REMOTELY PILOTED AIRCRAFT SYSTEM (RPAS) CONCEPT OF OPERATIONS (CONOPS) FOR INTERNATIONAL IFR OPERATIONS

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Glossary

Abbreviations and Acronyms

ACAS	Airborne collision avoidance system
ADS-B	Automatic dependent surveillance – broadcast
ADS-C	Automatic dependent surveillance – contract
AGL	Above ground level
AM(R)S	Aeronautical mobile route service
AMS(R)S	Aeronautical mobile satellite route service
ANSP	Air navigation services provider
ASBU	Aviation system block upgrade
ATC	Air traffic control
ATFM	Air traffic flow management
ATM	Air traffic management
ATS	Air traffic service
BRLOS	Beyond radio line-of-sight
BVLOS	Beyond visual line-of-sight
C2	C2 Link
CAA	Civil aviation authority
CNPC	Control and non-payload communications
CONOPS	Concept of operations

DAA	Detect and avoid
FF-ICE	Flight and flow information for a collaborative enviornment
FL	Flight level
FSS	Fixed satellite service
IFR	Instrument flight rules
MLAT	Multilateration
PANS	Procedures for air navigation services
PIC	Pilot-in-command
RCP	Required communication performance
RLOS	Radio line-of-sight
RNP	Required navigation performance
ROC	RPAS operator certificate
RPA	Remotely piloted aircraft
RPAS	Remotely piloted aircraft system
RPS	Remote pilot station
RWC	Remain-well-clear
SARPs	Standards and Recommended Practices
SSR	Secondary surveillance radar
UAS	Unmanned aircraft system
VFR	Visual flight rules
VHF	Very high frequency
VLOS	Visual line-of-sight

Definitions

The following definitions apply in the context of this document. All definitions are based on ICAO references except where indicted by brackets following the definition.

Aerial Work. An aircraft operation in which an aircraft is used for specialized services such as agriculture, construction, photography, surveying, observation and patrol, search and rescue, and aerial advertisement, etc.

Airborne collision avoidance system (ACAS). An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

> *Note.— SSR transponders referred to above are those operating in Mode C or Mode S. [Note in Annex 10 — Aeronautical Telecommunications*, Volume IV — *Surveillance and Collision Avoidance Systems only]*

ATS surveillance system. A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft.

> *Note.— A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR. Source: Annex 15 — Aeronautical Information Services 2016, 15th edition, Chapter 1, 1.1 Definitions.*

Automatic dependent surveillance — broadcast (ADS-B). A means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link.

Automatic dependent surveillance — contract (ADS-C). A means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, via a data link, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports.

> *Note.— The abbreviated term "ADS contract" is commonly used to refer to ADS event contract, ADS demand contract, ADS periodic contract or an emergency mode.*

Beyond visual line-of-sight (BVLOS) operation. An operation in which the remote pilot or RPA observer does not use visual reference to the remotely piloted aircraft in the conduct of flight.

Command and control (C2) link. The data link between the remotely piloted aircraft and the remote pilot station for the purpose of managing flight.

Detect and avoid (DAA). The capability to see, sense, or detect conflicting traffic or other hazards and take appropriate action.

Handover. The act of passing piloting control from one remote pilot station to another.

Lost C2 Link. The loss of command and control link contact with the remotely-piloted aircraft such that the remote pilot can no longer manage the aircraft's flight.

Operator. A person, organization or enterprise engaged in or offering to engage in an aircraft operation.

> *Note.— In the context of remotely piloted aircraft, an aircraft operation includes the remotely piloted aircraft system.*

Procedures for Air Navigation Services (PANS). PANS are approved by the Council. They comprise, for the most part, operating procedures regarded as not yet having attained a sufficient degree of maturity and stability for adoption as international Standards and Recommended Practices, or material of a more permanent character which is inappropriate or too detailed for incorporation in an Annex.

Remote flight crew member. A licensed crew member charged with duties essential to the operation of a remotely piloted aircraft system during a flight duty period.

Remote pilot. A person charged by the operator with duties essential to the operation of a remotely piloted aircraft and who manipulates the flight controls, as appropriate, during flight time.

Remote pilot-in-command. The remote pilot designated by the operator as being in command and charged with the safe conduct of a flight.

Remote pilot station (RPS). The component of the remote pilot aircraft system containing the equipment used to pilot the remotely piloted aircraft.

Remotely piloted aircraft (RPA). An unmanned aircraft which is piloted from a remote pilot station.

Remotely piloted aircraft system (RPAS). A remotely piloted aircraft, its associated remote pilot station(s), the required command and control links and any other components as specified in the type design.

Required communication performance (RCP) specification. A set of requirements for air traffic service provision and associated ground equipment, aircraft capability, and operations needed to support performance-based communication.

Required navigation performance (RNP). A statement of the navigation performance necessary for operation within a defined airspace.

> *Note.— Navigation performance and requirements are defined for a particular RNP type and/or application.*

RPA observer. A trained and competent person designated by the operator who, by visual observation of the remotely piloted aircraft, assists the remote pilot in the safe conduct of the flight.

RPAS operator certificate (ROC). A certificate authorizing an operator to carry out specified RPAS operations.

Standards and Recommended Practices (SARPs). SARPs are adopted by the Council under the provisions of the Convention. They are defined as follows:

> **Standard.** Any specification for physical characteristics, configuration, materiel, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention; in the event of impossibility of compliance, notification to the Council is compulsory under Article 38.
>
> **Recommended Practice.** Any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognized as desirable in the interests of safety, regularity or efficiency of international air navigation, and to which Contracting States will endeavour to conform in accordance with the Convention.

Segregated airspace. Airspace of specified dimensions allocated for exclusive use to a specific user(s).

State of Design. The State having jurisdiction over the organization responsible for type design.

State of Manufacturer. The State having jurisdiction over the organization responsible for the final assembly of the aircraft, engine or propeller.

State of Registry. The State on whose register the aircraft is entered.

State of the Operator. The State in which the operator's principal place of business is located or, if there is no such place of business, the operator's permanent residence.

Unmanned aircraft system. An aircraft and its associated elements which are operated with no pilot on board.

Visual line-of-sight (VLOS) operation. An operation in which the remote pilot or RPA observer maintains direct unaided visual contact with the remotely piloted aircraft.

ICAO RPAS Concept of Operations (CONOPS)

1 Introduction

Any aircraft intended to be flown without a pilot on board is referred to in the *Convention on International Civil Aviation* (Doc 7300), signed at Chicago on 7 December 1944 and amended by the ICAO Assembly as a “pilotless aircraft”. Today we call these aircraft “unmanned” rather than “pilotless”. Unmanned aircraft (UA) include a broad spectrum from meteorological balloons that fly freely to highly complex aircraft piloted from remote locations by licensed aviation professionals. The latter are part of the category referred to as “remotely piloted aircraft” or RPA that operate as part of a system, a remotely piloted aircraft system (RPAS).

RPAS are creating a new industry with large economic potential. They offer a vast range of capabilities and sophistication. Their associated technologies, designs, and operating concepts are evolving rapidly. It is within this context that States are being challenged with the safe and efficient integration of RPAS into environments shared by a highly regulated and well established manned aircraft industry.

1.1 Purpose

This concept of operations (CONOPS) aims to describe the operational environment of manned and unmanned aircraft thereby ensuring a common understanding of the challenges and how the subset that are remotely piloted can be expected to be accommodated and ultimately integrated into the airspace for international instrument flight rules (IFR) operations. It describes RPAS terms, unique attributes, challenges, and special considerations. In doing so, it provides a common view from which ICAO and individual States can prioritize and address needs associated with the introduction of RPA into their respective airspace. ICAO will use this CONOPS to inform the Air Navigation Commission, States and ICAO expert groups to scope proposed amendments to ICAO Standards and Recommended Practices (SARPs) and Procedures for Air Navigation Services (PANS). As such, this document serves as a general framework to represent the perspective of stakeholders from Member States, including regulators, operators, airspace users, manufacturers, air navigation service providers (ANSPs) and aerodrome operators.

1.2 Problem statement

As stated above, RPA operate as part of a system called an RPAS. When discussing RPAS or their operations, it is essential to clarify when the entire system (RPA + remote pilot station (RPS) + command and control (C2) link + other) is the focus or a portion of the system is the subject, e.g. the RPAS operator conducts RPAS operations, however RPA are separated from other aircraft in the airspace.

The operation of RPAS has been identified as having the potential for significant economic, societal and environmental benefits and the rapid growth of RPAS has caused an increasing demand for them to operate beyond visual line-of-sight (BVLOS) and in airspace open to other aircraft. While such operations are currently allowed, each case must be separately assessed from a safety risk management perspective. There is a need to establish the principles for RPAS operations in all classes of non-segregated airspace.

Today manned aviation develops and improves upon ways to aid a pilot with the responsibility of flying safely. Regulations (e.g., airworthiness certification) and procedures (e.g., periodic maintenance) assure the integrity of the pilot’s aircraft. Initial and recurrent training prepare the pilot for anticipated and unanticipated flight events. The pilot and perhaps others in the operator’s organization assist in the preparation and planning for a safe flight. Civil Aviation Authorities (CAA) and air navigation service providers (ANSP) provide and oversee a highly organized infrastructure comprised of procedures, routes, and services to assure safe flight. All aspects of the air navigation system combine to manage the safe, efficient flow of air traffic. The introduction of RPAS challenges the extant aviation system infrastructure and raises multiple questions.

Elements of the current aviation system (infrastructure, procedures, policies, etc.) may need to be modified to support the wide range of new capabilities characteristic of remotely piloted aircraft. The challenge is to integrate all of these diverse RPAS capabilities within the current aviation system without undue burden on current airspace users and service providers and without compromising safety. Once this is possible we can consider having achieved integration of manned and unmanned aircraft

Due to the absence of a pilot on board the aircraft, technical solutions have been developed to control the aircraft through data link from a remote location. The absence of a pilot on board also brings the challenge of matching the ability of the pilot to “see and avoid” and “remain-well-clear” of other traffic and dangerous situations, such as potential collisions with other airspace users or obstacles and severe weather conditions. Furthermore, the remote pilot must be able to communicate with air traffic control and other airspace users when and where necessary. This challenge means there are aspects that affect most, if not all, sectors of the aviation system. For example the consideration of novel ATC communication architectures, traffic management procedures, airworthiness approval of technical capability, the potential use of third-party communication service providers, and changes in the regulatory approvals and oversight regimes.

The existing SARPs and PANS must be revised, amended, or enhanced to define the manner in which RPAS will have to comply. Where RPAS can comply in a manner similar to manned aircraft, they should do so. RPA are not yet considered to be able to meet the intent of “see and avoid” comparable to a pilot on board, but will eventually be equipped with the capability to “detect and avoid” (DAA) other aircraft and hazards. Thus, some alternate means of compliance for RPAS must be included, where necessary, in future iterations of these documents.

By 2030, a large number of RPA will share the airspace with manned aviation, some will be flying IFR. While some RPAS operations will be conducted in accordance with IFR for a portion of their flight, others will operate only under VFR. Similarly, RPA will operate in and transit through national and international airspace as well as controlled and uncontrolled airspace. These RPA may depart from less congested aerodromes and arrive at similar destination aerodromes, while others may use congested aerodromes. All RPA will be expected to comply with the applicable procedures and airspace requirements defined by the State, including emergency and contingency procedures, which should be established and coordinated with the respective ANSPs. These types of operations mean that RPA will need to fly in national and international airspace.

Other RPA will only operate at low altitudes, where manned aviation activities are limited. For example, activities such as border protection, environmental uses, and wildfire and utility inspections; these could still mean transiting international airspace.

As airspace is a scarce and sought after resource, States need to take a balanced approach that harmonizes and meets the needs of users. This CONOPS highlights aspects needed for integration of RPAS, the newest entrant into the civil aviation system.

1.3 Scope

This CONOPS describes RPAS operations, system descriptions, operating environments, control methods, and interfaces with ANSPs and other aircraft. The scope is currently limited to certificated RPAS operating internationally within controlled airspace[1] under instrument flight rules (IFR) in non-segregated airspace and at aerodromes in the 2031 onward timeframe.

The scope of the CONOPS does not consider fully autonomous aircraft and operations, visual line-of-sight (VLOS), very low altitude airspace operations and very high altitude operations (e.g. above FL600) or carriage of persons and domestic operations.

The time frame aligns with ICAO's Aviation System Block Upgrade[2] (ASBU) estimated completion date for RPAS Block 3 activities. Block 3 represents a period when RPAS certification processes will be complete; avionics and ground systems made available; and State policies, regulations, procedures and guidance permitting routine and safe operations are in place.

The ability to pilot an aircraft remotely offers a vast potential for new types of aircraft and their operation that are not constrained by the need to accommodate human beings on board. This impacts the design of aircraft, e.g. mass, size, performance, endurance, where and how they can operate and how they can be assimilated into the airspace and its air traffic management system. There are also implications on the safety assurance processes, as the focus can move from protecting the persons on board an aircraft to those potentially affected by undesirable events, such as mid-air collisions or injury to people and damage to property on the ground.

Each of the following areas will challenge the aviation frameworks in different ways and at different rates and times, as determined by the needs of the evolving industries.

Future iterations of this document may expand this scope where evidence indicates unanticipated needs resulting from market growth, technology advances or other unforeseen conditions. This expansion is likely to include operations at very high altitude, very low altitude, autonomous aircraft and remote pilot control of multiple RPA as these activities are already being actively pursued by operators.

[1] The upper limit of control areas vary per the flight information region (FIR) for example, FL450, FL600 or FL660.

[2] ICAO's ASBUs provide a global systems engineering approach to facilitate the advancement of air navigation and enable global harmonization, increased capacities and improved environmental efficiency. The ASBU framework is presented in the ICAO Global Air Navigation Plan (GANP) and provides broadly-defined objectives. The framework has four Blocks (0, 1, 2, and 3), each defining associated modules, objectives and timelines. Three RPAS modules are defined in Blocks 1 (2019), Block 2 (2025) and Block 3 (2031 onwards).

1.3.1 RPAS operations

RPAS operations are currently structured around two major concepts: VLOS and beyond visual line-of-sight (BVLOS), which generally are being developed in areas not currently served by manned aircraft, e.g. the lower or higher altitude environments and extreme endurance. Operations that are conducted outside of VLOS are considered as “beyond VLOS” and where these can be flown in international airspace under IFR they are within the scope of this CONOPS. As experience is gained and technical capability grows, RPAS will undoubtedly transition into all areas of the airspace, as well as provide new solutions that will be adopted by manned aviation. It is clear that there will be continued innovation and with this a reasonable expectation to be able to access the airspace in a manner that will allow safe, seamless and efficient end-to-end operations for all aircraft operations.

1.3.2 RPAS technology aspects

The design opportunities provided by the relocation of the pilot have opened several areas that challenge the principles of the extant aviation framework, including the potential for one pilot to manage multiple aircraft and the use of highly automated and autonomous aircraft. This version of the CONOPS does not consider remote pilot control of multiple RPA. The distributed and interconnected system of systems of an RPAS operation enables new ways to share data, not only removing the need for some local sensors but offering the use of a wider information set; however, this increases dependency on the electromagnetic spectrum and associated communication methods.

The ability to locate remote pilot stations around the world offers considerable opportunity for new business models but raises questions of State-to-State oversight and cross-border relationships, particularly with regard to jurisdiction issues on enforcement and liability.

From an airworthiness assurance perspective, the level of demonstration required for remote pilot stations is an area where the levels and process of determining suitability may need to be considered very differently to that of a manned aircraft cockpit, from maintenance, configuration control and management processes to the certification process.

Such a fast paced and dynamic sector will also have very different lifecycles to that of manned aviation. A much wider range of aircraft will likely be produced that principally undertake aerial work activity. This diversity may not justify the cost of a type certification process as applicable for manned aircraft but will demand suitably flexible and responsive regulatory approval models that are performance based, supportive of innovation and which can develop the knowledge and skill sets of both regulators and industry in parallel with the technology changes.

1.3.3 Airspace aspects

RPAS operations will require access to the airspace in line with the most effective end-to-end flight profile. Provided the aircraft has the equipment required and follows the procedures for each class of airspace used, and can meet the rules of the air, this should be possible. The potentially different flight profiles and performance characteristics of RPA may pose some challenges for their management through the airspace that will need to be understood and resolved. Their behaviour under non-normal (contingency) conditions could similarly be very different from regular flight profiles and performance characteristics, but some degree of predictability and conformance to existing defined procedures will be needed to minimize conflict with other aircraft.

RPAS operations are, at first, likely to be managed through a process of accommodation, where each new challenge is addressed by using the flexibility within the airspace management system, and where necessary, limitations and conditions are set to minimize disruption to other users. Similarly, for operations in areas of airspace not currently subject to routine operations, the first usage cases will aid in the development of new rules and management processes.

As RPAS operations become more routine and frequent, and greater understanding of the operational scenarios develop, the required adaptations to the aviation framework will be identified and incorporated, such that in time, each operation becomes integrated into the overall system.

1.4 Key assumptions

The key assumption for RPAS is that in order to integrate seamlessly into the airspace, they must, as nearly as practicable, comply with the operational procedures that exist for manned aircraft and flight operations must not present an undue hazard or burden to persons, property, or other aircraft. Furthermore, RPAS operations must not degrade the current level of aviation safety or impair manned aviation safety or efficiency. This applies equally to all operators and all RPA/RPAS. Finally, RPAS should conform to manned aircraft standards to the greatest extent possible. When these principles are not achievable (due to unique RPAS designs or flight characteristics), and no alternate means of compliance are identified, the operation of such RPAS may be subject to safety risk mitigations, such as restricting operations to segregated airspace.

The key assumptions, which can be considered to apply to all RPAS operations, are described as follows:

1) access to the airspace remains available to all, providing each RPA is capable of meeting pertinent conditions, regulations, processes and equipage defined for that airspace;

2) new types of operations may need additional or alternative considerations, conditions, regulations, processes and operating procedures; the objective should be to add only the minimum necessary to achieve safe operation;

3) the RPA has the functional capability to meet the established normal and contingency operating procedures for the class of airspace, aerodrome, etc., when such procedures are available;

4) the flight operation does not impede or impair other airspace users, service providers (such as air traffic management (ATM), aerodromes etc.) or the safety of third parties on the ground and their property, etc.;

5) the RPA must operate in accordance with Annex 2 — *Rules of the Air*;

6) the RPAS must meet the applicable certification/registration/approval requirements;

7) the operator must meet the applicable certification/approval requirements; and

8) the remote pilot must be competent, licensed and capable of discharging the responsibility for safe flight.General considerations

Within the timescale considered, the general approach taken in the CONOPS is conformance to the existing aviation system and its planned evolution and updates, rather than significant modification or evolution albeit some level of change is envisioned. The expectation is that RPAS will be handled by ANSPs like manned aircraft.

This approach cannot be successful without permitting some degree of RPAS operations to support development of appropriate technical solutions. RPAS operations are also necessary for learning which adaptations should be made for the unique characteristics and atypical operations anticipated. Hence, it can be described as a period of accommodation that leads to integration, and ultimately to seamless operations of manned and unmanned aircraft.

1.4.1 Accommodation versus integration

Accommodation describes the condition when an RPAS can operate along with some level of adaptation or support that compensates for its inability to comply within existing operational constructs. This may be necessary during normal operations, abnormal or problem scenarios, and when emergency situations arise. For example, an RPA could be accommodated to operate in accordance with IFR in non-segregated airspace using techniques such as dedicated corridors, or increased spacing around the aircraft resulting in fewer restrictions on airspace usage. Accommodation allows for early RPA flights on a temporary and transitional basis and in limited numbers before the required technology, standards, and regulations are in place. The accommodation of RPAS in the aviation system is already routine in many States.

Integration refers to a future when RPA may be expected to enter the airspace system routinely without requiring special provisions. Integration will require the implementation of harmonized Standards and Recommended Practices (SARPs) and procedures (PANS); hence, the first transition towards this goal is dependent upon the publication of the ICAO SARPs, the first of which are scheduled for 2018 (remote pilot licence).

1.4.1.1 Accommodation from present to 2025

Due to the absence of regulation and industry standards prior to 2024[3], IFR capable RPA will be accommodated in controlled airspace using specialized, enabling techniques. This is a regular occurrence for military and civil operations today. Hence, the initial phase of accommodation can be maintained during this timeframe due to the relatively low number of RPAS operations anticipated.

1.4.1.2 Integration from 2025 onwards

With the availability of regulations, standards, and relevant supporting technology, RPAS operations are expected to begin integration by 2025. More complex and high-risk RPAS systems and operations—and their associated requirements—are likely to evolve and allow for incremental, integrated access to non-segregated airspace. Not until 2031[4] will a mature and complete set of technologies, standards,

[3] The year 2025 corresponds to ICAO ASBU Block 2 objectives for the RPAS module.
[4] The year 2031 corresponds to ICAO ASBU Block 3 objectives for the RPAS module

regulations, guidance and procedures be available to support transparent integration across the wide array of RPAS and the types of operation possible.

2 System overview

RPAS are a subset of UAS. The term UAS is encompassing of all aircraft flown without a pilot on board that operate as part of a larger system. This includes RPAS, autonomous aircraft and model aircraft. Autonomous aircraft differ from RPAS in that they do not permit intervention of a human pilot to fulfil their intended flight; whereas model aircraft are distinguished by their recreational use. In some instances, the three subcategories of UAS overlap.

An RPAS consists of a remotely piloted aircraft (RPA), remote pilot station (RPS), command and control (C2) link, and any other components as specified in the type design. These components must be approved as a system taking into account the interdependencies of the components. The RPAS must also be interoperable with the ATC and airspace user systems. This section provides further descriptions of the potential RPAS component designs that require approval and oversight.

2.1 Remotely piloted aircraft

There is a wide array of types of RPA. Many mimic the designs and flight characteristics of conventional aircraft. This is particularly true where RPA may be used in traditional manned operations, such as large commercial cargo transport. Whereas other RPA designs are dramatically different.

The opportunities in design, because the pilot is no longer situated within the aircraft, mean that novel architectures are possible. Unique applications of airframes, powerplants, fuels, and materials can result in flight characteristics different from conventional aircraft, most notably extreme flight endurances, very high altitudes, and slow flight.

There are a number of potential elements of RPA that, while essential for safe operation, are no longer considered as permanent features of the aircraft. For example, launch and recovery systems that replace typical landing gear, wheels and brakes. These systems are considered to be part of the aircraft system (i.e. RPAS) in so far as they are required for safe flight.

2.2 Remote pilot station

The RPS consists of the equipment used to command, control and monitor flight of the RPA. Designs can range from simple hand-held devices to complex, networked, multi-console configurations. The RPS may be located inside or outside of a building, and may be stationary or mobile (installed in a vehicle/ship/aircraft). Security, both physical and cyber, must be assured. An RPA will only be controlled from one RPS at a time.

For international operations—especially those involving very long duration flights—multiple, distributed RPS may be employed. These RPS may be located at different aerodromes, or at off-aerodrome locations, even in different States, as determined by the operator’s infrastructure or need for communications coverage .

When RPS are located across different States, there are a number of new challenges. The management and oversight of the RPS and the remote pilots flying the RPA, wherever they are located, are an obvious issue for both the operator and the operator's regulator. However, the legal aspects of jurisdiction and enforcement, when actions are necessary, are new topics that will need to be identified and resolved if confidence and trust in the aviation system is to be assured. Figure 1 illustrates a potential distributed network for RPS located among States during different phases of flight.

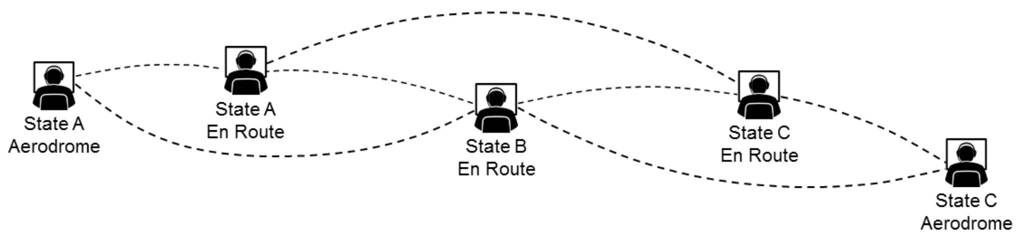

Figure 1 – Potential network of remote pilot stations

2.3 C2 Link

The command and control (C2) link is the data link between the remotely piloted aircraft and the remote pilot station for the purpose of managing flight. There are a variety of possible architectures and considerations in the design, security and management of the C2 Link.

2.3.1 Radio line-of-sight and beyond radio line-of-sight

The C2 Link can be maintained within radio line-of-sight (RLOS) or beyond radio line-of-sight (BRLOS).

RLOS: refers to the situation in which the transmitter(s) and receiver(s) are within mutual radio link coverage and thus able to communicate directly or through a terrestrial network, provided that the remote transmitter has RLOS to the RPA and transmissions are completed in a comparable timeframe.

BRLOS: refers to any configuration in which the transmitters and receivers are not in RLOS. BRLOS thus includes all satellite systems and possibly any system where an RPS communicates with one or more ground stations via a terrestrial network which cannot complete transmissions in a timeframe comparable to that of an RLOS system.

In order to facilitate international operations, the technical and performance requirements of both the RLOS and BRLOS C2 Links will need to be defined and agreed upon internationally.

Figures 2 and 3 provide simplified graphics of RLOS and BRLOS architectures.

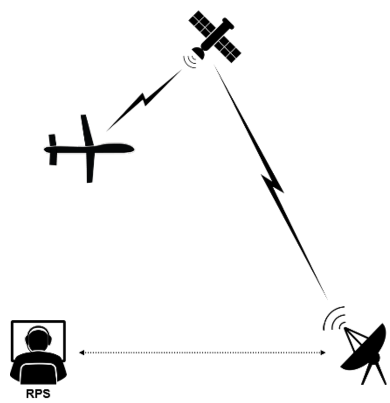

Figure 2 – beyond radio line-of-sight

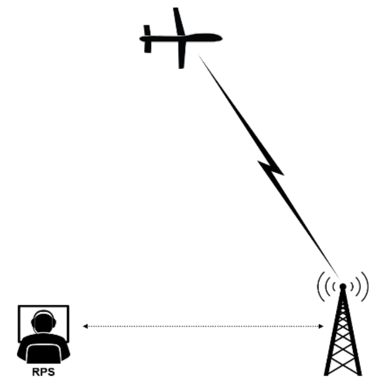

Figure 3 – radio line-of-sight

2.3.2 C2 Link performance

C2 Link performance requirements, will need to be adequate to not only allow the remote pilot to safely fly the RPA but also support other airspace performance requirements, such as RCP and PBN, which have agreed upon performance specifications on a global basis. States or ANSPs use these, globally agreed, specifications in designated airspaces to support operational requirements and separation standards. In order to access the airspace, operators must ensure their RPAS C2 Link has been designed and operates in accordance with these performance specifications.

2.3.3 C2 Link protection

The security of the data exchange between the RPA and RPS will need to be specified in technical standards in order to address vulnerabilities and associated mitigations.

2.3.4 Third party C2 Link service provision

The equipment and associated specifications necessary to enable the C2 Link between the RPS and RPA are considered components of the RPAS, whereas the provision of a third-party data link service is not. The transmitters and receivers used by data link service providers may be distributed in different States and belong to a single entity or be shared by others. When some of the components are controlled by a C2 Link service provider, the C2 Link service provider must be under the safety and security oversight of a civil aviation authority or other competent authority of a State. Alternatively, the RPAS operator must ensure that the service provider and C2 Link service provision is in accordance with the safety management system approved by the State of the Operator.

It must also be recognized that the C2 Link service provider will likely support multiple operators and aircraft. This introduces a potential failure element within shared C2 systems and thus the challenge to mitigate the consequences of the loss of the C2 Link when involving more than a single aircraft.

2.3.5 C2 link frequency spectrum and management

Appropriately allocated frequency bands for the provision of an aeronautical safety service will be used for the provision of the C2 Link. An example of such a frequency band is 5 030 – 5 091 MHz. This band is allocated to the aeronautical mobile route service (AM(R)S) and the aeronautical mobile satellite route service (AMS(R)S) and may be used for provision of both the terrestrial and the satellite C2 Link. Systems providing satellite service are not available in this band at present, however the feasibility of launching such a system is currently being studied (as of September 2016).

A number of frequency bands in the fixed satellite service (FSS) are also being considered for the provision of the C2 Link. The FSS has an abundance of satellite networks, however the radio regulatory conditions governing the use of these frequency bands are not comparable to those for frequency bands traditionally considered appropriate for the provision of aeronautical or other safety critical links.

The ITU World Radiocommunication Conference 2015 (WRC-15) developed Resolution 155, allocating the FSS for use by the RPAS control and non-payload communications (CNPC)[5], conditional to a number of specific conditions. These conditions will require further work within ITU and ICAO in defining the required technical characteristics for the space and earth stations, the interference environment within which they will be required to operate and the required performance of the C2 Link. The allocation of the FSS will be reviewed again by ITU WRC-23 (in 2023) to finalize any supporting radioregulatory provisions required.

ICAO provisions for C2 Link spectrum use will need to consider aeronautical safety implications due to potential link outages as well as data transmission latency, integrity, and security. A risk-based approach to C2 Link approval may be considered. Additionally, there may be a need to manage frequency assignments for the C2 Link, especially in areas where large numbers of RPAS operations are expected to take place.

2.4 Operational safety systems

Beyond those components of an RPAS required to enable physical flight, there are safety systems used to satisfy operational requirements and mitigate failures. The extent and sophistication of operational safety systems will vary depending on the intended use and complexity of the operational environment. Examples of particular importance in enabling international IFR operations include systems for detecting other aircraft and hazards; providing voice and data communication with ATC; and providing surveillance information to ATC (i.e. pressure-altitude reporting transponder, ADS-B or MLAT).

2.4.1 Detect and Avoid Capability

The detect and avoid (DAA) capability for RPAS is analogous to manned aviation's requirement to see and avoid and maintain vigilance for the purpose of detecting and avoiding potential collisions. It is considered a cornerstone necessary for enabling RPA integration. DAA capabilities include the ability to maintain vigilance while detecting and avoiding conflicting aircraft and other hazards (e.g. obstacles, terrain, and severe weather), determine an effective avoidance manoeuvre, execute the manoeuvre,

[5] CNPC is the ITU term for the C2 Link

and safely return to the original flight or ground trajectory. These capabilities must be available to the remote pilot so as to enable the appropriate decision(s) and action(s) to assure safe flight. However, in the event of failure, e.g. a lost C2 Link, it may be necessary for the DAA system to respond automatically to ensure enactment of the appropriate actions.

DAA technologies (airborne or ground-based) and procedures will need to be developed and certified/approved to ensure not only the safety of the RPA, but interoperability with other aircraft or obstacle collision avoidance systems. New procedures for controllers and pilots may be needed to ensure DAA use is understood and integrated into normal and contingency operating procedures. Furthermore, the remain-well-clear[6] capability of the DAA system must be compatible with the rules of the air and with any separation provision services provided by ATS. The DAA solution must not degrade the level of safety of the RPA or the overall aviation system.

2.4.2 RPAS/ATC communications

RPAS will need to maintain continuous voice communication watch on the appropriate communication channel and establish two-way communication, as necessary, with the appropriate air traffic control unit, except as may be prescribed by the appropriate ATS authority.

RPAS conducting IFR operations must communicate with ATC while in controlled airspace. The methods of communication may be via traditional air-ground very high frequency (VHF) radio or other means, such as satellite or terrestrial relays, data communications, internet-based systems, etc. Some options may involve reliance on third-party service providers. Whatever the ATC communication solution, it must be transparent to the controllers to maintain consistency with manned aircraft communications. Additionally, if alternative communications systems are used, the system should accommodate a transmission to and from the reception of the existing voice communications to facilitate shared awareness of communications to other airspace users.

Requirements for the communications system should align with ICAO's required communication performance (RCP) concept and related SARPs, procedures and guidance material.

2.5 System interfaces

Architectures for relaying information between ATC, navigation systems, surveillance systems, manned aircraft, the RPA and its RPS may involve terrestrial, satellite, and airborne links (i.e. ATC voice and data to remote pilots may be transmitted via ground telecommunications systems or relayed through the RPA). These system interfaces must be interoperable, in terms of performance and functionality, to ensure reliable, available, accurate, and consistent information exchanges.

New interfaces, such as a direct link from the RPS to ATC, are anticipated in some locations. These must be non-disruptive for ATC. Figure 4 provides a generic illustration of system interfaces.

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[6] ICAO *Manual on Remotely Piloted Aircraft Systems (RPAS)* (Doc 10019), section 10.4, 10.4.3.2 - Separation provision or remain-well-clear (RWC) The separator or agent responsible for separation provision can be: a) the corresponding ATC unit; or b) the airspace user, in which case the separation provision is referred to as RWC.

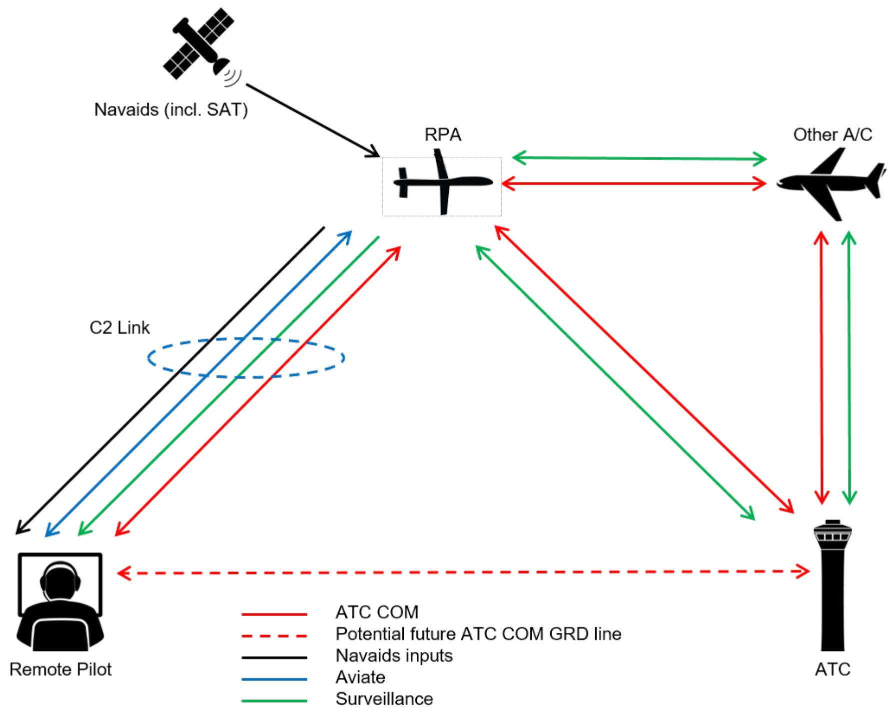

Figure 4 – System interfaces

2.6 Special considerations

2.6.1 Human performance

RPAS designs should ensure that the operating system and all associated components support human performance. Personnel tasked with initiating, managing, and maintaining and operating RPAS must have sufficient information to make safe, accurate, and timely decisions and to take appropriate actions. They must be suitably qualified and experienced in performing their duties.

2.6.2 Automation and human intervention

All system designs must ensure that the responsibility and liability for safe operation is retained by the operator and their flight crew. Remote pilots must be able to override or modify automated functions, except where such actions cannot be executed safely due to immediacy of the situation (such as an imminent collision avoidance manoeuvre) or where task complexity makes human intervention unreasonable.

2.6.3 Categorization of RPA

Categories of aircraft are useful for airworthiness certification, air traffic management, operations and pilot licensing. RPA share many attributes of manned aircraft but also have unique considerations to be taken into account in defining categorization schemes, such as damage potential (e.g., kinetic energy) and degree of on-board automation. Once defined, these categories will facilitate the articulation of system design criteria, standards, and limitations.

3 Airworthiness

Airworthiness is a determination of an aircraft's suitability for safe flight. In the case of RPA, airworthiness takes into consideration all components of the system needed for operational safety, i.e. the RPA, RPS(s), and C2 Link system(s). Airworthiness certification takes into account system configuration, usage, environment, and the hardware and software of the entire system. It also considers design characteristics, production processes, interoperability, reliability, and in-service maintenance procedures that adequately mitigate safety risks. Technical standards may be used to certify specific components of the RPAS.

3.1 General provisions

General provisions of airworthiness stipulate that:

- An RPA conducting international operations must have a certificate of airworthiness issued in accordance with the national regulations and in a manner consistent with Annex 8 — *Airworthiness of Aircraft*[7].

- An RPA conducting international operations must hold a type design approval in the form of a type certificate issued by the aviation safety regulator of the State of Design of the RPA (which may include the RPS).

- The RPS may hold a type design approval in the form of a type certificate (or supplemental type certificate) issued by the aviation safety regulator of the RPS of State of Design.

- The State of Design of an RPS may be different from the State of Design of the RPA.

3.2 Special airworthiness considerations

3.2.1 RPAS classifications

For this CONOPS, RPAS are not classified based on any physical configuration, size, or performance attributes. All RPA capable of international flight are considered viable provided they meet the minimum equipage and performance requirements for the airspace where they intend to operate. At a high level, this approach is acceptable. However, practical assessment of RPAS designs will likely require a risk-based classification scheme that accounts for the designs, degree of potential harm, operational intent, and operating environments.

3.2.2 Airworthiness and C2 Link service providers

When components of a C2 Link are provided by third parties, assurance of safety requirements of the link fall under the CAA and/or other competent authority of a State. Alternatively, an RPAS operator may be responsible for ensuring that each contracted service provider and C2 Link service provision is in

[7] Refer also to ICAO Annex 2, Appendix 4, 2.1 a).

accordance with the safety management system approved by the State of the Operator. In all cases, assurances must be made that end-to-end requirements are achieved and maintained.

3.2.3 Airworthiness approval and oversight

Determining the airworthiness approvals and ensuring adequate oversight of RPAS will be challenging due to rapidly evolving changes in technology, including hardware, software and its pedigree, distributed architectures, novel designs, and dependence on service provisions. To facilitate approvals and oversight, authorities and manufacturers will be helped by the establishment of agreed technical standards, safety metrics, and testing methodologies. Also needed will be appropriate guidance material and training for approval authorities or their designated representatives on the latest technologies and techniques used in the design, manufacturing, and hardware and software developments of RPAS.

The distributed nature of the RPAS also provides opportunities to apply different levels of assurance processes to the constituent elements. Full airworthiness assurance of the RPA is clearly necessary, but alternate methods may be more proportionate to other components of the RPAS. This may require new or amended processes appropriate to the potential safety risk concerns.

4 RPAS operations

RPAS operating internationally must comply with the framework regulations and requirements defined under the Convention on International Civil Aviation. At the highest level, this means the:

- RPAS operator must have obtained special authorization from all affected States;
- RPA must be so controlled as to obviate danger to civil aircraft;
- RPAS operators must hold an RPAS operator certificate;
- RPA must hold a valid certificate of airworthiness, issued against the approved type design (as recorded in the type certificate);
- RPA must meet the communications, navigations and surveillance (CNS) requirements for the airspace in which it flies;
- flight crew (remote pilot(s)) must hold valid licences appropriate to the RPA and RPS;
- the flight plan must comply with the conditions in Annex 2 — *Rules of the* Air, Chapter 3, 3.3; and
- RPAS must meet the DAA capability requirements for the airspace in which it flies and the operations to be performed.

Additionally, RPAS operations will require approvals encompassing the processes, manuals, procedures, and safety management systems applicable to the organization, its staff, and methods of operation. Although similar in arrangement to manned operators, distinctions will exist in the information recorded in this approval document. The distinctions will primarily pertain to the types and methods of flights permitted.

4.1.1 Aerodrome surface operations

On the aerodrome surface, RPAS will interact with ATC much the same as manned operations. Remote pilots will request permission to taxi, report aerodrome hazards, and accept clearances and instructions concerning surface movement. Upon request, remote pilots will receive ATC clearance information. The clearance may be loaded to RPAS automation or carried out manually by the remote pilot-in-command (PIC) or ground support personnel overseen by the remote PIC.

When taxiing on the surface, RPA will need to be capable of identifying and avoiding surface hazards (e.g., vehicles), adhering to ATC movement clearances, and abiding by all aerodrome signage and markings unless alternate methods are developed and agreed upon.

4.1.2 RPA landing

RPA may land similar to manned aircraft including the sub-phases from flare to the landing roll and/or aborted landing. However, some types of RPA may also employ non-conventional means of landing/recovery, such as the use of a cable or parachute, inducing a deep stall, or other methods. This may lead to a need to define landing/recovery areas that are not part of the formal runway/taxiway infrastructure.

4.1.3 Future operations

Types of operations expected in 2030 (see Footnote 4) will range from local national flights under a single operator, to dynamic and complex operations involving operators, flight crew members, and service providers based in multiple States. Fundamental to all future operations will be the requirement to abide by ICAO provisions and State regulations for the States being overflown.

4.2 Operators

RPAS operators are defined as any individual, organization, or enterprise engaged in RPAS operations. “RPAS operators” encompasses all commercial and private entities regardless of whether their RPA are flown for air transport, general aviation, or aerial work[8] purposes. Within this context, operators may represent individuals operating a single RPA, or large and sophisticated commercial entities engaged in global commerce. No distinctions are made within this CONOPS as to types of operators nor the operational nature of the RPAS service.

All operators that undertake operations in international airspace must hold an RPAS operator certificate and must comply with the requirements of the operational approval issued by the State of the Operator, including safety management system requirements.

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[8] ICAO Annex 6 — *Operation of Aircraft*, Parts I, II and III exclude consideration of aerial work for manned operations.

Operators of RPAS will be responsible for ensuring:

- airworthiness of the RPA;
- C2 Link services used during an operation meet appropriate performance requirements;
- flight crew members required for safety of flight are qualified and competent in their duties;
- arrangements with contractual entities (e.g. service providers) involved in the conduct of flight operations are appropriate;
- required records are established, managed and stored appropriately;
- compliance with all requirements established by the State of the Operator regarding its operation; and
- compliance with all international standards and ATM instructions.

4.2.1 Safety management

Understanding the risks of these future operations as well as the foreseeable introduction of new technologies and operations make adherence to sound safety management principles more important than ever. Therefore, the implementation of safety management principles by RPAS operators will contribute to the ability of assessing the safety risks associated with the RPAS operations and their potential impact on other service providers. The safety management system of an RPAS operator should be commensurate with the scope of the RPAS operator and the scale and complexity of its operations. Proper oversight of the implementation of safety management principles by RPAS operators will contribute to the ability of a State to effectively manage aviation safety.

4.3 Flight trajectories

Operational flight trajectories of RPAS will depend on the mission objectives, C2 Link coverage limits, restrictions imposed by IFR, and RPAS capabilities and equipage. It is envisioned that RPAS operational trajectories will not require segregation from other airspace users.

4.3.1 Point-to-point trajectories

The vast majority of international operations conducted by manned aircraft are point A to point B flights, typically flown to and from aerodromes, RPA offer the potential for increased point A to point A operations, for example, transit to distant operational areas and subsequent return to point of origin. Point-to-point operations in the international context may, due to assumed similarities in mission objectives of manned aircraft, mimic those operations in terms of flight planning and routes flown.

4.3.2 Defined trajectories

RPA may conform to *defined* operational trajectories whereby regular, predictive patterns are flown within a known duration. Defined operations are typical of surveillance or other missions where a particular, fixed geographic area is covered. These operations may challenge ATM integration in or near high-traffic densities, but otherwise could be managed routinely through preflight planning, coordination, and the use of airspace.

4.3.3 Dynamic trajectories

RPA may fly *dynamic* operational trajectories in which their flight path, altitudes, or duration could require blocking airspace and may be difficult to accurately predict beforehand. Examples of dynamic trajectories include tracking wildlife or monitoring an area of interest such as a wildfire for an indefinite period. Some of the variability in a dynamic trajectory may also be a characteristic of the RPAS design itself, such as when altitudes cannot be maintained predictably due to aircraft designs that account for air density to manage airspeed. Manned aircraft would typically fly dynamic trajectories under VFR, though IFR may be accommodated depending on traffic levels, desired altitude, weather conditions, surveillance coverage and the ability of ATC to dynamically block airspace.

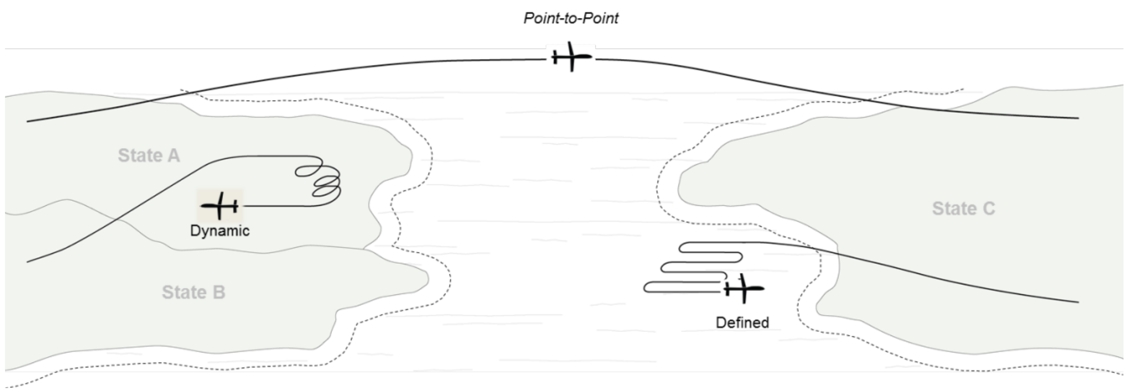

Figure 5 – International operational flight trajectories

Figure 5 depicts point-to-point and aerial work (dynamic and defined) operations over territorial and high-seas international airspace.

4.4 Operational planning

4.4.1 RPAS operators

The RPAS operator should establish procedures to ensure a seamless operation throughout the duration of the flight, including remote pilots who can carry out the responsibilities for the different phases of the flight, such as take-off, climb, cruise, approach and landing, all of which should be included in the operations manual and which should be provided for the use and guidance of the RPAS operations personnel concerned. RPA will need to adhere to air traffic flow management (ATFM) initiatives, make all necessary reports to ATC and comply with ATC instructions, as required.

4.4.2 Air traffic management

ATC interactions in different phases of the flight should be the same as with manned aviation. Remote pilots will need to communicate with ATC via voice or data communications.

4.4.3 Flight planning

As in the case of manned aircraft, a flight plan must be submitted for the flight of an RPA in accordance with Annex 2, Chapter 3, in particular, prior to operating across international borders. The flight plan must comply with the conditions in Annex 2, 3.3, and contain all relevant information specified in Annex 2, 3.3.2. Each State in which the flight is to operate may require additional information related to the planned operation of the RPA. Flight and flow for a collaborative environment (FF-ICE[9]) will contain the necessary information to support RPAS operations. Each State in which the flight is to operate may require additional information related to the planned operation of the RPA.

ANSPs or other responsible bodies review, accept, and modify submitted flight plans based on the timing, requested route, and any unique considerations associated with the aircraft, equipage, cargo, route or contingency procedures. For RPAS, ATM automation may be enhanced to enable approval or modification of route requests and recognition of user requests for off-nominal volumes of airspace. Any amended flight plan should be sent to the operator for concurrence or negotiation. Until such time as standardized procedures are established, the ANSP should be provided with, and approve the contingency plans for each IFR RPAS flight plan prior to the operation in case a contingency condition occurs.

4.5 Special considerations

4.5.1 Defining and managing international flight

International operations have traditionally been defined as when aircraft cross State boundaries or operate over the high seas. Unique to RPAS is the possibility that the RPA could conduct its full flight in the airspace of one State while the RPS is located in a different State. The remote flight crew members, support personnel, and third-party service providers may also be distributed and transferred among multiple States. The unique aspects of highly distributed international operations present challenges in managing the operations, airworthiness certification, personnel licensing, security and accident investigation as well as legal issues of jurisdiction and enforcement.

4.5.2 Delegated separation

In airspace where ATC provides separation services between participating aircraft, ATC procedures, flight crew procedures and aircraft equipage requirements already exist to maintain safe separation. It is anticipated that RPA may have the capability to separate themselves from some aircraft.

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[9] FF-ICE is the evolution from the flight plan (FPL) as we know it today, human readable only, to a machine readable system which will allow the flexibility for inclusion of any relevant information regarding a flight and/or the flow of traffic. It will contain core elements as part of the flight information exchange model (FIXM) used for its transmission and extensions to allow regional requirements to be also informed.

4.5.3 In-flight handover between remote pilot stations (RPS)

Unlike in manned aviation where the cockpit is integral to the aircraft, RPA can be piloted from any approved RPS. When more than one RPS is used for a flight, they may be collocated or they may be spread across the globe. In either case, the safe and effective handover of piloting control from one station to another must be assured.

4.5.4 In-flight transfer of C2 Link service providers

Transfer between C2 Link service providers may be permitted but would need to be confirmed by the remote PIC prior to transfer. Notification to ATC of a C2 Link service provider transfer would not be anticipated.

4.5.5 In-flight transfer of operators

It is envisioned that situations may exist where the operator could change mid-flight due to a contractual arrangement. Such a transfer would not necessarily be known to ATC, except in the flight plan. Otherwise, only the remote flight crew members would be made aware of the transfer to ensure communication with the appropriate flight operations and dispatcher support. In transferring operators, the responsibility for operational control would likely also transfer to the receiving operator.

4.5.6 Emergency and contingency operations

RPAS operations must include provisions for emergency and contingency situations that may arise during any phase of flight. Emergency and contingency procedures must be standardized to the greatest extent possible to allow predictable and safe mitigations to be planned.

Voice communications failure procedures may be slightly different for RPAS, as the remote pilot may have additional methods to communicate with ATC.

In the event an alternative procedure is planned, the RPAS operator should coordinate with, and obtain approval from, the ANSP prior to departure to assure ATM requirements will be met.

Emergency or contingency procedures should be standardized and published. To the extent possible, emergency and contingency procedures may be included in the flight plan during the transition period from accommodation to integration. This is particularly the case in lost C2 Link, inadequate C2 Link performance or loss of propulsion conditions where the remote pilot would have no or limited direct control of the RPA.

Any pre-programmed emergency or contingency procedures should ensure a safe response by the RPA.

4.5.7 Flight data recording

Adequate recording of RPAS operations will be required to support accident and incident investigations as well as for flight data analysis.

Data from RPAS operations and systems, both at the RPA and the RPS, should be recorded and maintained to facilitate ongoing safety assurance analyses, and to be made available for accident investigations.

5 Personnel licensing

All RPAS personnel responsible for safety of flight must be knowledgeable, trained, experienced and otherwise qualified in their respective duties. These qualifying requirements are manifest in personnel licences issued by the Licensing Authority.

5.1 Remote pilot

Remote pilots are required to receive medical certification, complete training, and demonstrate competency before being licensed to fly. The training requirements and degree of competency required depends upon the complexity of the RPA being flown and the purpose of flight. Requirements for smaller, less complex aircraft flown privately should be less strenuous than the requirements for remote pilots flying large, complex RPA in high-density airspace.

5.1.1 General remote pilot licensing provisions

All remote pilots should possess knowledge of aviation rules, regulations, and procedures. However, remote pilot certification qualifications may differ based on the RPA type, size or operational environment.

All remote pilots conducting international IFR operations must possess a remote pilot licence. The Licensing Authority of the State where the RPS is located will issue, renew, or validate remote pilot licences for qualified applicants.

The holder of a remote pilot licence and associated ratings and endorsements must not exercise the privileges beyond those issued, and must maintain the validity of their licence as required by the issuing authority.

5.1.2 Credit for prior experience

Military remote pilots and experienced pilots of manned aircraft may receive credit for their documented training and experience when applying for a remote pilot licence. This credit should only be applied where deemed comparable to the RPA licensing and rating requirements.

5.1.3 Class and type ratings

Different categories of RPA and RPS may, as considered necessary by the competent authority, require a class or type rating on the remote pilot licence. Class ratings pertain to systems having comparable handling and performance characteristics. Type ratings refer to systems requiring additional training beyond the initial licence or RPA class rating, for instance where operation of the RPAS requires a minimum of two remote pilots.

5.1.4 RPA category

This CONOPS does not address RPA categories (e.g. fixed-wing, rotorcraft, airship); it is expected that a single remote pilot licence which covers all types of scenarios will be implemented. This licence will be annotated with specific ratings, limitations and endorsements, as appropriate.

5.2 Remote pilot instructors

Instructors of remote pilots must, in addition to meeting the requirements for holding a remote pilot licence, receive training and have passed an assessment of competency in relevant RPA, RPS and applicable rating(s).

5.3 Remote pilot licence (RPL) examiners

RPL examiners must have demonstrated that they possess the competencies for RPL examiners and hold the qualifications to provide instruction for RPL training.

5.4 RPAS maintenance personnel

Knowledge and skills for RPAS maintenance personnel will be based on the RPA, RPS or other components of the RPAS where maintenance is required. Many of the basic qualifying requirements may be based on existing manned aircraft, whereas others may require specialized training and competency specific to the RPAS.

Specialized training may need to address maintenance during a flight.

5.5 Air traffic controllers

The introduction of RPAS may result in new ATC procedures, techniques and tools. These changes will require additional training for air traffic controllers but should not affect their licensing requirements.

6 Operating environments

RPA on IFR flight plans can be expected to transit all classes of airspace, cross international borders, and operate to and from both controlled and uncontrolled aerodromes. Unique RPAS capabilities may also allow for launch and recovery at locations other than traditional aerodromes.

6.1 International airspace rules and procedures

All aircraft flying within the territorial airspace of a State must abide by the airspace regulations and procedures of that State. States generally form their regulations and procedures in accordance with ICAO SARPs, while maintaining the right to file differences and apply their own rules and procedures within their territorial airspace. Unlike manned aircraft, RPAS operators must obtain special authorization prior to operating in territorial airspace of a State. This authorization may include specific permissions or limitations that must be complied with.

6.2 Airspace requirements and RPAS capabilities

RPAS must be able to comply with the requirements of the class of airspace in which they are operating. This requirement is inclusive of both equipage and operational parameters (e.g. transponder, two-way communications with ATC, etc.). As an IFR operation, RPA should be capable of flying the published instrument departure and arrival procedures, unless alternatives are agreed upon with the appropriate authority. RPAS will need to be equipped and have the required operational approvals in terms of required navigation performance (RNP), RCP and required surveillance performance (RSP) as required by the airspace within which they plan to operate. Development of separate, specialized procedures at established aerodromes should be minimized and still require agreement between all relevant parties. This includes ground manoeuvres where, for example, RPA will be expected to conform to existing systems, processes and procedures. This also includes such aspects as the capability to detect and respond to visual signs and markings.

Note. — See 4.5.6 for emergency and contingency operations.

6.3 RPAS performance limitations

The performance characteristics of certain RPA may not be typical of that for manned aircraft; air traffic controllers may need to accommodate a wider range of capabilities. Traditionally, controllers have safely managed occasional flights that do not match the operational capabilities of the typical fleet mix within their area of responsibility. Examples include accommodating experimental aircraft, historical aircraft, and newly certificated aircraft types. RPA variations in airspeed, turn radius, and climb or descent rates may require special handling. In small numbers, the impact on capacity and efficiency of the airspace can be minimized through pre-coordination with the ATC unit.

—END—