European Defence Agency

UMS Methodology and Coordination Roadmap

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Background

In December 2010, ten EDA participating Member States (pMS) and Norway signed a Programme Arrangement (PA), for launching an R&T programme on "European Unmanned Maritime Systems for mine-counter-measures and other naval applications (UMS)". In accordance to the UMS PA (see Section 2), the programme is managed by a Management Committee (MC). One of the tasks of the MC (see Section 2.3.a of UMS PA) is to:

> *"Develop an appropriate methodology supported by a coordination roadmap for implementing the UMS-programme. The methodology will include the establishment of a number of UMS-projects that will address the key-technology areas taking into account the objectives of the UMS-programme and the establishment of a recommendation on common interfaces and existing standards."*

Historical

In April 2008, the EDA Steering Board in R&T Director's formation, agreed on the setting of twenty two common European R&T priorities. One of these was the "Uninhabited Maritime Systems, especially underwater systems". This agreed priority was further examined by the pMS R&T experts of the EDA network ESM1 (Naval Systems and their Environment), who established a list of key-technologies needed for the appropriate functioning of the "Uninhabited Maritime Systems" irrespective of naval application. During the same year, the EDA Member States agreed on a number of urgent capability actions one of which was the "Maritime mine counter measures". Due to the obvious link between the R&T and CDP priorities, the EDA organized a joint workshop of R&T and Capability experts to identify urgent R&T needs related to both Uninhabited Systems and Mine Counter Measures. The workshop concluded that R&T was required (in some cases immediately, given national plans) and finalised the list of key-technologies to include those more directly linked to Mine Counter Measures. The full list of key-technologies was split into two pillars as shown in Annex 1 (see also Steering Board Decision No 2009/44 of 17 November 2009).

Concurrently, the EDA examined information on national plans that indicated the importance of Unmanned Maritime Systems in future naval operations. As a consequence, an R&T workshop was organized for obtaining proposals on possible collaborative R&T. The workshop resulted in the creation of 15 Ad-Hoc Working Groups (AHWGs) whose aim was to define the technical and financial elements of the future collaborative R&T. Based on this development, the European Defence Agency proposed to its participating Member States and Norway, a new R&T Cat.A programme on "European Unmanned Maritime Systems for MCM and other naval applications". This proposal was accepted by the EDA Steering Board in Ministers of Defence formation in November 2009.

Following on the work of the AHWGs, a number of pMS and Norway declared their willingness to contribute to the UMS programme in June 2010, thus establishing the UMS MC in order to supervise the management and implementation of the UMS programme. The UMS MC in collaboration with EDA finalised the UMS PA which was consequently signed by the Ministers of Defence in December 2010.

UMS PA text related to the UMS methodology

In accordance with the UMS PA, the UMS-contributing Members (UMS-cMs) have agreed to:

1) contribute to the building a future system-of-systems (SoS) that will include UUVs, USVs and standing nodes and could be used for improving European capabilities in a number of naval applications. This system-of-systems should take into account the notions of standardisation, interoperability, modularity and inter-changeability of modules of European USVs and UUVs and should also address regulation issues on the use of unmanned maritime vehicles.

2) launch UMS-projects to produce and demonstrate components that could be plugged into the various European USVs and UUVs based on common interfaces and standards; addressing the key-technologies included in the Annex 1.

3) use a coordinated approach with a :

    a. system-integration “upper level” which will design and demonstrate the technical system-of-systems concept and;

    b. “plug-and-play” component “lower level” which will work on specific component demonstrators based on the key-technologies identified.

4) demonstrate the system-of-systems for MCM and other naval operations.

Factors and boundaries to be considered

1) The different UMS-cMs have currently different national requirements and ambitions (both operational and industrial).

2) There are severe defence budget cuts that make European collaboration a good means for reducing both the cost and risk associated with R&T.

3) Several of the UMS-cMs participate in the EDA Maritime Mine Counter Measures (MMCM) Cat.B project.

Key-stakeholders and actors to be considered

The methodology should take into account all the key-stakeholders and actors including, the UMC-cMs, UMS MC, UMS-project Project Management Groups (PMGs), EDA, other EDA pMS, industry and third parties.

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The UMS methodology and coordination roadmap

Different national ambitions… Given the different national and industrial ambitions amongst its cMs the UMS programme does not aim at the creation of a single European family of UMS. It proposes instead the creation of a system-of-systems based on interoperable European UMS through a spiral development approach. This approach is necessary given the current financial situation as it would have been unwise and risky to attempt to address all key-technologies and achieve the UMS objective in one go. Instead the UMS-programme has agreed on a first set of R&T areas to investigate which are linked to national priorities and which will benefit the UMS-cMs irrespective of the global UMS outcome. These areas are reflected in the fourteen R&T projects listed in the UMS PA (see also Annex 1). Further investment in UMS key-technologies will enable the further expansion and advancement of UMS towards its main objective.

…fused into one asymmetric … To enable the fusion of the different UMS-cMs ambitions and requirements into a single programme, the UMS allows its cMs to allocate their limited funds and resources to R&T areas of their choice. Based on this approach the UMS programme is composed of a number of UMS-projects in which the participation and funding of UMS-cMs is asymmetric. This entails that the access-to and the use-of results from UMS-projects is equally asymmetric. However, the UMS MC encourages the exchange of information between UMS-projects in order to maximize the return of investment but also enhance the level of coordination, trust and common know-how amongst the UMS-cMs. High number of commonalities amongst the UMS-cMs should have a positive effect in any future attempts to pool-and-share in the area of UMS and related naval applications. In practice, the UMS Programme foresees the requirement for PMG Chairs to de-brief the UMS Management Committee when requested to do so and for UMS-projects to provide a recommendation on interfaces and standards to the System Integration level for further analysis. Any additional exchange of information is not obligatory and depends on the UMC-cMs of each UMS-project.

… but coordinated programme… The asymmetric participation of UMS-cMs creates a fragmented picture which could inhibit the aims of the programme. Therefore, the UMS-cMs acknowledged that some level of coordination is desirable to ensure coherency in the advancement of the work and decided to include under the UMS programme umbrella all EDA R&T projects related to UMS improvements; thus making the UMS programme the central EDA forum for addressing R&T issues in maritime robotics. In addition the UMS-cMs established a two-level programme. The “upper level” is the Systems Integration (SI) UMS-project which deals with the technical coordination necessary for achieving the UMS objective. In particular the SI UMS-project will examine the different key-technologies required to implement the future UMS SoS. It will monitor the developments in these key-technologies (either within or outside the UMS programme) and examine the need for further UMS-projects or EDA studies to address them. In addition, the SI UMS-project will examine the integration of these key-technologies into the future SoS through the use of commonly agreed interfaces and standards. On the other hand, the “lower level” is composed of all other UMS-projects dealing with specific key-technologies through which “plug & play” components and elements for integration are expected to result. Two of the “lower level” projects, the STANDIN and SARUMS, merit special attention as they will support directly the Systems Integration “upper level” by addressing the issues of standards/interfaces and regulations for UMS.

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… aiming at improving interoperability … An agreement on common interfaces and standards to support the interoperability of heterogeneous European UMS into a SoS and the integration of plug & play components is of particular importance as it will identify how the UMS aim will be achieved. As mentioned above, a specific UMS-project has been launched (Standards and Interfaces for more interoperable European UMS – STANDIN) in support of the SI UMS-project. The STANDIN will take into account information on standards/interfaces from UMS-projects and will examine in detail, with the financial support of EDA, the issue of common interfaces and standards. The STANDIN aim is to provide a relevant recommendation to the SI including any identified issues that may hinder the eventual achievement of the UMS-programme objective. The endorsement of the recommendation of the STANDIN project should enhance innovation (use of common interfaces/standards to enable industries to produce components to be easily integrated and tested on UMS), upgradability of UMS and plug & play. However, the STANDIN recommendation will not be translated into new standards or interfaces in the classical sense (e.g. see NATO STANAGS, etc). Instead, it will depend on the will of governments and industry to enforce the outputs of the recommendation which will thus turn them into "de-facto standards" for European UMS. It is important to note at this stage that the UMS objective can only be met if the European UMS industry agrees to also work towards it. If this does not take place then the STANDIN recommendation will probably never be implemented. While governments have agreed through the UMS PA to work towards the UMS objective, no such agreement exists on the industrial side. It is therefore, necessary to work towards the endorsement by European industry of the UMS objective and the STANDIN recommendation, in order to ensure that the governmental investment will have its full effects. If this is not achieved then future investment by UMS-cMs in the UMS-programme may be jeopardized.

… safety … An additional element which is addressed under UMS is the aspect of safety and regulations for UMS. The absence of such regulations will have a significant impact on the future use of UMS by the European navies and hence may hinder further technological development. In acknowledgement of this issue, the UMS-cMs have established a specific UMS-project on "Safety and Regulations for UMS – SARUMS". The objective of SARUMS is to provide European Navies a best practice safety framework for UMS that recognises their operational usage and the needs of Navies. This guidance will be based on the management of risk as well as applicable rules and regulations.

... and use of UMS … Both STANDIN and SARUMS but also all remaining UMS projects are aimed at improving and increasing the use of UMS systems. Some of the lower level UMS-projects are related to efforts for advancement of generic UMS technologies including sensors, communications, data fusion, autonomy, flow noise reduction, manoeuvrability and networked enabled coordination. Such advancements will benefit a number of naval applications. Other lower-level UMS-projects are related to specific capabilities in which UMS may be of use, including MCM (mine hunting for buried and drifting mines but also mine sweeping/jamming), harbour protection and anti-submarine warfare (see Annex 2).

… through the improvement of technological capacities of UMS … While the lower-level projects could be considered as separate entities, it is important to note that in some cases strong interconnections exist. For example, one important UMS-project for enabling the UMS objective, is the "Network Enabled Coordination System of Autonomous Vehicles – NECSAVE" which will attempt to establish the SoS between

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heterogeneous European UMS. NECSAVE results will be tested in the UMS-project "Modular Lightweight Minesweeping – MLM" which will attempt to emulate the signature of a ship by using signature generators carried by USVs in formation. NECSAVE outputs will be used to enable the USVs to maintain their formation. Indirectly connected to MLM is the UMS-project SIRAMIS which will provide knowledge on ship signatures and their interactions with sea-mines. Other projects indirectly linked to NECSAVE are the "Robust Underwater Communications in Acoustic Networks – RACUN" and the "Increased autonomy for AUVs (mission planning and obstacle avoidance) – Mission Planning". RACUN results could be combined with NECSAVE results to produce a network of UUVs and USVs. The difficulty in underwater communication implies the need for improved autonomy for unmanned underwater vehicles which is being addressed by Mission Planning. NECSAVE and RACUN results could be combined with Mission Planning to demonstrate the capacity to adapt a network of UUVs due to the detection of particular structures or objects (e.g. mines).

… via the joint efforts of the UMS cMs … The above examples, illustrate the interconnections between the various UMS-projects and accentuate the need for the technical coordination that will be provided through the SI level but also the need for exchange of information between the UMS-projects. For this purpose the UMS MC encourages the UMS-project groups to interact. Such interactions could be through joint or back-to-back meetings but also joint sea-trials and exchange of reports. In general UMS-project groups should be encouraged not to focus only on their own technical elements but to also understand the influence of their R&T outputs on the wider UMS programme. For this purpose de-briefs of all projects under UMS should be made at a yearly UMS-programme conference (based on UMS MC request). In addition the use of a coordination roadmap is essential for tracking these interconnections and assessing both the risk from technical difficulties but also the final impact of R&T on future armaments programmes and capabilities. Such a first version of the UMS coordination roadmap is shown in Fig.1.

… and EDA … The coordination roadmap has been produced based on a newly developed EDA tool called the European Defence R&T Strategy WAYS road-mapping tool. The WAYS road-mapping tool provides an integrated view of the UMS programme showing activities delivering outputs to UMS and its projects but also activities to which UMS provides results. The roadmap shows UMS related activities and projects under the EDA Directorates of Capability, Armaments, Industry & Market or R&T. It also includes a section of non-EDA activities (other) where established connections with national programmes or activities of other organisations (EU Commission or even NATO) could be identified. The interconnections between projects are shown as black arrows indicating the direction of deliverables. Current projects of interest to UMS in the Armaments directorate are the Maritime Mine Counter Measures (MMCM) Cat.B project and the Standardisation Group. In the R&T directorate, the now completed EDA studies of Maritime USVs and Energy Supply for UUVs have provided inputs to UMS projects. Through the use of roadmaps the EDA aims at assisting the UMS-cMs to make connections between the UMS-programme and national plans. Such connection to national plans can be seen in a MMCM dedicated roadmap where as an example the Polish MCM programme has been added. (see Fig.2).

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Fig.1 The integrated roadmap of the UMS programme. The UMS programme itself is shown in red with all other R&T activities below. The view is produced by selecting other activities with which the project has connections. The grey lines indicate activities whose timing is not defined. Green lines indicate activities whose timing is definitely defined. Connecting lines indicate shared/forwarded milestones (Executive summaries of UMS projects shared with UMS Programme Management Committee or UMS Study reports forwarded to MMCM Cat.B project, etc).

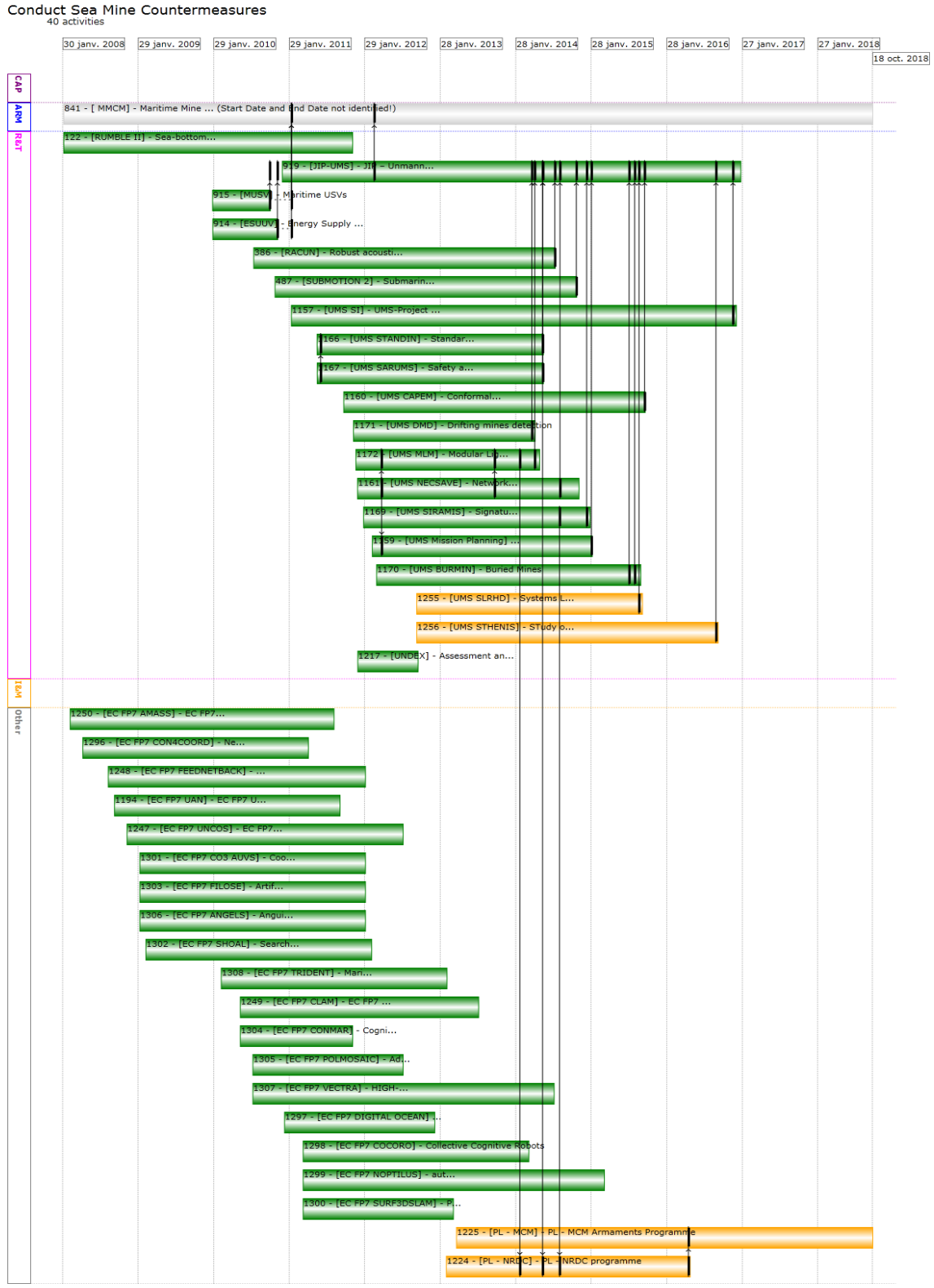

Fig.2 The integrated roadmap including EDA and non-EDA activities linked to the CDP task of "Conduct Sea Mine Countermeasures". The grey lines indicate activities whose timing is not defined. Green lines indicate activities whose timing is definitely defined while orange lines indicate activities whose timing is provisionally defined. Connecting lines indicate shared/forwarded milestones

(Executive summaries of UMS projects shared with UMS Programme Management Committee or UMS Study reports forwarded to MMCM Cat.B project, etc).

… both now and in the future. The current set of UMS-projects addresses only a fraction of the UMS key-technologies. Further investment in the form of additional UMS-projects is envisaged in order to achieve the UMS objective. Such additions are expected to take place on a regular basis (every one or two years) through a relevant UMS Programme Arrangement amendment, subject to UMS-cM approval. Furthermore, depending on the outcomes of the various UMS-projects; the availability of funds; the possible translation of UMS outputs into a joint future armaments programme like the Maritime Mine Counter Measures; the achieved levels of cooperation; exchange of information and know-how between UMS-cMs; and the readiness of the European UMS industry; the UMS-cMs may decide in the future to upgrade the Systems Integration UMS-project from a technical coordination project to a demonstration project. Moreover, the current UMS collaboration may also pave the way for the creation of a single European family of UMS. A decision by the UMS-cMs to work towards this more ambitious goal would lead to an amendment of the UMS PA and its current objectives.

UMS-programme third parties

The UMS MC should endeavour to increase participation of EDA pMS in the UMS-programme. Some EDA pMS may be encouraged in particular such as the UK.

Some UMS-projects like STANDIN and SARUMS but also the SI may require cooperation with other EDA bodies, such as the Standardization group, the Panel 7 on Civil-military synergies in Unmanned Systems (if active), the Project Team NEC and the MMCM Cat.B, but also other European Agencies and even third parties such as the USA or NATO. This should be addressed on an ad-hoc basis and taking into account political and industrial sensitivities.

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Annex 1

UMS Key-technologies and UMS-projects/Combined Cat.Bs/Relevant EDA OB Studies

UMS Key-technologies	Corresponding UMS-projects (Acronym)
A. Uninhabited Systems	EDA Operational Budget study on Maritime Unmanned Surface Vehicles (MUSV)
A1. Sensors	
A1. (i) Detection technologies e.g. tomographic sonars, optical sensors, chemical sensors etc, processing, EM sensors e.g. signal, image, data fusion etc	Evaluation of Thin Line Arrays (ETLAT)
	Conformal Array Performance Estimation Modelling (CAPEM)
	Harbour and Base Protection Systems (HaPS)
	See B3 below (BURMIN)
A1. (ii) Mission technologies e.g. navigation and positioning underwater	See A7 below (Mission Planning)
A2. Platform	
A2. (i) Energy (propulsion, speed, endurance)	EDA Operational Budget study on Energy Supply for Unmanned Underwater Vehicles (ESUUV)
	Study of Hybrid fuel cells Energy Interoperable System (STHENIS) (Provisional for 2012)
A2. (ii) Navigation (positioning, manoeuvring and sea keeping)	See A7 below (Mission Planning)
	Submarine coupled 6dof motions including boundary effects (SUBMOTION 2)
A2. (iii) Signature (Acoustic, radar, Magnetic, visual)	See A1.(i) above (CAPEM)

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A3. Communication	Robust Acoustic Communications in Underwater Networks (RACUN)
A4. Command, control and information	See A7 below (Mission Planning)
	See A7 below (NECSAVE)
A5. Systems launch recovery, handling and docking	*Systems Launch Recovery Handling and Docking (SLRHD) (Provisional for 2012)*
A6. Simulation	See A1.(i) above (CAPEM)
	See A2.(ii) above (SUBMOTION 2)
	See A7 below (NECSAVE)
A7. Autonomy	Increased Autonomy for AUV´s - mission planning and obstacle avoidance (Mission Planning)
	Network Enabled Cooperation System of Autonomous Vehicles (NECSAVE)
A8. Auxiliary equipment	
A9. Effectors	See A1.(i) above (HaPS)
	See B3 below (BURMIN)
A10. Standards of interoperability	Standard and interfaces for more interoperable European unmanned maritime systems (STANDIN)
A11. Influence mine-sweeping	See B.9 below (MLM)
A12. Regulations	Safety and Regulations for European Unmanned Maritime Systems (SARUMS)
B Next generation MMCM systems	
B1. Influence mine sweeping (Acoustic, Magnetic, Underwater Electric Potential, and Pressure Signature generation)	Signature Response Analysis of Multi-influence Mines (SIRAMIS)
B2. Mine detection	See B3 (BURMIN) and B8 (DMD) below

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B3. Buried mines	Buried mines (BURMIN)
B4. Mine disposal	
B4. (i) Cost effectiveness	See A2.(ii) above (SUBMOTION 2)
B4. (ii) Critical infrastructure	
B4. (iii) Environmental impact	
B5. Communication	See A3 above (RACUN)
B6. System launch, recovery, handling and docking (equipment, vehicles or deployed platforms)	
B7. Platform technologies	
B8. Drifting mines	Drifting Mines Detection (DMD)
B9. Light-weight minesweeping	Modular Light-weight minesweeping (MLM)
B10. Mine sweeping-mine jamming	See B1 (SIRAMIS) and B9 (MLM) above
B11. Mine threat analysis	See B1 above (SIRAMIS)

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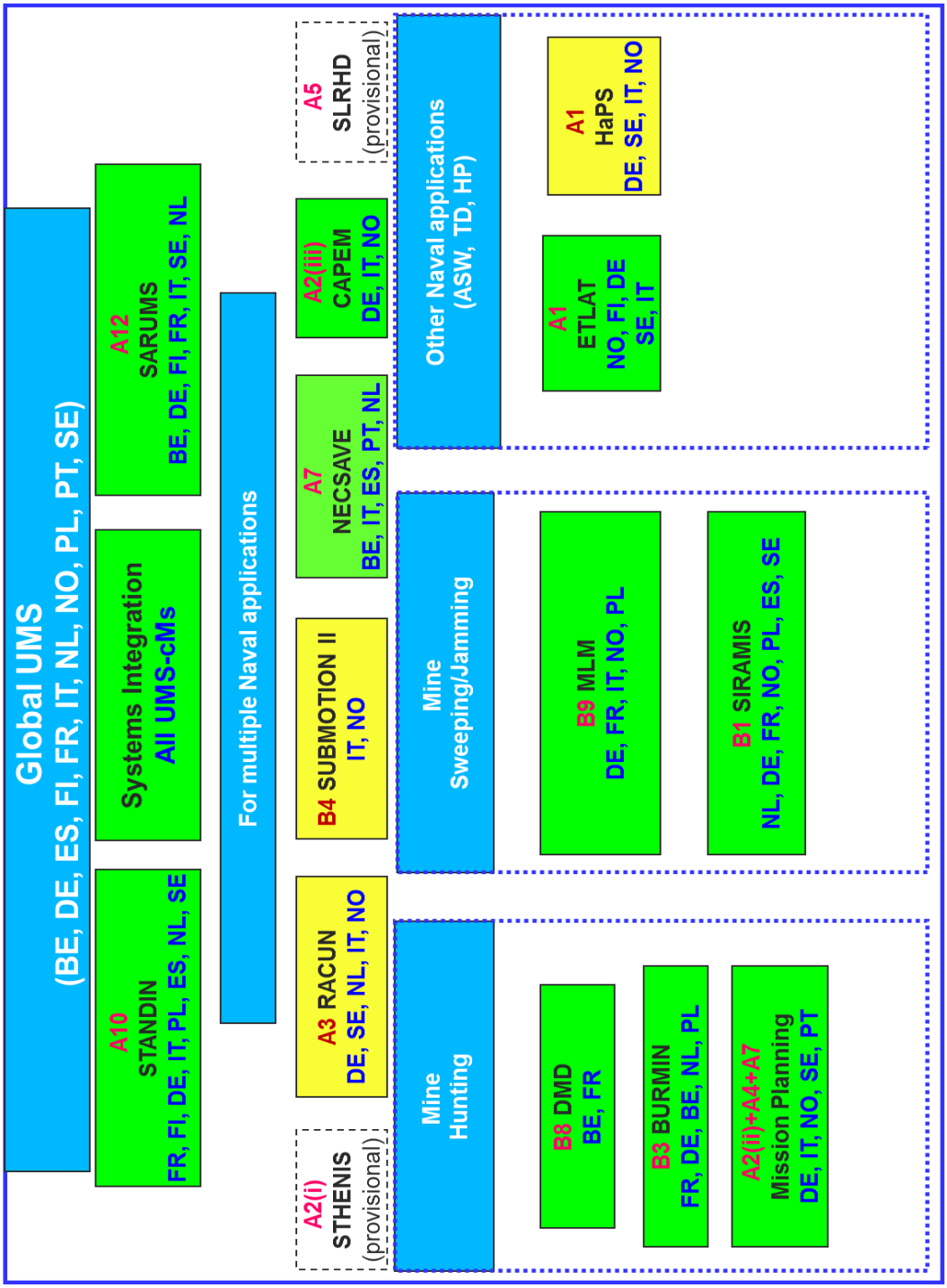
Annex 2

UMS Capability View



Annex 3

Abbreviations

AHWGs: Ad-Hoc Working Groups

CDP: Capability Development Plan

cMs: contributing Members

EDA: European Defence Agency

EDA pMS: EDA participating Member States

MC: Management Committee

MMCM: Maritime Mine Counter Measures

NEC: Network Enabled Capabilities

PA : Programme Arrangement

PMG: Project Management Group

R&T: Research and Technology

SI: System Integration

SoS: System of Systems

UMS: Unmanned Maritime Systems

USV: Unmanned Surface Vehicle

UUV: Unmanned Underwater Vehicle

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