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Session 3: GNSS Integrity and Aviation

# DME/DME Navigation as an Aviation Alternative to GNSS in Alpine Area

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# Introduction conventional navigation vs. PBN

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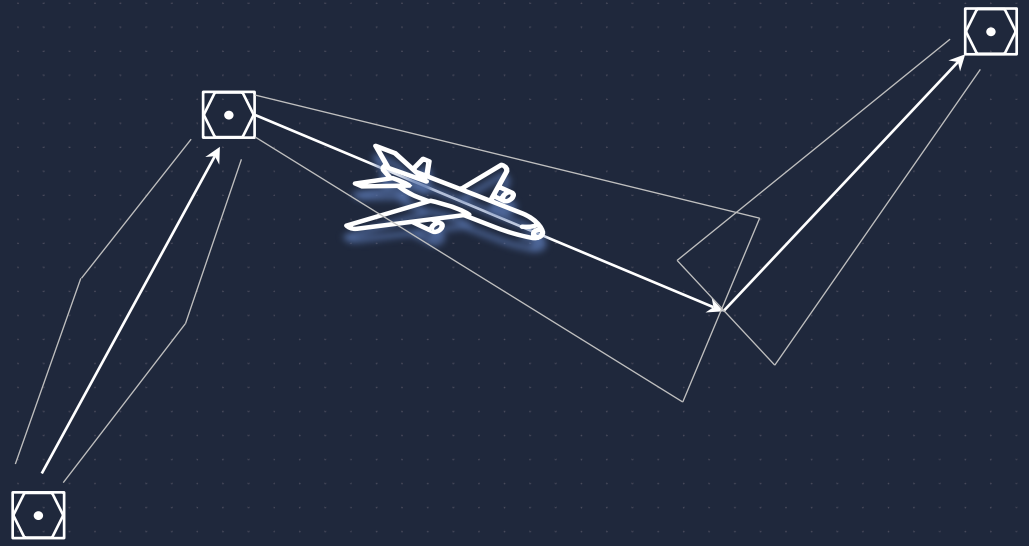
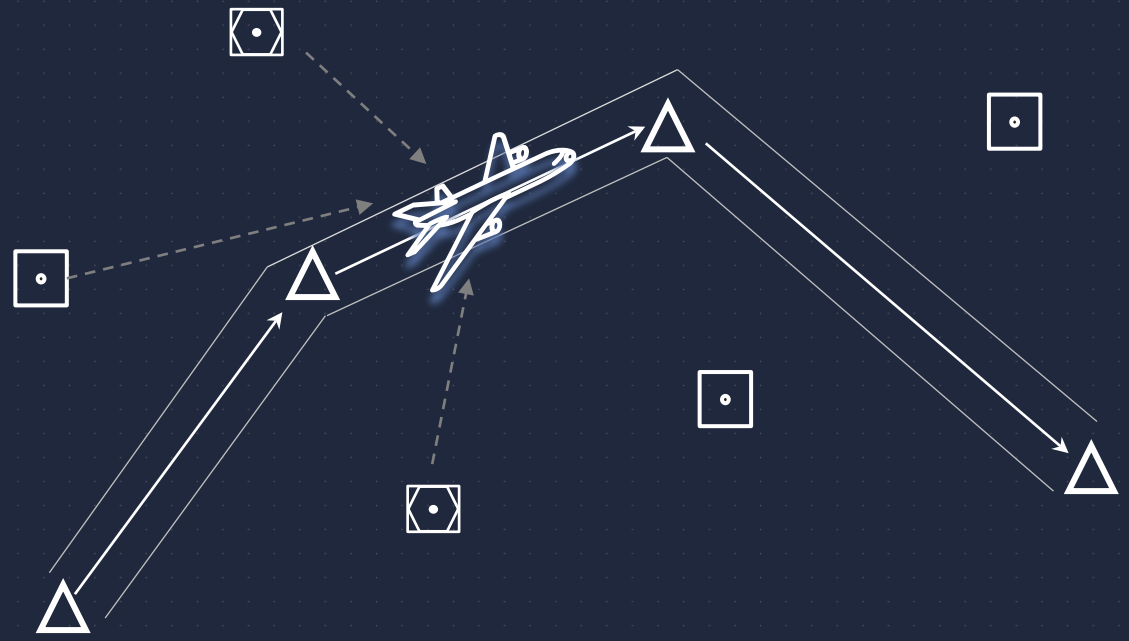


- conventional navigation
- based on dedicated ground navigation facilities



- performance-based navigation
- RNAV or RNP
- based on GNSS or suitable ground navigation facilities

# GNSS jamming vs. spoofing

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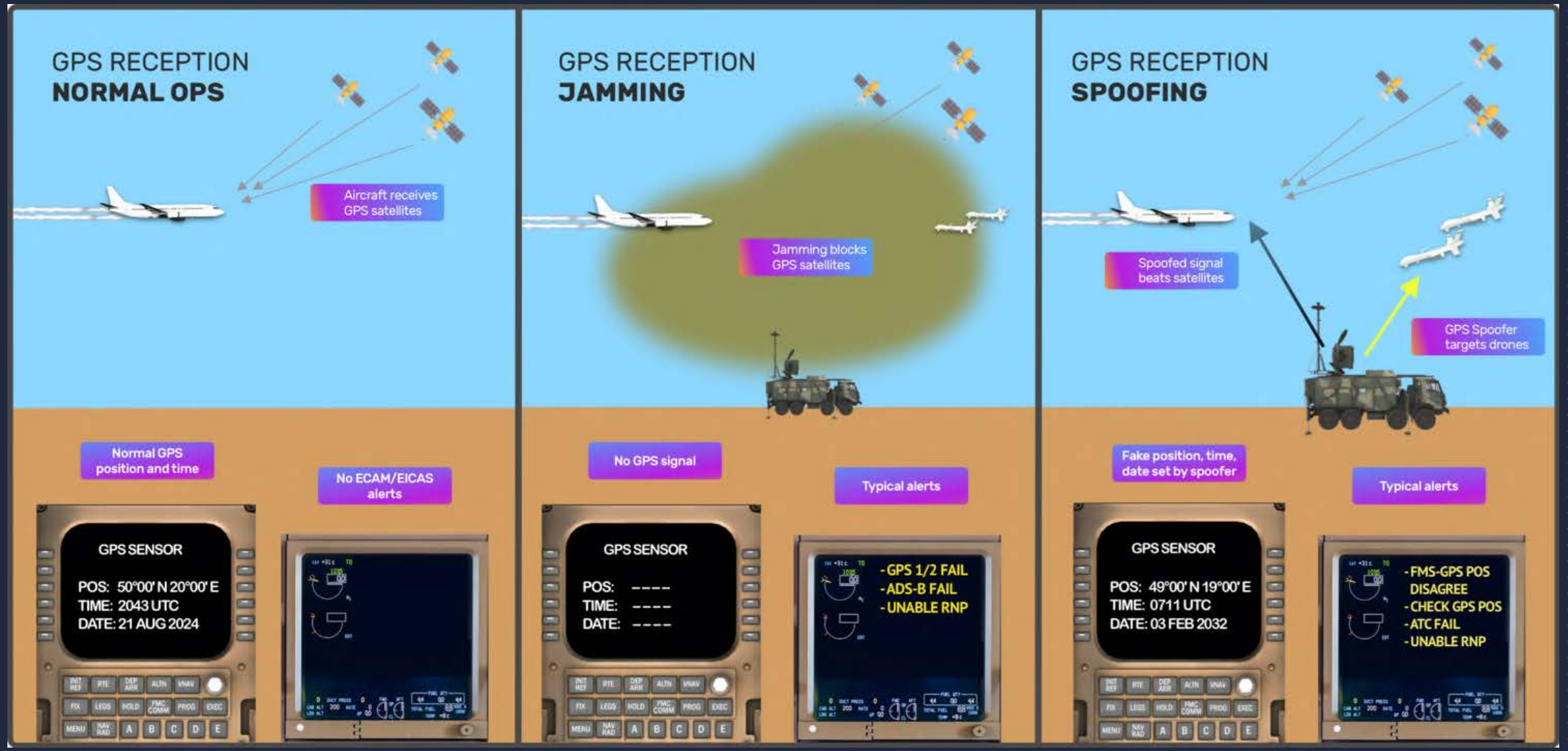
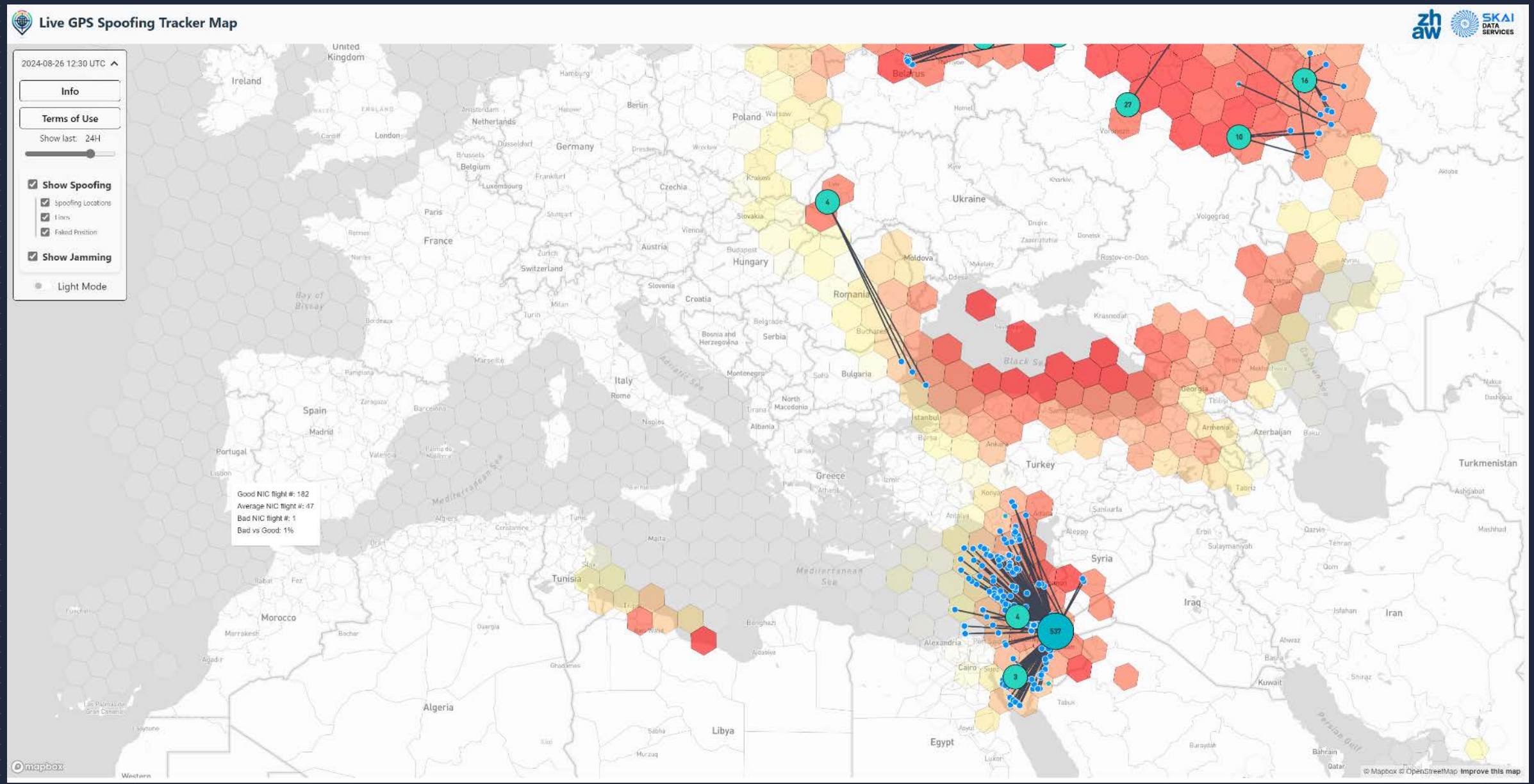



*Source: GPS Spoofing, Final Report, OPS Group, September 6, 2024*

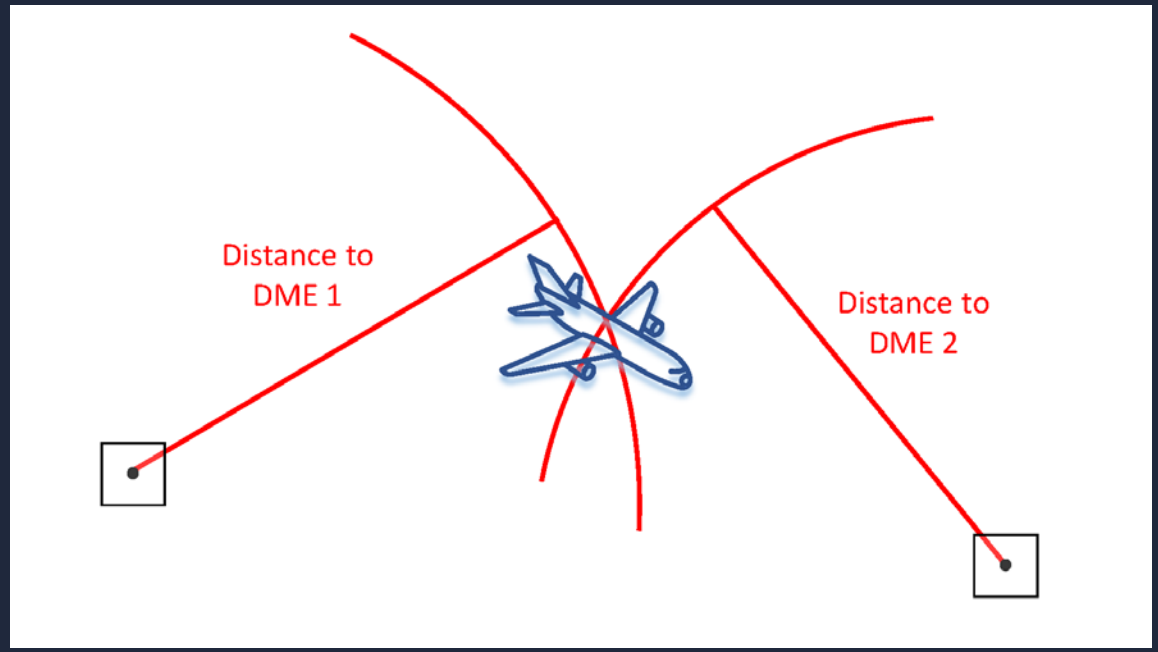




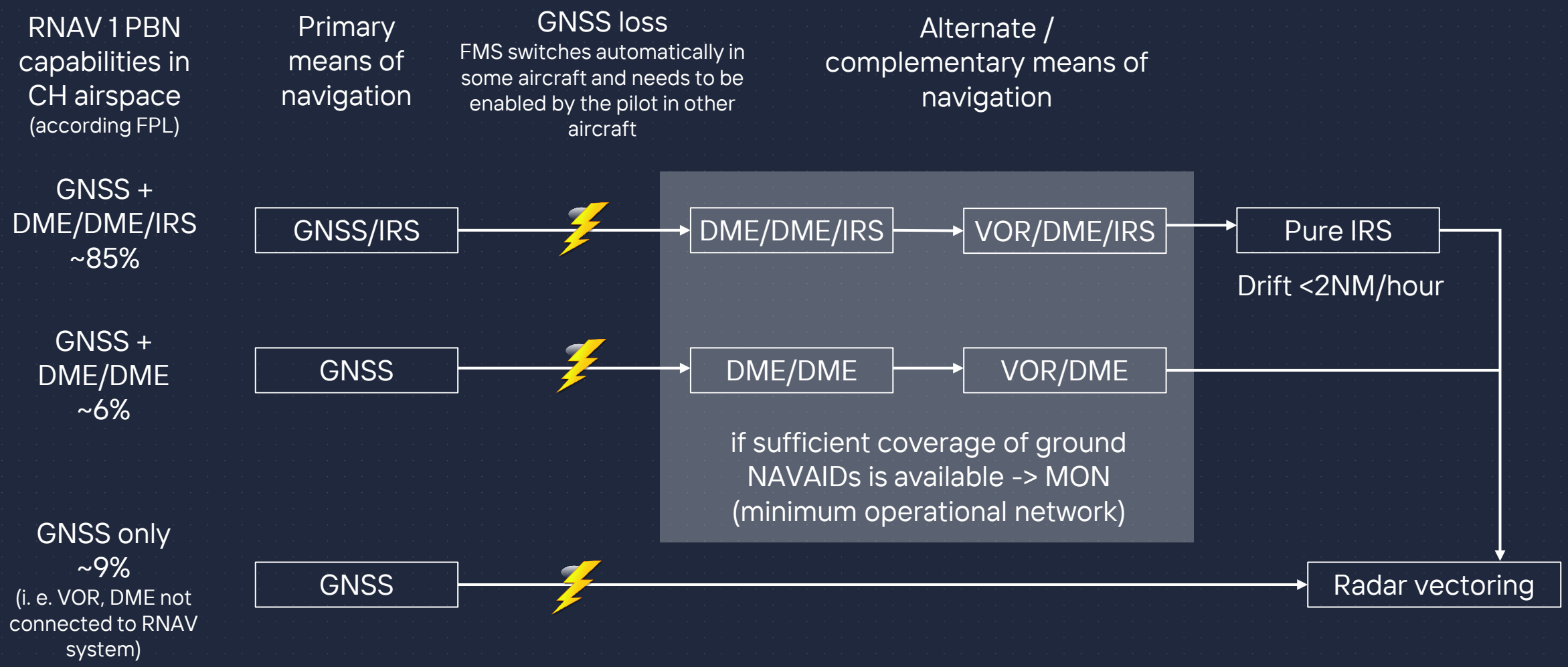

*Source: spoofing.skai-data-services.com*

DME network designed as Alternate Means of Navigation / Complementary Means of Navigation

- Redundancy available
- Same capacity for equipped aircraft
- Allows operation without need for 24h on-call service (Pikett)
- Coverage of international airports and en-route network



# GNSS loss – avionics reaction



# Navigation Facilities in Switzerland prior to PBN transition

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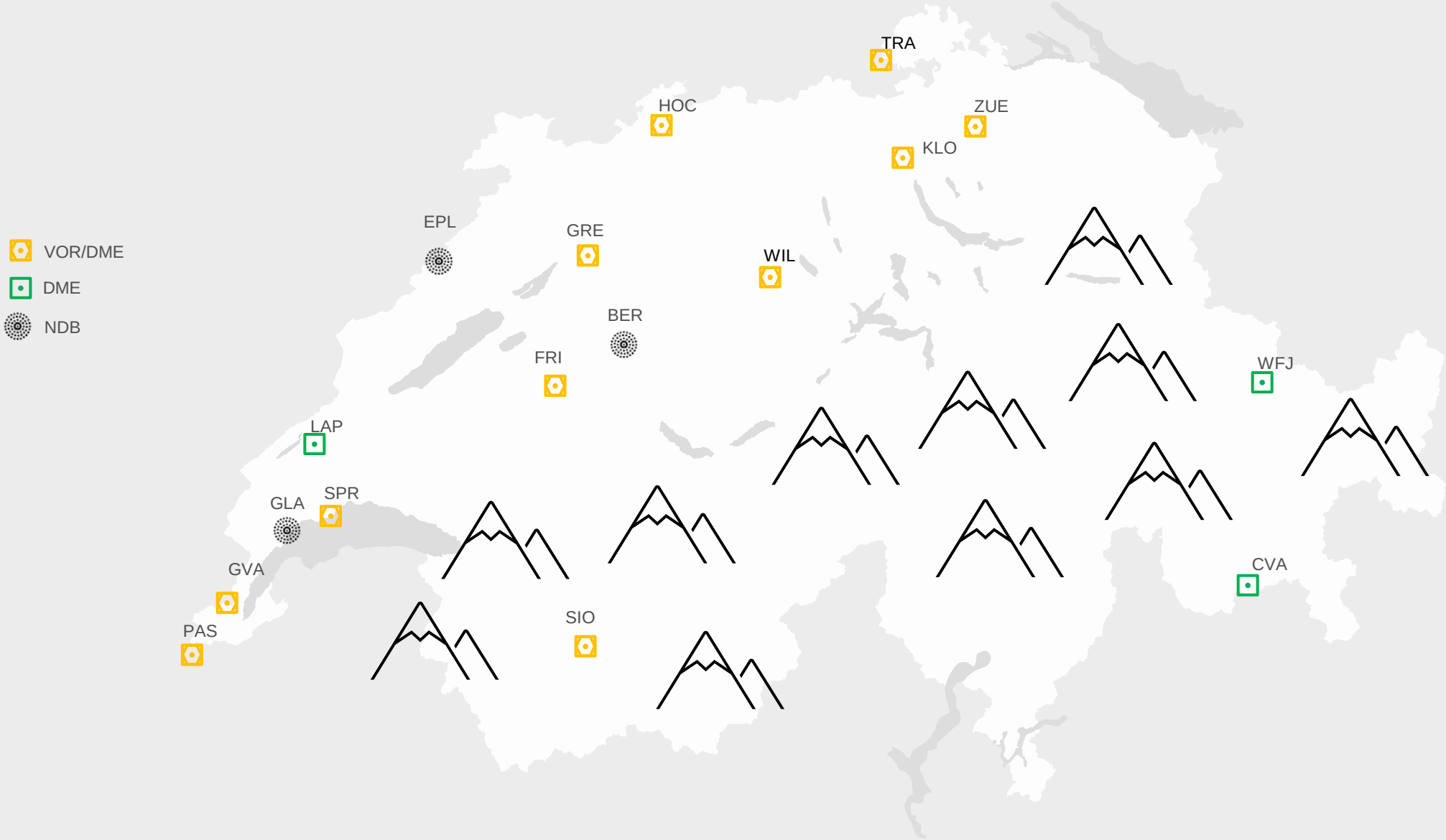

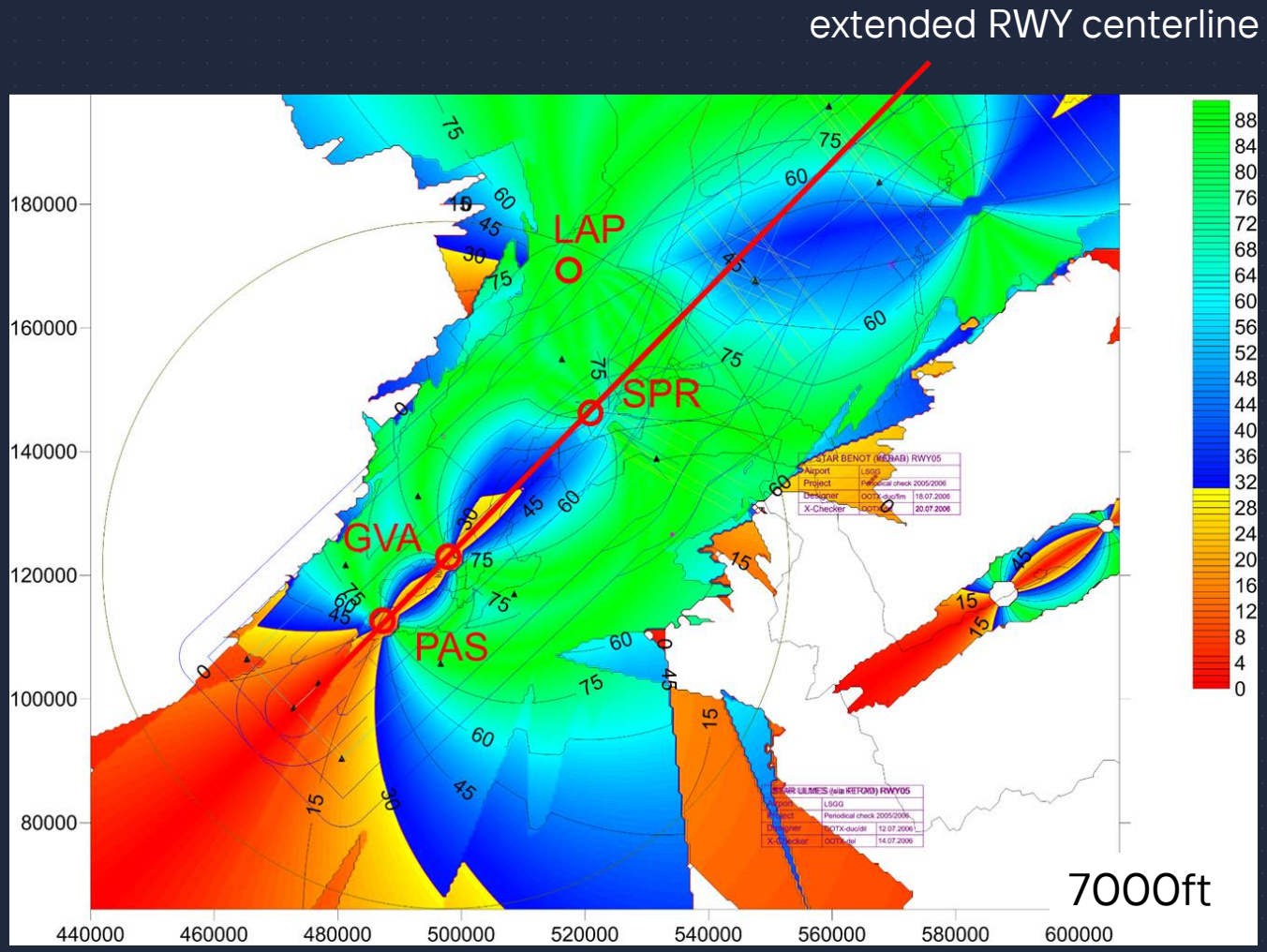


DME/DME coverage needs relocation of DME sites

## Assessment of new DME sites

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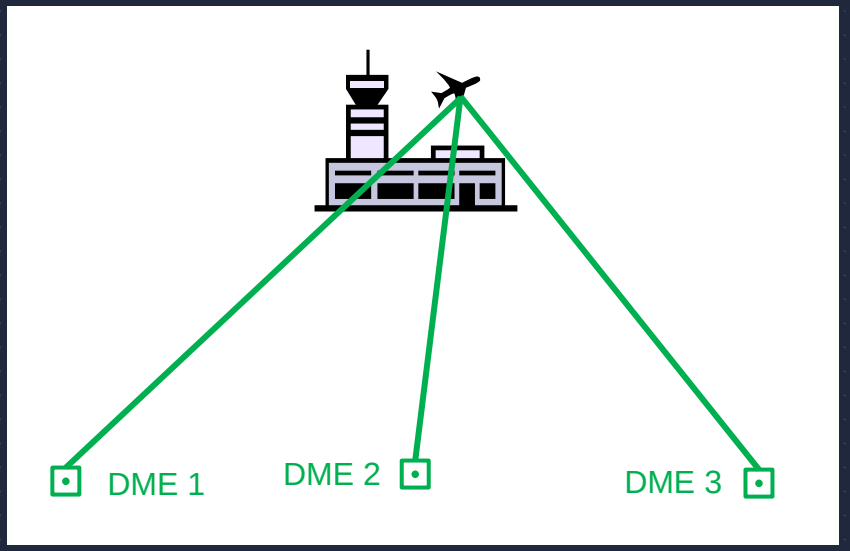
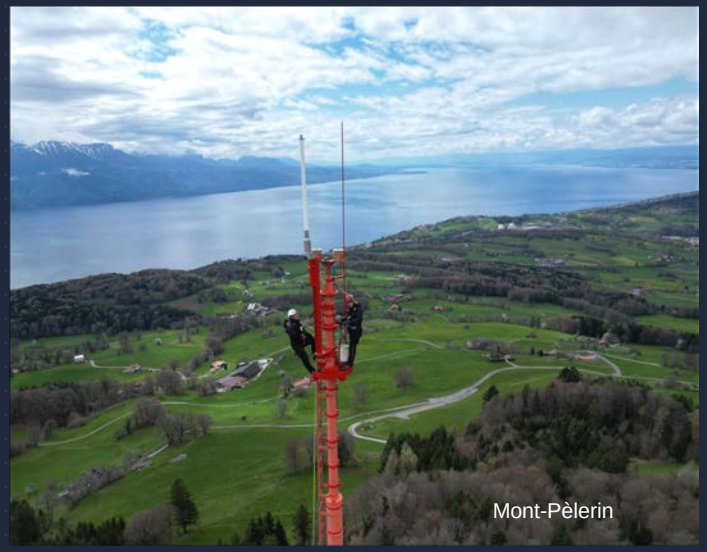
- Respecting geometry requirements (angles 30° - 150° as seen from the aircraft, distances 3 NM – 160 NM, initialization time 30 seconds) and redundancy need
- DME placement on top of mountains for visibility from DME to RWY and SID procedure
- Placement in the Swiss territory





Hoch-Ybrig


Mont-Pèlerin

# DME & VOR Network (in development)

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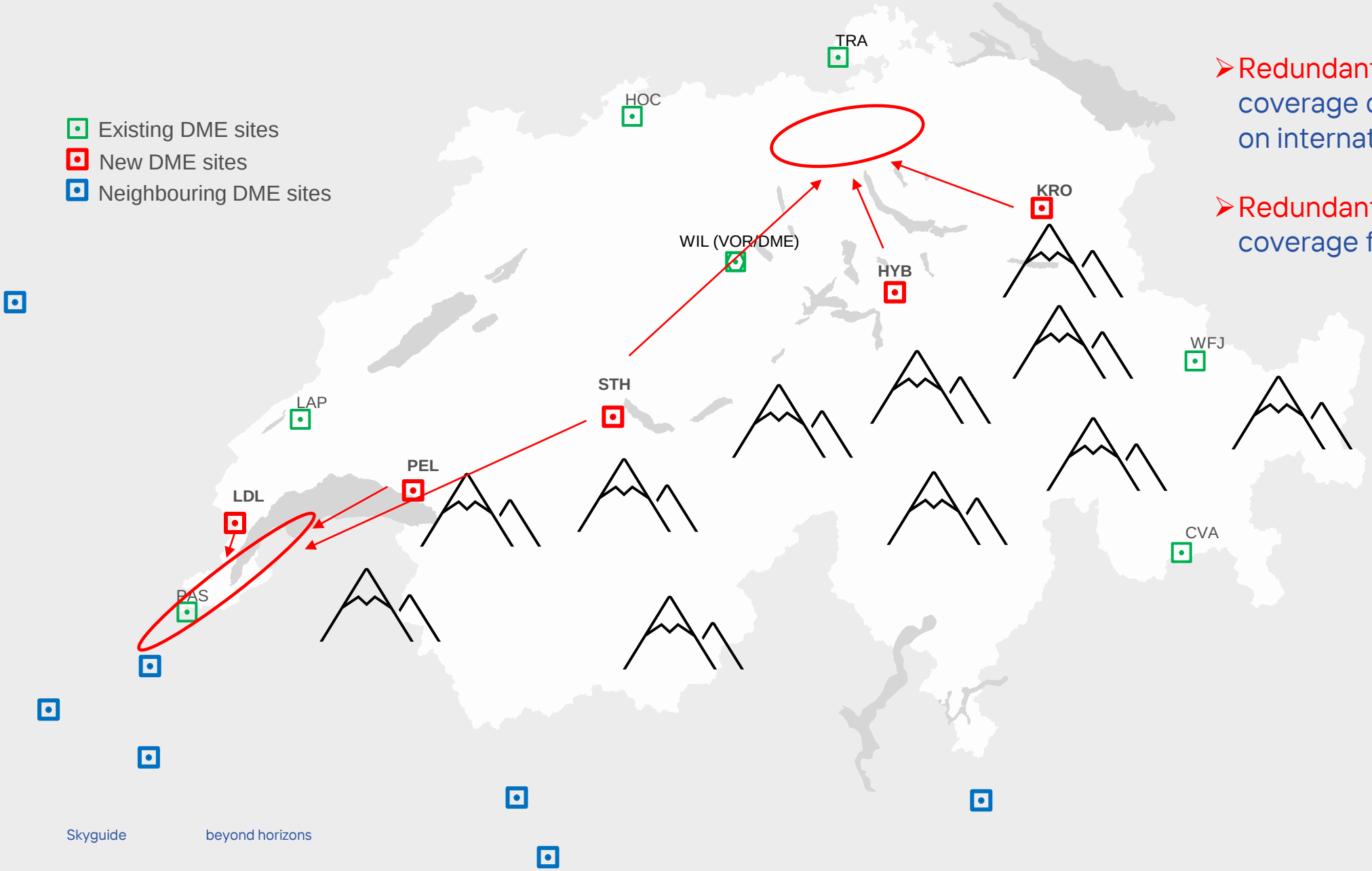
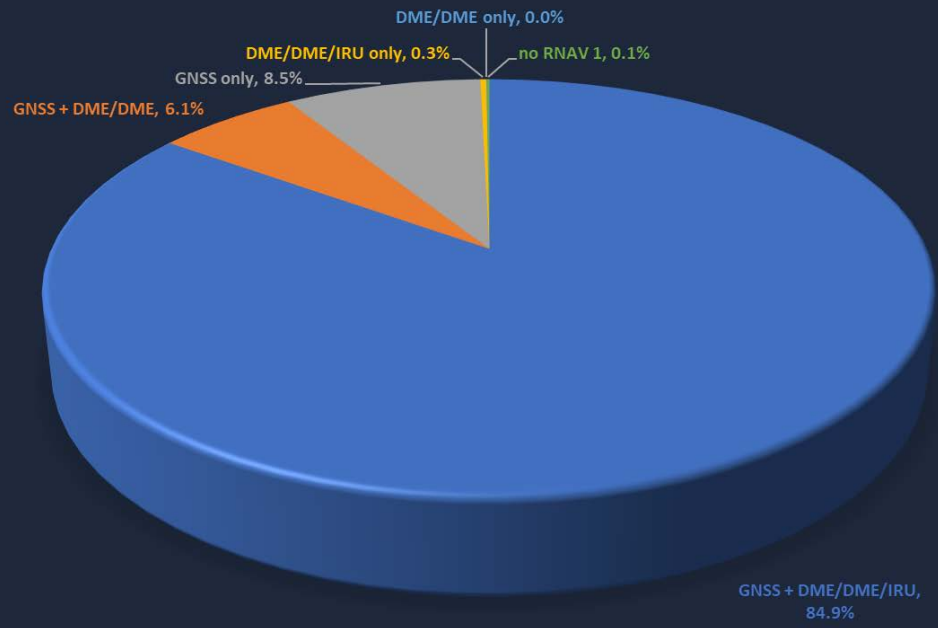



- Redundant DME/DME coverage down to the RWY on international airports
- Redundant DME/DME coverage for ATS routes

- >90% of aircraft DME/DME capable
- DME/DME navigation in case of GNSS jamming / unavailability
- DME/DME navigation partly possible in case of GNSS spoofing
- Radar vectoring in case DME/DME navigation not possible



- DME network with stations on top of mountains allow appropriate coverage in the Swiss airspace
- DME/DME navigation is a robust alternative in case of GNSS unavailability (e.g. jamming and partially spoofing)
- Radar vectoring available as alternative in case DME/DME navigation not possible
- But: Non-navigation effects of GNSS jamming/spoofing cannot be mitigated with the DME network

Short-term strategy
- Procedures for entering/leaving jammed/spoofed areas
- Switching off terrain warnings

Mid-term strategy
- Interference zone identification
- Restoring GNSS after interference
- TAWS improvements
- IRS robustness

Long-term strategy
- Signal authentication
- Beam-forming GNSS antennas (CRPA: Controlled Reception Pattern Antennas)

# Thank you for your attention