

Extended Squitter Update

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Topics

- **SICASP/7 Actions**
- **DO-181B Update**
- **FAA/DFS Frankfurt Measurements**
- **SICASP/ FRA Design Issue**
- **Louisville Op Eval 2**
- **AEEC 718/ ED-86**
- **Other**



Doc 9688

- **All of the technical requirements of Doc 9688 (The Manual on Mode S Specific Services) converted into SARPs**
 - Vol. II, Part 1, Chapter 5, Appendix 1
 - Requirements are consistent with the 1090 MOPS
- **Remaining Doc 9688 material (guidance material) will be contained in a new edition of Doc 9688**
- **Original idea of converting Doc 9688 to a “technical manual” not followed since SICASP informed that technical manuals have no standing in ICAO.**
 - Concept approved by the ANC
 - Not yet approved by the ICAO Council
- **SARPs approach preferable since SARPs have higher authority than a technical manual**



Mode S System SARPs: DF=19

- **DF=19 added as new squitter format for military applications**
- **As a minimum, DF19 squitter contains**
 - **5-bit Downlink Format (DF)**
 - **3-bit Application Field (AF)**
 - **These fields transmitted in the clear**
- **AF field values assigned as needed**
 - **AF=0 assigned for DF=19 squitters with same format as DF=17 and DF=18 squitters**
- **Where possible, recommended that next 5 bits after the AF field be used as a type code**
 - **Better utilization of DF=19 coding space**
- **SICASP approved DF=19 broadcast of Mode 1, 2 and 3/A codes**
 - **As contained in the 1090 MOPS**
 - **Coded as AF=0, type code=0**



Mode 1, 2 and 3/A Code Broadcast

| | |
|----|------------------------------|
| 1 | |
| 2 | |
| 3 | TYPE CODE = 0 |
| 4 | |
| 5 | |
| 6 | STATUS |
| 7 | Character Field (See Note 1) |
| 8 | C1 |
| 9 | A1 |
| 10 | C2 |
| 11 | A2 |
| 12 | C4 |
| 13 | A4 |
| 14 | X |
| 15 | B1 |
| 16 | D1 |
| 17 | B2 |
| 18 | D2 |
| 19 | B4 |
| 20 | D4 |
| 21 | STATUS |
| 22 | C1 |
| 23 | A1 |
| 24 | C2 |
| 25 | A2 |
| 26 | C4 |
| 27 | A4 |
| 28 | X |
| 29 | B1 |
| 30 | D1 |
| 31 | B2 |
| 32 | D2 |
| 33 | B4 |
| 34 | D4 |
| 35 | STATUS |
| 36 | C1 |
| 37 | A1 |
| 38 | C2 |
| 39 | A2 |
| 40 | C4 |
| 41 | A4 |
| 42 | X |
| 43 | B1 |
| 44 | D1 |
| 45 | B2 |
| 46 | D2 |
| 47 | B4 |
| 48 | D4 |
| 49 | |
| 50 | |
| 51 | |
| 52 | |
| 53 | RESERVED |
| 54 | |
| 55 | |
| 56 | |

Purpose. This register is used for Military Applications involving DF=19. Its purpose is to provide data in support of military applications.

‘TYPE CODE’ Definition:
 0 = Mode Code Information
 1 – 31 = Unassigned

1) The Character Field is used to indicate whether 2 characters or 4 characters are used in the Mode 1 Code. The logic shall be as follows:

- "0" = 2 Octal Codes
(A1-A4 & B1-B4)
- "1" = 4 Octal Codes
(A1-A4, B1-B4, C1-C4, & D1-D4)

2) The Status Fields are used to indicate whether the data is available or unavailable. The logic shall be as follows:

- "0" = Unavailable
- "1" = Available



Mode S System SARP:

On-the Ground Validation

- **On-the-ground validation check of 1090 MOPS added to SARPs**
- **Required for aircraft with extended squitter capability**
 - Recommended for all aircraft



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DO-181B Update

- **DO-181B to be revised to include the changes to the Mode S System SARPs approved at SICASP/7**
- **Changes have already been incorporated into MOPS requirements**
 - **Copy is available**
- **Changes to test procedures in process**
- **Expect SC-187 meeting in January to review changes**
 - **Will also include changes to DO-218A**
- **Likely that changes will be incorporated into DO-18C, rather than as a change to DO-181B**



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Frankfurt Measurements: DFS Objective

- **Estimate of current SSR 1030 / 1090 MHz interference rates in the Frankfurt area**
- **Measurements of air-ground (and air-air) Mode S Extended Squitter performance in the Frankfurt area**
- **Input into decision process on ADS-B technique to use in Germany**
- **Validation of analysis and simulations**



Frankfurt Measurements: FAA Objective

- **Airborne Extended Squitter performance measurements, particularly air-air-range**
- **Sampled baseband video (prior to pulse detection) to support development of improved reply processing**
- **Validation of analysis / simulations for the above**
 - **Requires estimate of current interference rates in the Frankfurt area**

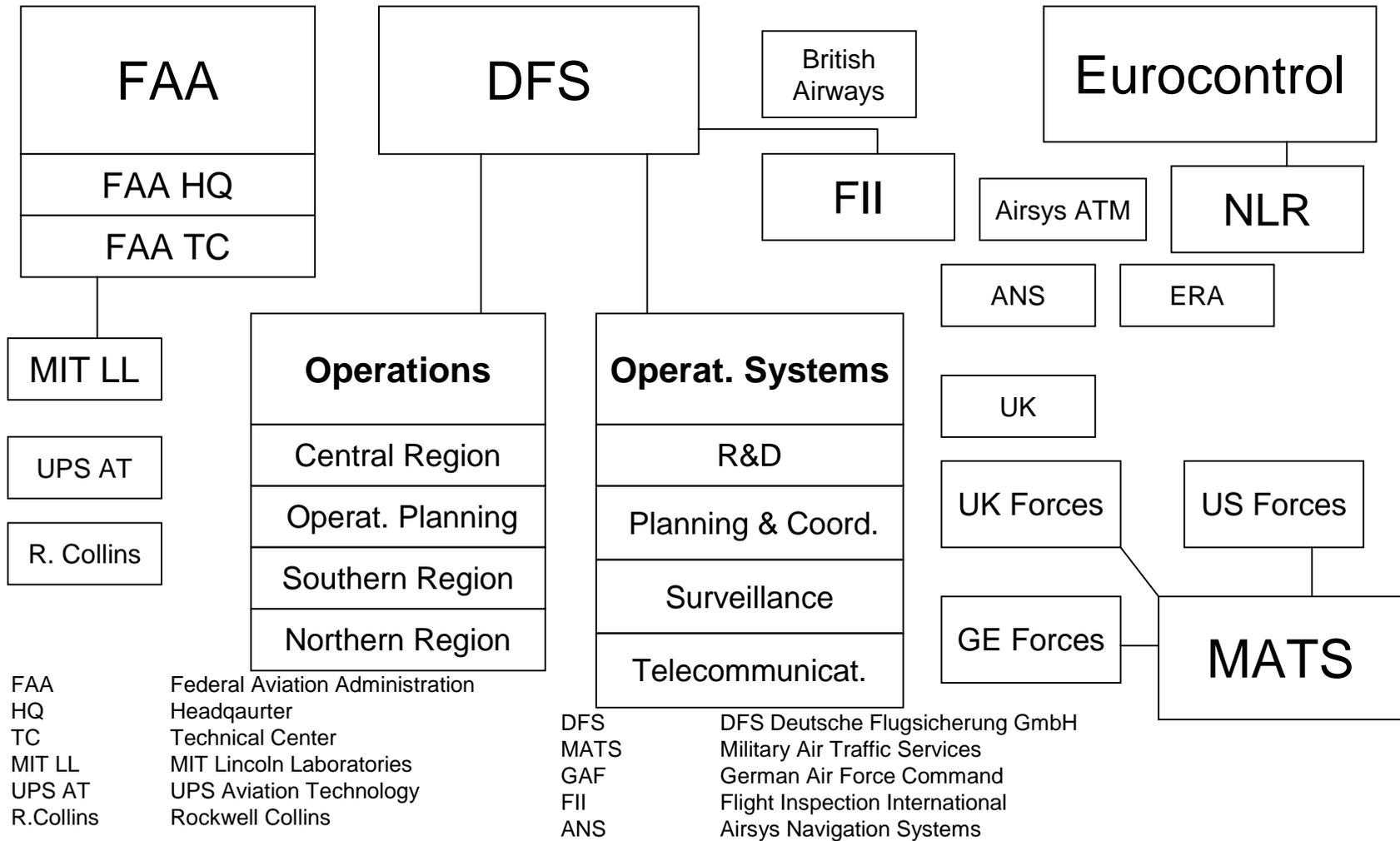


Trials Overview

- **DFS and FAA in conjunction with Eurocontrol successfully performed 1090 MHz Extended Squitter trials in the area of Frankfurt, Germany in May 2000**
- **Data collection flights were conducted on 5 days between May 19th and May 25th. Each party provided a project aircraft for the evaluation**
- **Extended Squitter ground stations were located at Wiesbaden and Langen**
- **Ground SSR and Mode S data were recorded in parallel**



Participating Organizations





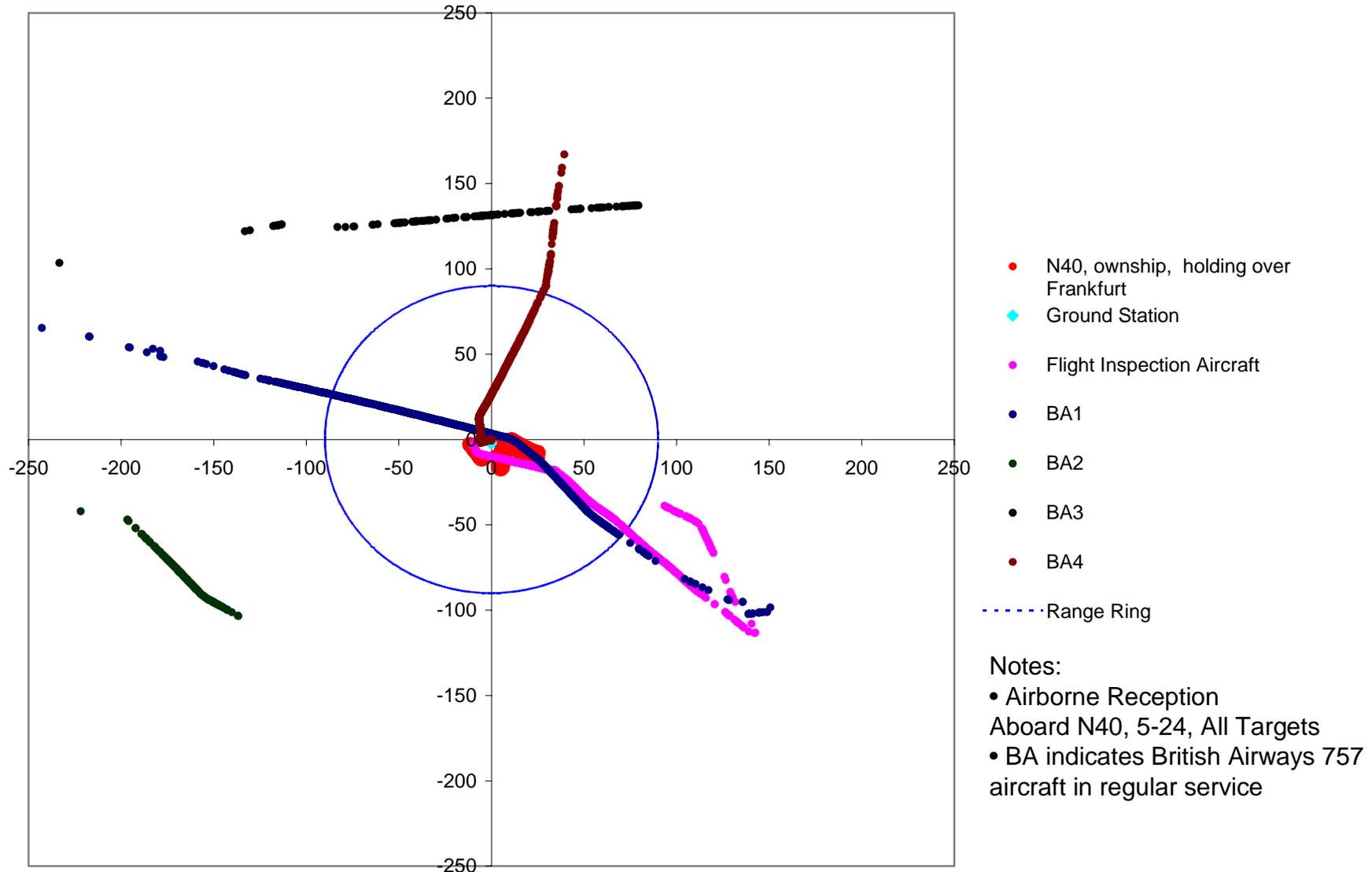
Participating Aircraft

- **The FAA WJH Technical Center aircraft was equipped to collect 1030 MHz and 1090 MHz r.f. environmental data**
- **All controlled aircraft (FAA, FII, NLR) were equipped to transmit, receive and record 1090 MHz Extended Squitters**
 - **WJHTC Boeing 727**
 - **FII Beech King Air 300**
 - **NLR Metroliner**
- **Several BA aircraft equipped with Extended Squitter served as targets of opportunity**



Extended Squitter Measurements at Frankfurt

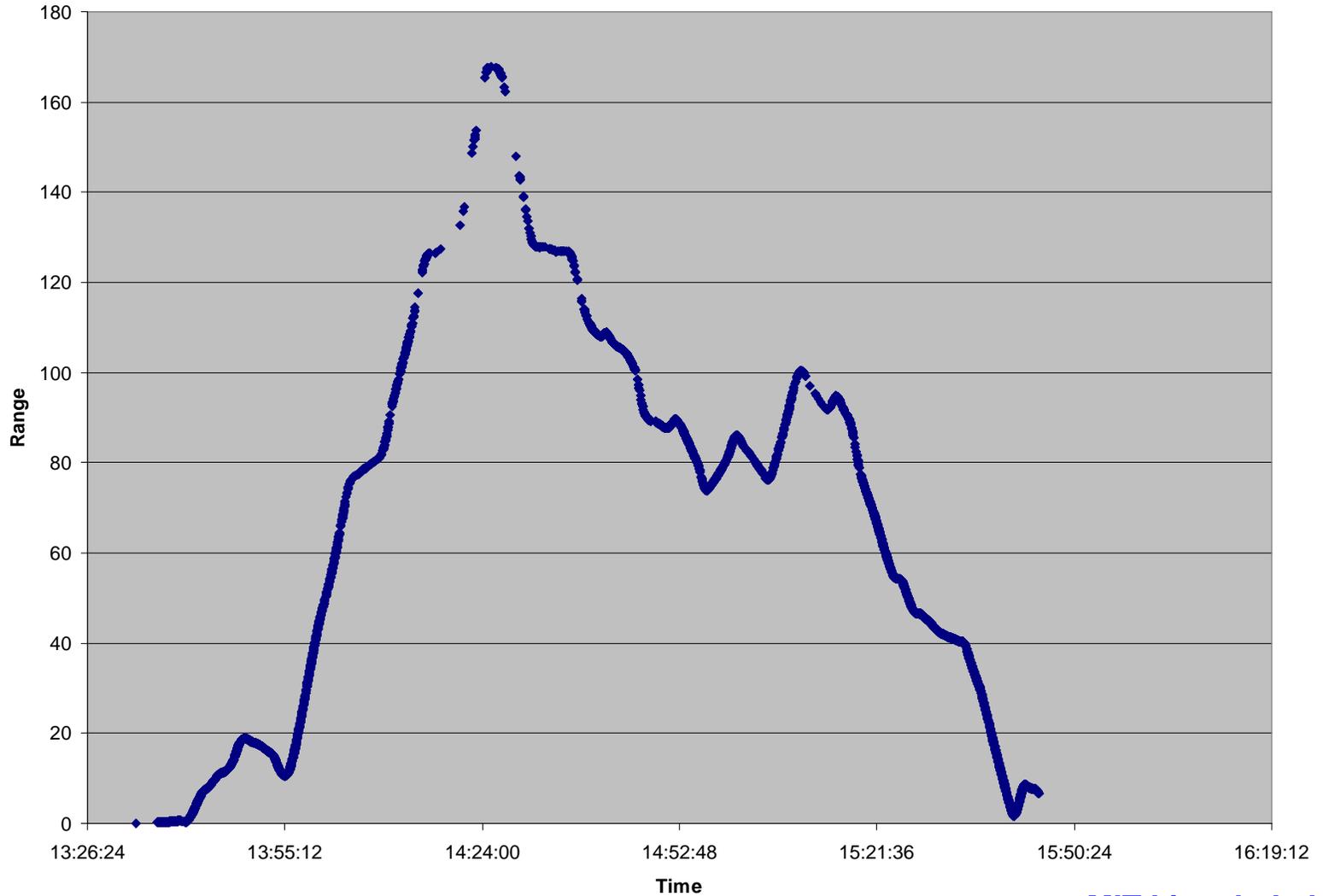
Air-Air Surveillance Performance





Air-to-Air Sample

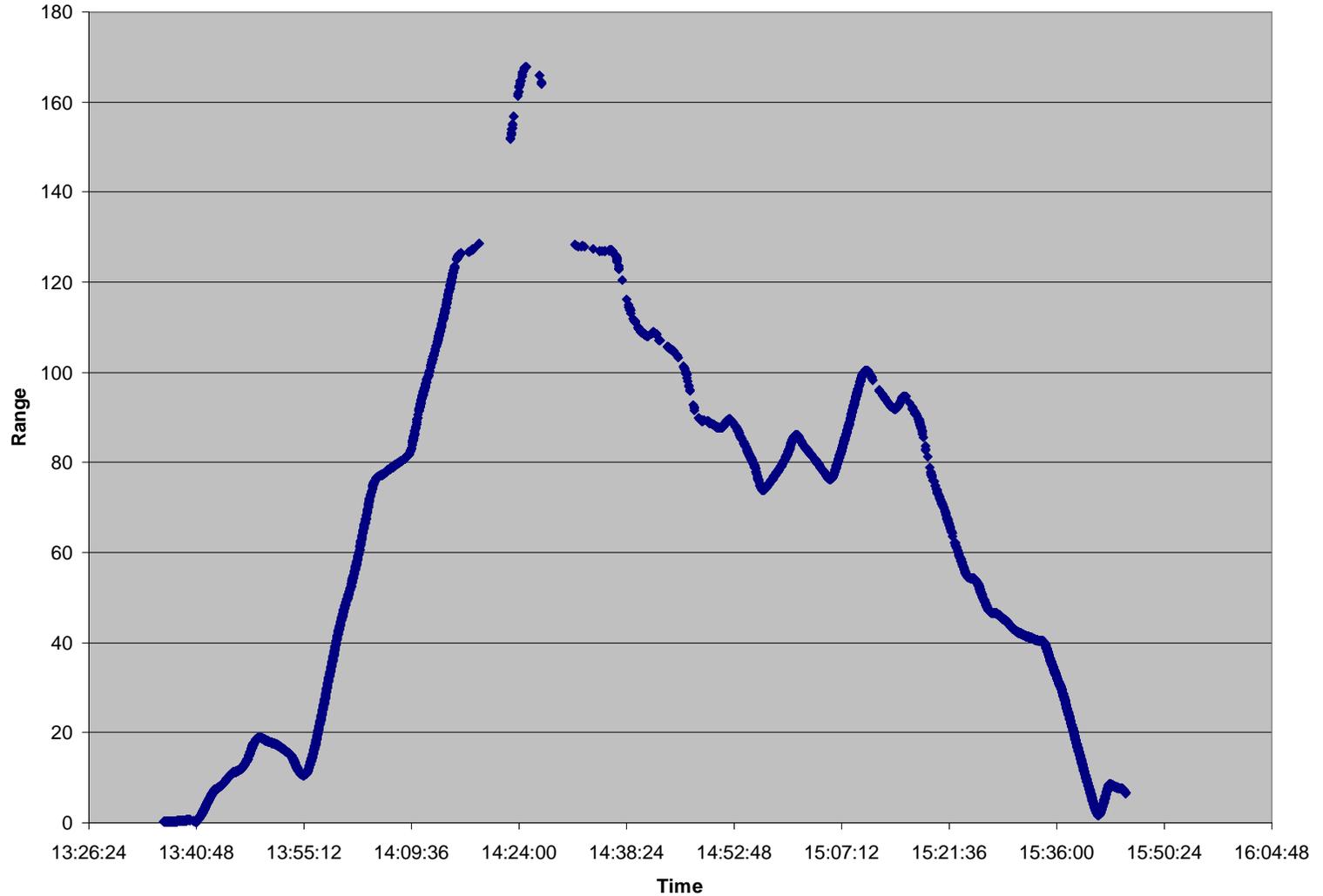
FII A/C Received by N40 (22 May)





Air-to-Air Sample

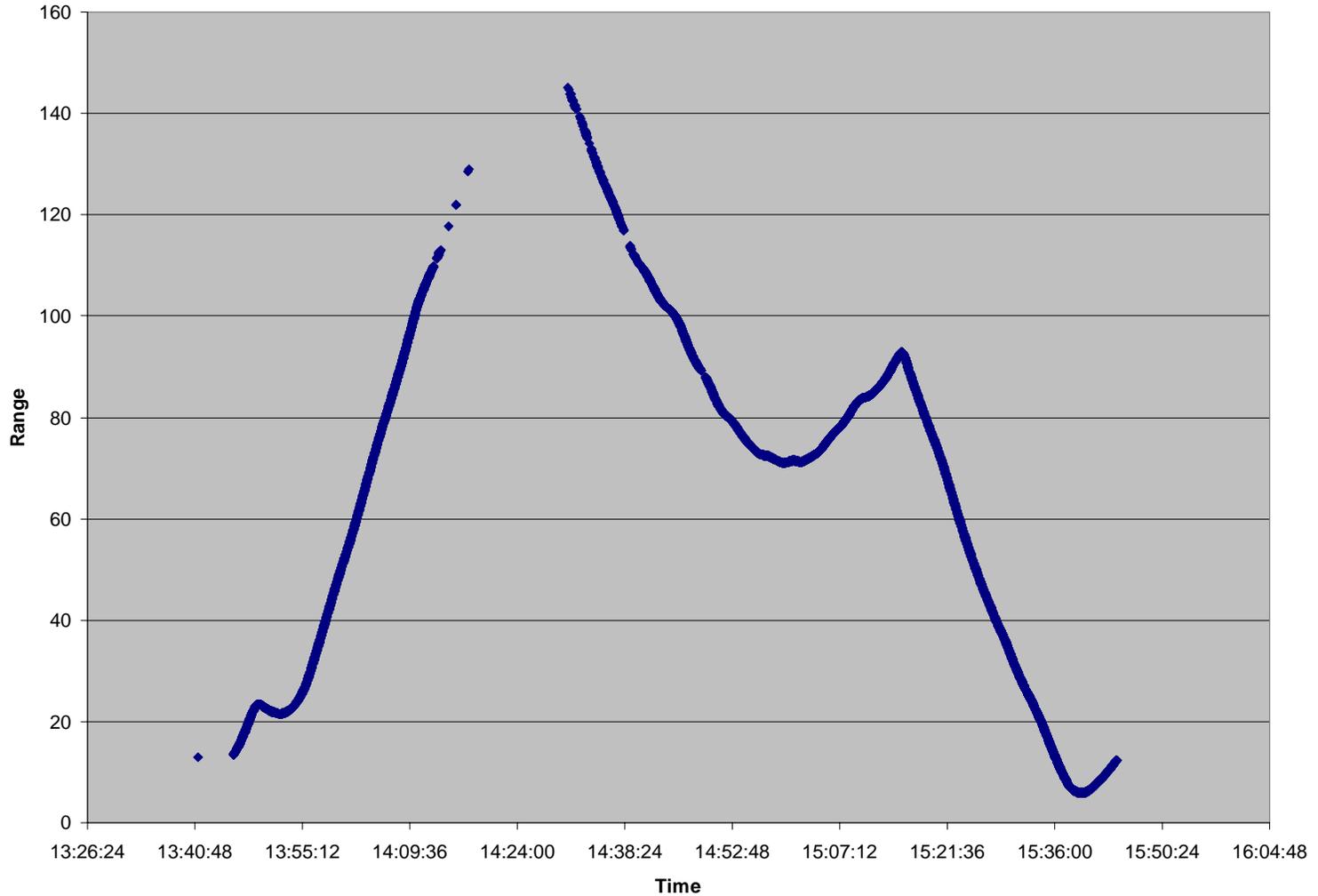
N40 Received by FII A/C (22 May)





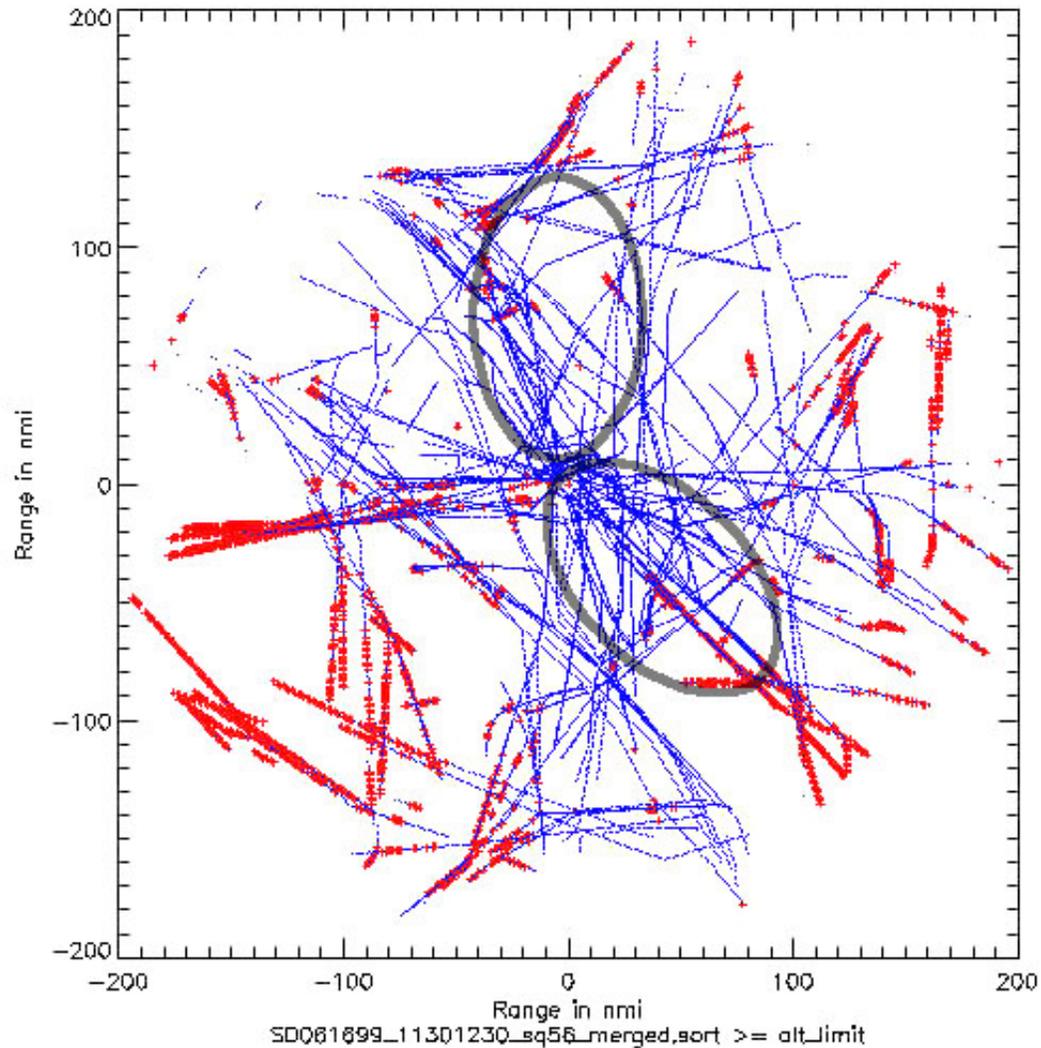
Air-to-Ground Sample

N40 Received by Langen Gnd. Station (22 May)





Langen “Spaghetti” Plot





Preliminary Conclusions

- **Sufficient 1030/1090 MHz environmental and squitter data were collected to allow for a valid assessment of the performance of Extended Squitter in the Frankfurt area**
- **1090 MHz ATCRBS reply rates were on the order of 50% higher in the Frankfurt area than at LAX (the worst case in the U.S.) while the Mode S reply rates and the contribution from TCAS were lower**
- **The range at which Extended Squitter air-air reception and tracking of targets was successful appears to be generally consistent with the MASPS requirements**
- **Extended Squitter air-to-ground reception range was well over 100 nmi and may have ultimately been limited by the non-optimum siting of the ground station antennas (e.g., blockage from higher nearby buildings)**



Status

- **Detailed analysis of the data is now underway and is expected to continue into early 2001**
 - Interim report is being published
- **Final report is planned for March 2001**



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Acquisition of ID and Type

- **It was intended to broadcast an additional ID and Type squitter every 5 sec in conjunction with long range deconfliction application**
 - Added to appendix A but not 2.2
 - Discovered too late to correct during final MOPS review
 - SARPs made to be consistent with 2.2
- **An early conclusion from the Frankfurt measurements is that acquisition performance is improved if received ID squitter retained longer than current 24 sec**
 - Retention for up to 4 minutes appears useful
- **Need to revisit ID acquisition to see if change(s) need to be made to Rev A.**



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