European Union Aviation Safety Agency

EASA concept for regulation of UAS 'certified' category operations of Unmanned Aircraft Systems (UAS), the certification of UAS to be operated in the 'specific' category and for the Urban Air Mobility operations - Issue 2.1

Implementing Regulation (EU) 2019/947 and Delegated Regulation (EU) 2019/945 published on 11th of June, 2019 are formalizing the performance-based, risk-based and operation centric concept for the regulation of unmanned aircraft (UA) initially proposed by EASA in 2015 based on the work performed by JARUS.

For UAS operations not posing a significant risk to third parties, operations in the 'open' category and in the lower end part of the 'specific' category rely on the tools foreseen in the EASA Basic Regulation (EU) 2018/1139, i.e. declarations and product safety legislation (CE class mark). This includes the use of standard scenarios (STS) as provided in the Appendix 1 to the Annex to the Regulation (EU) 2019/947.

In the 'specific' category of UAS operations, the need for an airworthiness certificate for the UA is based on the risk level (defined as SAIL in SORA):

- For high risk operations (i.e. SAIL V and VI) a high level of robustness is required which implies for the UA to have an airworthiness approval issued by EASA.
- For BVLOS (Beyond Visual Line of Sight) operations in urban environment.
- For operations with lower level of risk it might be required to use an UAS designed to industry standards or methodologies recognized adequate by EASA. UAS manufacturers may choose:
    - either to support the UAS operators in the approval process with detailed compliance and test data; or
    - apply to EASA, on a voluntary basis, for a Type-Certificate (TC) of the aircraft or equipment (this would provide a clear separation of responsibility between UAS operator and manufacturer); or
    - obtain a CE class marking for one of the UAS classes identified in the STS.

When after conducting the risk assessment the UAS operator verifies that the risk of the UAS operation has a level such that the operation cannot be conducted with an acceptable level of safety, even with mitigations at the highest level of robustness, then the UAS operation is considered to be under the 'certified' category.

New automation system – based aircraft (ASBA), such as Vertical Take-off and Landing (VTOL) aircraft, create new opportunities compared to traditional manned aircraft and ground vehicle operations; it is in particular opening the field of possibilities in terms of urban air mobility, carrying passengers or cargo. Although first air taxi operations are expected to be conducted with piloted ASBA, these machines are intended to transition to UA. In order to support the transitioning phase and also due to the similarities of these two type of operations, it was decided to have urban air mobility operations using manned ASBA covered under this concept paper as well.

This concept paper will address three types of operations:

- UAS operations conducted in the 'certified' category
- the process of certification of UAS intended to be operated in the 'specific' category of operations, and
- operations of manned automation system – based aircraft (ASBA) in an urban environment (manned and unmanned)

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1 Introduction

Due to the large variety of possible UAS operations, EASA decided to address them in different phases developing in the next years more than one NPA (notice of proposed amendment) while giving priority to those that are more likely to take place in the next 5/10 years. In this section a general overview of the concept for the 'certified' category of UAS operations will be provided (see section 1.1); however the scope of the first NPA will be limited to some operations (see section 1.2) and will include a proposal for amending the relevant regulation. Section 9 provides an overview of the planning for this rulemaking task.

1.1 UAS 'certified' category definition and considerations

Being dependent on the safety risk assessment process, the nature and risk of the type of operation concerned, the boundary between 'specific' and 'certified' category cannot be expressed in terms of mass of the UA.

UAS operations in the 'certified' category include operations with a high risk. As per Article 6 of Implementing Regulation (EU) 2019/947 and Article 40 of Delegated Regulation (EU) 2019/945, operations shall be classified in the 'certified' category when:

- conducted over assemblies of people with a UAS with dimensions of more than 3m;
- involving the transport of people;
- involving the carriage of dangerous goods, that may result in high risk for third parties in case of accident[1];
- the competent authority, based on the risk assessment provided by the UAS operator, considers that the risk of the operation cannot be adequately mitigated without the certification of the UAS and of the UAS operator and, where applicable, without the licensing of the remote pilot.

The 'certified' category for UAS operations requires:

- the certification of the UAS,
- the certification of the operator of UA,
- the licensing of the remote pilot (where applicable, e.g. for UA with the highest level of automation a remote pilot may not be needed).

1.2 Scope of the EASA NPA#1

Considering the wide spectrum of the 'certified' category for which all regulations are affected in several areas where EASA still need to gain experience, EASA plans to address the 'certified' category in different phases.

The scope of the first regulatory proposal (notice of proposed amendment – NPA#1) will be to address the following three types of operations:

[1] Fuel used to propel a UAS would not be considered as "dangerous good" since part of the UAS design

– Operations type #1: IFR operations for the carriage of cargo in airspace classes A-C and taking-off and landing at aerodromes under EASA's scope[2].

– Operations type #2: Operations of UAS taking off and/or landing in congested[3] (e.g. urban) environment using pre-defined routes in volume of airspaces where U-space services are provided (part of the flight could be in non-congested (e.g. rural) environment). These include operations of unmanned automation system – based aircraft (ASBA), carrying passengers (e.g. Vertical Take-Off and Landing (VTOL) air taxis) or cargo (e.g. UAS providing goods delivery services). Take-off and land could be at any aerodrome or any designated landing port, vertiport or landing site.

– Operations type #3: same as Operation type #2 with manned ASBA[4], including operations in airspace where U-space service is not available.

In addition for the NPA#1, the following boundary conditions will be considered:

– All elements (e.g. the Control Unit (CU)) are considered under the field of responsibilities of EU regulation;

– Fully autonomous operations are excluded[5];

– The CU may control one UA at a time or control simultaneously several UAs, also of different types and from different operators;

– Handover of an UA between different CU is possible.

NPA#1 will address all impacted domains (Initial Airworthiness (IAW), Continuing Airworthiness (CAW), Operations (OPS), Aerodromes, ATM/ANS-SERA and Remote Pilot Licensing (RPL)).

NPA#1 will address as well the process of certification of UAS for use in the 'specific' category of operations with high risk (i.e. SORA SAIL level V and VI), BVOLS operations in urban and for operations in lower risk when the UAS manufacturers decides, for business reasons, to apply for a certification of the UAS.

UAS operations of types #2 or #3, using non pre-defined routes, are not considered to happen in the immediate future therefore EASA will not propose at this time amendments to the relevant regulations. However the approach to be used will be explained in a format of Advance Notice of Proposed Amendment (A-NPA)[6] at a later point in time by EASA.

Other types of operations of UAS (e.g. HALE - High Altitude Long Endurance – operations, CU not considered under the field of responsibilities of EU regulation) will be addressed at a later point in time by EASA.

The scope of NPA#1 on 'certified' category operations of UAS, certification of UAS and UAM[7] is summarized in Figure 1:

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[2] Means falling under the scope of Regulation (EU) 139/2014

[3] According to Regulation (EU) 965/2012, ''congested area' means in relation to a city, town or settlement, any area which is substantially used for residential, commercial or recreational purposes'. Aerial operations in congested areas for civil purposes, below certain heights, are today not permitted (refer to SERA.3105 and SERA.5005(f)).

[4] This may be done under existing (special) VFR-rules

[5] This means that operations covered by the NPA#1 will be run either with a remote pilot being able to intervene in some flight phases and/or a fleet manager, e.g. to plan the mission or upload the contingency information in the UA

[6] An ANPA is a tool that allows to provide concepts, explanations and can be used to ask specific questions. It does not propose rules.

[7] There is no specific definition of Urban Air Mobility (UAM) today. Future UAM operations are likely to include aerial operations both with manned or unmanned aircraft in the congested areas of the cities, towns or settlements.

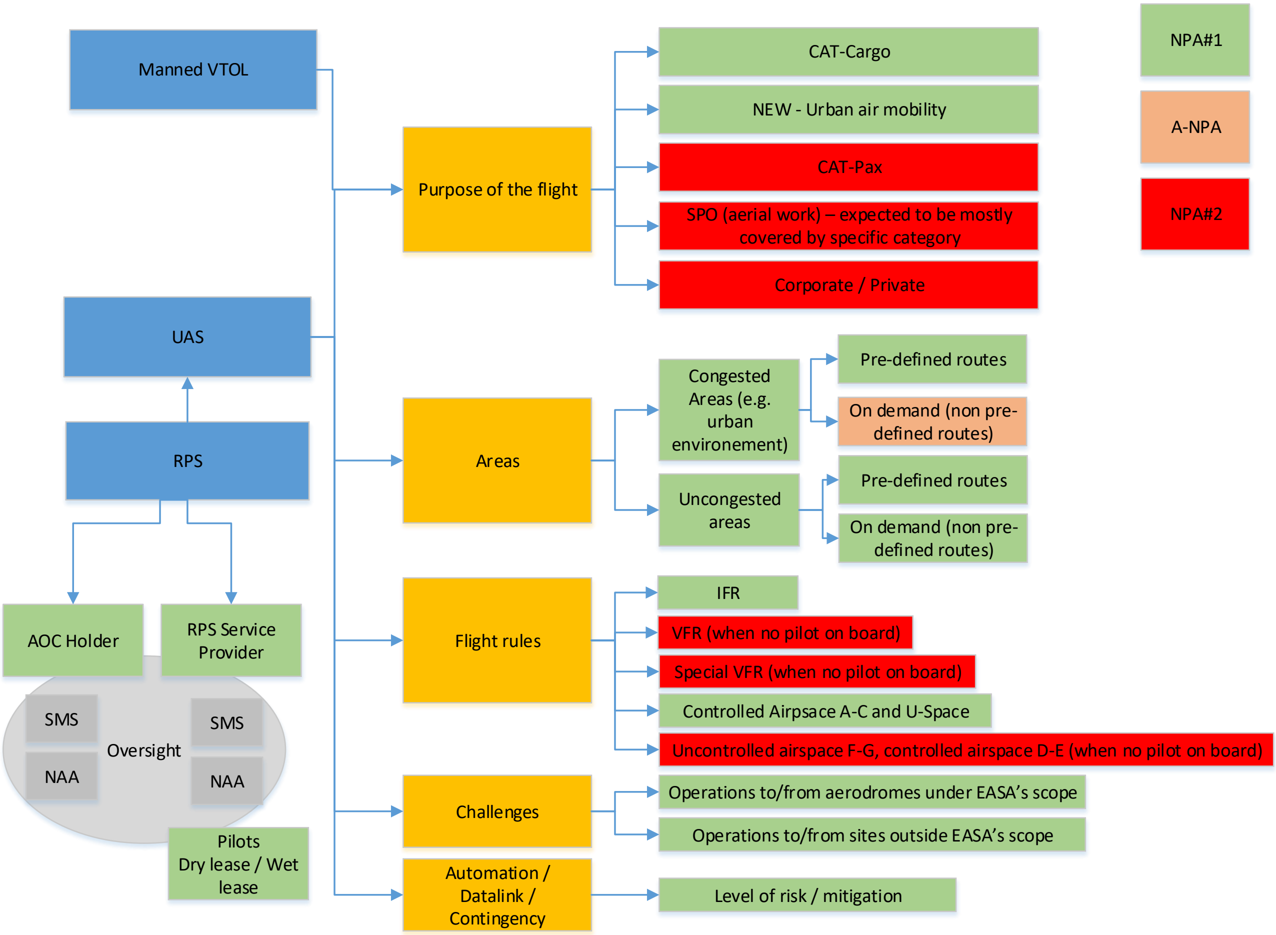


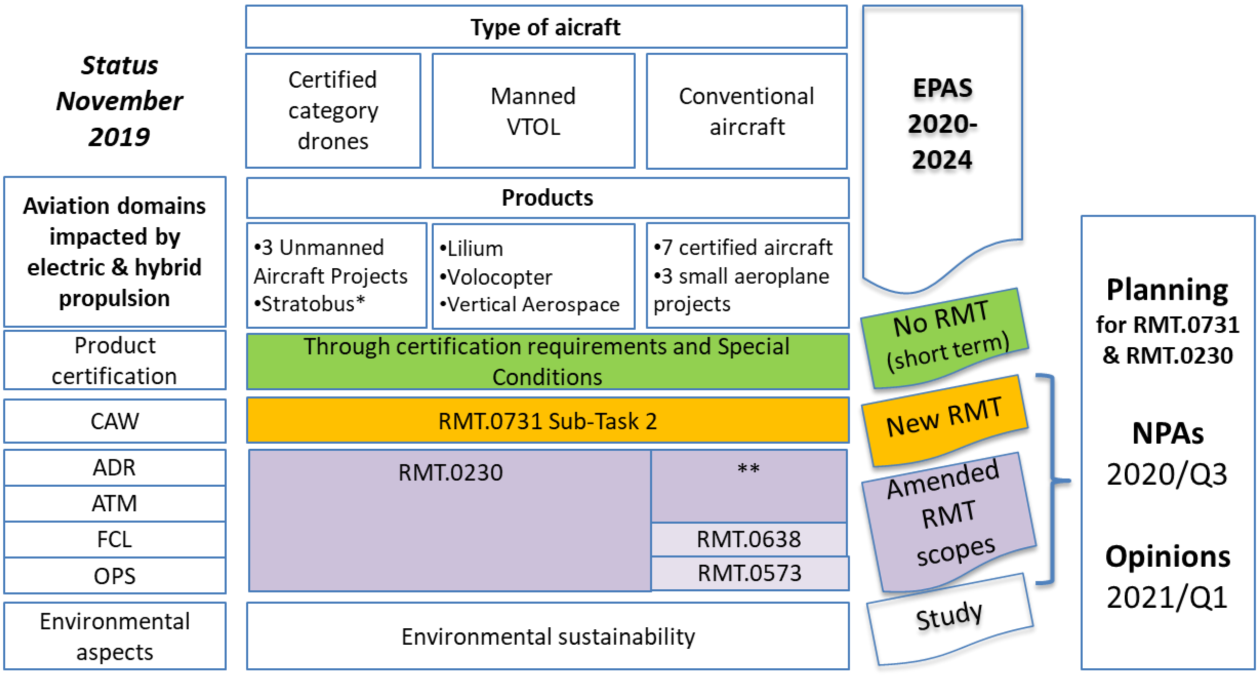
Figure 1 - Scope of NPA#1 on 'certified' category operations of UAS, and UAM operations

Note: The green box "Cargo-CAT" covers Operation Type #1. The green box "New Urban Air Mobility" covers Operation types #2 and #3 as described above. The red box "CAT-Pax" would cover for instance remotely piloted Large Aeroplane operations with passengers which are not intended to be cover in the first NPA.

1.3 Link with other EASA rulemaking tasks addressing electric and hybrid propulsion

Electric and hybrid propulsion, or using other alternative fuels, is an enabler for new products such as Vertical Take-Off and Landing (VTOL) aircraft. Therefore there is a strong interface in the EASA regulatory plan between the development of electric and hybrid propulsion and the RMT.0230 "Regulatory framework to accommodate UAS in the European aviation system".

Figure 2 summarizes how electric and hybrid propulsion is planned to be addressed for the various domains and depending on the type of aircraft:



** Stratobus is an airship remotely piloted*
*** RMT.0230 outputs for ADR and ATM will be reused for conventional aircraft*

Figure 2 - Overview of EASA RMTs addressing electrical and hybrid propulsion

1.4 Link with EASA Special Condition on Vertical Take-Off and Landing (VTOL)

A VTOL special condition (SC) was published by EASA in July 2019[8] to address some VTOL aircraft under certification. It is expected that the VTOL SC will be the basis for developing in the future a VTOL certification specification (CS). In section 3.3 the discussion of the proposed organisation of the CS landscape can be found.

EASA will ensure consistency of the NPA for the 'certified category' of UAS operations with such SC and this may involve the revision of the already published SC.

1.5 Link with EASA rulemaking tasks addressing safety risks stemming from information security incidents

Cybersecurity is an important topic that EASA is already addressing by proposing amendments to current regulations aimed at managing the information security risks that may compromise the confidentiality, integrity and availability of information being stored, transmitted or processed through the aeronautical information systems used in civil aviation that may ultimately have direct consequences on the safety of flight.

In particular two rulemaking tasks developed in parallel to the rulemaking task RMT.0230 have already reached the NPA stage:

[8] https://www.easa.europa.eu/document-library/product-certification-consultations/special-condition-vtol.

– RMT.0648 “Aircraft cybersecurity” with NPA 2019-01[9],

– RMT.0720 “Part – AISS - Management of information security risks” with NPA 2019-07[10].

The RMT.0648 proposes to create a new AMC 20-42 which will be applicable to any system regardless of the product it is installed on. This RMT will therefore affect the UAS initial airworthiness since AMC 20-42 will be referred to in the TC basis of the UA (refer to section 3.3).

RMT.0720 instead proposes the introduction of provisions for the management of information security risks related to aeronautical information systems used in civil aviation and will affect aviation organisations. PART-AISS will take into account the proportionality of the risks incurred by the different organisations and the type of operations, in order to control the residual risk without introducing unacceptable burdens. This will directly impact the organisations involved in UAS operations above cities or highly populated areas since there is no pilot on-board who could intervene otherwise as “last line of defence”.

1.6 Consistency with ICAO RPAS Panel approach

Starting from the used terminology (RPAS vs UAS, Control Unit vs RPS) the concept proposed in this paper is not fully in line with the approach currently taken by the ICAO RPAS Panel. However for UAS operations falling in the scope of ICAO (i.e. international IFR), the European regulation amendments proposed follow the ICAO development as far as practical (and available). The sections below identify areas where the ICAO approach is challenged without deviation being yet identified.

1.6.1 Scope

ICAO intends to regulate RPAS (remotely piloted aircraft systems) flying international in accordance with IFR from aerodrome to aerodrome (e.g. no vertiports). A remote pilot can only control one RPA (remotely piloted aircraft) at one moment and the pilot needs always be able to take direct control of the RPA.

EASA intends to regulate UA beyond the ICAO scope and include a higher level of automation allowing for example the control of several UAs by one pilot as foreseen for UAM. This is not considered critical with respect to compliance to ICAO SARPS as it is not in their scope.

1.6.2 Permeability between manned and unmanned operations

The current ICAO approach considers RPAS to be a new category of aircraft and is developing SARPS for the design and production of these new category and consequently in some areas a dedicated package of SARPS is proposed (e.g. for remotely piloted aeroplanes in Annex 8, for operation of RPAS in Annex 6).

EASA took a different approach and considerations of various operational scenarios like operation of multiple UA controlled by one CU, changes of the mode of operation from manned to unmanned between flights or even during, operation of manned and unmanned aircraft under a single operator certificate led to the development of the proposed concept. Where it is needed to provide flexibility and permeability between manned and unmanned operation the regulations for UAS should be integrated into the system through thorough amendments of existing regulations for manned aircraft. In other cases it seems beneficial to develop standalone new regulation for some dedicated issues (e.g. Control Unit Approval Holder).

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[9] https://www.easa.europa.eu/document-library/notices-of-proposed-amendment/npa-2019-01
[10] https://www.easa.europa.eu/document-library/notices-of-proposed-amendment/npa-2019-07

1.6.3 ICAO RPAS Certificate of Airworthiness (CofA)

ICAO proposes to issue a dedicated CofA to RPA including new fields related to the CU and C2 Link. As this would require a change of the CofA when any aircraft changes his mode of operation from manned to unmanned between flights or even during a flight this approach is considered to be too limiting.

There might not be a link between the operational life of a CU and an individual UA. While it needs to be ensured that any CU, before connected to any UA, is properly installed, maintained and in condition for safe operation there may not be a direct link between the airworthiness status of an UA and the serviceability of a CU. Therefore it cannot be expected that the CofA issued to the UA provides evidence of the airworthy status of the UAS (RPAS), as a complete system.

EASA proposes to use the established CofA form and to provide the required information in the "limitations/remarks". As the identical information is provided in the certificate this is currently not considered as a deviation from the ICAO proposal.

1.6.4 ICAO RPS TC vs EASA CU ETSO

ICAO proposes to issue either a TC to a RPS or to include the RPS into the type design of the UA (RPA). Apart from the argument that the Basic Regulation is not defining the RPS or the CU as an aviation product that may receive a TC, EASA does not consider the option to issue a separate TC as adequate due to the complex nature of the RPS/CU. As the RPS/CU might be installed into a new (or existing) building and highly integrated and connected to external networks and infrastructure and therefore the traditional aviation conformity process as used for aircraft is not feasible:

- Non-aviation requirements have to be considered when installing and operating a RPS/CU, e.g. for environmental protection, work conditions and last but not least physical security. As these legislations might be out of the scope of EASA depending on the location of the CU, it may not be possible to consider these requirements during type certification.
- The installer has to ensure that the RPS/CU is assembled, installed and maintained properly to ensure a final configuration as required for safe operation in accordance with installation data and it is expected that the installation and detailed configuration will vary due to the integration into local environment.
- For autonomous UA the "equipment to control" may be highly independent from the design of the UA but in this case it can be expected that the local adaptations and non-aviation aspects are driving the local set-up and do not justify a type certificate and related processes.

EASA intends to require that any type design of an RPA/UA includes the specifications of the CU and additionally to offer a process for the approval of airworthiness related aspects for the CU equivalent to an ETSO. This is not considered to be deviation from the ICAO approach as the RPS/CU is always part of the type design of any RPA/UA and the ICAO RPS layer concept as well as the ICAO approach to conformity and installation is followed.

1.6.5 ICAO C2 Link Service Provider approval vs EASA C2 link SLA

The operator has the final responsibility for the availability and adequate performance of all C2 Link services required for the safe operation of any UA. The required performance depends heavily on the operational needs due to the involved fleet of UA (and CU), the level of automation of the UA and the operational concept. Any related service provision needs to be highly integrated into operational procedures and the operator has to perform adequate oversight and monitoring of the required C2 link service provider depending of the required Service Level Agreement (SLA). The required C2 link services to control any UA from the CU will be established in the 'limitations/remarks' section of the CofA of the UA. Therefore EASA does not intend to issue a separate certificate for service provider of C2 Link services.

2 Definitions

In this document, there are terms used repeatedly. For the sake of not misleading the readers, some of the key definitions are summarised below:

Term	Definition	Comment
'certification'	it means any form of recognition in accordance with this Regulation, based on an appropriate assessment, that a legal or natural person, product, part, non-installed equipment, equipment to control unmanned aircraft remotely, aerodrome, safety-related aerodrome equipment, ATM/ANS system, ATM/ANS constituent or flight simulation training device complies with the applicable requirements of this Regulation and of the delegated and implementing acts adopted on the basis thereof, through the issuance of a certificate attesting such compliance.	Article 3(9) of the Basic Regulation[11]
'certificate'	it means any certificate, approval, licence, authorisation, attestation or other document issued as the result of a certification attesting compliance with the applicable requirements;	Article 3(12) o the Basic Regulation[11]
'product'	means an aircraft, an engine or a propeller	Article 3(3) o the Basic Regulation[11] This means that the Control Unit (CU) is not considered as a product
'aircraft'	means any machine that can derive support in the atmosphere from the reactions of the air other than reactions of the air against the earth's surface	Article 3(28) o the Basic Regulation[11]
'unmanned aircraft'	means any aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board.	Article 3(30) o the Basic Regulation[11]

[11] Regulation (EU) 2018/1139

Term	Definition	Comment
		An unmanned aircraft may transport people (e.g. flight crew not in duty)
'Control Unit (CU)'	means the equipment or system of equipment to control unmanned aircraft remotely as defined in point 32 of Article 3 of the Regulation (EU) 2018/1139, with the exception of any infrastructure supporting the C2 link service, which supports the control or the monitoring of the unmanned aircraft or both during any phase of the flight	In line with update of (EU) 2019/945 proposed in EASA Opinion on STS
'C2 Link service'	means a communication service between the unmanned aircraft and the CU provided by a third party	In line with planned update of (EU) 2019/945 (refer to EASA Opinion on STS)
'manned aircraft'	means any aircraft operating or designed to operate with a pilot on board	
'part'	means any element of a product, as defined by that product's type design	Article 3(4) o the Basic Regulation[11]
'C2 link'	The C2 (command and control) link is the logical connection, however physically realized, used for the exchange of information between the CU and the UA. It may enable the remote pilot's manipulation of the flight controls in the CU to be sent to the UA and for the UA to return its status to the remote pilot. The C2 Link therefore enables the remote pilot to manage the safe integration of the remotely piloted aircraft system into the global aviation, communications, navigation and surveillance operational environment.	Adapted from ICAO Annex 10 draft proposal Unmanned a/c like any other aircraft, will need to comply with airspace requirements and be equipped with CNS functionality as required for the respective airspace

3 Initial Airworthiness (IAW)

3.1 General principles

The Basic Regulation provides several options to document and certify the airworthiness of aviation *products* through issuance of:

- a (restricted) Certificate of Airworthiness (CofA) based on a (Restricted) Type Certificate;
- a Permit to Fly based on approved Flight Conditions;
- a restricted CofA based on a declaration, after EASA assessment of the design[12].

In line with the definitions provided in the Basic Regulation and within the scope of the concept paper:

- A Unmanned Aircraft (UA) is an *aircraft* and an aviation *product*.
    - Responsibilities for state of design, production and registry apply accordingly.
    - Operations of the UA may be performed with aircraft types and aircraft categories that may also be operated with a pilot on board, if the TC covers this possibility. In such a case, the change of mode of operation from manned to unmanned (remotely piloted) does not result in changes to the aircraft registry or the certificate of airworthiness and may be performed during flight.
- The Control Unit (CU) is not an aviation *product* (thus it may not receive its own TC or CofA) but the basic regulation refers to *equipment to control unmanned aircraft remotely*. The CU will be specified as part of the UA type design and may receive another type of certificate (e.g. ETSO) detailing the CU design data and specifications.
    - Responsibilities for state of design and production apply accordingly for any design and production activities for the CU or components of the CU as part of the approved data of the UA or an independent ETSO approval.

3.2 Proposed amendments to Part 21

3.2.1 Procedures for Type Certification

Article 58 of the Basic Regulation provides the legal basis to lay down detailed rules as delegated act with regard to conditions for the design and production of UA and their engines, propellers, parts, non-installed equipment and equipment to control the aircraft remotely.

The rules and procedures for manned and UA should be harmonized as far as possible to ensure that aircraft capable of manned and unmanned operation could be on one TC (and one CofA for the individual aircraft). Nevertheless rules and procedures for certification of UA need to address the specific characteristics and needs of UA and especially for non-installed equipment and equipment to control the aircraft remotely.

Part 21 provides the procedures for Airworthiness & Environmental Certification but several changes and/or adaptions are deemed necessary, among others:

[12] For the 'certified' category, it is not foreseen to use the provisions of the BR to issue a CofA based on a declaration of the manufacturer. The option to use industry standards and manufacturer declaration is available in the 'specific' category.

- formalisation of the applicability of Part 21 to the 'UA' and the 'Control Unit (CU)';
- process to establish modular certification basis to replace EASA policy E.Y013-01: "Policy Statement Airworthiness Certification of Unmanned Aircraft Systems (UAS)";
- clarification of UA type design and consideration of the Control Unit in the UA type design;
- introduction of the possibility of approval for the CU or its components beyond current ETSO;
- reporting and ADs for UAS, especially responsibilities in respect to CU;
- adaptation of CofA to include information on CU and C2 link under the limitations/remarks.

Organisational requirements for design organisation and production organisations might need to be adapted depending on the complexity of design and production and the risk of the operation.

3.2.2 Procedures for environmental certification of the UA

Point 21.B.85 of Part 21 covers noise, emissions and fuel venting. For noise, Point 21.B.85 refers to the existing chapters of ICAO, Annex 16, Volume I which address only the below categories of aircraft:

- Subsonic jet aeroplanes (Chapters 2, 3, 4 or 14);
- Propeller driven aeroplanes (Chapters 3, 4, 5, 6, 10 or 14);
- Helicopters (Chapters 8 or 11);
- Supersonic aeroplanes (for which the Chapter 12 is not developed);
- Tilt rotors (Chapter 13).

The following aircraft are not covered by ICAO Annex 16 and Point 21.B.85:

- VTOL (manned or unmanned);
- Any UAS which would not fit in one of the four Part 21 categories (subsonic jet airplanes, a propeller-driven airplanes, helicopters and tilt rotor);
- Supersonic aeroplanes for which the Chapter 12 of ICAO, Annex 16, Volume I has not yet been developed;
- Non conventional products (e.g. aerostat, jet packs…).

Part 21 needs to be amended in order to be able to treat applications of UAS or VTOL, including creation of the possibility to use special conditions as part of the environmental compatibility demonstrations.

These special conditions may be used later as input for the development of pre-defined noise requirements in CS, implementing the essential environmental requirements, in particular for noise, defined in Annex III of the Basic Regulation.

Environmental aspects might need to be addressed additionally in other regulatory areas like rules for operation or for vertiports.

3.3 Certification Specifications (CS)

The technical requirements for the design of products for certification are set as certification specifications (CS) and may be complemented as required with special conditions to build the certification basis that will be established for the certification of any specific aircraft type.

CSs should be proportionate to the risk of the operation ("safety continuum") and consist of performance based requirements supported by Acceptable Means of Compliance (AMC) making reference as much as possible to consensus-based standards developed by industry standardisation bodies.

Originally it was intended to draft one CS-UAS covering all kinds of UAS. While this CS-UAS may have provided a clear certification basis for all UAS products, it would have been difficult to develop proportionate requirements addressing all possible aircraft configurations (e.g. optionally piloted aircraft); it would have in particular created parallel paths to certify UAs with a different certification basis depending whether they start the certification process as manned or unmanned aircraft.

To avoid this ambiguity and to avoid an overlap with certification specifications for manned aircraft, the certification basis for an UAS is proposed to be built:

– starting with the "horizontal" CS applicable to the basic aircraft configuration complemented with,
– UA specific requirements (e.g. CU, C2-Link, Automation and recovery …). These UA specific requirements could be contained as modules in a dedicated vertical CS-UAS.

The modular approach presents several advantages:

– certification basis can be tailored to projects,
– there will be no overlap with existing CS,
– optionally piloted vehicles are covered,
– conversions of aircraft from manned to unmanned could be adequately addressed, and
– development and maintenance of requirements is more efficient.

For small UA where CS 23 is not an appropriate basis for the airframe a dedicated set of airworthiness requirements could be developed. This may be the certification basis for "small" UA as well as UA intended to be operated in the specific category. The CS will be developed in a later phase but is expected to be based on the technical content under development in JARUS Working Group 3 (Airworthiness)[13] and EASA Special Conditions[14].

Figure 3 illustrates the proposed solution with:

– a dedicated CS for UAS specific requirements in a "vertical" CS, and
– a dedicated CS for Light UAS.

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[13] During last JARUS plenary (14th to 18th of October, 2019), the JARUS CS-UAS has been approved for publication

[14] Refer for instance to EASA Proposed Special Condition SC-RPAS.1309-03 Equipment, systems, and installations: https://www.easa.europa.eu/document-library/product-certification-consultations/proposed-special-condition-sc-rpas1309-03

Part 21 needs to be amended to include requirements and guidance to identify the applicable CS as currently provided in the existing EASA policy E.Y013-01 as well as procedural aspects of adopting CS originally developed for manned aircraft to unmanned aircraft.

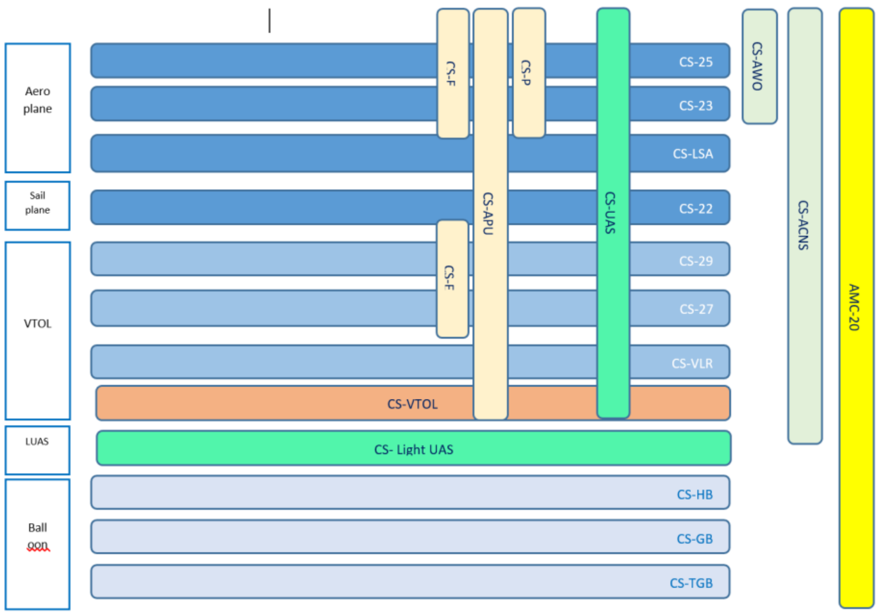

Figure 3 - Proposed CS organisation

Note: The NPA including the CS-UAS and CS for Light UAS will be addressed as indicated in section 9 for the end of 2021; it is indeed not considered time critical since Part 21 provides already flexibility for the definition of a Certification Basis for UA (through Special Conditions).

3.4 Operational Suitability Data (OSD)

OSD cover pilot type rating training syllabus, maintenance certifying staff type rating training syllabus and simulator qualification, the master minimum equipment list (MMEL) and possibly other areas, depending on the aircraft's systems.

OSD are approved as part of the type certificate like the aircraft flight manual and are important data for safe operations containing mandatory and recommended elements.

3.4.1 OSD in support of the Pilot 3-2-1 licensing concept

OSD are an essential element to support the Pilot 3-2-1 licensing concept (as per section 6) and specifically section 6.2.4). In line with Article 19 of the Basic Regulation (EU) 2018/1139, OSD cover the" minimum syllabus for a pilot type rating", as well as training areas of special emphasis. The type design will include such information that will then be used to determine the skills that the remote pilot should have.

During a UAS operation the function performed by the remote pilot can be decomposed in several actions (e.g. planning, inspection, decision making, communication, navigation, system management, taxing, T/O and landing, termination procedure, basic airmanship, detect and avoid, emergency procedures, evacuation).

With the progress of the level of automation some of the pilot actions will be transferred and performed by a machine. When the UAS manufacturer will be able to demonstrate with an acceptable level of reliability that one or more of the above actions may be performed safely by a machine, for each of them the pilot intervention may be reduced and at the end the remote pilot may not be able to intervene, not even in case of emergency.

3.4.2 OSD in support of the CAW concept

OSD may also provide data for training of staff involved in maintenance or installation of the CU. This will be developed in a future version of the concept paper.

3.5 Design, production and installation of the Control Unit

Design solution for the Control Unit vary significantly depending on the level of intervention of the remote pilot during the different phases of an operation, the different phases of flight and the operational concept. The CU might be a container with all required systems for operation or it might be installed in a building using conventional non-aviation systems, to control the environment and to protect the pilot from environmental conditions. While for standard IFR operation in the 'certified' category it is not expected that portable equipment is acceptable as CU, a portable unit might be acceptable for particular operational conditions or certain phases of the flight.

ICAO develops Airworthiness Standards and Recommended Practices (SARPS) for the RPS that address airworthiness related issues but also references operational and security elements that impact the RPS design and installation. It is expected that compliance with the full set of RPS SARPS will only be achieved after the CU is installed at the final location and when environmental conditions and specifications of external connections are complied with. Therefore, it will be only in cases of fully contained and autarkic systems that the manufacturer of the CU will be able to handover a system compliant to SARPS and fully conforming to the detailed specifications of the UA type design (or CU design approval).

To overcome these difficulties the ICAO RPAS Panel (RPASP) has developed and endorsed the RPS Layer Concept to support the definition of the CU and the level of precision and rigidity that is required for the design assurance and consequently for the production, conformity and maintenance efforts.

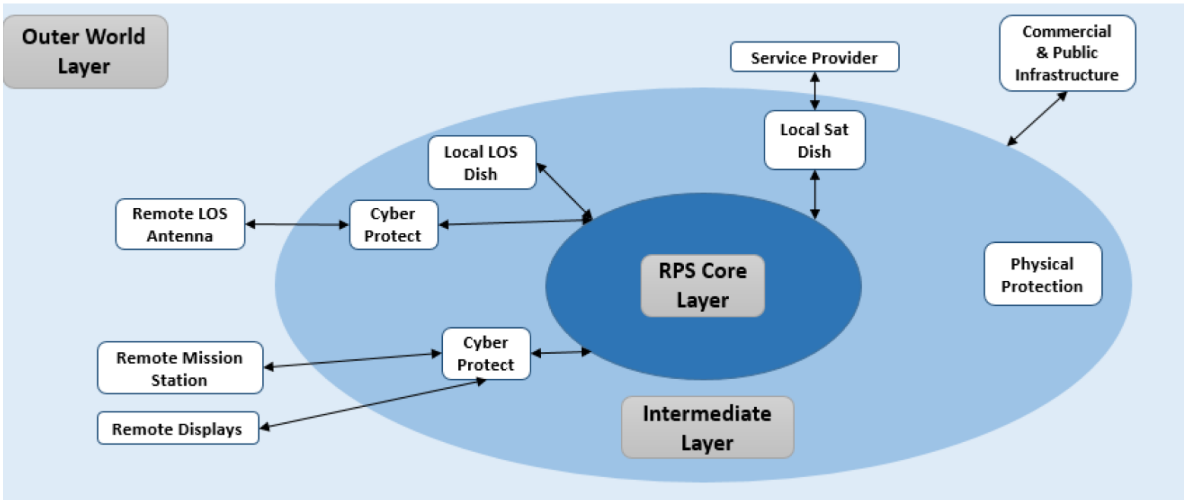

Figure 4 - ICAO RPS Layer Concept

Layer 1 - RPS Core Layer: all elements and equipment essential for the crew to operate the UA. The RPS/CU core layer components are expected to be designed and produced in accordance with normal aviation design and production procedures (e.g. in accordance with Part-21).

Layer 2 - Intermediate Layer: all assets, equipment and resources required to support the RPS/CU operation, to provide interface between the core and external layers and to provide protection from "undesired inputs" such as hacking, lighting, power failures, EMI etc.

Layer 3 – Outer World Layer: Commercial & Public Infrastructure, External Networks, C2 Link Service Provision

3.5.1 Consideration of the Control Unit in the UA type design

The proposed approach is to have the UA type design specifying all layers of the Control Unit as per following guidance:

Control Unit Layer	Level of specification expected	Example
Layer 1 - CU core layer	**The CU Core Layer** needs to be specified to the level of detail required to ensure compliance to the relevant airworthiness requirements and as far as required for safe operation including instructions for continuing airworthiness. It is expected that the components are specified at Part Number level and the configuration is specified in detail (e.g. screen resolution, firmware settings, software revisions).	Screen(s) example: Component defined by Manufacturer Part Number, Configuration defined by firmware settings, screen resolution, brightness and colour range, etc.
Layer 2 - CU intermediate layer	Layer 2 needs to be specified to the level of detail required to ensure continuous compliance to the relevant airworthiness requirements and as required for safe operation. It is expected that the components or performance are specified using industry standards (e.g. ventilation, air conditioning, lighting systems).	Lighting example: The type design holder of the UA specifies acceptable environmental conditions, e.g. EN 12464-1 for lighting conditions on work places that are compatible with the requirements (e.g. screen visibility)
Layer 3 - CU outer layer	It is expected that in cases of CU installed in a building the design organisation of the aircraft will not be able to specify in every detail the CU outer layers. The type design of the UA will specify required performance of elements of the outer layer (e.g. power provision, air conditioning, fire protection…) and will contain installation instructions.	Electrical power example: The type design holder of the UA specifies minimum electrical power requirement.

Table 1 – Level of specification expected for each Control Unit layer

In addition, the UA type design will need to identify the CU models that may be used to operate the UA, including UA specific configurations, instructions for connection and handover.

The allocation of layers to components and functions of the CU might vary between different UAS designs. Figure 4 illustrates a possible allocation of layers and the "level of control" a UA design organisation of a CU installed into a building infrastructure using external (or public) infrastructure may have. During the certification a comprehensive safety assessment of the UAS including the CU will need to be performed and the critical systems will be identified. The classification of "outer layer" does not prevent the need to adequately specify the performance and the safety requirements and in many cases available non-aviation standards might be acceptable. For some systems an aviation production and conformity process might be required and as a result some elements might be defined as core layer which could otherwise be classified as outer layer.

It is fully recognized that functions in the intermediate or outer layer may be critical. An example could be the cyber protection of connections from the CU to external networks. For these functions compliance with industry standards may be more adequate and agile to react against threads.

This concept should be capable of addressing various CU design solution by adapting the extend of using core layer definitions and process compared to reduced usage depending on level of autonomy of the UA and related safety effect of the CU.

3.5.2 Provision for optional design approval (e.g. ETSO) of the Control Unit or its components

It is expected that future UAS design will depend highly on automated capabilities and that the remote pilot interface will focus on flight management and monitoring functions. Together with the availability of industry standards this may allow for standardised CU designs that may be connected to different models of UA from different manufacturers.
Part 21 need to be amended to include the approval of the CU or its components. A process similar to ETSO or APU is considered to be appropriate.

As the CU is expected to be a highly modular system of components (screens, COM equipment, power supply, C2-Link …) where some of the components might have an independent equipment approval and these are combined equivalent to the concept of modular avionics.

3.5.3 Production of the CU core layer elements

Core layer elements are expected to be manufactured in an approved organisation (POA) in accordance with approved design data. They are delivered to the CU approval holder with a conformity statements and need to be installed in accordance with the installation instructions including required checks and functional testing. The initial installation of the CU may be equivalent to a final assembly.

3.5.4 Initial installation approval of the CU (including conformity process)

It is essential to install a new CU in accordance with the specifications of the UA type design and any data approved for the core layer as part of the type design and/ or separate approval (e.g. ETSO).

Based on the data provided in the CU specifications by the UA type design holder, the CU approval holder is responsible to control the assembly, installation and connection of "outer layers" of the CU included in its operations manual (refer to section 5.2.2).

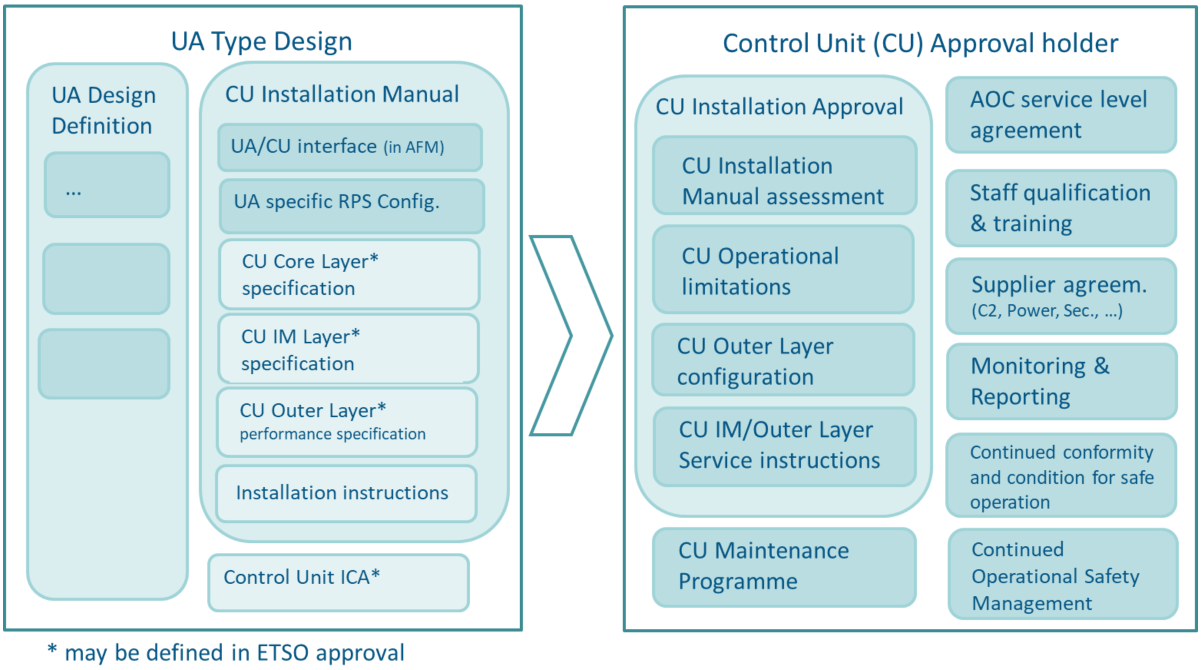

Figure 5 - UA Type Design and CU Installation Approval

The elements marked with an asterisk may be defined in an independent approval (refer to section 3.5.2).

Even in the case of a fully functional container delivered to the UAS operator the "installation" has to be in line with conditions specified for the CU design to ensure full compliance with airworthiness requirements. Conditions identified for environment, orography, external fire or security threads, etc. need to be complied with before releasing the CU to service.

The installation process will follow the CAW approach. The Control Unit will be released to service after the Control Unit approval holder (CU AH) ensure:

– instructions for the Control Unit installation, test[15] and verification are followed in accordance with the instructions of the Control Unit installation manual;

– conformity of the CU layers with the specifications of the UA type design.

Examples of acceptable Conformity demonstration of the Control Unit installation are provided in the table below:

CU Layer	Conformity demonstration of the Control Unit installation	Example
Layer 1 - CU core layer	An EASA Form 1 (or equivalent under bilateral) seems to be adequate unless a lower level of conformity process is accepted by the type design	Conformity recorded through an EASA Form 1 (or equivalent under

[15] This test might include "flight" testing, for example with a virtual UA provided by the UAS manufacturer as required by the UAS design organization and the installation might require dedicated training provided by the manufacturer.

CU Layer	Conformity demonstration of the Control Unit installation	Example
	holder of the UA depending on effect of non-conformities and failures.	bilateral) from manufacturer or maintenance organisation
Layer 2 - CU intermediate layer	A declaration of the parts manufacturer should be sufficient unless the type design holder of the aircraft requires a higher level.	The Control Unit approval holder (CU AH) ensures that the facilities are built or modified in accordance with the defined standard. Components (light switches, wiring, bulbs) will be selected by the operator in accordance with the standard.
Layer 3 - CU outer layer	The CU AH should ensure that the Layer 3 - CU outer layer complies with the specification.	The CU AH ensures that they have a service contract meeting the minimum requirement and put in place action to reduce/mitigate the possibility of shortage of power

Table 2 - Examples of acceptable Conformity demonstration of the Control Unit installation

The CU approval holder (as defined in section 5.3) will be responsible for the first physical installation of the CU and the continued operational safety of the CU.

Appropriate requirements and responsibilities of the CU approval holder would be established in the new Subpart CU of Part-ORO (as per section 5.6).

3.5.5 Control Unit identification

In accordance with the ICAO approach the CU will not be registered like an aircraft and no CofA will be issued. As further detailed in section 5, the CU certificate holder will responsible to identify within the operations manual (refer to section 5.2.2) the following information for all CU that it operates to clearly identify each CU:

a) the individual or legal entity owner of the CU;

b) the CU manufacturer and manufacturer's designation of CU;

c) the serial number of the CU; and

d) indication of the type or model of UA the CU is capable of controlling.

3.5.6 Design changes to the CU and release of the installation of modifications to the CU

Changes to the Control Unit, affecting the specification approved as part of the UA Type Design, require an approval of the change to the type design of the UAS before any operation with that UA model.

Any installation of modification would need to be released in accordance with section 4 after performance of required checks and functional testing.

3.6 Initial airworthiness considerations for the C2 Link

The C2 Link is the logical connection used for the exchange of information between the CU and the UA to enable the pilot to safely fly and integrate the UAS into the global aviation, communication, navigation and surveillance operational environment.

The C2 Link encompasses everything that is in between CU and the UA including any systems and equipment contributing to realize this link such as satellite or ground networks and including all transmitters and receivers on board of the UA or installed in the CU.

For all UA operations where the CU and the remote pilot shall be in the loop during the flight, or where the UA needs to exchange data, the C2 link technology must satisfy adequate airworthiness requirements to enable command and control. Any C2 link equipment installed on board of the UA or in the CU needs to be designed with a level of assurance that is in accordance with the intended function and operation. This includes functions to secure the exchange of information as well as recording, performance monitoring and display of required information to the remote pilot.

The C2 Link is required to support the remote pilot to perform a safe operation of the UA and for any operations that requires exchange of information for air traffic services, to support the remote pilot in his tasks required for air traffic services purposes, such as relay of ATC communications. It is an integral part of the UAS that contributes to the safety of the operation and meeting the airspace performance requirements in any given airspace. The required C2 Link performance derived from the UA characteristics and the airspace requirements is applied by the UAS designer to the specific design of the UAS (C2 Link specification).

3.7 Type Certification of UA to be operated in the 'specific' category

The 'specific category' as established in regulation EU 2019/947 does not always require a detailed design review of the UAS involved in that operation. Depending on the risk of an operation, a type certificate of the UAS may not be required for operations in the 'specific' category.

For high risk operations, Article 40(1)(d) of Regulation (EU) 2019/945 defines that the design, production and maintenance of a UAS shall be certified if it is used in the 'specific' category of operations and the operational authorisation issued by the competent authority, following a risk assessment provided for in Article 11 of Implementing Regulation (EU) 2019/947, considers that the risk of the operation cannot be adequately mitigated without the certification of the UAS. In this case the UAS manufacturer will be required to apply to EASA for a TC.

BVLOS operations in urban environment will also require an airworthiness certificate for the UA.

When a TC of the UA is not required, the responsibility for the airworthiness of the UAS is on the UAS operator who has to:

- provide to the national competent authority a risk assessment to obtain an operational authorisation;
- demonstrate that the UAS is adequate for the intended operation and is designed and manufactured in accordance with acceptable standards (the required assurance and integrity levels might include safety analyses and compliance demonstration similar to manned aircraft).

As the use of UA or equipment that is certified is allowed in the 'specific' category, a manufacturer might voluntarily apply for a TC as this simplifies the authorisation process for operators and to keep control of proprietary design data.

In this context, EASA may issue a restricted TC for a UA with operational limitations or approve equipment to be installed on UA (flight controller, termination system, etc.). The certification basis of a UA to be operated in the 'specific' category should contain a simple set of airworthiness requirements adapted to a generic concept of operation and mainly refer to available industry standards, similar to CS-LSA for manned light sport aircraft.

The certification process and the requirements especially on the organisational capabilities of the design and manufacturing organisations need to be proportionate to the risk.

Synergies with the developments in the context of the "Part 21 Light" (RMT 0727) activities related to recreational light aviation may exist especially for certification of UAS intended to be used in lower risk scenarios.

4 Continuing airworthiness (CAW)

Continuing Airworthiness is governed by Regulation (EU) No 1321/2014 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks. This regulation includes several annexes, each covering a determined topic (i.e. Part-M for Continuing airworthiness standards, Part-145 for Maintenance organisation etc.)

In the manned aviation context, 'continuing airworthiness' means all of the processes ensuring that, at any time in its operating life, the aircraft complies with the airworthiness requirements in force and is in a condition for safe operation.

4.1 Proposed approach for CAW of UAS operated in the 'certified' category

This section focuses on determining how much the content of Regulation (EU) 1321/2014 can be used for the continuing airworthiness of UAS operated in the 'certified' category. This does not presume under which regulatory form and structure this will be achieved (see section 4.2 on Basic regulation constraints).

Commission Implementing Regulation (EU) 2019/1383 applicable from 24 March 2020, will amend Regulation (EU) No 1321/2014, modifying the structure of the regulation as shown in Table 3:

Reference	Designation	Topic
Annex I	Part-M	Continuing airworthiness standards
Annex II	Part-145	Maintenance organisation
Annex III	Part-66	Maintenance licensing
Annex IV	Part-147	Maintenance training organisation
Annex Va	Part-T	Requirements for 3rd country a/c dry leased by an AOC
Annex Vb	Part-ML	Continuing airworthiness standards - light aircraft
Annex Vc	Part-CAMO	Continuing airworthiness management organisation
Annex Vd	Part-CAO	Combined (continuing airworthiness management and/or maintenance) organisation – non-complex aircraft

Table 3 - New structure of Regulation (EU) 1321/2014

4.1.1 Non-applicability of Part-ML and Part-CAO annexes for UAS operated in the 'certified' category

For UAS operated in the 'certified' category, it is not envisaged to use the Part-ML and Part-CAO annexes, which have specifically been developed in the frame of the EASA General Aviation roadmap.

Part-ML and Part-CAO address light and non-complex aircraft operated in conditions for which EASA do not foresee in the near future an equivalent in unmanned aviation (e.g. leisure aviation with passenger on board). However some operations in the specific category (i.e. agriculture, construction, photography operation etc.) may have a level of risk consistent with the scope of Part-ML and Part-CAO

In essence, the risks associated to the aircraft and the operations for which requirements of Part-ML and Part-CAO are applicable do not correspond to the risks entailed by the 'certified' category of UAS operation (e.g. urban mobility, IFR certified operations of UAS cargo).

Besides, the organisation requirements of Part-CAO do not encompass SMS elements, which would be a weakness when interfaces to the SMS elements of the UAS operator certificate holder will be required. In particular, it is expected that ICAO will extend the applicability of the SMS framework through an amendment of Annex 19 SARP to UAS operators involved in international operations and maintenance organisation providing service thereto.

Last but not least, it should be noted that NPA 2019-07 intends to exempt the Part-CAO organisation from the requirement to Manage Information Security Risks (cybersecurity).

4.1.2 Proposed approach for the Unmanned Aircraft (UA)

The objective of Regulation (EU) 1321/2014 is to establish common technical requirements and administrative procedures to ensure the continuing airworthiness of aircraft registered in an EU Member State (ref. Article 1).

Considering that, as explained in section 3.1, the certified UA shall be registered and have a valid (restricted) CofA issued by the competent authority, the applicability of Regulation (EU) 1321/2014 can be extended to the UA.

Therefore the general approach for the UA is to re-use and adapt existing Regulation (EU) 1321/2014 annexes such that the continuing airworthiness of the UAs will be similar to that of a manned aircraft, i.e. managed by a Part-CAMO organisation under Part-M standard, and maintained by a Part-145 maintenance organisation.

The main elements necessary to be adapted to UA will be:

- responsibilities,
- link and coordination with CU approval holder, and
- pre-flight inspection.

For the licencing of certifying staff responsible for releasing the maintenance of UA, it is also proposed to follow a path similar to manned aviation, where Part-145 maintenance certifying staff is licenced in accordance with Part-66 and Part-147.

The main elements necessary to be adapted to UA will be the types/categories of maintenance licence required and associated basic knowledge requirements.

4.1.3 Proposed approach for the Control Unit (CU)

4.1.3.1 Continuing airworthiness management of CU

Unlike the UA, the CU will not be registered or receive a CofA.

The requirements and responsibilities established by Regulation (EU) 1321/2014 for the continuing airworthiness management of the UA, which derive from the UA registration, are generally not adapted to the CU, which appears to function independently of the UA and without its identification and airworthiness certificate process.

There is also not always a correlation between the operating life of a CU and the operating life of a registered UA. This is because, as explained in the introduction, one CU may control one or several UA at a time and one UA can also be transferred from one CU to another during flight.

This means that Annex I (Part-M) and Annex Vc (Part-CAMO) are not adaptable to the CU.

However, since the CU design will be approved as part of the UA type design, it is essential to have an organisation responsible for **ensuring that, at any time in its operating life, the CU, including any installed component, conforms to approved design, specifications and performance, and is in a condition for safe**

operation of the certified UA. Therefore a new regulatory framework (responsibilities, duties, privileges…) must be developed for such organisation.

Rather than creating a new type of organisation similar to CAMO for CU, it is proposed to allocate the above-mentioned responsibilities to the organisation effectively operating the CU, i.e. the **CU approval holder**.

- These responsibilities will be established in the **new Subpart of Part-ORO (Subpart CU)** to be developed under Regulation (EU) 965/2012 (refer to section 5.3).
- The standard to which such activity is conducted will be kept in the continuing airworthiness domain, under a **new Subpart of Part-M (Subpart J)**. The main elements necessary to be introduced in new Part-M Subpart J will be a maintenance programme for the CU, the management of configuration, Airworthiness Directives (AD), defect, etc.

This approach is also supported by the fact that the organisation regulated by Subpart CU will be responsible for the first physical installation of the CU (refer to section 3.5.4). This approach implies that the Competent Authority, responsible for the oversight of the CU continuing airworthiness will be that defined by Regulation (EU) 965/2012.

Impact on regulation (EU) 965/2012:

- The main elements necessary to be introduced in new Part-ORO Subpart CU in this respect will be to establish the responsibility of the CU approval holder, as appropriate, for the continuing airworthiness management of the CU and to ensure that this activity is done in accordance with Part-M Subpart J. Coordination with the AOC holder or CAMO managing the UA should also be required.

4.1.3.2 Maintenance of CU

It also appears essential in this context to have personnel qualified and competent to carry out and release maintenance on the CU (including configuration and modifications), in accordance with defined standards and data.

The nature of the maintenance of the CU is foreseen to be very connected to the operation, in particular in the configuration and preparation of the CU before the flight. Besides, this maintenance will always be conducted at the CU facility and the related procedures should be adapted to the facility and particular CU installation. In this context, EASA sees the need to have this maintenance personnel as part of the CU personnel, rather than being seconded at the CU location by a Part-145 organisation, or sent over by a Part-145 organisation every time the operation requires it.

Due to the nature of the tasks to be performed (configuration, software upgrade, component removal/installation) it is considered that the organisation operating the CU can ensure that such personnel is appropriately qualified, by following requirements for personnel qualification established in a **new Annex called Part-UPM** (standing for unit personnel for maintenance) (in the continuing airworthiness domain). This new Part-UPM would be similar in its structure to Annex XIII (Part-PERS) to Regulation (EU) 2017/373 on ATM/ANS for the training and competence assessment of air traffic safety electronic personnel (ATSEP). It would be adapted to include certain knowledge requirement modules of the current Part-66 and it would be possible to use the Part-147.UAS organisation to impart certain training.

This unit personnel for maintenance would eventually be authorised by the CU approval holder, as applicable, to carry out and release the maintenance work carried out on the CU. The standard to which the maintenance of the core layer of the CU is accomplished would be established under a **new Annex Part-M.CU**.

Impact on regulation (EU) 965/2012:

– The main elements necessary to be introduced in Part-ORO Subpart CU in this respect will be to establish the responsibility of the organisation for having personnel qualified in accordance with Part-UPM for the maintenance of the core layer of the CU and for conducting that maintenance in accordance with the standards established in Part-M.CU.

4.1.4 Proposed approach for UA components and CU core layer components

For the maintenance of the UA components and CU core layer components, it is proposed to follow the same provisions than for manned aviation. This means that the maintenance of components shall be performed by a maintenance organisation approved in accordance with Part-145.UAS (holding a component rating). At the end of the process, this organisation release the maintenance performed on an EASA Form 1.

Note: certain existing derogations in Regulation (EU) 1321/2014 would be extended to unmanned aviation, which allow simple component maintenance to be released together with the UA or CU maintenance, where that component is fitted on the UA or CU during maintenance, or when that component is temporarily removed before reinstallation on the same UA or CU. No EASA Form 1 is issued in this case.

4.1.5 General principle summary

The principles exposed in the preceding sections can be visualised in Figure 6 below:

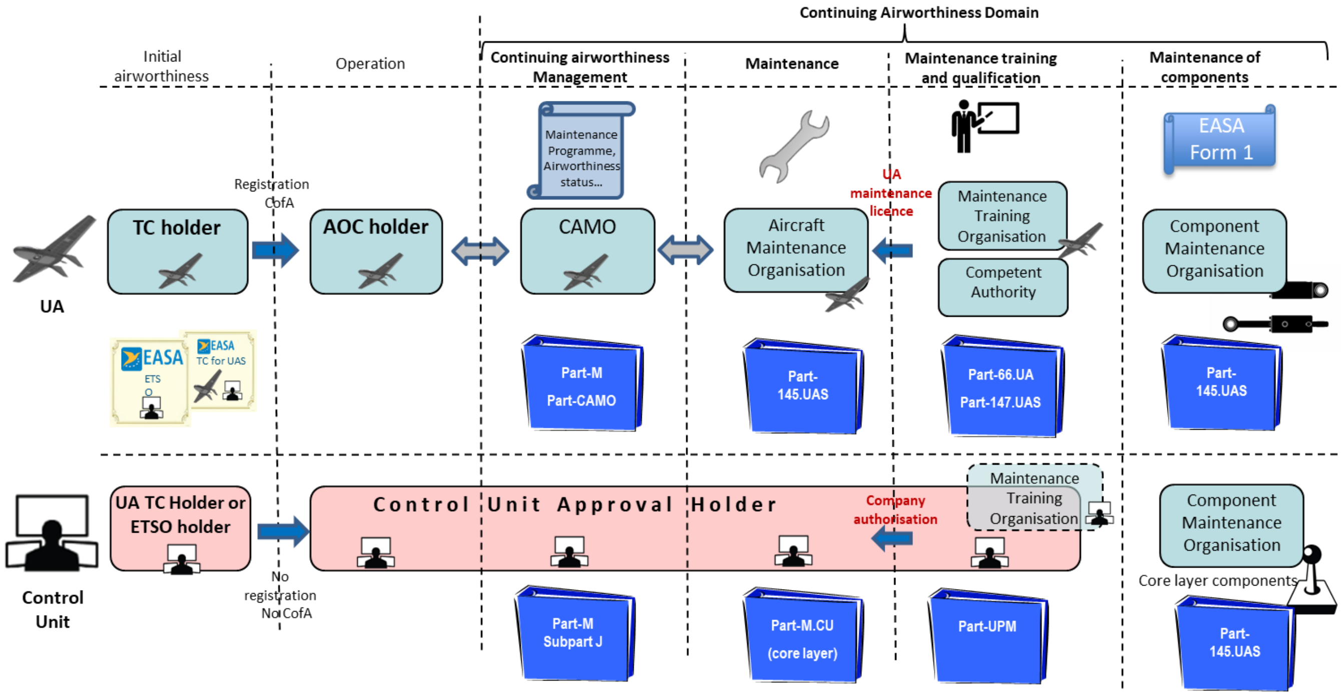

Figure 6 - General principles for CAW of UAS operated in the 'certified' category

4.2 Basic Regulation constraints for CAW of UAS operated in the 'certified' category

4.2.1 Foreword

The Treaty on the Functioning of the EU (Lisbon treaty) distinguishes 2 types of regulatory acts to supplement and implement the law, respectively the Delegated Act (Article 290) and Implementing Act (Article 291).

The two types of acts are subject to different procedures and the principal differences are:

– the EP and Council can scrutinise the Implementing Act (IA) and have a permanent right of information on the contents of the (IA)

– the EP and Council can veto the Delegated Act (DA) (or revoke delegation to the European Commission)

For each domain subject to rulemaking by EASA, the Basic Regulation specifies which type of act is to be used.

4.2.2 Distinction between continuing airworthiness management and maintenance

In line with Figure 6, continuing airworthiness (CAW) includes continuing airworthiness management and maintenance.

For manned aircraft, Article 17 of the Basic Regulation states that both continuing airworthiness management and maintenance are regulated by Implementing Act (IA), which is today Regulation (EU) 1321/2014.

For unmanned aircraft:

- Article 58 of the Basic Regulation imposes a Delegated Act (DA) for the maintenance of UAS. This means that the Basic Regulation impose 2 types of acts to regulate on one side the maintenance of manned aircraft and on the other side the maintenance of UA. The consequence is that the maintenance-related annexes of Regulation (EU) 1321/2014 (Part-145, Part-66 and Part-147) cannot be directly applied, neither to the UA nor to the CU.

- Article 57 of the Basic Regulation imposes an Implementing Act for the operations of the aircraft; moreover Annex IX paragraph 2.4.4 states "Unmanned aircraft must be operated only if it is in airworthy condition and where the equipment and the other components and services necessary for the intended operation are available and serviceable". It is therefore considered that it is the intention of the Basic Regulation to handle continuing airworthiness management through Article 57, thus through Implementing Act; for these reasons, current Part-M and Part-CAMO are proposed to be adapted for unmanned aircraft.

4.2.3 Competent authority requirements

In accordance with Article 62(15)(c) of the Basic Regulation, implementing acts are required to establish the provisions for the competent authority requirements.

This means that the delegated act referred to in section 4.2.2 cannot include a Section B for competent authorities, as opposed to Regulation (EU) No 1321/2014. Therefore if competent authority requirements are necessary for the annexes introduced in the delegated act, these competent authority requirements will be included in the section B of Regulation (EU) No 1321/2014.

4.2.4 Impact on concept

Regulation (EU) 1321/2014 can be used and adapted for the continuing airworthiness management of the UA (Part-M and Part-CAMO).

Article 58 of the Basic Regulation does not affect the concept proposed in section 4.1.3 for the management of the CU. This is the reason why it is proposed to include the continuing airworthiness management standards of the CU into a new Subpart J of the existing Part-M.

However a new Delegated Act is to be created for the:

- maintenance organisation involved in :
  - Maintenance of the UA (Part-145.UAS)
  - Maintenance of UA components and CU core layer components (Part-145.UAS)
- licencing of certifying staff involved in the maintenance of the UA (Part-66.UA);
- training of staff involved in the maintenance of the UA (also available for unit personnel for maintenance) (Part-147.UAS);
- maintenance standards for the CU core layer (Part-M.CU);
- qualification of personnel involved in CU maintenance (Part-UPM).

For the new Delegated Act, 2 different approaches can be initially envisaged:

- mirroring in the DA, all applicable provisions of the IA, and supplement them with UAS-specific provisions
- establishing only the UAS-specific provisions and referring to the IA for the common provisions.

This is still under discussion and no option has been so far selected. This will be discussed with the expert group and also within EASA legal services.

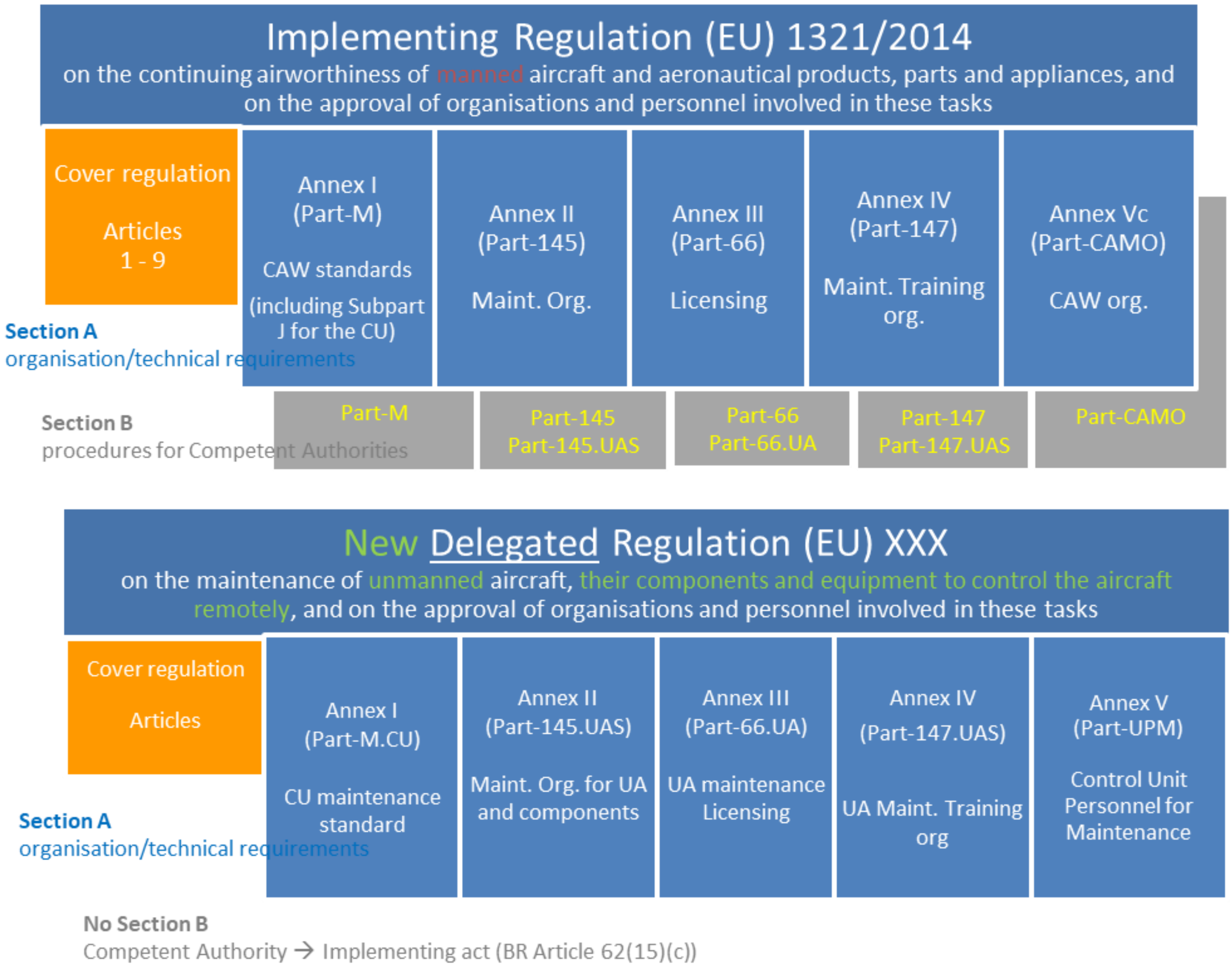

Figure 7 – Proposed structure for update of IA (EU) 1321/2014 and new DA

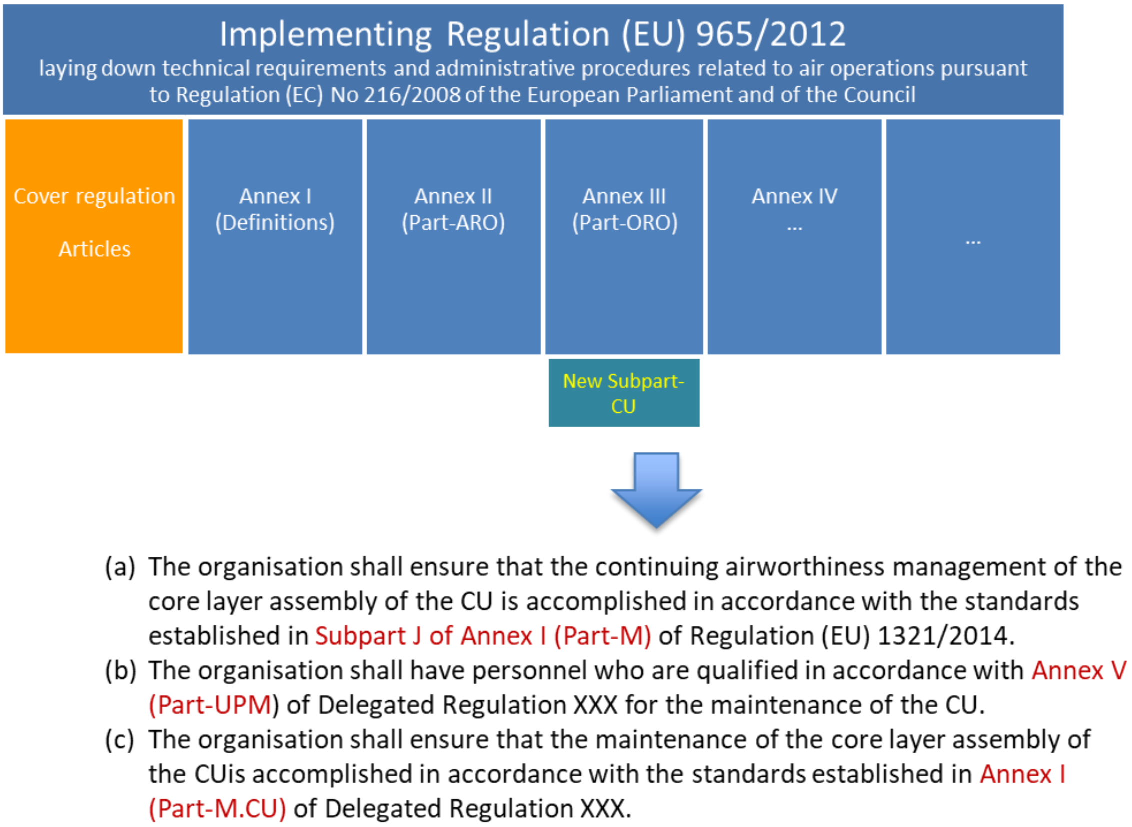

Figure 8 – Link with Regulation (EU) 965/2012

4.3 Additional considerations for CAW of UAS operated in the 'certified' category

4.3.1 'Complex motor-powered aircraft' criteria

For manned aircraft, under Regulation (EU) 1321/2014, the fact that an aircraft is classified as 'Complex motor-powered aircraft' determines that Part-M (as opposed to Part-ML) is applicable and that the responsible continuing airworthiness organisation will be approved under Part-CAMO and Part-145 (as opposed to Part-CAO) (ref. M.A.201).

For UA, if the decision is made in the first place to use Part-CAMO and Part-145 (or equivalent), there is an opportunity to free oneself from using 'complex motor-powered aircraft' as a criteria to define the continuing airworthiness regime.

However, there are additional provisions within each annex, which are required for 'complex motor-powered aircraft' only, such as the reliability programme (M.A.302) or the assessment of non-mandatory modification and inspections (CAMO.A.315).

In most of the cases, for UA, it is proposed not to make these requirements dependant on the complexity or type of aircraft or operation but adopt a permanent position.

Yet this approach may not be adapted to the aircraft release requirements which are different for the base maintenance of complex aircraft (use of category C certifying staff). A different approach may well be foreseen between the heavy maintenance of traditional large aircraft used as UA and the lighter scheduled maintenance of more innovative aircraft.

To address this at rule level, an alternative may be the use of a new UA classification or an assessment by the management system of the maintenance organisation (to determine the appropriate regime). This will require additional discussion with the expert group.

4.3.2 Link to other rulemaking tasks

Several rulemaking tasks are running in parallel to the rulemaking task RMT.0230 on 'certified' category of UAS:

- RMT.0255: 'Review of Part-66'
- RMT.0544: 'Review of Part-147'
- RMT.0731: "Electric and Hybrid Propulsion"

The rulemaking tasks RMT.0255 on Part-66 and RMT.0544 on Part-147 intend to address, in particular, the review of basic knowledge requirements and competency-based aspects of the certifying staff.

The rulemaking task RMT.0731 intend to address the gaps in the rule (e.g. in maintenance organisation class ratings, licence categories) caused by the fact that electrical propulsion was not considered in Regulation (EU) 1321/2014.

It is intended to coordinate these 3 tasks with RMT.0230 and propose similar provisions for UAS.

4.4 Continuing airworthiness for certified UAS operated in the 'specific' category

With reference to Article 40(1)(d) of Regulation (EU) 2019/945, the aspects of continuing airworthiness for certified UAS operated in the 'specific' category have not been discussed with the subgroup yet, but it is envisaged to allow the use of Annexes Vb (Part-ML) and Vd (Part-CAO), relevant to general aviation alleviations. Transitions measures for a possible change of category (from 'specific' to 'certified') may also need to be developed.

5 Operations (OPS)

5.1 UAS Operator Certification

The operator of a ‘certified’ category UAS shall undergo a certification procedure and shall receive a certificate as an organisation before starting air operations.

The certification requirements and process shall follow as closely as possible the traditional approach available under Part-ARO and Part-ORO of Regulation (EU) 965/2012. The UAS operator may therefore be issued an Air Operator Certificate (‘AOC’).

The certificate shall be issued by the NAA of the State of the Operator (SoO). SoO is the State where the principal place of business (for legal entities) or permanent residence (for natural persons) of the operator is located.

The NAA of SoO shall carry out the initial operator certification in cooperation with the competent authority responsible for aviation security matters. The aviation security rules of Regulation (EC) No 300/2008 and Regulation (EC) 185/2010, being part of the initial operator’s certification today, apply to ‘certified’ category UAS operations as long as they start from and end at EU airports. Aviation security measures with regard to operations to/from landing sites that currently do not fall under EU competence will remain under Member States competence until relevant EU measures are adopted and apply.

The Directive on Security Network and Information Systems[16] has been assessed as applicable to UAS operations in the ‘certified’ category. EASA will take the necessary measures to address these operations under RMT.0648: “Aircraft cybersecurity” and RMT.0720: “Part – AISS - Management of information security risks (refer to section 1.5 for more details). The NAA of SoO shall be responsible for the continued safety oversight of AOC holders certified by it, irrespective of the place of operation. The NAAs of the place(s) of operation shall exercise cooperative safety oversight.

The AOC for a UAS operator shall remain valid as long as the operator meets all the applicable requirements; it shall be subject to suspension, limitation, revocation, termination.

The Light UAS operator certificate (LUC)[17] may serve as an entry point for lower end ‘certified’ category UAS operations. For example, a LUC holder may carry out certain goods delivery operations in a rural environment, without a new UAS Operator certification procedure, if the risk assessment process demonstrates that the intended operation is low risk.

5.2 Conditions to obtain an Air Operator Certificate (AOC) for a UAS operator

5.2.1 Conditions on the UA

The UA shall be certified. The future Regulation on certified category UAS air operations shall specify if a TC (or RTC) issued by EASA and a valid CofA (or Restricted CofA) issued by the NAA of State of Registry (SoR) are required.

The list of certified UA intended to be used by the operator shall be included in the operations specifications to the AOC.

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[16] NIS Directive 2016/1148 concerning measures for a high common level of security of network and information systems across the Union.

[17] Part C of the annex to the Implementing Regulation (EU) 2019/945 on the rules and procedures for the operation of unmanned aircraft define the requirements for the voluntary Light UAS operator certificate (LUC).

The UAS shall be equipped with the necessary navigation, communication, surveillance, detect and avoid equipment[18], as well as any other equipment deemed necessary for the safety of the intended flight, taking into account the nature of the operation, air traffic management regulations and rules of the air applicable during any phase of the flight.

The approach to UAS technology from an operational perspective shall be neutral (technology agnostic) unlike the approach for manned aviation that distinguishes between aircraft categories and classes. However, a balance between prescriptive and performance-based approaches need be found in order to avoid too wide interpretations as it might be difficult for operators and competent authorities to implement and enforce, respectively.

A UAS must be operated only if it is in airworthy condition and where the equipment and the other components and services necessary *for the intended operation* are available and serviceable. This means that UAS operations with unserviceable parts will be allowed only if in accordance with MEL.

5.2.2 Conditions on the organisation

The applicant for an AOC shall have established a safety management system ('SMS') tailored to the complexity of the organisation and intended operation. This includes the ability to develop safety cases, assess tactical and strategic risks of intended operations by applying a validated risk assessment methodology and mitigate them.

It shall develop an OPS Manual (OM), including procedures to be followed by the Control Unit, for handover between two Control Units (if applicable), for management of C2 link connections across the entire flight, for communication with ATC and with data service providers.

Traditionally applied distinction to manned aircraft based on complexity (see also paragraph 3.2.1) shall not play a role in regulating 'certified' category UAS or it may be redefined, if necessary. Nevertheless, complexity of the organisation and operation need be taken into account.

5.3 Control Unit approval

A Control Unit organisation shall provide services under an approval by the competent authority of the Member State where it has its principal place of business. The Control Unit approval holder shall establish a service level agreement with the UAS operator, if this is not the UAS operator who provide such services for its own UAS operation.

The approval process shall be described in the future Regulation on certified category UAS air operations (Subpart CU of Part-ORO).

The Control Unit approval holder shall have the following responsibilities:

- successfully install the Control Unit in accordance with manufacturer specifications and required performance, and test its layer 2 and layer 3;
- ensure their personnel have received the required qualification according to their functions and are fit to perform their duties;
- make sure that their remote pilots have received recurrent and CRM training appropriate to the operational concept;

[18] If available as suitable for the airspace be flown

- comply with Part-M Subpart J of Implementing Regulation (EU) 1321/2014 to ensure that the CU including any installed component, is kept conform to approved design, specifications and performance, and is in a condition for safe operation of the UA (it is configured for a particular flight; it is compliant with the applicable ADs, etc.);
- have personnel qualified in accordance with Part-UPM of Delegated Regulation (on Continuing Airworthiness) for the maintenance of the Control Unit and shall ensure that the maintenance of its core layer is accomplished in accordance with the standards established in Part-M.CU of the same Delegated Regulation.
- monitor the quality of service provided by any external service providers;
- ensure that the Control Unit is protected against sabotage or other unlawful interference;
- ensure that for operations in volumes of airspace where U-space services are provided, are conducted with the applicable requirements; ensure that appropriate interfaces and service level agreements are established with U-space service providers whose services are used during the flight;
- ensure that for operations conducted in airspace classes A-C, the UAS operator complies with the airspace requirements and have indicated the relevant contingency and emergency procedures in the filled flight plan;
- ensure tactical operational control for the (portion of) flight for which the Control Unit approval holder is in charge of, whilst the UA operator shall maintain strategic operational control of the flight at all times.

The Control Unit personnel responsible for programming, pre-flight preparation and servicing as well as operating and remotely piloting shall have the relevant security clearances.

If the Control Unit approval holder does not provide remote pilots (i.e. in the case of dry lease), the competent authority shall enter limitations to the approval.

5.4 C2 link service provider

The provision of the C2 Link service during operation is likely to be dependent on local conditions (topography, EMI, weather). Potential operational limitations to the C2 link should be evaluated under the UAS design approval. The C2 link might also be dependent on systems and equipment (e.g. satellite networks) that cannot be specified in detail as part of the type design nor be subject to traditional aviation configuration control and surveillance. The quality of service provided by these systems and equipment should be compatible with the C2 link specifications established by the UAS designer/manufacturer.

Due to these challenges UAS operators and Control Unit approval holders have to conclude service level agreements with a C2 Link service provider to ensure that the required link performance is achieved.

A service level agreement shall contain specifications on frequencies and the quality of C2 Link service provision (latency, continuity, availability, C2 link loss or interruption etc.) in accordance with those established by the UAS manufacturer.

The C2 Link service providers is not an aviation approved organisation under the future Regulation on certified UAS air operations. The reason being that the performance requirements for the C2 link will depend on the level of autonomy of the UA and the operations being performed and this cannot be harmonised for the purpose of aviation for all UAS and all UA type of operations.

5.5 Responsibilities of the UAS operator certificate (AOC) holder

The UAS operator (AOC holder) shall:

- establish appropriate procedures for operational control of the UA in the OM manual; and
- ensure that remote pilots are licensed, when required depending on the level of automation of the UAS, appropriately rated and remain competent.

The UAS operator shall establish service level agreements with all needed Control Unit approval holders to ensure that all safety and security risks have been identified and properly mitigated to an acceptable level and that C2 link, compatibility, performance, handover and switch over, dry or wet lease of remote pilots have been properly addressed to a satisfactory level to ensure safe operations.

Those service level agreements shall be validated by and be under the safety and security oversight of the competent authority. The agreement(s) may only be notified to the competent authority, if the operator has been granted such privilege. But the competent authority will oversee through the UAS operator that these SLAs are met.

In addition, when the Control Unit is under its management, the UAS operator is responsible for the safety and security of the Control Unit, as well as for its conformity to initial and continuing airworthiness standards. The responsibility for conformity may be discharged through a CAMO.

The UAS operator shall ensure the operation of the UAS is in compliance with the applicable EU regulations and with the airspace requirements of the Member State in which the operation is conducted.

The UAS operator shall be responsible for maintaining an effective SMS, including safety risk management and management of change processes, taking into account actual risks stemming from their activities.

Before starting a UAS operation, the operator shall carry out a risk assessment as required by ORO.GEN.200 management system[19] and shall establish appropriate Standard Operating Procedures (SOPs).

The UAS operator shall include instructions for the loss of the C2 link in the operational flight plan, in accordance with the OM. Operational flight plan shall also include instructions for the handover between Control Units and the switch over of C2 link in the strategic planning of the mission.

It shall inform the competent authority and EASA, for organisations and service providers approved/certified by EASA, of any reportable occurrence. Typical reportable occurrences include acts of sabotage and other unlawful interference, significant failures, malfunctions or defects, near-miss, loss of C2 link etc. Regulation (EU) 376/2014 needs to be reviewed and modifications should be proposed for occurrences related to UAS which are not covered by the already reportable occurrences covered in that regulation.

In case of UA carrying passengers (e.g. VTOL UAS) the operator shall be responsible for managing the risks of e.g. unruly passengers on board. The methods will be defined by the operator based on the type of operation, safety and security (including e.g. passenger profiling) risk assessments.

The UAS operator shall be approved as or contract a CAMO for the continuing airworthiness of the UA and for arranging the accomplishment and release of the UA maintenance by a maintenance organisation.

[19] the identification of aviation safety hazards entailed by the activities of the operator, their evaluation and the management of associated risks, including taking actions to mitigate the risk and verify their effectiveness

The UAS operator shall also be responsible for recurrent training of the operator's personnel according to their functions and duties and shall recruit personnel who has the appropriated security clearances relevant to the function they perform.

5.6 Future Regulation on certified UAS air operations

There are still two options how OPS regulation could be updated in the future.

Both options are introducing relevant vertical and horizontal adaptations to existing Part-ARO, Part-ORO and Part-SPA of Regulation (EU) No 965/2012. In every existing Annex to Regulation (EU) No 965/2012 that is subject to adaptations, there shall be new subparts dedicated to the certification of an UAS operator and approval of the Control Unit organisation (Subpart CU of Part-ORO).

Option #1 would cover the three types of operations under a new Annex IX, as illustrated in Figure 9. This approach is considered innovative although there may be need to repeat many of the requirements already included in the existing Parts.

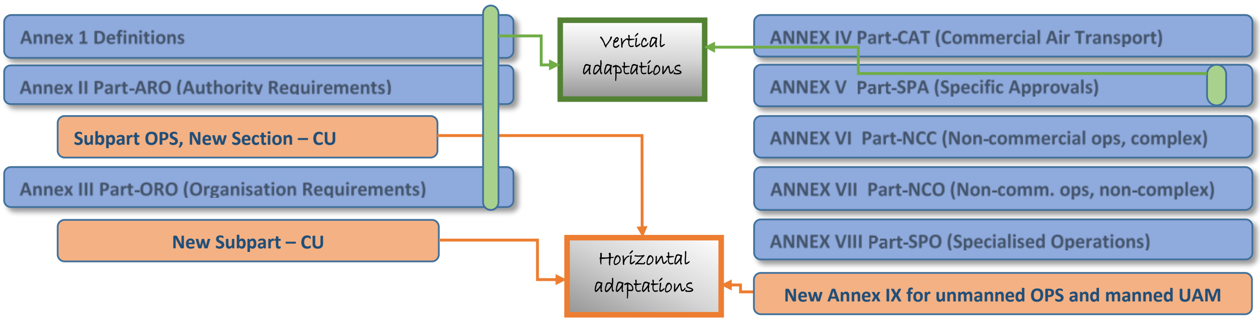

Figure 9 – Proposed approach for the amendments to existing OPS regulation – Option #1

Option #2 would cover operations type #1 through an update of Annex IV Part-CAT and operations type #2 and #3 under the new Annex IX which will be named in such a case Urban Air Mobility, as illustrated in Figure 10:

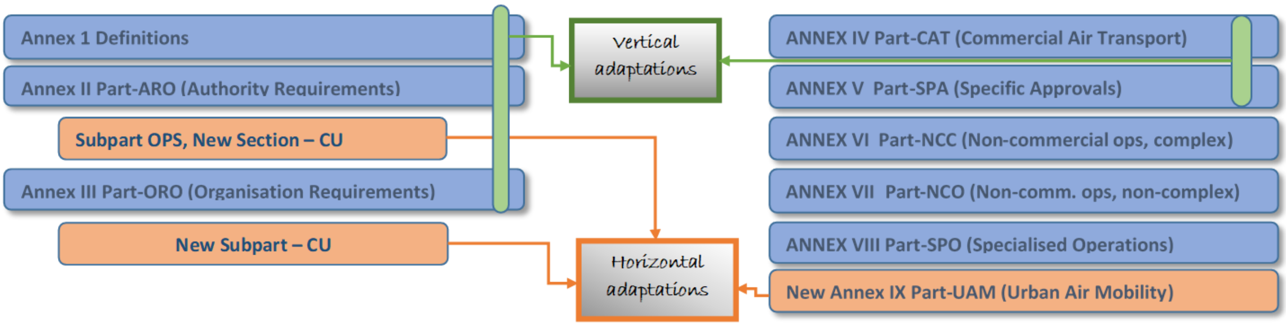

Figure 10 – Proposed approach for the amendments to existing OPS regulation – Option #2

6 Pilot 3-2-1 licensing concept

The pilot 3-2-1 licensing concept will encompass a regulatory framework that will address all **three** types of operation with **two** different licences both of which are based on **one** training concept (hence the name 3-2-1 licensing concept).

6.1 Operations types

In line with section 1.2, the proposed Pilot 3-2-1 licensing concept addresses three operations types, namely:

– International unmanned IFR cargo operation (type #1);

– unmanned operation of automation system – based aircraft systems (ASBA) (type #2);

– manned operation with vertical take-off and landing aircraft (VTOL) (type #3).

6.1.1 UAS operations type #1 – international unmanned IFR cargo operation

Operation type #1 falls into the scope of ICAO's work on UAS. For these operations, an 'ICAO international IFR Annex 1' remote pilot licence (IRPL)[20] is proposed which will have different ratings/endorsements with ICAO Annex /limitations.

6.1.2 UAS operations type #2 – unmanned ASBA operation

As the ICAO framework referred to in section 6.1.1 above is applicable to international IFR operation only, a new innovative framework is proposed to regulate operation type #2. A new type of licence, the automation system – based aircraft pilot licence (APL) will be introduced to cover UAS operation in congested (e.g. urban) or non-congested (e.g. rural) environment using pre-defined routes in volume of airspaces where U-space services are provided.

6.1.3 UAS operation type #3 – manned VTOL operation

Operation type #3 will, as operation type #2, take place in congested (e.g. urban) or non-congested (e.g. rural) environment, using only manned VTOL, a specific kind of ASBA, both inside and outside the U-space environment. The same licence, the APL, will be issued for this type of operation, with manned aircraft operation privileges on VTOL type ratings.

6.2. Overview and main elements of the 3-2-1 licensing concept for IRPL and APL

6.2.1 General

As outlined above in section 6.1 and illustrated on the Figure below, the two licences IRPL and APL will cover all three types of operation:

[20] The IRPL licence will be ICAO compliant

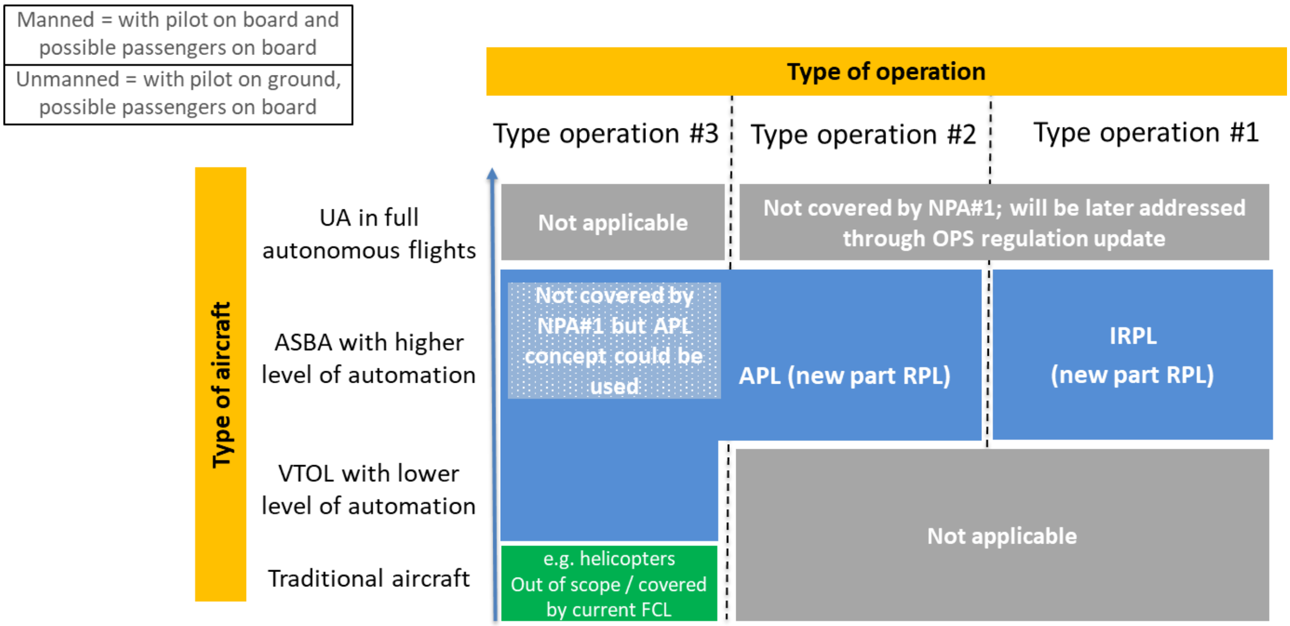

Figure 11 – Link between types of aircraft, types of operation and types of licenses

While the regulatory framework for the IPRL needs to fully follow ICAO standards, for the APL an innovative and more flexible framework is proposed for the reasons specified in section 6.2.2 below.

However, the IRPL and the APL will be covered by a common training concept, in order to harmonise training requirements, where possible. The details of this common training concept are outlined in the following sections.

6.2.2 APL principles and objectives

Because many aircraft, in particular VTOL, will be used first with a pilot on board and in the future operated remotely, EASA is proposing to have a license scheme with ratings and endorsements which, for operations type #3, allows the pilot to progressively operate aircraft from manned to unmanned. Such progression in addition to the awaited ‘dual use’ (manned / unmanned VTOL) as well as the development of aircraft with different propulsion concepts and different levels of automation all in all require a flexible regulatory framework.

The objectives of the APL framework are:

(a) To foster standardisation and harmonisation of licensing requirements for pilots in order to facilitate the operation of UAS in a safe manner in the airspace;
(b) to ensure an acceptable safe level and adequate competency of any pilot involved in the operation of manned/unmanned (automated) aircraft systems;
(c) to establish requirements for the introduction of a licence for pilots involved in the operation of manned/unmanned (automated) aircraft systems;
(d) to develop, based on the level of automation and type of operation, tailored competency-based initial training and bridging courses, and associated assessments for pilots involved in the operation of manned/unmanned ASBA;
(e) to ensure that pilots involved in the operation of manned/unmanned ASBA conduct training at either an approved training organisation (ATO) in conjunction with an UA operator certificate

holder (or CU approval holder) or solely at an UA operator certificate holder (or CU approval holder), as appropriate.

6.2.3 IRPL/APL theoretical knowledge training (TK) proposed concept

The IRPL/APL theoretical knowledge training (TK) proposed concept is illustrated in Figure 12 below and further details in the following sections:

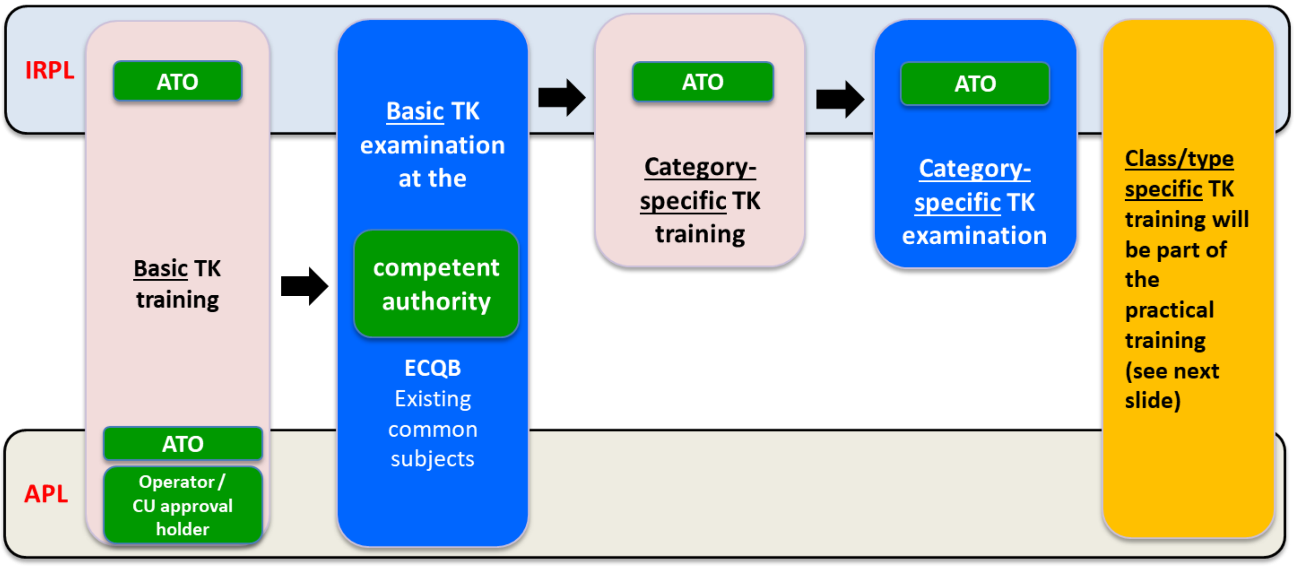

Figure 12 – IRPL/APL theoretical knowledge training (TK) proposed concept

6.2.3.1 Basic theoretical knowledge training (both for IRPL and APL)

The basic theoretical knowledge training for both IRPL and APL will consist of the common subjects which are relevant for all types of operation and levels of automation, irrespective of particular propulsion systems.

For IRPL, the training should be conducted at an ATO (as mandated by ICAO). For the APL, the basic theoretical knowledge training should be conducted either at an ATO or at an operator or CU approval holder.

6.2.3.2 Basic theoretical knowledge examination (both for IRPL and APL)

The basic theoretical knowledge examination for the IRPL and the APL will be provided by the competent authority and based on existing ECQB questions on common subjects.

6.2.3.3 Category-specific theoretical knowledge training (IRPL only)

The category-specific training which should be conducted at an ATO is mandated by ICAO and is therefore foreseen for the IRPL only. It constitutes additional theoretical knowledge as relevant for the aircraft category (aeroplane, helicopter...) under which the particular UAV is falling.

6.2.3.4 Category-specific theoretical knowledge examination (IPRL only)

For testing the category-specific knowledge, ICAO is more open and allows the conduct of the knowledge examination at an ATO.

6.2.4 Class/Type-specific training

Depending on the level of autonomy of the machine, two possible ratings are anticipated, a class rating for high level of automation or a type-specific rating for lower levels of automation.

For high level of automation, it is anticipated that there will not no remote pilot but a UAS fleet manager who still needs to have personnel trained as planner and manager of the flight (e.g. to plan the mission and all the information needed to conduct the flight as well as the contingency information to be uploaded on the UA). These requirements will be then placed in the OPS regulation.

This concept is illustrated on Figure 13 below:

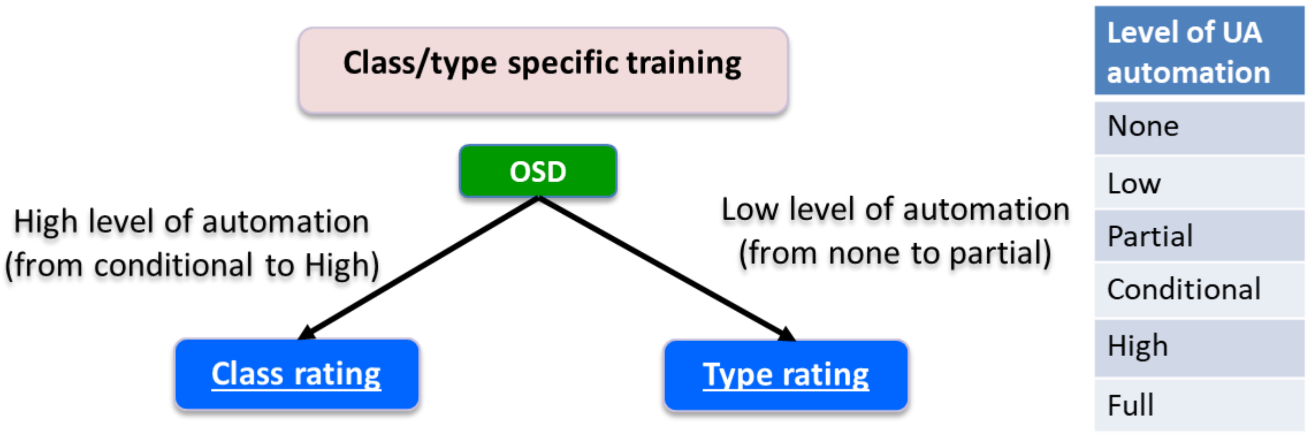

Figure 13 – Class/type specific training proposed concept

<u>Note</u>: although Article 19 of the Basic Regulation (EU) 2018/1139 only refers to "minimum syllabus of pilot type rating", EASA considers that the OSD concept can be extended for the pilot training part to the notion of class rating; this approach would be indeed similar to what is currently done for "minimum syllabus of maintenance certifying staff type rating training" where Part-66 defines also groups of ratings.

Whatever the rating, the class or type-specific trainings will encompass both practical and class/type-specific theoretical knowledge training as illustrated on Figure 14 below.

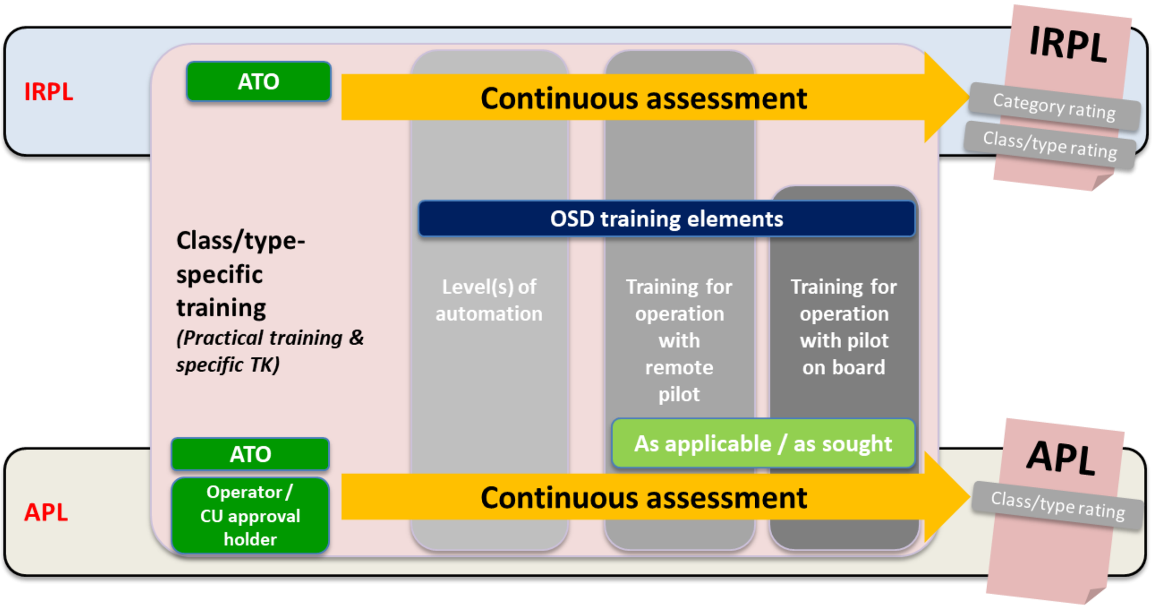

Figure 14 – Class/type specific training detailed concept

6.2.5 Type-specific training

As explained in section 3.7, it will be the responsibility of the aircraft manufacturer to define the training syllabus for the particular aircraft type as part of the OSD. This OSD training syllabus is to be used by training organisations and aircraft operators for developing a competency-based training programme (CBTP) for a particular aircraft (type-specific training). The training syllabus for that CBTP may be based on industry standards.

Applicants for an IRPL will need to complete the type-specific training either at an ATO. Applicants for an APL will need to complete the training either at an ATO or at an operator which operates the particular aircraft, or, as regards the remote pilot station, at the CU approval holder. In both cases, the type-specific training will encompass both practical flight instruction as well as additional theoretical knowledge as relevant for the particular aircraft.

The type-specific training course will need to reflect all of the following:

- high-level training requirements and competencies as set out in Part-RPL;
- training elements mandated by OSD (via reference in Part-RPL), including training elements related to the level(s) of automation (as referred to in Section 3.7) of the particular type; and
- in the case of the APL, training elements as necessary for manned/unmanned operation, depending from the privileges sought.

In cases where the training is provided by an aircraft operator/CU approval holder or by an ATO on behalf of an aircraft operator/CU approval holder, the training course may already include the operating procedures of that aircraft operator.

As already mentioned above, OSD training elements will reflect the type-specific training that is necessary in the context of all automation-related capabilities of the particular aircraft.

The competence of the applicants is continuously assessed throughout the competency-based training programme (CBTP). This continuous assessment replaces a skill test at the end of the training. When an applicant has completed the CBTP and reached the required competency level, the training provider will issue a product-specific training course completion certificate. In the case of APL, the course completion certificate will need to include information on the privileges (manned/unmanned operation) for which the applicant was trained and assessed.

The CBTP will also allow to consider previous experience of the applicant gained as a Part-FCL licence or military licence holder.

Coordination with the OPS group of RMT.0230 will be necessary in order to establish the above described links between the licensing training and the operator/CU approval holder-specific training as well as in order to consider the training privileges of an operator/CU approval holder.

6.2.5.1 Type-specific licence issue

Applicants who have successfully completed the training and examination as specified in section 6.2.3 as well as the product-specific type training (section 6.2.5) and have been issued with the course completion certificate for the type-specific training can apply to the competent authority for the issue of an IRPL or an APL, including a rating for the aircraft on which the type-specific training was completed. In the case of the APL, the rating will be restricted to the type of operation (manned/unmanned) for which the applicant received training.

The IRPL, APL and the aircraft ratings included therein will however not include further remarks or limitations related to the level of automation, as the level of automation is type-specific. All automation-based operation capabilities (including different automation levels, as applicable) therefore need to be fully addressed during the type-specific training.

In the case of the APL, the applicant will need to hold a medical certificate which is appropriate with regard to the privileges (manned/unmanned operation) sought (pilot class 2 or 3 medical certificate).

6.2.5.2 Extension of privileges

IRPL or APL holders who wish to extend their privileges to further types will need to complete type-specific training (as specified above in section 6.2.5 above) related to the new type and, in the case of an IRPL holder to seeks privileges for an UAS in another aircraft category, category-specific training and examination as per sections 6.2.3.3 and 6.2.3.4 above.

APL holders who wish to extend their privileges from manned to unmanned operation or vice-versa will need to complete the relevant parts of the type-specific training (as specified above in section 6.2.5).

6.2.5.3 Training providers

The particular training provider, which can be an independent training provider or, in the case of APL, part of the UA operator or CU approval holder, will need to develop the relevant training programme and have it approved by the competent authority.

6.3 Proposed amendments to the Aircrew Regulation

To introduce the IPRL and the APL in the Aircrew Regulation, the following amendments are needed:

- introducing of a new Annex IX - Part-RPL, including:
    - a general part with requirements which are the same for the IRPL and the APL (e.g. minimum age, language proficiency); and
    - two specific parts for the IRPL and the APL;
- amendments to Annex IV – Part-MED: pilot class 2/3 medical certificates;
- amendments to Annex VII – Part-ORA: Training has to be done via a CBTA approach at an ATO or an operator;

amendments to Annex VI – Part-ARA: Introduction of a new Subpart RPL with authority requirements for the IRPL and the APL.

7 Air Traffic Management (ATM) / Air Navigation Services (ANS) and Single European Rules of the Air (SERA)

7.1 General principles

In general, the main purpose of ATM/ANS[21] and SERA[22] requirements is to allow safe, and orderly and efficient air traffic. One of the major objectives of ATM and SERA is to avoid collisions.

Indeed, one of the underlying principles of SERA is the principle of "see and avoid" which shall be used by the pilot in command as last line of defence to avoid mid-air collision in all airspace classes. Taking into account that in the UAS operations the pilot is not on-board this principle cannot be applied as in the case of manned aircraft and this shall be mitigated with adequate alternative means. Although it is EASA's ultimate goal that UAS have a capability to "detect and avoid" (DAA) and/or "sense and avoid" (SAA) other aircraft, developed in accordance with European harmonised set of validated standards adapted to the European airspace, these systems do not exist yet. Therefore, there is a need to use strategic and tactical mitigation means offered by the ATM/U-space[23/24] system. This can be acceptable until DAA/SAA capabilities are available to enable a low number of UAS operations in a given airspace volume although this may not be sufficient for safely integrating manned and large number of UAS operations.

There are different concepts of operations such as the one of ICAO[25] and the operational concept for ATM developed by EUROCONTROL[26] which develop further these general principles and which have been used in the development of the sections below. It is important to note that only parts of these concepts of operation related to the scope of this first regulatory phase (as detailed in section 1.2) have been used.

The application of the objectives and principles within ATM/ANS-SERA concept will be different depending on the type of operations and how the air risk is mitigated in each of them.

In the rest of the section, the concept is organised around the three types of operations defined in section 1.2.

7.2 Mitigating air risk in operations of type #1 (IFR unmanned cargo operations in airspace classes A-C)

Operations of type #1 (IFR unmanned cargo operations in airspace classes A-C) fall into the scope of ICAO's RPAS Panel work on UAS. Being IFR certified, the UAS are expected to comply with the IFR rules and the applicable SERA and ATM requirements.

ICAO is assuming that DAA is available, certified and compatible with all airspace requirements. This is the reason why the ICAO operational concept extends also to airspace classes D and E[27], where VFR traffic might request a clearance to enter into the airspace but separation from IFR traffic is not provided. In the proposed

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[21] ATM/ANS are regulated in Europe by Commission Implementing Regulation (EU) 2017/373: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0373&from=EN

[22] Standardised Rules of the Ai (SERA) is included in Commission Implementing Regulation (EU) No 923/2012 of 26/09/2012 – SERA: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:281:0001:0066:EN:PDF

[23] U-space is being defined by EASA regulatory developments in parallel to this task. In general it is understood as a set of digitalised and automated set of services to safely managed large number of UAS traffic in a given volume of airspace.

[24] The U-space services foreseen in this CONOPS are those that will be included in the EASA regulatory proposal. Today it includes services in U1 and some of the services in U2.
https://www.sesarju.eu/sites/default/files/documents/reports/European ATM Master Plan Drone roadmap.pdf

[25] ICAO RPAS CONOPS can be found: https://www.icao.int/safety/UA/Documents/RPAS%20CONOPS.pdf

[26] EUROCONTROL UAS ATM Integration Operational Concept can be found:
https://www.eurocontrol.int/sites/default/files/publication/files/uas-atm-integration-operational-concept-v1.0-release%2020181128.pdf

[27] The services available in each airspace class can be found in Appendix 4 of SERA Regulation: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:281:0001:0066:EN:PDF

operational concept, EASA assumes that the DAA may not be always available. This is the reason why the airspace classes have been limited to A-C[28] where in principle VFR traffic is separate from IFR traffic.

In addition to the assumption that UAS is IFR certified it is assumed that the UAS for operations type #1 is equipped with all the necessary Communication, Navigation and Surveillance (CNS) equipment and complies with all the interoperability requirements to fly in the European airspace.

- For communication, the UAS shall comply with the relevant datalink requirements when it flies above FL295 and with the relevant radio communication requirements for ATC communications. As C2 link is also used for ATC communications, the performance requirements will be more demanding and redundant C2 links will need to be ensured. The C2 link contingencies procedures shall be harmonised made available to relevant ATS unit in the flight plan.
- For navigation, the UAS is Performance Based Navigation (PBN) certified and is able to comply with the applicable PBN requirements for the European airspace (RNAV5 for en-route and RNP1/RNAV1 for approach respectively).
- For surveillance requirements, the UAS is equipped with Mode S transponders, ADS-B out as applicable[29].
- In addition, the following is assumed for the ATM point of view in order to enable safe and orderly UAS's operations:
  - Depending on the UA weight[30], the UAS is equipped with TCAS II 7.1 coupled with the autopilot. The failure rates for the autopilot will need to be considered in the overall safety assessment based on the operational concept. When the UA weight or UA performance (e.g. rate of climb and descend) are such that the equipage of TCAS II 7.1 coupled with autopilot is not feasible or safe, an alternative means need to be reviewed and demonstrated to EASA.
  - The UAS is able to follow the arrival and departures procedures and its behaviour such as speed, climb-/descent-/turn-rates in the airspace are the same as for manned aircraft.
  - The UAS has automatic take-off and landing capabilities. This implies that the UAS is certified to conduct Cat III precision approaches and landings with no decision height and no runway visual range limitation (ILS CAT III-C). However it has to be investigated if for UAS equivalent new technologies and procedures could enable these capabilities.
  - The UA is able to safely fly the go-around procedures when required.

There may be some operational limitations to this concept because there are not so many aerodromes in the world equipped to support Cat III-C precision approach operations with no decision height and no runway visual range limitation. Alternative concepts supporting the same safety levels need to be demonstrated from the UAS certification, operational, ATM and aerodromes point of view.

When any of the above cannot be guaranteed, then the use of 'smart segregation tools' need to be applied (e.g. specific corridors, or segregation by time/space).

[28] EASA acknowledges this limitation. Therefore equivalent means need to be identified e.g. additions to TMZ in class D, development of specific corridors in order to achieve equivalent safety levels.
[29] If the UA MTOM > 5.7 tons or TAS > 250 kts
[30] If the UA MTOM > 5.7 tons

As explained in ICAO RPAS CONOPS and also in EUROCONTROL UAS ATM Operational Concept, the main points to be addressed are when reviewing the SERA and ATM/ANS requirements are:

– Lost C2 procedures and contingency,
– Detect and Avoid and associated procedures, if available,
– Direct controller-pilot communication,
– Airspace management aspects,
– Performance conformance,
– Flight planning,
– Lights to be displayed,
– Interception procedures, and
– Phraseology.

There are other important topics such as meteorological adverse conditions and contingency measures in case of any CNS related outages, but they will be considered at a later stage.

ICAO RPAS Panel is expecting to provide the relevant proposals for amending ICAO Annexes 2, 10, 11 and PANS-ATM in 2020 and 2021. EASA will use whatever is available prior to issuing EASA's NPA in Q4 2020 which aims to amend SERA and ATM/ANS regulations as applicable.

7.3 Mitigating air risk in operations of type #2 (UAS flying in urban environment where U-space services are available)

As required in SERA.3105 on minimum heights and except when necessary for take-off or landing, or except by permission from the competent authority, aircraft shall not be flown over the congested areas of cities, towns or settlements or over an open-air assembly of persons, unless at such a height as will permit, in the event of an emergency arising, a landing to be made without undue hazard to persons or property on the surface. The minimum heights for VFR flights shall be those specified in SERA.5005(f) and minimum levels for IFR flights shall be those specified in SERA.5015(b).

This requirements implies that today aircraft operations in an urban are not very often (e.g. mainly police helicopters, HEMS and perhaps some specially authorised balloons).

UAS due to their design performance and operational approach offer new paradigm to allow, depending of societal acceptance and noise tolerance, more operations in urban environment.

As these operations are still under development and demonstration phases, the Agency is still gathering relevant information and experience on the way to manage the UAS traffic safely in the urban environment. Therefore, it is expected that the first type of operations in an urban environment will follow a limited set of 'pre-defined' routes for which the relevant competent authorities have got assurance that the air and ground risk are properly mitigated and therefore compliance with SERA.3105 can be achieved.

For operations of type #2, that the following assumptions are made:

– U-space services are available and able to support strategic, pre-tactical and whenever feasible tactical (e.g. in the form of dynamic geo-awareness) de-confliction if required by the traffic and traffic complexity or support DAA capabilities;

- UAS fly at Very Low Levels (VLL[31]) and therefore segregated from normal VFR traffic. This is below the minimum height for VFR. Whereas outside of urban environment, VLL are below 500 ft, VLL in urban environment are higher and in some cities could be up to 4000 ft or above.
- Operations in urban environment can be inside the control zone (CTR) of an aerodrome, nearby or outside the CTR. In this case, there shall be coordination procedure between the ATS Unit and the relevant U-space service providers to guarantee appropriate separation/segregation between manned and unmanned traffic.
- UAS can fly above VLL in urban environment but still inside a volume of airspace designated by the Member State or competent authority (e.g. can be the city) as airspace where U-space services are provided. In this case, there shall be coordination procedure between the ATS Unit and the relevant U-space service providers to guarantee appropriate separation/segregation between manned and unmanned traffic.
- In general, the Member States or the designated competent authority will use the already existing tools in SERA and the principles already used in the Flexible Use of Airspace (FUA) regulation for dynamic airspace management. They will establish those volumes of airspace where U-space services are provided as restricted airspace.

The Member State needs to make this information available to manned aviation (in particular if operations are expected to occur above VLL in an urban environment) by publishing it in AIP and NOTAM as applicable. Until suitable DAA capabilities are available this is the only way to ensure that the air risk is properly mitigated when operating UAS in urban environment. The publication of the relevant requirements for UAS to fly in these volume of airspace within urban environment is made available to UA operator certificate holders and remote pilots (or fleet managers) with the publication of the UAS geographical zones required in Article 15 of Implementing Regulation (EU) 2019/947 or in the AIP. This needs to be discussed with the expert group.

Operations of UAS in urban environment will first be run like today's manned helicopter operations in urban environment and even more restricted in some cases because they need to use one the published pre-defined routes. However, once the reliability of such unmanned aircraft is proven and more advance U-space services are available (such as more advance tactical de-confliction services or DAA capabilities), operations of type #2 will be expanded and will become more regular.

For operations within the CTR of an aerodrome, it is important that the traffic managed by ATC, mainly the manned helicopter operations in the urban environment is procedurally separated and segregated from the UAS traffic managed by U-space services providers. In a first step as long as DAA is not fully available respective functionalities based e.g. on flight plan information and or position reports will have to be implemented. At a later stage:

- manned aviation flying in an urban environment could also be managed by U-space services providers providing strategic and tactical de-confliction services, or
- all UAS in the urban environment are equipped with DAA capabilities suitable for that operational environment.

As stated above, in the first implementation phase, type#2 operations will follow predefined set of routes. While this might be considered as an operational limitation, this is important to ensure proper strategic de-

[31] 'Very Low-Level' means the airspace below the minimum height for VFR flights as listed in SERA.5005 (f) of Regulation (EU) No 923/2012

confliction until the tactical de-confliction services are available or the DAA capabilities are demonstrated to be safe. The establishment of these predefined routes needs also to consider the availability of appropriate landing sites-vertiports for normal operations and also for contingency. The way to predefine the set of routes will be discussed with the expert group.

7.4 Mitigating air risk in operations of type # 3 (piloted VTOL operations)

When the pilot is on-board, in general the 'see and avoid' principle is complied with. However, this will depend on the level of automation of the vehicle to follow the predefined route/trajectory and the capability of the on-board pilot to take control of the aircraft and avoid collision at any point in time.

As it is foreseen that the piloted VTOL is only a transitional phase until confidence is gained on remotely-piloted/self-piloted VTOL or UAS VTOL, the same operational constraints than in operations type #2 are to be applied. If the pilot can take control of the aircraft and avoid collision, then the piloted VTOL may be allowed to fly in airspace classes D and E like today manned aviation. This may be useful for the transit part of the air-taxi flight between the aerodrome and the urban environment. The pilot on board shall comply with the applicable requirements in SERA depending if the aircraft is flying IFR or VFR and he/she shall comply with the ATC instructions as required.

When the piloted VTOL is flying in a volume of airspace where U-space services are provided, it is expected that piloted VTOL also adheres to these U-space services and uses them to mitigate the air risk with other UAS or manned aircraft flying in the same volume of airspace. This approach will allow a faster transition between piloted VTOL and UAS VTOL. However, this needs still to be discussed with the expert group.

7.5 Link with U-space regulatory developments

In parallel to this regulatory developments and as already committed by EASA during the High Level Conference on Drones in Amsterdam in 2018, EASA is working together with the European Commission and with the support of Member States, SJU and EUROCONTROL in the development of a high level regulatory framework for U-space. The first EASA's Opinion of U-space (U-space is a set of digitalised and automated services to managed large number of UAS operations in a volume of airspace) is expected to be published in Q1 2020. The first EASA's proposal for high level regulation is expected to define roles and responsibilities for the establishment of U-space, U-space service providers requirements, UAS and aircraft operators requirements, ATM/ANS providers and Member States requirements. The first draft regulation will propose a limited set of mandatory U-space services to be used in the volume of airspace where U-space services are provided. However, the Member States may, depending on the traffic and traffic complexity, require additional U-space services. U-space services available will mature in the near future and EASA will make proposals for amending the first regulation once more mature services are available. The Agency might proposed a limited set of rules needed to manage the UAS traffic when these can be easily accepted by all. These can be right of way rules that are needed to avoid collisions.

The regulatory developments including a more precise definition and description of the services will be further considered in the subsequent modifications of this concept paper.

7.6 Proposed regulatory approach and amendments to the ATM/ANS and SERA regulations

The regulatory approach to be followed is the following:

a. to analyse the requirements for the different type of operations and required technical capabilities;

b. to compare these requirements and capabilities with the objectives within SERA and ATM/ANS regulations;

c. identified options whether the regulatory provision can be applied as it is, modified and adapted or whether new regulatory provision.

This requires a review of all SERA provisions and the technical requirements of the ATM/ANS regulation.

The following amendments are expected to be addressed during this first phase:

- Amendments to Commission Implementing Regulation (EU) No 923/2012, SERA, to include proposal either coming from ICAO RPAS Panel for operations type #1 or from the expert group for operations type #2 and type #3.
- Amendments to Commission Implementing Regulation (EU) 2017/373, on common requirements for ATM/ANS and its safety oversight as applicable/required to consider UAS operations all types.
- Amendments to U-space regulation to be still developed as applicable to cover in particular operations types #2 and #3.

8 Aerodromes

Section 8 addresses issues related to aerodrome design and operational services and covers two possible situations:

- Operations type #1 are operations which will take-off and land only at aerodromes within EASA's scope;
- Operations types #2 and #3 are operations which could take-off and land at any aerodrome or any designated landing port, vertiport or landing site.

8.1 Clarifications related to aerodromes within EASA's scope

Regulation (EU) No 2018/1139 does not apply to all aerodromes in Europe. It applies to aerodromes which are open to public use, serve commercial air transport and have a paved instrument runway of 800 metres or more, or exclusively serve helicopters using instrument approach or departure procedures. A list of the aerodromes that fall under the EASA scope per Member State is shown below:

Country	EASA ADRs	Exempted
Austria	7	1
Belgium	6	0
Bulgaria	5	1
Croatia	9	1
Cyprus	2	0
Czech Republic	5	0
Denmark	14	5
Estonia	4	0
Finland	24	0
France	107	51
Germany	55	21
Greece	39	8
Hungary	6	2
Iceland	4	0
Ireland	10	2
Italy	43	5

Country	EASA ADRs	Exempted
Latvia	1	0
Lithuania	3	0
Luxembourg	1	0
Malta	1	0
Netherlands	7	2
Norway	50	1
Poland	15	2
Portugal	15	4
Romania	16	0
Slovakia	6	2
Slovenia	3	2
Spain	36	1
Sweden	41	1
Switzerland	8	3
UK	49	0

Figure 15 - List of the aerodromes that fall under the EASA scope per Member State

Aerodromes which are not falling under the scope of Regulation (EU) No 2018/1139 are regulated through a national regulatory framework.

For this reason, any Regulation proposed by EASA will have a limited applicability; however, in order to establish and maintain a coherent system it is important that any national regulations issued for aerodromes that fall outside EASA scope, should mirror the EU requirements.

8.2 Operating considerations

The operation of a UAS at an aerodrome surface is a complex and challenging issue. The absence of on-board pilots removes a crucial element that ensures proper orientation within the aerodrome environment, adherence to the instructions issued by air traffic control and collision avoidance with other aircraft, vehicles and infrastructure. Consequently, while developing the 'certified' category regulatory framework, the following general safety principles should be taken to account:

- The UAS should be able to orientate within the aerodrome environment;
- The UAS should be able to adhere and acknowledge the instructions issued by ATC in a timely and correct manner;
- The UAS operation should not increase the risk of collision with other UAS and manned aircraft, vehicles and infrastructure; and
- The UAS should be able to park safely on the assigned parking position.

These generic safety objectives are explained in the following sections.

8.2.1 Orientation within the aerodrome environment

Pilots orientate themselves within the aerodrome environment based on visual cues from signs, lights and markings and in more advanced cases using on-board moving maps.

The specifications of visual aids for aerodromes are included in ICAO Annex 14, which in Europe have been transposed in CS-ADR.DSN. These specifications (e.g. light colour and intensity, size and colours of signs and markings) are established in such a way to ensure that human eye is able to see them at a specified distance and visibility conditions in order to have a continuous flow of traffic and reduce the risk of collisions and dis-orientation.

It is expected that the Remote Pilot (RP) will be able to identify the visual aids at the aerodrome. Furthermore, if other means on board systems are used to support the orientation of the UAS in the aerodrome environment, such as Aerodrome Moving Maps, it has to be explored if additional ground systems are required to support and complement on-board systems.

This is also related to the ability of the remote pilot to follow assigned taxi-routes from/to the runway to the assigned parking position. The remote pilot should have the means to identify the assigned route which needs to be communicated by ATC in a timely, correct and unambiguous manner.

8.2.2 Adherence to and acknowledgement of air traffic services/ATC instructions in the manoeuvring area

Air traffic services are responsible for providing instructions to aircraft on the manoeuvring area and apron management services, if established at the apron. With manned aircraft, this is done through direct voice communication between controllers and pilots although there are cases where instructions are transmitted though digital messages (D-TAXI).

For UAS, direct voice communication could be used as long as instructions are communicated in a timely manner; in particular, transaction times shall be such that any delays anticipated would be as low as possible.

8.2.3 Risk of collision between UAS and other UAS, manned aircraft, vehicles and infrastructures

The risk of collision between UAS and other UAS and manned aircraft, vehicles and infrastructure should not increase.

For manned aircraft, pilots, when operating on the ground, are using the ‘see and avoid’ principle in order to maintain clearances from other aircraft, vehicles and infrastructure.

For UAS, the absence of an on-board pilot cancels this principle; therefore other alternative means should be employed to ensure that the remote pilot detects other aircraft, vehicles and infrastructure in the proximity of the UA.

Although different technologies may be used to achieve this, the general objective of any of them should be to provide accurate and in a timely manner information as well as advisory on how to resolve the conflict.

8.2.4 Parking considerations

Pilots traditionally complete the parking of aircraft by using external assistance. This can be done with the support of a person on the ground, by following specific markings or following the instructions by a Visual Docking Guidance and Control System (VDGCS) or an advanced system (A-VDGCS) which provide alignment and stopping information. The basic principle is that the pilot is following the instructions given.

In the case of UAS, the absence of an on-board pilot creates an additional challenge. Current technical means which are in use may not be usable unless the remote pilot is able to see them. The issue may be resolved:

- either by towing the aircraft to the stand (this is applicable for conventional or aircraft having wheels in general), or
- by employing such means that provide required information which can be identified by the remote pilot.

Any other technology to be used should ensure that if any automated instructions are used these are transferred to the remote pilot as soon as possible and contingency procedures should be in place in case of system failure.

8.4 VTOL operations

For VTOL, the characteristics of the landing location should be identified, irrespective if it is located within an aerodrome or at a remote location. Considering the fact that they have similar characteristics with rotorcrafts, current heliports, apart from runways, may be used provided that UAS dimensions and performance meet the design characteristics of the heliport. In any case, a detailed assessment of the EASA aerodromes and heliports rules and SARPS of Annex 14 Volume II Heliports should be conducted to ensure that specifications can accommodate the operation of VTOL UAS and if necessary develop new ones, in particular when these vertiports or landing sites are located in an urban environment

VTOL requirements for their specific operating sites, so called vertiports are becoming of specific significance. Even more so, the issuing of individual vertiport permits by national authorities is expected a cumbersome legal proceedings and its expected duration presents a potentially the most time wise critical item. As of today, European technical aerodrome requirements are basically limited to runways. Stand-alone heliport requirements are subject to ICAO, Annex 14 Vol II Heliports transposed at national level. Vertiport requirements doesn't exists, so far.

The harmonised technical requirements for vertiports seems to be of common EU interest. Besides the positive effect of fostering the European VTOL technology as such, this harmonisation is particularly important for small and medium VTOL manufacturers who are dependent on other actors. If requirements are harmonised, these manufacturers would have an easier access to EU markets.

A common European approach to vertiports could be established in the scope of the drone programme, provided as a non-formal format (i.e. 'vertiport manual'). The development should be set in synchronisation of EASA current heliports rules and ICAO SARPS with the manufacturers requirements.

9 Planning

The term of reference (ToR) of RMT 0230 includes a table proposing the list of deliverable and the planning dates for publication.

Based on the maturity of the elements that contributes to the concept of the 'certified' category some changes will be proposed in a new revision of the ToR that will be developed in the coming weeks.

Since in some areas the technologies and available standards are not yet mature enough, a full airspace integration of UA will not be immediately achieved and a phased approach is needed.

The NPA#1 will include amendments to:

- Regulation (EU) 748/2012 (Part-21)
- Regulation (EU) 1321/2014 (continuing airworthiness) and creation of a new delegated regulation for the maintenance organisation, training and licencing involved in UAS
- Regulation (EU) 1178/2012 (Air crew)
- Regulation (EU) 965/2012 (Air ops)
- Regulation (EU)139/2014 (Aerodrome)
- Regulation (EU) 923/2012 (SERA)
- Commission Implementing Regulation (EU) 2017/373, if considered necessary.

However, the following aspects will <u>not</u> be <u>covered</u> in the NPA#1:

- Rules of the Air and Separation Provisions for BVLOS operations in relation to VFR and IFR traffic
- DAA capabilities validated in all airspace classes within European airspace (therefore operations in class D-G are not foreseen when there is not pilot on-board for the time being);
- Fully autonomous operations.

In some other areas, ICAO is working in parallel on drafting SARPS and the European Rulemaking process might need to consider these developments (e.g. in the area of requirement for operators, ATM/ANS-SERA, DAA) once available.

This NPA#1 expected to be published by EASA in Q4 2020 will follow the standard rulemaking process, including a 3 months public consultation.

An EASA opinion may be expected one year later.

An NPA#2 may be proposed in 2022 to cover the remaining amendments to the regulations.

The development of an NPA including the new CS UAS, CS light UAS, amendments to CS ETSO and to CS-36 is planned for the end of 2021, while further amendments to ATM/ANS, ATCO, SERA, ACAS and CS-ACNS, mainly in relation to the introduction of Detect and Avoid Systems/Capabilities but not only, are planned for end of 2022.