



# Impact of DME on UAT

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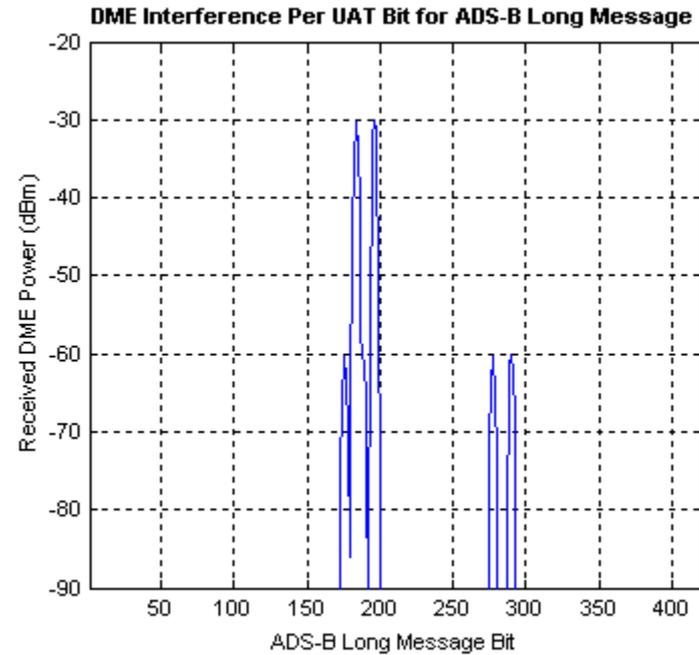
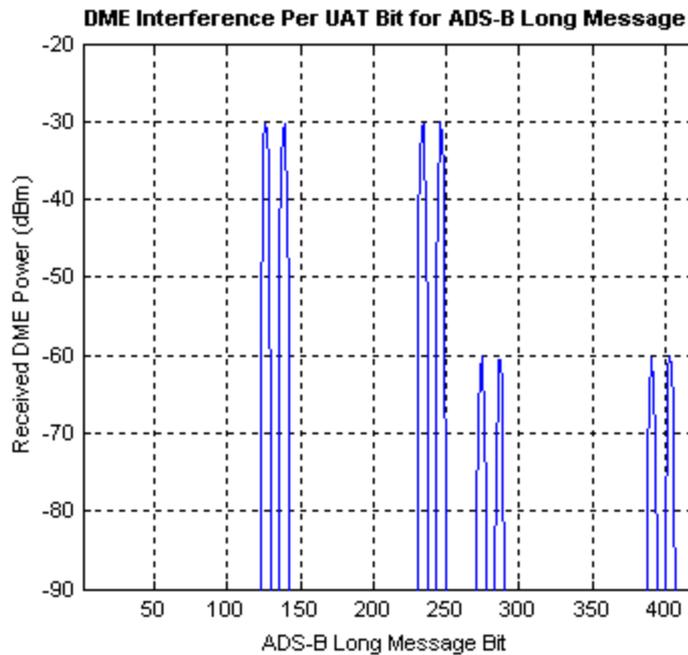
# Modeling DME Interference on UAT

- ❖ Simulated transmission of 1000 messages and averaged probability of message success while varying range to transmitter.
- ❖ Generated squitter at rate of 2700 pulse-pairs per second (ppps)
- ❖ Used most recently proposed coding scheme
  - Long message: RS(48,34)
  - Short message: RS(30,18)
- ❖ Methodology
  - Assess impact of a single DME
  - Without clearing 978 MHz, assess worst-case scenario in Europe
  - Clear 978 MHz, and assess worst-case scenario in Europe



# DME Interference

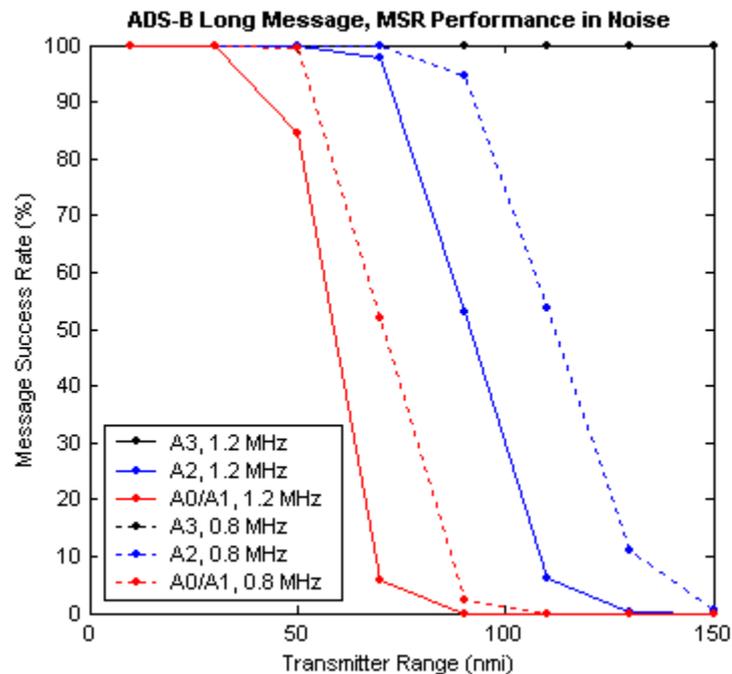
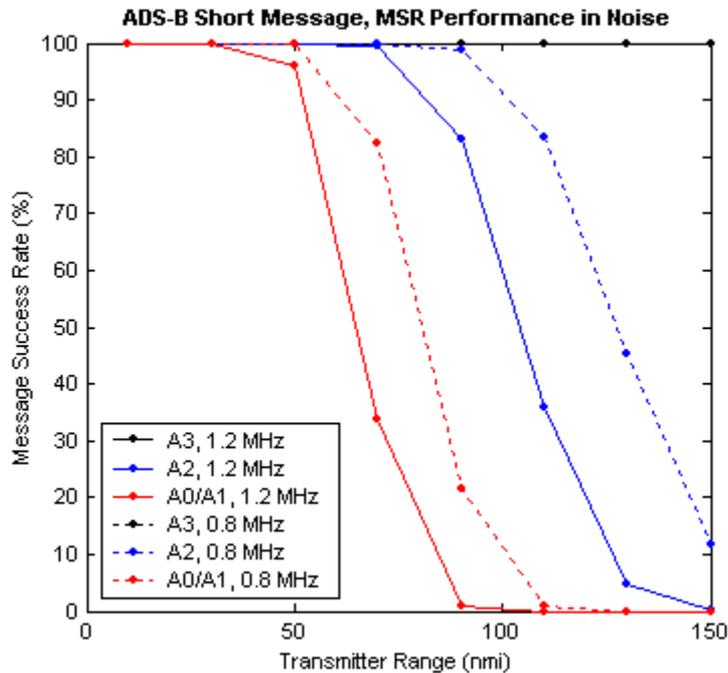
- ❖ *Example*
  - DME-1: 2700 ppps @ -30 dBm
  - DME-2: 2700 ppps @ -60 dBm
- ❖ Arriving pulse-pairs can overlap with multiple DME interferers.





# Performance in Noise

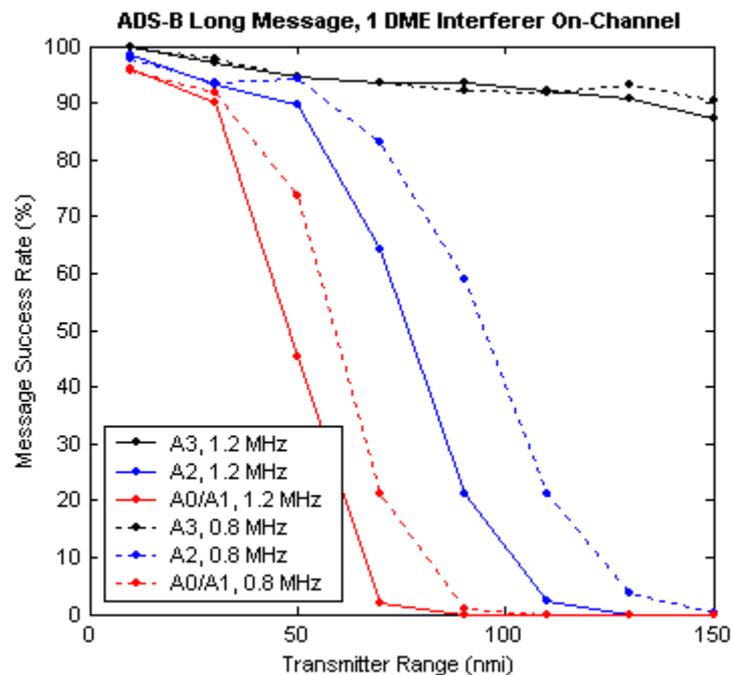
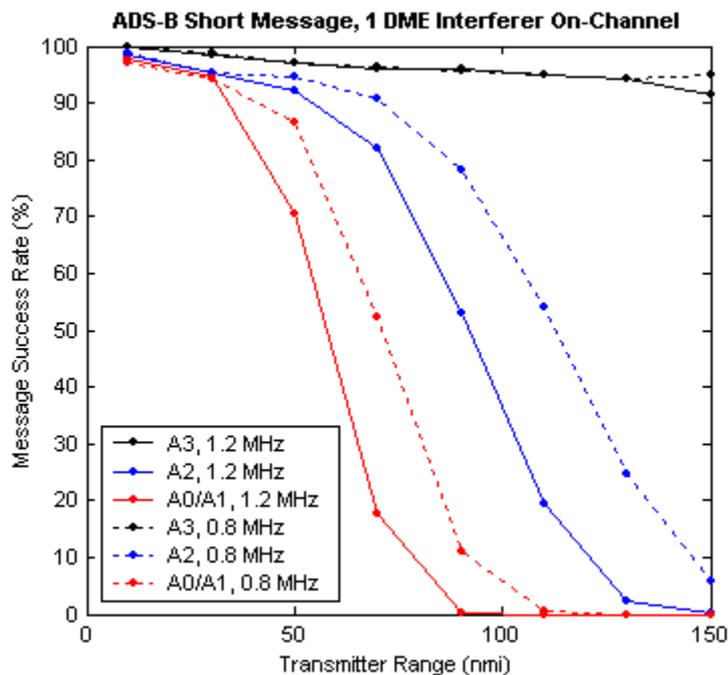
- ❖ No DME interferer present





# Performance w/ One DME at -70 dBm

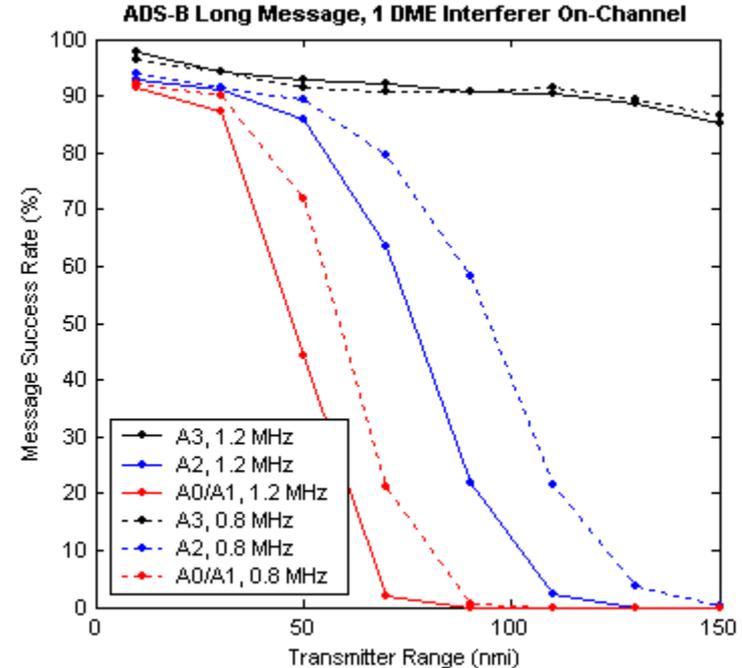
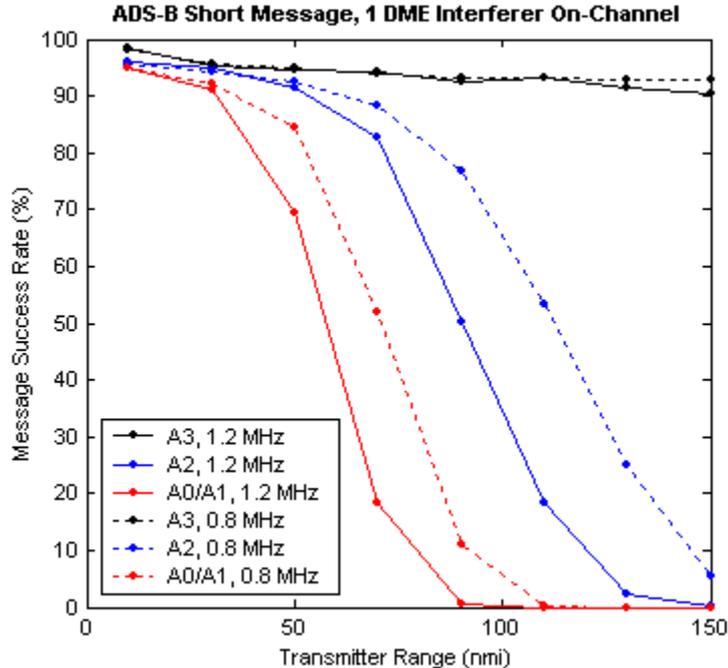
- ❖ One DME, on-channel, -70 dBm





# Performance w/ One DME at -60 dBm

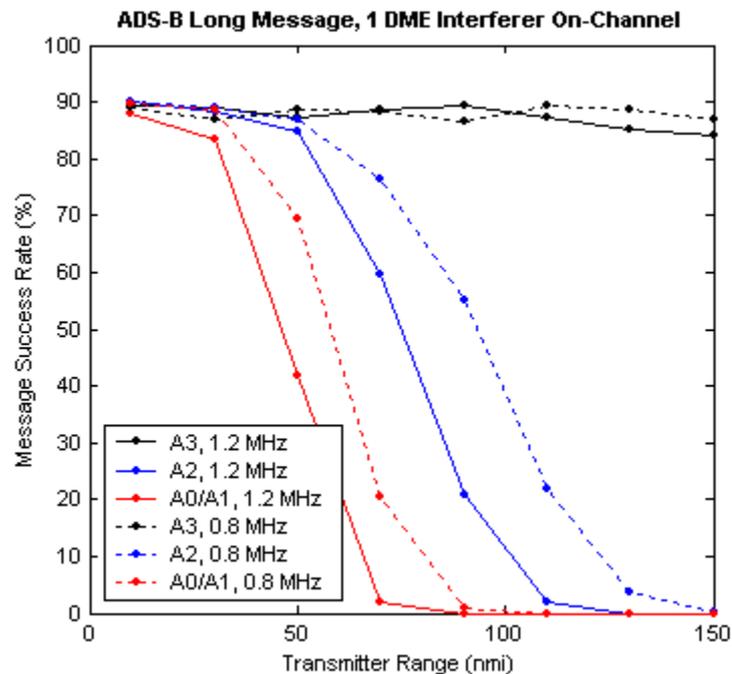
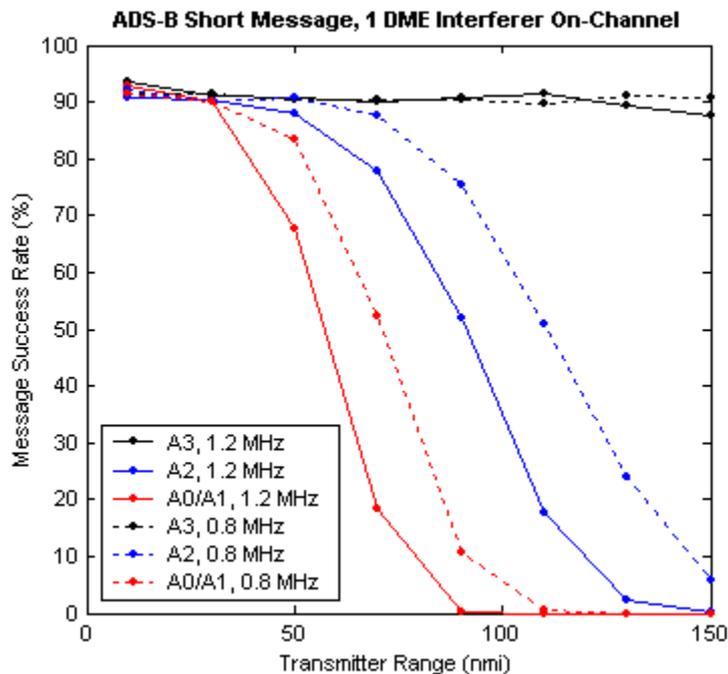
- ❖ One DME, on-channel, -60 dBm





# Performance w/ One DME at -30 dBm

- ❖ One DME, on-channel, -30 dBm



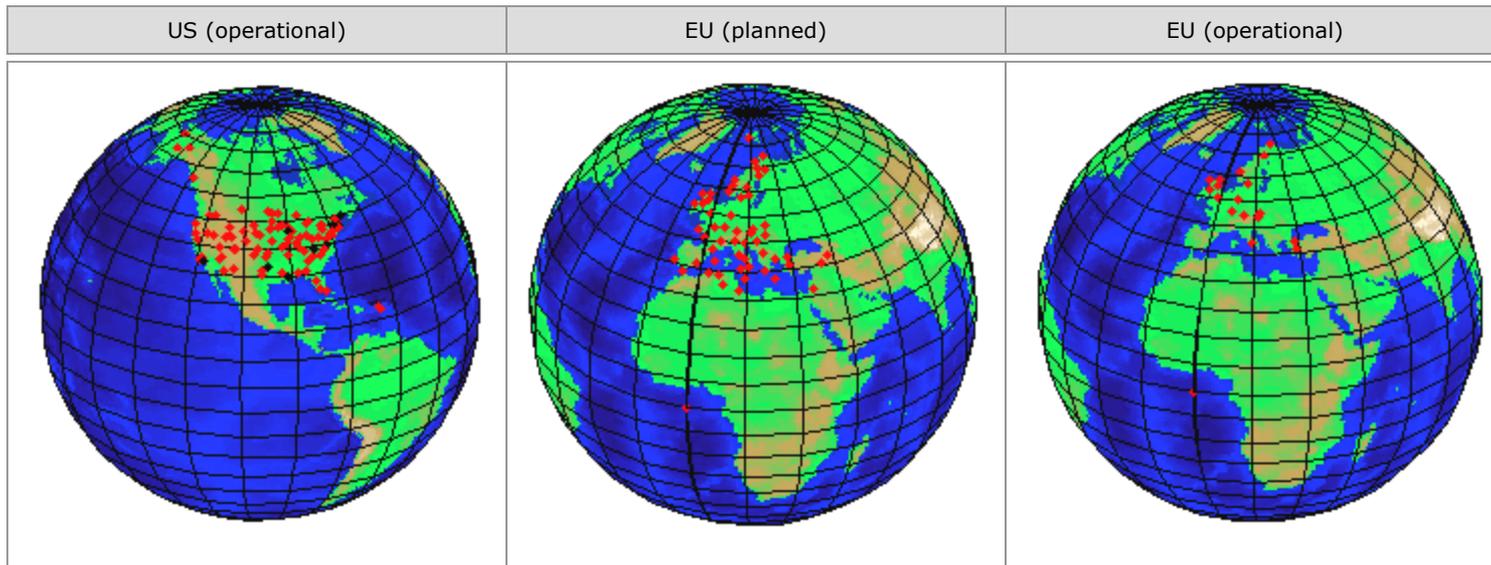


# Extracting Worst-Case DME Scenario in Europe

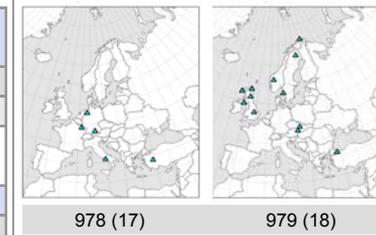
- ❖ Objective is to derive worst-case scenario for DME interference on UAT in Continental Europe using available databases.
- ❖ Simulated an aircraft flying at various altitudes in Europe and computed received power from DME ground stations.
- ❖ Model parameters and assumptions:
  - UAT frequency is 978 MHz
  - DME ground stations ERPs are as given in supplied databases
  - DME ground antenna is 8-dBi, directional or 0-dBi, omni-directional
  - UAT receive antenna is 0-dBi, omni-directional
  - UAT adjacent channel rejection of DME is
    - 20 dB for 1.2 MHz filter
    - 40 dB for 0.8 MHz filter
  - Used 1/8-degree resolution for latitude/longitude
    - Currently experimenting with finer scales



# Locations of DME Ground Transponders



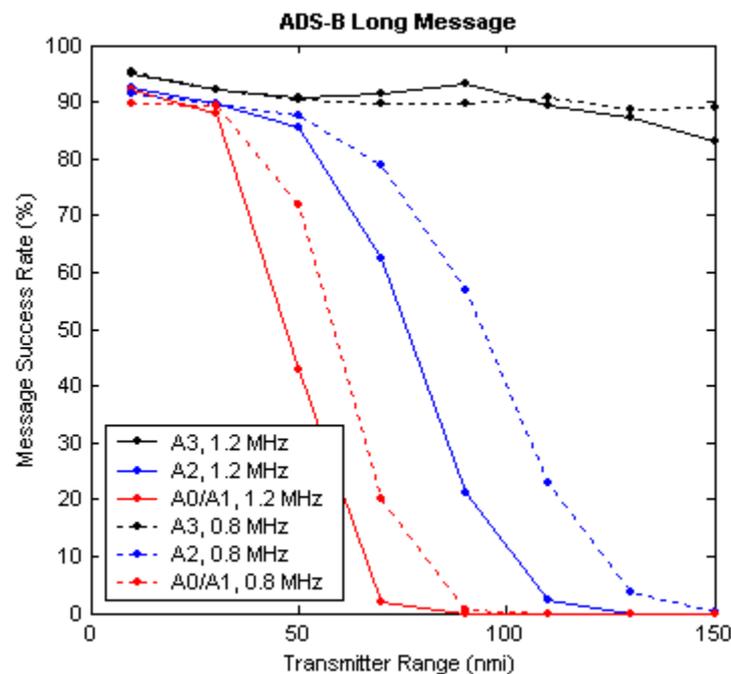
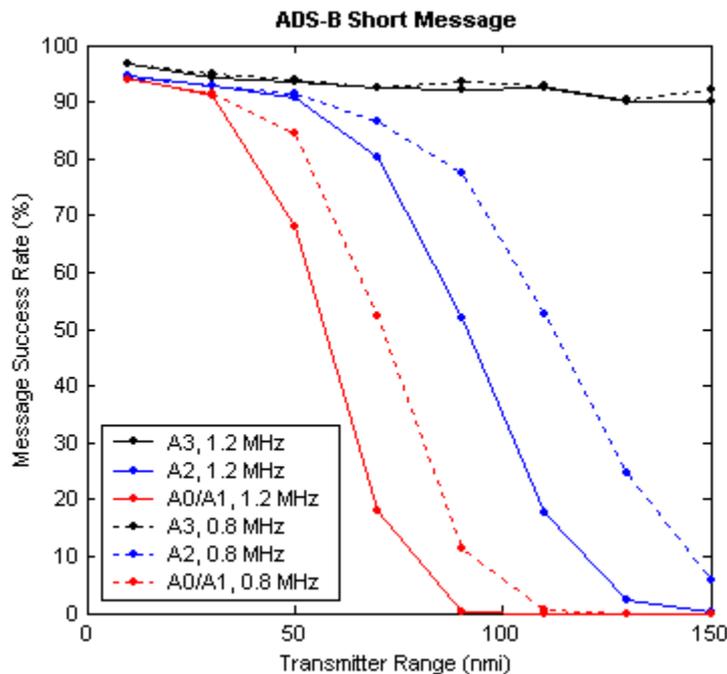
Received DME Power Levels for EU (operational)				
<i>978 Not Cleared</i>				
Criteria:	At least 2 interferers (omni)		At least 2 interferers (directional)	
Altitude	978	979	978	979
20000 ft	-55	-83	-54	-77
40000 ft	-49	-83	-55, -69	-
<i>978 Cleared</i>				
Criteria:	At least 2 interferers (omni)		At least 2 interferers (directional)	
Altitude	978	979	978	979
20000 ft	-	-52, -77	-	-58, -71
40000 ft	-	-56, -77	-	-65, -70





# Altitude = 20,000 ft , (omni)

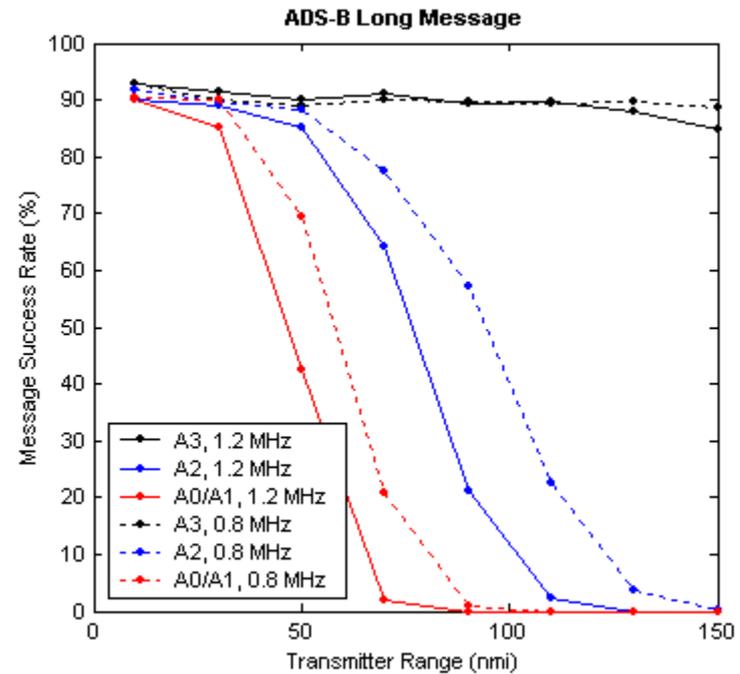
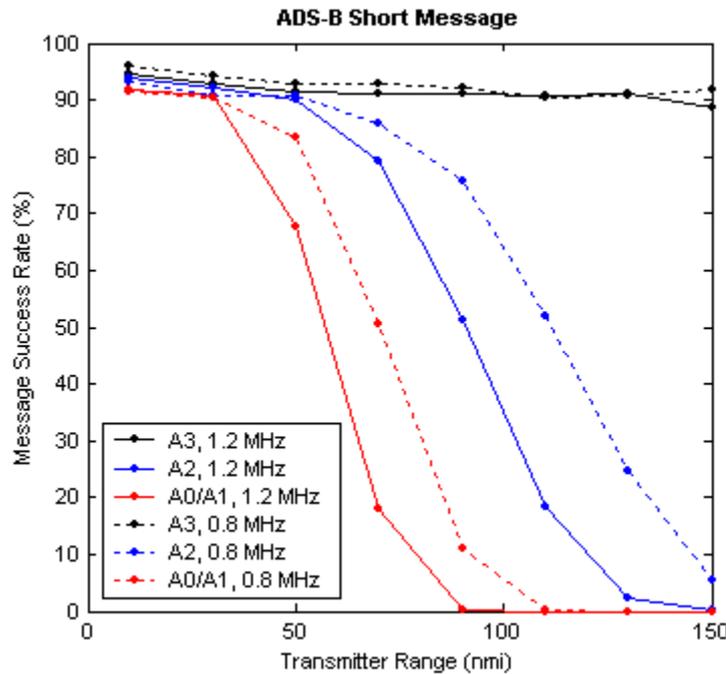
- ❖ DME-1: omni-directional, 978 MHz, -55 dBm
- ❖ DME-2: omni-directional, 979 MHz, -83 dBm





# Altitude = 40,000 ft , (omni)

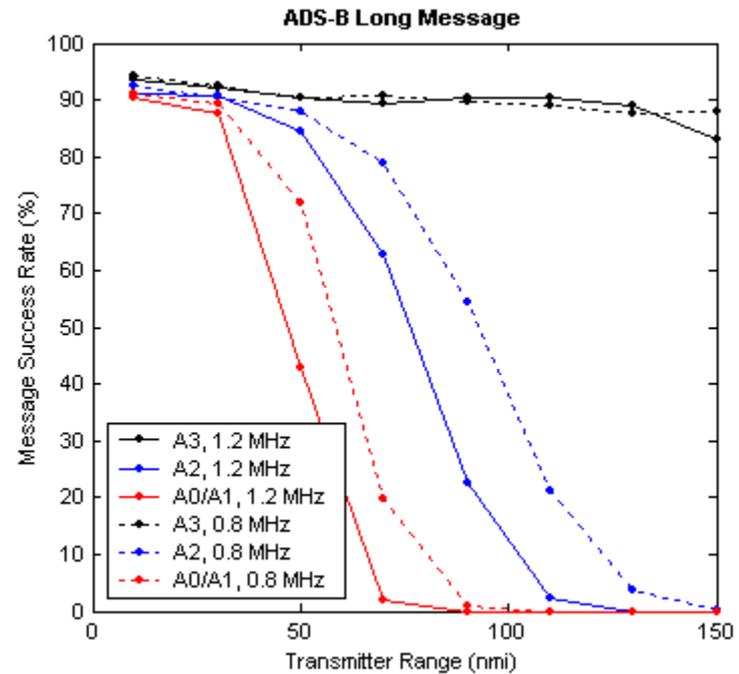
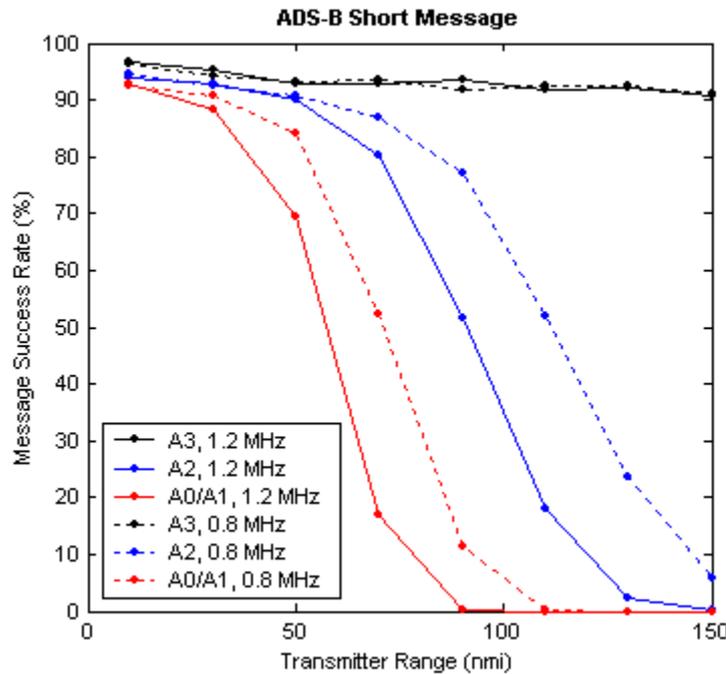
- ❖ DME-1: omni-directional, 978 MHz, -49 dBm
- ❖ DME-2: omni-directional, 979 MHz, -83 dBm





# Altitude = 20,000 ft , (directional)

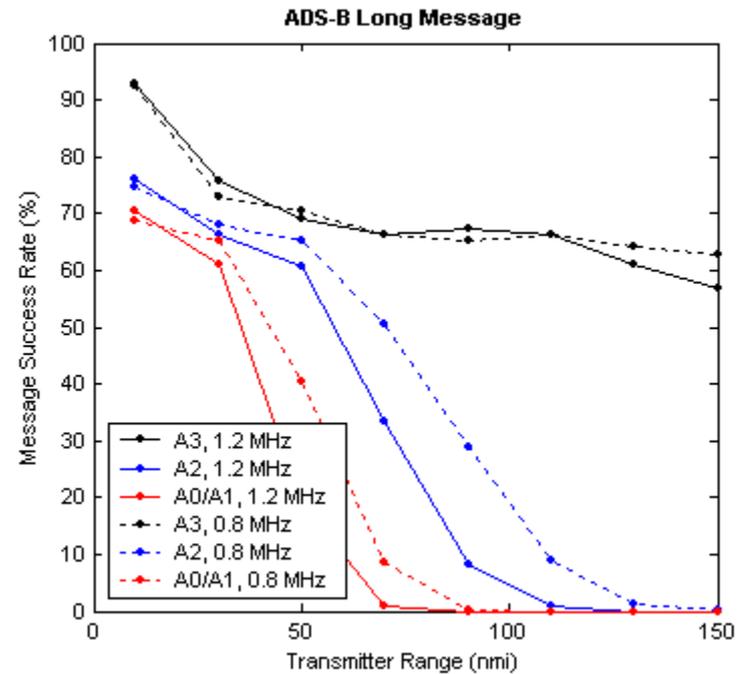
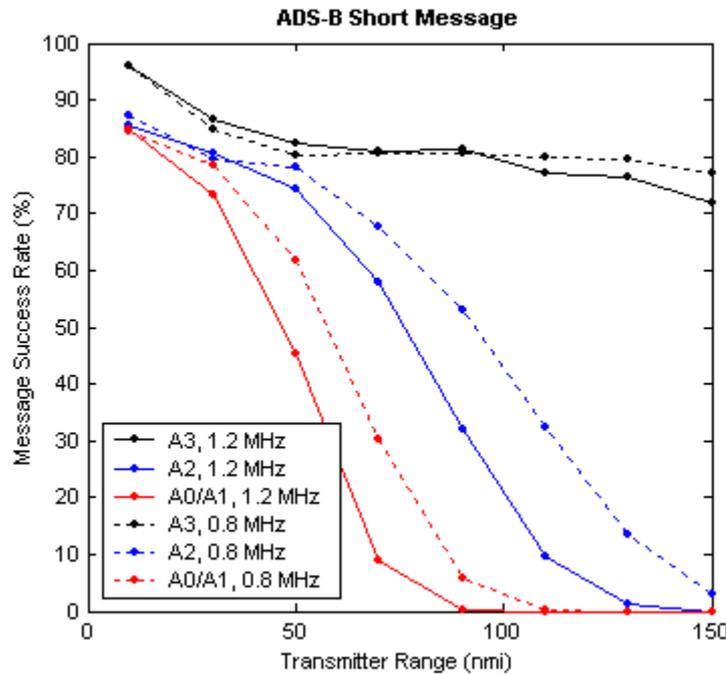
- ❖ DME-1: directional, 978 MHz, -54 dBm
- ❖ DME-2: directional, 979 MHz, -77 dBm





# Altitude = 40,000 ft , (directional)

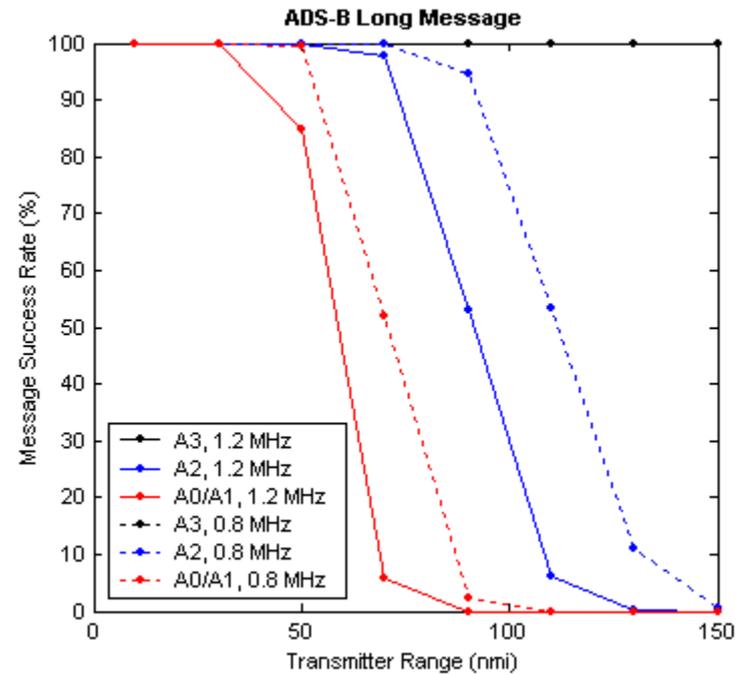
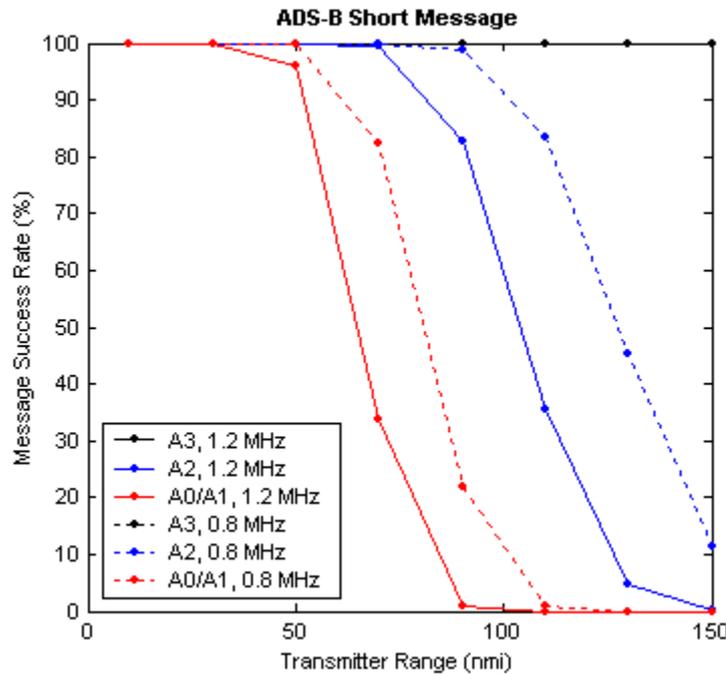
- ❖ DME-1: directional, 978 MHz, -55 dBm
- ❖ DME-2: directional, 978 MHz, -69 dBm





# Altitude = 20,000 ft , (directional)

- ❖ DME-1: directional, 979 MHz, -58 dBm
- ❖ DME-2: directional, 979 MHz, -71 dBm





# Conclusions

- ❖ For A3, a single DME on-channel can reduce MSR by 5 to 15%.
- ❖ For A0-A2, a single DME on-channel can reduce MSR by as much as 20% for ADS-B short messages, and as much as 40% for long messages, once beyond a certain range.
- ❖ UAT can survive worst-case scenario in Europe with either the 1.2 or 0.8 MHz filters if 978 MHz is cleared.
- ❖ UAT can coexist with DME without clearing 978 MHz, but this requires a shuffling of the DME frequencies to reduce impact of worst-case scenario.