have to operate within segregated ARES in all phases of flight (Climb, Cruise and Descent). Some ad-hoc airspace structures as cylinders and corridors have to be designed and published. (This need for management of UAS is not foreseen to be implemented in Step 1 but must be taken into account by ATM operations and future information sharing principles of Step 1).

5.1.4.Taxi- out

Flight Crew requests the Taxi Clearance from the Tower Ground Controller (or from the appropriate ATS unit according to local airport procedures). The Ground Controller assesses the tactical situation, selects the most appropriate routing as proposed by the ATM system (SMAN) [AO-0205] and issues a taxi clearance utilizing D-TAXI for equipped aircraft [AUO-0302-A] and R/T for non-equipped aircraft.

Flight Crew acknowledges the taxi clearance and related routing is depicted on the Aircraft HMI superimposed with airport moving map. This display also includes the status of runways and taxiways, obstacles, and stands [AO-0206] [AUO-0602] [AUO-0603].

During the taxi-out, the planned departure sequence may be changed to sequence for example, departures from adjacent airports that are interfering [TS-0302]. Additionally, at any moment the Tower ground Controller may alter the ground routing and with the support of the ATM system uplink the new taxi routing instruction to Flight Crew. Once acknowledged, the related routing is updated on the aircraft HMI as well as within the local ground system. The Target Take-off time may be updated in the ground system accordingly.

The Tower ground Controller issues clearances and instructions to safely manage the progression of the flight along its taxi route and may also revise the taxi routing using preferably data link for equipped aircraft or else R/T in case of time critical situation.

The Tower Ground Controller uses the A-SMGCS to monitor the aircraft movement and track its progress against the issued taxi-out route and its position with respect to other surface traffic. He is provided with an alert if the system detects unauthorized / unidentified traffic or potential conflicts or incursions involving mobile units (moving and stationary unit) on runways and taxiways [AO-0104] [AUO-0605]. The aircraft system also automatically provides alerts to Flight Crew in case of traffic at proximity of the runway. Vehicle drivers are provided with information on traffic to assist them in maintaining situational awareness particularly in times of low visibility [AO-0204] [AO-0206].

The aircraft reaches departure runway holding position and the Tower Ground Controller transfers control to the Tower Runway Controller, using R/T.

5.1.5.Take-off

The Tower Runway Controller verifies that the final approach area to the runway is clear, that the aircraft will meet arrival/departure separation requirements and that the departing aircraft will comply with its CTOT window prior to providing by R/T the line-up instruction to the aircraft.

The Tower Runway Controller by visual reference and/or using the ground system verifies that the runway is free of obstacles for the take-off of the aircraft. The Tower Runway Controller issues the take-off clearance to Flight Crew using R/T.

Flight Crew initiates the take-off roll and the aircraft is airborne. The ground system detects that the aircraft is airborne and initiates an automated departure message.

The Tower Runway controller is provided with the necessary tools to enable the application of time based wake turbulence radar separation rules (TBS) so as to aid towards stabilising the overall time spacing between departing aircraft [AO-0303] [AO-0304A].

4D trajectory data computed by the aircraft systems are automatically down linked to the ATM system in accordance with the rules set in the contract (e.g. ADS-C EPP). The objective is to feed ATC tools with more precise data (Actual Take-Off Time and derived Estimated Times Over) so as to improve their prediction capabilities [IS-0303-A].

5.1.6.Climb

The trajectory (UP4DT/ReqMT) contains the SID and is ideally unrestricted up to the cruise altitude. The trajectory data shared by the aircraft allows improved prediction for the ground systems thereby reducing the need for intermediate level constraints and facilitating Continuous Climb Departure (CCD) [AOM-0705].

Wherever possible, airspace and procedures have been designed to enable optimised profile climbs that achieve the near continuous climb while still allowing Controllers flexibility in managing the tactical situation.

An MTCD-based tool assists Controller in identifying conflicts and updating the route if required to ensure the flight remains conflict free [CM-0405]. Conflict Detection and Resolution tools support Controller task management in Terminal Area Operations [CM-0406].

5.1.7.Cruise

The trajectory (UP4DT/ReqMT) includes pre-defined routes and ideally preferred cruising route (free route) [AOM-0501]. Cruise Climb (CC) may be authorised if appropriate e.g. for business jets flying at high level and when/where traffic permits [AUO-0304].

Throughout the whole flight, aircraft derived data[27] [IS-0302] are used to enhance the performance of ground based applications (including tracking, safety nets, conflict detection and monitoring tools) used by Executive and Planning Controllers. Trajectory management is supported by specific automation that permits Controllers to monitor and amend the trajectory and perform planning tasks [CM-0104].

Also throughout the flight, the aircraft automatically down link weather data from onboard sensors (e.g. winds/temperatures) when/where requested in the ADS-C contract[28]. This data are used by MET Service Providers to improve forecasts and provide Airspace users with last up to date MET data e.g. winds/temperatures on several points and flight levels during cruise and descent to make onboard trajectory predictions more reliable [IS-0501].

All along the flight the monitoring of the complexity is coordinated between the planning controllers, MSP and LTM with decisions taken by MSP (punctual actions on traffic) or LTM (more global actions, e.g. on a flow of traffic in which the flight is included. They commonly monitor the demand/capacity balance and ensure that sector overloads will be avoided

[27] ADS-B out allows the aircraft to broadcast position, speed, altitude, flight ID, Wake Vortex category, etc. but not gross weight and min/max speed schedule which will require a new standard in a further step than step 1 (IS-0302); to be noted that gross weight and min/max speed schedule are part of ADS-C EPP in step 1(IS-0303).

[28] The exchange of met data (e.g. winds/temperatures) already exists between A/C & FOC via ADS-C/ACARS and will be in step 2 between A/C & ATC via e.g. next ADS-C EPP standard or A/G SWIM (IS-0501).).

through the application of support tools [CM-0103] [CM-0104]. As complexity in very busy airspace may be so high that it will not be possible to manage it with conventional ATC means, further operational improvement managing controllers' workload will cover the dynamic management of airspace/route structure [CM-0102-A].

The multi-sector planner/planning Controller [CM-0301], based on better knowledge on the flight profile through the trajectory data automatically down linked as requested in the contract (e.g. ADS-C EPP) [IS-0303-A], is able to better plan flights through sectors and to improve the accuracy of the AMAN at destination by applying Controlled Time Over/Arrival (CTO/CTA). He is supported by medium term complexity management and conflict resolution tools to de-conflict or synchronise trajectories [CM-0104]. Likewise, thanks to the introduction of new trajectory exchange mechanism, coordination between adjacent ATC centres and with the network manager is more efficient.

Dynamic DCB process in execution phase
Around a few hours until a few minutes before the entry, the Local Traffic Manager monitors the balance between demand and capacity by assessing traffic demand and ATC workload.

In case of a detected problem the Local Traffic Manager performs an analysis of different parameters to determine the nature of the problem including complexity assessment [CM-0103] and decides if actions need to be taken.

If appropriate, dynamic airspace reconfigurations (e.g. sectors reorganisations, ARES reallocation) will be used to solve the problem [CM-0102A].

One or several STAM (Short Term ATFCM Measures) from the dDCB/STAM catalogue will be chosen to provide an efficient solution. STAM measures are fine-tuned technics for dDCB adjustment, which can apply to flights still on the ground as well as airborne flights. [DCB-0205]

In that case and if time permits, a CDM process is activated between the partners concerned (adjacent Local Traffic Managers, Airspace Users, and Network Manager) to share the information, and decide on the implementation.

In case the local measures will be insufficient to solve the issue or have not been accepted through the CDM process, the Local Traffic Manager escalates to the Network Manager for the implementation of a network solution (scenarios, regulations).

For STAM measures agreed and implemented, the Local Traffic Manager monitors their effectiveness and adjusts them if required.

All concerned Actors will input information (e.g. changes to capacity, trajectories etc.) into the System, dynamically updating the Network Operations Plan and coordinating such actions where appropriate applying CDM. The System keeps all actors informed about the Network Operations Plan updates.

In case of a Short Term ATFCM Measure affecting an airborne flight following the dynamic DCB process, coordination will be made with PC/MSP for its implementation taking into account real traffic situation.

Conformance monitoring and MTCD-based tools provide real-time assistance to the Executive Controller for monitoring trajectory conformance and provide resolution advisory information based upon predicted conflict detection [CM-0204].

The use of Advanced RNP routes, as well as the Offset function of the avionics system following an ATC instruction, ease separation provision by the Executive Controller [AOM-0404].

To plan across several sectors is possible resulting from actions commonly supported by planning controllers and multi sector planning. The use of data link allows Controllers to issue long duration and/or complex clearances through multi sectors (for example 2D PTC based on pre-defined 2D routes with required navigational performance (2D RNP) [CM-0601]). Instructions in time critical situations will continue to be transmitted via R/T.

A time before the flight enters his Multi Sector Area (MSA), the Planning Controller (or the Multi Sector Planner (MSP) if endorsing the responsibilities of the ATC Planning role for a group of sector, and these sectors be manned with one Executive controller – see § 4.2 Roles and Responsibilities) is provided by the FDPS system with information related to this flight [CM-0301]. This information is the result of the integration in the trajectory of aircraft derived data as well as information coming from other ACCs concerned by the flight thanks to improved interoperability.

This flight belongs to some flows of traffic under the survey of the planning role. Actions on the entry and exit conditions are taken according to the range of the planning area under survey. Detection of conflicts [CM-0104], actions on the flow in which the flight is included may be taken on the support of coordination when there is an overlapping of the area of responsibility between MSP and Planning controller. MSP eventually act in cooperation with the LTM in the monitoring task of the demand/capacity balance.

MSP or the planning controller may solve a conflict either by modifying the entry conditions in the sector (point of entry, FL, estimated time) or by making a conflict resolution decision [CM-0204] using "what if" function.

If time permits, the Airspace users may be involved to find the preferred way to respect the new constraints and the Network manager as well to keep the overall performance of the ATM system in case of multiple UP4DT/ReqMT affected.

The Executive Controller issues the new clearance, using data link [AUO-0302a] or voice in situations requiring immediate actions. Flight Crew loads the clearance data in the aircraft system, acknowledges the clearance and activates the revised trajectory [AUO-0303A] which is automatically down linked to provide ground system with updated trajectory data (ADS-C EPP) [IS-0303-A].

Flight Crew flies the new UP4DT/ReqMT and the Executive Controller, assisted by a route conformance tool, monitors the progress of the aircraft with respect to the given clearance [CM-0203].

The complexity management continues to be assured through the respective roles of MSP and LTM, taking into account the planning controller's feedback. Demand versus Capacity is continuously checked with the assurance of the control of the expected sector workloads and this with the application of support tools [CM-0103] [CM-0104]. As complexity in very busy airspace may be so high that it will not be possible to manage it with conventional ATC means further operational improvement managing Controllers' workload will cover the dynamic management of airspace/route structure [CM-0102-A].

The deviations to the Target time Over/Arrival (TTA/TTO) if any, are monitored by the Network Management function.

Military flights are integrated with other flights and managed as contained in the ReqMT and OAT flight plan [AOM-0304-A].

When an Airspace Reservation/Restriction is used, the cruise phase is interrupted at ARES entry point and re-starts at exit point. The training duration within the ARES is as close as possible the planned one if the flight is not constrained, and in conformance with the agreed CTOs if the flight is constrained. The planned training duration needed to fulfil the mission should be preferably kept against the planned time at entry point during the CDM process.

Use of air ground data link e.g. CPDLC for CTO allocation may be considered for combat aircraft[29] but voice communication will remain for any clearance. Additionally, even though a time constraint cannot be uplinked to MMS in step 1, the capability to respect a time

[29] if MIDS accommodation to ATM proves to be feasible

constraint over a way point communicated by voice is perfectly controlled by airborne military systems and aircrew.

The management of the evolving traffic situation is supported by automation that permits specific ATM roles to manage complexity [CM-0103] and ensures the involvement of all stakeholders that will be involved in later flight phases [DCB-0304].

Preparation of the descent during cruising phase
In order to prepare the descent, Flight Crew receives the latest up to date arrival parameters [IS-0402a].

In parallel, Flight Crew has received from Airspace Users and loaded into the aircraft systems the last updated winds and temperatures. For capable flights, this information is normally routinely provided by the FOC (this procedure may change depending on Company's SOP). Following these updates, the new trajectory predictions computed by the aircraft systems are automatically down linked in accordance with the contract terms, i.e. in case of deviation of the predictions greater than the thresholds specified by ATC in the contract (e.g. via ADS-EPP[30]) [IS-0303-A]. It will feed ATC tools including the trajectory prediction, in particular to allow a more robust time synchronisation on merging points at arrival.

Before beginning the descent (to avoid busy approach phases), Flight Crew has received through the D-TAXI service [AUO-0302-A] the planned runway exit and taxi-in route computed by the Arrival Airport Ground ATM System and has added this information to the aircraft system. Flight Crew checks the feasibility of the runway exit on the basis of aircraft performances, runway status and weather conditions to prepare the optimized braking and the runway vacation at the coordinated runway exit whilst minimising the Runway Occupancy Time. This procedure may shift depending on Company's SOP (it can be performed manually or via automation using e.g. Brake-To-Vacate function [AUO-0702] [AUO-0703]).

Tailored arrival procedures may also be offered, on a per flight basis, if traffic permits, from TOD to IAF or to runway taking in account other traffic and constraints to optimize the descent and minimise the need for low level airborne holding [AOM-0704]. The Executive Controller En route issues an inbound clearance including the STAR and Approach to be flown to Flight Crew [AUO-0302-A]. Upon receipt of the inbound clearance Flight Crew loads the data in the aircraft system, acknowledges the clearance and activates the revised trajectory [AUO-0303-A] which is automatically down linked to provide ground system with updated trajectory data (e.g. ADS-C EPP) [IS-0303-A].

Triggered by Flight Crew acknowledgement of the inbound clearance, an ADS-C contract is sent to the aircraft requesting the "ETA min/max" computed onboard for the CTA metering point (where necessary to manage capacity constraints) associated to the inbound clearance (e.g. IAF). Upon receipt, the aircraft system automatically down links the ETA min/max on the required point (e.g. ADS-C ETA min/max report) [IS-0303-A].

The AMAN servicing the destination determines the sequence and required sequencing actions. If a required time constraint falls within the ETA min/max window, the AMAN proposes a CTA at the defined metering point as a potential solution. This information is provided to the relevant Controllers (E-TMA or TMA) [TS-0103].

In the more congested Terminal Areas, the Arrival Management system (AMAN) provides support to coordination of traffic flows into multiple airports in the vicinity to enable a smooth delivery to the runways [TS-0303].

[30] Contract terms are also named TMR Trajectory Management Requirements

If the flight is to be integrated into an arrival sequence involving traffic departing from within the AMAN horizon of the destination airfield, AMAN and DMAN processes will be linked through A-CDM to allow a smooth arrival flow [TS-0304].

The ATM system computes a prediction of the modified trajectory[31], should the CTA be implemented to allow the concerned ATS Units to check the acceptability of this change from a complexity and occupancy point of view on the portion of trajectory in their area of responsibility.

Once analysed by them[32] Controller(s) currently responsible for the flight, notified through the ATM System, up links the CTA (via CPDLC) [AUO-0302-A]. Through ground-ground coordination all concerned ATS Units are made aware of the CTA constraint given to a particular flight and may analyse the potential effect in their airspace.

Flight Crew acknowledges the CTA, thereby agreeing to adhere to it and loads it into the aircraft system, which activates a revised trajectory [AUO-0303-A] which is automatically down linked to provide ATM system (Trajectory Predictor and its client functions) with the last up to date trajectory data (e.g. ADS-C EPP) [IS-0303-A]. Implicit in the allocation of a CTA, is that ATC agrees to facilitate it as far as practicable.

Trajectory conformance monitoring in both air and ground systems ensures that the flight complies to the revised Trajectory with the required accuracy and performance [CM-0204].

When the aircraft is about to reach the TOD position, Flight Crew request the descent clearance. The Executive Controller ensures that no potential conflict exists and clears the aircraft for descent.

5.1.8.Arrival

The Aircraft commences its descent in compliance with the trajectory (UP4DT/ReqMT) which contains ideally an unrestricted optimum profile allowing a continuous descent [AOM-0702] or a near idle 3D profile integrating a time constraint when and where required (CTA) [TS-0103]. Airspace and procedures have been designed to enable optimise profile descents to achieve the near continuous descent while still allowing Controllers flexibility in managing the tactical situation.

Using the System, the Planning Controller evaluates the projected descent flight path and identifies to the Executive Controller any converging flight that may present a potential conflict within his sector [CM-0104]. The Executive Controller evaluates the situation and issues the appropriate instructions to resolve the conflict.

Flight Crew continuously receives the latest airport information, including weather, runway in use, via the D-OTIS [IS-0402].

When building the arrival sequence, AMAN has also considered constraints from the taxi route as planned by SMAN e.g. choice of the arrival runway with regard to the shortest route to the planned aircraft stand. The SMAN has also needed information on the planned arrival sequence with the aim to calculate a conflict-free route to the aircraft parking stand [TS-0104].

The Multi-Sector Planner / Planning Controller of the next sector evaluates the projected trajectory of the aircraft to ensure that it is conflict free and, if it is, agrees the exit/entry conditions within his sector through the System. Coordination between the En-route and TMA Multi-Sector Planner or Planning Controllers (depending on the E-TMA or TMA

[31] the capability for the AMAN or associated ground predictor tool to compute the anticipated effect of a CTA on the trajectory in the upstream ATS Units is under validation.

[32] The capability for concerned (intermediate) ATS units to analyse and agree on the trajectory change proposal is under validation

operational organisation) is supported by terminal area automation that assists in determining conflict free routing in the TMA [CM-0405].

The Executive Controller transfers the aircraft to the next sector Executive Controller. The System supports handover by communicating the event to Flight Crew via data link (silent transfer procedures) and to the downstream sector/unit.

The APOC updates the ATM System, the Tower Ground Controller, the AOCC and the Ground Handling Agent to enable the assignment of required turn round services on a timely basis. If the stand has been changed with respect to the planned one, the AOCC provides the new stand number to Flight Crew via data link.

The ATM System updates the planned runway exit and related taxi-in route [AO-0205]. The information is provided to the Tower Ground Controller and TWR Runway Controller. If modified, the updated Estimated Landing and in block times are sent to the APOC and to the Airspace User. When different from the initially sent runway exit and taxi route, the ATM System transmits the revised data to Flight Crew, as information, via data link [AUO-0302-A].

The Executive Controller ACC (feeder) transfers the aircraft to the Executive Controller TMA. The Executive Controller TMA evaluates the arrival management sequence and the intervals between the flights and determines to utilize the sequence as published.

Conflict detection and resolution tools will support Controller task management in Terminal Area Operations [CM-0406].

5.1.9.Approach

Terminal Airspace is enhanced with the use of Advanced RNP terminal routes including STAR and Approach [AOM-0603].

For this example, the ATC method applied in approach to merge arrival streams is ASAS Spacing [TS-0105] (or manual ASAS spacing [TS-0107]). So before reaching the merge initiation point, Controller requests Flight Crew to identify the target aircraft on his HMI (preceding aircraft in the landing sequence). Flight Crew confirms the identification to Controller.

In other cases, the merging of arrival streams may be achieved using RNP or P-RNAV based standard instrument procedures (STAR). Where no standard procedures exist, or the conditions are not appropriate to utilise them, standard open-loop ATC clearances may be used to vector aircraft but it should remain the exception. Flight Crew then receives the ATC instruction for ASPA manoeuvre (e.g. Merge behind target aircraft with the required time spacing specified by the AMAN and the point at which the Merge Behind procedure will be terminated e.g. FAF) [AUO-0302-A]. Flight Crew loads this information into the aircraft system and checks the feasibility of the manoeuvre. If the procedure is achievable, Flight Crew accepts the ASPA instruction, stops the CTA operation (if still current) and activates it in the aircraft system which will execute the ASPA manoeuvre [TS-0105].

Controller has delegated the execution of the spacing task to Flight Crew. Controller remains responsible for the separation thus applies a spacing (preferably time based) which includes a buffer added to the applicable minimum separation. Controller closely monitors the ASPA manoeuvre to ensure separation is not infringed and instructs Flight Crew to stop the manoeuvre before the FAF.

Flight Crew then receives instructions for the final approach.

5.1.10.Final approach

Flight Crew flies the procedure contained within the UP4DT / ReqMT, e.g. RNP transition to GLS/LPV Localiser Precision with Vertical Guidance Approach [AOM-0602].

The Approach Controller transfers control of the flight to the Tower (Control Tower) while instructing Flight Crew to contact the Tower Runway Controller preferably via R/T.

The Tower Runway Controller provides Flight Crew with the required landing information. He monitors the traffic situation and intervenes if required.

When Flight Crew is not using visual separation, the Final Approach controller and the Tower Runway controller are provided with the necessary tools to enable the application of time based wake turbulence radar separation rules on final approach (TBS), so as to aid towards stabilising the overall time spacing between arrival aircraft [AO-0303] [AO-0304B].

In case of low visibility operations, GBAS CATII/III may be used for precision approaches [AO-0505a][33] and/or Enhanced Vision "Head Up" combined with LPV/SBAS to facilitate landing [AUO-0403].

Controller monitors by visual reference and by using the A-SMGCS that the runway is clear of previous landing traffic and adjacent traffic, ensuring that the traffic complies with instructions and that the runway remains clear of other possible obstructions.

5.1.11. Landing and taxi-in

The Tower Runway Controller issues the "Landing Clearance" (including the runway exit previously agreed) by R/T. Flight Crew acknowledges the landing clearance.

Flight Crew lands the aircraft decelerating appropriately to vacate at the runway exit coordinated with ATC (manually or using automation e.g. Brake-To-Vacate function [AUO-0702] [AUO-0703]). The ATM System detects touch-down and disseminates this information to the Airspace User and airport information system. The System makes this information available to other users. The EIBT is updated.

The Tower Runway Controller confirms that the flight has landed via visual confirmation and via the Ground Surveillance System (A-SMGCS). When the aircraft is clear of the runway, the Tower Runway Controller transfers control of the flight to the Tower Ground Controller.

The Tower Ground Controller provides the taxi-in route clearance preferably by data link [AUO-0302a]. Flight Crew acknowledges the taxi clearance and related routing is depicted on the Aircraft HMI superimposed with airport moving map [AUO-0602].

The SMAN informs the ground Controller of any deviation from route/plan it has detected. Then the ground Controller gives a new taxi route to Flight Crew with the assistance of the SMAN [AO 0205].

The Tower Ground Controller uses the A-SMGCS to monitor the aircraft movement and track its progress against the issued taxi-out route and its position with respect to other surface traffic. He will be provided with an alert if the system detects unauthorized / unidentified traffic or potential conflicts or incursions involving mobile units (moving and stationary unit) on runways and taxiways [AO-0104] [AUO-0605]. The aircraft system will also automatically provide alerts to Flight Crew in case of traffic at proximity of the runway. Vehicle drivers are provided with information on traffic to assist them in maintaining situational awareness particularly in times of low visibility [AO-0204] [AO-0206].

Flight Crew manoeuvres the aircraft looking out using visual navigation aids (e.g. taxiway markings and lighting) and assisted by the routing displayed onboard the aircraft. For aircraft equipped with ADS-B in, ADS-B out equipped aircraft and vehicles are displayed on the Aircraft HMI, providing Flight Crew with information on adjacent surface traffic, supplementing visual observations and enhancing see-and-be-seen procedures especially in Low Visibility Operations (LVO). Flight Crew correlates the traffic information displayed

[33] (initially based on current GPS L1 in step 1, on dual GNSS in next steps)

within the aircraft and visible externally with the alerts and instructions received from the Tower Ground Controller and manoeuvres the aircraft accordingly [AUO-0602] [AUO-0603].

Instructions with regard to other aircraft or ground vehicles are issued via R/T. The cleared taxi route and its subsequent revisions are provided by D-TAXI [AUO-0302-A], except when dictated by safety (e.g. crossing of active runways) where voice is used.

Flight Crew proceeds in accordance to the taxi instruction to the first physical stop line/stop bar as confirmed by the routing displayed on the moving map and awaits further clearance/instructions. If the Aircraft proceeds across an illuminated stop bar, the Ground System provides Flight Crew and the Tower Controllers with an automated alert [AUO-0605] who immediately instruct Flight Crew to stop, using R/T.

If the Taxi Clearance Limit is an active runway, the Tower Ground Controller instructs Flight Crew to contact related responsible Tower Runway Controller who will issue clearance to cross via R/T.

The Tower Runway Controller verifies, either visually or using the ground Surveillance System (A-SMGCS), that the aircraft is crossing the runway and once vacated, he instructs Flight Crew to contact the Tower Ground Controller responsible for this ground surface area; transferring control of the aircraft.

As the Aircraft approaches the stand, the aircraft is guided to the correct stop position by stand guidance means.

The System detects “in block”, records the event and disseminates the information to the Airspace User and makes the information available for other users.

5.1.12.Post flight phase[34]

During the whole operation of the flight, Key Performance Indicators or KPIs including agreed Civil Users – Military Users Key Performance Indicators on airspace usage have monitored throughout the operation to determine how effective ATM has meet Airspace User’s demand (Airspace, airport / airdrome, services). Once operation has ended, monitoring acts as driver for further improvements of the ATM System. Both Users and Providers (ANSPs, APs, Network, Meteorological and aeronautical Information and auxiliary services) are able to assess the actual operation (Routes actually flown, usage of allocated airspace, mission effectiveness and flexibility, runway utilisation, stands allocated, taxi routes used, time deviations from Target Times and it’s causes) against the planed operation and to assess the adequacy of the Network / Regional / Local capacity provision and to take suitable actions as to continuously enhance civil-military cooperation and coordination.

For keeping environmental sustainability of the ATM System, Network efficiency indicators are monitored to describe the environmental performance of the ATM network. Even though most of the sustainability policies are valid at local level, the defined Sustainability Framework for ATM has integrated a set of Key environmental Performance Indicators that takes into account local specificities for assessing the operation and detect improvement opportunities.

[34] Post Flight Phase is defined in Deployment Baseline Concept. There are no OIs in Step 1 that develop further improvement in Post Flight phase rather what DeploymentBaseline had set. However, text included describes in high level overview Deployment Baselineconcept State derived from Deployment BaselineOIs, which final elements are to be identified by WPC.2 (T2.2 Short term Deployment Scenarios).

Appendix A **References**

FRAMEWORK Reference documents for CONOPS/DODs (High level Information about Concepts)

- ICAO Global ATM Concept Document, Doc 9854.
- European Air Traffic Management Master Plan Edition 1 - 30 March 2009 (Not updated)
- SESAR Definition Phase : D3 "ATM Target Concept"
- GANIS Working Document: The Framework for Global Harmonisation

MAIN Reference Documents for CONOPS/DODs (Body textual references about Concepts)

- SJU: Concept Storyboard, Version 01.00.00
- SESAR Definition Phase: DLT-0612-222-02-00_D3_Concept of Operations
- SESAR B4.2: Initial 4D Trajectory Management Operations (iTOPS), Version 01.00.00
-
- Introduction to the Mission Trajectory - Version 1.0
- SESAR B4.2: Trajectory Management Document, Version 00.02.33
- SESAR B4.2: Full scope Step 1 scenario update
- SESAR The Concept of Operation at a glance, (with military (red) & GA/R (blue) inputs
- SESAR B4.2 + X.2s: Multi-flight Business Trajectories Issue Management Conclusion Report
- SESAR B4.2 + X.2s: TTA Issue Management Conclusion Report (Expected)
- SESAR B4.2: Initial Service Taxonomy Document
- SESAR LEXICON

COMPLEMENTARY Reference Documents for CONOPS/DODs (For OIs detailed descriptions, Enablers, Performance, KPAs, KPIs, Performance Metrics, and Architecture Models)

- SESAR B1: Integrated Roadmap Version V1.03b
- SESAR B4.1 Deliverable 016, V1.0E: Validation Targets Step1 (Final Draft)
- SESAR B4.3: Architecture Description Document
- SESAR B4.1: ATM Business Reference Model Report, v00-01-00
- B4.1 Draft Validation Target Allocation for Step 1 – For Consultation, v00.01.00

AUXILIARY Reference Documents for CONOPS/DODs

- EUROCONTROL STATFOR, Medium Term Forecast, February 2011
- EUROCONTROL STATFOR, Short Term Forecast, February 2011
- EUROCONTROL STATFOR, Business Aviation in Europe in 2010,
- Directorate Single Sky Civil-Military ATM Co-ordination Division (DSS/CM), Military Statistics, Edition 2011
- EUROCONTROL, European ATS Route Network (ARN) Version 7 Concept of Operations & Catalogue of Projects
- EUROCONTROL, Introduction to the Mission Trajectory, V1.0
- SESAR 07.05.02, Advanced Flexible Use of Airspace (OSED)
- EUROCONTROL, Performance Review Report 2010

Appendix B
Mapping of SESAR Packages, Sub Packages and OFA to ICAO ASBU

ICAO Block	ICAO Thread	ICAO Module	SESAR Operational Package	SESAR Operational Sub-Package	SESAR OFA number	SESAR Operational Focus AREA	Step	Initial Operating Capability
0	15	**B0-15** - Improved Traffic Flow through Runway Metering	End to End Traffic Synchronisation	Traffic Synchronisation	OFA04.01.03	AMAN + Point Merge	1	2007
0	15	**B0-15** - Improved Traffic Flow through Runway Metering	End to End Traffic Synchronisation	Traffic Synchronisation	OFA04.01.03	Integrated AMAN DMAN	1	2007
1	15	**B1-15** - Improved Approach and Departure Management through Integration	End to End Traffic Synchronisation	Integrated Surface Management	OFA04.02.03	Surface management Integrated with Arrival and Departure Management	1 or 2	2013
1	15	**B1-15** - Improved Approach and Departure Management through Integration	End to End Traffic Synchronisation	Integrated Surface Management	OFA04.02.01	Surface Planning and Routing	1 or 2	2013
1	15	**B1-15** - Improved Approach and Departure Management through Integration	End to End Traffic Synchronisation	Traffic Synchronisation	OFA04.01.04	DMAN Multiple Airports	1 or 2	2013
1	15	**B1-15** - Improved Approach and Departure Management through Integration	End to End Traffic Synchronisation	Integrated Surface Management	OFA04.02.03	Surface management Integrated with Arrival and Departure Management	1 or 2	2013
1	15	**B1-15** - Improved Approach and Departure Management through Integration	End to End Traffic Synchronisation	Integrated Surface Management	OFA04.02.03	Surface management Integrated with Arrival and Departure Management	1 or 2	2014
1	15	**B1-15** - Improved Approach and Departure Management through Integration	End to End Traffic Synchronisation	Integrated Surface Management	OFA04.02.03	Integrated AMAN DMAN	1 or 2	2014
1	15	**B1-15** - Improved Approach and Departure Management through Integration	End to End Traffic Synchronisation	Traffic Synchronisation	OFA04.01.02	AMAN and Extended AMAN horizon	1 or 2	2010
1	15	**B1-15** - Improved Approach and Departure Management through Integration	End to End Traffic Synchronisation	Traffic Synchronisation	OFA04.01.02	AMAN and Extended AMAN horizon	1 or 2	2015
2	15	**B2-15** - Linked AMAN/DMAN	End to End Traffic Synchronisation	Traffic Synchronisation	OFA04.01.04	DMAN Multiple Airports	1 or 2	2013
2	15	**B2-15** - Linked AMAN/DMAN	End to End Traffic Synchronisation	Traffic Synchronisation	OFA04.01.03	AMAN + Point Merge	1 or 2	2020
2	15	**B2-15** - Linked AMAN/DMAN	End to End Traffic Synchronisation	Traffic Synchronisation	OFA04.01.01	Integrated AMAN DMAN	1 or 2	2020
0	65	**B0-65** - Improved Airport Accessibility	Increased Runway and Airport Throughput	Weather Resilience	OFA01.01.01	LVPs using GBAS	1	2013
1	65	**B1-65** - Optimised Airport Accessibility	Increased Runway and Airport Throughput	Weather Resilience	OFA01.01.01	LVPs using GBAS	1	2013

1	70	**B1-70** - Increased Runway Throughput through Dynamic Wake Vortex Separation	Increased Runway and Airport Throughput	Enhanced Runway Throughput	OFA01.03.02	Dynamic Vortex Separation	1	2012
1	70	**B1-70** - Increased Runway Throughput through Dynamic Wake Vortex Separation	Increased Runway and Airport Throughput	Enhanced Runway Throughput	OFA01.03.01	Time Based Separation	1	2013
0	75	**B0-75** - Improved Runway Safety (A-SMGCS)	Increased Runway and Airport Throughput	Airport Safety	OFA01.02.01	Airport safety nets	1	2013
1	75	**B1-75** - Enhanced Safety and Efficiency of Surface Operations (A-SMGCS/ATSA-SURF)	Increased Runway and Airport Throughput	Airport Safety	OFA01.02.02	Enhanced situational awareness	1	2013
1	75	**B1-75** - Enhanced Safety and Efficiency of Surface Operations (A-SMGCS/ATSA-SURF)	Increased Runway and Airport Throughput	Weather Resilience	OFA01.01.02	Pilot enhanced vision	1	2013
1	75	**B1-75** - Enhanced Safety and Efficiency of Surface Operations (A-SMGCS/ATSA-SURF)	Increased Runway and Airport Throughput	Airport Safety	OFA01.02.01	Airport safety nets	1	2013
2	75	**B2-75** - Optimised Surface Routing and Safety Benefits (A-SMGCS Level 3-4, ATSA-SURF IA and SVS)	End to End Traffic Synchronisation	Integrated Surface Management	OFA04.02.01	Surface Planning and Routing	1 or 2	2013
2	75	**B2-75** - Optimised Surface Routing and Safety Benefits (A-SMGCS Level 3-4, ATSA-SURF IA and SVS)	End to End Traffic Synchronisation	Integrated Surface Management	OFA04.02.05	Guidance assistance to aircraft and vehicles	1	2013
2	75	**B2-75** - Optimised Surface Routing and Safety Benefits (A-SMGCS Level 3-4, ATSA-SURF IA and SVS)	End to End Traffic Synchronisation	Integrated Surface Management	OFA04.02.05	Guidance assistance to aircraft and vehicles	1	2013
0	80	**B0-80** - Improved Airport Operations through A-CDM	Integrated and Collaborative Network Management	Demand and Capacity Balancing Airports	OFA05.01.01	Airport Operations Planning and CDM	1 or 2	2007
0	80	**B0-80** - Improved Airport Operations through A-CDM	Integrated and Collaborative Network Management	Demand and Capacity Balancing Airports	OFA05.01.01	Airport Operations Planning and CDM	1	2010
0	80	**B0-80** - Improved Airport Operations through A-CDM	Integrated and Collaborative Network Management	Demand and Capacity Balancing Airports	OFA05.01.01	Airport Operations Planning and CDM	1 or 2	2012
0	80	**B0-80** - Improved Airport Operations through A-CDM	Integrated and Collaborative Network Management	Demand and Capacity Balancing Airports	OFA05.01.01	Airport Operations Planning and CDM	1	2013
0	80	**B0-80** - Improved Airport Operations through A-CDM	Integrated and Collaborative Network Management	Demand and Capacity Balancing Airports	OFA05.01.01	Airport Operations Planning and CDM	1	2007
0	80	**B0-80** - Improved Airport Operations through A-CDM	Integrated and Collaborative Network Management	Demand and Capacity Balancing Airports	OFA05.01.01	Airport Operations Planning and CDM	1	2010
1	25	**B1-25** - Increased Interoperability, Efficiency and Capacity though FF-ICE/1 application before Departure	Moving from Airspace to Trajectory Management	Conflict Management and Support Tools	OFA03.03.03	Enhanced Decision Support Tools and Performance Based Navigation	1	2008
1	25	**B1-25** - Increased Interoperability, Efficiency and Capacity though FF-ICE/1 application before Departure	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.01	Trajectory Management Framework	1	2013

1	25	**B1-25** - Increased Interoperability, Efficiency and Capacity though FF-ICE/1 application before Departure	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.08	System Interoperability with air and ground data sharing	1	2013
1	25	**B1-25** - Increased Interoperability, Efficiency and Capacity though FF-ICE/1 application before Departure	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.08	System Interoperability with air and ground data sharing	1	2013
2	25	**B2-25** - Improved Coordination through multi-centre Ground-Ground Integration: (FF-ICE/1 and Flight Object, SWIM)	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.01	Trajectory Management Framework	1 or 2	2017
2	25	**B2-25** - Improved Coordination through multi-centre Ground-Ground Integration: (FF-ICE/1 and Flight Object, SWIM)	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.08	System Interoperability with air and ground data sharing	1 or 2	2017
2	25	**B2-25** - Improved Coordination through multi-centre Ground-Ground Integration: (FF-ICE/1 and Flight Object, SWIM)	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.01	Trajectory Management Framework	1 or 2	2020
2	25	**B2-25** - Improved Coordination through multi-centre Ground-Ground Integration: (FF-ICE/1 and Flight Object, SWIM)	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.08	System Interoperability with air and ground data sharing	1 or 2	2016
2	25	**B2-25** - Improved Coordination through multi-centre Ground-Ground Integration: (FF-ICE/1 and Flight Object, SWIM)	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.04	Business and Mission Trajectory	1 or 2	2016
3	25	**B3-25** - Improved Operational Performance through the introduction of Full FF-ICE	Moving from Airspace to Trajectory Management	Conflict Management and Support Tools	OFA03.03.03	Enhanced Decision Support Tools and Performance Based Navigation	1	2013
3	25	**B3-25** - Improved Operational Performance through the introduction of Full FF-ICE	Moving from Airspace to Trajectory Management	Conflict Management and Support Tools	OFA03.03.03	Enhanced Decision Support Tools and Performance Based Navigation	1 or 2	2017
1	30	**B1-30 -** Service Improvement through Integration of all Digital ATM Information	Information Management	SWIM	ENB02.01.01	SWIM	1	2013
1	30	**B1-30 -** Service Improvement through Integration of all Digital ATM Information	Information Management	SWIM	ENB02.01.01	SWIM	1	2015
1	30	**B1-30 -** Service Improvement through Integration of all Digital ATM Information	Information Management	SWIM	ENB02.01.01	SWIM	1	2015
1	31	**B1-31** - Performance Improvement through the application of System Wide Information Management (SWIM)	Information Management	SWIM	ENB02.01.01	SWIM	1	2013
1	31	**B1-31** - Performance Improvement through the application of System Wide Information Management (SWIM)	Information Management	SWIM	ENB02.01.01	SWIM	1	2013
1	31	**B1-31** - Performance Improvement through the application of System Wide Information Management (SWIM)	Information Management	SWIM	ENB02.01.01	SWIM	1	2013
1	31	**B1-31** - Performance Improvement through the application of System Wide Information Management (SWIM)	Information Management	SWIM	ENB02.01.01	SWIM	1	2016
1	31	**B1-31** - Performance Improvement through the application of System Wide Information Management (SWIM)	Information Management	SWIM	ENB02.01.01	SWIM	1	2016

1	31	**B1-31** - Performance Improvement through the application of System Wide Information Management (SWIM)	Information Management	SWIM	ENB02.01.01	SWIM	1	2016
1	10	**B1-10** - Improved Operations through Dynamic ATS Routing	Efficient and Green Terminal Airspace Operations	Enhanced Route Structures	OFA02.01.01	Optimised RNP Structures	1 or 2	2015
1	10	**B1-10** - Improved Operations through Dynamic ATS Routing	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.03	Free Routing	1 or 2	2015
1	10	**B1-10** - Improved Operations through Dynamic ATS Routing	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.07	Cruise climb	1	2015
3	10	**B3-10** - Traffic Complexity management	Integrated and Collaborative Network Management	Demand and Capacity Balancing En-Route	OFA05.03.01	Airspace Management and AFUA	1, 2 or 3	2017
3	10	**B3-10** - Traffic Complexity management	Moving from Airspace to Trajectory Management	Conflict Management and Support Tools	OFA03.03.04	Sector team operations	1 or 2	2017
0	35	**B0-35** - Improved Flow Performance through Planning based on a Network-Wide view	Integrated and Collaborative Network Management	Demand and Capacity Balancing En-Route	OFA05.03.04	Enhanced ATFCM processes	1 or 2	2011
0	35	**B0-35** - Improved Flow Performance through Planning based on a Network-Wide view	Integrated and Collaborative Network Management	Demand and Capacity Balancing En-Route	OFA05.03.07	Network Operations Planning	0 or 2	2007
0	35	**B0-35** - Improved Flow Performance through Planning based on a Network-Wide view	Integrated and Collaborative Network Management	Demand and Capacity Balancing En-Route	OFA05.03.07	Network Operations Planning	1 or 2	2010
0	35	**B0-35** - Improved Flow Performance through Planning based on a Network-Wide view	Integrated and Collaborative Network Management	Demand and Capacity Balancing En-Route	OFA05.03.07	Network Operations Planning	1 or 2	2012
1	35	**B1-35** - Enhanced Flow Performance through Network Operational Planning	Integrated and Collaborative Network Management	Demand and Capacity Balancing En-Route	OFA05.03.06	UDPP	1, 2 or 3	2015
2	35	**B2-35 -** Increased user involvement in the dynamic utilisation of the network	Integrated and Collaborative Network Management	Demand and Capacity Balancing En-Route	OFA05.03.07	Network Operations Planning	1, 2 or 3	2016
0	85	**B0-85 -** Improved access to Optimum Flight Levels through Climb/Descent Procedures using ADS-B	Moving from Airspace to Trajectory Management	Airborne Spacing and Separation	OFA03.02.03	ATSA-ITP	1	2012
1	85	**B1-85** - Increased Capacity and Flexibility through Interval Management	Moving from Airspace to Trajectory Management	Airborne Spacing and Separation	OFA03.02.01	ASPA S&M	1	2013
1	85	**B1-85** - Increased Capacity and Flexibility through Interval Management	Moving from Airspace to Trajectory Management	Airborne Spacing and Separation	OFA03.02.01	ASPA S&M	1	2013
1	105	**B1-105** - Better Operational Decisions through Integrated Weather Information (Strategic >40 Minutes)	Information Management	SWIM	ENB02.01.01	SWIM	1	2016
0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Improved Vertical Profiles	OFA02.02.01	CDA	1	2007

0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Improved Vertical Profiles	OFA02.02.01	CDA	1	2013
0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Enhanced Route Structures	OFA02.01.01	Optimised RNP Structures	1	2007
0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Enhanced Route Structures	OFA02.01.01	Optimised RNP Structures	1	2015
0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Enhanced Route Structures	OFA02.01.02	Point Merge in Complex TMA	1	2007
0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Enhanced Route Structures	OFA02.01.02	Point Merge in Complex TMA	1	2015
0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Enhanced Route Structures	OFA02.01.01	Optimised RNP Structures	1	2009
0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Improved Vertical Profiles	OFA02.02.04	Approach Procedures with Vertical Guidance	1	2011
0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Enhanced Route Structures	OFA02.01.01	Optimised RNP Structures	1	2011
0	5	**B0-5 -** Improved Flexibility and Efficiency in Descent Profiles (CDOs)	Efficient and Green Terminal Airspace Operations	Enhanced Route Structures	OFA02.01.02	Point Merge in Complex TMA	1	2011
1	5	**B1-5 -** Improved Flexibility and Efficiency in Descent Profiles (OPDs)	Efficient and Green Terminal Airspace Operations	Improved Vertical Profiles	OFA02.02.04	Approach Procedures with Vertical Guidance	1	2015
0	20	**B0-20 -** Improved Flexibility and Efficiency in Departure Profiles	Efficient and Green Terminal Airspace Operations	Improved Vertical Profiles	OFA02.02.03	CCD	1 or 2	2013
1	40	**B1-40** - Improved Traffic Synchronisation and Initial Trajectory-Based Operation	End to End Traffic Synchronisation	Traffic Synchronisation	OFA04.01.05	i4D + CTA	1 or 2	2018
1	40	**B1-40** - Improved Traffic Synchronisation and Initial Trajectory-Based Operation	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.01	Trajectory Management Framework	1 or 2	2017
1	40	**B1-40** - Improved Traffic Synchronisation and Initial Trajectory-Based Operation	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.01	Trajectory Management Framework	1 or 2	2017
1	40	**B1-40** - Improved Traffic Synchronisation and Initial Trajectory-Based Operation	Moving from Airspace to Trajectory Management	4D Trajectory Management	OFA03.01.01	Trajectory Management Framework	1 or 2	2017

Appendix C **OI steps Step 1**

These OI steps are based on the integrated roadmap version 1.03b.

As the work on the integrated roadmap is on-going there will be differences to the actual version of the integrated roadmap.

Most of the OI steps relating to SWIM are not covered in the scenario text as well as OI steps relating to UDPP. Furthermore there are four OI steps not referenced in the scenario. The OI steps without a link in the scenarios are marked with an *.

OI step ID	**OI step Title**
AO-0104	Airport Safety Nets including Taxiway and Apron
AO-0204	Airport Vehicle Driver's Traffic Situational Awareness
AO-0205	Automated Assistance to Controller for Surface Movement Planning and Routing
AO-0206	Enhanced Guidance Assistance to Airport Vehicle Driver Combined with Routing
AO-0207	Surface Management Integrated With Departure and Arrival Management
AO-0208-A	Advanced Information Management and System Integration in the ATC Tower*
AO-0303	Time Based Separation for Final Approach - full concept
AO-0304	Weather-dependent reductions of Wake Vortex separations for final approach and departure
AO-0505	Improved Low Visibility Operations Using GBAS (based on GPS L1 in step 1)
AOM-0304-A	Mission Trajectories
AOM-0404	Optimised Route Network using Advanced RNP1
AOM-0501	Use of Free Routing for Flight in Cruise Inside FAB above a certain level
AOM-0603	Enhanced Terminal Airspace for RNP-based Operations
AOM-0702	Advanced Continuous Descent Approach (ACDA)
AOM-0704	Tailored Arrival
AOM-0705	Advanced Continuous Climb Departure
AUO-0102	User Driven Prioritisation Process (UDPP) as an input to Airport/Network CDM *
AUO-0103	Manual User Driven Prioritisation Process (UDPP) *
AUO-0203-A	Shared Business / Mission Trajectory (initial Shared Business/Mission Trajectory in step 1)
AUO-0204-A	Agreed Reference Business / Mission Trajectory (initial Ref Business/Mission Trajectory in step 1)
AUO-0302-A	Provision of clearances using Data link: Initial and time based implementation
AUO-0303-A	Revision of reference business/mission trajectory using data link: initial and time based implementation.
AUO-0304	Initiating Optimal Trajectories through Cruise-Climb Techniques
AUO-0403	Enhanced Vision on Head Up display for the Pilot in Low Visibility Conditions
AUO-0602	Guidance Assistance to Aircraft on the Airport Surface
AUO-0603	Enhanced Guidance Assistance to Aircraft on the Airport Surface Combined with Routing
AUO-0605	Automated Alerting of Runway Incursion to Pilots (and Controller)
AUO-0702	Optimised braking to vacate at a pre-selected runway exit coordinated with Ground ATC by voice
AUO-0703	Optimised braking to vacate at a pre-selected runway exit coordinated with Ground ATC by Data link
AUO-0801	Environmental Restrictions Accommodated in the Earliest Phase of Flight Planning
CM-0102-A	Automated Support for Dynamic Sectorisation and Dynamic Constraint Management
CM-0103	Automated Support for Traffic Complexity Assessment
CM-0104	Automated Controller Support for Trajectory Management
CM-0204	Medium Term Conflict Detection with Conflict Resolution Advisories and Conformance Monitoring
CM-0301	Sector Team Operations Adapted to New Roles for Tactical and Planning Controllers
CM-0405	Automated Assistance to ATC Planning for Preventing Conflicts in Terminal Area Operations

CM-0406	Automated Assistance to ATC for Detecting Conflicts in Terminal Areas Operations
CM-0601	Precision Trajectory Clearances (PTC)-2D Based On Pre-defined 2D Routes
CM-0811	Enhanced Ground Based Safety nets. *
DCB-0103	Network Operation Plan available
DCB-0304	Airport CDM extended to Regional Airports
DCB-0305	Network Management Function in support of UDPP *
IS-0301	Interoperability between AOCC and ATM Systems *
IS-0302	Use of Aircraft Derived Data (ADD) to enhance ATM ground system performance.
IS-0303-A	Use of onboard 4D trajectory data to enhance ATM ground system performance: initial and time based implementation
IS-0402	Extended provision of Terminal Information using data link
IS-0501	Use of Airborne Weather Data by Meteorological Service to Enhance Weather Forecasting
IS-0701	SWIM - baseline information model in accordance with AIRM Step1 *
IS-0702	SWIM - European Ground Communication Infrastructure *
IS-0703	SWIM - governance & supervision *
IS-0704	SWIM - Ground-Ground limited services *
IS-0705	SWIM - Ground-Ground extended services *
SDM-0201	Remotely Provided Air Traffic Service for Single Aerodrome *
SDM-0203	Generic' (non-geographical) Controller Validations *
TS-0103	Controlled Time of Arrival (CTA) through use of data link
TS-0104	Integration of Surface Management Constraint into Arrival Management
TS-0105	ASAS Sequencing and Merging as Contribution to Traffic Synchronisation in TMA (ASPA-S&M)
TS-0107	ASAS Manually Controlled Sequencing and Merging
TS-0202	Departure Management Synchronised with Pre-departure Sequencing
TS-0203	Departure Management integrating Surface Management Constraints
TS-0302	Departure Management from Multiple Airports.
TS-0303	Arrival Management into Multiple Airports
TS-0304	Integrated Arrival / Departure Management in the Context of proximate airports
TS-0305	Arrival Management Extended to En Route Airspace *
TS-0306	Optimised Departure Management in the Queue Management Process
TS-0308	Co-ordination of Pre-departure Management and Arrival Metering (Co-ordination of Arrival and Departure Flows) *

Appendix D **Actors, Roles and Responsibilities**

1 Document Information

1.1 Purpose and scope of the document

The aim of this document is to describe the hierarchical organisation of actors of the ATM system; their individual human actors and their roles and responsibilities for Concept Storyboard Step 1 and the associated Process Model. The scope of the document encompasses civil and military operations. However, even if the role of the civil and military actors remain the same, in the majority of cases, some differences exist and are described in the document.

For some Actors whose roles and responsibilities may change according to their parent organisation, high-level generic descriptions are given. For other Actors wholes roles are well defined according to international standards (e.g. Flight Crew) more detailed responsibilities are presented in tabular form. Where there is a new Actor role described, or a new responsibility(s) for an existing Actor, then validation will be carried out at SESAR WP project level.

In order to be aligned with SESAR CONOPS the described actors are based on SESAR Definition Phase deliverables for WPs 2.2 and 2.4 as defined in 2. At the same time it recognises the progress that has been made since then in subsequent projects such as Episode 3 and SESAR WP4.2 Trajectory Management.

1.2 Reference documents

1. SESAR CONOPS DLT-061-222-02-00.
2. SESAR Description of Responsibilities DLT-061-242-00-09.
3. NATO Architecture Framework v3 (NAF).
4. ICAO Doc 4444 Air Traffic Management.
5. ICAO Doc 9854 Global OCD.
6. IATA Worldwide Scheduling Guidelines
7. Airport Collaborative Decision Making Manual

2 Airspace User Operations

Airspace User Operations represent all the activities undertaken by those organisations and individuals who have access to and operate in the airspace which is managed for ATM purposes in accordance with ICAO and national procedures. For the purpose of this document only those actors directly involved in ATM operations are described.
The main types of civil Airspace User Operations are:

- Scheduled Airline Operations / Organisation (A). The most extensive organization for Airspace User Operations is run by Airlines with a worldwide network. The daily operations of these Airlines, with up to thousands of flights per day all over the world, require a lot of flexibility. In order to give the best possible service to their passengers, maintaining punctuality and a high quality of service, Airlines have to run and to maintain a complex organization. This category regroups Cargo, Regional, Network, Charter and Low cost operators.
- Business Aviation Operations / Organisation (BA). Another important segment of Airspace Users is Business Aviation, which concerns the operation or use of aircraft by companies for the carriage of passengers or goods as an aid to the conduct of their business.
- Military Aviation Operations / (MA). Determined by strategic objectives dealing with National and International security and defence policies and commitments, the operation or use of military/State aircraft (combat aircraft, military air transport aircraft, tankers, AWACS, training aircraft, helicopters…) concern Air defence and policing flights, Search and rescue, instructional and training flights, combined air operations as part of complex scenarios and UAS operations for which special use of airspace may be needed.
- General Aviation Operations / Organisation (GA), which operates civilian aircraft for purposes other than commercial passenger transport, including personal, business, and instructional flying, represents another type of Airspace Users.

Depending on the size and organization of the Airspace User, the roles and tasks defined in this document may move from one actor to another, or may be consolidated into one actor, depending on the actually existing actors within the Airspace User organization. As an extreme example, General Aviation does no have any organization except the pilot, so this actor will be responsible for all the tasks related to this/her individual flight. On the other hand General Aviation does not have to deal with many tasks which are important for the operations of other Airspace Users.

2.1 Aircraft Operator

For the purposes of this document, the Airspace User is considered as an Aircraft Operator (AO) either with scheduled air services or without scheduled air services (military, business aviation…). The AO is expected to run sophisticated decision support tools for flight route planning, including 4D flight trajectory calculation, management of route catalogue, management of relevant aeronautical information, meteorological information, route cost estimations and airspace reservations. . These decision support systems will be used for both strategic and tactical flight planning. When restrictions are unavoidable and changes to their plans become necessary, the AO will negotiate with Network Management, Airspace Management, ATC and Airport Management to determine the best possible alternatives suitable to both sides and feasible under the given circumstances.

2.1.1 Flight Schedule Planner

The Flight Schedule Planner schedules the flight programme of the airline for each season during the business development phase. The output of the process in Trajectory Management terms is the Business development Trajectory (BDT). The Flight Schedule Planner takes part in the IATA Airport Slot Conferences and it creates the AO Flight Schedule based on the business strategy and on management objectives of the airline as well as aircraft and flight crew resources.
The Flight programme for military is generally performed by the different forces and command staffs according the national organisation (Air Force, Navy, Army aviation). National and international exercises are part of flight schedules and coordinated in advance at relevant levels between military and civil ATM authorities. Additional non-scheduled flights in response to operational immediacy events are out of scope of the document.

2.1.2 Airline Operations and Control Centre

The Airline Operations and Control Centre (AOCC) is an organisational unit of an airline hosting the roles of Flight Dispatcher, Slot Manager, Strategic & A-CDM Manager thereby managing the operations of the Airline and implementing the flight programme. Their respective roles are described below.

The overall responsibility of the AOCC 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 airline network.

The main tasks of the AOCC concern the late planning phase (i.e. short term) and the execution phase of flights. The AOCC is the point of contact within Airspace User Operations for all subjects related to CDM.

The AOCC is responsible for improving airline network performance (integrity) and optimization of the SBT (prior to departure) and RBT (execution phase) to ensure the users' business objectives for a flight are met. It devises solutions for constraints arising from the NOP.

The AOCC is also responsible for "arrival and departure priority proposals" (slot swapping and inbound priority sequencing) and decision are taken in the frame of a CDM process. In general it will make proposals for flight prioritization as part of the User Preferred Prioritization Process (UDPP).

The Wing Operations Centre (WOC) is the equivalent organisational unit for military operations. Nevertheless, the term is generic and such unit may be differently named and placed at different levels (Squadron, Air Base, Air Command....) according the national organisation.

The different tasks are comparable and WOC take the same responsibilities in terms of SMT and RMT management to ensure the user's mission objectives are met, for a flight or a group of synchronised flights.[35]

Changes in responsibilities

- Improve airline network performance and share the User Preferred 4D Trajectories
- Make proposals for flight prioritization as part of the User Driven Prioritization Process (UDPP)
- Update the AOP with information within the Airspace User area of responsibility.

2.1.2.1 Flight Dispatcher

A Flight Dispatcher is responsible for planning and monitoring the progress of a flight and is an actor normally associated with commercial airline operations. Depending on the modus operandi of the airline, a Flight Dispatcher may have the authority to delay, divert or cancel a flight at any time. Similarly, a flight might not be able to be released from the stand without the signature of both the Captain of the aircraft and the Flight Dispatcher.

A Flight Dispatcher typically must be licensed by the aviation authority of a country and must demonstrate extensive knowledge of meteorology and aviation, to a level comparable to the holder of an airline transport pilot licence.

The Flight Dispatcher uses sophisticated software tools to monitor the flight's progress and advises the Flight Crew of any circumstances that might affect flight safety. Shared responsibility adds a layer of checks and balances to aircraft operations and greatly improves safety.

2.1.2.2 Slot Manager

The Slot Manager is responsible for monitoring the adherence to the airport slots (see definition) allocated to the Airspace User at the bi-annual Coordination Conference. This includes the prioritisation of outbound and inbound flights in a CDM process. Additionally, the Slot Manager is responsible for negotiating slot exchanges (swaps) with other Airspace Users, e.g. during UDPP, and negotiating with the Airport Slot Coordinator for ad hoc slots.

2.1.2.3 Strategic and CDM Manager

The Strategic and CDM Manager's prime responsibilities are the overall management of the daily operations of the Airspace User and the initiation of CDM processes with concerned partners to resolve potential and existing problems.

[35] Within this context synchronised refers to the synchronised timing of a group of flights departing from different bases that will eventually come together In a volume of airspace (e.g. air-to-air refuelling).

2.1.3 Airline Station Manager

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 AO organization some of these tasks may be carried out by or delegated to Ground Handling Agents.
The Airline Station Manager needs to inform the AOCC 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.
An equivalent manager for military informs the WOC on the status of the turn-around process.

2.1.4 Flight Crew

General
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/EASA provisions, and within airline standard operating procedures. It ensures that the aircraft operates in accordance with ATC clearances and with the agreed Reference Business Trajectory. For military, some additional rules not covered by ICAO may be implemented by the States for State Aircraft.
Responsibilities to assure airborne spacing with regard to another aircraft may be delegated by ATC to the Flight Crew under specific circumstances. The Flight Crew will then be responsible for spacing using ASAS-Airborne-Spacing (e.g. Sequencing and Merging). ATC will still retain responsibility for separation from other aircraft.

Changes in responsibilities
- Execute the flight according to the current flight plan i.e. agreed UP 4D trajectory where appropriate
- Comply with clearance/instruction given by ATC using voice or data link
- Request deviations of agreed UP 4D trajectory where appropriate if deemed necessary mainly for safety, operational and/or economic reasons
- Obtain information on landing conditions from the destination airport's information service (D-OTIS)
- Assume responsibility to maintain own spacing from other airborne traffic (e.g. sequencing and merging) when temporarily delegated by ATC. This responsibility is not applicable by UAS pilots in command

The Flight Crew's **responsibilities** include furthermore:

2.	Obtain information about weather forecasted for the planned flight route
3.	Check NOTAM and other environmental information relevant to the flight.
4.	Conform to the issued departure slot, if any.
5.	Maintain a continuous listening watch on the appropriate ATC communications channels (to include Datalink)
6.	Accept/reject ATC proposed alternative routings based on safety and feasibility.
	Assume responsibility to maintain inside /outside segregated areas according the case.
	Assume responsibility dedicated to Leader of multi-aircraft formation.
10	Obtain a clearance from ATC prior to deviating from the cleared flight plan route.
11..	When, for reasons of flight safety deviation from the cleared flight plan route must be taken without clearance (e.g. following a TCAS advisory), inform ATC of actions taken as expeditiously as possible.
13	Take over responsibility for the visual separation assurance on final approach on request of ATC. This responsibility is not applicable by UAS pilots in command.
14.	Assume responsibility to maintain own spacing from other airborne traffic (e.g. sequencing and merging) when temporarily delegated by ATC. This responsibility is not applicable by UAS pilots in command.
15.	Assume responsibility to maintain own spacing on the manoeuvring area in respect of ATC taxi instructions.
16.	Assume responsibility to maintain own spacing on the apron in respect of other aircraft and vehicles when departing and arriving on stand.
	Assume responsibility to maintain standard aircraft separation in a multi-aircraft formation
17.	Perform flight according to IFR or VFR. VFR not applicable for UAS.
18.	Provide ATC with mandatory information calls e.g. "on frequency, leaving frequency, leaving altitude, reaching altitude, start-up-request, taxi request, reaching assigned position" etc.
19.	Send position reports to AOCC where applicable.
20.	Co-ordinate alternate routings or deviations in flight trajectory for non-capable 4-D aircraft

	with AOCC where applicable.
21.	Coordinate with De-icing Agent when de-icing is required.

2.1.5 Flight Support and Technical Officer

The Flight Support and Technical Officer carries out tasks in order to support Flight Operations.
The main tasks are the update of Flight Dispatch and Business Trajectory Management Systems and Data Bases with aeronautical information as well as company routes and performances. Also the update of other operational documentation such as the AO Operations Manuals is carried out.
With the advent of SWIM also the management of Airspace Users' SWIM components falls into his responsibility.

Changes in responsibilities

- Manage the Airspace Users' SWIM components

2.1.6 Wing Operations Centre

The WOC is a generic designation of a military entity in charge of dispatching and prioritising the flights, developing and planning Mission Trajectories, and managing Flight Data and environmental issue.

Changes in responsibilities

- Ensure Mission Trajectory Planning and Monitoring
- Ensure Airspace Reservation Management in coordination with trajectory management.
- Share the Mission Trajectories intentions (ReqMT), including airspace reservation/restriction (ARES) demand.
- Participate to CDM process and make proposals for flight prioritization.

2.2 Ground Handling Agent

General

The Ground Handling Agent has the role to execute the aircraft turn-round agreements established with the Aircraft Operators and is responsible for the turn-round of all arriving aircraft. Ground Handling covers a complex series of processes that are required to separate an aircraft from its load (passengers, baggage, cargo and mail) on arrival and combine it with its load prior to departure. [www.iata.org]
This actor may be a function of the Aircraft Operator itself, on behalf of the Airline Station Manager, provided by the Airport Operator or contracted to a separate entity. Nevertheless the responsibilities remain the same.
The Turn-round process is considered as a "black box" for ATM. There is no requirement to be aware of what is occurring whilst the aircraft is on the stand. ATM only requires knowledge of certain milestones i.e. on and off block times, ready for start. It is acknowledged that there are numerous actors performing vital roles during the turn-round process. These roles are all consolidated within the actor Ground Handling Agent who as an amalgam provides ATM with the necessary knowledge to plan and oversee the daily operations of the aerodrome.

Responsibilities

The following table lists the Ground Handler's responsibilities:

1.	Define ground operations staff plans.
2.	Manage ground handling resource allocation (including ground staff, service vehicles, buses, etc.).
3.	Manage ground handling activities (incl. turn-around operations).
4.	Agree/update target aircraft ready time (TOBT).
5.	Manage the turn-round in accordance with the TOBT.
6.	Provide turn-around progress information (milestones) through Airport CDM.

2.3 De-icing Agent

General

De-icing facilities should be provided at aircraft stands or at specified remote areas along the taxiway leading to the runway meant for take-off. The effect of volume of traffic and departure flow rates should also be considered. [4]

Within this context the concerned actor although acting on behalf of the Aircraft Operator may be a delegated third party. The main interactions of the De-icing Agent are with the Apron Manager for stand de-icing and with the Flight Crew and the Tower Ground Controller for remote de-icing.

Responsibilities

The specific responsibility for the De-icing Agent is to ensure that the departing aircraft is free of snow and ice and that the holdover effect of the de-icing treatment is still in effect at the end of taxiing and when take-off clearance of the treated aircraft is given.

3 Airport Airside Operations

3.1 Airport Operator

General
The Airport Operator is responsible for the physical conditions on the manoeuvring area, apron and in the environs of the aerodrome. This includes assurance that the scale of equipment and facilities provided are adequate for the flying activities which are expected to take place at that Airport.
An Airport Operator must also ensure an effective safety management system is in place and, in those activities which are related to the safe operation of the aerodrome, to provide staff who are competent and where necessary, suitably qualified. In terms of ATM activities, some tasks may be undertaken by an appointed or contracted ANSP.

Responsibilities

Table 3 below shows the Airport Operator's main responsibilities. It is accepted that some of these will be carried out by individual actors (e.g Airport Duty Officer) on behalf of the Airport Operator, but they are descibed here as a consolidated list.

1.	Analysis of airport resources (strategic).
2.	Long term planning of airport infrastructure (runways, taxiways, apron, gates, terminals, etc.).
3.	Planning of gate usage (including special gate usage, e.g. Schengen gates, security areas).
4.	Long term planning of repair and construction work on the movement area.
5.	Management of the airport airside surfaces (snow removal, runway cleaning, lighting system etc.) in coordination with the Tower Supervisor where appropriate.
6.	Co-ordination of airport slots with airlines and national slot co-ordinator.
7.	Providing information on the flight's "gate open" where this may impact on the Estimated Off-Block Time. etc.
8.	De-icing of aircraft prior to flight on behalf of the Airspace User.[36]
9.	Assignment of gates or stands to arriving flights.
10.	Analysis of unforeseen aerodrome constraints.
11.	Information on restrictions of aerodrome resources to demand.
12.	Management of airport resources on the day of operation (gates, vehicles, stands, de-icing facilities etc.) on behalf of the Airspace User.
13.	Crisis management on the day of operation.
14.	Dissemination of relevant airport information.
15.	Management of priority flights
16.	Information sharing between airport partners (ATS, AOCCs, Network Management, aircraft).
17,	Aerodrome Safeguarding
18.	Aerodrome Fire and Resue Service

3.1.1 Airport Duty Officer

General
The airport company has to operate the airport in accordance with international and national regulations and has to keep the airport in a safe condition. Airport operations are carried out by Airport Duty Officers. The Airport Duty Officer is the responsible manager for the daily operations, entitled by the airport operator to be in charge of assuring that the airport is operated in accordance with its national licensing conditions and international regulations.. The main interactions are with the Aircraft Operators, ATC and Airport Operations.
Responsibilities
The Airport Duty Officer's main responsibilities are:

1.	Supervision of local flight restrictions.
2.	Changes to the Airport infrastructure, including the manoeuvring area under the delegated authority of the Tower Supervisor.

[36] Coordinated with the Tower Ground Controller when the latter is responsible for sequencing of the flight to the de-icing stand.

3.	Initiating airport-related aeronautical publications and information.
4.	Establishing airport policies and requirements.
5.	Managing the implementing the Airport snow and ice clearance plan.
6.	In case of accidents and emergenies acting as on-scene commander in coordination with the resue services.
7.	Ensuring the best interest of passengers and airlines are met.

3.1.2 Airport Operations Centre

The Airport Operations Centre (APOC) is the central organisational unit responsible for airport airside operations. In terms of human actors the role and responsibilities of the APOC may be represented by an APOC Supervisor among APOC Stakeholder Agents.[37]
Airport Resources are planned and allocated iteratively and fed into the NOP. The data has also to be collected into the airport information sharing database, which will be the entry-point for SWIM applications. Military Air Bases co-located with civil airports have to provide required data to the APOC. On the day of operation the plan is consolidated through the balanced mapping of Business/Mission Trajectories demand on the various airport resources, e.g. allocation of aircraft stands, gates and de-icing facilities on behalf of Aircraft Operator when so requested and check-in areas for passengers within the terminals. The plan does not concern co-located Military Air Base resources dedicated to military aircraft.
The APOC hosts the role of the Airport CDM Project Manager (A-CDM PM)[38].

3.1.2.1 APOC Supervisor

The APOC supervisor liaises with all APOC participants, acts as a final decision maker in case of issues for which no consensus has been reached.

Changes in responsibilities

- Liaison between airport operations and Network,
- Liaison between airport stakeholders,
- Ensures that total airport overview and information is available to all relevant stakeholders,
- Initiates UDPP when appropriate,
- Coordinate with the relevant APOC stakeholders on the feasibility of specific airport scenario's,
- Ensures that agreed actions are taken by the appropriate stakeholder(s),
- Monitors that expected benefits from agreed actions are reached and coordinates any new operational measure if appropriate,
- Acts as arbitrator in case mutual agreed decision cannot be made in time,
- Updates the AOP with information within the APOC sphere of responsibility.

3.1.2.2 Airport CDM Project Manager

The Airport CDM Project Manager is responsible for ensuring and improving communication between all stakeholders, including data-management of CDM relevant data. This includes the dissemination of airport information like landing time, constraints, turn-round time, "Departure Planning Information" and received "Flight Update Messages", etc.
Airport Collaborative Decision Making (A-CDM) is a concept which aims at improving Air Traffic Flow and Capacity Management (ATFCM) at airports by reducing delays, improving the predictability of events and optimising the utilisation of resources. Implementation of Airport CDM allows each Airport CDM Partner to optimise their decisions in collaboration with other Airport CDM Partners, knowing their preferences and constraints and the actual and predicted situation.
The decision making by the Airport CDM Partners is facilitated by the sharing of accurate and timely information and by adapted procedures, mechanisms and tools.
The Airport CDM concept is divided in the following Elements:

- Airport CDM Information Sharing

[37] Still under discussion: Alternative definition for APOC: An operational management structure that permits relevant airport stakeholders to have a common operational view and to communicate, coordinate and collaboratively decide on the progress of present and near term airport operations.

[38] The role of A-CDM PM can be carried out by any of the CDM partners. For simplicity purposes it is here allocated to the APOC.

- CDM Turn-round Process – Milestones Approach
- Variable Taxi Time Calculation
- Collaborative Management of Flight Updates
- Collaborative Pre-departure Sequence
- CDM in Adverse Conditions
- Advanced CDM

The main Airport CDM Partners are:

- The Airport Operator
- Aircraft Operators
- Ground Handlers
- De-icing companies
- The Air Navigation Service Provider (ATC)
- The CFMU
- Support services (Police, Customs and Immigration etc) [7]

3.1.3 Apron Manager

General

The Apron Manager is responsible for guidance of aircraft to and from the stands (e.g. providing push-back approval), ensuring the safe and efficient movement of aircraft and vehicles within his/her area of responsibility according to local procedures. The Apron Manager also maintains close coordination with Tower Ground Controller, AOCC and APOC on planned aircraft movements.

Normally, control of the activities and the movement of aircraft and vehicles rest with ATC with respect to the manoeuvring area. In the case of aprons, such responsibility sometimes rests with the apron management. Airlines may hire third party services for apron management service under the supervision of the airport authority, in compliance with its regulations or through airlines own regulations [ICAO]. The role of Apron Manager is thus described here.

Responsibilities

The Apron Manager's main responsibilities are:

1.	The guidance of aircraft to and from the stands.
2.	Ensuring the safe and efficient movement of aircraft and vehicles within his/her area of responsibility according to local procedures.
3.	Maintaining close coordination with Tower Ground Controller, AOCC and APOC on planned aircraft movements using A-CDM.

3.1.4 Stand Planner

The Stand Planner has the role to of assigning flights/aircraft to their stands on a given airport, taking into account inter alia: aircraft type, aircraft load (e.g. passenger vs. cargo), gate assignment to airlines, origin/destination of flight (e.g. Schengen, international, …) . The Stand Planner modifies the plan dynamically to comply with real time constraints (stand usage conflicts, stand out-of-service etc.). The stand plan is generated during the medium/short-term phase and is iterated throughout up to and including the execution phase.

3.2 Airport Slot Negotiator

General

The Airport Slot Negotiator's role in ATM is three-fold:

- To prepare the allocation of airport slots to Aircraft Operators wanting to operate from/to a fully coordinated airport on a seasonal basis, in a neutral, non-discriminatory and transparent way. The corresponding responsibility (Airport Capacity and Aircraft Operators' Requests Collation) is to define the number of available airport slots based on information collected from the

Airport Operator and ATC, and to collate airport slot requests from Aircraft Operators wanting to operate at the airport. This responsibility occurs during the Long-term Planning phase.

- To facilitate the operations of Aircraft Operators at schedule facilitated airports. The corresponding responsibility (Airport Slot Negotiation) is to negotiate with the Aircraft Operators the allocation of airport slots in accordance with the rules and regulations and to define the airport slot allocation plan. This responsibility occurs during all phases.
- To monitor the use of airport slots and adherence of Aircraft Operators to allocated schedules. The corresponding responsibility (Airport Slot Monitoring) is to monitor that the utilisation of airport slots by the Aircraft Operators is in accordance with the airport slot allocation plan. This responsibility occurs during the Execution phase.

The Airport Slot Negotiator has a purely CDM role in the sense that he/she has to negotiate with all the involved stakeholders in order to balance traffic demand (from Aircraft Operators) and airport capacity defined by the Airport Operator and ATC.

Responsibilities

The following table lists the Airport Slot Negotiator's responsibilities, classified by Airport Slot Negotiator's functions:

1.	**Airport Capacity and Aircraft Operators' Requests Collation**
1.1.	Collate capacity information from the Airport Operator
1.2.	Collate capacity information from ATC
1.3.	Define airport slot availability
1.4.	Collate Aircraft Operators' slot requests
1.5.	Identify airport slot issues (e.g. over demand, unused slots in previous season, …)
2.	**Airport Slot Negotiation**
2.1.	Negotiate airport slot allocation with the Aircraft Operators
2.2.	Create the airport slot allocation plan
2.3.	Collect Aircraft Operators' additional requests
2.4.	Update the airport slot allocation plan
3.	**Airport Slot Monitoring**
3.1.	Monitor the utilisation of airport slots by the Aircraft Operators

3.3 Vehicle Driver

General

The Vehicle Driver retained as a SESAR actor at airport level is the one operating on the airport manoeuvring area (i.e. beyond the apron) and as such is licensed by the Airport Operator. During present-day operations, control procedures are largely based on visual methods for maintaining separation other vehicles and aircraft. These procedures will be enhanced through the availability of traffic display capabilities.

Responsibilities

The single main responsibility of the Vehicle Driver is to ensure the safe and efficient movement of his assigned vehicle on the airport manoeuvring area.

In order to fulfil that responsibility, the Vehicle Driver should be provided with the following services:

- Position information: The airport moving map function allows the Vehicle Driver to determine the actual position of his vehicle on the airport surface. Regardless of either forward visibility or aerodrome complexity, the provision of a satellite navigation based airport mapping function that includes own vehicle position and direction of travel will significantly increase the situational awareness of the Vehicle Driver.

- Route display: Where installed, routing information, including clearance limits and 'hold short' positions are received via datalink from the Tower (Ground) Controller and displayed as an integral part of the airport moving map referred to above and both supplement and reinforce verbal instructions as explained further below.
- Time critical information and the initial clearance to proceed are issued via radio.
- Information and instructions as required, to prevent collisions with aircraft, other vehicles and known obstacles.
- The ground traffic display function will support the Vehicle Driver during operations on the manoeuvring area. The main goal of the ground traffic display function is to reduce the potential for conflicts, errors and collision with other aircraft / vehicles by providing enhanced situational awareness to the Vehicle Driver operating on the airport surface in all weather conditions.
- Alert of incursions into unauthorized areas. The Vehicle Driver will be responsible to respond to an A-SMGCS instruction or other safety net alert, unless specifically instructed otherwise by the Tower Controller. The surface movement alerting function should be used in vehicles, operating on the manoeuvring area:
    - To avoid collision with fixed obstacles;
    - To avoid runway incursions of vehicles operating on the manoeuvring area;
    - To avoid entry to taxiways, which have not been authorized for use by the Tower Controller
    - To avoid deviation from pre-defined routes on the manoeuvring area, issued by the Tower Controller

In addition to these services, the Vehicle Driver of emergency and operational vehicles should be provided with:

- The capability to locate the site of an emergency within the displayed range of the system; and
- Information on special priority routes.

4 Network Operations

4.1 Two main fields of activity

4.1.1 European Airspace Organisation

This activity takes place mainly in the long-term planning phase, but not only. The actors involved in the process are primarily the High Level Airspace Policy Bodies (HLAPB), the Airspace Designer and the CDM Group. Their main responsibilities are:

- to elaborate airspace policy, organisation, processes and procedures in line with regulatory packages,
- to design and optimise the airspace structure and ATS route network to provide an harmonised continuum for the efficient usage by both the military and the civil users,
- to elaborate the rules for airspace management for all the ATM phases.

4.1.2 Network Management

Network Management encompasses Airspace Management (ASM) and Demand and Capacity Balancing (DCB). It takes place in all the ATM phases.

The actors directly involved in Network Management are:

- At Network level: the Network Manager and the CDM Group
- At Sub-Regional Level: the Flow Manager
- At National and/or Sub-Regional level (medium to short term): the Airspace Manager
- At Local level: the Local Capacity Manager and the Local Traffic Manager.

It is important to note that these actors are more or less all concerned by both Airspace Management and Demand and Capacity Balancing activities. Those two processes are interdependent, as ASM is one among the available means to achieve DCB and ASM should not work in isolation from DCB.

4.2 Roles and responsibilities

The functions and responsibilities of actors involved in Network Operations are described below. Those different roles may be distributed among various actors according to each organisation.

4.2.1 High Level National / Sub-regional Airspace Policy Body (HL APB)

Role:

- Has a leading role within the Strategic Level 1 Cycle activities at national level and at the sub-regional (FAB) level. It is responsible for assuring prerequisites for the most optimum operational Airspace Configuration for the volume(s) of airspace within its responsibility;
- Closely coordinates with the adjacent HL APBs (both in horizontal and vertical plane) in order to ensure that national /sub-regional airspace design projects are compatible and consistent with cross-border airspace policy.
- Closely coordinates with the Network Manager to obtain required information, data and expertise, and to ensure that national/sub-regional airspace design projects are compatible and consistent with all the plans, in particular with the overall Network Operations Plan;
- Enable seamless and synchronized operational transition between the neighbouring Airspace Configurations;

- Relies on the expertise of all the stakeholders within the CDM process, mainly on the national or sub-regional expertise as Flow Managers, Airspace Managers, Local Capacity / Traffic Managers, working in the area of its responsibility;
- Consults any of the stakeholders and users of the airspace (e.g. different service providers, civil or military airspace users, etc);
- Supports National Supervisory Agencies (NSAs) (or its sub-regional equivalent) in performance monitoring activities.

Deliverables:

- Defined airspace policy for the volume of airspace under its responsibility, taking into account the European Network Strategy Plan;
- Defined coherent and consistent airspace policy with neighbours (States or FABs);
- Decisions related to airspace design , organisation and management enabling the most optimum Airspace Configuration definition and operational deployment;
- Defined processes and procedures to enable Airspace Configuration definition and facilitate and coordinate operational deployment and implementation of the plans;
- Definition of processes and procedures for seamless and synchronized transition between different Airspace Configurations;
- Support National Supervisory Authority (NSA) (or its sub-regional equivalent) in definition of performance targets for the airspace under its responsibility, consistent with those at the European Network level;
- Agreed set of pre-defined Airspace Configurations applicable for the volume of airspace under its responsibility;
- Continuous review of the different European Plans to take into account new or changing demands on the airspace;
- Continuous update of the Airspace Data Repository (ADR) resulting from the airspace design and organisation changes under its responsibility.

4.2.2 Airspace Designer

Airspace Designer shall be understood as a function performed by different stakeholders.
This function allows the establishment of airspace structures in order to accommodate the different types of air activity, volume of traffic and differing levels of service in accordance with the airspace policy defined by the HLAPB.

In the Long-term Planning phase, the main task is based on the design and optimisation of the ATS route network and the areas such as conventional TSAs and TRAs, but also Cross Border Areas (CBAs) and Variable Profile Areas (VPAs). Design options for both the efficient usage by the military of such areas and the optimum route network for civil airspace users are also prepared within the context of the advanced FUA.

In the long, medium-short planning, ad-hoc airspaces might be designed to accommodate major events (e.g. large scale military exercises, Chief of States Summit, Olympic Games, Football World Cup …etc….) leading to AIP Supplement publications.

4.2.3 CDM Group for European Network Airspace Organisation and Management

This Collaborative Decision Making (CDM) Group is composed by the Network Manager, National Air Navigation authorities including Military (through High Level Airspace Policy Body (HLAPB)), FAB entities if existing, Air Navigation Service Providers (ANSP), Airspace Users, Airport operators and all other concerned operational stakeholders as Airspace Manager, Flow Manager, Local capacity/traffic Managers…

This CDM group establishes the different plans described in SES II Regulations package at strategic (long-term) and operational level, while applying the airspace design principles. This includes simulations ('What if?') and/or optimisation tools using the best available information with respect to the planning time horizon. This process will start in the long-term planning phase and continues to be updated at regular intervals, and as soon as an acceptable maturity is reached, the resulting outline of the Airspace Configuration is detailed and published in the NOP.

Responsible for:

- Establishing airspace planning, i.e. Airspace Configuration definition and deployment process criteria, prioritisation rules and performance targets;
- Establish coherent and consistent agreements based on political decisions to allow CBA & CBO.
- As soon as mature – providing with the result national or sub-regional plan to the Network Manager in order to ensure a coherent integration of agreed airspace design projects in the Network Strategy Plan (NSP) and the Network Operations Plan (NOP).

In doing that:

- Respect the SES II regulatory package (i.e. Performance Regulation, Network Management Regulation, Airspace Regulation, FUA Regulation) in deciding on the airspace policy, organisation, processes and procedures to be applied at medium/short-term planning and execution phase (SES Levels 2 and 3);
- Respect the different agreed plans (Network Strategy Plan and Network Operational Plan containing the European Route Network Improvement Plan) agreed through the Network Manager Working Arrangements related to airspace organisation, design, planning and operational deployment;

Particular Tasks:

- Establish coherent and consistent cross-border airspace policy with neighbours (adjacent States or FABs) in order to achieve seamless and unconstrained air traffic flow and ATM;
- Anticipate civil traffic demand for the targeted tactical timeframe based on the historic data and already known future data;
- Anticipate military activity demand for the targeted tactical timeframe based on the historic data and already known future data;
- Anticipate environmental constraints and set the environmental protection targets, e.g. CO2 pollution quotas;
- Decide upon airspace design, organisation and management – Airspace Configurations (e.g. ATS Routes, Airspace reservation/restriction, CDR propagation/consistency, Early Access to Weekend routes, night routes, direct routes, User Preferred Routing (free route airspace)), to mitigate/eliminate any inconsistencies at the State or FAB borders/FIR boundaries, while enabling synchronized switching among different Airspace Configurations;
- Identify, through assessment based on appropriate historic data any capacity and/or complexity constraints and decide on the mitigating measures;
- Decide on the national/sub-regional Network performance targets for the targeted tactical timeframe;
- Develop or amend as appropriate the CDM processes and procedures for definition and management of Airspace Configurations at medium/short-term planning and execution phase (SES Levels 2 and 3); and
- Agree on the set of predefined Airspace Configurations;
- Depending on FAB organisation, it can be anticipated that Airspace Organisation CDM Groups could also be organised at Sub-Regional level providing input to the European CDM Group.

Analyse KPIs and make recommendations for enhancements.

4.2.4 European Network Manager

The Network Manager acts as catalyst and facilitator for an efficient overall network management by all ATM stakeholders

Role:

- Has a key role within the long-term planning phase to ensure the most efficient performance of the European Network;
- Monitors all the long-term local or sub-regional activities and identifies situations where the Network performance may be affected by national and/or sub-regional decisions;
- Closely coordinates with all the involved HLAPBs in order to ensure coherency of the European Network operations;
- Provides to the national/sub-regional HLAPBs all the required information, data and expertise;
- Prepares, through appropriate coordination, seasonal plans or plans for special events;
- Participates to airspace design activities and simulation activities to improve the overall process;
- At the end of the long-term planning phase, delivers an initial integrated Network Operations Plan based on the local/sub-regional activities outcomes;
- Ensures that any change to the airspace design, organisation and management, is accommodated in the ADR and reflected in the NOP as appropriate;
- Disseminates a consolidated regional ASM plan, currently in the form of an AUP (Airspace Use Plan) and updated AUP's, via the NOP Portal;
- During the medium to short term phases the Network Manager will be working towards identifying and mitigating significant DCB issues strategically, which affect the network at a regional level. Dependent upon the related ANSP involved, such mitigation is also likely to require Network Management influence at sub-regional and local levels.
- The factors that will influence Network Manager to address DCB initiatives are likely to be broadly similar to today; rules and performance targets (2011 NM IR) governing the Department of Network Management, seasonal variations (currently referred to as Axis), large scale military activity, and reductions in normal capacity, due to things like weather, major infrastructure implementation and industrial action.
- During DCB the Network Manager will be working closely with the Aircraft Operators, Airspace Manager, Flow Manager and Local Capacity Manager. The subsequent agreed outcomes are then published via the NOP Portal.
- During the execution phase, he assures the stability of the NOP (Network Operations Plan), reacting to unexpected events, which impact on overall network performance, such as unusual meteorological conditions or loss of significant assets (e.g. runways, airports). Among other means, activating pre-agreed scenarios will enable the Network Manager to restore Network stability.

Responsibilities

The European Network Manager's main responsibilities are:

1.	Assess the impact of the expected traffic demand with ATM capacity declared in the Network Operations Plan.
2.	Assess the impact of the expected airport traffic demand (based on airport slots) on the network capacity.
3.	Identify expected capacity shortfalls between traffic demand and airspace capacity.
4.	Assess the impact of special events on the network.
5.	Assess the impact of critical events on the network.
6.	Identify ATM and ATFCM solutions (eg scenarios) to avoid bunching of aircraft at hot spots.
7.	Identify ATM and ATFCM solutions (eg scenarios) to avoid over delivery to ATC.
8.	Co-ordinate ATFCM solutions (eg scenarios) with Airspace Users/ Flow Managers/Local Traffic Managers in a refinement process.
9.	Assess single ATFCM measures in regard to their impact on the network.

10.	Co-ordinate with Flow Managers/Local Traffic Managers in case of single ATFCM measures having impact on the network.
11.	Optimise ATFCM measures at Network level
12.	Assess the impact of different airspace configurations on the network traffic flow.
13.	Co-ordinate use of different airspace configurations with the concerned Flow Managers / Local Traffic Managers.
14.	Co-ordinate Regional daily airspace use plans and updates with Airspace Managers.
15.	Disseminate consolidated Regional daily airspace use plans and updates
16.	Optimise Airspace Management at Network level.
17.	Ensure that the NOP is published and updated appropriately.
18.	Contribute to the critical events and crisis management activities.

Changes in responsibilities

- The Network Manager supports the Airspace User Driven Prioritisation Process (UDPP). The UDPP-Step1 process depends on CDM between the concerned Airspace Users at the local CDM-airport during operations, supported by a Network level global AU agreement on a set of rules monitored by the Network Manager as UDPP-Referee. During operations, in case AUs after several optimisations and iterations do not come to an agreed solution, the Network Arbitration role makes sure that in the UDPP process a resolution for the conflict between the Business/Mission Trajectories demand and constraints due to network capacity is proposed and, as a last resort, a solution is decided. This arbitration process shall follow the pre-agreed rules, and is monitored by the Network Manager in its UDPP Referee role.
- The activity addressed at Network level includes also the compilation of the NOP, the successive integration of Shared Business/Mission Trajectories, the collection and dissemination of constraints, the real-time identification of potential interactions between (accepted and agreed) Reference Business/Mission Trajectories and (newly published) Shared Business/Mission Trajectories and the communication of these interactions to the corresponding Airspace Users.

4.2.5 Flow Manager

- The Flow Manager has a generic FAB responsibility for the planning activities that take place within the Medium to Short term planning and execution phases. FM's won't be responsible for planning activity within the long term planning phase, but are more likely to act as an expert resource in the process. The medium and long term planning tasks are likely to be distinct from those in the Short term & Execution Phases, this is mainly due to the changes in the nature and the reliability of the available demand and capacity data[39]; therefore, the two elements may well be carried out by two distinct actors "FM Planning" and "FM Execution".

- Through the long to medium term planning phases Flow Managers will closely coordinate with appropriate Local Capacity Managers (LCM), ensuring that all opportunities to optimise capacity are fully explored, and limitations within the relevant timeframes are known. Where limitations exist (this may be within local infrastructure, staffing or processes), an appropriate plan of action is devised and agreed upon at least between the Flow Manager and Local Capacity Manager (LCM). This plan may then be shared with the Network Manager for regional impact assessment and NOP updating.

  It is anticipated that as the planning phases progress through time, operators will refine their intended trajectories to better match their specific business demands at that time. The improving dataset results in increasing levels of confidence in the anticipated demand and workload levels, this allows in turn for the "fine tuning" of any planned or implemented ATFCM measures, with better levels of accuracy and granularity.

- The Flow Manager will, based on known and forecast Civil/Military demand, attempt to match the capacity of the FAB to that of the demand pattern, and then inform the Network Manager of the intended plan for visibility and Network consistency. Where a purely FAB contained solution is unavailable, Network options will be considered in conjunction with the Network Manager.

[39] See Chapter 4 Operational Scenarios

- Based on forecast civil demand and capacity issues, if an anticipated civil demand is excessive (i.e. the result of a special event or seasonal Axis Flow) or a planned military exercise excessively limits civil capacity in relation to normal levels of demand, the FM may send to the Airspace Manager (AM) specific requests for mitigation, and the likely result if such mitigation is not achieved.

  Dependent upon the AM's ASM solution, FM Planning may well have to initiate further ATFCM measures to resolve any remaining forecast DCB imbalances. The resulting plan is then coordinated with the Network Manager for both visibility and, where necessary, to take appropriate actions.

- In short term planning, the FM may act to optimize the ASM/ATFCM plan for the FAB zone, taking into consideration data coming from LTM and AM. In that process, he will work closely with Local Traffic Manager (LTM), Airspace Manager (AM) and Network Manager.

- The FM's generic DCB responsibilities during the execution phase are one of initiating, organising, carrying out and co-ordinating actions between the Network Manager and LTM.

- The levels to which an FM will become involved in any one of these individual activities will vary from FAB to FAB; this balance will result from the size, staffing, economic and political make up of a particular FAB.

Responsibilities

Flow Manager's main responsibilities are:

1.	Assess the impact of the expected traffic demand with ATM capacity declared in the Network Operations Plan.
2.	Assess the impact of the expected airport traffic demand (based on the Network Operations Plan).
3.	Integrate the impact of any special events on traffic demand in the planning activities
4.	Identify and coordinate actions to optimise capacity at FAB level
5.	Identify ATM and ATFCM solutions (eg scenarios) to avoid bunching of aircraft at hot spots.
6.	Identify ATM and ATFCM solutions (eg scenarios) to avoid overload of control sectors.
7.	Co-ordinate ATFCM solutions (eg: scenarios, reroutings) with Aircraft Users/ Local Traffic Managers/Network Manager in a refinement process
8.	Optimise ATFCM measures/scenarios at FAB level
9.	Co-ordinate use of different airspace configurations (e.g. sectors configurations) with Local Traffic Managers for the purpose of optimising at FAB level
10.	Co-ordinate and optimise Airspace Management at FAB level
11.	Keep informed about current use of airspace at tactical level
12.	Co-ordinate with Network Manager in case of single ATFCM measures having impact on the network
13.	Contribute to the critical events and crisis management activities.

4.2.6 Local Capacity Manager

- The Local Capacity Manager is based at an operational ATSU focusing on either an ACC or Airfields operation. The Local Capacity Manager is a planning role, which contributes to the sub-regional capacity planning. .

- The main tasks of the Local Capacity Manager are to participate in strategic AOM and DCB planning meetings, to analyse and establish traffic flows and local capacity values for various sector configurations and airport capabilities and to contribute to the establishment of local DCB procedures and practices.

The local information and knowledge base they have provides an important platform on which to build the optimised sub-regional capacity plan. The type of local factors that an Local Capacity Manager will take account of are: Geo-political (i.e. quiet hours), related procedures, staff availability, sector flexibility, non-nominal weather environments, special events, optimised landing / departure rates, infrastructure and un-serviceability.

4.2.7 Airspace Manager

- This function focuses on medium to short term planning phase. It corresponds to ASM level 2. It can be implemented at National and/or Sub-Regional level.

- The Airspace Manager is responsible for the medium to short term planning of national and potentially FAB level ASM right up to its operational implementation within European FUA (Flexible Use of Airspace) framework constraints. The AM role may in reality be filled by two actors: The Civil Airspace Manager (CAM) & The Military Airspace Manager (MAM), these actors would then have clear locally defined roles and areas of authority.

- The Airsapce Manager task is to manage the competing airspace demands from Civil and Military operations in a pragmatic way, taking account of relevant factors.

The output will involve the management of things like: CDR's, Euro (RAD) restrictions, exercise restriction, airspace allocation. This is resolved into an agreed plan which is then communicated to Flow Manager, Local Traffic Manager and Network Manager.

Responsibilities

The Airspace Manager's main responsibilities are:

1.	Co-ordination of major airspace events well in advance, such as large scale military exercises or air shows, which require additional use of existing segregated airspace and other ad-hoc airspace structures specifically designed.
2.	Elaboration of the planned national/FAB daily airspace use plans taking into account civil and military needs and constraints.
3.	Coordination of national/FAB daily airspace use plans and updates with the Network Manager and others AMs as appropriate.
4.	Submit national/FAB daily airspace use plans.
5.	Submit updates on airspace use plans in case of changes or modifications of airspace allocation.
6.	Inform all concerned actors about early access to weekend routes/conditional routes through the Network Operations Plan.
7.	Monitoring of the efficiency of the application of the FUA Concept by use of pre-determined FUA indicators.

4.2.8 Approved Agency

- Approved Agencies are units which are authorised by States to deal with Airspace Managers for airspace allocation and utilisation matters.
- Their responsibilities include the submission of their needs for airspace to the AM and of any update on their request.
- They are permitted to negotiate for airspace to be allocated by AM within the European AFUA (Flexible Use of Airspace) framework constraints.
- They are also required to ensure that the airspace usage is in accordance with the agreed airspace use plan.

4.2.9 Local Traffic Manager (LTM)

- The Local Traffic Manager (LTM) functionally lies in between the Flow Manager and (multi)-sector planning actors, taking a view over a group of multi sector areas and/or sectors (potentially a complete ACC) and any Airfield Towers that fall within the LTM's area of responsibility. He acts as the coordinating link between the ANSP, sub-regional and regional flow and airspace management.

- The LTM is a major actor of the DCB processes both for the medium to short term planning phase and the execution phase. In case of an imbalance, he is responsible for identifying the adequate measures to be taken, in coordination with the appropriate partners (that could include NM, FM, other LTMs and AUs).

- The LTM provides a bridge in understanding between operational perceptions of complexity, workload & demand and how that translates into ATFCM requirements as deliverable occupancy & workload values.

- In execution phase and appropriately in short term planning, the LTM works closely with Supervisors and Multi Sectors Planners. The LTM is also likely to be either a Supervisor, or report to one, and as such will retain local safety accountability. Any ATFCM initiatives will have to be approved by him.

Responsibilities

The Local Traffic Manager's main responsibilities are:

1.	Monitor forecast demand against declared capacity.
2.	Furthermore, in short-term and execution phases, monitor sector workloads, this includes traffic complexity assessment.
3.	Assess the impact of different airspace configurations on the traffic flows and sectors workloads.
4.	Assess the impact of Airport special events or any special events, within his area of responsibility, on traffic demand.
5.	Devise and coordinate appropriate actions (ATFCM measures, Airspace Management measures) to resolve any imbalances (concerning traffic flows and/or sectors workloads) in co-ordination with appropriate actors.
6.	Provide advance notice of demand that peaks above capacity.
7.	Provide advance notice of unusual sector workloads.
8.	Provide advance notice of peaks in traffic complexity.
9.	Provide information on, and solutions for unexpected increases in demand, workload or complexity.
10.	Optimise ATC/ATFCM system performance including the instigation and coordination of remedial action with any ATS provider, Airspace Users or aerodrome to ensure maximum system performance.
11.	Notify the ACC Supervisor of any reduction in declared capacity.
12.	Advise the ACC Supervisor on sector opening/closing and staffing to meet the demand.
13.	Monitor the impact of departure, en-route and arrival management systems on traffic in the area of interest.
14.	Monitor the impact of traffic and complexity management in neighbouring areas on his area of interest.
15.	Manage demand when impacted by weather or following an incident or unusual occurrence, and airspace configurations.
16.	Contribute to the critical events and crisis management activities.

5 Air Traffic Services Operations

The roles of Approach Controller, Departure Controller, Arrival Controller etc. have not been addressed as their individual responsibilities can generally be found in the roles of the Planning and Executive Controllers.

5.1 Supervisor

5.1.1 ACC/Approach Supervisor

General: The ACC/Approach Supervisor is responsible for the general management of all activities in the Operations Room. He decides on staffing and manning of controller working positions in accordance with expected traffic demand. Supported by simulations of traffic load and of traffic complexity he decides about the adaptation of sector configurations to balance capacity to forecast demand. Based on the results of simulations required flow control measures may be implemented by ATFCM through a CDM process.

Responsibilities
The ACC/Approach Supervisor's main responsibilities are:

1.	Analysis of traffic flows and sector load in collaboration with LTM/FMP and the Flow Manager.
2.	Split or combine of control sectors according to expected traffic load after co-ordination with Local Traffic Manager.
3.	Allocation of sector configuration and declared capacity.
4.	Decide on staffing and manning of controller working positions according to their training and sector validations.
5.	The planning, activation and de-activation of flow control measures on the day of operations.
6.	Coordinating with the other concerned Supervisors on the activation and de-activation of special use airspace.
	Coordinating with the other concerned Supervisors if short term planning changes are allowed by ASM Level 1.
7.	Collaboration with the Local Traffic/Flow Manager regarding re-routing of traffic in case of overload.
8.	Alert search and rescue organisation in case of an aircraft accident or aircraft uncertainty.
9.	Support decision on runway in use in co-operation with Airport Operator (APOC) and Tower Supervisor. (to confirm for En Route)
10.	Initiates implementation/removal of ACC flow measures based on runway acceptance rates. (to confirm for En Route)
11.	Collaboration with adjacent ACC supervisors.

5.1.2 Airport Tower Supervisor

General: The Tower Supervisor is responsible for the safe and efficient provision of air traffic services by the Tower crew. He decides on staffing and manning of controller working positions in accordance with expected traffic demand. He represents the Tower when coordinating with the Airport Operator on operational issues.

Responsibilities

The Tower Supervisor's main responsibilities are:

1.	Provide and maintain a duty roster of ATM personnel with regard to the resource management of the Tower..
2.	Determine expected Tower Runway and Tower Ground workload by analysing traffic forecast information.
3.	Decide on runway(s) for landing and take-off in co-operation with in cooperation with all concerned partners.
	Activate/de-activate TMA subdivisions in relation with runway in use and all other possible

	airspace structure within CTR / TMA.
	Ensure that all available information in ATIS are recorded
4.	Maintain close liaison with the Airport Operator with respect to the daily inspection of the movement area, the aerodrome lighting system, the marking of obstructions, snow clearance etc.
5.	Coordinate with the Airport Operator regarding traffic emergencies/incidents on the movement area.
6.	Coordinate with the ACC/Approach Supervisors and Local Traffic Manager regarding the implementation of traffic smoothing measures (i.e. spacing between same direction departures).
7.	Implement and discontinue limited visibility operations (CAT II or CAT III) after liaison with Airport Operator and ACC/Approach Supervisors.
	Trigger all relevant alert phases (Incerfa, Alerfa, Detresfa)[40] falling to his responsibility
8.	Initiate Airport traffic smoothing procedures (i.e. restricted push backs, perimeter holds, taxi routings, tug movements) in coordination with Airport Operator and the Tower Ground Controller.

5.2 Air Defence Supervisor

He is responsible for the general management of all activities related to Air defence missions. He decides on staffing in accordance with planning.

He's responsible for coordinating the activation / de activation or any changes of an ARES with the other (civil & military) supervisors impacted by the ARES.

5.3 ATC Sector Executive Controller Role

The ATC Sector Executive role has responsibility for traffic management within the sector and for the tactical tasks.

It is responsible for the safe and expeditious flow of all flights operating within its area of responsibility. Its principal tasks are to separate known flights operating within its area of responsibility and to issue instructions to pilots for conflict resolution and segregated airspace circumnavigation.

Additionally, it monitors the trajectory (4D and 3D) of aircraft, according to the clearance they have received. The responsibilities of the ATC Sector Executive role are focused on the traffic situation, as displayed at the Controller Working Position (CWP), and are very much related to task sharing arrangements within the sector team.

Responsibilities

Executive Controller main responsibilities are:

1.	Identify conflict risks between aircraft.
2.	Provide separation between controlled flights.
3.	Provide sequencing between controlled flights.
4.	Provide flight information to all known flights.
5.	Provide information on observed but unknown flights that may constitute traffic for known aircraft.
6.	Monitor flights regarding adherence to flight plan/RBT.
7.	Monitor the air situation picture.
8.	Communicate with pilots by means of R/T or data link.
9.	Monitor information on airspace status, e.g. activation/ deactivation of segregated/reserved airspace.
10.	Input data into the flight data processing system regarding tactical route modification, modification of flight level etc.
11.	Monitor the weather situation.
12.	Relay to pilots SIGMETS that may affect the route of a flight.
13.	Re-route flights to avoid bad weather areas if so requested.
14.	Monitor aircraft equipment status according to information provided by the system.

[40] The ICAO phases of uncertainty, alerting and distress in relation to an aircrafts flight status in emergency.

15.	Co-ordinate with Planning Controller or MSP (inter-sector co-ordination) and adjacent centre/sector Executive Controllers.
16.	Coordinate with the Planning Controller about planned conflict solution strategies based on system derived solution proposals.
17.	Coordinate the implementation of system derived conflict solutions with the Planning Controller.
18.	Handle flight-information.
19.	Apply appropriate separation to all controlled flights departing his area of jurisdiction.
20.	Transfer control of aircraft to the appropriate Executive Controller when clear of traffic within his area of jurisdiction.
21.	Assign specified headings, speeds and levels suitable for the planned approach.
22.	Inform pilots about the intended approach procedures and determine (if not done by arrival management systems) the approach sequence.
23.	Issue approach and, if necessary, holding instructions.
24.	Issue approach clearance.
25.	He provides Alerting Service (ALRS) to all known flights according to the following three different phases (INCERFA,ALERFA,DETRESFA)

Changes in Responsibilities

- Monitor flights regarding adherence to flight plan (i.e. agreed UP 4D trajectory)
- Communicate with Flight Crews by means of R/T or data link
- Co-ordinate with Planning Controller or MSP (inter-sector co-ordination) and adjacent centre/sector Executive Controllers

5.4 Air Defence ATC Executive Role

The main responsibility of the Air Defence ATC Executive role is to contribute to the safe realisation of a mission inside or outside an ARES.

It is responsible for:

- Maintaining the assets inside the ARES (when the mission takes place in an ARES)
- Issuing instructions to pilots for conflict resolution vis-a-vis external traffic and or within the mission assets
- Issuing instructions to pilots for mission completion/realisation
- Providing situation awareness
- Triggering alert in case of emergency
- Providing any information related to weather forecast, airfield status, etc

It is assisted for:

- Preparing and executing hand over
- Coordinating with other units/controllers

Monitoring the traffic outside the ARES

5.5 New roles in ATM layered planning

This section is dedicated to the new roles in ATM layered planning and scoped for the short term and execution phase of this process. Indeed in Step 1, one of the main improvements is that a new ATM layered planning is made possible with the introduction of new roles (i.e. Complexity Manager, Mulit Sector Planner). New working methods and optimized tasks sharing are defined; the main objectives are to improve safety, improve capacity, reduce controller workload per flight and reduce tactical intervention on flights.

In Step 1 ATC Planning will be organised in a way that is suited to the traffic density and technical environment. The roles associated with the ATM layered planning in an En Route control centre are:

- “ATC Sector Planning” refers to a planning role working on one ATC sector and for which tasks would be approximately what the corresponding controller is doing in today’s environment enriched by enhanced sector team task sharing resulting, in EC workload smoothing...
- “Multi-sector Planning” refers to an ATC planning role, involved in organising air traffic over a number of ATC sectors (a family of sectors) within ATSU airspace. Depending on the ATSU environment and operational working methods the Multi-sector Planner would serve several tactical controllers in a role somewhat extended from the ATC Sector Planning role in today’s environment (group of sectors Planner responsibilities). Alternatively he/she would perform tasks at the interface between the LTM and the Planning Controller.
- “Complexity Management” refers to an operator role responsible for the entire ATSU airspace consisting of a large number of ATC sectors and a number of sector families. He/she is responsible for complexity assessment and resolution.

The Roles in the ATM Layered Planning could overlap. Actors endorsing these roles would depend on local ATSU or ANSP procedures, operating methods and traffic environment. A given actor could assume a given role, part of the tasks of a given role, several roles or part of the tasks of several roles.

For example the Multi-sector Planner (as an actor) could perform solely the task of sector planning extended to 2 or more sectors (Group of sectors Planners responsibilities), and could also perform elements of the complexity management role.

Similarly, the LTM (as an actor) could also perform the Complexity Manager tasks.

5.5.1 ATC Sector Planning Controller Role

The ATC Sector Planning role is mainly responsible for, planning and coordination of the traffic entering or existing within the ATC Sector.

Furthermore, it provides tactical flight control assistance to the ATC Sector Executive role.

Responsibilities

The responsibilities of ATC Sector Planning are to:

- Co-ordinate entry and exit conditions.
- Check flight plans/iRBTs for possible conflicts and complexity issues within its area of responsibility.
- Plan conflict-free flight path through its area of responsibility.
- Coordinate with the ATC Sector Executive role about planned conflict solution strategies based on system derived solution proposals
- Implement solution strategies by communicating trajectory changes to the aircraft through the concerned ATC Sector Executive role via Data Link (or voice).
- In coordination with the ATC Supervisory or Local Traffic Management roles determine the need for additional Executive Controller(s) in the case where forecast overload situations are developing.
- Input tactical trajectory changes into the Flight Data Processing System when delegated by the Executive Controller.

Co-ordinate with adjacent control areas/sectors for the delegation of airspace or aircraft

5.5.2 Multi Sector Planner Role

The Multi-Sector Planning role is responsible for a multi-sector area (MSA) comprising of two or more of the present control sectors. Depending on the ATSU environment and operational working methods the Multi-sector Planning:

- It is operationally positioned between Complexity Management and the Sector Planning.
- It may perform tasks related to workload distribution and sectorisation management, and also the task related to the ATC Sector Planning (ref. ATM Layered Planning table).

Responsibilities

The main responsibilities for Multi Sector Planning are:

- Common to both sector team organization
    - Monitor internal and external constrictions, complexity and constraints for the next 15 to 30 minutes.
    - If necessary balance workload, individually optimise entering flights on the planned route and within given dynamic constraints (target times, target levels, target speeds), or coordinated for a new route.
    - Be knowledgeable of iRBT management issues to avoid actions that would compromise compliance e.g. CTA or CTO.
    - Co-ordinate re-routing options with adjacent control areas/sectors.
    - Mitigate real time traffic complexity and optimize workload by applying constraints e.g. level capping, top of descent advisories, target times, levels or speeds, miles in trail procedures etc.

Execute ATC Sector Planning responsibilities for a group of sectors.

5.5.3 Complexity Management Role

Complexity Management assures that traffic complexity remains within the limits that the controllers can safely cope with. This process supports an efficient provision of Separation Services. Complexity Management detects zones/volumes of high complexity and takes mitigation measures against Controller overloads. The role of Complexity Management may be performed by the Local Traffic Management actor on one end and the Multi Sector Planning actor on the other These new roles and responsibilities are completely new in the ATM Layered Planning and their final definition and allocation to adequate actors is dependent on the validation activities

Responsibilities

The Complexity Management role is:

- Responsible for balancing the workload of sectors within the ATSU or assigned Sector Family.
- Sensitive to the internal and external complexities expected for the future 30-90 mins.
- Will re-organise internal ATC sectors, or families of sectors, implement complexity problem resolutions with simple rules.
- May adjust internal air traffic flows or constraints according to forecast traffic and priority rules.
- Will re-route specific flights, if they have a high complexity signature
- Will be aware of any Network issues related to forecast traffic and possible actions
- Manages workload rather than capacity. Through the display system and system advisories, it has an awareness of both situational complexity and its effects on the individual workloads.
- Interacts with ATC planners, multi-sector planners and other ATSU planners, as well as with the airport capacity planners and Flow managers.

5.6 Tower Runway Controller

General: The Tower Runway Controller is responsible for the provision of air traffic services to aircraft within the control zone, or otherwise operating in the vicinity of controlled aerodromes (unless transferred to Approach Control/ACC, or to the Tower Ground Controller), by issuing clearances, instructions and permission to aircraft, vehicles and persons as required for the safe and efficient flow of traffic. The Tower Runway Controller will be assisted by arrival, departure and surface management systems, where available.

Responsibilities

The Tower Runway Controller's main responsibilities are:

1.	Issue clearance to enter/ leave/ cross the control zone.
2.	Issue clearance to enter the traffic circuit.
3.	Give instructions to integrate VFR flights with IFR flights to achieve a landing sequence.
	Issue clearance for VMC Approach to IFR flights
4.	Sequence departures.
5.	Ensure sufficient spacing between successive departures.
6.	Issue landing clearance to arriving flights and the runway exit point, as appropriate.
7.	Issue instructions to arriving flights to go-around when it is unsafe to land (e.g. runway still occupied).
8.	Provide information on runway breaking action.
	Operate the arresting gear system during take-off and landing phases for equipped aircraft. (MIL)
9.	Provide information wind direction and speed on final approach.
10.	Give instructions to taxi to the take-off position for departing flights and operate the stop bars if required.
11.	Issue take-off clearance to departing flights in accordance with the CTOT, if issued.
	Issue clearance for the dropping of parachutists in coordination with the Tower Ground Controller (MIL)
	Issue clearance for aerobatic manoeuvres over runways
12.	Give authorisation to the Tower Ground Controller for the crossing of runways by surface traffic.
13.	Operate the aerodrome lighting system in co-operation with the Tower Ground Controller.
	Trigger additional runway inspections in case of suspected Foreign Object Debris (FOD) or unexpected pollution of the runway surface.
14.	Issue essential local traffic information and essential aerodrome information.
15.	Perform a flight information service within his area of responsibility.
16.	Issue reports/observations of significant weather changes from that published.
17.	Perform alerting service within his area of responsibility
	Trigger alert and intervention of emergency vehicles in case of incident or accident
18.	Manage integration of departures in the arrival sequence in mixed-mode operations.

5.7 Tower Ground Controller

General: The Tower Ground Controller is part of the controller team responsible for providing an Air Traffic Service at controlled aerodromes. His main task is the provision of ATS to aircraft and vehicles on the manoeuvring area. He must also ensure that airport maintenance vehicles carrying out necessary improvements on an active manoeuvring area do not interfere with the movement of aircraft. He will be assisted by an advanced surface movement guidance and control system (A-SMGCS).

Responsibilities

The Tower Ground Controller's main responsibilities are:

1.	Issue clearances, instructions and permission to aircraft, vehicles and persons operating on the manoeuvring area as required for the safe and efficient flow of traffic, e.g.: • essential local traffic information, essential aerodrome information, meteorological information; • taxi instructions to arriving and departing flights; • permission to start engines; • permission to push-back; • instructions to towing aircraft • instruction on arrival stand; • information on de-icing procedures.
2.	Operate the aerodrome lighting system in co-operation with the Tower Runway Controller.
3.	Co-ordinate ground movements on the landing area with the Tower Runway Controller.

4.	Monitor all aircraft and vehicle movements on the manoeuvring area and issue instructions where appropriate to ensure separation between aircraft and other ground mobiles.
5.	Issue departure clearances to departing IFR flights.
6.	Co-ordinate ramp departures and arrivals with the Airport Operator.
7.	Monitoring the progress of arriving aircraft until the aircraft is safely parked on stand and the engines shut down.
	Co-ordinate helicopters starting-up, aircraft taxiing with the Tower Runway Controller when parachute dropping in progress. (MIL)
8.	Co-ordinate runway/taxiway maintenance vehicle operations with the Airport Duty Officer.
9.	Co-ordinate runway/taxiway maintenance vehicle operations with the Tower Runway Controller.
10.	Coordinate remote de-icing procedures with De-icing Agent.
11.	Direct the operation of emergency vehicles on the runways/taxiways when required.

Remark: On military aerodromes the role of Ground Controller is generally combined with that of the Runway Controller.

Changes in Responsibilities

- The Automated Assistance System for Surface Movement Planning and Routing provides Controller with the most efficient taxi route
- Remark: On military aerodromes the role of Ground Controller is generally combined with that of the Runway Controller.
- Coordinate with the relevant APOC stakeholders on the feasibility of specific airport scenario's
- Update the AOP with information within the Airport ATC area of responsibility.

5.8 Tower Clearance Delivery Controller

General: The Clearance Delivery Controller is part of the controller team responsible for providing an Air Traffic Service at controlled aerodromes. His main task is the verification of Flight data (e.g.FPL, CTOT, Stand, TSAT etc) and the delivery of ATC Clearance (Departure Clearance) and Start-Up Approval.

It is important to note that, according to the aerodrome environment (e.g. airport complexity, traffic density, etc.) and the local regulations at a specific airport, the tower positions may share tasks and responsibilities. To this respect, control areas and responsibilities are clearly defined in local documents and agreements at each airport.

Responsibilities

The Tower Clearance Delivery Controller's main responsibilities are:

1.	Issue departure clearances to departing IFR fligths.
2.	Issue Start-Up Approval.
3.	Verify Flight data, e.g. FPL, CTOT, Stand, TSAT etc.
4.	
5.	

5.9 Flight Data Operator

General: The Flight Data Operator (FDO) is responsible for validating the flight plan information received from Aircraft Operators (including individual pilots). In addition, the Flight Data Operator provides an advisory service (a "help desk") to the individual pilot on flight plan issues when the automated system is unable to provide the assistance required if requested.
The Flight Data Operator is responsible, under the direction of the Multi-Sector/Planning/Executive Controller (depending on sector configuration), for the input of the additional fight data, such as routing, altitudes, destination and alternates, for flights that have filed an airborne flight plan.
In the event of aircraft diversions the Flight Data Operator is responsible for any manual updating of flight data, to reflect newly issued routing and destination. This ensures that downstream sectors are aware of the revised trajectories through an updated Network Operations Plan.
Additionally, he is responsible for the manual preparation, input and dissemination of flight data (e.g. the verbal transfer of estimates) in the event of automated systems degradation.

Responsibilities

The FDO's responsibilities are:

1.	Validate the syntax of all received flight plans in cases of System rejection.
2.	Assist Multi-Sector/Sector Planning Controller in updating basic flight plan information to enable the System to properly process air-filed flight plans.
3.	Provide advice and information to individual aircraft operators regarding route and airspace availability.
4.	Process and input flight plan changes to the System regarding aircraft diversions in coordination with the Local Traffic Manager.
5.	Process and input flight data changes in cases of inconsistency between planned fight data and actual flight data.
6.	Ensure that the appropriate Planning Controller is made aware of any downstream constraints that may affect the new routing of diverted aircraft.
7.	Maintain a current data base on airspace, routings and restrictions within the Flight Plan System.
8.	Respond to information queries originated by aircraft operators regarding flight plan issues.
9.	In the event degraded operations, re-input basic information into the System to ensure the timely re-correlation of all known aircraft.