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| A close up of a sign  Description automatically generated | **World Radiocommunication Conference (WRC-23)Dubai, 20 November - 15 December 2023** |  |
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| **PLENARY MEETING** | **Addendum 7 toDocument 4-E**  |
| **5 July 2023** |
| **Original: English** |
| Director, Radiocommunication Bureau |
| REPORT OF THE DIRECTOR ON THE ACTIVITIES OF THE RADIOCOMMUNICATION SECTOR |
| part 7 [[1]](#footnote-1)\*ICAO PROGRESS ON STANDARDS AND RECOMMENDEDPRACTICES (SARPs[[2]](#footnote-2)) PREPARATION For REMOTELY PILOT AIRCRAFT SYSTEMS |

# 1 Introduction

1.1 As the specialized agency of the United Nations responsible for helping its 193 Member States harmonize their aircraft operations ICAO recognized in 2006 that it needed to begin considering how Remotely Piloted Aircraft Systems (RPAS), also known as Unmanned Aircraft Systems in ITU-R, could be safely and efficiently integrated into the global aviation system. Building on the work of its Unmanned Aircraft Systems Advisory Group (UAS-AG) ICAO established the Remotely Piloted Aircraft Systems Panel (RPASP) in May 2014 and tasked it to:

• serve as the focal point and coordinator of all ICAO RPAS-related work, with the aim of ensuring global interoperability and harmonization;

• develop an RPAS regulatory concept and associated guidance material to support and guide the regulatory process;

• review ICAO SARPs, propose amendments and coordinate the development of RPAS-related SARPs with other ICAO expert groups;

• assess impacts of proposed provisions on existing manned aviation; and

• coordinate, as needed, to support development of a common position on bandwidth and frequency spectrum requirements for command and control of RPAS for the International Telecommunication Union (ITU), World Radio Communication Conference (WRC) negotiations.

1.2 The RPASP has met multiple times per year since 2014 and has developed RPAS-related SARPs. ICAO anticipates completing its entire first package of RPAS-related SARPs to become applicable by 2026 so that its Member States will be able to begin benefiting from international civil RPAS flights.

# 2 RPAS Spectrum Considerations

2.1 RPAS are becoming a major component of the aviation industry offering considerable socio-economic benefits. These benefits will spread across many national and international sectors most notably agriculture and fishery, support after natural disasters, remote imaging and utility inspection, communications, news gathering and broadcasting as well as uncrewed cargo transport. These benefits not only include reduced crewing costs but also the ability for the aircraft to remain in the air for longer durations because crew changes do not require the aircraft to land. In the longer term it is anticipated that RPAS will create their own unique opportunities that are not possible when the pilot is flying in the aircraft.

2.2 From a spectrum perspective, RPAS require modest bandwidth to enable secure and robust communications between the remote pilot and the remotely piloted aircraft to enable the remote pilot to safely manage the flight. However, there are many RPAS applications that will require more significant bandwidth to nsupport their mission payload backhaul objectives. ICAO has identified a number of frequency bands (from VHF to Ka band) that, depending on the operation, are suitable for remote management of the RPA’s flight. These spectrum options will be selected based on the location, area and range of the operation. It is important to note that spectrum options for mission payload backhaul which are not limited by safety considerations, have not been identified by ICAO.

# 3 Development of SARPs related to RPAS Operations

## 3.1 Topics covered by the SARPs

3.1.1 The SARPs required to support ICAO’s goal cover a wide range of topics such as:

• air traffic management;

• airworthiness;

• human performance;

• remote pilot licensing;

• RPAS operations;

• safety management systems;

• detect and avoid (DAA) or surveillance systems including airborne collision avoidance systems (ACAS), ground proximity warning systems or other safety nets;

• telecommunications for C2 Link (also known as Control and Non-Payload Communications (CNPC) in ITU-R) and for air traffic control; and

• operational procedures relevant to RPAS, which includes C2 Link and DAA operations.

3.1.2 Two of those topics (DAA and C2 Links) require radio frequency spectrum.

## 3.2 Detect and Avoid

3.2.1 DAA specific radio frequency spectrum is identified in ITU-R Report M.2204 "Characteristics and spectrum considerations for sense and avoid systems use on unmanned aircraft systems". This report identifies existing frequency bands that are allocated for aeronautical radionavigation and could be used for DAA. These bands include 5 350-5 470 MHz, 8 750-8 850 MHz, 9 300-9 500 MHz, 13.25-13.4 GHz, and 15.4-15.7 GHz for DAA systems onboard aircraft and 2 700-2 900 MHz, 9 000-9 200 MHz, and 15.4-15.7 GHz for ground based DAA systems.

## 3.3 C2 Link

3.3.1 ICAO has identified specific C2 Link frequencies and included those in the SARPs contained in Annex 10, Volume V to the Convention on International Civil Aviation (ICAO Convention). The SARPs include frequencies to support both terrestrial and satellite-based C2 Links operating in the VHF, L, S, C, Ku, and Ka Bands. ICAO has developed a comprehensive suite of C2 Link security requirements to ensure adequate C2 Link authentication, integrity, anti-replay, confidentiality, and logical access control as well as validation requirements on the cryptographic algorithms and modules being used. The first package of C2 Link related SARPs were adopted and became effective in July 2021 as "Communication Systems and Procedures Relating to Remotely Piloted Aircraft Systems C2 Link", in Annex 10, Volumes V and VI to the ICAO Convention. These SARPs will become applicable by November 2026.

## 3.4 Required C2 Link Performance

3.4.1 In addition, since the C2 Link plays an important role in the safe operation of the RPAS, ICAO is developing the concept of Required C2 Link Performance (RLP) to systematically and comprehensively capture all of the performance requirements of the C2 Link to ensure the remote pilot (RP) is able to manage the flight of the RPA in a safe and timely manner. RLP not only includes the requirements for C2 Link availability, continuity and integrity but also requirements on the maximum length of time that the C2 Link can be interrupted due to propagation-related effects or interference.

3.4.2 By its definition the C2 Link provides the only connection between the RP and the remotely piloted aircraft (RPA) to enable the RP to safely manage the flight. However, this C2 Link may be comprised of many components operating in series or in parallel to deliver the required robust connection over the entire service area of the flight. Even so, radio frequency (RF) propagation variability or interference may induce longer interruptions than acceptable level of interruptions to the C2 Links ability to maintain the required connection. If those interruptions are too long then the SARPs require the RPAS to enter a Lost C2 Link state.

## 3.5 Mitigation measures for Lost C2 Link

3.5.1 Other SARPs and Procedures for Air Navigation Services (PANS), which are under development, cover not only RLP but also mitigation measures for the situation where the RPAS enters a Lost C2 Link state. Although it is anticipated that this Lost C2 Link (LC2L) state will occur only rarely, ICAO SARPs also define the provisions to continuously maintain airspace safety even when the LC2L state occurs. To align with those provisions defined in ICAO SARPs, these LC2L state procedures are programmed into the aircraft prior to takeoff and they can be updated during the progress of the flight, as necessary, while the C2 Link is still working. These LC2L procedures defined in SARPs will be well known to both the RP and to the Air Traffic Controllers (ATC). The consequent operational procedures for the RP and ATC will ensure that the RPA operates in a precoordinated and predictable manner when this rare L2CL state occurs.

3.5.2 To complement these LC2L procedures, the ICAO SARPs also require that:

• any RPAS operated in accordance with Instrument Flight Rules (IFR) shall have a DAA capability which enables the RP to avoid conflicting traffic and in the future other hazards as well. The RPA shall be equipped with an automated system that performs appropriate collision avoidance manoeuvres, even when the RPAS is in a LC2L state, except where the collision avoidance responsibilities of the remote pilot can be adequately exercised otherwise;

• from an airworthiness perspective, the C2 Link, as integrated in the RPAS, shall perform its intended function under all anticipated operating conditions;

• the RPAS operator implements a safety management system (SMS) that incorporates the framework and principles defined in Annex 19;

• the RPAS operator has an approvals process for and continuous monitoring of any C2 Link Communications Service Provider (C2CSP) that provides part or all of the C2 Link service; and

• there is active oversight of any C2 Link service provision integrated into the RPAS operator’s, operational safety processes to ensure that safety-related topics are addressed prior to commencement of any operations and managed in a prearranged manner if they occur during the flight.

To this end the C2 Link SARPs in Annex 10, Volume VI (Aeronautical Telecommunications) and in Annex 6, Part IV (Operation of Aircraft) include continuous monitoring of the C2 Link’s compliance with the RLP and the reporting of any occurrences of interference related operational events.

# 4 SARPs specific to Resolution 155 (Rev. WRC19)

4.1 Most of the RPAS-related SARPs developed by ICAO are not focused on a single C2 Link technical solution so they apply equally to the use of the Fixed Satellite Service (FSS) service spectrum as to any other appropriately allocated service or spectrum. However, ICAO has included certain procedural and technical requirements in its SARPs that recognize the unique nature of the use of the FSS by RPAS.

4.2 Of particular note are SARPs that require the FSS operator to inform the RPAS Operator before they make any changes to the service they are providing as a result of any coordination activity after the initial Service Level Agreement (SLA) has been agreed. This does ensure that the RPAS operator will not continue to fly without being aware that their C2 Link performance may be different from what was agreed.

4.3 Although generic to any technology the SARPs do require the FSS operator (and any other C2CSP) to perform real-time monitoring, estimation and prediction of interference risks and plan solutions for potential harmful interference scenarios as well as act immediately when their attention is drawn to any harmful interference.

# 5 Summary

5.1 ICAO recognizes the unique aspects of RPAS and the corresponding unique solutions that are required, to ensure that airspace safety, for which ICAO is responsible, is maintained. As such ICAO has developed and continues to develop (as described in Sections 3 and 4 as well as listed in the examples in the attached Appendix) a comprehensive set of RPAS related SARPs that will evolve as the RPAS industry matures. These ICAO SARPs recognize and mitigate the imperfect nature of the C2 Link with technical and procedural provisions to maintain airspace safety.

Appendix: Examples of ICAO SARPs supporting C2 Links for RPAS

**APPENDIX**

**EXAMPLES OF ICAO SARPS SUPPORTING C2 LINKS FOR RPAS**

The following lists examples of the comprehensive approach taken by ICAO in its SARPs regarding C2 Links for RPAS. Some of the SARPs are already adopted and effective, all are expected to become applicable by November 2026.

**Annex 6 “*Operation of Aircraft*”**

**Part IV “*International Operations – Remotely Piloted Aircraft Systems*”**

**(New material. Current status 2023-06-06: This material has undergone review by States.**

**Pending final review by Air Navigation Commission and Council)**

1. **3.3.1 – safety management**

3.3.1 The operator shall implement a safety management system (SMS) that incorporates the framework and principles defined in Annex 19, Chapter 4 and Appendix 2, and in this Chapter.

*Note.— Annex 19 includes safety management provisions for RPAS operators. Further*

*guidance is contained in the* Safety Management Manual *(Doc 9859).*

1. **3.6.3 – Safe operation of the C2 Link**

3.6.3.1 The State of the Operator shall be responsible for the oversight of the C2 Link service provision, whether any of the C2 Link components are under the control of the RPAS operator or a C2 Link communications service provider (C2CSP).

*Note.— Such oversight of the C2 Link service provision may be conducted as part of*

*the State of the Operator’s oversight of the RPAS Operator safety management system.*

3.6.3.2 When the operator exercises direct control over the entire C2 Link(s), the operator shall be responsible for the safe operation of all C2 Link components. Such responsibilities shall be detailed in a service level agreement (SLA) internal to the operator.

3.6.3.3 When a portion of, or all of, the C2 Link(s) is under the operational control of a C2CSP, the operator shall establish an SLA with the C2CSP prior to commencing operations.

3.6.3.4 The SLA shall be approved by the State of the Operator.

3.6.3.5 The SLA shall contain at least:

a) legal identification of the party(ies);

b) scope of the provided service, including hours of service and service area;

c) performance requirements of the C2 Link provision, including the QoSR which is commensurate with the C2 Link specification required, under normal conditions, for the operator’s intended operations;

d) security measures and management, including security requirements for the C2 Link provision;

e) procedures for planned outages and contingencies, including reporting requirements;

f) safety management responsibilities and processes related to safety risk management and safety assurance, including safety risk assessment and mitigation, safety performance monitoring and measurement, safety reporting, and safety analysis;

g) arrangements to facilitate oversight of the C2 Link service provision by the State of the Operator; and

h) the C2CSP emergency response plan (ERP) including how they would address service losses and how they would be restored.

3.6.3.6 In exercising its oversight function of the C2 Link service provision in accordance with 3.6.3.1, the State of the Operator shall:

a) verify that the C2 Link service is to be provided by an authorized C2CSP;

*Note.— Such an authorization or approval would normally be issued by the State in which the C2CSP is located. Further guidance is provided in the Manual on C2 Links for Remotely Piloted Aircraft Systems (Doc xxxxx).*

b) establish and document monitoring processes to ensure that the C2 Link service provision meets the established requirements, including C2 Link quality of service required (QoSR) and security;

c) establish and document monitoring processes to raise findings, and to request and monitor corrective actions related to the C2 Link service provision;

d) take appropriate measures, when necessary, to resolve C2 Link service provision findings identified in application of the continuous monitoring processes; and

e) approve, in accordance with its national regulations, the use of a C2CSP which has been authorized as per 3.6.3.6 a) above.

*Note.— Such preparation and oversight activities may be conducted as part of the State of the Operator’s oversight of the processes and procedures of the RPAS Operator.*

3.6.3.7 The C2CSP shall establish and document processes to perform C2CSP monitoring of the QoSD as part of their routine operations, with the objective of ensuring that the C2 Link service provision meets the applicable requirements, including the C2 Link QoSR specified in the SLA.

3.6.3.8 The operator shall be responsible for monitoring that the C2 Link service provision QoSD meets the QoSR, including its security, and shall:

1. document any observed anomalies; and
2. report any observed anomalies to the C2CSP, in accordance with the SLA.
	* + 1. The operator shall notify the State of the Operator of:
3. all C2 Link provision degradations with regards to the SLA that occur during operations; and
4. degradations that cannot be resolved by direct interaction between the operator and the C2CSP, when the C2CSP is not the operator.
5. **4.3.1 d) – flight preparation**

4.3.1 A flight shall not be commenced until flight preparation forms have been completed certifying that the remote pilot-in-command is satisfied that: (…)

1. a C2 Link(s) is (are) expected to be available for the duration of the flight and meets the performance criteria;
2. **4.3.3.7 – operational flight planning**

4.3.3.7 The operator shall ensure that the remote pilot is provided with information regarding factors that could affect the quality of the C2 Link for each segment of the operation.

1. **4.5.1 – establishment, assurance and termination of the C2 Link**

4.5.1.1 When managed through the C2 Link, taxiing or ground movement shall not be initiated or shall be aborted if the Quality of Service Experienced (QoSE) does not provide the required performance for the remote pilot to safely control the RPA.

4.5.1.2 Take-off shall not be initiated or, if safe to do so, shall be aborted if the QoSE does not provide the required performance for the remote pilot to safely control the RPA.

4.5.1.3 A switchover to another C2 Link or network shall be conducted in accordance with the procedures defined in the operations manual, to include confirming the QoSE of the accepting C2 Link or network.

4.5.1.4 The remote pilot shall initiate the condition of a lost C2 Link state if, while in flight, the QoSE has been determined by the remote pilot to be insufficient to actively manage the flight in a safe and timely manner.

1. **4.5.3 f) – take-off and landing**

*Note 1.— RPAS may be operated from aerodromes, to include both airports and heliports, open to public use or other locations fulfilling the operational requirements and that meet the system configuration, design and performance requirements.*

*Note 2.— This section also applies to launch and recovery operations.*

4.5.3 For operations from other than aerodromes open to public use, the operator or remote pilot shall consider the following: (…)

f) service provision ensuring required C2 Link performance (transaction time, availability, continuity and integrity);

1. **4.5.5 a) – emergencies and contingencies**

4.5.5 The RPAS operations manual shall contain procedures to mitigate at least the following: […]

a) lost C2 Link;

1. **4.5.7 - C2 Link contingency and emergency procedures**

4.5.7.1 If any of the C2 Link components fail, actions shall be taken to minimize the time that the remote pilot is not actively managing the flight of the RPA.

4.5.7.2 The RPAS operations manual shall state the actions to be taken by the remote pilot to minimize the time that the RPAS is in a lost C2 Link state.

4.5.7.3 Contingency switchovers shall be performed in line with security measures and procedures that ensure that the accepting C2 Link or network is authenticated and authorized.

4.5.7.4 Contingency handovers shall be performed in line with security measures and procedures that ensure that the accepting RPS is authenticated and authorized to take control of the RPA.

4.5.7.5 A means or process for anticipating C2 Link interruptions or lost C2 Link states shall be provided to the remote pilot.

1. **4.5.8 – lost C2 Link**

4.5.8.1 In the event of a lost C2 Link, an RPA shall be capable of following a pre-programmed and predictable flight profile.

4.5.8.2 Prior to flight, the operator shall ensure that if the RPAS enters a lost C2 Link state, the RPA will follow the procedures contained in Annex 2 or the relevant State Aeronautical Information Publication (AIP).

4.5.8.3 The operator shall establish crew procedures for C2 Link interruption and lost C2 Link operations.

*Note.— Additional procedures related to emergencies, voice communication failure and contingencies are described in the Procedures for Air Navigation Services — Air Traffic Management (Doc 4444), Chapter 15.*

4.5.8.4 When operating in airspace where SSR transponder carriage is required, the RPAS/RPA shall be capable of setting the transponder to Mode A Code 7400 to indicate a lost C2 Link state.

4.5.8.5 When operating in airspace where ADS-B carriage is required or if ADS-B is part of the RPA detect and avoid (DAA) capability, the RPAS/RPA shall be capable of selecting the appropriate functionality to indicate a lost C2 Link state.

4.5.8.6 Remote pilots shall notify the ATC unit as soon as practicable upon the lost C2 Link procedures being activated for any flight under ATC or any flight that may affect controlled flights and, if applicable, upon the C2 Link being successfully restored.

1. **6.3 – C2 Link**

6.3 The C2 Link shall comply with the requirements defined in Annex 10, Volume VI.

1. **11.3.1 – maintenance programme**

11.3.1 A maintenance programme for each RPA, each RPS and any ground-based communication infrastructure as required by 8.3 shall contain the following information:

*Note.— Ground-based infrastructure and equipment includes, inter alia, launch and recovery equipment and any C2 Link equipment under the operator’s control, associated with the operation of RPAS.*

a) maintenance tasks and the intervals at which these are to be performed, taking into account the anticipated utilization of the RPAS;

b) when applicable, a continuing structural integrity programme;

c) procedures for changing or deviating from a) and b) above; and

d) when applicable, condition monitoring and reliability programme descriptions for the RPAS and all its components.

**Annex 8 “*Airworthiness of Aircraft*”**

**Part II “*Procedures for Certification and Continuing Airworthiness*”**

**(Adopted March 2021, effective July 2021. Will become applicable in 2026)**

1. **1.4 – issuance of Type Certificate**

1.4.3 As of 26 November 2026, the Type Certification of the remotely piloted aircraft shall include the remote pilot station and the C2 Link as defined in the appropriate parts.

1. **Note under 3.4 – aircraft limitations and information**

(…)

*Note. — As of 26 November 2026, information necessary for the safe operation of the RPA include those applicable to remote pilot stations (RPS) and C2 Link.*

1. **Note under 3.5 – temporary loss of airworthiness**

(…)

*Note. — As of 26 November 2026, for remotely piloted aircraft, that which must be restored to an airworthy condition includes the RPS controlling the RPA, the required C2 Link(s) or any other components defined by the appropriate airworthiness requirements.*

**Annex 8 “*Airworthiness of Aircraft”***

**Part VIII “*Remotely Piloted Aeroplanes*”**

**(Adopted March 2021, effective July 2021. Will become applicable in 2026)**

1. **1.2. – operating limitations**

1.2.1 Limiting conditions shall be established for the remotely piloted aeroplane, its powerplant, systems and equipment (see 7.2). Compliance with the Standards of this part shall be established assuming that the remotely piloted aeroplane is operated within the limitations specified. The limitations shall include a margin of safety to render the likelihood of accidents arising therefrom extremely remote.

1.2.2 Limiting ranges of any parameter whose variation may compromise the safe operation of the remotely piloted aeroplane, e.g. mass, centre of gravity location, load distribution, speeds, ambient air temperature, altitude and C2 Link performance, shall be established within which compliance with all the pertinent Standards in this part is shown.

*Note 1.— The maximum operating mass and centre of gravity limits may vary, for example with each altitude and with each separate operating condition, e.g. take-off, en route, landing.*

*Note 2.— Maximum operating mass may be limited by the application of noise certification*

*Standards (see Annex 16 —* Environmental Protection*, Volume I —* Aircraft Noise*, and Annex 6 —* Operation of Aircraft*.*

1. **7.8 – C2 Link information**

7.8 Sufficient information shall be given on any relevant C2 Link relating to configuration, operation, performance, emergency procedures, and operating limitations.

1. **10.2.2 – Integration**

10.2.2 Integration tests. The remotely piloted aeroplane shall complete satisfactorily tests with all approved types of remote pilot stations, as are necessary to verify the validity of the declared conditions and limitations and to ensure that remote pilot stations will operate satisfactorily and reliably using any specified C2 Link and supporting C2 Link communication service providers, as specified under the anticipated operating conditions.

1. **10.3.1 – controls and information**

10.3.1 The remote pilot station shall be integrated in such a way as to allow timely control as required for safe and efficient control of the remotely piloted aeroplane by the remote flight crew. This shall include at least the following:

1. processing the data provided by the remotely piloted aeroplane regarding:

— attitude, altitude, position, heading, speed, vertical speed, turning information;

— powerplant and propeller speed;

— detect and avoid;

— weather conditions;

— C2 Link state and performance according to the SARPs defined in the applicable sections of Annex 10 for remotely piloted aircraft systems; and

— status of automated systems, including the current lost C2 Link state;

1. controlling the remotely piloted aeroplane in the anticipated operating condition;
2. controlling the powerplant according to Chapter 5 of this part;
3. information on predicted QoSD in the geographical area of the flight based on the QoSR and C2 Link specification; and
4. status of automated systems, including flight controls exceedance or malfunctions.
5. **10.4 – C2 Link**

10.4.1 The remotely piloted aeroplane and remote pilot station system architecture shall be compatible with any specified C2 Link and supporting C2 Link communication service providers as specified, to enable the remotely piloted aeroplane to be operated safely under the anticipated operating conditions.

10.4.2 Means shall be provided to monitor the C2 Link performance and the C2 Link state according to metrics defined in the applicable parts of Annex 10, reacting according to the transaction completion criteria defined in Annex 6.

1. **11.6 – automatic taxi, take-off and landing**

11.6 Any systems installed on the remotely piloted aeroplane that are required for automatic taxi, take-off or landing shall ensure that loss, degradation, or interruption of navigational information or C2 Link does not adversely affect safety during taxi, take-off or landing.

1. **11.7 – C2 Link**

11.7 The C2 Link, as integrated in the remotely piloted aircraft system, shall perform its intended function under all anticipated operating conditions. Considerations regarding the C2 Link shall include:

1. a means to maintain C2 Link through foreseeable operating conditions;
2. a means to regain C2 Link in the event that it is temporarily interrupted;

c) a means to ensure continued safe flight and landing in the event that the RPAS enters a lost C2 Link state;

d) incorporation of C2 Link performance and operational limitations as required in Chapter 7 of this part; and

e) a means to monitor the performance and status of the C2 Link.

**Annex 8 “*Airworthiness of Aircraft”***

**Part IX “*Remotely Piloted Helicopters*”**

**(Adopted March 2021, effective July 2021. Will become applicable in 2026)**

1. **1.2.2 – operating limitations**

1.2.2 Limiting ranges of any parameter whose variation may compromise the safe operation of the remotely piloted helicopter, e.g. mass, centre of gravity location, load distribution, speeds, ambient air temperature, altitude and C2 Link performance, shall be established within which compliance with all the pertinent Standards of this part is shown.

*Note 1.— The maximum operating mass and centre of gravity limits may vary, for example, with each altitude and with each practicably separate operating condition, e.g. take-off, en route, landing.*

*Note 2.— Maximum operating mass may be limited by the application of noise certification Standards (see Annex 16 — Environmental Protection, Volume I — Aircraft Noise and Annex 6 — Operation of Aircraft.*

1. **4.2. c) - provision for emergencies**

4.2 Special consideration shall be given to design features that affect the ability of the remote flight crew member to maintain controlled flight. This shall include at least the following: (,,,)

c) *Provision for emergencies.* Means shall be provided which shall either automatically prevent, or enable the remote flight crew to deal with emergencies resulting from foreseeable failures of equipment, systems, the C2 Link, and the remote pilot station, the failure of which would endanger the remotely piloted helicopter. Reasonable provisions shall be made for continuation of essential services following engine or system failures to the extent that such failures are catered for in the performance and operating limitations specified in the Standards in this Annex and in Annex 6.

1. **Note under 6.1.2**

6.1.2 The design of the equipment and systems required by 6.1 and their installation shall be such that: (…)

*Note.— The system safety assessment process includes integration of the remote pilot station and the specification of the C2 Link. See also 10.3.3 of this part.*

1. **7.8 – C2 Link information**

7.8 Sufficient information shall be given on any relevant C2 Link relating to configuration, operation, performance, emergency procedures, and operating limitations.

1. **10.2.2 – integration tests**

10.2.2 *Integration tests.* The remotely piloted helicopter shall complete satisfactorily tests with all approved types of remote pilot stations, as are necessary to verify the validity of the declared conditions and limitations and to ensure that the remote pilot station will operate satisfactorily and reliably using any specified C2 Link and supporting C2 Link communication service providers, as specified under the anticipated operating conditions.

1. **10.3.1 a) and d) – controls and information**

10.3.1 The remote pilot station shall be integrated in such a way as to allow timely control as required for safe and efficient control of the remotely piloted helicopter by the remote flight crew. This shall include at least the following:

a) processing the data provided by the remotely piloted helicopter regarding:

— attitude, altitude, position, heading, speed, vertical speed, turning information;

— powerplant;

— detect and avoid;

— weather conditions;

— rotor speed;

— C2 Link state and performance according to the SARPs defined in the applicable sections of Annex 10 for remotely piloted aircraft systems; and

— status of automated systems, including the current lost C2 Link state; (…)

d) information on predicted QoSD in the geographical area of the flight based on the QoSR and C2 Link specification; and (…)

1. **10.4 – C2 Link**

10.4.1 The remotely piloted helicopter and remote pilot station system architecture shall be compatible with any specified C2 Link and supporting C2 Link communication service providers as specified, to enable the remotely piloted helicopter to be operated safely under the anticipated operating conditions.

10.4.2 Means shall be provided to monitor the C2 Link performance and the C2 Link state according to metrics defined in the applicable parts of Annex 10, reacting according to the transaction completion criteria defined in Annex 6.

1. **10.5.4 b) and d)**

10.5.4 **Recommendation**.— *In addition to those specified in 7.5, the following procedures should be included, inter alia: (…)*

*b) C2 Link specifications and procedures for switchover of remotely piloted helicopter command and control from one C2 Link to another and to respond to temporary interruption or loss of the C2 Link; (…)*

*d) security procedures unique to remotely piloted aircraft systems (e.g. remote pilot station security, C2 Link, etc.); and (…)*

1. **11.6 – automatic taxi, take-off and landing**

11.6 Any system installed on the remotely piloted helicopter that is required for automatic taxi, take-off or landing shall ensure that loss, degradation, interruption of navigational information or C2 Link does not adversely affect safety during taxi, takeoff or landing.

1. **11.7 – C2 Link**

11.7 The C2 Link, as integrated in the remotely piloted aircraft system, shall perform its intended function under all anticipated operating conditions. Considerations regarding the C2 Link shall include at least:

a) a means to maintain C2 Link through foreseeable operating conditions;

b) a means to regain C2 Link in the event that it is temporarily interrupted;

c) a means to ensure continued safe flight and landing in the event that the RPAS enters a lost C2 Link state;

d) incorporation of C2 Link performance and operational limitations as required in Chapter 7 of this part; and

e) a means to monitor the performance and status of the C2 Link.

**Annex 8 “*Airworthiness of Aircraft”***

**Part X “*Remote Pilot Station*”**

**(Adopted March 2021, effective July 2021. Will become applicable in 2026)**

1. **1.2 – RPS interfaces and integration**

1.2 All necessary information for the safe and correct interfaces between the remote pilot station and the remotely pilot aircraft shall be made available, including those limitations concerning the C2 Link and information necessary for intended function of any C2 Link as specified in the type design.

1. **2.2 – functioning**

2.2 The remote pilot station shall be designed and constructed so as to function reliably within its operating limitations under its anticipated operating conditions when integrated within a remote piloted aircraft system using any C2 Link and supporting communications services, as specified under the anticipated operating conditions in the type design.

**Annex 10 *“Aeronautical Telecommunications”***

**Volume V *“Aeronautical Radio Frequency Spectrum Utilization”***

**(Adopted March 2021, effective July 2021. Will become applicable in 2026)**

**CHAPTER 5.   UTILIZATION OF FREQUENCIES FOR RPAS C2 LINK COMMUNICATION SERVICES**

*Applicable as of 26 November 2026*

**5.1   Satellite-based C2 Link systems**

5.1.1   Satellite-based RPAS C2 Link systems shall operate in the following frequency bands:

1. *frequency bands with an appropriate allocation to aeronautical safety services under the aeronautical mobile‑satellite (route) service (AMS(R)S)*. Frequency bands that meet these criteria and can be used for RPAS C2 Links, subject to the conditions associated with the allocations, are: 1 610 – 1 626.5 MHz and 5 000 – 5 150 MHz;

*Note.— The SARPs contained in Annex 10, Volume III, Part I, Chapter 4 and Part II, Chapter 2 address requirements for air traffic control (ATC) communications.*

1. *frequency bands with an allocation to aeronautical safety services under the mobile-satellite service (MSS) where AMS(R)S operations have priority access.* Frequency bands that meet these criteria and can be used for RPAS C2 Links are: 1 545 – 1 555 MHz and 1 646.5 – 1 656.5 MHz*;*

*Note.— The SARPs contained in Annex 10, Volume III, Part I, Chapter 4 and Part II, Chapter 2 address requirements for ATC communications.*

1. *frequency bands with an allocation to the fixed satellite service (FSS) where the conditions in ITU Resolution 155 (WRC-15) are met*. Frequency bands in which this resolution applies are:
* 10.95 – 11.2 GHz (space-to-Earth);
* 11.45 – 11.7 GHz (space-to-Earth);
* 11.7 – 12.2 GHz (space-to-Earth) in Region 2;
* 12.2 – 12.5 GHz (space-to-Earth) in Region 3;
* 12.5 – 12.75 GHz (space-to-Earth) in Regions 1 and 3;
* 19.7 – 20.2 GHz (space-to-Earth);
* 14.0 – 14.47 GHz (Earth-to-space); and
* 29.5 – 30.0 GHz (Earth-to-space) with an ITU satellite earth station class of “UG”.

*Note 1.— UG is an earth station on board an unmanned aircraft communicating with a space station of a geostationary-satellite network in the fixed-satellite service for the control and non-payload communications of unmanned aircraft systems in non-segregated airspaces in the frequency bands listed under resolves 1 of ITU Resolution 155 (WRC‑15).*

*Note 2.— Particular note needs to be taken of the timing and order of functions as delineated in ITU Resolution 155 (WRC‑15), and in particular the references to necessary actions.*

5.1.2   Remotely piloted aircraft (RPA) and remote pilot station (RPS) earth stations shall operate within the notified and recorded technical parameters of the associated satellite network, including specific or typical earth stations as published by the ITU.

5.1.3   RPA and RPS earth stations operating in accordance with 5.1.1 c) shall use FSS assignments that have been successfully coordinated under Article 9 of the ITU Radio Regulations and recorded in the Master International Frequency Register (MIFR) with a favourable finding under Article 11 of the ITU Radio Regulations including Nos. 11.31, 11.32 or 11.32A where applicable, and except those assignments that have not successfully completed coordination procedures under No. 11.32 by applying Appendix 5 paragraph 6.d.i of the ITU Radio Regulations.

**5.2   Terrestrial C2 Link communication systems**

5.2.1   Terrestrial RPAS C2 Link systems shall operate in bands allocated to the Aeronautical Mobile (Route) Service (AM(R)S). Frequency bands with such allocations include 113.250 MHz and 136.925 MHz (common signalling channels for VDL Mode 4), 960-1164 MHz and 5030-5091 MHz. The operation of the C2 Link within any of these bands shall be implemented so as to be compatible with the systems currently using these allocations. Compatibility shall be ensured through the development and application of necessary SARPs and determined on the basis of regional air navigation agreements.

**Annex 10 *“Aeronautical Telecommunications”***

**Volume VI *“Communication Systems and Procedures Relating to Remotely Piloted Aircraft Systems C2 Link”***

**Part I *“C2 Link Procedures”***

**(Adopted March 2021, effective July 2021. Will become applicable in 2026)**

**CHAPTER 2.    SPECIFICATIONS**

**2.1    GENERAL**

*Note. 1— The C2 Link is the logical connection, however physically realized, used for the exchange of information between the remote pilot station (RPS) and the remotely piloted aircraft (RPA). It enables the remote pilot’s manipulation of the flight controls in the RPS to be sent to the RPA and for the RPA to return its status to the remote pilot. The C2 Link also enables the remote pilot to manage the safe integration of the remotely piloted aircraft system (RPAS) into the global aviation, communications, navigation and surveillance operational environment.*

*Note 2.— Guidance on the systems and procedures relating to the C2 Link is included in the* Manual on Remotely Piloted Aircraft Systems (RPAS) *(Doc 10019).*

2.1.1    Any time reference to the C2 Link service and time-stamping of the information carried by the C2 Link shall be in Coordinated Universal Time (UTC).

*Note 1.— This does not apply to the time-stamping internal to the network communication protocol.*

*Note 2.— The time stamp includes the date and time.*

**2.2    SUPPORTED FUNCTIONS**

2.2.1    The C2 Link shall only support the remote pilot tasks required for the safe and efficient operation of the RPAS.

*Note.— Annex 6 contains requirements for safe operation of the RPAS.*

2.2.2    When the C2 Link includes support for the remote pilot tasks required for air traffic control (ATC) purposes, such as relay of ATC communications, the C2 Link performance shall, in a secure manner, meet the performance required for those tasks appropriate to the airspace requirements.

*Note 1.— Airspace requirements vary depending upon air traffic density and complexity and may be reflected in equipage or separation requirements.*

*Note 2.— Alternate means of communications between the remote pilot and air traffic control may obviate the need for the C2 Link to be used for ATC communications.*

**2.3    SERVICE PROVISION**

2.3.1    The C2 Link service shall only be used for the transmission of information relating to the safe and efficient operation of the RPAS and be limited to the information described in 2.2.1.

2.3.2    Each State shall designate the authority responsible for documenting and implementing a C2CSP oversight process, in accordance with Annex 6.

*Note.— Details on State and C2CSP responsibilities related to the oversight of C2 Link service provision can be found in Annex 6.*

2.3.3    The duration between C2 Link initiation and C2 Link termination shall not exceed the time of flight and ground operations, plus the time necessary to perform safety and security checking before and after each flight.

*Note.— Efficient use of the limited frequency spectrum resource requires that a link be released and made available to other users when not in use.*

2.3.4    The C2 Link specification shall be commensurate with the C2 Link performance required for safe operations.

2.3.5    The C2 Link’s QoSR shall be commensurate with the C2 Link specification required for safe operations.

2.3.6    The C2 Link’s QoSD shall be commensurate with the C2 Link QoSR.

2.3.7    The C2 Link service area geographical coordinates and time of provision, intended for RPAS operational use, shall be validated and verified to ensure that the C2 Link service area is safe for use by its intended recipients.

*Note 1.— The* World Geodetic System — 1984 (WGS-84) Manual *(Doc 9674) contains requirements for data quality.*

*Note 2.— Intended recipients can be remote pilot or ATC units concerned.*

2.3.8    A proactive process for anticipating and mitigating interrupted or lost C2 Link states shall be implemented and described by the C2CSP to the RPAS operator.

2.3.8.1    The C2CSP shall notify the RPAS operator of any scheduled outages of the C2 Link service provision.

2.3.8.2    Arrangements shall be in place to ensure that the scheduled outage does not affect any RPA during any phase of flight.

2.3.9    The C2CSP shall notify the RPAS operator of any unscheduled degradation in their service provision, the kind of degradation being experienced and an estimated duration for that degradation.

2.3.10    Before providing any C2 Link service, the C2CSP shall demonstrate to the responsible authority initial compliance with the provisions contained in 2.3.1 and 2.3.3 through 2.3.8.

**2.4    C2 LINK SERVICE AREA**

2.4.1    The C2 Link service area shall be compatible with the planned areas of operation (including contingency operations) of the RPA and the location of all of the RPS involved in the operation.

2.4.2    The RPA and RPS shall always remain within the C2 Link service area.

2.4.3    **Recommendation.**— *To ensure the QoSR is always met, a margin to account for the expected worst-case propagation fluctuations in the received signal level should be included when determining the C2 Link service area.*

**CHAPTER 3.    PROCEDURES**

*Note.— Provisions contained in Annex 6 require an operator to provide, for the use and guidance of personnel concerned, an operations manual containing all the instructions and information necessary for operations personnel to perform their duties.*

**3.1    GENERAL**

3.1.1    Prior to the flight, the C2CSP shall provide the RPAS operator with appropriate means to establish that the C2 Link QoSD, security, and service area meet the requirements for safe operation of the planned flight (including contingency operations).

3.1.2    **Recommendation.**— *In the case where the C2 Link service can be provided by more than one link, the RPAS should use the link with the highest QoSD.*

**3.2    ESTABLISHMENT, ASSURANCE AND TERMINATION OF THE C2 LINK**

3.2.1    Human factors principles shall be considered in the design of the RPS, in order for the remote pilot to manage the C2 Link during the flight and prevent its unintentional termination.

*Note.— Situations may occur in which the C2 Link would need to be terminated during the flight in order to increase the safety level of the flight. However, unintentional termination must be prevented.*

3.2.2    Appropriate technical and procedural means shall be provided to the remote pilot to establish and maintain the C2 Link, including the interaction with the C2CSP. These means shall be documented in the operations manual.

3.2.3    An indication shall be provided to the remote pilot when the C2 Link has been successfully established between the RPS and the RPA and when it is interrupted, lost or terminated.

3.2.4    Information about any C2 Link-related outages that are planned to occur during the expected duration of the flight shall be provided to the remote pilot during flight planning.

3.2.5    Means shall be provided to the remote pilot to verify that the C2 Link meets the QoSR as part of the pre-flight check of the RPAS.

3.2.6    The procedure supporting the switchover between links or networks that comprise the entire C2 Link shall be contained in the operations manual.

3.2.7    Before performing a switchover to another link or network, the remote pilot shall be provided with sufficient information on the QoSD of the accepting link or network to confirm that it will meet the QoSR.

3.2.8    **Recommendation.**— *Switchovers between the links or networks that constitute the C2 Link during flight should be minimized.*

3.2.9    The procedure and the phraseology supporting handover of the C2 Link provision between RPS shall be contained in the operations manual.

3.2.10    The procedure supporting the handover shall include a report on the status of the QoSE of the C2 Link prior to initiating the handover.

3.2.11    A handover shall only be initiated if the accepting RPS is able to confirm that its C2 Link with the RPA achieves the QoSR needed to ensure that the handover will be successful.

3.2.12   The condition of a lost C2 Link state shall be initiated by the RPAS or through an action by the remote pilot when the performance of the C2 Link has been insufficient to enable active management of the RPA for longer than the lost C2 Link decision time.

3.2.13    The duration of the lost C2 Link decision time shall be in accordance with the operational management and safety requirements of the airspace.

3.2.14    Only the remote pilot shall terminate or authorize the termination of the C2 Link.

3.2.15    The C2CSP shall not intentionally terminate a C2 Link without the explicit consent of the remote pilot.

**3.3    ESTABLISHMENT AND ASSURANCE OF ATC COMMUNICATIONS**

3.3.1    ATC communications relayed through the RPA and the C2 Link shall be consistent with those defined for manned aircraft.

*Note.— ATC communication procedures contained in Annex 10* — Aeronautical Telecommunications, *Volume II* — Communication Procedures including those with PANS status*, and the* Procedures for Air Navigation Services — Air Traffic Management *(PANS-ATM, Doc 4444).*

3.3.2    **Recommendation.**— *Switchovers between links and networks that make up the C2 Link should be avoided during transfer of ATC communications.*

**3.4    CONTINGENCY AND EMERGENCY PROCEDURES**

3.4.1    The remote pilot shall be provided with all the available RPAS status information pertinent to expedite the recovery of the C2 Link.

3.4.2    Technical and procedural means shall be provided to indicate to the remote pilot/RPS and the RPA when the C2 Link has been successfully restored after a lost C2 Link state has occurred.

3.4.3    From the lost C2 Link decision state, the RPAS shall either return to the nominal C2 Link state or enter the lost C2 Link state once the lost C2 Link decision time has been exceeded.

3.4.4    After being in a lost C2 Link state, a remote pilot action shall be required to return the RPAS to a nominal C2 Link state, in accordance with the procedures contained in the operations manual.

**3.5    SECURITY**

3.5.1    Information exchange between the RPS and RPA carried on the C2 Link shall be sufficiently secure to prevent unauthorized interference with the RPAS.

3.5.2    The RPAS C2 Link design, monitoring system and operating procedures shall be such as to minimize the potential for any unauthorized control of the RPA or the RPS during any operating phases.

**3.6    DISPLAY**

3.6.1    RPS controls and displays shall present data in a manner minimizing the potential for errors, misinterpretation or misunderstandings.

3.6.2    The C2 Link state information shall be presented to the remote pilot.

3.6.2.1    An indication of the C2 Link QoSD, in real time, shall be provided to the remote pilot.

**3.7    MONITORING**

3.7.1    An automatic monitoring system shall be implemented in the RPA and RPS, to provide an alert to the remote pilot if any of the following occur within the period of operation:

 a) RPA or RPS C2 Link and/or subsystem link and/or C2CSP emission has ceased;

 b) RPA or RPS C2 Link and/or subsystem link and/or C2CSP reception has ceased;

 c) transmission of the amount of information required for the safe control of the aircraft has fallen below a level specified by the type certificate holder;

 d) interruption of the C2 Link has occurred; or

 e) the C2 Link QoSD has degraded below the stated QoSR.

3.7.2    The monitoring system shall provide an alert to the remote pilot in the event of the failure of the monitoring system itself.

**3.8    RECORDS**

3.8.1    A C2 Link log, written or electronic, shall be maintained in each RPS.

3.8.2    The record shall commence as soon as the C2 Link is established and end only after the C2 Link is terminated.

3.8.3    Written log entries shall be made only by authorized and on-duty persons in the RPS.

*Note.— Authorized on-duty persons can be remote pilots or any other person having knowledge of facts pertinent to the entries.*

3.8.4    All entries shall be complete, clear, correct and intelligible. Unnecessary marks or notations shall not be made in the log.

3.8.5    In written logs, any correction in the log shall be made by the authorized on-duty person.

3.8.5.1    Corrections shall be initialled, dated and a rationale given for traceability.

3.8.6    The following information shall be entered in logs by the authorized on-duty person:

 a) the name of the authorized on-duty person in charge of the log;

 b) the identification of the RPS;

 c) the date;

 d) the time of opening and closing of the RPS;

 e) the time of establishment and termination of the C2CSP service;

 f) the time of establishment and termination of the C2 Link;

 g) the QoSE of the links and networks used;

 h) the reason for the switchover of links and networks that make up the C2 Link;

 i) the signature of the authorized on-duty person;

 j) all lost C2 Link and lost C2 Link decision state events, location of the RPA with the time of occurrence, and probable assessed cause when practicable;

 k) any detected harmful or notable radio frequency interference, with as much detail as possible; and

 l) any information relevant to C2 Link provision considered by the remote pilot as valuable.

3.8.6.1    In the log, all time-related information shall use a UTC reference and all geographical related information shall use a WGS-84 reference.

3.8.7    The C2 Link messages related to the C2 Link management shall be electronically recorded in the RPA and in any RPS which is in control of the RPA.

3.8.8    The C2 Link management message record shall be retained for at least 30 days after completion of the flight. When the record is pertinent to accident and incident investigations, it shall be retained for longer periods until it is evident that the record will no longer be required.

3.8.9    The RPA shall maintain an electronic log, automatically recording any information described in 3.8.1 to 3.8.8 that is available to the RPA.

3.8.10    The RPA shall maintain an automatically recorded electronic log of any received or transmitted ATC/remote pilot communication, as either voice or data, if relayed through the RPA.

3.8.11    The RPS shall maintain an automatically recorded electronic log of any received and transmitted ATC/remote pilot communication, as either voice or data.

**Annex 10 *“Aeronautical Telecommunications”***

**Volume VI *“Communication Systems and Procedures Relating to Remotely Piloted Aircraft Systems C2 Link”***

**Part II *“C2 Link Systems”***

**(Adopted March 2021, effective July 2021. Will become applicable in 2026)**

**CHAPTER 2.    GENERAL**

**2.1    SYSTEM DESCRIPTION**

2.1.1    The RPAS communication system shall comprise the following systems.

2.1.1.1    A communication system supporting communications external to the RPAS dedicated to the airspace requirements functions.

2.1.1.2    A C2 Link communication system supporting communications internal to the RPAS, which comprises at a minimum:

 a) an interface with the RPS;

 b) an interface with the RPA;

 c) a transmitter located in the RPS communicating with a receiver located in the RPA; and

 d) a transmitter located in the RPA communicating with a receiver located in the RPS.

*Note 1.— The C2 Link communication system between the RPS and the RPA may comprise one or more different communication links and may be provided by one or more C2CSPs.*

*Note 2.— The C2 Link communication system may comprise ground and/or airborne and/or satellite links and systems*.

2.1.2    The RPAS shall be equipped with a lost C2 Link state detection system designed with a level of assurance that is in accordance with the intended operation.

**2.2    SPECTRUM**

2.2.1    The RPAS C2 Link system shall be operated only in frequency bands which are appropriately allocated and protected by the ITU Radio Regulations.

2.2.2    C2 Link system frequency assignment planning shall be designed to provide immunity from harmful interference and not create harmful interference.

*Note.— Provision for international frequency channel assignment planning can be found in the* C2 Link System Guidance Manual *(in preparation).*

**2.3    SYSTEM CHARACTERISTICS**

2.3.1    The C2 Link system shall enable the RPA to unambiguously and at any time ensure that it is controlled by an authorized RPS.

2.3.2    The total period of radiation of the C2 Link system transmitters shall be as short as practicable, consistent with the need for avoiding saturation of the spectrum while limiting interruption of the C2 Link.

2.3.3    The C2 Link system radio frequency transmitters shall radiate no more power than is necessary to achieve the C2 Link specification.

**2.4    DATA TRANSMISSION CHARACTERISTICS**

2.4.1    The C2 Link system message sequencing shall be based on priority criteria.

2.4.2    The C2 Link system message sequence management shall use time-stamping.

2.4.3    The order of priority of the transmission of information between the RPS and the RPA shall be:

 a) RPA flight control and configuration messages;

 b) high priority detect and avoid (DAA) messages;

 c) air traffic control communications including distress calls and urgency messages;

 d) flight safety telemetry messages including low priority DAA messages;

 e) other flight safety messages;

 f) routine telemetry messages;

 g) air traffic services other than ATC communications; and

 h) other messages.

*Note 1.— The above order of priority is for the transmission of information over the C2 Link. The order of priority of messages transmitted by communication systems other than the C2 Link will remain as listed in Annex 10, Volume II, Chapter 4 and Volume III, Part I, Table 3-1.*

*Note 2.— Distress and urgency messages are defined in Annex 10, Volume II, 5.3.1.1.*

**2.7    PERFORMANCE REQUIREMENTS**

2.7.1    The QoSD of the C2 Link system shall be sufficient to support the operational and performance requirements for ATC service in the planned and contingency areas of operation of the RPA.

*Note.— These requirements include required communication performance (RCP), required surveillance performance (RSP) and required navigation performance (RNP) when appropriate.*

**2.10    C2 LINK COMMUNICATION SERVICE PROVIDER (C2CSP)**

2.10.1    The RPAS operator shall establish a service level agreement (SLA) with one or more C2CSPs concerning the C2 Link service provision.

*Note 1.— An SLA is required even when the operator is its own C2CSP.*

*Note 2.— The SLA defines the relationship and responsibilities of the two parties in accordance with the following Standards.*

2.10.2    The C2CSP shall ensure that the QoSD is at any time meeting the QoSR.

2.10.2.1    The C2CSP shall conduct, with RPAS operators, real time interference monitoring, estimation and prediction of interference risks, and planning solutions for potential harmful interference scenarios under the oversight of the competent authority.

2.10.3    The C2CSPs, RPAS operators and competent authorities shall act immediately when their attention is drawn to any harmful interference.

2.10.4    The C2CSP shall have the qualified resources and adequate documentation that will allow competent authorities to perform their oversight.

**2.10.5    Terrestrial C2 communication service providers**

2.10.5.1    Terrestrial RPAS equipment shall operate in frequency spectrum with an allocation as described in Annex 10, Volume V, Chapter 5, section 5.2.

**2.10.6    Satellite C2 communication service providers**

2.10.6.1    Satellite RPAS equipment shall operate in frequency spectrum with an allocation as described in Annex 10, Volume V, Chapter 5, section 5.1.

2.10.6.2    SLAs between satellite C2CSPs and RPAS operators shall ensure that, once a satellite network has completed successful coordination, which guarantees the level of protection necessary to ensure the overall RPAS C2 Link QoSD, the protection level is not eroded as a result of subsequent satellite coordination agreements.

2.10.6.3    SLAs between satellite C2CSPs and RPAS operators shall ensure that satellite C2CSPs act immediately when their attention is drawn to any harmful interference.

2.10.6.4    The satellite C2CSP shall be responsible for ensuring that once a satellite network has completed successful coordination, the C2 Link specifications continue to be met as a result of subsequent agreements between satellite operators.

**Annex 10 *“Aeronautical Telecommunications”***

**Volume VI *“Communication Systems and Procedures Relating to Remotely Piloted Aircraft Systems C2 Link”***

**Part II *“C2 Link Systems”***

**(Snapshot of material currently under development. Projected applicability in 2026)**

**Amend Section 2.1 as follows:**

**2.1 SYSTEM DESCRIPTION**

 …

**Add the following new paragraphs:**

2.1.3 The RPAS shall be equipped with a lost C2 Link state detection system designed with a level of assurance that is in accordance with the intended operation.

2.1.4 The logical C2 Link User Data shall have complete priority over any non safety-of-flight data when they are both transmitted over the same physical link.

**New Section 2.2 “System Interfaces” being added. Not shown here, as not relevant to Resolution 155.**

**Amend previous Section 2.2 to become section 2.3:**

**~~2.2~~2.3 FREQUENCY SPECTRUM**

…(renumber paragraphs from 2.2.x to 2.3.x)…

**Add new paragraphs 2.3.1.1, 2.3.1.2 and two new Notes:**

2.3.1.1 Terrestrial RPAS equipment shall operate in frequency spectrum with an allocation as described in Annex 10, Volume V, Chapter 5, section 5.2.

2.3.1.2 Satellite RPAS equipment shall operate in frequency spectrum with an allocation as described in Annex 10, Volume V, Chapter 5, section 5.1

*Note.— When a C2 Link is operated in frequency bands allocated to the AM(R)S or AMS(R)S, it is recognized that those safety services benefit from special measures to ensure freedom from harmful interference through Article 4.10 of the ITU Radio Regulations. When a C2 Link is operated in other frequency bands which cannot benefit from the application of Article 4.10 of the ITU Radio Regulations then RPAS safety-of-life needs to be managed through compliance with the operational measures described in Annex 6, Part IV taking into account the technical measures described in this Volume VI of Annex 10.*

*Note.— When the physical link operates in frequency bands allocated to the aeronautical safety-of-flight service only data associated with safety-of-flight shall be transmitted.*

…

**Add new paragraph 2.3.3:**

2.3.3 The C2 Link System shall be designed to enable efficient and equitable spectrum usage while enabling the QoSR to be met.

**Amend Section 2.4 as follows:**

**Heading amended from “Data Transmission Characteristics” to “System Characteristics”**

**2.4 SYSTEM CHARACTERISTICS**

…

**Add two new paragraphs and a Note:**

2.4.4 The C2 Link System transmitter(s) shall be designed and operated to enable the C2 Link specification to be met while minimizing unwanted emissions and allowing compatibility with other systems.

*Note. — Compatibility between aeronautical systems standardized or to be standardized by ICAO, operated in frequency bands allocated to the aeronautical mobile (route) service AM(R)S or the aeronautical mobile satellites (route) service AMS(R)S is managed by ICAO in accordance with the ITU Radio Regulations.*

2.4.5 The C2 Link system receiver(s) shall be designed and operated to enable the C2 Link specification to be met in the RF environment in which the RPA is operating while allowing compatibility with other systems.

**Replace Sections 2.6, 2.7 and 2.8, to add provisions on Required Link Performance and C2 Link System Security:**

**2.6 C2 LINK USER DATA PERFORMANCE REQUIREMENT**

2.6.1 When required to ensure safe and efficient RPAS operation, C2 Links shall meet a Required Link Performance (RLP) that is determined by the State in which the RPA is operating.

2.6.3 The Required Link Performance (RLP) shall be determined so as to enable the remote pilot to manage the operation of the RPA.

2.6.4 The Required Link Performance (RLP), determined by the State in which the RPAS is operating, shall enable the RPAS to comply with the safety requirements in the airspace and phase of flight in which the RPA is operating.

**2.7 CONTROL DATA CHARACTERISTICS AND PERFORMANCE REQUIREMENTS**

2.7.1 The C2 Link System shall respond to C2 Link Control Data with a performance consistent with the RLP as established for the airspace and phase of flight in which the RPA is operating.

2.7.2.1 The probability of a C2 Link System connecting the RPS to the wrong RPA during the establishment and reestablishment of the C2 Link Connection shall be consistent with the RLP as established for the airspace and phase of flight in which the RPA is operating.

**2.8 C2 LINK SYSTEM SECURITY**

2.8.1 The C2 Link System shall employ mutual peer entity authentication to a level consistent with the RLP as established for the airspace and phase of flight in which the RPA is operating.

2.8.2 The C2 Link System shall employ data origin authentication to a level consistent with the RLP as established for the airspace and phase of flight in which the RPA is operating.

2.8.3 The C2 Link System shall employ data integrity and anti-replay protection to a level consistent with the RLP as established for the airspace and phase of flight in which the RPA is operating.

2.8.4 The C2 Link System shall employ confidentiality protection to a level consistent with the RLP as established for the airspace and phase of flight in which the RPA is operating.

2.8.5 The C2 Link System shall employ cryptographic algorithms, with algorithm selection and key strength consistent with the RLP as established for the airspace and phase of flight in which the RPA is operating.

2.8.6 The C2 Link System shall employ cryptographic modules whose design is approved by the State responsible for the oversight of the RPAS operator for protection of C2 Link User Data and Control Data while they are passing through the C2 Link.

2.8.7 The C2 Link System shall employ logical access control consistent with the RLP as established for the airspace and phase of flight in which the RPA is operating.

*Note. – Logical access control protects against unauthorized access to the C2 Link System by cyber threats through the RPS or RPA C2 Link Management.*

**Amend Section 2.10 as follows:**

**2.10 C2 LINK COMMUNICATION SERVICE PROVIDERS (C2CSP)**

…

**Add the following new paragraph:**

2.10.5 SLAs between C2CSPs operating terrestrial based C2 Link Systems and RPAS operators shall ensure that C2CSPs act immediately when their attention is drawn to any harmful interference.

…

**Replace paragraph 2.10.6.2 with the following:**

2.10.6.2 SLAs between satellite C2CSPs operating satellite based C2 link Systems and RPAS operators shall ensure that the C2CSP notifies the RPAS operator before any change in the service provision performance is implemented as a result of a satellite coordination process subsequent to the initial agreement.

*Note.— The satellite coordination process is prescribed in the ITU-R Radio Regulations.*

*…*

**Add the following new paragraph:**

2.10.7 SLAs between satellite C2CSPs operating satellite bases C2 Link Systems and RPAS operators shall ensure that satellite C2CSPs act immediately when their attention is drawn to any harmful interference.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. \* This Part is provided in response to the *instructs the Director of the Radiocommunication Bureau* 5 of Resolution **155 (Rev.WRC-19)**. [↑](#footnote-ref-1)
2. In the 193 ICAO Member States, through the ICAO Convention the SARPs constitute the rule of law and form a regulatory framework for aviation, covering personnel licensing, technical requirements for aircraft operations, airworthiness requirements, aerodromes and systems used for the provision of communications, navigation and surveillance, as well as other technical and operational requirements. [↑](#footnote-ref-2)