MPAR Network Spectrum Usage Study Update

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Current Surveillance Radars: Spectral Distribution

**Long-Range Air Surveillance**
- ARSR-1, 2, 3, 4 (FAA, USAF)
- FPS-20, 66, 67 (USAF)

**Terminal Weather Surveillance**
- TDWR (FAA)

**Terminal Air and National Weather Surveillance**
- ASR-8, 9, 11 (FAA, USAF)
- NEXRAD (NOAA, FAA, USAF)
MPAR Replacement Concept

All Aircraft and Weather Observation Missions

MPAR: 2.7–2.9 GHz
Study Objective

- How much total RF bandwidth will the MPAR network need? Can it fit into the targeted S-band window?
  ⇒ This study provides estimates based on realistic and reasonable assumptions

- MPAR disclaimer
  - MPAR is only one of several possible solutions for NextGen Surveillance and Weather Radar Capability (NSWRC)
  - Only notional functional requirements have been defined for MPAR
    - Performance requirements and architecture not defined yet
    - This study assumes particular MPAR configurations and performance characteristics that we deem to be reasonable
  - MPAR locations based on MIT LL siting analysis which also assumed certain configuration and performance parameters
• MPAR network frequency usage model is in place and yields reasonable results but
  – Model is sensitive to input parameters
  – Some key input parameters are still under debate

• FAA Spectrum Office has been funding a related study
  – Potential spectrum usage optimization of current S-band radar networks (Exelis)
  – FAA wants consistency in method and input parameters between the two studies

• Final results await resolution of model input debate
MPAR Network Frequency Usage Model

MPAR sitting study results and assumed radar architecture

List of all possible frequency channel pairs

RF propagation model

Table of propagation loss between all channel pairs

If pair within same radar

Optimize channel frequency assignments to minimize spectral usage span

Table of minimum frequency separation needed for each channel pair

Interference Model

Emission model

Mutual antenna gain model

Receiver model

INR tolerance threshold

INR = Interference-to-noise ratio

= items currently under debate
Model Inputs Under Debate

- **RF propagation model**
  - NTIA ITM (Irregular Terrain Model) is well-established but has known problems
  - Exelis developed hybrid TIREM (Terrain Integrated Rough Earth Model)-ITM model to address issues—will it be acceptable to NTIA?

- **Mutual antenna gain**
  - Coupling between two radar antennas to be $\leq X$ dB for $Y\%$ of the time: How to specify value for $Y$?
  - FAA Spectrum Office choice of $Y$ appears to be too conservative based on validation with current radar pairs

- **INR tolerance threshold**
  - Exelis and NOAA conducting studies to determine threshold for current radars
  - Initially assumed MPAR threshold values should be re-evaluated in light of widely ranging values coming out for current radars

NTIA = National Telecommunications and Information Administration

LINCOLN LABORATORY
Massachusetts Institute of Technology
CONUS Radar Replacement Scenarios

- **Scenario 1 (FAA only)**
  - Legacy: 222 ASRs + 44 TDWRs = 266 radars
  - New: 43 MPARs + 177 TMPARs = 220 radars
  - 17% reduction

- **Scenario 2 (FAA + NOAA)**
  - Legacy: 222 ASRs + 44 TDWRs + 143 NEXRADs = 409 radars
  - New: 157 MPARs + 132 TMPARs = 289 radars
  - 29% reduction

- **Scenario 3 (FAA + NOAA + USAF)**
  - Legacy: 222 ASRs + 44 TDWRs + 143 NEXRADs + 116 ARSR/FPSs = 525
  - New: 192 MPARs + 142 TMPARs = 334 radars
  - 36% reduction

More legacy networks replaced by MPAR ⇒ More fractional reduction in total radar count

TMPAR is scaled down “terminal area only” MPAR
Other Radars in 2.7-2.9 GHz Band

- Military-owned ASRs (or GPN equivalents) in CONUS not included in MPAR replacement plans
- If replaced by MPAR
  - Performance benefits: Wind-shear alerts, 3D tracking, wind farm clutter mitigation
  - Potentially more efficient overall MPAR network deployment
- If not replaced by MPAR
  - Source/victim of interference unaccounted for in spectrum usage study
- Recommend
  - MPAR network siting analysis including these additional radars
  - MPAR network spectrum usage analysis including these radars as (1) replaced by MPAR and (2) not replaced by MPAR