EUROCONTROL Specification for Medium-Term Conflict Detection

EUROCONTROL

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EUROCONTROL Specification for Medium-Term Conflict Detection

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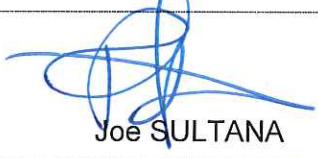
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Abstract	
This document provides system requirements for Medium-Term Conflict Detection (MTCD).	

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1.2	28/10/2016	NETOPS informal consultation	All
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TABLE OF CONTENTS

ANNEXES

EXECUTIVE SUMMARY

This EUROCONTROL Specification provides system requirements for Medium-Term Conflict Detection (MTCD). This is considered to comprise three distinct functions as follows:

a) The detection and notification to the controller of probable loss of the required separation between two 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 blocking airspace that might have been used by the other, e.g. In case of pilot request for an alternative level or when resolving a conflict involving one of the aircraft.

The requirement specifies the criteria for detecting *encounters* between aircraft and between aircraft and airspace, for grouping encounters into *interactions* where they form a cohesive unit to be treated together, the notification of interactions to the relevant controllers and the capabilities of the human-machine interface.

This document describes objectives to be achieved and system requirements describing a behaviour of the system that achieves the objectives.

1 INTRODUCTION

1.1. Purpose

The Single European Sky ATM Research (SESAR) programme is the European Air Traffic Management (EATM) modernisation programme, combining technological, economic and regulatory aspects and using the Single European Sky (SES) legislation to synchronise the plans and actions of the different stakeholders and federate resources for the development and implementation of the required improvements throughout Europe.

The original version of this specification supported, notably, the SESAR ATM Deployment Sequence [*SESAR-D4*] which describes the operational improvements steps that make-up the three implementation phases to achieve SESAR full deployment. Implementation Phase 1, addressing developments in the 2008-2012 timeframe, defines, inter alia, the deployment of "Automated Assistance to ATC Planning for Preventing Conflicts in Enroute Airspace" and "Automated Flight Conformance Monitoring". In this way, the document specified requirements for medium-term conflict detection within the context of the SESAR baseline system as defined by [*SESAR-D4*].

This update of the specification supports the SESAR Deployment Manager's Deployment Programme 2016 [DP-2016], which provides the project view for full implementation of the Pilot Common Projects (PCP). In particular, [DP-2016] identifies coherent families of implementation activities, underpinning the deployment of the 6 ATM Functionalities in the PCP. The family 3.2.1 - Upgrade of ATM systems (NM, ANSPs, AUs) to support Direct Routings (DCTs) and Free Routing Airspace (FRA) - is of direct relevance to this specification, while family 1.2.5 - Implement Advanced RNP routes below Flight Level 310 - has indirect links with this specification.

This document is also consistent with the following essential requirements of Annex II of the Single European Sky (SES) Interoperability Regulation (EC) No 552/2004, as amended by Regulation (EC) 1070/2009:

> "The EATMN, its systems and their constituents shall support, on a coordinated basis, new agreed and validated concepts of operation that improve the quality, sustainability and effectiveness of air navigation services, in particular in terms of safety and capacity."

> "Flight data processing systems shall accommodate the progressive implementation of advanced, agreed and validated concepts of operation for all phases of flight, in particular as envisaged in the ATM Master Plan."

The document also supports the European Single Sky Implementation (ESSIP) objective ATC12.1, for the implementation of automated support for conflict detection, resolution support information and conformance monitoring.

This specification has been developed and updated in collaboration with operational stakeholders (mainly ANSPs) and ATM ground systems manufacturing industry and will be maintained under the EUROCONTROL Advisory Framework.

The specification may be used by Air Navigation Service Providers (*ANSPs*) in the planning and procurement of *ATM* systems that form the SESAR Baseline.

1.2. Scope

The requirements for MTCD cover three distinct functions as follows:

- The detection and notification to the controller of probable loss of the required separation between two aircraft;

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

- The detection and display to the controller of aircraft-to-aircraft encounters where, although the required separation will be achieved, each aircraft is blocking airspace that might have been used by the other, e.g. In case of pilot request for an alternative level or when resolving a conflict involving one of the aircraft.

The scope of this specification covers both planning and tactical aspects of MTCD, the implementation of which might be through an integrated planner/tactical MTCD or through separated planning, tactical, near-term, etc. tools.

Operational requirements for MTCD were produced as part of the European Air Traffic Control Harmonisation and Integration Programme (*EATCHIP*) managed by the European Organisation for the Safety of Air Navigation (EUROCONTROL) and documented in the EATCHIP Operational Requirements Document for MTCD [*EATM-MTCD*].

In the nine years following publication of [*EATM-MTCD*] a number of implementation and validation activities have been performed within the European ATM Programme (EATMP) and by its stakeholders. Of these, the FASTI tools that have been developed and validated by EUROCONTROL (PROVE), DFS (VAFORIT), DSNA (ERATO) and NATS (iFACTS) were studied and documented in the FASTI Baseline Description [*BASELINE*].

Within the FASTI programme, an MTCD Operational Services and Environment Description [*MTCD-OSED*] has been produced, describing the required system services for a number of defined environments.

The [*MTCD-OSED*] forms the top-level source of required system services for the purpose of this specification, whilst the description of the system functionality that is required in order to provide the required services is drawn from [*BASELINE*].

The target environments for the *FASTI* toolset are defined in FASTI Operational Concept [*CONOPS*] and in [*MTCD-OSED*]. This document should be considered as describing the minimum level of capability within the most demanding of the target environments.

1.3.   Applicability

These requirements are intended to be used by Air Navigation Service Providers (*ANSPs*) in the planning and procurement of *ATM* systems, particularly those including the *FASTI* controller support tools.

As prescribed by the EUROCONTROL Regulatory and Advisory Framework, this document constitutes a voluntary specification. The user of the present document shall be aware that, in the absence of an Implementing Rule concerning Medium-Term Conflict Detection, the specification does not confer presumption of conformity to any piece of European legislation; especially, the specification does not by itself ensure compliance with the Essential Requirements of Regulation (EC) 552/2004 as amended by Regulation (EC) N° 1070/2009, which is binding in most of the EUROCONTROL member states.

1.4.   Conventions

> *The term "shall" denotes a mandatory requirement.*
>
> *The term "should" denotes recommendation or best practice.*
>
> *The term "may" denotes an optional element.*

The term 'system' in the context of the requirement refers to any part of the ATM automation, without implying any sub-system breakdown.

Requirement sections are preceded with a statement in **bold italics** describing the objective that the requirements are intended to fulfil.

1.5.   Definitions

Cleared Level	*The flight level at or to which an aircraft is authorised to proceed under conditions specified by an ATC unit.*
Current Level	*In principle, the actual level of an aircraft, though this might be approximated by the last level computed in the system track.*
Encounter	*The predicted approach of an aircraft within a specified distance of another aircraft, or a designated volume of airspace, classified respectively as "aircraft-to-aircraft" and "aircraft-to-airspace" encounters*
Interaction	*A set of one or more encounters that should be treated as a whole when determining their resolution.*
Level	*A generic term relating to the vertical position of an aircraft in flight and meaning variously, height, altitude or flight level.*
Loss of Separation	*The contemporaneous breeching of defined horizontal and vertical limits, either predicted by comparison of flight trajectories, or actually realised by aircraft.*
Planned Trajectory	*A trajectory representing the most likely behaviour of a flight through an Area of Interest (AoI), from take-off to touch-down, over the medium term.[1]*
Sector	*A part of airspace controlled by a team of controllers, defined, notably, by its geographical co-ordinates, vertical extent and its assigned radio frequency/frequencies.[2]*
Sector Entry/Exit Level	*The level agreed between two sector controllers at which an aircraft will be cleared while the aircraft is being transferred between the sectors.*
System Track	*A generic entity representing the surveillance data as transmitted by the surveillance system.*
Tactical Trajectory	*A trajectory representing the expected behaviour of the aircraft taking into account all clearances and other instructions issued to the aircraft but without making assumptions on subsequent clearances to be issued. [See TP-SPEC]*

1.6.   Abbreviations

ANSP	*Air Navigation Service Provider*
AoI	*Area of Interest*
AoR	*Area of Responsibility*
ATC	*Air Traffic Control*
ATM	*Air Traffic Management*
ATS	*Air Traffic Services*
AU	*Airspace User*

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[1] Supersedes definition given in the EUROCONTROL ATM Lexicon.
[2] Supersedes definition given in the EUROCONTROL ATM Lexicon.

CFL	*Cleared Flight Level*
CWP	*Controller Work Position*
DCT	*Direct Routing*
EATCHIP	*European Air Traffic Control Harmonisation and Integration Program*
EATMP	*European Air Traffic Control Program*
ESSIP	*European Single Sky Implementation*
FASTI	*First ATC Support Tools Implementation*
FIR	*Flight Information Region*
FL	*Flight Level*
FUA	*Flexible Use of Airspace*
GAT	*General Air Traffic*
HMI	*Human-Machine Interface*
IFR	*Instrument Flight Rules*
LoA	*Letter of Agreement*
MSP	*Multi Sector Planner*
MTCD	*Medium-Term Conflict Detection*
NM	*Network Manager*
OAT	*Operational Air Traffic*
ORD	*Operational Requirements Document*
OSED	*Operational Requirements and Services Description*
PCP	*Pilot Common Project*
RVSM	*Reduced Vertical Separation Minima*
SES	*Single European Sky*
SESAR	*Single European Sky ATM Research*
TCT	*Tactical Controller Tool*
TMA	*Terminal Area*
TP	*Trajectory Prediction*
TRA	*Temporary Reserved Area*
TSA	*Temporary Segregated Area*
VFR	*Visual Flight Rules*
VPA	*Variable Profile Area*

1.7. Reference Material

[IOP-REG]   Regulation (EC) No 552/2004 of the European Parliament and of the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network (the interoperability Regulation), as amended by Regulation (EC) No 1070/2009 of the European Parliament and of the Council of 21 October 2009 amending Regulations (EC) No 549/2004, (EC) No 550/2004, (EC) No 551/2004 and (EC) No 552/2004 in order to improve the performance and sustainability of

	the European aviation system
[SESAR-D4]	SESAR D4 – The ATM Deployment Sequence, January 2008
[SESAR-D5]	SESAR D5 – The SESAR Master Plan, April 2008
[CONOPS]	FASTI Operational Concept, Edition 1.1
[EATM-MTCD]	Operational Requirements for EATCHIP Phase III Added Functions, Volume 5, MTCD, Edition 2.0
[MTCD-OSED]	FASTI MTCD Operational Service & Environment Description
[BASELINE]	FASTI Baseline Description, Edition 1.1
[TP-SPEC]	EUROCONTROL Specification for Trajectory Prediction, Edition 2.0, March 2017
[SAFETY]	FASTI Preliminary Safety Case
[DP-2016]	Deployment Programme 2016, 30 September 2016

1.8.   Document Structure

This specification contains three chapters as follows:

Chapter 1 (this chapter) provides an introduction to the specification, describing the purpose, scope, applicability, and conventions used, defining acronyms and terms used within the specification and identifying reference documents.
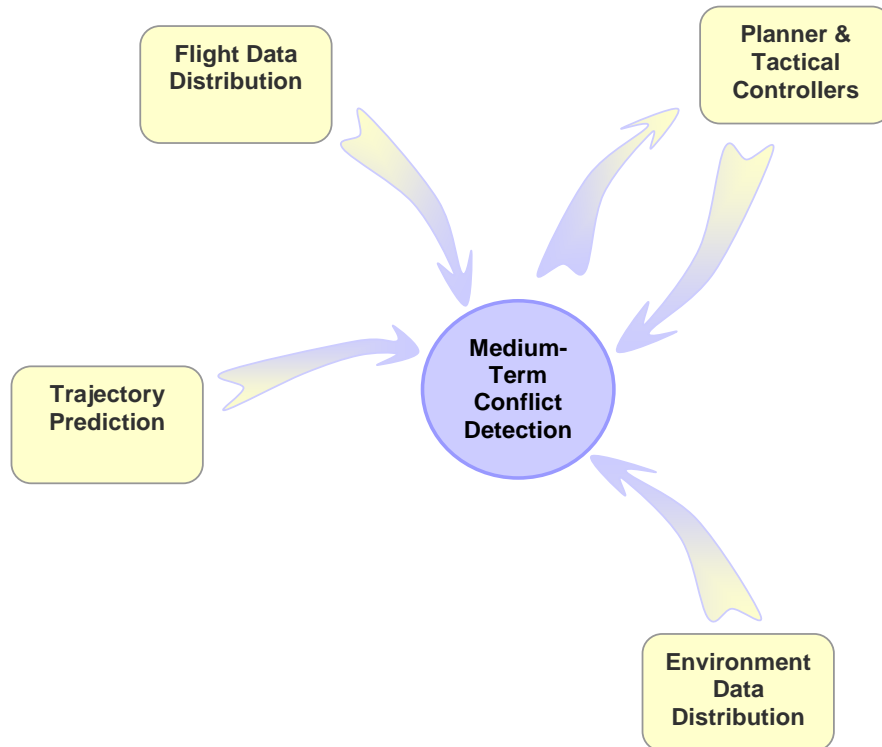
Chapter 2 gives an overview of the Medium-Term Conflict Detection service.

Chapter 3 provides the functional requirements of the Medium-Term Conflict Detection service.

2 MEDIUM-TERM CONFLICT DETECTION OVERVIEW

2.1. Context

The context of *MTCD* within the SESAR baseline system is depicted in Figure 1, below.

FIGURE 1 - MTCD CONTEXT

The interaction with the external entities is described as follows:

Flight Data Distribution – flight data is provided to MTCD for all eligible flights;

Trajectory Prediction – the Planned and Tactical Trajectories (see [*TP-SPEC*]) are provided to MTCD and form the basis upon which the detection of encounters is performed;

Environment Data Distribution – airspace data is provided to MTCD and forms the basis of the detection of aircraft-to-airspace encounters; the airspace configuration and sectorization are used to determine the responsibility of detected encounters, and parameterized operational procedures and letters of agreement define the encounter criteria;

Planner/Multi sector Planner & Tactical Controllers – interactions are displayed to the controllers and are coordinated and managed by them.

2.2. MTCD Logical Breakdown

The purpose of MTCD is to notify the controller of interactions that occur in the medium-term (e.g. up to 20 minutes) that might require aircraft to be re-planned or re-cleared or may affect the choice of a desired clearance.

> *An interaction is defined as a set of one or more encounters that have been grouped because they should be treated as a whole when determining their resolution.*
>
> *An encounter denotes the predicted approach of an aircraft within a specified distance of another aircraft, or a designated volume of airspace, classified respectively as "aircraft-to-aircraft" and "aircraft-to-airspace" encounters.*

Note that not all encounters represent potential problems – see "context encounters", below.

Aircraft-to-aircraft encounters are further classified as either based on the Planned Trajectory or on the Tactical Trajectory, as described in the FASTI TP Operational Requirements Document [*TP-SPEC*].

A tactical-based aircraft-to-aircraft encounter represents a conflict between aircraft where the position of one or both aircraft is determined from the tactical trajectory; it is further classified according to whether the aircraft are flying according to conflicting clearances or whether the conflict is a result of an aircraft deviating from its clearance.

A plan-based aircraft-to-aircraft encounter represents either a problem or a contextual encounter. The latter, classified as a "context", represents an encounter between two aircraft such that the possible actions available on each aircraft are limited by the presence of the other, e.g. one aircraft flying 2000 feet above another aircraft.

A problem is further classified as either an "entry problem", an "exit problem", or an "in-sector problem". Normally, in a two-controller sector configuration, the sector planner would be responsible for solving entry and exit problems (see [*CONOPS*]); depending on the tactical workload and the nature of the problem, the sector planner might also solve - or prepare a resolution for – an in-sector problem.

Thus, an interaction will normally comprise a problem together with a number of context aircraft that constrain the resolution of the problem. Occasionally, a number of problems may be grouped under a single interaction where it is likely that they may all be solved by a single action. Alternatively, an interaction might contain no problems, only context encounters, indicating aircraft in proximity to one-another and therefore airspace that is blocked to the each other.
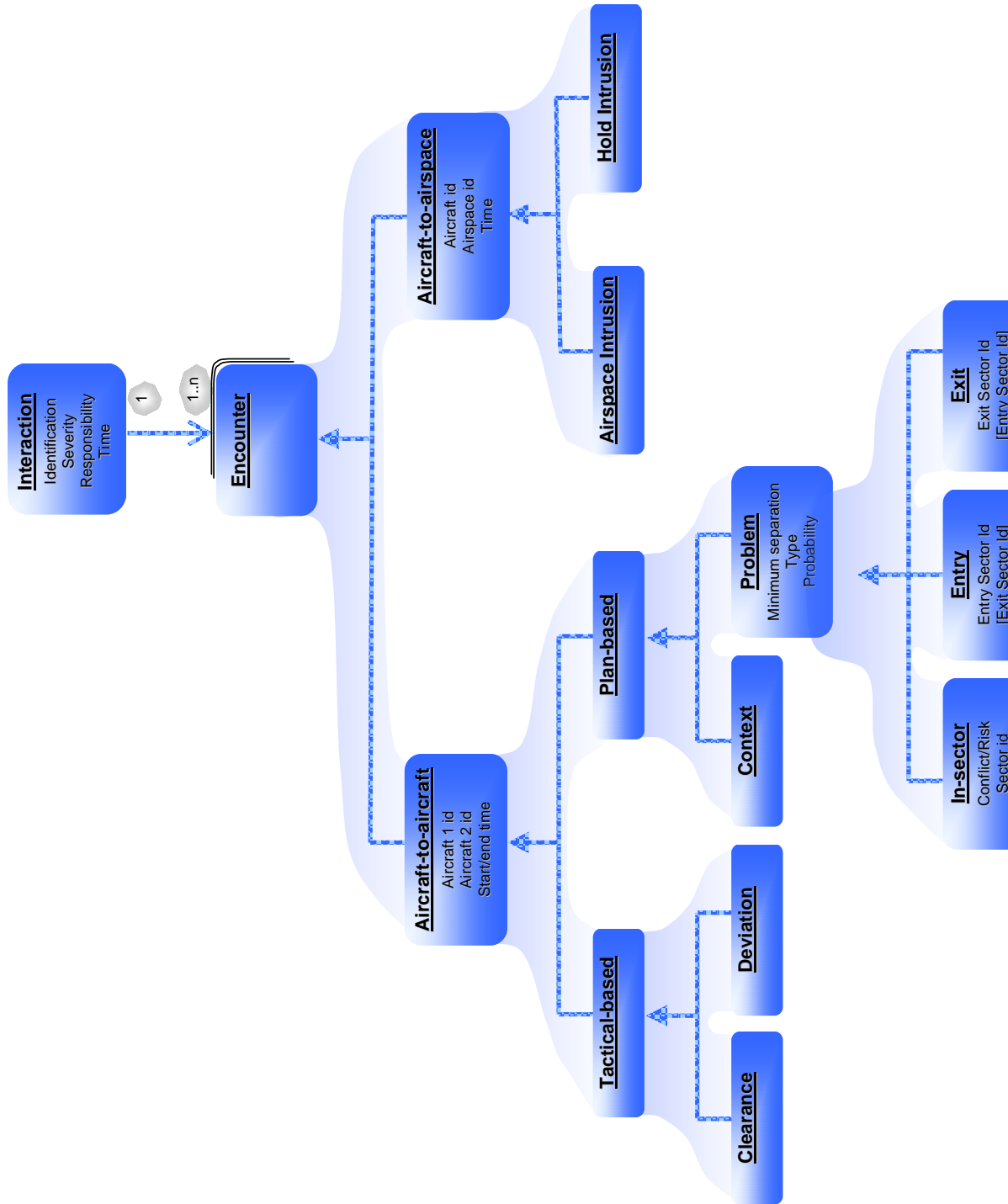
FIGURE 2 - MTCD INFORMATION MODEL

3 FUNCTIONAL REQUIREMENTS

3.1. Plan-Based Encounters

3.1.1 Plan-Based Problem Encounters

The system identifies ENCOUNTERS between flights based on their planned trajectories, taking into account airspace characteristics and uncertainty.

<u>Eligibility</u>

3.1.1.1 The system **shall** detect aircraft-to-aircraft encounters between all controlled *GAT* flights, once coordinated into the system area of responsibility and for which the trajectory is being updated with the actual progress of the aircraft (monitoring aids).

3.1.1.2 The system **shall** detect aircraft-to-aircraft encounters between *GAT* flights that meet the criteria described above and *OAT* flights that have been coordinated to cross *GAT* airspace.

<u>Region</u>

3.1.1.3 The system **may** permit the definition of airspace volumes in which *MTCD* is inhibited.

<u>Separation and Uncertainty</u>

3.1.1.4 The system **shall** permit the definition of separation parameters according to airspace volumes.

3.1.1.5 The system **shall** suppress the creation of a problem between trajectory portions that follow *ATS* routes that are pre-defined as "deemed separated".

3.1.1.6 The system **should** permit separation parameters to be defined independently in the longitudinal, lateral and vertical dimensions.

3.1.1.7 The system **should** allow independent definition of vertical separation parameters inside and outside of *RVSM* airspace, and for *RVSM* and non-*RVSM* capable flights.

3.1.1.8 The system **shall** permit the definition of separation parameters applicable to type of airspace.

3.1.1.9 The system **shall** permit the dynamic evolution of uncertainty that is added to the separation parameters to reflect the growing uncertainty in each dimension per flight phase with increasing look-ahead time.

3.1.1.10 The system **may** correlate sources of uncertainty affecting different flights.

3.1.1.11 The system **may** calculate the probability of *loss of separation* based on the uncertainties of each flight and the encounter geometry.

The system detects entry problems.

3.1.1.12 The system **shall** detect an entry problem in the case where all of the following conditions are fulfilled:

1. The trajectories of two aircraft, at least one of which is entering a *sector*, infringe horizontal and vertical separation criteria on the hypothesis that the aircraft entering the sector remains at its coordinated entry level;

2. The *loss of separation* occurs within a defined time of the aircraft entering the *sector* and before leaving the *sector*;

3. The problem has not been detected as an exit problem for the previous *sector*.

The system detects exit problems.

3.1.1.13 The system **shall** detect an exit problem in the case where both of the following conditions are fulfilled:

1. The trajectories of two aircraft, at least one of which is exiting a *sector*, infringe horizontal and vertical separation criteria on the hypothesis that the aircraft exiting the *sector* is at its coordinated exit level;

2. The *loss of separation* occurs within a defined time prior to the aircraft exiting the *sector*;

3.1.1.14 According to operational procedures or Letters of Agreement, the system **may** detect exit problems between aircraft, both of which are exiting a *sector*, where the trajectories infringe horizontal and vertical separation criteria within a defined time of entering the next sector or *FIR*.

The system detects and classifies in-sector problems.

Detection

3.1.1.15 The system **shall** detect an in-sector problem in the case where both of the following conditions are fulfilled:

1. The trajectories of two aircraft infringe horizontal and vertical separation criteria;

2. The *loss of separation* occurs within defined times of the aircraft entering the *sector* and prior to the aircraft exiting the *sector*;

Classification

3.1.1.16 The system **shall** classify those in-sector problems that occur between the current and cleared levels of the aircraft (or at the entry level if the aircraft has not yet entered the *sector* or the *current level* is invalid) as a "conflict".

3.1.1.17 The system **shall** classify in-sector problems that occur between the *cleared level* (or the entry level if the aircraft has not yet entered the *sector*) and the exit level as a "risk".

3.1.2 Plan-Based Context Encounters

The system detects plan-based context encounters.

3.1.2.1 The system **shall** detect context encounters where the trajectories of two aircraft would infringe horizontal separation criteria on the assumption that either aircraft could change its level to any level between its entry and exit level, plus/minus a predefined margin.

3.1.3 Area of Interest (AOI) problems

3.1.3.1 The system **may** detect/probe the exit problems within *AoI* if the following conditions are fulfilled:

- if the both flights are controlled by the exiting sector or if one of the flights is controlled by the exiting sector and the other flight does not penetrate the *sector* (pure *AoI* flight) the trajectories infringe horizontal and vertical separation criteria within a defined time of exiting *FIR*. The problems occur within the predefined *MTCD* horizon

3.2. Tactical-Based Encounters

Eligibility

3.2.1.1 The system **shall** detect tactical aircraft-to-aircraft encounters within the *sector* between all controlled flights.

Region

3.2.1.2 The system **may** permit the definition of airspace volumes in which *TCT* is inhibited.

Separation and Uncertainty

3.2.1.3   The system **shall** permit the definition of separation parameters according to airspace volumes.

3.2.1.4   The system **shall** permit the definition of separation parameters applicable to the concerned *sector*.

3.2.1.5   The system **shall** permit the dynamic evolution of uncertainty that is added to the separation parameters to reflect the growing uncertainty in each dimension per flight phase with increasing look-ahead time.

3.2.1.6   The system **may** calculate the probability of *loss of separation* based on the uncertainties of each flight and the encounter geometry.

3.2.2   Open-Clearance Conflicts

The system detects tactical-based conflict encounters.

3.2.2.1   The system **shall** detect conflicts between Tactical Trajectories and between Tactical Trajectories and Planned Trajectories (see [*TP-SPEC*]).

3.2.3   Deviation Conflicts

The system detects conflict encounters for aircraft deviating from their clearance.

3.2.3.1   The system **may** detect conflicts between Tactical Deviation Trajectories (based on State Vector) and Tactical Trajectories and between Tactical Deviation Trajectories and Planned Trajectories (see *TP-SPEC*]).

3.3.   Aircraft to Airspace Encounters

3.3.1   Airspace Intrusion

The system re-validates flight trajectories upon activation and de-activation of airspace restrictions.

3.3.1.1   Upon activation of a temporary airspace restriction, the system **shall** detect all flights whose planned trajectory enters the restricted airspace.

3.3.1.2   Upon deactivation of a temporary airspace restriction, the system **should** detect all flights that could be given a shorter route through the previously-closed airspace.

3.3.1.3   Upon entry of a change to the timetable of an airspace restriction, the system **shall** detect all flights whose planned trajectory enters the restricted airspace within the planned activation times.

3.3.1.4   Upon creation of a new airspace restriction, the system **shall** detect all flights whose planned trajectory enters the restricted airspace.

3.3.2   Hold Intrusion

The system detects flights whose planned trajectory traverse active levels of a holding stack.

3.3.2.1   The system **shall** detect flights whose Planned or Tactical Trajectory passes within a defined distance of an active holding volume at a level between the actual and *cleared level* of any aircraft in the holding stack.

3.4.   Interaction Management

3.4.1   Grouping and Identification

The system groups encounters to form cohesive interactions to be treated as a whole by the controller.

3.4.1.1   The system **shall** group each aircraft-to-aircraft problem encounter with context encounters involving either of the subject aircraft of the problem encounter to form a single interaction.

3.4.1.2   The system **shall** be capable of grouping aircraft-to-aircraft problem encounters into a single interaction where the following conditions are fulfilled:

1.   the same *sector* has been assigned responsibility for each encounter;

2.   the *encounters* occur within a predefined time of one-another;

3.   there is an aircraft common to each *encounter*.

3.4.1.3   The system **shall** consider the *encounter* with the earliest start time, that is not a context encounter, as the *encounter* on which the *interaction* is based for posting purposes.

3.4.1.4   The system **shall** assign a unique identity to each *interaction*, which remains unchanged for the duration of the *interaction*.

3.4.1.5   The system **shall** prevent the intermittent termination and re-creation of an *interaction* due to spurious trajectory updates and fluctuations around boundary conditions.

3.4.1.6   The system **may** retain *interactions* containing a tactical-based conflict where the conflict has been resolved through the issuance of heading instructions, in order to facilitate the controller's monitoring of the situation.

3.4.1.7   The system **shall** group the various *encounters* derived from the combinations of planning trajectory, tactical trajectory and tactical deviation trajectory of the same aircraft pair, to present a consolidated view to the controller.

3.4.2   Posting

The system presents an interaction to the sector responsible for acting on it.

3.4.2.1   The system **shall** present *interactions* at a pre-defined time prior to the start time of the *encounter* on which the *interaction* is based.

3.4.2.2   The system **may** withhold the presentation of an *interaction* based on an aircraft-to-aircraft encounter until the probability of *loss of separation* reaches a pre-defined level.

3.4.2.3   The system **shall** present *interactions* based on aircraft-to-airspace encounters to the *sector* in which the airspace is first intersected by the trajectory.

3.4.2.4   The system **may** present *interactions* based on aircraft-to-airspace encounters to the *sector* currently controlling the flight or to the first *sector* that will control the flight if not yet under control of a system sector.

3.4.2.5   The system **shall** present *interactions* based on tactical-based aircraft-to-aircraft encounters to the *sector* currently controlling the flights and, in the case where a flight is under transfer, to the *sector* to which the flight is being transferred.

3.4.2.6   The system **shall** present *interactions* based on plan-based aircraft-to-aircraft in-sector problem encounters to the *sector* in which the problem occurs.

3.4.2.7   The system **shall** present *interactions* based on plan-based aircraft-to-aircraft exit problem encounters to the *sector* being exited by the flight(s).

3.4.2.8   The system **shall** present *interactions* based on plan-based aircraft-to-aircraft entry problem encounters to the *sector* being entered by the flight(s).

3.4.2.9   The system **may** present *interactions* based on plan-based aircraft-to-aircraft entry problem encounters also to the *sector* being exited by the flight(s).

3.4.2.10 The system **may** present *interactions* based on plan-based aircraft-to-aircraft exit problem encounters also to the *sector* being entered by the flight(s).

3.4.3   Sector Team Coordination

The system facilitates cooperation within the sector team when acting on interactions.

Responsibility

3.4.3.1   The system **should** assign initial responsibility[3] at a *sector* for *interactions* based on plan-based aircraft-to-aircraft encounters to the planning controller[4].

3.4.3.2   The system **should** assign initial responsibility at a *sector* for *interactions* based on aircraft-to-airspace encounters to the planning controller.

3.4.3.3   The system **should** assign responsibility at a *sector* for *interactions* based on tactical-based aircraft-to-aircraft encounters (including Tactical deviation Trajectory encounters) to the tactical controller.

3.4.3.4   The system **should** permit the planning controller to transfer responsibility of an *interaction* to the tactical controller.

3.4.3.5   The system **should** automatically transfer *interactions* from the planning controller to the tactical controller at a predefined time before the start of the *interaction*.

Coordination

3.4.3.6   The system **shall** allow the planning controller to highlight an *interaction* to the tactical controller.

3.4.3.7   The system **shall** allow an *interaction* to be lowlighted at a *sector* by instruction from either the tactical or planning controller at the *sector*.

Reminders

3.4.3.8   The system **may** provide a reminder to reassess an *interaction* at a time requested by the controller.

3.4.3.9   The system **may** provide a reminder of imminent conflict for tactical-based aircraft-to-aircraft encounters and plan-based aircraft-to-aircraft encounters that are classified as conflicts, at a predefined time prior to calculated *loss of separation*.

3.4.4   Probe

The system allows the controller to probe a clearance or re-route for potential problems (conflicts or risks) prior to issuing the instruction to the aircrew.

3.4.4.1   The system **shall** provide the capability to edit a tentative trajectory, submit the tentative trajectory (re-routing or *FL* change) to a conflict probe prior to applying it to the flight record as a clearance or planned trajectory change.

3.4.4.2   The system **shall** provide the capability to check proposed coordination conditions or clearances for problems prior to applying them to the flight record.

3.4.4.3   The potential conflicts stemming from the conflict probe of tentative trajectory **shall** be presented (what-if capabilities)

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[3] Assignment of responsibility in this context should be understood as being for the interaction as a system entity, governing the particular display attributes of the interaction at the controller work positions, and is supposed to be consistent with the operational assignment of responsibility for the interaction defined by procedures.

[4] The planning controller should be understood in this context to refer to the controller[s] responsible for the planning of the sector and, depending on the concept/working method, might constitute a dedicated planner controller, the tactical controller (in case of single person operations), or a group/multi-/meta-sector planner.

3.5. Human-Machine Interface

3.5.1 Agenda

The system provides the control team with an overview of all problems at its sector and their status.

3.5.1.1 The system **shall** indicate at a *sector* the problems on which the *sector* has the responsibility to act.

3.5.1.2 The system **should** indicate the severity of the problem in terms of the minimum separation and the time until eventual *loss of separation*.

3.5.1.3 The system **should** indicate the type of problem (crossing, reciprocal, catch-up, etc).

3.5.1.4 The system **should** indicate the status of the problem and the responsibility within the sector team.

3.5.1.5 The system **should** permit the tactical controller to display only those problems that are assigned tactical responsibility (see paragraph 3.4.3).

3.5.1.6 The tactical conflict alert and conflict info **shall** be displayed within the air situation windows (track label) with a suitable indication.

3.5.2 Horizontal Projection

The system facilitates the controller's comprehension of a problem.

3.5.2.1 The system **shall** depict the geometry of a controller-selected problem in the horizontal plane.

3.5.2.2 The system **shall** show also other flights constraining the resolution of the selected problem (i.e. all other aircraft-to-aircraft encounters that are part of the problem interaction).

3.5.3 Vertical Projection

The system facilitates the controller's comprehension of interactions in the vertical progression of a flight.

3.5.3.1 The system **shall** present the planned trajectory of a controller-selected flight in the vertical plane, together with any aircraft-to-aircraft problems in which the flight is involved.

3.5.3.2 Other flights blocking levels in the vicinity of the subject flight **shall** also be indicated in the vertical projection (i.e. any aircraft-to-aircraft context encounters involving the subject flight, either within a problem interaction or isolated).

3.6. Exceptions

The system makes the controller aware when the MTCD function is not available for all or certain flights.

3.6.1.1 The system **shall** warn the controller when *MTCD* is unavailable.

3.6.1.2 The system **shall** indicate flights for which *MTCD* is unable to be performed due to incomplete trajectory or other flight data.

3.6.1.3 The system **shall** warn the controller when the performance of the *MTCD* function is unreliable due to a failure in a function on which it depends.

3.6.1.4 The system **may** warn the controller that *MTCD* is inhibited in an airspace volume

ANNEX A: GUIDELINES FOR THE USE OF THE EUROCONTROL SPECIFICATION FOR MEDIUM-TERM CONFLICT DETECTION

1 INTRODUCTION

These guidelines accompany the Medium-Term Conflict Detection specification in order to give advice to ANSPs in the use of the specification for a local system procurement, and to ensure a correct understanding of the specification.

The principal means by which these guidelines are provided is through satisfaction arguments that are presented for each operational objective (identified by blue italicized text in the functional requirement sections of the specification). For the purpose of this specification, a satisfaction argument provides domain knowledge and assumptions that, when combined with the specification of the required behaviour of the system, demonstrate that the operational objective will be achieved. Assumptions may be about elements external to the ANSP (e.g. aircraft performance) and elements internal to the ANSP, which can be considered as requirements on the ANSP's operation of the system. Collectively, the domain knowledge and assumptions should allow a complete understanding of the specification, and should permit the ANSP to decide the applicability of the requirements to their own environment.

In the electronic version of this document, certain figures can be animated by clicking on them. Figures for which an animation is available are identified by the cursor taking the form of a hand and the text "Click to animate" appearing when the cursor is placed over the figure.

2 FUNCTIONAL REQUIREMENTS

2.1. Plan-Based Encounters (3.1)

2.1.1 Plan-Based Problem Encounters (3.1.1)

The system identifies encounters between flights based on their planned trajectories, taking into account airspace characteristics and uncertainty.

Domain Knowledge

The reliability of problem detection based on planned trajectories depends on the accuracy and stability of the planning information. For certain flight types, the nature of the flight might be such that a planned trajectory cannot be established with a sufficient degree of certainty. Thus it is the case for *OAT* flights operating in training areas (combat training, refuelling or surveillance patterns). Nevertheless, *OAT IFR* transiting, flying among *GAT* traffic, have planned trajectories based on *OAT* published routes described in their flight plans. Therefore, plan-based problem detection is limited to *GAT* flights where the route is known and to *OAT* flights transiting among *GAT*. These flights become eligible for problem detection only once their planned trajectories achieve a certain level of reliability – entry conditions known, correlation established with a track and monitoring aids updates being made.

The various operating environments in which the use of *MTCD* is envisaged are summarized in [*MTCD-OSED*]. The reliability of the planning information is dependent on the airspace and traffic characteristics defined by each operating environment. In the worst case, the environment might be so highly tactical (e.g. in a *TMA*) that problem detection based on planned trajectories is unusable. In these cases, the airspace is excluded from plan-based problem detection through the definition of an applicability region.

Elsewhere the separation parameters and detection horizon are adapted to the nature of the environment; in large *sectors* where the trajectories are stable, the horizon can be relatively long and the separation parameters large, whereas in smaller, more dynamic *sectors*, the horizon and separation parameters might need to be reduced.

To achieve adequate performance in terms of warning time and nuisance rate, the uncertainty of the trajectory prediction must be modelled in addition to the separation parameters[5].
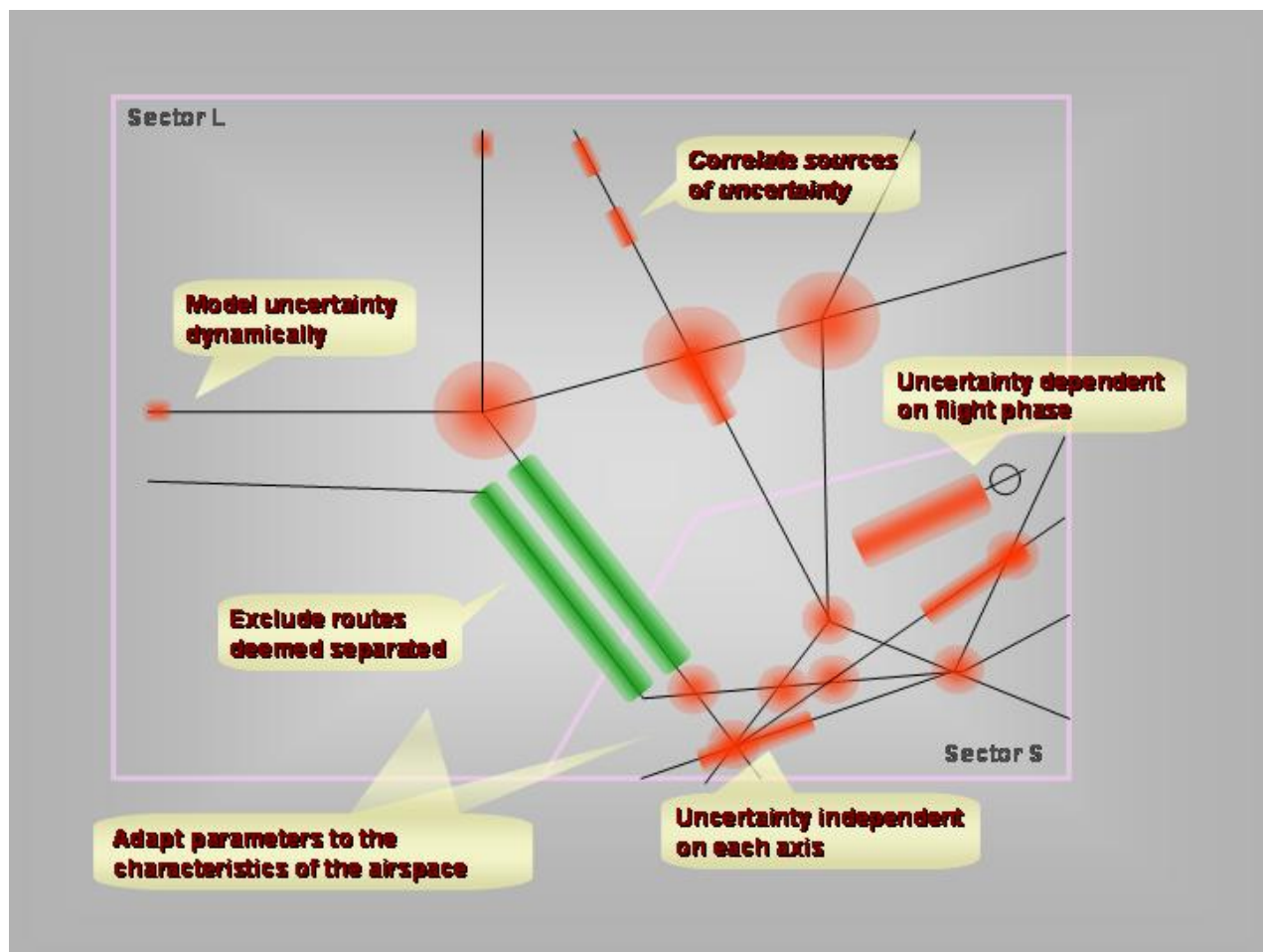
FIGURE 3 – HORIZONTAL SEPARATION AND UNCERTAINTY

Where an aircraft is within a certain distance behind another aircraft on the same route, the uncertainty in the trajectory that arises from errors in the wind model is likely to affect both aircraft in a similar fashion. By correlating the contribution of uncertainty, the separation parameters might be reduced between these two flights, thereby avoiding the declaration of potential conflicts where these are unwanted.

Assumptions

The system calculates and maintains an up-to-date trajectory for each flight in accordance with [*TP-SPEC*], and these are available to the *MTCD* once the entry of the flight to the *AoR* has been coordinated. Other items of flight data, such as flight rules and traffic category are also available.

The error probability distribution of the trajectory is known.

The system contains a database of environment features defining the Area of Responsibility and allowing the definition of *MTCD* parameters.

The provision of information on conflicts involving *OAT* is independent of the conflict avoidance responsibility between *GAT* and *OAT* controllers.

The system provides the capability to enter adaptation data that meets the requirements of military combat traffic, e.g. climb rates, turns and speeds.

[5] It is a matter of design whether the modelling of uncertainty is performed as part of the TP or the MTCD.

The system detects entry problems.

Domain Knowledge

An entry problem is loosely defined as a problem involving an aircraft entering the *sector*, that would occur within a short time of sector entry were the aircraft not to transit to another level. If not solved by the planner/Multi Sector Planner, the entry problem might present great difficulty to the tactical controller given the small amount of time available to resolve the problem tactically.

Operational procedures often dictate that it is the transferring sector's responsibility to ensure that aircraft do not conflict shortly after entering the next *sector* (e.g. by converging or catch-up situations). In this case, such a problem is identified as an exit problem rather than entry problem (see exit problems, below).
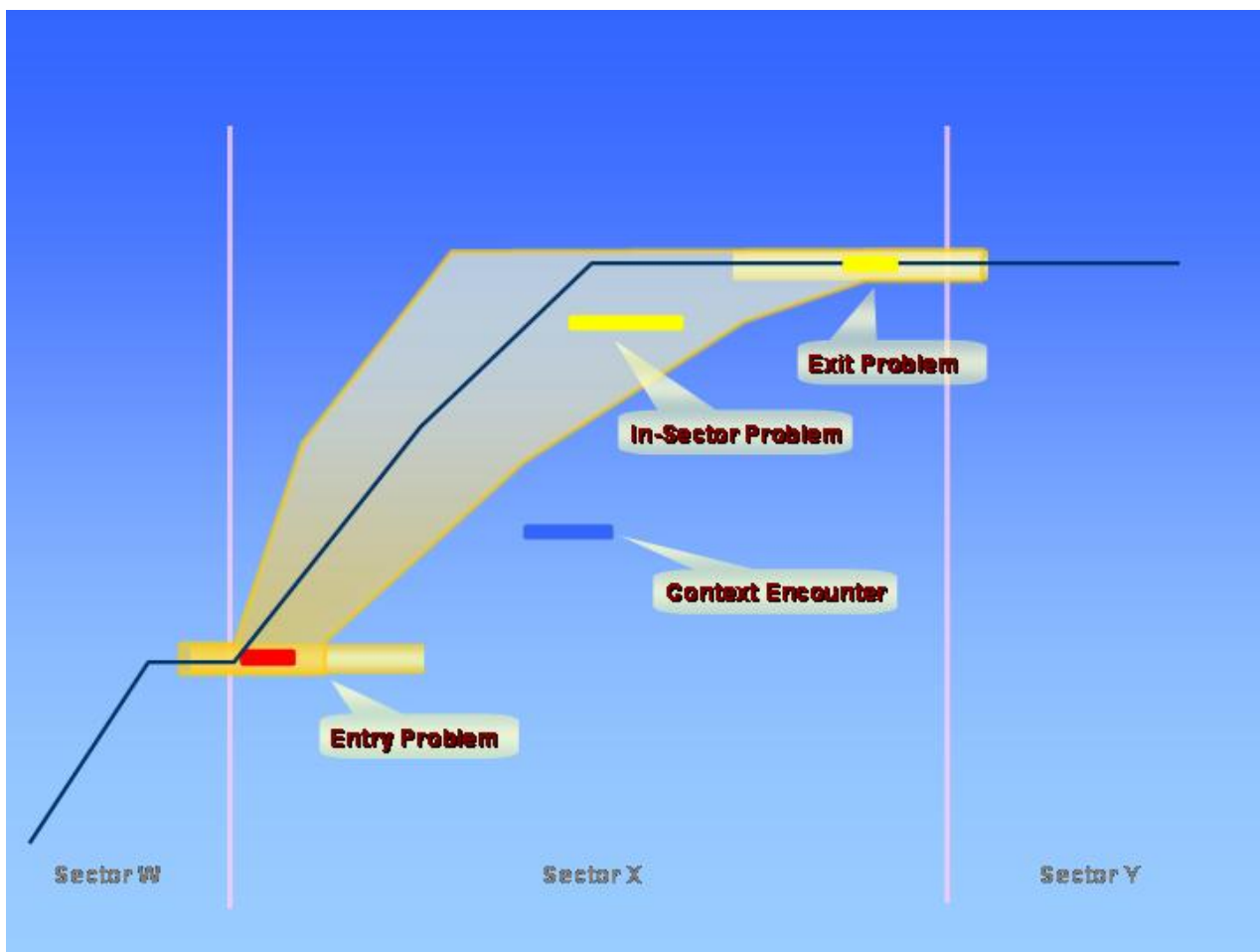
FIGURE 4 - PLAN-BASED ENCOUNTER TYPES

Assumptions

The system contains a database defining *ATC* sectors.

The status of each flight with respect to each *sector* is known (e.g. coordinated in, on frequency, etc).

For flights coordinated to enter the subject sector, until the aircraft is transferred on the frequency of the *sector*, the system calculates a "what-if" trajectory on the hypothesis that the aircraft will conform and then maintain its coordinated entry level. For flights already on the subject sector frequency, the normal planned trajectory (see [*TP-SPEC*]) is used.

The system detects exit problems.

Domain Knowledge

An exit problem is loosely defined as a problem involving either an aircraft exiting the *sector*, that would occur within a short time prior to exiting the *sector*, or depending on operational procedures or Letters of Agreement, two aircraft that converge shortly after leaving the *sector*[6]. If not solved by the planner/ Multi Sector Planner, the exit problem might present significant difficulty, in the former case, to the tactical controller in clearing the aircraft to its coordinated exit level or, in the latter case, to the controller of the next sector given the small amount of time available to resolve the problem tactically.

Assumptions

The system contains a database defining *ATC sectors*.

The status of each flight with respect to each *sector* is known (e.g. coordinated in, on frequency, coordinated out, etc).

The trajectory used for detecting exit conflicts is the planned trajectory (see [*TP-SPEC*]). However, only those conflicts occurring within the prescribed limits before and after the sector boundary are considered exit conflicts.

The system detects and classifies in-sector problems.

Domain Knowledge

An in-sector conflict is defined as a conflict occurring sufficiently inside a *sector*, or not hindering the sector entry or exit, such that it might normally be resolved by the tactical controller. In-sector conflicts may nevertheless be resolved by the planner/ Multi Sector Planner in the interest of reducing the tactical workload, if this can be achieved efficiently by changing the sector entry or exit conditions.

The tactical controller needs to be able to distinguish between those problems that might require action to avoid *loss of separation* (i.e. that occur within the current clearance of each flight), and those that constrain the subsequent clearances to be given to a flight to achieve its planned exit conditions. The former are termed "conflicts" and the latter "risks".

Note that in implementations that also classify entry and exit problems as conflicts and risks, the classification of a problem might be different between two sectors. For example, an exit problem at one *sector* would be classified as a risk until the aircraft is cleared to its exit level, though in the next sector, the corresponding entry problem would be classified as a conflict regardless of the current clearance.

Assumptions

The system contains a database defining *ATC sectors*.

The status of each flight with respect to each *sector* is known (e.g. coordinated in, on frequency, coordinated out, etc).

The trajectory used for detecting in-sector conflicts is the planned trajectory (see [*TP-SPEC*]). However, only those conflicts that do not satisfy the criteria to be classified as entry or exit problems are classified as in-sector problems.

In cases where an *encounter* might be identified as a problem in multiple sectors, the conflict/risk classification is performed with respect to each *sector*, such that a single encounter might have multiple classifications.

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[6] Note that this is not quite the same as defining an area of common interest for the contemporaneous display of an entry problem both at the receiving sector and at the transferring sector (see paragraph 2.4.2)

2.1.2 Plan-Based Context Encounters (3.1.2)

The system detects plan-based context encounters.

Domain Knowledge

The use of context encounters is twofold; firstly, when detected as part of a problem interaction, the context encounters identify other aircraft that may constrain options for the resolution of the problem. Secondly, a context encounter between two aircraft identifies airspace that is "blocked" to each aircraft and therefore unavailable in case of aircrew request (e.g. for weather avoidance).

Assumptions

For flights coordinated to enter the subject *sector*, until the aircraft is transferred on the frequency of the next sector, the system conceptually calculates a "what-if" trajectories on the hypothesis that the aircraft will conform and then maintain each level between its coordinated entry level and exit level plus a prescribed buffer either side of these levels. This can be simplified by classifying all encounters as context that satisfy horizontal problem criteria but not vertical.

2.2. Tactical-Based Encounters (3.2)

2.2.1 Open-Clearance Conflicts (3.2.2)

*The system detects tactical-based conflict encounters.*

<u>Domain Knowledge</u>

Tactical-based problems refer to those involving aircraft on open constraints (e.g. an intermediate cleared level or assigned heading) that are modelled by the tactical trajectory (see [*TP-SPEC*]). A tactical deviation trajectory is also created for flights that are deviating from their clearance and this is similarly checked for conflicts with other flights on the assumption that the aircraft will continue its current (deviating) path. In this case, both a tactical trajectory and tactical deviation trajectory might exist for the flight, e.g. in case an aircraft on a radar heading is found to be deviating from its assigned heading).
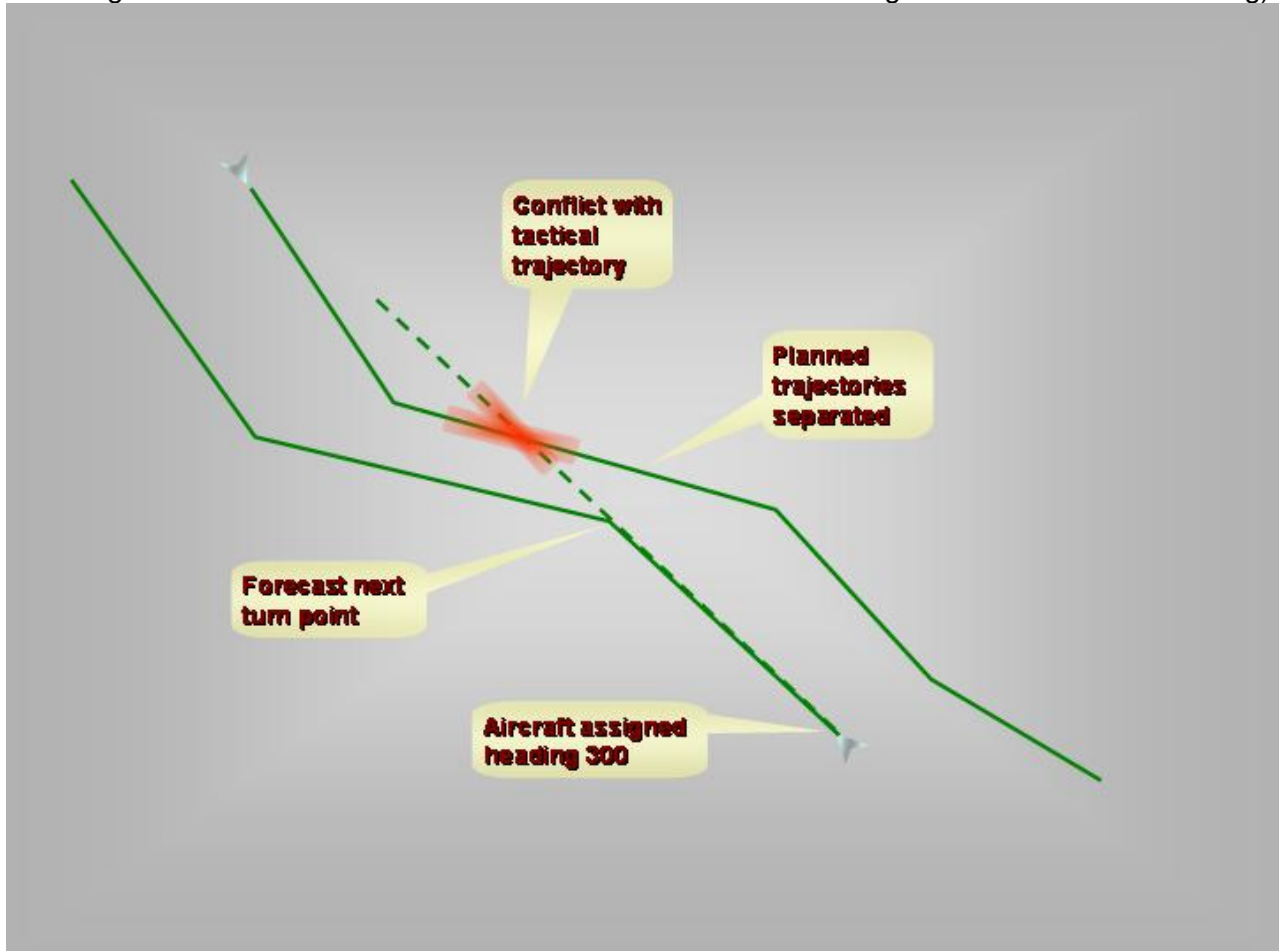
FIGURE 5 – TACTICAL MTCD IN THE HORIZONTAL PLANE (CLICK TO ANIMATE)

To avoid nuisance warnings, the look-ahead horizon is normally shorter than that used for plan-based problem detection as it is expected that a further clearance would be issued.
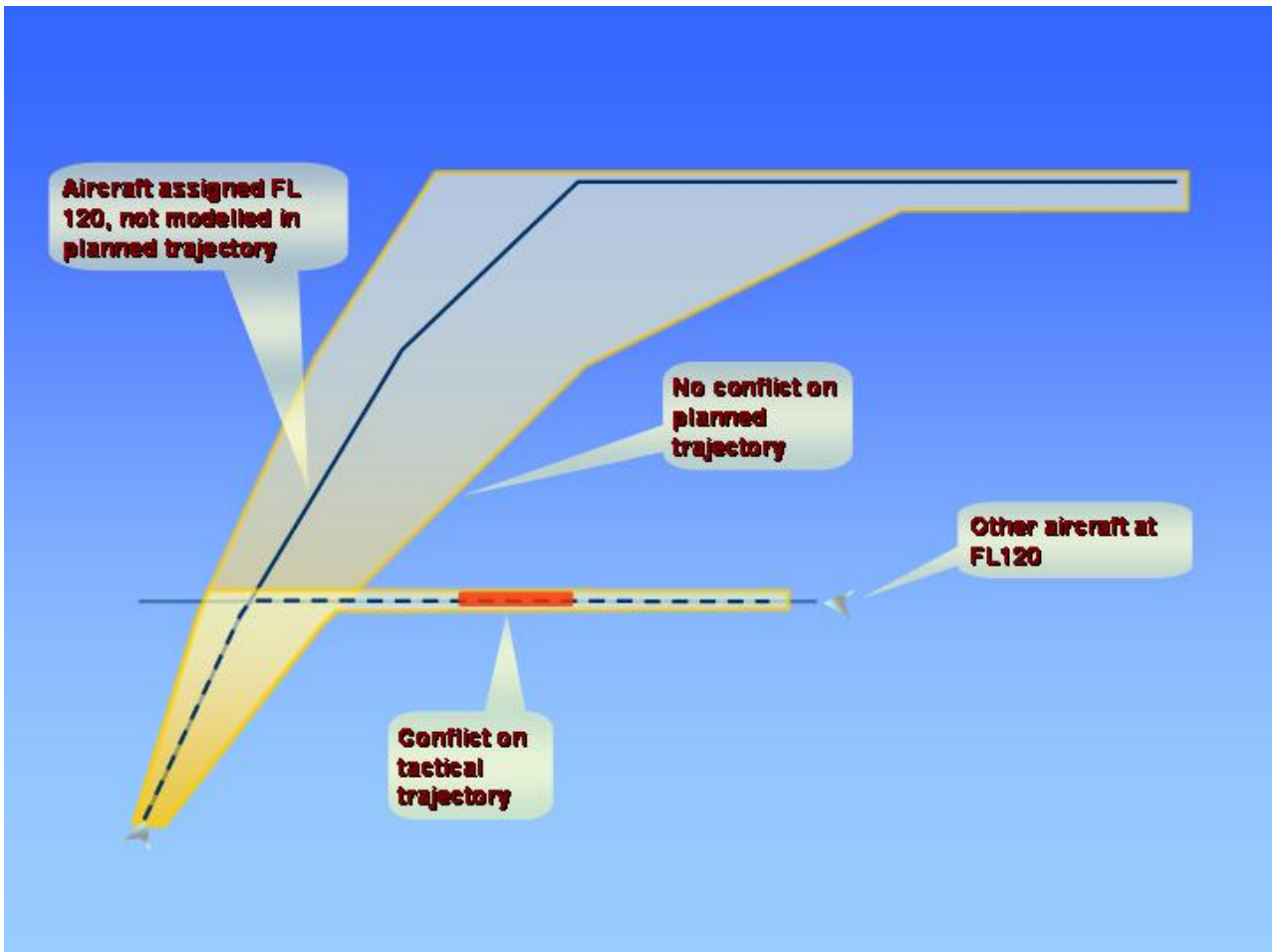
FIGURE 6 – TACTICAL MTCD IN THE VERTICAL PLANE (CLICK TO ANIMATE)

Encounters that are obtained on the basis of the tactical trajectory are of primary interest to the tactical controller, and might be packaged in a Tactical Controller Tool (TCT).

Assumptions

Clearances are entered into the system and a tactical trajectory calculated as described in [*TP-SPEC*].

For flights for which a tactical trajectory exists, these are checked against tactical and planned trajectories of other eligible flights.

2.2.2 Deviation Conflicts (3.2.3)

The system detects conflict encounters for aircraft deviating from their clearance.

Domain Knowledge

An aircraft may deviate from the path defined by the planned trajectory due to navigation error, a mismatch between the flight plans used by the aircraft and the ground system, or in cases where a clearance is not entered into the ground system.

Where the prescribed working method dictates that the controller must react promptly to deviation warnings by amending the trajectory, deviation conflicts might not be desired.

Assumptions

Lateral deviation of the *system track* from the planned trajectory is monitored by the system and a tactical deviation trajectory calculated as described in [*TP-SPEC*].

For flights for which a tactical deviation trajectory exists, this is checked against tactical, tactical deviation, and planned trajectories of other eligible flights.

2.3. Aircraft to Airspace Encounters (3.3)

2.3.1 Airspace Intrusion (3.3.1)

The system re-validates flight trajectories upon activation and de-activation of airspace restrictions.

<u>Domain Knowledge</u>

Within the concept of the Flexible Use of Airspace (FUA), Temporary Reserved Areas (TRAs) and Temporary Segregated Areas (TSAs) are established in response to the need for civil, military, R&D, training, test flights or activities of a temporary nature which, due to the nature of their activities, need segregation to protect both them and non-participating traffic.

TRAs and TSAs are allocated by the Airspace Management Cell pre-tactically (normally the day before operations) in response to daily requests for specific periods, and are activated tactically in accordance with the actual requirement. TRAs and TSAs may be defined as Variable Profile Areas (VPA) in which the geographic scope is defined by reference to one or more published airspace blocks.

Upon creation and each update of a flight's trajectory, it is validated against scheduled and actual airspace restrictions as described in [*TP-SPEC*]. However, an unscheduled change of status of a temporary airspace restriction or the creation of a new airspace restriction requires the revalidation of all flights.

<u>Assumptions</u>

Airspace activation, deactivation, creation and deletion are input to the system.

In the case of TRAs or TSAs being described by means of a VPA, the system contains a database defining the elementary airspace blocks from which the VPA is composed.

The system validates trajectories against airspace restrictions as described in [*TP-SPEC*].

2.3.2 Hold Intrusion (3.3.2)

The system detects flights whose planned trajectory traverse active levels of a holding stack.

<u>Domain Knowledge</u>

Holding is a procedure used to delay an aircraft whilst confining it to a designated portion of airspace. A holding procedure is defined in relation to a fix (radio navigation aid, significant point or designated location), whereby the aircraft normally flies a racetrack pattern comprising two 180 degree turns lasting one minute, interspersed with straight legs at a given heading, each also of one minute duration.

The most common use of holding is in the form of a holding stack for regulating aircraft waiting to land at a congested airport or where the landings are interrupted – e.g. due to a blocked runway or bad weather. Aircraft normally join the stack at the top and are progressively descended when levels below become available. The aircraft at the bottom of the stack is normally the first to leave to commence its approach to land.

As aircraft normally have a higher ground speed at higher levels, the airspace required to protect the holding stack gets progressively larger at increasing levels.

<u>Assumptions</u>

The area of airspace to be protected for holding is defined in the system.

The flights in the holding pattern and their actual and cleared levels are known, such that the total levels within the holding pattern that are blocked are known.

2.4. Interaction Management (3.4)

2.4.1 Grouping and Identification (3.4.1)

The system groups encounters to form cohesive interactions to be treated as a whole by the controller.

Domain Knowledge

Interactions are formed by grouping associated *encounters* into a unit to be treated as a whole by the controller. A typical *interaction* comprises an aircraft-to-aircraft problem encounter and context encounters that involve either of the subject aircraft of the problem. In this way, the controller is presented the problem to solve together with the aircraft that might constrain the resolution. In addition, where an aircraft is involved in multiple problems, these might be grouped into a single interaction in order to facilitate the most efficient resolution. Where multiple encounters are grouped into an *interaction*, the *interaction* is deemed to begin at the start time of the earliest non-context encounter (i.e. a problem detected on planned trajectories of a tactical-based conflict).
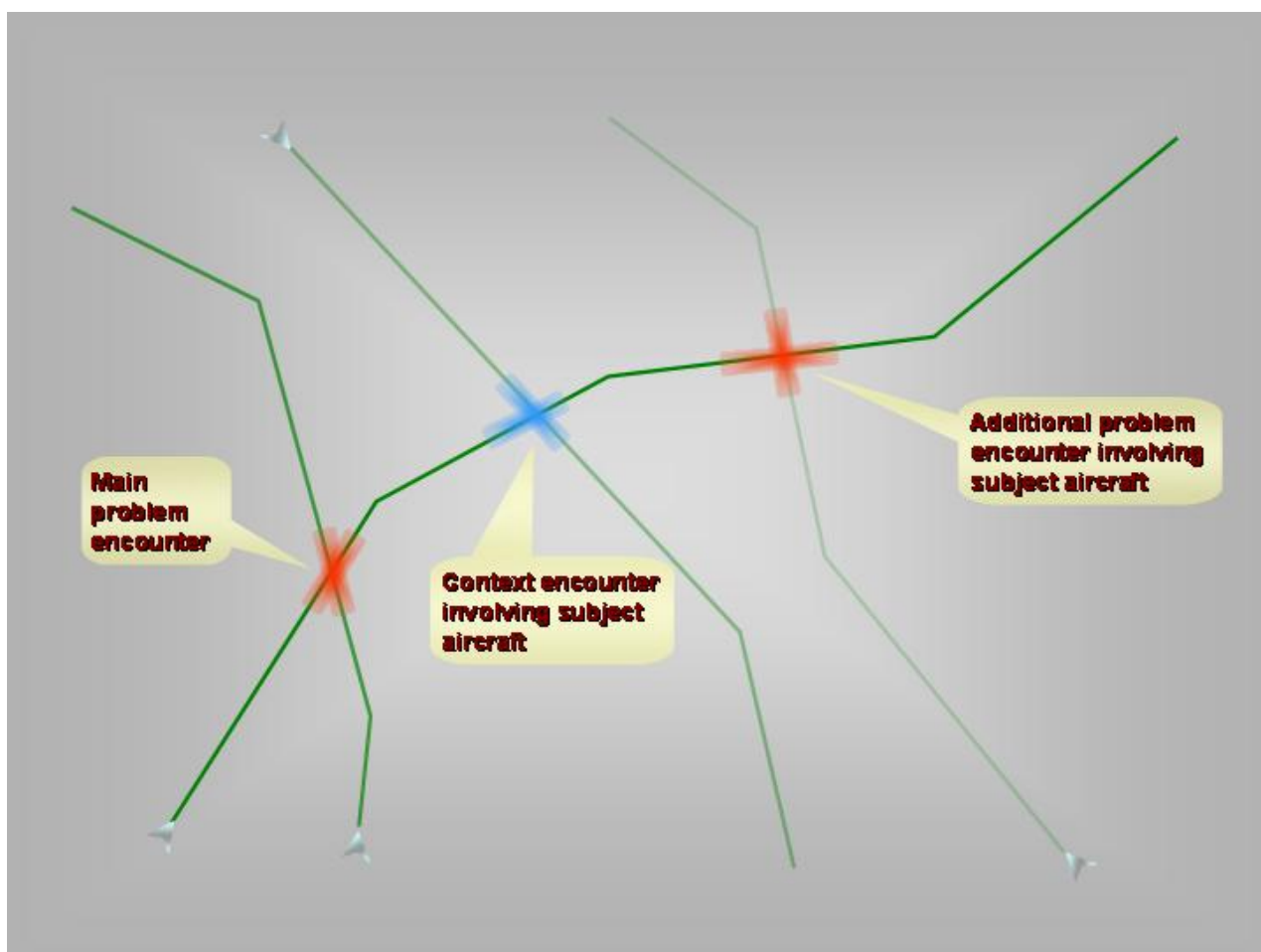
FIGURE 7 - INTERACTION FORMATION

According to operational procedures, it might be desirable to maintain the display of an *interaction* even after radar vectoring has been used to resolve the conflict, in order to facilitate the monitoring of the *interaction*. These would normally be presented with different attributes than unresolved interactions to indicate that no further intervention is required, and might be kept until the aircraft are diverging.

Assumptions

The system provides an *HMI* for displaying *interactions*.

An *interaction* need not be implemented as a physical entity; a logical grouping of a displayed encounter with other encounters involving one of the flights in the subject encounter can be made for the duration of the display of the subject encounter – e.g. on displaying the horizontal aspect of an encounter, other encounters involving one of the flights of the subject encounter are retrieved and displayed.

2.4.2   Posting (3.4.2)

The system presents an interaction to the sector responsible for acting on it.

Domain Knowledge

In principle, an *interaction* is posted only to the *sector* that is responsible for acting on it. One exception may exist, depending on operational procedures, where an entry problem is displayed both at the entry sector (who has the responsibility for resolving the conflict) and at the sector(s) upstream for each of the aircraft, such that the upstream sectors might attempt to propose conflict-free transfer conditions.

Where the transfer of a flight has been initiated to another *sector*, any remaining problems that occur in the transferring sector are also displayed in the receiving sector if not already displayed.

Conflicts with restricted airspace are posted to the *sector* containing the restricted airspace. According to the airspace and route structure, it can be beneficial also to post the conflict to an upstream sector such that a potentially less penalising avoiding route can be initiated earlier.
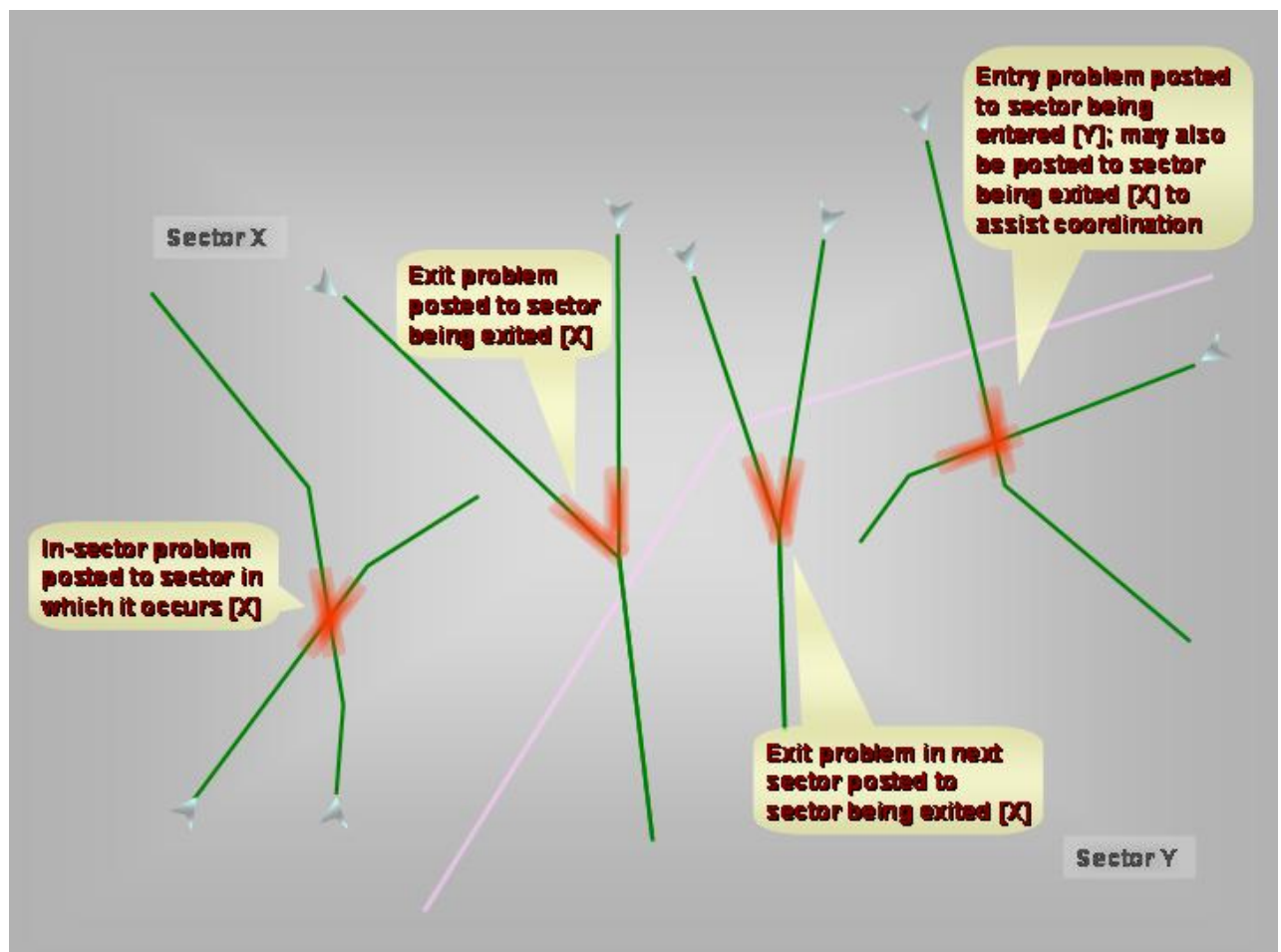
FIGURE 8 - INTERACTION POSTING

Assumptions

The sector assignment of a conflict is made as described in paragraphs 2.1 and 2.2.

The system contains the mapping of Controller Work Positions (*CWPs*) to sectors.

Conflicts are either distributed only to their assigned sectors' *CWPs* or are broadcast to all *CWPs*, the *CWP* itself admitting only those conflicts assigned to its *sector*(s).

The assumption and transfer of communications of flights is known by the system.

2.4.3   Sector Team Coordination (3.4.3)

The system facilitates cooperation within the sector team when acting on interactions.

Domain Knowledge

Although *interactions* are considered as posted to the *sector* as a whole, responsibility for acting on the problem is assigned to either the planner/ Multi Sector Planner or tactical controller based on the context of the *interaction,* as described in [*CONOPS*]. This assignment of responsibility may control display attributes of the conflict at the work positions in order to facilitate the controllers' prioritization of their work. However, it is not intended to prevent a controller acting on a conflict that is assigned to another member of the sector team (e.g. the planning controller assisting the tactical controller by entering a tactical clearance through the PC *HMI*).

For *interactions* based on plan-based aircraft-to-aircraft encounters and aircraft-to-airspace encounters, it is normally the task of the sector planner/ Multi Sector Planner to make an initial assessment of the *interaction* and to take action if appropriate. If the planner/MSP deems that no action is required, he can lowlight the *interaction*. Alternatively, in cases where he deems special action is required, he can highlight the *interaction*. At a certain, pre-defined time before the start of the *interaction*, the responsibility for the *interaction* might be transferred from the planner to the tactical controller if it has not already been resolved by the planner/MSP. The planner/MSP may also transfer the *interaction* earlier. In this context, the terms "highlight" and "lowlight" should be understood as respectively as "drawing attention to" and "diverting attention from", without implying any particular display mechanism.

For *interactions* based on tactical-based encounters, the responsibility is assigned to the tactical controller.

Assumptions

Planner, Multi Sector Planner and tactical roles are assigned to Controller Work Positions (*CWPs*).

An *HMI* is provided for the display of interactions.

2.4.4   Probe (3.4.4)

The system allows the controller to probe a clearance or re-route for potential problems (conflicts or risks) prior to issuing the instruction to the aircrew.

Domain Knowledge

The aircraft-to-aircraft context encounters identify aircraft that might conflict were either aircraft cleared to – or through – the level of the other, thereby constituting an implicit "what-if?" probe. In addition, the controller may create a tentative trajectory (see [*TP-SPEC*]) in order to probe for potential problems a clearance or re-route prior to issuing the instruction to the aircrew.

Assumptions

The system provides an *HMI* that allows rapid entry of a tentative clearance (heading, routing, etc.) or tentative coordination conditions to be probed.

The system creates a tentative trajectory as described in [*TP-SPEC*].

2.5.   Human-Machine Interface (3.5)

This section makes use of three notional tools – the agenda, the horizontal projection, and the vertical projection – as a framework on which to describe generic requirements of the human-machine interface. In practice, some or all of these capabilities might be integrated with pre-existing tools such as the traffic plan view display or flight data displays rather than implemented as dedicated tools.

2.5.1 Agenda (3.5.1)

The system provides the control team with an overview of all problems at its sector and their status.

Domain Knowledge

The controller working method described in [*CONOPS*] describes a process whereby the system notifies conflicts to the controller, who then analyses it and decides whether to resolve the conflict, to ignore/remove the conflict (i.e. it is judged not to require action), or to continue to monitor it to come to a decision later. The planner/ Multi Sector Planner controller is able to decide that a conflict notified to him is best resolved tactically and consequently transfer the conflict to the tactical controller.

The agenda is a conceptual tool that notifies the controller of new conflicts and maintains conflicts that the controller is monitoring. Removed and resolved conflicts are either removed from the agenda or their status indication is changed accordingly. The responsibility for resolving a conflict is indicated on the agenda, and this can be transferred by the planner/ Multi Sector Planner to the tactical controller.

The agenda might provide purely a tabular display or *interactions*, or might incorporate a graphical display, either in one dimension (e.g. representing *interactions* on a timeline), or in two dimensions (e.g. with minimum separation on one axis and remaining time to conflict on the other).

Detailed descriptions of example graphical representations of *interaction* and conflict information are provided in [*BASELINE*].

Assumptions

The agenda might be the primary tool for the sector planner/ Multi Sector Planner to identify planning conflicts and to coordinate the resolution of in-sector conflicts with the tactical controller. The tactical controller remains responsible for identifying possible *loss of separation* by scanning the traffic situation (see [*CONOPS*]).

2.5.2 Horizontal Projection (3.5.2)

The system facilitates the controller's comprehension of a problem.

Domain Knowledge

The horizontal projection is a conceptual tool that makes a projection of the traffic plan view forward in time to show the relative positions of the aircraft involved in an *interaction*. This might take the form of a static representation of the horizontal flight paths of the aircraft involved in the *interaction*, highlighting the portions of the paths that are conflicting; alternatively, a dynamic representation might animate the paths of each aircraft from the current position up to the time of completion of the *interaction*, possibly also depicting the uncertainty in the position calculation.

The purpose of the horizontal projection is to facilitate the controller's assimilation of the *interaction*, particularly in determining a resolution action by a horizontal manoeuvre (e.g. by giving a direct route clearance to allow an aircraft to pass safely behind another aircraft).

Assumptions

The horizontal projection might be used to assist the appreciation of a conflict and for the planning of future clearances. It is not used to assist the tactical vectoring of aircraft.

2.5.3 Vertical Projection (3.5.3)

The system facilitates the controller's comprehension of interactions in the vertical progression of a flight.

Domain Knowledge

The vertical projection is a conceptual tool that depicts the vertical profile of a flight, together with other aircraft with which it interacts.

The vertical projection might be used in the planning of a flight by showing available and blocked levels for the flight.

2.6.   Exceptions (3.6)

The system makes the controller aware when the MTCD function is not available for all or certain flights.

Domain Knowledge

This section describes the handling of exception cases by the system.

MTCD relies on complete and consistent trajectory data within its area of operation. Any interruptions in the processing chain that lead to incomplete or inconsistent trajectories, either for all or individual flights, must be notified to the controller such that the appropriate manual action is performed.

According to operational procedures, warnings of non-conformance generated by the monitoring aids might be sufficient for the controller to be aware of the impact on *MTCD*, obviating the need for a specific *MTCD* warning in this case.

Assumptions

MTCD status information is integrated with other warnings and presented on the *CWPs* according to locally-defined operational practice.

The basic principle of task sharing between the automation system and the control team, as described in the FASTI Preliminary Safety Case [*SAFETY*], is as follows:

1. the automation is responsible for detecting conflicts and non-conformances between flights operated within prescribed conditions;

2. the automation is responsible for warning the controller when it is unable to detect a conflict or non-conformance (for example because the flight does not meet the prescribed conditions or because some information is missing);

3. The controller is responsible for issuing clearances that ensure separation.

EUROCONTROL