CIVIL AVIATION SAFETY AUTHORITY
OF PAPUA NEW GUINEA

PNG
Civil Aviation Rule
Part 171

Aeronautical Telecommunication Service Organisation – Certification and Operation

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DESCRIPTION

The Civil Part 171 prescribes the regulatory requirements for persons or organisations providing aeronautical telecommunication services in support of the PNG civil aviation air navigation system. The rule also provides for the organisations to provide support for individual navigation requirements.

BULLETIN

This Part first came into force on 1 January 2004 and now incorporates the following amendments:

Amendment	Applicable Date
Amendment 1	01 May 2016
Amendment 2	14 December 2020
Amendment 3	02 November 2021
Amendment 4	03 November 2022
Amendment 5	04 November 2024
Amendment 6	19 November 2025

Summary of amendments:

Amendment 6 of Part 171 aligns with the following:

- *Amendment 94 of ICAO Annex 10 Vol I;*
- *Amendment 93 of ICAO Annex 10 Vol III;*
- *Amendment 91 to Annex 10 Vol Part V; and*
- *1st Edition of Annex 10 Vol VI*

Amendment 6:
(Docket25/16/CAR171/43)

(a) New Rules

(1) Rule 171.3 (7) – referencing definitions, abbreviation and unit of measure.

(2) Appendix A (A.2) (4) –VOR operating frequency band and the frequency used for channel separation, spacing and tolerance.

(3) Appendix A (A.3) (k) –pairing of the runway localizer and glide path transmitter frequencies of an ILS system.

(4) Appendix A (A.5) –Distance Measuring Equipment (DME) that are associated with VOR or ILS systems.

(5) Appendix B (B.4) (c) –Secondary Surveillance Radar (SSR) transponder Mode C on the need for automatic pressure altitude transmission capability.

(6) Appendix B (B.4) (d) –all transponders, regardless of the airspace in which they will be used, shall respond to Mode C interrogations with pressure-altitude information.

(7) Appendix C (C.1.1) – use of Aeronautical Mobile-satellite (Route) Service. The requirements, frequency bands to operate, the provision of services and the coverage.

(8) Appendix C (C.1.5) –AFTN network. The characteristic of interregional AFS circuits and data signaling rate for transmission, modulation and signaling.

(9) Appendix C (C.2.3) – Satellite Voice Communication (SATVOICE) Characteristics.
(10) Appendix C (C.2.4) (c) –Selective calling system (SELCAL) tones designated by color, letter or number.
(11) Appendix C (C.2.4) (d) –Aeronautical stations to communicate with SELCAL equipped aircraft that have SELCAL encoders to support all tones.
(12) Appendix C (C.2.4) (e) –SELCAL tones using Red T through Red 9.
(13) Appendix E –adoption and transposition of the first edition of Volume VI to Annex 10 on Communication Systems and Procedure relating to Remotely Piloted Aircraft Systems (RPAS) C2 Link.
(14) Appendix F –ICAO Annex 10 Volume I, II, III, IV, V, VI definitions.
(15) Appendix G –ICAO Annex 10 Volume I, II, III, IV, V, VI abbreviations.
(16) Appendix H – I - ICAO Annex 10 Volume I, II, III, IV, V, VI units of measure.

(b) Amendments.

(1) Appendix C (C.1) (a) (1) – word "digital" deleted and word "voice and" inserted. Word "operating agencies" delete and word "operators" inserted.

(2) Appendix C (C.1.1 SSR Mode S Air-Ground Data Link) – word "C.1.1" number 1 after decimal deleted and inserted number 2 and reads "C.1.2 SSR Mode S Air-Ground Data Link".

(3) Appendix C (C.1.2 VHF Air-Ground Digital Link (VLD)) – word "C.1.2" number 2 after decimal deleted and inserted number 3 and reads "C.1.3 VHF Air-Ground Digital Link (VLD)".

(4) Appendix C (C.1.3 Air-ground VHF digital link communications system characteristics) – word "C.1.3" number 3 after decimal deleted and inserted number 4 and reads "C.1.4 Air-ground VHF digital link communications system characteristics".

(5) Appendix C (C.1.4 Aircraft Addressing System) – word "C.1.4" number 4 after decimal deleted and inserted number 6 and reads "C.1.6 Aircraft Addressing System"

(6) Appendix C (C.1.4) (5) – word "3.5.1.1" deleted and word "9.1.1" inserted.

(7) Appendix C (C.2.3 Selective calling system (SELCAL)) – word "C.2.3" number 3 after decimal deleted and inserted number 4 and reads "C.2.4 Selective calling system (SELCAL)".

(8) Appendix C (C.2.4 Aeronautical Speech Circuits) – word “C.2.4” number 4 after decimal deleted and inserted number 5 and reads “C.2.5 Aeronautical Speech Circuits”.

(9) Appendix C (C.2.5 Emergency Locator Transmitter (ELT) For Search and Rescue) – word “C.2.5” number 5 after decimal deleted and inserted number 6 and reads “C.2.6 Emergency Locator Transmitter (ELT) for Search and Rescue”.

(10) Appendix E – word “shall” replace with “must

(c) Editorials

Nil

Schedule of Rules

Subpart A — General

171.1 Purpose

This Part prescribes rules governing—

(1) the certification and operation of organisations providing aeronautical telecommunication services in support of IFR flight or an air traffic service; and

(2) the operating and technical standards for facilities operated by those organisations.

171.3 Definitions, Abbreviations and Units of Measure

In this Part—

Aeronautical Telecommunication Service means—

(1) a telecommunication service provided to support the following services as defined in Annex 10, Volume II, Chapter 1:

(i) aeronautical broadcasting service:

(ii) aeronautical fixed service (AFS):

(iii) aeronautical mobile service:

(iv) aeronautical radio navigation service; and

(2) any other telecommunication service provided specifically to support the Papua New Guinea air navigation system:

Annex 10 means Annex 10 to the Convention as amended from time to time:

Critical Performance Parameter means a performance parameter that has a direct effect on the operational integrity of a facility:

Facility means the—

(1) following types of communication systems for the aeronautical broadcast service (as that service is defined in Annex 10, Volume II, Chapter 1):

(i) Meteorological information for aircraft in flight:

(ii) Automatic terminal information service ; and

(2) following types of communication systems for the aeronautical fixed service (as that service is defined in Annex 10, Volume II, Chapter 1):

(i) ATS direct speech circuits:

(ii) Aeronautical fixed telecommunication network

(iii) Ground-ground data interchange; and

(3) ground elements of the following types of communication systems for the aeronautical mobile service (as that service is defined in Annex 10, Volume II, Chapter 1):

(i) HF air-ground communication:

(ii) VHF air-ground communication:

(iii) UHF air-ground communication:

(iv) Selective calling system:

(v) Air-ground data interchange; and

(4) following types of radio navigation aids for the aeronautical radio navigation service (as that service is defined in Annex 10, Volume II, Chapter 1 and Volume I, Chapter 1):

(i) Instrument Landing System:

(ii) Microwave Landing System:

(iii) Global Navigation Satellite System:

(iv) VHF Omni-directional radio range:

(v) Distance Measuring Equipment:

(vi) Non-directional Radio Beacon:

(vii) Precision Approach Radar:

(viii) Secondary Surveillance Radar:

(ix) Primary Surveillance Radar

(x) Automatic Dependent Surveillance Broadcast:

(xi) Automatic Dependent Surveillance Contract: and

(5) following types of telecommunication systems that support an air traffic service:

(i) Flight data processing system:

(ii) Rādar data processing system:

(iii) Radar and flight data processing system.

(6) types of Communication Navigation Surveillance/Air Traffic Management services acceptable to the Director.

(7) Definitions, Abbreviations and Units of Measure are in Appendix F, G and H.

171.5 Requirement for certificate

(a) Except as provided in paragraph (c), no person shall provide an aeronautical telecommunication service or operate a facility except under the authority of, and in accordance with the provisions of, a telecommunication service certificate issued under this Part.

(b) The Director may grant a certificate authorising aeronautical telecommunication services varying from the operation of a single private facility to a network of facilities required for the Papua New Guinea air navigation system.

(c) A person may operate a facility on an aeronautical radio frequency without holding a telecommunication service certificate if—

(1) the facility—

(i) is a radio-communication facility that does not support an air traffic service; or

(ii) is a radio navigation aid that does not support IFR flight or an air traffic service; and

(2) the facility does not interfere with any other aeronautical telecommunication service or facility; and

(3) where applicable—

(i) the National Information Technology Authority (NICTA) has granted a written radio apparatus licence for the facility; and

(ii) the Director has allocated an identification code or call sign for the facility.

171.7 Application for certificate

An applicant for the grant of a telecommunication service certificate must complete form CA 171/01 and submit it to the Director with—

(1) the exposition required by rule 171.77; and

(2) a payment of the appropriate application fee prescribed by regulations made under the Act.

171.9 Issue of certificate

An applicant is entitled to a telecommunication service organisation certificate if the Director is satisfied that—

(1) the applicant meets the requirements of Subpart B; and

(2) the applicant, and the applicant's senior person or persons required by rule 171.51(a)(1) are fit and proper persons; and

(3) the granting of the certificate is not contrary to the interests of aviation safety.

171.11 Privileges of certificate holder

(a) A telecommunication service certificate specifies the types of facilities that the certificate holder is authorised to operate.

(b) Subject to rule 171.111, the holder of a telecommunication service certificate may operate any of the facility types listed on the holder's certificate provided that—

(1) each facility operated is listed in the holder's exposition; or

(2) if the facility is not listed in the exposition, its operation is for site test purposes controlled by the procedures required by rule 171.53(b).

171.13 Duration of certificate

(a) A telecommunication service certificate may be granted or renewed for a period of up to 5 years.

(b) A telecommunication service certificate remains in force until it expires or is suspended or revoked.

(c) The holder of a telecommunication service certificate that expires or is revoked must forthwith surrender the certificate to the Director.

(d) The holder of a telecommunication service certificate that is suspended, must forthwith produce the certificate to the Director for appropriate endorsement.

171.15 Renewal of certificate

(a) An application for the renewal of a telecommunication service certificate must be made on form CA 171/01.

(b) The application must be submitted to the Director before the application renewal date specified on the certificate or, if no such date is specified, not less than 30 days before the certificate expires.

171.17 Identification of codes and call signs

(a) No person may operate-

(1) a radio navigation aid, unless it has been allocated an identification code by the Director under paragraph (c); or

(2) a radio communication transmitter on an aeronautical radio frequency other than one operated under rule 171.5(c), unless it has been allocated a call sign by the Director under paragraph (c).

(b) An applicant for the allocation of an identification code or a call sign under paragraph (a), must complete form CA 171/02 and submit it to the Director with, if applicable, a payment of the appropriate application fee prescribed by regulations made under the Act.

(c) The Director may allocate an identification code for a radio navigation aid or a call sign for a radio communication transmitting aeronautical facility if the Director is satisfied that the allocation of a code or call sign is not contrary to the interest of aviation safety.

171.19 Notification of aeronautical facility information

A person operating an aeronautical facility must, as soon as practicable-

(1) forward to the provider of the AIS-

(i) information on the operational details of the aeronautical facility, for publication in the PNGAIP; and

(ii) information concerning any change in the operational status of the aeronautical facility, for the issue of a NOTAM; and

(2) check, if applicable, that the information forwarded under paragraph (1) has been accurately published; and

(3) notify the Director of a promulgated information incident in accordance with Part 12.

171.21 Information provided by an aeronautical facility

A person operating an aeronautical facility must not permit the facility to continue in operational service if that person suspects or has any cause to suspect that the information being provided by that facility is erroneous.

Subpart B — Certification Requirements

171.51 Personnel requirements

(a) An applicant for the grant of a telecommunication service certificate must engage, employ or contract:

(1) A senior person identified as the Chief Executive who has the authority within the applicant's organisation to ensure that all activities undertaken by the organisation can be financed and carried out to meet applicable operational requirements, and in accordance with the requirements prescribed by this Part:

(2) A senior person or group of senior persons who are responsible for ensuring that the applicant's organisation complies with the requirements of this Part. Such nominated person or persons must be ultimately responsible to the Chief Executive:

(3) Sufficient personnel to inspect, supervise, and maintain the facilities listed in the applicant's exposition.

(b) The applicant must —

(1) establish a procedure to assess the competence of those personnel who are authorised by the applicant to place any of the facilities listed in the applicant's exposition into operational service; and

(2) establish a procedure to maintain the competence of those authorised personnel; and

(3) provide those authorised personnel with written evidence of the scope of their authorisation.

171.53 Facility requirements

(a) An applicant for the grant of a telecommunication service certificate must establish procedures to ensure that—

(1) each facility listed in their exposition—

(i) is designed, installed and commissioned to meet the applicable operational specification; and

(ii) conforms with the applicable system characteristics and specification standards prescribed in Volume I, III and IV of Annex 10; and

(2) information on the operational status of any of the radio navigation aids listed in the applicant's exposition that are essential for the approach, landing and take-off at an aerodrome, is provided without delay—

(i) to the aerodrome control tower if that aerodrome has one; and

(ii) to the air traffic control unit providing an approach control service for that aerodrome if such a service is being provided; and

(3) each facility listed in their exposition is installed with suitable power supplies and means to ensure continuity of operation appropriate to the needs of the operational service being supported; and

(4) each facility listed in their exposition is installed in accordance with the security programme required by rule 171.55 to minimise the risk of destruction, damage or interference with the operation of the facility; and

(5) any critical site area of any facility listed in their exposition is—

(i) clearly identified on the site drawings for the facility; and

(ii) physically protected by suitable signposts on the site; and

(iii) protected by written agreements with the site owner, aerodrome operator and air traffic control unit as appropriate, to ensure that site restrictions are not infringed by buildings, fences, vehicles, machinery or aircraft.

(b) Where an applicant intends to operate a temporary facility for the purpose of carrying out site tests, the applicant must establish a procedure for conducting those tests in accordance with paragraph (c).

(c) The procedure must ensure that there is no possible interference to any other operating facility and that appropriate information is forwarded to the Aeronautical Information Service (AIS) for the issue of a NOTAM or the publication of a Supplement to the Aeronautical Information Publication.

171.55 Security programme

(a) An applicant for the grant of a telecommunication service certificate must establish a security programme for the facilities listed in their exposition.

(b) The security programme required by paragraph (a) must specify the physical security requirements, practices and procedures that may be necessary —

(1) to minimise the risk of destruction, damage, or interference, to the certificate holder's facilities if such an act to a facility is likely to endanger the safety of air navigation; and

(2) to prevent unauthorised access to a facility; and

(3) for personnel to follow in the event of a bomb threat or other threat of violence at a facility; and

(4) to monitor unattended facilities to detect unauthorised intrusion or interference at a facility.

(5) To protect critical information and communications technology systems from interference that may jeopardise the safety of air navigation services.

(c) The security programme required under paragraph (a) must include procedures to notify, investigate and report security incidents to the Director in accordance with Part 12.

171.57 Documentation

(a) An applicant for the grant of a telecommunication service certificate must hold copies of relevant equipment manuals, relevant technical standards and practices (including Annex 10) and any other documentation (including technical instructions) that is necessary for the provision and operation of the facilities listed in their exposition.

(b) An applicant must establish a procedure to control all the documentation required by paragraph (a). The procedure must ensure that—

(1) all documentation is reviewed and authorised by appropriate personnel before issue; and

(2) current issues of all relevant documentation are available to staff at all locations where they need access to such documentation for the provision and operation of facilities; and

(3) all obsolete documentation is promptly removed from all points of issue or use; and

(4) changes to documentation are reviewed and approved by appropriate personnel; and

(5) the current version of each item of documentation can be identified to preclude the use of out of date editions.

171.59 Periodic inspection and testing

(a) An applicant for the grant of a telecommunication service certificate must establish procedures for the periodic inspection and testing of the facilities listed in their exposition to verify that they meet the applicable operational requirements and performance specifications.

(b) These procedures must —

(1) cover ground inspections and ground tests, and where necessary flight tests; and

(2) include the criteria for establishing or changing the period between the periodic tests for a facility having regard to—

(i) any applicable information published by the International Civil Aviation Organisation (ICAO) or any other aeronautical authority; and

(ii) any applicable reliability data for the facility; and

(iii) information on the proven reliable performance of the facility, the proven performance of other similar facilities, and the stability of the facility's operating environment; and

(3) ensure that the grounds for establishing or changing the period between the periodic tests for a facility are documented.

(c) In addition, the applicant must establish—

(1) a programme of periodic ground inspections for each facility; and

(2) a programme of periodic ground tests for each facility; and

(3) a programme of periodic flight tests for each radio navigation aid unless the applicant can establish from the criteria in paragraph (b)(2) that periodic ground tests can replace the periodic flight tests for a facility without affecting the safety of air navigation.

(d) The programmes required by paragraph (c)(2) and (3) for the periodic ground and flight tests must be based on the criteria in paragraph (b)(2) and must specify the maximum period between the tests for each facility.

(e) The applicant must notify the Director within seven days of any radio navigation aid that is not subjected to periodic flight tests required.

171.61 Certification of facility performance

An applicant for the grant of a telecommunication service certificate must establish a procedure to ensure that no facility listed in their exposition is placed into operational service unless—

(1) the person placing the facility into operational service is authorised and is assessed as competent under the procedures required by rule 171.51(b); and

(2) the appropriate checks have been carried out to verify the performance of the facility; and

(3) the facility record has been completed in accordance with the procedures required by rule 171.71.

171.63 Inspection measuring and test equipment

(a) An applicant for the grant of a telecommunication service certificate must ensure that appropriate inspection, measuring and test equipment is available for their personnel to maintain the safe operation of each facility listed in their exposition.

(b) An applicant must establish a procedure to control, calibrate and maintain all of the applicant's inspection, measuring and test equipment to ensure that each item of equipment has the precision and accuracy that is necessary for the measurements and tests to be performed.

(c) The procedure must ensure that each item of test equipment required for the measurement of critical performance parameters is—

(1) calibrated before use and at prescribed intervals against certified equipment having a known valid relationship to nationally recognised standards:

(i) except where no such standards exist, the basis used for the calibration must be documented; and

(ii) records of such calibration and the standard used must be maintained in accordance with the procedures required by rule 171.71; and

(2) identified with a suitable indicator to show its calibration status; and

(3) controlled to—

(i) safeguard against adjustments that would invalidate the calibration setting; and

(ii) ensure that the handling, preservation and storage is such that the accuracy and fitness for use is maintained.

(d) Where hardware and software systems are used as an alternative form of facility performance testing, the functions of the systems must be checked—

(1) before being released for use in order to establish that they are capable of verifying the performance of the facility; and

(2) at prescribed intervals; and

(3) records of these checks must be maintained as evidence and verification of adequate performance of the test system.

171.65 Notification of facility information

(a) An applicant for the grant of a telecommunication service certificate must establish a procedure to notify the users of the facilities listed in their exposition of the operational information for each facility and of any changes in the operational status of those facilities.

(b) The procedure must ensure that—

(1) the operational information on any facility that supports an air traffic service or the Papua New Guinea air navigation system is forwarded to the Aeronautical Information Service (AIS) for publication in the Papua New Guinea Aeronautical Information Publication; and

(2) the users of a facility are notified without delay of any change in the operational status of a facility if the change may affect the safety of air navigation. For those facilities published in the Papua New Guinea Aeronautical Information Publication the information concerning any change to their operational status must be forwarded to the Aeronautical Information Service for the issue of a NOTAM.

171.67 Facility check after accident or incident

(a) An applicant for the grant of a telecommunication service certificate must establish a procedure to check and record the operating condition of any facility listed in their exposition that may have been used by an aircraft or an air traffic service involved in an accident or incident.

(b) The procedure must ensure that—

(1) the checks are carried out as soon as practicable after notification to the applicant's organisation of such an accident or incident; and

(2) the record of the facility's operating condition as checked and the past recorded history are kept in a secure place for possible use by any subsequent investigation.

(3) the records required to be secured under paragraph (b) (2) are retained for 3 years from the date of the last entry made on that record.

171.69 Facility malfunctions

(a) An applicant for the grant of a telecommunication service certificate must establish a procedure to notify, investigate, and rectify any detected or reported malfunction of any facility listed in their exposition in accordance with the requirements of rule Part 12.

(b) The procedure must ensure that a report is forwarded to the Director whenever a facility malfunction investigation reveals that—

(1) the facility has been operating outside the allowable tolerances; or

(2) the facility had the potential to operate outside the allowable tolerances; or

(3) there appears to be a recurring cause for the facility malfunction reports.

(c) The report required in paragraph (b) must be forwarded within 10 days of the malfunction being detected or reported and must include full details of the malfunction, the findings of the investigation and the corrective action taken to prevent a recurrence.

171.71 Records

(a) An applicant for the grant of a telecommunication service certificate must establish procedures to identify, collect, index, store, maintain and dispose of the records that are necessary for the safe provision and operation of the facilities listed in their exposition.

(b) The procedures must ensure that—

(1) a record is kept for each facility in order to—

(i) document the performance of the facility; and

(ii) provide a history of its maintenance and the periodic inspections and tests. The history must be traceable to the person or persons responsible for each of the recorded activities; and

(2) there is a record of the documentation required by rule 171.59(b)(3) concerning the establishment of, or change in, the periodic tests for a facility; and

(3) there is a record for each item of test equipment required for the measurement of critical performance parameters. The record must provide a traceable history of the location, maintenance, and the calibration checks for such test equipment; and

(4) there is a record of each facility malfunction recorded and investigated under the procedures required by rule 171.69(a). The record must detail the nature of the malfunction, the findings of the investigation, the follow up corrective actions, or where applicable include a copy of the report forwarded to the Director; and

(5) there is a record of each internal audit of the applicant's organisation carried out under the procedures required by rule 171.77; and

(6) there is a record for each person who is authorised by the applicant to place facilities into operational service. The record must include details of their experience, qualifications, training, competence assessments and current authorisations; and

(7) all records are legible and of a permanent nature; and

(8) all facility records are retained for a period of at least 3 years unless a longer period is required to establish a performance history for a facility.

171.73 Safety Management System

An applicant for the grant of an aeronautical telecommunication service organization certificate must establish and implement a safety management system which meets the requirements of CAR Part 100.

171.75 Quality Management System

An applicant for the grant of an aeronautical telecommunication service organization certificate must establish and implement a quality management system which meets the requirements of CAR Part 100.

171.77 Organisation exposition

(a) An applicant for the grant of a telecommunication service certificate must provide the Director with an exposition which must contain—

(1) a statement signed by the Chief Executive on behalf of the applicant's organisation confirming that the exposition and any included manuals—

(i) define the organisation and demonstrate its means and methods for ensuring ongoing compliance with this Part; and

(ii) will be complied with at all times; and

(2) the titles and names of the senior person or persons required by rule 171.51(a)(1) and (2); and

(3) the duties and responsibilities of the senior person or persons specified in paragraph (a)(2) including matters for which they have responsibility to deal directly with the Director or the Authority on behalf of the organisation; and

(4) an organisation chart showing lines of responsibility of the senior persons specified in paragraph (a)(2) and extending to each location listed under paragraph (a)(7); and

(5) a summary of the applicant's staffing structure at each location listed under paragraph (a)(7); and

(6) a list of the types of facilities to be covered by the certificate; and

(7) a summary of the scope of activities at each location where personnel are based for the purpose of providing or maintaining the facilities listed under paragraph (a)(8); and

(8) a list providing the operational details of each facility associated with each location listed under paragraph (a)(7); and

(9) details of the applicant's security programme required by rule 171.55; and

(10) details of the applicant's procedures required by rule —

(i) 171.51(b)(1) and (2) regarding the competence of personnel; and

(ii) 171.53(a) regarding the design, installation and commissioning of facilities; and

(iii) 171.53(b) regarding operation of temporary facilities for site tests; and

(iv) 171.57 regarding the control of documentation; and

(v) 171.59 regarding periodic inspections and tests of facilities; and

(vi) 171.61 regarding the certification of facility performance; and

(vii) 171.63 regarding the control, calibration and maintenance of inspection, measuring and test equipment; and

(viii) 171.65 regarding the notification of facility information; and

(ix) 171.67 regarding facility checks after notification of an accident or incident; and

(x) 171.69 regarding facility malfunctions; and

(xi) 171.71 regarding the identification, collection, indexing, storage, maintenance and disposal of records; and

(xii) 171.73 regarding safety management system of the organisation; and

(xiii) 171.75 regarding quality management system of the organisation; and

(xiv) 171.115 regarding safety assessments; and

(11) procedures to control, amend and distribute the exposition.

(b) The applicant's exposition must be

(c) acceptable to the Director.

Subpart C — Operating Requirements

171.101 Continued compliance

The holder of a telecommunication service certificate must —

(1) hold at least one complete and current copy of their exposition at each major location specified in their exposition; and

(2) comply with all procedures detailed in their exposition; and

(3) make each applicable part of their exposition available to personnel who require those parts to carry out their duties; and

(4) continue to meet the standards and comply with the requirements of Subpart B prescribed for certification under this Part; and

(5) notify the Director of any change of address for service, telephone number, or facsimile number required by form CA 171/01 within 28 days of the change.

171.103 Identification codes and call signs

The holder of a telecommunication service certificate requiring an identification code for a radio navigation facility or a call sign for a communications facility must apply to the Director on form CA 171/02 with the appropriate details.

171.105 Communication procedures

The holder of a telecommunication service certificate must ensure that their procedures for operating the facilities listed in their exposition are in accordance with the applicable communication procedures prescribed in Annex 10, Volume II.

171.107 Operating and maintenance instructions

(a) The holder of a telecommunication service certificate must provide, for the use and guidance of their personnel, operating and maintenance instructions for each facility listed in their exposition.

(b) The instructions required by paragraph (a) must—

(1) be controlled by the documentation control procedures required by rule 171.57; and

(2) set out the requirements for operating and maintaining each facility; and

(3) include a list of the—

(i) critical performance parameters; and

(ii) associated minimum performance levels for those parameters; and

(iii) test equipment required for the measurement of those parameters; and

(iv) mandatory check procedures for placing the facility into operational service; and

(v) mandatory inspection and test procedures for the operation and maintenance of the facility.

171.109 Deviations

(a) Subject to compliance with rule 171.111(a), the holder of a telecommunication service certificate may deviate from any requirement of this Part to meet an emergency situation if there is a need to take immediate action for the protection of life or property involving carriage by air.

(b) A certificate holder who deviates from a requirement of this Part under paragraph (a) must provide a written report to the Director as soon as practicable, but in any event not later than 14 days after the emergency. The report must cover the nature, extent and duration of the deviation.

171.111 Limitations on Certificate Holder

(a) The holder of a telecommunication service certificate must not operate a facility (except for site test purposes controlled by the procedures required by rule 171.53(b)) if there is any cause to suspect the integrity of the information being provided by the facility. A cause to suspect the integrity of the information being provided by a facility includes the infringement of any critical site area of the facility until performance checks on the facility verify that the infringement does not and will not affect the performance of the facility

(b) A certificate holder must not operate a radio transmitting facility on an aeronautical radio frequency except pursuant to a written radio apparatus licence granted by the National Information Technology Authority for the facility.

(c) Except where a deviation under rule 171.109 is required or a site test is carried out under the procedures required by rule 171.53(b), a certificate holder must not operate a facility unless—

(1) the facility is listed in the holder's exposition; and

(2) the performance of the facility meets the applicable published information; and

(3) the performance of the facility meets the applicable facility requirements in rule 171.53(a); and

(4) any integrity monitoring system for the facility is fully functional; and

(5) all the periodic tests for the facility are completed in accordance with the programmes established under rule 171.59(c)(2) and (3); and

(6) the facility is included in the holder's airways security programme if the destruction, damage, or interference of the facility is likely to endanger the safety of an aircraft in flight; and

(7) the provisions of the holder's airways security programme for the facility are being complied with.

171.113 Changes to certificate holder's organisation

(a) The holder of a telecommunication service certificate must ensure that their exposition is amended so as to remain a current description of the holder's organisation and facilities.

(b) The certificate holder must ensure that any amendments made to the holder's exposition meet the applicable requirements of this Part and comply with the amendment procedures contained in the holder's exposition.

(c) The certificate holder must provide the Director with a copy of each amendment to the holder's exposition as soon as practicable after its incorporation into the exposition.

(d) Where a certificate holder proposes to make a change to any of the following, prior notification to and acceptance by the Director is required:

(1) The Chief Executive:

(2) The listed senior persons:

(3) The security programme:

(4) The types of facility the holder operates.

(e) The Director may prescribe conditions under which a certificate holder may operate during or following any of the changes specified in paragraph (d).

(f) A certificate holder must comply with any conditions prescribed under paragraph (e).

(g) Where any of the changes referred to in this rule requires an amendment to the certificate, the certificate holder must forward the certificate to the Director as soon as practicable.

(h) The certificate holder must make such amendments to the holder's exposition as the Director may consider necessary in the interests of aviation safety.

171.115 Safety Assessments

(a) The holder of an aeronautical telecommunications service certificate must provide a safety assessment report or safety case study to the Director-

(1) for any proposed changes to its operations; and

(2) relocation of services or facilities and equipment; and

(3) implementation of new communications, surveillance or other safety-significant systems and equipment, including those providing new functionality or capabilities.

(b) The holder of an aeronautical telecommunications service certificate must ensure that users of the services are consulted when carrying out the safety assessment as required under paragraph(a).

(c) The holder of an aeronautical telecommunications service certificate where appropriate, must ensure that adequate provision is made for post-implementation monitoring to verify that the defined level of safety continues to be met.

Subpart D — Facility Specifications and Requirements

171.201 Additional Specifications and Requirements

The following specifications and requirements are applicable to the aeronautical facilities referred to in rule 171.53(a)(1)-

(1) Each NDB listed in an aeronautical telecommunication service certificate holder's exposition must conform to the following specification standards, in addition to the specification standards prescribed in ICAO Annex 10, Volume I, section 3.4:

(i) the radiated signal must be either, an uninterrupted carrier amplitude modulated by the on/off keying of a 1020 Hz plus or minus 50 Hz tone, or an uninterrupted carrier identified by the on/off keying of a second carrier separated 1020 Hz plus or minus 50 Hz from the continuous carrier:

(ii) the monitoring functions recommended in paragraphs 3.4.8.2 and 3.4.8.4 of ICAO Annex 10, Volume I are mandatory specification requirements for each NDB aeronautical facility:

(iii) the monitoring system for each NDB aeronautical facility must transmit a warning to a control point and switch off the NDB upon detection of any of the conditions detailed in paragraphs 3.4.8.1 and 3.4.8.2 of ICAO Annex 10, Volume I; and

(2) each UHF DME listed in an aeronautical telecommunication service certificate holder's exposition must conform with the following requirements, in addition to the specifications prescribed in section 3.5 of ICAO Annex 10, Volume I:

(i) the beacon code identity signal prescribed in paragraph 3.5.3.6.3 of ICAO Annex 10, Volume I must be transmitted at least once but not more than twice every 40 seconds with the code groups equally spaced:

(ii) the monitor function recommended in paragraph 3.5.4.7.2.3 of ICAO Annex 10, Volume I, is a mandatory specification requirement for each DME aeronautical facility; and

(3) each radio navigation aid listed in an aeronautical telecommunication service certificate holder's exposition must be provided with a monitoring system that will remove the aeronautical facility from operational service and transmit a warning to an appropriate control point upon detection of any of the following conditions:

(i) navigation information outside the prescribed tolerance for the facility:

(ii) Failure of the identification signal:

(iii) failure of the monitoring system.

(4) Each VHF Omnidirectional radio range (VOR), Instrument Landing Systems (ILS) and Global Navigation System (GNSS) listed in an aeronautical telecommunication service certificate holder's exposition must comply with the additional specifications and requirements listed in Appendix A.

(5) Each Secondary Surveillance Radar (SSR), Human Factors considerations, Airborne Collision Avoidance System (ACAS), Mode S Extended Squitter, Mode S Extended Squitter Receiving System Characteristics (ADS-B IN and TIS B IN) listed in an aeronautical telecommunication service certificate holder's exposition must comply with the additional specifications and requirements listed in Appendix B.

(6) Each Aeronautical Telecommunication Network (ATN), SSR Mode S Air Ground Data Link, VHF Air Ground Data Link (VDL), Aircraft Addressing System, Single Sideband (SSB) High Frequency (HF) communication system, Selective Calling System (SELCAL), Aeronautical Speech Circuits and Emergency Locator Transmitter (ELT) for search and rescue listed in an aeronautical telecommunication service certificate holder's exposition must comply with the additional specifications and requirements listed in Appendix C.

(7) Each radio frequencies allocated in Radio Frequency Spectrum for Distress, frequencies below and above 30MHz and frequencies used for RPAS C2 Link Communication Services listed in the aeronautical telecommunication service certificate holder's exposition must comply with the additional specification and requirements listed in Appendix D.

Appendix A - Radio Navigation Aids

A.1 Standard radio navigation aids

(a) The standard radio navigation aids must be:

(1) the instrument landing system (ILS) conforming to the Standards contained in ICAO Annex 10 Volume I Chapter 3, 3.1;

(2) the microwave landing system (MLS) conforming to the Standards contained in ICAO Annex 10 Volume I Chapter 3, 3.11;

(3) the global navigation satellite system (GNSS) conforming to the Standards contained in ICAO Annex 10 Volume I Chapter 3, 3.7;

(4) the VHF omnidirectional radio range (VOR) conforming to the Standards contained in ICAO Annex 10 Volume I Chapter 3, 3.3;

(5) the non-directional radio beacon (NDB) conforming to the Standards contained in ICAO Annex 10 Volume I Chapter 3, 3.4;

(6) the distance measuring equipment (DME) conforming the Standards contained in ICAO Annex 10 Volume I Chapter 3, 3.5 and

(7) the en-route VHF marker beacon conforming to the Standards contained in ICAO Annex 10 Volume I Chapter 3, 3.6.

(b) Differences in radio navigation aids in any respect from the Standards of ICAO Annex 10 Volume 1 Chapter 3 must be published in an Aeronautical Information Publication (AIP).

(c) Wherever there is installed a radio navigation aid that is neither an ILS nor an MLS, but which may be used in whole or in part with aircraft equipment designed for use with the ILS or MLS, full details of parts that may be used must be published in an Aeronautical Information Publication (AIP).

A.2 VHF Omnidirectional Radio Range (VOR)

(a) Each VOR listed in an aeronautical telecommunication service certificate holder's exposition must conform with the following requirements, in addition to the specifications prescribed in ICAO Annex 10, Volume 1, Chapter 3, 3.3:

(1) The VOR must be constructed and adjusted so that similar instrumental indications in the aircraft represent equal clockwise angular deviations (bearings), degree for degree from magnetic North as measured from the location of the VOR.

(2) The VOR must radiate a radio frequency carrier with which are associated two separate 30Hz modulations. One of these modulations must be such that its phase is independent of the azimuth of the point of observation (reference phase). The other modulation (variable phase) must be such that its phase at the point of observation with respect to the VOR.

(3) The reference and variable phase modulations must be in phase along the reference magnetic meridian through the station.

(4) The VOR must operate in the band 111.975 MHz to 117.975 MHz except that frequencies in the band 108 MHz to 111.975 MHz. The highest assignable frequency must be 117.950 MHz. The channel separation must be in increments of 50 kHz referred to the highest assignable frequency. In areas where 100 kHz channel spacing is in general use, the frequency tolerance of the radio frequency carrier must be plus or minus 0.005 per cent.

A.3 Instrument Landing System (ILS)

(a) Each ILS listed in an aeronautical telecommunication service certificate holder's exposition must conform with the following requirements, in addition to the specifications prescribed in ICAO Annex 10, Volume 1 Chapters 2 and 3, and Attachment C.

(b) Basic Requirements. The ILS must comprise the following basic requirements:

(1) VHF localizer equipment, associated monitor system, remote control and indicator equipment;

(2) UHF glide path equipment, associated monitor system, remote control and indicator equipment;

(3) An appropriate means to enable glide path verification checks.

(c) Distance to threshold information to enable glide path verification must be provided by either VHF marker beacons or distance measuring equipment (DME), together with monitor systems and remote control and indicator equipment.

(d) If DME is used in lieu of marker beacons, the equipment must conform to the specifications in ICAO Annex 10, Volume 1, 3.1.7.6.5. and Attachment C, 2.11.

(e) Facility Performance Categories I, II and III – ILS must provide indications at designated remote control points of the operational status of all ILS ground systems as follows:

(1) for all Category II and Category III ILS, the air traffic services unit involved in the control of aircraft on final approach must be one of the designated remote control points and must receive information on the operational status of the ILS, with a delay commensurate with the requirements of the operational environment.

(2) for a Category I ILS, if that ILS provides an essential radio navigation service, the air traffic services unit involved in the control of aircraft on the final approach must be one of the designated remote control points and must receive information on the operational status of the ILS, with a delay commensurate with the requirements of the operational environment.

(f) The ILS must be constructed and adjusted so that, at a specific distance from the threshold, similar instrumental indications in the aircraft represents similar displacements from the course line or ILS glide path as appropriate, irrespective of the particular ground installation in use.

(g) The localizer and glide path components specified in ICAO Annex 10, Volume 1, 3.1.2.1 (a) and (b) which form part of a Facility Performance Category I - ILS must comply at least with the Standards in ICAO Annex 10, Volume 1, 3.1.3 and 3.1.5 respectively, excepting those in which application to Facility Performance Category II - ILS is prescribed.

(h) The localizer and glide path components specified in ICAO Annex 10, Volume 1, 3.1.2.1 (a) and (b) which form part of a Facility Performance Category II - ILS must comply with the Standards applicable to these components in a Facility Performance Category I – ILS, as supplemented or amended by the Standards in ICAO Annex 10, Volume 1, 3.1.3 and 3.1.5 in which application to Facility Performance Category II –ILS is prescribed.

(i) The localizer and glide path components and other ancillary equipment specified in ICAO Annex 10, Volume 1, 3.1.2.1.3, which form part of a Facility Performance Category III – ILS, must otherwise comply with the Standards applicable to these components in Facility Performance Category I and II – ILS, except as supplemented by the Standards in ICAO

Annex 10, Volume 1, 3.1.3 and 3.1.5 in which application to Facility Performance Category III – ILS is prescribed.

(j) To ensure an adequate level of safety, the ILS must be so designed and maintained that the probability of operation within the performance requirements specified is of a high value, consistent with the category of operational performance concerned.

(k) At locations where ILS facilities serving opposite ends of the runway or different runways at the same airport use the same paired frequencies, an interlock must ensure that only one facility must radiate at a time. When switching from one ILS facility to another, radiation from both must be suppressed for not less than 20 seconds.

(l) The pairing of the runway localizer and glide path transmitter frequencies of an instrument landing system used must be acceptable to the Director.

A.4 Global Navigation Satellite System (GNSS)

(a) The general functions and use of GNSS must conform with the following requirements, in addition to the specifications prescribed in ICAO Annex 10, Volume 1 Chapters 2, 3 and Attachment D.

(1) Functions.

The GNSS must provide position and time data to the aircraft - data which are derived from pseudo-range measurements between an aircraft equipped with a GNSS receiver and various signal sources on satellites or on the ground.

(b) GNSS Elements

The GNSS navigation service must be provided using various combinations of the following elements installed on the ground, on satellites and/or on board the aircraft:

(1) Global Positioning System (GPS) that provides the Standard Positioning Service (SPS) as defined in ICAO Annex 10, Volume 1 Chapter 3.7.3.1.1;

(2) Global Navigation Satellite System (GLONASS) that provides the Channel of Standard Accuracy (CSA) as defined in ICAO Annex 10, Volume 1 Chapter 3.7.3.1.2;

(3) Galileo that provides a single- and dual-frequency Open Service (OS) as defined in ICAO Annex 10, Volume 1 Chapter 3.7.3.1.3;

(4) BeiDou Navigation Satellite System (BDS) that provides the BDS Open Service (BDS OS) as defined in ICAO Annex 10, Volume 1 Chapter 3.7.3.1.4;

(5) Aircraft-based augmentation system (ABAS) as defined in ICAO Annex 10, Volume 1, 3.7.3.3;

(6) Satellite-based augmentation system (SBAS) as defined in ICAO Annex 10, Volume 1, 3.7.3.4;

(7) Ground-based augmentation system (GBAS) as defined in ICAO Annex 10, Volume 1, 3.7.3.5;

(8) Aircraft GNSS receiver as defined in ICAO Annex 10, Volume 1, 3.7.3.6.

(c) GNSS Specific Provisions

(1) A procedure for the collection and dissemination of Receiver Autonomous Integrity Monitoring (RAIM) prediction warning must be provided by the ANSP in the provision of GNSS service.

(2) It must be permissible to terminate a GNSS satellite service provided by one of its elements (as specified in ICAO Annex 10 Volume I Chapter 3, 3.7.2) on the basis of at least a six-year advance notice by a service provider.

(3) All GNSS-based operations must ensure that GNSS data relevant to those operations are recorded.

(4) These recordings data are primarily intended for use in accident and incident investigations. They may also support periodic confirmation that accuracy, integrity, continuity and availability are maintained within the limits required for the operations approved.

(i) Recordings must be retained for a period of 14 days. When the recordings are pertinent to accidents and incident investigations, they should be retained for longer periods until it is evident that they will no longer be required.

A.5 UHF Distance Measuring Equipment (DME)

(a) General

(1) When a DME is associated with an ILS, MLS or VOR for the purpose of constituting a single facility, must;~~:~~

(i) be operated on a standard frequency pairing.
(ii) be collocated within the limits prescribed for associated facilities; and
(iii) comply with the identification provisions.

(2) Technical characteristics of interrogator must be define to ensure the interrogator;

(i) does not jeopardize the effective operation of the DME system, e.g. by increasing transponder loading abnormally; and

(ii) is capable of giving accurate distance readings.

Appendix B - Surveillance

B.1 Secondary Surveillance Radar (SSR)

When SSR is installed and maintained in operation as an aid to air traffic services, it must conform with the provisions of ICAO Annex 10, Volume IV Chapters 2, 3 and 5.

B.2 Interrogation modes (ground to air)

Note. — As referred to in Annex 10, Volume IV, Mode A/C transponders are those which conform to the characteristics prescribed in ICAO Annex 10, Volume IV, 3.1.1. Mode S transponders are those which conform to the characteristics prescribed in ICAO Annex 10, Volume IV, 3.1.2. The functional capabilities of Mode A/C transponders are an integral part of those of Mode S transponders.

(a) Interrogation for air traffic services must be performed on the modes described in ICAO Annex 10, Volume IV, 3.1.1.4.3 or 3.1.2. The uses of each mode must be as follows:

(1) Mode A – to elicit transponder replies for identity and surveillance.

(2) Mode C – to elicit transponder replies for automatic pressure-altitude transmission and surveillance.

(3) Intermode –

(i) Mode A/C/S all-call: to elicit replies for surveillance of Mode A/C transponder and for the acquisition of Mode S transponders.

(ii) Mode A/C-only all-call: to elicit replies for surveillance of Mode A/C transponders. Mode S transponders do not reply.

(b) Mode S –

(1) Mode S-only all-call: to elicit replies for acquisition of Mode S transponders.

(2) Broadcast: to transmit information to all Mode S transponders. No replies are elicited.

(3) Selective: for surveillance of, and communication with, individual Mode S transponders. For each interrogation, a reply is elicited only from the transponder uniquely addressed by the interrogation.

(c) In areas where improved aircraft identification is necessary to enhance the effectiveness of the ATC system, SSR ground facilities having Mode S features must include aircraft identification capability.

B.3 Side-Lobe Suppression Control Interrogation

(a) Side-lobe suppression must be provided in accordance with the provisions of ICAO Annex 10, Volume IV chapter 3.1.1.4 and 3.1.1.5 on all Mode A, Mode C and intermode interrogations.

(b) Side-lobe suppression must be provided in accordance with the provisions of ICAO Annex 10, Volume IV Chapter 3.1.2.1.5.2.1 on all Mode S-only all-call interrogations.

B.4 Transponder reply modes (air-to-ground)

(a) Transponder must respond to Mode A interrogations in accordance with the provisions of ICAO Annex 10, Volume IV Chapter 3.1.1.7.12.1 and 3.1.1.7.12.2.

(b) The pressure-altitude reports contained in Mode S replies must be derived as specified in 3.1.1.7.12.2.

(c) For aircraft equipped with 7.62 m (25 ft) or better pressure-altitude information provided by Mode S transponders in response to selective interrogations (i.e. in the AC field, 3.1.2.6.5.4) must be reported in 7.62 m (25 ft) increments.

(d) All Mode A/C transponders must report pressure-altitude encoded in the information pulses in Mode C replies.

(e) All Mode S transponders must report pressure-altitude encoded in the information pulses in Mode C replies and in the AC field of Mode S replies.

(f) When a Mode S transponder is not receiving more pressure-altitude information from a source with a quantization of 7.62 m (25 ft) or better increments, the reported value of the altitude must be the value obtained be expressing the measured value of the uncorrected pressure-altitude of the aircraft in 30.48 m (100 ft) increments and the Q bit (see 3.1.2.6.5.4 b) must be set to 0.

(g) Transponders used within airspace where the need for Mode S airborne capability has been determined must also respond to intermode and Mode S interrogations in accordance with the applicable provisions of 3.1.2.

(h) Requirements for mandatory carriage of SSR Mode S transponders must be on the basis of regional air navigation agreements which must specify the airspace and the airborne implementation timescales.

(i) The agreements indicated in 2.1.4.8 must provide at least five years notice.

(j) Where the need for Mode C automatic pressure-altitude transmission capability within a specified airspace has been determined, transponders, when used within the airspace concerned, must respond to Mode C interrogations with pressure-altitude encoding in the information pulses.

(k) All transponders, regardless of the airspace in which they will be used, must respond to Mode C interrogations with pressure-altitude information.

B.5 Mode A reply codes (information pulses)

(a) All transponders must be capable of generating 4 096 reply codes conforming to the characteristics given in ICAO Annex 10, Volume IV Chapter 3.1.1.6.2.

(b) The following Mode A codes must be reserved for special purposes:

(c) Code 7700 to provide recognition of an aircraft in an emergency.

(d) Code 7600 to provide recognition of an aircraft with radio communication failure.

(e) Code 7500 to provide recognition of an aircraft which is being subjected to unlawful interference.

(f) Appropriate provisions must be made in ground decoding equipment to ensure immediate recognition of Modes A codes 7500, 7600 and 7700.

(g) Mode A code 0000 must be reserved for allocation subject to regional agreements, as a general purpose code.

(h) Mode A code 2000 must be reserved to provide recognition of an aircraft which has not received any instructions from air traffic control units to operate the transponder.

B.6 Mode S airborne equipment capability

All mode S transponders must conform to one of the following five levels:

(a) Level 1 transponder must have the capabilities prescribed for:

(1) Mode A identity and Mode C pressure-altitude reporting;

(2) Intermode and Mode S all-call transaction;

(3) Addressed surveillance altitude and identity transaction;

(4) Lockout protocols;

(5) Basic data protocols except data link capability reporting;

(6) Air-air service and squitter transactions.

(b) Level 2 – Level 2 transponders must have the capabilities of 2.1.6.1.1 and also those prescribed for:

(1) standard length communications (Comm-A and Comm-B);

(2) data link capability reporting;

(3) aircraft identification reporting;

(4) data parity with overlay control for equipment certified on or after 1 January 2020.

(c) Level 3 – Level 3 transponders must have the capabilities of 2.1.6.1.2 and also those prescribed for ground-to-air extended length message (ELM) communications.

(d) Level 4 – Level 4 transponders must have the capabilities of 2.1.6.1.3 and also those prescribed for air-to-ground extended length message (ELM) communications.

(e) Level 5 – Level 5 transponders must have the capabilities of 2.1.6.1.4 and also those prescribed for enhanced Comm-B and extended length message (ELM) communications.

(f) Extended squitter – Extended squitter transponders must have the capabilities of 2.1.6.2, 2.1.6.1.3, 2.1.6.4 or 2.1.6.1.5, the capabilities prescribed for extended squitter operation and the capabilities prescribed for ACAS cross-link operation. Transponder with these capabilities must be designated with suffix “e”.

(g) SI capability – Transponders with the ability to process SI codes must have the capabilities of 2.1.6.1.1, 2.1.6.1.2, 2.1.6.1.3, 2.1.6.1.4, 2.1.6.1.5 and also those prescribed for SI code operation. Transponders with this capability must be designated with a suffix “s”.

(h) Extended squitter non-transponder devices. Devices that are capable of broadcasting extended squitter’s that are not part of a Mode S transponder must conform to all of the 1090 MHz RF signals in space requirements specified for a Mode S transponder, except for transmit power levels for the identified equipment class as specified in 6.1.1.

(i) All Mode S transponders used by international civil air traffic must conform, at least, to the requirements of Level 2 prescribed in 2.1.6.1.2.

(j) Mode S transponder installed on aircraft with gross mass in excess of 5700 kg or a maximum cruising true airspeed capability in excess of 463 km/h (250kt) must operate with antenna diversity as prescribed in ICAO Annex 10, Volume 4 Chapter 3.1.2.10 if:

(1) The aircraft individual certificate of airworthiness is first issued on or after 1 January 1990; or

(2) Mode S transponder carriage is required on the basis of regional air navigation agreement in accordance with ICAO Annex 10, Volume 4 Chapter 2.1.3.3.1 and 2.1.3.3.2.

(k) Capability Reporting in Mode S Squitter's.

Capability reporting in Mode S acquisition squitter's (unsolicited downlink transmissions) must be provided in accordance with the provisions of ICAO Annex 10, Volume 4 Chapter 3.1.2.8.5.1 for all Mode S transponders installed on or after 1 January 1995.

(l) Extended Length Message (ELM) Transmit Power

In order to facilitate the conversion of existing Mode S transponders to include full Mode S capability, transponders originally manufactured before 1 January 1999 must be permitted to transmit a burst of 16 ELM segments at a minimum power level of 20dBW.

B.7 SSR Mode S address (aircraft address)

The SSR Mode S address must be one of 16 777 214 twenty -four-bit aircraft addresses allocated by ICAO to the State of Registry or common mark registering authority and assigned as prescribed in ICAO Annex 10, Volume 4 Chapter 3.1.2.4.1.2.3.1.1 and the Appendix to Chapter 9, Part 1, Volume III, Annex 10.

B.8 Human Factors Considerations

(a) Human Factors principles must be observed in the design and certification of surveillance radar, transponder and collision avoidance systems.

(b) Operation of Controls

(1) Transponder controls which are not intended to be operated in flight must not be directly accessible to the flight crew.

(2) The operation of transponder controls, intended for use during flight, must be evaluated to ensure they are logical and tolerant to human error. In particular, where transponder mode switching (i.e. an operational state to 'Standby' or 'off') is minimized.

(3) The flight crew must have access at all times to the information of the operational state of the transponder.

B.9 Airborne collision avoidance system (ACAS)

The general functions and use of ACAS must conform with the following requirements, in addition to the specifications prescribed in ICAO Annex 10, Volume 4 Chapters 3 and 4.

(a) ACAS I General provisions and characteristics

(1) Functional requirements.

ACAS 1 must perform the following functions:

(i) surveillance of nearby SSR transponder- equipped aircraft; and

(ii) provide indications to the flight crew identifying the approximate position of aircraft as an aid to visual acquisition.

(2) Signal format

The RF characteristics of all ACAS I signals must conform to the provisions of Chapter 3, 3.1.1.1 through 3.1.1.6 and 3.1.2.1 through 3.1.2.4.

(b) General provisions relating to ACAS II and ACAS III

(1) Functional requirements

(i) ACAS functions.

ACAS must perform the following functions:

(A) surveillance;

(B) generation of TAs;

(C) threat detection;

(D) generation of Resolution Advisories (RAs);

(E) coordination; and

(F) communication with ground stations.

(ii) The equipment must execute functions (B) through (E) on each cycle of operation.

(iii) The duration of a cycle must not exceed 1.2 seconds.

(2) Surveillance performance requirements

(i) General surveillance requirements.

ACAS must interrogate SSR Mode A/C and Mode S transponders in other aircraft and detect the transponder replies. ACAS must measure the range and relative bearing of responding aircraft. Using these measurements and information convey be transponder replies, ACAS must estimate the relative positions of each responding aircraft. ACAS must include provisions for achieving such position determination in the presence of ground reflections, interference and variations in signal strength.

(A) Track establishment probability

ACAS must generate an established track, with at least a 0.90 probability that the track is established 30 s before closest approach, on aircraft equipped with transponders when all of the following conditions are satisfied:

(I) the elevation angles of these aircraft are within ±10 degrees relative to the ACAS aircraft pitch plane;

(II) the magnitudes of these aircrafts rates of change of altitude are less than equal to 51m/s (10 000 ft/min);

(III) the transponder and antennas of these aircraft meet the Standards of Chapter 3, 3.1.1 and 3.1.2;

(IV) the closing speeds and directions of these aircraft, the local density of SSR transponder-equipped aircraft and the number of other ACAS interrogators in the vicinity (as determined by monitoring ACAS broadcasts, 4.3.7.1.2.4) satisfy the conditions specified in Table 4-1; and

(V) the minimum slant range is equal to or greater than 300m (1 000 ft).

(B) ACAS must continue to provide surveillance with no abrupt degradation in track establishment probability as any one of the condition bounds defined in 2.3.5.2 is exceeded.

(C) ACAS must not track Mode S aircraft that report that they are on the ground.

(D) ACAS must achieve the required tracking performance when the average SSR Mode A/C asynchronous reply rate from transponders in the vicinity of the ACAS aircraft is 240 replies per second and when the peak interrogation rate received by the individual transponders under surveillance is 500 per second.

(E) False track probability

The probability that an established Mode A/C track does not correspond in range and altitude, if reported, to an actual aircraft must be less than 10^{-2}. For an established Mode S track this probability must be less than 10^{-6}. These limits must not be exceeded in any traffic environment.

B.10 Mode S Extended Squitter

The general functions and use of Mode S Extended Squitter must conform with the following requirements, in addition to the specifications prescribed in ICAO Annex 10, Volume 4 Chapters 2, 3, 4 and 5.

(a) Mode S Extended Squitter Transmitting System Characteristics

(1) ADS-B out requirements

(i) Aircraft, surface vehicles and fixed obstacles supporting ADS-B message generation function and the ADS-B message exchange function (transmit) as depicted in Figure 5-1.

(ii) ADS-B transmissions from aircraft must include position, aircraft identification and type, airborne velocity, periodic status and event driven messages including emergency/priority information.

(iii) Extended squitter transmitting equipment must use formats and protocols of the latest version available.

(iv) Extended squitter ADS-B transmitting requirements. Mode S extended squitter transmitting equipment must be classified according to the units range capability and the set of parameters that it is capable of transmitting consistent with the following definition of general equipment classes and the specific equipment classes defined in Tables 5-1 and 5-2;

(A) Class A extended squitter airborne systems support an interactive capability incorporating both an extended squitter reception capability (i.e. ADS-B IN) in support of onboard ADS-B applications;

(B) Class B extended squitter systems provide a transmission only (i.e. ADS-B OUT without an extended squitter reception capability) for use on aircraft, surface vehicles, or fixed obstructions; and

(C) Class C extended squitter systems have only a reception capability and thus have no transmission requirements.

(2) Class A extended squitter system requirements. Class A extended squitter airborne systems must have transmitting and receiving subsystem characteristics of the same class (i.e. A0, A1, A2, or A3) as specified in 2.4.1.1 and 2.4.2.1.2

(3) Control of ADS-B Out Operations.

(i) Protection against reception of corrupted data from the source providing the position must be satisfied b error detection on the data inputs and the appropriate maintenance of the installation.

(ii) If an independent control of the ADS-B OUT function is provided, then the operational state of the ADS-B OUT function must be provided to the flight crew, at all times.

B.11 Mode S Extended Squitter Receiving System Characteristics (ADS-B IN and TIS-B IN)

As referred to in paragraph 2.4 on general functions and in addition to the use of Mode S Extended Squitter, detailed technical provisions for Mode S extended squitter receivers can be found within RTCA DO-260B/EUROCAE ED-102A, “Minimum Operational Performance Standards for 1 090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS B)”.

Appendix C – Communications

C.1 Digital Data Communication Systems

(a) Aeronautical Telecommunication Network (ATN)

(1) Introduction.

The ATN is specifically and exclusively intended to provide voice and data communications services to air traffic service provider organizations and aircraft operators in support of:

(i) air traffic services communications (ATSC) with aircraft;

(ii) air traffic services communications between ATS units;

(iii) aeronautical operational control communications (AOC); and

(iv) aeronautical administrative communications (AAC).

(2) The general requirements and the Standards and Recommended Practices in sections 3.4 to 3.8 of ICAO Annex 10 Volume III Part I Chapter 3 define the minimum required protocols and services that will enable the global implementation of the aeronautical telecommunications network (ATN).

(3) ATN communication services must support ATN applications.

(4) Requirements for implementation of the ATN must be made on the basis of regional air navigation agreements. These agreements must specify the area in which the communication standards for the ATN/OSI or the ATN/IPS are applicable.

(5) General Requirements

(i) The ATN must either use International Organization for Standardization (ISO) communication standards for open systems interconnection (OSI) or use the Internet Society (ISOC) communications standards for the Internet Protocol Suite (IPS).

Note 1. — ATN/IPS implementation is preferred for ground-ground networks. While ATN/OSI continues to be supported in air-ground networks, particularly when using VDL Mode 2, it is expected that future air-ground implementations will use the ATN/IPS.

Note 2. — Interoperability between interconnecting OSI/IPS networks is expected to be arranged prior to implementation.

Note 3. — Guidance material on interoperability between ATN/OSI and ATN/IPS is contained in Doc 9896.

(ii) The AFTN/AMHS gateway must ensure the interoperability of AFTN and CIDIN stations and networks with the ATN.

(iii) An authorized path(s) must be defined on the basis of a predefined routing policy.

(iv) The ATN must transmit, relay and deliver messages in accordance with the priority classifications and without discrimination or undue delay.

(v) The ATN must provide means to define data communications that can be carried only over authorized paths for the traffic type and category specified by the user.

(vi) The ATN must provide communication in accordance with the prescribed required communication performance (RCP).

Note. — The Manual on Required Communication Performance (RCP) *(Doc 9869) contains the necessary information on RCP.*

(vii) The ATN must operate in accordance with the communication priorities defined in Table 3-1* and Table 3-2.

(viii) The ATN must enable exchange of application information when one or more authorized paths exist.

(ix) The ATN must notify the appropriate application processes when no authorized path exists.

(x) The ATN must make provisions for the efficient use of limited bandwidth subnetworks.

(xi) The ATN must enable an aircraft intermediate system (router) to connect to a ground intermediate system (router) via different subnetworks.

(xii) The ATN must enable an aircraft intermediate system (router) to connect to different ground intermediate systems (routers).

(xiii) The ATN must enable the exchange of address information between applications.

(xiv) Where the absolute time of day is used within the ATN, it must be accurate to within 1second of coordinated universal time (UTC).

Note. — The time accuracy value results in synchronization errors of up to two seconds.

C.1.1 AERONAUTICAL MOBILE-SATELLITE (ROUTE) SERVICE (AMS(R)S)

(a) GENERAL

(1) Any mobile-satellite system intended to provide AMS(R)S must conform to the requirements of this chapter.

(2) An AMS(R)S system must support packet data service, or voice service, or both.

(3) Requirements for mandatory carriage of AMS(R)S system equipment including the level of system capability must be made on the basis of regional air navigation agreements which specify the airspace of operation and the timescales for the carriage of equipment. A level of system capability must include the performance of the AES, the satellite and the GES.

(4) The agreements indicated in paragraph (3) must provide at least two years' notice of mandatory carriage of airborne systems.

(5) Civil aviation authorities should coordinate with national authorities and service providers those implementation aspects of an AMS(R)S system that will permit its worldwide interoperability and optimum use, as appropriate.

(b) RF CHARACTERISTICS

(1) When providing AMS(R)S communications, an AMS(R)S system must operate only in frequency bands which are appropriately allocated to AMS(R)S and protected by the ITU Radio Regulations.

(2) The total emissions of the AES necessary to meet designed system performance must be controlled to avoid harmful interference to other systems necessary to support safety and regularity of air navigation.

(3) The AES equipment shall operate properly in an interference environment causing a cumulative relative change in its receiver noise temperature ($\Delta T/T$) of 25 per cent.

(4) Every aircraft earth station and ground earth station must be designed to ensure that messages transmitted in their order of priority, are not delayed by the transmission and/or reception of other types of messages. If necessary, as a means to comply with the above requirement, message types must be terminated even without warning, to allow messages to be transmitted and received.

(5) All AMS(R)S data packets and all AMS(R)S voice calls must be identified as to their associated priority.

(6) Within the same message category, the system must provide voice communications priority over data communications.

(7) An AMS(R)S system providing a packet data service must be capable of operating as a constituent mobile subnetwork of the ATN.

(8) An AMS(R)S system must allow subnetwork users to address AMS(R)S communications to specific aircraft by means of the ICAO 24-bit aircraft address.

C.1.2 SSR Mode S Air-Ground Data Link

(a) General provisions

The general requirements set out below and the Standards and Recommended Practices in sections 5.2.2 to 5.3 of ICAO Annex 10 Volume III Part I Chapter 5 define the protocols and services that will enable the global provision of the Mode S Air-Ground Data links.

(1) *Message categories.* The Mode S subnetwork must only carry aeronautical communications classified under categories of flight safety and flight regularity as specified in Annex 10, Volume II, Chapter 5, 5.1.8.4 and 5.1.8.6.

(2) *Signals in space.* The signal-in-space characteristics of the Mode S subnetwork must conform to the provisions contained in Annex 10, Volume IV, Chapter 3, 3.1.2.

(3) *Code and byte independency.* The Mode S subnetwork must be capable of code and by the independent transmission of digital data.

(4) *Data transfer.* Data must be conveyed over the Mode S data link in segments using either standard length message (SLM) protocols or extended length message (ELM) protocols as defined in 3.1.2.6.11 and 3.1.2.7 of Annex 10, Volume IV.

(5) *Bit numbering.* In the description of the data exchange fields, the bits must be numbered in the order of their transmission, beginning with bit 1. Bit numbers must continue through the second and higher segments of multi-segment frames. Unless otherwise stated, numerical values encoded by groups (fields) of bits must be encoded using positive binary notation and the first bit transmitted must be the most significant bit (MSB) (3.1.2.3.1.3 of Annex 10, Volume IV).

(6) *Unassigned bits.* When the length of the data is not sufficient to occupy all bit positions within a message field or subfield, the unassigned bit positions must be set to 0.

C.1.3 VHF Air-Ground Digital Link (VDL)

(a) General provisions

(1) The very high frequency (VHF) Digital Link (VDL) Mode 2 and the VDL Mode 4 provide data service capabilities. The VDL Mode 3 provides both voice and data service capabilities. The data capability is a constituent mobile subnetwork of the aeronautical telecommunication network (ATN). In addition, the VDL may provide non-ATN functions.

(2) Standards and Recommended Practices are prescribed in ICAO Annex 10, Volume III Chapter 6 with Technical Specifications in Docs 9776, 9805 and 9816.

(3) Sections 6.1.2 to 6.8.2 contain Standards and Recommended Practices for VDL Modes 2 and 3. Section 6.9 contains Standards and Recommended Practices for VDL Mode 4.

(b) Radio channels and functional channels.

(1) *Aircraft station radio frequency range*. An aircraft station must be capable of tuning to any of the channels in the range specified in ICAO Annex 10 Volume III Section 6.1.4.1 within 100 milliseconds after the receipt of an auto tune command. In addition, for VDL Mode 3, an aircraft station must be able to tune to any channel in the range specified in ICAO Annex 10 Volume III Section 6.1.4.1 within 100 milliseconds after the receipt of any tuning command.

(2) *Ground station radio frequency range*. A ground station must be capable of operating on its assigned channel within the radio frequency range detailed in 6.1.4.1.

(3) *Common signaling channel*. Frequency 136.975MHz must be reserved as a worldwide common signaling channel (CSC) for VDL Mode 2.

(c) System capabilities

(1) *Data transparency*. The VDL system must provide code-independent, byte-independent transfer of data.

(2) *Broadcast*. The VDL system must provide link layer data broadcast services (Mode 2) and/or voice and data broadcast services (Mode 3). For VDL Mode 3, the data broadcast service must support network multicasting capability originating from the ground.

(3) *Connection management*. The VDL system must establish and maintain a reliable communications path between the aircraft and the ground system while allowing but not requiring manual intervention.

Note. *— In this context "reliable" is defined by the BER requirement specified in 6.3.5.1.*

(4) *Ground network transition*. A VDL-equipped aircraft must transition from one ground station to another when circumstances dictate.

(5) *Voice capability*. The VDL Mode 3 system must support a transparent, simplex voice operation based on a "Listen-Before-Push-To-Talk" channel access.

C.1.4 Air-ground VHF digital link communications system characteristics

(a) The radio frequencies used must be selected from the radio frequencies in the band 117.975–137 MHz. The lowest assignable frequency must be 118.000 MHz, and the highest assignable frequency must be 136.975 MHz. The separation between assignable frequencies (channel spacing) must be 25 kHz.

Note. *— ICAO Annex 10 Volume V specifies that the block of frequencies from 136.9 – 136.975 MHz inclusive is reserved for VHF air-ground digital communications.*

(b) The design polarization of emissions must be vertical.

C.1.5 AFTN NETWORK

(a) Interregional AFS circuits being implemented or upgraded must employ high quality telecommunications service. Modulation rate must take into account traffic volume expected under both normal and alternate route conditions.

(b) In international data interchange of characters, a 7-unit coded character set providing a repertoire of 128 characters and designated as International Alphabet No. 5 (IA-5) must be used.

(c) The data signaling rate should be chosen from among the following:

600 bits/s	4 800 bits/s
1200 bits/s	9 600 bits/s
2400 bits/s	

(d) The type of transmission for each data signaling rate should be chosen as follows:

1 600 bits/s	Synchronous or asynchronous serial transmission
1 200 bits/s	Synchronous or asynchronous serial transmission
2 400 bits/s	Synchronous serial transmission
4 800 bits/s	Synchronous serial transmission
9 600 bits/s	Synchronous serial transmission

(e) The type of modulation for each data signaling rate should be chosen as follows:

600 bits/s	Frequency
1 200 bits/s	Frequency
2 400 bits/s	Phase
4 800 bits/s	Phase
9 600 bits/s	Phase-amplitude

C.1.6 Aircraft Addressing system

(a) General

The provisions of ICAO Annex 10 Volume III Chapter 9 prescribes the Aircraft addressing system as provided for by ICAO for States of Registry.

(1) Global communications, navigation and surveillance systems must use an individual aircraft address composed of 24 bits. At any one time, no address must be assigned to more than one aircraft. The assignment of aircraft addresses requires a comprehensive scheme providing for a balanced and expandable distribution of aircraft addresses applicable worldwide.

(2) The aircraft address must be one of 16 777 214 twenty-four-bit aircraft addresses allocated by ICAO to the State of Registry or common mark registering authority and assigned as prescribed in the Appendix to this chapter.

(3) Non-aircraft transponders that are installed on aerodrome surface vehicles, obstacles or fixed Mode S target detection devices for surveillance and/or radar monitoring purposes must be assigned 24-bit aircraft addresses.

(4) Note. — Under such specific conditions, the term "aircraft" can be understood as "aircraft (or pseudo-aircraft) or vehicle (A/V)" where a limited set of data is generally sufficient for operational purposes.

(5) Mode S transponders used under specific conditions stated in 3.5.1.1 must not have any negative impact on the performance of existing ATS surveillance systems and ACAS.

C.2 Voice Communication Systems

C.2.1 General Requirements Aeronautical Mobile Service.

(a) The general requirements for Air-Ground VHF communication system and characteristics are as set out below in addition to the Standards and Recommended Practices in sections 2.2 to 2.3.3.4 of ICAO Annex 10 Volume III Part II chapter 2.

(b) The characteristics of the air-ground VHF communication system used in the International Aeronautical Mobile Service must be in conformity with the following specifications:

(c) Radiotelephone emissions must be double sideband (DSB) amplitude modulated (AM) carriers. The designation of emission is A3E, as specified in the ITU Radio Regulations.

(d) Spurious emissions must be kept at the lowest value which the state of technique and the nature of the service permit.

Note. *— Appendix S3 to the ITU Radio Regulations specifies the levels of spurious emissions to which transmitters must conform.*

(e) The radio frequencies used must be selected from the radio frequencies in the band 117.975 – 137 MHz. The separation between assignable frequencies (channel spacing) and frequency tolerances applicable to elements of the system must be as specified in Volume V.

Note. — The band 117.975 – 132 MHz was allocated to the Aeronautical Mobile (R) Service in the ITU Radio Regulations (1947). By subsequent revisions at ITU World Administrative Radio Conferences the bands 132 – 136 MHz and 136 – 137 MHz were added under conditions which differ for ITU Regions, or for specified countries or combinations of countries (see RRs S5.203, S5.203A and S5.203B for additional allocations in the band 136 – 137 MHz, and S5.201 for the band 132 – 136 MHz).

(f) The design polarization of emissions must be vertical.

C.2.2 Single sideband (SSB) HF communication system characteristics for use in the aeronautical mobile service.

The characteristics of the air-ground HF SSB system, where used in the Aeronautical Mobile Service, must be in conformity with the ICAO Annex 10 Volume III Part II Chapter 2 Section 2.4.1.1.1 to 2.4.1.9.

C.2.3 Satellite Voice Communication (SATVOICE) Characteristics

(a) For ground-to-air calls, the SATVOICE system must be capable of contacting the aircraft and enabling the ground party/system to provide, as a minimum, the following:

1. secure calling;
2. priority level as defined in Table 2-1; and
3. aircraft SATVOICE number, which is the aircraft address expressed as an 8-digit octal number.

(b) For ground-to-air calls, the SATVOICE system must be capable of locating the aircraft in the appropriate airspace regardless of the satellite and ground earth station (GES) to which the aircraft is logged on.

(c) For air-to-ground calls, the SATVOICE system must be capable of:

1. contacting the aeronautical station via an assigned SATVOICE number, which is a unique 6-digit number or public switched telephone network (PSTN) number; and
2. allowing the flight crew and/or aircraft system to specify the priority level for the call as defined in Table 2-1

Table 2-1. Priority levels for SATVOICE calls (air-to-ground/ground-to-air)

Priority level	Application category
1 / EMG / Q15 Emergency (highest) Safety of flight	Distress and urgency. For use by flight crew, when appropriate.
2 / HGH / Q12 Operational high (second highest) Safety of flight	Flight safety. Typically assigned to calls between aircraft and ANSPs.
3 / LOW / Q10 Operational low (third highest) Safety of flight	Regularity of flight, meteorological, administrative. Typically assigned to calls between aircraft operators and their aircraft.
4 / PUB / Q9 Non-operational (lowest) Non safety	Public correspondence.

C.2.4 Selective calling system (SELCAL)

(a) Where a SELCAL system is installed, the following system characteristics must be applied:

(1) Transmitted code. Each transmitted code must be made up of two consecutive tone pulses, with each pulse containing two simultaneously transmitted tones. The pulses must be of 1.0 plus or minus 0.25 seconds duration, separated by an interval of 0.2 plus or minus 0.1 second.

(2) Stability. The frequency of transmitted tones must be held to plus or minus 0.15 per cent tolerance to ensure proper operation of the airborne decoder.

(3) Distortion. The overall audio distortion present on the transmitted RF signal must not exceed 15 per cent.

(4) Per cent modulation. The RF signal transmitted by the ground radio station must contain, within 3 dB, equal amounts of the two modulating tones. The combination of tones must result in a modulation envelope having a nominal modulation percentage as high as possible and in no case less than 60 per cent.

(5) Transmitted tones. Tone codes must be made up of various combinations of the tones listed in the following table and designated by colour and letter as indicated:

Designation	Frequency (Hz)
Red A	312.6
Red B	346.7
Red C	384.6
Red D	426.6
Red E	473.2
Red F	524.8
Red G	582.1
Red H	645.7
Red J	716.1
Red K	794.3
Red L	881.0
Red M	977.2
Red P	1 083.9
Red Q	1 202.3
Red R	1 333.5
Red S	1 479.1

Note 1. *— It must be noted that the tones are spaced by Log–1 0.045 to avoid the possibility of harmonic combinations.*

Note 2*. — In accordance with the application principles developed by the Sixth Session of the Communications Division, the only codes at present used internationally are selected from the red group.*

Note 3. *— Guidance material on the use of SELCAL systems is contained in the Attachment to Part II.*

Note 4*.— The tones Red P, Red Q, Red R, and Red S are applicable after 1 September 1985, in accordance with 4.3.2.*

(b) As from 1 September 1985, aeronautical stations which are required to communicate with SELCAL-equipped aircraft must have SELCAL encoders in accordance with the red group in the table of tone frequencies in paragraph (a)(5) above. After 1 September 1985, SELCAL codes using the tones Red P, Red Q, Red R, and Red S may be assigned.

C.2.5 Aeronautical Speech Circuits

Technical provisions relating to international aeronautical speech circuit switching and signaling for ground-ground applications is as prescribed in ICAO Annex 10 Volume III Part II Chapter 4 and Doc 9804.

(a) The use of circuit switching and signaling to provide speech circuits to interconnect ATS units not interconnected by dedicated circuits must be by agreement between the Administrations concerned.

(b) The application of aeronautical speech circuit switching and signaling must be made on the basis of regional air navigation agreements.

(c) The ATC communication requirements defined in Annex 11, Section 6.2 must be met by implementation of one or more of the following basic three call types:

(1) instantaneous access;

(2) direct access; and

(3) indirect access.

(d) In addition to the ability to make basic telephone calls, the following functions must be provided in order to meet the requirements set out in Annex 11:

(1) means of indicating the calling/called party identity;

(2) means of initiating urgent/priority calls; and

(3) conference capabilities.

(e) The characteristics of the circuits used in aeronautical speech circuit switching and signaling must conform to appropriate ISO/IEC international standards and ITU-T recommendations.

(f) Digital signaling systems must be used wherever their use can be justified in terms of any of the following:

(1) improved quality of service;

(2) improved user facilities; or

(3) reduce costs where quality of service is maintained.

(g) The characteristics of supervisory tones to be used (such as ringing, busy, number unobtainable) must conform to appropriate ITU-T recommendations.

(h) To take advantage of the benefits of interconnecting regional and national aeronautical speech networks, the international aeronautical telephone network numbering scheme must be used.

C.2.6 Emergency Locator Transmitter (ELT) For Search and Rescue

(a) General

Technical provisions relating to Emergency Locator Transmitter (ELT) for search and rescue application is as prescribed in ICAO Annex 10 Volume III Part II Chapter 5 and Appendix.

(b) Until 1 January 2005, emergency locator transmitters must operate either on both 406 MHz and 121.5 MHz or on 121.5 MHz.

Note. *— From 1 January 2000, ELTs operating on 121.5 MHz will be required to meet the improved technical characteristics contained in section 5.2.1.8 of ICAO Annex 10 Volume III Part II Chapter 5.*

(c) All installations of emergency locator transmitters operating on 406 MHz must meet the provisions of ICAO Annex 10 Volume III Part II Chapter 5.3.

(d) All installations of emergency locator transmitters operating on 121.5 MHz must meet the provisions of ICAO Annex 10 Volume III Part II Chapter 5.2.

(e) From 1 January 2005, emergency locator transmitters must operate on 406 MHz and 121.5 MHz simultaneously.

(f) All emergency locator transmitters installed on or after 1 January 2002 must operate simultaneously on 406 MHz and 121.5 MHz.

(g) The technical characteristics for the 406 MHz component of an integrated ELT must be in accordance with 5.3.

(h) The technical characteristics for the 121.5 MHz component of an integrated ELT must be in accordance with 5.2.

(i) A 406 MHz ELT register must be kept and register information regarding the ELT must be immediately available to search and rescue authorities. The register must be updated whenever necessary.

(j) ELT register information must include the following:

(1) transmitter identification (expressed in the form of an alphanumerical code of 15 hexadecimal characters);

(2) transmitter manufacturer, model and, when available, manufacturer's serial number;

(3) COSPAS-SARSAT* type approval number;

(4) name, address (postal and e-mail) and emergency telephone number of the owner and operator;

(5) name, address (postal and e-mail) and telephone number of other emergency contacts (two, if possible) to whom the owner or the operator is known;

(6) aircraft manufacturer and type; and

(7) colour of the aircraft.

Note 1. *— Various coding protocols are available. Depending on the protocol adopted, one of the following may be included as supplementary identification information to be registered:*

a) aircraft operating agency designator and operator's serial number; or

b) 24-bit aircraft address; or

c) aircraft nationality and registration marks.

The aircraft operating agency designator is allocated to the operator by ICAO through the State administration, and the operator's serial number is allocated by the operator from the block 0001 to 4096.

Appendix D – Aeronautical radio frequency spectrum utilization

D.1 Definitions

Definitions relating to aeronautical radio frequency spectrum utilization as prescribed in ICAO Annex 10, Volume V.

D.2 Distress frequencies as prescribed in ICAO Annex 10, Volume V.

(a) Frequencies for emergency locator transmitters (ELYTs) for search and rescue.

(b) Search and rescue frequencies.

D.3 Utilization of Frequencies below 30 MHz as prescribed in ICAO Annex 10, Volume V.

(a) Method of operations.

(b) NDB frequency management.

D.4 Utilization of Frequencies above 30 MHz as prescribed in ICAO Annex 10, Volume V.

(a) Utilization in the frequency band 117.975 – 137.000 MHz

(b) Utilization in the frequency band 108 – 117.975 MHz

(c) Utilization in the frequency band 960 – 1 215 MHz for DME

(d) Utilization in the frequency band 5 030.4 – 5 150.0 MHz

D.5 Utilization of Frequencies for RPAS C2 Link Communication Services as prescribed in ICAO Annex 10, Volume V.

(a) Satellite-based C2 Link systems

(1) Satellite-based RPAS C2 Link systems must operate in the following frequency bands:

(i) *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 may 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;

(ii) *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 may be used for RPAS C2 Links are: 1 545 – 1 555 MHz and 1 646.5 – 1 656.5MHz;

(iii) *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".

(2) RPA and RPS earth stations must operate within the notified and recorded technical parameters of the associated satellite network, including specific or typical earth stations as published by the ITU.

(3) RPA and RPS earth stations operating in accordance with 5.1.1 (c) must 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 favorable 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.

(b) Terrestrial C2 Link communication systems

(1) Terrestrial RPAS C2 Link systems must 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 signaling frequencies for VDL Mode 4), 960-1164 MHz and 5030-5091 MHz. The operation of the C2 Link within any of these bands must be implemented to be compatible with the systems currently using these allocations. Compatibility must be ensured through the development and application of necessary SARPs and determined on the basis of regional air navigation agreements.

Appendix E – Communication Systems and Procedure relating to Remotely Piloted Aircraft Systems C2 Link.

E.1 SPECIFICATIONS

(a) GENERAL

(1) Any time reference to the C2 Link service and timestamping of the information carried by the C2 Link must be in Coordinated Universal Time (UTC).

(b) SUPPORTED FUNCTIONS

(1) The C2 Link must only support the remote pilot tasks required for the safe and efficient operation of the RPAS.

(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 must, in a secure manner, meet the performance required for those tasks appropriate to the airspace requirements.

(c) SERVICE PROVISION

(1) The C2 Link service must 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 (b) (1).

(2) Each State must designate the authority responsible for documenting and implementing a C2CSP oversight process, in accordance with Annex 6.

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

(4) The C2 Link specification must be commensurate with the C2 Link performance required for safe operations.

(5) The C2 Link's QoSR must be commensurate with the C2 Link specification required for safe operations.

(6) The C2 Link's QoSD must be commensurate with the C2 Link QoSR.

(7) The C2 Link service area geographical coordinates and time of provision, intended for RPAS operational use, must be validated and verified to ensure that C2 link service area is safe for use by its intended recipients.

(8) A pro-active process for anticipating and mitigating interrupted or lost C2 Link states must be implemented and described by the C2CSP to the RPAS operator.

(9) The C2CSP must notify the RPAS operator of any scheduled outages of the C2 Link service provision.

(10) Arrangements must be in place to ensure that the scheduled outage does not affect any RPA during any phase of flight.

(11) The C2CSP must 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.

(12) Before providing any C2 Link service, the C2CSP must demonstrate initial compliance with the provisions contained in (1) and (3) through (8) to the responsible authority.

(d) C2 LINK SERVICE AREA

(1) The C2 Link service area must be compatible with the planned (including contingency) areas of operation of the RPA and the location of all of the RPSs involved in the operation.

(2) The RPA and RPS must always remain within the C2 Link service area.

(3) 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 while determining the C2 Link service area.

E.1.1 PROCEDURES

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.

(a) GENERAL

(1) Prior to the flight, the C2CSP must 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).

(2) 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.

(b) ESTABLISHMENT, ASSURANCE AND TERMINATION OF THE C2 LINK

(1) Human factors principles must 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.

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

(3) An indication must 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.

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

(5) Means must 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.

(6) The procedure supporting the switchover between links or networks that comprise the entire C2 Link must be contained in the operations manual.

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

(8) The Switchovers between the links or networks that constitute the C2 Link during flight should be minimized.

(9) The procedure and the phraseology supporting handover of the C2 Link provision between RPS must be contained in the operations manual.

(10) The procedure supporting the handover must include a report on the status of the QoSE of the C2 Link prior to initiating the handover.

(11) A handover must 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.

(12) The condition of a lost C2 Link state must 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.

(13) The duration of the lost C2 Link decision time must be in accordance with the operational management and safety requirements of the airspace.

(14) Only the remote pilot must terminate or authorize the termination of the C2 Link.

(15) The C2CSP must not intentionally terminate a C2 Link without the explicit consent of the remote pilot.

(c) ESTABLISHMENT AND ASSURANCE OF ATC COMMUNICATIONS

(1) ATC communications relayed through the RPA and the C2 Link must be consistent with those defined for manned aircraft.

(2) Switchovers between links and networks that make up the C2 Link should be avoided during transfer of ATC communications.

(d) CONTINGENCY AND EMERGENCY PROCEDURES

(1) The remote pilot must be provided with all the available RPAS status information pertinent to expedite the recovery of the C2 Link.

(2) Technical and procedural means must 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) From the lost C2 Link decision state, the RPAS must 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.

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

(e) SECURITY

(1) Information exchange between the RPS and RPA carried on the C2 Link must be sufficiently secure to prevent unauthorized interference with the RPAS.

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

(f) DISPLAY

(1) RPS controls and displays must present data in a manner minimizing the potential for errors, misinterpretation or misunderstandings.

(2) The C2 Link state information must be presented to the remote pilot.

(3) An indication of the C2 Link QoSD, in real-time, must be provided to the remote pilot.

(g) MONITORING

(1) An automatic monitoring system must 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:

(2) RPA or RPS C2 Link and/or sub-system link and/or C2CSP emission has ceased;

(3) RPA or RPS C2 Link and/or sub-system link and/or C2CSP reception has ceased;

(4) 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;

(5) interruption of the C2 Link has occurred; or

(6) the C2 Link QoSD has degraded below the stated QoSR.

(7) The monitoring system must provide an alert to the remote pilot in the event of the failure of the monitoring system itself.

(h) RECORDS

(1) A C2 Link log, written or electronic, must be maintained in each RPS.

(2) The record must commence as soon as the C2 Link is established and end only after the C2 Link is terminated.

(3) Written log entries must be made only by authorized and on-duty persons in the RPS.

(4) All entries must be complete, clear, correct and intelligible. Unnecessary marks or notations must not be made in the log.

(5) In written logs, any correction in the log must be made by the authorized on-duty person.

(6) Corrections must be initialled, dated and a rationale given for traceability.

(7) The following information must be entered in logs by the authorized on-duty person:

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

(ii) the identification of the RPS;

(iii) the date;

(iv) the time of opening and closing of the RPS;

(v) the time of establishment and termination of the C2CSP service;

(vi) the time of establishment and termination of the C2 Link;

(vii) the QoSE of the links and networks used;

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

(ix) the signature of the authorized on-duty person;

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

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

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

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

(9) The C2 Link messages related to the C2 Link management must be electronically recorded in the RPA and in any RPS which is in control of the RPA.

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

(11) The RPA must maintain an electronic log, automatically recording any information described in (1) to (8) that is available to it.

(12) The RPA must maintain an automatically recorded electronic log of any received or transmitted ATC/remote pilot communication either voice or data, if relayed through the RPA.

(13) The RPS must maintain an automatically recorded electronic log of any received and transmitted ATC/remote pilot communication either voice or data.

E.2 C2 LINK SYSTEMS

E.2.1 GENERAL

(a) SYSTEM DESCRIPTION

(1) The RPAS communication system must comprise the following systems:

(2) A communication system supporting communications external to the RPAS dedicated to the airspace requirements functions;

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

(i) an interface with the RPS;

(ii) an interface with the RPA;

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

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

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

(b) SPECTRUM

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

(2) C2 Link system frequency assignment planning be designed to provide immunity from harmful interference and not create harmful interference.

(c) SYSTEM CHARACTERISTICS

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

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

(3) The C2 Link system radio frequency transmitters radiate no more power than is necessary to achieve the C2 Link specification.

(d) DATA TRANSMISSION CHARACTERISTICS

(1) The C2 Link system message sequencing must be based on priority criteria.

(2) The C2 Link system messages sequence management must use timestamping.

(3) The order of priority of the transmission of information between the RPS and the RPA must be:

(i) RPA flight control and configuration messages;

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

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

(iv) flight safety telemetry messages including low priority DAA messages;

(v) other flight safety messages;

(vi) routine telemetry messages;

(vii) air traffic services other than ATC communications; and

(viii) other messages.

(e) SIGNAL ACQUISITION AND TRACKING

Reserved

(f) PRIORITY AND PRE-EMPTIVE ACCESS

Reserved

(g) PERFORMANCE REQUIREMENTS

(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.

(h) SYSTEMS INTERFACES

Reserved

(i) RECORDS

Reserved

(j) C2 LINK COMMUNICATION SERVICE PROVIDERS (C2CSP)

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

(2) The C2CSP must ensure that the QoSD is at any time meeting the QoSR.

(3) The C2CSP must 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.

(4) The C2CSPs, RPAS operators and competent authorities must act immediately when their attention is drawn to any harmful interference.

(5) The C2CSP must have the qualified resources and adequate documentation that will allow competent authorities to perform their oversight.

(6) Terrestrial C2 communication service providers

(7) Terrestrial RPAS equipment must operate in frequency spectrum with an allocation as described in Annex 10, Volume V, Chapter 5, section 5.2.

(8) Satellite C2 communication service providers

(9) Satellite RPAS equipment must operate in frequency spectrum with an allocation as described in Annex 10, Volume V, Chapter 5, section 5.1.

(10) SLAs between satellite C2CSPs and RPAS operators must 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.

(11) SLAs between satellite C2CSPs and RPAS operators must ensure that satellite C2CSPs act immediately when their attention is drawn to any harmful interference.

(12) The satellite C2CSP must 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.

(k) FSS SYSTEMS

Reserved

(l) C BAND SATCOM SYSTEMS

Reserved

(m) C BAND TERRESTRIAL SYSTEMS

Reserved

(n) SELF-ORGANIZED AIRBORNE SYSTEMS

Reserved

Appendix F – Definitions

ACAS broadcast means a long Mode S air-air surveillance interrogation (UF = 16) with the broadcast address.

ACAS I means an ACAS which provides information as an aid to "see and avoid" action but does not include the capability for generating resolution advisories.

ACAS II means an ACAS which provides vertical resolution advisories in addition to traffic advisories.

ACAS III means an ACAS which provides vertical and horizontal resolution advisories in addition to traffic advisories.

Active RAC means an RAC is active if it currently constrains the selection of the RA. RACs that have been received within the last six seconds and have not been explicitly cancelled are active.

Adaptive modulation means a system's ability to communicate with another system using multiple burst profiles and a system's ability to subsequently communicate with multiple systems using different burst profiles.

Advanced receiver autonomous integrity monitoring means an ABAS function making use of ISD.

Aerodrome control radio station means a station providing radio communication between an aerodrome control tower and aircraft or mobile aeronautical stations.

AeroMACS downlink means the transmission direction from the base station to the mobile station.

AeroMACS handover means the process in which a mobile station migrates from the air-interface provided by one base station to the air-interface provided by another BS. A break-before-make AeroMACS handover is where service with the target BS starts after a disconnection of service with the previous serving BS.

AeroMACS uplink means the transmission direction from the mobile station (MS) to the base station.

Aeronautical administrative communications means communications necessary for the exchange of aeronautical administrative messages.

Aeronautical broadcasting service means a broadcasting service intended for the transmission of information relating to air navigation.

Aeronautical fixed circuit means a circuit forming part of the aeronautical fixed service.

Aeronautical fixed service means a telecommunication service between specified fixed points provided primarily for the safety of air navigation and for the regular, efficient and economical operation of air services.

Aeronautical fixed station means a station in the aeronautical fixed service.

Aeronautical fixed telecommunication network means a worldwide system of aeronautical fixed circuits provided, as part of the aeronautical fixed service, for the exchange of messages and/or digital data between aeronautical fixed stations having the same or compatible communications characteristics.

Aeronautical fixed telecommunication network circuit means a circuit forming part of the aeronautical fixed telecommunication network.

Aeronautical mobile service means an aeronautical mobile service reserved for communications relating to safety and regularity of flight, primarily along national or international civil air routes.

Aeronautical Mobile Airport Communications System means a high-capacity data link supporting mobile and fixed communications on the aerodrome surface.

Aeronautical mobile-satellite service means an aeronautical mobile-satellite service reserved for communications relating to safety and regularity of flights, primarily along national or international civil air routes.

Aeronautical mobile-satellite service means a mobile-satellite service in which mobile earth stations are located on board aircraft; survival craft stations and emergency position-indicating radio beacon stations may also participate in this service.

Aeronautical operational control means communication required for the exercise of authority over the initiation, continuation, diversion or termination of flight for safety, regularity and efficiency reasons.

Aeronautical radio navigation service means a radio navigation service intended for the benefit and for the safe operation of aircraft.

Aeronautical station means a land station in the aeronautical mobile service. In certain instances, an aeronautical station may be located, for example, on board ship or on a platform at sea.

Aeronautical telecommunication agency means an agency responsible for operating a station or stations in the aeronautical telecommunication service.

Aeronautical telecommunication log means a record of the activities of an aeronautical telecommunication station.

Aeronautical telecommunication network means a global internetwork architecture that allows ground, air-ground and avionic data subnetworks to exchange digital data for the safety of air navigation and for the regular, efficient and economic operation of air traffic services.

Aeronautical telecommunication service means a telecommunication service provided for any aeronautical purpose.

Aeronautical telecommunication station means a station in the aeronautical telecommunication service.

AFTN communication centre means an AFTN station whose primary function is the relay or retransmission of AFTN traffic from (or to) a number of other AFTN stations connected to it.

AFTN destination station means an AFTN station to which messages and/or digital data are addressed for processing for delivery to the addressee.

AFTN origin station means an AFTN station where messages and/or digital data are accepted for transmission over the AFTN.

AFTN station means a station forming part of the aeronautical fixed telecommunication network and operating as such under the authority or control of a State.

Airborne collision avoidance system means 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.

Aircraft address means a unique combination of 24 bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.

Aircraft address means a unique combination of twenty-four bits available for assignment to an aircraft for the purpose of air ground communications, navigation and surveillance.

Aircraft address means a unique combination of twenty-four bits available for assignment to an aircraft for the purpose of air ground communications, navigation and surveillance.

Aircraft data circuit-terminating equipment means an aircraft specific data circuit-terminating equipment that is associated with an airborne data link processor. It operates a protocol unique to Mode S data link for data transfer between air and ground.

Aircraft data link processor means an aircraft-resident processor that is specific to a particular air-ground data link (e.g. Mode S) and which provides channel management, and segments and/or reassembles messages for transfer. It is connected to one side of aircraft elements common to all data link systems and on the other side to the air-ground link itself.

Aircraft earth station means a mobile earth station in the aeronautical mobile-satellite service located on board an aircraft.

Aircraft operating agency means a person, organization or enterprise engaged in, or offering to engage in, an aircraft operation.

Aircraft station means a mobile station in the aeronautical mobile service, other than a survival craft station, located on board an aircraft.

Aircraft-based augmentation system means an augmentation system that augments and/or integrates the information obtained from the other GNSS elements with information available on board the aircraft.

Air-ground communication means two-way communication between aircraft and stations or locations on the surface of the earth.

Air-ground control radio station means an aeronautical telecommunication station having primary responsibility for handling communications pertaining to the operation and control of aircraft in a given area.

Air-initiated protocol means a procedure initiated by a Mode S aircraft installation for delivering a standard length or extended length downlink message to the ground.

Air-report means a report from an aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting.

Air-to-ground communication means one-way communication from aircraft to stations or locations on the surface of the earth.

Alert limit means for a given parameter measurement, the error tolerance not to be exceeded without issuing an alert.

Alert means an indication provided to other aircraft systems or annunciation to the pilot to identify that an operating parameter of a navigation system is out of tolerance.

Alternative means of communication means a means of communication provided with equal status, and in addition to the primary means.

Altitude crossing RA means a resolution advisory is altitude crossing if own ACAS aircraft is currently at least 30 m (100 ft) below or above the threat aircraft for upward or downward sense advisories, respectively.

Angular displacement sensitivity means the ratio of measured DDM to the corresponding angular displacement from the appropriate reference line.

Antenna port means a point where the received signal power is specified. For an active antenna, the antenna port is a fictitious point between the antenna elements and the antenna pre-amplifier. For a passive antenna, the antenna port is the output of the antenna itself.

Application entity means an AE represents a set of ISO/OSI communication capabilities of a particular application process (see ISO/IEC 9545 for further details).

Approach angle means the difference in the ground headings of the two aircraft at closest approach, with 180 degrees defined as head on and 0 degrees defined as parallel.

ATN security services means a set of information security provisions allowing the receiving end system or intermediate system to unambiguously identify (i.e. authenticate) the source of the received information and to verify the integrity of that information.

ATS direct speech circuit means an aeronautical fixed service telephone circuit, for direct exchange of information between air traffic services units.

ATS interfacility data communication means automated data exchange between air traffic services units in support of flight notification, flight coordination, transfer of control and transfer of communication.

ATS message handling service means an ATN application consisting of procedures used to exchange ATS messages in store-and-forward mode over the ATN such that the conveyance of an ATS message is in general not correlated with the conveyance of another ATS message by the service provider.

ATS message handling system means the set of computing and communication resources implemented by ATS organizations to provide the ATS message handling service.

Authorized path means a communication path suitable for a given message category.

Automatic dependent surveillance — contract means 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.

Automatic dependent surveillance-broadcast IN means a function that receives surveillance data from ADS-B OUT data sources.

Automatic dependent surveillance-broadcast OUT means a function on an aircraft or vehicle that periodically broadcasts its state vector (position and velocity) and other information derived from on-board systems in a format suitable for ADS-B IN capable receivers.

Automatic telecommunication log means a record of the activities of an aeronautical telecommunication station recorded by electrical or mechanical means.

Automatic terminal information service means the automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof.

Axial ratio means the ratio, expressed in decibels, between the maximum output power and the minimum output power of an antenna to an incident linearly polarized wave as the polarization orientation is varied over all directions perpendicular to the direction of propagation.

Back course sector means the course sector which is situated on the opposite side of the localizer from the runway.

Base station means a generalized equipment set providing connectivity, management and control of the mobile station.

BDS Comm-B Data Selector means the 8-bit BDS code determines the register whose contents are to be transferred in the MB field of a Comm-B reply. It is expressed in two groups of 4 bits each, BDS1 (most significant 4 bits) and BDS2 (least significant 4 bits).

BDS Open Service means the specified level of positioning, velocity and timing accuracy that is available to any BDS user on a continuous, worldwide basis.

BeiDou Navigation Satellite System means the satellite navigation system operated by China.

Bit error rate means the number of bit errors in a sample divided by the total number of bits in the sample, generally averaged over many such samples.

Blind transmission means a transmission from one station to another station in circumstances where two-way communication cannot be established but where it is believed that the called station is able to receive the transmission.

Broadcast means a transmission of information relating to air navigation that is not addressed to a specific station or stations.

Burst profile means set of parameters that describe the uplink or downlink transmission properties associated with an interval usage code. Each profile contains parameters such as modulation type, forward error correction type, preamble length, guard times, etc.

Burst means a time-defined, contiguous set of one or more related signal units which may convey user information and protocols, signalling, and any necessary preamble.

C2 Link communication service provider means an entity which provides a portion of, or all of, the C2 Link service for the operation of an RPAS.

C2 Link coverage area means the area in which the C2 Link service can be received including the area where the QoSD does not meet the QoSR.

C2 Link interruption means any temporary situation where the C2 Link is unavailable, discontinuous, introduces too much delay, or has inadequate integrity; but where the lost C2 Link decision time has not been exceeded.

C2 Link log means a record of the activities related to the C2 Link.

C2 Link service area means the area within the C2 Link coverage area where the C2 Link QoSD meets the QoSR.

C2 Link service means a communication service providing the C2 Link.

C2 Link specification means the minimum performance to be achieved by the C2 Link equipment in conformity with the applicable airworthiness system design requirements.

C2 Link means the data link between the remotely piloted aircraft and the remote pilot station for the purposes of managing the flight.

Capability report means information identifying whether the transponder has a data link capability as reported in the capability (CA) field of an all-call reply or squitter transmission.

Carrier-to-multipath ratio means the ratio of the carrier power received directly, i.e. without reflection, to the multipath power, i.e. carrier power received via reflection.

Carrier-to-noise density ratio means the ratio of the total carrier power to the average noise power in a 1 Hz bandwidth, usually expressed in dBHz.

Channel of standard accuracy means the specified level of positioning, velocity and timing accuracy that is available to any GLONASS user on a continuous, worldwide basis.

Channel rate accuracy means this is relative accuracy of the clock to which the transmitted channel bits are synchronized. For example, at a channel rate of 1.2 kbits/s, maximum error of one part in 106 implies the maximum allowed error in the clock is ±1.2 × 10-3 Hz.

Channel rate means the rate at which bits are transmitted over the RF channel. These bits include those bits used for framing and error correction, as well as the information bits. For burst transmission, the channel rate refers to the instantaneous burst rate over the period of the burst.

Circuit mode means a configuration of the communications network which gives the appearance to the application of a dedicated transmission path.

Climb RA means a positive RA recommending a climb but not an increased climb.

Close-out means a command from a Mode S interrogator that terminates a Mode S link layer communication transaction.

Closest approach means the occurrence of minimum range between own ACAS aircraft and the intruder. Thus range at closest approach is the smallest range between the two aircraft and time of closest approach is the time at which this occurs.

Cluster of interrogators means two or more interrogators with the same interrogator identifier (II) code, operating cooperatively to ensure that there is no interference to the required surveillance and data link performance of each of the interrogators, in areas of common coverage.

Collision avoidance logic means the sub-system or part of ACAS that analyses data relating to an intruder and own aircraft, decides whether or not advisories are appropriate and, if so, generates the advisories. It includes the following functions: range and altitude tracking, threat detection and RA generation. It excludes surveillance.

Comm-A means a 112-bit interrogation containing the 56-bit MA message field. This field is used by the uplink standard length message and broadcast protocols.

Comm-B means a 112-bit reply containing the 56-bit MB message field. This field is used by the downlink SLM, ground-initiated and broadcast protocols.

Comm-C means a 112-bit interrogation containing the 80-bit MC message field. This field is used by the uplink extended length message protocol.

Comm-D means a 112-bit reply containing the 80-bit MD message field. This field is used by the downlink ELM protocol.

Communication centre means an aeronautical fixed station which relays or retransmits telecommunication traffic from (or to) a number of other aeronautical fixed stations directly connected to it.

Connection establishment delay means connection establishment delay, as defined in ISO 8348, includes a component, attributable to the called subnetwork (SN) service user, which is the time between the SN-CONNECT indication and the SN-CONNECT response. This user component is due to actions outside the boundaries of the satellite subnetwork and is therefore excluded from the AMS(R)S specifications.

Connection means a logical association between peer-level entities in a communication system.

Control motion noise means that portion of the guidance signal error which causes control surface, wheel and column motion and could affect aircraft attitude angle during coupled flight, but does not cause aircraft displacement from the desired course and/or glide path.

Convolutional turbo codes means type of forward error correction code.

Coordination interrogation means a Mode S interrogation (uplink transmission) radiated by ACAS II or III and containing a resolution message.

Coordination reply means a Mode S reply (downlink transmission) acknowledging the receipt of a coordination interrogation by the Mode S transponder that is part of an ACAS II or III installation.

Coordination means the process by which two ACAS-equipped aircraft select compatible resolution advisories (RAs) by the exchange of resolution advisory complements (RACs).

Core satellite constellation(s) means the core satellite constellations are GPS, GLONASS, Galileo and BDS.

Corrective RA means a resolution advisory that advises the pilot to deviate from the current flight path.

Course line means the locus of points nearest to the runway centre line in any horizontal plane at which the DDM is zero. Course sector. A sector in a horizontal plane containing the course line and limited by the loci of points nearest to the course line at which the DDM is 0.155.

CPDLC message set means a list of standard message elements and free text message elements.

CPDLC message means Information exchanged between an airborne system and its ground counterpart. A CPDLC message consists of a single message element or a combination of message elements conveyed in a single transmission by the initiator.

Crossing encounter means an encounter in which the altitude separation of the two aircraft exceeds 100 ft at the beginning and at the end of the encounter window, and the relative vertical position of two aircraft at the end of the encounter window is reversed from that at the beginning of the encounter window.

Current data authority means the designated ground system through which a CPDLC dialogue between a pilot and a controller currently responsible for the flight is permitted to take place.

Current slot means the slot in which a received transmission begins.

Cycle means the term "cycle" used in this chapter refers to one complete pass through the sequence of functions executed by ACAS II or ACAS III, nominally once a second.

Data circuit-terminating equipment means a DCE is a network provider equipment used to facilitate communications between DTEs.

Data link capability report means Information in a Comm-B reply identifying the complete Mode S communications capabilities of the aircraft installation.

Data link entity means a protocol state machine capable of setting up and managing a single data link connection.

Data link flight information services means the provision of FIS via data link.

Data link initiation capability means a data link application that provides the ability to exchange addresses, names and version numbers necessary to initiate data link applications.

Data link service sublayer means the sublayer that resides above the MAC sublayer. For VDL Mode 4, the DLS sublayer resides above the VSS sublayer. The DLS manages the transmit queue, creates and destroys DLEs for connection oriented communications, provides facilities for the LME to manage the DLS, and provides facilities for connectionless communications.

Data link-automatic terminal information service (D-ATIS) means the provision of ATIS via data link.

Data terminal equipment means a DTE is an endpoint of a subnetwork connection.

Data transit delay means the average value of the statistical distribution of data delays. This delay represents the subnetwork delay and does not include the connection establishment delay.

Data transit delay means the average value of the statistical distribution of data delays. This delay represents the subnetwork delay and does not include the connection establishment delay.

Difference in depth of modulation means the percentage modulation depth of the larger signal minus the percentage modulation depth of the smaller signal, divided by 100.

Descend RA means a positive RA recommending a descent but not an increased descent.

Directory service means a service, based on the ITU-T X.500 series of recommendations, providing access to and management of structured information relevant to the operation of the ATN and its users.

Displacement sensitivity (localizer) means the ratio of measured DDM to the corresponding lateral displacement from the appropriate reference line.

DME dead time means a period immediately following the decoding of a valid interrogation during which a received interrogation will not cause a reply to be generated.

DME/N means Distance measuring equipment, primarily serving operational needs of en-route or TMA navigation, where the "N stands for narrow spectrum characteristics.

DME/P means the distance measuring element of the MLS, where the "P" stands for precise distance measurement. The spectrum characteristics are those of DME/N.

Domain means a set of end systems and intermediate systems that operate according to the same routing procedures and that is wholly contained within a single administrative domain.

Doppler shift means the frequency shift observed at a receiver due to any relative motion between transmitter and receiver.

Double channel simplex means simplex using two frequency channels, one in each direction.

Downlink ELM means a term referring to extended length downlink communication by means of 112-bit Mode S Comm-D replies, each containing the 80-bit Comm-D message field (MD).

Downlink means a term referring to the transmission of data from an aircraft to the ground. Mode S air-to-ground signals are transmitted on the 1 090 MHz reply frequency channel.

Duplex means a method in which telecommunication between two stations can take place in both directions simultaneously.

Effective acceptance bandwidth means the range of frequencies with respect to the assigned frequency for which reception is assured when all receiver tolerances have been taken into account.

Effective adjacent channel rejection means the rejection that is obtained at the appropriate adjacent channel frequency when all relevant receiver tolerances have been taken into account.

Encounter class means encounters are classified according to whether or not the aircraft are transitioning at the beginning and end of the encounter window, and whether or not the encounter is crossing.

Encounter window means the time interval [tca – 40 s, tca + 10 s].

Encounter means for the purposes of defining the performance of the collision avoidance logic, an encounter consists of two simulated aircraft trajectories. The horizontal coordinates of the aircraft represent the actual position of the aircraft but the vertical coordinate represents an altimeter measurement of altitude.

End-to-end means pertaining or relating to an entire communication path, typically from:

(1) the interface between the information source and the communication system at the transmitting end to

(2) the interface between the communication system and the information user or processor or application at the receiving end.

End-user means an ultimate source and/or consumer of information.

Energy per symbol to noise density ratio means the ratio of the average energy transmitted per channel symbol to the average noise power in a 1 Hz bandwidth, usually expressed in dB. For A-BPSK and A-QPSK, one channel symbol refers to one channel bit.

Equivalent isotropically radiated power means the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain).

Essential radio navigation service means a radio navigation service whose disruption has a significant impact on operations in the affected airspace or aerodrome.

Established track means a track generated by ACAS air-air surveillance that is treated as the track of an actual aircraft.

Extended Go lay Code means an error correction code capable of correcting multiple bit errors.

Extended length message means a series of Comm-C interrogations (uplink ELM) transmitted without the requirement for intervening replies, or a series of Comm-D replies (downlink ELM) transmitted without intervening interrogations.

Facility Performance Category I — ILS means an ILS which provides guidance information from the coverage limit of the ILS to the point at which the localizer course line intersects the ILS glide path at a height of 30 m (100 ft) or less above the horizontal plane containing the threshold.

Fan marker beacon means a type of radio beacon, the emissions of which radiate in a vertical fan-shaped pattern.

Final approach mode means the condition of DME/P operation which supports flight operations in the final approach and runway regions.

Forward error correction means the process of adding redundant information to the transmitted signal in a manner which allows correction, at the receiver, of errors incurred in the transmission.

Forward error correction means the process of adding redundant information to the transmitted signal in a manner which allows correction, at the receiver, of errors incurred in the transmission.

Frame means the basic unit of transfer at the link level. In the context of Mode S subnetwork, a frame can include from one to four Comm-A or Comm-B segments, from two to sixteen Comm-C segments, or from one to sixteen Comm-D segments.

Frame means the link layer frame is composed of a sequence of address, control, FCS and information fields. For VDL Mode 2, these fields are bracketed by opening and closing flag sequences, and a frame may or may not include a variable-length information field.

Frequency assignment means a logical assignment of centre frequency and channel bandwidth programmed to the base station.

Frequency channel means a continuous portion of the frequency spectrum appropriate for a transmission utilizing a specified class of emission.

Front course sector means the course sector which is situated on the same side of the localizer as the runway.

Gain-to-noise temperature ratio means the ratio, usually expressed in dB/K, of the antenna gain to the noise at the receiver output of the antenna subsystem. The noise is expressed as the temperature that a 1-ohm resistor must be raised to produce the same noise power density.

Galileo Open Service means the specified level of positioning, velocity and timing accuracy that is available to any Galileo user on a continuous, worldwide basis.

Galileo means the satellite navigation system operated by the European Union.

Gaussian filtered frequency shift keying means a continuous-phase, frequency shift keying technique using two tones and a Gaussian pulse shape filter.

GBAS/E means a ground-based augmentation system transmitting an elliptically-polarized VHF data broadcast.

GBAS/H means a ground-based augmentation system transmitting a horizontally-polarized VHF data broadcast.

General formatter/manager means the aircraft function responsible for formatting messages to be inserted in the transponder registers. It is also responsible for detecting and handling error conditions such as the loss of input data.

Global navigation satellite system means the satellite navigation system operated by the Russian Federation.

Global navigation satellite system means a worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers and system integrity monitoring, augmented as necessary to support the required navigation performance for the intended operation.

Global positioning system means the satellite navigation system operated by the United States.

Global signalling channel means a channel available on a worldwide basis which provides for communication control.

GNSS position error means the difference between the true position and the position determined by the GNSS receiver.

Ground data circuit-terminating equipment means a ground specific data circuit-terminating equipment associated with a ground data link processor. It operates a protocol unique to Mode S data link for data transfer between air and ground.

Ground data link processor means a ground-resident processor that is specific to a particular air-ground data link (e.g. Mode S), and which provides channel management, and segments and/or reassembles messages for transfer. It is connected on one side (by means of its DCE) to ground elements common to all data link systems, and on the other side to the air-ground link itself.

Ground earth station means an earth station in the fixed satellite service, or, in some cases, in the aeronautical mobile-satellite service, located at a specified fixed point on land to provide a feeder link for the aeronautical mobile-satellite service.

Ground-based augmentation system means an augmentation system in which the user receives augmentation information directly from a ground-based transmitter.

Ground-based regional augmentation system means an augmentation system in which the user receives augmentation information directly from one of a group of ground-based transmitters covering a region.

Ground-initiated Comm-B means the ground-initiated Comm-B protocol allows the interrogator to extract Comm-B replies containing data from a defined source in the MB field.

Ground-initiated protocol means a procedure initiated by a Mode S interrogator for delivering standard length or extended length messages to a Mode S aircraft installation.

Ground-to-air communication means one-way communication from stations or locations on the surface of the earth to aircraft.

Half course sector means the sector, in a horizontal plane containing the course line and limited by the loci of points nearest to the course line at which the DDM is 0.0775. Half ILS glide path sector. The sector in the vertical plane containing the ILS glide path and limited by the loci of points nearest to the glide path at which the DDM is 0.0875.

Homing means the procedure of using the direction-finding equipment of one radio station with the emission of another radio station, where at least one of the stations is mobile, and whereby the mobile station proceeds continuously towards the other station.

Horizontal miss distance means the minimum horizontal separation observed in an encounter.

ILS continuity of service means that quality which relates to the rarity of radiated signal interruptions. The level of continuity of service of the localizer or the glide path is expressed in terms of the probability of not losing the radiated guidance signals.

ILS glide path angle means the angle between a straight line which represents the mean of the ILS glide path and the horizontal.

ILS glide path sector means the sector in the vertical plane containing the ILS glide path and limited by the loci of points nearest to the glide path at which the DDM is 0.175.

ILS glide path means that locus of points in the vertical plane containing the runway centre line at which the DDM is zero, which, of all such loci, is the closest to the horizontal plane.

ILS integrity means that quality which relates to the trust which can be placed in the correctness of the information supplied by the facility. The level of integrity of the localizer or the glide path is expressed in terms of the probability of not radiating false guidance signals.

ILS Point "A" means a point on the ILS glide path measured along the extended runway centre line in the approach direction a distance of 7.5 km (4 NM) from the threshold.

ILS Point "B" means a point on the ILS glide path measured along the extended runway centre line in the approach direction a distance of 1 050 m (3 500 ft) from the threshold.

ILS Point "C" means a point through which the downward extended straight portion of the nominal ILS glide path passes at a height of 30 m (100 ft) above the horizontal plane containing the threshold.

ILS Point "D" means a point 4 m (12 ft) above the runway centre line and 900 m (3 000 ft) from the threshold in the direction of the localizer.

ILS Point "E" means a point 4 m (12 ft) above the runway centre line and 600 m (2 000 ft) from the stop end of the runway in the direction of the threshold.

ILS reference datum Point "T" means a point at a specified height located above the intersection of the runway centre line and the threshold and through which the downward extended straight portion of the ILS glide path passes.

Increased rate RA means a resolution advisory with a strength that recommends increasing the altitude rate to a value exceeding that recommended by a previous climb or descend RA.

Initial approach mode means the condition of DME/P operation which supports those flight operations outside the final approach region and which is interoperable with DME/N.

Integrity support data means a set of parameters that characterize the signal-in-space (SIS) integrity performance for each specific core satellite constellation and ARAIM service type.

Integrity support message means a dedicated core satellite constellation broadcast navigation message that contains ISD parameters which may improve ARAIM performance compared to the default ISD values.

Integrity means a measure of the trust that can be placed in the correctness of the information supplied by the total system. Integrity includes the ability of a system to provide timely and valid warnings to the user (alerts).

Intermediate system means a system which performs relaying and routing functions and comprises the lowest three layers of the OSI reference model.

International telecommunication service means a telecommunication service between offices or stations of different States, or between mobile stations which are not in the same State, or are subject to different States.

Interpilot air-to-air communication means two-way communication on the designated air-to-air channel to enable aircraft engaged in flights over remote and oceanic areas out of range of VHF ground stations to exchange necessary operational information and to facilitate the resolution of operational problems.

Intruder means an aircraft for which ACAS has an established track.

Ionosphere-free pseudo-range means a pseudo-range in which the first order ionosphere effect on signal propagation has been removed by a linear combination of pseudo-range measurements from signals on two distinct frequencies from the same satellite.

ISM generator means entity which determines the values of the ISD parameters transmitted in the ISM for ARAIM for a given core satellite constellation.

Key down time means the time during which a dot or dash of a Morse character is being transmitted.

Level aircraft means an aircraft that is not transitioning.

Link layer means the layer that lies immediately above the physical layer in the Open Systems Interconnection protocol model. The link layer provides for the reliable transfer of information across the physical media. It is subdivided into the data link sublayer and the media access control sublayer.

Link management entity means a protocol state machine capable of acquiring, establishing and maintaining a connection to a single peer system. An LME establishes data link and subnetwork connections, "hands-off" those connections, and manages the media access control sublayer and physical layer. An aircraft LME tracks how well it can communicate with the ground stations of a single ground system. An aircraft VME instantiates an LME for each ground station that it monitors. Similarly, the ground VME instantiates an LME for each aircraft that it monitors. An LME is deleted when communication with the peer system is no longer viable.

Link means a link connects an aircraft DLE and a ground DLE and is uniquely specified by the combination of aircraft DLS address and the ground DLS address. A different subnetwork entity resides above every link endpoint.

Location indicator means a four-letter code group formulated in accordance with rules prescribed by ICAO and assigned to the location of an aeronautical fixed station.

Logon address means a specified code used for data link logon to an ATS unit.

Lost C2 Link decision state means the state of the RPAS in which a C2 Link interruption has occurred, but the duration of which does not exceed the lost C2 Link decision time.

Lost C2 Link decision time means the maximum length of time permitted before declaring a lost C2 Link state during which the C2 Link performance is not sufficient to allow the remote pilot to actively manage the flight in a safe and timely manner appropriate to the airspace and operational conditions.

Lost C2 Link state means the state of the RPAS in which the C2 Link performance has degraded, as a result of a C2 Link interruption that is longer than the lost C2 Link decision time, to a point where it is not sufficient to allow the remote pilot to actively manage the flight in a safe and timely manner.

M burst means a management channel data block of bits used in VDL Mode 3. This burst contains signalling information needed for media access and link status monitoring.

Mean power of a radio transmitter means the average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions.

Media access control means the sublayer that acquires the data path and controls the movement of bits over the data path.

Meteorological operational channel means a channel of the aeronautical fixed service, for the exchange of aeronautical meteorological information.

Meteorological operational telecommunication network means an integrated system of meteorological operational channels, as part of the aeronautical fixed service, for the exchange of aeronautical meteorological information between the aeronautical fixed stations within the network.

MLS approach reference datum means a point on the minimum glide path at a specified height above the threshold.

MLS datum point means the point on the runway centre line closest to the phase centre of the approach elevation antenna.

Mobile station means a station in the mobile service intended to be used while in motion or during halts at unspecified points. An MS is always a subscriber station.

Mobile surface station means a station in the aeronautical telecommunication service, other than an aircraft station, intended to be used while in motion or during halts at unspecified points.

Mode 2 means a data-only VDL mode that uses D8PSK modulation and a carrier sense multiple access control scheme.

Mode 3 means a voice and data VDL mode that uses D8PSK modulation and a TDMA media access control scheme.

Mode 4 means a data-only VDL mode using a GFSK modulation scheme and self-organizing time division multiple access.

Mode S air-initiated Comm-B protocol means a procedure initiated by a Mode S transponder for transmitting a single Comm-B segment from the aircraft installation.

Mode S broadcast protocols means procedures allowing standard length uplink or downlink messages to be received by more than one transponder or ground interrogator respectively.

Mode S ground-initiated Comm-B protocol means a procedure initiated by a Mode S interrogator for eliciting a single Comm-B segment from a Mode S aircraft installation, incorporating the contents of one of 255 Comm-B registers within the Mode S transponder.

Mode S multisite-directed protocol means a procedure to ensure that extraction and close-out of a downlink standard length or extended length message is affected only by the particular Mode S interrogator selected by the aircraft.

Mode S packet means a packet conforming to the Mode S subnetwork standard, designed to minimize the bandwidth required from the air-ground link. ISO 8208 packets may be transformed into Mode S packets and vice-versa.

Mode S specific protocol means a protocol that provides restricted datagram service within the Mode S subnetwork.

Mode S specific services entity means an entity resident within an XDLP to provide access to the Mode S specific services.

Mode S specific services means a set of communication services provided by the Mode S system which are not available from other air-ground subnetworks, and therefore not interoperable.

Mode S subnetwork means a means of performing an interchange of digital data through the use of secondary surveillance radar Mode S interrogators and transponders in accordance with defined protocols.

Mode W, X, Y, Z means a method of coding the DME transmissions by time spacing pulses of a pulse pair, so that each frequency can be used more than once.

Multilink means the ability to use more than one available air-ground subnetworks in order to provide the required performance.

Network station means an aeronautical station forming part of a radiotelephony network.

Next data authority means the ground system so designated by the current data authority through which an onward transfer of communications and control can take place.

Nominal C2 Link state means the state of the RPAS when the C2 Link performance is sufficient to allow the remote pilot to actively manage the flight of the RPA in a safe and timely manner appropriate to the airspace and operational conditions.

Non-network communications means Radiotelephony communications conducted by a station of the aeronautical mobile service, other than those conducted as part of a radiotelephony network.

Offset frequency simplex means a variation of single channel simplex wherein telecommunication between two stations is effected by using in each direction frequencies that are intentionally slightly different but contained within a portion of the spectrum allotted for the operation.

Operational control communications means communications required for the exercise of authority over the initiation, continuation, diversion or termination of a flight in the interest of the safety of the aircraft and the regularity and efficiency of a flight.

Operational control communications means communications required for the exercise of authority over the initiation, continuation, diversion or termination of a flight in the interest of the safety of the aircraft and the regularity and efficiency of a flight.

Original rate means the original rate of an ACAS-equipped aircraft at any time is its altitude rate at the same time when it followed the original trajectory.

Original trajectory means the original trajectory of an ACAS-equipped aircraft is that followed by the aircraft in the same encounter when it was not ACAS equipped.

Own aircraft means the aircraft fitted with the ACAS that is the subject of the discourse, which ACAS is to protect against possible collisions, and which may enter a manoeuvre in response to an ACAS indication.

Packet means the basic unit of data transfer among communication devices within the network layer (e.g. an ISO 8208 packet or a Mode S packet).

Partial rise time means the time as measured between the 5 and 30 per cent amplitude points on the leading edge of the pulse envelope.

Partial usage sub-channelization means a technique in which the orthogonal frequency division multiplexing symbol subcarriers are divided and permuted among a subset of sub-channels for transmission, providing partial frequency diversity.

Path following error means that portion of the guidance signal error which could cause aircraft displacement from the desired course and/or glide path.

Physical layer means the lowest level layer in the Open Systems Interconnection protocol model. The physical layer is concerned with the transmission of binary information over the physical medium (e.g. VHF radio).

Point-to-point means pertaining or relating to the interconnection of two devices, particularly end-user instruments. A communication path of service intended to connect two discrete end-users; as distinguished from broadcast or multipoint service.

Positive RA means a resolution advisory that advises the pilot either to climb or to descend (applies to ACAS II).

Potential threat means an intruder deserving special attention either because of its close proximity to own aircraft or because successive range and altitude measurements indicate that it could be on a collision or near-collision course with own aircraft. The warning time provided against a potential threat is sufficiently small that a traffic advisory is justified but not so small that a resolution advisory would be justified.

Preventive RA means a resolution advisory that advises the pilot to avoid certain deviations from the current flight path but does not require any change in the current flight path.

Primary frequency means the radiotelephony frequency assigned to an aircraft as a first choice for air-ground communication in a radiotelephony network.

Primary means of communication means the means of communication to be adopted normally by aircraft and ground stations as a first choice where alternative means of communication exist.

Protected service volume means a part of the facility coverage where the facility provides a particular service in accordance with relevant SARPs and within which the facility is afforded frequency protection.

Pseudo-range means the difference between the time of transmission by a satellite and reception by a GNSS receiver multiplied by the speed of light in a vacuum, including bias due to the difference between a GNSS receiver and satellite time reference.

Pulse amplitude means the maximum voltage of the pulse envelope.

Pulse code means the method of differentiating between W, X, Y and Z modes and between FA and IA modes.

Pulse decay time means the time as measured between the 90 and 10 per cent amplitude points on the trailing edge of the pulse envelope.

Pulse duration means the time interval between the 50 per cent amplitude point on leading and trailing edges of the pulse envelope.

Pulse rise time means the time as measured between the 10 and 90 per cent amplitude points on the leading edge of the pulse envelope.

Quality of service means the totality of the characteristics of an entity that bear on its ability to satisfy stated and implied needs.

Quality of service delivered means a statement of the QoS achieved or delivered to the RPAS operator by the C2CSP.

Quality of service experienced means a statement expressing the QoS that the remote pilot believes they have experienced.

Quality of service required means a statement of the QoS requirements of the RPAS operator to the C2CSP.

Quality of service means the information relating to data transfer characteristics used by various communication protocols to achieve various levels of performance for network users.

RA sense means the sense of an ACAS II RA is “upward” if it requires climb or limitation of descent rate and “downward” if it requires descent or limitation of climb rate. It can be both upward and downward simultaneously if it requires limitation of the vertical rate to a specified range.

Radio bearing means the angle between the apparent direction of a definite source of emission of electro-magnetic waves and a reference direction, as determined at a radio direction-finding station. A true radio bearing is one for which the reference direction is that of true North. A magnetic radio bearing is one for which the reference direction is that of magnetic North.

Radio direction finding means Radio determination using the reception of radio waves for the purpose of determining the direction of a station or object.

Radio direction-finding station means a radio determination station using radio direction finding.

Radiotelephony network means a group of radiotelephony aeronautical stations which operate on and guard frequencies from the same family and which support each other in a defined manner to ensure maximum dependability of air-ground communications and dissemination of air-ground traffic.

Readback means a procedure whereby the receiving station repeats a received message or an appropriate part thereof back to the transmitting station so as to obtain confirmation of correct reception.

Receiver means a subsystem that receives GNSS signals and includes one or more sensors.

Reed-Solomon code means an error correction code capable of correcting symbol errors. Since symbol errors are collections of bits, these codes provide good burst error correction capabilities.

Regular station means a station selected from those forming an en-route air-ground radiotelephony network to communicate with or to intercept communications from aircraft in normal conditions.

Remote pilot station means the component of the remotely piloted aircraft system containing the equipment used to pilot the remotely piloted aircraft.

Remotely piloted aircraft means an unmanned aircraft which is piloted from a remote pilot station.

Remotely piloted aircraft system means a remotely piloted aircraft, its associated remote pilot station(s), the required C2 Link(s) and any other component as specified in the type design.

Reply efficiency means the ratio of replies transmitted by the transponder to the total of received valid interrogations.

Required communication performance means a statement of the performance requirements for operational communication in support of specific ATM functions (see Manual on Required Communication Performance (RCP) (Doc 9869)).

Required rate means for the standard pilot model, the required rate is that closest to the original rate consistent with the RA.

Reserved (bits/words/fields) means Bits/words/fields that are not allocated, but which are reserved for a particular GNSS application.

Residual error rate means the ratio of incorrect, lost and duplicate subnetwork service data units (SNSDUs) to the total number of SNSDUs that were sent.

Resolution advisory means an indication given to the flight crew recommending:

a) a manoeuvre intended to provide separation from all threats; or

b) a manoeuvre restriction intended to maintain existing separation.

Resolution advisory complement means information provided by one ACAS to another via a Mode S interrogation in order to ensure complementary manoeuvres by restricting the choice of manoeuvres available to the ACAS receiving the RAC.

Resolution advisory complements record means a composite of all currently active vertical RACs (VRCs) and horizontal RACs (HRCs) that have been received by ACAS. This information is provided by one ACAS to another ACAS or to a Mode S ground station via a Mode S reply.

Resolution advisory strength means the magnitude of the manoeuvre indicated by the RA. An RA may take on several successive strengths before being cancelled. Once a new RA strength is issued, the previous one automatically becomes void.

Resolution message means the message containing the resolution advisory complement (RAC).

Reversed sense RA means a resolution advisory that has had its sense reversed.

Route segment means a route or portion of route usually flown without an intermediate stop.

Router means a router is a node that forwards Internet protocol (IP) packets not explicitly addressed to itself. A router manages the relaying and routing of data while in transit from an originating end system to a destination end system.

Routing Directory means a list in a communication centre indicating for each addressee the outgoing circuit to be used.

Satellite-based augmentation system means a wide coverage augmentation system in which the user receives augmentation information from a satellite-based transmitter.

Search means the condition which exists when the DME interrogator is attempting to acquire and lock onto the response to its own interrogations from the selected transponder.

Secondary frequency means the radiotelephony frequency assigned to an aircraft as a second choice for air-ground communication in a radiotelephony network.

Secondary surveillance radar means a surveillance radar system which uses transmitters/receivers (interrogators) and transponders.

Segment means a portion of a message that can be accommodated within a single MA/MB field in the case of a standard length message, or MC/MD field in the case of an extended length message. This term is also applied to the Mode S transmissions containing these fields.

Self-organizing time division multiple **access** means a multiple access scheme based on time-shared use of a radio frequency (RF) channel employing:

(1) discrete contiguous time slots as the fundamental shared resource; and

(2) a set of operating protocols that allows users to mediate access to these time slots without reliance on a master control station.

Sensitivity level means an integer defining a set of parameters used by the traffic advisory (TA) and collision avoidance algorithms to control the warning time provided by the potential threat and threat detection logic, as well as the values of parameters relevant to the RA selection logic.

Service data unit means a unit of data transferred between adjacent layer entities, which is encapsulated within a protocol data unit (PDU) for transfer to a peer layer.

Service flow means a unidirectional flow of media access control layer (MAC) service data units (SDUs) on a connection that is providing a particular quality of service (QoS).

Service level agreement means the agreement between the C2CSP and the RPAS operator covering the safety, performance, service area and security of the C2 Link provision as required for the RPAS operator's intended operations.

Simplex means a method in which telecommunication between two stations takes place in one direction at a time.

Single channel simplex means Simplex using the same frequency channel in each direction.

Slot means one of a series of consecutive time intervals of equal duration. Each burst transmission starts at the beginning of a slot.

Slotted aloha means a random access strategy whereby multiple users access the same communications channel independently, but each communication must be confined to a fixed time slot. The same timing slot structure is known to all users, but there is no other coordination between the users.

Spare (bits/words/fields) means Bits/words/fields that are not allocated or reserved, and which are available for future allocation.

Spot beam means Satellite antenna directivity whose main lobe encompasses significantly less than the earth's surface that is within line-of-sight view of the satellite. May be designed so as to improve system resource efficiency with respect to geographical distribution of user earth stations.

Standard length message means an exchange of digital data using selectively addressed Comm-A interrogations and/or Comm-B replies

Standard positioning service means the specified level of positioning, velocity and timing accuracy that is available to any global positioning system user on a continuous, worldwide basis.

Subnetwork connection means a long-term association between an aircraft DTE and a ground DTE using successive virtual calls to maintain context across link handoff.

Subnetwork dependent convergence function means a function that matches the characteristics and services of a particular subnetwork to those characteristics and services required by the internetwork facility.

Subnetwork entity means in this document, the phrase "ground DCE" will be used for the subnetwork entity in a ground station communicating with an aircraft; the phrase "ground DTE" will be used for the subnetwork entity in a ground router communicating with an aircraft station; and, the phrase "aircraft DTE" will be used for the subnetwork entity in an aircraft communicating with the station. A subnetwork entity is a packet layer entity as defined in ISO 8208.

Subnetwork entry time means the time from when the mobile station starts the scanning for BS transmission, until the network link establishes the connection, and the first network user "protocol data unit" can be sent.

Subnetwork layer means the layer that establishes, manages and terminates connections across a subnetwork.

Subnetwork management entity means an entity resident within a GDLP that performs subnetwork management and communicates with peer entities in intermediate or end-systems.

Subnetwork service data unit means an amount of subnetwork user data, the identity of which is preserved from one end of a subnetwork connection to the other.

Subnetwork means an actual implementation of a data network that employs a homogeneous protocol and addressing plan, and is under the control of a single authority.

Subscriber station means a generalized equipment set providing connectivity between subscriber equipment and a base station.

Surveillance radar means radar equipment used to determine the position of an aircraft in range and azimuth.

Switchover means the act of transferring the active datalink path between the RPS and the RPA from one of the links or networks that constitutes the C2 Link to another link or network that constitutes the C2 Link.

System efficiency means the ratio of valid replies processed by the interrogator to the total of its own interrogations.

System A VDL-capable entity means a system comprises one or more stations and the associated VDL management entity. A system may either be an aircraft system or a ground system.

Telecommunication means any transmission, emission, or reception of signs, signals, writing, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems.

Threat means an intruder deserving special attention either because of its close proximity to own aircraft or because successive range and altitude measurements indicate that it could be on a collision or near-collision course with own aircraft. The warning time provided against a threat is sufficiently small that an RA is justified.

Time division duplex means a duplex scheme where uplink and downlink transmissions occur at different times but may share the same frequency.

Time division multiple access means a multiple access scheme based on time-shared use of an RF channel employing:

(1) discrete contiguous time slots as the fundamental shared resource; and

(2) a set of operating protocols that allows users to interact with a master control station to mediate access to the channel.

Time division multiplex means a channel sharing strategy in which packets of information from the same source but with different destinations are sequenced in time on the same channel.

Timeout means the cancellation of a transaction after one of the participating entities has failed to provide a required response within a pre-defined period of time.

Time-to-alert means the maximum allowable time elapsed from the onset of the navigation system being out of tolerance until the equipment enunciates the alert.

Total voice transfer delay means the elapsed time commencing at the instant that speech is presented to the AES or GES and concluding at the instant that the speech enters the interconnecting network of the counterpart GES or AES. This delay includes vocoder processing time, physical layer delay, RF propagation delay and any other delays within an AMS(R)S subnetwork.

Touchdown means the point where the nominal glide path intercepts the runway.

Track means a sequence of measurements representing positions that could reasonably have been occupied by an aircraft.

Track means the condition which exists when the DME interrogator has locked onto replies in response to its own interrogations, and is continuously providing a distance measurement.

Traffic advisory means an indication given to the flight crew that a certain intruder is a potential threat.

Traffic information service – broadcast IN means a surveillance function that receives and processes surveillance data from TIS-B OUT data sources.

Traffic information service – broadcast OUT means a function on the ground that periodically broadcasts the surveillance information made available by ground sensors in a format suitable for TIS-B IN capable receivers.

Transit delay means in packet data systems, the elapsed time between a request to transmit an assembled data packet and an indication at the receiving end that the corresponding packet has been received and is ready to be used or forwarded.

Transitioning aircraft means an aircraft having an average vertical rate with a magnitude exceeding 400 feet per minute (ft/min), measured over some period of interest.

Transmission rate means the average number of pulse pairs transmitted from the transponder per second.

Transponder occupancy means a state of unavailability of the transponder from the time it detects an incoming signal that appears to cause some action or from the time of a self-initiated transmission, to the time that it is capable of replying to another interrogation.

Tributary station means an aeronautical fixed station that may receive or transmit messages and/or digital data but which does not relay except for the purpose of serving similar stations connected through it to a communication centre.

Turn extent means a heading difference defined as an aircraft's ground heading at the end of a turn minus its ground heading at the beginning of the turn.

Two-frequency glide path system means an ILS glide path in which coverage is achieved by the use of two independent radiation field patterns spaced on separate carrier frequencies within the particular glide path channel.

Two-frequency localizer system means a localizer system in which coverage is achieved by the use of two independent radiation field patterns spaced on separate carrier frequencies within the particular localizer VHF channel.

Uplink ELM means a term referring to extended length uplink communication by means of 112-bit Mode S Comm-C interrogations, each containing the 80-bit Comm-C message field (MC).

Uplink means a term referring to the transmission of data from the ground to an aircraft. Mode S ground-to-air signals are transmitted on the 1 030 MHz interrogation frequency channel.

User group means a group of ground and/or aircraft stations which share voice and/or data connectivity. For voice communications, all members of a user group can access all communications. For data, communications include point-to-point connectivity for air-to-ground messages, and point-to-point and broadcast connectivity for ground-to-air messages.

VDL management entity means a VDL-specific entity that provides the quality of service requested by the ATN-defined SN_SME. A VME uses the LMEs (that it creates and destroys) to enquire the quality of service available from peer systems.

VDL Mode 4 burst means a VHF digital link (VDL) Mode 4 burst is composed of a sequence of source address, burst ID, information, slot reservation and frame check sequence (FCS) fields, bracketed by opening and closing flag sequences.

VDL Mode 4 DLS system means a VDL system that implements the VDL Mode 4 DLS and subnetwork protocols to carry ATN packets or other packets.

VDL Mode 4 specific services sublayer means the sublayer that resides above the MAC sublayer and provides VDL Mode 4 specific access protocols including reserved, random and fixed protocols.

VDL station means an aircraft-based or ground-based physical entity, capable of VDL Mode 2, 3 or 4.

Vertical miss distance means notionally, the vertical separation at closest approach. For encounters in the standard encounter model, by construction the vertical separation at the time tca.

Vertical speed limit RA means a resolution advisory advising the pilot to avoid a given range of altitude rates. A VSL RA can be either corrective or preventive.

VHF digital link means a constituent mobile subnetwork of the aeronautical telecommunication network, operating in the aeronautical mobile VHF frequency band. In addition, the VDL may provide non-ATN functions such as, for instance, digitized voice.

Virtual origin means the point at which the straight line through the 30 per cent and 5 per cent amplitude points on the pulse leading edge intersects the 0 per cent amplitude axis.

Vocoder means a low bit rate voice encoder/decoder.

Voice unit means a device that provides a simplex audio and signalling interface between the user and VDL.

Voice-automatic terminal information service means the provision of ATIS by means of continuous and repetitive voice broadcasts.

VDL Mode 4 specific services means the VSS user could be higher layers in the VDL Mode 4 SARPs or an external application using VDL Mode 4.

WAIC component means any tangible entity of a WAIC network on board an aircraft.

WAIC network means a network comprised of interrelated WAIC components, such as components used for wireless communications, security or network management.

WAIC system means a system which provides wireless communications between points on board a single aircraft. A WAIC system may be comprised of one or more WAIC networks necessary for establishing, maintaining and securing wireless communications. A WAIC system consists of interrelated sets of WAIC components on board the same aircraft, so that a single aircraft contains only a single WAIC system.

Warning time means the time interval between potential threat or threat detection and closest approach when neither aircraft accelerates.

Wireless avionic intra-communication means Radiocommunication between two or more aircraft stations located on board a single aircraft for aircraft applications supporting the safe operation of the aircraft.

XDCE means a general term referring to both the ADCE and the GDCE.

XDLP means a general term referring to both the ADLP and the GDLP.

Z marker beacon means a type of radio beacon, the emissions of which radiate in a vertical cone-shaped pattern.

Appendix G – Abbreviations

AAC	means aeronautical administrative communications
ABAS	means *aircraft-based augmentation system*
ACAS	means airborne collision avoidance system
ADCE	means *aircraft data circuit-terminating equipment*
ADS	means automatic dependent surveillance
ADS-B	means *automatic dependent surveillance-broadcast*
ADLP	means *aircraft data link processor*
AE	means *application entity*
AES	means aircraft earth station
AFS	means *aeronautical fixed service*
AFTN	means *aeronautical fixed telecommunication network*
AIDC	*means interfacility data communication*
AMHS	*means ATS message handling system*
AOC	*means* aeronautical operational control
ARAIM	*means advanced receiver autonomous integrity monitoring*
ATIS	*means* automatic terminal information service
ATN	*means* aeronautical telecommunication network
ATSMHS	*means ATS message handling service*
BDS	*means BeiDou Navigation Satellite System*
BER	*means* bit error rate
CMN	*means control motion noise*
CSA	*means channel of standard accuracy*
CTC	*means convolutional turbo codes*
C2CSP	*means C2 Link communication service provider*
DCE	*means data circuit-terminating equipment*
DDM	*means* difference in depth of modulation
DIR	*means directory service*
DLE	*means data link entity*
DLIC	*means data link initiation capability*
DLS	*means data link service*
DME	*means* distance Measuring Equipment
DTE	*means data terminal equipment*
ELM	*means extended length message*
EIRP	*means equivalent isotropically radiated power*
FA	*means final approach*
FEC	*means* forward error correction
GBAS	*means ground-based augmentation system*
GDCE	*means ground data circuit-terminating equipment*
GDLP	*means ground data link processor*
GES	*means* ground earth station
GFM	*means general formatter/manager*
GFSK	*means gaussian filtered frequency shift keying*

GLONASS	*means global navigation satellite system*
GNSS	*means global navigation satellite system*
GPS	*means global positioning system*
GRAS	*means ground-based regional augmentation system*
GSC	*means global signalling channel*
IA	*means initial approach*
IS	*means intermediate system*
ISD	*means integrity support data*
ISM	*means integrity support message*
ITU	*means international telecommunication union*
LME	*means link management entity*
MAC	*means media access control*
MS	*means mobile station*
PFE	*means path following error*
PUSC	*means partial usage sub-channelization*
QoS	*means quality of service*
QoSD	*means quality of service delivered*
QoSE	*means quality of service experienced*
QoSR	*means quality of service required*
RA	*means resolution advisory*
RAC	*means resolution advisory complement*
RCP	*means required communication performance*
RPA	*means remotely piloted aircraft*
RPAS	*means remotely piloted aircraft system*
RPS	*means remote pilot station*
SBAS	*means satellite-based augmentation system*
SDU	*means service data unit*
SLA	*means service level agreement*
SNDCF	*means subnetwork dependent convergence function*
SNSDU	*means subnetwork service data unit*
SPS	*means standard positioning service*
SS	*means subscriber station*
SSR	*means* secondary surveillance radar
STDMA	*means self-organizing time division multiple access*
TA	*means traffic advisory*
TDD	*means time division duplex*
TDM	*means* time division multiplex
TDMA	*means time division multiple access*
VDL	*means* VHF digital link
VSL	*means vertical speed limit*
WAIC	*means wireless avionic intra-communications*

Appendix H – Units of Measure

Electric Field Strength	Volts per meter (V/m)
Output Power	Watts (W)
Pulse Width/Duration	unit of time, seconds
Radio Frequency	Hertz (Hz) Radio frequency are measured in KHz, MHz and GHz depending on the specific frequency range.
Radio Signal Strength	Decibels (dB)
Rate of Modulation	Baud (Bd)
Signal Level	Decibel-milliwatt (dBm)
Signal to noise ratio (SNR)	Decibels (dB)
Transmission of Data	bits per second (bps)