OSED for Controller Team Organisation- Roles and Responsibilities in a Trajectory Based Operation Within En-Route Airspace (including MSP)

Document information	
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Abstract

The project P04.07.08 focuses on Controller Team Organisation; specifically Roles and Responsibilities within a Trajectory based Operation within En-route Airspace.

The key objective of P04.07.08 is to develop the Roles, Responsibilities and Tools associated with different Controller Team Organisations in En-route airspace to maximise the benefits of controller tools.

This OSED describes a document which is based on the NATS iFACTS Quick Win, which focuses on the sector staffing configuration of 1 Planner Controller to 2 Executive Controllers in a 2D Separation Environment. The Tools designed to support the MSP staffing configuration were designed to be built upon existing 2D separation

management tools for En Route based on the NATS iFACTS system.

Further editions of the OSED will be published as the MSP concept is refined and updated in this project.

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Executive summary

The project P04.07.08 focuses on Controller Team Organisation; specifically Roles and Responsibilities within a Trajectory based Operation within En route Airspace; however this OSED refers to the Quick Win phase of work within the project and is SESAR Step 1, therefore a time-based operation.

The concept and tools developed are in support of SESAR concept steps 1 (Time Based Operations) and will support the evolution of operations from 2D, through to 3D to 4D as defined in the SESAR Concept of Operation.

The key objective of P04.07.08 is to develop the Roles, Responsibilities and Tools associated with different Controller Team Organisations in En Route airspace to maximise the benefits of controller tools.

The principal controller team organisation to be developed is the MSP (Multi-Sector Planner), the underlying principle being 1 Planner supporting 'n' Executive Controllers. In addition other organisations such as combined Executive/Planner operations such as SPO (Single Person Operations) will be considered.

This OSED is based on the NATS iFACTS Quick Win, which focuses on the sector staffing configuration of 1 Planner Controller to 2 Executive Controllers in a 2D Separation Environment. The Tools designed to support the MSP staffing configuration were designed to be built upon existing 2D separation management tools for En Route based on the NATS iFACTS system; however, what is described in this document is the general concept rather than that specific implementation

Prior to this Quick Win within SESAR, NATS had previously undertaken some early maturity development and validation for an MSP concept in which the method of working called Collaborative Control was devised; in this, the Executive controllers (which may be two or more) within the Multi-Sector group work together to achieve the exit conditions that the Planner has set at the boundary of the whole group. However, it was realised that it was not feasible, even with advanced support tools, to expect the Planner to be responsible for agreeing not only entry and exit coordinations for each flight at the planning sector boundary, but also at each of the internal boundaries between the Executive sectors. Thus, Collaborative Control removes the need for every flight to have set and agreed an explicit coordination at every tactical boundary, the concept requiring significant system support so that the traffic situation throughout the whole planning sector is made available to each of the Executives as necessary (and suitably filtered to be of practical use). Although the Collaborative Control concept requires further development and concept validation (this will form a further thread of work within P4.7.8), it was clear that there was the potential for significant benefit to be derived from an MSP operation. For the Quick Win, the scope of the MSP role was limited to just two tactical sectors. Owing to the fact that there is a single internal (tactical) boundary, a normal coordination model is employed at both the internal and external boundaries (i.e. no Collaborative Control is employed in this initial concept).

This OSED draws on the knowledge from the NATS V3 Validation Simulation (EXE-04.07.08-VP-304) that took place in Feb/March 2012 and on the sector staffing configuration of one Planning Controller to two Executive Controllers (1PC to 2EC); and should be read in conjunction with the P04.07.02 OSED which details the type of Planner Support Tools envisaged to support the new roles and responsibilities in a trajectory based operation within En Route airspace. As mentioned, this OSED will be published as the MSP concept is refined and updated in this project.

1.1 Purpose of the document

The Operational Service and Environment Definition (OSED) describes the operational concept defined in the Detailed Operational Description (DOD) in the scope of its Operational Focus Area (OFA).

It defines the operational services, their environment, use cases and requirements.

The OSED is used as the basis for assessing and establishing operational, safety, performance and interoperability requirements for the related systems further detailed in the Safety and Performance Requirements (SPR) document. The OSED identifies the operational services supported by several entities within the ATM community and includes the operational expectations of the related systems.

This OSED is a top-down refinement of the 04.02 Consolidation of operational concept validation and definition including operating mode and air-ground tasks sharing DOD produced by the federating OPS 04.02 project. It also contains additional information which should be consolidated back into the higher level SESAR concepts using a “bottom up” approach.

The figure below presents the location of the OSED within the hierarchy of SESAR concept documents.

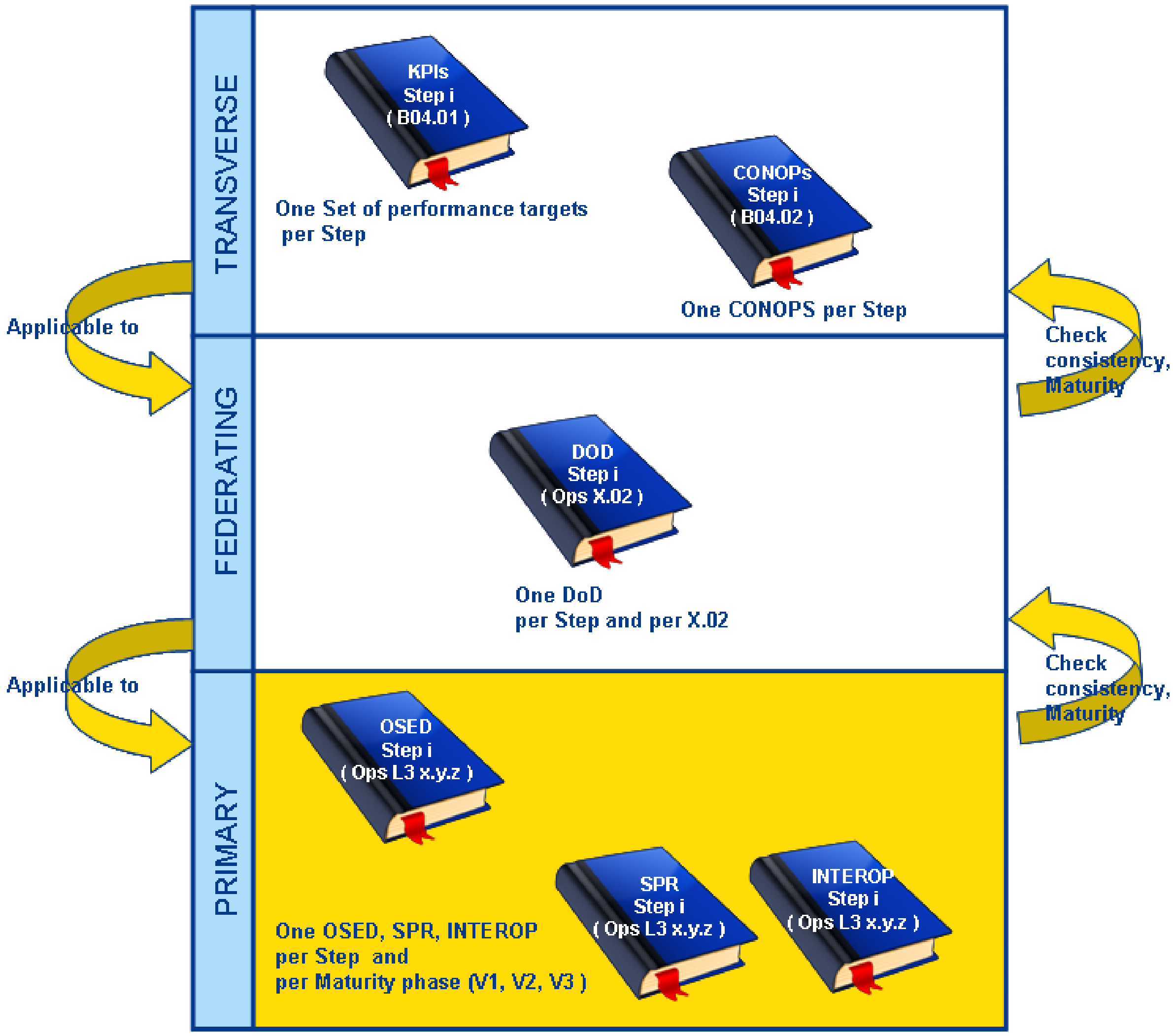


Figure 1: OSED document with regards to other SESAR deliverables

In Figure 1, the Steps are driven by the OI Steps addressed by the project in the Integrated Roadmap document**.**

It is expected that several updates to this OSED will be produced during the lifecycle of the P04.07.08 project execution phase.

1.2 Scope

This document is the OSED relating to the P04.07.08 Controller Team Organisation, Roles and Responsibilities in a Trajectory Based Operation within En-route Airspace (including Multi-Sector Planner) element of the SESAR operational concept. It will be a top down refinement of the SESAR Operational Concept Description (OCD) and Concept of Operations (ConOps) produced by SESAR WPB04.02 and the Detailed Operational Description (DOD) produced by WP4.2.

This OSED details the operational concept for the following Operational Focus Area (OFA):

- 3.3.4 “Sector Team Operations”

Operational Package	**Operational Sub-Package**	**Operational Focus Area (OFA)**	**Operational Improvements**
PAC03 Moving from Airspace to Trajectory Management	Conflict Management and Support Tools	Sector team operations	CM-0301 Sector Team Operations Adapted to New Roles for Tactical and Planning CM-0302-A Ground Based Automated Support for Managing Traffic Complexity Across Several Sectors*

*CM-0302 is addressed in both VALS and VALP and is currently submitted as a CR to be split between Step 1 and Step 2.

Figure 2 and Figure 3 show the key dependencies with the projects in sWPs 4.7 and 5.7 and also the other sWPs in the WP and the System WP (WP10) in relation to P4.7.8. The key interactions are with the following projects / sWPs and WPs:

- P4.7.1 / P4.7.2 – coordination with other level 3 projects including complexity management and the underlying separation management and goal achievement tools.
- sWPs 4.2 and 5.2 – coordination on concept issues and key deliverables (OSEDs, Validation Plans, Validation Reports, SPRs, interops.
- sWP 4.3 – validated P4.7.8 V3 prototype made available to sWP 4.3 for subsequent integrated and cross-validation activities as required outside the scope of this project. Coordination of the validation of some concepts linked with working method and task sharing.
- sWPs 4.5 and 5.5 – coordination on the underlying trajectory framework and capability.
- sWP 5.9 – coordination and usability requirements .
- P10.4.1 – coordination of requirements for systems (industry) development.

Note that there is an indirect link to the system work package projects 10.1.7, 10.2.1 and 10.4.2 but these will be principally via sWP 4.2 / 4.3, sWP 4.5 and sWP4.7 respectively.

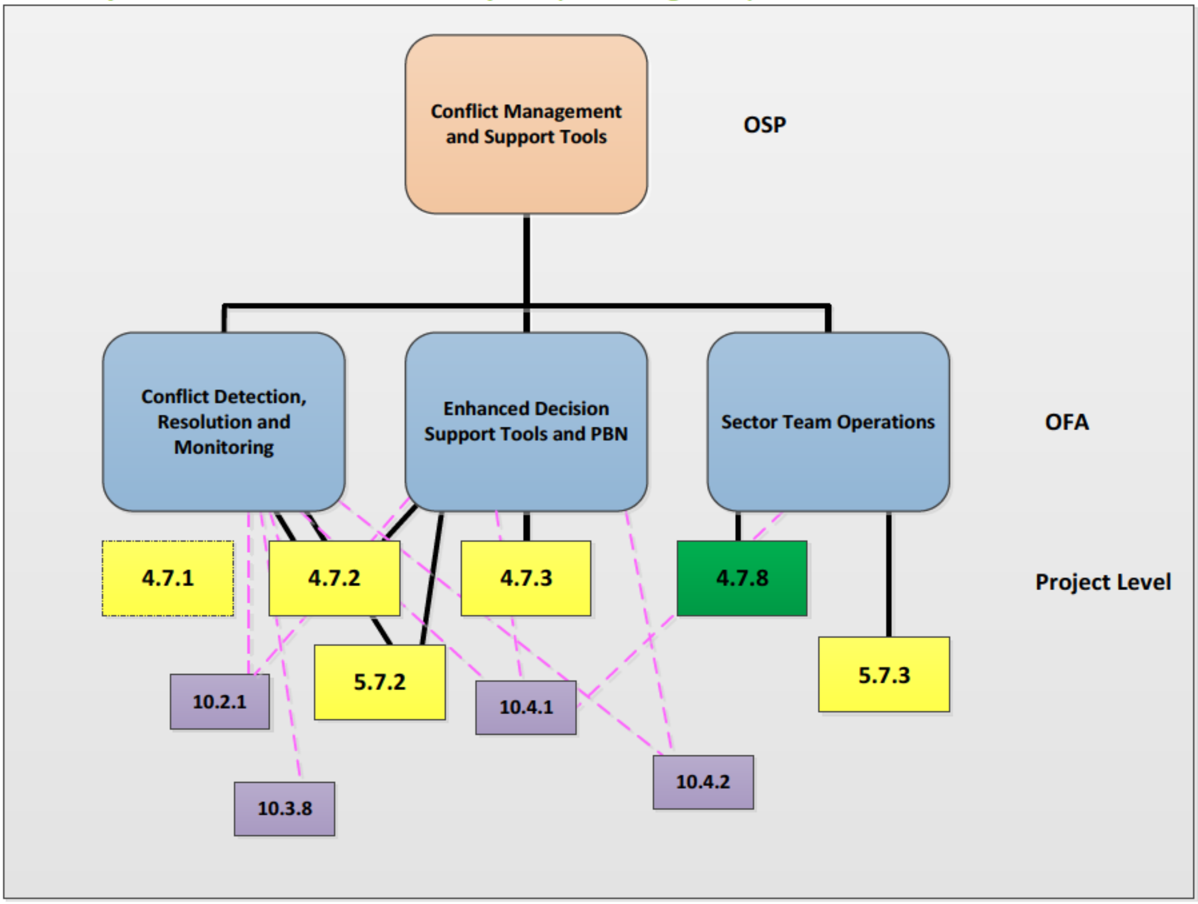


Figure 2: Operational Sub-package Diagram

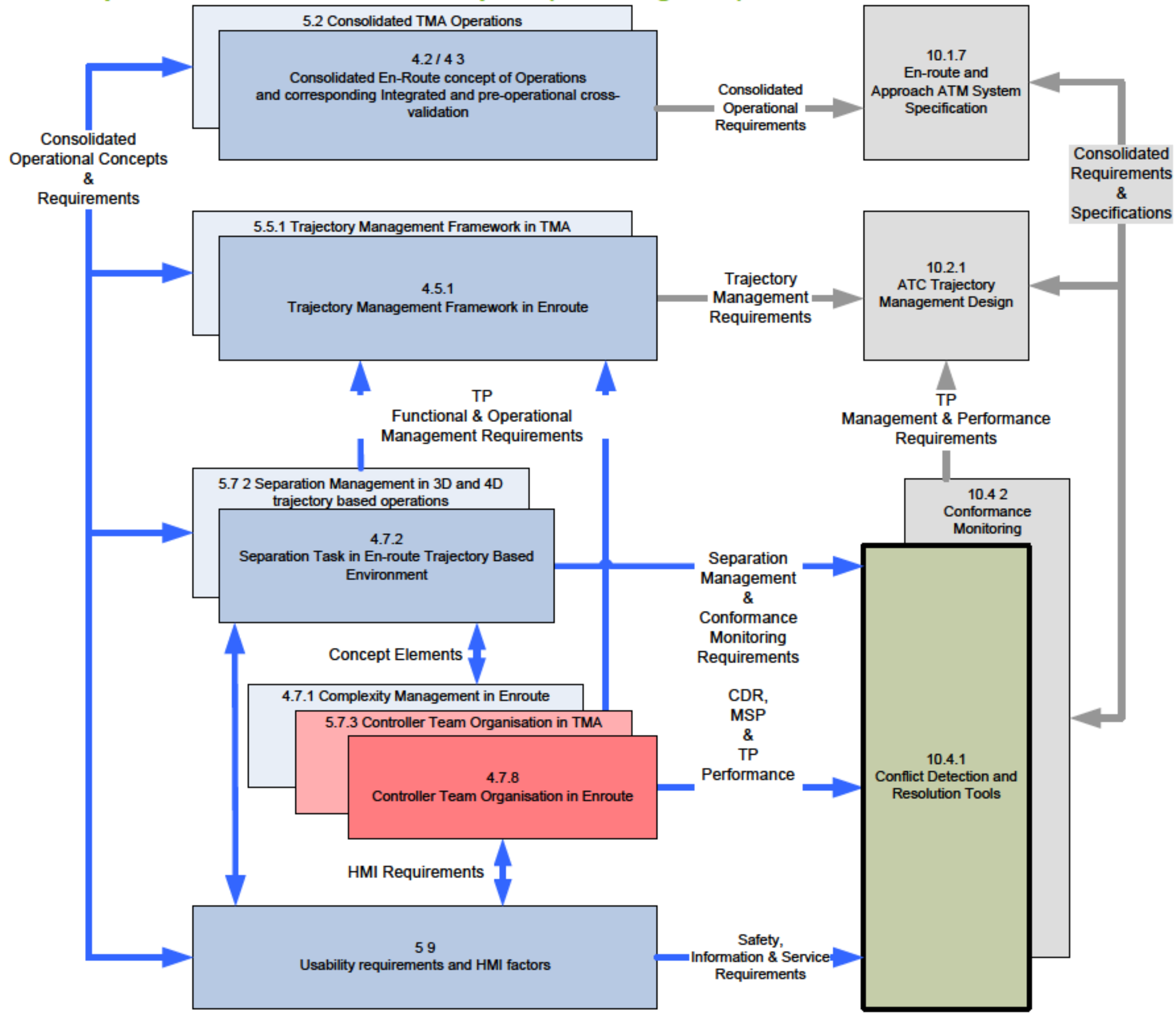


Figure 3: Key dependencies with other level projects in sWP 4.7/5.7 and other sWPs in the WP and the System WP.

1.3 Intended readership

The intended audience for this document are other P04.07.08 team members, and those in corresponding technical projects of P04.07.02.

At a higher project level, WP4.2 and WP B are expected to have an interest in this document.

External to the SESAR project, other stakeholders are to be found among:

- Air Navigation Service Providers (ANSP)
- Airspace Users
- Affected employee unions

This document should also be read in conjunction with the documentation for WP04.07.02. This OSED details the operational concept for the Operational Focus Area (OFA)

- 3.3.1 "Conflict Detection, Resolution and Monitoring"
- 3.3.3 "Enhanced Decision Support Tools and Performance Based Navigation"

P04.07.02 is developing the enhanced toolsets that are referred to within WP04.07.08.

1.4 Structure of the document

The remainder of section 1 details some background into the SESAR programme with the main aims of P04.07.08, and a Glossary of Terms, Acronyms and Terminology.

Section 2 contains Mapping tables that provide the link to the relevant DODs. It also details in simple terms and plain language the operational concept in the scope of the addressed Operational Focus Area.

Section 3 describes the detailed Operating method; both the previous and new SESAR Operating method for the Executive and Planner Controller roles and a brief description of the tools that have been designed to support the concept. The main differences between the old and new operating method are clearly defined.

Section 4 details the Operational Environment in which the concept is based. It is a vehicle for the detailed description of the environment for the Operational Processes and Services as described in section 2. Any technical constraints that have been identified that may have an impact on the concept or solution are detailed here.

Section 5 contains the Use Cases that have been identified in the DOD that are using the services referred to in section 2.

Section 6 lists the operational and functional requirements for the Multi-Sector Planner Concept

Section 7 lists the reference documents used in the production of this OSED

1.5 Background

A significant aim of the SESAR Programme is to allow ATC to offer and facilitate aircraft flight profiles that reflect, as closely as possible, each one's user preferred profile (generally the most efficient profile taking account of fuel-burn, standard operating procedures, weather, airline specific business drivers etc.). The complexity and workload issues associated with providing a safe ATC service virtually necessitate the division of airspace into discrete geographical units (sectors), each with its own controller team responsible for clearing the aircraft to fly a profile that best fits its desires whilst ensuring the provision of safe separation between aircraft and airspace restrictions.

The Executive (E) and Planner (P) two-person controller team is currently a common sector manning organisation found in several European Area Control Centres. Centre Watch Supervisors must ensure that there are enough suitably sector-valid controllers in the duty watch at all times to allow sectors to be opened (or split) in times of high traffic, even though this may be only for a relatively small proportion of the total time (which is not cost-effective). Each open sector requires two appropriately qualified controllers from the available pool. It is not unusual for the sector demand to exceed the available controller resource such that sectors can be split no further – a situation that results in flow restrictions, procedural level-capping and other such measures to ensure safety at the expense of less ideal flight profiles and/or delays.

In the traditional two-person E-P team the Planner has fairly limited scope for managing complexity and workload by redistributing the traffic (e.g. through "tactical re-routes") without significant coordination with adjacent sectors – workload that may itself mitigate against such a course of action despite its potential benefit to the sector (and the overall traffic flow).

However, it is an almost inevitable consequence that this division of responsibility between discrete controller teams leads to more piecemeal planning for each flight as the operational requirement for predictability and assurance of the flight's state as it passes from sector to sector becomes a significant factor for the provision of separation. This tends to increase the incidence of intermediate level clearances ("stepped climbs/descents") and actual level-outs by aircraft and reduces the opportunity for direct routes over a longer distance. A significant amount of Research and Development within ATM has been conducted over recent years in order to design and implement controller support tools that aim to enhance the efficiency of Area Control Operations.

Significant work has been undertaken within NATS regarding the development for advanced support tools and a complementary operational concept in order to enhance the efficiency of Area Control

Operations since the late 1990s. The FACTS (Future Area Control Tools Support) project developed an initial core set of controller support tools supporting both the decision making and monitoring aspects of the air traffic control task (both tactical and planning) based upon the underlying functions of Trajectory Prediction (TP), Medium Term Conflict Detection (MTCD) and Flight Path (sometimes known as Conformance) Monitoring (FPM). From this initial phase of concept development a first implementation project was initiated for the deployment of the executive tools into the London Area Control Centre (LACC) based upon the architecture of the (then) New En-Route Centre (NERC) at Swanwick, a deployment known as Interim FACTS or iFACTS. Having completed the R&D phases of development of the iFACTS concept (as distinct to the FACTS concept owing to its reliance on the NERC architecture) in 2003, the iFACTS system went operational across all LACC sectors in 2011.

Whilst the implementation project to deliver iFACTS into the LACC Operation was underway, the R&D development under the wider FACTS programme continued and broadened its remit from the core separation provision concept and support tools to begin to address the roles and responsibilities of the Controller Team with a view to the development of concepts that would allow a more flexible team structure than the typical Planner-Executive pair (known as '1P-1E' – one Planner to one Executive). In particular, the division of separation responsibility between Planner and Executive and, for a team structure of more than one Executive Controller to one Planner ('1P-nEs'), the division of separation responsibility between those several Executives was the key concept issue, the underlying tools and FDP allowing more dynamic distribution of the necessary flight data and problem information (e.g. aircraft conflicts) between the controllers in the team. This concept is what generally referred to as Multi-Sector Planner (although it is not the only concept to be known by that title).

Over two phases of early concept development, an approach to MSP was devised in which the Executive Controllers within the MSP sector-group worked together to achieve the exit conditions that the Planner had set at the boundary of the whole group – a method of working that was called Collaborative Control. One of the significant issues that influenced this approach was the early realization that it was not feasible to expect the Planner to be responsible for agreeing not only the entry and exit co-ordinations for each flight at the overall boundaries of the sector-group but also any at the "internal" boundaries between the sectors operated by each Executive; neither was it desirable simply to transfer the work associated with planning across those boundaries to the Executive Controllers. Thus, one of the fundamental tenets of Collaborative Control is that co-ordination between Executive Controllers need only be agreed in those situations where a particular separation or traffic management problem exists, otherwise flights can be transferred from sector to sector without prior co-ordination (this method of operation is contingent on the correct information being distributed to each Executive by the support tools as previously mentioned).

Although the Collaborative Control concept requires further development and concept validation (and forms the primary subject of a Step 1 thread within P4.7.8) it was clear that there was the potential for significant benefit to be derived from an MSP operation. As a result of the early promise shown by MSP and the (then) imminent commencement of iFACTS operations at LACC it was proposed that a first deployment of an interim MSP concept should be developed based on iFACTS and the current NERC architecture (i.e. the legacy FDP system) allowing the controllers to be organized into either the traditional 1P-1E or a new 1P-2E sector team structure – this development was known as Interim MSP ('iMSP').

As mentioned above, previous early development phases of a multi-sector planner concept suggested that significant operational benefit could be gained through such a concept. With the more advanced concept of Collaborative Control reliant on the underlying FDP system upgrade and targeted at an iTEC implementation, a piece of work was initiated to investigate whether a more limited MSP concept could be developed for operational implementation and deployment in a shorter timeframe as an upgrade to the LACC iFACTS system. The iMSP concept development was therefore undertaken with this target in mind and with a number of constraints imposed upon it:

- the concept should be deployable on the NERC/iFACTS system at LACC
- the concept would be limited to a one Planner to two Executives (1P-2E) team arrangement
- although it would not be expected that all potential pairs of sectors could be operated as 1P-2E simultaneously across the LACC operation, the concept should be applicable to a wide variety of sector types and should cope with normal traffic levels (i.e. not only light or night-time traffic)

- minimal change should be required to the iFACTS tactical tools, although it is accepted that support tools for the Planner may need to be developed
- minimal change should be required to the architecture of the NERC system
- minimal change to the roles, responsibilities and tasks of the Planner and Executive Controllers using iFACTS
- the concept should not be inconsistent with the envisaged target MSP concept ("Full MSP") and should be a stepping-stone towards the future deployments

The early phases of development for iMSP determined a number of concept criteria which were felt to be consistent with these constraints and which became, effectively, the criteria against which the objectives of the subsequent validation activities were set:

- the role, responsibilities and tasks of the Executive Controller operating in a 1P-2E mode will be as similar as possible to that of standard 1P-1E operation
- the "internal boundary" between the two sectors (or sector groups) within a 1P-2E combination will be a coordinated boundary (i.e. there will be an explicit exit level from one sector and entry level into the next across the internal boundary for flights that are expected to traverse both sectors); the internal boundary may be lateral or vertical and may be set automatically from an appropriate sector adaptation file (in the case of a standing agreement, for example)
- although the specific nature of certain tasks may change, in general the role and responsibilities of the Planner Controller when responsible for two Executive Controllers will be as similar as possible to those when operating in the 1P-1E mode
- it will be primarily the responsibility of the Planner to set the coordination at the internal boundary, however all members of the Controller Team should have the ability to set and/or amend the level(s) and any supplementary coordination conditions
- the Planner will not be expected to monitor both sector (i.e. Executive) frequencies coincidentally when operating in 1P-2E mode, but will have access to both.
- as a result of having responsibility for traffic across two sectors (or groups of sectors), tools to support the Planner in the identification of acceptable entry coordination offers and the selection of appropriate exit levels will be required
- as far as possible, additional support for the Planner will be provided through enhancement of the current toolset rather than the introduction of completely new tools and HMI

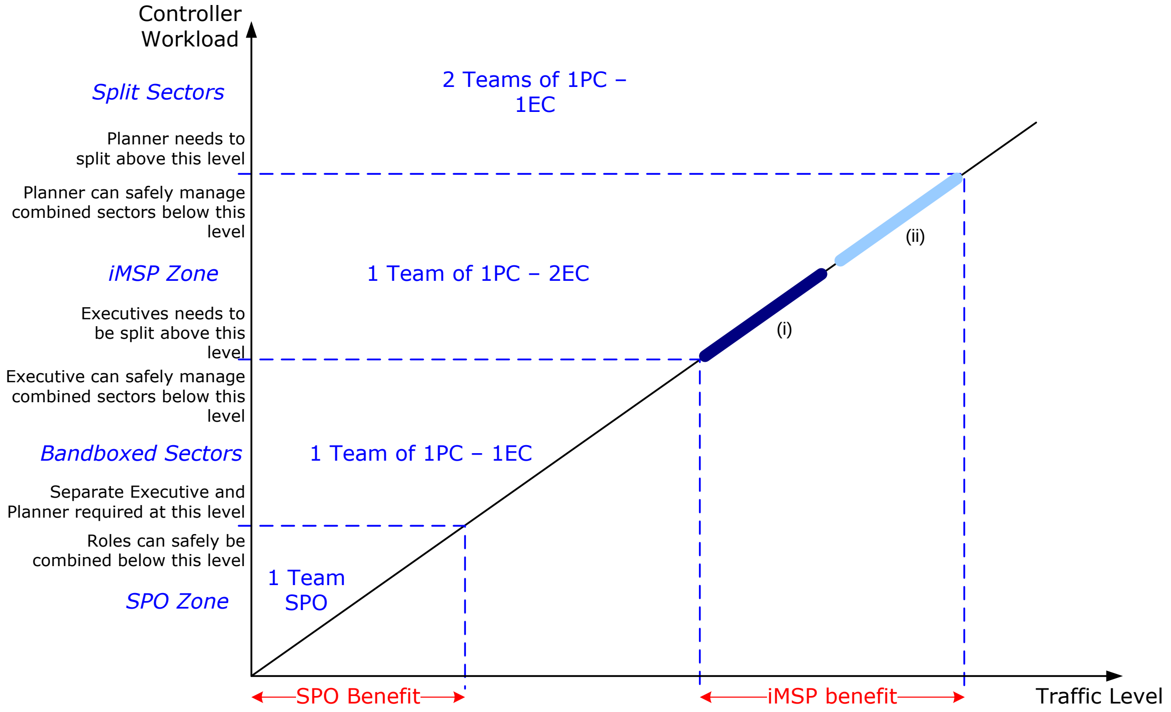
The iMSP concept, as developed as a Quick Win thread of work within P4.7.8 for SESAR concept Step 1 (time-based operations), can therefore be summarized as one in which the Planner is responsible for the sectors under the control of two Executive Controllers, the common boundary between them being one across which a coordination agreement must be put in place either explicitly (generally by the Planner) or from a standard operational procedure (e.g. a standing agreement). Enhancements to the NERC planning tools (including Look-See, What-If, electronic strips etc.) have been developed in order to increase the efficiency of the planning and decision-making processes in order that the workload of the Planner in a 1P-2E team structure remains within acceptable limits at traffic levels that are comfortable, but not especially low, for the Executives.

In the context of the wider development of Multi-Sector Planner concepts within P4.7.8, the iMSP concept is seen as a first step towards the more advanced (both from an operational and technical point of view) Collaborative Control concept in which internal boundaries (there may be more than one) need not be co-ordinated by procedure. Key operational concerns and issues associated with the move from a dedicated to a shared Planner such as support to the Executive, monitoring the tactical situation, anticipation of situations that require remedial intervention and revision, and the perceived safety issues associated with the second controller listening to each frequency have all to be addressed without the additional impact of a significant change to the division of separation responsibilities of the controllers in the team. The on-going development of the more advanced MSP concepts in the later threads of the Project will gain valuable insight into these issues and guidance as to how they can be best addressed.

Three phases of development and validation were planned for the iMSP concept (the first of these preceded the start of P4.7.8 and focussed on the development of the support tools for the Planner).

The latter two, a V2 exercise 'iMSP2' (EXE-04.07.08-VP-157) was held in Dec '10 and the Release 2 V3 exercise 'iMSP3' (EXE-04.07.08-VP-304) in March '12 both included the enhanced planner tools and the 1PC-2EC operation (the latter also investigated a variation on the team structure with a single Controller solely responsible for the sector – Single Person Operations or "SPO").

At the core of the iMSP concept is the proposal that there exists a level of traffic complexity that exceeds the capacity levels of the single team of two controllers (one Planner and one Executive) in a bandboxed configuration, yet does not fully utilise the capacity of the four controllers in a split configuration (two sectors each controller by a Planner and an Executive). When it is the workload of the Executive that forces the split to maintain safe and acceptable levels of workload, the Planner may still be able to manage their task load comfortably at this point. The Multi-Sector Planner concept of 1P-2E with enhanced planner tools support is proposed as a concept that could bridge this gap. There may also be an opportunity during quieter traffic situations for a single controller (SPO) to perform the role of both Planner and Executive using the enhanced toolset. The diagram below presents a schematic of this view – note however that the relationship between workload and traffic level is far from the simple one suggested by the picture and that it is purely to illustrate how the iMSP (and SPO) configurations could be exploited as traffic levels rise and fall.



(i) periods where the traffic level and complexity was deemed to be sufficiently high that the bandboxed Executive position was required to be split, and

(ii) periods where, although the two Executive controllers felt that traffic levels were sufficiently high that they could not operate bandboxed, the two Planners felt that they could safely combine the sectors onto a single Planner position

Figure 4 Sector staffing arrangements and traffic levels

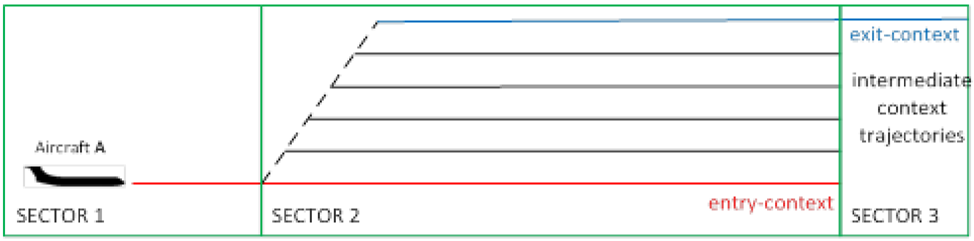
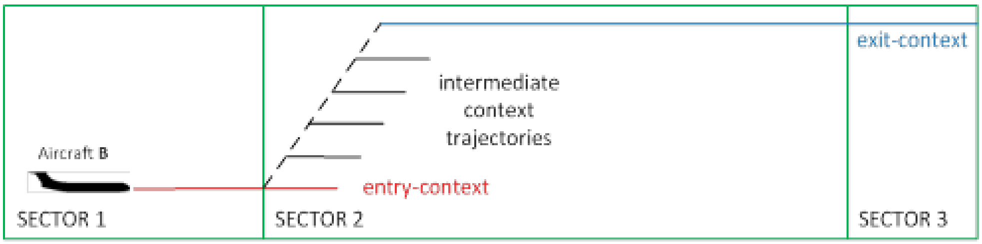
1.6 Glossary of terms

Separation Related Terms.	
Separation Criteria	A generic term which covers the ***Separation Minima*** and the thresholds used for problem identification.
Separation	Spacing between an aircraft and a ***Hazard***.
Lateral Separation	***Separation*** expressed in terms of horizontal distance or angle of convergence/divergence between tracks
Vertical Separation	***Separation*** expressed in units of vertical distance
Separation Minima Related Terms Note: that the separation minima define the legal separation between hazards in a controlled airspace.	
Separation Minima	The minimum displacements between an aircraft and a ***Hazard*** which maintain the risk of collision at an acceptable level of safety. Note: ICAO Doc 9689 describes the methodology to be used for the determination of ***Separation Minima***.
Minimum Lateral Separation	The ***lateral separation*** threshold above which the ***separation minima*** are fulfilled Note: Different thresholds may be applied for tactical and planning purposes. Note: Different thresholds are applied in different MTCD volumes and may be applied for different separation modes (e.g. heading-v-heading, RNP-v-RNP)
Minimum Vertical Separation	The ***vertical separation*** threshold above which the ***separation minima*** are fulfilled Note: Different thresholds are applied above and below the ***RVSM*** limit.
Reduced Vertical Separation Minimum (RVSM)	A reduction to 1000 feet ***vertical separation*** between flights, which is used in Europe and on the North Atlantic, between FL290 and FL410.
Separation of Interest	The ***separation*** threshold below which the proximity of a pair of aircraft is considered to be of interest to a controller, for the airspace and conditions concerned. Note: At this point there may be no actual risk that ***separation minima*** are infringed. The values chosen for the various controller activities and tools are larger than the separation criteria in order to provide an adequate margin of safety. The controller and the aids used need to have awareness of the applicable separation minima for the airspace concerned. Note: This is a generic term, independent of the planning or tactical layers of separation activity. Particular instances of the ***Separation of Interest*** may be applied for each level of separation activity. The actual ***separation*** values used will take into account aspects such as the type of clearance issued, the requested navigation precision and the airspace rules. They will also relate to the type of trajectory used at the specific layer of concern. They may vary according to circumstances such as the geometry of the ***conflicts***/***encounters*** and prevailing conditions such as adverse weather.
Planning Separation (of Interest)	A particular instance of the ***Separation of Interest*** which is applied during planning activities. Note: This is a generic term relevant to the planning layers of separation activity. Particular instances of this may be applied for each level of layered planning separation activity. The actual ***separation*** values used will vary according to the circumstances. For instance, in the case of Planner Controllers coordinating traffic into and out of sectors, it is the horizontal distance threshold below which the proximity of a pair of aircraft is considered to be of interest to a Planner Controller when determining the acceptability of sector entry or exit co-ordination.

	The TC may choose to increase this **Planning Separation**, in which case the PC must re-coordinate the relevant aircraft.
Tactical Separation (of Interest)	A particular instance of the ***Separation of Interest*** which is applied by ExecutiveControllers when controlling traffic under their responsibility.
System Separation (of Interest)	A particular instance of the ***Separation of Interest*** which is applied by automated system tools for the detection of ***Encounters***. E.g. the ***separation of interest*** used by the Tactical Support tool.
Conflict management Related Terms	
Hazard	The objects or elements that an aircraft can be separated from. Note: In En-Route, these can be: other aircraft, airspace with adverse weather conditions, or airspace with incompatible airspace activity.
Separation Violation	A separation violation relates to a situation where the applicable ***separation minima*** have actually been infringed Note: e.g. Short Term Conflict Alert (STCA) or Minimum Safe Altitude Warning (MSAW). These situations are not within the scope of Separation Management as covered in the 4.7.2 OSED.
Conflict **Potential Conflict** **Predicted Conflict**	These terms relate to any situation involving aircraft and hazards in which the applicable ***separation minima*** may be compromised. Note**:** These terms are in general widespread usage and within the context of this glossary are synonymous. They relate to potential ***infringements of separation minima.*** More specifically they are used in the context of ATCO activities where actions are performed in order to anticipate and resolve conflicts (potential/predicted) for separation management purposes. This is in contrast to the situations detected and processed by CD&R tools where the terminology used is '***encounters',*** which relates to the applicable ***Separation of Interest*** used by the tool-set, rather than ***Separation Minima***. ***Conflicts*** are a subset of ***Encounters***
Encounter	A situation where an aircraft is predicted to be within the applicable ***separation of interest*** with respect to another aircraft, or a designated volume of airspace, classified respectively as "aircraft-to-aircraft" and "aircraft-to-airspace" encounters. Notes: Encounters are related to the various detection tools and may work to different look-ahead time horizons with different separation criteria, using different trajectories. Different tool configurations can therefore be expected to yield different encounters. Some ***Encounters*** are also ***Conflicts*** The ***Separation of Interest*** thresholds are considered with respect to any applicable ***uncertainty volumes*** around the predicted aircraft position(s).
Planning Encounter	A specific instance of an ***Encounter*** which is predicted using any of the planning related ***trajectories*** and the ***Planning Separation***
Tactical Encounter	A specific instance of an ***Encounter*** which is predicted using any of the tactical related ***trajectories*** or the ***Entry Coordination Trajectories,*** and the ***Tactical Separation.***
[Tactical/Planning] Deviation Encounter	A specific instance of a ***[Tactical/Planning] Encounter*** which is predicted using at least one ***[Tactical/Planning] Deviation Trajectory***.
[Tactical/Planner] Context Encounter	To support the controllers' traffic management task, environmental flights which may be of interest due to their anticipated vertical and lateral profiles, known as **[Tactical/Planner] Context** (or alternatively "[Tactical/Planner] Traffic"), will be highlighted to controllers. Planner Context flights may not currently be involved in an encounter with the

	subject flight based on their current clearance or existing coordinated levels but may need to be considered by the Planner when making coordination choices for their sector. **Context Encounters** are detected between Context Trajectories. With Planner Context there is only one separation threshold, "Context Separation", and therefore no such concept as a "Context Conflict". When referring to **Context Encounters** operationally the environmental flights may just be labelled as "Traffic".
Closest Point of Approach	The point on the ***Trajectory***, which is being evaluated, where the distance to the ***hazard*** is predicted to be minimal. Note: In some cases the evaluation may be made on the basis of a trajectory segment, e.g. when two aircraft join the same route at the same speed. Subsequent points along the trajectory being evaluated, beyond the closest point of approach are separated from the hazard by progressively increasing distance.
Predicted Infringement Point	The point on the ***Trajectory***, which is being evaluated, for a particular ***Encounter***, where infringement of the applicable ***Separation of Interest*** is predicted at respective flight positions for the trajectories concerned.
Potential Infringement Point	The point on the ***Trajectory***, which is being evaluated, for a particular ***Encounter***, where infringement of the applicable ***Separation of Interest*** may potentially occur within the ***uncertainty volumes*** for the trajectories concerned.
What-if Probing	A process where a private copy of a ***Trajectory*** that is in operational use and associated data is taken and used as a ***Tentative Trajectory*** to check the impact of changes to the flight data on the occurrence of predicted ***Encounters***, without affecting the corresponding data for the actual flight. Note: On completion the what-if data and the ***Tentative Trajectory*** may be discarded or used to implement an update to the actual flight data and to construct the necessary clearance.
What-else Probing	A process where several ***Speculative Trajectories*** and associated data arising from ***What-If Probing*** are assessed for the impact on the occurrence of predicted ***Encounters***. The ***Speculative Trajectories*** utilise flight data other than that currently committed or tentatively selected (during ***What-If Probing*** operations) by the controller.
Electronic Flight Strip	*EFS contain information for each flight coordinated with a sector. A typical flight data strip will contain the following: Sector Entry Flight level, Aircraft Callsign, aircraft type, Requested Flight Level (RFL), speed, route information and estimated times at significant fixes.*
Trajectory and Flight Related Terms See Figure 2 for an overview of the trajectory usage.	
Uncertainty, **Uncertainty Volume**	The volume of airspace, around the nominal predicted future position of a flight, within which a flight is expected to be contained to a given statistical confidence (e.g. 95%) at the time to which the prediction relates. The uncertainty relates to the trajectory prediction and may therefore be considered as a property of the particular trajectory concerned. Note: The zone can be decomposed into along-track (longitudinal), across-track (lateral) and vertical dimensions.
Trajectory	The predicted behaviour of an aircraft Note: the ***Trajectory*** is usually modelled as a set of consecutive segments linking waypoints and/or points computed by the aircraft avionics (e.g. FMS) or by the ground system to build the vertical profile and the lateral transitions. Note: Each point is defined by a longitude, latitude, a vertical distance and a time.
Tentative Trajectory	Tentative ***trajectories*** are created from another trajectory that is in operational use (Tactical, Planning or otherwise). They reflect tentative what-if flight data selected by the controller. If these conditions are then committed the Tentative trajectory and

	the associated data will be used to establish the new operational trajectory. If the conditions are discarded then it will also be discarded. Note: Tentative trajectories support ***What-If probing*** and are created during this process.
Speculative Trajectory	A ***Trajectory*** that uses flight data other than those currently committed or tentatively selected (during a ***What-If Probing*** operation), by the controller. Note: Speculative Trajectories are produced for the purpose of ***What-Else probing***.
Tactical Trajectory	The ***Tactical Trajectory*** is calculated within a short look-ahead time (e.g. up to 20 minutes) during tactical ATC operations . It therefore reflects an accurate view of the predicted flight evolution, starting from the current flight position (generally, as reported by surveillance), with low ***uncertainty*** and high precision. It is kept up to date with all clearances, including tactical instructions. During any open tactical manoeuvres it will also be reflecting those temporary conditions. It is usually determined with a fast update rate (e.g. 5 seconds) and with an optimised ***Uncertainty*** calculation; to maximise response and minimise the incidence of false alarms. Note: The Tactical Trajectory supports the tactical ATC operations when the flight is predicted to follow its cleared behaviour (or its coordinated behaviour)
[Tactical/Planning] Deviation Trajectory	The ***Deviation Trajectory*** provides the predicted profile of the aircraft based on the observed behaviour, extrapolated from the particular deviation from the current clearance (or deviation from coordination constraint for Planning Deviation Trajectories). Note: ***Deviation Trajectories*** are necessary for situations where non-compliance with a flight's expected tactical or coordinated behaviour is observed, with respect to an applicable tolerance threshold. ***Deviation Trajectories*** support Tactical/Planner ATC operations when the flight has deviated from its predicted behaviour. The ***Tactical Deviation Trajectory*** is useful for a short prediction horizon (e.g. 3-5 minutes). A ***Planning Deviation Trajectory*** follows the cleared route of the flight, irrespective of any coordination constraints (as the flight has been observed to be deviating from these constraints). During periods where a ***Deviation Trajectory*** is necessary it may also be used by TC/PC CD&R Aid.
Subject Flight	A flight that has been explicitly selected by the Controller concerned.
Subject Trajectory	The ***Trajectory*** of the ***Subject Flight***
Environmental Flight	A flight of interest to the Controller which is not the ***Subject Flight***. The ***Subject Flight*** will be checked for ***encounters*** with all ***Environmental Flights***.
Context Flight	A flight that may need to be considered by the Planner ATCO when making coordination choices for the sector, due to its anticipated vertical and lateral profiles. A ***Context Flight*** is involved in a ***Context Encounter***. Note: ***Context Flights*** may not currently be involved in a ***Planning Encounter*** based on their current clearance or existing coordinated levels.
Environment Trajectory	The ***Trajectory*** of an ***Environmental Flight***
Context Trajectory	***Context Trajectories*** represent the expected utilisation of airspace by each flight. ***Context Trajectories*** are built for the ***Subject Flight*** and ***Environmental Flights.*** Note: **Context Trajectories** are similar to ***Coordination Trajectories***. Each **Context Trajectory** maintains a single level and follows the lateral profile of the ***Planned Trajectory***. ***Context Trajectories*** are built at every standard Flight Level

	from the entry-context level to the exit-context level. The identification of entry-context and exit-context levels is dictated by the information available in the system at the time of the probe. They represent the lowest and highest level at which the flight is anticipated to occupy in the sector. The Origin and Termination points on ***Context Trajectories*** depend on whether the flight is the ***Subject flight*** or an ***Environmental flight*** and on the flight's anticipated vertical profile. Example of Subject Flight **Context Trajectories**:  Example of Environmental Flight **Context Trajectories**: 
User Preferred Route	A preferred route that is provided by an Airspace User during the flight planning and agreement phase. In Step 1 it may take advantage from ***Free Route Airspace (FRA)*** for optimum routings. Note: 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
Planning Trajectory Related Terms *Since the needs of the PC and TC differ in many respects, the trajectories produced to support the planning and tactical roles are different.* *Planning Trajectories are used to predict encounters between flights that are of concern to the PC. They take account of the original flight plan, modified by agreed co-ordination constraints and standing agreements, but possibly unconstrained by tactical instructions.*	
Planned Trajectory	The ***Planned Trajectory*** represents the stable medium to long term behaviour of the aircraft but may be inaccurate over the short term where tactical instructions that will be issued to achieve the longer term plan are not yet known. It takes into account the planned route and requested vertical profile, strategic ATC constraints, ***Closed Loop Instructions/Clearances***, co-ordination conditions and the current state of the aircraft. Assumptions may be made to close ***Open Loop Instructions/Clearances*** issued by tactical controllers. It is calculated within the planning look-ahead timeframe, starting from the Area of Interest of the unit concerned, or the aircraft's current position (whichever is later). It is constrained during all phases of flight by boundary crossing targets (e.g. standing agreements between the Units concerned). Note: The ***Planned Trajectory*** supports the ATC planning operations. It is used primarily to support data distribution within the system and in the determination of the top of descent point. As such, uncertainty does not need to be calculated for this trajectory. It is also used as the starting point for derivation of more specific local ATC trajectories.
Planned Sequence	A ***Trajectory*** that is derived from the ***Planned Trajectory*** and It follows the vertical

Trajectory	and lateral profile of the ***Planned Trajectory***, truncated in time to an adaptable parameter (e.g. 25 minutes). ***Uncertainty*** is added (although the lateral uncertainty may be zero). Note: The Planned Sequence Trajectory is used for the determination of co-ordination levels and the sector penetration sequence. It is used for both manual coordination and integrated coordination purposes and may be used by the CD&R Aid (with the ***Planning Separation***) for traversals of the sector concerned (CD&R for entry and exit to the sector are covered by the ***Coordination Trajectory***).
[Entry/Exit] Coordination Trajectory	A ***Trajectory*** that is derived from the ***Planned Sequence Trajectory.*** It follows the lateral profile of the ***Planned Sequence Trajectory***[1] but maintains a specific coordination level relevant to the boundary between two sectors. It represents the expected behaviour of the aircraft according to the entry/exit co-ordination conditions. **Entry** = A ***Trajectory*** that is built at levels associated with the sector entry coordination for the flight. **Exit** = A ***Trajectory*** that is built at levels associated with the sector exit coordination for the flight. Note: The ***Coordination Trajectory***: • Supports both lateral and vertical boundary co-ordinations; • Can have the origin and end truncated (e.g. at sector boundaries); • Is necessary for predicting ***encounters*** with flights that are co-ordinated with the sector but not yet in communication with that sector. Because it is only needed for boundary crossing conditions it can have a relatively short prediction horizon; typically up to the point where the flight is assumed by the sector concerned.
Initial Reference Business Trajectory (iRBT for Step 1)	The representation of an airspace user's intention with respect to a given flight, guaranteeing the best outcome for this flight (as seen from the airspace user's perspective), respecting momentary and permanent constraints. The ***Reference Business Trajectory*** (RBT) refers to the Business Trajectory during the execution phase of the flight. It is the Business Trajectory which the airspace user agrees to fly and the Air Navigation Service Providers (ANSP) and Airports agree to facilitate (subject to separation provision) Note: The iRBT is the Step 1 attempt to move towards the full SESAR Reference Business Trajectory. It is shared between the Step 1 SWIM subscribers and is updated from down-linked aircraft trajectory updates. The extent to which this update, synchronisation and sharing is possible within Step 1 will depend on progress made by enabling projects. Likewise the extent to which guarantees can be made concerning best outcome will be subject to the same Step 1 development progress and validation.
Level Block	A level or a range of levels that is blocked off to other traffic, e.g. crossers
Clearance and Instruction Related Terms	
Open loop Instruction/Clearance	An ATC clearance or instruction where a full trajectory extrapolation beyond the point or segment(s) affected is not possible using the normal prediction process, i.e. without special measures to assert a closure condition (e.g. time limit on headings and most probable point of return to original routing). Open loop instructions/clearances can be cancelled by a Closed-loop instruction/clearance . Note: Most tactical instructions/clearances take this form; they include heading

[1] It may be possible for the lateral profile of Coordination Trajectories to be altered from that of the Planning Trajectory to take into account relevant Coordination Constraints applied at the boundary between two sectors.

	(including track offset), level, and speed restrictions and exceptionally could also cover rates of climb or descent.
Closed loop Instruction/Clearance	An ATC clearance or instruction where a full trajectory extrapolation beyond the point or segment(s) affected is possible using the normal prediction process. Note: A typical example is a direct route from one point to another on the original route.

The following table identifies terms that may be used in the current OSED but introduced by other SESAR projects or other European programs.

Terms referenced elsewhere in SESAR	
Performance Based Navigation (PBN) **Required Navigation Performance (RNP)** **Area navigation (RNAV)**	P04.07.03
ASAS (Airborne Separation Assistance System)	P04.07.06
Complexity **Complexity Management**	sWP04.02 DOD, sWP07.02 DOD, P04.07.01
Free Route, Free Routing, Free Route Airspace (FRA)	sWP04.02 DOD, P07.05.03
Flexible Use of Airspace (FUA)	P07.05.02
Functional Airspace Block (FAB)	www.eurocontrol.int/articles/functional-airspace-blocks-fabs-and-single-european-sky-ses
Queue Management	05.06, 07.02
Integrated Coordination	P04.07.02

1.7 Acronyms and Terminology

Term	Definition
1P-1E	*One Planner controller to one Executive controller*
1P– 2E	*One Planner Controller to two Executive Controllers*
1P– nE	*One Planner Controller to 'n' (i.e. Multiple) Executive Controllers*
2D, 3D, 4D	*Two Dimensional, Three Dimensional, Four Dimensional*
ACARS	*Aircraft Communications Addressing and Reporting System*
ACAS	*Airborne Collision Avoidance System*
ACC	*Area Control Centre*
AIS	*Aeronautical Information Services*

Term	Definition
AMAN	*Arrival MANager*
ANSP	*Air Navigation Service Provider*
AOC	*Aircraft Operations Centre*
AoI	*Area Of Interest*
AoR	*Area of Responsibility*
ARN	*ATS Route Network*
ASAS	*Airborne Separation Assistance/Assurance System*
ATC	*Air Traffic Control*
ATCO	*Air Traffic Controller*
ATIS	*Automatic Terminal Information Service*
ATM	*Air Traffic Management*
ATN	*Aeronautical Telecommunications Network*
ATS	*Air Traffic Services*
CD	*Conflict Detection*
CD/R	*Conflict Detection and Resolution*
CDM	*Collaborative Decision Making*
CFL	*Cleared (Current) Flight Level*
CNS	*Communications, Navigation and Surveillance*
CPDLC	*Controller Pilot Data Link Communication*
CTA	*Control Time of Arrival*
CTO	*Control Time Over*
CWP	*Controller Working Position*
DFS	*Deutsche Flugsicherung GmbH (German ANSP)*
DMAN	*Departure MANager*
DOD	*Detailed Operational Description*
DSNA	*Direction des Services de la Navigation Aérienne (Directorate Air Navigation Services) (French ANSP)*
E-ATMS	*European Air Traffic Management System*

Term	Definition
E-OCVM	*European Operational Concept Validation Methodology*
EC	*Executive Controller*
ECAC	*European Civil Aviation Conference*
EFS	*Electronic Flight Strip*
FAB	*Functional Airspace Block*
FASTI	*First ATC Support Tools Implementation (programme)*
FDPS	*Flight Data Processing System*
FIR	*Flight Information Region*
FIS	*Flight Information Service*
FL	*Flight Level*
FMS	*Flight Management System*
FTS	*Fast Time Simulation*
GA	*General Aviation*
GAT	*General Air Traffic*
HMI	*Human-Machine Interface*
ICAO	*International Civil Aviation Organisation*
iFACTS	*Interim Future Area Control Tools Support*
IFL	*Internal Flight Level*
IFR	*Instrument Flight Rules*
IP	*Implementation package*
IOC	*Initial Operational Capability*
ITEC	*Interoperability Through European Collaboration*
LACC	*London Area Control Centre*
LS	*Looksee*
LAGS	*Local Area Groups*
LS/WI	*Looksee/what-if*
MET	*METeorological services*

Term	Definition
MONA	*MONitoring Aids*
MSP	*Multi Sector Planning*
MTCD	*Medium-Term Conflict Detection*
NATS	*National Air Traffic Services (UK ANSP)*
NFL	*Entry Flight Level*
OAT	*Operational Air Traffic*
OI	*Operational Improvement*
OSED	*Operational Service(s) Environmental Description*
PC	*Planning Controller*
PIR	*Project Initiation Report*
PTC	*Precision Trajectory Clearances*
R&D	*Research and Development*
RBT	*Reference Business Trajectory*
RFL	*Requested Flight Level*
R/T	*Radio Telephony*
RTA	*Requested Time of Arrival*
RTS	*Real Time Simulation*
RVSM	*Reduced Vertical Separation Minimum*
SESAR	*Single European Sky ATM Research Programme*
SJU	*SESAR Joint Undertaking (Agency of the European Commission)*
STCA	*Short-Term Conflict Alert*
SVFR	*Special Visual Flight Rules*
SYSCO	*System Supported CO-ordination*
TDB	*Track Data Block*
TLPD	*Traffic Loading Prediction Device*
TMA	*Terminal Manoeuvring Area*
ToC	*Top Of Climb*

Term	Definition
ToD	*Top Of Descent*
TP	*Trajectory Prediction*
TSA	*Temporary Segregated Area*
UAC	*Upper Airspace Control*
UAS	*Unmanned Aerial Systems*
UIR	*Upper Flight Information Region*
V&V	*Validation and Verification*
VDL	*VHF Digital Link*
VFR	*Visual Flight Rules*
VHF	*Very High Frequency*
VLJ	*Very Light Jet*
WI	*What-If*
WP	*Work Package*
XFL	*Exit Flight Level*
Term	**Definition**
SESAR Programme	*The programme which defines the Research and Development activities and Projects for the SJU.*
SJU Work Programme	*The programme which addresses all activities of the SESAR Joint Undertaking Agency.*

2 Summary of Operational Concept from DOD

2.1 Mapping tables

This section contains the link with the relevant DOD, scenarios and use cases, environment, processes and services relevant for this particular OSED.

The following tables shall be coherent with the related DOD Ops<X>.02: iterations with OPS <X>.02 may be necessary in relation with the consolidation activities.

Table 1 lists the Operational Improvement steps (OIs from the Integrated Roadmap , within the associated Operational Focus Area addressed by the OSED.

Each OIs should in general be allocated to a single OSED, but the possibility of having multiple OSEDs for the same OIs may occur. In this case, the OSED is either the 'Master' (M) or 'Contributing' (C) for the OIs.

Relevant OI Steps ref. (coming from the Integrated Roadmap)	Operational Focus Area name / identifier	Story Board Step	Master or Contributing (M or C)	Contribution to the OIs short description
CM-0301 Sector Team Operations Adapted to new Roles for Tactical and Planning Controllers	Sector Team Operations	1	C	Depending on local needs, new operating procedures are in place such as the Planning Controller providing support to a number of Executive Controllers operating in different adjacent sectors. In this configuration, the Planning Controller filters predicted conflicts with a focus on conflict-free trajectories* to alleviate or smooth the tactical workload of the Executive Controllers, thus ensuring that potentially critical traffic situations and the associated workload are manageable for the ECs at the time of occurrence *Conflict-free trajectories are not the focus at this stage of the concept
CM-0302-A Ground based Automated Support for Managing Traffic Complexity across Several Sectors.	Sector Team Operations	1	C	The system provides support for smoothing flows of traffic and de-conflicting flights in a multi-sector/multi-unit environment. Controllers are assisted in alleviating traffic complexity, traffic density, and traffic flow problems

Table 1: List of relevant OIs within the OFA

Table 2 identifies the link with the applicable scenarios and use cases of the DOD.

Scenario identification	Use Case Identification	Reference to DOD section where it is described
OS-4-03 Separation Management in	UC-SEP-01	4.2.3
	UC-SEP-03	
	UC-SEP-04	

Scenario identification	Use Case Identification	Reference to DOD section where it is described
En Route	UC-SEP-06	
	UC-SEP-07	
	UC-SEP-09	
	UC-SEP-10	
	UC-SEP-11	
	UC-SEP-12	
	UC-SEP-14	
	UC-SEP-16	

Table 2: List of relevant DOD Scenarios and Use Cases

Table 3 identifies the link with the applicable environments of the DOD.

Operational Environment	Class of environment	Reference to DOD section where it is described
Airspace	En-route airspace	3.1
Airspace	RVSM airspace	3.1
Airspace	Class C airspace (above FL195)	3.1
Airspace Structure	ATS Routes (Which are becoming more conditional); ATC Sectors; Airspace Reservations)	3.1
Traffic	Aircraft in climb, aircraft in descent, aircraft in level flight and aircraft in cruise (i.e. all traffic apart from that in Terminal Airspace)	3.1

Table 3: List of relevant DOD Environments

Table 4 identifies the link with the applicable Operational Processes and Services defined in the DOD.

DOD Process / Service Title	Process/ Service identification	Process/ Service short description	Reference to DOD section where it is described
Process	Manage Traffic Complexity	The identification of a problem to the implementation and monitoring of the determined solution.	5.1.1
Process	Monitor Traffic	From a Planner perspective	5.1.2

DOD Process / Service Title	Process/ Service identification	Process/ Service short description	Reference to DOD section where it is described
		monitoring the evolution of traffic approaching the AoR and detecting conflicts. From an Executive perspective monitoring traffic approaching and within the sector and detecting conflicts.	
Process	Separate Traffic	The performing of any necessary activities to solve conflicts as detected by the Planning or Executive Controller.	5.1.3
Process	Avoid Collision	The performing of any necessary activities to maintain separation between two or more aircraft	5.1.4

Table 4: List of the relevant DOD Processes and Services

Table 5 summarizes the Requirements including Performance (KPA related) requirements relevant of the OSED. This table supports defining the performance objectives in the scope of the addressed OFA. The DOD performance requirements are structured to respond to Key Performance Indicators (PI) targets / decomposed PIs, so this table will support traceability to the performance framework.

DOD Requirement Identification	DOD requirement title	Reference to DOD section where it is described
REQ-04.02-DOD-0005.0006	The system shall permit ATCOs to conduct screen to screen coordination and dialogue between ATCOs of adjacent ATSUs / sectors	Step 1 DOD 6.1
REQ-04.02-DOD-0005.0014	New Operating procedures should be implemented in the Sector Team to permit a single Multi Sector Planning Controller to provide support to a number of Tactical Controllers operating in different adjacent sectors depending on local needs.	Step 1 DOD 6.1
REQ-04.02-DOD-0005.0015	The Multi Sector Planning Controller providing support to a number of Tactical Controllers operating in different adjacent sectors shall filter predicted conflicts with a focus on conflict free trajectories.	Step 1 DOD 6.1

Table 5: List of the relevant DOD Requirements

2.2 Operational Concept Description

The SESAR Concept Storyboard defines 3 ATM Operational Steps (Step 1, Step 2, Step 3) which correspond to the original SESAR ATM Service Levels (Service Levels 2, 3 and 4 respectively). The Operational Steps tell the 'story' of what the SESAR ATM system will look like at the key milestones in the implementation phase of 2010 to 2020.

This OSED is based on the SWP04.02 DOD**Error! Reference source not found.** which is based on he high level SESAR operational concept description, and provides a refinement of the scope identified for the addressed SESAR Concept Storyboard Step.

To ensure coherency, the 4.2DOD was written in coordination with the other x.2 Step 1 DODs particularly, with those for P05.02 and P07.02. More specifically attention is given to those concepts where there is an overlap between the two Px.02 concerns.

SWP04.02 DOD and hence this P04.07.08 OSED focuses on the En-route operations in Step 1. It is important to note that in Step 1, the aircraft and the ANSPs will not be fully equipped to enable the deployment of the SBT/SMT and RBT/RMT concepts to the same extent as will be possible by the end of Step 2.

The key objective of P04.07.08 is to develop the Roles, Responsibilities and Tools associated with different Controller Team Organisations in En Route airspace to maximise the benefits of controller tools. The principal controller team organisation to be developed is MSP (Multi-sector Planner), but other organisations such as combined E/P operations including SPO (Single Person Operations) will be considered. In addition, the concept development work will take into account of the different ATC environments in which tools are required to operate.

As detailed in the Abstract and Executive summary this OSED is a preliminary document, based on the NATS iFACTS Quick Win, which focuses on the sector staffing configuration of 1 Planner Controller to 2 Executive Controllers in a 2D Separation Environment. The Tools designed to support the MSP staffing configuration were designed to be built upon existing 2D separation management tools for En Route based on the NATS iFACTS system.

This diagram below, Figure 5, shows the Benefit Mechanisms for MSP:

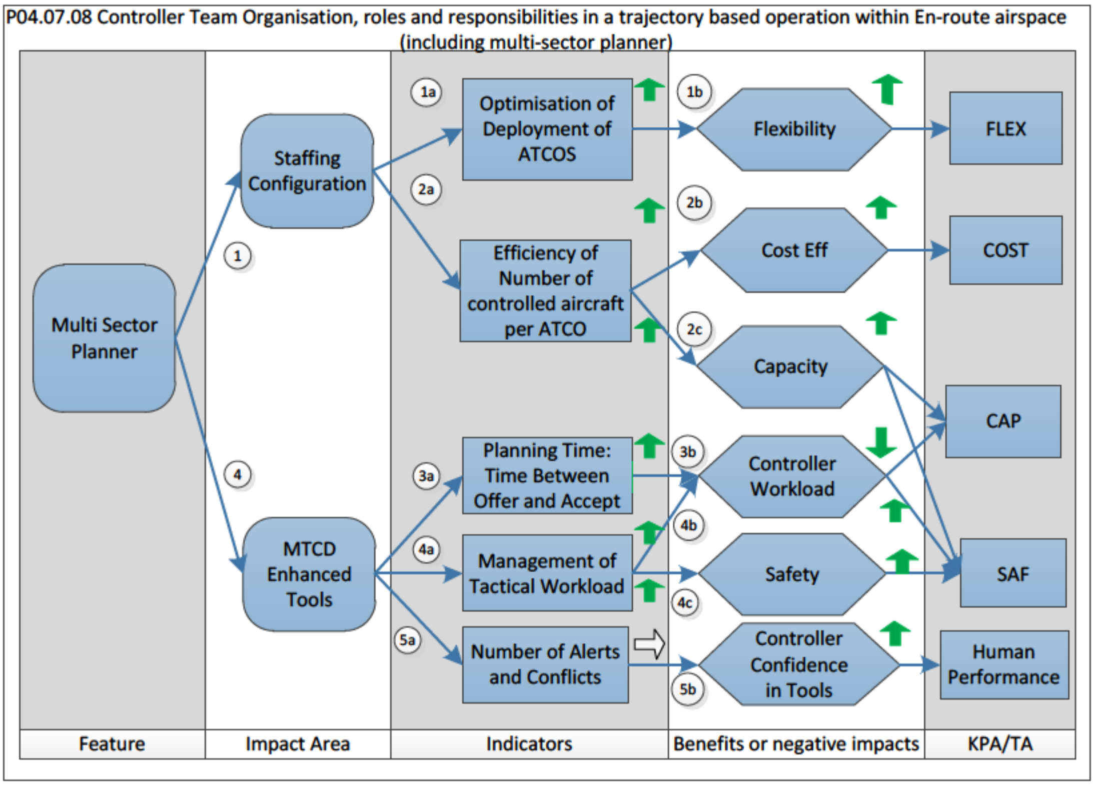


Figure 5: MSP Benefits Mechanism Drawing

Feature Description: Multi Sector Planner

Mechanisms:

1. The staffing configuration will be changed from current operations. For operations between 1P-1E split and bandboxed operations, 1 Planner to 2 Executives will be used.
1. a) Flexibility through the deployment of MSP is envisaged since the staffing configuration is not restricted to 1PC to 1EC in either a split or bandboxed sector configuration.
1. b) More staffing options available leads to increased flexibility.

2. a) There is a significant opportunity to optimize the number of controlled aircraft per controller, potentially reducing the number of controllers required per watch and thereby contributing to the SESAR KPI of reducing the Gate-to-Gate costs by 50% per flight (reduced delay, minimized flight time, fewer constraints).
2. b) Fewer controllers required on watch will reduce staffing costs.
2. c) The controllers on a watch freed up by being able to run MSP on an ad-hoc basis could be used to open up more sectors thereby potentially contributing to an increased capacity (related KPI – 73% increase by 2020; 3-fold increase in the longer term) / reduced delays. There is also a small potential capacity increase owing to lower overall controller workload as a result of the need to issue fewer clearances because of the potential for more direct routes and fewer level caps. This could also provide a corresponding benefit on the cockpit side as a result of having to respond to fewer ATC instructions.
3. a) The MTCD Enhanced Planner Tools include Planner Support such as Planner Interaction Vector Lines which aim to reduce workload and time spent with Vector Lines. By only highlighting flights that are of coordination interest when the Planner controller conducts a Look-See/What-If, it focuses attention so decisions can potentially be made quicker and frees up capacity to do other tasks.
3. b) The tools are aimed to support the controller as much as possible, giving more spare capacity to monitor and gain situational awareness and decrease workload.
4. MTCD Enhanced Tools have been developed in collaboration with P04.07.02 to support the MSP which includes a tactical clearance probe when a Look-See/What-If is invoked, Planner Context traffic highlighted to show Executive workload and MTCD-Enhanced Look-see/What-If which highlights flights only of coordination interest to the Planner.
4. a) The Planner Context and Planner Views aim to gain situational awareness of the Executive workload.
4. b) With increased situational awareness from the Planner Views and Planner Context, the controller workload should decease so the Planner is not overloaded.
4. c) Increased situational awareness of the Executive controller is a necessity so that the safety can be maintained and to ensure the Planner is in the loop.
5. a) The MTCD Enhanced Planner Tools aim to help the controller and to ensure the safety levels are at least maintained.
5. b) As the controllers use the tools more and more, their confidence and user acceptance in the tools and the concept should increase which will affect human performance.

3 Detailed Operating Method

3.1 Previous Operating Method

In current operations in the majority of En-route environments the controller team consists of two main actors; the Executive Controller (E) and the Planner Controller (P). Each team is responsible for looking after a distinct volume of airspace. The aim of this sector team is two-fold:

- To ensure aircraft enter a defined sector of airspace separated from other aircraft which are transiting the sector, and to ensure that the aircraft exits the sector at a flight level that is separated from other aircraft that are entering and leaving the same sector. This is done by allocating an exit flight level appropriate and achievable for each flight (essentially the Planner controller responsibility).
- Once the aircraft is in jurisdiction with(i.e. under the control of) an airspace sector, ensure the aircraft attains the desired exit flight level, or transits the airspace if already at cruising level, in the most safe, efficient and expeditious manner as is possible (Executive Controller responsibility).

In order to understand the previous Operating method within En Route airspace a brief description will be given as to how airspace is divided up to ensure that the amount of traffic in the air at any one time can be fragmented into manageable amounts. Within a defined section of airspace e.g. the London FIR, the volume of airspace will be split up into distinct geographical areas. These geographical areas of airspace can then be split down into smaller sections of airspace (either laterally or vertically) depending on the loading of traffic within that airspace at the time.

In the majority of En-route Area Control Centres the sector staffing configuration is as shown in Figure 6; for 1 Sector there is 1 Executive controller and 1 Planner controller. In this example, Sector 1 and 2 originate from the same geographical chunk of airspace, and when that area is split down into smaller sectors, it is most commonly the case that the Executive controllers will sit adjacent to one another, due to the fact that a large proportion of the traffic will be transiting from Sector 1 to Sector 2 or vice versa, and it is probable that the Executive controllers will discuss the flight in some form e.g. Sector 2 requests that Sector 1 turns an aircraft left x degrees for presentation purposes.

For the sector to be configured as is shown in Figure 6, the traffic would be sufficiently busy enough to warrant 2 separate E and 2 P. As there is natural peaks and troughs in the traffic throughout the day and night, during the quieter periods it is feasible to “bandbox” (combine) sectors together, as shown in Figure 7.

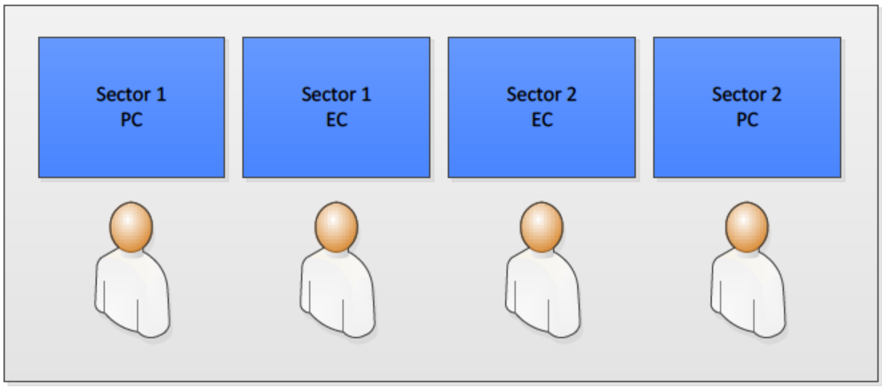


Figure 6: Current Sector Staffing Configuration (Split)

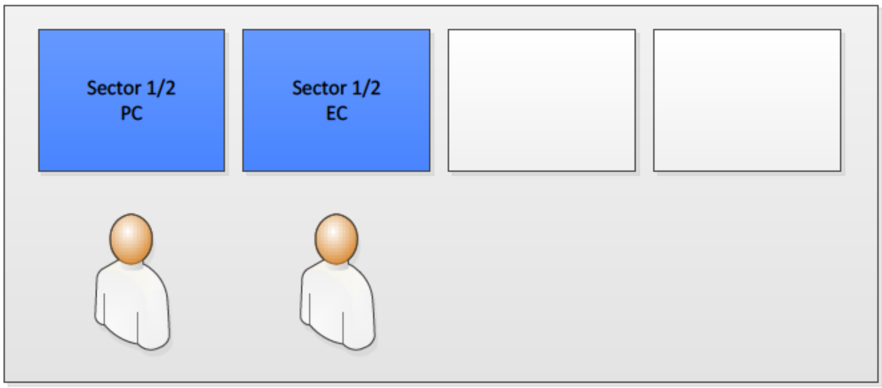


Figure 7: Current Sector Staffing Configuration (Bandboxed)

The Executive and Planner controller work together as a close-knit team, where the Planner controller will proactively assist the Executive controller by anticipating and responding to their needs and monitoring the R/T, while the Executive controller is in radio communication with the aircraft and issues the relevant instructions to them. Each role is described in further detail below:

3.1.1 Planner Controller

The Planner will receive information for an aircraft that is flight planned to enter their sector by the previous sector sending a coordination 'offer' for the aircraft, if they are not already aware of the approaching flight (e.g. from observation or the radar display). This offer will propose a flight level for the aircraft to be flying at. It is then the Planners responsibility to assess that offer; i.e. determine if the flight level is acceptable before they accept the offer. They make this assessment with the various sources of information available to them.

These sources of information available to the Planner are twofold; firstly the flight data available to each sector (either in electronic or paper format; for the purpose of this document referred to as a 'strip'). A typical flight data strip will contain the following: Sector Entry Flight level, Aircraft Callsign, aircraft type, Requested Flight Level (RFL), speed, route information and estimated times at significant fixes. The second source of information will be in some form of basic support derived from radar data, e.g. vector lines.

Some systems do have additional support to the Planner. For example LACC uses what is termed a "look-see". This tool highlights on the radar screen and the electronic flight strips any flights that have been coordinated into or out of the sector at the same flight level as the subject flight under offer. The Planner can also perform a "what-if" by asking the system "what-if" the aircraft were to be at this flight level instead? Again, any flights that have been coordinated at the "what-if'd" level into and out of the sector will be highlighted via the Track Data Blocks (TDBs) on the radar display and Electronic flight Strips (EFS). The Planner by a combination of these 2 (or 3) forms of data will make the decision as to whether it is safe to accept the aircraft into the sector at that particular flight level. If two or more aircraft are offered to the Planner at the same flight level from the same sector, it can generally be assumed that the offering sector will take the responsibility for separating those two flights prior to transfer to the next sector team.

The Planner has various options available to them. Firstly depending on the proximity of the subject flight to any other environmental flights at the same level, s/he may decide to request from the offering sector for the aircraft to be locked on the current heading, or turned left/right x degrees in order to achieve the required separation from other aircraft. Alternatively the Planner may decide if prudent to do so, to amend the entry flight level (NFL) of the aircraft if they predict that it will become less than the required separation from other aircraft even with the use of headings or direct routings. If the workload of the sector is high, the Planner where possible, will choose to amend the NFL of a flight as when a sector is busy the easiest way to reduce the Executive controller's workload is to solve the conflicts at the sector entry point. Where possible, should an NFL amendment need to be made, the Planner will endeavour to maintain the level of a flight that is already in the cruise phase and "penalize" a climber or descender by constraining that flight's profile. It also reduces the Planner workload as once the confliction is solved by a change of NFL; no monitoring of the scenario is required, which would be the case if heading were used.

Once an aircraft is accepted in to the sector, the Planner is then responsible for planning out a suitable exit flight level (XFL) for that aircraft. This depends on various factors:

1. If the aircraft is an overflight and already at the requested cruising level. In this case the XFL will be equal to the NFL.
2. If the aircraft is subject to a standing agreement which means that the aircraft does not require manual coordination – the XFL is known to the Executive controller by procedure (and training) and to the system through adaptation data.
3. The aircraft in the sector needs to be allocated an XFL. Depending on the constraints of the sector boundary, either laterally or vertically the Planner will endeavour to allocate the aircrafts requested flight level. It is the Planner's judgement as to whether the aircraft's XFL is achievable/suitable given the traffic situation at the particular time. The Planner will make this decision based upon the traffic complexity and loading and their perception of the Executive workload at the time.

Once the aircrafts XFL has been set, this coordination offer will be sent (electronically) to the Planner at the next sector in the coordination sequence for the flight. The receiving Planner will then assess the suitability of the NFL, and decide whether to accept or reject the offer depending on the traffic situation at the time within their area of jurisdiction. This coordination cycle of offer-review-accept-offer-review-accept continues as the flight traverses through the various airspace sectors on their lateral and vertical flight planned profile.

In addition to coordinating aircraft into and out of the sector safely, the Planner has numerous other tasks, of which telephone calls are a significant one. The Planner must make and receive telephone calls to and from adjacent sectors. Telephone calls can be made and received for various reasons; for example, to amend an aircraft's entry or exit coordination, or if the Executive wishes to climb or descend aircraft that they are in communication with, but not yet in jurisdiction as the aircraft has not yet entered the sector boundary.

The Planner must also wherever possible, monitor the R/T frequency of the Executive controller. This is primarily for safety reasons in the event of incorrect read backs or emergency scenarios. It is also useful for the Planner in gaining a suitable level of situational awareness, or for picking up various requests that the pilots may have. This can save the Executive controller having to repeat the request to the Planner, or having to act upon it him/herself.

3.1.2 Executive Controller

The responsibility of the Executive controller is to manage a safe, orderly and expeditious flow of air traffic throughout their area of jurisdiction. The Executive maintains radio contact with the aircraft and will issue instructions to the pilots via the R/T (some of these will be eligible for transmission by CPDLC in the near future).

Like the Planner, the Executive is provided with various sources of information to assist them in their executive tasks. Firstly, a source of flight data, either in the form of electronic or paper flight strips. The Executive uses the flight data to gain information about a flight, to detect conflicts and to plan ahead and make decisions on how best to solve any conflicts. Another main source of information available to the Executive is the situation display, which greatly assists the Executive in developing their situational awareness. The Executive uses the situation display to identify aircraft (from the Mode A), the aircraft position, and the actual aircraft altitude (from Mode C readings). In some operational units the situation display is also configurable for the Executive to access other aircraft information, such as selected heading, speeds through Mode S airborne downlinked parameters. The radar is also used to make decisions on conflict solving and allows the Executive to monitor aircraft profiles to ensure that their executive decision and actions are ensuring and maintain the required separation between aircraft.

Some area control systems such as iFACTS in LACC do have additional support for the Executive in terms of a trajectory prediction (TP) and Medium Term Conflict Detection (MTCD) which allows the detection of potential interactions and conflicts between flights. MTCD compares the trajectories created by the TP to determine how close two flights will come within or one another and if the closed point of approach falls below defined minima (e.g. 15 Nm) the iFACTS display will show an interaction symbol, with the colour of the symbol being the indicator of the severity of the interaction (red being the most severe and indicating a predicted loss of separation between the two aircraft given their current clearances). Additionally the Flight Path monitoring (FPM) functionality of the iFACTS toolset allows alerts to be shown to the Executive is the FPM detects that the flight is not complying with the clearances entered into the iFACTS instruction palette.

IFACTS also allows the Executive to assess the implications of clearances by a “tactical what-if” Clearance probe when a heading/level/speed is selected in the instruction palette prior to pressing ENTER to commit the clearance. The “tactical what-if” is shown by trajectory based interaction vectors and interactions in the iFACTS toolset.

As mentioned in section 3.1.1 the Executive is supported by the Planner. The Executive can make any requests to the Planner for tasks such as amendments to coordinations or asking an adjacent sector permission to issue instructions to aircraft that they are in communication with but not yet in their area of jurisdiction. If the Executive feels it is within their capabilities they will instigate making and answering telephone calls, particularly if they can see that the Planner is involved in another task.

There are certain airspace sectors in which a significant amount of coordination is effected Executive to Executive, in particular when a sector has a vertical divisional boundary. In these cases is it important that the two executives sit adjacent to one another, with their individual planners sat on the other side to them. The executives can then easily lean over and point at each other’s situation displays at individual aircraft and discuss specific coordinations.

3.2 New SESAR Operating Method

CM-0301 describes Sector Team Operations adapted to new roles for the Executive controller and Planner controller, where the Planner provides support to a number of Executive Controllers operating in different adjacent sectors. In this operating environment the PC is supported by a number of Planner support tools which are based on MTCD and Trajectory Prediction. Therefore the proposed new SESAR method of operating not only focuses on staffing configuration, but also on the tools that will support the controllers in the new staffing configuration. As described in section 3.1.2, the tools that are available to the Executive controller can also be adapted and used to assist in the planning task as well as the executive.

Below describes both areas of the new SESAR operating method:

3.2.1 Sector Staffing Configuration

As described in section 3.1, the majority of en-route area control centres operate with staffing configuration of 1PC to 1EC. The specific sectors can be split or bandboxed according to the traffic loading which either doubles or halves the number of required controllers.

The new SESAR operating method proposes that one Planner can provide support to a number of Executive controllers. As Figure 8 demonstrates, in this example the executive sectors are split into Sector 1 and Sector 2, however both are supported by the one Planner. This implies that the sector is sufficiently busy enough for to warrant 2 separate Executive controllers, however the workload is acceptable for one Planner. Often, in current operations it is the case that when a sector is split one sector tends to be a lot busier than the other, hence the multi sector planner (MSP) would therefore bridge a gap between a bandboxed and split sector.

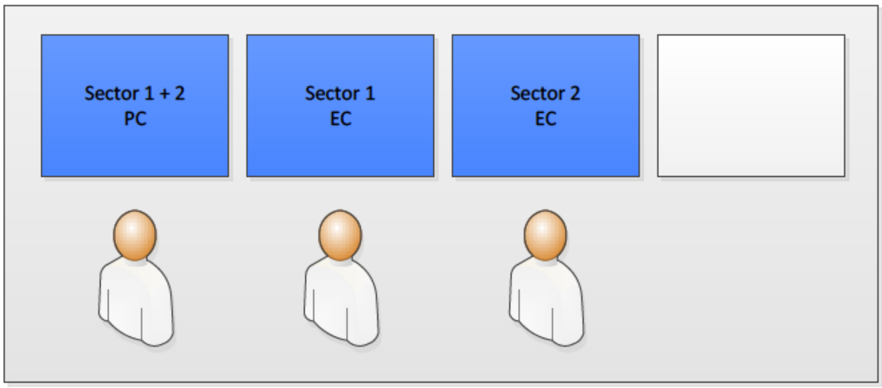


Figure 8: Multi Sector Planner Staffing Configuration

Going one step further from the MSP concept, it is also proposed that certain sectors may feasibly be able to be managed by one controller, i.e. the controller is both the Executive *and* the Planner- Single Person Operations (SPO). Figure 9 demonstrates this.

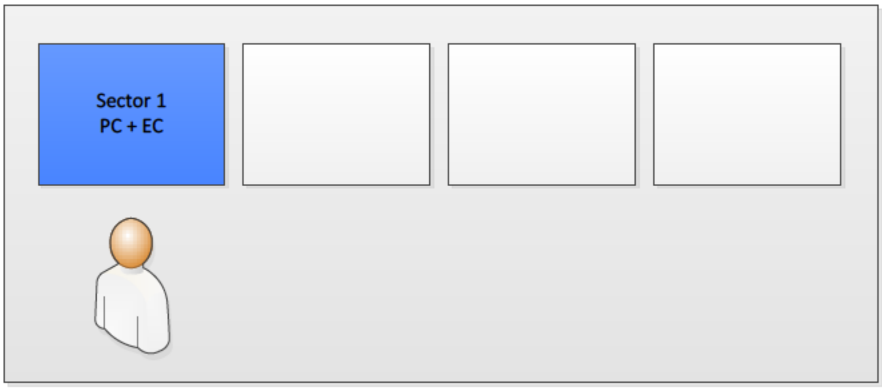


Figure 9: Single Person Operations

Therefore with new sector staffing configurations possible, as the traffic levels rise and fall throughout the day, the sector configurations could follow a flow, as demonstrated in Figure 10. The flow chart below is far from representative of the complex relationship between workload and traffic level, however it is intended to be a schematic view.

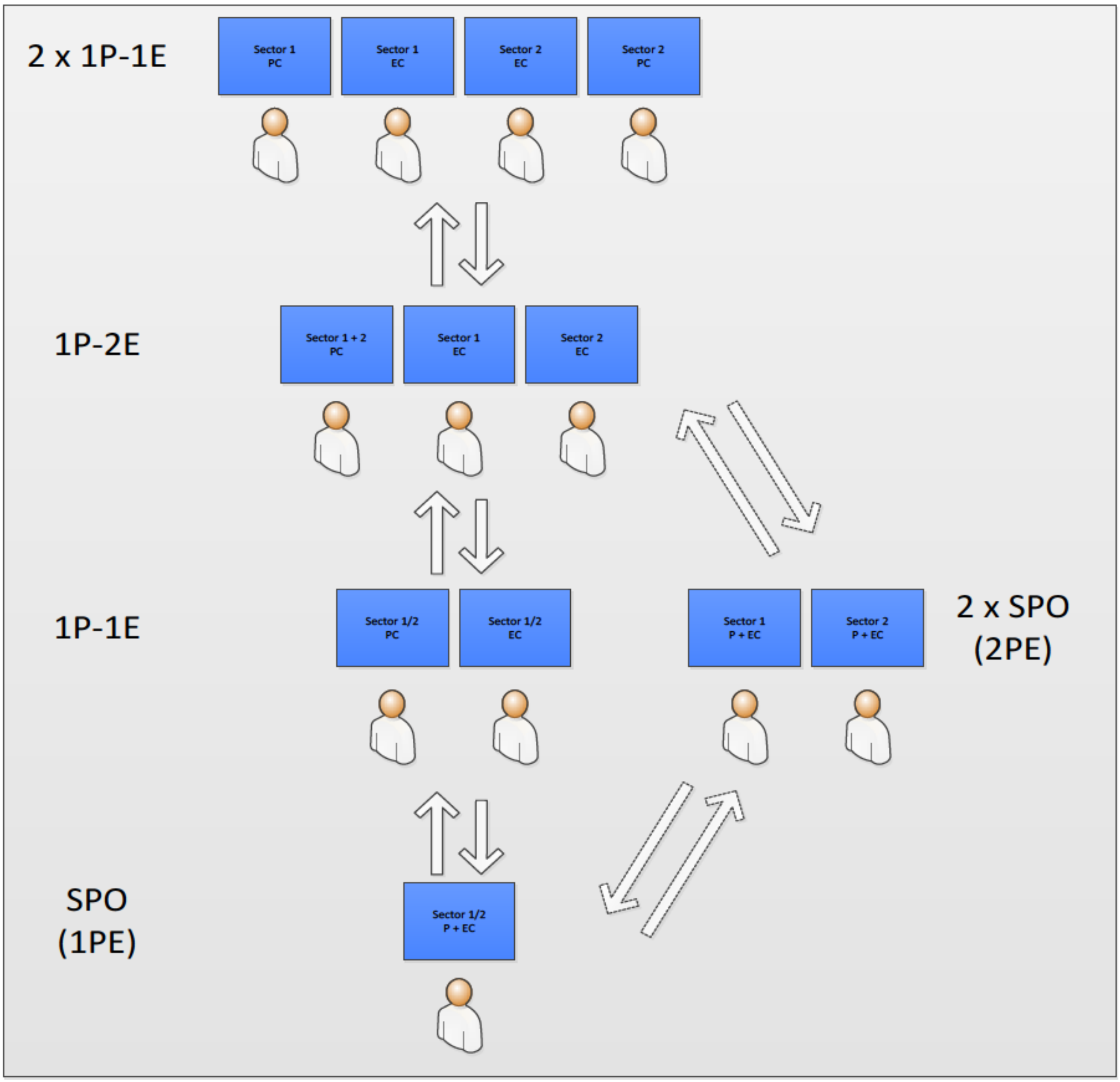


Figure 10: Sector Staffing Configuration Flow Diagram

3.2.2 Planner Controller Role within a Multi-Sector Environment

The eventual aim of P04.07.08 within Step 1 is that a new ATM layered planning is made more possible with the introduction of new roles such as a Complexity Manager and an MSP (see section 4.2). Within the DOD there is detail regarding the MSP as an ATC planning role, involved in organising air traffic over a number of ATC sectors within ATSU airspace. Depending on the ATSU environment and operational working methods the Multi-Sector Planner would serve several Executive controllers in a role somewhat extended from the ATC Sector Planning role in today's environment. Alternatively s/he would perform tasks at the interface between the Local Traffic Manager (LTM) and the Planning Controller. The MSP could also perform elements of the complexity management role.

However, due to the fact that this initial OSED focuses primarily on the NATS Quick Win, the focus within this document is upon the MSP limited to two Executive sectors, i.e. 1PC to 2EC.

The new 1P-2E operating method means that the Planner controller has the same responsibilities as before, but now for two Executive controllers rather than one. The main implication with regards to the

MSP responsibilities is coordinating the internal boundary between the two sectors within the Multi-Sector Team.

From the point of view of either Executive controller, there is an entry coordination and an exit coordination for every flight regardless of whether it will traverse just one of the executive-sectors or both (in this document "executive-sector" will be used as a short-hand term to describe the volume of airspace that is the responsibility of a single Executive controller and may comprise one or more airspace sectors). The diagram below (Figure 11) helps to clarify these aspects of the concept and shows the two executive-sectors within a multi-sector (a term that will be used to describe the airspace for which the Multi-Sector Planner has responsibility and which comprises the two executive-sectors). Future development of the concept (in P04.07.08 and P05.07.03) will remove the requirement for every flight to be coordinated over the internal boundaries (there may be several in a 1P – nE operational concept).

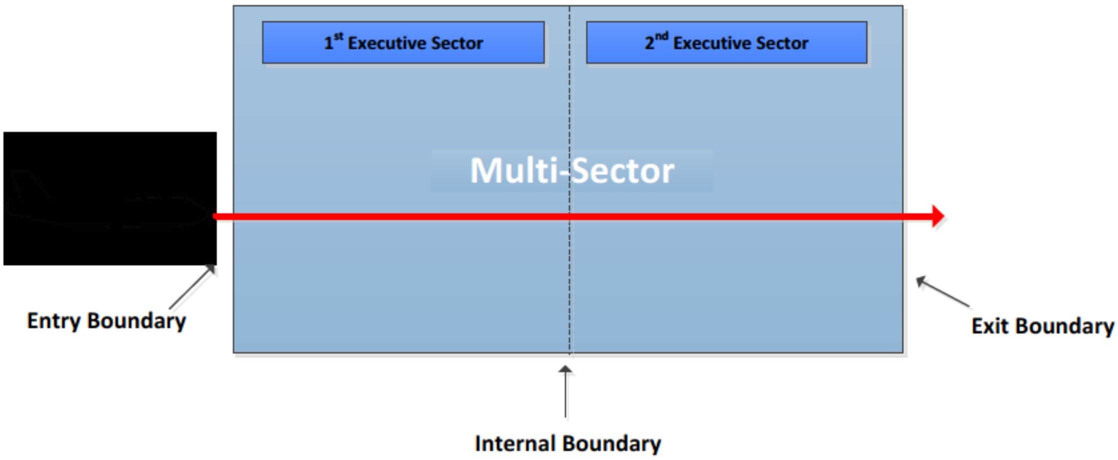


Figure 11: Diagram to show the 2 Executive Sectors within a Multi-Sector Team

The significant difference between the entry/exit boundaries into and out of the multi-sector and the internal boundary within the multi-sector is that, whereas the Planner for the multi-sector must come to an agreement with another Planner for the entry/exit boundaries, at the internal boundary he is aware of, and responsible for, the traffic on both sides of the internal boundary and is therefore in a position to dictate a suitable coordination level – in effect, he is both the offering *and* receiving Planner. In the MSP concept, this fact is exploited to reduce the workload associated with setting the internal-boundary coordination since the normal electronic dialogue (select – offer – review – accept) that applies to the other sector boundaries is no longer relevant and the Planner can simply enter the desired level for the system to treat that as an agreed coordination. In fact, right up until the aircraft is transferred from Executive 1 to Executive 2, the Planner (or either Executive) can amend the internal-boundary level simply by selecting a different one – no revision dialogue is necessary (it is accepted that, if the aircraft is near the boundary, verbal coordination is likely to be effected between the Executives before the boundary level is amended – this is standard operating procedure in that scenario). Significantly, from the point of view of the Executive Controllers, there is a coordinated level at the exit boundary of Executive-sector 1 and a coordinated level at the entry boundary of Executive-sector 2 – the flight has exactly the same coordination agreements (and transfer of control and communications procedures, which are dependent on the nature of the coordination) as the other flights which are traversing only one of the Executive-sectors.

The internal boundary between the two Executive sectors may be either lateral or vertical and the coordination procedures may be different according to the type of boundary. See Figure 12 for an example of how coordination is affected over a lateral boundary within a multi-sector team. In this example, the flight is maintaining the same lateral profile across both sectors so it is the MSPs responsibility to allocate a level that is safe to both exit Executive Sector 1 and enter Executive Sector 2.

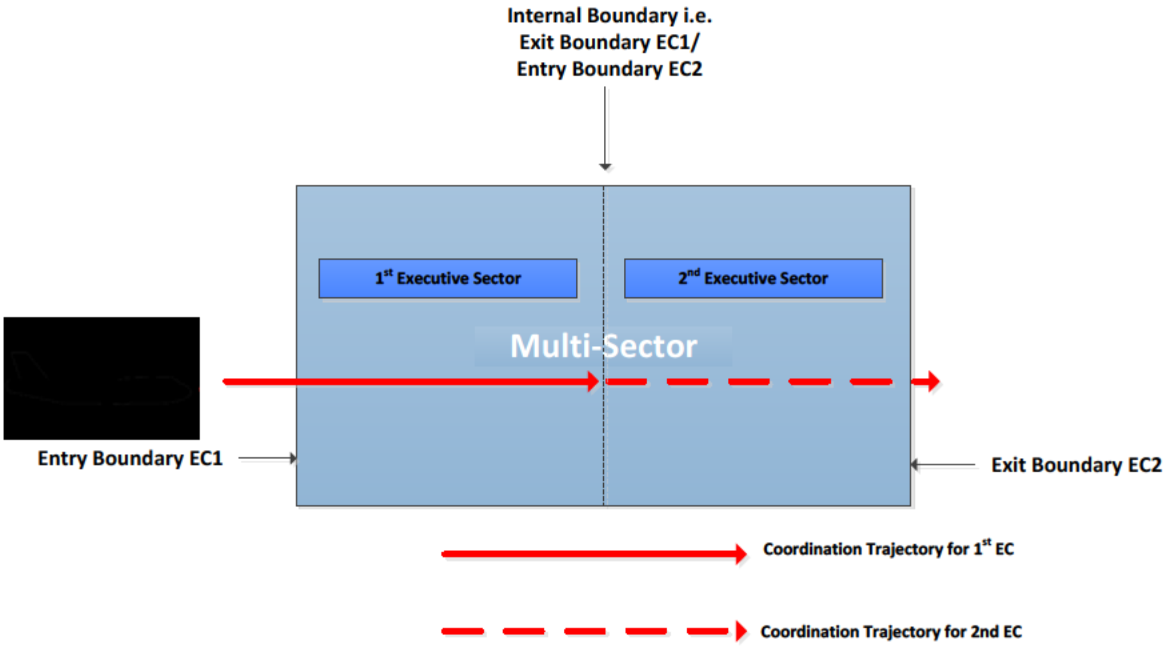


Figure 12: Coordination over a lateral boundary within a multi-sector team

If the internal boundary is a vertical division, the coordination procedures may differ in that the highest (if the coordination offer is climbing) or lowest level (if the coordination offer is descending) in the Executive sector is offered (as is the procedure for vertical coordination's within En route Sectors at LACC). This helps to reduce workload for the Planner, as the climbing or descending of the aircraft from one executive sector to another is at the discretion of the Executive controller and the MSP will not know at what stage the aircraft will be able to be climbed or descended. See Figure 13 for an example:

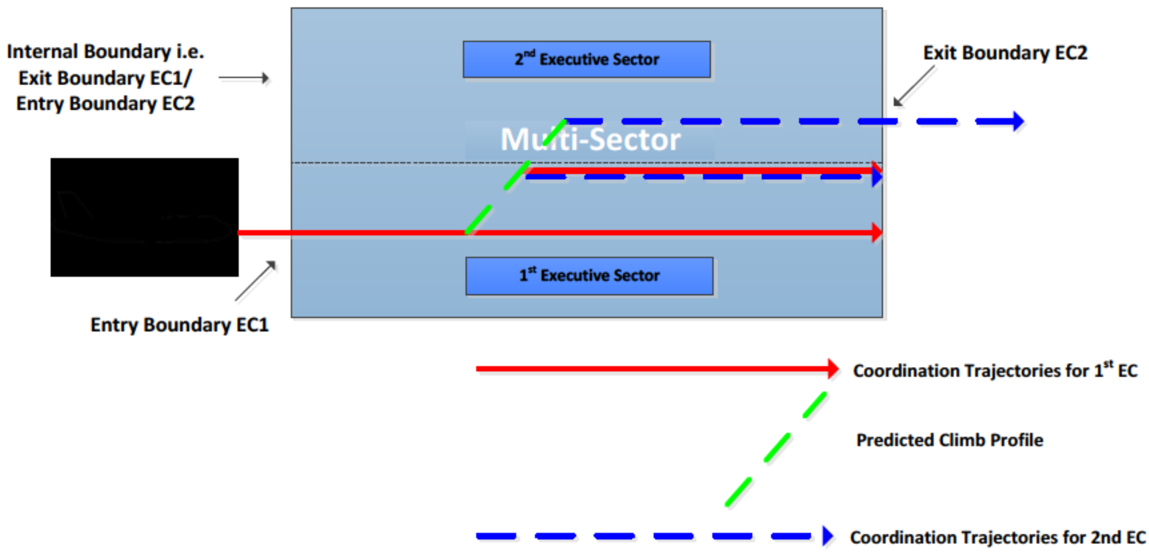


Figure 13: Coordination over a Vertical boundary within a multi-sector team

In the above example, by setting out the highest level in Executive Sector 1, it is then the EC 1 responsibility to ensure that when the aircraft is transferred to EC2, that it is separated from any other traffic and that it can therefore be climbed through the internal vertical divisional boundary at any time by EC2. It is also possible that the EC may consider it expedient to offer another level in their sector and are able to amend the internal boundary coordination themselves if they see fit.

There are several potential benefits that could be realized through the Planner's overall responsibility for the multi-sector group. From the point of view of his role as a workload regulator, the Planner will be able to select a "planning profile" through the airspace (the planning profile being the coarse vertical profile defined by the entry – internal – exit boundary levels along the expected track of the aircraft) which helps to balance the expected induced complexity (the level of "difficulty" the Planner imposes on the Executive through his selection of target exit coordinations) across the two Executive-sectors and to respond more readily as the actual workload of the ECs becomes apparent through the initial selection and subsequent amendment of the internal boundary. From the perspective of the airspace users, a similar process can be employed to ensure that the planning profile (both lateral and vertical) allows the aircraft to fly a trajectory that is less restricted (or, at least, that any restrictions to the flown trajectory constrain it as little as possible from its desired profile). In reality, the Planner must (as always) balance these two goals of safe sector workload and quality of service, but it is expected that the ability to set a planning profile across a larger volume of airspace has the potential to enhance that aspect of his role.

3.2.3 Planner Controller Support Tools

The SESAR definition phase study has confirmed that the ATM system performance is highly dependent upon the role of the controllers, their abilities and the level of technical system support provided to them. However, expectations are that the human will not be able to deal with the future level of traffic and its complexity in the same way as it is done today.

As described in the DOD (04 02-DO7-WP4) the focus within the MSP staffing configuration is on conflict free trajectories to alleviate or smooth the tactical workload of the Executive controller, thus ensuring that potentially critical traffic situations and the associated workload are manageable for the ECs at the time of occurrence. This falls under the OFA 03.03.01 Conflict Detection, Resolution and Monitoring which states that early solving of conflicts provides potential for task load reduction.

In order to assist the MSP in generating conflict free trajectories, it is essential that the role is supported by specific tools. Development of Enhanced Planner Tools is covered in other work packages, e.g. 4.7.2, so relevant documentation should also be read in conjunction with this OSED. However, brief overviews of the types of tools that were developed and tested during the NATS iMSP3 Validation are described below:

3.2.3.1 Conflict Detection and Resolution Tools

Conflict Detection Tools provide automated assistance to MSP, and/or Planning Controllers as well as Executive controllers. They can be used at a strategic or tactical level.

The requirements for a CDT cover one or several of the following functions:

a) The detection and display to the controller of probable loss of the required separation between 2 or more aircraft;

b) The detection and notification to the controller of aircraft penetrating segregated or otherwise restricted airspace;

c) The detection and display to the controller of aircraft-to-aircraft encounters where, although the required separation will be achieved, each aircraft is predicted to be occupying airspace that may be used by the other, e.g. in the case of pilot request for an alternative level or when resolving a conflict involving one of the aircraft/

In order to reach these operational requirements, CDT assists the controller in conflict identification and planning tasks by:

- Providing automated early detection of potential conflicts
- Facilitating identification of flexible routing/conflict free trajectories;
- Identifying aircraft constraining the resolution of a conflict or occupying a flight level requested by another aircraft.

3.2.3.1.1 Enhanced MTCD

Enhanced MTCD falls under the category of Conflict Detection Tools (CDT) as described above (taken from section 3.1.5.1.1 of the DOD).

As described in section 3.1.1 in certain ACC's such as LACC the PC has use of a "look-see\what-if" which highlights to the Planner any aircraft that are coordinated into or out of the sector at the same flight level as the aircraft subject to the "look-see\what-if". Enhanced MTCD works by only highlighting those aircraft to the Planner that actually poses a coordination separation *issue*, or that may be of coordination *interest*. This is possible by the system comparing the planning trajectories of all flights known to a sector and if it predicts that any flight will come within a defined planner separation volume (e.g. 20nm) then these aircraft will be highlighted to the Planner, as opposed to a simple level match. HMI also provides a visual identification of the geometry and geography of the predicted encounters. The assumption with enhanced MTCD is that the Planner will be able to make much faster coordination decisions and therefore handle a greater amount of traffic.

3.2.3.1.2 Integrated Coordination

The Enhanced MTCD could also be used for an automatic coordination process - Integrated Coordination (IC) - in which the system automatically accepts into the sector those flights which the TP calculates are not a coordination issue. Only those aircraft that the TP calculates will be a coordination issue will be referred to the Planner for their manual acceptance. This saves time in that the Planner does not have to spend time considering every single aircraft that is offered to the sector.

3.2.3.2 "Traffic"

As well as MTCD Enhanced Looksee\What-if (as described in section 3.1.1) (LS/WI) highlighting to the Planner any aircraft that pose a coordination issue, the potential to highlight any "traffic" (contextual flights) to a subject aircraft will support the MSP in enhancing their situational awareness of the traffic situation. This tool highlights any potentially interacting flights which are of planning interest to the sector due to their anticipated profiles, which can therefore assist the MSP in mitigating the Executive controller workload by planning out the most suitable XFL for an aircraft – they represent potential tactical problems that the Executive controller will need to resolve within the sector.

A set of derived trajectories probed by MTCD may provide the Planner with a picture of the predicted potential problems both at likely exit levels, but also throughout the sector between entry and exit points and levels allowing an improved judgement of the potential tactical workload which might occur as a result of setting particular coordination targets.

In the NATS iMSP simulation, this traffic tool was termed Planner Context.

3.2.3.3 Monitoring Aids (MONA)

As described in section 3.1.5.1.2 of the DOD, monitoring aids helps the controllers to reduce the workload associated with traffic monitoring tasks by:

- Providing warnings if aircraft deviate from a clearance or plan and reminders of instructions to be issued;
- Providing conformance monitoring triggering trajectory re-calculation essential for the CDT.

A MONA alert may indicate:

- A deviation from an ATC clearance (Lateral, Vertical),
- A controller clearance input error (The ATC Clearance is respected by the flight but the clearance monitored by the system is not good),
- A deviation from the predicted lateral/vertical/4D profile which is not as a result of either the aircraft not complying with the clearance or the controller mis-entering the clearance but which may impact on the predicted traffic situation and erode the separation that was expected (e.g. due to poor prediction of the winds)
- A planned action to be made (communication transfer, etc.).

3.2.3.3.1 Textual alerts

The types of MONA as described above are seen as an essential form of support for the MSP. In the NATS iMSP simulation, Planner specific MONA were tested in the form of textual alerts above the aircraft TDBs on the radar to alert the PC of any aircraft that may need attention e.g. aircraft that may not achieve the XFL, or aircraft that are not conforming to the agreed coordinated constraints that has been applied to the aircraft trajectory.

3.2.3.4 System Supported Coordination (SYSCO)

System supported co-ordination (SYSCO) as referenced in section 3.1.5.1.3 of the DOD is the provision of system support capability and the development of procedures to automatically electronically co-ordinate and transfer flights in sectors of an ATS unit or between adjacent ATS units, based on a shared set of flight data.
The SYSCO concept was intended to address all coordination scenarios that were likely to occur within the "ECAC core area".

- Permits controllers to conduct screen to screen co-ordination between adjacent ATSU's /sectors reducing workload associated with co-ordination task.
- Enables controllers to conduct co-ordination dialogue and transfer flights between ATSUs.
- Facilitates early resolution of conflicts through inter ATSU/sector co-ordination.

3.2.3.5 Electronic Entry of Coordination Conditions

A substantial part of the Planner task is to negotiate coordination to and from adjacent sectors. In the majority of en route centres this task is conducted over the telephone and can take up a large proportion of the Planner workload. The ability for the Planner to be able to enter these coordination conditions electronically without the requirement for a telephone call can reduce workload considerably. In addition, if the electronic entry of these coordination conditions automatically updates the Executive controller electronic flight data and Track Data Blocks (TDBs), this then negates the need for the Planner to verbally inform the Executive, again reducing the workload for both roles.

As described in section 3.1.1, often the Planner will resolve a confliction between 2 aircraft by applying coordination conditions to one or both of the flights, e.g. by requesting an aircraft is turned by x degrees. It is beneficial if the application of these conditions can update both the Planner coordination and the Executive trajectory in order that the trajectories are representative of what the profile the aircraft is actually flying, which can prevent spurious interactions in any of the separation tools that may be available to the sector team.

3.2.3.6 Flight Data Display

If the MSP is to have the responsibility of supporting more than one Executive controller they must be adequately supported by an appropriate flight data display in which the MSP can suitably manage their Planner tasks. It is also important that the MSP does not become inundated with flight data due to the fact that they now have to manage what is essentially double the amount of flight strips as for 1 Executive controller. This could be in the form of combined flight data strips for both Executives and/or a display in which both sets of Executive flight data can clearly be seen and accessed.

As an MSP, the Planner needs to be able quickly to assess any outstanding tasks to be actioned. In terms of accessing this information through the flight data display, having flight data strips that are dynamic in nature is essential. Dynamic EFS function by displaying to the MSP only the flight data that relate to flights where a specific task is required to be actioned against it. As soon as an aircraft is coordinated in to and out of the sector the flight data will be hidden from view, and only recovered (i.e. displayed to the Planner) in the event that something has changed about the nature of the flight, or its coordination. For example, the receiving sector is unable to accept the aircraft at the offered coordination level and request an alternate offer, or should the flight be identified as a potential encounter in the enhanced looksee/whatif probes

3.2.3.6.1 Planner Views

When assessing the traffic situation from the situation display and also the flight data display, the MSP must be able to easily distinguish between each of the Executive Sectors traffic set. This could be in the form of a button press to suppress the 'other' sectors flight information for the duration of the press, and when released, the information reverts back to both sectors traffic being displayed.

3.2.3.7 Communication Tools

3.2.3.7.1.1 Cordless Headset

In the majority of European En route centres one of the responsibilities of a Planner is to monitor the R/T of the Executive. If, as is the case in an MSP staffing configuration, the Planner has the responsibility of more than one Executive then there is a requirement to be able to listen to both frequencies either at the same time, *or,* be able to switch between the two frequencies independently. Additionally, the Planner may need to move between the two Executive workstations freely; therefore a cordless headset is a solution to this problem. The specific solution will be dependent on the particular Controller Work Position (CWP) arrangement for a specific implementation.

3.3 Differences between new and previous Operating Methods

3.3.1 Sector Staffing Configuration

The main differences between the new and previous sector staffing configuration is the ability of the Planner to support more than one Executive controller, as a Multi Sector Planner. The MSP role will enable a bridging of the gap between the time when a sector is band boxed (i.e. 1PC to 1EC) and when it is necessary to split the sector (i.e. 2PC to 2ECs). This will therefore enable the following benefits:

- 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.
- Contribute to increase airspace capacity through the ability to open more sectors more often.
- Contributes to the overall efficiency of the operation.

Additionally another main difference to the new sector staffing configuration will be the ability of a single controller to undertake both the planning and executive roles, as an SPO (Single Person Operations).

3.3.2 PC Operating Method

As described in section 3.2.1.1, the main difference for the Planner role when acting as an MSP, is the responsibility to coordinate the internal boundary between the 2 sectors within the multi-sector team, as well as coordinating each aircraft into and out of the multi sector, regardless of whether a flight is traversing one or both of the two Executive sectors.

The main difference to the Planner method of operating is that they will be supported by a number of Planner Support tools, as detailed in section 3.2.2. The support tools could be all or some of the tools listed below:

- Conflict Detection Tools e.g. Enhanced MTCD
- MONA e.g. textual alerts on the radar display for flights requiring attention.
- Communication Tools e.g. Cordless Headset
- System Supported Coordination e.g. Integrated Coordination, Dynamic EFS
- Electronic Entry of Coordination Conditions
- "Traffic" Tools e.g. Planner Context.

- Planner views (MSP Specific)

The support tools will enable the controller to effectively assist more than one Executive controller as is currently the case. This is due to the fact that the tools will support the Planner in the following ways:

- Faster coordination decisions on aircraft NFL based on the fact that MTCD will highlight to the controller only the aircraft that are of coordination interest to the Planner.
- Faster coordination decisions on aircraft XFL due to enhanced MTCD 'what-if' probing and "Traffic" highlights.
- Faster coordination conditions agreed with adjacent sectors due to being able to enter coordination conditions electronically which also decrease the amount of telephone calls required.
- Combined flight data displays for both Executive controllers with dynamic movement of flight data in order to quickly and easily determine what planner tasks need to be actioned.
- Cordless headset enabling the MSP to move freely between workstations and monitor one or both executive frequencies if required.

3.3.3 Executive Controller Operating Method

The Executive controller fundamental tasks as detailed in section 3.1.2 will not change. However the fact that they no longer have a dedicated planner will have some impact. It may be the case that the Executive takes it upon themselves to effect their own coordination either electronically or by telephone if they can see that their MSP is engaged on another task and their workload allows it.

4 Detailed Operational Environment

This section will detail firstly some general characteristics of an En Route Environment within Europe, both current and envisaged for the future. Secondly, it will detail more specifically an En Route Environment which would be suitable for an MSP operation.

4.1 Operational Characteristics

4.1.1 General En Route Characteristics

4.1.1.1 Trajectory based Operations

As described in SESAR D3- 'The ATM Target Concept', the future of air traffic will be based on trajectories representing the business/mission intentions of the airspace users. The trajectory is agreed for each flight and integrates any ATM and Airport Constraints. This results in a trajectory that the user agrees to fly and the ANSP and airport agree to facilitate. The concept has been designed to minimise the changes to trajectories and to achieve the best outcome for all users. In that respect, user preferred routing will apply without the need to adhere to a fixed route structure in low/medium density area. The Airspace User owns the Business Trajectory (BT) and has primary responsibility over its operation. Where ATM constraints (including those arising from infrastructural and environmental restrictions/regulations) need to be applied, finding an alternative BT that achieves the best business/mission outcome within these constraints is left to the individual user and agreed through CDM process. The owners' prerogatives do not affect ATC or Pilot executive decision processes. The business/mission trajectories will be described as well as executed with the required precision in all 4 dimensions

This initial OSED, written as specifically focused for the NATS Quick Win will focus on the Operational Environment within a **current** En Route ACC Centre within the ECAC area, which will not yet be operating with full Trajectory based operations.

4.1.1.2 Traffic Characteristics

En route airspace includes all traffic operating within the airspace except terminal airspace (i.e. below FL195). Traffic within En route airspace can consist of aircraft in climb, aircraft in descent, aircraft in level flight and aircraft in the cruise. Therefore each sector depending on its vertical limits can have a wide range of traffic within it.

Traffic characteristics will vary by airspace type:

- Upper Airspace e.g. above FL285: Mainly overflights and a proportion of flights with relatively little vertical change near their ToC/ToD points;
- Lower Airspace e.g. under FL285: A mix of overflights and descending/climbing aircraft depending on the sector. A higher proportion of airfield inbounds and outbounds to both airfields both within and outside the sector of interest, including ones from TMAs in neighbouring FIRs.

4.1.1.3 Airspace structure

En route airspace considered in 04.07.08 is managed airspace in which a separation service will be provided. The vertical scope of the airspace considered is FL195 up to FL660.

The airspace is RVSM up to FL410 and the class of airspace is class C or above.

Airspace within the En route area is split up into different sectors, with each sector having its own AoR. Sectors are grouped geographically into distinct area groups. These sectors within these groups can be split down or band boxed together depending on volume and complexity of traffic at the time. The watch Supervisor is responsible for monitoring predicted traffic levels in conjunction with Flow Management.

Currently in en route airspace sector boundaries are rigid and unchanging. However, the development of Functional Airspace Blocks (FABs) are leading less fragmentation within the EU, due to volumes of airspace being used based on operational requirements and not constrained by State boundaries. The introduction on FABs has the potential to reduce many of the geographical constraints existing between internal FIR boundaries within the participating states. This is expected to open up increased opportunities for more optimised routings. One of the Operational Improvements, arising from these initiatives, and expected in Step 1, will be increased possibilities for direct and free routing with reduced state and FIR boundary related constraints. The local ATSU level toolset for separation management will work with these free routings, during the execution phase, dealing with flights that traverse directly across large regions of FAB airspace.

In airspace where P04.07.08 applies, ATS routes of the ARN will be based upon Basic-RNAV. Sector boundaries are currently fixed (laterally and vertically), but the concept also allows for dynamic sector volumes that can be adjusted to suit the traffic demand.

4.1.1.4 Separation Minima

Within the context of Step 1, current vertical separation minima will be applied including Reduced Vertical Separation Minima (RVSM) between FL290 and FL410.

Lateral and Longitudinal separation will be as per current local ANSP regulations and agreements with adjacent ANSPs.

4.1.1.5 CNS Capability

No changes to CNS capability are expected for the scope of this initial OSED; Radar coverage, standard navigation routes, navigation equipage on aircraft and fixed route-networks will remain as current.

4.1.1.6 Ground-Ground Communication

- Flight data processing exchanges will be ensured by OLDI messages, supported by SYSCO.
- Sector to Sector communication achieved by the use of telephone lines.

4.1.1.7 Air-Ground Communication

- Between Air and Ground, communications will be achieved primarily by voice, and also by Data Link exchanges (available from 2013 within the core area and as of 2015 in all of the ECAC area).
- There will be widespread use of 8.33 kHz channel spacing.
- CPDLC will be used for non-time critical clearances such as Route Clearances.

4.1.2 MSP Candidate

4.1.2.1 Trajectory based Operations and Operating System

Although the ultimate aim of the SESAR programme is for all En Route airspace operating by means of a 4D Trajectory Based Operation, there are currently no En Route Centres within Europe operating to this level. However, in order for a MSP method of operations to be viable, it is envisaged that some form of operating system that supports aircraft trajectories is necessary; the focus of the system and tools to be driven by Trajectory Prediction (TP) and Medium Term Conflict Detection (MTCD) which then provides the controllers with decision making support and facilitates the early detection of conflicts in and around the sector. This therefore enables the sector controllers to be able to safely deal with a higher volume of traffic than normal, which is key for a Planner controller to be responsible for two Executive sectors rather than one.

In addition to a Trajectory based operating system, it is also considered necessary for the operating system to provide some form of support tools that specifically assist the Planner Controller in their duties in order to operate as an MSP effectively (see section 3.2.3).

4.1.2.2 Airspace Structure

An En-route environment suited to an MSP method of operations would be one in which the airspace is typically split into geographic regions, and those regions divided up into a number of sectors (which can be combined or split down, as described in section 3.3.1). The total number of sectors within the centre would be at least twenty, with staffing figures in the region of 200-300 fully qualified Air Traffic Controllers across the En Route Centre across the full 24hr operation. For any En Route Centres smaller than this, the benefits of a more efficient staff deployment through the use of MSP may not be realised.

4.1.2.3 Traffic Levels, Complexity and Staffing Resource

The traffic levels and complexity within an En route environment can vary considerably throughout the day, with each geographical area and sectors within that area experiencing peaks and troughs. These variations in traffic levels and complexity can be dependent on various factors:

- Sector and route arrangement (airspace design) – the interaction between core traffic flows etc.
- Flight schedules: The manner in which flights are scheduled results in natural increases 'peaks' in traffic loading. E.g., early in the morning Oceanic arrivals cause a peak in traffic, and similarly when they begin to depart again, generally late morning. Few aircraft are scheduled to depart or arrive during the night; therefore the night-time is generally very quiet.
- Oceanic Tracks: Dependent on the published Oceanic Tracks of the day, this can mean that the majority of the Oceanic traffic will either be 'north-about' or 'south-about' which determines which route and therefore sectors the aircraft will fly through that day.
- Weather: The occurrence and location of weather within a geographical area can greatly increase the complexity and workload of a sector due to the aircraft requiring weather avoidance clearances.
- Emergencies: If an aircraft experiences an emergency scenario this can immediately increase the workload and complexity within a sector, as the aircraft concerned will likely to need more focused attention.

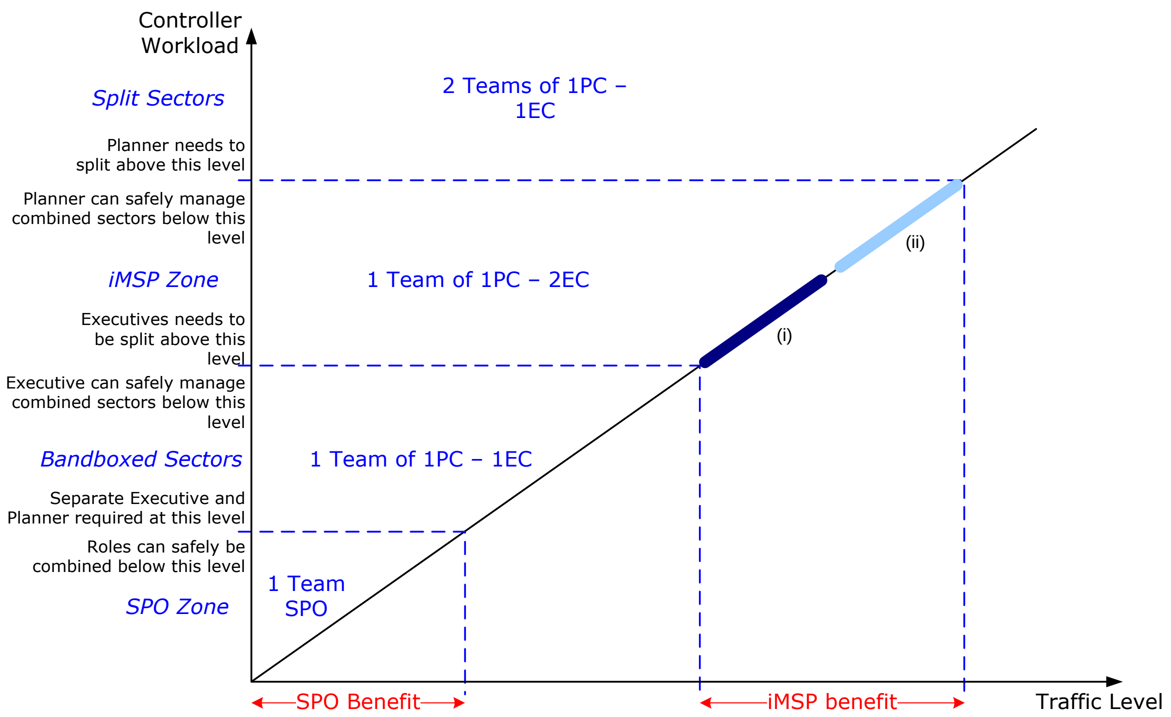
The implication of all of the above factors is that the traffic flow through each sector, while often following similar patterns, can be unpredictable. This also dictates that the staffing configuration for any particular time of day can also be unpredictable. Therefore, MSP is likely to be of most benefit in En Route Centres where sector configurations, and hence staffing options, are flexible and dynamic.

When considering the sector staffing configurations, it is not a simple clear cut relationship to be able to say that as the traffic levels and complexity increase, the sector splits down further.

- Firstly, the combining and splitting of sectors does not necessarily reflect the workload of both the Executive and the Planner. Depending on the nature of the sector, it can often be the case that one role is busier than the other. For example some airspace sectors can be largely bi-directional, i.e. the sector has two main traffic flows; East and West, or North and South. These types of sectors tend to be largely tactically intensive sectors with the Planning task being relatively simple. Other airspace sectors may be multi-directional, with traffic entering and leaving the sector in numerous directions, and therefore creating many points of confliction within the sector. This can create intensive workload for both the Planner and the Executive controller.
- Secondly, it is not as simple and clear cut to suggest that as traffic loading increases, so does complexity and therefore workload. Taking the above examples, for a sector that is bi-directional, often the tactical task of separating aircraft can be simpler than within a sector that has multi-directional cross over points. Therefore the former can usually cope with a higher level of traffic than the latter due to the lower complexity level.

Due to the factors stated above and also factors described in 4.1.4.1, it can be difficult to plan exactly at what times of the day a sector will be combined and at what times the sector will be required to be split. The ACC Supervisor will have access to certain traffic loading prediction device (TLPD), however these types of tools can be fairly crude and only used as a guideline. The implication therefore, is that there must always be a minimum number of staff available to cover the event of any groups of sectors splitting down as far as possible- two controllers for each sector (1PC to 1EC). This results in a considerable number of controllers who are effectively 'on-standby', but are often not utilised.

Within the LACC, the options for combining and splitting the sectors are limited to 1PC and 1EC per sector. As depicted in the diagram below, there is a potential gap between a 1P–1E sector team and a 2P-2E Sector team in which an MSP configuration could fit in. This assumes however, that this level of traffic and complexity is for a long enough period to make an MSP option worthwhile.



4.1.2.4 Air Traffic Controller Sector Validations and MSP

A Multi-Sector Planner sector staffing configuration is likely to be of most benefit in En Route Centres where groups of sectors form larger geographical areas of airspace. Typically within an En Route Centre, an individual controller's validations (approximately 3), will be on sectors that are able to be bandboxed together or split apart. This is primarily to do with the fact that at night-time, these sectors will be bandboxed together due to low traffic levels, therefore the controllers' need to be suitably qualified for all sectors within that group. Also during the peaks and troughs of traffic loading and complexity throughout the day, whenever a group of sectors combine or split is it necessary that this bandboxing and splitting is not constrained by the controller validations.

Currently it would not be possible to create a multi-sector group from completely different geographical reasons, due the reasons mentioned above and additionally, for a Planner controller to be able to operate successfully as an MSP, the two sectors within the multi-sector team must share a common internal boundary. This is due to the fact although it is the MSPs responsibility to set the internal boundary coordination, it is prudent that the Executive controllers also share this boundary in that they have the ability to set / amend this level or attach supplementary coordination conditions to the aircraft at the internal boundary. Additionally, if the two sectors within the multi sector group were not adjacent (either laterally or vertically) this would double the workload for the MSP as coordination in and out of each sector would be required, rather than the NFL-IFL-XFL process as proposed.

4.2 Roles and Responsibilities

4.2.1 En Route Actors

4.2.1.1 Actors

The actors involved in Step 1 operations include the following:

1. Airspace User related actors, including:

- The civil Airline Operations Users: Aircraft Operator and the Airline Operational Control (AOC) related actors and agents
- The military Users: Wing Operations Centres (WOC) and Air Defence Units (ADU)

1. Network Management related actors: Network Manager (NM), Flow Manager (FM), Airspace Manager (Civil Airspace Manager (CAM) & The Military Airspace Manager (MAM)), Local Traffic Manager (LTM), Complexity Manager (CM)
2. Flight Crew
3. ATS Actors: ANSP, ACC Supervisor, Air Defence Supervisor, ATC Sector Team which can include various combinations of Multi Sector Planner, Planning Controller, Executive Controller, Executive Air Defence Controller. Note that Approach Controllers with Arrival Management responsibilities have an influence on the en-route operations for the negotiation and agreement of arrival constraints.

The deployment of ATM actors varies throughout Europe and can depend on company policy, local procedures, operating methods and traffic environment. In some cases a particular actor may be responsible for a given role, part of the tasks of a given role, several roles or part of the tasks of several roles. Likewise, some actors may be named differently and implemented at different organisational levels. For this reason no further descriptions are provided for Actors. Instead a comprehensive description of the roles and responsibilities follows.

4.2.1.2 Roles and Responsibilities

Roles and Responsibilities are described at a higher level in the WPB4.2 document “Actors-Roles and Responsibilities”. The following section is focused on the specific activities and tasks related to En Route Operations in step 1.

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. MSP). However, for this initial OSED focusing on the NATS ‘Quick Win’ iMSP, this section will details any differences from current operations in a typical En Route Centre for the Actors.

The sector team operations can consist of the following actors and configurations:

- ACC Supervisory Role
- Executive Controller
- Planner Controller – 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 Planner – a planning role involved in organising air traffic over number of ATC 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.
- Single Person Operator (SPO) - Combining the roles and responsibilities of both the PC and EC where level of traffic and traffic complexity permits.

The table below provides a description for each role, and any envisaged changes to current operations if in an MSP environment.

Role	Responsibility- current operations	Envisaged change to current operations in an MSP configuration
ACC Supervisory Role	The general management of all activities in the operations room Making decisions in staffing and manning of controller work positions in accordance with expected traffic demand	The ACC Supervisor must now make decisions on the staffing and manning of controller work position with reference to an additional option of 1P-2E. They must consider the time period of peaks and troughs in traffic flow and the optimal staffing configuration for the traffic levels- consideration must be given if the time period is judged to be suitable for a 1P-2E operation and if it is it long enough to justify this staffing configuration.
Single Sector Planner Controller	Achieve a safe, orderly and expeditious flow of air traffic within their area of jurisdiction Coordinate the NFL and XFL of aircraft into and out of their sector AoR (1 single sector with 1 E) Boundary problems are resolved by re-coordinating i.e. amending NFL\XFL or amending the trajectory of the aircraft via heading/speeds etc. Planning Horizon- 10 to 15 minutes Has the use of ATC Support Tools With the support of the ATC Tools, balance workload between the sectors. In coordination with the ATC Supervisory or Local Traffic management roles determine the need for additional ECs in the case where forecast overload situations are developing	No changes to roles and responsibilities in a 1P -1E sector staffing configuration, however the use of Enhanced Planner Support Tools will also be available to the single sector Planner controller.

Executive Controller	Achieve a safe, orderly and expeditious flow of air traffic within their area of jurisdiction Responsibility for traffic management within the sector and for the tactical tasks. Separate known flights operating within its AoR and to issue instructions to pilots for conflict resolution and segregated airspace circumnavigation. Monitoring the trajectories of the aircraft according to the clearances they have received.	No change to the Executive Controller Role anticipated at this stage of the concept
NEW ROLES:	**Same as current**	**New Responsibilties**
Multi-sector Planner Controller	Achieve a safe, orderly and expeditious flow of air traffic within their area of jurisdiction Boundary problems for each of the sectors are resolved by re-coordinating i.e. amending NFL\XFL or amending the trajectory of the aircraft via heading/speeds etc. Monitor internal and external constrictions, complexity and constraints for the next 15 to 30 minutes. Has the use of ATC Support Tools	Has the use of Enhanced Planner Support Tools (see section 3.2.3 for details) The MSP is responsible for a multi-sector area (MSA) of two or more of the present control sectors. These must be sectors within the same geographical region of which are contiguous (either laterally or vertically) The common shared boundary between the two Executive sectors is the Internal boundary of the multi-sector team, of which the MSP is responsible for coordinating across if no standing agreement or pre-defined procedures are in place. Coordinate the NFL, IFL and XFL of aircraft into and out of their AoR which covers *multiple* sectors (each of the multiple sectors has 1 E) *Note- this initial OSED focuses on MSP limited to 1PC to2EC. Execute ATC Sector Planning responsibilities for a group of sectors. As an MSP, the Planner is no longer able to monitor both sectors R/T continuously, therefore the system should

		provide adequate support to mitigate against this- e.g. some form of Flight Path Monitoring, Alerts to show any deviations from clearances etc.
Single Person Operator	Achieve a safe, orderly and expeditious flow of air traffic within their area of jurisdiction Boundary problems for each of the sectors are resolved by re-coordinating i.e. amending NFL\XFL or amending the trajectory of the aircraft via heading/speeds etc. Monitor internal and external constrictions, complexity and constraints for the next 15 to 30 minutes. Has the use of ATC Support Tools Responsibility for traffic management within the sector and for the tactical tasks. Separate known flights operating within its AoR and to issue instructions to pilots for conflict resolution and segregated airspace circumnavigation. Monitoring the trajectories of the aircraft according to the clearances they have received.	Combining the roles and responsibilities of both the PC and the EC where level of traffic and traffic complexity permits. Has the use of Enhanced Planner Support Tools

4.3 Constraints

The main constraint within WP04.07.08 and specifically regarding the 'Quick Win' iMSP within LACC is the fact that the concept and tools are limited at the moment to using the legacy FDP functionality. In the future, when technologies such as a trajectory-based FDP system are implemented, the toolset will need to be re-worked to function alongside these new technologies.

In terms of the concept, the following constraints should be considered:

- The concept is currently constrained by the rigid sector structures within En Route airspace.
- The concept is constrained by the geographical locations of Local Area Groups (LAGS) within En Route airspace i.e. will not be possible to be MSP for one sector in the South of the airspace and one from the North of the airspace
- The particular target implementation for the concept is constrained by the architectural implications of the current NERC system in terms of electing and splitting etc.
- The concept is constrained by the current operating procedures for coordination, handover and standing agreements.

For other ANSPs within Europe the systems available to that ANSP must be suitable for supporting the addition of Enhanced Planner Tools.

5 Use Cases

5.1 Scenario scope

All of the Use Cases applicable to this OSED fall under the Operational Scenario OS-4-03 Separation Management in En Route.

As detailed in the mapping table in section 2.1, there is a list of relevant Scenarios and Use Cases that reference P04.07.08. After reviewing each of the Use Cases only **(UC-SEP-09 - Performing inter-sectors automated coordination dialogue)** was considered to be relevant for this preliminary OSED. This is because the other Use Cases listed can be relevant to an MSP, Planning controller or an Executive controller, regardless of the sector staffing configuration, and are not purely focused on the role of the MSP. The following scenarios and Use Cases are specific to what the main difference is for an MSP being responsible for two Executive controllers as opposed to one Executive controller.

5.2 Scenario 1 – Nominal

5.2.1 Use Case # 1: Coordination of a flight through a Multi-sector Team with a Vertical Internal Boundary

5.2.1.1 Assumptions

It is assumed that the following tools will be available to the E and the P in some form.

- Conflict Detection Tools
- Planner Support Tools
- System supported coordination tools (ATSU/ATSU and sector/sector)

5.2.1.2 Pre-conditions

- Sector 1 and 2 are managed by 1 E each
- Sector 1 and 2 are jointly managed by an MSP
- A flight (FLY01) is offered to the MSP.

5.2.1.3 Post-conditions

- FLY01 is coordinated through both sectors within the Multi-sector team.

5.2.1.4 Operating Method

Step	Multi-Sector Planner	Executive controller Sector 1	Executive controller Sector 2	Notes
1	MSP receives an offer for FLY01 for Sector 1	EC 1 receives flight data for FLY01		
2	MSP assess suitability of FLY01 NFL and accepts the aircraft into Sector 1			MSP assess the suitability of the offer by the use of Planner Support tools as detailed in section 3.2.2. Also for use cases detailing the use of such tools refer to P04.07.02 OSED
3	MSP reviews the aircrafts RFL and recognises that the aircraft will traverse both Sector 1 and 2			
4	MSP sets internal flight level which initiates an electronic offer to Sector 2		EC 2 receives flight data for the aircraft.	The setting of an internal vertical flight level will depend on local procedures. For example at LACC, for an offer made over a vertical boundary, the highest level in the offering sector (if offering 'up') will be set, or the lowest level (if offering 'down').
5	MSP then assesses a suitable XFL to set out for Sector 2			MSP assess the suitability of an XFL by the use of Planner Support tools as detailed in section 3.2.2. Also for use cases detailing the use of such tools refer to P04.07.02 OSED

5.2.2 Use Case # 2: Coordination of a flight through a Multi-sector Team with a Lateral Internal Boundary

5.2.2.1 Assumptions

- As 5.2.1.1

5.2.2.2 Pre-conditions

- As 5.1.2

5.2.2.3 Post-conditions

- As 5.1.3

5.2.2.4 Operating method

Step	Multi-Sector Planner	Executive controller Sector 1	Executive controller Sector 2	Notes
1	MSP receives an offer for an FLY01 for Sector 1	EC 1 receives flight data for FLY01		
2	MSP assess suitability of FLY01 NFL and accepts the aircraft into Sector 1			MSP assess the suitability of the offer by the use of Planner Support tools as detailed in section 3.2.2. Also for use cases detailing the use of such tools refer to P04.07.02 OSED
3	MSP looks at the aircrafts route and recognises that the aircraft will traverse both Sector 1 and 2			
4	MSP assesses a suitable internal flight level which initiates an electronic offer to Sector 2. Note: if a Standing Agreement is in place across the Internal Boundary the IFL will be set automatically by the system.		EC 2 receives flight data for the aircraft.	MSP asses a suitable internal flight level by the use of the Planner Support Tools as detailed in section 3.2.2. Also for use cases detailing the use of such tools refer to P04.07.02 OSED
5	MSP then assess a suitable XFL to set out for Sector 2			MSP assess the suitability of an XFL by the use of Planner Support tools as detailed in section 3.2.2. Also for use cases detailing the use of such tools refer to P04.07.02 OSED

5.2.3 Use Case # 3: Pilot changes RFL so therefore flight no longer will traverse both sectors within the Multi-sector team

5.2.3.1 Assumptions

- As in 5.2.1.1

5.2.3.2 Pre-conditions

- FLY01 has been coordinated through both sectors within the Multi-sector team.
- FLY01 is in contact with EC Sector 1
- EC Sector 2 has flight data for FLY01

5.2.3.3 Post-conditions

- FLY01 is coordinated through Sector 1 only.

5.2.3.4 Operating method

Step	Multi-Sector Planner	Executive controller Sector 1	Executive controller Sector 2	Notes
1		Pilot of FLY01 informs EC1 that they are requesting a new cruising flight level. EC1 informs the MSP		In current operations, the PC is likely to pick up this information due to the fact they are continually monitoring the R/T. However, in an MSP configuration it may be necessary for the EC to pass on this information.
2	MSP acknowledges information and recognises that the new RFL will mean FLY01 will only traverse through Sector 1 and not both Sector 1 and 2.			
3	The MSP must withdraw the flight from Sector 2.		Sector 2 EC is alerted to the withdrawal of FLY01 from their flight data set by the updating of electronic flight data and various HMI indications.	This method of withdrawing a flight is an electronic process which is necessary when amending the coordination sequence.

4	MSP asses a suitable new XFL for Sector 1 and sets XFL.			MSP assess the suitability of an XFL by the use of Planner Support tools as detailed in section 3.2.2. Also for use cases detailing the use of such tools refer to P04.07.02 OSED
5		Sector 1 EC flight data will reflect new XFL Coordination		

5.2.4 Use Case # 4: Pilot changes RFL which means that the flight will traverse both sectors within the Multi-sector team

5.2.4.1 Assumptions

- As in 5.2.1.1

5.2.4.2 Pre-conditions

- FLY01 is coordinated with Sector 1 due the Pilot RFL staying within the vertical boundaries of Sector 1

5.2.4.3 Post-conditions

- FLY01 is coordinated through Sector 1 and 2 due to the new RFL.

5.2.4.4 Operating method

Step	Multi-Sector Planner	Executive controller Sector 1	Executive controller Sector 2	Notes
1		Pilot of FLY01 informs EC1 that they are requesting a new cruising flight level. EC1 informs the MSP		In current operations, the PC is likely to pick up this information due to the fact they are continually monitoring the R/T. However, in an MSP configuration it may be necessary for the EC to pass on this information.
2	MSP recognises that the new RFL means		Sector 2 EC receives flight information for	This method of withdrawing a flight is an electronic process which is necessary when amending the

	that the XFL for Sector 1 will need to change the level to the IFL, which therefore sends an offer up to Sector 2. If the original next sector on the coordination sequence has already accepted the flight, the MSP may need to withdraw the offer		Sector 2	coordination sequence.
3	MSP then needs to set an XFL for Sector 2. MSP asses a suitable new XFL for Sector 2 and sets XFL.			MSP assess the suitability of an XFL by the use of Planner Support tools as detailed in section 3.2.2. Also for use cases detailing the use of such tools refer to P04.07.02 OSED

5.3 Scenario 2 – Non-nominal

5.3.1 Use Case # 5: Weather in the Sector

5.3.1.1 Assumptions

- As in 5.2.1.1

5.3.1.2 Pre-conditions

- Sector 1 and 2 are jointly managed by an MSP

5.3.1.3 Post-conditions

- Multi-sector is split into 2 separate PCs

5.3.1.4 Operating method

Step	Multi-Sector Planner	Executive controller Sector 1	Executive controller Sector 2	ACC Supervisor	Flight Crew	Notes
1					Pilots report weather within the Sector 2 flight levels/lateral area.	
2			EC Sector 2 informs MSP			
3	MSP makes an assessment in conjunction with the ACC Supervisor to determine if possible to continue in an MSP staffing configuration or not.			ACC Supervisor makes an assessment in conjunction with the MSP to determine if possible to continue in an MSP staffing configuration or not.		
4	MSP prepares to split PC position			ACC Supervisor calls in another PC		

5.3.2 Use Case # 6: Aircraft declares emergency

5.3.2.1 Assumptions

- As in 5.2.1.1

5.3.2.2 Pre-conditions

- Sector 1 and 2 are jointly managed by an MSP

5.3.2.3 Post-conditions

- Multi-sector is split into 2 separate PCs

5.3.2.4 Operating method

Step	Multi-Sector Planner	Executive controller Sector 1	Executive controller Sector 2	ACC Supervisor	Flight Crew	Notes
1					Pilots reports an emergency situation within Sector 2	
2			EC Sector 2 informs MSP			
3	MSP makes an assessment in conjunction with the ACC Supervisor to determine if possible to continue in an MSP staffing configuration or not.			ACC Supervisor makes an assessment in conjunction with the MSP to determine if possible to continue in an MSP staffing configuration or not.		
4	MSP prepares to split PC position or to work “man and boy” (if splitting the sector would be undesirably disruptive during the handling of the emergency)			ACC Supervisor calls in another PC		

5.3.3 Use Case # 7: Holding within the multi-sector

5.3.3.1 Assumptions

- As in 5.2.1.1

5.3.3.2 Pre-conditions

- Sector 1 and 2 are jointly managed by an MSP

5.3.3.3 Post-Conditions

- Multi-sector is split into 2 separate PCs

5.3.3.4 Operating method

Step	Multi-Sector Planner	Executive controller Sector 1	Executive controller Sector 2	ACC Supervisor	Flight Crew	Notes
1				ACC Supervisor receives instruction Terminal Control that delays at inbound airfields require holding En route. ACC Supervisor informs MSP		This use case is also applicable to any other instances that may cause aircraft holding e.g. Aircraft emergency, weather.
2	MSP receives instruction from ACC Supervisor that delays at inbound airfields require holding En route. MSP informs both EC to begin holding aircraft within their sectors.					
3	MSP makes an assessment in conjunction with the ACC Supervisor to determine if possible to continue in an MSP staffing			ACC Supervisor makes an assessment in conjunction with the MSP to determine if possible to continue in an MSP staffing configuration or not.		

	configuration or not.					
4	MSP prepares to split PC position			ACC Supervisor calls in another PC		

5.3.4 Use Case # 8: Workstation Failure

5.3.4.1 Assumptions

- As in 5.2.1.1

5.3.4.2 Pre-conditions

- Sector 1 and 2 are jointly managed by an MSP

5.3.4.3 Post-Conditions

- Multi-sector is split into 2 separate PCs

5.3.4.4 Operating method

Step	Multi-Sector Planner	Executive controller Sector 1	Executive controller Sector 2	ACC Supervisor	Flight Crew	Notes
1	MSP experiences workstation failure.					A MSP should be supported by 2 workstations, 1 adjacent to either EC
2	MSP moves across to the other Planner workstations and continues to manage the sector			ACC Supervisor calls in another PC		
3	MSP continues to manage both EC sectors with					

	second PC 'man and boy' until it is possible for workstation to be fixed, or to move to another spare workstation.					

5.4 Scenario 3 –Transition

5.4.1 Use Case # 9: Transition from 1SPO > 1P 1EC

5.4.1.1 Assumptions

It is assumed that the following tools will be available to the SPO in some form.

- Conflict Detection Tools
- Planner Support Tools
- System supported coordination tools (ATSU/ATSU and sector/sector)

5.4.1.2 Pre-conditions

- Sector traffic loading and complexity is such that the sector is managed by an SPO.

5.4.1.3 Post-Conditions

- Sector team organisation is 1PC 1EC

5.4.1.4 Operating method

Step	SPO	Planner Controller	ACC Supervisor	Notes
1			ACC Supervisor consults TLPD and sees that a peak in traffic loading is predicted in 20 minutes time.	
2			Decision is made to change staffing configuration to 1PC	

			1EC.Informs SPO	
3	SPO acknowledges ACC Supervisor instructions and prepares to receive incoming PC		ACC Supervisor calls a PC into the operations room	
4	SPO gives incoming PC relevant information in order that they can take over the PC role	PC arrives at workstation and receives handover information from SPO		The splitting of the sector configuration will requires some kind of workstation configuration in order that the relevant flight data and HMI is correct for all positions Consideration should be given as to when another controller arrives to split the SPO position, if it is more feasible to come in as a PC or a EC.

5.4.2 Use Case # 10: Transition from 1P 1EC > 1P 2EC

5.4.2.1 Assumptions

It is assumed that the following tools will be available to the EC and the PC in some form.

- Conflict Detection Tools
- Planner Support Tools
- System supported coordination tools (ATSU/ATSU and sector/sector)

5.4.2.2 Pre-conditions

- Sector traffic loading and complexity is such that the sector is managed by 1PC to 1EC

5.4.2.3 Post-Conditions

- Sector team organisation is 1PC to 2EC

5.4.2.4 Operating method

Step	ACC Supervisor	Executive controller Sector 1	Planner controller Sector 1	Executive controller Sector 2	Notes
1	ACC Supervisor consults TLPD and sees that a peak in traffic loading is predicted in 20 minutes time.				
2	ACC Supervisor assesses that traffic loading will be such to warrant a MSP staffing configuration. Informs the current sector controllers				
3	ACC Supervisor calls another controller to the operations room	EC prepares to split sector in to Sector 1 and Sector 2	PC prepares for sector to be split into EC Sector 1 and EC Sector 2		The splitting of the sector configuration will requires some kind of workstation configuration in order that the relevant flight data and HMI is correct for all positions
4		EC1 provides handover information to incoming EC2		EC2 receives handover information from EC1	

5.4.3 Use Case # 11: Transition from 1P 2EC > 2P 2EC

5.4.3.1 Assumptions

- As 5.4.2.1

5.4.3.2 Pre-conditions

- Sector traffic loading and complexity is such that the sector is managed in a MSP configuration i.e. 1PC to 2EC.

5.4.3.3 Post-Conditions

- Sector team organisation is 2PC to 2EC

5.4.3.4 Operating method

Step	Multi-Sector Planner	Executive controller	Executive controller	Planner controller Sector 2	ACC Supervisor	Notes
1					ACC Supervisor consults TLPD and sees that a peak in traffic loading is predicted in 20 minutes time.	
2					ACC Supervisor assesses that traffic loading will be such to warrant a 2PC 2EC staffing configuration. Informs the current sector controllers	
3	MSP prepares to split MSP position into Sector 1 PC Sector 2 PC				ACC Supervisor calls another controller to the operations room	
4	MSP provides PC Sector 2 with relevant Handover information			PC Sector 2 receives relevant handover information from MSP		The splitting of the sector configuration will requires some kind of workstation configuration in order that the relevant flight data and HMI is correct for all positions

It can be assumed that the reverse process of the above use cases would also be true; i.e. the transition from 2PC to 2EC > 1PC to 2EC > 1PC to 1EC > SPO.

However, it is not being suggested that the transition process must be as rigid as following the above use cases. It would still be feasible that the prediction in traffic loading and complexity is that the sector would 'skip' certain parts of the transition; i.e. the traffic peak predicted may be such that the sector transition goes from 1P-1E straight to 2P-2E, therefore missing out the MSP stage. In addition the SPO sector configuration may only ever be feasible during night-time hours. The main point to emphasize is that the sector staffing configuration is flexible and dynamic, ensuring that the most efficient deployment of staff is utilised at all times.

6 Requirements

6.1 MSP System High Level Requirements

[REQ]

Identifier	REQ-04.07.08-OSED-0001.1001
Requirement	An iMSP controller shall be able to fulfil their role and responsibilities as a Planner
Title	System
Status	<In Progress>
Rationale	An iMSP staffing configuration shall not prohibit the Planner from fulfilling any of their roles and responsibilities
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.1002
Requirement	The MSP shall be supported by 2 workstations. The workstations shall display the same information in that an update to any coordination information on one workstation shall simultaneously update the other.
Title	System
Status	<In Progress>
Rationale	The MSP must be able to move freely between each workstation in order to sit next to either of the Executive controllers and have the most up to date coordination displayed (although the “synchronization” of some aspects of the HMI may be triggered by a user input when moving to the alternative CWP)
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0006	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.1003
Requirement	The MSP shall have the ability to move freely between the sector workstations while monitoring the R/T and/or speaking on the telephone by some form of communication tool e.g. a cordless headset
Title	System
Status	<In Progress>
Rationale	The MSP should not be constrained to one workstation
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.1004
Requirement	The MSP shall have the ability to monitor one or both sector frequencies simultaneously and be able to switch between the two
Title	System
Status	<In Progress>
Rationale	The MSP can make a decision about which Executive Sector to monitor according to perceived workload/complexity.
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.1005
Requirement	To be configured in a 1PC – 2EC configuration, both the iMSP and Executive controllers shall be aided by support tools.
Title	System
Status	<In Progress>
Rationale	The MSP may not be able to continually monitor both Executive Sector frequencies so therefore the sector needs additional support tools.
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.1006
Requirement	The MSP shall have a consolidated view of both Executive sectors flight data displays.
Title	System
Status	<In Progress>
Rationale	The MSP shall not have to look at different situation displays for both sets of Executive flight data
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0006	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.1007
Requirement	The iMSP consolidated situation display shall display all relevant information pertinent to both Executive sectors
Title	System
Status	<In Progress>
Rationale	The MSP shall be able to gain pertinent information from scanning the situation display, and no pertinent information shall be hidden when in a consolidated view
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.0008
Requirement	The MSP should be able to select a view that filters flight data and encounters of one Executive sector (although critical information associated with the non-selected Executive sector may override that filter).
Title	System
Status	<In Progress>
Rationale	There may be situations where the MSP only wishes to view 1 sector for a brief period of time (e.g. if there is clutter on the situation display) and there should be no opportunity for confusion for the MSP between the 2 sets of Executive data and encounters
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.0009
Requirement	The Executive's flight data display and role should not change between working in a 1PC - 1EC environment and a 1PC - 2EC environment
Title	System
Status	<In Progress>
Rationale	The Executives role and information display does not change with regards to the sector staffing configuration in MSP.
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.0010
Requirement	The MSP should have the ability to edit the IFL up until the time the flight is transferred between the Executive Sectors.
Title	System
Status	<In Progress>
Rationale	This allows the MSP to have some flexibility when setting the IFL between the 2 Executive Sectors.
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0006	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.0011
Requirement	The Executive controller shall have the ability to amend the IFL at any time before transfer of the aircraft between EC1 and EC2.
Title	System
Status	<In Progress>
Rationale	This allows the EC to amend the IFL to suit their tactical plans with the traffic without creating extra workload for the MSP
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0006	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.0012
Requirement	The encounters (both tactical and planning) predicted by the CD&R tools shall be filtered such that they are able to differentiate those applicable to the combined (planning) sector or each of the particular (tactical) sectors.
Title	System
Status	<In Progress>
Rationale	There shall be no confusion as to which sector an interaction is applicable to.
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0015	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.0013
Requirement	It shall only be possible to perform the MSP role for contiguous sectors
Title	System
Status	<In Progress>
Rationale	The Bandboxing and Splitting of multi-sector groupings shall not be constrained by controller validations
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.0014
Requirement	The system shall enable a rapid transition between different sector staffing configurations.
Title	System
Status	<In Progress>
Rationale	The effective operation of the sector shall not be impacted by a change in sector staffing configuration.
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

[REQ]

Identifier	REQ-04.07.08-OSED-0001.0015
Requirement	During transition between different sector staffing configurations that include MSP, the system shall provide sufficient data and information to enable controller handovers.
Title	System
Status	<In Progress>
Rationale	There shall be no opportunity for any sector data to be lost/in the incorrect place when transitioning between different sector staffing configurations
Category	<Operational>
Validation Method	<Analytical Modelling>
Verification Method	

[REQ Trace]

Relationship	Linked Element Type	Identifier	Compliance
<SATISFIES>	<ATMS Requirement>	REQ-04.02-DOD-0005.0014	<Partial>

6.2 Information Exchange Requirements

After reviewing the information exchange process within the sWP04.02 DOD**Error! Reference source not found.**, none are considered to be relevant to his OSED as no new information is to be exchanged between the actors for the MSP concept at this stage of the project.

At a SWIM mode level, the exchanges between the air and ground and also between the actors as described in section 4 remain the same as current operations today.

Therefore, there are no information exchange requirements in this OSED.

7 References

7.1 Applicable Documents

The following documents were used to provide input/guidance/further information/other:

[1] WP4 Detailed Operational Description (DOD) Step 1 D07, Edition 00.03.00

http://extranet.sesarju.eu/WP_04/Project_04.02

[2] 04.02 Concept Validation Strategy document Step 1 D59, Edition 00.03.00

http://extranet.sesarju.eu/WP_04/Project_04.02

[3] Project Initiation Report: Controller Team Organisation, Roles and Responsibilities in a Trajectory Based Operation within En Route Airspace (including MSP). Edition 00.02.00

http://extranet.sesarju.eu/WP_04/Project_04.07.08

[4] 04.07.08Validation Report D010, Edition 00.02.00

http://extranet.sesarju.eu/WP_04/Project_04.07.08

[5] WPB.04.02, SESAR WPB4.2 Actors - Roles and Responsibilities Edition 00.01.05, 11/05/2011