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THE CIVIL AVIATION ACT,
(CAP. 80)

REGULATIONS

(Made under section 5)

THE CIVIL AVIATION (COMMUNICATION SYSTEMS) (AMENDMENT) REGULATIONS, 2026

Citation

GN. No. 75 of 2017

1. These Regulations may be cited as the Civil Aviation (Communication Systems) (Amendment) Regulations, 2026 and shall be read as one with the Civil Aviation Communication Systems) Regulations, 2017, hereinafter referred to as the "principal Regulations".

Amendment of regulation 2

2. The principal Regulations are amended in regulation 2, by-

(a) adding in their appropriate alphabetical order the following new definitions:

""Air Traffic Services message handling service (ATSMHS)" 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";

"Air Traffic Services message handling system (AMHS) means the set of computing and communication resources implemented by ATS organizations to provide the ATS message handling service"; and

(b) deleting the word "ently" appearing in the definition of the term "air navigation service provider" and substituting for it the word "entity".

Deletion and substitution of regulation 4

3. The principal Regulations are amended by deleting regulation 4 and substituting for it the following;

"Requirements for communication, navigation and surveillance facilities

4.-(1) The minimum requirements for planning, installation, commissioning, training, operations and maintenance of facilities shall conform to these Regulations.

(2) The ANSP accompanied by the Authority Inspector shall verify the standards of the new CNS equipment at Manufacturer's factory before the equipment is shipped for installation.

(3) The ANSP shall ensure the Authority Inspector is included in the implementation of subregulation (2) and trained by the manufacturer to have an understanding of the facility operation and technology used.".

Amendment of regulation 6

4. The principal Regulations are amended in regulation 6, by-

(a) adding immediately after subregulation (1) the following:

"(2) Subject to subregulation (1), the ANSP shall notify the Authority of its intention to procure, install, use, decommission, upgrade or relocate any communication, navigation and surveillance facility or facilities in the designated airspace and aerodromes not less than thirty days prior to the date of commencement of the process."; and

(b) renumbering subregulation (2) as subregulation (3).

Amendment

5. The principal Regulations are amended in

of regulation 7

regulation 7, by-

(a) adding at the end of subregulation (2), the words "and required procedures"; and

(b) adding immediately after subregulation (2) the following:

"(3) The Authority shall communicate to the ANSP the inspection and audit report including any corrective action required of the inspections and audits.

(4) The ANSP shall submit to the Authority a corrective action plan for addressing deficiencies within the time stipulated in the audit report and implement the corrective action plan proposed after acceptance by the Authority.

(5) Where the ANSP does not implement the corrective action plan within the period agreed in subregulation (4), the Authority shall take the appropriate punitive action as provided in Part XVII of these Regulations.".

Deletion and substitution of regulation 10

6. The principal Regulations are amended by deleting regulation 10 and substituting for it the following:

"Availability, reliability and test equipment

10.-(1) The ANSP shall be responsible for the provision of communication, navigation and surveillance services and facilities to ensure availability of telecommunication information and data necessary for the safe, regular and efficient operation of air navigation.

(2) The functional specification of the ANSPs telecommunication services shall include values and characteristics as follows:

(a) availability;

(b) reliability;

(c) accuracy;

(d) integrity;
(e) mean time between failure; and
(f) mean time before failure (MTBF).".

Deletion and substitution of regulation 12

7. The principal Regulations are amended by deleting regulation 12 and substituting for it the following:

"Record keeping

12.-(1) The ANSP shall-
(a) keep copies of relevant equipment manuals, technical standards, practices, instructions, maintenance procedures, site logbooks, systems backup data, equipment and test gear inventory and any other documentation that are necessary for the provision and operation of the facility;
(b) establish a procedure for the control of the documentation required under these Regulations;
(c) keep records under the control of the relevant key personnel; and
(d) control access to the records system to ensure appropriate security.

(2) The ANSP shall ensure that surveillance data and voice communication for air navigation service operational systems are recorded continuously, and procedures are established for the retention and utilisation of such recordings for analysis.

(3) The recorded information shall be retained for a period of at least thirty days.

(4) The pertinent information subjected for investigation shall be retained for longer periods until they are no longer required.".

Deletion and substitution of regulation 13

8. The principal Regulations are amended by deleting regulation 13 and substituting for it the following:

"Documentation

13.-(1) The ANSP shall keep and maintain all documents which are necessary for the operation and maintenance of the service and make available copies of such documents to personnel where needed.

(2) The documents under subregulation (1) include-

(a) relevant civil aviation regulations applicable in the United Republic;
(b) the air navigation service provider's operations manual;
(c) records of malfunction and safety incident reports;
(d) copies of relevant equipment manual, technical standards, practices, instructions, maintenance procedures and site log books;
(e) records of occurrences and actions relating to operation, maintenance, modification, failure, faults, removal from and restoration to service;
(f) procedure for the control of documentation (QMS Manual);
(g) records of internal audit reports;
(h) agreements with other organizations;
(i) records of investigation into serious incidents;
(j) records of staff deployment, duty and leave rosters;

(k) records of equipment spares;
(l) records of job description, training programme and plan of each staff member; and
(m) all related air navigation service technical standards and technical guidance material developed by the Authority.

(3) A document retained for this regulation shall be retained for at least three years, if paper based and one hundred and eighty days, if computer based.

(4) The air navigation service provider shall establish a process for the authorisation and amendment of these documents to ensure that they are constantly updated and ensure that-

(a) the currency of the documentation can be readily determined;
(b) the amendments to the documentation are controlled in accordance with established quality management principles;
(c) only current versions of documents are available; and
(d) the person authorising the creation and any revision is identified.

(5) The air navigation service provider shall ensure that where documents are held as computer-based records and where paper copies of computer-based records are made, they are subjected to the same control as paper documents

(6) An air navigation service provider shall establish procedures to identify, collect, index, store, maintain, and dispose records covering-

(a) the performance and maintenance history of each

facility;
(b) the establishment of the periodic test programmes for each facility;
(c) each item of test equipment required for the measurement of critical performance parameters;
(d) each reported or detected facility malfunction;
(e) each internal quality assurance review; and
(f) each person who is authorised to place facilities into operational service.".

Deletion and substitution of regulation 15

9. The principal Regulations are amended by deleting regulation 15 and substituting for it the following:

"Flight inspection

15. Communication Navigation Surveillance provider shall ensure that navigational systems prescribed by the Authority are available for use by aircraft engaged in air navigation and are subjected to periodic ground and flight inspection.".

Addition of regulation 15A

10. The principal Regulations are amended by adding immediately after regulation 15 the following:

"Operational and maintenance plan

15A.-(1) Communication Navigation and Surveillance provider shall establish an operation and maintenance plan that meets the safety requirements stipulated in these Regulations.

(2) The operation and maintenance plan in sub regulation (1) shall provide for the timely and appropriate detection and warning of system failures and degradations.".

Deletion and substitution

11. The principal Regulations are amended by deleting regulation 18 and substituting for it the following:

of regulation 18

"Proficiency certification program

18.-(1) The Air Navigation Service Provider shall develop proficiency certification program for ATSEP engaged in the installation, training, operations and maintenance of Communication, Navigation and Surveillance systems in accordance with guidelines provided by the Authority.

(2) The Authority shall certify ATSEP involved in the installation, training, operations and maintenance of Communication, Navigation and Surveillance systems in accordance with the Civil Aviation Regulations.".

Addition of regulations 19A, 19B and 19C

12. The principal Regulations are amended by adding immediately after regulation 19 the following:

"Safety case, notification of Aeronautical facility status and interruption to service

19A.-(1) The Air Navigation Service Provider shall ensure that for safety critical systems, including automated air traffic control systems, communication systems and instrument landing systems, the commissioning of such systems shall include the conduct of a safety case or equivalent.

(2) The Air Navigation Service Provider shall ensure that human factors principles are observed in the design, operations and maintenance of aeronautical telecommunication facilities.

(3) An air navigation service provider shall, as soon as possible-

(a) forward to the Aeronautical Information Services,

(i) information on the operational details of any new facility for publication in the Aeronautical Information

Publication; and

(ii) information concerning any change in the operational status of any existing facility, for the issue of a Notice to Airmen; and

(b) ensure that the information forwarded under paragraph (a) has been accurately published.

(4) An air navigation service provider shall-

(a) establish a procedure to be used in the event of interruption to or when upgrading communication, navigation and surveillance systems;

(b) specify an acceptable recovery time for each service.

Facility malfunction incident reporting and operational status of Communication Navigation and Surveillance systems

19B.-(1) An air navigation service provider shall establish procedures for the reporting, collection and notification of facility malfunction incidents and safety incidents.

(2) The procedures in subregulation (1) shall be documented in the MANSOPS.

(3) An air navigation service provider shall compile reports of incidents and review such reports periodically with its maintenance contractors to-

(a) determine the cause of the incidents and determine any adverse trends;

(b) implement corrective and preventive actions where necessary to prevent recurrence of the incidents; and

(c) implement any measures to improve the safety performance of the aeronautical telecommunication service.

(4) The air navigation service provider shall-

(a) report any serious service failure or safety incident to the Authority and investigate such incidents in order to establish how and why the incident happened, including possible organizational contributing factors and to recommend actions to prevent a recurrence; and

(b) ensure that information on the operational status of each communication, navigation and surveillance facility that is essential for the en-route, approach, landing, and take-off phases of flight is provided to meet the operational needs of the service being provided.

Interface arrangement for support services

19C. An air navigation service provider shall formalize interface arrangements where applicable with external organizations in the form of service level agreements, detailing the following:

(a) interface and functional specifications of the support service;

(b) service level of the support service such as availability, accuracy, integrity and recovery time of failure of service; and

(c) monitoring and reporting of the operational status of the service to the service provider.

Development of contingency plan

19D. CNS service providers shall develop contingency plans and ensure continuity of CNS operations in the event of natural disasters, cyberattacks, system failures, or other relevant crises.".

Amendment of regulation 37

13. The principal Regulations are amended in regulation 37, by-

(a) designating the contents of section 37 as subregulation (1); and

(b) adding immediately after subregulation (1) as designated the following:

"(2) Where the system provides AMS(R)S packet data service, it shall meet the following requirements:

(a) an AMS(R)S system providing a packet data service shall be capable of operating as a constituent mobile subnetwork of the ATN;

(b) connection establishment delay shall not be greater than 70 seconds;

(c) data transit delay values shall be based on a fixed subnetwork service data unit (SNSDU) length of 128 octets and shall be defined as average values;

(d) data transit delay from-aircraft with highest priority shall not be greater than 40 seconds for the highest priority data service;

(e) data transit delay to-aircraft with highest priority shall not be greater than 12 seconds for the highest priority data service;

(f) data transfer delay (95th percentile) from-aircraft with highest priority shall not be greater than 80 seconds;

(g) data transfer delay (95th percentile) to-aircraft with highest priority shall not be greater than 15 seconds;

(h) connection release delay (95th percentile) shall not be greater than 30 seconds in either direction;

(i) residual error rate from-aircraft direction shall not be greater than 10-4 per SNSDU;

(j) residual error rate to-aircraft direction shall not

be greater than 10-6 per SNSDU;

(k) connection resilience probability of a subnetwork connection (SNC) provider-invoked SNC release shall not be greater than 10-4 over any one-hour interval; and

(l) the probability of an SNC provider-invoked reset shall not be greater than 10-1 over any one-hour interval.".

Amendment of regulation 77

14. The principal Regulations are amended in regulation 77(2) by deleting the phrase "1 September, 1985" and substituting for it the phrase "3 November, 2022".

Deletion and substitution of Eleventh, Twelfth and Sixteenth Schedules

15. The principal Regulations are amended by deleting the Eleventh, Twelfth and Sixteenth Schedules and substituting for them the following:

"ELEVENTH SCHEDULE

(Made under regulation 66)

1.TECHNICAL PROVISIONS RELATING TO INTERNATIONAL GROUND-GROUND DATA INTERCHANGE AT MEDIUM AND HIGHER SIGNALLING RATES

Note.— Throughout this section in the context of coded character sets, the term "unit" means the unit of selective information and is essentially equivalent to the term "bit".

1.1 General

1.1.1 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) shall be used. Compatibility with the 5-unit coded character set of International Telegraph Alphabet No. 2 (ITA-2) shall be ensured where applicable.

1.1.2 When the provisions of 1.1.1 are applied, International Alphabet No. 5 (IA-5) contained in Table 8-2 shall be used.

1.1.2.1 The serial transmission of units comprising an individual character of IA- 5 shall be with the low order unit (b1) transmitted first.

1.1.2.2 When IA-5 is used, each character shall include an additional unit for parity in the eighth level position.

1.1.2.3 When the provisions of 1.1.2.2 are applied, the sense of the character parity bit shall produce even parity in links which operate on the start- stop principle, and odd parity in links using end-to-end synchronous operations.

1.1.2.4 Character-for-character conversion shall be as listed in Tables 8-3 and 8-0 for all characters which are authorized in the AFTN format for transmission on the AFS in both IA-5 and ITA-2.

1.1.2.5 Characters which appear in only one code set, or which are not authorized for transmission on the AFS shall be as depicted in the code conversion tables.

1.2 Data transmission characteristics

1.2.1 8.6.2.1 The data signalling rate shall be chosen from among the following:
1 600 bits/s 4 800 bits/s
1 200 bits/s 9 600 bits/s
2 400 bits/s

1.2.2 The type of transmission for each data signalling rate shall be chosen as follows:

Data signalling rate	Type of transmission
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

1.2.3 The type of modulation for each data signalling rate shall be chosen as follows:

Data signalling rate	Type of modulation
1 600 bits/s	Frequency
1 200 bits/s	Frequency
2 400 bits/s	Phase
4 800 bits/s	Phase
9 600 bits/s	Phase-amplitude

Note.— This standard does not necessarily apply to ground-ground extensions of air-ground links used exclusively for the transfer of air- ground data, inasmuch as such circuits may be considered as part of the air-ground link.

1.2.4 CHARACTER STRUCTURE ON DATA LINKS

1.2.4.1 Character parity shall not be used for error checking on CIDIN links. Parity appended to IA-5 coded characters per 1.1.2.2, prior to entry to the CIDIN shall be ignored. For messages exiting the CIDIN, parity shall be generated in accordance with 1.1.2.3.

1.2.4.1 Characters of less than eight bits in length shall be padded out to eight bits in length before transmission over any octet-based or bit-oriented communications network. The padding bits shall occupy the higher order end of the octet, i.e. bit 8, bit 7 as required, and shall have the binary values 0.

1.2.5 When exchanging data over CIDIN links using bit-oriented procedures, the entry centre address, exit centre addresses and destination addresses in the Transport and CIDIN Packet Headers shall be in the IA-5 character set contained in Table 8-2.

1.2.6 When transmitting messages in AFTN format over CIDIN links using bit-oriented procedures, the messages shall be in the IA-5 character set contained in Table 8-2.

1.3 Ground-ground character-oriented data link control procedures

Note.— The provisions of this section pertain to ground-ground data interchange applications using IA-5 prescribed by 8.6.1 and which employ the ten transmission control characters (SOH, STX, ETX, EOT, ENQ, ACK, DLE, NAK, SYN, and ETB) for data link control, over synchronous or asynchronous transmission facilities.

1.3.1 Descriptions. The following descriptions shall apply to data link applications contained in this section:

(a) A master station is that station which has control of the data link at a given instant.

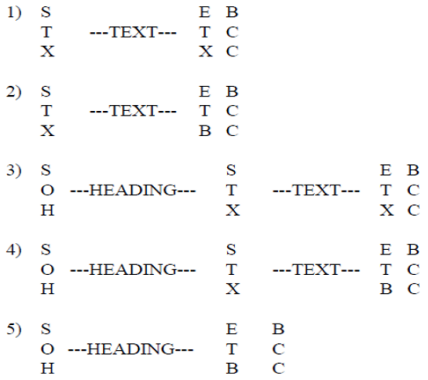
(b) A slave station is one that has been selected to receive a transmission from the master station.

(c) A control station is the single station on a multipoint link that is permitted to assume master status and deliver messages to one or more individually selected (non-control) tributary stations, or it is permitted to assign temporary master status to any of the other tributary stations.

1.3.2 MESSAGE COMPOSITION

(a) A transmission shall consist of characters from IA-5 transmitted in accordance with 1.1.2.2 and shall be either an information message or a supervisory sequence.

(b) An information message used for the exchange of data shall take one of the following forms:



Note 1.— BCC is a block check character (BCC).

Note 2.— In formats 2), 4), and 5) above which end with ETB, some continuation is required.

(c) A supervisory sequence shall be composed of either a single transmission control character (EOT, ENQ, ACK or NAK) or a single transmission control (ENQ) preceded by a prefix of up to 15 non-control characters, or the character DLE used in conjunction with other graphic and control characters to provide additional communication control functions.

1.3.3 Three system categories are specified in terms of their respective circuit characteristics, terminal configurations, and message transfer procedures as follows:

(a) System category A: two-way alternate, multipoint allowing either centralized or non-centralized operation and single or multiple message- oriented information transfers without replies (but with delivery verification);

(b) System category B: two-way simultaneous, point-to-point employing message associated blocking and modulo 8 numbering of blocks and acknowledgements; na

(c) System category C: two-way alternate, multipoint allowing only centralized (computer-to-terminal) operation, single or multiple message transfers with replies.

1.3.3.1 In addition to the characteristics prescribed in the paragraphs that follow for both system categories A and B, other parameters that shall be accounted for in order to ensure viable, operationally reliable communications include:

(a) the number of SYN characters required to establish and maintain synchronization;

Note.— Normally the transmitting station sends three contiguous SYN characters and the receiving station detects at least two before any action is taken.

(b) the values of system time-outs for such functions as “idle line” and “no response” as well as the number of automatic retries that are to be attempted before manual intervention is signalled;

(c) the composition of prefixes within a 15character maximum.

Note.— By agreement between the administrations concerned, it is permissible for supervisory signals to contain a station identification prefix using characters selected from columns 4 through 7 of IA-5.

1.3.3.1 For multipoint implementations designed to permit only centralized (computer-toterminal) operations, the provisions of 8.6.3.7 shall be employed.

1.3.4 BLOCK CHECK CHARACTER

1.3.4.1 Both system category A and B shall utilize a block check character to determine the validity of a transmission.

1.3.4.2 The block check character shall be composed of 7 bits plus a parity bit.

1.3.4.3 Each of the first 7 bits of the block check character shall be the modulo 2 binary sum of every element in the same bit 1 to bit 7 column of the successive characters of the transmitted block.

1.3.4.4 The longitudinal parity of each column of the block, including the block check character, shall be even.

1.3.4.5 The sense of the parity bit of the block check character shall be the same as for the information characters (see 1.1.2.3).

1.3.4.6 SUMMATION

1.3.4.6.1 The summation to obtain the block check character shall be started by the first appearance of either SOH (start of heading) or STX (start of text).

1.3.4.6.2 The starting character shall not be included in the summation.

1.3.4.6.3 If an STX character appears after the summation has been started by SOH, then the STX character shall be included in the summation as if it were a text character.

1.3.4.6.4 With the exception of synchronous idle, all the characters which are transmitted after the start of the block check summation shall be included in the summation, including the end of transmission block and end of text control character which signals that the following character is the block check character.

1.3.4.7 No character, SYN or otherwise, shall be inserted between the ETB or ETX character and the block check character.

1.3.5 DESCRIPTION OF SYSTEM CATEGORY A

System category A: is one in which a number of stations are connected by a multipoint link and one station is permanently designated as the control station which monitors the link at all times to ensure orderly operation.

1.3.5.1 LINK ESTABLISHMENT PROCEDURE

1.3.5.1.1 To establish the link for transmission, the control station shall either:
(a) poll one of the tributary stations to assign it master status; or
(b) assume master status and select one or more tributary (slave) stations to receive a transmission.

1.3.5.1.2 Polling shall be accomplished by the control station sending a polling supervisory sequence consisting of a prefix identifying a single tributary station and ending in ENQ.

1.3.5.1.3 A tributary station detecting its assigned polling supervisory sequence shall assume master status and respond in one of two ways:
(a) if the station has a message to send, it shall initiate a selection supervisory sequence as described in 1.3.5.1.5;
(b) if the station has no message to send, it shall send EOT, and master status shall revert to the control station.

1.3.5.1.4 If the control station detects an invalid or no response resulting from a poll, it shall terminate by sending EOT prior to resuming polling or selection.

1.3.5.1.5 Selection shall be accomplished by the designated master station sending a selection supervisory sequence consisting of a prefix identifying a single station and ending in ENQ.

1.3.5.1.6 A station detecting its assigned selection supervisory sequence shall assume slave status and send one of two replies:
(a) if the station is ready to receive, it shall send a prefix followed by ACK. Upon detecting this reply, the master station shall either select another station or proceed with message transfer;
(b) if the station is not ready to receive, it shall send a prefix followed by NAK and thereby relinquish slave status. If the master station receives NAK, or no reply, it shall either select another or the same tributary station or terminate;
(c) it shall be permissible for N retries ($N \geq 0$) to be made to select a station for which NAK, an invalid reply, or no response has been received.

1.3.5.1.7 If one or more stations have been selected and have properly responded with ACK, the master station shall proceed with message transfer.

1.3.5.2 MESSAGE TRANSFER PROCEDURE

1.3.5.2.1 The master station shall send a message or series of messages, with or without headings to the selected slave station(s).

1.3.5.2.2 The transmission of a message shall begin with:
(a) SOH if the message has a heading,
(b) STX if the message has no heading; and

(c) be continuous, ending with End of Text , immediately followed by a block check character.

1.3.5.2.3 After transmitting one or more messages, the master station shall verify successful delivery at each selected slave station.

1.3.5.3 DELIVERY VERIFICATION PROCEDURE

1.3.5.3.1 The master station shall send a delivery verification supervisory sequence consisting of a prefix identifying a single slave station and ending in Enquiry.

1.3.5.3.2 A slave station detecting its assigned delivery verification supervisory sequence shall send one of two replies:

(a) if the slave station properly received all of the transmission, it shall send an optional prefix followed by acknowledge.

(b) if the slave station did not receive all of the transmission properly, it shall send an optional prefix followed by negative acknowledge.

1.3.5.3.3 If the master station receives no reply or an invalid reply, it shall request a reply from the same or another slave station until all selected stations have been properly accounted for.

1.3.5.3.4 If the master station receives a negative reply (NAK) or, after $N \geq 0$ repeat attempts, no reply, it shall repeat that transmission to the appropriate slave stations at a later opportunity.

1.3.5.3.5 After all messages have been sent and delivery verified, the master station shall proceed with link termination.

1.3.5.4 LINK TERMINATION PROCEDURE

1.3.5.4.1 The terminate function, negating the master or slave status of all stations and returning master status to the control station, shall be accomplished by the master station transmitting end of transmission.

1.3.6 DESCRIPTION OF SYSTEM CATEGORY B

System category B: is one in which two stations are on a point-to-point, full-duplex link and each station has the capability to maintain concurrent master and slave status, i.e. master status on its transmit side and slave status on its receive side and both stations can transmit simultaneously.

1.3.6.1 LINK ESTABLISHMENT PROCEDURE

1.3.6.1.1 To establish the link for message transfers (from the calling to the called station), the calling station shall request the identity of the called station by sending an identification supervisory sequence consisting of data link escape character followed by a colon character, an optional prefix, and enquiry.

1.3.6.1.2 The called station, upon detecting enquiry, shall send one of two replies:

(a) if ready to receive, it shall send a sequence consisting of data link escape followed by a colon, a prefix which includes its identity and ended by acknowledge 0 (see 8.6.3.6.2.5). This establishes the link for message transfers from the calling to the called station;

(b) if not ready to receive, it shall send the above sequence with the

acknowledge 0 replaced by negative acknowledge.

1.3.6.1.3 Establishment of the link for message transfers in the opposite direction can be initiated at any time following circuit connection in a similar manner to that described above.

1.3.6.2 MESSAGE TRANSFER PROCEDURE

1.3.6.2.1 System category B message transfer provides for message associated blocking with longitudinal checking and modulo 8 numbered acknowledgements.

1.3.6.2.2 It is permissible for a transmission block to be a complete message or a portion of a message. The sending station shall initiate the transmission with SOTB N followed by:

(a) Start of heading if it is the beginning of a message that contains a heading;
(b) STX if it is the beginning of a message that has no heading;
(c) SOH if it is an intermediate block that continues a heading; and
(d) STX if it is an intermediate block that continues a text.

Note.— SOTB N is the two-character transmission control sequence DLE= (characters 1/0, and 3/13) followed by the block number, N, where N is one of the IA-5 characters 0, 1 ... 7 (characters 3/0, 3/1 ... 3/7).

1.3.6.2.3 A block which ends at an intermediate point within a message shall be ended with ETB; a block which ends at the end of a message shall be ended with ETX.

1.3.6.2.4 It shall be permissible for each station to initiate and continue to send messages to the other concurrently according to the following sequence.

(a) It shall be permissible for the sending station (master side) to send blocks, containing messages or parts of messages, continuously to the receiving station (slave side) without waiting for a reply.
(b) It shall be permissible for replies, in the form of slave responses, to be transmitted by the receiving station while the sending station is sending subsequent blocks.

Note.— By use of modulo 8 numbering of blocks and replies, it shall be permissible for the sending station to send as many as seven blocks ahead of the received replies before being required to stop transmission until six or less blocks are outstanding.

(c) If a negative reply is received, the sending station (master side) shall start retransmission with the block following the last block for which the proper affirmative acknowledgement was received.

1.3.6.2.5 Slave responses shall be according to one of the following:

(a) if a transmission block is received without error and the station is ready to receive another block, it shall send DLE, a colon, an optional prefix, and the appropriate acknowledgement ACKN (referring to the received block beginning with SOTB N, e.g. ACK0, transmitted as DLE0 is used as the affirmative reply to the block numbered SOTB0, DLE1 for SOTB1, etc.);
(b) if a transmission block is not acceptable, the receiving station shall send DLE, a colon, an optional prefix, and NAK.

1.3.6.2.6 Slave responses shall be interleaved between message blocks and transmitted at the earliest possible time.

1.3.6.3 LINK TERMINATION PROCEDURE

1.3.6.3.1 If the link has been established for message transfers in either or both directions, the sending of EOT by a station shall signal the end of message transfers in that direction. To resume message transfers after sending EOT, the link shall be re-established in that direction.

1.3.6.3.2 EOT shall only be transmitted by a station after all outstanding slave responses have been received or otherwise accounted for.

1.3.6.4 CIRCUIT DISCONNECTION

1.3.6.4.1 On switched connections, the data links in both directions shall be terminated before the connection is cleared. In addition, the station initiating clearing of the connection shall first announce its intention to do so by transmitting the two-character sequence DLE EOT, followed by any other signals required to clear the connection.

1.3.7 DESCRIPTION OF SYSTEM CATEGORY C (CENTRALIZED)

System category C: (centralized) is one (like system category A) in which a number of stations are connected by a multipoint link and one station is designated as the control station but (unlike system category A) provides only for centralized (computer-to-terminal) operations where message interchange (with replies) shall be constrained to occur only between the control and a selected tributary station.

1.3.7.1 LINK ESTABLISHMENT PROCEDURE

1.3.7.1.1 To establish the link for transmission the control station shall either:

(a) poll one of the tributary stations to assign it master status; or
(b) assume master status and select a tributary station to assume slave status and receive a transmission according to either of two prescribed selection procedures:
    (i) selection with response (see 1.3.7.1.5); or
    (ii) fast select (see 1.3.7.1.7).

1.3.7.1.2 Polling is accomplished by the control station sending a polling supervisory sequence consisting of a prefix identifying a single tributary station and ending in ENQ.

1.3.7.1.3 A tributary station detecting its assigned polling supervisory sequence shall assume master status and respond in one of two ways:

(a) if the station has a message to send, it shall initiate message transfer. The control station assumes slave status;
(b) if the station has no message to send, it shall send EOT and master status shall revert to the control station.

1.3.7.1.4 If the control station detects an invalid or no response resulting from a poll, it shall terminate by sending EOT prior to resuming polling or selection.

1.3.7.1.5 Selection with response is accomplished by the control station assuming master status and sending a selection supervisory sequence consisting of a prefix identifying a single tributary station and ending in ENQ.

1.3.7.1.6 A tributary station detecting its assigned selection supervisory sequence shall assume slave status and send one of two replies:

(a) if the station is ready to receive, it shall send an optional prefix followed by ACK. Upon detecting this reply, the master station shall proceed with message transfer;

(b) if the station is not ready to receive, it shall send an optional prefix followed by NAK. Upon detecting NAK, it shall be permissible for the master station to again attempt selecting the same tributary station or initiate termination by sending EOT.

Note.— If the control station receives an invalid or no reply, it is permitted to attempt again to select the same tributary or after N retries (N ≥ 0) either to exit to a recovery procedure or to initiate termination by sending EOT.

1.3.7.1.7 Fast select is accomplished by the control station assuming master status and sending a selection supervisory sequence, and without ending this transmission with ENQ or waiting for the selected tributary to respond, proceeding directly to message transfer.

1.3.7.2 MESSAGE TRANSFER PROCEDURE

1.3.7.2.1 The station with master status shall send a single message to the station with slave status and wait for a reply.

1.3.7.2.2 The message transmission shall begin with:

(a) SOH if the message has a heading, — STX if the message has no heading; and

(b) be continuous, ending with ETX, immediately followed by BCC.

1.3.7.2.3 The slave station, upon detecting ETX followed by BCC, shall send one of two replies:

(a) if the messages were accepted and the slave station is ready to receive another message, it shall send an optional prefix followed by ACK. Upon detecting ACK, the master station shall be permitted either to transmit the next message or initiate termination;

(b) if the message was not accepted and the slave station is ready to receive another message, it shall send an optional prefix followed by NAK. Upon detecting NAK, the master station may either transmit another message or initiate termination. Following the NAK reply, the next message transmitted need not be a retransmission of the message that was not accepted.

1.3.7.2.4 If the master station receives an invalid or no reply to a message, it shall be permitted to send a delivery verification supervisory sequence consisting of an optional prefix followed by ENQ. Upon receipt of a delivery verification supervisory sequence, the slave station repeats its last reply.

1.3.7.2.5 N retries (N ≥ 0) may be made by the master station in order to get a valid slave reply. If a valid reply is not received after N retries, the master station exits to a recovery procedure.

1.3.7.3 LINK TERMINATION PROCEDURE

1.3.7.3.1 The station with master status shall transmit EOT to indicate that it has no more

messages to transmit. EOT shall negate the master/slave status of both stations and return master status to the control station.

1.4 Ground-ground bit-oriented data link control procedures

Note.— The provisions of this section pertain to ground-ground data interchange applications using bit-oriented data link control procedures enabling transparent, synchronous transmission that is independent of any encoding; data link control functions are accomplished by interpreting designated bit positions in the transmission envelope of a frame.

1.4.1 The following descriptions shall apply to data link applications contained in this section:

(a) Bit-oriented data link control procedures enable transparent transmission that is independent of any encoding.

(b) A data link is the logical association of two interconnected stations, including the communication control capability of the interconnected stations.

(c) A station is a configuration of logical elements, from or to which messages are transmitted on a data link, including those elements which control the message flow on the link via communication control procedures.

(d) A combined station sends and receives both commands and responses and is responsible for control of the data link.

(e) Data communication control procedures are the means used to control and protect the orderly interchange of information between stations on a data link.

(f) A component is defined as a number of bits in a prescribed order within a sequence for the control and supervision of the data link.

(g) An octet is a group of 8 consecutive bits.

(h) A sequence is one or more components in prescribed order comprising an integral number of octets.

(i) A field is a series of a specified number of bits or specified maximum number of bits which performs the functions of data link or communications control or constitutes data to be transferred.

(j) A frame is a unit of data to be transferred over the data link, comprising one or more fields in a prescribed order.

(k) A common ICAO data interchange network (CIDIN) switching centre is that part of an automatic AFTN switching centre which provides for the entry, relay, and exit centre functions using the bit-oriented link and CIDIN network procedures specified in this section and includes the appropriate interface(s) with other parts of the AFTN and with other networks.

1.4.2 BIT-ORIENTED DATA LINK CONTROL PROCEDURES FOR POINT-TO-POINT, GROUND-GROUND DATA INTERCHANGE APPLICATIONS EMPLOYING SYNCHRONOUS TRANSMISSION FACILITIES

Note.— The following link level procedures are the same as the LAPB link level procedures described in ITU CCITT Recommendation X.25, Section 2, Yellow Book (1981 version). Later versions of Recommendation X.25 will be reviewed as they are released to ascertain whether or not they should be adopted.

1.4.2.1 Frame format. Frames shall contain not less than 32 bits, excluding the opening and closing flags, and shall conform to the following format:

FLAG F	ADDRESS A	CONTROL C	INFORMATION I	FCS	FLAG F

1.4.2.1.1 A frame shall consist of an opening flag (F), an address field (A), a control field (C), an optional information field (I), a frame check sequence (FCS), and a closing flag sequence (F), and shall be transmitted in that order.

Note.— In relation to CIDIN, the opening flag, the fields A and C, the FCS and the closing flag form together the Data Link Control Field . The field I is denoted as the Link Data Field.

1.4.2.1.1.1 The flag (F) shall be the 8-bit sequence 01111110 which delimits the beginning and ending of each frame. It shall be permissible for the closing flag of a frame to also serve as the opening flag of the next frame.

1.4.2.1.1.2 The address (A) field shall consist of one octet, excluding 0 bits added to achieve transparent transmission, which shall contain the link address of the combined station.

1.4.2.1.1.3 The control (C) field shall consist of one octet, excluding 0 bits added to achieve transparent transmission, and shall contain the commands, responses, and frame sequence number components for the control of the data link.

1.4.2.1.1.4 The information (I) field shall contain digital data which may be presented in any code or sequence but shall not exceed a maximum of 259 octets, excluding 0 bits added to achieve transparent transmission. The I field shall always be a multiple of 8 bits in length.

1.4.2.1.1.5 The frame check sequence shall consist of two octets, excluding 0 bits added to achieve transparent transmission, and shall contain the error detecting bits.

1.4.2.2 A frame check sequence shall be included in each frame for the purpose of error checking.

1.4.2.2.1 The error checking algorithm shall be a cyclic redundancy check (CRC).

1.4.2.2.2 The CRC polynomial (P(x)) shall be-

$$x^{16} + x^{12} + x^5 + 1.$$

1.4.2.2.3 The FCS shall be a 16-bit sequence. This FCS shall be the ones' complement of the remainder, R(x), obtained from the modulo 2 division of by the CRC polynomial, P(x).

$$x^{16}[G(x)] + x^K(x^{15} + x^{14} + x^{13} + \ldots + x^2 + x^1 + 1)$$

G(x) shall be the contents of the frame existing between, but including neither, the final bit of the opening flag northe first bit of the FCS, excluding bits inserted for transparent transmission.
K shall be the length of G(x) (number of bits).

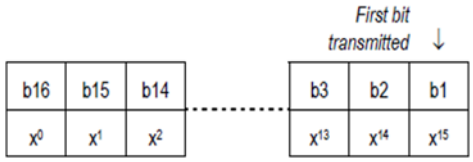
1.4.2.2.4 The generation and checking of the FCS accumulation shall be as follows:

(a) the transmitting station shall initiate the FCS accumulation with the first

(least significant) bit of the address (A) field and shall include all bits up to and including the last bit preceding the FCS sequence, but shall exclude all 0 bits (if any) inserted to achieve transparent transmission;

(b) upon completion of the accumulation the FCS shall be transmitted, starting with bit b1 (highest order coefficient) and proceeding in sequence to bit b16 (lowest order coefficient) as shown below;

First bit transmitted ↓



(c) the receiving station shall carry out the cyclic redundancy check (CRC) on the content of the frame commencing with the first bit received following the opening flag, and shall include all bits up to and including the last bit preceding the closing flag, but shall exclude all 0 bits (if any) deleted according to the rules for achievement of transparency;

(d) upon completion of the FCS accumulation, the receiving station shall examine the remainder, in the absence of transmission error, the remainder shall be-

1111000010111000 (x^0 through x^{15}, respectively).

1.4.2.3 Achievement of transparency. The frame format contents (A, C, link data field, and FCS) shall be capable of containing any bit configuration.

1.4.2.3.1 The following rules shall apply to all frame contents, except flag sequences:

(a) the transmitting station shall examine the frame contents before transmission, and shall insert a single 0 bit immediately following each sequence of 5 consecutive 1 bits;

(b) the receiving station shall examine the received frame contents for patterns consisting of 5 consecutive 1 bits immediately followed by one (or more) 0 bit(s) and shall remove the 0 bit which directly follows 5 consecutive 1 bits.

1.4.2.4 Special transmission sequences and related link States. In addition to employing the prescribed repertoire of commands and responses to manage the interchange of data and control information, stations shall use the following conventions to signal the indicated conditions:

(a) Abort is the procedure by which a station in the process of sending a frame ends the frame in an unusual manner such that the receiving station shall ignore the frame. The conventions for aborting a frame shall be:

(i) transmitting at least seven, but less than fifteen, one bits (with no inserted zeros);

(ii) receiving seven one bits.

(b) Active link State. A link is in an active State when a station is transmitting a frame, an abort sequence, or interframe time fill. When the link is in the active State, the right of the transmitting station to continue transmission shall be reserved.

(c) Interframe time fill. Interframe time fill shall be accomplished by

transmitting continuous flags between frames. There is no provision for time fill within a frame.

(d) Idle link State. A link is in an idle State when a continuous one condition is detected that persists for 15 bit times, or longer. Idle link time fill shall be a continuous one condition on the link.

(e) Invalid frame. An invalid frame is one that is not properly bounded by two flags or one which is shorter than 32 bits between flags.

1.4.2.5 MODES

1.4.2.5.1 Operational mode. The operational mode shall be the asynchronous balanced mode (ABM).

1.4.2.5.1.1 It shall be permissible for a combined station in ABM to transmit without invitation from the associated station.

1.4.2.5.1.2 A combined station in ABM shall be permitted to transmit any command or response type frame except DM.

1.4.2.5.2 Non-operational mode. The non-operational mode shall be the asynchronous disconnected mode (ADM) in which a combined station is logically disconnected from the data link.

1.4.2.5.2.1 It shall be permissible for a combined station in ADM to transmit without invitation from the associated station.

1.4.2.5.2.2 A combined station in ADM shall transmit only SABM, DISC, UA and DM frames. (See 1.4.2.7 for a description of the commands and responses to which these frame types refer.)

1.4.2.5.2.3 A combined station in ADM shall transmit a DM when a DISC is received, and shall discard all other received command frames except SABM. If a discarded command frame has the P bit set to "1", the combined station shall transmit a DM with the F bit set to "1".

1.4.2.6 Control field functions and parameters. Control fields contain a command or a response and sequence numbers where applicable. Three types of control fields shall be used to perform-

(a) numbered information transfer (I-frames);
(b) numbered supervisory functions (S-frames); and
(c) unnumbered control functions (U-frames).

Note:The control field formats shall be as shown in Table 8-5. The functional frame designation associated with each type control field as well as the control field parameters employed in performing these functions shall be described in the following paragraphs.

1.4.2.6.1 The I-frame type is used to perform information transfers. Except for some special cases it is the only format which shall be permitted to contain an information field.

1.4.2.6.2 The S-frame type is used for supervisory commands and responses that perform link supervisory control functions such as acknowledge information frames, request transmission or retransmission of information frames, and to request a temporary suspension of transmission of I-frames. No information field shall be contained in the S-frame.

1.4.2.6.3 The U-frame type is used for unnumbered commands and responses that provide additional link control functions. One of the U-frame responses, the frame reject (FRMR) response, shall contain an information field; all other frames of the U-frame type shall not contain an information field.

1.4.2.6.4 The station parameters associated with the three control field types shall be as follows:

(a) Modulus. Each I-frame shall be sequentially numbered with a send sequence count, N(S), having value 0 through modulus minus one (where modulus is the modulus of the sequence numbers). The modulus shall be 8. The maximum number of sequentially numbered I-frames that a station shall have outstanding (i.e. unacknowledged) at any given time shall never exceed one less than the modulus of the sequence numbers. This restriction on the number of outstanding frames is to prevent any ambiguity in the association of transmission frames with sequence numbers during normal operation and/or error recovery.

(b) The send State variable V(S) shall denote the sequence number of the next in-sequence I-frame to be transmitted.

1. The send State variable shall take on the value 0 through modulus minus one (modulus is the modulus of the sequence numbering and the numbers cycle through the entire range).
2. The value of V(S) shall be incremented by one with each successive in-sequence I-frame transmission, but shall not exceed the value of N(R) contained in the last received frame by more than the maximum permissible number of outstanding I-frames (k). See i) below for the definition of k.

(c) Prior to transmission of an in-sequence I-frame, the value of N(S) shall be updated to equal the value of V(S).

(d) The receive State variable V(R) shall denote the sequence number of the next in-sequence I-frame to be received.

(i) V(R) shall take on the values 0 through modulus minus one.

(ii) The value of V(R) shall be incremented by one after the receipt of an error-free, in-sequence I- frame whose send sequence number N(S), equals V(R).

(e) All I-frames and S-frames shall contain N(R), the expected sequence number of the next received frame. Prior to transmission of either an I or an S type frame, the value of N(R) shall be updated to equal the current value of the receive State variable. N(R) indicates that the station transmitting the N(R) has correctly received all I-frames numbered up to and including N(R) – 1.

(f) Each station shall maintain an independent send State variable, V(S), and receive State variable, V(R), on the I- frames it sends and receives. That is, each combined station shall maintain a V(S) count on the I-frames it transmits and a V(R) count on the I-frames it has correctly received from the remote combined station.

(g) The poll (P/F) bit shall be used by a combined station to solicit (poll) a response or sequence of responses from the remote combined station.

(h) The final (P/F) bit shall be used by the remote combined station to indicate the response frame transmitted as the result of a soliciting (poll) command.

(i) The maximum number (k) of sequentially numbered I-frames that a station may have outstanding (i.e. unacknowledged) at any given time is a station parameter which shall never exceed the modulus.

Note.— k is determined by station buffering limitations and should be the subject of bilateral agreement at the time of circuit establishment.

1.4.2.7 Commands and responses. It shall be permissible for a combined station to generate either commands or responses. A command shall contain the remote station address while a response shall contain the sending station address. The mnemonics associated with all of the commands and responses prescribed for each of the three frame types (I, S, and U) and the corresponding encoding of the control field are as shown in Table 8- 6.

1.4.2.7.1 The I-frame command provides the means for transmitting sequentially numbered frames, each of which shall be permitted to contain an information field.

1.4.2.7.2 The S-frame commands and responses shall be used to perform numbered supervisory functions (such as acknowledgement, polling, temporary suspension of information transfer, or error recovery).

1.4.2.7.2.1 The receive ready command or response (RR) shall be used by a station to-

(a) indicate that it is ready to receive an I-frame;
(b) acknowledge previously received I-frames numbered up to and including N(R) – 1;
(c) clear a busy condition that was initiated by the transmission of RNR.

Note.— It is permissible for a combined station to use the RR command to solicit a response from the remote combined station with the poll bit set to "1".

1.4.2.7.2.2 It shall be permissible to issue a reject command or response (REJ) to request retransmission of frames starting with the I-frame numbered N(R) where:

(a) I-frames numbered N(R) – 1 and below are acknowledged;
(b) additional I-frames pending initial transmission are to be transmitted following the retransmitted I-frame(s);
(c) only one REJ exception condition, from one given station to another station, shall be established at any given time: another REJ shall not be issued until the first REJ exception condition has been cleared;
(d) the REJ exception condition is cleared (reset) upon the receipt of an I-frame with an N(S) count equal to the N(R) of the REJ command/response.

1.4.2.7.2.3 The receive not ready command or response (RNR) shall be used to indicate a busy condition, i.e. temporary inability to accept additional incoming I-frames, where-

(a) frames numbered up to and including N(R) – 1 are acknowledged;

(b) frame N(R) and any subsequent I-frames received, if any, are not acknowledged (the acceptance status of these frames shall be indicated in subsequent exchanges);

(c) the clearing of a busy condition shall be indicated by the transmission of an RR, REJ, SABM, or UA with or without the P/F bit set to "1".

1.4.2.7.2.3.1

(a) A station receiving an RNR frame when in the process of transmitting shall stop transmitting I-frames at the earliest possible time.

(b) Any REJ command or response which was received prior to the RNR shall be actioned before the termination of transmission.

(c) It shall be permissible for a combined station to use the RNR command with the poll bit set to "1" to obtain a supervisory frame with the final bit set to "1" from the remote combined station.

1.4.2.7.2.4 It shall be permissible for the selective reject command or response (SREJ) to be used to request retransmission of the single I-frame numbered N(R) where:

(a) frames numbered up to N(R) – 1 are acknowledged; frame N(R) is not accepted; the only I-frames accepted are those received correctly and in sequence following the I-frame requested; the specific I-frame to be retransmitted is indicated by the N(R) in the SREJ command/response;

(b) the SREJ exception condition is cleared (reset) upon receipt of an I-frame with an N(S) count equal to the N(R) of the SREJ;

(c) after a station transmits a SREJ it is not permitted to transmit SREJ or REJ for an additional sequence error until the first SREJ error condition has been cleared;

(d) I-frames that have been permitted to be transmitted following the I-frame indicated by the SREJ are not retransmitted as the result of receiving a SREJ; and

(e) it is permissible for additional I-frames pending initial transmission to be transmitted following the retransmission of the specific I-frame requested by the SREJ.

1.4.2.7.3 The U-frame commands and responses shall be used to extend the number of link control functions. Transmitted U-frames do not increment the sequence counts at either the transmitting or receiving station.

(a) The U-frame mode-setting commands (SABM, and DISC) shall be used to place the addressed station in the appropriate response mode (ABM or ADM) where-

(i) upon acceptance of the command, the station send and receive State variables, V(S) and V(R), are set to zero;

(ii) the addressed station confirms acceptance at the earliest possible time by transmission of a single unnumbered acknowledgement, UA;

(iii) previously transmitted frames that are unacknowledged when the command is actioned remain unacknowledged; and

(iv) the DISC command is used to perform a logical disconnect, i.e. to inform the addressed combined station that the transmitting combined station is suspending operation. No information field shall be permitted with the

DISC command.

(b) The unnumbered acknowledge response (UA) shall be used by a combined station to acknowledge the receipt and acceptance of an unnumbered command. Received unnumbered commands are not actioned until the UA response is transmitted. No information field shall be permitted with the UA response.

(c) The frame reject response (FRMR), employing the information field described below, shall be used by a combined station in the operational mode (ABM) to report that one of the following conditions resulted from the receipt of a frame without an FCS error:

(i) a command/response that is invalid or not implemented;

(ii) a frame with an information field that exceeds the size of the buffer available;

(iii) a frame having an invalid N(R) count.

Note.— An invalid N(R) is a count which points to an I-frame which has previously been transmitted and acknowledged or to an I-frame which has not been transmitted and is not the next sequential I-frame pending transmission.

(d) The disconnected mode response (DM) shall be used to report a non-operational status where the station is logically disconnected from the link. No information field shall be permitted with the DM response.

Note.— The DM response shall be sent to request the remote combined station to issue a mode-setting command or, if sent in response to the reception of a mode-setting command, to inform the remote combined station that the transmitting station is still in ADM and cannot action the mode-setting command.

1.4.2.1 EXCEPTION CONDITION REPORTING AND RECOVERY

This section specifies the procedures that shall be employed to effect recovery following the detection or occurrence of an exception condition at the link level. Exception conditions described are those situations that may occur as the result of transmission errors, station malfunction, or operational situations.

1.4.3.1 Busy condition. A busy condition occurs when a station temporarily cannot receive or continue to receive I-frames due to internal constraints, e.g. due to buffering limitations. The busy condition shall be reported to the remote combined station by the transmission of an RNR frame with the N(R) number of the next I- frame that is expected. It shall be permissible for traffic pending transmission at the busy station to be transmitted prior to or following the RNR.

Note.— The continued existence of a busy condition must be reported by retransmission of RNR at each P/F frame exchange.

1.4.3.1.1 Upon receipt of an RNR, a combined station in ABM shall cease transmitting I-frames at the earliest possible time by completing or aborting the frame in process. The combined station receiving an RNR shall perform a time-out operation before resuming asynchronous transmission of I-frames unless the busy condition is reported as cleared by the remote combined station. If the RNR was received as a command with the P bit set to "1", the receiving station shall respond with an S-frame with the F bit set to "1".

1.4.3.1.2 The busy condition shall be cleared at the station which transmitted the RNR when the internal constraint ceases. Clearance of the busy condition shall be reported to the remote station by transmission of an RR, REJ, SABM, or UA frame (with or without the P/F bit set to "1").

1.4.3.2 N(S) sequence error. An N(S) sequence exception shall be established in the receiving station when an I-frame that is received error free (no FCS error) contains an N(S) sequence number that is not equal to the receive variable V(R) at the receiving station. The receiving station shall not acknowledge (shall not increment its receive variable V(R)) the frame causing the sequence error, or any I-frames which may follow, until an I- frame with the correct N(S) number is received. A station that receives one or more I-frames having sequence errors, but which are otherwise error free, shall accept the control information contained in the N(R) field and the P/F bit to perform link control functions, e.g. to receive acknowledgement of previously transmitted I-frames (via the N(R)), to cause the station to respond (P bit set to "1").

1.4.3.2.1 The means specified in 1.4.3.2.1.1 and 1.4.3.2.1.2 shall be available for initiating the retransmission of lost or errored I-frames following the occurrence of a sequence error.

1.4.3.2.1.1 Where the REJ command/response is used to initiate an exception recovery following the detection of a sequence error, only one "sent REJ" exception condition, from one station to another station, shall be established at a time. A "sent REJ" exception shall be cleared when the requested I-frame is received. A station receiving REJ shall initiate sequential (re)transmission of I-frames starting with the I- frame indicated by the N(R) contained in the REJ frame.

FRMR INFORMATION FIELD BITS FOR BASIC (SABM) OPERATION

1.4.3.2.1.2 In the event a receiving station, due to a transmission error, does not receive (or receives and discards) a single I-frame or the last I- frame(s) in a sequence of I-frames, it shall not detect an out-of- sequence exception and, therefore, shall not transmit REJ. The station which transmitted the unacknowledged I-frame(s) shall, following the completion of a system-specified time-out period, take appropriate recovery action to determine the sequence number at which retransmission must begin.

1.4.3.2.1.3 A combined station which has timed out waiting for a response shall not retransmit all unacknowledged frames immediately. The station may enquire about status with a supervisory frame.

Note 1.— If a station does retransmit all unacknowledged I-frames after a time-out, it must be prepared to receive a subsequent REJ frame with an N(R) greater than its send variable V(S).

Note 2.— Since contention may occur in the case of two-way alternate communications in ABM or ADM, the time-out interval employed by one combined station must be greater than that employed by the other combined station so as to permit contention to be resolved.

1.4.3.3 FCS error. Any frame with an FCS error shall not be accepted by the receiving station and will be discarded. No action shall be taken by the receiving station as the result of that frame.

1.4.3.4 Frame reject exception condition. A frame reject exception condition shall be established upon the receipt of an error-free frame which contains an invalid or

unimplemented control field, an invalid N(R), or an information field which has exceeded the maximum established storage capability. If a frame reject exception condition occurs in a combined station, the station shall either:

(a) take recovery action without reporting the condition to the remote combined station; or

(b) report the condition to the remote combined station with a FRMR response. The remote station will then be expected to take recovery action; if, after waiting an appropriate time, no recovery action appears to have been taken, the combined station reporting the frame reject exception condition may take recovery action. Recovery action for balanced operation includes the transmission of an implemented mode-setting command. Higher level functions may also be involved in the recovery.

1.4.3.5 Mode-setting contention. A mode-setting contention situation exists when a combined station issues a modesetting command and, before receiving an appropriate response (UA or DM), receives a mode- setting command from the remote combined station. Contention situations shall be resolved in the following manner:

(a) when the send and receive mode-setting commands are the same, each combined station shall send a UA response at the earliest respond opportunity. Each combined station shall either enter the indicated mode immediately or defer entering the indicated mode until receiving a UA response. In the latter case, if the UA response is not received:

(i) the mode may be entered when the response timer expires; or

(ii) the mode-setting command may be reissued;

(b) when the mode-setting commands are different, each combined station shall enter ADM and issue a DM response at the earliest respond opportunity. In the case of DISC contention with a different mode-setting command, no further action is required.

1.5.1.2 Time-out functions. Time-out functions shall be used to detect that a required or expected acknowledging action or response to a previously transmitted frame has not been received. Expiration of the time-out function shall initiate appropriate action, e.g. error recovery or reissuance of the P bit. The duration of the following time-out functions is system dependent and subject to bilateral agreement:

(a) combined stations shall provide a time-out function to determine that a response frame with F bit set to "1" to a command frame with the P bit set to "1" has not been received. The time-out function shall automatically cease upon receipt of a valid frame with the F bit set to "1";

(b) a combined station which has no P bit outstanding, and which has transmitted one or more frames for which responses are anticipated shall start a time-out function to detect the no-response condition. The time-out function shall cease when an I- or S-frame is received with the N(R) higher than the last received N(R) (actually acknowledging one or more I-frames).

CONTROL CHARACTERS

Abbreviation	*Meaning*	*Position in the code table*
ACK	Acknowledge	0/6
BEL	Bell	0/7
BS	Backspace	0/8
CAN	Cancel	1/8
CR	Carriage return*	0/13
DC	Device control	–
DEL	Delete	7/15
DLE	Data link escape	1/0
EM	End of medium	1/9
ENQ	Enquiry	0/5
EOT	End of transmission	0/4
ESC	Escape	1/11
ETB	End of transmission block	1/7
ETX	End of text	0/3
FE	Format effector	–
FF	Form feed	0/12
FS	File separator	1/12
GS	Group separator	1/13
HT	Horizontal tabulation	0/9
IS	Information separator	–
LF	Line feed*	0/10
NAK	Negative acknowledge	1/5
NUL	Null	0/0
RS	Record separator	1/14
SI	Shift-in	0/15
SO	Shift-out	0/14
SOH	Start of heading	0/1
SP	Space	2/0
STX	Start of text	0/2
SUB	Substitute character	1/10
SYN	Synchronous idle	1/6
TC	Transmission control	–
US	Unit separator	1/15
VT	Vertical tabulation	0/11

GRAPHIC CHARACTERS

Graphic	*Note*	*Name*	*Position in the code table*
(space)		Space (*see* 7.2)	2/0
!		Exclamation mark	2/1
"	4	Quotation mark, Diaeresis	2/2
#		Number sign	2/3
¤	2	Currency sign	2/4
%		Percent sign	2/5
&		Ampersand	2/6
'	4	Apostrophe, Acute accent	2/7
(		Left parenthesis	2/8
)		Right parenthesis	2/9
*		Asterisk	2/10
+		Plus sign	2/11
,	4	Comma, Cedilla	2/12
–		Hyphen, Minus sign	2/13
.		Full stop (period)	2/14
/		Solidus	2/15
:		Colon	3/10
;		Semi-colon	3/11
<		Less-than sign	3/12
=		Equal sign	3/13
>		Greater-than sign	3/14
?		Question mark	3/15
@		Commercial 'at'	4/0
[		Left square bracket	5/11
\		Reverse solidus	5/12
]		Right square bracket	5/13
^	4	Upward arrow head, Circumflex accent	5/14
_		Underline	5/15
`		Grave accent	6/0
{		Left curly bracket	7/11
|		Vertical line	7/12
}		Right curly bracket	7/13
~	3	Overline, Tilde	7/14

* See Note 1.

DIACRITICAL SIGNS

In the character set, some printing symbols may be designed to permit their use for the composition of accented letters when necessary for general interchange of information. A sequence of three characters, comprising a letter, BACKSPACE and one of these symbols, is needed for this composition, and the symbol is then regarded as a diacritical sign. It should be noted that these symbols take on their diacritical significance only when they are preceded or followed by the BACKSPACE character: for example, the symbol corresponding to the code combination 2/7 (') normally has the significance of APOSTROPHE, but becomes the diacritical sign ACUTE ACCENT when it precedes or follows the BACKSPACE character.

NAMES, MEANINGS AND FONTS OF GRAPHIC CHARACTERS

At least one name is assigned to denote each of the graphic characters. These names are intended to reflect their customary meanings and are not intended to define or restrict the meanings of graphic characters. No particular style or font design is specified for the graphic characters.

UNIQUENESS OF CHARACTER ALLOCATION

A character allocated to a position in the table may not be placed elsewhere in the table.

TABLES FOR THE ELEVENTH SCHEDULE

DC_4 — A device control character which is primarily intended for turning off, stopping or interrupting an ancillary device. If it is not required for this purpose, it may be used for any other device control function not provided by other DCs.

Examples of use of the device controls

1) One switching
on — DC_2 off — DC_4

2) Two independent switchings
First one on — DC_2 off — DC_4
Second one on — DC_1 off — DC_3

3) Two dependent switchings
General on — DC_2 off — DC_4
Particular on — DC_1 off — DC_3

4) Input and output switching
Output on — DC_2 off — DC_4
Input on — DC_1 off — DC_3

DEL — *Delete* — A character used primarily to erase or obliterate an erroneous or unwanted character in punched tape. DEL characters may also serve to accomplish media-fill or time-fill. They may be inserted into or removed from a stream of data without affecting the information content of that stream, but then the addition or removal of these characters may affect the information layout and/or the control of equipment.

DLE — *Data link escape* — A transmission control character which will change the meaning of a limited number of contiguously following characters. It is used exclusively to provide supplementary data transmission control functions. Only graphic characters and transmission control characters can be used in DLE sequences.

EM — *End of medium* — A control character that may be used to identify the physical end of a medium, or the end of the used portion of a medium, or the end of the wanted portion of data recorded on a medium. The position of this character does not necessarily correspond to the physical end of the medium.

ENQ — *Enquiry* — A transmission control character used as a request for a response from a remote station — the response may include station identification and/or station status. When a "Who are you?" function is required on the general switched transmission network, the first use of ENQ after the connection is established shall have the meaning "Who are you?" (station identification). Subsequent use of ENQ may, or may not, include the function "Who are you?", as determined by agreement.

EOT — *End of transmission* — A transmission control character used to indicate the conclusion of the transmission of one or more texts.

ESC — *Escape* — A control character which is used to provide an additional control function. It alters the meaning of a limited number of contiguously following bit combinations which constitute the escape sequence.
Escape sequences are used to obtain additional control functions which may provide among other things graphic sets outside the standard set. Such control functions must not be used as additional transmission controls.
The use of the character ESC and of the escape sequences in conjunction with code extension techniques is the subject of an ISO Standard.

ETB — *End of transmission block* — A transmission control character used to indicate the end of a transmission block of data where data are divided into such blocks for transmission purposes.

ETX — *End of text* — A transmission control character which terminates a text.

FF — *Form feed* — A format effector which advances the active position to the same character position on a predetermined line of the next form or page.

HT — *Horizontal tabulation* — A format effector which advances the active position to the next predetermined character position on the same line.

Information separators

IS_1 (US) — A control character used to separate and qualify data logically; its specific meaning has to be defined for each application. If this character is used in hierarchical order as specified in the general definition of IS, it delimits a data item called a UNIT.

IS_2 (RS) — A control character used to separate and qualify data logically; its specific meaning has to be defined for each application. If this character is used in hierarchical order as specified in the general definition of IS, it delimits a data item called a RECORD.

IS_3 (GS) — A control character used to separate and qualify data logically; its specific meaning has to be defined for each application. If this character is used in hierarchical order as specified in the general definition of IS, it delimits a data item called a GROUP.

IS_4 (FS) — A control character used to separate and qualify data logically; its specific meaning has to be defined for each application. If this character is used in hierarchical order as specified in the general definition of IS, it delimits a data item called a FILE.

LF — *Line feed* — A format effector which advances the active position to the same character position of the next line.

NAK — *Negative acknowledge* — A transmission control character transmitted by a receiver as a negative response to the sender.

NUL — *Null* — A control character used to accomplish media-fill or time-fill. NUL characters may be inserted into or removed from a stream of data without affecting the information content of that stream, but then the addition or removal of these characters may affect the information layout and/or the control of equipment.

Table 8-5. Control field formats

Control field format for	Control field bits							
	1	2	3	4	5	6	7	8
Information transfer (I frame)	0	*N(S)*			*P*	*N(R)*		
Supervisory commands/responses (S frame)	1	0	*S*	*S*	*P/F*	*N(R)*		
Unnumbered commands/responses	1	1	*M*	*M*	*P/F*	*M*	*M*	*M*

where:

N(S) = send sequence count (bit 2 = low order bit)
N(R) = receive sequence count (bit 6 = low order bit)
S = supervisory function bits
M = modifier function bits
P = poll bit (in commands)
F = final bit (in responses)

Table 8-6. Commands and responses

Type	*Commands*		*Responses*		*C field encoding* 1	2	3	4	5	6	7	8
Information transfer	I	(information)			0		*N(S)*		*P*		*N(R)*	
Supervisory	RR	(receive ready)	RR	(receive ready)	1	0	0	0	*P/F*		*N(R)*	
	RNR	(receive not ready)	RNR	(receive not ready)	1	0	1	0	*P/F*		*N(R)*	
	REJ	(reject)	REJ	(reject)	1	0	0	1	*P/F*		*N(R)*	
Unnumbered			DM	(disconnected mode)	1	1	1	1	*P/F*	0	0	0
	SABM	(set asynchronous balanced mode)			1	1	1	1	*P*	1	0	0
	DISC	(disconnect)			1	1	0	0	*P*	0	1	0
			UA	(unnumbered acknowledgement)	1	1	0	0	*F*	1	1	0
			FRMR	(frame reject)	1	1	1	0	*F*	0	0	1

SI — *Shift-in* — A control character which is used in conjunction with SHIFT-OUT and ESCAPE to extend the graphic character set of the code. It may reinstate the standard meanings of the bit combinations which follow it. The effect of this character when using code extension techniques is described in an ISO Standard.

SO — *Shift-out* — A control character which is used in conjunction with SHIFT-IN and ESCAPE to extend the graphic character set of the code. It may alter the meaning of the bit combinations of columns 2 to 7 which follow it until a SHIFT-IN character is reached. However, the characters SPACE (2/0) and DELETE (7/15) are unaffected by SHIFT-OUT. The effect of this character when using code extension techniques is described in an ISO Standard.

SOH — *Start of heading* — A transmission control character used as the first character of a heading of an information message.

SP — *Space* — A character which advances the active position one character position on the same line. This character is also regarded as a non-printing graphic.

STX — *Start of text* — A transmission control character which precedes a text and which is used to terminate a heading.

SUB — *Substitute character* — A control character used in the place of a character that has been found to be invalid or in error. SUB is intended to be introduced by automatic means.

SYN — *Synchronous idle* — A transmission control character used by a synchronous transmission system in the absence of any other character (idle condition) to provide a signal from which synchronism may be achieved or retained between data terminal equipment.

VT — *Vertical tabulation* — A format effector which advances the active position to the same character position on the next predetermined line.

1.5 Common ICAO data interchange network (CIDIN)

1.5.1 INTRODUCTION

The common ICAO data interchange network (CIDIN) is an element of the aeronautical fixed service (AFS) which uses bit-oriented procedures, store and forward techniques and packet switching techniques based on CCITT Recommendation X.25 to carry messages of specific applications of the AFS such as AFTN and operational meteorological information (OPMET).

The CIDIN provides a reliable common network service for the conveyance of application messages in binary or text form to air traffic service providers and aircraft operating agencies.

1.5.1.1 CIDIN entry and exit centres or stations shall be used to connect application entities to the CIDIN.

Note The interfacing between CIDIN and application entities is a matter for local implementation.

1.5.1.2 CIDIN relay centres shall be used to forward packets between CIDIN entry and exit centres or stations which are not directly connected.

1.5.1.3 General
1.5.1.4 There shall be four protocol levels defined to control the transfer of messages between CIDIN switching centres:

— the data link protocol level
— the X.25 packet protocol level
— the CIDIN packet protocol level
— the CIDIN transport protocol level.

Note 1.— The details of CIDIN communication procedures and system specifications, as implemented in Europe, are shown in the EUR CIDIN Manual (EUR Doc 005).

1.5.1.5 THE DATA LINK PROTOCOL LEVEL

1.5.1.6 X.25 packets to be transferred between two CIDIN switching centres or a CIDIN switching centre and a packet switched data network, shall be formatted into data link frames.

1.5.1.7 Each data link frame shall consist of a data link control field (DLCF), possibly followed by a link data field, and shall be terminated by a frame check sequence and flag (being the second part of the DLCF). If a link data field is present, the frame shall be denoted as an information frame.

1.5.1.8 X.25 packets shall be transmitted within the link data field of information frames. Only one packet shall be contained in the link data field.

1.5.1.9 The X.25 packet protocol level
1.5.1.10 Each CIDIN packet to be transferred on CIDIN circuits between CIDIN switching centres shall be formatted into one X.25 packet. When a packet switched data network is used, it shall be permissible to format the CIDIN packet into more than one X.25 packet.

1.5.1.11 The integrity of each CIDIN packet shall be preserved by the X.25 packet protocol by mapping each CIDIN packet onto one complete X.25 packet sequence, as defined in CCITT Recommendation X.25.

1.5.1.12 Each X.25 packet shall consist of an X.25 packet header, possibly followed by a user data field (UDF)

1.5.1.13 The X.25 packet protocol is based on the application of virtual circuit procedures. A virtual circuit shall be defined as a logical path between two CIDIN switching centres. If a packet switched data network is used to interconnect two CIDIN switching centres, the procedure shall provide full compatibility with the procedures to be followed for virtual circuits according to CCITT Recommendation X.25.

1.5.1.14 THE CIDIN PACKET PROTOCOL LEVEL

1.5.1.15 Each transport header and the associated segment shall be preceded by a CIDIN packet header. No further segmentation of the CIDIN message shall be used between transport protocol level and CIDIN packet protocol level. Both headers, therefore, shall be used in combination. Together they shall be referred to as the communications control field (CCF). Together with the message segment they form CIDIN packets that shall be transmitted from entry centre to exit centre(s), when necessary, through one or more relay centres, as an entity.

1.5.1.16 CIDIN packets of one CIDIN message shall be relayed independently via predetermined routes through the network thus allowing alternative routing on a CIDIN packet basis as necessary.

1.5.1.17 The CIDIN packet header shall contain information to enable relay centres to handle CIDIN packets in the order of priority, to transmit the CIDIN packets on the proper outgoing circuit(s) and to duplicate or multiplicate CIDIN packets when required for multiple dissemination purposes. The information shall be sufficient to apply address stripping on the exit addresses as well as on the addressee indicators of messages in AFTN format.

1.5.1.18 The transport protocol level
1.5.1.19 Information exchanged over the CIDIN shall be transmitted as CIDIN messages.

1.5.1.20 The length of a CIDIN message shall be defined by the CIDIN packet sequence number (CPSN). The maximum permissible length is 215 packets which in effect results in no practical limitation.

1.5.1.21 If the length of a CIDIN message and its transport and packet headers (as defined below) exceeds 256 octets, the message shall be divided into segments and placed in the CIDIN user data field of CIDIN packets. Each segment shall be preceded by a transport header containing information to enable the re- assembly of the CIDIN message at the exit centre(s) from individually received segments and to determine further handling of the received complete CIDIN message.

1.5.1.22 All segments of one CIDIN message shall be provided with the same message identification information in the transport header. Only the CPSN and final CIDIN packet (FCP) indicator shall be different.

1.5.1.23 Recovery of messages shall be performed at the transport level.

1.5.1.24 Any method used to assign aircraft addresses shall ensure efficient use of the entire address block that is allocated to The United Republic of Tanzania

TWELFTH SCHEDULE

(Made under regulation 61)

A WORLDWIDE SCHEME FOR THE ALLOCATION, ASSIGNMENT AND APPLICATION OF AIRCRAFT ADDRESSES

1. GENERAL

1.1 Global communications, navigation and surveillance systems shall use an individual aircraft address composed of 24 bits. At any one time, no address shall 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. DESCRIPTION OF THE SCHEME

2.1 Table 9-1 provides for blocks of consecutive addresses available to States for assignment to aircraft. Each block is defined by a fixed pattern of the first 4, 6, 9, 12 or 14 bits of the 24-bit address. Thus, blocks of different sizes (1 048 576, 262 144, 32 768, 4 096 and 1 024 consecutive addresses, respectively) are made available.

3. MANAGEMENT OF THE SCHEME

3.1 The International Civil Aviation Organization (ICAO) shall administer the scheme so that appropriate international distribution of aircraft addresses can be maintained.

4.0 ALLOCATION OF AIRCRAFT ADDRESSES

4.1 Blocks of aircraft addresses shall be allocated by ICAO to the State of Registry or common mark registering authority. Address allocations to States shall be as shown in Table 9-1.

4.2 A State of Registry or common mark registering authority shall notify ICAO when allocation to that State of an additional block of addresses is required for assignment to aircraft

4.3 Any future requirement for additional aircraft addresses shall be accommodated through coordination between ICAO and the States of Registry or common mark registering authority concerned. A request for additional aircraft addresses shall only be made by a registering authority when at least 75 per cent of the number of addresses already allocated to that registering authority have been assigned to aircraft.

4.4 ICAO shall allocate blocks of aircraft addresses to non-Contracting States upon request.

5.0 ASSIGNMENT OF AIRCRAFT ADDRESSES

5.1 During the registration process, using its allocated block of addresses, the Authority or common mark registering authority shall assign an individual aircraft address to each suitably equipped aircraft entered on a national or international register (Table 9-1).

Note.— For an aircraft delivery, the aircraft operator is expected to inform the airframe manufacturer of an address assignment. The airframe manufacturer or other organization responsible for a delivery flight is expected to ensure installation of a correctly assigned address supplied by the State of Registry or common mark registering authority. Exceptionally, a temporary address may be supplied under the arrangements.

5.2 Aircraft addresses shall be assigned to aircraft in accordance with the following principles:

(a) at any one time, no address shall be assigned to more than one aircraft with the exception of aerodrome surface vehicles on surface movement areas. If such exceptions are applied by the State of Registry, the vehicles which have been allocated the same address shall not operate on aerodromes separated by less than 1 000 km;

(b) only one address shall be assigned to an aircraft, irrespective of the composition of equipment on board. In the case when a removable transponder is shared by several light aviation aircraft such as balloons or gliders, it shall be possible to assign a unique address to the removable transponder. Registers 0816, and 2016, of the removable transponder shall be correctly updated each time the removable transponder is installed in any aircraft;

(c) the address shall not be changed except under exceptional circumstances and shall not be changed during flight;

(d) when an aircraft changes its State of Registry, the new registering State shall assign the aircraft a new address from its own allocation address block, and the old aircraft address shall be returned to the allocation address block of the State that previously registered the aircraft;

(e) the address shall serve only a technical role for addressing and identification of aircraft and shall not be used to convey any specific information; and

(f) the addresses composed of 24 ZEROS or 24 ONES shall not be assigned to aircraft; and

(g) 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 shall be assigned 24 bit aircraft addresses.

5.2.1 Any method used to assign aircraft addresses shall ensure efficient use of the entire address block that is allocated by the Authority.

5.2.2 Mode S transponders used under specific conditions stated under regulation 61 should not have any negative impact on the performance of existing ATS surveillance systems and ACAS.

5.3 Assignment of aircraft addresses to unmanned aircraft (UA)

Note — States may need to consider withholding aircraft addresses to unmanned aircraft (UA) unless certain criteria have been met. Proper and efficient utilization of available bandwidth and capacity at 1 090 MHz is a key element to ensure the safe operation of aeronautical surveillance systems, including secondary surveillance radar (SSR), automatic dependent surveillance — broadcast (ADS-B) and airborne collision avoidance systems (ACAS). A large number of UA equipped with ADS-B OUT transmitters operating at 1 090 MHz may adversely affect the operation of surveillance systems in the area. Reference is made to the guidance material contained in the Aeronautical Surveillance Manual (Doc 9924), intended to assist States when validating the utilization of 1 090 MHz.

6. ADMINISTRATION OF THE AIRCRAFT ADDRESS ASSIGNMENTS

6.1 The State of Registry or common mark registering authority shall administer the allocated block of aircraft addresses so that appropriate assignment of aircraft addresses within its allocated block can be maintained.

Note. — The aircraft address is an essential element that needs to be correctly configured in an aircraft to support operation of systems and functions, such as SSR Mode S, ADS-B, datalink, collision avoidance and emergency location.

6.2 States shall establish and publish an administrative procedure for requesting and assigning aircraft addresses.

Note. — An example of an effective administrative procedure, including the indication of the aircraft address in the certificate of registration, which can be used by the State of Registry or common mark registering authority, can be found in the Aeronautical Surveillance Manual (Doc 9924).

6.3 The State of Registry or common mark registering authority shall put in place measures to ensure that aircraft registered under their responsibility are flying with a correct aircraft address.

Note. — Examples of such measures can be found in 2.1.7 of Appendix of the Aeronautical Surveillance Manual (Doc 9924).

7. APPLICATION OF AIRCRAFT ADDRESSES

7.1 The aircraft addresses shall be used in applications which require the routing of information to or from individual suitably equipped aircraft.

Note 1.— Examples of such applications are the aeronautical telecommunication network (ATN), SSR Mode S, ADS-B, emergency locator transmitter (ELT) and airborne collision avoidance system (ACAS).

Note 2.— This Standard does not preclude assigning the aircraft addresses for special applications associated with the general applications defined therein. The fixed Mode S transponders to monitor the Mode S ground station operation. Address assignments for special applications are to be carried out in conformance with the procedure established by the Authority to manage the 24- bit address assignments to aircraft.

7.2 An address consisting of 24 ZEROs shall not be used for any application.

8. ADMINISTRATION OF THE TEMPORARY AIRCRAFT ADDRESS ASSIGNMENTS

8.1 Temporary addresses shall be assigned to aircraft in exceptional circumstances, such as when operators have been unable to obtain an address from their individual States of Registry or common mark registering authority in a timely manner. ICAO shall assign temporary addresses from the block "ICAO1" shown in Table 9-1.

8.2 When requesting a temporary address, the aircraft operator shall supply to ICAO: aircraft identification, type and make of aircraft, name and address of the operator, and an explanation of the reason for the request.

8.2.1 Upon issuance of the temporary address to the aircraft operators, ICAO shall inform the State of Registry of the issuance of the temporary address, reason and duration.

8.3 The aircraft operator shall-

(a) inform the State of Registry of the temporary assignment and reiterate the request for a permanent address; and
(b) inform the airframe manufacturer.

8.4 When the permanent aircraft address is obtained from the State of Registry, the operator shall-

(a) inform ICAO without delay;
(b) relinquish his/her temporary address; and
(c) arrange for encoding of the valid unique address within 180 calendar days.

8.5 If a permanent address is not obtained within one year, the aircraft operator shall reapply for a new temporary aircraft address. Under no circumstances shall a temporary aircraft address be used by the aircraft operator for over one year.

Table 9-1. Allocation of aircraft addresses to States

Note.— The left-hand column of the 24-bit address patterns represents the most significant bit (MSB) of the address.

State	Number of addresses in block						Allocation of blocks of addresses (a dash represents a bit value equal to 0 or 1)
	2 048	4 096	8 192	32 768	262 144	1 048 576	
Afghanistan		*					0111 00 000 000 -- ----------
Albania	*						0101 00 000 001 0 ----------
Algeria				*			0000 10 100 --- -- ----------
Andorra	*						1100 10 010 001 ----------
Angola		*					0000 10 010 000 -- ----------
Antigua and Barbuda	*						0000 11 001 010 0 ----------
Argentina					*		1110 00 --- --- -- ----------
Armenia	*						0110 00 000 000 0 ----------
Australia					*		0111 11 --- --- -- ----------
Austria				*			0100 01 000 --- -- ----------
Azerbaijan	*						0110 00 000 000 1 ----------
Bahamas		*					0000 10 101 000 -- ----------
Bahrain		*					1000 10 010 100 -- ----------
Bangladesh		*					0111 00 000 010 -- ----------
Barbados	*						0000 10 101 010 0 ----------
Belarus	*						0101 00 010 000 0 ----------
Belgium				*			0100 01 001 --- -- ----------
Belize	*						0000 10 101 011 0 ----------
Benin	*						0000 10 010 100 0 ----------
Bhutan	*						0110 10 000 000 0 ----------
Bolivia (Plurinational State of)		*					1110 10 010 100 -- ----------
Bosnia and Herzegovina	*						0101 00 010 011 0 ----------
Botswana	*						0000 00 110 000 0 ----------
Brazil					*		1110 01 --- --- -- ----------
Brunei Darussalam	*						1000 10 010 101 0 ----------
Bulgaria				*			0100 01 010 --- -- ----------
Burkina Faso		*					0000 10 011 100 -- ----------
Burundi		*					0000 00 110 010 -- ----------
Cabo Verde	*						0000 10 010 110 0- ----------
Cambodia		*					0111 00 001 110 ----------
Cameroon		*					0000 00 110 100 -- ----------
Canada					*		1100 00 --- --- -- ----------
Central African Republic		*					0000 01 101 100 -- ----------
Chad		*					0000 10 000 100 -- ----------
Chile		*					1110 10 000 000 -- ----------
China					*		0111 10 --- --- -- ----------
Colombia		*	*				0000 10 101 10- -- ----------
Comoros	*						0000 00 110 101 0 ----------
Congo		*					0000 00 110 110 -- ----------
Cook Islands	*						1001 00 000 001 0 ----------
Costa Rica		*					0000 10 101 110 -- ----------

State	Number of addresses in block						Allocation of blocks of addresses (a dash represents a bit value equal to 0 or 1)
	2 048	4 096	8 192	32 768	262 144	1 048 576	
Côte d'Ivoire		*					0000 00 111 000 -- ----------
Croatia	*						0101 00 000 001 1 ----------
Cuba		*					0000 10 110 000 -- ----------
Cyprus	*						0100 11 001 000 0 ----------
Czechia				*			0100 10 011 --- -- ----------
Democratic People's Republic of Korea				*			0111 00 100 --- -- ----------
Democratic Republic of the Congo		*					0000 10 001 100 -- ----------
Denmark				*			0100 01 011 --- -- ----------
Djibouti	*						0000 10 011 000 0 ----------
Dominica	*						1100 10 010 010 0- ----------
Dominican Republic		*					0000 11 000 100 -- ----------
Ecuador		*					1110 10 000 100 -- ----------
Egypt				*			0000 00 010 --- -- ----------
El Salvador		*					0000 10 110 010 -- ----------
Equatorial Guinea		*					0000 01 000 010 -- ----------
Eritrea	*						0010 00 000 010 0 ----------
Estonia	*						0101 00 010 001 0 ----------
Eswatini	*						0000 01 111 010 0- ----------
Ethiopia		*					0000 01 000 000 -- ----------
Fiji		*					1100 10 001 000 -- ----------
Finland				*			0100 01 100 --- -- ----------
France					*		0011 10 --- --- -- ----------
Gabon		*					0000 00 111 110 -- ----------
Gambia		*					0000 10 011 010 -- ----------
Georgia	*						0101 00 010 100 0 ----------
Germany					*		0011 11 --- --- -- ----------
Ghana		*					0000 01 000 100 -- ----------
Greece				*			0100 01 101 --- -- ----------
Grenada	*						0000 11 001 100 0 ----------
Guatemala		*					0000 10 110 100 -- ----------
Guinea		*					0000 01 000 110 -- ----------
Guinea-Bissau	*						0000 01 001 000 0 ----------
Guyana		*					0000 10 110 110 -- ----------
Haiti		*					0000 10 111 000 -- ----------
Honduras			*				0000 10 111 010
Hungary					*		0100 01 110 ---
Iceland			*				0100 11 001 100
India						*	1000 00 --- ---
Indonesia					*		1000 10 100 ---
Iran, (Islamic Republic of)					*		0111 00 110 ---
Iraq					*		0111 00 101 ---
Ireland			*				0100 11 001 010
Israel					*		0111 00 111 ---
Italy						*	0011 00 --- ---
Jamaica			*				0000 10 111 110
Japan						*	1000 01 --- ---
Jordan					*		0111 01 000 ---

State	Number of addresses in block						Allocation of blocks of addresses (a dash represents a bit value equal to 0 or 1)
	2 048	4 096	8 192	32 768	262 144	1 048 576	
Kazakhstan	*						0110 10 000 011 0 ----------
Kenya		*					0000 01 001 100 -- ----------
Kiribati	*						1100 10 001 110 0 ----------
Kuwait		*					0111 00 000 110 -- ----------
Kyrgyzstan	*						0110 00 000 001 0 ----------
Lao People's Democratic Republic		*					0111 00 001 000 -- ----------
Latvia	*						0101 00 000 010 1 ----------
Lebanon				*			0111 01 001 --- -- ----------
Lesotho	*						0000 01 001 010 0 ----------
Liberia		*					0000 01 010 000 -- ----------
Liby				*			0000 00 011 --- -- ----------
Lithuania	*						0101 00 000 011 1 ----------
Luxembourg	*						0100 11 010 000 0 ----------
Madagascar		*					0000 01 010 100 -- ----------
Malawi		*					0000 01 011 000 -- ----------
Malaysia				*			0111 01 010 --- -- ----------
Maldives	*						0000 01 011 010 0 ----------
Mali		*					0000 01 011 100 -- ----------
Malta	*						0100 11 010 010 0 ----------
Marshall Islands	*						1001 00 000 000 0 ----------
Mauritania	*						0000 01 011 110 0 ----------
Mauritius	*						0000 01 100 000 0 ----------
Mexico				*			0000 11 010 --- -- ----------
Micronesia, (Federated States of)	*						0110 10 000 001 0 ----------
Monaco	*						0100 11 010 100 0 ----------
Mongolia	*						0110 10 000 010 0 ----------
Montenegro	*						0101 00 010 110 0 ----------
Morocco				*			0000 00 100 --- -- ----------
Mozambique		*					0000 00 000 110 -- ----------
Myanmar		*					0111 00 000 100 -- ----------
Namibia	*						0010 00 000 001 0 ----------
Nauru	*						1100 10 001 010 0 ----------
Nepal		*					0111 00 001 010 -- ----------
Netherlands, Kingdom of the				*			0100 10 000 --- -- ----------
New Zealand				*			1100 10 000 --- -- ----------
Nicaragua		*					0000 11 000 000 -- ----------
Niger		*					0000 01 100 010 -- ----------
Nigeria		*					0000 01 100 100 -- ----------
North Macedonia	*						0101 00 010 010 0- ----------
Norway				*			0100 01 111 --- -- ----------
Oman	*						0111 00 001 100 0 ----------
Pakistan				*			0111 01 100 --- -- ----------
Palau	*						0110 10 000 100 0 ----------
Panama		*					0000 11 000 010 -- ----------
Papua New Guinea		*					1000 10 011 000 -- ----------
Paraguay		*					1110 10 001 000 -- ----------

State	Number of addresses in block						Allocation of blocks of addresses (a dash represents a bit value equal to 0 or 1)
	2 048	4 096	8 192	32 768	262 144	1 048 576	
Peru		*					1110 10 001 100 -- ----------
Philippines				*			0111 01 011 --- -- ----------
Poland				*			0100 10 001 --- -- ----------
Portugal				*			0100 10 010 --- -- ----------
Qatar	*	*					0000 01 101 010 -- ----------
Republic of Korea				*			0111 00 011 --- -- ----------
Republic of Moldova	*						0101 00 000 100 1 ----------
Romania				*			0100 10 100 --- -- ----------
Russian Federation						*	0001 -- --- --- -- ----------
Rwanda		*					0000 01 101 110 -- ----------
Saint Kitts and Nevis	*						1100 10 010 011 0- ----------
Saint Lucia	*						1100 10 001 100 0 ----------
Saint Vincent and the Grenadines	*						0000 10 111 100 0 ----------
Samoa	*						1001 00 000 010 0 ----------
San Marino	*						0101 00 000 000 0 ----------
Sao Tome and Principe	*						0000 10 011 110 0 ----------
Saudi Arabia				*			0111 00 010 --- -- ----------
Senegal		*					0000 01 110 000 -- ----------
Serbia				*			0100 11 000 --- -- ----------
Seychelles	*						0000 01 110 100 0 ----------
Sierra Leone	*						0000 01 110 110 0 ----------
Singapore				*			0111 01 101 --- -- ----------
Slovakia	*						0101 00 000 101 1 ----------
Slovenia	*						0101 00 000 110 1 ----------
Solomon Islands	*						1000 10 010 111 0 ----------
Somalia		*					0000 01 111 000 -- ----------
South Africa				*			0000 00 001 --- -- ----------
South Sudan	*				*		1100 10 010 100 0- ----------
Spain							0011 01 --- --- -- ----------
Sri Lanka				*			0111 01 110 --- -- ----------
Sudan		*					0000 01 111 100 -- ----------
Suriname		*					0000 11 001 000 -- ----------
Sweden				*			0100 10 101 --- -- ----------
Switzerland				*			0100 10 110 --- -- ----------
Syrian Arab Republic				*			0111 01 111 --- -- ----------
Tajikistan	*						0101 00 010 101 0 ----------
Thailand				*			1000 10 000 --- -- ----------
Timor-Leste	*						1100 10 010 101 0- ----------
Togo		*					0000 10 001 000 -- ----------
Tonga	*						1100 10 001 101 0 ----------
Trinidad and Tobago		*					0000 11 000 110 -- ----------
Tunisia				*			0000 00 101 --- -- ----------
Türkiye				*			0100 10 111 --- -- ----------
Turkmenistan	*						0110 00 000 001 1 ----------
Tuvalu	*						1100 10 010 111 0- ----------
Uganda		*					0000 01 101 000 -- ----------

State	Number of addresses in block						Allocation of blocks of addresses (a dash represents a bit value equal to 0 or 1)
	2 048	4 096	8 192	32 768	262 144	1 048 576	
Ukraine				*			0101 00 001 --- -- ----------
United Arab Emirates		*					1000 10 010 110 -- ----------
United Kingdom					*		0100 00 --- --- -- ----------
United Republic of Tanzania		*					0000 10 000 000 -- ----------
United States						*	1010 -- --- --- -- ----------
Uruguay		*					1110 10 010 000 -- ----------
Uzbekistan	*						0101 00 000 111 1 ----------
Vanuatu	*						1100 10 010 000 0 ----------
Venezuela (Bolivarian Republic of)				*			0000 11 011 --- -- ----------
Viet Nam				*			1000 10 001 --- -- ----------
Yemen		*					1000 10 010 000 -- ----------
Zambia		*					0000 10 001 010 -- ----------
Zimbabwe	*						0000 00 000 100 0 ----------
Other allocations							
ICAO[1]				*			1111 00 000 --- -- ----------
ICAO[2]	*						1000 10 011 001 0 ----------
ICAO[2]	*						1111 00 001 001 0 ----------

1. ICAO administers this block for assigning temporary aircraft addresses as described in section 8.

2. Block allocated for special use in the interest of flight safety.

SIXTEENTH SCHEDULE

(Made under regulation 77)

SELCAL SYSTEM

1. SELCAL is a signalling method which can alert an individual aircraft that a ground station wishes to communicate with it. SELCAL signals can be transmitted over either high frequency or very high frequency radios.

2. As of 3 November 2022, where a SELCAL system is installed, the following system characteristics shall be applied:

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

(b) Frequency stability. The frequency of transmitted tones shall be held to plus or minus 0.15 per cent tolerance to ensure proper operation of the airborne decoder;

(c) Distortion. The overall audio distortion present on the transmitted RF signal shall not exceed 15 per cent;

(d) Level stability. The RF signal transmitted by the ground radio station shall contain, within 3 dB, equal amounts of the two modulating tones. The combination of tones shall result in a modulation envelope having a nominal modulation percentage as high as possible and not less than 60 percent as of 3 November 2022; and

(e) Transmitted codes shall be made up of various combinations of the tones listed in Table. They are designated by colour and letter or number as indicated.

Table 16.1 SELCAL tones designated by colour and letter or number (applicable as of 3 November 2022)

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
Red T	329.2
Red U	365.2
Red V	405.0
Red W	449.3
Red X	498.3
Red Y	552.7
Red Z	613.1
Red 1	680.0
Red 2	754.2
Red 3	836.6
Red 4	927.9
Red 5	1029.2
Red 6	1141.6
Red 7	1266.2
Red 8	1404.4
Red 9	1557.8

Note 1.— The frequencies of the tones are spaced by Log –1 0.0225 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

3. As of 3 November 2022, aeronautical Stations which are required to communicate with SELCAL equipped aircraft shall have SELCAL encoders that support all tones in accordance with Table 16 -1.

4. As of 3 November 2022, SELCAL codes using tones Red T through Red 9 as given in Table 16-1 shall only be assigned to SELCAL-equipped aircraft with the capability of receiving these tones.

Amendment of Fifteenth Schedule

15. The principal Regulations are amended in Fifteenth Schedule by-

(a) deleting "figure 2-1" and "figure 2-2" appearing in paragraph 4.1.8.2 and substituting for them the following:

Table 1

Class of emission	*Stations*	*Max. peak envelope power (P_p)*
H2B, J3E, J7B, J9B, A3E*, H3E* (100% modulation)	Aeronautical stations Aircraft stations	6 kW 400 W
Other emission such as A1A, F1B	Aeronautical stations Aircraft stations	1.5 kW 100 W

* A3E and H3E to be used only on 3 023 kHz and 5 680 kHz.

(b) adding immediately after paragraph 4.1.8.2 the following:

"4.1.8.3. Method of operation. Single channel simplex shall be employed".

Dodoma,
22nd December, 2025

MAKAME M. MBARAWA
Minister for Transport