



**CIVIL AVIATION SAFETY AUTHORITY
OF PAPUA NEW GUINEA**

**PNG
Civil Aviation Rule
Part 171**

**Aeronautical Telecommunication Service Organisation –
Certification and Operation**

Applicable 02 November 2021

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	Effective Date
Amendment 1	01 May 2016
Amendment 2	14 December 2020
Amendment 3	02 November 2021

Summary of amendments:

Amendment 3:

(Docket 21/09/CAR171/44)

Rule 171.3 amended – facility definition formatted and numbered for clarity;

Rule 171.53 amended – paragraph (b) amended and new paragraph (c) added for clarity;

Rule 171.55(c) amended – the word ‘rule’ deleted;

Rule 171.63 amended – paragraph (d) amended and new paragraphs (1) and (2) added for clarity;

Rule 171.107 amended – paragraphs (a) and (b) amended, new paragraphs (b)(1), (b)(2) and (b)(3) added and paragraphs (1) to (4) renumbered for clarity.

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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

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 (VOLMET):
 - (ii) Automatic terminal information service (ATIS); and
- (2) following types of communication systems for the aeronautical fixed service (as at service is defined in Annex 10, Volume II, Chapter 1):
 - (i) ATS direct speech circuits:
 - (ii) Aeronautical fixed telecommunication network (AFTN):
 - (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 (SELCAL):
 - (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 (ILS):
 - (ii) Microwave Landing System (MLS):
 - (iii) Global Navigation Satellite System GNSS):
 - (iv) VHF Omni-directional radio range VOR):
 - (v) Distance Measuring Equipment (DME):
 - (vi) Non-directional Radio Beacon (NDB):
 - (vii) Precision Approach Radar (PAR):
 - (viii) Secondary Surveillance Radar (SSR):
 - (ix) Primary Surveillance Radar (PSR);
 - (x) Automatic Dependent Surveillance(ADS-B):
 - (xi) Automatic Dependent Surveillance Contract(ADS-C):and
- (5) following types of telecommunication systems that support an air traffic service:
- (i) Flight data processing system (FDPS):
 - (ii) Radar data processing system (RDPS):
 - (iii) Radar and flight data processing system (RFDPS).
- (6) types of Communication Navigation Surveillance/Air Traffic Management (CNS/ATM) services acceptable to the Director.

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) and
- (3) 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 procedures for conducting those tests in accordance with paragraph (c).
- (c) The procedures 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. Where no such standards exist, the basis used for the calibration must be documented. Records of such calibrations and the standards 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; andrecords 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

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- (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 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.

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.

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.

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;
- (2) Global Navigation Satellite System (GLONASS) that provides the Channel of Standard Accuracy (CSA) navigation signal as defined in ICAO Annex 10, Volume 1 Chapter 3.7.3.2;
- (3) Aircraft-based augmentation system (ABAS) as defined in ICAO Annex 10, Volume 1, 3.7.3.3;
- (4) Satellite-based augmentation system (SBAS) as defined in ICAO Annex 10, Volume 1, 3.7.3.4;
- (5) Ground-based augmentation system (GBAS) as defined in ICAO Annex 10, Volume 1, 3.7.3.5;
- (6) 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.

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 by 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.

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 I 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 conveyed by 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.
- (5) 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
- (6) Control of ADS-B Out Operations.
 - (i) Protection against reception of corrupted data from the source providing the position must be satisfied by 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)
 - (3) Introduction.

The ATN is specifically and exclusively intended to provide digital data communications services to air traffic service provider organizations and aircraft operating agencies 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).
 - (4) 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 1 second of coordinated universal time (UTC).

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

C.1.1 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.1.2 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.1.3 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.1.4 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 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.2.4. 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.2.5 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.