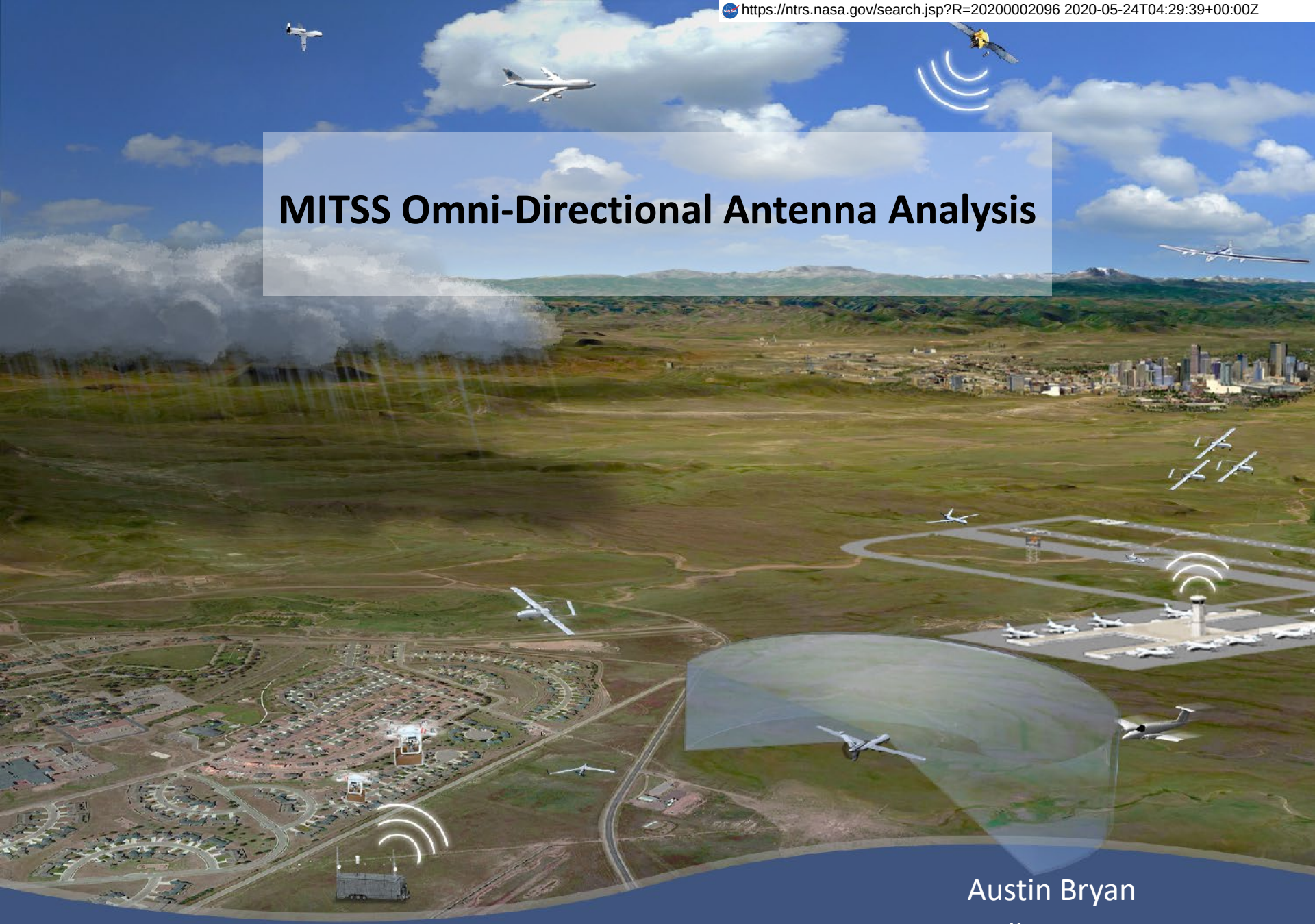
MITSS Omni-Directional Antenna Analysis



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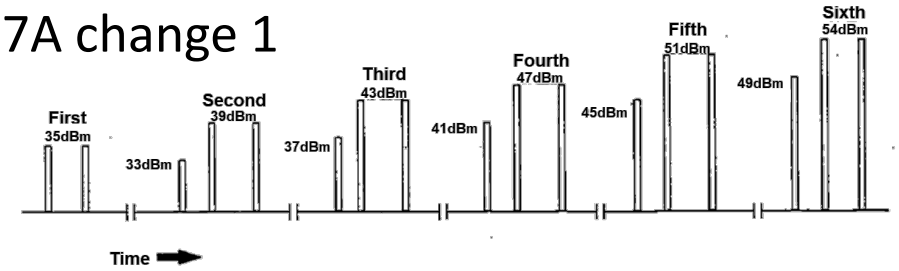
Methodology

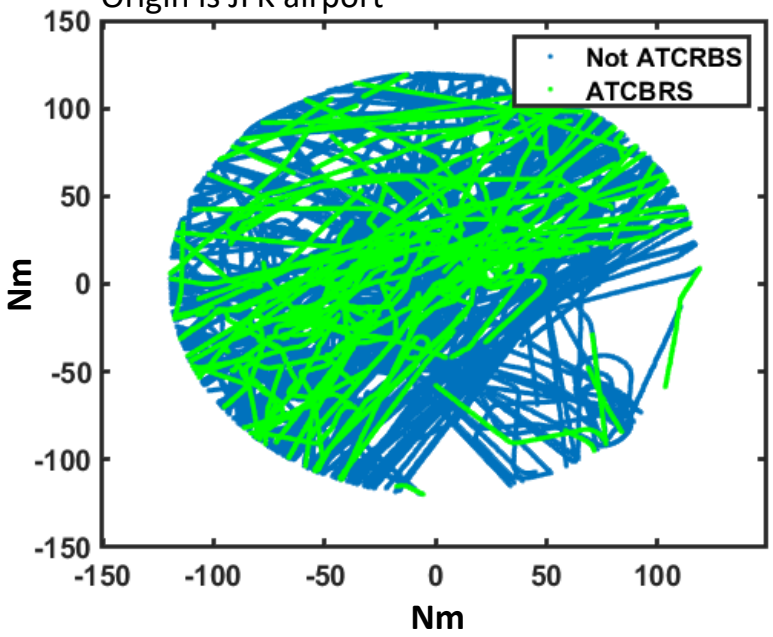
- Goal: Assess effect of omnidirectional TCAS antenna on spectrum environment and ownship Mode S and Mode C surveillance range
- MIT Surveillance Simulation (MITSS)
  - Used to inform DO-300A hybrid surveillance requirements
- Change equipage of existing aircraft in track data to Omni antennas
- Level 6 Whisper-shout from DO-197A change 1
  - DO-197A is TCAS I MOPS
- DO-185B Interference limiting



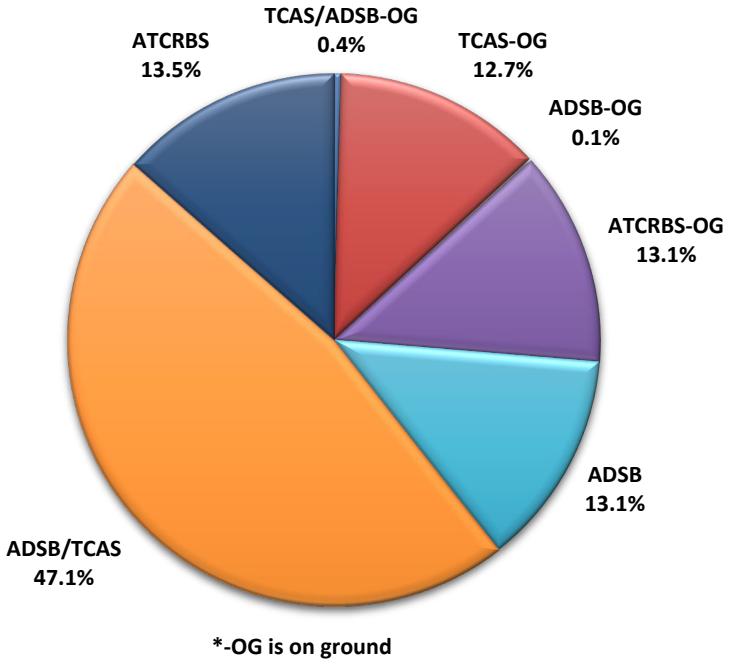
Traffic Data

- Input file: Radar tracks centered at JFK from Sunday, November 29, 2009 between 17:00 and 18:00 EST because it was identified as worst case traffic density
  - Tracks taken from RADES and TRAMS and combined
  - Additional on ground aircraft added

On ground aircraft not included in plot
Origin is JFK airport



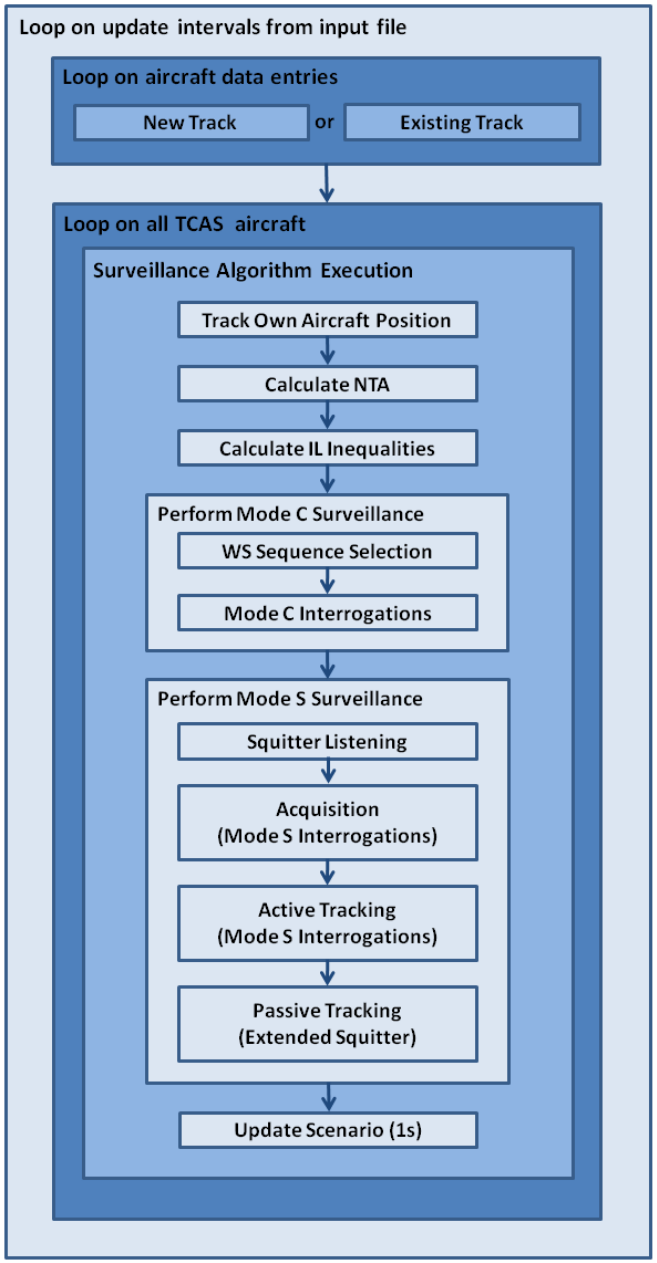
Equipage



*-OG is on ground

MITSS Overview

RADES Data
&
TRAMS Data



Outputs:

Transponder Utilization %
Surveillance Range
Interrogation/Reply Rates

Metrics

- Metrics are averaged over all TCAS equipped aircraft less than 30nm from JFK sensor

- Transponder Utilization
  - Percentage of time transponder is in use
  - Affected by the following
    - Sent long and short replies
    - Received Whisper Shout interrogations that cause suppression
    - Received Mode S interrogations that require a reply
    - Received Mode S interrogations that cause suppression

- TCAS receiver occupancy
  - Percentage of time receiver is in use
  - Affected by the following
    - Sent and heard long and short replies (1090)

- Reliable Surveillance Range (nmi)

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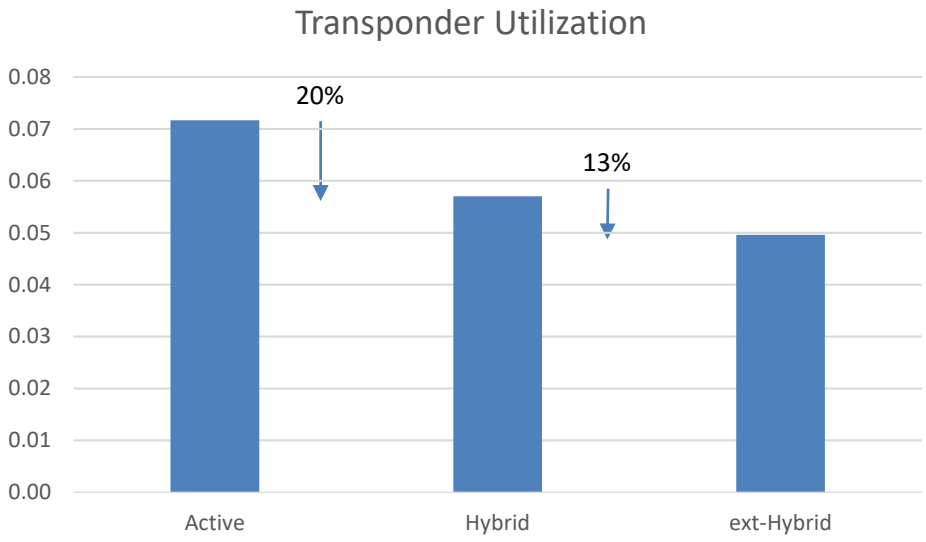
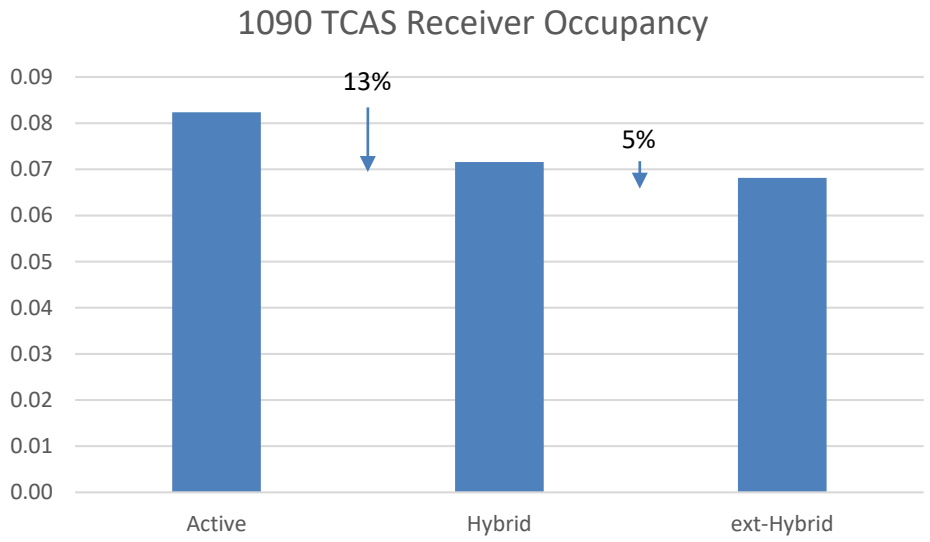
Results: Comparison between Active only, Hybrid, and extended Hybrid Surveillance

- Goal: assess the effect of running only active surveillance against hybrid surveillance, and extended hybrid surveillance when equipped with a top and a bottom omni antenna

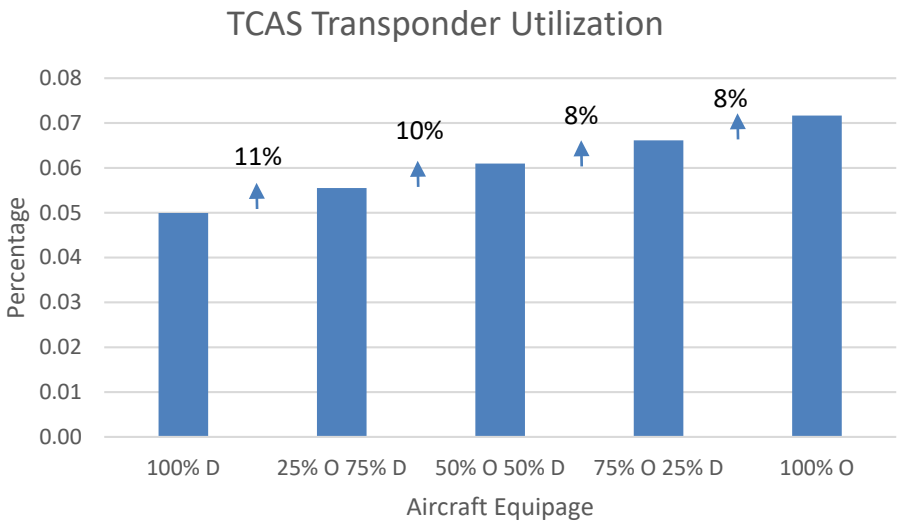
- No significant change in Reliable Surveillance Range

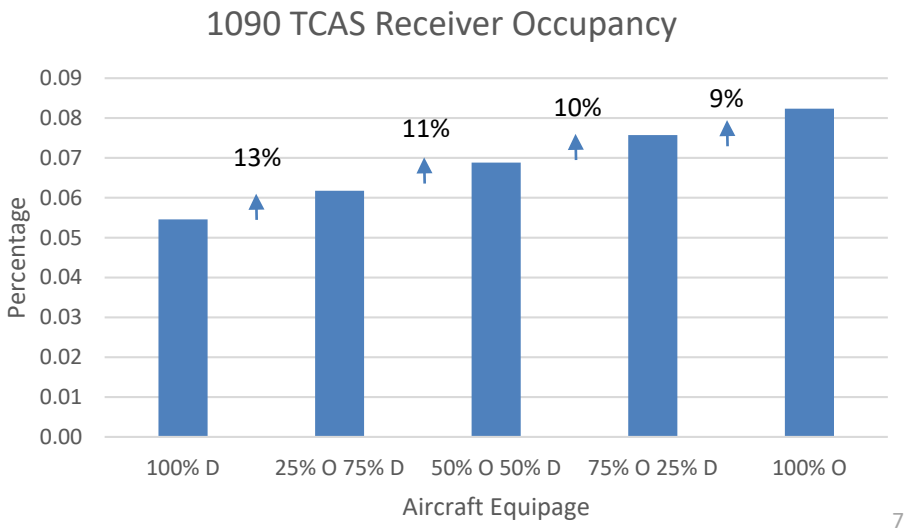




Results: Different Aircraft Equipage Percentages Active surveillance

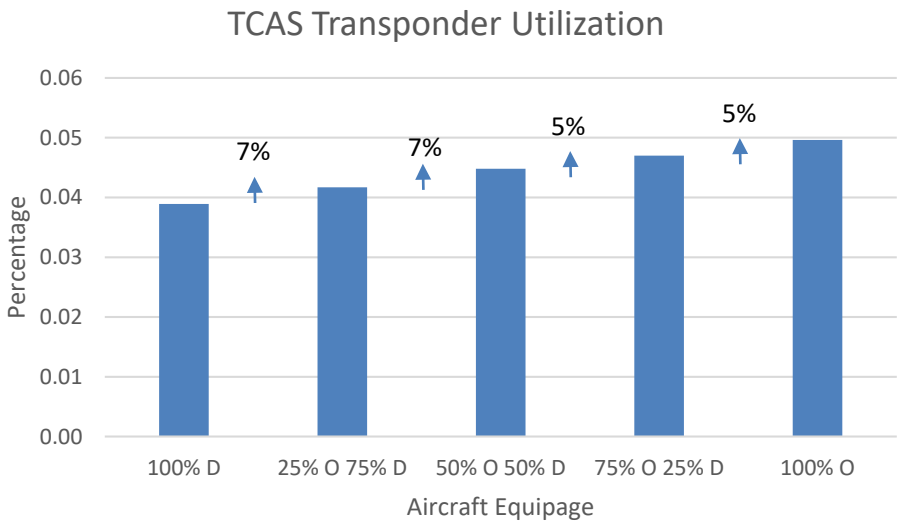
- Goal: assess the effect of different percentages of aircraft equipping with omnidirectional antenna using only active surveillance
- %O is the percentage of all the aircraft assigned Top omni antenna and Bottom omni antenna
- %D is the percentage of all the aircraft assigned Top directional antenna and Bottom omni antenna

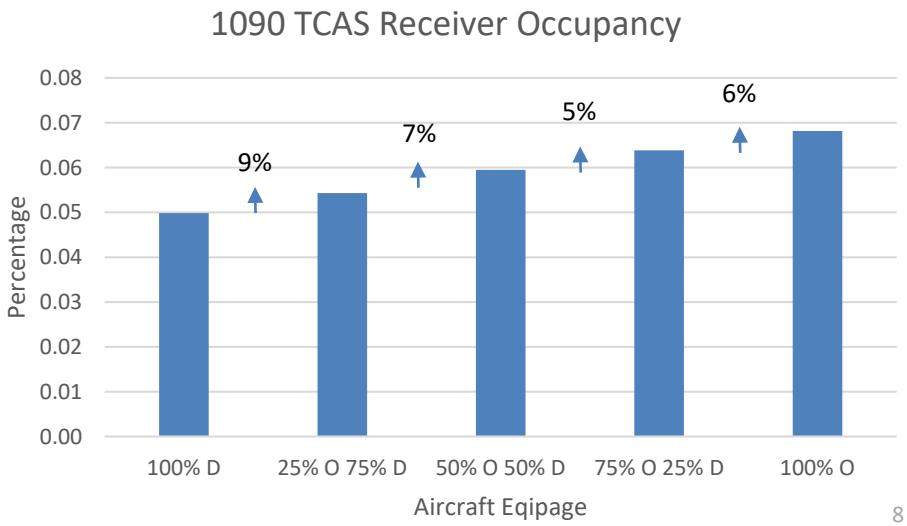




Results: Different Aircraft Equipage Percentages Hybrid Surveillance

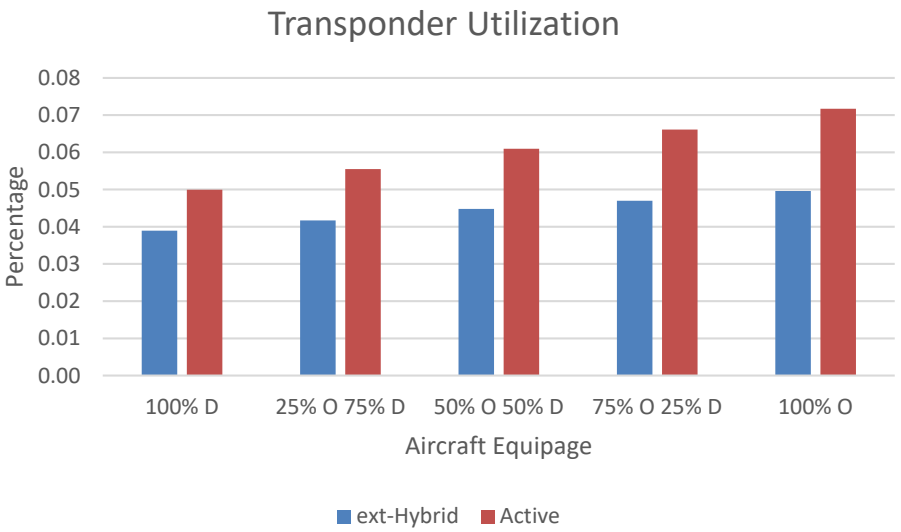
- Goal: assess the effect of different percentages of aircraft equipping with omnidirectional antenna while utilizing extended Hybrid Surveillance.
- No significant change in Reliable Surveillance Range

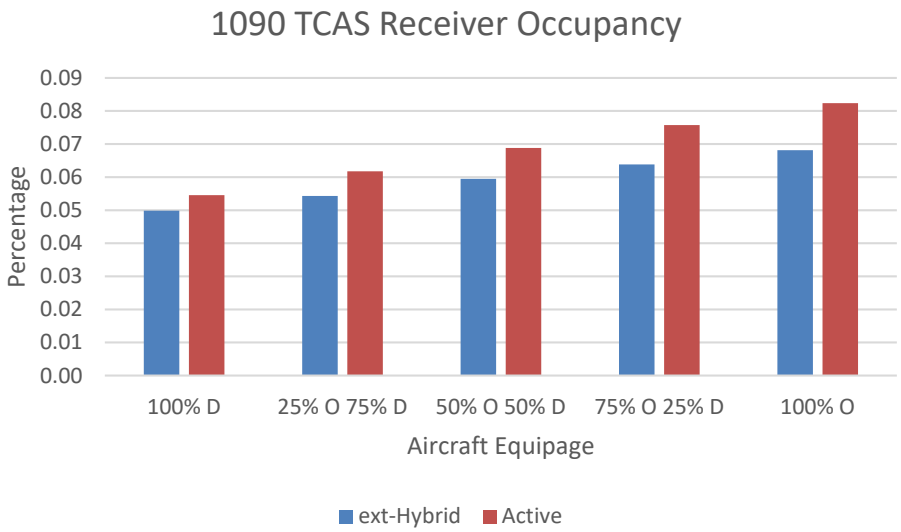




Results: Comparison between Active and extended Hybrid Surveillance

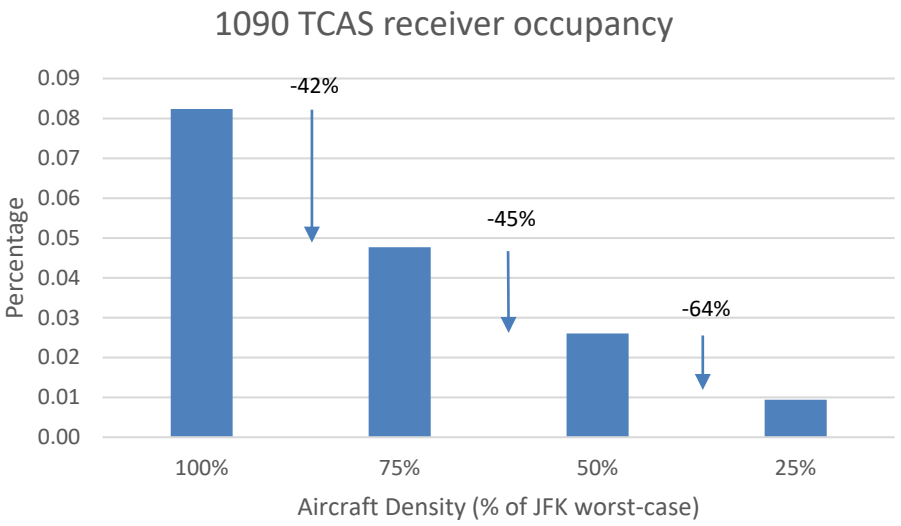
- Blue bars represent the runs with extended hybrid surveillance enabled
- Red Bars represent data using only active surveillance
- No significant change in Reliable Surveillance Range
- Omni antennas running extended hybrid surveillance is roughly equivalent to Directional antennas running just active surveillance in terms of transponder utilization

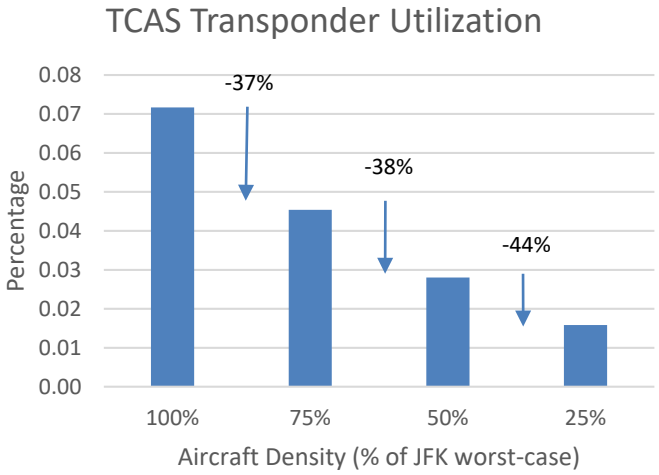


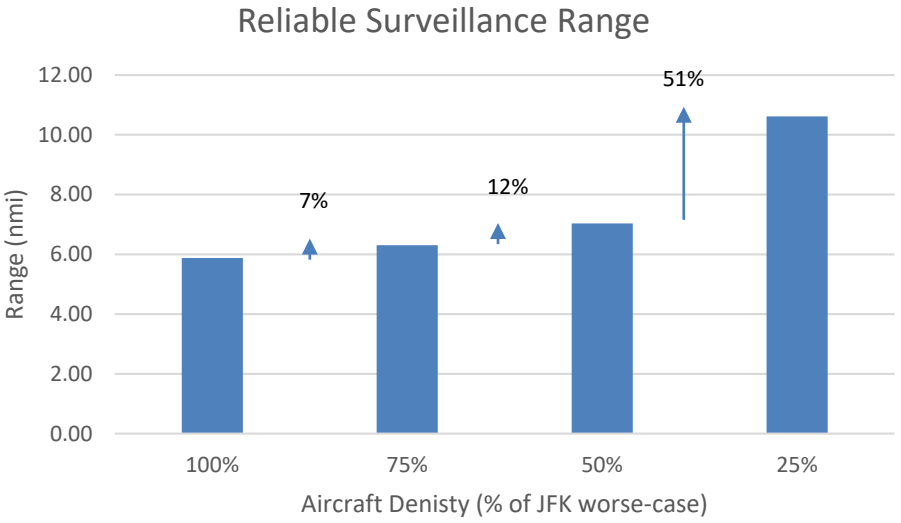


Results: Less Dense Airspace

- Goal: assess omni-antenna performance in less dense airspace environments using active surveillance
- All aircraft have a Top Omni antenna and a Bottom Omni antenna
- A random selection of aircraft were removed from the JFK airspace.
  - E.g., 25% means 75% of the aircraft have been removed

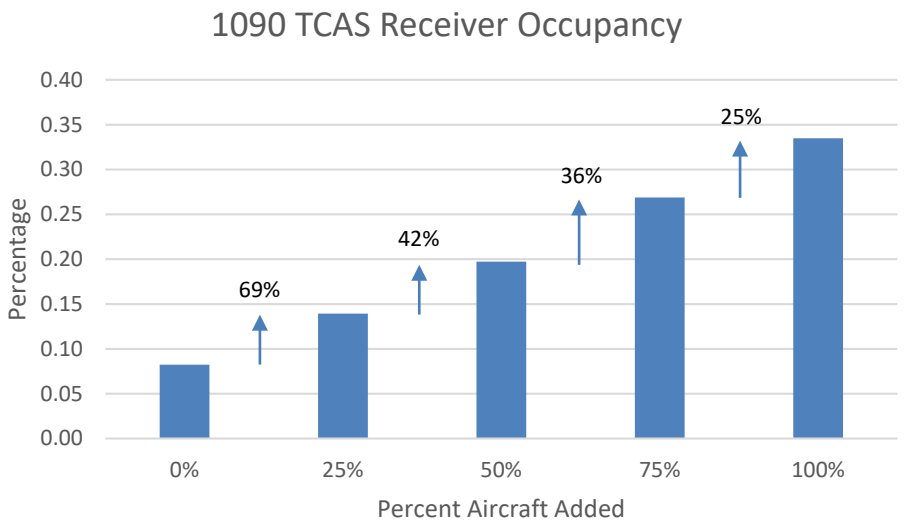


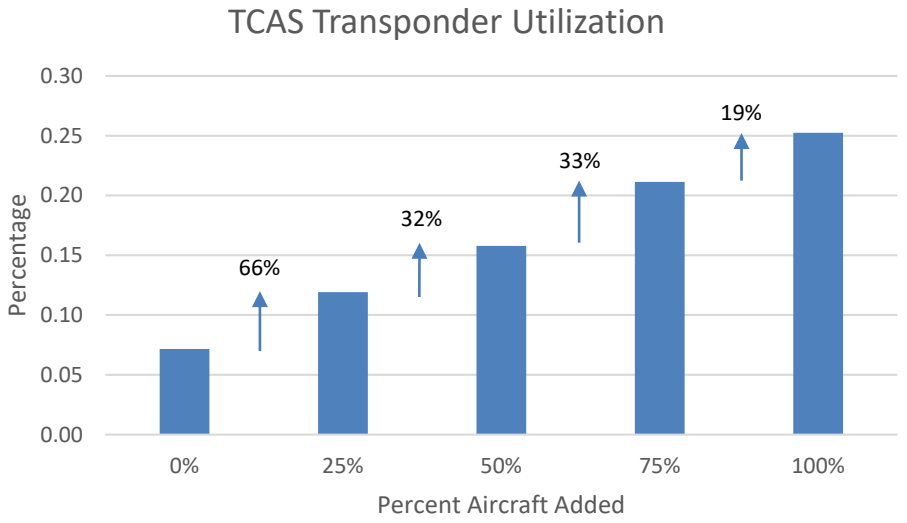




Results: More Dense Airspace

- Goal: assess omni-antenna performance in more dense airspace environments using <u>active surveillance</u>
- All aircraft have a Top Omni antenna and a Bottom Omni antenna
- A random selection of aircraft were added to the JFK airspace.
  - E.g., 100% means twice the number of aircraft in the original JFK dataset are simulated
- Reliable Surveillance range remained around 5.9nmi for all cases
  - Likely due to already being maximally limited





Future steps

- New degarbling methods
- New Whisper Shout sequences
- Reduce update rate