



Civil-Military Collaborative Decision-Making in the future European Air Traffic Management

Harmonised military views







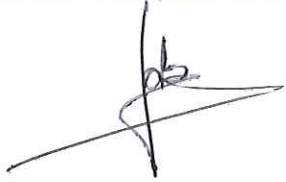
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This paper provides harmonized military views on civil-military collaborative decision-making operational processes developed by SESAR for the future <i>'trajectory-based operations'</i> in European Air Traffic Management.		
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EXECUTIVE SUMMARY

Building on the global operational ATM concept of Trajectory-Based Operations, 'Single European Sky' is developing throughout SESAR a future ATM environment, in which network-wide collaborative planning and decision-making are key to improve the effectiveness of the ATM system and to enable the airspace users to fly their optimal trajectories unconstrained by airspace organization.

Trajectory-Based Operations (TBO) makes full use of the integration of military demand within the trajectory driven processes and the dynamic configuration of airspace structures throughout collaborative decision-making (CDM) processes at national, FAB and European ATM Network levels.

This paper provides harmonized military views¹ on the civil-military aspects of the operational CDM² processes as developed by SESAR for the planning phase of the future TBO environment. It focuses on the integrated management of the military airspace user demand for trajectories and airspace in accordance with the concepts of 'Mission Trajectory' and 'Advanced Flexible Use of Airspace'.

The main body of the paper develops the following high-level harmonized Military Views (MV) on CDM:

MV1: The military Airspace Users will engage in CDM except when they have/reach a limit in their capability to accept ATM compromises due to defined priorities.

Strategic framework

MV2: A national or international (bi- or multilateral) strategic framework document for Airspace Management (ASM) and Air Traffic Flow Management (ATFM) should be elaborated by each State. It defines actors, roles, responsibilities, airspace configuration³ and trajectory management principles and priority rules as well as the decision process and it should be regularly updated in accordance with the expected scope of military missions and the evolutions of air traffic management.

Sharing of information

MV3: The Military will only share Mission Trajectory data relevant to Air Traffic Management with authorized partners and on a need to know basis. Sharing of mission related information is explicitly excluded.

MV4: Mission Trajectory data sharing shall be performed in a harmonized standard format at ECAC level.

Impact assessments and automation support

MV5: Each actor engaged in CDM shall be able to assess the impact of initial requests and negotiation proposals on the effectiveness of its operations with the support of appropriate tools and based on specific assessment criteria.

MV6: Automated tools will improve the quality of CDM. However, military decision-making will remain based on the human assessment of computed and non-computed options.

Negotiation, priority rules and settlement

MV7: In accordance with the CDM strategic framework, each civil or military ATM demand may be associated with a priority level and flexible/negotiation parameters.

¹ This paper reflects a pan-European military ATM dimension, framed by national participation in the Military Harmonization Group (MilHaG) and Military ATM Board (MAB).

² SESAR 2020 Concept of Operations, Edition 01.00.00, 28 November 2017: "Collaborative decision-making (CDM) is defined as a process focused on how to decide on a course of action articulated between two or more community members. Through this process, ATM community members share information related to that decision, agree on, and apply the decision-making approach and principles. The overall objective of the process is to improve the performance of the ATM system as a whole while balancing the needs of individual ATM community members. From a military perspective CDM is a process from which all participating parties can gain benefits through the negotiation of proposed options. The negotiation stops either at the moment when all participating parties agree with the result or when they reach a limit in their capability to accept further compromise due to defined priorities".

³ ERNIP Part 3, Airspace Management Guidelines – The ASM Handbook – Edition 5.5, 05/12/2018: The airspace configurations are to be comprised of predefined fixed and flexible airspace structures, including temporary airspace reservations, if feasible pre-defined airspace scenarios, routing options or optimised trajectories and optimum ATC sectorisation capable of being dynamically adapted to traffic demand. Airspace configurations are to be activated, through a CDM process, depending upon the driving strategic objective(s) for a particular geographic area and/or time period.

MV8: To overcome the complexity related to civil-military negotiation and conflict resolution, the civil-military CDM processes should be supported by a system of ATM priority rules.

MV9: Civil-military CDM terminates either when an agreement is reached or when the Military reach their ATM flexibility limit, situation in which the priority rules apply.

Dependencies

MV10: In the future ATM environment, the management of military AU demand will consist of two distinctive but integrated processes, ASM and Trajectory Management.

MV11: A national consolidated military airspace demand will be used by both ASM and Trajectory Management processes at all levels (local, FAB, network) following an assessment and de-confliction of military airspace users' requirements performed by designated national entities.

MV12: The Military may contribute to improve traffic prediction as well as demand and capacity balancing by sharing data and engaging in CDM but will not be subject to User Driven Prioritization Process UDPP⁴.

MV13: The ATM system support available to Military Airspace User will integrate and/or interface with mission planning, aeronautical information and weather, ASM, ATFCM, and flight planning data in order to process all attributes of military mission requirements.

ATTACHMENT 'A' provides a detailed operational view on the civil-military CDM associated to the planning processes of Trajectory-Based Operations.

ATTACHMENT 'B' provides examples of current practices for the application of military and civil priorities.

⁴ UDPP is managing the prioritisation of flights in order to provide flexibility to Airspace Users to manage their operations in response to delays at departure, En route or arrival, whilst ensuring that this flexibility is consistent with the operational needs of affected Air Traffic Services Units.

Source: SESAR Operational Concept Document, Edition 01.01.01, 31 October 2018

HIGH-LEVEL MILITARY VIEWS ON THE OPERATIONAL CDM PROCESSES IN 'TRAJECTORY-BASED OPERATIONS'

1. Context and requirements

1.1. The ATM Modernization will significantly change the operating method and technical systems in order to meet the performance objectives of 'Single European Sky'. The 2035 concept of operations for the European ATM is 'Trajectory Based Operations' (TBO). It represents a fundamental shift from the management of flights through tactical intervention to a more strategic focus on planning and intervention by exception enabling the airspace users to fly their preferred/requested trajectories without airspace configuration constraints.

1.2. By applying the TBO management principles, the AUs will plan, optimize and agree the Business/Mission Trajectory due to be flown throughout Collaborative Decision-Making (CDM) with relevant ATM actors (ANSP, Airports, Network Manager, and other users of airspace).

1.3. TBO enables a dynamic adjustment of airspace configurations to meet predicted traffic demand and complexity, whilst keeping any distortions to Business/Mission Trajectories to the absolute minimum. To that end, Advanced ASM processes based on the concept of Dynamic Airspace Configuration (DAC) will deliver an optimized and network-wide coordinated organization of airspace structures including Airspace Reservations/Restrictions (ARES).

1.4. With DAC in place, ARES designed according to Variable Profile Area VPA and Dynamic Mobile Area DMA principles will be allocated through a civil-military CDM process, aiming at fulfilling the military mission requirements whilst minimising the impact on the ATM network performance.

1.5. A User Driven Prioritization Process UDPP enabled by CDM will optimize the accommodation of diverse airspace users' requirements based on new rules for prioritization that will replace the legacy first-planned/first-served slot allocation.

1.6. A prerequisite to CDM is the sharing among all actors concerned of a single, reference, trajectory information via connections enabled by System Wide Information Management (SWIM) for both Business and Mission Trajectories.

1.7. Automation is a key enabler to ensuring timely and effective decision-making. Automated tools able to present users with the consequences and the constraints of their request on the global network and other users as well as possible alternative solutions that take into account flexibility, complexity, and available resources will be available.

1.8. For the military AU, the implementation of the Mission Trajectory (MT) concept will facilitate the integration of mission-specific requirements into the TBO environment. A key evolution is the sharing of an integrated ATM requirement (flight profile and ARES) thru solutions as the improved OAT Flight Plan and its future evolution towards 4D trajectory.

1.9. To be applicable at pan-European level, the CDM processes developed by SESAR need a harmonized input from the Military ATM community.

2. Military objectives and principles to CDM

2.1. While the overarching civil-military objective of CDM is to improve the performance of the European ATM Network operations, the specific military objective is to have optimal routing and effective access to airspace in order to train for and conduct the assigned missions with the necessary ATM support, nationally and across borders, including with short-notice.

2.2. The overall principle applicable to civil-military CDM processes is to balance the ATM network performance needs, civil AU business preferences, and military AU mission requirements by optimizing their preferences and requirements throughout common solutions and/or application of pre-agreed priorities..

2.3. The performance targets and supporting indicators driving the ATM optimization in SES/SESAR are not compatible with military objectives and needs. Consequently, to assess the impact of ATM solutions on mission objectives, the Military will need to implement and use a specific framework.

2.3. In the TBO environment, the civil-military CDM processes will apply mainly to the planning phase of the ATM processes as described by the SESAR CONOPS. The core of CDM activities is the 4D trajectory-planning phase⁵.

2.4. SESAR will define CDM processes that integrate the military ATM needs in accordance with the concepts of 'Mission Trajectory' (MT) and 'Advanced Flexible Use of Airspace' (AFUA) as agreed by the Military ATM community.

2.5. A system of predefined civil and military ATM priorities applicable at both local/sub-regional and network levels is required to overcome the complexity of CDM within a pan-European context involving various local/sub-regional and regional actors (Civil and Military Airspace Users, ANSPs, Network Manager,...).

2.6 Military ASM requests cannot be addressed in isolation for a single mission. Each military mission is part of a training/operations plan, which takes into consideration national operational priorities, airspace users' needs, military ATM capabilities and constraints for a specific time duration. Consequently, a local assessment, de-confliction and consolidation of military airspace requirements will be performed by designated military entities for each time slot before submitting any ASM request.

2.7. Major international and joint military exercises are planned throughout specific processes between military and civil stakeholders well in advance. Consequently, airspace reservations and all flights related to those exercises remain out of the scope of the CDM processes described by SESAR.

2.8. The Wing Operations Centre WOC⁶ represents the key ATM capability of the military Airspace User, which facilitates the trajectory and/or the airspace required to fulfil military missions as well as the interfaces with the ATM network.

2.9. To support the future CDM processes, when defining their ATM demand, the military AU will take into consideration relevant information on civil traffic and airspace configuration made available by the ATM system support.

2.10. To share its ATM demand with other ATM stakeholders, the military AU should use a standardized mean. The prerequisite is the ability of the ATM systems to process MT data that integrate all types of airspace reservation and any other relevant military mission specifics.

2.11. The human decision will keep privacy over the ATM system independent from the level of automation.

2.12. The analysis of SESAR' approaches to CDM leads to the identification of the following main components of civil-military CDM processes:

- sharing of information
- impact assessments
- negotiation/decision process.

Those components are supported by:

- various actors.

Processes and actors with their roles and responsibilities shall be clearly defined in a:

- strategic framework specific to each State/FAB

A generic high-level view on the civil-military CDM processes in the context of TBO is presented in figure 1.

⁵ The overall TBO planning process consists of two distinct phases: the scheduling phase (little trajectory data available, related evaluations are based on scheduled operations or historical data) and the 4D trajectory planning phase, which starts once the Airspace User provided/shared its desired/requested trajectory; from that moment, the Shared Business/Mission Trajectory is used as baseline for negotiation (when required) to ensure the availability of necessary resources and to identify airspace configurations minimizing the impact on trajectories. *Source: SESAR 2020 Concept Of Operations, Edition 01.00.00, 28 November 2017.*

⁶ In SESAR, WOC is a generic term, which designates the operational processes and services directly related to the airspace users and linked to Mission Trajectories and other aerial activities. This definition avoids detailing the diverse organisational structures existing in Europe. *Source: Mission Trajectory Detailed Concept, Edition 1.0, 22.10.2012.*

In the context of this paper, WOC designates the CDM actor representing the military airspace user.

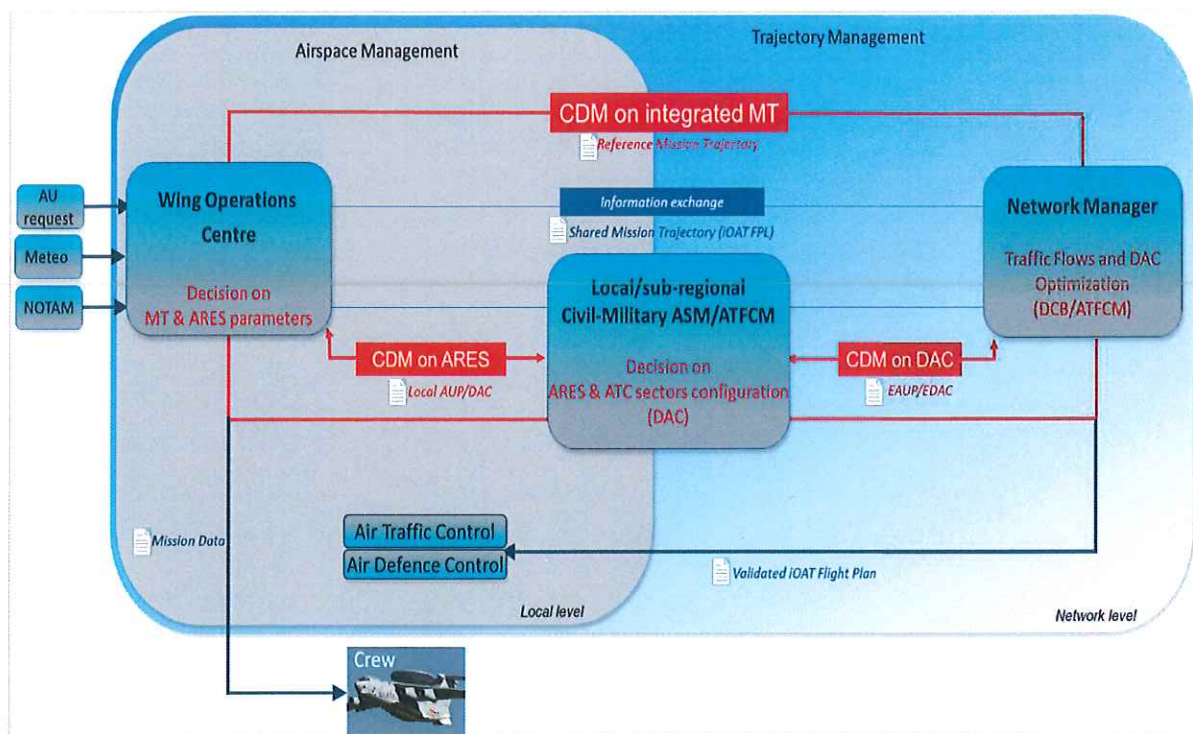


Figure 1, high-level view on the civil-military collaborative planning and decision-making in TBO

3. Sharing of information

3.1. To enable CDM, the Military will share relevant ATM information with accredited CDM partners based on the "need to know" principle. Consequently, the MT and ARES data set shared for CDM would not provide the full set of military information but only related unclassified ATM information without any reference to the type of mission performed.

3.2. In accordance with mission requirements, the shared MT will provide two major attributes for supporting CDM, flexibility of ATM parameters for negotiation (e.g. activation time, flight level band, location for ARES or time over specific reference point for trajectory) and/or a priority level.

3.3. To be valuable to all actors and the network, the information shall be harmonized at ECAC level. To share information on Mission trajectories, the Military will use a standardized format, which benefits from appropriate system and service support.

3.4. The technical support for military-civil information exchange will comply with both military and civil confidentiality and security requirements as defined by competent authorities.

3.5. NM systems shall be able to process military mission specifics related to sensitive information, aircraft performance, formation flights, ARES allocation, and synchronisation of multiple missions etc., hence facilitating the allocation of AU specific demands.

4. Impact assessment and automation support

4.1. For the military airspace user, a WOC function will provide automation support for the airspace and trajectory planning and decision-making processes.

4.2. WOC will assess equally, the impact of its ATM demand on airspace configuration and network operations and the impact of civil counter proposals on military missions with the support of a 'what if' automated tool integrated in its mission planning support system.

4.3. The local/sub-regional joint civil-military ASM-ATFCM function proposed by SESAR should play a central role in the civil-military CDM by having the ability to perform combined ASM-ATFCM assessments of airspace

configuration scenarios on civil traffic and military requirements, hence offering timely solutions for their balancing at both of local/sub-regional and network levels.

4.4. Unlike the civilian model based on economic objectives, the achievement of military missions cannot be measured so easily through quantified indicators. In this context, the assessment of the impacts on defence activities will have to be done through human analysis, supported by 'what if' tools. To assess the impact of ATM solutions on mission objectives, the Military will need to implement and use a specific framework.

5. Negotiation and decision

5.1. The Military will engage in consultation and negotiation with relevant ATM stakeholders in order to reach an agreement on a proposed solution for optimizing airspace configurations and traffic flows in accordance with the flexibility and priority defined for each ATM request.

5.2. Considering the variety of CDM actors as well as their cross-border interactions, an escalation process towards upper level authorities to solve conflicting situation may be not possible. An alternative way stays in pre-defined priority criteria/rules. A 'system of priorities' that encompasses both civil and military priority criteria will be defined and periodically updated by civil and military authorities at State level in coordination with NM as part of a CDM strategic framework document.

5.3. Negotiation will stop either when participating parties agree a proposed solution or when there are limitations to further accepting compromises, case in which relevant priority rules are applied. Attachment B provides an example of a set of priorities that could be used by the military as well as a description of a Traffic Light Scheme principle that may be used as a civil set of priorities.

5.5. Application of civil and military priorities shall be framed by specific rules and procedures. While several types of military mission require full priority (e.g. real air policing/air defence missions) there will be situations when military flights will accept prioritisation following civil requests according to rules defined in the strategic framework. These rules may define occurrences, limitations and applicability of civil and military priorities.

5.6. The military airspace user (WOC actor in SESAR) decides when military objectives cannot be met in order to move to the "Priority Rules".

6. Strategic framework

6.1. A framework/agreement to ensure expeditious and equitable civil-military CDM is mandatory. State civil and military aviation authorities in coordination with the European network manager should elaborate a national or international (bi- or multilateral) strategic framework document for ASM and ATFM, which will include CDM.

6.2. The framework document will define the civil and military actors, roles, responsibilities, airspace configuration and trajectory management principles and priority rules as well as the processes associated to CDM. It should be regularly reviewed and updated in accordance with the expected scope of military missions and the evolutions of air traffic management.

6.3. To support the assessment of civil-military CDM feasibility as well as a periodical review of the framework, some performance indicators on priorities application may be defined at national/sub-regional level.

6.4. To ensure consistent CDM processes at pan-European level it is recommended to develop and implement harmonized framework templates among States/FABs.

7. Actors

7.1. The Wing Operations Centre WOC will represent the key ATM capability of the military AU, able to share, negotiate and mitigate against any constraint both Mission and Business Trajectories, including the appropriate ARES that best meet the mission requirements. WOC will provide the basis for civil-military CDM processes by defining flexible parameters and priorities in MT/ARES data set whenever compatible with mission objectives. The WOC function and its ATM system support will be deployed in accordance with the architecture of the military national ATM systems.

7.2. The local/sub-regional joint civil-military ASM/ATFCM actor (Flow Managers, Local Traffic Managers, and Airspace Managers) proposed by SESAR should ensure an integrated management of military demand for airspace and trajectories as well as the consistency of the CDM processes performed at local/sub-regional

and regional levels. With respect to its foreseen capabilities, this actor shall be able to make the decision on the allocation of ARES within the area of responsibility.

7.3 Within the civil-military CDM, the Network Manager will propose optimization of airspace configurations (including ARES) and trajectories with respect to the flexibility/priority defined by the military airspace user and the provisions of the agreed CDM strategic framework.

8. ASM/ATFCM dependencies

8.1. Sharing and negotiation of MT data will be possible only after a first step in ASM process is concluded. WOC in coordination with the joint civil-military local/sub-regional ASM-ATFCM actor will judge for each type of ARES the flexible parameters subject to CDM. Decision on ARES allocation will determine the flexibility of MT for supporting NM' optimization and prioritization processes.

8.2. The decision on the type of ARES design (static, Variable profile or Modular Area, Dynamic Mobile Area) is an exclusive attribute of the Military Airspace User represented by WOC.

8.3. As an overall rule, the military flights are not subject to civil User Driven Prioritization Process (UDPP), including when performed as business trajectories. The military AU will support the DCB processes by sharing standardized airspace and trajectory information through the MT lifecycle ensuring their integration into the traffic prediction tools and accepting, when possible, their modification within the limits of defined flexibility.

8.3. In TBO, the MT management related processes: mission preparation, ASM, ATFCM, weather information management, and flight planning will be integrated at the extent necessary to address all attributes of military mission within CDM.

ATTACHMENT A

Operational view on Civil-Military CDM in the 4D planning phase of Trajectory-Based Operations

Figure A1 provides a view on the operational civil-military CDM processes for the integrated management of military ATM demand within the 4D Trajectory planning phase in TBO environment.

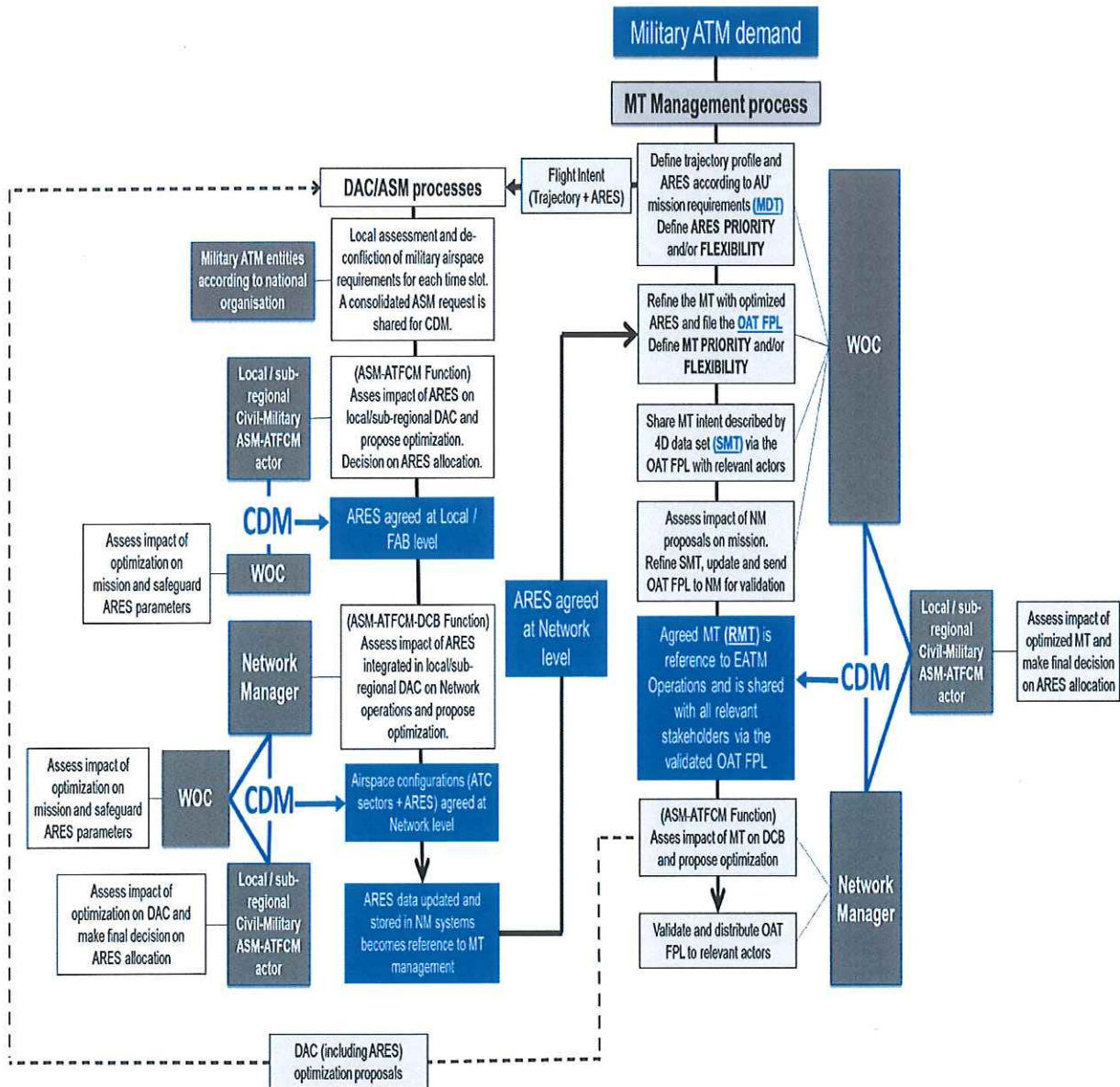


Figure A1, civil-military CDM for integrated management of MT in TBO planning phase

ATTACHMENT B

Examples for a possible application of civil and military priorities

B.1. Priority rules

The application of civil and military priorities for trajectory and airspace requests will address needs that can potentially be of a conflicting nature generated by specific constraints to CDM. Application of priorities shall be based on rules established in advance by means of negotiation between all affected civil and military stakeholders and published in the civil-military CDM strategic framework.

B.2. Military priorities

The following set of priorities for military requests may be attached to the ATM demand:

- P1, full priority: not any of the ATM parameters of the military mission is subject of negotiation. The ATM demand will be accommodated by civil ATM actors in accordance with the initial request.
- P2, high priority: negotiation on the mission request will be limited to one specified flexible parameter (i.e. activation time, position, track, altitude block) as defined by WOC.
- P3, normal priority: negotiation is possible on all flexible parameters of the mission.

These priorities are applicable under some conditions or restrictions, for example:

- P1: this priority could only be used for operational or government flights, or for very limited events in the case of training activities.
- P2: this priority may be applicable to a limited number of annual (or quarterly or monthly) occurrences or restricted activities during some predefined slots according to civil activity forecast.
- P3: no limitation for CDM.

These occurrences, events or predefined slots should be periodically reviewed during assessment sessions in order to fine-tune the priority applicability modalities.

B.3. Civil priorities

An example of the application of civil priorities is the Traffic Light Scheme (TLS) developed by FABEC. The TLS allows a priority usage by GAT of a particular area, well established in advance and for specific periods, to manage traffic peaks by introducing thresholds above which restrictions to military activity are applied. The TLS described below is only an indication of a GAT constraint for a particular area, as follows:

- Green: no GAT constraints.
- Orange: GAT has constraints, however GAT has no priority but may ask for it based on CDM in the planning phase. If CDM fails, priority remains to military.
- Red: GAT has constraints and will have priority during specific time slots according to traffic level in related ATC sectors.

By example, for a specific area the military activity may be limited below FL 350 for traffic threshold level 1 (45 flights per hour), and below FL 295 for traffic threshold level 2 (55 flights per hour).

Limited in time, these measures must nevertheless still allow achievement of some major military missions as Air-to Air Refuelling or Airborne Early Warning flights. The display of TLS is in accordance with the optimum strategy of the sector configuration and the military activity shall not be constrained by other factors.



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