



ECC Report **268**

Technical and Regulatory Aspects and the Needs for
Spectrum Regulation for Unmanned Aircraft Systems
(UAS)

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0 EXECUTIVE SUMMARY

Unmanned Aircraft Systems (UAS) technology has gone through massive development in recent years, and the market for civil UAS shows exponential growth, similar to all other significant new technologies. There are a number of challenges in fully realising the potential for growth that UAS bring with them. One of these challenges is meeting the spectrum requirements for UAS. Frequencies are used for command and control¹ and identification as well as for payload transmissions (e.g. onboard cameras sending information to the ground).

In 2015, ECC conducted a survey on the civil use of UAS pilotless aircraft. The purpose of this questionnaire was to collect available information from CEPT administrations. The questionnaire was also made available to Organisations which have an MOU/LOU with the ECC including ICAO, EASA and other competent organisations.

Other activities in this field included ADCO (Group of Administrative Co-operation under the R&TTE Directive) who conducted a campaign on Remotely Piloted Aircraft Systems (RPAS).

This Report focusses on UAS that fly in circumstances where they do not need communications with air traffic control (ATC). This is the case of aircraft flying under visual flight rules (VFR) in airspace classes E (controlled airspace) and F and G (uncontrolled airspace as long as not designated as Radio Mandatory Zone (RMZ)). This is also the case for aircraft flying between 0 metres and the local minimum height for controlled airspace. The local minimum height above which airspace is controlled depends on the airspace structure and the location of airports.

This Report follows the 'Prototype' Commission Regulation from EASA which only encompasses the Open Category and the Specific Category but not the Certified Category as defined in the new regulatory approach for Europe. This Report therefore covers the area between flying models under SRD regulations on one hand and Certified Category use (more ITU-R relevant, real aeronautical use) on the other hand. Within this area, many new UAS applications for professional use emerge.

The airspace classes are described in Annex 4 of ITU-R Report M.2171 [1].

The professional use can roughly be mapped with the Open Categories A2 and A3 (see section 5.4.1) and the Specific Category (see section 5.4.2). In these categories, a requirement for electronic identification is foreseen.

In their responses to the questionnaire, some administrations supported the harmonisation of preferred frequencies for UAS. The main reasons behind their proposal are that:

- Using unlicensed bands shared by various types of applications would not be appropriate for some professional UAS due to risk of interference, and may not meet the expectations of professional UAS service providers (unsecure investments, emission limits do not support the intended operating range);
- Harmonisation would foster a common market for UAS products and may for some professional UAS usage scenarios help to avoid cross-border issues.

In relation to the definition of an individual authorisation opportunity for professional use of UAS, this needs to be defined by the national administration, taking into account national circumstances.

The communications links that are considered in this Report deal with command and control and possibly support for sense and avoid. It could be necessary to add a downlink video stream as an essential requirement of the safe operation of a UAS.

¹ Command and control for the purposes of this Report includes, where appropriate, sense and avoid.

A possible solution for small-size professional UAS would be if the communications for command and control as well as the payload (usually video, sometimes data) could be accommodated within the same frequency band, because the capacity for carrying multiple radios on a UAS is limited. In consequence, the radio equipment installed in the UAS may need to be one system for command and control as well as the payload information.

For the payload information, there is much more capacity needed for downlinking video information than, for example, uplinking commands to configure the payload of the UAS.

The selected frequency bands and the associated regulation should be able to support the spectrum need for the control of UAS, but also include some provisions to allow payload links. The associated regulation should also make it possible to share the frequency band or bands between these two usages for countries wishing to do so, while on one hand ensuring that the payload resource, unlike command and control, is not subject to aeronautical safety constraints and on the other hand that the payload does not use the control resource and thereby compromise the safety of the UAS.

Another solution is to consider separate adjacent bands for command and control on one hand, and video payload on the other hand (close to each other, if possible).

Given the many possibilities for new innovative UAS applications, it is nearly impossible to derive a common spectrum demand figure as an amount of MHz.

The most common channel bandwidth for telecommand and control is 1 MHz or between 300 kHz and 3 MHz, mostly spread spectrum, and duty cycled. The spectrum use can be shared. The systems must be robust, possibly under shared licensed access. In this scenario, the maximum bandwidth for such links may need to be limited to ensure provision of at least a minimum number of channels, otherwise the interference probability would be too high and UAS used at the same location could not avoid using the same frequencies.

For video payload information (downlink), typical test licences and product information indicate a need for 10 MHz, but the needs could also be less.

The frequency tuning ranges identified in ERC Recommendation 25-10 [2] Annex 3 for cordless cameras, portable video links and mobile video links are seen as a possibility for UAS video downlinks.

One possibility for professional UAS applications is to use existing mobile MFCN networks to provide connectivity to UAS by usual (unmodified) mobile networks with Long Term Evolution (LTE) technology provided that the command and control link(s), where appropriate, meet the relevant aviation safety requirements prevalent in the country of concern. This can be realised either by an external LTE device attached to UAS or in future by implementing SIM-cards installed within UAS. Such a connectivity could be used both for serving the payloads such as video or other collected data via sensors and for the command and control function of UAS. One project considered possibilities to implement a dedicated UAS traffic management system to enable future secure BLOS operations by using the frequency band 1710-1785 MHz/1805-1880 MHz. Other trials have shown that other mobile bands are also able to effectively support UAS².

UAS connectivity based on usual MFCN networks and technology could be an enabler for professional UAS applications operating at BLOS. The use would be based on individual authorisation, harmonised frequencies with sufficient spectrum capacity and coverage of existing infrastructure. The UAS would be registered and the position can be tracked over the mobile network. No-fly zones or geographical restrictions in general could be implemented via the UAS traffic management system.

² Several trials have taken place including by Nokia and Qualcomm, see <https://www.qualcomm.com/news/onq/2017/05/03/qualcomm-technologies-releases-lte-drone-trial-results>

Apart from the possibility of using MFCN networks, other professional UAS use can be envisaged which is independent from using MFCN. Some UAS operators may not wish to subscribe their application to an MFCN network or may have specific requirements which could not be fulfilled by an MFCN-based solution.

Providing frequency opportunities for professional UAS applications based on MFCN usage or operating without using a MFCN would support all options for new innovative professional UAS applications.

The Open Categories A0 and A1 are seen as the non-professional use 'lower' Open Categories. Non-professional UAS use is considered to make use of frequency opportunities under general authorisations (predominantly in the 2.4 GHz and 5.8 GHz bands). In this context, the use of 5 GHz WAS/RLAN as defined by ECC/DEC/(04)08 [4] is not allowed for airborne unmanned aircraft. UAS in these categories often separate the frequency use between command and control on one hand and payload (e.g. video from a camera) on the other hand.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
ADCO	Group of Administrative Co-operation
ADS-B	Automatic dependant surveillance broadcast
ANAC	National Civil Aviation Authority (in Brazil and also in Portugal)
ATC	Air traffic control
ATM/ANS	Air traffic Management/Air Navigation Services
BLOS	Beyond Line of Sight
BRLOS	Beyond Radio Line of Sight
CEPT	European Conference of Postal and Telecommunications Administration
CNCP	Control and non-payload communications
CS	Certification Specifications
DoC	Declaration of Conformity
EASA	European Aviation Safety Agency
EC	European Commission
ECC	Electronic Communications Committee
ECO	European Communications Office
ERM	EMC and Radio Spectrum Matters
ETSI	European Telecommunications Standards Institute
EU	European Union
ICAO	International Civil Aviation Organization
IMEI	International mobile equipment identity
LOS	Line of Sight
LOU	Letter of Understanding
LTE	Long Term Evolution
MFCN	Mobile Fixed Communications Network
MOU	Memorandum of Understanding
NAA	National Aviation Authority
QE	Qualified entity
RED	Radio Equipment Directive
RF	Radio frequency
RMZ	Radio Mandatory Zone
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft Systems

Abbreviation	Explanation
R&TTE	Radio and Telecommunication Terminal Equipment
S&A	Sense and avoid
SRD	Short Range Device
TCAM	Telecommunication Conformity Assessment and Market Surveillance Committee
UA	Unmanned Aircraft
UACS	Unmanned Aircraft Control Station
UAS	Unmanned Aircraft Systems
UAV	Unmanned aerial vehicle
VFR	Visual flight rules
VLOS	Visual Line of Sight
WRC-12	World Radio Conference 12

1 INTRODUCTION

Recent years have seen massive development in Unmanned Aircraft Systems (UAS) technology, and the market for civil UAS shows exponential growth similar to other new technologies. There are a number of challenges in fully realising the potential for growth that UAS bring with them. One of these challenges is meeting the spectrum requirements for UAS. Frequencies are used for command and control and identification as well as payload transmissions (e.g. onboard cameras sending information to the ground).

This Report focusses on UAS that fly in circumstances where they do not need communications with air traffic control (ATC). This is the case of aircraft flying under visual flight rules (VFR) in airspace classes E (controlled airspace) and F and G (uncontrolled airspace as long as not designated as Radio Mandatory Zone (RMZ)). This is also the case for aircraft flying between 0 metres and the local minimum height for controlled airspace. The local minimum height above which airspace is controlled depends on the airspace structure and the location of airports.

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Other activities in this field include ADCO (Group of Administrative Co-operation under the RE Directive) which had a campaign on Remotely Piloted Aircraft Systems (RPAS). Several ECC administrations confirmed interest for such a campaign.

2 GENERAL UAS DESCRIPTION

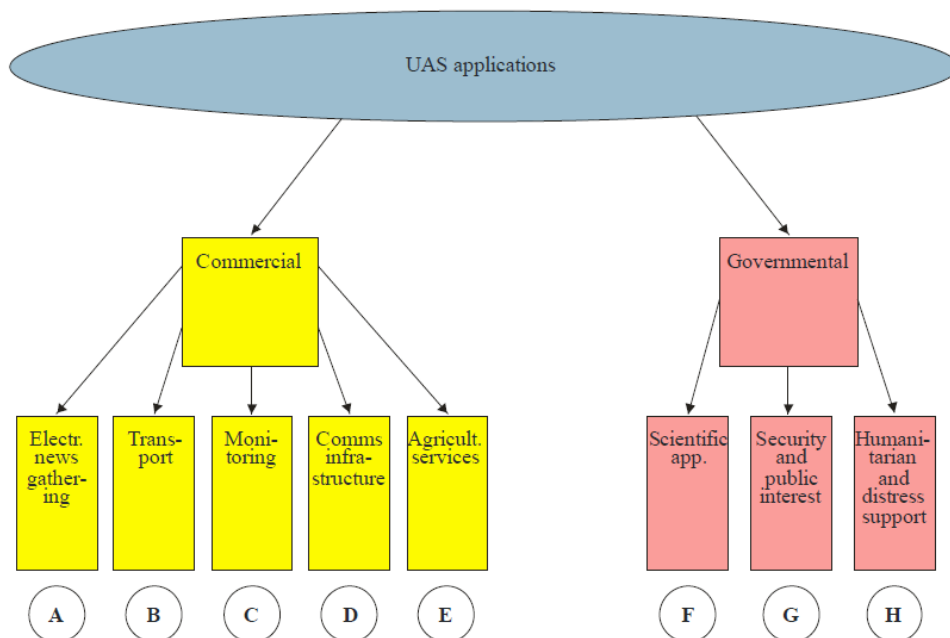
A general UAS description is included in Report ITU-R M.2171 (12/2009) [1].

Deployment of Unmanned Aircraft Systems (UAS) will require access to either terrestrial or satellite spectrum, or both.

Communications are key in UAS systems due to the remote nature of human presence. Safety-of-flight and the protection of the public are the driving factors when considering the seamless flight of UAS within civilian air traffic. In the end, safe operation of UAS relies on communications which represents a critical step in enabling UAS operations in non-segregated airspaces.

2.1 EXAMPLE PROFESSIONAL UAS USAGE SCENARIOS

Report ITU-R M.2171 (12/2009) [1] provides an overview about typical UAS application sectors:



Report M.2171-01

Figure 1: UAS applications

Table 1: Examples

Mission type	Example description
A	Movie making, sports games, popular events like concerts.
B	Cargo planes with reduced man power (one-man-cockpit).
C	Inspections for industries, e.g. oil fields, oil platforms, oil pipelines, power line, rail line.
D	Provision of airborne relays for cell phones in the future.
E	Commercial agricultural services like crop dusting.
F	Earth science and geographic missions (e.g. mapping and surveying, aerial photography) biological, environmental missions (e.g. animal monitoring, crop spraying, volcano monitoring, biomass surveys, livestock monitoring, tree fertilization).
G	Coast line inspection, preventive border surveillance, drug control, anti-terrorism operations, strike events, search and rescue of people in distress, and national security. Public interest missions like remote weather monitoring, avalanche prediction and control, hurricane monitoring, forest fires prevention surveillance, insurance claims during disasters and traffic surveillance.
H	Famine relief, medical support, aid delivery. Search and rescue activities.





2.2 CONSTRAINTS IN RELATION WITH THE CARRYING CAPACITY OF PROFESSIONAL UAS

The communications links that are considered in this Report deal with command and control and possibly support for sense and avoid. It could be necessary to add a downlink video stream as an essential requirement of the safe operation of a UAS.

A possible solution for small-size professional UAS would be if the communications for command and control as well as the payload (usually video, sometimes data) could be accommodated within the same frequency band because the capacity for carrying multiple radios on a UAS is limited. In consequence, the radio equipment installed in the UAS may need to be one system for command and control as well as the payload information.

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For video payload information (downlink), typical test licences and product information indicate a need for 10 MHz but the needs could also be less.

The frequency tuning ranges identified in ERC Recommendation 25-10 [2] Annex 3 for cordless cameras, portable video links and mobile video links are a possibility for UAS video downlinks noting that the frequency band 2 700-2 900 MHz is excluded from air-to-ground use and therefore would not be suitable.

The UAS categories which are 'professional use' and which are in the focus of this Report have also the electronic identification requirement (see section 5.4.1).

2.3 SENSE AND AVOID

ITU-R Report M.2204 (11/2010) [3] describes characteristics and spectrum considerations for sense and avoid systems use on UAS. Small airborne anti-collision radar sensors may be used in the future. The aeronautical radionavigation allocations offer possible opportunities, as do other radiodetermination allocations that are currently used on the ground, e.g. in the traffic telematics or industrial field. Ultra-sound sensors may also be an option for the time being due to their attractive costs.

Alternatively, ADS-B broadcasts, beacons or any other means of providing cooperative awareness message may be a solution. The challenge with this is that it is currently not mandatory to implement such a feature for the variety of different unmanned aircraft.

3 CEPT QUESTIONNAIRE

Detailed information and an assessment of the responses to the CEPT questionnaire in 2015 on UAS have been established and the information is included in Annex 1 of this Report.

In order to get proper information the questionnaire was split into 2 parts:

- Part 1: Spectrum regulation part: this part focuses on current and planned spectrum regulation as well as existing problems and interference cases and is intended to be filled out by CEPT administrations;
- Part 2: Aeronautical regulation part: this part focuses on the aeronautical definitions, regulations, requirements and operational scenarios of such UAS and is intended to be filled out by stakeholders including air traffic management organisations, users, industry, etc.

The European Communications Office (ECO) received in total 58 responses. 30 responses were from CEPT administrations, and 28 responses were from stakeholders.

The question was raised whether the development of a new ECC harmonisation deliverable on frequency bands for UAS would be necessary. In their responses to the questionnaire, 14 administrations supported the harmonisation of preferred frequencies for UAS. The main reasons behind their proposal are that:

- Using unlicensed bands shared by various types of applications is likely to increase the risk of interference to and from UAS;
- Using unlicensed bands would limit the range of operation;
- Harmonisation would allow users to operate UAS close to a border or in cross-border scenarios;
- Harmonisation would reduce the global footprint of UAS on the spectrum resources.

It is considered that a new opportunity for professional UAS use should be found. This would also support the new European regulation under development for UAS.

4 ADCO MARKET SURVEILLANCE CAMPAIGN

ADCO R&TTE 51 has endorsed the final report on the 7th R&TTE common market surveillance campaign carried out by the national market surveillance authorities' members of the ADCO R&TTE (now ADCO RED). This campaign was focused on Remotely Piloted Aircraft Systems (RPAS).

The report is also available on the commission's website http://ec.europa.eu/growth/sectors/electrical-engineering/red-directive_en under the topic "Market Surveillance Reports" (Here the direct link on the report: <http://ec.europa.eu/DocsRoom/documents/13343/attachments/1/translations/en/renditions/native>).

79 products were checked in 1st half of 2015; control links mostly use 2.4 GHz (84%) while some products have video cameras which use also 5.8 GHz (about 25%). Most products are manufactured in the Far East (92%). Many products are not marked CE (37%); missing or incomplete Declaration of Conformity (DoC) (45%), documentation compliance only around 21%; technical compliance: 50%, almost independent from price, non-compliant for spurious emissions (23 products) and too high power/power density emissions (14), mostly remote control part, overall non-compliance is 92%. Some equipment CE marked while obviously not intended for the European market -> compliance with EN 300 440 [5] claimed but higher US emission levels referenced. Auto landing functions were implemented by about 30% of the products to prevent from uncontrollable falling down.

These results are supported by feedback from ADCO regarding the 7th R&TTE Market Surveillance Campaign on Remotely Piloted Aircraft System where most sampled products used the 2.4 GHz band for command and control purposes.

The ADCO Report highlights, among others, the following conclusions for the frequency bands of the tested Remotely Piloted Aircraft System:

- Four out of five (82%) products had administrative non-compliances within the meaning of R&TTE Directive; this non-compliance level is extremely high;
- Half (51%) of all assessed RPAS were found to be non-compliant in relation to the effective use of spectrum;
- Due to the low compliance with administrative requirements, the overall non-compliance is approximately 92%;
- Spurious emissions (70%) and radiated power/power density (23%) are the main reasons for non-compliance.

ADCO recommends that economic operators should be identified to find possible solutions, civil aviation authorities will be informed, and customs will be informed.

5 NEW COMMISSION REGULATION (EU) LAYING DOWN RULES AS REGARDS UNMANNED AIRCRAFT OPERATION

Current situation:

Currently, the European Union (EU) regulation on aviation does not regulate the operation of remotely piloted aircraft (RPA) with a mass of 150 kg or less. Such aircraft are governed by national rules. Because of differing national rules on criteria and conditions for the operation of UAS and related safety issues, operators must apply for a separate authorisation in each country. In the Commission's view, the current fragmented regulatory framework inhibits the further proliferation of UAS and overall growth of the EU market in UAS.

The current governing regulation, Regulation 216/2008 on Common Rules in the Field of Civil Aviation [6], only covers aircraft whose mass is above that size. RPA above the threshold of 150 kg fall within the mandate of the European Aviation Safety Agency (EASA).

Change process:

Since 2014, the European Commission has been engaged in promoting the integration of unmanned aircraft systems into the European civil aviation airspace. Following the EASA's Technical Opinion adopted in 2015 that recommended a risk-based regulatory approach to govern the operation of unmanned aircraft, the Commission introduced a proposal to replace the current regulation governing unmanned aircraft.

The proposal is designed to integrate all unmanned aircraft, regardless of their size, into the EU aviation safety framework. A key objective of the proposal is to ensure that the design, production, maintenance, and operation of unmanned aircraft comply with the essential requirements of manned aircraft. The European Parliament and other EU bodies strictly regulate the processing of personal data and the right to private life. Operators of UASD will be subject to tougher standards and requirements contained in the Data Protection Regulation, adopted by the European Parliament in April 2016, which is applicable as of 25 May 2018.

Once the proposal on UAS is approved by the Parliament and the Council of the EU, it will contribute towards the integration of unmanned aircraft into the European aviation airspace and provide the Commission with the legal authority to adopt delegated acts in compliance with the EASA's standards. See the notices of proposed amendment and steps towards a new regulation in [26][27][28] Note that the EASA Regulation does not address spectrum management aspects with regard to other radio services and applications than those set out by International Civil Aviation Organization (ICAO) to ensure the operations of aeronautical services.

5.1 TERMINOLOGY USED

5.1.1 EU, EASA and ICAO

At the European Union (EU) level, no uniform terminology is used to denote what is commonly known as drones. The European Parliament uses the term "civil drones" to differentiate civilian drones from those intended for military purposes. The European Commission uses the term "Remotely Piloted Aircraft Systems" (RPAS). The European Aviation Safety Agency (EASA), an EU body established in 2002 with the mandate to issue implementing rules and approve airworthiness standards, defines drones as "unmanned aircraft", which includes any aircraft operated or designed to be operated without a pilot on board." This term also includes machines that are normally not perceived by the general public as aircraft, such as flying toys, small tethered balloons, or kites. The EASA uses the term "drones" in all its communications to the general public. The EASA's definition of a drone is in line with the definition of "unmanned aerial vehicle" (UAV) provided by the International Civil Aviation Organization (ICAO), which is in charge of implementing the 1944 Chicago Convention on International Civil Aviation. The ICAO defines a UAV as "a pilotless aircraft, in the sense of Article 8 of the Convention on International Civil Aviation, which is flown without a pilot-in-command onboard and is either remotely and fully controlled from another place (ground, another aircraft, space) or programmed and fully autonomous." UAVs are further divided into two categories: (1) those that are remotely

piloted by a human and hence are designated as RPAS; and (2) those that are “autonomous,” meaning those that are controlled by a computer without pilot intervention after take-off. This second category is outside the scope of the EU’s regulation.

The new Draft EU regulation has introduced two definitions: one for unmanned aircraft and one for equipment used to remotely control the unmanned aircraft. The reason was to avoid that the equipment to remotely control the unmanned aircraft be systematically part of the “certification” of the unmanned aircraft. Therefore, unmanned aircraft covers only the flying element (the aircraft). As the equipment to remotely control the unmanned aircraft is a key element of its operations, this equipment must also be regulated by the prototype regulation (see below).

A writing convention uses unmanned aircraft system (UAS) to cover both the unmanned aircraft and the equipment to remotely control it. Unmanned aircraft system is an internationally recognised definition and its acronym (UAS) well known.

5.1.2 ITU

Report ITU-R M.2171 (12/2009) [1] describes the following terminology:

Unmanned aircraft (UA): Designates all types of aircraft remotely controlled.

Unmanned aircraft control station (UACS): Facilities from which a UA is controlled remotely.

Control Link subsystem: Communication link between the UA and the UACS carrying telecommands (from the pilot to the UA) and telemetry (from the UA to the pilot).

Control and non-payload communications (CNPC): The radio links, used to exchange information between the UA and UACS, that ensure safe, reliable, and effective UA flight operation. The functions of CNPC may be related to different types of information such as: telecommand messages, non-payload telemetry data, support for navigation aids, air traffic control voice relay, air traffic services data relay, target track data, airborne weather radar downlink data, non-payload video downlink data.

Sense and avoid (S&A): this corresponds to the piloting principle “sense and avoid” used in all air space volumes where the pilot and/or operator is responsible for ensuring separation from nearby aircraft, terrain, weather, obstacles and other hazards . See ICAO RPAS manual 10019, chapter 10 [29].

- Unmanned aircraft system (UAS): Consists of the following subsystems;
- Unmanned aircraft (UA) subsystem (i.e. the aircraft itself);
- Unmanned aircraft control station (UACS) subsystem;
- Air traffic control (ATC) communications subsystem (not necessarily relayed through the UA);
- Sense and avoid (S&A) subsystem;
- Payload subsystem (e.g. video camera ...);
- Radio line-of-sight (LoS): is defined as the direct radio line of sight radiocommunication between the UA and UACS.

Beyond radio line-of-sight (BLoS): is defined as the indirect radio communication between the UA and a UACS using satellite communication services.

Handover operations: is the transfer:

- Of a direct (LoS) RF communication from one dedicated UACS to another (LoS) dedicated UACS;
- Of a direct (LoS) to an indirect (BLoS) RF communication link or vice versa.

The airspace classes are described on the Annex 4 of the ITU-R Report M.2171 [1].

5.1.3 Classification of air spaces

The aim of the WRC-12 Agenda item 1.3 was to study the spectrum requirements and possible regulatory actions needed to support the safe operation of all kinds of UA in non-segregated airspaces.

Segregated airspace is restricted airspace of defined dimensions for the exclusive use of specific users.

Non-segregated airspace is airspace other than those designated as segregated airspace.

The category of airspace has a pronounced impact on the data rate required for ATC communications, command and control, and particularly regarding sense and avoid.

5.2 NEW KEY PRINCIPLES

The Riga Declaration on Remotely Piloted Aircraft, “Framing the Future of Aviation” [7] which was adopted on March 6 2015, by Commission representatives, civil aviation officials, data protection national authorities, and representatives from the manufacturing industry, recognised the following key guiding principles to be taken under consideration in the future regulation of drones:

1. Drones must be dealt with as a new type of aircraft and any safety rules imposed must be proportional to the risk of each operation;
2. There is a critical need for the EU to establish safety rules immediately and to lay down technologies and standards for the integration of drones within civil aviation;
3. The protection of privacy and safety of individuals will lead to greater public acceptance;
4. The operator of a drone bears responsibility for its use.

In connection with the last principle, the Declaration raised the issue of insurance, third-party liability, and compensation schemes for victims, all of which fall within the domain of the individual EU Members.

In September 2015, the European Parliament’s Transport and Tourism Committee adopted, on its own initiative, the Report on Safe Use of Remotely Piloted Aircraft Systems (RPAS), Commonly Known as Unmanned Aerial Vehicles (UAVs), in the Field of Civil Aviation [15]. In the Report, the Committee endorsed the key principles agreed to in the Riga Declaration [7], and the Commission’s intention to remove the 150 kg threshold and replace it with a comprehensive EU regulatory framework. The Committee also approved the EASA’s new competence to regulate drones and urged the EASA to budget funds for drone-related activities.

5.3 EUROPEAN AVIATION SAFETY AGENCY

The EASA provides opinions and formulates technical rules relating to the construction, design, and operational aspects of aircraft, and is also responsible for assisting the Commission by providing technical, administrative, and scientific support.

In May 2015, the EASA adopted a document titled Concept of Operations for Drones: A Risk Based Approach to Regulation of Unmanned Aircraft [8], which urged regulation of the operation of drones in a manner proportionate to the risk of the specific operation, and proposed to establish three categories of drone operations: Open, Specific, and Certified, with associated regulatory regimes. To mitigate privacy concerns, the EASA suggested the installation of chips/SIM-cards in drones. Other suggestions included the self-registration of drone operations in a Web-based application maintained by the local authorities.

At the request of the Commission, the EASA issued a Technical Opinion on Introduction of a Regulatory Framework for the Operation of Unmanned Aircraft on December 18 2015. The Opinion contains 27 specific proposals for a regulatory framework and for low-risk operations of all unmanned aircraft irrespective of their size. The Technical Opinion divides drones into three categories depending on risk:

1. Open (low risk): Safety is ensured through compliance with operational limitations, mass limitations as a proxy of energy, product safety requirements, and a minimum set of operational rules. The ‘open’ category does not require any pre-approval as safety is ensured notably by a

combination of measures including requirements and limitations on the operation, the unmanned aircraft system and the involved personnel and organisations. These general measures are complemented by conditions to access to airspace determined by the Member States;

2. Specific (medium risk): Authorisation is given by a national aviation authority (NAA), possibly assisted by a qualified entity (QE), following a risk assessment performed by the operator. A manual of operations lists the risk mitigation measures. The ‘specific’ category requires operators to obtain an authorisation given by the competent authority based on a risk assessment performed by the operator. As this could be burdensome for authorities and operators, a concept of standard scenario covering certain types of operations or flights has been developed. As operations with different risk levels are envisaged, the standard scenario will identify the cases where in lieu of the authorisation, a simple declaration by the operator will be sufficient to start the operation. These standard scenarios will be included in Certification Specifications (CS);
3. Certified (higher risk): The requirements applicable to this category are comparable to those for manned aviation. Oversight is provided by the NAA (issue of licenses and approval of maintenance, operations, training, Air Traffic Management/Air Navigation Services (ATM/ANS), and airfield organisations) and EASA (design and approval of foreign organisations).

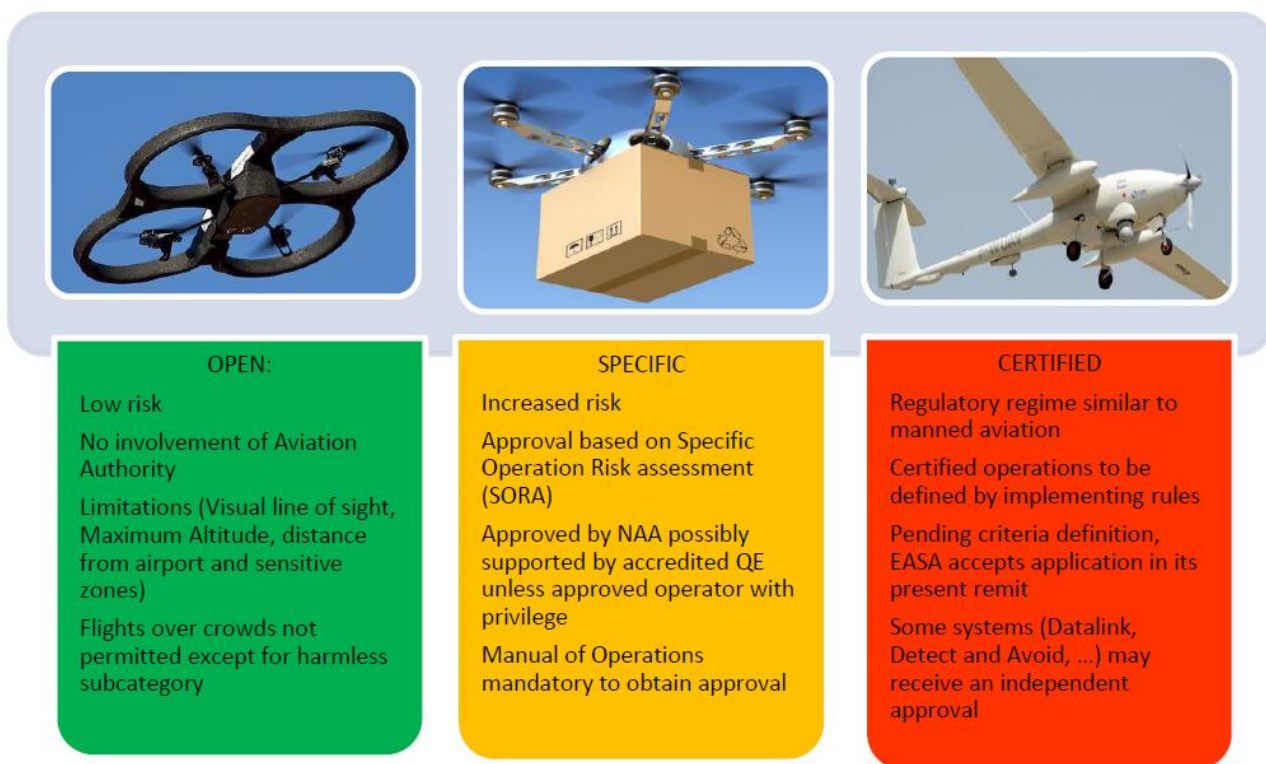


Figure 2: The three categories of operations in the operation centric approach

This operation centric approach is risk based. Theoretically a legislation only based on risk assessment could work but would lead to a significant burden for operators and competent authorities (e.g. operators to produce risk assessments, authorities to approve risk assessment). In addition for complex operations conducted with complex unmanned aircraft, there could be benefit to adopt a certification approach as it would avoid re-doing compliance demonstration and as it would give confidence to the public.

The balance between these considerations has led to create the three categories. In addition, some of these unmanned aircraft can be considered as toys, which are regulated by the product legislation.

The European Aviation Safety Agency (EASA) has also published a first draft of Commission implementing rules ('Prototype' Commission Regulation on Unmanned Aircraft Operations and its Explanatory Note) [9] to provide a clearer idea of what could be a European regulation and further engage with stakeholders. These 'prototype' rules are building on the Technical Opinion on the operation of UAS published in December 2015, the related public consultation, based on a concept of operations for UAS and a proposal to create common

rules for operating UAS in Europe issued earlier in 2015. The ‘Prototype’ Commission Regulation only encompasses the Open Category and the Specific Category but not the Certified Category.

The safety of the ‘open’ category relies in particular on a set of limitations: unmanned aircraft maximum take-off mass must be below 25 kg as a proxy to a limitation in energy, flight are limited to height below 10 m above ground or sea level and the unmanned aircraft must remain in visual line of sight (VLOS) of the remote pilot in order to reduce the risk of collision with other unmanned aircraft. The 25 kg limit was chosen because it is quite frequently the limit for ‘model aircraft’ to fly without an approval of its design. It is also the limit adopted by the FAA (see Table 2: USA – FAA’s operational constraints for small UAS), ANAC Brazil and Transport Canada. Of course with such a maximum take-off mass, there is a need to have subcategories in order to have rules proportionate to the risk. The limitations to 150m and VLOS are very important to mitigate the risk of collision with other aircraft.

Table 2: USA – FAA’s operational constraints for small UAS

Category	Summary of proposed requirements
Operational limitations	<ul style="list-style-type: none"> ▪ Must weigh less than 55 lbs. (25 kg); ▪ Must operate within visual line-of-sight only; ▪ May not operate above any persons not directly involved in the operation; ▪ Must only operate during the day, no night-time operations; ▪ Maximum airspeed of 100 mph (161 km/h); ▪ Maximum altitude of 500 feet (152 m) above ground level; ▪ Must not operate carelessly or recklessly; ▪ Establishment of a micro-manned aircraft system (UAS) category (4.4 lbs. or less) (2.0 kg or less); ▪ Must yield right-of-way to other aircraft, manned or unmanned
Operator certification and responsibilities	<ul style="list-style-type: none"> ▪ Must either hold a remote pilot airman certificate or under direct supervision of a person who does; ▪ Must pass a knowledge test initially and every 24 months; ▪ Must be vetted by the Transportation Security Administration (TSA); ▪ Must obtain an unmanned-aircraft operator’s certificate with a small UAS rating
Aircraft requirements	<ul style="list-style-type: none"> ▪ FAA airworthiness certification not required, but operator must conduct a pre-flight check of the UAS to ensure safe condition for operation
Model aircraft	<ul style="list-style-type: none"> ▪ Would not apply to model aircraft that satisfy all of the criteria specified in Section 336 of Public Law 112-95; ▪ Would codify the FAA’s enforcement authority by prohibiting model aircraft operators from endangering the safety of the national airspace system

The FAA published Part 107 for the regulation of small-UAS operations, which became applicable in August 2016 and whose scope is comparable to the EASA Open Category. Preliminary subcategories of operations have been created to ensure that the rules remain proportionate. They are characterised as follows:

1. A class of unmanned aircraft system. The essential requirements for the class of UAS may call for installation of geofencing functionality and electronic identification;
2. A set of limitations (maximum height; distance from uninvolved persons; VLOS) as appropriate;
3. Requirement for pilot competence as appropriate.

The combination of these three factors ensures the safety of the subcategory. Four preliminary categories have been defined from Open Category – subcategories A0 to A3, ranging from the less complex to the more complex one.

The Council of the EU, and specifically the transport, telecommunications, and energy ministers in charge of the aviation market, advocate a harmonised EU approach to civil UAS use while emphasising the need to take into consideration the experience gained in this field by the Member States, according to their comments at a public hearing. Most of the ministers were of the opinion that the EASA was the entity best suited to develop technical and safety standards, licenses, and certificates, and agreed on the gradual and progressive integration of UAS into civil aviation.

It was agreed with Member States that the Commission and EASA would develop a roadmap to provide more clarity on what are the plans to roll out the operation centric concept. The roadmap includes information on rulemaking tasks, development of standards, research, cooperation with international organisations and FAA. It was developed during three workshops with Member States (March, April and May 2016) and presented to Industry at a workshop in June. However, this roadmap did not fully clarify all issues, and EASA decided to produce a prototype regulation for 'open' and 'specific' categories by the end of the summer. This prototype regulation proposes actual rules providing the necessary clarity, notably on what are the responsibilities of the Member States and what is the flexibility offered to them. It has been called 'prototype' to reflect the fact that they should help preparing the formal rulemaking process that will follow.

Indeed, the intention is to publish this 'prototype' regulation and gather reactions which will be used to develop the necessary Notice of Proposed Amendments later in 2016. Reactions will be collected using a dedicated mailbox and dedicated workshops. In addition, as this prototype regulation will be available at the start of the negotiations between the European Commission, the Council and the Parliament, they may facilitate debates and avoid that the Basic Regulation text becomes too specific. The detailed cover regulation should become a key element in these discussions.

Some of the provisions of the prototype rules will contribute to the application of other legislations such as security, privacy, data protection and environment. For example the requirements for geofencing together with the possibility for Member States to define zones where the activity of UAS is prohibited or limited, contributes to security and privacy. This provides an effective means to adapt unmanned aircraft operations to the specific context of each Member State. Another significant flexibility is relative to the register of unmanned aircraft operators: Member States have quite an amount of flexibility in its implementation provided it includes the information required by the rule.

EASA will continue preparations of Implementing Acts concerning the operations of UAS, but these are not meant to regulate UAS radio equipment, at least not in the open and specific categories.

5.4 DESCRIPTION OF THE PROPOSED CATEGORIES

Professional use in categories A3 and the Specific Category would benefit from common usage opportunities for professional UA use. Otherwise, fragmentation of the European UAS market is a real risk concerning frequency use.

5.4.1 Open Category (maximum weight is 25 kg)

Subcategories:

- AO: 250 g limit, max 15 m/s, max 50 m height;
- A1: Small UAS, heavier than A0, typically up to 4 kg (no explicit limit, limitation is based on kinetic energy impact possibilities), max 50m height, Visual Line of Sight (VLOS), controller must be at least at the age of 14. In first-person-view mode or follow-me mode possible;
- A2: same as A1, but with additional requirements due to higher kinetic energy impact possibility involved, user manual must inform about the obligations of the controller (e.g. to stay at least 50m away from uninvolved persons). Geofencing and electronic identification systems;
- A3: Comparable to A2 but up to a height of 150m (500 ft) above ground level, unless otherwise determined by the competent authority for the operational area based on airspace considerations (above

150m: Specific category). Competence/training is needed, i.e. examination. Within a range such that the remote pilot, or a UA observer who is situated within the VLOS of the remote pilot, maintains VLOS; clear and effective communication shall be established between the remote pilot and the UA observer; with a minimum horizontal distance of 20 m from uninvolved persons if flying a rotorcraft, or 50 m otherwise.

The subcategories A0 to A1 can mainly be served by general authorisations in terms of spectrum. A2 and A3 may fall into more professional use (competence/examination needed).

Note: the Open Categories are still under discussion and a restructuring of the categories as well as some of the mentioned details above to some extent is likely. This includes discussions to identify for category AO that the related requirements should be governed by the applicable toy regulation (2009/48/EC).

In the Open Categories, A2 and A3 as well as the Specific Category described below, an electronic identification of the unmanned aircraft is required. This can be part of the radio telecommand and control system.

‘Electronic identification’ means a function to identify a UA in flight without direct physical access to that aircraft. The system shall transmit the following data as applicable according to standards acceptable to EASA:

- a) The registration of the operator;
- b) The class of the UAS;
- c) The type of UA operation;
- d) The status of its geofencing;
- e) Its position and height.

Electronic identification is planned as a mandatory functionality required for UAS equipped with an audio sensor or a camera of more than 5 megapixels and a real-time video transmission link or any other type of sensor able to record personal data, or required by the zone of operation.

The technical specifications (or standards) for electronic identification are still to be created.

Registration and electronic identification allow taking action against a negligent or reckless operator. Together with geofencing, it can contribute to addressing the security risk through identification of potential threats or the designation of zones for the protection of sensitive installations.

Electronic identification contributes to the law enforcement of privacy rights and geofencing contributes to addressing the privacy risk through the creation of zones for the protection of the privacy of a community.

Where required for the airspace of the operation, a management function according to standards acceptable to EASA should provide functions to:

- a) Transmit information on the intended flight plan and changes to it during operation;
- b) Receive information on the acceptance of flight plans and related authorisations;
- c) Receive information on other manned aircraft or UA operations;
- d) Receive information on temporary restricted and prohibited airspace areas or volumes.

This means that those UAS categories which are ‘professional use’ and which are in the focus of This Report have the electronic identification requirement.

EASA’s initial proposal focused on technical requirements and remote-pilot competence, and defined several subcategories complemented by the designation of zones by Member States. This system of zones could allow Member States to determine which UAS subcategories are allowed in each zone. As an alternative to this proposal, 21 Member States drafted a counterproposal that contained simpler rules focusing on remote-pilot responsibility and on few or no technical requirements for risk mitigation.

A compromise between the initial proposal and the counterproposal was reached, by reducing the complexity of the rule as required by the Member States, by keeping some technical requirements, and by defining the

remote-pilot competence in a more proportionate way. The subcategorisation in the Open Category as well as the designation of zones provides flexibility to the individual Member States.

UAS subcategory	UAS class	MTOM/ Joule (J)	Distance from people	Maximum height of the operation	Remote-pilot competence	Age of the remote pilot	Main technical requirements (CE marking)	UAS registration	Electronic identification, geofencing
A1 Fly over people	Privately built	< 250 g	Fly over uninvolved people (not over assemblies of people)	< 50 m	Leaflet	No limitation	N/a	No, if without camera of > 5 MP or an audio sensor	No
	C0						Directive 2009/48/EC, no sharp edges, awareness leaflet		
	C1	< 80 J or 900 g		< 50 m	Leaflet	14 years or with supervisor	Kinetic energy, no sharp edges, selectable height limit, awareness leaflet	Only for operator	If required by the zone of operations
A2 Fly close to people	C2	900 g to 4 kg	Fly intentionally in proximity to but at a safe distance from uninvolved people (> 20 m for rotary-wing UAS or > 50 m for fixed-wing UAS)	< 120 m or up to 50 m above a higher obstacle, at the request of the owner of the object	Leaflet plus CoC (theoretical qualification) and exam in an approved centre	16 years or with supervisor	Mechanical strength, lost-link management, selectable height limit, awareness leaflet	Operator and UA	Yes
A3 Fly far from people	C3	< 25 kg	Fly in an area where it is reasonably expected that no uninvolved person will be present	< 120 m or up to 50 m above a higher obstacle, at the request of the owner of the object	Leaflet plus online training with a test	16 years or with supervisor	Lost-link management, selectable. height limit, awareness leaflet	Operator and UA	If required by the zone of operations
	C4		In addition to the above, keep a safety distance from the boundaries of congested areas of cities, towns or settlements, or aerodromes				Operational. Instructions, awareness leaflet		
	Privately built		N/a						

Figure 3: The compromise proposal for the UAS Open Category - subcategories

5.4.2 Specific Category

The Specific Category is applicable to all operations not complying with the limits of the Open Categories. It basically requires the operator to perform a risk assessment that the competent authority confirms through an authorisation.

There is an increased risk for those professional use cases which do not fall under A0 to A3. This increased risk requires increased mitigations. Pilot/operator competence is required. Operational authorisation is required. Detailed requirements depend on the exact use case and related operational manual. Certification is needed (handled ultimately by a national authority).

It is planned that two types of standard scenarios would be defined, the former requiring the operator to submit a declaration, and the latter requiring the competent authority to issue an authorisation. In addition, the operator would have the possibility to apply for a light UAS operator certificate with privileges to authorise its operations.

5.5 MARKET FORECAST

According to a report by the European Parliament’s Committee on Transport and Tourism, the EU holds a leading edge in the civilian sector, with 2,500 operators (400 in the UK, 300 in Germany, 1,500 in France, 250 in Sweden, etc.) compared to 2,342 operators in the rest of the world [25]. It is estimated that within the next ten years the UAS industry could be worth 10% of the aviation market, or €15 billion per year. The Aerospace and Defence Industries Association of Europe forecast that about 150,000 UAS-related jobs will be created in Europe by 2050, excluding employment generated through operator services.

5.6 PROPOSED NEW REGULATION

In December 2015, the Commission introduced a proposal [26],[28] to adopt EU rules on UAS and to repeal Regulation 216/2008 [6]. The main objective of the proposed Regulation is to establish and maintain the same civil aviation safety standards for manned and unmanned aviation throughout the EU, and at the same time to ensure a high and uniform level of environmental protection. It also seeks to expand the EASA's competence to include RPAS with a mass below 150 kg. The proposed Regulation would apply, inter alia, to the design, production, maintenance and operation of unmanned aircraft, their engines, propellers, parts and non-installed equipment, as well as the equipment to control unmanned aircraft remotely, where such aircraft are operated within the Single European Sky airspace by an operator established or residing within the territory to which the Treaties apply.

The aim is that the proposed new regulation will enter into force from 2020. It is to highlight that Open Categories and the Specific Category for UAS will also in the future be under radio equipment regulation and market surveillance (see section 5.11).

A. Requirements for Unmanned Aircraft

Pursuant to article 45 of the proposed Regulation, the design, production, maintenance, and operation of unmanned aircraft and their engines, propellers, parts, non-installed equipment, and equipment to control them remotely would need to comply with the essential requirements set out in Annex IX.

- Article 45 refers to "Essential Requirements" in Annex IX specifically devoted to UAS and UAS operations. Essential Requirements are the principles that should underpin all aviation activities, in this case UAS design, production, maintenance and operation. The annex has two parts. The first part of essential requirements applies to all UAS covered in the Regulation. The requirements relate to safety, but impose the obligation to an operator to respect existing rules on privacy, data protection, liability, insurance, security or environmental protection. Safety rules hence should be framed in such a way that they contribute to the correct application of these existing rules. The second part of the essential requirements cover UAS operations for which an authorization or declaration is required. They relate to the traditional aviation areas of airworthiness, organisations, operators and operations;
- Article 46 explains how UAS manufacturers and operators can demonstrate how they comply with the requirements. The novelty is the extension of the range of traditional "means of compliance" (certification and licensing) is broadened with declarations, product safety rules. The rules would allow no requirement at all in function of the particular risk;
- Article 47 empowers the Commission to enact delegated acts in areas where more detailed rules might be required.

B. Compliance of Unmanned Aircraft

The Commission would be given the authority to adopt delegated acts concerning the specifications for the design, production, maintenance, and operation of unmanned aircraft. UAS would be subject to certifications and declarations that they comply with such specifications. A UAS certificate would specify its safety-related limitations, operating conditions, and privileges.

C. Market Surveillance Mechanisms

Mass-produced unmanned aircraft that pose a very low risk would be subject to the existing market surveillance mechanisms provided in Regulation 765/2008 [17] and Decision No. 768/2008 [18]. The national aviation authorities would remain indirectly involved, as the operational capability limitations that would be imposed (e.g., that the unmanned aircraft should not fly higher than, for instance, 50 meters to minimise risks) would have to stem directly from traditional aviation requirements. The market surveillance mechanism would rely on justified complaints filed from citizens or undertakings to detect noncompliant products. Findings of noncompliance in one particular Member State would then be communicated throughout the single EU market. The EASA, which would assume additional responsibilities, would not be responsible for the oversight of the market surveillance mechanisms. The Commission, in exercising its authority as the EU body in charge of implementation, would be authorized to verify if the Member States were fulfilling their responsibilities.

D. Delegated Acts

The proposed Regulation does not set forth specifications for the design, production, maintenance, and operation of unmanned aircraft. Such specifications will be promulgated by the Commission in delegated acts, pursuant to article 47 of the proposed Regulation. When the Commission adopts such acts, it has to immediately notify the Parliament and the Council simultaneously. This authority will be granted to the Commission for an indefinite period of time. A delegated act adopted pursuant to Art. 47 of the proposed Regulation shall enter into force only if no objection has been expressed by the European Parliament or the Council within two months after they received notification of that act or if, before the expiration of that period, the European Parliament and the Council have both informed the Commission that they will not object. Until the delegated acts are adopted, the relevant provisions of Regulation (EC) 216/2008 [6] would continue to apply.

In delegated acts the Commission would determine the

1. Conditions and procedures for issuing, maintaining, amending, suspending, or revoking the certificates for the design, production, maintenance, and operation of unmanned aircraft;
2. Conditions for situations in which, with a view to achieving the objectives of the Regulation and while taking account the nature and risk of the particular activity concerned, such certificates must be required or declarations must be permitted;
3. Conditions and procedures under which an operator of an unmanned aircraft must rely on the certificates or declarations issued in accordance with airworthiness and environmental standards, and other essential requirements;
4. Conditions under which the requirements concerning the design, production, and maintenance of unmanned aircraft and their engines, propellers, parts, non-installed equipment, and equipment to control them remotely shall not need to meet certain other specifications in the Regulation;
5. Marking and identification of unmanned aircraft and;
6. Conditions under which operations of unmanned aircraft must be prohibited, limited, or subject to certain conditions in the interest of safety.

5.7 THIRD PARTY LIABILITY ISSUES AND SECURITY

Currently, all insurance obligations for aircraft operations are governed by Regulation 785/2004 [10], which requires all commercial operators of aircraft to purchase third-party liability insurance. Regulation 785/2004 contains limits for the minimum amount of third-party liability insurance based on the mass of aircraft during take-off. For UA that weigh less than 500 kg, the minimum cover required is €660,000. UA that weigh less than 20 kg are not subject to insurance requirements.

The prototype regulation does not directly address these important issues because they are regulated at European or National level. They will however contribute to implementing them as follows:

1. Operators must register except if they operate only unmanned aircraft (UA) of the simpler subcategories;
2. The Member State may define zones or airspace areas where UA operations are prohibited or restricted: these can be created, for instance, for security reasons;
3. Obligation for the operator to comply with security requirements (Operator: natural or legal person that operate the UAS);
4. The pilot of a UA must not fly close to emergency response efforts;
5. The learning objectives for the pilot involved in flying the most complex subcategories of the 'open' category envisage the knowledge of flight restrictions (e.g. security) and the understanding of ethical airmanship. The same applies for the competence of a pilot for the 'specific' category;
6. The risk assessment of the 'specific' category must take into account areas with special limitations (e.g. for Security or privacy reasons);
7. Geofencing and electronic identification will be required in standards of some subcategories in the 'open' category.

5.8 PRIVACY ISSUES

The EU and its Member States have adopted strict privacy and personal data rules, contained in the 1995 Data Protection Directive [11] and based on articles 7 and 8 of the binding 2009 Charter of Fundamental Rights of the European Union, and on article 16 of the Treaty on the Functioning of the European Union. EU Members are also bound by article 8 of the Council of Europe Convention on Human Rights. In addition, Members have their own constitutional and statutory rules on privacy, and domestic legislation implementing EU legislation.

Commercial users of UAS appear to fall under the EU legislation on personal data protection. Thus, commercial operators of UAS have to comply with the applicable data protection principles, such as those concerning purpose limitations, data minimization, and proportionality, as well as the transparency principle, which requires individuals to be informed of any processing carried out during the operation of a UAS. On the other hand, private users of UAS for hobby and leisure purposes may be exempt from the scope of the Data Protection Directive based on the household exemption. Other exemptions contained in the Directive concern processing for journalistic purposes and for law enforcement purposes. Possible criminal uses of civil UAS would fall within the competence of EU Member States, since they are allowed to not apply the data protection rules on grounds of public safety, public security, and public order.

UA normally carry video cameras to enable pilots to fly them or have other technological installations to record and store data that can eventually be uploaded on the Internet. Consequently, the private life and property of individuals may be interfered with and violated when UAS capture images of people in their houses or gardens. Also, surveillance equipment installed on UA would make possible the gathering and processing of personal data and thus interfere with and potentially violate the right to privacy and data protection of individuals. The future regulation of the manufacturing and trade of UAS, including the production, selling, buying, internal and international trade, and notice for buyers on risks and hazards, be designed in a manner to minimise any risks to citizens and their rights.

5.9 ON-GOING PROCESS TOWARDS THE NEW REGULATION

Some issues will be taken into further consideration, especially where relevant impacts are foreseen, and a detailed analysis could be conducted, also depending on the feedback provided by stakeholders in the on-going process:

1. Geofencing systems e.g. categories that should install these systems; definition of geographical data format and reference; way information should be provided to the operator and uploaded in the UA;
2. Identification e.g. interoperability with other manned aircraft; ways enforcement authorities could identify UA;
3. Registration and authorisation e.g. minimum threshold; factors to take into consideration (such as privacy, UAS carrying a HD camera); possibility of declaration as alternative to registration;
4. Pilot Competence e.g. categories for which license is needed; use of online tutorial for less risky subcategories;
5. Procedure for authorities, e.g. different authorities to identify: aviation, market surveillance and enforcement;
6. Monitoring and enforcement activities; how to check that the flight limitations are respected; training courses;
7. Role of Competent Authorities with regards to oversight, registration, designation and certification; flow of information of authorities across Member States; resources needed (e.g. for examining a document, testing or inspecting the UAS, issuing certificates, authorisations and approvals; maintain register of UA operators, declarations and authorisations and certificates);
8. Categorisation, e.g. subcategorisation of the 'open' category and criteria according to which this should be done (e.g. weight, risk elements); model aircraft;
9. Occurrences reporting, e.g. category and damage to be reported; how this should be done; by whom (e.g. self-reporting of the operator);
10. Fragmentation of rules, e.g. currently rules quite fragmented at national level and the need to foster harmonisation.

Germany released on 7 April 2017 a new national regulation for UAS, the “Verordnung zur Regelung des Betriebs von unbemannten Fluggeräten“ [19]. This national ruling deviates in some points from the EASA prototype regulation, though the main principles are the same.

Some key points of the new regulation are as follows:

- All flying models and UAS with a weight of more than 250g shall be marked with name and address of the owner. The regulator assumes that the operator will be found when the owner is known. An in-flight check cannot be performed under these rules (no electronic identification). With this ruling, the German regulator wants to avoid administration costs such as for a central database etc.;
- As of a starting mass of ≥ 2 kg, evidence of knowledge about use and control of UAS is necessary. This evidence can be provided by a pilot licence, examination certificate. Model flight areas are excluded from the license/examination requirement. The minimum age bound to the options to provide the evidence is 14 or 16 years. The duration of validity is limited to 5 years;
- All operations performed by ‘blue-light’ organisations are exempted from individual licensing. For all other use during daylight, this is exempted from individual operator licensing up to a total mass of 5 kg. The operation of flying models/drones/UAS during night or above 5 kg requires an individual licence;
- Operations are prohibited at sensible site (e.g. prisons, industry sites, governmental buildings, sites where police and rescue activities are performed, certain traffic ways, airfields, at heights above ground > 100 metres (flying models excluded), above residential living areas, etc.); justified exceptions are possible;
- All use is prohibited with regard to use as a weapon (includes already aspects of causing fear, panic or anxiety) and the transport of dangerous goods;
- First-Person-View flights are possible, i.e. control supported by an installed onboard camera, or by a supporting observer person wearing video glasses on the ground, and up to a height above ground of 30 metres.

The prototype regulation from EASA (which is the basis for discussions at European level) uses a more differentiated categorisation based on a risk assessment. Start masses up to 25 kg are possible in the license-free „Open“-category. Additional parameters are defined to limit the acceptable total risk.

In particular for operations outside of the line-of-sight, an evaluation of the safety considerations is performed according to the German regulation. Anti-collision and avoidance features may enable operations to be able for licensing.

These national German regulations are seen as an interim step and may be reviewed when a harmonised European regulation enters into force.

The formal agreement on the proposed European regulation (EASA prototype regulation) is expected in the course of 2017/ early 2018. It will follow a consultation process (Advanced Notice of Proposed Amendment) most likely to be performed in 2017.

5.10 GEOFENCING

The proposed new prototype regulation [9] defines ‘geofencing’: ‘means an automatic advisory function to provide information of UA position in relation to airspace areas or volumes provided as geographical limitations and may limit the access of the UA to these areas’.

Geofencing reduces the air risk when zones are created for the protection of aerodromes and other sensitive sites, e.g. military installations, governmental institutions, power plants, hospitals, certain public places in city centres, both on a permanent or temporary basis.

Geofencing is planned as a mandatory functionality required for UAS heavier than 900 g, or required by the zone of operation.

Safe unmanned low level operations will require communication and tracking capabilities. The existing communication and surveillance infrastructure for manned aviation is in many cases already reaching its full capacity and can also not always be used, from a technical point of view, for low level operations.

Low level operations will therefore have to rely on another infrastructure that will provide the communication and tracking capabilities and at the same time be compatible with existing surveillance and air traffic service solutions. To allow tracking, the operator of an unmanned aircraft must be easily identifiable, similar to number plates for cars or registration of aircraft. Studies [22] are undertaken to identify what infrastructure is most suited to provide the communication and tracking capabilities for these low level operations. Then the exact information content will have to be defined to enable the operators to safely fly, together with the tracking requirements for traffic planning, safety, security or privacy purposes.

Geofencing – qualifying specific airspace as conditional or no fly zones – is a concrete measure to improve safety. The measure can also be used for security, privacy or environmental protection. The rules will establish the institutional framework for managing the EU "geofencing" system. The system should be EU wide – its application local. The rules will determine which authorities can drive such dynamic geofencing system. For example could individual cities set the conditions to overfly city centres, specific residential areas or beaches. Police and security forces could determine security sensitive zones. These conditions should then be clear for manufacturers and for operators in a dynamic way. Therefore, the data format and the data base management should become standardised.

The supporting communication and tracking system will build on existing initiatives and solutions. The current and future mobile 4G and 5G networks could be suitable candidates. The communication and tracking services could be provided at the local, regional or national levels and will also manage and feed the (dynamic) geofencing system. Just like road traffic now makes way for an ambulance, so will unmanned private low level air traffic make way for low level medical or other urgency unmanned aircraft.

Geofencing contributes to addressing the privacy risk through the creation of zones for the protection of the privacy of a community.

In some cases it may be not possible to define no-fly zones in advance.

5.11 APPLICABILITY OF DIRECTIVES FOR PLACING ON THE MARKET AND PUTTING INTO OPERATIONS

Being remotely piloted, unmanned aircraft use the radio frequency spectrum and may create harmful interferences with other radio equipment. Unmanned aircraft may also create electromagnetic disturbances. In order to avoid such interferences and disturbances, Directive 2014/53/EU [30] on Radio Equipment ('RED') applies to the vast majority of unmanned aircraft in use today.

Current situation:

According to Annex I.3 of the RE Directive [30], airborne products, parts and appliances falling within the scope of Article 3 of Regulation (EC) No 216/2008 [6] of the European Parliament and of the Council are not covered by the RE Directive.

Ground aviation radio equipment is not excluded from the RE Directive [30] (for example remote controls of UAS are always subject to the RE Directive).

According to Annex II of Regulation (EC) No 216/2008 [6], Article 4(1), (2) and (3) of that Regulation do not apply to 'unmanned aircraft with an operating mass of no more than 150 kg'. Therefore, UA of 150 kg or less should be considered as radio equipment within the scope of the Radio Equipment Directive (RED). In future, this may change because of a new EASA regulation.

Proposed changes of the regulation currently under discussion, see EASA NPA 2017-05(A) and (B) [26][28]

The European Aviation Safety Agency published a Notice of Proposed Amendment (NPA) in May/June 2017 for the introduction of a regulatory framework for the operation of drones/unmanned aircraft system operations in the open and specific categories.

This proposal constitutes a delegated act in accordance with article 47 of the proposed Regulation and lays down technical requirements and procedures for the operation of UAS in the open and Specific Category. The proposal also provides conditions for the making available on the market of UAS intended to be used in

the Open Category and lays down requirements for market surveillance for such UAS. For the making available on the market, the proposal is a legislation following the model of Decision 768/2008 [18].

A dedicated Annex II on making available on the market (Part-MRK) to the new regulation is proposed in the NPA document to define the conditions for making UAS available on the market. Article II.1 'Subject matter and scope' of Part-MRK clarifies that this legislation applies only to UAS designed to be operated in the Open Category (i.e. mass-produced UAS and basically including all UAS placed on the European market and authorised to operate without further approval).

In the explanatory part of the NPA 2017-05 (A) [26], clause 2.3.2.2 about CE marking, it is explained that the 'Part-MRK together with Appendix I to Part-UAS define the new EU harmonisation legislation that UAS operated in the open category will have to comply with, as well as with other applicable rules, such as the RE Directive 2014/53/EU.'

However, the Part MRK itself does not contain any reference to the RE Directive [30] or to Art. 3.2 of the RE Directive which requires that radio equipment has to be constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference.

Neither does Annex I Appendices I.1-6, which contains product requirements for UAS Class C0, C1, C2, C3, C4 and for UAS components, contain an essential requirement for the effective and efficient use of spectrum and avoidance of harmful interference.

The above exception in the RE Directive and the extension of the scope of the proposed new EASA Basic Regulation, which is currently being discussed by the Union's co-legislators to cover all unmanned aircraft (i.e. irrespective of its operating mass), would lead to the situation that the RE Directive and the Electromagnetic Compatibility Directive (EMCD) [31] would no longer apply to any unmanned aircraft. However, discussions within the process towards the new EASA basic regulation led at the time of writing of this report to an agreement on a text that would amend the relevant exception in the RE Directive and the EMC Directive via the future EASA Basic Regulation, thus ensuring that the RE Directive/ EMC Directive are applicable, in future, to UA irrespective of their mass. If the proposed text under discussion is approved it would mean that RE Directive and EMC Directive will be applicable to UAS with the exception of 'certified UAS intended for operation only on frequencies allocated by the Radio Regulations of the ITU for exclusive aeronautical use'.

For the UAS radio equipment, the placement on the market and putting into operation would still be covered by the RE Directive and EMC Directive while the aviation part will be covered by EASA and its implementing regulations.

This would ensure a seamless continuation of the application and enforcement of the RE Directive and the EMC Directive, especially in view of the rather poor compliance rate of consumer unmanned aircraft available on the market.

Radio equipment which is intended for airborne use but which is also intended for certain other uses would also be subject to the RE Directive and EMC Directive even in the case of certified UAS.

For UAS in the Certified Category, an essential requirement in the new EASA regulation will apply equivalent to the RE Directive.

The further process for adoption of the new regulation is currently planned to be completed in 2018.

The European Aviation Safety Agency published on 6 February 2018 an (Opinion No 01/2018) on the Introduction of a regulatory framework for the operation of unmanned aircraft systems in the 'open' and 'specific' categories [33].



Figure 4: EASA rulemaking process milestones

There will also be an impact assessment as part of this NPA process towards the new regulation.

6 FREQUENCY CONSIDERATIONS

6.1 FREQUENCY CONSIDERATIONS FOR PROFESSIONAL UAS USE

This Report focusses on UAS that fly in circumstances where they do not need communications with air traffic control (ATC). This is the case for aircraft flying under visual flight rules (VFR) in airspace classes E (controlled airspace) and F and G (uncontrolled airspace as long as not designated as Radio Mandatory Zone (RMZ)). This is also the case for aircraft flying between 0 metres and the local minimum height for controlled airspace. The local minimum height above which airspace is controlled depends on the airspace structure and the location of airports.

This Report follows the 'Prototype' Commission Regulation from EASA which only encompasses the Open Category and the Specific Category but not the Certified Category as defined in the new regulatory approach for Europe. This Report therefore covers the area between flying models under SRD regulations on one hand and Certified Category use (more ITU-R relevant, real aeronautical use) on the other hand. Within this area, many new UAS applications for professional use emerge.

The most common channel bandwidth for telecommand and control is 1 MHz or between 300 kHz and 3 MHz, mostly spread-spectrum, duty cycled, shared spectrum use, systems must be robust, shared licensed access.

Many professional UAS applications are considered to require a larger operational range and hence, more radiated power than currently available by current regulatory opportunities under general authorisations. Another aspect is that such plans for professional use include substantial investments from which it could be understood that relying totally on generally authorized frequency use without any protection does not fulfil the expectations of such service providers.

The target would be a CEPT harmonisation deliverable which defines harmonised technical conditions for the 'UAS' market.

In their responses to the questionnaire, 14 administrations supported the harmonisation of preferred frequencies for UAS. The main reasons behind their proposal are that:

- Using unlicensed bands shared by various types of applications is likely to increase the risk of interference to and from UAS;
- Using unlicensed bands would limit the range of operation;
- Harmonisation would allow users to operate UAS close to a border or in cross-border scenarios;
- Harmonisation would reduce the global footprint of UAS on the spectrum resources.

It is considered that a new opportunity for professional UAS use should be found. This would also support the new European regulation under development for UAS.

One possibility for professional UAS applications is to use existing mobile MFCN networks to provide connectivity to UAS by usual (unmodified) mobile networks with LTE technology provided that the command and control link(s), where appropriate, meet the relevant aviation safety requirements prevalent in the country of concern. This can be realised either by an external LTE device attached to UAS or in future by implementing SIM-cards installed within UAS. Such a connectivity could be used both for serving the payloads such as video or other collected data via sensors and for the command and control function of UAS. One project considered in Germany [22] possibilities to implement a dedicated UAS traffic management system to enable future secure BLOS operations by using the frequency bands 1710-1785

MHz/1805-1880 MHz. Other trials have shown that other mobile bands are also able to effectively support UAS³.

First results from these investigations in Germany with regard to the technical feasibility (e.g. up to which heights above ground could be supported) are expected by summer 2017.



Figure 5: Possibility for professional UAS applications is to use existing mobile MFCN networks

UAS connectivity based on usual MFCN networks and technology could be an enabler for professional UAS applications operating at BLOS. The use would be based on individual authorisation, harmonised frequencies with sufficient spectrum capacity and coverage of existing infrastructure (no need for investment for any roll-out of a new communication infrastructure). The UAS would be registered and the position can be tracked over the mobile network. No-fly zones or geographical restrictions in general, could be implemented via the UAS traffic management system.

Connectivity over MFCN can provide a lot of benefits to the UAS ecosystem:

- MFCN can be part of unmanned traffic management solutions and enable no-fly zones;
- MFCN enables identification and registration schemes for drones;
- MFCN can assist law enforcement by enabling identification and tracking of drones.
- Mobile networks have a track record to ensure privacy and data protection including respective tools for implementation.

³ Several trials have taken place including by Nokia and Qualcomm, see <https://www.qualcomm.com/news/onq/2017/05/03/qualcomm-technologies-releases-lte-drone-trial-results>

These capabilities allow MFCN to provide end-to-end solutions in the emerging UAS market. Mobile devices in MFCN are uniquely identified by the International mobile equipment identity number (IMEI) and the subscriber is identified via the SIM by the unique International Mobile Subscriber Identity (IMSI). The device IMEI system can be used for UA registration and the SIM IMSI can also be used for UAS operator registration.

Apart from the possibility of using MFCN networks, other professional UAS use can be envisaged which is independent from using MFCN. Some UAS operators may not wish to subscribe their application to an MFCN network or may have specific requirements which could not be fulfilled by an MFCN-based solution.

Providing frequency opportunities for professional UAS application based on MFCN usage or operating without using a MFCN network would support all options for new innovative professional UAS applications.

6.2 FREQUENCY CONSIDERATIONS FOR NON-PROFESSIONAL UAS USE

Non-professional UAS use is considered to make use of frequency opportunities under general authorisations. The most common use is found in the 2400-2483.5 MHz (ERC/REC 70-03 [23], Annexes 1 and 3) and 5725-5875 MHz bands (non-specific use according to ERC/REC 70-03 Annex 1) under the current regulatory conditions set out in ERC/REC 70-03. These usage opportunities are based on harmonised frequency use without restrictions (RE Directive Class 1 equipment) and use is only bound to the operational limits provided in the ERC/REC 70-03 and the EC Decision for SRDs.

There are also other frequency opportunities under general authorisation scheme such as for non-specific SRD or specific ones, e.g. ERC/REC 70-03 [23] Annex 8 for model control.

The usage opportunities described above are provided on a non-protected basis. The frequency opportunities are based on shared, un-coordinated frequency use and UAS users have to take into account the possibility of receiving interference.

The use of 5 GHz WAS/RLAN as defined by ECC/DEC/(04)08 [4] is not allowed for UAS. WAS/RLAN is in this case defined as an application in the mobile service and the allocation is for the mobile service except the aeronautical mobile service. The relevant class 1 equipment subclass 54 excludes therefore any usage between ground and airplanes, and in analogy to this, also any use between ground and UAS. The use in 5150-5350 MHz is limited to indoor environments, and above 5250 MHz, the DFS mechanism is required. The detection and hence protection, of specific radar signals cannot be ensured when the DFS is implemented onboard of a UAS application.

An explanatory paper [24] concerning the use of WAS/RLAN onboard of vehicles such as cars, lorries, busses, trains and onboard aircraft was adopted by ECC WG FM, explaining that the RLAN operation while in motion may not allow a proper application of the DFS mechanism, e.g. when onboard of a car. In consequence, RLAN in motion onboard of a UAS application is also considered as not possible.

An explanatory paper related to non-professional UAS use under general authorisations was adopted by ECC WG FM [32].

6.3 SECURITY MEASURES FOR COMMAND AND CONTROL LINKS

The command and control link may suffer acts of unlawful interference including deliberate sabotage. These possible illegal acts advise that the command and control links for UAS must incorporate security measures including the encryption of these links. These security measures have implications on the bandwidth and channelling of these links. The application of these measures would be carried out, in a manner proportional to the risk, in those operations in which there is a certain risk of damage to third parties or damage to air operations. The recreational or non-professional uses of UAS would not presumably involve the use of such measures.

7 CONCLUSIONS

This Report focusses on UAS that fly in circumstances where they do not need communications with air traffic control (ATC). This is the case of aircraft flying under visual flight rules (VFR) in airspace classes E (controlled airspace) and F and G (uncontrolled airspace as far as not designated as a Radio Mandatory Zone (RMZ)). This is also the case for aircraft flying between 0 metres the local minimum height for controlled airspace. The local minimum height above which airspace is controlled depends on the airspace structure and the location of airports.

This Report follows the ‘Prototype’ Commission Regulation from EASA which only encompasses the Open Category and the Specific Category but not the Certified Category as defined in the new regulatory approach for Europe. This Report therefore covers the area between flying models under SRD regulations on one hand and Certified Category use (more ITU-R relevant, real aeronautical use) on the other hand. Within this area, many new UAS applications for professional use emerge.

The airspace classes are described on the Annex 4 of the ITU-R Report M.2171 [1]. The professional use can roughly be mapped with the Open Categories A2 and A3 and the Specific Category. In these categories, a requirement for electronic identification is foreseen.

In their responses to the questionnaire, some administrations supported the harmonisation of preferred frequencies for UAS. The main reasons behind their proposal are that:

- Using unlicensed bands shared by various types of applications would not be appropriate for some professional UAS due to risk of interference, and may not meet the expectations of professional UAS service providers (unsecure investments, emission limits do not support the intended operating range);
- Harmonisation would foster a common market for UAS products and may for some professional UAS usage scenarios help to avoid cross-border issues.

In relation to the definition of an individual authorisation opportunity for professional use of UAS, this needs to be defined by the national administration, taking into account national circumstances.

The communications links that are considered in This Report deal with command and control and possibly support for sense and avoid. It could be necessary to add a downlink video stream as an essential requirement of the safe operation of a UAS.

A possible solution for small-size professional UAS would be if the command and control as well as the payload (usually video, sometimes data) could be communicated within the same frequency band because the capacity for carrying multiple radios on a UAS is limited. In consequence, the radio equipment installed in the UAS may need to be one system for command and control as well as the payload information.

For the payload information, there is much more capacity needed for downlinking video information than, for example, uplinking commands to configure the payload of the UAS.

The selected frequency bands and the associated regulation should be able to support the spectrum need for the control of UAS but also include some provisions to allow payload links. The associated regulation should also make it possible to share the frequency band or bands between these two usages for countries wishing to do so, while on one hand ensuring that the payload resource, unlike command and control, is not subject to aeronautical safety constraints and on the other hand that the payload does not use the control resource and thereby compromise the safety of the UAS.

Another solution is to consider separate adjacent bands for command and control on one hand, and video payload on the other hand (close to each other, if possible).

Given the many possibilities for new innovative UAS applications, it is nearly impossible to derive a common spectrum demand figure as an amount of MHz.

The most common channel bandwidth for telecommand and control is 1 MHz or between 300 kHz and 3 MHz, mostly spread-spectrum, and duty cycled. The spectrum use can be shared. The systems must be

robust, possibly under shared licensed access. In this scenario, the maximum bandwidth for such links may need to be limited to ensure provision of at least a minimum number of channels, otherwise the interference probability would be too high and UAS used at the same location could not avoid using the same frequencies.

For video payload information (downlink), typical test licences and product information indicate a need for 10 MHz but the needs could also be less.

The frequency tuning ranges identified in ERC Recommendation 25-10 [2] Annex 3 for cordless cameras, portable video links and mobile video links are seen as a possibility for UAS video downlinks.

One possibility for professional UAS applications is to use existing mobile MFCN networks to provide connectivity to UAS by usual (unmodified) mobile networks with LTE technology provided that the command and control link(s), where appropriate, meet the relevant aviation safety requirements prevalent in the country of concern. This can be realised either by an external LTE device attached to UAS or in future by implementing SIM-cards installed within UAS. Such a connectivity could be used both for serving the payloads such as video or other collected data via sensors and for the command and control function of UAS. One project considered possibilities to implement a dedicated UAS traffic management system to enable future secure BLOS operations by using the frequency bands 1710-1785 MHz/1805-1880 MHz. Other trials have shown that other mobile bands are also able to effectively support UAS⁴.

UAS connectivity based on usual MFCN networks and technology could be an enabler for professional UAS applications operating at BLOS. The use would be based on individual authorisation, harmonised frequencies with sufficient spectrum capacity and coverage of existing infrastructure. The UAS would be registered and the position can be tracked over the mobile network. No-fly zones or geographical restrictions in general could be implemented via the UAS traffic management system.

Apart from the possibility of using MFCN networks, other professional UAS use may be envisaged which is independent from using MFCN. Some UAS operators may not wish to subscribe their application to an MFCN network or may have specific requirements which could not be fulfilled by an MFCN-based solution.

The Open Categories A0 and A1 are seen as the non-professional use 'lower' Open Categories. Non-professional UAS use is considered to make use of frequency opportunities under general authorisations (predominantly in the 2.4 GHz and 5.8 GHz bands). In this context, the use of 5 GHz WAS/RLAN as defined by ECC/DEC/(04)08 [4] is not allowed for airborne unmanned aircraft. UAS in these categories often separate the frequency use between command and control on one hand and payload (e.g. video from a camera) on the other hand.

⁴ Several trials have taken place including by Nokia and Qualcomm, see <https://www.qualcomm.com/news/onq/2017/05/03/qualcomm-technologies-releases-lte-drone-trial-results>

ANNEX 1: CEPT QUESTIONNAIRE IN 2015 ON UAS

A1.1 RESPONDERS

Responses (total of 58):

CEPT administrations (30):

Albania, Austria, Belgium, Bosnia Herzegovina, Croatia, Cyprus, Czech Republic, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Montenegro, Netherlands, Norway, Portugal, Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Stakeholders (28):

Note: for the aeronautical regulations part, some national authorities have been included by CEPT administrations in their answers.

Aerodromo Municipal de Portimão (POR), Agencia Estatal de Seguridad Aérea (E), Airfilms Productions B.V. (NED), Belgian Civil Aviation Authority –BCAA, Bundeskommission Modellflug im DAeC -EMIG-RC, Chairman- (D), Civil Aviation Authority (CZE), Civil Aviation Agency (LVA), Dep. of Civil Aviation (CYP), DFS Deutsche Flugsicherung GmbH (D), Direction Generale de l'Armement –DGA (F), European Aviation Safety Agency – EASA, Euro USC International (G), Switzerland(DETEC), Federal Supervisory Authority for Air Navigation Services (D), Finavia Corporation (FI), The Finnish Border Guard (FI), Air navigation services Guardia Nacional Republicana (POR), Kantonspolizei Bern (SUI), IPQ - CT190 - Individual Expert (POR), Robonic Ltd Oy (FI), Selex (I), Slovenia Control LTD, Skeye BV (NED), Swiss Federation of Civil Drones – SFCD, Telespazio (I), Trimble (BEL), Unidade Especial de Polícia - Núcleo de Meios Técnicos e Audiovisuais (POR) and VTO Technologies Ltd (G).

To note:

A national report from Denmark on the future regulation of civil drones March 2015 is added at the end of part 1 of this summary.

A1.2 SPECTRUM REGULATION PART

- Question 1: Is there already a national regulatory framework (or reports available on civil UAS)?**

Albania	Yes
Austria	Yes
Belgium	Yes
Bosnia Herzegovina	No
Croatia	No
Cyprus	No
Czech Republic	No
Estonia	No

Finland	Yes
France	No
Georgia	No
Germany	No
Greece	Yes
Hungary	No
Ireland	No
Italy	No
Latvia	Yes
Lithuania	No
Montenegro	No
Netherlands	Yes
Norway	No
Portugal	No
Russian Federation	No
Serbia	No
Slovakia	No
Slovenia	No
Spain	No
Sweden	No
Switzerland	Yes
United Kingdom	Yes

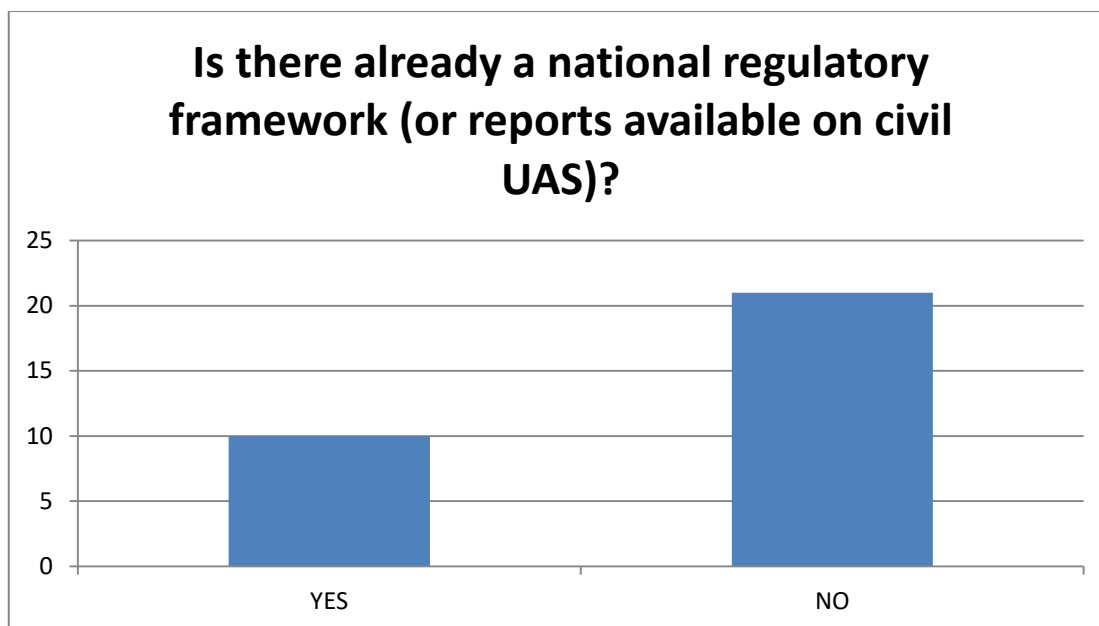


Figure 6: Availability of a National regulatory framework

Assessment of WGFM CG Drones:

Several national regulatory frameworks already exist. Some administrations under 'No' indicate to be at drafting stage of a national regulatory framework. There are differences amongst them. See also Section A1.9, question 10 (part 2 of the questionnaire).

EASA proposes to create common rules for the operation of drones in Europe.

TCAM subgroup: what is under RE-D and what is under EASA regulation?


As for drones applying the strict interpretation – other interpretations are also possible due to several defined exclusions in both directives - would mean that drones with a weight above 150 kg would fall outside the RED and be covered by the Regulation (EC) No. 216/2008 [6] (only). Drones with a weigh of 150 kg and below are covered by the RED (only). Lowering this weight limit (as this is under discussion, some proposals even go down to 0 kg) would therefore have an effect on the application of the two directives⁵. The outcome of such discussions could have some impact on the way how frequencies for drones are authorised.

A lot of information delivered in the responses to the questionnaire is not related to spectrum issues.

- **Question 1.1: If so, have you identified any challenges within the existing national regulatory framework?
(Please provide additional information including links/documents available)**

Austria	Only for the aeronautical part; https://www.austrocontrol.at/jart/prj3/austro_control/main.jart?rel=en&content-id=1380112440527 (partly in German)
Albania	http://www.akep.al/en/legislation/regulation Regulation for conditions for use of frequencies and technical requirements for radio equipment exempted from individual authorization

⁵ There are also questions about the applicability of the toy directive and the machinery directive

Greece	<p>The existing regulatory framework consists of the implementation of the provisions within the EC Decision (2006/771/EC as amended by 2013/752/EU) and the ERC RECOMMENDATION (70-03) with respect to the frequency ranges for model control in the framework of short range device regulation No challenges have been identified</p>
Latvia	<p>Existing national regulatory framework covers only recreational and sport model aircraft activities. Link to existing national regulation: http://likumi.lv/doc.php?id=141998 Latvia is developing new UAS regulation.</p>
Netherlands	<p>The challenge is finding broadband spectrum for the payload (Video)</p>  <p>4 Netherlands Report.pdf</p>
Switzerland	<p>- Flying model control under national regulation RIR 1007-02 - Common UAS models operate in the ISM bands</p>
United Kingdom	<p>Bands allocated exclusively to the Aeronautical service are managed by the civil Aviation Authority whose policies on spectrum use are laid out in chapter 5 of CAP722 (http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=415). Other bands are managed by Ofcom. Authorisation in any band allocated to the Aeronautical Service (exclusively or otherwise) is co-ordinated with the CAA. Only Ofcom may authorise the civil use of the radio spectrum. Any authorisation would be consistent the Authorisations Framework. As far as challenges are concerned the following have been identified so far in order ensure safe operations of UAV:-</p> <ul style="list-style-type: none"> • Finding sufficient appropriately protected spectrum • Compatibility with incumbent systems • Defining the requirement • Developing regionally/globally agreed planning criteria in order to optimise spectrum usage <p>Additional issues may be present for payload but those uses are likely to be met in bands that are not used for command and control purposes. Those bands are not managed by the aviation regulator. Ofcom provides information on frequencies and technical restrictions that apply to the operation of radio-controlled models in OfW311 http://stakeholders.ofcom.org.uk/spectrum/information/licence-exempt-radio-use/licence-exempt-devices/ofw311</p>

Assessment of WGFm CG Drones:

NL: some experience with illegal use. Sees also demand for spectrum outside of 2.4 GHz / 5 GHz. NL commissioned a study by research entity about the impact on other users in 2.4 GHz (results by May 2016).

Latvia is developing new UAS regulation.

Analyse in more detail links from Austria, Sweden and UK.

• **Question 1.2: 'NO' Remarks**

Czech Republic	There is no special document dealing with frequencies in case of UAS (the only aeronautical regulation is available - see Question 7)
Estonia	Ministry of Economic Affairs and Communications is drafting new performance passed regulation for UAS
France	No regulatory framework for UAS from a spectrum regulation point of view currently exists
Georgia	For the time being no
Germany	No
Hungary	Hungary has not a national regulatory framework on civil UAS yet. NMHH published a prospectus on frequency usage and licensing aspects of UAS in 2014 (http://nmhh.hu/dokumentum/164476/uav_tajekoztato_v51.pdf). In order to help users to select the appropriate frequency we summarized the usable frequencies for SRD utilization in table format extracting from our NTFA.
Ireland	Not Related to Spectrum Matters.
Italy	The Italian administration has not received any request of frequency for drones yet
Montenegro	Under study
Norway	<p>No, there is no regulatory framework in place for RPAS, related to spectrum use.</p> <p>However, we have the following comment;</p> <p>First of all it is necessary to have a clear understanding of what is covered by EASA and what is not covered by EASA. We believe radio products not covered by EASA should be covered by the Radio Equipment Directive (RED). TCAM is currently looking into some issues regarding the Radio Equipment Directive and the text that we believe is written for exclusion of products that are within the scope of EASA. In particular we believe that products that are exempted from the EASA requirements should be in the scope of the RED. And we believe it will be a good idea to make sure that even products that are under the scope of the EASA requirement should comply with the same set of minimum requirements as other radio products. The reason is that if the aeronautical systems comply with at least the same set of minimum requirements as other radio systems, then it will be easier to perform good compatibility studies when frequency use changes.</p> <p>Based on input from some stakeholders we believe that in some cases professional stakeholders may want to use traditional aeronautical radio systems like for example transponder (for anti-collision/identification) or VHF either on board the drones or from the ground when operating drones. (A drone operator who wishes to communicate to other users of the same airspace may find that the aeronautical communication radio is virtually the only way to warn another airspace user about a potentially dangerous situation.)</p> <p>Our current national regulation on radio equipment essentially states that radio equipment compliant with the EASA requirements may be used on board aircraft. EASA has several mechanisms that a manufacturer may use to demonstrate compliance. The concept of ETSO approval is probably the most convenient method for national authorities and other stakeholders in many cases (Our experience from the traditional aircraft sector is that it is very easy to communicate to people that they must be sure to buy ETSO-approved equipment). However, in many cases the existing/traditional ETSOs are not appropriate for drones since there is no pilot on board the drone that can operate radio equipment on board the drone in the same way as a pilot does in a traditional aircraft.</p>

	<p>So as a radio administration we wish for a standard or specification that equipment manufacturers can demonstrate compliance with in the near future. We believe European Standards Organizations will not create such standards unless they are asked to do so since they currently believe that this is within the scope of EASA. Therefore, unless EASA has resources to do this, it would be nice if EASA could request the standards organizations to do this work for EASA. If this is not in the scope of EASA, it would be nice if EASA can make it clear for the stakeholders that this is the view of EASA.</p> <p>Modern electronics can have low weight. It would be nice if EASA could point out how to deal with cases where drones/drone operators are using traditional aeronautical radio such as transponders and aeronautical communication radio such as VHF. A transponder in a low weight drone may affect the surveillance system for traditional aircraft. But since the use of transponders in drones have some obvious benefits, we don't think that it should be forbidden to use transponders in drones. Perhaps the use of such radio products in drones can be dealt with as "specific risk operations", ref. EASA A-NPA 2015-10?</p>
Portugal	No, there is no national regulatory framework for UAS in Portugal.
Russian Federation	Only for radio control models
Slovakia	No
Spain	There is no regulatory framework

Assessment of WGFm CG Drones:

It will be a good idea to make sure that even products that are under the scope of the EASA requirement should comply with the same set of minimum requirements as other radio products. The reason is that if the aeronautical systems comply with at least the same set of minimum requirements as other radio systems, then it will be easier to perform good compatibility studies when frequency use changes. This would also ensure that there are not any gaps in the regulations, i.e. cases where the defined exclusions leave it open about which regulation should apply. Disadvantage: double application of Directives. Note that EASA regulation from their perspective does not try to ensure the protection of other radio services.

Many CEPT administrations have no national framework or very limited framework. These may benefit from the guidance from CEPT.

- **Question 2: Are there specific frequencies (incl. requirements) identified for UAS in your NTFA?**

Albania	Yes
Austria	No
Belgium	Yes
Bosnia Herzegovina	No
Croatia	No
Cyprus	No
Czech Republic	No
Finland	Yes
France	No
Georgia	No
Germany	No
Greece	Yes
Hungary	No
Ireland	Yes
Italy	Yes
Latvia	Yes
Lithuania	No
Lithuania	No
Montenegro	No
Netherlands	Yes
Norway	No
Portugal	No
Russian Federation	Yes
Serbia	No
Slovakia	No
Slovenia	No
Spain	No
Sweden	No
Switzerland	Yes

United Kingdom	No
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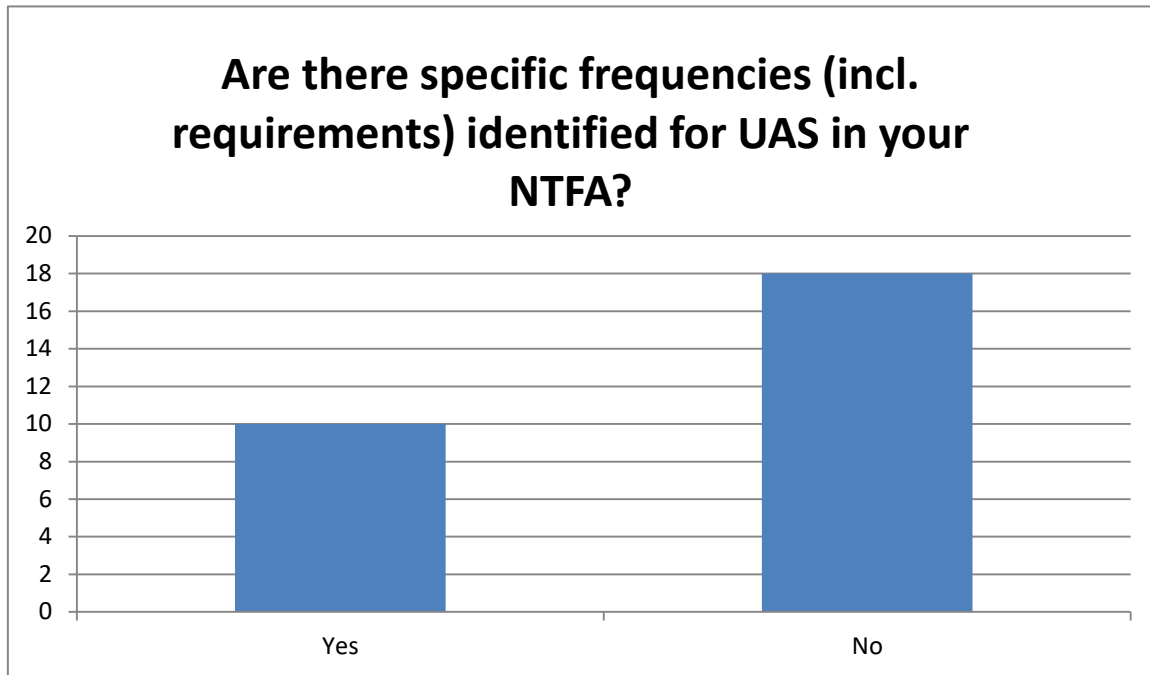


Figure 7: Specific frequencies identified?

Assessment of WGFM CG Drones:

Answers mostly informed only about ‘SRD’ regulations used by drones and also 5030-5091MHz, according to note 5.443C of Radio Regulation (WRC 2012).

Some differences noted, e.g. Denmark in 5 GHz w.r.t. DFS and indoor/outdoor 5150-5250 MHz. In general, sometimes, an administration allows more (i.e. has a ‘positive restriction’). With drones, this could potentially lead to interference problems.

• Question 2.1: If so, please provide information in the field below

Albania	http://www.akep.al/en/legislation/regulation
Finland	<p>There are frequencies for telecommand equipment for use with scale model aircraft in the frequency band 34.995–35.225 MHz. In addition, collective licence-exempt frequencies are available for wide-band data transmission equipment (WAS/RLAN) in 2,4 GHz and 5,8 GHz. None of these frequency bands are specifically identified as UAS frequencies.</p> <p>Also in the National Frequency Table of Allocations we have the frequency band 5031-5090 MHz allocated for the control and non-payload communications for aeronautical route traffic (passenger / freight).</p>
Greece	<p>The following frequency ranges are available for model control (including flying models) and there aren’t any special provisions in place for other types of UAS (eg governmental use):</p> <p>26.995 MHz, 27.045 MHz, 27.095 MHz, 27.145 MHz, 27.195 MHz (according to 2013/752/EU and ERC REC 70-03)</p> <p>40.665 MHz, 40.675 MHz, 40.685 MHz, 40.695 MHz (according to ERC/DEC/(01)12 and ERC REC 70-03)</p>

	34.995–35.225 MHz (only for flying models, according to ERC/DEC/(01)11 and ERC REC 70-03)
Ireland	<p>Insofar as model aircraft are concerned, ComReg is aligned with ECC Recommendation 70-03, which provides for unlicensed operation of model aircraft using specific frequencies and associated technical parameters.</p> <p>Currently, within Ireland, UAS operate largely in harmonised licence exempt spectrum (i.e., 2.4 GHz and 5.8 GHz)</p> <p>Apart from the above allowances, no frequencies have been yet identified for UAS.</p>
Italy	5030-5091MHz, according to note 5.443C of Radio Regulation(WRC 2012)
Latvia	34,995-35,225 MHz 100mW e.r.p. dedicated for aircraft model use only.
Netherlands	<p>- 5030 – 5091 MHz</p> <p>- 2300 – 2495 MHz</p> <p>And license exempt spectrum (2,4 and 5 GHz)</p>
Russian Federation	<p>The Decision of the State Radio Frequency Commission №07-20-03-001 from 07.05.2007 «Allocation of frequency bands for Short Range Devices» harmonization to use by radiocontrol flying models (toys) the following frequency bands:</p> <p>26.957-27.283 MHz, 28.0-28.2 MHz, 40.66-40.7 MHz and 2400-2483.5 MHz</p>
Switzerland	<p>- 34,995 – 35,225 MHz</p> <p>- Band ISM 2,4 GHz and Band ISM 5 GHz</p>

• **Question 2.2: 'NO' Remarks**

Austria	Currently, they are using SRD and RLAN Equipment. There are specific frequencies planed for the CNPC-Link depending on harmonization measures.
Czech Republic	There are no frequencies (terms and definitions, (national) footnotes etc.) identified for UAS in the Czech NTFA (Decree No. 105/2010 Coll.)
France	<p>No specific frequencies currently identified for UAS.</p> <p>Specific frequencies have been identified for flying models related to EC Decision 2006/771/CE amended as well as Decisions ERC/DEC/(01)11 and ERC/DEC/(01)12 and implemented nationally through French frequency Regulator ARCEP decision n°2014-1263.</p>
Georgia	No specific frequencies yet.
Germany	No
Hungary	There are no specific frequencies for UAS, yet. The study has been started at NMHH about the possible new regulation on usage of frequencies for UAS purposes.
Montenegro	Under study
Norway	No, there are presently no defined frequency areas for RPAS/UAS in the Norwegian NTFA.
Portugal	No, the Portuguese NTFA does not designate spectrum specifically intended for the use of UAS.
Slovakia	In the NTFA (2015-2016) of the Slovak Republic we have no such frequencies or requirements identified for UAS applications.

Spain	There are not specific frequencies in Spain for UAS
Sweden	There are no specific frequencies. UAS are assigned frequencies in the aeronautical bands for ATC. Otherwise UAS use licence exempted bands, e.g. 2.4 GHz and 5 GHz bands
United Kingdom	Not specifically but bands are listed along with potential use in the aforementioned CAP722. Additionally bands for the usage of UAS would be reflected in the UK Frequency Allocation Table (http://stakeholders.ofcom.org.uk/spectrum/information/uk-fat/) Ofcom provides minimum requirements for the establishment, installation and use of licence exempt short range devices in document IR2030/23 http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-policy-area/spectrum-management/research-guidelines-tech-info/interface-requirements/IR_2030-june2014.pdf

A1.3 SPECTRUM HARMONISATION MEASURES

- **Question 3: Is there a requirement for harmonisation measures needed?**

Albania	No
Austria	Yes
Belgium	Yes
Bosnia Herzegovina	No
Croatia	No
Czech Republic	Yes
Dominik Meyer	Yes
Finland	Yes
France	No
Georgia	No
Germany	No
Greece	Yes
Hungary	Yes
Ireland	Yes
Italy	No
Latvia	Yes
Lithuania	Yes
Montenegro	No
Netherlands	Yes
Norway	Yes

Portugal	Yes
Russian Federation	No
Serbia	No
Slovakia	No
Spain	Yes
Sweden	Yes
Switzerland	Yes
United Kingdom	Yes

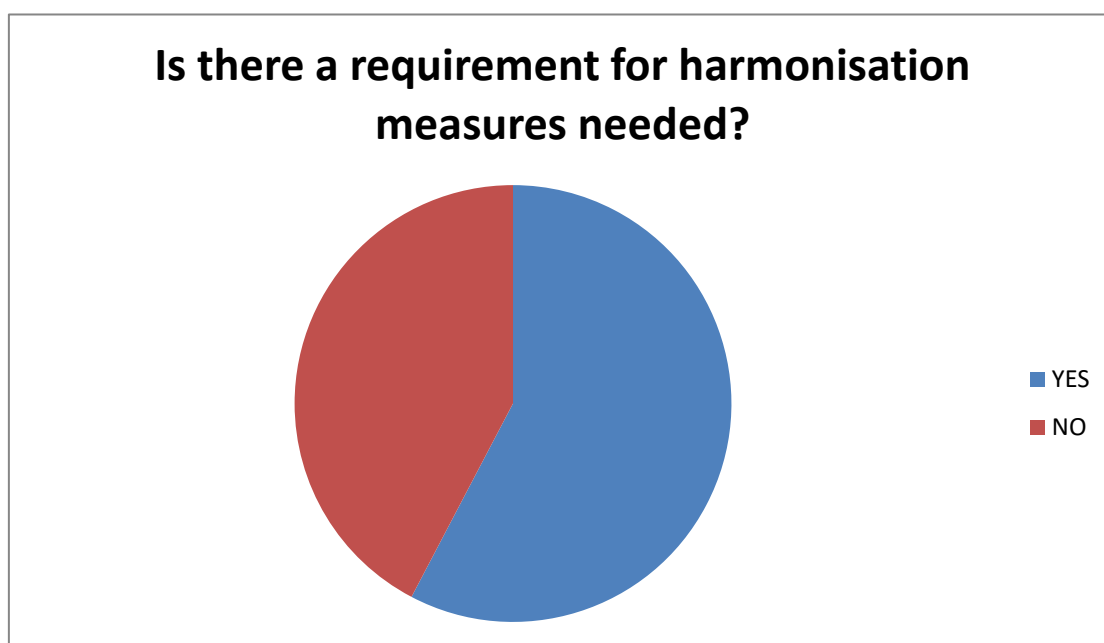


Figure 8: Need for harmonisation - Answers

Assessment of WGFM CG Drones:

Answers differ very much from each other. It is not clear which specific technical and regulatory harmonised conditions are concerned.

A collection of all the material and helping to identify guidelines/guidance as well as problems with current approaches may be helpful.

Questions raised: should one indicate preferred shared bands for drones? This implies to restrict them from using other frequencies (similar to the 'ISM-concept'). Higher frequencies above 6 GHz could also be considered in this context (though line-of-sight will be required normally at such frequencies). Relates also to risks involved (shorter or greater operating range, potential to interfere in a given frequency range). One may distinguish between CNPC and payload communications.

• **Question 3.1: 'YES-answers' - Please explain**

	If so, please indicate which ECC deliverable
Austria	ECC Decision would be preferred, but ECC Recommendation is also possible.
Czech Republic	Perhaps an ECC Recommendation
Finland	There is a lot of interest for different kind of applications using UAS. At the moment, there are no harmonized frequencies (other than those that are for SRDs, WLANs etc.) that would provide longer link distances between the controller (remote pilot) and UAS. Therefore, we believe that European-wide harmonization for frequencies for UAS is highly required and work towards an ECC Decision or ECC Recommendation should start quickly.
Greece	Yes, we believe there should be harmonization measures across CEPT under an ECC Decision for critical (e.g. civil governmental) applications
Hungary	WRC12 designated the 5030-5091 MHz band for UAS radio applications. As the national usage of this band by microwave landing systems (MLS) is negligible, the NMHH intends to open the 5030-5091 MHz band for professional UAS use. Nevertheless the Authority does not experience considerable radio equipment manufacturing activity for this band in Hungary. There is a need of harmonization at least CEPT level for frequency band (primarily the 5030-5091 MHz band) and coordination of RloS (radio line-of-sight) equipment in conjunction with a harmonized ETSI standard by the opinion of NMHH.
Ireland	<p>There might be a need for harmonization measures. Given the nature of operation of UAS, ComReg is of the opinion that the potential for interference with other systems harmonize these frequencies may be higher than when compared with similar systems which are operational on a ground-based platform only. Therefore, further consideration should be given to implementation of additional harmonization measures – this may serve to mitigate the potential for UAS to cause harmful interference to other systems using similar frequencies.</p> <p>Further, it is noted that many UAS currently operate using licence exempt spectrum. In light of this fact, and given the accelerating rate of growth of RPAS for professional services, ComReg believes that harmonization efforts may require careful consideration in the near future. The nature of the service which harmonizes the UAS, height & range of operation, associated transmit power levels, and coexistence with other systems are all examples of factors which may need to be considered when assessing any need for harmonization.</p>
Latvia	Waiting for common technical regulations in EC.
Lithuania	ECC recommendations would be helpful at this stage.
Netherlands	<p>Yes, harmonization of frequency bands and technical parameters.</p> <ul style="list-style-type: none"> - A ECC report that describes the radio applications (and spectrum requirements) used by drones; - ECC Recommendation that addresses the identification of (preferred) frequency bands that can be used by drones; - ECC Recommendation, aimed at harmonization implementation measures for Drones in the (preferred) identified frequency bands <p>Note: including the possibility of LSA in frequency bands that are identified for MFCN.</p>
Norway	<p>Yes, due to common borders with neighbouring countries, we consider there to be a need for harmonization of spectrum related to frequency use for RPAS.</p> <p>We would prefer an ECC Recommendation.</p>
	ECC recommendations would be helpful at this stage.
Portugal	Yes. The Portuguese Administration considers that a harmonization measure at CEPT level facilitates the regulation for the use of frequencies by UAS. As a first step an ECC Report on UAS

	<p>would identify, among other subjects, UAS frequency usage, type of application (e.g. control and non-payload communications (CNPC), categorization of the UAS (e.g. by concept of operation, weight, etc.). This ECC Report would give a clear picture of the UAS environment, focusing mainly in the frequency bands, usage scenarios and the corresponding conditions for the use of the spectrum.</p> <p>As a second step, the development of an ECC Decision would identify spectrum and conditions for the use of the spectrum by UAS.</p>
Spain	<p>We need harmonized bands below 2ghz for uas. Spain would support to develop a new ecc regulation on this issue</p>
Switzerland	<p>Yes, there is a potential requirement for civil UAS with specific technical and regulatory harmonized conditions.</p>
United Kingdom	<p>Given that the aircraft will operate globally and in some cases travel between countries or regions there is a need for harmonisation measures. Additionally it has been assumed that global harmonisation will minimise the amount of spectrum required to ensure the safe operation of UAVs.</p>

<p>Assessment of WGFM CG Drones:</p> <p>Application of 216/2008 and RE-D (and other directives) for drones still under discussion or can be subject to changes.</p> <p>Those in favour of a harmonisation deliverable like to see the frequencies identified for drones in a central document and also related technical conditions as well as information about other regulation covered by the document.</p> <p>14 administrations indicated support for a harmonisation deliverable. An appropriate way forward could be suggested in creating first an ECC Report which outlines the needs, pros and cons of a harmonisation deliverable and then, to be decided at a later stage, a harmonisation deliverable (ECC/DEC or ECC/REC). The ECC Report should also give an overview of the application scenarios, planned fields of operations.</p> <p>From the answers to part 2, one can also see some motivations (demand) in favour of a harmonisation deliverables (need for clear rules, common market, ensure air traffic safety, spectrum compatibility, etc.)</p> <p>NLOS communications may need from the operational viewpoint some harmonisation, if not covered elsewhere (e.g. RR).</p> <p>Several administrations also report using the AMS(R)S (aeronautical safety) allocated 5030-5091 MHz frequency band.</p>
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• **Question 3.2: 'NO-answers' - Please indicate the reasons**

Albania	<p>There is no requirements about the harmonisation measures because the usage of this frequencies does not need Individual Authorisation.</p>
France	<p>There are currently no requests from UAS manufacturers for harmonization measures. The current questionnaire is aimed at collecting the manufacturers' forecast for UAS frequency needs in the near future.</p>
Georgia	<p>For harmonisation measures relevant ECC decisions and recommendations are to be implemented.</p>
Germany	<p>Not yet. First we need to check how the UAS will be handled by the international aviation law.</p>
Italy	<p>The Italian administration has not received any request of frequency for drones yet.</p>
Montenegro	<p>Since we still do not have national regulatory framework set up, no requirement for harmonisation</p>

	are yet needed.
Russian Federation	Not yet, due to very limited usage of civil UAS at the current stage
Serbia	Requirements will be provided by adopting regulations for UAS
Slovakia	We have received no such requirement for harmonization of the measures.

A1.4 SPECTRUM USE (CATEGORISATION, DIFFERENTIATION)

• Question 4: Do you have / foresee different types of regulation for different radio applications?

Albania	any other
Austria	control and non-payload communications (CNPC) payload (incl. video)
Belgium	control and non-payload communications (CNPC) payload (incl. video)
Bosnia Herzegovina	any other
Croatia	control and non-payload communications (CNPC) payload (incl. video) any other
Czech Republic	control and non-payload communications (CNPC) payload (incl. video)
Finland	control and non-payload communications (CNPC) payload (incl. video)
France	any other
Georgia	any other
Germany	any other
Greece	control and non-payload communications (CNPC) payload (incl. video)
Hungary	control and non-payload communications (CNPC) payload (incl. video) any other
Ireland	any other
Latvia	control and non-payload communications (CNPC) payload (incl. video) any other
Lithuania	any other
Netherlands	any other

Norway	any other
Portugal	control and non-payload communications (CNPC) payload (incl. video) any other
Russian Federation	any other
Serbia	any other
Slovakia	any other
Slovenia	any other
Spain	any other
Sweden	any other
Switzerland	control and non-payload communications (CNPC) payload (incl. video) any other
United Kingdom	control and non-payload communications (CNPC) payload (incl. video)

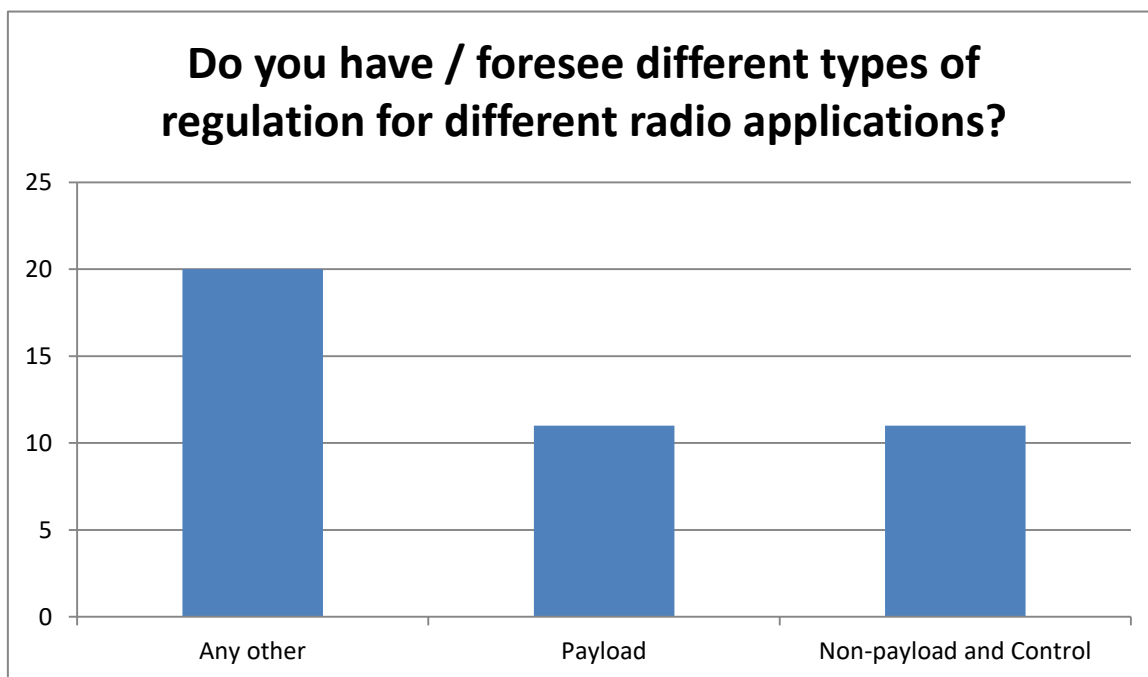


Figure 9: Differentiation payload vs non-payload and control

Assessment of WGFM CG Drones:

• **Question 4.1: 'Control and Non-Payload' - Please explain**

Austria	This should be harmonised within CEPT
Czech Republic	There is a need to use licensed (dedicated) frequencies due to the safety reasons (CNPC).
Finland	CNPC communications will require more protected radio link than the payload communications, since it is seen as safety related communication.
Greece	Currently there are no specific provisions for different type of applications within the UAS scope of applications. General provisions (such as those for WAS/RLANs and non-specific short range devices) apply according the above mentioned EC Decision and ERC Recommendation.
Hungary	The Hungarian regulation currently does not distinguish the CNPC, payload and other radio devices in the SRD bands. As more and more UASs will operate there may be a need to separate the payload and the CNPC radio links, and a backup (safety) control channel. According to expert level plan of NMHH the RLoS CNPC radio links may operate in the 5030-5091 MHz band by modified regulation. The payload radio links can operate in the PMSE bands if the usage is defined as PMSE by our understanding. In order to avoid the in-band interference for CNCP a separate band should be found for the backup (safety) control channel.
Latvia	Non-specific short range device spectrum could be used for various applications.
Portugal	There is no regulation for different radio applications for UAS applications in Portugal. This needs to be further investigated.
Switzerland	Objective to identify a dedicated spectrum for CNPC
United Kingdom	<p>Given that this integral to the safe operation of the aircraft and the public's perception of that safe operation spectrum and the systems used for this application will have to meet the requirements of the aviation regulatory authorities which on a local scale would be the Civil Aviation Authority and on a global scale ICAO.</p> <p>As UAS activity increases in the hobby, commercial and professional areas, some exclusive frequencies with co-ordination (license) would be useful for professional UAS operations carrying high value or critical payloads. This could be for broadcasters wanting to use a UAS to cover a large event which would require guaranteed communications for both control (safety) and payload (content).</p>

Assessment of WGFM CG Drones:

Several replies: there is a need to use licensed (dedicated) frequencies due to the safety reasons (CNPC - control and non-payload communications (CNPC)).

Given that this integral to the safe operation of the aircraft and the public's perception of that safe operation spectrum and the systems used for this application will have to meet the requirements of the aviation regulatory authorities which on a local scale would be the Civil Aviation Authority and on a global scale ICAO.

As UAS activity increases in the hobby, commercial and professional areas, some exclusive frequencies with co-ordination (license) would be useful for professional UAS operations carrying high value or critical payloads. This could be for broadcasters wanting to use a UAS to cover a large event which would require guaranteed communications for both control (safety) and payload (content).

Payload (content): not linked to safety aspects. Some administrations mentioned PMSE frequencies in this context. Look to Answers in part 2.

Several administrations have a national framework with various weight categories (list them in a table..)

Compare whether certain categorisations are included either in the spectrum regulation or the aeronautical regulation on national level (e.g. flight height restrictions, exclusion zones (may depend on whether based on air traffic safety or spectrum compatibility)).

Needs more investigation.

• **Question 4.2: 'Payload' - Please explain**

Austria	They may use those frequencies, which are already licenced or foreseen for the relevant user groups (Police Forces, firefighters, TV production).
Belgium	The control-command link and the payload link are designed in such a way that never ever a failure in the payload link can end up in a failure of the control command link and thus in a crash of the aircraft. It can be done by separate circuits or by other technical solutions.
Czech Republic	Unlicensed frequencies (General Authorisation) could be used in specific cases (payload).
Finland	CNPC communications will require more protected radio link than the payload communications, since it is seen as safety related communication.
Greece	Difference on regulation between payload and non-payload radio communications should be assessed, especially for critical UAS applications, given the fact that payload communication transmissions will take place from high altitude.
Hungary	See the answer to question 4.1.
Latvia	Non-specific short range device spectrum could be used for various applications.
Portugal	There is no regulation for different radio applications for UAS applications in Portugal. This needs to be further investigated.
Switzerland	Objective to identify a dedicated spectrum for payload communications
United Kingdom	<p>As noted: payload is not linked to safe flight and does not need the same consideration as that spectrum used in support of the control of the UAS itself. Here, to a certain extent, the physical limitations of the UAS may impact its ability to carry a variety bands in support of its payload requirements.</p> <p>As UAS activity increases in the hobby, commercial and professional areas, some exclusive frequencies with co-ordination (license) would be useful for professional UAS operations carrying high value or critical payloads. This could be for broadcasters wanting to use a UAS to cover a large event which would require guaranteed communications for both control (safety) and payload (content).</p>

• **Question 4.3: 'Any other' - Please specify**

Albania	No
Bosnia Herzegovina	All depends on requests we receive. So far, we had none
France	<p>There are currently no such provisions, as long as the different UAS stations comply with the national frequency regulation.</p> <p>In the future, some frequency bands may be identified for Command and Control functions, but only for operations implying a certain level of aeronautical safety to be defined by the national aeronautical authority.</p>
Georgia	We each radio applications should be considered. For the time being, with this regard no regulation exists but in future ECC appropriate deliverable should be used for harmonisation purposes.
Germany	Not yet, (see Q2)
Hungary	See the answer to question 4.1
Ireland	No regulations currently exist within Ireland for UAS. However, ComReg will continue to monitor national and international developments in this area, and may review the need for regulatory requirements should spectrum usage needs within this field evolve in the future.
Latvia	Non-specific short range device spectrum could be used for various applications.
Lithuania	Under consideration.
Netherlands	Due to the technical neutral spectrum regime and convergence our policy is to have as few types of regulation as possible in our national frequency table.
Norway	<p>Today the use of frequencies for the different applications is mainly regulated through the regulation "Regulations concerning general authorizations for the use of radio frequencies"(License exempt frequencies), but nothing is RPAS-specific. We also have RPAS operators who apply for a license to be able to use frequencies exclusively for RPAS operations/tests. However, there has only been issued a very limited number of licenses for this purpose(in VHF-/UHF-bands). But the demand is increasing.</p> <p>We have had several enquiries regarding the use of frequencies reserved for amateur radio use. The enquiries mainly contain questions regarding amateur license holders and the possibility of using these frequencies for RPAS control.</p>
Portugal	There is no regulation for different radio applications for UAS applications in Portugal. This needs to be further investigated.
Russian Federation	No. The question is under consideration.
Serbia	<p>Currently there are no regulations for UAS.</p> <p>The regulation shall be in accordance with the ITU and CEPT regulations for all types of applications.</p>
Slovakia	<p>No, we have not special frequency spectrum regulation for UAS in Slovak Republic. Into the future we will keep implementations of the CEPT/ECC common regulation for UAS.</p> <p>So far, we have only one general authorization No. VPR-15/2012 on use frequencies for the operation by radio equipment dedicated for remote control models purpose in the air, on land or over or under the water surface - in line with Annex 8 of the ERCREC 70-03.</p> <p>For different types radio applications we plan same type of regulation.</p>

Slovenia	No, NTFA can be used
Spain	No
Switzerland	Not yet, discussions have just started. Focus is on non-line of sight flights.

Assessment of WGFM CG Drones:

• **Question 5: Do you have / foresee different types of regulation for different concepts of operation? Please explain**

Albania	any other
Belgium	visual line-of-sight / non visual line of sight safety aspects user groups range of operation
Bosnia Herzegovina	any other
Croatia	weight and/or dimensions visual line-of-sight / non visual line of sight safety aspects user groups range of operation any other
Czech Republic	visual line-of-sight / non visual line of sight user groups range of operation
Finland	weight and/or dimensions visual line-of-sight / non visual line of sight user groups
France	any other
Georgia	safety aspects range of operation
Germany	any other
Greece	any other
Hungary	safety aspects any other
Ireland	weight and/or dimensions visual line-of-sight / non visual line of sight safety aspects user groups range of operation

	any other
Latvia	weight and/or dimensions visual line-of-sight / non visual line of sight safety aspects user groups range of operation any other
Lithuania	any other
Netherlands	any other
Norway	weight and/or dimensions visual line-of-sight / non visual line of sight safety aspects user groups range of operation
Portugal	weight and/or dimensions visual line-of-sight / non visual line of sight safety aspects user groups range of operation any other
Russian Federation	any other
Serbia	any other
Slovakia	any other
Slovenia	any other
Spain	any other
Switzerland	any other
United Kingdom	weight and/or dimensions visual line-of-sight / non visual line of sight safety aspects user groups

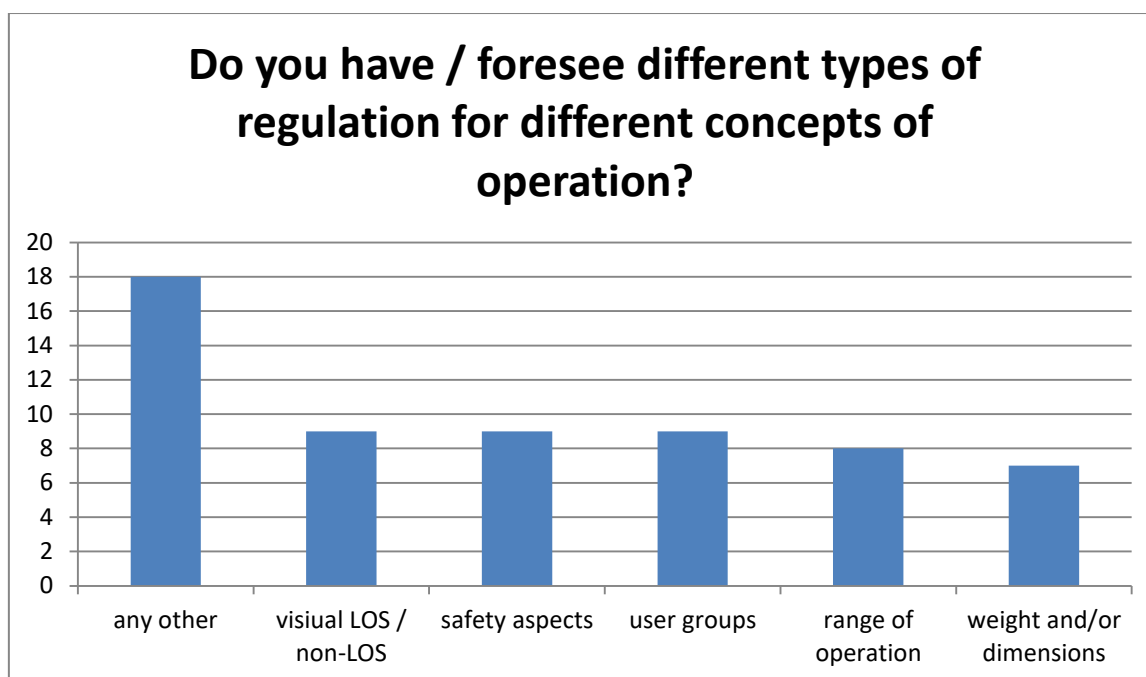


Figure 10: Different types of regulation and concepts of operation

• **Question 5.1: 'weight and/or dimensions' Please explain**

Finland	There are different types of use of UAS and therefore there may also be a need to regulate the use by different regulations.
Ireland	See Answer to 5.6.
Latvia	Under consideration.
Norway	When RPA's exceeds a certain weight and dimension, there are safety issues to be considered when contemplating which frequency band will be the most appropriate for control of the RPAS. For bigger RPA's, it will be more crucial to be able to sustain the control communication with the RPAS to avoid larger RPA's of significant size and dimension, falling down or malfunctioning in other ways in areas where they might do serious damage.
Portugal	There is no regulation for different concepts of operation for UAS applications in Portugal. This needs to be further investigated.
United Kingdom	We do envisage different regulation for spectrum which will be based on the safety of other aircraft and the public in general however that will involve other aspects of operation. The primary driver will be safety and ensuring that a CNPC link is suitable to meet the aeronautical safety requirements that will be based on the threat posed to other aircraft and the public in general that in turn is dependent on the potential kinetic energy of a UAV and its proximity to another aircraft or the public.

• **Question 5.2: 'Visual LOS/ NLOS' - Please explain**

Czech Republic	The only visual line-of-sight mode is allowed for civil UAS in the Czech Republic at present
Finland	There are different types of use of UAS and therefore there may also be a need to regulate the use by different regulations.

Ireland	See Answer to 5.6.
Latvia	Under consideration.
Norway	Related to difference in spectrum use, which frequency bands will be used for VLOS and BVLOS is dependent on the defined distances and altitudes the BVLOS and VLOS RPAS will be able to travel.
Portugal	There is no regulation for different concepts of operation for UAS applications in Portugal. This needs to be further investigated.
United Kingdom	It is likely that the safety requirements will be the same for UAVs with the same operational function that are operating within line of sight or beyond line of sight but may well operate in different frequency bands due to the nature of operation.

• **Question 5.3: 'Safety-aspects' - Please explain**

Belgium	Belgian Civil Aviation Authority (BCAA) uses a risk based, operational centric approach. This means that BCAA doesn't use a categorization of aircraft based on weight or dimensions apart from the 150kg limiting its competence in RPAS business. The national regulation tries to make clear requirements for different type of users like toys players, model aircraft users (non-professional use for recreation and sports) and professional use of aircraft. BCAA handles both visual and beyond visual line of sight operations.
Georgia	We think first of all , questions 5.3 and 5.5 have to be taken into account.
Hungary	As for safety aspects, there is a need for a backup (security) control channel which should operate in a different frequency band from CNPC by opinion of NMHH.
Ireland	See Answer to 5.6.
Latvia	Under consideration.
Norway	The use of widely used frequency bands with very low level of protection such as 2.4 GHz for control of drones is not desirable. We also refer to question 5.1.
Portugal	There is no regulation for different concepts of operation for UAS applications in Portugal. This needs to be further investigated.
United Kingdom	It is likely that the safety requirements will be the same for UAVs with the same operational function that are operating within line of sight or beyond line of sight but may well operate in different frequency bands due to the nature of operation.

• **Question 5.4: 'User groups' - Please explain**

Czech Republic	There is a need to use licensed (dedicated) frequencies for commercial use (unlicensed frequencies (General Authorisation) could be used for recreational purposes)
Finland	There are different types of use of UAS and therefore there may also be a need to regulate the use by different regulations.
Ireland	See Answer to 5.6.
Latvia	Under consideration.

Norway	<p>We do not have regulations in place targeting specific RPAS user groups, but our primary focus would be commercial users, due to recreational users being able to make use of the license exempt frequency bands given by the document “Regulations concerning general authorizations for the use of radio frequencies” for recreational-/hobby purposes.</p> <p>However, given the signs of exponential growth within the RPAS industry, the spectrum needs of non-commercial users will also have to be taken into consideration in the near future, to avoid saturation within the license exempt frequency bands used by the non-commercial users, as they are already heavily used (there are no frequency bands within the license exempt frequency bands that are specifically dedicated to RPAS).</p>
Portugal	<p>There is no regulation for different concepts of operation for UAS applications in Portugal. This needs to be further investigated.</p>
United Kingdom	<p>It would be challenging and resource heavy for administrations to make a distinction between users group which in turn would influence which spectrum band could or could not be used. Some states may well make a distinction for military usage, which would be out of scope for an ECC deliverable.</p>

• **Question 5.5: 'Range of operation' - Please explain**

Czech Republic	<p>Range of operation corresponds with weight and dimensions of UAS and its endurance (and vice versa)</p> <p>Weight and/or dimensions: Model aircraft < 20 kg maximum take-off mass (MTOM) and/or UAS < 20 kg MTOM, used solely for recreational purposes are out of CAA (Czech Republic) scope (out of registration, regulation)</p>
Georgia	<p>We think first of all , questions 5.3 and 5.5 have to be taken into account.</p>
Ireland	<p>See Answer to 5.6.</p>
Latvia	<p>Under consideration.</p>
Norway	<p>No, but for BVLOS operations (and especially long distance operations), satellite communication might be considered a solution, depending on the distances and altitudes the BVLOS RPAS would be able to travel.</p>
Portugal	<p>There is no regulation for different concepts of operation for UAS applications in Portugal. This needs to be further investigated.</p>

• **Question 5.6: 'Any other' - Please specify**

Albania	<p>No</p>
France	<p>There are currently no such provisions.</p> <p>In the future, there may be some frequency bands identified for Command and Control functions, but only for operations implying a certain level of aeronautical safety. This level will be fixed by the civil aviation authority and not by the frequency regulator.</p>
Germany	<p>Not yet, (see Q2)</p>
Greece	<p>We foresee different types of regulation for critical (e.g. civil governmental) and non-critical operations</p> <p>For non-critical applications the existing framework (ERC RECOMMENDATION (70-03)) should be sufficient, although studies might be needed to verify this conclusion, given the fact that all relevant systems/ bands included in ERC REC 70-03 had been originally studied under the</p>

	<p>assumption that frequencies were to be used at ground level.</p> <p>Moreover, for identified critical applications, where the risk of interference to the UAS cannot be negligible, the development of harmonisation measures seems to be necessary. In these cases the use of a dedicated frequency range, used on a shared access basis exclusively for UAS applications, could be considered, preferably by an ECC Decision taking into account potential cross border coordination issues.</p>
Hungary	<p>Weight and/or dimensions and the visual line-of-site and non-visual line-of-site control rules of UAS basically belong to Aviation Authority, and are not in focus of spectrum management. Until the national regulation differs from the classification of ITU, we can apply ITU UAS categories can be found in report ITU-R M.2171 [1].</p>
Ireland	<p>From a spectrum management viewpoint, ComReg is of the opinion that it is reasonable to anticipate that different types of regulation may be required for different concepts of operation in the future - this may be contingent upon a number of factors including those suggested above, such as the nature of service utilising the UAS, range of operation, height restrictions, and associated power requirements.</p>
Latvia	Under consideration.
Lithuania	Under consideration.
Netherlands	<p>Some concepts of operation require exclusive spectrum rights and some concepts of operation can share the available spectrum. The operator of the UAS has to decide which kind of license he will apply for.</p>
Portugal	<p>There is no regulation for different concepts of operation for UAS applications in Portugal. This needs to be further investigated.</p>
Russian Federation	No. The question is under consideration.
Serbia	<p>Currently there are no regulations for UAS.</p> <p>The regulation shall be in accordance with the ITU and CEPT regulations for all types of applications.</p>
Slovakia	<p>For different concepts of operation we have not frequency spectrum regulation for UAS in Slovak Republic. Into the future we will keep implementations of the CEPT/ECC common regulation for UAS.</p> <p>For different concepts of operation we plan same type of regulation – one or more particular general authorizations.</p> <p>General authorization format is well known and proven way (on national level) for implementation decisions and recommendations in the area European frequency spectrum regulations.</p>
Slovenia	No
Spain	No
Switzerland	Not yet, but is foreseen in accordance with international developments.

Assessment of WGFM CG Drones:

A1.5 EXISTING PROBLEMS SUCH AS INTERFERENCE

- **Question 6: Are there existing problems such as interference cases or illegal spectrum use by UAS?**

Albania	No
Austria	No
Belgium	Yes
Bosnia Herzegovina	No
Croatia	No
Cyprus	No
Czech Republic	No
Finland	Yes
France	No
Georgia	No
Germany	No
Greece	No
Hungary	Yes
Ireland	No
Italy	No
Lithuania	Yes
Montenegro	No
Netherlands	Yes
Norway	No
Portugal	No
Russian Federation	No
Serbia	No
Slovakia	No
Slovenia	No
Spain	No

Switzerland	Yes
United Kingdom	Yes

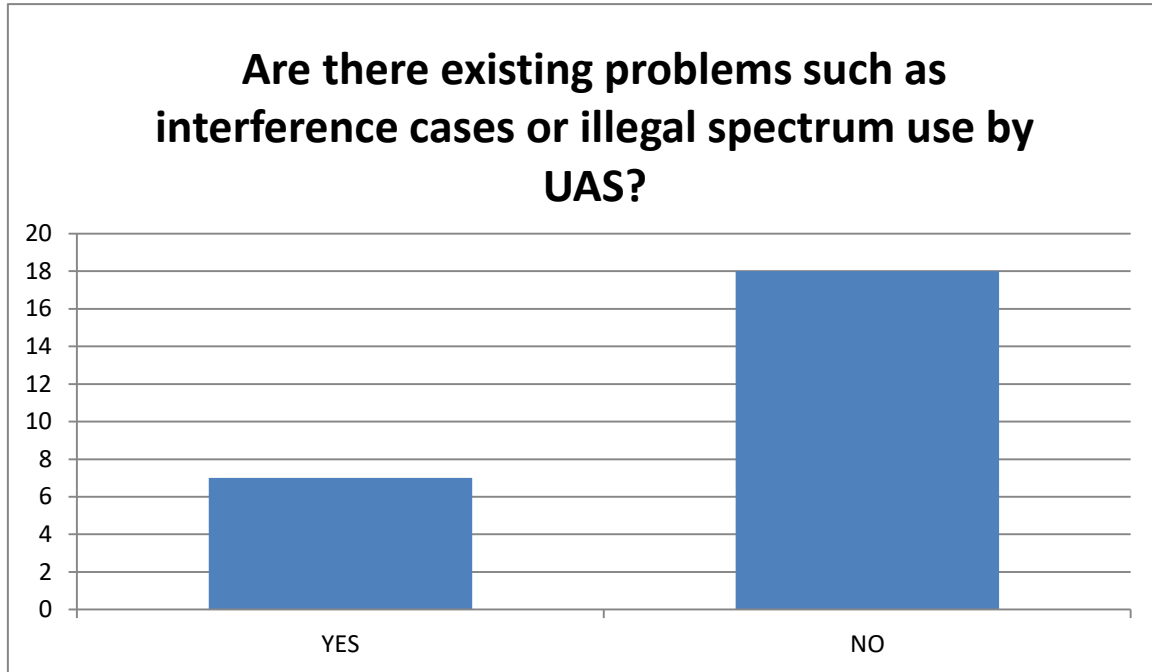


Figure 11: Existing problems such as interference

Assessment of WGFM CG Drones:
 7 replies said yes;
 Illegal use of frequencies;
 Over powered transmitters;
 Not may reported cases of electromagnetic interference;
 See ADCO RED campaign results.

• Question 6.1: YES answer - Please explain the problems(s)

Belgium	There are cases where the RPAS user tried an illegal use of frequency. Our national CEPT stopped the user before things could go wrong
Finland	Our Market Surveillance Team performed a measurement campaign where several radio controlled multicopters where tested. The tests are a part of the common European market surveillance campaign. The results were alarming: the tested equipment didn't pass (exceedings in transmitting power and incorrect operating frequencies). The results of the common campaign will be published by R&TTE ADCO.
Hungary	There is no official information about interference cases, but according to the experiences of UAS users the SRD power limits are frequently violated in 433 MHz, 2.4 GHz and 5 GHz bands.
Latvia	There have been cases of non EU market video transmitter mounted on UAS, resulting in interference with aviation radar and instrumental landing systems.

Lithuania	Interferences from illegal equipment with illegal spectral settings exist.
Netherlands	Yes. Illegal use of spectrum. See attached document in question 1. The use of frequencies by drones can have a greater impact on other frequency users. Because the frequencies are used in the air, the interference areas will also be larger
Switzerland	Crash of an UAS behind the airfield due to adverse electromagnetic interference. The problems were not known before; the electromagnetic interference must have acted by the UAS as a similar opposite command that led to its destruction. There was only material loss. Electromagnetic fields in a city, a region or underground electric power supplies are very common, therefore this point has to be considered properly. In the meantime, the problem has been solved through software (frequencies used in this case were in the 2.4 GHz)
United Kingdom	<p>Almost certainly over powered FPV transmitters. The UAS manufacturers seem confused about the 5.8GHz band, the UK acceptable frequencies and power. You can purchase FPV transmitters that cover Bands A-F covering a frequency range of 5645-5945MHz at high power (up to 2W) when the UK allows 25mW e.i.r.p. from 5725-5875MHz. Harmonising this might persuade the manufacturers to limit the transmit frequency range.</p> <p>Due to a lack of harmonisation UAVs, to-date, have been allocated frequencies on an ad-hoc basis by the administration in which the UAV was built and first flown, when that UAV is exported or used in another country the frequencies originally assigned may not be suitable. Should the UAV be then operated it can and has caused interference issues.</p>


• **Question 6.2: 'NO' Remarks**

Albania	Till now AKEP has not identified any interference cases or illegal spectrum use by UAS.
Austria	Up to now no interference cases have been reported.
Cyprus	Not reported
Czech Republic	No interference problems (complaints) indicated by Czech Telecommunication Office. Illegal (spectrum) use assessment is difficult due to the lack of information provided by Civil Aviation Authority.
France	No interference cases involving UAS have been reported to the ANFR to this day.
Georgia	We haven't yet meet such kind of problems.
Germany	There are no reported Problems that can be traced back to the use of UAS.
Greece	There are no reported cases of interference
Ireland	No Interference cases reported to date.
Italy	We have no cases of interference or illegal spectrum, in fact we are not aware of drones working in our country.
Norway	<p>No official reports. But there have been enquiries regarding the frequencies given by the document "Regulations concerning general authorizations for the use of radio frequencies"(license exempt frequencies), where users report a lot of activity on the frequencies available for RPAS (the frequencies are not specifically dedicated to RPAS use, but more generalized use). This has also led to interruption of the control function.</p> <p>There have also been verbal reports on illegal use, however, no reports on any communication being disrupted by this alleged illegal use of frequencies.</p>

	You can find more details on the document “Regulations concerning general authorizations for the use of radio frequencies” in the link below.
Portugal	No interference has been reported do far. However, in order to prevent the use of UAS in 2.4 GHz or other bands using more power than the authorised, it is beneficial to define an appropriate framework.
Russian Federation	Not yet, due to very limited usage of civil UAS at the current stage
Slovakia	We received no one report to eliminate existing problems with regard to interference cases or illegal spectrum use by UAS.
Spain	At this moment, we haven´t detected any interference. however, we may have them in the future

A1.6 ADDITIONAL INFORMATION

- **Question 7: Any further relevant information? If so, please add here.**

Czech Republic	<p>Air Navigation Services of the Czech Republic (ANS) (http://www.rlp.cz/en/Pages/homepage.aspx) – has issued a supplement X (Unmanned systems) to (ICAO Annex) L2 regulation recently, which “sets binding national requirements for the design, construction, maintenance, modification and operation of unmanned systems that meet the criteria of Annex II to Regulation of the European Parliament and Council Regulation (EC) no. 216/2008 [6], as amended, and is the recommended procedure for the operation of model aircraft with maximum take-off mass not exceeding 20 kg” (not available in English – see here http://lis.rlp.cz/predpisy/predpisy/index.htm and click “L2” and then “Doplňk X” in the 2nd level column right).</p> <p>- Civil Aviation Authority Czech Republic (CAA) (http://www.caa.cz/letadla-bez-pilota-na-palube/unmanned-aircraft) – there is ‘Unmanned Aircraft Department’ as a part of this office dealing with authorization (see the application form and instructions – there are items No. 25 and No. 27 concerning frequencies).</p> <p>Although part of the process is a checking of device and verification of the ability of the pilot to control the UAS, no one in the approval process is involved into the verification of the frequencies used.</p> <p>CTO is interested in entering into this process.</p>
Denmark	 <p>6 Denmark Report.pdf</p>
Estonia	We can not decide our plans with regard to the future use of frequencies for UAS before the decisions or recommendations in ECC, ITU and ICAO level are made.
France	<p>The protection of privacy should be taken into account when recording data onboard UAS.</p> <p>http://www.cnil.fr/linstitution/actualite/article/article/usages-des-drones-et-protection-des-donnees-personnelles/</p>
Georgia	UAS application should be reflected in our national NTFA.

Greece	<p>EETT Telecommunication Equipment Dept. participated in relevant RTTE ADCO campaign for RPAS Drones. Five (5) types of equipment have been evaluated for administrative and technical compliance. Based on our market survey results most of the products available in Greek market operate at 2.4GHz.</p> <p>Furthermore, it is believed that the proliferation of UAS applications operating within the framework of SRDs (ERC RECOMMENDATION (70-03)) will require technical review on the usage of the respective frequency bands, given the fact that the footprint of spectrum usage will be altered by the UAS applications, mainly due to the increased altitude from which these applications operate. Special attention should be given to the effect that UAS applications will have on existing SRD applications sharing the same band.</p>
Ireland	Ireland intends to make a contribution to the current ADCO R&TTE Market Surveillance Campaign on Remotely Piloted Aircraft Systems (RPAS), which seeks to determine the compliance level of RPAS available on the European market.
Netherlands	<p>The use of public or private LTE-networks.</p> <p>See also: http://www.telecompaper.com/news/radioaccess-demos-drone-over-private-lte-network--1090181</p>
Norway	<p>http://eng.nkom.no/laws-and-rules/regulations .</p> <p>It is not uncommon to experience WIFI-problems when using computers with 2.4 GHz in crowded areas. Since some drone systems also use such widely used frequencies with low protection requirements, it is likely that there have been some incidents related to the use of these frequencies for control of drones, even if we are not aware of any confirmed cases in Norway.</p>
Portugal	<p>Beyond spectrum issues, subjects like safety (including state safety), personal data protection and privacy as well as civil responsibility should be addressed by the relevant/competent bodies.</p> <p>Additionally, we would like to inform that in Portugal there are some frequencies available on a license exempt basis for model control (as in Annex 8 of Recommendations 70-03).</p>
United Kingdom	Limited tests carried out in the UK for the seventh joint cross-border market surveillance campaign showed that 4 out of the 5 units under test were non-compliant in some way. Full details of the tests are contained in reports submitted during the summer as part of that campaign. Due to the nature of UAS operation and elevated platform, any unwanted/spurious emissions have the potential to radiate over a large area.

A1.7 AERONAUTICAL REGULATION PART

A1.8 EXISTING REGULATORY FRAMEWORK

- Question 8: Is there already a national regulatory framework or reports available on civil UAS?**

Aerodromo Municipal de Portimão (POR)	No
AESA (E)	Yes
Airfilms Production (NED)	Yes
Austria	Yes
Belgian Civil Aviation Authority (BCAA)	Yes
Bundeskommision Modelflug (D)	Yes

Civil Aviation Authority (CZE)	Yes
Civil Aviation Agency (LVA)	Yes
Croatia	Yes
Dep. of Civil Aviation (CYP)	No
Switzerland	Yes
DFS Deutsche Flugsicherung (D)	Yes
DGA (F)	Yes
EASA	Yes
EuroUSC International (G)	Yes
Federal Supervisory Authority for Air Navigation Services (D)	Yes
Finavia	No
Finland	Yes
France	Yes
Guardia Nacional Republicana (POR)	No
Hungary	Yes
IPQ (POR)	Yes
Kantonspolizei Bern (SUI)	Yes
Lithuania	Yes
Montenegro	No
Norway	Yes
Robonic (FI)	No
Selex (I)	Yes
Skeye (NED)	Yes
Slovenia Control	No
Sweden	Yes
Swiss Federation of Civil Drones	No
Telespazio (I)	Yes
The Finnish Border Guard	Yes
Trimble (BEL)	Yes

Unidade Especial de Polícia - Núcleo de Meios Técnicos e Audiovisuais (POR)	No
United Kingdom	Yes
VTO Technologies (G)	Yes

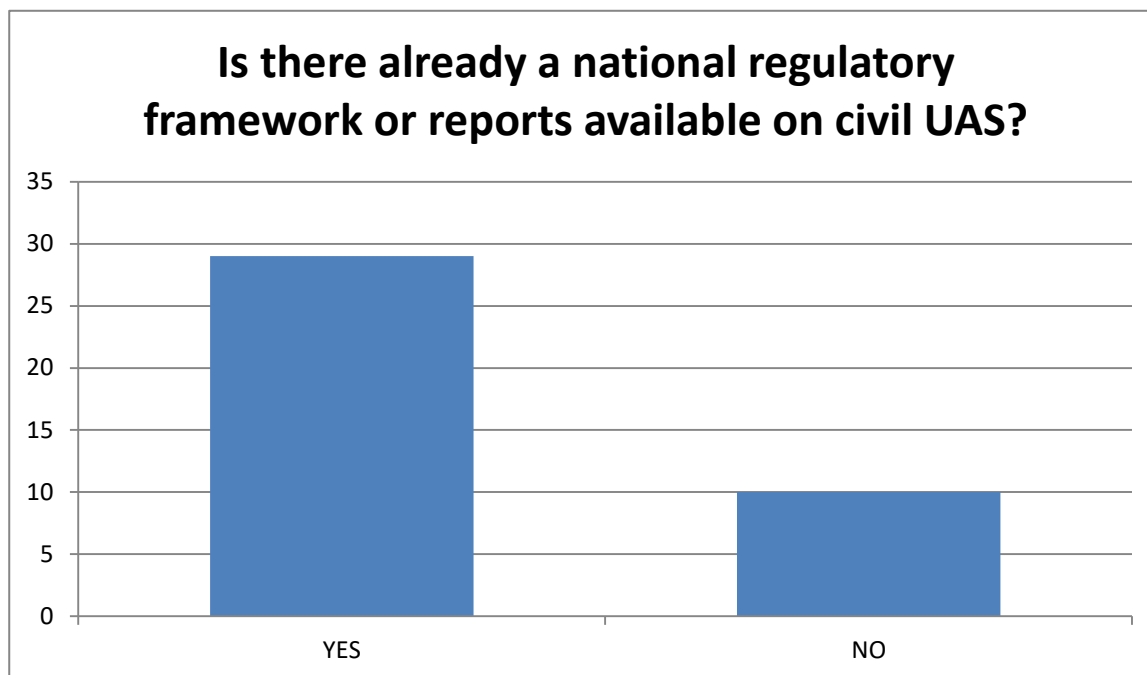






Figure 12: Availability of a National regulatory framework

- **Question 8.1: If so, have you identified any challenges within the existing national regulatory framework? (Please include links/documents if possible)**

AESA (E)	You can find more information in this link http://www.seguridadaerea.gob.es/lang_en/cias_empresas/trabajos/rpas/marco/default.aspx
Civil Aviation Agency (LVA)	Existing national regulatory framework covers only recreational and sport model aircraft activities. Link to national regulation: http://likumi.lv/doc.php?id=141998 Latvia is developing new UAS regulation. Planned to be in force by the end of 2015. And this regulation will define requirements for today's identified users operations.
Civil Aviation Authority (CZE)	No specific frequencies nor maximum output power are mentioned in the RPAS regulation. It can be downloaded in English here: https://www4.icao.int/rpas/Documents/Czech%20UAS%20regulatory%20framework%202013-05-30%20-%20ENGLISH.pdf
Croatia	http://narodne-novine.nn.hr/clanci/sluzbeni/2015_05_49_974.html
DGA (F)	Arrête of april 11 th , 2012. Security when UAV fail and fall. Terrorism activity, i.e. from the perspective of blocking/prohibiting/ enforcing that drones are not used at a given time and location.

<p>DFS Deutsche Flugsicherung (D)</p>	<p>National regulation is available for UAS below 25kg. The national regulations can found in the attached documents:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  2a DFS - Legal conditions in Germany </div> <div style="text-align: center;">  2b DFS - Nfl I 281 Translation EN.pdf </div> <div style="text-align: center;">  2c DFS - WGFM Questionnaire UAS 27 </div> </div>
<p>EASA</p>	<p>Currently, EASA is only responsible for drones with a maximum take of weight in excess of 150 kg, except for military, customs, police, search and rescue, firefighting, coastguard operations as well as similar activities and services. EASA has published an intermediate policy: https://www.easa.europa.eu/document-library/policy-statements/ey013-01. This policy addresses the airworthiness-certification aspects of the drones. The unique characteristics of drones, including the command and control link, are addressed with special conditions. This means that the certification basis is established individually per project. The policy foresees high level safety objectives for the command and control link:</p> <p>7.2 Command and Control Link</p> <p>Consideration of the following airworthiness factors should be included in the UAS type certification basis:</p> <ul style="list-style-type: none"> a) The UAS flight crew should be provided with a continuous indication of the command and control link signal strength together with the maximum link range. b) Any single failure in the command and control system (uplink or downlink) should not affect normal control of the unmanned aircraft. c) Uplinks/downlinks are sensitive to electromagnetic interference (EMI). The command and control link, in addition to operating in appropriate frequency band(s), should be adequately protected from this hazard. d) Contingencies for failures or interruptions of the command and control link must be defined by the applicant and evaluated as part of the airworthiness certification. For example: lapse times, intermittent failures, alternate modes of command and control and total loss of command and control link. <p>Currently, below 150 kg, national regulations are applicable. Such regulations can be accessed here on EASA Web site: http://www.easa.europa.eu/unmanned-aircraft-systems-uas-and-remotely-piloted-aircraft-systems-rpas . A summary of worldwide drone regulations can be accessed here: http://drones.newamerica.org .</p> <p>In March 2015, EASA presented its new regulatory approach for safely operating drones. This new approach is called “concept of operations”. This “concept of operations” foresees regulations proportionate to the operational risks (http://www.easa.europa.eu/newsroom-and-events/general-publications/concept-operations-drones). Such regulations have to be developed and endorsed.</p>
<p>EuroUSC International (G)</p>	<p>There is no element of airworthiness assessment of the Remotely Piloted Aircraft Systems (RPAS). This allows sub standard ‘hobby’ type systems to be used in a commercial environment posing significant safety risks. Record keeping is very poor. EuroUSC operate a comprehensive database of registered RPAS along with a safety database of reported occurrences. Operators systems are unchecked with regards to transmission power output by the regulating body left to EuroUSC to advise its candidates. Frequency allocation and transmission is simply not covered.</p> <p>http://www.caa.co.uk/docs/33/CAP%20722%20Sixth%20Edition%20March%202015.pdf</p> <p>Currently, requirements are varied across countries. For example, the UK have no airworthiness requirement where as the Netherlands have rigid requirements including an independent airworthiness assessment of each and every RPAS intended for commercial operations.</p>

	<p>Transmission power output limits are varied across the countries. The UK allow 2.4GHz @ 100mW whereas France have limited these 2.4GHz transmissions to 10mW. This means that an operator is often forced to make major modifications to their RPAS each time they operate in a different country.</p>
Federal Supervisory Authority for Air Navigation Services (D)	<p>A national regulatory framework for civil UAS is the LuftVG and the LuftVO, which implements regulations and definitions for UAS in a very general and high level manner. Special national regulations for spectrum management are envisaged to be included into the Frequenzverordnung, which determines national spectrum use based on radio regulations from ITU.</p> <p>For that regulatory framework, no current experiences</p>
Finland	<p>Not yet as our regulatory framework consists of a number of sections in the Aviation Act (864/2014) and a new regulation to be issued soon after 1 October 2015.</p>
France	<p>The whole framework is available at the following web link:</p> <p>http://www.developpement-durable.gouv.fr/Quelle-place-pour-les-drones-dans,45924.html</p> <p>Moreover the following administrative orders describe the usage and conception rules for UAS:</p> <ul style="list-style-type: none"> - Arrêté du 17 décembre 2015 relatif à l'utilisation de l'espace aérien par les aéronefs qui circulent sans personne à bord https://www.legifrance.gouv.fr/eli/arrete/2015/12/17/DEVA1528469A/jo/texte - Arrêté du 17 décembre 2015 relatif à la conception des aéronefs civils qui circulent sans personne à bord, aux conditions de leur emploi et aux capacités requises des personnes qui les utilisent https://www.legifrance.gouv.fr/eli/arrete/2015/12/17/DEVA1528542A/jo/texte
Hungary	<p>The Hungarian Aviation Act (ACT XCVII. Of 1997 on Air Traffic) and other decrees contain the fundamental requirements related to UAS civil operation. The detailed national regulatory framework of civil operation is under preparation.</p> <p>The main challenge of the UAS business is to certify any unmanned aircraft system as air vehicle, ground control station and communication link as well as the operator.</p>
IPQ (POR)	<p>Just for sports, but only permitted in Certified Airfields, exclusively for aero models.</p>
Kantonspolizei Bern (SUI)	<p>http://www.bazl.admin.ch/dienstleistungen/02658/index.html?lang=de</p>
Lithuania	<p>Regulation on the Unmanned Aircraft Operations, approved by Order No. 4R-17 of Director of Civil Aviation Administration, 23 January 2014. http://caa.lt/index.php?-1659137123</p>
Norway	<p>The RPAS industry has evolved past the initial regulatory framework (prepared by the Norwegian CAA), and so the existing regulatory framework for RPAS operational issues is being revised and updated, and is currently out on public hearing. The finalized version will be made public during the fall of 2015.</p> <p>The Norwegian radio regulation for radio licenses for Norwegian aircraft relies heavily on the EASA approval concepts, but for the time being we lack the exact requirements for radio products for drones from EASA. Since the general view is that airborne products are covered by EASA, the European Standardization Organisations do not seem particularly interested in developing standards for this purpose since they must see a future for such standards to be willing to use their resources on this task. Therefore we see that radio technologies that were not developed for control of drones are used for control of drones. We are about to revise this regulation, but for the mentioned reasons for the time being we feel that we lack a good solution</p>

	<p>for drones.</p> <p>The regulatory framework of the Norwegian CAA existing today is considered a minimum-requirement regulatory framework, which will have to adapt to the progress of the RPAS technology and industry continuously. And there has also been made some decisions in conjunction with the development of this regulatory framework, which will have to be revised and compared to the future European regulatory framework, which is under construction.</p>
Selex (I)	<p>Radio systems for Identification/Surveillance required by new ENAC rule for small RPAS in low level operations requires dedicated studies. A systems for electronic identification which allows real-time transmission of data concerning the RPAS and the owner / operator and the essential data of flight based on existing ADS-B 1090 MHz ES (Extended Squitter) could be evaluated, but the impact on existing/planned ADS-B Surveillance system for larger aircraft/RPAS operations requires careful evaluations, as this spectrum is already overloaded in certain airspaces and will become even more in the future. Dedicated impact studies and technical/operational limitations to overcome these should be performed.</p>
Telespazio (I)	<p>Existing ENAC regulation issued on 16th March 2015. ENAC regulation on RPAS (MTOW below 150kg) is available at the following links:</p> <ul style="list-style-type: none"> • https://www.enac.gov.it/La_Normativa/Normativa_Enac/Regolamenti/Regolamenti_ad_hoc/info-122671512.html • https://www.enac.gov.it/La_Normativa/Normativa_Enac/Disposizioni/info593565219.html <p>Concerning RPAS with MTOW > 150kg, Telespazio is working in collaboration with JARUS on the set-up of RCP target parameters for the use of satcom links for RPAS BRLOS Operations, in the context of ESA / EDA funded DeSIRE 2 Project (see attached presentation). Documentation set by the JARUs Group on RCP for C2 CNPC link in BRLOS operations can be found through the following link: http://jarus-rpas.org/index.php/deliverable/category/12-external-consultation-on-jarus-c2-rcp</p> <p>See document attached</p>
The Finnish Border Guard	<p>Aviation act and aviation regulations are most important framework for UAS regulation. National RPAS regulation is on draft phase and it is expected that it will be published during 2015.</p> <p>Existing frequency regulations, available frequencies and power limits have been planned mostly for the UAS which are used inside visual line of sight (VLOS). However security authorities have needs to fly beyond visual line of sight (BVLOS). In connection with that there should be available suitable frequency windows and higher power limits for BVLOS activities in order to send high quality command information from ground to air and receive high quality payload and control information from air to ground. Suitable frequencies and powers would decrease aviation risks. Using of those frequencies and powers should be possible also on state border areas.</p>
Trimble (BEL)	<p>Yes. The regulations (likely released by the end of 2015) contain limits (e.g. max height limit of 90 m) and operator requirements (logging, licensing) that are more strict than the current EASA proposal.</p>
Switzerland	<p>The regulation with regard to unmanned system is the DETEC Ordinance on Special Category Aircraft (OSCA). For the time being, it is not possible to issue a “Type Certificate” for UAS, but that will change in the future.</p> <p></p> <p>1 DETEC-file to be attached.doc</p>

United Kingdom	Yes in CAP722 (see the answer to Question 1 of part 1 for the link)
VTO Technologies (G)	Securing BVLOS RPAS frequencies

• **Question 8.2: 'NO' Remarks**

Dep. of Civil Aviation (CYP)	Draft national regulatory framework exists
Guardia Nacional Republicana (POR)	There is no regulation available in Portugal for the operation of civil RPAS.
Montenegro	Under study.
Robonic (FI)	Regulations are under development and to be finished, will be published during autumn 2015 by Finnish CAA (Trafi). They will be concentrated on VLOS operations.
Slovenia Control	There is no national regulatory framework
Swiss Federation of Civil Drones	Not for frequencies.

Assessment of WGFM CG Drones:

A national regulatory framework or reports available on civil UAS is available in a considerable number of countries.

Further assessment needed to analyse in more detail what kind of UAS is covered by existing national regulations since some are limited to only certain UAS (e.g. weight limits, only models). Structure the national conditions expressed in these regulations:

1. EASA airworthiness requirements and their applicability (under change process at this moment)
2. Civil/ Non-civil use (definitions, may not be the same for all countries, e.g. in relation to some security applications)
3. control link control and max. operating range limits, also LOS and NLOS
4. contingencies/safe modes in case of interference or any interruption of the control link
5. weight limits
6. exclusion zones (or alternatively, permit to use only at dedicated zones/ airfields)
7. flight height restrictions
8. operator requirements (need to pass an examination before operating certain drones??)
9. Day/night restrictions
10. Restrictions to support enforcement (may include record keeping, databases, electronic identification, other restrictions)
11. Satellite communication links to/from drones.

• **Question 9: Are there specific frequencies mentioned within these regulations?**

Aerodromo Municipal de Portimão (POR)	No
AESA (E)	No
Airfilms Production (NED)	No
Austria	No
Belgian Civil Aviation Authority (BCAA)	Yes
Bundeskommision Modellflug (D)	No
Civil Aviation Authority (CZE)	No
Civil Aviation Agency (LVA)	No
Croatia	No
Dep. of Civil Aviation (CYP)	No
Switzerland	No
DFS Deutsche Flugsicherung (D)	Yes
DGA (F)	Yes
EASA	No
EuroUSC International (G)	No
Federal Supervisory Authority for Air Navigation Services (D)	No
Finavia	No
Finland	No
France	No
Guardia Nacional Republicana (POR)	No
Hungary	No
IPQ (POR)	Yes
Kantonspolizei Bern (SUI)	No
Lithuania	No
Montenegro	No
Norway	No
Robonic (FI)	No
Selex (I)	No

Skeye (NED)	No
Slovenia Control	No
Sweden	No
Swiss Federation of Civil Drones	No
The Finnish Border Guard	Yes
Telespazio (I)	Yes
Trimble (BEL)	No
Unidade Especial de Polícia - Núcleo de Meios Técnicos e Audiovisuais (POR)	No
United Kingdom	Yes
VTO Technologies (G)	Yes

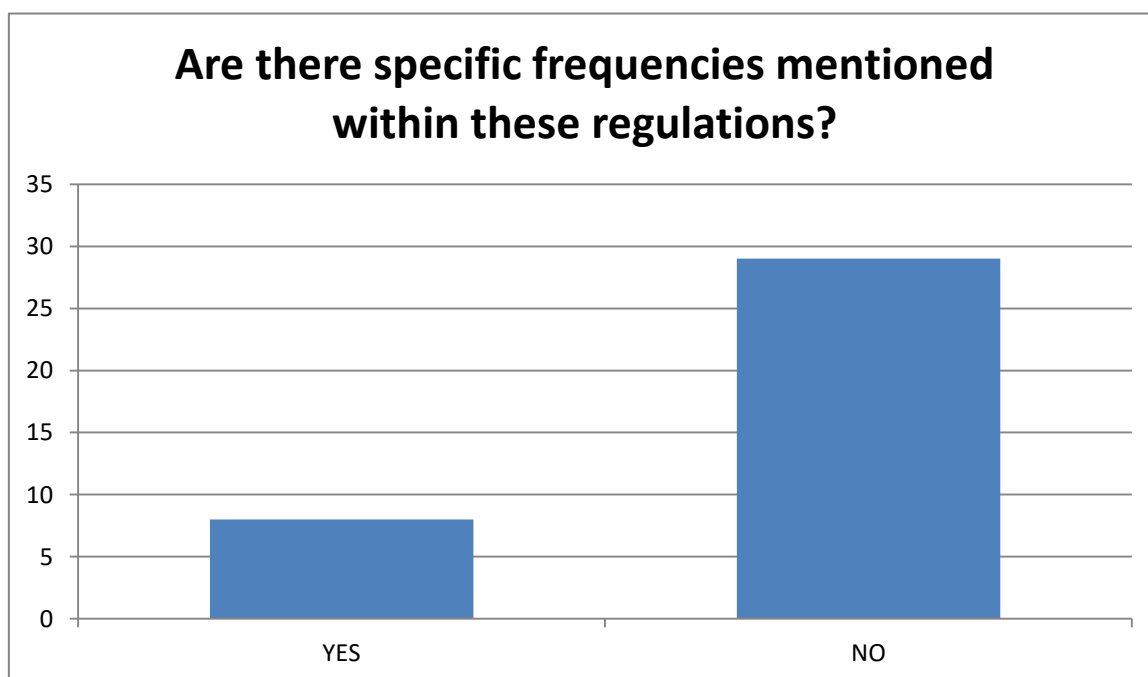


Figure 13: Specific frequencies identified

• **Question 9.1: 'YES-answer' - Please indicate**

Belgian Civil Aviation Authority (BCAA)	Belgian Civil Aviation Authority states clearly in the regulation that only frequencies accepted by the national CEPT (IBPT-BIPT) may be used by RPAS operators. They need to ask for permission or positive advice before they can use the RPAS for professional use. The frequencies used for toys and model aircraft are covered by the regulatory framework for entering the market place and are in compliance with European Directive for toys and CE markings requirements for products and services put on the European market.
DFS Deutsche Flugsicherung (D)	Only radio equipment (telemetry equipment) that complies with the provisions governing such equipment may be used. The provisions and orders issued by the Federal Network Agency

	governing this equipment shall be observed. In case of sustained or repeated (radio) interferences, the Federal Network Agency and the aeronautical authorities are to be informed.
DGA (F)	2.4 GHz
IPQ (POR)	The assigned for aero models.
Telespazio (I)	ENAC regulations make specific reference to the obligation for the RPAS Data Link to make use of authorized frequencies, without specifying the frequencies range. The JARUS document does not make any specific reference to frequencies.
The Finnish Border Guard	According to aviation regulations radio licenses are requested from Communications Regulatory Authority (CRA) but National Civil Aviation Authority (NCAA) conducts radio equipment surveillance in connection with inspections of aircraft. Also VHF radio rules have to take in to account if aviation radio is used during UAS flights. According to regulations of CRA command and control transmitters can be used on frequency area 5030-5091 Mhz. Other frequencies are considered case by case. License to use possible transmitters of payload have to request separately. According to aviation regulations it is recommended that aviators of aircraft listen to international emergency frequency 121.5 Mhz but in practice RPAS pilots have rarely possibility to do that.
United Kingdom	See chapter 5 for a full explanation but the following frequency bands are mentioned 255 - 526.5 kHz Radionavigation 108 – 137 MHz Radionavigation/Radiocommunications 328.6 – 335.4 MHz Radionavigation 960 – 1 350 MHz Radionavigation/Radar 2 700 – 3 100 MHz Radar 4 200 – 4 400 MHz Radionavigation 5 000 – 5 150 MHz Radionavigation 9 000 – 9 200 MHz Radar 9 300 – 9 500 MHz Radar <i>Note: Radionavigation/radiolocation bands: this does not reflect any specific provisions for UAS yet</i> As well as 35 MHz, 2.4 GHz and 5.8 GHz
VTO Technologies (G)	5030-5091 MHz Note: The national document only reflects the WRC-12 decision.

• **Question 9.2: 'NO' Remarks**

Civil Aviation Agency (LVA)	In the current regulation it is defined that during radio controlled model flight can be used radio frequencies which are defined in the regulations about radio frequency spectrum for model aircraft flight operations.
Civil Aviation Authority (CZE)	Usually 2,4 (uplink) and 5,8 (downlink) GHz are used (98%).
EASA	EASA intermediate policy (https://www.easa.europa.eu/document-library/policy-statements/ey013-01) does not mention specific frequencies and states that “It is reminded that approval for all frequencies used in UAS operations must be obtained from national authorities. This is not part of an airworthiness approval”.
EuroUSC International (G)	There are no frequencies currently allocated specifically for commercial RPAS but there is a strong requirement. Many systems utilise a wide range of frequencies including 2.4GHz, 5.8GHz, 433MHz. The operators of these RPAS often express difficulties in identifying legal limits for power

	<p>outputs.</p> <p>A simple document is required stating legal frequency and power output limits (mW) for airborne RPAS. The current stakeholder document is not easily interpreted.</p> <p>http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-information/UKFAT_2013.pdf</p> <p>433 – 459MHz frequencies tend to have better range qualities and could be utilised for extended and beyond line of sight flight operations</p>
Federal Supervisory Authority for Air Navigation Services (D)	<p>Currently there are no special frequencies within the Frequenzverordnung for use of UAS scheduled. The general spectrum for these kinds of frequencies will be a very important topic for future use of UAS in German airspace. For that, control and non-payload communication of UAS in non-segregated airspace is one item on the agenda (Agenda Item 1.5) of the next world radio conference in November 2015 (WRC-15) and also a substantial part of the ICAO-Position for this WRC-15.</p>
Guardia Nacional Republicana (POR)	<p>There is no specific frequencies available in Portugal for the operation of civil RPAS.</p>
Hungary	<p>There are no specific frequencies in these regulations. The UAS purpose frequencies will be provided within the spectrum regulation framework (see the answers to Questions 1 and 2 in the Spectrum regulation part).</p>
Kantonspolizei Bern (SUI)	<p>The BAKOM has to define the use of frequencies.</p>
Montenegro	<p>Under study.</p>
Robonic (FI)	<p>Regulations are under development and to be finished, will be published during autumn 2015 by Finnish CAA (Trafi). They will be concentrated on VLOS operations.</p>
Selex (I)	<p>Only generic requirements on the use of authorized frequencies and chosen in order to minimize voluntary and non-voluntary interferences which could compromise safety (“Il data link deve utilizzare frequenze autorizzate e scelte opportunamente in modo da minimizzare la possibilità di interferenze involontarie e volontarie che possano compromettere la sicurezza delle operazioni”)</p>
Slovenia Control	<p>Frequencies are not specified</p>
Swiss Federation of Civil Drones	<p>Civil UAS use band in 2.4 and 5.8GHz, often where WLAN is.</p>
Trimble (BEL)	<p>They refer to the BIPT</p>

Assessment of WGFM CG Drones:

The vast majority of the existing national aeronautical frameworks for UAS do not define any specific frequency use for UAS. These documents often simply refer to the national regulatory framework for frequency use, and in particular to the possibilities for UAS operation inside of the existing provisions for generally authorised frequency use.

A1.9 CATEGORISATION OF UAS

- **Question 10: Explain the categorisation of UAS (e.g. by concept of operation, range of operation, weight, visual line-of-sight/ non visual line of sight, safety aspects, user groups, etc.) in use in your country, including important technical requirements**

	Please explain here and include link/documentation pertinent to your country, if possible
AESA (E)	There are different types of drones depending on weight (more or less than 150 Kg, 25 Kg,...)
Airfilms Production (NED)	Any other Weight and/or dimensions, visual line-of-sight / non visual line of sight http://www.ilent.nl/onderwerpen/transport/luchtvaart/dronevliegers/
Austria	http://www.austrocontrol.at/jart/prj3/austro_control/main.jart?rel=en&content-id=1380112440527
Belgian Civil Aviation Authority (BCAA)	<p>Belgian Civil Aviation Authority (BCAA) uses a risk based, operational centric approach. This means that BCAA doesn't use a categorization of aircraft based on weight or dimensions apart from the 150kg limiting its competence in RPAS business. The national regulation tries to make clear requirements for different type of users like toys players, model aircraft users (non-professional use for recreation and sports) and professional use of aircraft. BCAA handles both visual and beyond visual line of sight operations.</p> <ul style="list-style-type: none"> • Safety aspects : BCAA only accepts RPAS operations after approved safety analysis report looking into emergency scenarios and the preventive and corrective actions taken. • The minimal technical requirements are : Art. 46. §1. Every RPAS has to be equipped with : 1° fail-safe system and/or other procedure to stop the flight safely, when needed 2° a tracking system to find back the RPA after landing ; 3° navigation lights ; 4° navigation-instruments adapted to the type of flight and executed in compliance with the applicable legislation ; 5° anti-collision lights when the RPAS operates in a zone where other aircraft operate at the same time. <p>§2. A RPAS is developed so that : 1° the circuits for command and control shall never be disturbed by interference or other problem coming from the payload circuit ; 2° the execution of an emergency scenario shall never lead to an uncontrollable crash of the RPA ; 3° if the case, the reaction time of the communication shall never jeopardize the safety of the operations.</p>
Bundeskommision Modelflug (D)	There is a primary categorization, the purpose of the mission. It is divided in commercial use and use for sports and recreation (aeromodelling). For both groups only VLOS-

	<p>operation is permitted. There are no common technical requirements. Commercial use always needs a permission for operation while the aeromodelling area can operate without permission if the mass of the drone (or model) is below 5 kg. From 5 – 25 kg a permission is required but it is linked to the airfield, not to the model or person. Above 25 kg a certification of the model is required. In the area of aero-modelling drones are models like i.e. fixed wing models or helicopters.</p>
Civil Aviation Agency (LVA)	<p>In the new UAS regulation there is foreseen categorization by weight:</p> <ul style="list-style-type: none"> - up to 1.5 kg - more than 1.5. kg up to 25 kg - more than 25 kg
Civil Aviation Authority (CZE)	<p>Regulation can be downloaded here: https://www4.icao.int/rpas/Documents/Czech%20UAS%20regulatory%20framework%202013-05-30%20-%20ENGLISH.pdf</p> <p>All aspects are used: VLOS/BVLOS, area of operations (away from people, close to people, >5,5 km from aerodrome or closer), below 100 m AGL in CTR, below 300 m AGL elsewhere, MTOM of 0,91 kg, 7 kg, 20 kg and many other aspects. Kinetic energy is not used directly but is used "behind the scenes" during assessment of safety distances.</p>
Croatia	<p>There are 3 different class of UAVs: up to 5 kg, from 5 to 25 kg, and to (including) 150kg</p>
Dep. of Civil Aviation (CYP)	<p>Risk based categorisation</p>
Switzerland	<p>Swiss FOCA follows a risk-based approach. Operation with low risk are proceeded with no or little regulation. Basically there are two categories: “Open” & “Specific” “Open” = max. 30 kg, 100m outside of crowds, VLOS (Visual line of sight). Open does not require an authorisation from Swiss FOCA. A crowd is defined as a minimum of 24 people standing close together, as on a bus station during rush hours or an open air concert. The rationale is that one cannot escape if surrounded by many people around. It is therefore possible in Switzerland to fly in cities, as long as the 100m distance from crowds is respected. “Specific” = everything else. An authorisation from FOCA is required. A Total Hazard and Risk Assessment is required to evaluate the safety conditions required for the intended operation. These safety requirements can be technical or operational. From the authorisation side there are specific category authorisations for: VLOS closer than 100m to crowds but not direct over the crowd (SIDE approval) VLOS direct over the crowd (OVER approval) VLOS tethered BLOS</p>
DFS Deutsche Flugsicherung (D)	<p>See document attached</p>
DGA (F)	<p>ANFR Registration is working on this affair. Control and non-payload communications (CNPC) Both, frequencies must be different. Control UAV is only control UAV and mustn't be jamed by video frequency. Weight and/or dimensions In France we have "Arrête april 11th, 2012"</p> <p>micro < 2 kg ; mini 2 to 20 kg ; >20kg = class 1 150 à 600 kg = class 2</p>

	< 600 kg = class 3
EASA	<p>The current European regulation only foresees drones over 150 kg and below 150 kg. The proposed EASA concept of operations anticipates a risk-based approach based on operations.</p> <p>There would be 3 operational categories:</p> <ul style="list-style-type: none"> • open category without involvement of aviation authorities for low risk operations. This category would have operational limitations: visual line of sight, maximum altitude, minimum distance for airport and sensitive zones. It is likely that this category will be defined by a maximum kinetic energy translated into simple parameters for straightforward interpretation (probably with weight and other factors). • Specific category with an approval from the national aviation authorities possibly supported by qualified entities and/or qualified operator for an increased risk. A safety risk assessment would be required. The operation would be approved on the basis of an operations manual. The airworthiness of the drone and the competence of the staff operating the drone would be based on the outcome of the risk assessment. • Certified category: this category is similar to manned aviation. The limit between “specific” and “certified” categorie and control could receive an independent approval from the certification of the drone. <p>A summary of the current national categories can be accessed here: http://drones.newamerica.org</p>
EuroUSC International (G)	<p>The CAA categorise operations by mass(</p> <p>EuroUSC have their own internal categorisation system which they are happy to share which is based on the concept of operation and pilot competence. 'tablet' programmed, waypoint operated RPAS fit into a different class and carry different pilot skills to a manually operated RPAS. Mass also fits into the equation</p> <p>There are currently International standards in planning which may well create various classes of RPAS split by size and weight of RPAS and types of operation. Small systems tend to be flown at close ranges. Therefore, small hobby typr multi-rotor systems which rarely tend to operate in excess of 150 metres could easily operate on lower power output such as 2.4GHz @ 20mW. This measure may help to alleviate interference for operators of larger systems with higher frequency power outputs.</p>
Finavia	<ul style="list-style-type: none"> - Weight >25 kg - Weight <25 kg - Controlled visually - Controlled non visually
Finland	<p>The most important division line is the one between VLOS and BVLOS operations. The type of the operating area (densely populated areas/open-air crowds of persons/vicinity of airports/other) is also very important, as well as the mass of the UA (max 7 kg over densely populated areas and open-air crowds of persons; max 25 kg generally).</p>
France	<p>The administrative order « arrêté du 11 avril 2012 relatif à l'utilisation de l'espace aérien par les aéronefs qui circulent sans personne à bord » mentioned above describes a categorization of UAS in categories and operational scenarios according to the mass of the UAS as well as altitude and distance of flight, and population density in the area.</p> <p>http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000025834986</p>
Guardia Nacional	<p>There is no regulation available in Portugal for the operation of civil RPAS. The national</p>

Republicana (POR)	<p>regulatory initiative belongs to the ANAC (Portuguese National Civil Aviation Authority). ANAC held two events (seminars) in 2015 in order to promote national debate on the use of airspace and gather opinions from its stakeholders. Following these initiatives ANAC drafted a legislative proposal which included a chapter on communications and radio frequencies. This chapter of this project has been left to the care of Portuguese authority for communications. ANAC's legislative project for the use of airspace by RPAS was presented to the Portuguese Government and to date has not been approved.</p> <p>GNR, as the most important low-enforcement institution in Portugal, with public safety responsibility in over 94% of the national territory, and also as state aircraft user and major stakeholder, proposed to the Portuguese aeronautic authority to adopt the following categorization for civil RPAS legislation:</p> <p>Category Civil Classification MTOW (Kg) Range (Km)* Typical flight altitude (m) Autonomy (Hours) Indicative Values I Micro < 5 < 10 < 250 < 1 II Mini < 25 < 10 < 300 < 2 III Medium < 150 < 70 ** < 3.000 > 3 * The range can be limited by the communications capacity. ** Distance limited by terrestrial communications. In case equipped with satellite communication system, range can be higher.</p>
Hungary	<p>- Categorization of Maximum Take Off Weight (MTOW): MTOW < 0,5 kg MTOW = 0,5 < 7 kg MTOW = 7 < 25 Kg MTOW = 25 < 150 kg</p> <p>- Categorization of civil operation: HOBBY operation : only recreational flying PROFESSIONAL operation (by companies)</p>
IPQ (POR)	NIL
Kantonspolizei Bern (SUI)	<p>Nato classification is usually used: http://www.google.ch/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CCkQFjABahUKEwjup8qR29rGAhXGoYAKHV0UBS4&url=http%3A%2F%2Fuvs-info.com%2Fphocadownload%2F05_3b_2010%2FP061-062_NATO_Dave-Ehredt.pdf&ei=gwylVa7aIsbDggTdqJTAg&usg=AFQjCNEKrRp0VEao4Q8MdWmToJN-LE2KA&bvm=bv.97653015.d.eXY http://www.bazl.admin.ch/dienstleistungen/02658/index.html?lang=en</p>
Lithuania	<p>By weight: up to 300 g, 300 g – 25 kg, above 25 kg. By range of operation: normal use in visual line-of-sight (but in any case not further than 1000 m from the operator's location). Individual authorizations for exceptional use above visual line-of-sight also determinate. Safety aspects: normal use - keeping the minimum distance not less than 50 m from vehicles, buildings and other persons. Individual authorizations for exceptional use also determinate. http://caa.lt/index.php?-1659137123</p>
Montenegro	Under study.
Norway	<p>The regulatory framework is being revised and will be finalized during the fall of 2015. But to give an example, the following (simplified) is what is suggested:</p> <p>RO 1 can have a starting total weight of up til 2.5 kg and a maximum velocity of 60 knots RO 2 can have a starting total weight of up til 25 kg and a maximum velocity of 80 knots</p>

	<p>RO 3 can have a starting total weight of 25 kg or more and a maximum velocity of 80 knots or more, or be driven by a turbine motor, in which will require an operator permit (of the sort RO 3, jf.§34).</p> <p>Operator permit (RO 3) is also mandatory for flying BVLOS.</p>
Robonic (FI)	Regulations are under development and to be finished, will be published during autumn 2015 by Finnish CAA (Trafi). They will be concentrated on VLOS operations.
Selex (I)	<p>According to ENAC Regulation RPAS which are under ENAC responsibility are distinguished in terms of MTOW and Operations as:</p> <ul style="list-style-type: none"> • RPAS with MTOW below 0.3 kg • RPAS with MTOW between 0.3 kg and 2 kg • RPAS with MTOW between 2 kg and 25 kg • RPAS with MTOW between 25 kg and 150 kg <p>Operations can be conducted in:</p> <ul style="list-style-type: none"> • Visual Line of Sight (LOS) • Extended Visual Line of Sight (EVLOS) • Beyond Line of Sight (BLOS)
Skeye (NED)	All VLOS
Slovenia Control	NO CATEGORISATION OF UAS IS SPECIFIED
Sweden	<p>http://www.transportstyrelsen.se/sv/luftfart/Luftfartyg-och-luftvardighet/Obemannade-luftfartyg-UAS/</p> <p>Permission from the Transport Agency is required for unmanned aircraft used or designed for:</p> <ul style="list-style-type: none"> • Testing and research • Commercial purposes, therefore any kind of activity in which remuneration is received for work performed • Mission flight and the like, which are not regarded as pleasure or recreation • Be flown out of sight of the pilot. <p>All unmanned aerial vehicles, which falling within the above points is called by the Transport Agency as a UAS, and get a special registration mark.</p> <p>1.1 UAS divided into the following categories of permit</p> <p>1.1.1 Category 1A Unmanned aircraft with a maximum take off weight of less than or equal to 1.5 kg, which develops a maximum kinetic energy of 150 J and is flown only within sight of the pilot. Learn more about Category 1A UAS http://www.transportstyrelsen.se/sv/luftfart/Luftfartyg-och-luftvardighet/Obemannade-luftfartyg-UAS/Sok-tillstand-for-UAS/Kategori-1A/ and how to apply for permission.</p> <p>1.1.2 Category 1B Unmanned aircraft with a maximum takeoff weight of more than 1.5 kg but less than or equal to 7 kg, which develops a maximum kinetic energy of up to 1000 J and operated solely within view of the pilot. Read more Category 1B http://www.transportstyrelsen.se/sv/luftfart/Luftfartyg-och-luftvardighet/Obemannade-luftfartyg-UAS/Sok-tillstand-for-UAS/Kategori-1B/ UAS and how to apply for permission.</p> <p>1.1.3 Category 2 Unmanned aircraft with a maximum takeoff weight of more than 7 kg which only operated within sight of the pilot. Learn more about Category 2 http://www.transportstyrelsen.se/sv/luftfart/Luftfartyg-och-luftvardighet/Obemannade-luftfartyg-UAS/Sok-tillstand-for-UAS/Kategori-2/ UAS and how to apply for permission.</p>

	<p>1.1.4 Category 3 Unmanned aircraft certified to be flown and checked out of sight of the pilot. Learn more about Category 3 http://www.transportstyrelsen.se/sv/luftfart/Luftfartyg-och-luftvardighet/Obemannade-luftfartyg-UAS/Sok-tillstand-for-UAS/Kategori-3/ UAS and how to apply for permission.</p>
Swiss Federation of Civil Drones	<p>By environment: - fix and temporary populated areas (cities, villages, events) - airfields and controlled airspace - any other</p> <p>By operation type: VLOS - Visual Line of Sight of the Pilot EVLOS - Enhanced VLOS (VLOS for Observer, FPV (First Person View) for Pilot) BVLOS - Beyond VLOS (FPV for Pilot only)</p> <p>EVLOS and BVLOS will be typically more than 500m from the control station.</p>
Telespazio (I)	<p>According to our experience, UAS categorization depends mainly on:</p> <ul style="list-style-type: none"> • RLOS /BRLOS Operations • MTOW (above or below 150 kg) • Area of operations overflown (depending on population density). <p>As prime contractor for DeSIRE 2 project, our main interest is on large RPA Platforms employed in BRLOS Operations over low populated /maritime areas for specific institutional applications. The use of satcom link for CNPC data is key for BRLOS Operations and it is our main target in the project.</p>
The Finnish Border Guard	<p>Aviation act and aviation regulations are most important framework for UAS regulation. National RPAS regulation is on draft phase and it is expected that it will be published during 2015. It is estimated that Drafted RPAS regulation is or will be one of the most liberal RPAS regulation in the Europe.</p> <p>Right now and in practice VLOS activities with less than 25 kg MTOW under 150 meters altitude are allowed without special permission. Using of more than 25 kg MTOW UAS is usually subjected to license. BVLOS activities are allowed only inside segregated airspace.</p> <p>The Finnish Border Guard has been planned to start VLOS and BVLOS test flights on state border and maritime areas with fixed wing UAS during next year and with heli-/multi-copter type UAS during next five years.</p>
Trimble (BEL)	They are divided in groups by concept of operation.
Unidade Especial de Polícia - Núcleo de Meios Técnicos e Audiovisuais (POR)	<p>The category of UAV is Quadcopter type. Used in traffic control and masses of people. It can be used in cartography, searching for missing persons.</p> <p>The weight of the machines are 2 to 3 klg</p>
United Kingdom	<p>See chapter 1 Section 2 of CAP722 but basically they are currently divided into 3 categories by weight</p> <p>Small UAS 0-20 kg responsibility of national aviation authority Light UAS 20-150 kg responsibility of national aviation authority UAS >150 kg responsibility of European Aviation Safety Agency</p>
VTO Technologies (G)	<p>European harmonisation of BVLOS (Beyond Visual Line of Sight) RPAS C2C frequencies, essential for BVLOS RPAS operations regulatory compliance. Not essential for BVLOS RPAS operations regulatory compliance. Control and non-payload communications (CNPC), payload (incl. video). Visual line-of-sight / non visual line of sight, range of operation.</p>

	Range and distances involved. Long range RPAS frequencies require stronger signals and frequency bands.
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Assessment of WGFM CG Drones:

A number of different concepts for the categorisation of UAS exists:

1. No categorisation at all
2. Environmental based categorisation (metropolitan areas, villages, event-based);
3. By operation type (VLOS, EVLOS, FPV (First Person View) for Pilot), BVLOS - Beyond VLOS (FPV for Pilot only);
4. Risk based categorisation (requires an analysis for each UAS type and its type of mission, may differentiate according to the type of user (hobby or professional), operating distance and its conditions, weight and dimensions of the UAS, safety-features (e.g. anti-collision features, safe modes). The risk based categorisation approach can also include elements of the environmental-based and operating type-based categorisation approach as outlined under 2 and 3.

A1.10 EXISTING PROBLEMS DURING THE OPERATION/TEST OF UAS

- **Question 11: Have there been any problems in respect to radio (e.g. Interferences, lost connections, fail safe features, etc.) during the operation and/or test of a UAS?**

Aerodromo Municipal de Portimão (POR)	No
AESA (E)	No
Airfilms Production (NED)	Yes
Austria	No
Belgian Civil Aviation Authority (BCAA)	Yes
Bosnia Herzegovina	No
Bundeskommision Modelflug (D)	No
Civil Aviation Agency (LVA)	No
Civil Aviation Authority (CZE)	Yes
Croatia	No
Dep. of Civil Aviation (CYP)	No
DFS Deutsche Flugsicherung (D)	Yes
DGA (F)	Yes
SWITZERLAND	Yes
EASA	No
EuroUSC International (G)	Yes
Federal Supervisory Authority for Air Navigation Services (D)	No

Finavia	No
Finland	No
Guardia Nacional Republicana (POR)	Yes
Hungary	No
IPQ (POR)	No
Lithuania	Yes
Montenegro	No
Norway	No
Robonic (FI)	No
Selex (I)	No
Skeye (NED)	No
Slovenia Control	No
Swiss Federation of Civil Drones	Yes
Telespazio (I)	No
The Finnish Border Guard	Yes
Trimble (BEL)	No
Unidade Especial de Polícia - Núcleo de Meios Técnicos e Audiovisuais (POR)	No
United Kingdom	Yes
VTO Technologies (G)	No

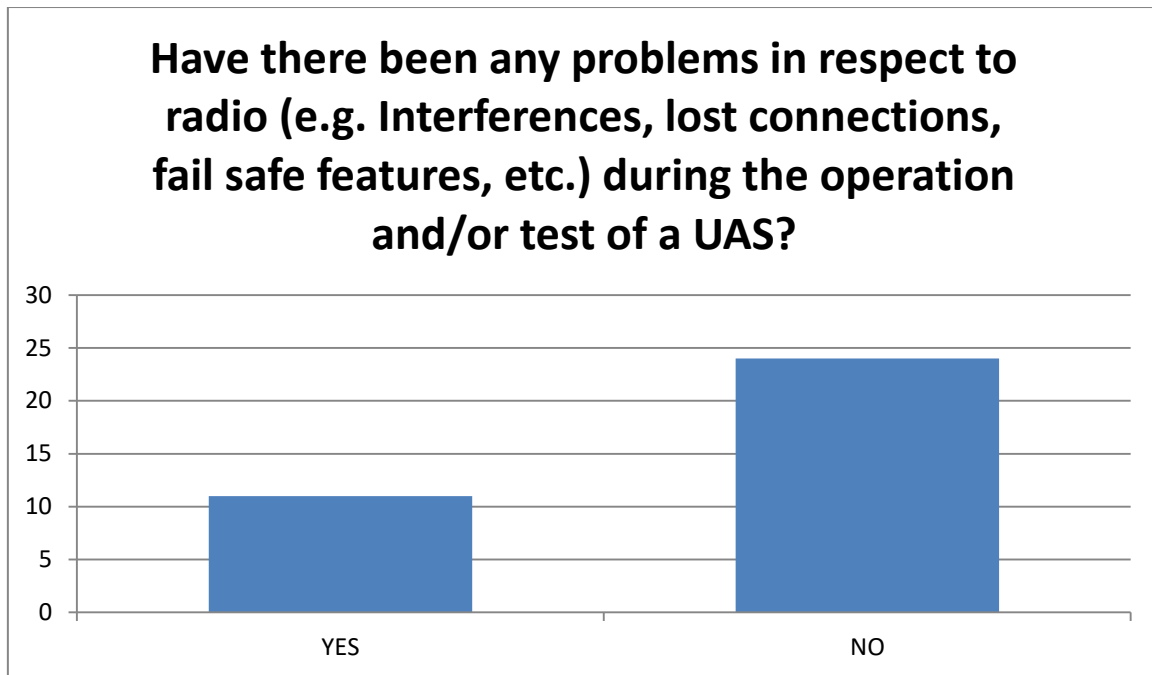


Figure 14: Existing problems


• Question 11.1: Please explain the problem(s)

Belgian Civil Aviation Authority (BCAA)	BCAA had some cases of loss of radio control link and also one case of trial to use illegal frequency band.
Civil Aviation Authority (CZE)	C2 datalink fails time to time but it is not easy to determine the reason (might be hardware failure, software failure or interference or out of reach reasons). Several older types operated on 35 MHz were very vulnerable to interference, 2,4 GHz seems quite good, but is sensitive to unobstructed direct connection.
Switzerland	Crash of an UAS behind the airfield due to adverse electromagnetic interference. The problems were not known before; the electromagnetic interference must have acted by the UAS as a similar opposite command that led to its destruction. There was only material loss. Electromagnetic fields in a city, a region or underground electric power supplies are very common, therefore this point has to be considered properly. In the meantime, the problem has been solved through software (frequencies used in this case were in the 2.4 GHz)
DFS Deutsche Flugsicherung (D)	It has been observed that sometimes frequencies are used that are forbidden by national and international regulations (e.g. 1090 MHz). Also datalink loss will be occurring sometimes, causing unplanned use of the UA.
DGA (F)	With medical operating and domestic application. In our country there are a lot of things who work with remote control
EuroUSC International (G)	Range issues are frequently experienced when operating in areas of intense 2.4GHz transmissions. Operators often experience poor reception of camera images when using 5.8GHz at the legal transmission power prompting them to fit illegal, high power transmitter modules. Many users are unaware of the effects of solar flares on the reception of GPS reception and poor piloting skills often leads to situations where operators find themselves operating with a GPS capture failure and without sufficient skills to operate manually. EuroUSC test for this scenario as part of their flight operations examination.

	<p>This should not cause interference with the command and control frequency and specific frequencies and power outputs be listed with an obvious route allowing an operator to operate worldwide without constant changing of transmitter modules.</p> <p>Commercial operators should have their own protected frequencies requiring a licence which would only be available to registered commercial RPAS operators helping to prevent ‘cowboy’ hobby type inherently unsafe operators.</p> <p>2.4GHz is widely used, especially in congested areas where wi-fi routers etc fill the spectrum. This causes high background interference reducing the operating range of commercial operations. Many hobby type aircraft and toys use a power output far in excess of requirements. A reduced power output and therefore range help to keep toys close to operators helping safety and helping to reduce interference. Perhaps a specific frequency such as 1.2GHz could be used for commercial RPAS operations. Many hobby ‘First Person View’ operators are illegally broadcasting far in excess of the legal limits without any fear of prosecution and often unaware of any legal requirements.</p>
Guardia Nacional Republicana (POR)	<p>For GNR, the possibility to open up segregated airspace to civil unmanned aircraft flight in Portugal creates a very complex security problem materialized through the possibility of civil RPAS flying over areas (Class A, C and D), assigned to airfields and airports, overflight people and urban spaces.</p> <p>For safety & security reasons it is desirable to interdict any possibility of flying civil RPAS on (less than 150 kg) in urban areas which makes the lack of national legislation a serious problem. The best solution is to only allow RPAS flights in “G Class” space, which represent also the need of law enforcement and compliance over the use of radio frequencies by unauthorized civilian’s users.</p>
Lithuania	Cases of lost connections (and lost equipment) are known.
Swiss Federation of Civil Drones	<p>If using legal power: lost connections</p> <p>Mostly: Use of illegal power to prevent connection loss</p>
The Finnish Border Guard	<p>Due to low flying altitudes, forests and shape of ground the radio horizon is achieved quite fast. Sometimes it has been losses of command and control connections due to unsuitable antennas or placement of the antennas on the drone or on the ground. It has also been noticed that the manufactures do not want to make suitable transmitters for BVLOS activities due to possibilities to fly BVLOS separates a lot between different countries. It makes BVLOS suitable equipment more expensive than those really should be.</p> <p>In order to make economical BVLOS activities possible for security authorities, it is necessary to establish higher segregated areas for UAS activities and ensure releasing of suitable frequency windows and using of more powerful transmitters on security authorities duties. It is also worth to notice that many security authorities conducts their duties outside of mobile phone connection areas so command and control and payload information connections cannot be based on mobile phone nets. It is assumed that in the future security authorities need to establish link network or use satellite connections in order to fly long distance controlled BVLOS flights.</p>
United Kingdom	See the answer to question 4 of part 1

- **Question 11.2: ‘NO’ Remarks**

Aerodromo Municipal de Portimão (POR)	Non.
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AESA (E)	WE HAVE NO ANY INFORMATION
Austria	Not yet official reported
Bosnia Herzegovina	No reported use of UAS
Bundeskommission Modellflug (D)	In the area of aeromodelling using 2.4 GHz equipment interference is very hard to identify and there are no proven events. Lost connections are quite normal due to exceeding the range of the R/C-equipment. For sophisticated drones above the toy-area this is covered by automatic means like a GPS-based return-to-home function.
Civil Aviation Agency (LVA)	Not reported.
Croatia	Not to our knowledge
Dep. Of Civil Aviation (CYP)	No Info
EASA	<p>EASA does not currently have occurrence reports from drones' incidents and accidents. This is due to the fact that no drone has been certified by EASA so far.</p> <p>On the other hand, EASA follows the incidents/accidents which are reported by the military.</p> <p>Example: MQ-1B, T/N 00-3068, 27 June 2014, United States Air Force Aircraft Accident Investigation Board Report</p> <div style="text-align: center;">  <p>3 EASA.pdf</p> </div> <p>Another accident was recently reported:</p>
Federal Supervisory Authority for Air Navigation Services (D)	Non of such problems with civil UAS known. This question should also be directed to the federal states in there responsibility for civil UAS, the federal armed forces for military UAS and to DFS with reference to the ferry flight of the military UAS EuroHawk in 2011.
Finland	No reported problems so far, but the regulation to be issued very soon contains reporting requirements.
Hungary	There have not been any problems with the approved frequencies.
IPQ (POR)	Not to my knowledge
Montenegro	The more precise information will be provided when the test is completed.
Norway	There have not been any official reports in respect to this. However, we have been informed of lost connections when using the license exempt frequencies for control.
Robonic (FI)	There has not been any problems with Robonic's test site flights
Selex (I)	No interferences have been recorded by Selex ES during RPAS operations and flight tests, although these have been always conducted in segregated airspaces.

Slovenia Control	NO OPERATIONAL PROBLEMS ARE KNOWN
Telespazio (I)	N/A to DeSIRE 2 project, as these aspects have not yet been addressed.
Trimble (BEL)	No remarks
Unidade Especial de Polícia – Núcleo de Meios Técnicos e Audiovisuais (POR)	Anything

<p>Assessment of WGFM CG Drones:</p> <p>Reported problems include:</p> <ol style="list-style-type: none"> 1. Illegal use of frequencies; 2. Use of greater emission levels to enhance the operating distance or to make the drone s operation safer against interference and loss of the control link; 3. Problem that UAS dominantly use 2.4 GHz (or other ‘unlicensed’ bands), fully under ‘no protection’ conditions and where interference is always a possibility; a fact which may not be understood by all UAS users; 4. Lack of frequency harmonisation for: <ol style="list-style-type: none"> a. Professional UAS’ with more mission-critical type of mission (the idea is to have a frequency opportunity which is more dedicated to UAS than a generally authorised ‘SRD-band’; b. BVLOS UAS (could be individually licensed).

A1.11 ADDITIONAL INFORMATION

- **Question 12: Any further relevant information? If so, please add here.**

AESA (E)	No
Airfilms Production (NED)	<p>The Netherlands is currently killing the RPAS market with the introduced regulations. The playfield for professional operators has become complicated, non-flexible and limited to a situation that results in a very small perspective.</p> <p>They made rules like exams for companies, aircrafts & pilots, but there a no certified / accredited companies (manufacturing and pilot schools).</p>
Bundeskommision Modelflug (D)	<p>There is an information-flyer for customers under preparation by the DAeC (German Aero Club). The draft is attached.</p> <p>Also there are ongoing activities for the integration of drones into the air space. The complete A-NPA is available here: https://easa.europa.eu/system/files/dfu/A-NPA%202015-10.pdf</p> <p>An executive summary is available here: http://easa.europa.eu/document-library/notices-of-proposed-amendment/npa-2015-10</p>
Switzerland	Swiss FOCA has authorised several BLOS operations and VLOS tethered.
DFS Deutsche Flugsicherung (D)	Operation of drones may cause possible radio-frequency interference with other services which may lead to misconduct of the drone or the other service, respectively. This aspect should be considered by the regulatory measures.
DGA (F)	It's time for us in Europe to have a real frame work to control frequency and we

	will be happy to contribute of this registration by my knowledge and my experience.
EuroUSC International (G)	<p>It is strongly believed that an International, protected and licensed RPAS operating frequency is required. Transmissions from commercial and hobby RPAS should be periodically and randomly checked and illegal users should be prosecuted.</p> <p>This should be an enforced, encoded, channel hopping protocol as currently widely utilised by the hobby fraternity utilising 2.4GHz. The power output should be sufficient to ensure reception above and beyond the maximum permitted flight envelope range. A specific, protected frequency range should be made available for commercial RPAS. Perhaps with a licence requirement where only registered commercial operators can apply and obtain.</p>
Guardia Nacional Republicana (POR)	Most European countries are still striving with problem of unauthorized civil RPAS use. Legislation left to the responsibility of national authorities is urgent. The GNR expectation is that the future European regulatory framework and its transposition into law will shape the adoption of more efficient security measures.
IPQ (POR)	Very low knowledge of Rules of Air, and air navigation by the operators of UAV's.
Norway	New and updated regulatory framework is to be published soon (late fall 2015).
Swiss Federation of Civil Drones	<p>Transmission of an image is not only payload! If the image is used to give the pilot the in-air-view to observe the sky for traffic, this link will be part of the cockpit and be part of the control link.</p> <p>More from the practice: There exist solutions for digital image transmission. As the control of the UAS as well as the telemetry is not a huge data load, the same link will be used for control and telemetry as well.</p> <p>Loss of one (image, control or telemetry) results anyway in an emergency situation. So there is no need to split into several links (with a higher possibility of interferences).</p> <ul style="list-style-type: none"> - If you have control and telemetry but no image, you cannot observe the sky for traffic --> emergency - If you have no control but telemetry and image, autopilot may continue, but you cannot tell him that there is traffic --> emergency - If you have control and image but no telemetry, you have no idea about the system status (power consumption, speed, position) --> emergency <p>So, image transmission may also be part of the control link. It is "only" payload, if you have a spare sensor for ground observing (no matter if infrared or normal picture or any other sensor)</p> <p>-----</p> <p>A special frequency to UAS is very welcome. But it must be powerful enough to fly BVLOS and to transmit an image quality of FullHD at least (lower resolution prevent of observing the sky for traffic) with a latency of less than 150ms (if lower, a pilot cannot control the UAS without the support of an autopilot).</p>
Telespazio (I)	The use of dual-link satcom concept is a key for BRLOS applications, and it is main target of the project to demonstrate its suitability for RPA CNPC Data for future integration of RPAS into non segregated, civil airspace.
Trimble (BEL)	No further info
Unidade Especial de Polícia -	Anything

Núcleo de Meios Técnicos e Audiovisuais (POR)	
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Assessment of WGM CG Drones:

- When defining dedicated solutions for UAS frequency use, it needs to define which type of communications may use it (only control/telecommand or also telemetry which may include some images, or even a video link or feedback for telecommand/control). In this regard, some scenarios may need to be described and to, e.g. in a second step, if necessary, study on possible frequencies for payload links (video and images);
- Some concern about interference from drones expressed (2.4 GHz, or 5.8 GHz);
- For BVLOS UAS: need to consider satcom concepts as well as terrestrial spectrum use;
- A harmonised spectrum use possibility for UAS should reduce the unauthorised frequency use.

ANNEX 2: LIST OF REFERENCES

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- [4] ECC/DEC/(04)08 (07/2004): The harmonised use of the 5 GHz frequency bands for the implementation of Wireless Access Systems including Radio Local Area Networks
- [5] ETSI EN 300 440 (2009-03): Short range devices; Radio equipment to be used in the 1 GHz to 40 GHz frequency range
- [6] Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC
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- [9] 'Prototype' Commission Regulation on Unmanned Aircraft Operations 22 August 2016 Explanatory Note
- [10] Regulation 785/2004/EC of the European Parliament and of the Council of 21 April 2004 on insurance requirements for air carriers and aircraft operators
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- [13] void
- [14] Communication from the Commission to the European Parliament and the Council: A new era for aviation opening the aviation market to the civil use of remotely piloted aircraft systems in a safe and sustainable manner: COM(2014)207 final
- [15] REPORT25 September 2015 (A8-0261/2015) on safe use of remotely piloted aircraft systems (RPAS), commonly known as unmanned aerial vehicles (UAVs), in the field of civil aviation (2014/2243(INI))
- [16] Void
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- [19] Drucksache 39/17 (18.01.17) Verordnung zur Regelung des Betriebs von unbemannten Fluggeräten
- [20] Void
- [21] ECC/DEC/(01)03 Annex 2: ECO Frequency Information System (EFIS) – Application terminology
- [22] Deutsche Telekom's article on High-level cooperation, available at: <https://www.telekom.com/en/media/media-information/archive/high-level-cooperation-443952>
- [23] ERC Recommendation 70-03: Relating to the use of Short Range Devices (SRD)
- [24] FM(17)067 Annex 37: Explanatory paper related to RLAN equipment using the 5 GHz bands in vehicles, including the usage under the non-specific SRD regulation
- [25] European Parliament resolution of 29 October 2015 on safe use of remotely piloted aircraft systems (RPAS), commonly known as unmanned aerial vehicles (UAVs), in the field of civil aviation (2014/2243(INI))
- [26] European Aviation Safety Agency; Notice of Proposed Amendment 2017-05 (A); Introduction of a regulatory framework for the operation of drones Unmanned aircraft system operations in the open and specific category
- [27] Proposal for a Regulation of the European Parliament and the Council on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and repealing Regulation (EC) No 216/2008 of the European Parliament and of the Council (COM/2015/0613 final - 2015/0277 (COD))
- [28] European Aviation Safety Agency; Notice of Proposed Amendment 2017-05 (B)- Introduction of a regulatory framework for the operation of drones - Unmanned aircraft system operations in the open and specific category
- [29] ICAO RPAS manual 10019, chapter 10 - Detect-And-Avoid

- [30] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC
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