

COVER SHEET TO AMENDMENT 90

**INTERNATIONAL STANDARDS
AND RECOMMENDED PRACTICES**

AERONAUTICAL TELECOMMUNICATIONS

**ANNEX 10
TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION**

**VOLUME IV
SURVEILLANCE AND COLLISION AVOIDANCE SYSTEMS**

FIFTH EDITION — JULY 2014

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Checklist of Amendments to Annex 10, Volume IV

	<i>Effective date</i>	<i>Date of applicability</i>
Fifth Edition (incorporates Amendments 70 to 89)	14 July 2014	13 November 2014
Amendment 90 (adopted by the Council on 7 March 2018) Replacement pages (xi), 1-2, 2-6, 2-7, 3-3, 3-4, 3-22, 3-23, 3-25, 3-26, 3-27, 3-28, 3-43, 3-44, 3-44A, 3-44B, 3-62, 3-68, 3-70, 3-76, 4-23, 4-30, 4-31, 4-32, 4-48, 4-49, 4-50, 4-51, 5-3 to 5-14, 6-1 and 6-2	16 July 2018	8 November 2018



Transmittal note

Amendment 90

to the

International Standards and
Recommended Practices

AERONAUTICAL TELECOMMUNICATIONS

(Annex 10, Volume IV, to the Convention on International Civil Aviation)

1. Insert the following new and replacement pages in Annex 10, Volume IV (Fifth Edition) to incorporate Amendment 90 which becomes applicable on 8 November 2018.
 - a) Page (xi) — Foreword
 - b) Page 1-2 — Chapter 1
 - c) Pages 2-6 and 2-7 — Chapter 2
 - d) Pages 3-3, 3-4, 3-22, 3-23, 3-25, 3-26, 3-27,
3-28, 3-43, 3-44, 3-44A, 3-44B, 3-62,
3-68, 3-70 and 3-76 — Chapter 3
 - e) Pages 4-23, 4-30, 4-31, 4-32,
and 4-48 to 4-51 — Chapter 4
 - f) Pages 5-3 to 5-14 — Chapter 5
 - g) Pages 6-1 and 6-2 — Chapter 6
 2. Record the entry of this amendment on page (iii).
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Amendment	Source(s)	Subject(s)	Adopted/approved Effective Applicable
85	Aeronautical Surveillance Panel (ASP)	a) Update of provisions relating to secondary surveillance radar (SSR) (Modes A/C and S) and automatic dependent surveillance — broadcast (ADS-B) using 1 090 MHz extended squitter resulting from operational experience; b) introduction of a system-level and functional requirement for multilateration systems used for air traffic surveillance; c) introduction of an initial set of technical requirements for airborne surveillance applications that are enabled by the use of ADS-B IN messages on the flight deck; d) new requirements for display of proximate traffic, traffic advisory (TA) and resolution advisory (RA); e) update of provisions on hybrid surveillance in light of relevant recent developments; and f) introduction of a new functional requirement for monitoring own aircraft's vertical rate during an RA which would be affected by implementing a new version of the collision avoidance system (CAS) logic (commonly referred to as traffic alert and collision avoidance system (TCAS) Version 7.1). The new version of the CAS logic would also include a change in the annunciation of the RA "Adjust Vertical Speed, Adjust" to "Level Off".	26 February 2010 12 July 2010 18 November 2010
86	—	No change.	—
87	—	No change.	—
88-A	—	No change.	—
88-B	—	No change.	—
89 (5th edition)	Aeronautical Surveillance Panel (ASP)	Surveillance systems	3 March 2014 14 July 2014 13 November 2014
90	First and second meetings of the Surveillance Panel (SP/1 and SP/2)	a) airborne collision avoidance system (ACAS); and b) secondary surveillance radar (SSR) and wide area multilateration (WAM).	7 March 2018 16 July 2018 8 November 2018

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES

CHAPTER 1. DEFINITIONS

Note 1.— All references to “Radio Regulations” are to the Radio Regulations published by the International Telecommunication Union (ITU). Radio Regulations are amended from time to time by the decisions embodied in the Final Acts of World Radiocommunication Conferences held normally every two to three years. Further information on the ITU processes as they relate to aeronautical radio system frequency use is contained in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation including statement of approved ICAO policies (Doc 9718).

Note 2.— The Mode S extended squitter system is subject to patent rights from the Massachusetts Institute of Technology (MIT) Lincoln Laboratory. On 22 August 1996, MIT Lincoln Laboratory issued a notice in the Commerce Business Daily (CBD), a United States Government publication, of its intent not to assert its rights as patent owner against any and all persons in the commercial or non-commercial practice of the patent, in order to promote the widest possible use of the Mode S extended squitter technology. Further, by letter to ICAO dated 27 August 1998, MIT Lincoln Laboratory confirmed that the CBD notice has been provided to satisfy ICAO requirements for a statement of patent rights for techniques that are included in SARPs, and that the patent holders offer this technique free of charge for any use.

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

Note.— SSR transponders referred to above are those operating in Mode C or Mode S.

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

Note.— SSR Mode S transponders transmit extended squitters to support the broadcast of aircraft-derived position for surveillance purposes. The broadcast of this type of information is a form of automatic dependent surveillance (ADS) known as ADS-broadcast (ADS-B).

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

Automatic dependent surveillance-broadcast (ADS-B) IN. A function that receives surveillance data from ADS-B OUT data sources.

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

Human Factors principles. Principles which apply to design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance.

Secondary surveillance radar (SSR). A surveillance radar system which uses transmitters/receivers (interrogators) and transponders.

Note.— The requirements for interrogators and transponders are specified in Chapter 3.

Surveillance radar. Radar equipment used to determine the position of an aircraft in range and azimuth.

Traffic information service – broadcast (TIS-B) IN. A surveillance function that receives and processes surveillance data from TIS-B OUT data sources.

Traffic information service – broadcast (TIS-B) OUT. A function on the ground that periodically broadcasts the surveillance information made available by ground sensors in a format suitable for TIS-B IN capable receivers.

Note.— This technique can be achieved through different data links. The requirements for Mode S extended squitters are specified in Annex 10, Volume IV, Chapter 5. The requirements for VHF digital link (VDL) Mode 4 and universal access transceiver (UAT) are specified in Annex 10, Volume III, Part I.

Transponder occupancy. A state of unavailability of the transponder from the time it detects an incoming signal that appears to cause some action or from the time of a self-initiated transmission, to the time that it is capable of replying to another interrogation.

Note.— Signals from various systems that contribute to transponder occupancy are described in the Aeronautical Surveillance Manual (Doc 9924), Appendix M.

Note.— Level 4 permits extended length data link communications from air to ground and thus may provide access from the ground to airborne data sources and the transmission of other data required by air traffic services which are not available with Level 2 transponders.

2.1.5.1.5 Level 5 — Level 5 transponders shall have the capabilities of 2.1.5.1.4 and also those prescribed for enhanced Comm-B and extended length message (ELM) communications (3.1.2.6.11.3.4, 3.1.2.7.6 and 3.1.2.7.9).

Note.— Level 5 permits Comm-B and extended length data link communications with multiple interrogators without requiring the use of multisite reservations. This level of transponder has a higher minimum data link capacity than the other transponder levels.

2.1.5.1.6 *Extended squitter* — Extended squitter transponders shall have the capabilities of 2.1.5.1.2, 2.1.5.1.3, 2.1.5.1.4 or 2.1.5.1.5, the capabilities prescribed for extended squitter operation (3.1.2.8.6) and the capabilities prescribed for ACAS cross-link operation (3.1.2.8.3 and 3.1.2.8.4). Transponders with these capabilities shall be designated with a suffix “e”.

Note.— For example, a level 4 transponder with extended squitter capability would be designated “level 4e”.

2.1.5.1.7 *SI capability* — Transponders with the ability to process SI codes shall have the capabilities of 2.1.5.1.1, 2.1.5.1.2, 2.1.5.1.3, 2.1.5.1.4 or 2.1.5.1.5 and also those prescribed for SI code operation (3.1.2.3.2.1.4, 3.1.2.5.2.1, 3.1.2.6.1.3, 3.1.2.6.1.4.1, 3.1.2.6.9.1.1 and 3.1.2.6.9.2). Transponders with this capability shall be designated with a suffix “s”.

Note.— For example, a level 4 transponder with extended squitter capability and SI capability would be designated “level 4es”.

2.1.5.1.7.1 SI code capability shall be provided in accordance with the provisions of 2.1.5.1.7 for all Mode S transponders installed on or after 1 January 2003 and by all Mode S transponders by 1 January 2005.

Note.— Mandates from certain States may require applicability in advance of these dates.

2.1.5.1.8 *Extended squitter non-transponder devices.* Devices that are capable of broadcasting extended squitters that are not part of a Mode S transponder shall conform to all of the 1 090 MHz RF signals in space requirements specified for a Mode S transponder, except for transmit power levels for the identified equipment class as specified in 5.1.1.

2.1.5.2 All Mode S transponders used by international civil air traffic shall conform, at least, to the requirements of Level 2 prescribed in 2.1.5.1.2.

Note 1.— Level 1 may be admitted for use within an individual State or within the terms of a regional air navigation agreement. The Mode S Level 1 transponder comprises the minimum set of features for compatible operation of Mode S transponders with SSR Mode S interrogators. It is defined to prevent a proliferation of transponder types below Level 2 which would be incompatible with SSR Mode S interrogators.

Note 2.— The intent of the requirement for a Level 2 capability is to ensure the widespread use of an ICAO standard transponder capability to allow worldwide planning of Mode S ground facilities and services. The requirement also discourages an initial installation with Level 1 transponders that would be rendered obsolete by later requirements in certain airspace for mandatory carriage of transponders having Level 2 capabilities.

2.1.5.3 Mode S transponders installed on aircraft with gross mass in excess of 5 700 kg or a maximum cruising true airspeed capability in excess of 463 km/h (250 kt) shall operate with antenna diversity as prescribed in 3.1.2.10.4 if:

- a) the aircraft individual certificate of airworthiness is first issued on or after 1 January 1990; or

- b) Mode S transponder carriage is required on the basis of regional air navigation agreement in accordance with 2.1.3.3.1 and 2.1.3.3.2.

Note.— Aircraft with maximum cruising true airspeed exceeding 324 km/h (175 kt) are required to operate with a peak power of not less than 21.0 dBW as specified in 3.1.2.10.2 c).

2.1.5.4 CAPABILITY REPORTING IN MODE S SQUITTERS

2.1.5.4.1 Capability reporting in Mode S acquisition squitters (unsolicited downlink transmissions) shall be provided in accordance with the provisions of 3.1.2.8.5.1 for all Mode S transponders installed on or after 1 January 1995.

2.1.5.4.2 **Recommendation.**— *Transponders equipped for extended squitter operation should have a means to disable acquisition squitters when extended squitters are being emitted.*

Note.— This will facilitate the suppression of acquisition squitters if all ACAS units have been converted to receive the extended squitter.

2.1.5.5 EXTENDED LENGTH MESSAGE (ELM) TRANSMIT POWER

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

Note.— This represents a 1 dB relaxation from the power requirement specified in 3.1.2.10.2.

2.1.6 SSR Mode S address (aircraft address)

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

2.1.7 Transponder occupancy

Note.— See Appendix M of the Aeronautical Surveillance Manual (Doc 9924) for guidance on consistent modelling of transponder occupancy.

2.2 HUMAN FACTORS CONSIDERATIONS

Recommendation.— *Human Factors principles should be observed in the design and certification of surveillance radar, transponder and collision avoidance systems.*

Note.— Guidance material on Human Factors principles can be found in Doc 9683, Human Factors Training Manual and Circular 249 (Human Factors Digest No. 11 — Human Factors in CNS/ATM Systems).

2.2.1 Operation of controls

2.2.1.1 Transponder controls which are not intended to be operated in flight shall not be directly accessible to the flight crew.

2.2.1.2 **Recommendation.**— *The operation of transponder controls, intended for use during flight, should be evaluated to ensure they are logical and tolerant to human error. In particular, where transponder functions are integrated with other system controls, the manufacturer should ensure that unintentional transponder mode switching (i.e. an operational state to 'STANDBY' or 'OFF') is minimized.*

Note.— *This may take the form of a confirmation of mode switching, required by the flight crew. Typically 'Line Select' Keys, 'Touch Screen' or 'Cursor Controlled/Tracker-ball' methods used to change transponder modes should be carefully designed to minimize flight crew error.*

2.2.1.3 **Recommendation.**— *The flight crew should have access at all times to the information of the operational state of the transponder.*

Note.— *Information on the monitoring of the operational state of the transponder is provided in RTCA DO-181 E, Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/ Mode Select (ATCRBS/Mode S) Airborne Equipment, and in EUROCAE ED-73E, Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders.*

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3.1.1.6 REPLY TRANSMISSION CHARACTERISTICS (SIGNALS-IN-SPACE)

3.1.1.6.1 *Framing pulses.* The reply function shall employ a signal comprising two framing pulses spaced 20.3 microseconds as the most elementary code.

3.1.1.6.2 INFORMATION PULSES

3.1.1.6.2.1 Information pulses shall be spaced in increments of 1.45 microseconds from the first framing pulse. The designation and position of these information pulses shall be as follows:

Pulses	Position (microseconds)
C ₁	1.45
A ₁	2.90
C ₂	4.35
A ₂	5.80
C ₄	7.25
A ₄	8.70
X	10.15
B ₁	11.60
D ₁	13.05
B ₂	14.50
D ₂	15.95
B ₄	17.40
D ₄	18.85

Note.— The Standard relating to the use of these pulses is given in 2.1.4.1. Information on the “X” pulse is contained in the Aeronautical Surveillance Manual (Doc 9924).

3.1.1.6.2.2 The position of the X pulse shall not be used in replies to Mode A or Mode C interrogations if the safe operation of surveillance systems cannot be maintained.

3.1.1.6.2.3 **Recommendation.**— Utilization of the X pulse for special applications should be carried out in conformance with a procedure established by the State to ensure compatibility of all systems.

3.1.1.6.3 *Special position identification pulse (SPI).* In addition to the information pulses provided, a special position identification pulse shall be transmitted but only as a result of manual (pilot) selection. When transmitted, it shall be spaced at an interval of 4.35 microseconds following the last framing pulse of Mode A replies only.

3.1.1.6.4 *Reply pulse shape.* All reply pulses shall have a pulse duration of 0.45 plus or minus 0.1 microsecond, a pulse rise time between 0.05 and 0.1 microsecond and a pulse decay time between 0.05 and 0.2 microsecond. The pulse amplitude variation of one pulse with respect to any other pulse in a reply train shall not exceed 1 dB.

Note.— The intent of the lower limit of rise and decay times (0.05 microsecond) is to reduce sideband radiation. Equipment will meet this requirement if the sideband radiation is not greater than that which, theoretically, would be produced by a trapezoidal wave having the stated rise and decay times.

3.1.1.6.5 *Reply pulse position tolerances.* The pulse spacing tolerance for each pulse (including the last framing pulse) with respect to the first framing pulse of the reply group shall be plus or minus 0.10 microsecond. The pulse interval tolerance of the special position identification pulse with respect to the last framing pulse of the reply group shall be plus or minus 0.10 microsecond. The pulse spacing tolerance of any pulse in the reply group with respect to any other pulse (except the first framing pulse) shall not exceed plus or minus 0.15 microsecond.

3.1.1.6.6 *Code nomenclature.* The code designation shall consist of digits between 0 and 7 inclusive, and shall consist of the sum of the subscripts of the pulse numbers given in 3.1.1.6.2 above, employed as follows:

<i>Digit</i>	<i>Pulse Group</i>
First (most significant)	A
Second	B
Third	C
Fourth	D

3.1.1.7 TECHNICAL CHARACTERISTICS OF TRANSPONDERS WITH MODE A AND MODE C CAPABILITIES ONLY

3.1.1.7.1 *Reply.* The transponder shall reply (not less than 90 per cent triggering) when all of the following conditions have been met:

- the received amplitude of P_3 is in excess of a level 1 dB below the received amplitude of P_1 but no greater than 3 dB above the received amplitude of P_1 ;
- either no pulse is received in the interval 1.3 microseconds to 2.7 microseconds after P_1 , or P_1 exceeds by more than 9 dB any pulse received in this interval;
- the received amplitude of a proper interrogation is more than 10 dB above the received amplitude of random pulses where the latter are not recognized by the transponder as P_1 , P_2 or P_3 .

3.1.1.7.2 The transponder shall not reply under the following conditions:

- to interrogations when the interval between pulses P_1 and P_3 differs from those specified in 3.1.1.4.3 by more than plus or minus 1.0 microsecond;
- upon receipt of any single pulse which has no amplitude variations approximating a normal interrogation condition.

3.1.1.7.3 *Dead time.* After recognition of a proper interrogation, the transponder shall not reply to any other interrogation, at least for the duration of the reply pulse train. This dead time shall end no later than 125 microseconds after the transmission of the last reply pulse of the group.

3.1.1.7.4 SUPPRESSION

Note.— This characteristic is used to prevent replies to interrogations received via the side lobes of the interrogator antenna, and to prevent Mode A/C transponders from replying to Mode S interrogations.

3.1.1.7.4.1 The transponder shall be suppressed when the received amplitude of P_2 is equal to, or in excess of, the received amplitude of P_1 and spaced 2.0 plus or minus 0.15 microseconds. The detection of P_3 is not required as a prerequisite for initiation of suppression action.

3.1.1.7.4.2 The transponder suppression shall be for a period of 35 plus or minus 10 microseconds.

3.1.1.7.4.2.1 The suppression shall be capable of being reinitiated for the full duration within 2 microseconds after the end of any suppression period.

Note.— Limited data link activity including single segment Comm-A, uplink and downlink broadcast protocols and GICB extraction may be performed by both II codes.

3.1.2.5.2.1.2.4 *SI: Surveillance identifier.* This 6-bit value shall define a surveillance identifier (SI) code. These SI codes shall be assigned to interrogators in the range from 1 to 63. The SI code value of 0 shall not be used. The SI codes shall be used with the multisite lockout protocols (3.1.2.6.9.1). The SI codes shall not be used with the multisite communications protocols (3.1.2.6.11.3.2, 3.1.2.7.4 or 3.1.2.7.7).

3.1.2.5.2.1.3 *CL: Code label.* This 3-bit (14-16) uplink field shall define the contents of the IC field.

Coding (in binary)

000	signifies that the IC field contains the II code
001	signifies that the IC field contains SI codes 1 to 15
010	signifies that the IC field contains SI codes 16 to 31
011	signifies that the IC field contains SI codes 32 to 47
100	signifies that the IC field contains SI codes 48 to 63

The other values of the CL field shall not be used.

3.1.2.5.2.1.3.1 *Surveillance identifier (SI) code capability report.* Transponders which process the SI codes (3.1.2.5.2.1.2.4) shall report this capability by setting bit 35 to 1 in the surveillance identifier capability (SIC) subfield of the MB field of the data link capability report (3.1.2.6.10.2.2).

3.1.2.5.2.1.4 *Operation based on lockout override*

Note 1.— The Mode S-only all-call lockout override provides the basis for acquisition of Mode S aircraft for interrogators that have not been assigned a unique IC (II or SI code) for full Mode S operation (protected acquisition by ensuring that no other interrogator on the same IC can lock out the target in the same coverage area).

Note 2.— Lockout override is possible using any interrogator code.

3.1.2.5.2.1.4.1 *Maximum Mode S-only all-call interrogation rate.* The maximum rate of Mode S-only all-call interrogations made by an interrogator using acquisition based on lockout override shall depend on the reply probability as follows:

- a) for a reply probability equal to 1.0:
the smaller of 3 interrogations per 3 dB beam dwell or 30 interrogations per second;
- b) for a reply probability equal to 0.5:
the smaller of 5 interrogations per 3 dB beam dwell or 60 interrogations per second; and
- c) for a reply probability equal to 0.25 or less:
the smaller of 10 interrogations per 3 dB beam dwell or 125 interrogations per second.

Note.— These limits have been defined in order to minimize the RF pollution generated by such a method while keeping a minimum of replies to allow acquisition of aircraft within a beam dwell.

3.1.2.5.2.1.4.2 **Recommendation.**— *Passive acquisition without using all-call interrogations should be used in the place of lockout override.*

Note.— *The Aeronautical Surveillance Manual (Doc 9924) provides guidance on different passive acquisition methods.*

3.1.2.5.2.1.4.3 *Field content for a selectively addressed interrogation used by an interrogator without an assigned interrogator code.* An interrogator that has not been assigned with a unique discrete interrogator code and is authorized to transmit shall use the II code 0 to perform the selective interrogations. In this case, selectively addressed interrogations used in connection with acquisition using lockout override shall have interrogation field contents restricted as follows:

UF = 4, 5, 20 or 21
PC = 0
DI = 7
IIS = 0
LOS = 0 except as specified in 3.1.2.5.2.1.5
TMS = 0

3.1.2.5.2.1.4.4 An interrogator that has not been assigned with a unique discrete interrogator code and is authorized to transmit using II code 0 shall not attempt to extract an air-initiated Comm-B message announced by DR = 1 or 3.

Note.— *These restrictions permit surveillance transaction, GICB transaction and Comm-B broadcast extraction, but prevent the interrogation from making any changes to transponder multisite lockout or communications protocol states.*

3.1.2.5.2.1.5 Supplementary acquisition using II equals 0

Note 1.— *The acquisition technique defined in 3.1.2.5.2.1.4 provides rapid acquisition for most aircraft. Due to the probabilistic nature of the process, it may take many interrogations to acquire the last aircraft of a large set of aircraft in the same beam dwell and near the same range (termed a local garble zone). Acquisition performance is greatly improved for the acquisition of these aircraft through the use of limited selective lockout using II equals 0.*

Note 2.— *Supplementary acquisition consists of locking out acquired aircraft to II=0 followed by acquisition by means of the Mode S-only all-call interrogation with II=0. Only the aircraft not yet acquired and not yet locked-out will reply resulting in an easier acquisition.*

3.1.2.5.2.1.5.1 Lockout within a beam dwell

3.1.2.5.2.1.5.1.1 **Recommendation.**— *When II equals 0 lockout is used to supplement acquisition, all aircraft within the beam dwell of the aircraft being acquired should be commanded to lock out to II equals 0, not just those in the garble zone.*

Note.— *Lockout of all aircraft in the beam dwell will reduce the amount of all-call fruit replies generated to the II equals 0 all-call interrogations.*

3.1.2.5.2.1.5.2 Duration of lockout

3.1.2.5.2.1.5.2.1 Interrogators performing supplementary acquisition using II equals 0 shall perform acquisition by transmitting a lockout command for no more than two consecutive scans to each of the aircraft already acquired in the beam dwell containing the garble zone and shall not repeat it before 48 seconds have elapsed.

Note.— *Minimizing the lockout time reduces the probability of conflict with the acquisition activities of a neighbouring interrogator that is also using II equals 0 for supplementary acquisition.*

3.1.2.5.2.1.5.2.2 **Recommendation.**— Mode S only all-call interrogations with $II=0$ for the purpose of supplementary acquisition should take place within a garble zone over no more than two consecutive scans or a maximum of 18 seconds.

3.1.2.5.2.2 All-call reply, downlink format 11

1	6	9	33
DF	CA	AA	PI
5	8	32	56

The reply to the Mode S-only all-call or the Mode A/C/S all-call interrogation shall be the Mode S all-call reply, downlink format 11. The format of this reply shall consist of these fields:

Field	Reference
DF downlink format	3.1.2.3.2.1.2
CA capability	3.1.2.5.2.2.1
AA address announced	3.1.2.5.2.2.2
PI parity/interrogator identifier	3.1.2.3.2.1.4

3.1.2.5.2.2.1 **CA: Capability.** This 3-bit (6-8) downlink field shall convey information on the transponder level, the additional information below, and shall be used in formats DF = 11 and DF = 17.

Coding

- 0 signifies Level 1 transponder (surveillance only), and no ability to set CA code 7 and either airborne or on the ground
- 1 reserved
- 2 reserved
- 3 reserved
- 4 signifies Level 2 or above transponder and ability to set CA code 7 and on the ground
- 5 signifies Level 2 or above transponder and ability to set CA code 7 and airborne
- 6 signifies Level 2 or above transponder and ability to set CA code 7 and either airborne or on the ground
- 7 signifies the DR field is not equal to 0 or the FS field equals 2, 3, 4 or 5, and either airborne or on the ground

When the conditions for CA code 7 are not satisfied, aircraft with Level 2 or above transponders:

- a) that do not have automatic means to set the on-the-ground condition shall use CA code 6; and
- b) with automatic on-the-ground determination shall use CA code 4 when on the ground and 5 when airborne.

Data link capability reports (3.1.2.6.10.2.2) shall be available from aircraft installations that set CA code 4, 5, 6 or 7.

Note.— CA codes 1 to 3 are reserved to maintain backward compatibility.

3.1.2.5.2.2.2 **AA: Address announced.** This 24-bit (9-32) downlink field shall contain the aircraft address which provides unambiguous identification of the aircraft.

3.1.2.5.3 **Lockout protocol.** The all-call lockout protocol defined in 3.1.2.6.9 shall be used by the interrogator with respect to an aircraft once the address of that specific aircraft has been acquired by an interrogator provided that:

- the interrogator is using an IC code different from zero; and
- the aircraft is located in an area where the interrogator is authorized to use lockout.

Note 1.— Following acquisition, a transponder is interrogated by discretely addressed interrogations as prescribed in 3.1.2.6, 3.1.2.7 and 3.1.2.8 and the all-call lockout protocol is used to inhibit replies to further all-call interrogations.

Note 2.— Regional IC allocation bodies may define rules limiting the use of selective interrogation and lockout protocol (e.g. no lockout in defined limited area, use of intermittent lockout in defined areas, and no lockout of aircraft not yet equipped with SI code capability).

3.1.2.5.4 Stochastic all-call protocol. The transponder shall execute a random process upon acceptance of a Mode S-only all-call with a PR code equal to 1 to 4 or 9 to 12. A decision to reply shall be made in accordance with the probability specified in the interrogation. A transponder shall not reply if a PR code equal to 5, 6, 7, 13, 14 or 15 is received (3.1.2.5.2.1.1).

Note.— The random occurrence of replies makes it possible for the interrogator to acquire closely spaced aircraft, replies from which would otherwise synchronously garble each other.

3.1.2.6 ADDRESSED SURVEILLANCE AND STANDARD LENGTH COMMUNICATION TRANSACTIONS

Note 1.— The interrogations described in this section are addressed to specific aircraft. There are two basic interrogation and reply types, short and long. The short interrogations and replies are UF 4 and 5 and DF 4 and 5, while the long interrogations and replies are UF 20 and 21 and DF 20 and 21.

Note 2.— The communications protocols are given in 3.1.2.6.11. These protocols describe the control of the data exchange.

3.1.2.6.1 SURVEILLANCE, ALTITUDE REQUEST, UPLINK FORMAT 4

1	6	9	14	17	33
UF	PC	RR	DI	SD	AP
5	8	13	16	32	56

The format of this interrogation shall consist of these fields:

<i>Field</i>	<i>Reference</i>
UF uplink format	3.1.2.3.2.1.1
PC protocol	3.1.2.6.1.1
RR reply request	3.1.2.6.1.2
DI designator identification	3.1.2.6.1.3
SD special designator	3.1.2.6.1.4
AP address/parity	3.1.2.3.2.1.3

3.1.2.6.1.1 PC: Protocol. This 3-bit, (6-8) uplink field shall contain operating commands to the transponder. The PC field values 2 through 7 shall be ignored and the values 0 and 1 shall be processed for surveillance or Comm-A interrogations containing DI = 3 (3.1.2.6.1.4.1).