

Examples of RF Transmissions in Europe

Surveillance/MICA Workshop

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RF Measurements

- EUROCONTROL has the necessary equipment to performed RF measurements
 - 1030 and 1090MHz RF recording and analysis
 - Ground RF measurements of airborne RF measurements
- RF measurement
 - To evaluate the interrogations and replies of aircraft vs ICAO limits
 - To detect specific problem in a region
 - To evaluate the impact of specific surveillance systems on the environment (e.g. WAM)

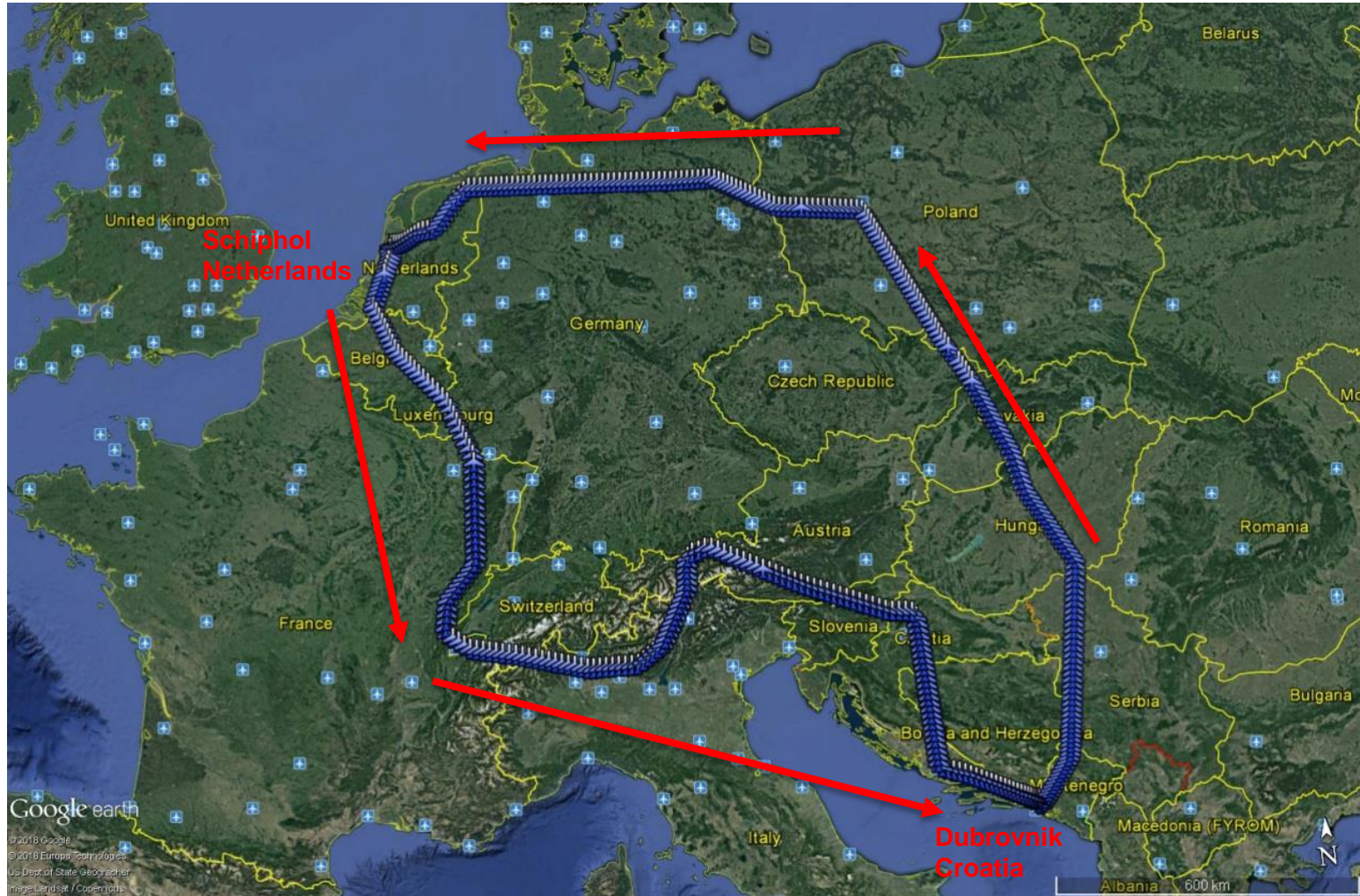
Use of Ground Measurements

- The RF bands are recorded on the ground and analysed:
 - Select aircraft with the highest number of replies and with good power budget
 - Verify if the peak reply rates of these aircraft are below or above ICAO capability
- Limitations
 - Measurement < reality – not all replies are decoded
 - Difficult to determine the causes of excessive number of replies
 - Limited view on 1030 MHz transmissions
- Advantages
 - Permanent
 - More affordable than airborne recording

Use of Airborne Measurements

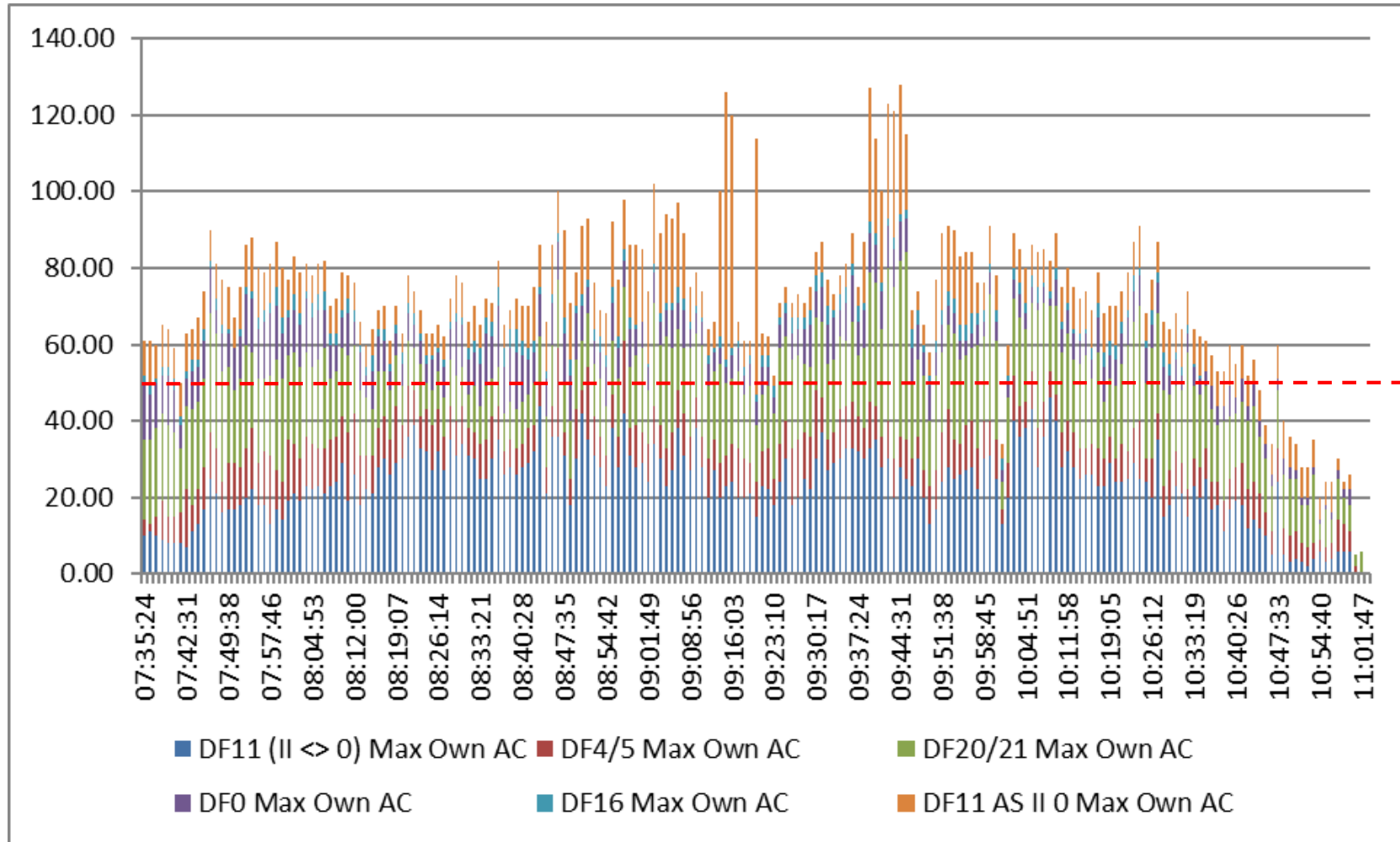
- The RF bands are recorded on a test aircraft
 - Measure the 1090 MHz replies transmitted by the test aircraft transponder
 - Measure the interrogations received on 1030MHz
 - Measure of activity on the suppression bus
- Limitations
 - Limited in time
 - Not necessarily at the peak time
 - Cost
- Advantages
 - 100 % level of confidence on own AC 1090 transmissions
 - Full visibility of 1030 – Xpdr occupancy calculation
 - Determination of sources of interrogations including military

Example of Airborne Measurement Campaign



Maximum number of Mode S replies / second

ICAO minimum reply rate capability: 50 Mode S replies / second



Between Schiphol and Dubrovnik

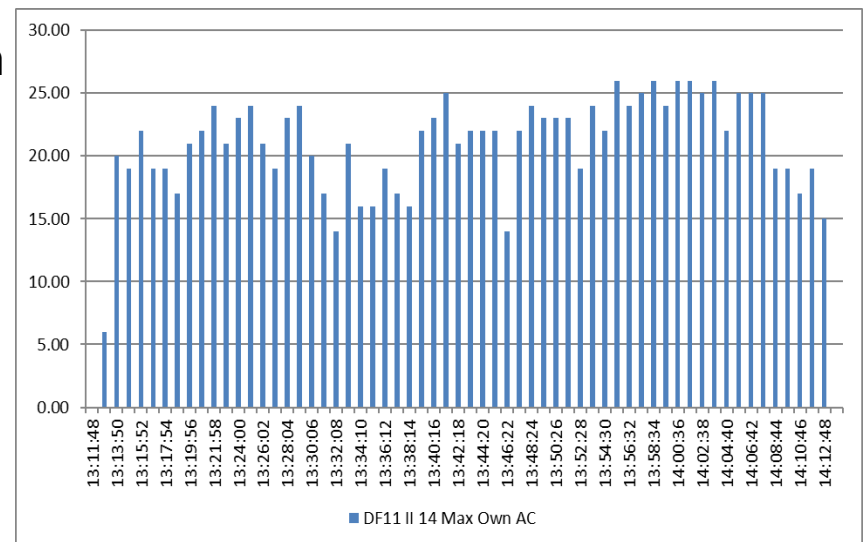
All-Call replies on II<>00

- Maximum number of All-Call replies per second to ground Mode S radar
 - including TRD radars (II14 and matching SI),
 - excluding mobile radars on II 00
- Red: max number of All-Call replies per second > 20
- High number of All-Call replies due to:
 - Some Mode S interrogators trigger too many All-Call replies in the beam (on average, more than 6 All-Call replies per period of 200 msec).
 - Some Mode S interrogators don't apply lockout on the aircraft
 - Due to high number of Mode S radar



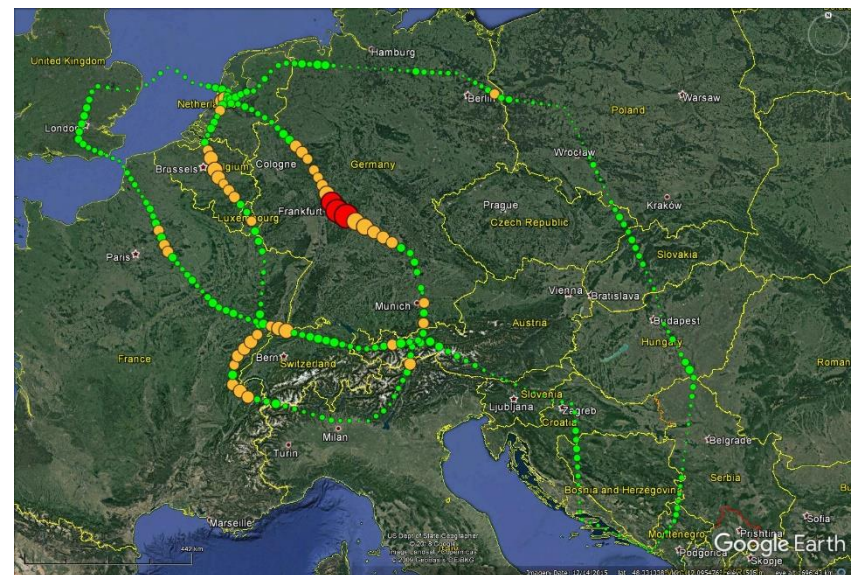
All-Call replies to TRD radar

- Maximum number of All-Call replies per second to TRD Mode S radars (II14 and matching SI)
- Red: max number of All-Call replies per second > 10
- This particular TRD radar triggers up to 26 Mode S replies in its beam
- ICAO:
 - Max 6 All-Call replies in the beam
 - Max 18 Mode S replies per 100ms
 - Max 50 Mode S replies per second
- Test Mode S radar shall be programmed and monitored carefully



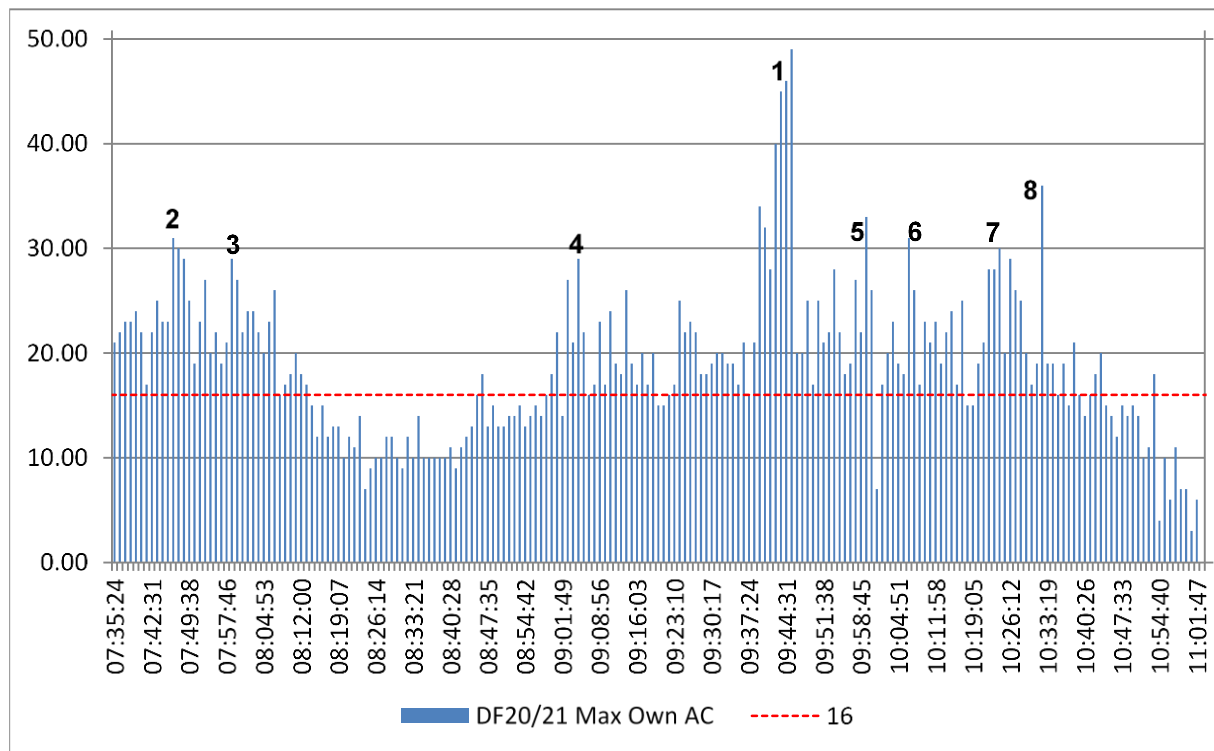
TCAS Replies

- Maximum number of TCAS replies per second
- Red: max number of TCAS replies per second > 10
- Mean number of TCAS replies per second
- Red: mean number of TCAS replies per second > 10
- Highest TCAS activity in the vicinity of large airports, otherwise the impact is limited



Maximum number of long Mode S replies / sec

ICAO minimum reply rate capability: 16 long Mode S replies / sec

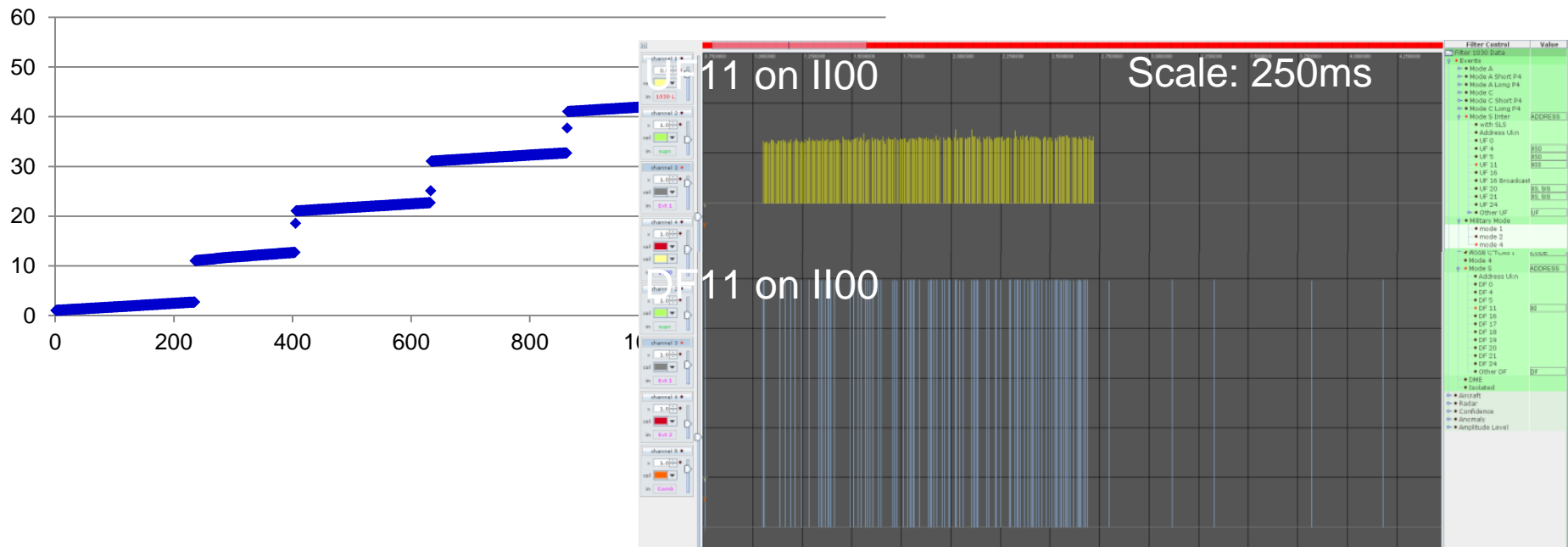


- In general, due to the number of interrogators which 3 long replies (BDS40, BDS50 and BDS60) every scan.
- Peak 1 is due to selective interrogations from military interrogators on II 00 (up to 41/sec).
- Other peaks are due to the abnormal behavior of an interrogator (not the same in all peaks) which triggers many long replies due to BDS re-extraction

Mobile interrogators on II = 00 (1/2)

- Operation of mobile interrogators on II = 00 shall be carefully monitored as the number of interrogations may be very high
 - Below a radar sending more than 200 All-Call interrogations in the beam, and triggering in the example 95 All-Call replies in 1.64s.

Nbr All-Call interrogations vs Time (sec)



Mobile interrogators on II = 00 (2/2)

- Below 3 mobile interrogators on II = 00 triggering
 - 12 long Mode S replies to radar at 1.95s
 - 15 long Mode S replies to radar at 2.9s
 - 14 long Mode S replies to radar at 2.9s

The Mode S interrogators trigger more than 6 Mode S long replies per 100msec, which is above the minimum transmission rates specified in ICAO Annex 10 Vol. IV.

Radars turning at 2.9s:
BDS 10, 17, 20, 40, 50 and 60 are continuously extracted.

Radar turning at 1.95s:
BDS 10, 17 and 20 are continuously extracted (not 40, 50 and 60).

