6.6 For example, if bit 1 is the only bit declared in error, the error syndrome at the receiver will be {HEX} 3935EA, while bit 31 produces {HEX} FDB444, and bit 111 has syndrome {HEX} 000002. Thus if those three bits are all declared in error, the error syndrome will be calculated to be {HEX} C481AC. The table of individual bit syndromes can be pre-calculated and stored in the receiver. It is possible for two or more subsets of the low confidence bits to match the syndrome. In such cases, the message is rejected, and no harm is done. However, if a high confidence bit has been declared in error, and a single subset of the low confidence bits matches the syndrome, the message will be "corrected" to the wrong message, producing an undetected error. (If no subset matches the syndrome, it must be true that a high confidence bit error has been made, and the message is rejected.)

6.7 Clearly, for processing time and error bounding reasons, the maximum number of low confidence bits to process must be limited. The number of cases to consider is given by 2^n. If "n" low confidence bits exist for a message, the number of cases grows exponentially with "n" (e.g. 32 at n = 5; 4 096 at n = 12). The undetected error rate is proportional to the number of cases, and thus also grows exponentially with "n." However, since the Hamming distance of 6 for the Mode S parity code implies that undetected errors are essentially zero if "n" is kept less than or equal to 5, a value of 5 is recommended for "n."

Appendix H

MODE S PROTOCOL CONSIDERATIONS

Note.— In regions of overlapping coverage, Mode S ground stations must coordinate their activities to permit the correct operation of the Mode S surveillance and communications protocols. The multisite protocols provide this coordination with a minimum of ground cooperation through the use of a site identifier in uplink transmissions. The non-selective protocols require ground-to-ground coordination of ground station activity but are more efficient in the use of channel time. However, the non-selective lockout protocols are not compatible with the Mode S subnetwork protocols.

1. ACQUISITION AND LOCKOUT PROTOCOLS

1.1 General

1.1.1 In order to selectively interrogate a Mode S-equipped aircraft, the ground station must know the aircraft's Mode S address and approximate position. To acquire the addresses of Mode S aircraft, each ground station transmits all-call interrogations. A Mode S-equipped aircraft will respond to such an interrogation with its unique address. On the first or second antenna scan after receiving the initial all-call replies, the ground station will discretely interrogate the aircraft and command the lockout condition for the IC in use by the ground station. The benefit of waiting until the second scan before lockout is that it allows a better estimate of aircraft velocity, which gives a more accurate estimate of the time that the aircraft will be in the main beam on the next scan. After acquisition, the aircraft's 24-bit address will be added to the ground station's file of acquired aircraft.

1.1.2 Once acquired, the Mode S-equipped aircraft should be locked out from replying (instructed not to respond) to subsequent Mode S all-call interrogations in order to minimize all-call synchronous garbling. This lockout condition is controlled by the Mode S ground station through Mode S selectively addressed interrogations. If for any reason an aircraft ceases to receive discretely-addressed interrogations containing a lockout command for a period of approximately 18 seconds (corresponding to a few antenna scans), any existing lockout will lapse so that the aircraft may be reacquired by normal Mode S acquisition.

1.1.3 The interrogation used by the ground station to elicit all-call replies depends upon the acquisition technique in effect at that site.

1.2 Multisite acquisition and lockout

1.2.1 Multisite acquisition is carried out by using the Mode S-only all-call interrogation UF = 11. The IC of the interrogating site is contained in the interrogation. Two types of ICs are defined:

a) the II code is used for multisite surveillance and data link coordination. II codes of 1 to 15 are valid (an II code of ZERO (0) is interpreted as non-selective); and

b) the SI code is used only for multisite surveillance and the limited data link functions identified SI codes of 1 to 63 are valid. SI code ZERO (0) is not used.

1.2.2 The transponder replies to this interrogation if it is not in a state of lockout to that specific IC. The transponder has a total of 79 independent lockout timers to maintain the lockout state requested by the ground stations (i.e. 16 II and 63 SI lockout timers).

1.2.3 An SI code is composed of the IC field and the CL field. Only transponders complying with at least Amendment 73 (or higher) of Annex 10 will decode the CL field in order to determine whether the content of the IC field is an II code or an SI code. Transponders which have not been upgraded to handle SI codes will, by default, consider the content of the IC field as being an II code value. Therefore, if CL is not equal to zero (meaning that the IC field contains an SI code), the non-upgraded transponders will encode the parity sequence of the reply using the "matching" II code rather than the SI code contained in the interrogation.

1.2.4 The interrogator which will receive Mode S-only all-call replies encoded with the "matching" II code will normally reject these replies. The consequence is that transponders which have not been upgraded to handle SI codes will not be detected by the interrogator operating with an SI code.

1.2.5 The following technique enables the acquisition and detection of non-SI capable transponders for the transition period.

1.2.6 The interrogator, when operating with an SI code, should be configurable by the user to accept Mode S-only all-call replies for which the "matching" II code has been used to encode the parity sequence.

1.2.7 The target which has sent such replies should be considered as equipped with a non-SI capable transponder, even if the content of Register 10_{16} states that the transponder has the SI capability.

1.2.8 The interrogator, if operating with an SI code, should be configurable by the user to interrogate targets equipped with non-SI capable transponders using the Mode S selective protocols foreseen for II code operation. The II code to be used should be the "matching" II code.

1.2.9 The interrogator, if operating with an SI code, should be configurable by the user to either:

a) not lockout non-SI capable transponders on the "matching" II code; or

b) use intermittent lockout for this "matching" II code.

Note.— This is to allow neighbouring interrogators operating with the "matching" II code to acquire the non-SI capable transponders.

1.2.10 The interrogator, if operating with an II code, should be configurable by the user to either:

a) not lockout Mode S transponders that do not report the SI capability in Register 10_{16}; or

b) use intermittent lockout for Mode S transponders that do not report the SI capability in Register 10_{16}.

Note.— This is to allow neighbouring interrogators operating with an SI code and the "matching" II code to acquire the non-SI capable transponders.

1.2.11 This technique should only be used to detect aircraft not equipped with SI code capable transponders entering mandated SI code airspace so that appropriate action can be taken (e.g. they can be re-routed out of such airspace).

1.3 Acquisition and lockout techniques

1.3.1 When the system is operating in the multisite mode, separate interrogation of Mode S and Mode A/C targets can be achieved by the use of the Mode A/C-only all-call, together with the Mode S-only all-call, UF = 11.

1.3.2 As the name implies, the Mode S-only all-call interrogation elicits replies only from Mode S transponders. It is therefore used in conjunction with the Mode A/C-only all-call interrogation (distinguished by a short P_4 pulse). This latter interrogation elicits replies only from Mode A/C transponders and therefore complements the Mode S-only all-call so that Mode A/C and Mode S transponders reply to at most one of the interrogations. This avoids the possibility of having the same aircraft under surveillance as both a Mode A/C and a Mode S aircraft.

1.3.3 One technique for managing the RF channel is for each all-call interrogation to be followed by its own listening window. At the expense of more sophisticated management of the reply processors, an alternative technique obtains the benefit of a shared listening interval by pairing the two all-call interrogations as shown in Figure H-1. This shared listening interval results in a much more efficient use of the time line. The spacing between the interrogations is such that replies are received simultaneously from a Mode A/C transponder and a Mode S transponder at the same range. This allows enough time for a Mode A/C transponder to recover from the SLS caused by the P_1-P_2 Mode S interrogation preamble before it receives the Mode A/C-only all-call.

Note 1.— When operating with overlapping all-calls, there is the possibility for marginally performing transponders to exhibit unexpected results. Some Mode A/C transponders have been observed not to suppress properly to the equal amplitude P_1-P_2 suppression pair of the Mode S preamble. This usually results in the transponder improperly detecting a P_3 pulse within the P_6 waveform, and responding with a Mode A reply. This can result in a ghost target being reported up to 10 NM closer in slant range than the actual target position. If the transponder does not recover in time to accept the legitimate interrogation, it will not respond at its actual position.

Note 2.— Some of the benefits of a combined listening interval of Mode A/C-only and Mode S-only all calls can be obtained without ghost targets by using both combined and separate listening intervals during a beam dwell. In this approach, some interrogations are combined as shown in Figure H-1, but other Mode A/C-only and Mode S only all call interrogations with separate listening intervals are interspersed with the combined interrogations during the beam dwell. A Mode A/C track is only initiated on replies received from Mode A/C interrogations with separate listening intervals.

1.3.4 The PI field of an all-call reply, DF = 11, elicited by a Mode S-only all-call interrogation (UF = 11) is encoded using the IC received in the interrogation that elicited the reply. This is composed of CL and IC fields of the all-call interrogation. This address is used in the encoding of the PI field in exactly the same manner as the transponder Mode S address is used to generate the AP field. Ground stations operating in the multisite mode decode all-call replies using their own IC as the expected address. All-call FRUIT replies produced by adjacent ground stations will not be accepted by the local ground station since they would be encoded using a different IC. This rejection of all-call replies by the IC eliminates the possibility of extraneous all-call tracks being formed from Mode S FRUIT replies.

1.3.5 The use of all-call lockout makes it necessary for ground stations to coordinate surveillance activities in regions of overlapping coverage to ensure that all ground stations are allowed to acquire Mode S aircraft. If ground stations cannot coordinate via ground communications, the transponder multisite lockout feature is employed.

1.3.6 The multisite lockout feature is based upon the use of ICs (II and SI) and multiple transponder lockout timers. The Mode S transponder can be selectively and independently locked out to multisite all-call interrogations originating from up to 78 different ICs. Adjacent sites using different ICs are unaffected by the other sites' lockout activity and hence can perform acquisition and lockout in a completely autonomous manner. Restrictions on interrogator operations must be taken into account.

1.3.7 Implementation of SI code capability (Annex 10, Volume IV, Chapter 2, 2.1.5.1.7.1) can be determined by monitoring bit 35 of the data link capability report (register 10_{16}). This report should be routinely extracted at track acquisition. SI codes cannot be used in a region of airspace until all of the Mode S aircraft are equipped for SI codes. This monitoring should continue after SI codes are put into use to identify any transponder that is not SI-capable. Follow-up action should be initiated for aircraft that are detected that are not equipped with SI codes.

1.3.8 The reason that all aircraft must be SI-equipped is that a non-SI code-capable Mode S transponder will misinterpret the SI code contained in the Mode S-only all-call interrogation. The II or SI code included in a Mode S-only all-call interrogation is contained in a 7-bit field composed of the 3-bit CL field and the 4-bit IC field as follows:

CL coding (in binary):

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

1.3.9 A transponder that does not support SI codes will not detect the CL field and will therefore interpret the IC field as always containing an II code. This causes the mapping of a set of SI codes into an II code. For example, ICs of II = 1 and SI = 1, 17, 33 and 49 will all have “0001” in the IC field. If an aircraft not equipped for SI codes is operating in a region of overlapping coverage of interrogators with II = 1 and SI = 16, the following interaction will occur:

a) if the aircraft is acquired first by the II = 1 interrogator, the aircraft will be locked out to II = 1. An all-call interrogation from the SI interrogator expressing SI = 17 will not elicit an all-call reply because the transponder interprets the code as II = 1, and it is locked out to II = 1; and

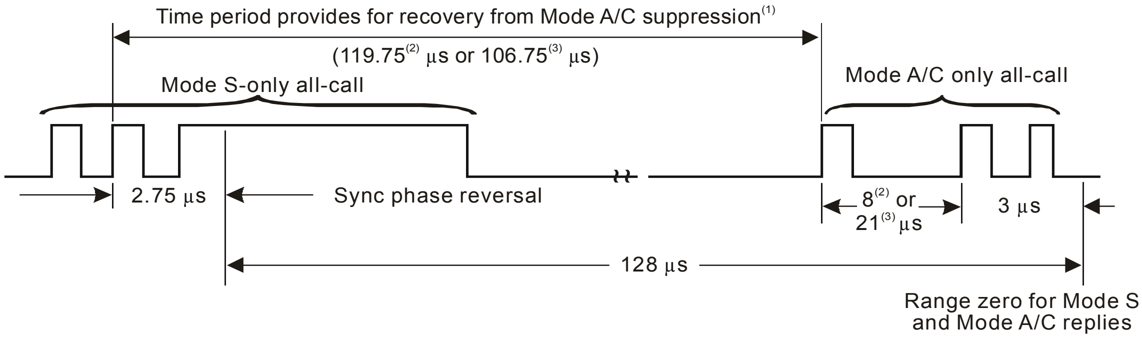
b) if the aircraft is acquired first by the SI interrogator, the transponder will reply to the SI = 17 all-call interrogation since it is not locked out to II = 1. The SI interrogator will not be able to lock out the transponder, since the mechanism for II and SI code lockout is entirely different. Therefore, the transponder will not recognize the SI lockout command (and will not change its lockout status to any II code).

1.3.10 Thus, with a transponder not equipped with SI code capability, there will never be a loss of surveillance coverage for an interrogator with an II code. Surveillance loss can only happen to the SI code interrogator and then only for a certain combination of II and SI codes.

1.3.11 The transition to SI codes is manageable through monitoring compliance to the SI code requirement via the data link capability report and (where possible for fixed interrogators) assigning II and SI codes for adjacent interrogators to avoid possible interaction. It is possible to assign more than one SI code to an interrogator on a sector basis. This approach might be useful as another means to avoid interacting SI and II codes. For mobile interrogators, or for fixed interrogators where non-interacting SI and II codes cannot be used, a low rate of lockout override Mode S-only all-call interrogations by the SI code interrogator can be used to acquire the occasional non-SI code Mode S transponder. Another means for managing this situation is for the interrogators operating with II codes to periodically remove lockout for non-SI equipped Mode S transponders to ensure acquisition by SI interrogators.

1.4 Non-selective acquisition and lockout

1.4.1 Addressed interrogations containing II = 0 are not compatible with the Mode S subnetwork protocols. These protocols monitor discrete interrogations for II activity and use non-zero II codes for routing of downlink messages to intended ground addresses. Thus the use of non-selective acquisition (which is based on II = 0) cannot be used with



Legend:

1. Maximum suppression time equals 45 µs.
2. Mode A.
3. Mode C.

Note 1.— It is desirable to provide at least 45 microseconds spacing between the interrogations to ensure that Mode A/C transponders recover from the suppression caused by the Mode S interrogation preamble. The spacing shown is the maximum possible without interfering with the receipt of zero range Mode S all-call replies.

Note 2.— If gain time control is to be used, the spacing of 128 microseconds must be used to provide an identical range zero point for Mode S and SSR replies.

Figure H-1. Combined interrogation for site selective acquisition

an interrogator that is supporting the Mode S subnetwork. For this reason, II = 0 is no longer authorized for use in normal Mode S acquisition. II = 0 is now reserved for adaptive acquisition in connection with stochastic/lockout override technique.

1.4.2 The PC field is used either for lockout or for communication purposes. When the PC field in an interrogation is used for communication purposes, non-selective lockout can be accomplished in the same interrogation by the use of the LOS in the SD field.

1.5 Clustered interrogator acquisition and lockout

Interrogators with overlapping coverage using the same IC may be linked via a ground network to coordinate their surveillance and communications activities. This provides the reduced all-call FRUIT benefit of the non-selective acquisition technique in a form that is compatible with the Mode S subnetwork. Since ground coordination is provided, clustered interrogators may use the non-selective communications protocols.

1.6 Stochastic acquisition

1.6.1 While Mode S lockout can reduce synchronous garbling on acquisition, it cannot eliminate it completely, nor is it effective in the case where a Mode S ground station resumes operation after a period of inactivity and must therefore acquire many Mode S aircraft simultaneously. These latter cases are handled by a feature called the stochastic acquisition mode. In this mode, the Mode S ground station interrogates using a special all-call interrogation command that instructs aircraft to reply with a specified less-than-unity reply probability. The resulting reduced reply rate means that some all-call replies will be received ungarbled, and these aircraft will thus be acquired. Once an aircraft is acquired, it is locked out and hence no longer interferes with the all-call replies from the remaining unacquired aircraft. The process is repeated until all aircraft are acquired.

1.6.2 This form of acquisition uses the Mode S-only all-call interrogation, UF = 11. The specified reply probability is contained in the PR field and can be selected from the values 1, 1/2, 1/4, 1/8 or 1/16. The transponder will not reply if a lockout condition is in effect. Otherwise, the transponder executes a random process and replies only if the outcome of the random process is consistent with the specified reply probability. For example, if the PR code specifies a reply probability of 1/4, the transponder will generate a random number between zero and one and will reply only if:

a) a lockout condition does not apply; and

b) the generated random number is less than or equal to 0.25.

Note.— The stochastic acquisition technique described in the following paragraphs is only an example. Other modes of stochastic acquisition may also be employed.

1.6.3 Implementation can include the following two modes:

a) *Initial acquisition mode.* This mode is executed after a period of Mode S ground station inactivity. It consists of periodic Mode S-only all-call interrogations (4–6 or more per beam dwell) followed by a listening interval out to the range of interest. These are interspersed with scheduled Mode S intervals to permit discrete interrogation and lockout of Mode S addresses acquired on the previous scan. The minimum probability assignment used for this purpose is a site-dependent parameter chosen to match the Mode S traffic load handled by this site. The program for reacquisition begins at this lowest probability level and then moves to higher probability levels after several scans in order to reduce the overall acquisition time. Aircraft not acquired initially, as well as all-call garbling situations which occur unexpectedly during normal operation, are handled as described in the following paragraph; and

b) *Adaptive acquisition mode.* Mode S replies received with uncorrectable errors during the all-call listening interval are grouped together if they correlate in range and azimuth. Groups formed of three or more replies per dwell are interpreted as evidence of an all-call synchronous garbling occurrence. A trial Mode S track is initiated at the approximate range and azimuth of the correlated replies. On the next scan, the ground station interrogates using a Mode S-only all-call with a specified reply probability of one half. With high probability, an ungarbled reply will be received from one of the two transponders in the garbling situation during the four or more interrogation opportunities possible during a beam dwell, thereby permitting discrete interrogation and lockout on the following scan. If acquisition is not successful, the trial track will be dropped since the continued garbling situation will lead to the initiation of a fresh trial track. Residual garbling caused by more than two aircraft in the initial garble set will also result in a new trial track. The last aircraft in the garbling set will be acquired by the normal all-call process in use at the site.

1.7 Lockout override

1.7.1 Lockout override may be used in situations where it is believed that the lockout activities of an adjacent ground station are preventing Mode S acquisition by the local ground station. For example, the adjacent ground station may inadvertently be using the same II code as the local ground station. Use of this mode must be strictly limited since it elicits Mode S all-call replies from acquired as well as unacquired aircraft and therefore can cause a substantial level of Mode S all-call FRUIT.

1.7.2 An acquisition technique can be defined that combines features of the site-addressed and stochastic acquisition approaches. It uses the Mode S-only all-call, UF = 11, and employs PR codes that define reply probabilities of 1, 1/2, 1/4, 1/8 and 1/16. In this case, the transponder is instructed to disregard the lockout state in making a reply decision. This will of course result in the continued possibility of garbled all-call replies since both acquired and unacquired Mode S aircraft can reply to the all-call interrogations. The stochastic mode is used to handle the resulting garbling.

2. CONCEPTS FOR MODE S ACQUISITION WITHOUT LOCKOUT

2.1 Mode S acquisition using lockout override

2.1.1 Operational concept

2.1.1.1 Certain interrogators (e.g. mobile military interrogators) may not be in a position to have an assigned II or SI code in order to perform normal Mode S surveillance. A technique for performing Mode S acquisition using lockout override that does not require an assigned IC is described in this section.

2.1.1.2 An operational concept for Mode S acquisition using lockout override is defined as follows:

a) Routine aircraft surveillance is performed by these interrogators using Mode A/C, primary radar surveillance, or other means. For Mode A/C, monopulse processing must be used for having a lower interrogation rate. The channel time now available is used for Mode S acquisition;

b) On each scan, this type of interrogator schedules a number of Mode S-only all-call interrogations, followed by a listening interval appropriate for the operating range. These interrogations contain a lockout override code that commands Mode S transponders to respond to the interrogation regardless of their lockout state. The resulting synchronous garble is managed through the use of PR = 10 to 12 in the Mode S-only all-call interrogation. These codes command lockout override, together with a reduced probability of reply;

c) Every ungarbled Mode S all-call reply is processed and correlated in range and azimuth to the corresponding Mode A/C or primary radar track. The all-call reply contains the 24-bit aircraft address. This address is used in Mode S discretely addressed interrogations to obtain any supplemental information available from that aircraft. These discretely addressed interrogations contain an IC equal to ZERO (0) but do not contain any lockout commands. The discrete surveillance replies contain Mode C and Mode A codes which can also be used as further correlation criteria with a Mode A/C track. The interrogator has not modified in any way the lockout state of the aircraft as established by neighbouring Mode S interrogators using the multisite lockout protocols;

d) The 24-bit aircraft address is stored in the track file and is used for a subsequent update of this supplemental information;

e) The Mode S acquisition status of every aircraft in track is maintained in the track file, with one of the three following characteristics:

   1) aircraft address acquired;

   2) confirmation that the aircraft is not Mode S equipped, since a prescribed number of interrogations has not resulted in an error-free reply reception or a Mode S preamble detection; or

   3) Mode S acquisition in process; and

f) In order to minimize all-call FRUIT, all-call interrogations are only transmitted in beam dwells containing aircraft that are currently in the acquisition process.

2.1.2 Control of synchronous garble

2.1.2.1 The above operational concept for Mode S acquisition is based on the use of the lockout override feature. As the name implies, a Mode S-only all-call interrogation carries a code (PR = 8 to 12) that instructs the transponder to reply to this all-call regardless of its lockout state. Lockout override would be of limited use by itself since such transmissions would likely result in synchronously garbled Mode S all-call replies from aircraft close in slant range and within the same beam dwell as the aircraft of interest. The synchronous garble range for a Mode S all-call reply is 9.6 km (5.2 NM).

2.1.2.2 Mode S includes another feature known as "stochastic acquisition" that should be used with lockout override. Stochastic acquisition overcomes synchronous all-call garble by commanding the transponder (via a code in the all-call interrogation, PR = 10 to 12) to respond with a probability less than unity. Available probabilities are 1/4, 1/8 and 1/16. A reply probability of less than one reduces the total number of replies from a set of aircraft in garble range. This increases the likelihood of receiving a single ungarbled reply from an unacquired aircraft. Stochastic acquisition makes it possible to acquire a Mode S aircraft, even in relatively dense environments.

2.1.2.3 The performance of stochastic acquisition as a function of the number of aircraft in a garble zone and the probability used is presented in Table H-1. A summary of the performance to be expected with this technique is presented in Table H-2. The rows in Table H-2 indicate the number of aircraft in the garble zone defined by the beamwidth, and the 9.6 km (5.2 NM) garble zone for the Mode S all-call reply. It should be noted that having more than ten aircraft in the defined zone is quite rare. The columns indicate the maximum and average number of interrogations needed for 99 per cent probability of acquisition.

2.1.3 Maximum all-call interrogation rate

2.1.3.1 *Limit for a standard Mode S interrogator*

The maximum all-call interrogation repetition rate specified in the Mode S system SARPs (Annex 10, Volume IV, Chapter 3, 3.1.2.11.1.1 refers) is 250 per second. This interrogation repetition rate sets the limit of 1 030 and 1 090 MHz interference caused by the all-call interrogation activity of a single Mode S interrogator.

Table H-1. Number of interrogations required for 99 per cent probability of acquisition

	Stochastic probability		
Number of aircraft in garble zone	*0.5*	*0.25*	*0.125*
2	16	22	40
3	35	31	46
4	72	41	53
5	>100	56	61
6		76	70
7		>100	80
8			93
9			105
10			121

Table H-2. Lockout override acquisition performance (interrogations) p = 0.25 (2 to 5 aircraft), p = 0.125 (6 to 10 aircraft)

	Single aircraft		*All aircraft*	
Number of aircraft in garble zone	*Maximum number of interrogations for 99% probability of acquisition*	*Average interrogations for acquisition*	*Maximum number of interrogations for 99% probability of acquisition*	*Average interrogations for acquisition*
2	22	5	26	8
3	31	7	38	13
4	41	10	54	20
5	56	13	76	29
6	70	16	97	38
7	80	18	114	46
8	93	20	133	55
9	105	23	155	66
10	121	27	181	78

2.1.3.2 *1 030 MHz considerations*

The stochastic/lockout override technique uses a standard Mode S-only all-call and, therefore, has the same effect on the 1 030 MHz channel as the all-call generated by a standard Mode S interrogator. From a 1 030 MHz perspective, an interrogator using stochastic/lockout override could operate at the same all-call interrogation rate as a standard Mode S interrogator.

2.1.3.3 *1 090 MHz considerations*

2.1.3.3.1 A standard Mode S interrogator using lockout will only elicit all-call replies from Mode S aircraft just entering coverage, or those aircraft that have timed out of lockout due to failure to receive an interrogation in the last 18 ±1 second. A very high assumption for the number of aircraft not in the lockout state in a high traffic environment is about one aircraft per beam dwell, or a total of 120 aircraft for an interrogator with a standard 3-degree beamwidth (3 dB). Given a maximum specified all-call PRF of 250, this would yield a maximum of about 250 Mode S all-call replies per second per standard Mode S interrogator.

2.1.3.3.2 An interrogator using lockout override will have a higher reply rate to its all-call interrogations since lockout is not used. Assume an interrogator with a 10-second scan, a 3.6-degree beamwidth and 700 aircraft in track. The average beam loading will be seven aircraft for each of the 100 beam positions per scan. If a stochastic probability of 0.25 is used, there will be an average of around two replies to each all-call interrogation.

2.1.3.3.3 On this basis, the total all-call interrogation rate for this example interrogator using lockout override should be limited to about 125 Mode S-only all-call interrogations per second to avoid generating any more Mode S FRUIT than a standard Mode S interrogator.

2.1.3.3.4 Different target loadings, beamwidths and scan rates will lead to different operating points. However, the operating principle is to limit total Mode S all-call FRUIT to no more than the low level generated by a standard Mode S interrogator.

2.1.4 Example of interrogator use of lockout override

2.1.4.1 *Interrogator characteristics*

Assuming that the interrogator has a beamwidth of 3.6 degrees, a range of 370 km (200 NM) and a scan time of 10 seconds, using 10 lockout override all-call interrogations per beam dwell leads to an interrogation rate of 100 per second. This is within the interrogation rate allowed by the SARPs, even after adjustment for the higher number of replies produced per interrogation.

2.1.4.2 *Expected performance*

Table H-2 indicates the maximum and average number of interrogations needed to achieve a 99 per cent probability of acquisition. Since ten interrogations are used per beam dwell, the maximum and average number of scans for acquisition can be determined by dividing the last two columns of Table H-2 by ten and rounding up to the next whole scan. The result is shown in Table H-3.