

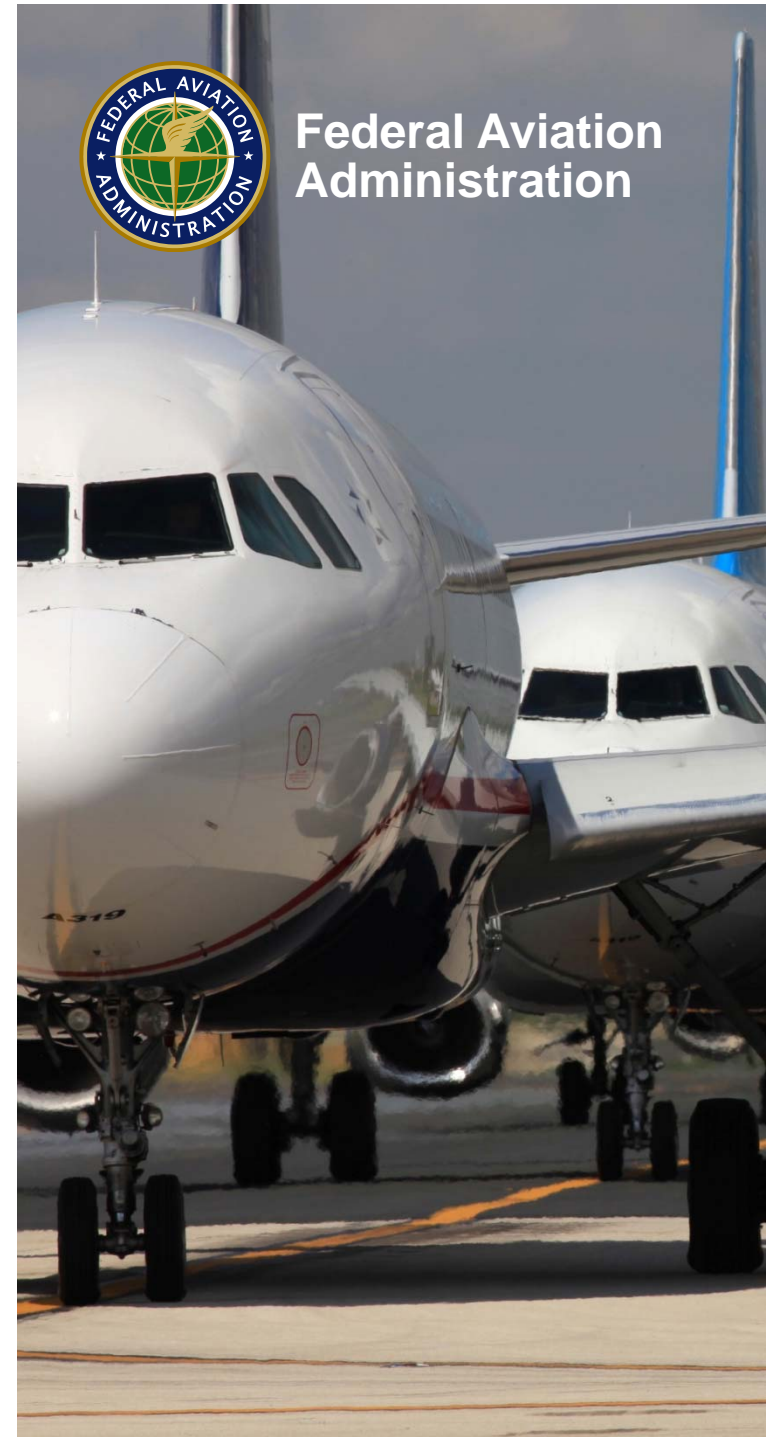
Work As Never Imagined

A Case Study on Flight Deck Displays for New Airspace Operations

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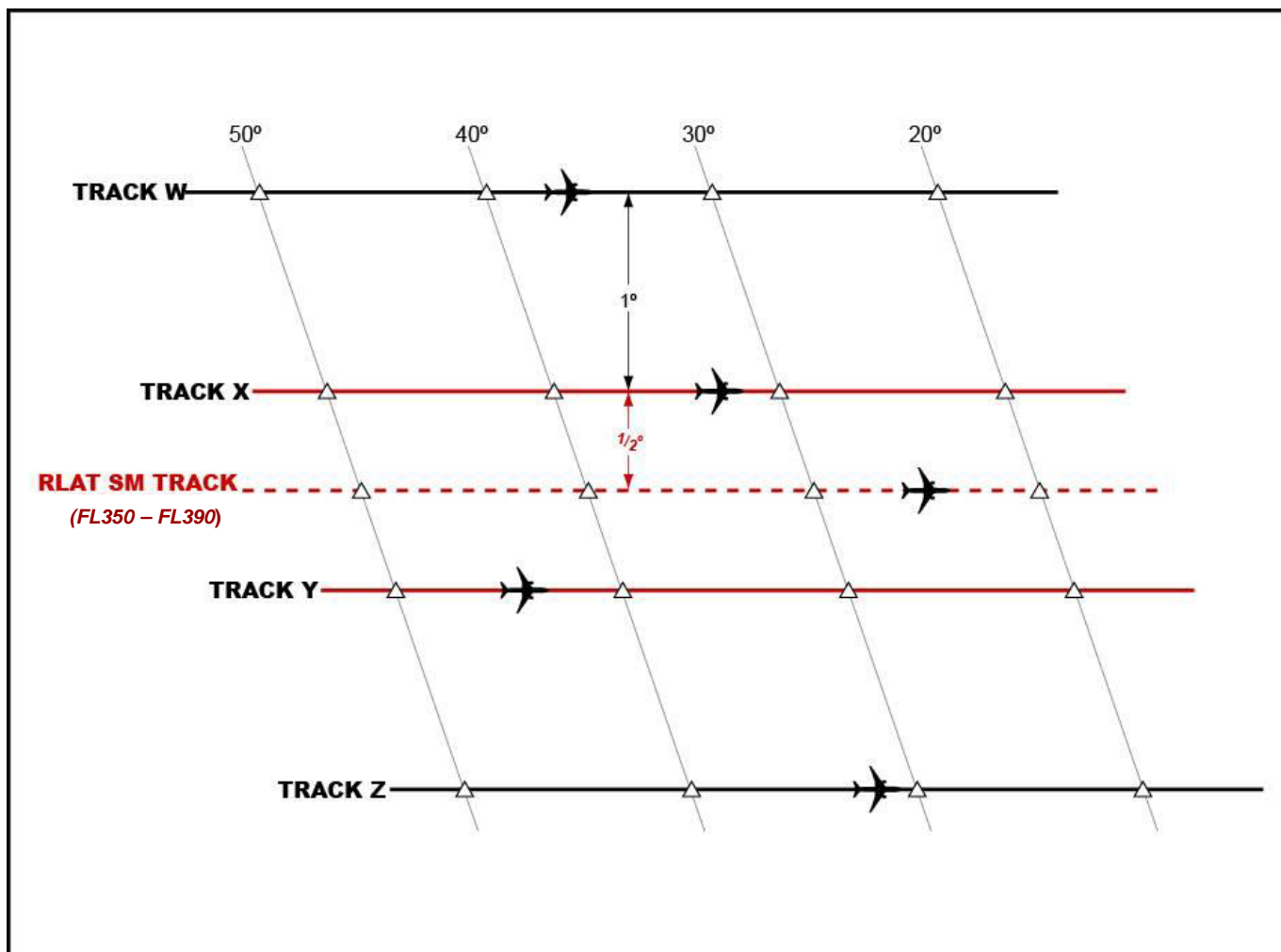


Background

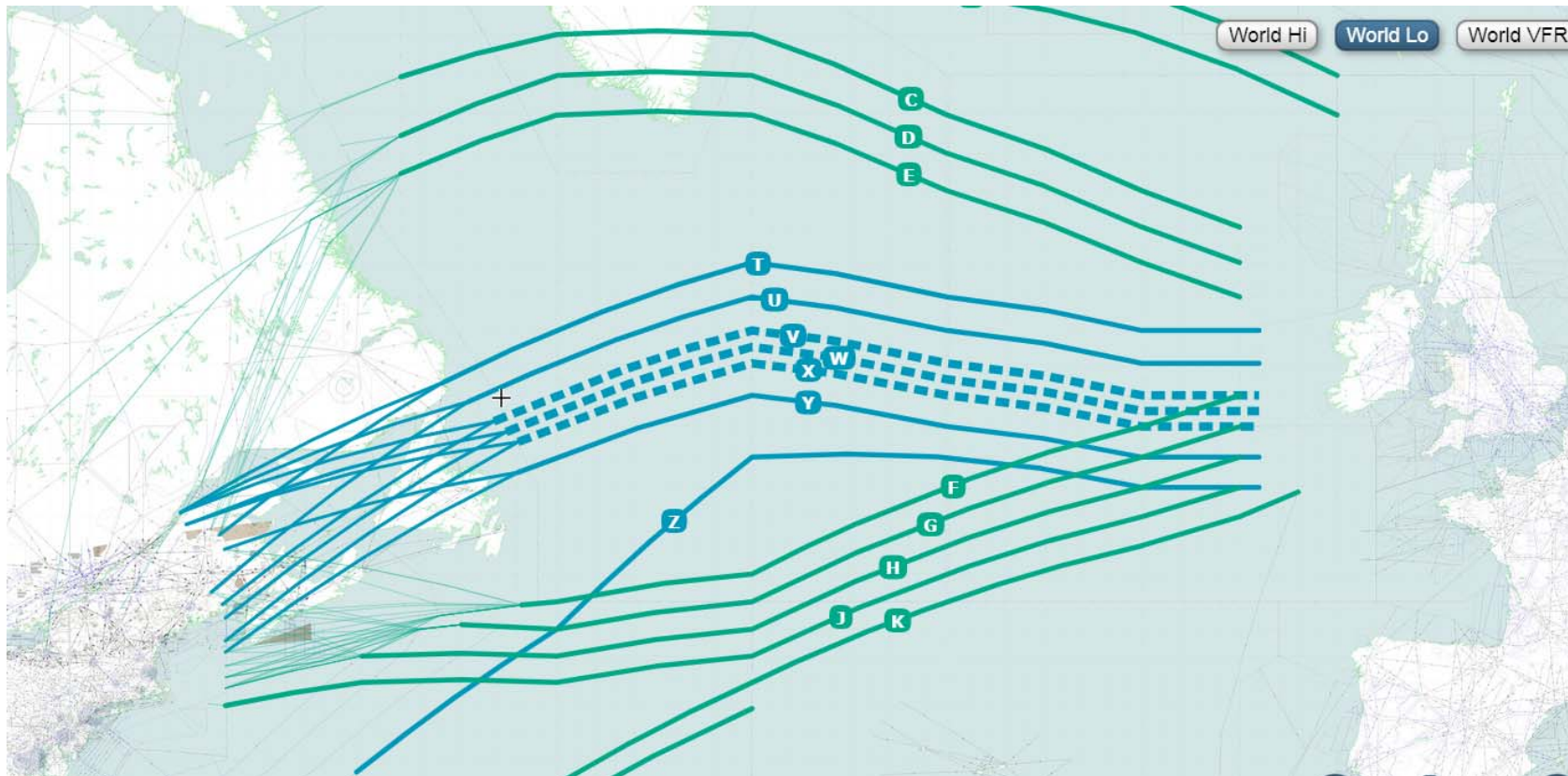
- On average, an aircraft is operable for about 30 years before it has to be retired
- The avionics for many aircraft were designed before some of the current operations were known
- Case study: half-degree waypoints in North Atlantic Track System



RLatSM Phase 1



The NAT Tracks



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Topics, Ambiguous Displays

- **Pilot Prefix/Suffix Confusion**
 - letter N/E/S/W placement in 424 para 7.2.5 5-character identifiers can be misconstrued (N in front or N in back)
- **Truncation/ Rounding**
 - full Latitude and Longitude entries are truncated or rounded to 7-characters, producing ambiguous displays (whole and half degree inputs are displayed the same)
- **Generic Display Names**
 - full Latitude and Longitude entries are given *LL01 or similar generic display names

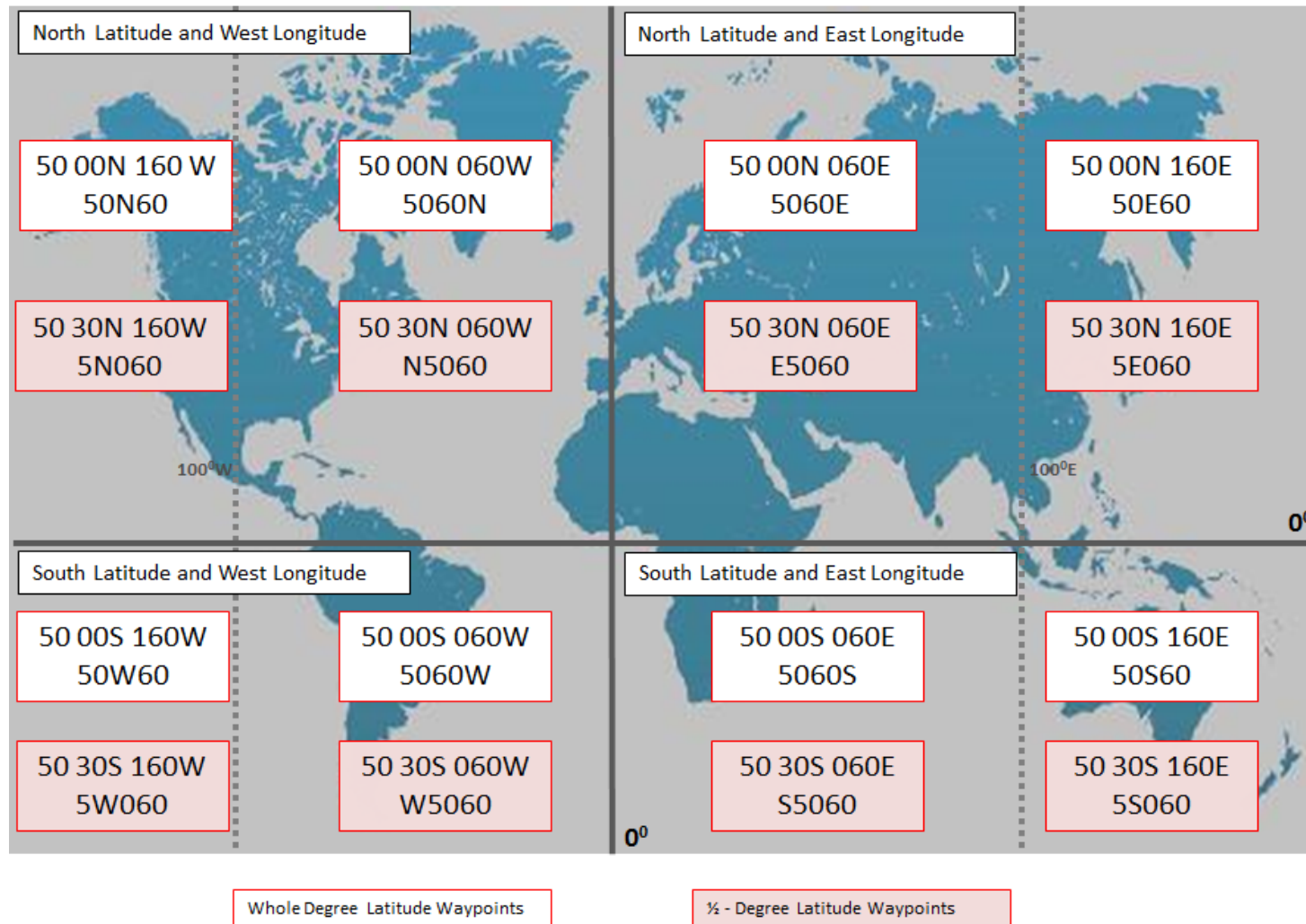


ARINC 424 paragraph 7.2.5 – Oceanic Waypoints

- **ARINC 424 (7.2.5) naming convention for undesignated oceanic waypoints uses the placement of the letter N/E/S/W to identify world quadrant and whether the waypoint is a whole degree or half degree latitude**
 - New half degree of latitude tracks in NAT:
 - 5040N = 50.00N 040.00W (whole degree of latitude)
 - N5040 = 50.30N 040.00W (half degree of latitude)
 - World quadrants have similar human factor issues where prefix/suffix determines whole vs half degree:
 - North Lat/West Long, North Lat/East Long, South Lat/West Long, South Lat/East Long



ARINC 424 – Oceanic Waypoints



Truncation of minutes



Figure 1

FMC Display: Half-Degree Waypoint Latitude and Longitude (13 Characters) Inserted Into FMC

- 50 degrees-30 minutes North latitude, 20 degrees West longitude inserted into the FMC using full latitude and longitude degrees and minutes (i.e., 13 characters)
- The waypoint IDENT is truncated to 7 characters.



Truncation of minutes (cont.)

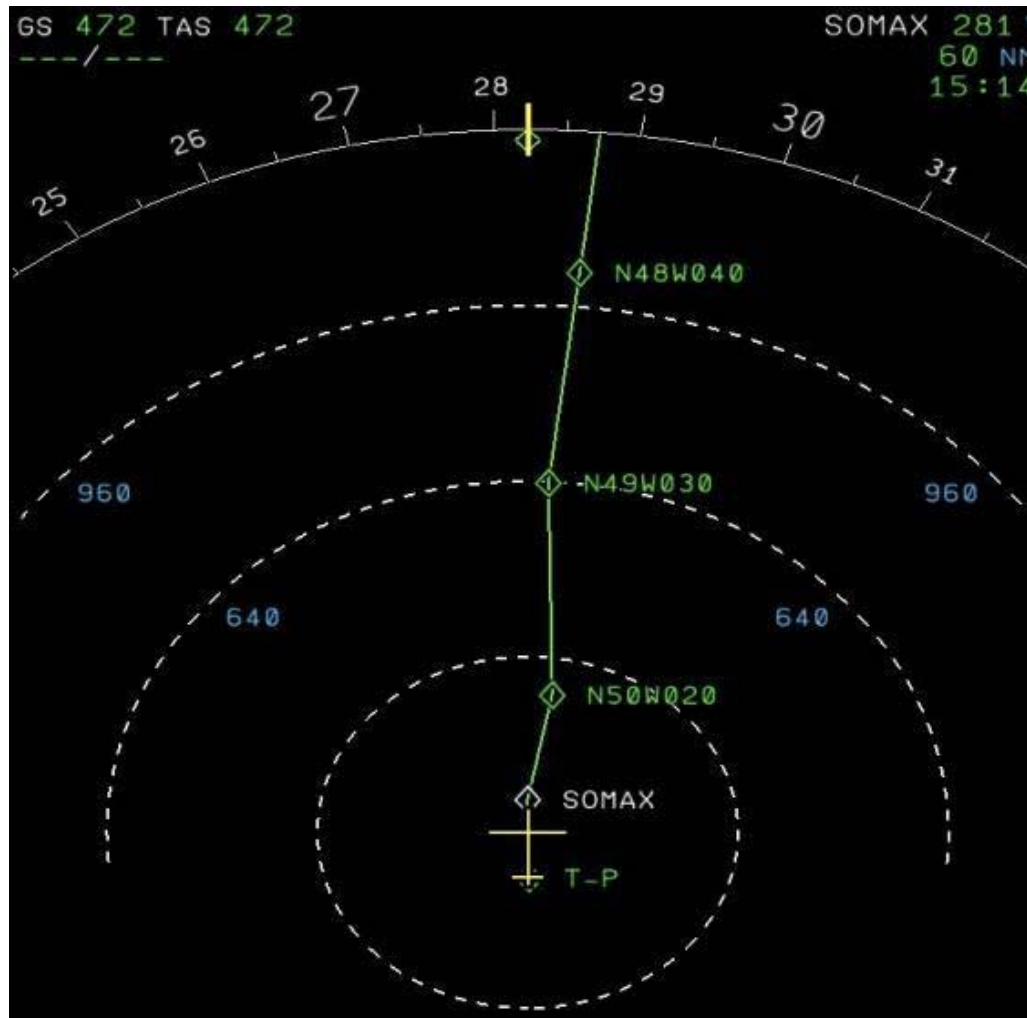


Figure 2

Map Display: Full Waypoint Latitude and Longitude (13 Characters Inserted into FMC)

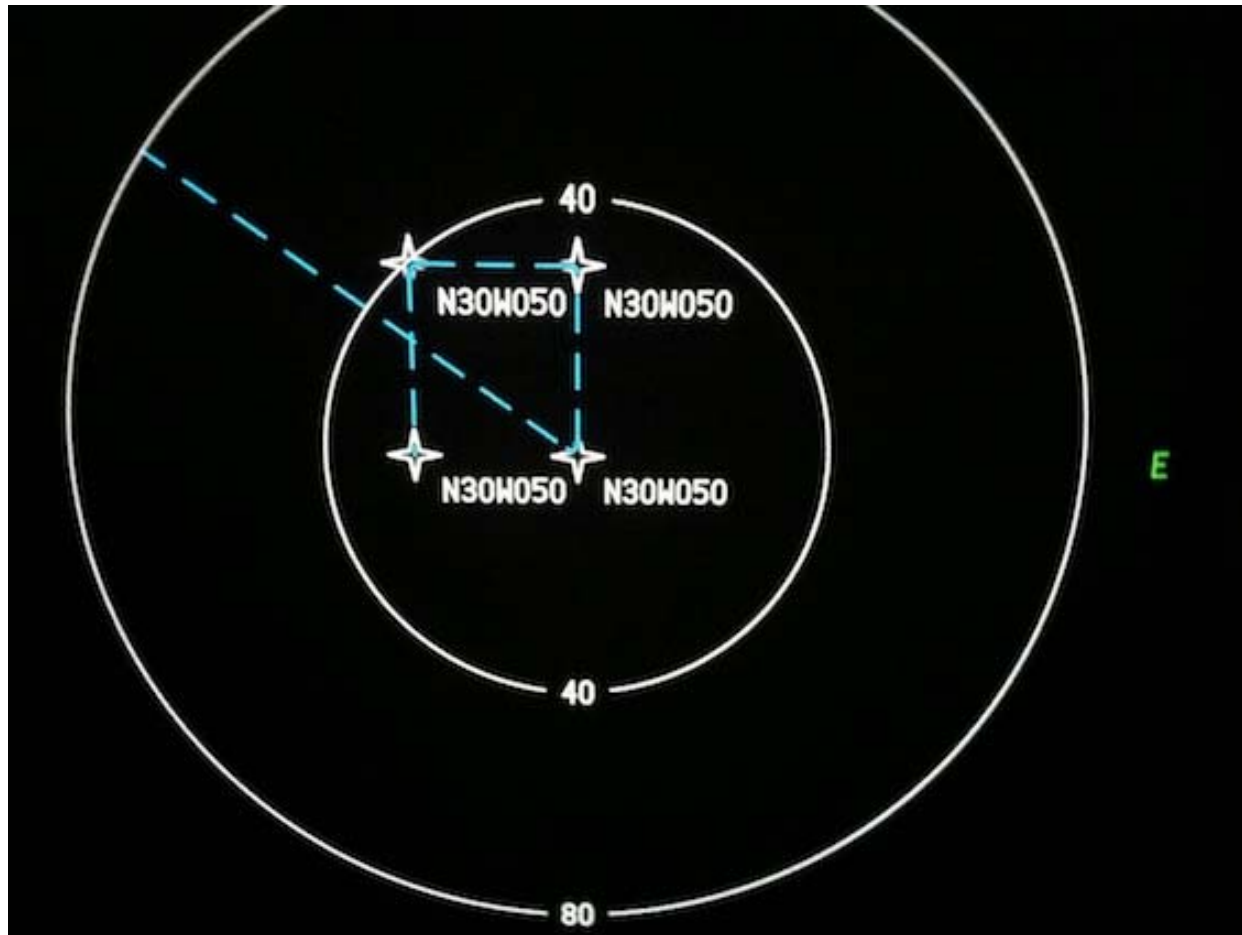
- 50 degrees-30 minutes North, 20 degrees West displayed is displayed in 7 characters.
- Minutes of latitude are not displayed.
- The Map display would be the same for 50 degrees North, 20 degrees West

NOTE:

- Truncated ½ degree waypoint names are ambiguous.



7-Character Display Ambiguity



Generic display (here, *LL01)



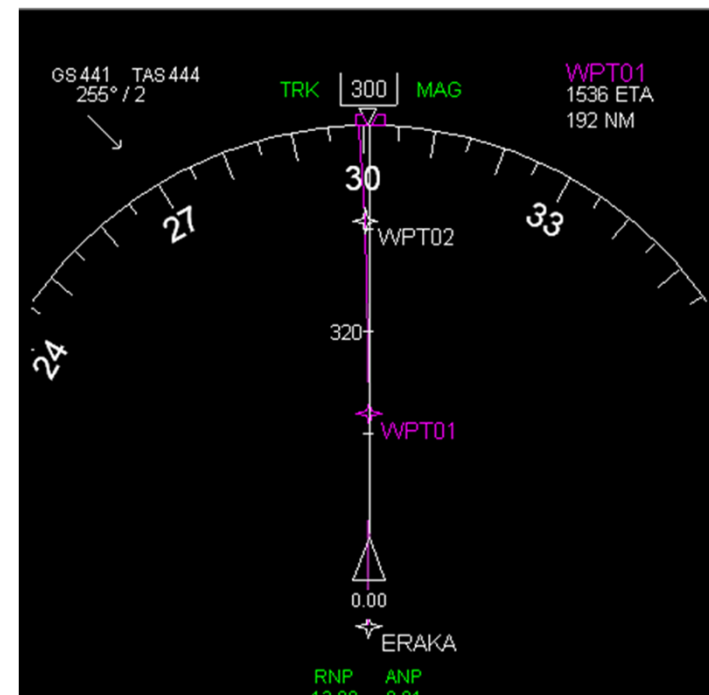
Display Ambiguity Due to Generic Naming: “WPTxx”

- Lat/Lon Waypoints entered into the FMS using lat/lon format
- However, waypoints displayed as FMS renamed waypoints in the MCDU and on the map

Route:

- ERAKA
- N60W020
- N61W030
- N61W040
- N61W050
- URTAK

```
ACT RTE LEGS 1/2
302° 292NM
WPT01 .772/FL360
300° 301NM
WPT02 .771/FL360
295° 291NM
WPT03 .769/FL360
299° 291NM
WPT04 .768/FL360
270° 286NM
URTAKE .767/FL360
RNP/ACTUAL-----
2.00/0.10NM RTE DATA>
```



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This is a Reality

- **Pilots and controllers are expected to adapt to new operations**
- **Equipment was not designed with all these new operations in mind**
- **How do we mitigate risk?**



Risk Mitigations

(in decreasing order of effectiveness)

- 
- Eliminate hazard
 - Alter design
 - Incorporate engineered features or safety devices
 - Provide warning devices
 - Incorporate signage, procedures, training

Decreasing effectiveness

Source: MIL-STD-882E System Safety Handbook



How do we handle work as never imagined?

- **Aviation is all about change**
- **Equipment design cannot anticipate all possible future operations**
- **Design for flexibility:**
 - Equipment
 - Procedures, especially to catch the “gotchas”
 - Training for the new ops
- **Monitor operational data**
- **Multiple checks and balances**

