Supporting
European
Aviation

EUROCONTROL

GNSS RFI Solutions
(Short Term)

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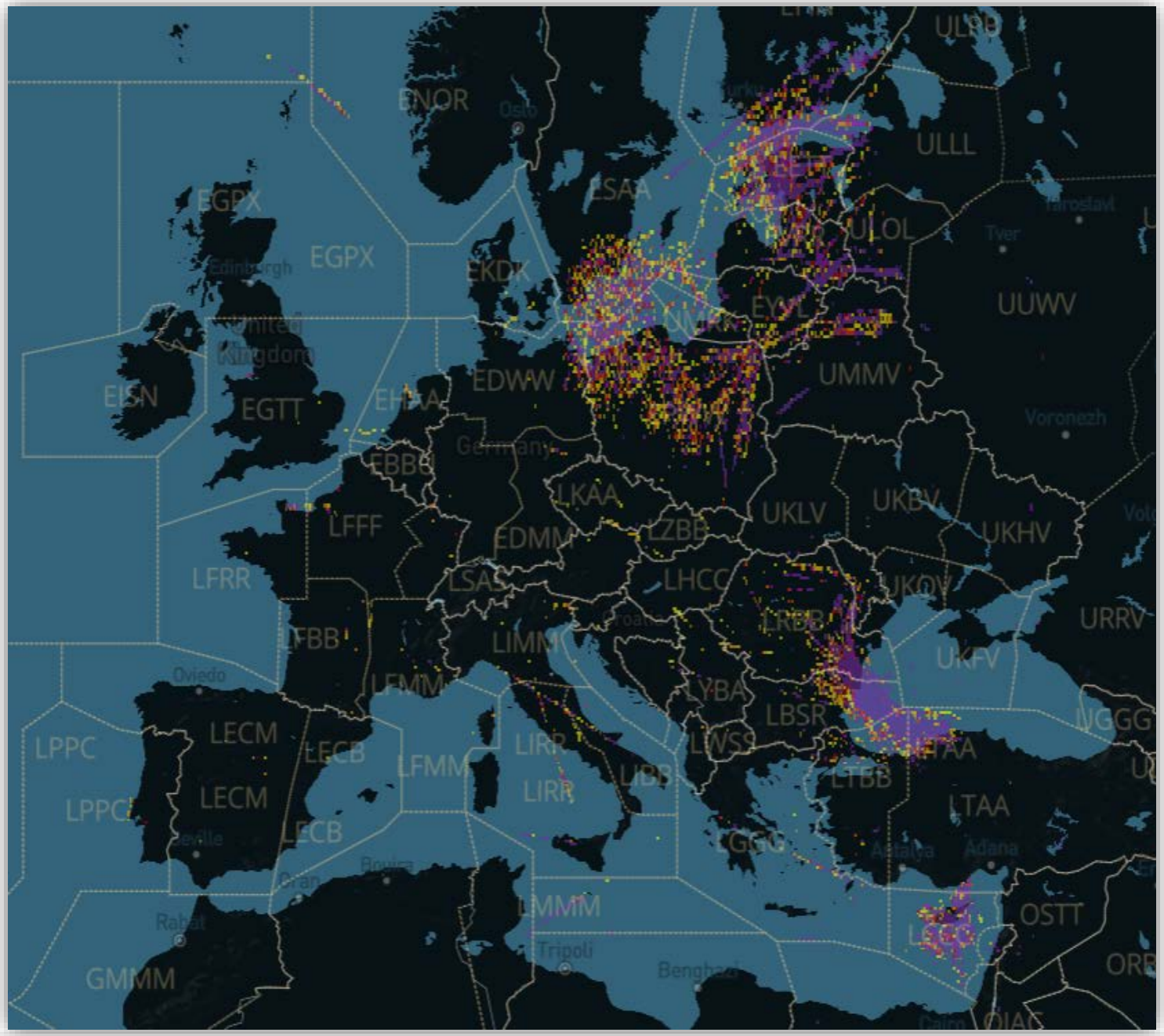
FOUNDING MEMBER SESAR JOINT UNDERTAKING

NETWORK MANAGER



European ADS-B based GNSS RFI Monitoring Network by EUROCONTROL

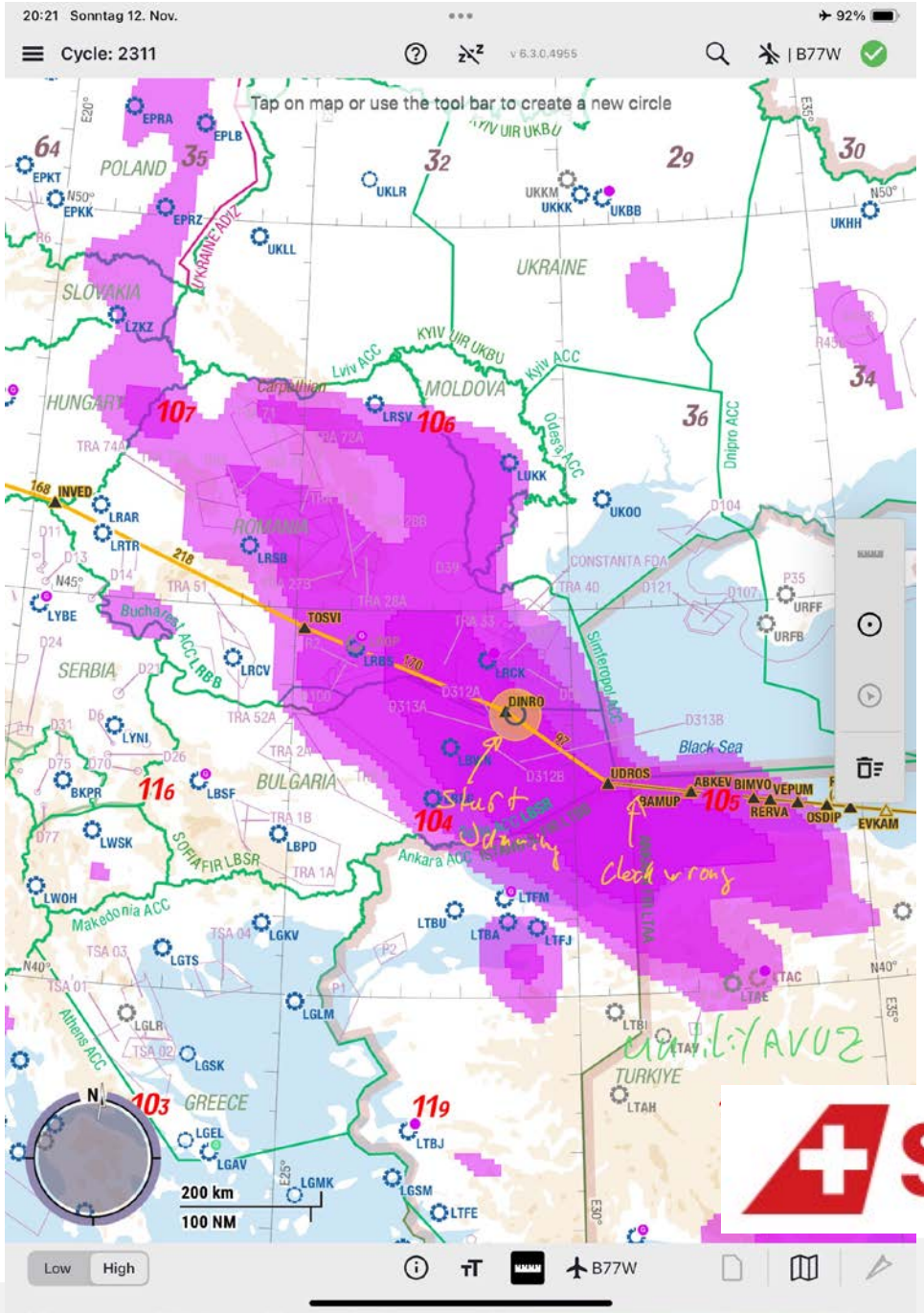
- Interference situation from last week (week 4) showing impacted traffic
- Dedicated network for CNS Monitoring (including Mode S interrogation load)
- Combined with flight plan equipage information, can estimate number of aircraft which may need ATC vectoring assistance

Request from Pilots: Give me the “GPS Weather” on my EFB!

- **GNSS RFI Layer in Lido mPilot**

Pilot Trial Operational Feedback

While flying eastwards in a B777, the flight crew first noticed signs of jamming at the position **DINRO**, situated in the middle of the RFI layer. After **UDROS**, the aircraft clock showed incorrect time. Jamming persisted until **YAVUZ**, located in Eastern Turkey, which is outside the coverage of the RFI Layer.



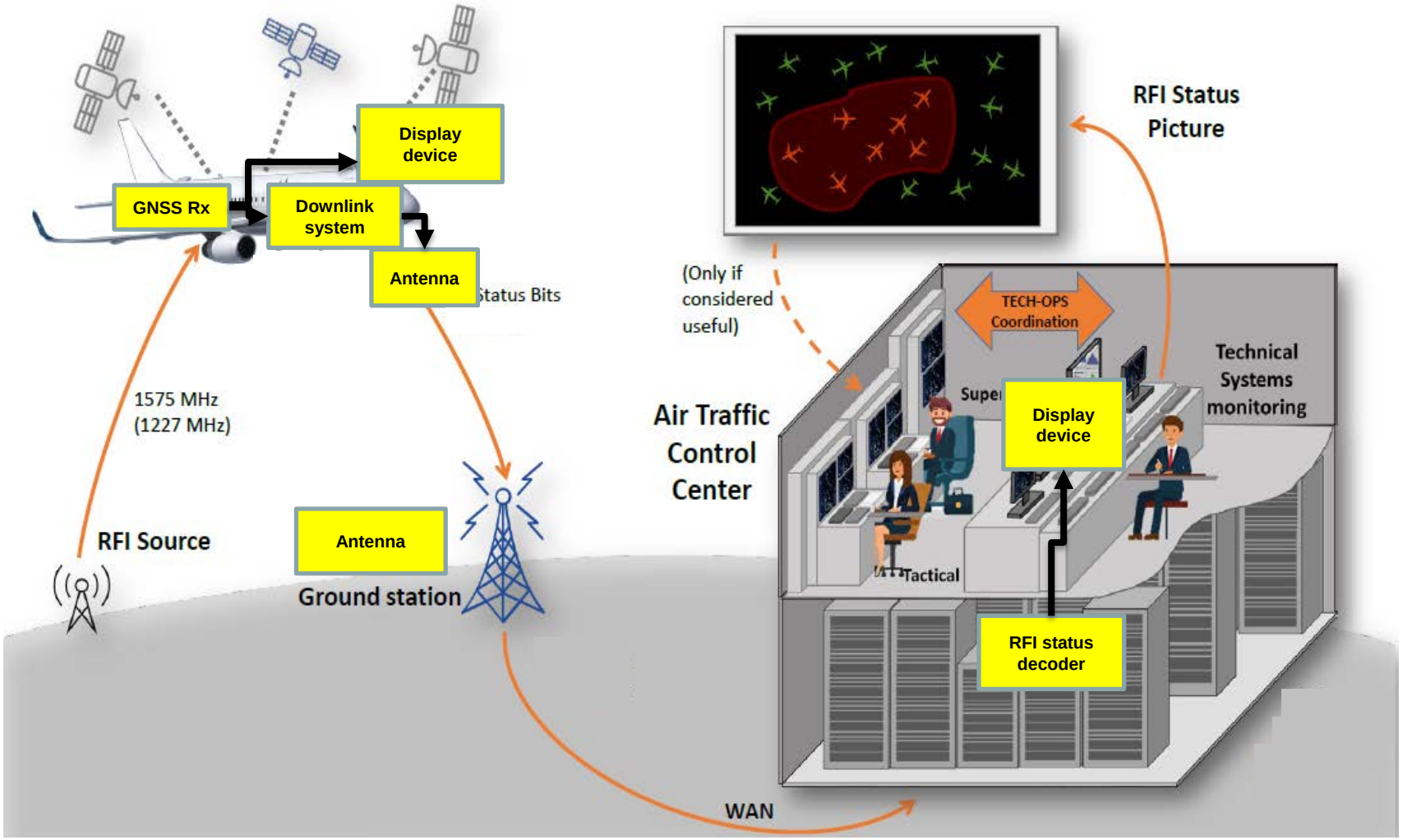
Envisioned Next Generation RFI Mitigation Function

Functional architecture (ADS-B low PIC today, dedicated bits in future!)

Steps

1. GNSS Receiver **detects RFI** and **reports** it to the **ground**
2. Ground stations **process RFI status** and allow generating an integrated RFI status picture for multiple aircraft
3. TECH services coordinate with OPS on impacted areas and launch **operational mitigation measures**
4. Report to the **radio regulator**

Incorporation in next generation GNSS and ADS-B equipment standards under development



EUROCAE WG107:
DME Supporting PBN Positioning

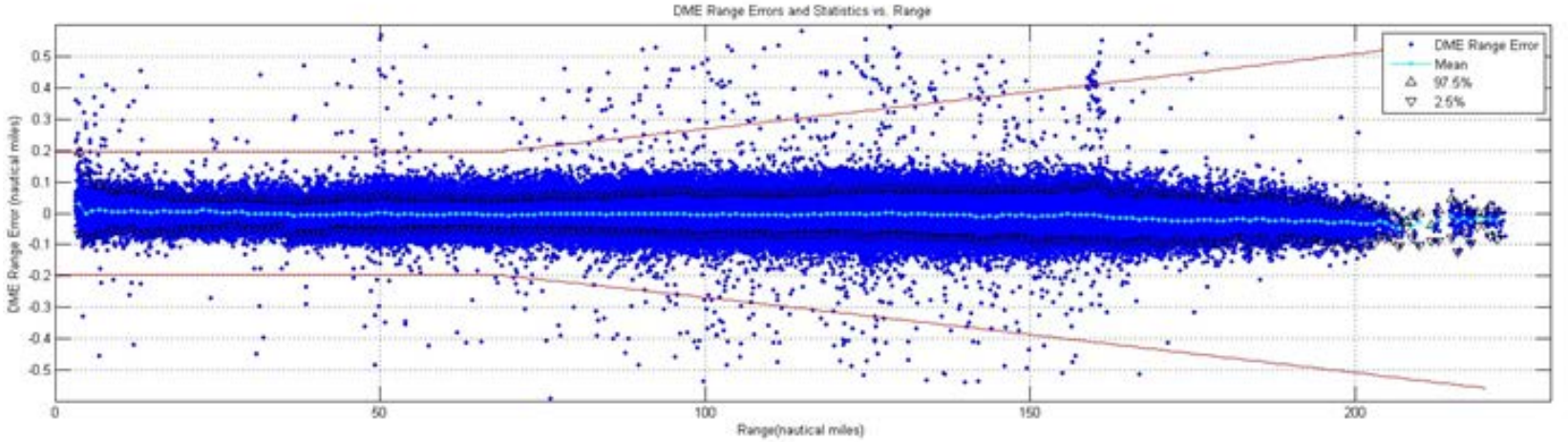
- Giving credit to DME equipment performance improvements since the minimum standards were written in the 1990's

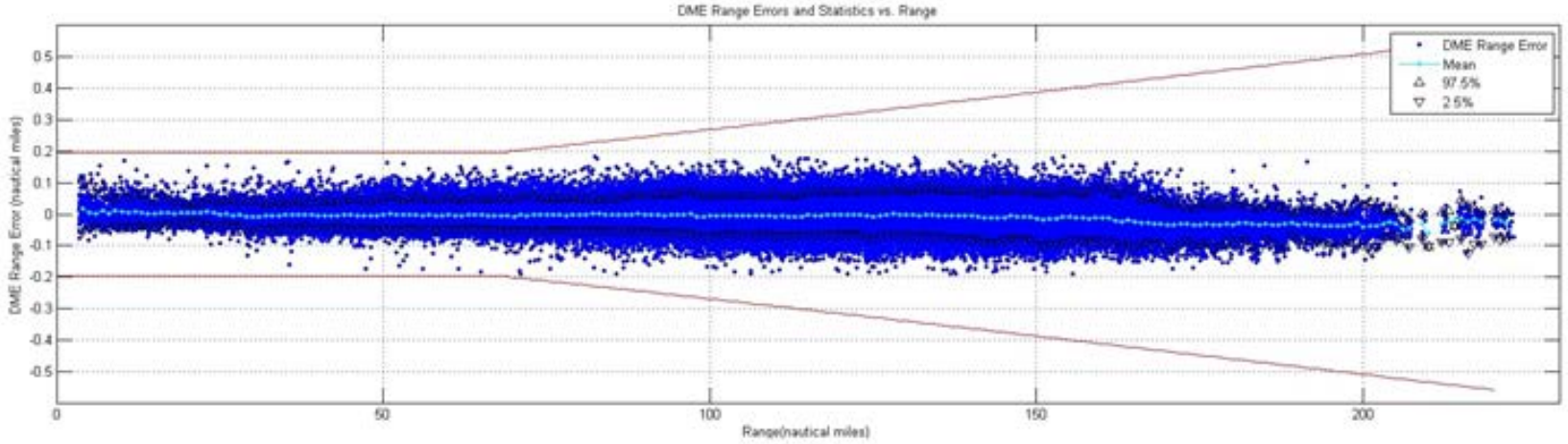
- Update of ED57, DME Transponder MOPS (Minimum Operational Performance Standard)
- New MASPS for DME supporting RNP (Minimum Aviation System Performance Standard)

- To be compatible with RNP/RNAV MASPS, DO 236D / ED-75E
- To be compatible with ICAO PBN Manual Doc 9613
- To provide one acceptable basis for State Authorization of optional use of DME in PBN
- To support move from DME/DME to Multi DME Navigation (all in view)

DME Signal in Space Performance / In-Flight Data

Slant Range Accuracy up to 200NM





Data from several European State DME's at around FL200

Full raw dataset: 797,505points

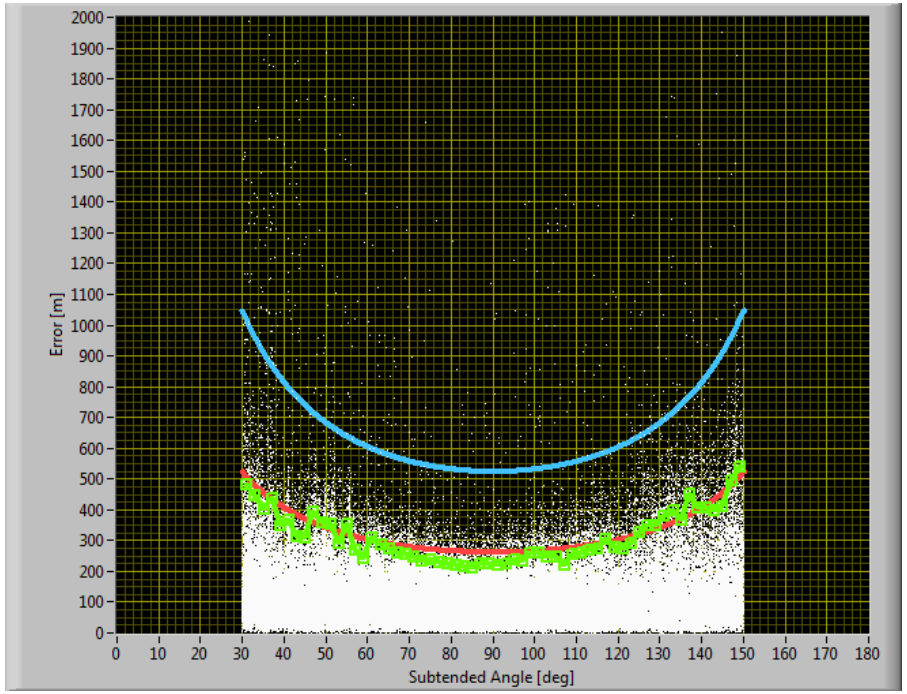
20 sec filter dataset: 413,808 points

Data aggregated for all stations

Results similar for a more recent, low altitude data set

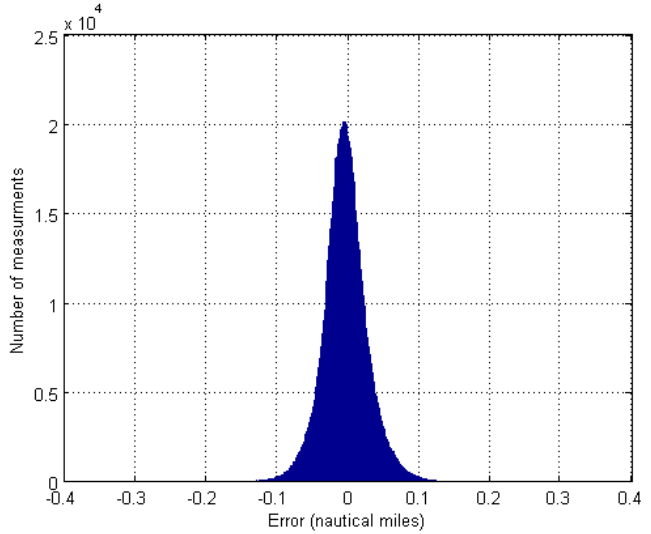
DME Signal in Space Performance / In-Flight Data

Slant Range Accuracy

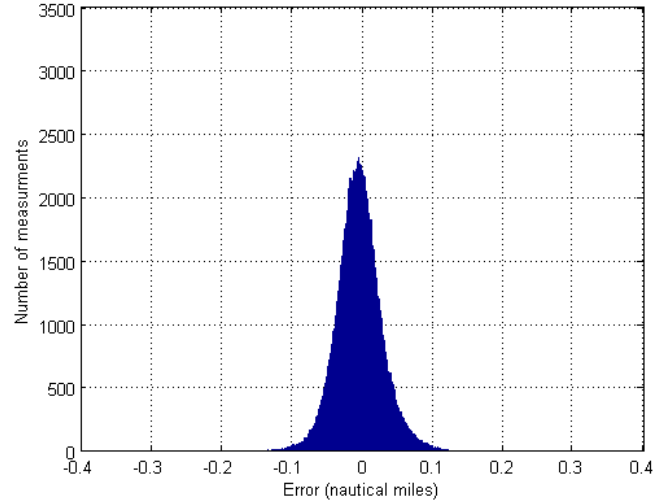


- Measured accuracy twice better than standards
  - Range error : $2\sigma < 0.1$NM
  - DME/DME NSE: $2\sigma < 0.3$ NM

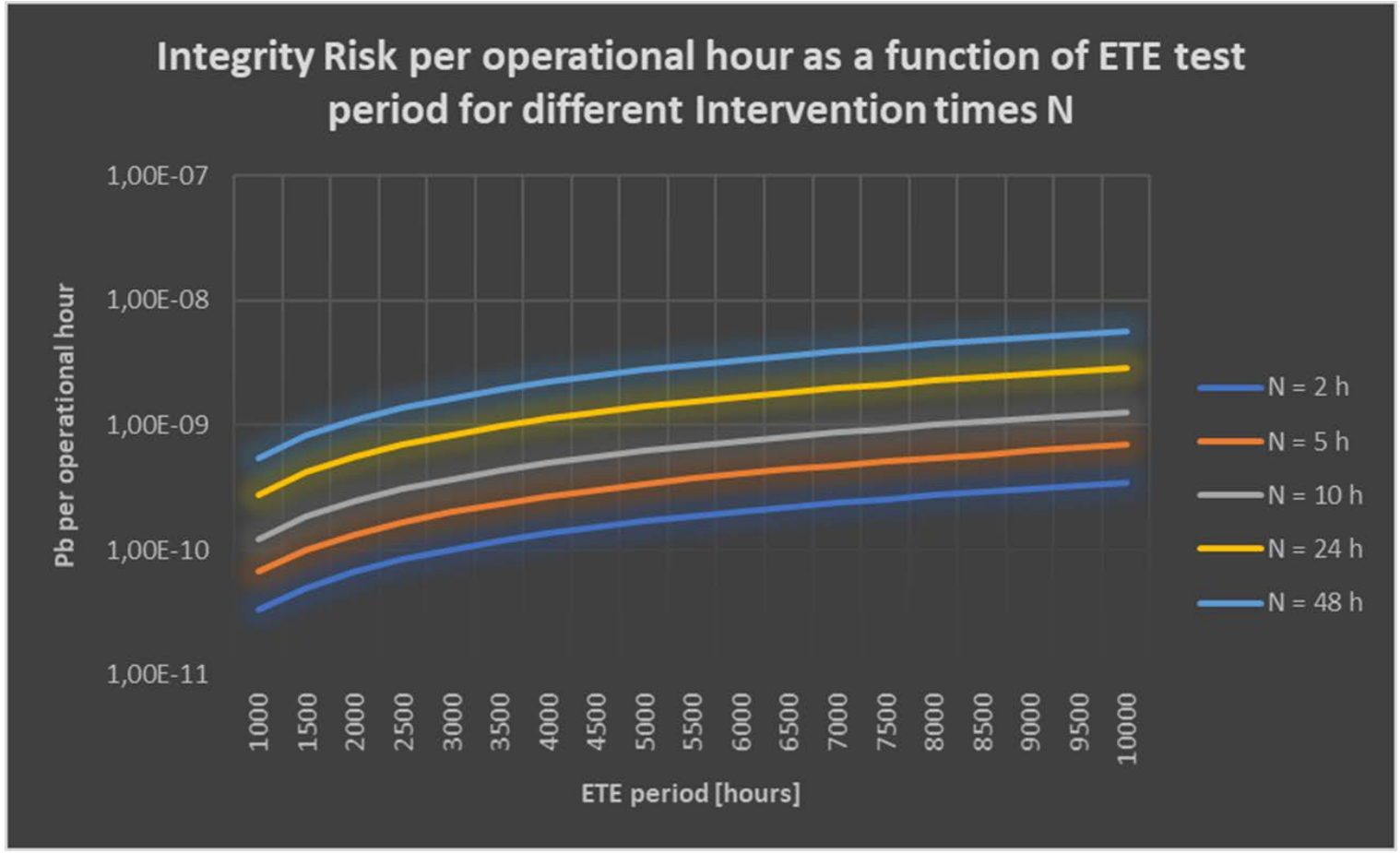
- Without 20 s filter applied:
  - Mean = -0.0038 NM (-7.04m)
  - Standard deviation = 0.0333 NM (61m)



- With 20 s filter applied:
  - Mean = -0.005001NM (-9.26 m)
  - Standard deviation = 0,0322 NM (59m)



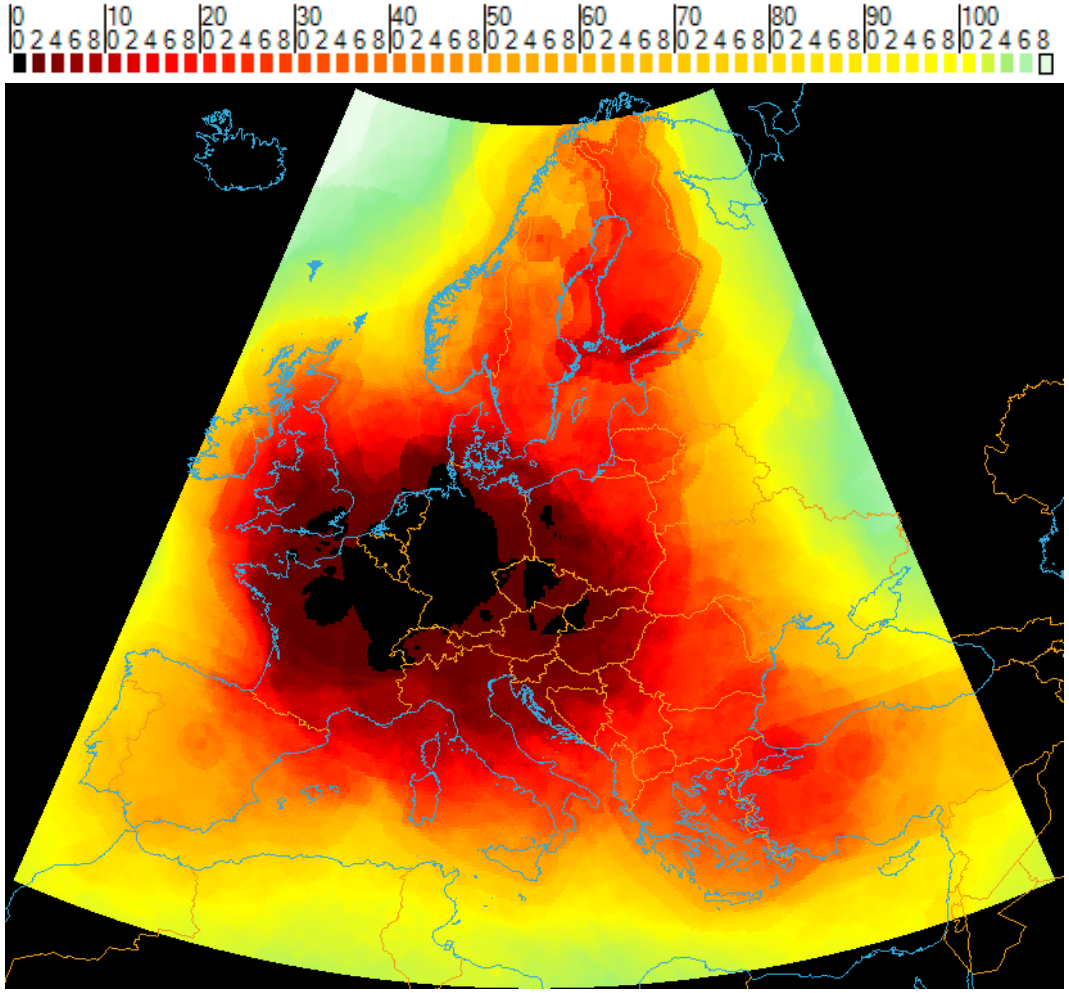
DME Ground Transponder Integrity



Current generation DME installed in Europe typically meet 1-10^{-7}/h Integrity!

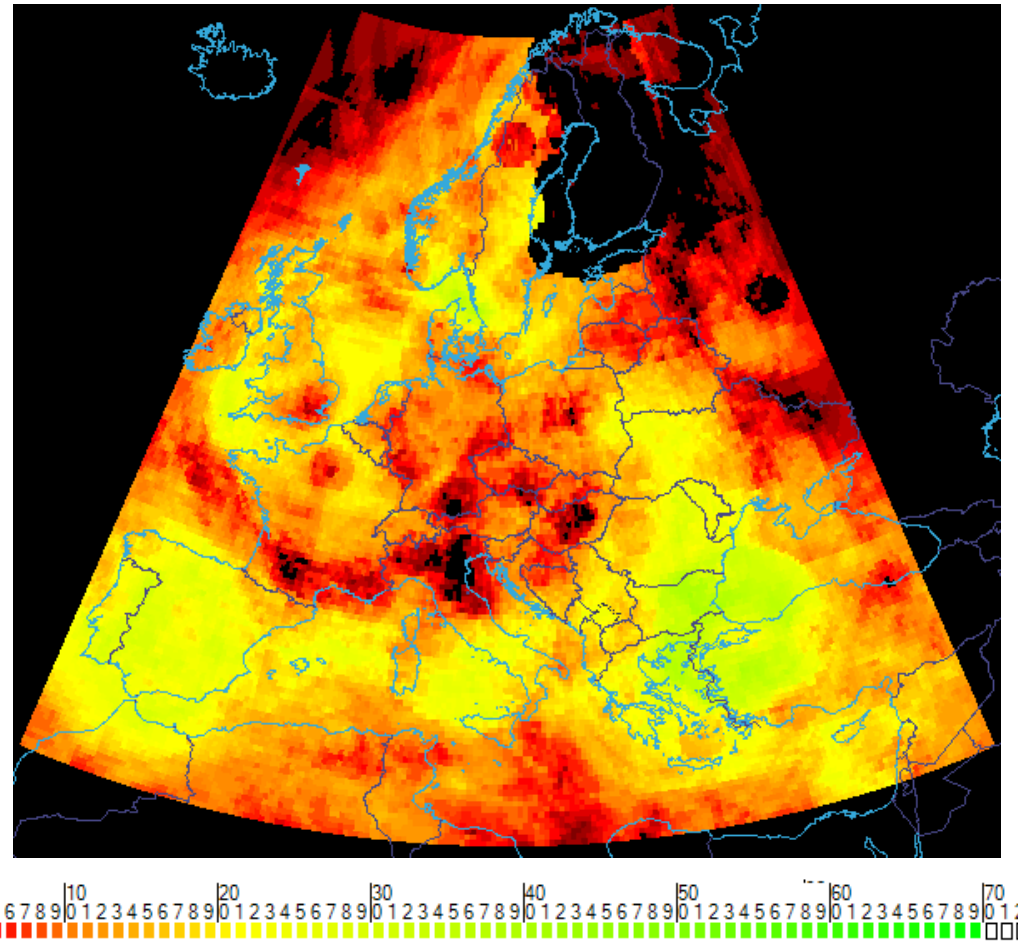
DME Spectrum Congestion & Evolution

Number of available En-Route DME channels
(Black = no channels available)



Evaluation of Channel Gain from various measures

Example: decoupling of VHF from UHF (no more pairing constraints)



ECAC DME Channel Distribution *(no optimization logic applied!)*