Near-miss between Swissair MD-11 and American Airlines Boeing 767-300 at 050N 013W, July 3, 2000.

Micro-summary: **An ATC systems error results in a faulty clearance, resulting in a near miss between a MD-11 and Boeing 767.**

Event Date: **2000-07-03 at 0348 UTC**

Investigative Body: **Air Accident Investigation Unit (AAIU), Ireland**

Investigative Body's Web Site: **http://www.aaiu.ie/**

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AAIU Report No 2001-016

AAIU File No. **2000/0042**

Published: Oct 26 2001

Name of Operators:	Swissair / American Airlines
Manufacturer:	McDonnell Douglas / Boeing
Model:	MD11 / B767-300
Nationality:	Swiss / USA
Call Signs:	SWR127 / AAL 176
Place of Incident:	050N 013W, in SOTA
Date and Time (UTC):	3 July 2000, 0348 hours

NOTIFICATION

A. The Air Accident Investigation Unit (AAIU) was notified verbally of the serious incident on the morning of 3 July 2000 by the Irish Aviation Authority (IAA). Thereafter, a written IAA Aviation Incident Report Form, No. 187/2000, was transmitted to the AAIU.

The Chief Inspector of Accidents, Mr. Kevin Humphreys, assisted by Mr Frank Russell, Inspector of Accidents, initiated a formal investigation into this serious incident, under the Air Navigation (Notification and Investigation of Accidents and Incidents) Regulations, 1997.

Notification of the serious incident and the investigation was sent to the Aircraft Accident Investigation Bureau of Switzerland, the US National Safety Transportation Board (NTSB), American Airlines, Swissair, the International Civil Aviation Organisation (ICAO) and the IAA.

B. The serious incident was also examined by Ireland's AIRPROX Panel, who produced Report, No. 02/00. In Ireland, the AIRPROX Panel examines all airproximity reports which are submitted by either pilots or ATC controllers.

SYNOPSIS

On Monday 3 July, 2000, circa 0348 hours, a Swissair MD-11 aircraft, callsign SWR 127, reported a near miss with another aircraft, identified as an American Airlines B767, callsign AAL 176. The event occurred at 050N 013W in the Shannon Oceanic Transition Area (SOTA) (*Annex A*), approximately 210 nautical miles South West of the Cork VOR. SOTA is a designated Reduced Vertical Separation Minima (RVSM) area.

SWR 127 was en route from Boston to Zurich and maintaining Flight Level (FL) 320. AAL 176 was en route from JFK, New York, to Frankfurt and, at the time of the event, was climbing from FL 290 to FL 370, having received clearance from Shannon Radar. The aircraft commander of SWR 127 had been observing AAL 176 to his left and below him for more than five minutes when he got the impression that it had started climbing. This was confirmed by warnings on his Traffic Alert and Collision Avoidance System (TCAS). He immediately turned his aircraft 10º to his right and observed AAL 176 climbing through his assigned level, within 0.5 nautical miles (NM) of his left wing.

Prior to leaving the Shannon frequency some minutes later, the commander of SWR 127 advised that he intended filing an air traffic incident report involving AAL 176 with the Swiss authorities.

1. FACTUAL INFORMATION

1.1. History of the Flight

AAL 176 was en route from New York to Frankfurt, SWR 127 was en route from Boston to Zurich. Radar service was being provided by Shannon Control . Both aircraft were part of the eastbound air traffic flow on the North Atlantic Organised Track System, routing from 50N 15W to KENUK (*Annex B*) and were in a group of four aircraft which passed 50 N 15 W in close horizontal proximity. At 0340 hours AAL 176 at FL 290 and SWR 127 at FL 320 reported 15 W and were assigned discreet transponder codes thus allowing the radar and Flight Data processing system to automatically correlate the discreet code with the aircraft call sign. This causes the aircraft call sign to appear in the label attached to the aircraft position symbol on the Controller's radar display. The other adjacent aircraft were call signs TSC 142 at FL 330 and AUA 514 at FL 390 . In all, 147 aircraft were planned through 50 N 15 W that morning.

AAL 176, AUA 514 and TSC 142 were advised that radar identification was established by the sector radar controller and were issued with onward clearances.
The assignment of transponder codes and issuance of onward clearances were annotated on the corresponding flight progress strips by the sector Planning Controller. AAL 176, which had been originally flight planned at FL 290 to GAPLI (*Annex B*), requested FL 370 and was instructed to standby for climb clearance. At 0341 hours, in position 8 NM east of 15 W, the SWR 127 radar track and associated label data block containing, inter alia, its call sign, FL and ground speed disappeared from the radar screen. This label data block would normally be displayed on screen when the radar track representing the aircraft position is displayed. Up to this point SWR 127 had not been advised that radar identification had been established and had not been issued with onward clearance. This clearance is normally issued shortly after initial radio contact when radar identification has been established, (as was the case for the other three aircraft in the 'bunch'). Air Traffic Control procedures require that the aircraft's flight progress strip be annotated when onward clearance is issued.

The sector Radar Controller did not observe that the SWR 127 radar track had disappeared off his radar display. The other controller, the sector Planning Controller, (working the airspace sector alongside the radar controller), who has responsibility for the management of the flight progress strips, was not alerted by the fact that SWR 127 had not been advised that radar identification had been established, that onward clearance had not been issued to SWR 127 and that the appropriate annotation on the flight progress strip had not been entered.

At 0346 hours the sector Radar Controller issued clearance to AAL 176 to climb to FL 370. At 0348 hours SWR 127 advised Shannon that he observed traffic to his left and that he was diverting to the right. The sector Radar Controller did not copy the callsign and requested the aircraft reporting to identify itself. SWR 127 repeated his callsign and confirmed that he was turning right, adding that the traffic to his left was at about a half-mile. The radar recording shows AAL 176 climbing through FL 318 at this time. AAL 176 responded to this transmission by identifying itself as the traffic. SWR 127 asked AAL 176 if he saw him? AAL 176 replied in the negative saying that he had received clearance to FL 370. When prompted by SWR 127 to look to his right, AAL 176 responded that he now had SWR 127 in sight. In his report, the commander of SWR 127 said that he observed AAL 176 left and below him for more than 5 minutes. He then had the impression that the aircraft commenced climbing (it was half-dark at the time, 20 minutes before sunrise), when he received three TCAS warnings, blue, amber and finally red-10 ↑ and advisory "climb". As he was aware of the traffic above him, which was TSC 142, at FL 330, he decided to turn right approximately 10º and saw AAL 176 passing through his assigned flight level.

The sector Radar Controller then asked SWR 127 to confirm that he was squawking his assigned transponder code.
SWR 127 responded in the affirmative. Some 30 seconds later the SWR 127 radar track and label data block re-appeared on the radar screen 74 NM east of 015 W. The Radar and Flight Data Systems' Short Term Conflict Alert (STCA) had not activated, as at this time, the conflict no longer existed. At 0350 hours SWR 127 was advised that radar identification was established and onward clearance eastwards was issued. This was approximately 10 minutes after initial radio contact was made with SWR 127.

1. 2 Collision Alert and Avoidance Systems

Alerting and avoidance systems have been introduced in recent years to assist pilots and air traffic controllers in maintaining safe separation.

Airborne Collision Avoidance System (ACAS)

ACAS equipment currently available is TCAS II, a proprietary version of the system, which uses SSR transponder returns to calculate potential airborne conflicts and automatically provides the flight deck crew with alerting and collision avoidance information. TCAS can provide alerting information on any aircraft transmitting an SSR code but collision avoidance guidance can only be provided for conflicting aircraft transmitting Mode C or Mode S.

- In the subject incident, Swissair informed the investigation that there had been no indications of a malfunction of any sort, neither in the ATC transponder nor in the TCAS system of their aircraft, which is version 6.04. American Airlines informed the investigation that AAL 176 departed JFK on 2 July, 2000, with its TCAS inoperative.

Short Term Conflict Alert (STCA)

STCA is an automated system that alerts controllers to potential conflicts between aircraft returns on the radar display. STCA recognises an aircraft under ATC control by reference to its Mode A code. Conflict alert warnings will only be given for two aircraft where at least one is being controlled from an ATC unit equipped with STCA. When the system detects a potential conflict, an audio alarm, flashing SSR labels and a discreet tabular area on the radar display giving the call sign or call sign/SSR code, alert the radar controller.

- In the subject incident the STCA did not activate due to the earlier loss of the SWR 127 radar track.

1.3 Radar Coverage

a. Radar coverage of the airspace, for which the Irish Aviation Authority is responsible, is provided from: seven Monopulse Secondary Surveillance Radar (MSSR) Sensors and three Primary Surveillance Radar (PSR) Sensors, located at Dublin Airport (two co-located MSSR/PSR), Cork Airport (PSR), Mount Gabriel (two MSSRs), Co. Cork, Shannon Airport (co-located MSSR/PSR), Woodcock Hill (MSSR) Co. Clare, and Dooncarton (MSSR) Co. Mayo, (*Annex C*). Each MSSR Sensor is equipped with a rotating radar antenna, and dual interrogators, receivers, extractors and trackers (*Annex D*). Having received aircraft replies, to interrogations from the radar sensor, the extractors and trackers process the received replies and generate monoradar tracks, which are transmitted over data lines to the Air Traffic Control Centres (Shannon, Dublin, Cork (*Annex E*).

The Shannon enroute ATC centre receives monoradar tracks from the selected Mt. Gabriel MSSR Sensor, Woodcock Hill, Shannon, Dooncarton and the selected Dublin MSSR/PSR Sensor; which are then processed by the Radar Data Processing System (RDPS). The RDPS Multi Radar Tracking (MRT) process generates a single system track output from the combined monoradar track inputs. The MRT system track is then sent to the controller's radar display. If an aircraft is transmitting it's assigned A code and a flight plan exists in the Flight Data Processing System (FDPS) associated with that particular A Code, then a correlated track containing the aircraft flight identification will be sent to the controller's radar display. If, after correlation, radar contact with an aircraft is lost, then the aircraft identification is displayed in the "lost label" tabular area of the controller's radar display, (the lost label field on the controller's radar display contains the prefix L, signifying Lost, aircraft call sign, A code, and Flight Level).

A system area of 1024 x 1024 nautical miles is defined in the RDPS. The system area is divided into 16 x16 nautical mile cells with up to three radars, on a priority basis, defined in each cell. The MRT calculates the position of an aircraft based on the input data from each mono radar track.

Radar coverage in the extreme southwest, which is in the general area of the incident, and extreme northwest of Ireland is mostly single radar coverage, while the southwest and northwest has double radar coverage, rising to triple and quadruple coverage to the west and overland. Providing more than single radar coverage, by locating radar sensors with diverse geographic locations, helps to overcome problems of poor single radar coverage, such as screening by hills or mountains, reflections, garbling etc. Garbling ('ghost' aircraft/plots/tracks), is a limitation on the radar system which can occur when

data arriving at the SSR sensor from one aircraft overlaps with data from another.
This may not be a problem if the overlapping transponder replies can be deconflicted but when simultaneously arriving data cannot be separated the SSR data from either or all of the aircraft can be corrupted. Modern monopulse SSR sensors include techniques to minimise the effects of garbling, but there is currently no completely effective degarbling mechanism.

b. Conflict Alert (CA) is a safety net, which provides the radar controller with a warning (audible and visual) should two or more aircraft come within defined separation boundaries of each other. The Conflict Alert will only be generated if the aircraft are known by the system and that at least one of the aircraft is correlated, e.g. two aircraft may be in conflict but if the radar sensor has, for whatever reason, only detected one aircraft, then the conflict alert will not be activated. Conflict Alert takes account of Reduced Vertical Separation Minima (RVSM) equipped aircraft in that the height parameter allows for 1000ft separation for RVSM and 2000ft separation for non RVSM aircraft.

c. In August 1999, Air Traffic Services (ATS) in Shannon noted an anomaly with the display of Radar Tracks between bearings 245º - 253º magnetic, and distances 182 – 243 NM approximately from Mount Gabriel, i.e. the general area of the subject incident. This anomaly was identified solely on controller reports and ATC instructors observations. The effect was that, on occasions, a Radar Track was not displayed when two or more aircraft were in close geographical proximity. While no ATC incident arose as a result of this radar anomaly a Memorandum was issued by ATS Management to all Radar Controllers to be extremely vigilant while carrying out aircraft climbs or descents in this specific area. Simultaneously, Air Navigation Services (ANS), carried out an engineering investigation into the source of the problem. No identifiable cause was found for this particular report.

1.4 Engineering Investigation

On the 3 July 2000 Swiss Air SWR127 entered the Shannon Upper Area Control (UAC) from the west (ocean) and it's aircraft transponder replied to Monopulse Secondary Surveillance Radar (MSSR) interrogations. The replies were then processed by the Shannon Centre Multi Radar Tracking System for presentation, as a correlated track, on the controllers Radar Display (PVD). Subsequently replies from SWR127 were lost for about 9 minutes and the associated PVD flight plan data (track label) was entered on the PVD lost label tabular. Mandatory Occurrence Report (MOR) 187/2000 was raised and an investigation was initiated by ANS Engineering to determine the reason(s) for the loss of aircraft replies from SWR127.

Initial investigation indicated that the aircraft was under Mount Gabriel Radar coverage only and that the MSSR replies from SWR127 were overlapping (garbling) with AAL176 and AUA514. MSSR replies were again received from SWR127 when the aircraft came within Woodcock Hill MSSR coverage. Further investigation concentrated on the false plot/track ('ghost') processing of the MSSR extractor (ERM870) and the TPR1000 tracker. AIRSYS ATM, the MSSR supplier, was advised of the problem on 19 July 2000 and information was requested on the likely cause of the problem.

A similar occurrence to MOR 187/2000 was recorded on the 23 August 2000. Analysis indicated that, under certain conditions, real aircraft replies could be suppressed at the level of the ERM 870 extractor. AIRSYS ATM was forwarded all relevant data as the investigation progressed. Following a technical investigation of the supplied data, AIRSYS ATM advised that the enabling of the 'ghost' processing in the ERM 870 could, under certain conditions, result in the suppression of actual aircraft replies. AIRSYS ATM acknowledged that the ERM 870 technical manual did not warn of the possibility that real aircraft replies could be suppressed when the 'ghost' processing was enabled in the ERM 870 extractor. Following consultation with ATC and Engineering Operations, the 'ghost' processing in the ERM 870 extractors of all MSSRs was removed by the 31 August 2000 and a staff notice issued warning against enabling 'ghost' processing in the ERM 870 extractor.

The 'ghost' processing in the ERM 870 had been enabled as a result of investigation and in response to ATC reports of 'ghost' aircraft tracks displayed on PVDs and, which in some cases, resulted in the subsequent generation of erroneous Online Data Interchange (OLDI) co-ordination messages ABI, (Advanced Boundary Indication) and ACT, (Activation Message) to adjacent centres. Following discussion with ATC and Engineering Operations, initially one ERM 870 extractor was configured to suppress 'ghost' aircraft. Analysis of the processing was made, using the EUROCONTROL SASS-C tool and comparisons were also made with extractors that were not configured to suppress 'ghosts'. ATC operational evaluation took place in parallel. Over the period mid May to mid July 1999 and in consultation with ATC and Engineering Operations, the A channels of the MSSR ERM 870 extractors had 'ghost' processing introduced on: Mt Gabriel, Shannon and Woodcock Hill. Reversion to the B channels, which is one of two diverse route channels, could be initiated very quickly from the Technical Control Desk if required. Operational evaluation and technical analysis indicated a marked decrease in the number of 'ghosts' with no apparent impact on system performance. 'Ghost' tracks continued to be generated from the other MSSRs and, in consultation with ATC and Engineering Operations, the remaining MSSR extractors were configured to suppress 'ghost' tracks, at the level of the ERM 870, in mid July 1999.

Following removal of the 'ghost' processing from the ERM 870, urgent assistance, was requested from AIRSYS ATM in finding a solution to the generation of 'ghost' aircraft tracks. Two on-site investigations have taken place resulting in a proposed solution by AIRSYS ATM that will require a software change to the TPR1000 Trackers. An order has been issued to AIRSYS for the implementation of the software change.

1.5 Air Traffic Control (ATC) Investigation

The duties of the Sector Radar Controller and the Sector Planning Controller are laid down in the Shannon Manual of Air Traffic Services (MATS), Part 2, Level 2.

The duties of the Sector Radar controller are numerous and include, inter alia, the following .

- Radar Controllers shall ensure that radar identification is established and maintained in accordance with published procedures before attempting to provide a radar service to aircraft, in accordance with ICAO DOC 4444 – RAC 501, Part VI para 6.2.

- Provide up-to-date information on the position and separation of traffic to the Planning Controller when required.

  The duties of the Sector Planning Controller are numerous and include, inter alia, the following:

- Provide Air Traffic Control Service to aircraft in his/her sector in accordance with published procedures.

- Maintain flight progress strips on the active bay in flight level sequence, update flight progress strips to the inactive bay when no longer required for control purposes.

- Inform the Radar Controller of any potential conflicts as early as possible.

In MATS Part 2, Section 2-5, the operational concept on intra sector coordination is outlined as follows:

"The philosophy of operation of a (Radar) control suite is that of a combined team effort between the Radar and Planning Controller".

Among the chain of events leading up to the serious incident on the morning of 3 July 2000 was the breakdown in communications between the Radar Controller and SWR 127 for almost 8 minutes and the concurrent breakdown in communications between the Radar Controller and the Planning Controller in relation to SWR 127. The Radar Controller correctly pointed to the fact that SWR 127 radar signal was lost for this same period thus depriving him of primary situational data on his radar screen, while he and the Planner continued to deal with the other aircraft in their sector. However, the Radar Controller did speak to SWR 127 at 0340 hours, providing the onward discrete squawk code, which SWR 127 acknowledged and programmed. The next procedural step by the Radar Controller would have been to advise SWR 127 that it had been identified on radar and onward clearance then issued. Simultaneous to the loss of the SWR 127 radar signal no onward clearance was given by the Radar Controller and communications with SWR 127 effectively ceased for 8 minutes. It is also noted that SWR 127 did not initiate any communications with ATC after having being assigned its squawk code. At 0346 hours AAL 176 was given clearance to climb from FL 290 to FL 370, thus passing in close proximity to SWR 127 at FL 320, and precipitating the incident.

Shortly after the incident the Radar and Planning Controllers were relieved of their duties and their ATC ratings withdrawn. This was pending a detailed debrief by ATS management, their review of all the events contributing to this occurrence and their intended remedial action.

2. ANALYSIS

The US Federal Aviation Administration (FAA) and the aviation industry have developed a three tiered prevention system to minimize the occurrence of near midair collisions (NMACs) and midair collisions.

The first tier is the flight crews, who carry primary responsibility for maintaining safe separation between aircraft. They are required to adhere to the principal of "see and be seen", and their training specifically includes the use of scanning techniques to identify other aircraft as well as special procedures to be used to avoid NMACs.

The second tier is the air traffic control system, which uses air traffic control procedures and radar derived data to maintain safe separation between aircraft.

The third tier is the Traffic Collision Avoidance System (TCAS), which has been installed on all aircraft that are used by scheduled passenger airlines. TCAS senses when the flight of an aircraft may be in conflict with that of another aircraft and provides the flight crew with guidance as to what action to take to resolve the potential conflict.

Flight Crew

This serious incident began when, after initial radio communications with the Radar Controller, the radar data replies from SWR 127 were lost and this loss was not noted by the Radar Controller, nor did the Planning Controller question the absence of transmissions from the Radar Controller to SWR 127 advising that he was identified and issuing an onwards ATC clearance. At 0340.32 hours AAL 176 requested and was given clearance by Radar to climb from FL 290 to FL 370. In the semi darkness, just before dawn, the commander of SWR 127, was observing an aircraft below him for about five minutes. At this point he had not received any identification and onward clearance response from Radar, following their earlier initial communications. The commander of SWR 127 then perceived that the aircraft below him had started to climb and this was confirmed to him by warnings on his TCAS. Standard Operating Procedures (SOP's) in response to TCAS warnings require him to climb or descend. In this case he decided to make a level turn right through 10º, as he was equally aware that he had another aircraft above him at FL 330. Also, he had the then unknown climbing aircraft in his sight. The commander reported to Radar that this aircraft had passed within ½ NM of his position and climbing. The investigation was unable to verify the exact passing distance between the two aircraft on a subsequent re-run of the radar tapes, due to the loss of the SWR 127 signal. However, there is no reason to doubt the accuracy of the commander's assessment, which resulted from TCAS warnings and his own observations.

ATC

ATS Engineering report that, with increasing North Atlantic traffic and also since the introduction of Reduced Vertical Separation Minima (RVSM), the incidence of aircraft in garbling situations has increased. Garbling can result in the generation of false aircraft tracks, often referred to as "ghost" aircrafts/plot/tracks. MSSR Radar systems provide processing functions that try to identify false aircraft/plot/tracks, which can be generated by the MSSR receiver, extractor or tracker processing chain. These functions are usually available as system parameters, i.e. they can be enabled or disabled if so required.

Lengthy investigation by ATS Engineering proved conclusively that the reason for the missing data replies from SWR 127 was due to the "ghost" processing function of the MSSR ERM 870 extractor. The transponder replies from SWR 127 were, at the time of the occurrence, overlapping (garbling) with the replies from AAL 176 and AUA 514. This "ghost" processing function was disabled on 31 August 2000 and a software change proposed by AIRSYS to remedy the incidence of false tracks, is currently under evaluation and test by ATS Engineering.

On the liveware or human level, the breakdown in communications between the Radar Controller and SWR 127 on the one hand and the Radar Controller and the Planning Controller on the other, represented an extraordinary lapse of concentration on the part of both controllers. The Radar is the controllers primary source of aircraft positional data and, in this occurrence, the data of SWR 127 was missing, due to a software shortcoming. However, this necessary but missing technical input to the controllers was compounded by the non-follow up call to SWR 127 and by the non-questioning by either controller of each other as to what happened to SWR 127. What followed was almost eight minutes of controller silence in relation to SWR 127 which, in turn, was only broken by SWR 127 calling the Radar Controller. This was clearly not in compliance with the Procedures laid down in the duties of Sector and Planning Radar Controllers.

TCAS

The SWR 127 TCAS system, which was functioning normally, alerted the commander to a possible conflict and led him to take avoiding action. The AAL 176 TCAS which was placarded inoperative on 2 July 2000, was made serviceable again on 5 July 2000 *. The commander of AAL 176 was unaware of his close passing proximity to SWR 127 as he climbed to FL 370. It was not until the commander of SWR 127 spoke to him on the radio that he realised the gravity of the situation. It can be contended, in retrospect, that had the TCAS of AAL 176 been functioning normally then it's commander too would have been alerted to a possible conflict and appropriate avoiding action taken. However, in the event, this did not occur.

FAR 91.221 (b) states: Traffic Alert and collision avoidance system, operation required. "Each person operating an aircraft equipped with an operable traffic alert and collision avoidance system shall have that system on and operating".

FAR 121.356 (a) states: "Unless otherwise authorized by the Administrator, each certificate holder operating a large airplane that has a passenger seating configuration, excluding any pilot seat, of more than 30 seats, shall equip its airplanes with an approved TCAS II traffic alert and collision avoidance system and the appropriate class of Mode S transponder according to the following schedule…….".

The investigation notes the different wording of the above two FAR's as they relate to TCAS equipment. The former being explicit that the system should be "on and operating" while the latter presumes an implicit requirement.

* Under American Airlines Minimum Equipment List (MEL), which complies with the NMEL as required by FAA Regulations (FAR's), the TCAS system is allowed to be inoperative for 10 flight days (Category C, MEL item). The company has recommended that this system be upgraded to Category B, which only allows for the TCAS system to be inoperative for 3 flight days.

3. CONCLUSIONS

(A) Findings

3.1 At 0339.28 initial radio contact was established between AAL 176 and Shannon Radar. Shannon issued a discrete transponder code, 2061, which AAL 176 acknowledged.

3.2 At 0340.08 initial radio contact was established between SWR 127 and Shannon Radar. Shannon issued a discrete transponder code, 2062, which SWR 127 acknowledged. Shortly thereafter radar signal was lost. SWR 127 was neither advised that he was identified nor issued with an onward ATC clearance. This is contrary to ATC procedures.

3.3 At 0340.32 AAL 176 was identified by radar and onward clearance to Frankfurt was issued.

3.4 From the time of initial contact with SWR 127 at 0340.08 no further radio communications ensued between Shannon and SWR 127 until 0348.

3.5 At 0341.49 initial radio contact was established between TSC 142 and Shannon Radar. Shannon issued a discrete transponder code, 2060, which TSC 142 acknowledged.

3.6 At 0346.27 AAL 176 was cleared by Radar from FL 290 to FL 370.

3.7 At 0348.01 SWR 127 contacted Shannon advising of traffic at his left wing and that he was diverting to his right. The commander of SWR 127 was responding to his own observations and TCAS warnings.

3.8 At 0349.47 the radar signal of SWR 127 reappeared.

3.9 At 0349.50 Shannon identified SWR 127 and onward clearance to Zurich was issued.

3.10 At 0356.48, prior to changing to his next frequency, the commander of SWR 127 advised Shannon that he was going to file a traffic incident report with AAL 176.

3.11 At a subsequent re-run of the radar tapes in Shannon the investigation was unable to determine the exact horizontal distance between SWR 127 and AAL 176 due to the loss of SWR 127 radar reply for over 8 minutes and 10 seconds.

3.12 The Radar Controller and the Planning Controller were relieved of their duties following this incident, pending an ATS management enquiry.

3.13 Detailed investigation by ATS Engineering Division proved conclusively that the reason for the missing radar data replies from SWR 127 was due to the "ghost" processing function of the MSSR FRM 870 Extractor. The transponder replies from SWR 127 were, at the time of the event, overlapping (garbling) with the replies from AUA 514 and AAL 176.

3.14 The "ghost" processing function was disabled by ATS Engineering on 31 August 2000 and staff notices were issued by management warning against the use of the function.

3.15 Following consultation between ATS Engineering and AIRSYS ATM, the supplier of the equipment, a software change proposed by AIRSYS ATM to reduce the incidence of false tracks, is currently under ATS evaluation and test.

3.16 A not dissimilar loss of radar contact in the same general area of SOTA happened in August 1999. No air traffic incident occurred but, following an engineering investigation, no definite cause of that particular radar track loss was established. However, ATC management issued a memorandum to staff urging vigilance in carrying out climbs or descents in the area affected.

3.17 The level of situational awareness of the commander of SWR 127, which led to his decisive and positive avoiding action, deserves the highest praise.

(B) Causal Factors

The primary cause of this serious incident was the loss of SWR 127 radar signal due to a functional anomaly in the software, which led the Radar Controller to incorrectly give climb clearance to AAL 176 from FL 290 to FL 370.

Other factors contributing to the incident include the breakdown in communications between the Radar Controller and SWR 127 subsequent to their initial radio contact, the eight minutes non-communication between the Radar Controller and the Planning Controller in relation to SWR 127 and the inoperative TCAS on AAL 176.

4. SAFETY RECOMMENDATIONS

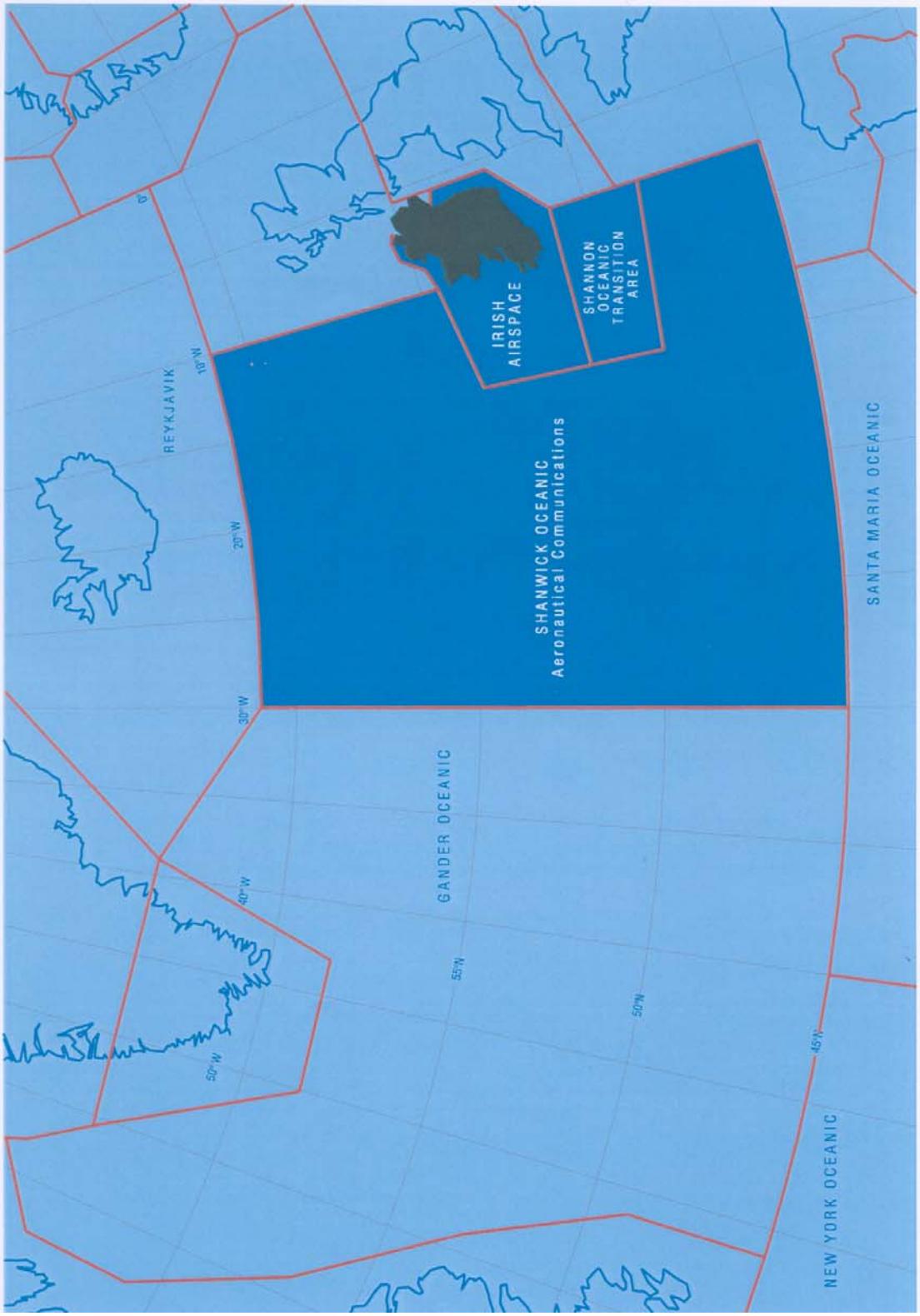
4.1 It is recommended that the IAA undertakes an urgent technical investigation into the Secondary Surveillance Radar System to discover the reason for the loss of the radar signal which contributed to the events leading to the incident.

This was issued to the IAA as an interim *Safety Recommendation on 13 September 2000. The IAA accepted this Safety Recommendation.* **(SR 37 of 2001)**

4.2 It is recommended that the IAA urgently reviews the Training Procedures and Practices employed by Radar and Planning Controllers and amend as necessary in the light of the events leading to the incident.

This was issued to the IAA as an interim *Safety Recommendation on 13 September 2000. The IAA accepted this Safety Recommendation.* **(SR 38 of 2001)**

ANNEX A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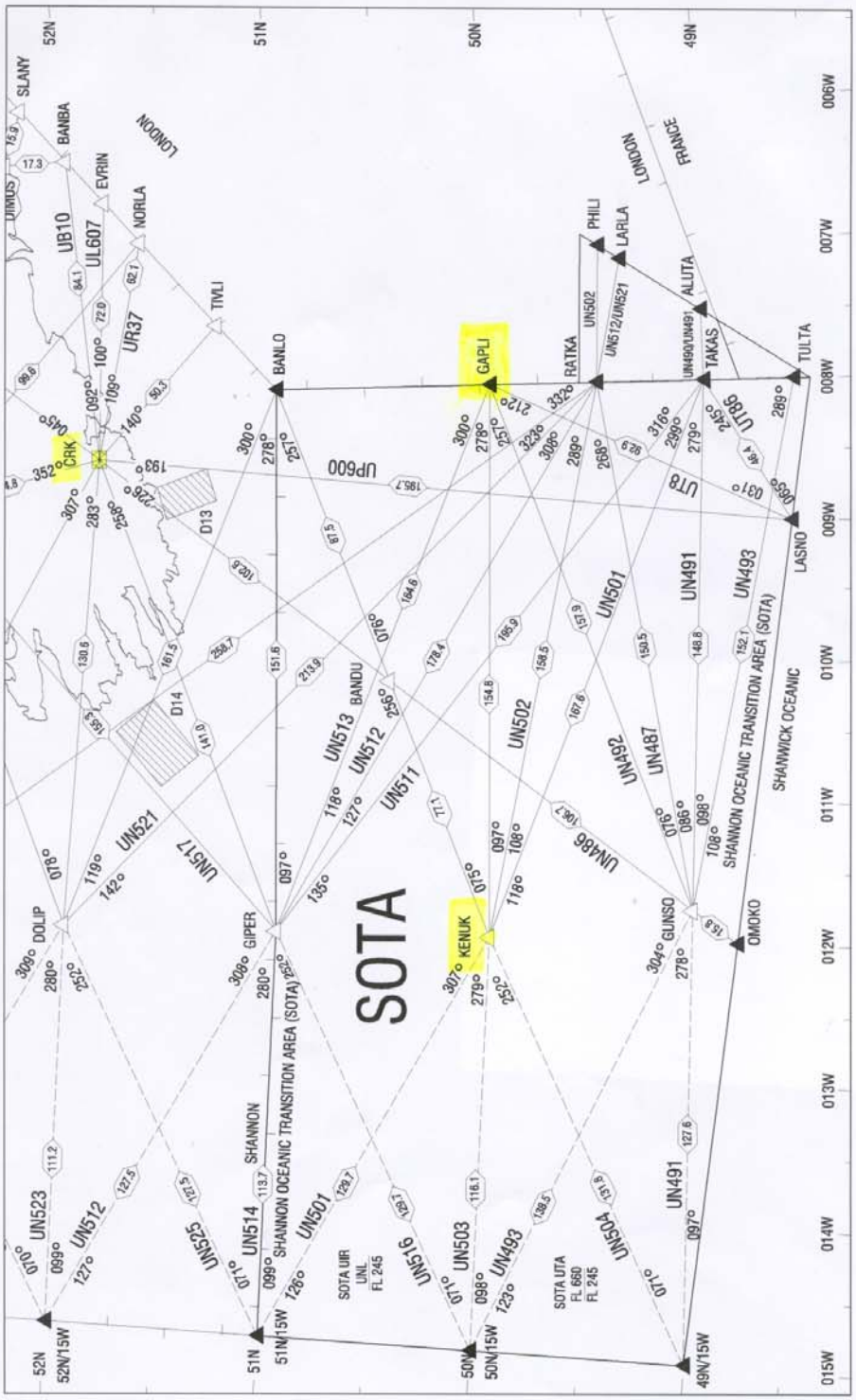
ANNEX B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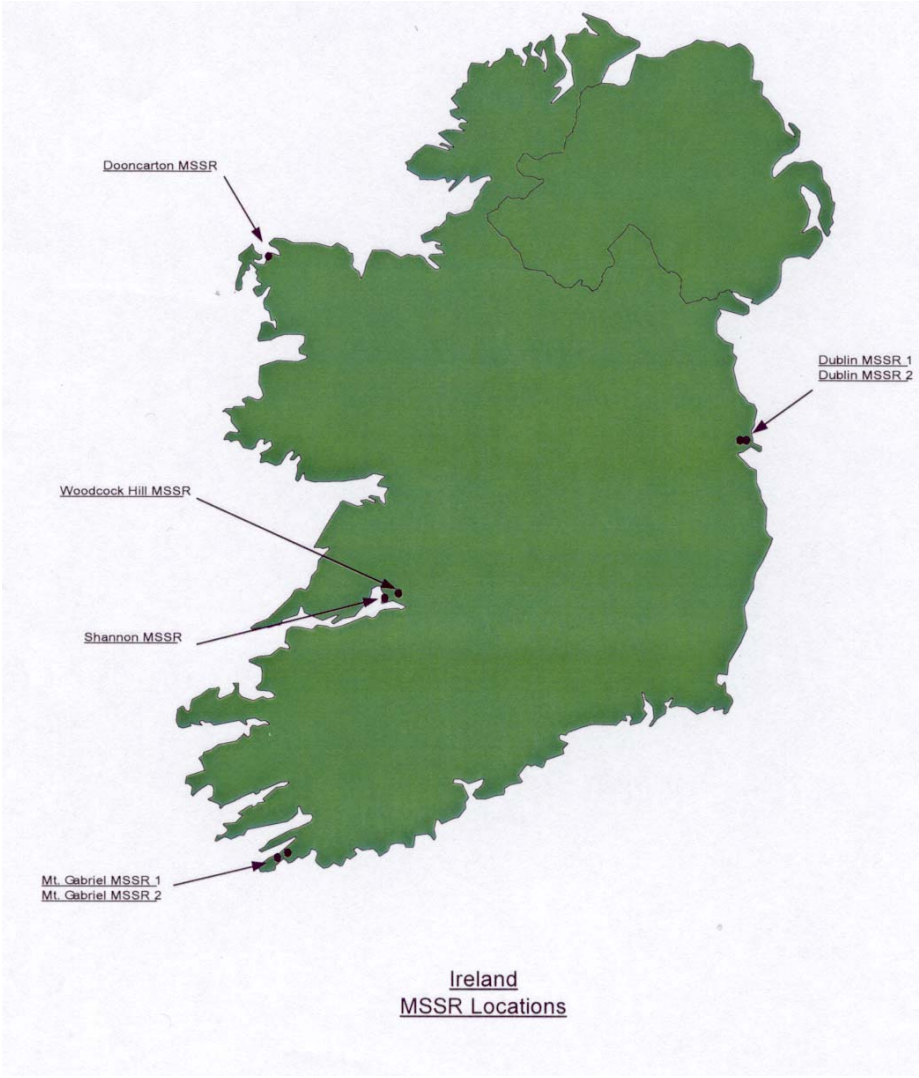
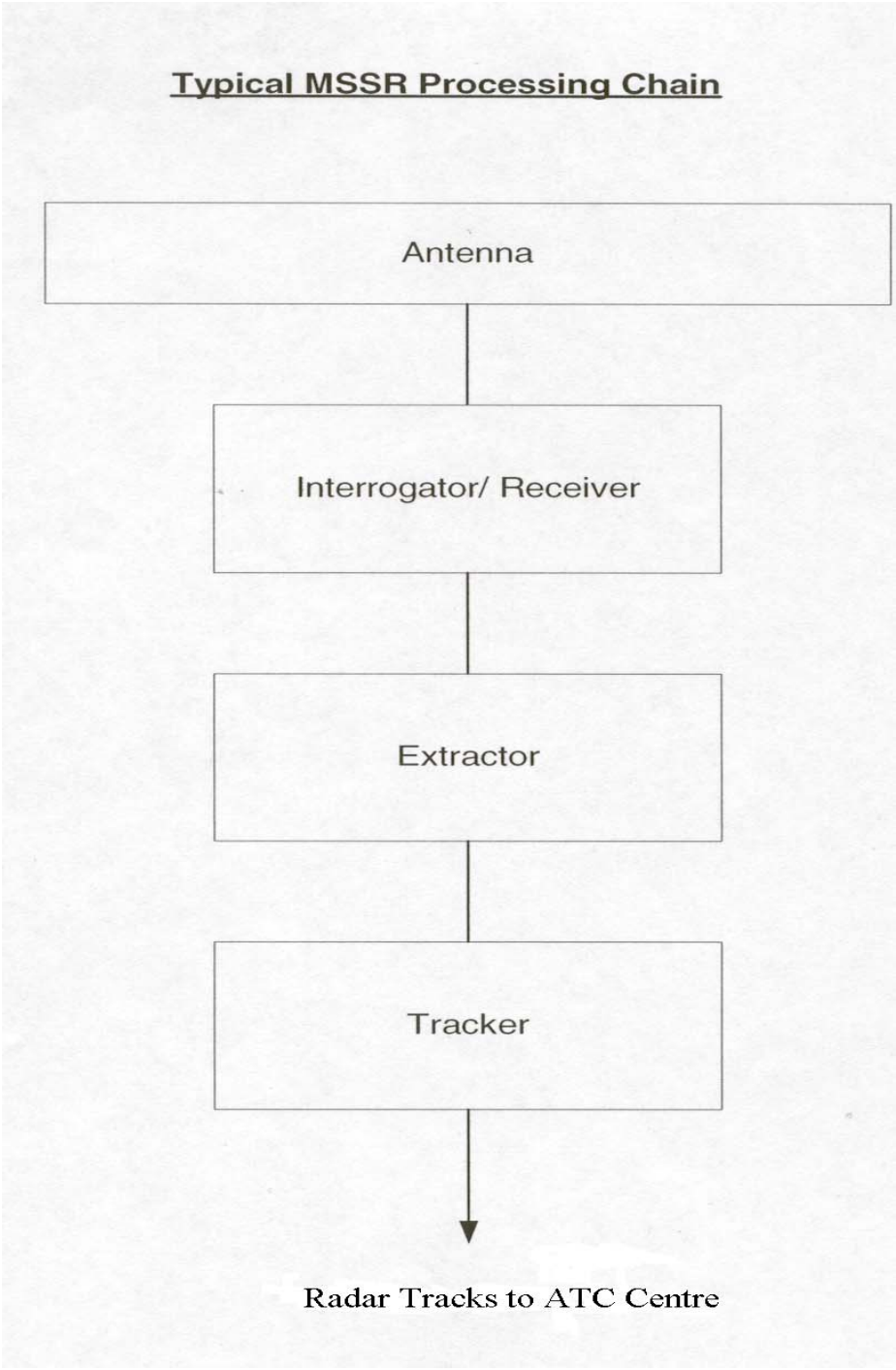
49N/15W

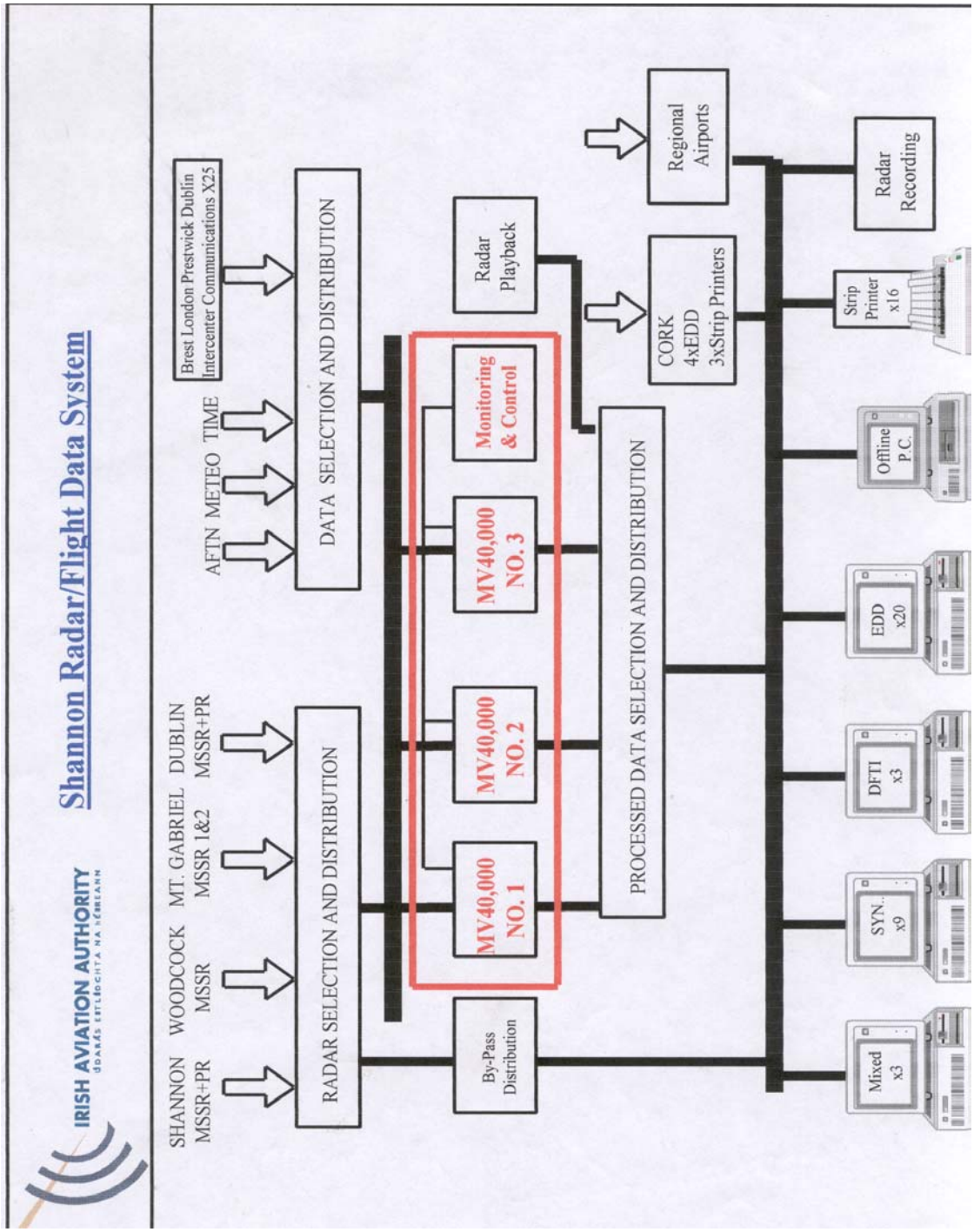
ANNEX C


Dooncarton MSSR
Dublin MSSR 1
Dublin MSSR 2
Woodcock Hill MSSR
Shannon MSSR
Mt. Gabriel MSSR 1
Mt. Gabriel MSSR 2
Ireland
MSSR Locations

ANNEX D


Typical MSSR Processing Chain
Antenna
Interrogator/ Receiver
Extractor
Tracker
Radar Tracks to ATC Centre

ANNEX E


IRISH AVIATION AUTHORITY
Shannon Radar/Flight Data System
SHANNON MSSR+PR
WOODCOCK MSSR
MT. GABRIEL MSSR 1&2
DUBLIN MSSR+PR
AFTN
METEO
TIME
Brest London Prestwick Dublin Intercenter Communications X25
DATA SELECTION AND DISTRIBUTION
RADAR SELECTION AND DISTRIBUTION
By-Pass Distribution
MV40,000 NO. 1
MV40,000 NO. 2
MV40,000 NO. 3
Monitoring & Control
Radar Playback
PROCESSED DATA SELECTION AND DISTRIBUTION
CORK 4xEDD 3xStrip Printers
Regional Airports
Mixed x3
SYN. x9
DFTI x3
EDD x20
Offline P.C.
Strip Printer x16
Radar Recording