

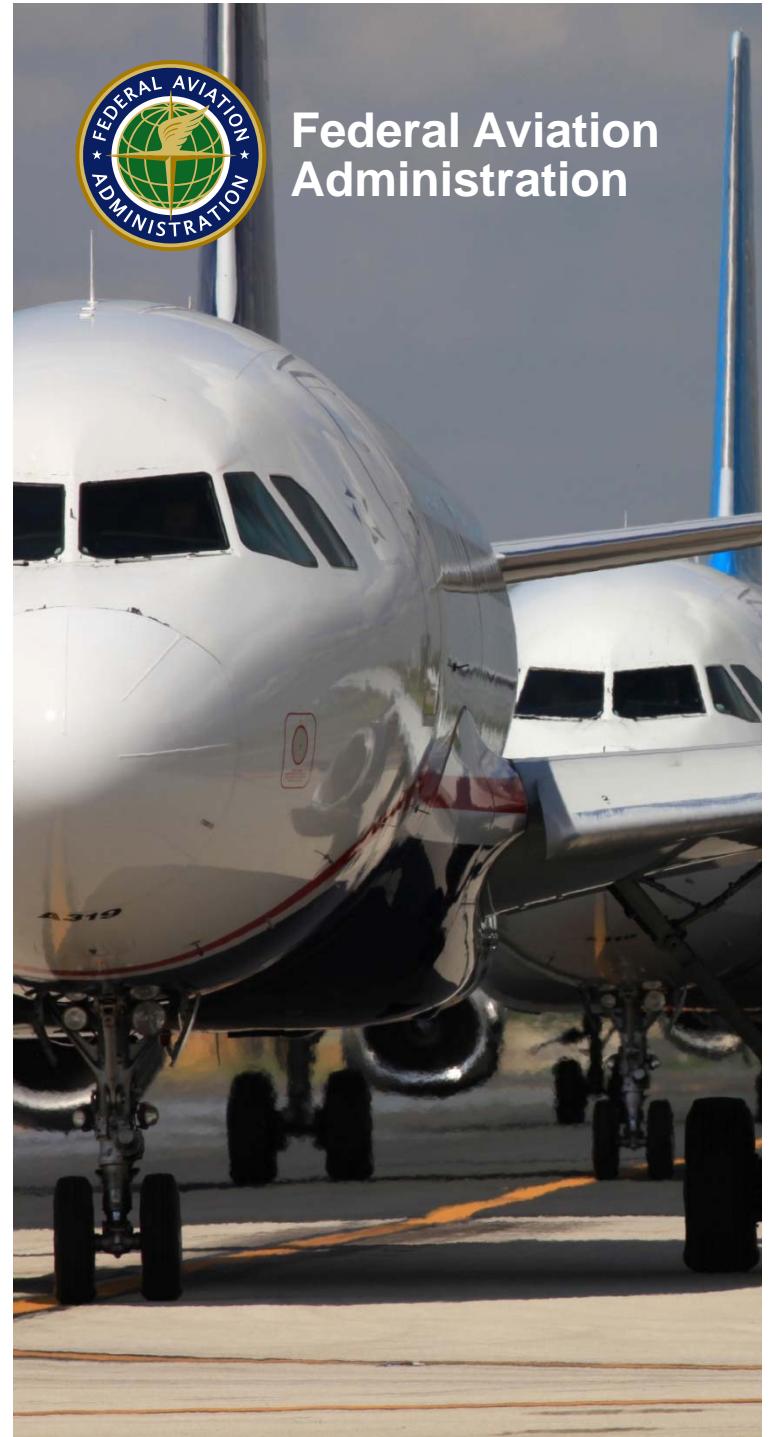
# Work As Never Imagined

## *A Case Study on Flight Deck Displays for New Airspace Operations*

Kathy H Abbott, PhD, FRAeS

Federal Aviation Administration

30 May 2017

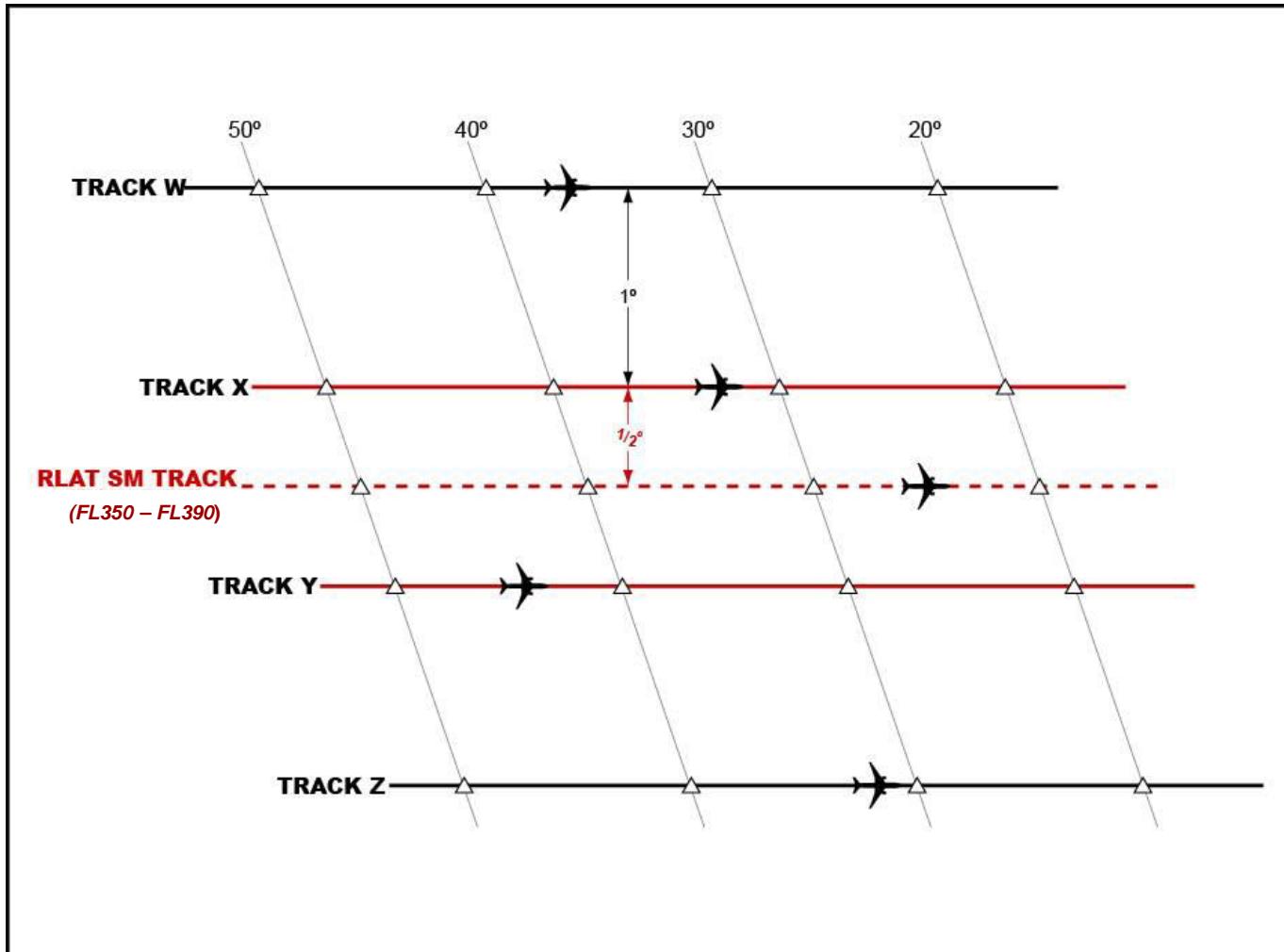


# Background

- 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



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# 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

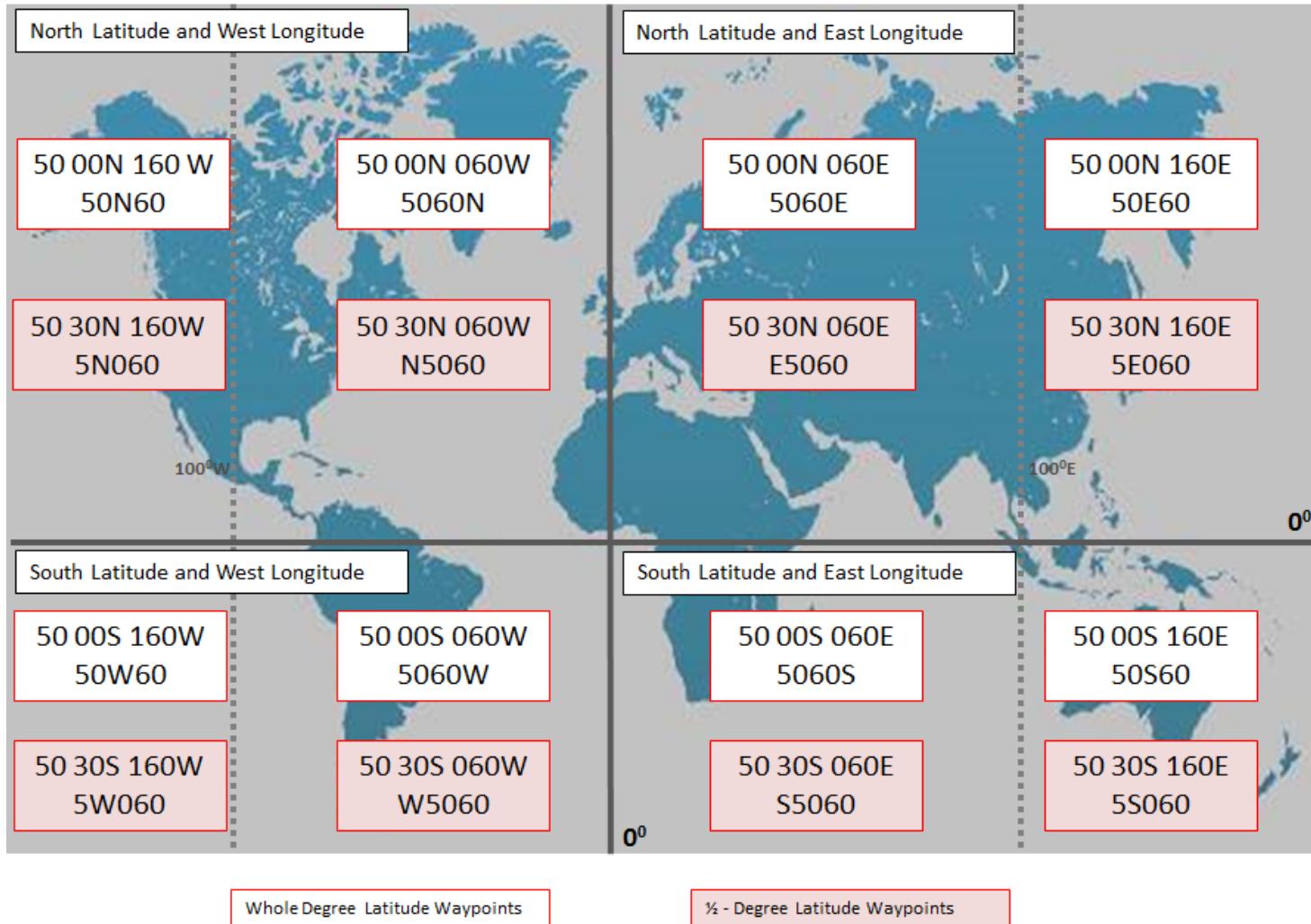


# ARINC 424 paragraph 7.2.5 – Oceanic Waypoints

- ARINC 424 (7.2.5) naming convention for undesignedated 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



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# Truncation of minutes



**Figure 1**

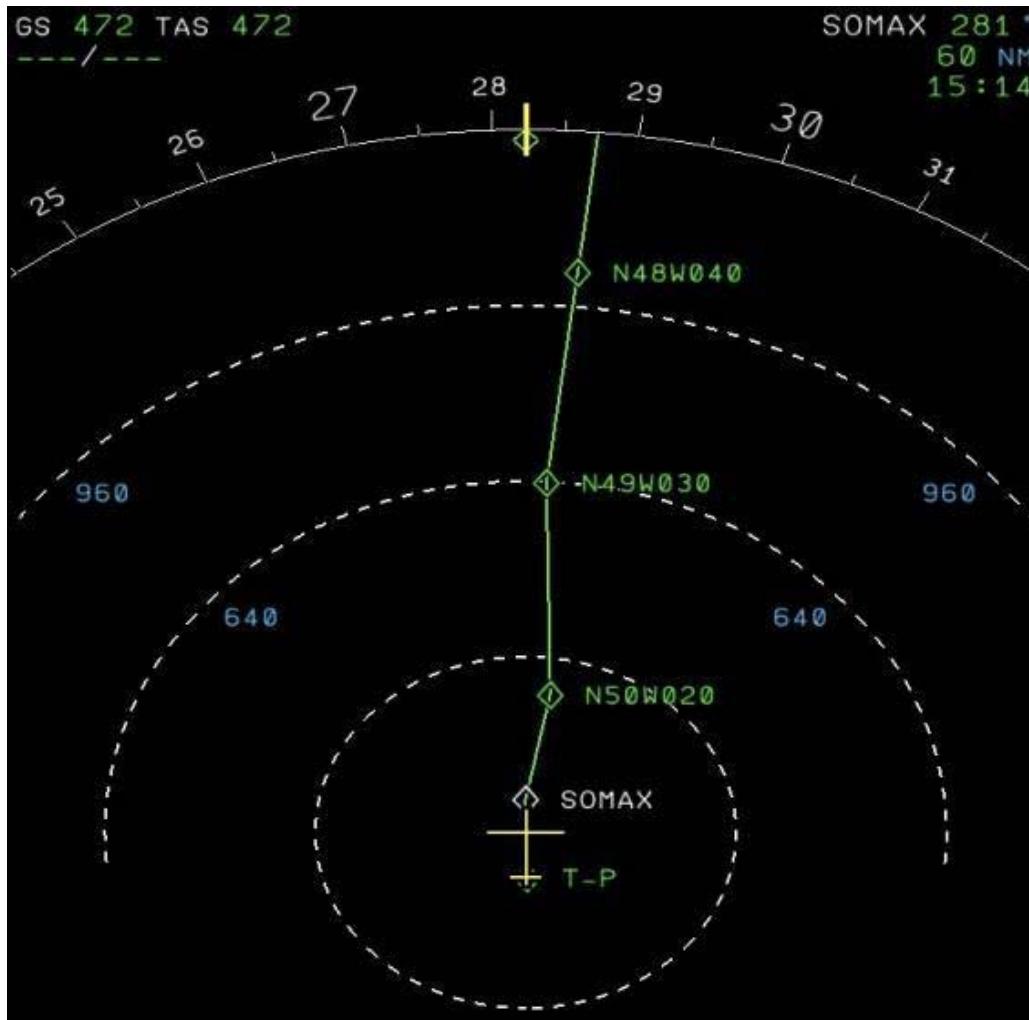
**FMC Display: Half-Degree Waypoint Latitude and Longitude (13 Characters) Inserted Into FMC**

- 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.



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# Truncation of minutes (cont.)



**Figure 2**

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

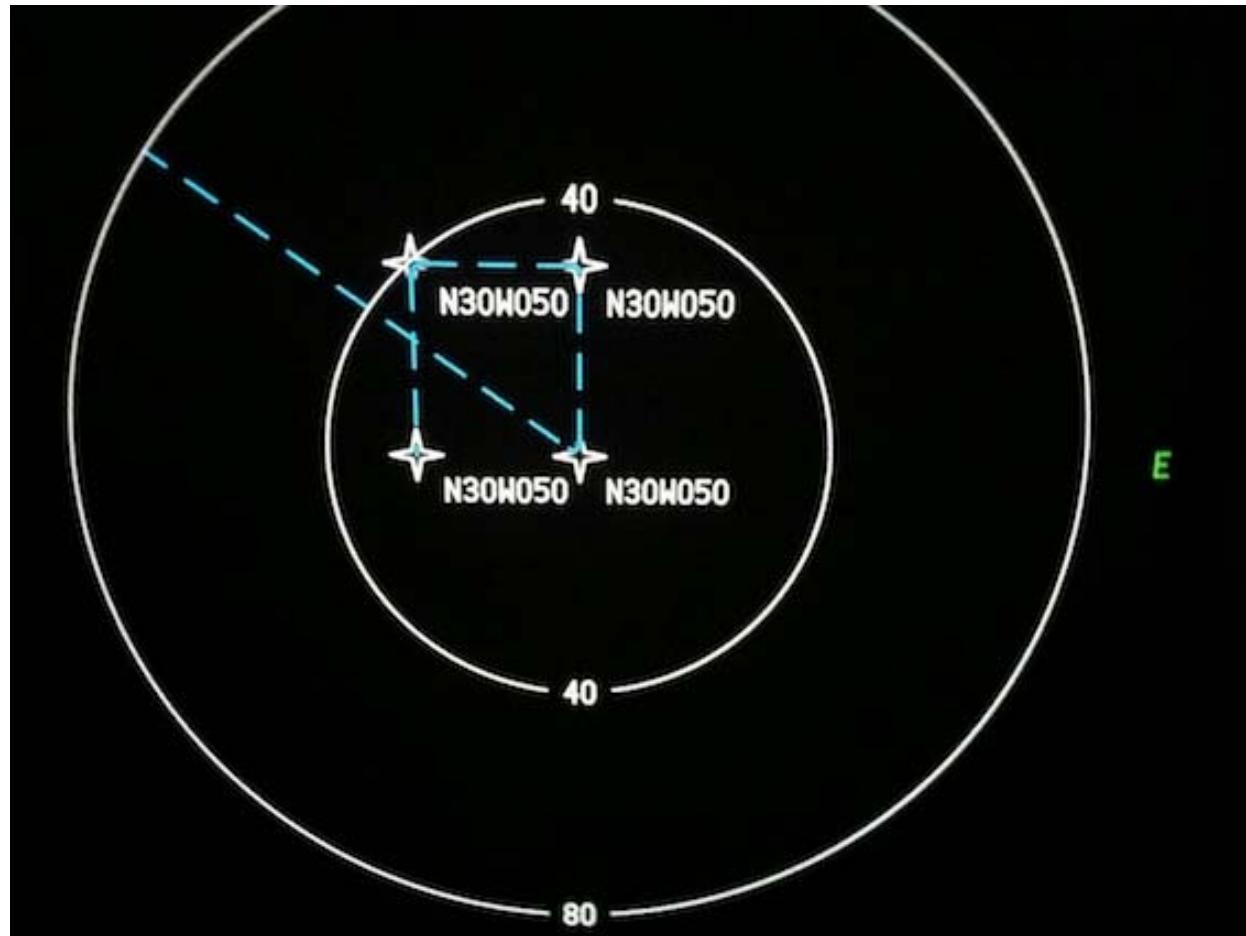
- 50 degrees-30 minutes North, 20 degrees West displayed is displayed in 7 characters.
- Minutes of latitude are not displayed.
- The Map display would be the same for 50 degrees North, 20 degrees West

**NOTE:**

- **Truncated  $\frac{1}{2}$  degree waypoint names are ambiguous.**



# 7-Character Display Ambiguity



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# Generic display (here, \*LL01)



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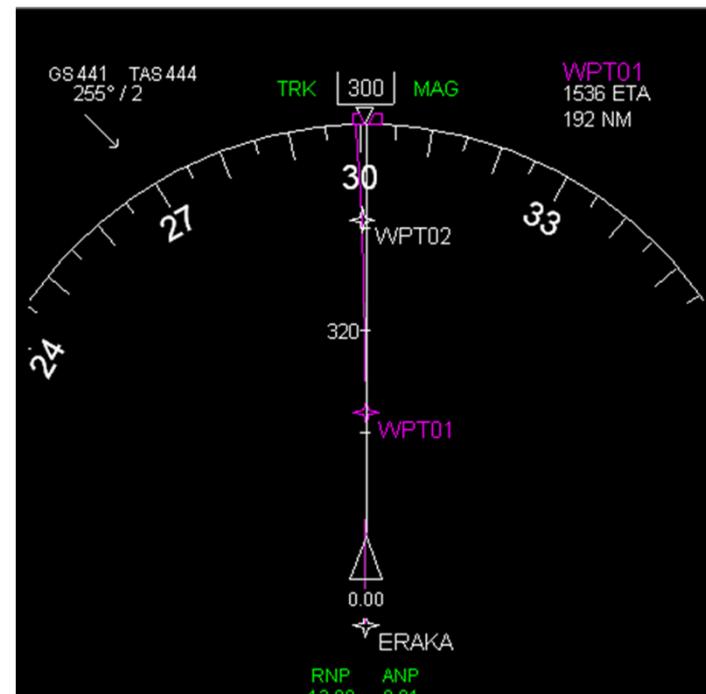
# Display Ambiguity Due to Generic Naming: “WPTxx”

- 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°		292 NM	
WPT01		.772 / FL360	
300°		301 NM	
WPT02		.771 / FL360	
295°		291 NM	
WPT03		.769 / FL360	
299°		291 NM	
WPT04		.768 / FL360	
270°		286 NM	
URTAK		.767 / FL360	
RNP / ACTUAL -----			
2.00 / 0.10 NM	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**

