



International Consortium for Telemetry Spectrum



Encroachment Threats to Aeronautical Telemetry UPDATE #9

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Presented to:
ICTS Forum

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Background

- **Spectrum reallocation for broadband high priority for POTUS**
 - 2010 POTUS EO, “Unleashing the Wireless Broadband Revolution”
 - 2013 POTUS EO, “Expanding America's Leadership in Wireless Innovation”
- **1695-1710 MHz studied in 2010, decision to reallocate and auction the band for geographic sharing with commercial broadband**
- **1755 - 1850 MHz studied extensively over a three year period**
 - 2011 - 2012 NTIA study - relocation possible, but too expensive and takes too long
 - 2012 - 2013 CSMAC Working Groups study - sharing alone impractical
 - 2012 Congress passes Middle Class Tax Relief and Job Creation Act of 2012 (LAW)
 - Directed new auction processes; licensing of 2155 – 2180 MHz band by Feb 2015, strongly pushing for 1755-1780 MHz as the preferred pairing with 2155-2180 MHz for LTE
 - Services Transition Plans consistent with the DoD Alternative Proposal
 - Hybrid sharing, compression and relocation alternative proposal

DOD Alternative Proposal for 1755 – 1780 MHz

- **Combination of sharing, relocation, compression**
 - Reduced cost to approximately \$3.5B, upgrade/modernize DoD capabilities
 - Retains some shared access to 1755 – 1780 MHz for SATOPS, EW, TRR at 6 sites, limited ACTS
 - SATOPS cost reduced significantly
 - Retains entire 1780–1850 MHz, including compression of AMT and majority of ACTS
 - AMT and ACTS costs reduced significantly
 - Relocation of Point-to-Point Microwave and DoD Video Surveillance/Robotics to existing federal bands (Fixed point to point microwave systems)
 - Gains access to 2025-2110 MHz band for airborne systems (SUAS, HRV, TTNT) and TRR to be shared with incumbent broadcasters and existing federal SATOPS in US

Reallocation of 1755-1780 MHz Timeline

- **March 2013:**
 - FCC notified NTIA of 1755-1780 MHz auction “date”.
- **July 2013:**
 - DoD Alternative Proposed by DoD to NTIA, estimated total cost of \$3.5B
- **November 2013:**
 - NTIA endorsed the DoD Alternative Proposal in a letter to the FCC
- **December 2013:**
 - Ranges submitted Transition Plan to HQ (OPNAV N2N6 for US Navy).
- **January 2014:**
 - Transition Plans submitted to NTIA and Technical Panel (Tech Panel reps from NTIA, FCC, OMB)
- **March 2014:**
 - NTIA estimated costs and timelines to FCC, Congress, and GAO.
- **April 2014:**
 - NAVAIR answered questions from Technical Panel
- **May 2014:**
 - Technical Panel finds all DOD Transition Plans to be sufficient.
- **November 13, 2014:**
 - FCC auction start date.
- **April 2015 (estimated):**
 - DoD receives spectrum relocation funds
 - Begins execution of Transition Plan.

DoD Capabilities 1755-1780 MHz Band

| System Category | Service | Mission |
|-------------------------------------|----------------|---|
| Air Combat Training Systems (ACTS) | AF/Navy/USMC | Aircraft /ground data links for flight/weapons monitoring; enabling aircrew readiness through robust and realistic training at multinational, joint, wing, group, and unit levels |
| Aeronautical Mobile Telemetry (AMT) | All Services | Aircraft and aerial weapons systems test and evaluation telemetry: multiple systems of flight pods, ground stations and remote controlled targets; at numerous locations |
| Space Ground Link Sub-system (SGLS) | AF/Navy | Network enables satellite launch, deployment, orbit/mission control, emergency recovery, and end of life disposal for DoD, IC, Allied and Civil Space Systems |
| Tactical Radio Relay (TRR) | Army/Navy/USMC | Transportable, line of sight tactical battle space command and control communications for voice and data |
| Small Unmanned Aerial Systems (UAS) | All Services | Video and telemetry links for small, low altitude unmanned aerial platforms (e.g. RQ-11B Raven, PUMA, WASP, RQ-21A STUAS) carrying various sensor packages |
| Fixed Point-to-Point Microwave | Army | Fixed microwave data communications; primary support for Army Corps of Engineers |
| Precision Guided Munitions | AF/Navy | C2 and video guidance links for AGM-130, GBU-15 and SLAM-ER air-to-ground munitions |
| High Resolution Video | AF/Navy/Army | Air/Ground video surveillance to support targeting pods (Litening) and criminal investigations/law enforcement; |
| Land Mobile Robotic Video Links | All Services | Video links to remote operators for Explosive Ordnance Disposal (EOD), Counter Improvised Explosive Device (CIED) and De-mining operations |
| Software Defined Radios | All Services | Joint Tactical Radio System (JTRS) and Navy's Naval Integrated Fire Control- Counter Air (NIFC-CA) |
| Electronic Warfare (EW) Systems | All Services | Airborne and ground-based electronic attack (jamming) |

Total Transition Cost Summary

| Category | 2014 Cost Estimates | 2011 Cost Estimates | Comments |
|-----------------------|---------------------|---------------------|--|
| Microwave Systems | \$ 29M | \$ 42M | Relocate to 7 GHz (consistent with 2011 study) |
| Tactical Radio Relays | \$ 685M | \$ 160M | USMC TRR Proposal (Issue #1) |
| Air Combat Training | \$ 68M | \$ 4,498M | Compress vs. Relocate to 2025-2110 MHz |
| PGMs | \$ 39M | \$ 518M | Compress vs. Relocate to 1435-1525 MHz |
| High Res Video | \$ 35M | \$ 55M | Relocate to 2025-2110 or 2200-2290 MHz (consistent with 2011 study) |
| Satellite Operations | \$ 26M | \$ 2,350M | Remain in Band vs. Consolidation & Geographical relocation of Gnd Stations |
| Mobile Telemetry | \$ 483M | \$ 3,099M | Compress vs. Relocate to other AMT bands |
| Robotics | \$ 130M | \$ 143M | Relocate to 4 GHz (consistent with 2011 study) |
| Small UAS | \$ 774M | \$ 1,408M | Expand range to 2 GHz (consistent with 2011 study; reduced # of affected ground terminals) |
| Other | \$ 635M | \$ 364M | TTNT (Issue #2) |
| HQ Management | \$ 451M | \$ 272M | Addition of DISA tools |
| Total | \$ 3,355M | \$ 12,910M | Jul 2013 Memo to NTIA cost = \$3,477M |

Key Transition Plan Assumptions

- **FCC rules and transition requirements for 1755-1780 MHz must be consistent with the DoD Alternative Proposal, including reallocation of 2025 - 2110 MHz to provide DoD access**
- **NTIA and OMB will start the transition clock at the close of the auction**
 - Agencies have been advised to assume fund disbursement will not occur for 3 months after auction closes
 - The timelines in Services and DSO transition plans are dependent to the receipt of funds
- **It is anticipated that early entry coordination request will come immediately after close of the auction and licenses have been awarded (within weeks)**
 - Funds will be required to establish processes to support coordination prior to the disbursement of funds
 - As a result, all Services and DSO will request pre-auction funding

Range Telemetry Guidance

**...to compress telemetry operations in
1755 - 1850 MHz into 1780 - 1850 MHz**

“The Plan”

Under the NTIA directed 1755-1780 MHz transition

- **Aircraft**

- Upgrade to multi-tier transmitters
 - SOQPSK minimum – SOQPSK & CPM capable is preferred
 - NAVAIR will upgrade all aircraft not yet upgraded
 - 3 aircraft at Pax River and 14 aircraft at China Lake.
 - Not feasible for weapons at this time

- **Ground Stations**

- Upgrade to multi-tier receivers
 - NAVAIR will upgrade all receivers not yet upgraded
 - Twenty at Pax River (4-channel).
 - Twenty at China Lake (4-channel).
 - Forty at Point Mugu (2-channel).
 - Twenty at PMRF (4-channel).
 - None for MDA.
- Protect all ground antennas against overload
 - Typically via filters.
 - Replace old antennas if they cannot be modified or modifications are coast prohibitive.
 - Plan to replace six antennas at Point Mugu

The Plan (cont'd)

- **Aircraft**

- Upgrade to remotely controllable spectrum agile transmitters.
 - Allows real-time control of transmitter characteristics during flight
 - Center frequency, modulation type, power level, on/off. etc.
 - Upgrade only “High fly time aircraft”
 - » 10 at PAX and 5 at CL.

- **Ground Stations**

- Upgrade infrastructure to support remotely controllable spectrum agile transmitters.
- Make all Ground Stations L/S/C-band capable (spectral flexibility)
 - Pax River would modify 25 ground stations.
 - China Lake would modify 13 ground stations.
 - Point Mugu would modify 7 ground stations (and replace 6).
 - PMRF would modify 16 ground stations.
 - MDA would modify 5 ground stations.

The Plan *(cont'd)*

- **Spectrum analysis, software upgrades and mitigation network/capabilities.**
 - Necessary engineering studies and de-confliction software upgrades
 - New spectrum monitoring systems.
 - For Pax River, China Lake, and Point Mugu.
- **Mobile ground stations**
 - To facilitate the transition.
 - Mobile systems would provide telemetry coverage while a fixed ground station undergoes modification.
 - Five Systems
 - Two for Pax River.
 - Three to be shared between China Lake and Point Mugu.

US Navy Ranges Transition Timeline

Accelerated transition timeline:

**Patuxent River, MD:
China Lake, CA
Point Mugu, CA:**

Original Timeline

**120 months
120 months
120 months**

Accelerated Timeline

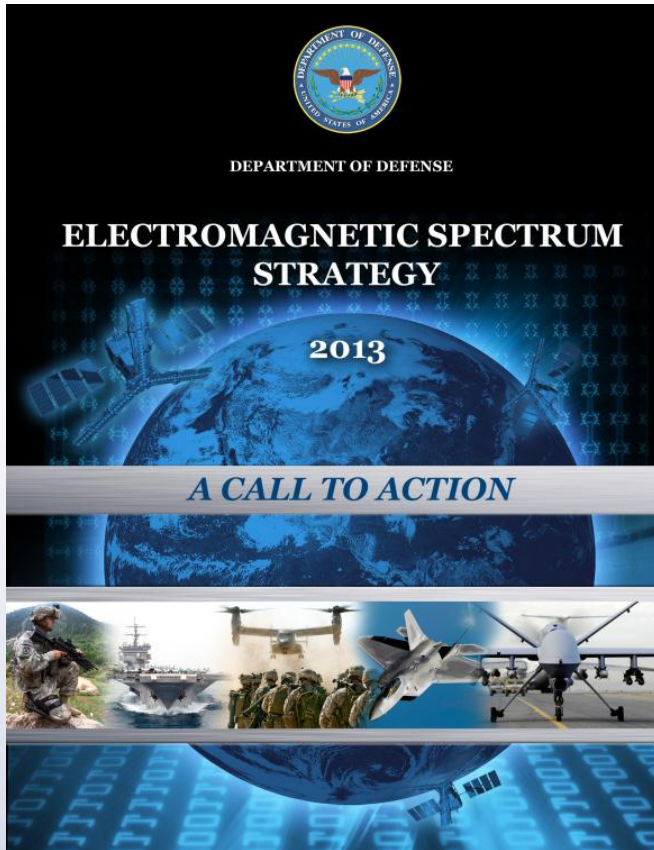
**105 months (102+3)
91 months (88+3)
88 months (85+3)**

| ID | Task Name | Start | Finish | Duration | 2015 | | 2016 | | | | 2017 | | | | 2018 | | | | 2019 | | | | 2020 | | | | 2021 | | | | 2022 | | | | 2023 | | | | 2024 | | | | 2025 | |
|----|----------------------------------|------------|------------|----------|------|----|------|----|----|----|------|----|----|----|------|----|----|----|------|----|----|----|------|----|----|----|------|----|----|----|------|----|----|----|------|-------|----|----|------|--|--|--|------|--|
| | | | | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | | | | | | |
| 1 | Auction Funds | 2/9/2015 | 2/9/2015 | 1d | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Telemetry Ground Stations NAWCWD | 2/9/2015 | 6/8/2022 | 1913d | ▼ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Sea Range Telemetry | 2/9/2015 | 3/22/2022 | 1857d | ■ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Land range Telemetry | 2/9/2015 | 6/8/2022 | 1913d | ■ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | FOC NAWCWD Telemetry | 6/8/2022 | 6/8/2022 | 0d | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | FOC ♦ | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Telemetry Ground Stations NAWCAD | 2/9/2015 | 12/26/2023 | 2317d | ▼ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Atlantic test range Telemetry | 2/9/2015 | 12/26/2023 | 2317d | ■ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | FOC ATR Telemetry | 12/26/2023 | 12/26/2023 | 0d | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | FOC ♦ | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15 | Airborne Telemetry Systems | 2/11/2015 | 7/26/2022 | 1945d | ▼ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16 | NAMCAD Aircraft | 2/11/2015 | 2/4/2022 | 1823d | ■ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 | FOC NAWCAD Aircraft | 2/4/2022 | 2/4/2022 | 0d | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | FOC ♦ | | | | | | | | |
| 19 | NAWCWD Aircraft | 2/11/2015 | 7/26/2022 | 1945d | ■ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21 | FOC NAWCWD Aircraft | 7/26/2022 | 7/26/2022 | 0d | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | FOC ♦ | | | | | | | | |
| 22 | FOC NAVAIR Aircraft | 7/27/2022 | 9/6/2022 | 30d | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | ■ | | | | | | | | |

NAWCAD = Naval Air Warfare Center Aircraft Division
NAWCWD = Naval Air Warfare Center Weapons Division
Sea Range = Point Mugu, CA
Land Range = China Lake, CA
Atlantic Test Range = Patuxent River, MD
FOC = Full Operational Capability

Recent DoD AMT Initiatives

Action Plan being developed for the DOD EMS Strategy



“All Joint functions--movement and maneuver, fires, command and control intelligence, protection, and sustainment rely on capabilities that use the spectrum. . . . DoD must act now to ensure access to the congested and contested electromagnetic environment of the future. Specifically, the Department must adapt how it acquires and uses spectrum resources.”

-- Ashton B. Carter, Deputy Secretary of Defense

More Recent DoD AMT Initiatives

❖ **S4G Continues its Stewardship efforts**

- ❖ *The Spectrum Stewardship Senior Steering Group (S4G) was established to manage the activities, initiatives and responses of the test ranges to issues and needs related to radio spectrum for Test & Evaluation.*

❖ **C-Band Working Group (CBWG) established on 25 October 2010**

- ❖ *The purpose of the CBWG was to develop a roadmap to guide the implementation of C-Band telemetry capabilities at DoD test ranges using the bands obtained through the World Radiocommunication Conference in 2007*

❖ **Tri-Service (Army/Navy/Air Force) C-Band Requirements Study (TSCRS) Completed**

- ❖ *TSCRS objective was to identify the technical requirements for AMT capability for all of the major telemetering mission categories, or mission domains.*
- ❖ *The basic goal was to identify & prioritize the technical barriers to implementing C-band AMT capability with the same level of service quality and reliability as provided by current L- and S-Band AMT systems. These barriers are referred to as “gaps” and were identified through a gap analysis process.*
- ❖ *The completed Study was just released and the TSCRS effort concluded – now the hard work begins.*



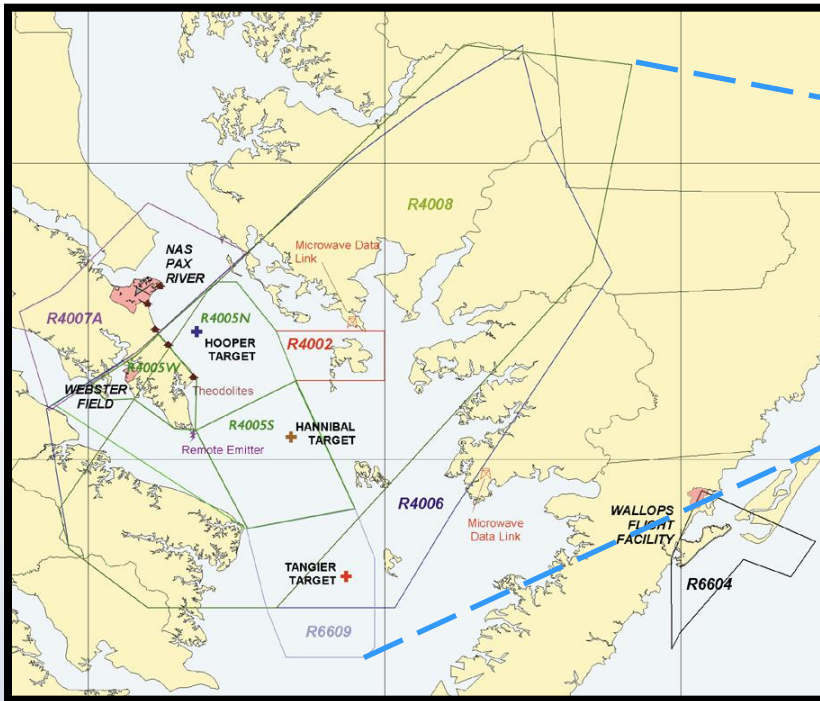
Questions?

*(If time permits – I have some back-up slides
might be of interest to the group that were
cleared for public release and are part
of the FCC Public Notice for AWS-3)*

Patuxent River Special Use Restricted Airspace

Chesapeake Test Range
Approximately 2,700 square miles
Surface to 85,000 feet

Offshore Atlantic Ranges
Approximately 50,000 square miles
Surface to unlimited altitude



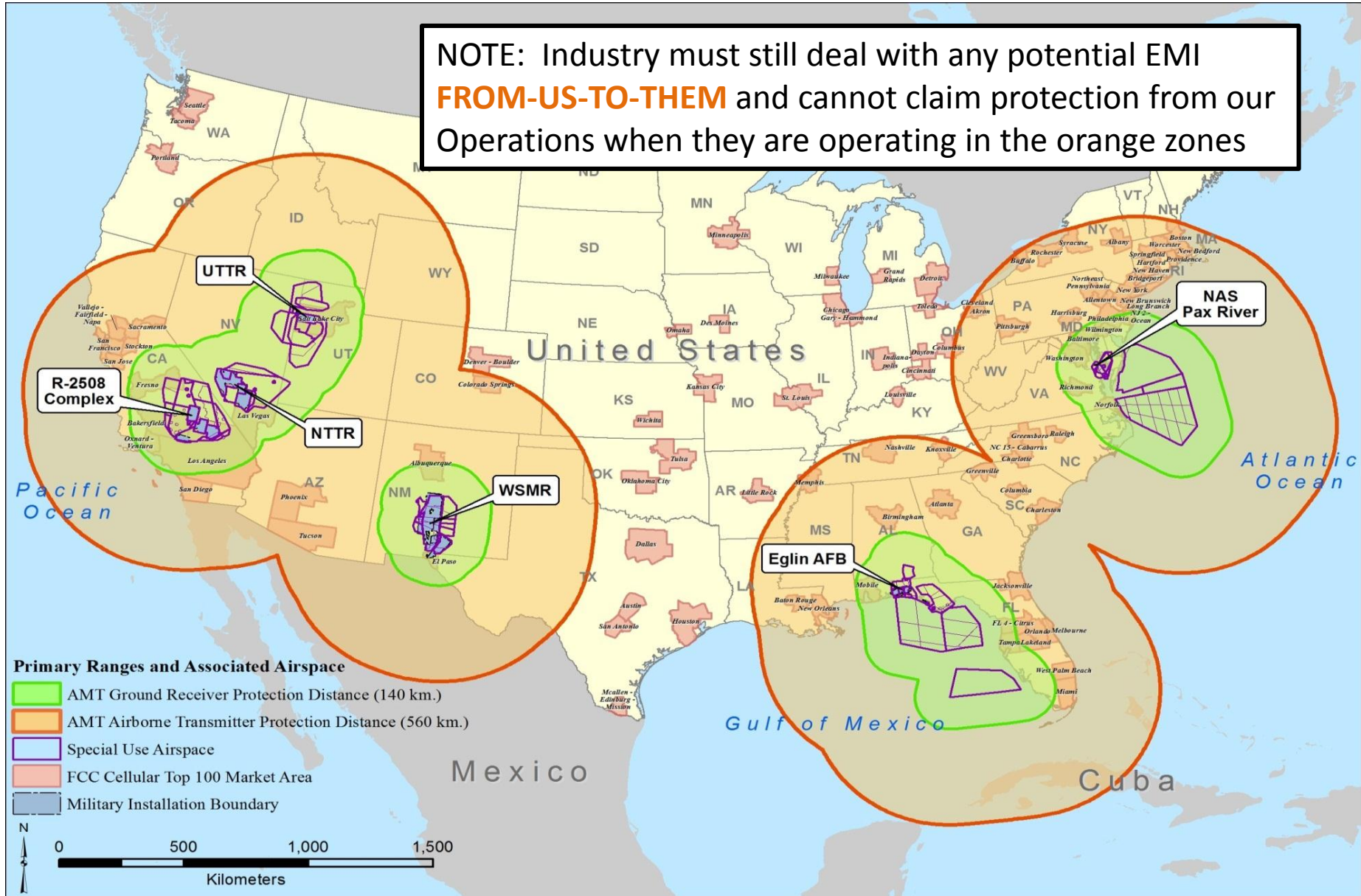
China Lake and Point Mugu Special Use Restricted Airspace

**China Lake (Land range)
Point Mugu (Sea Range)
Approximately 56,000 square miles
Surface to unlimited**



AMT Receiver Coordination Distances – Initial

NOTE: Industry must still deal with any potential EMI **FROM-US-TO-THEM** and cannot claim protection from our Operations when they are operating in the orange zones



AMT Receiver Coordination Distances – Post 5 Year Plan

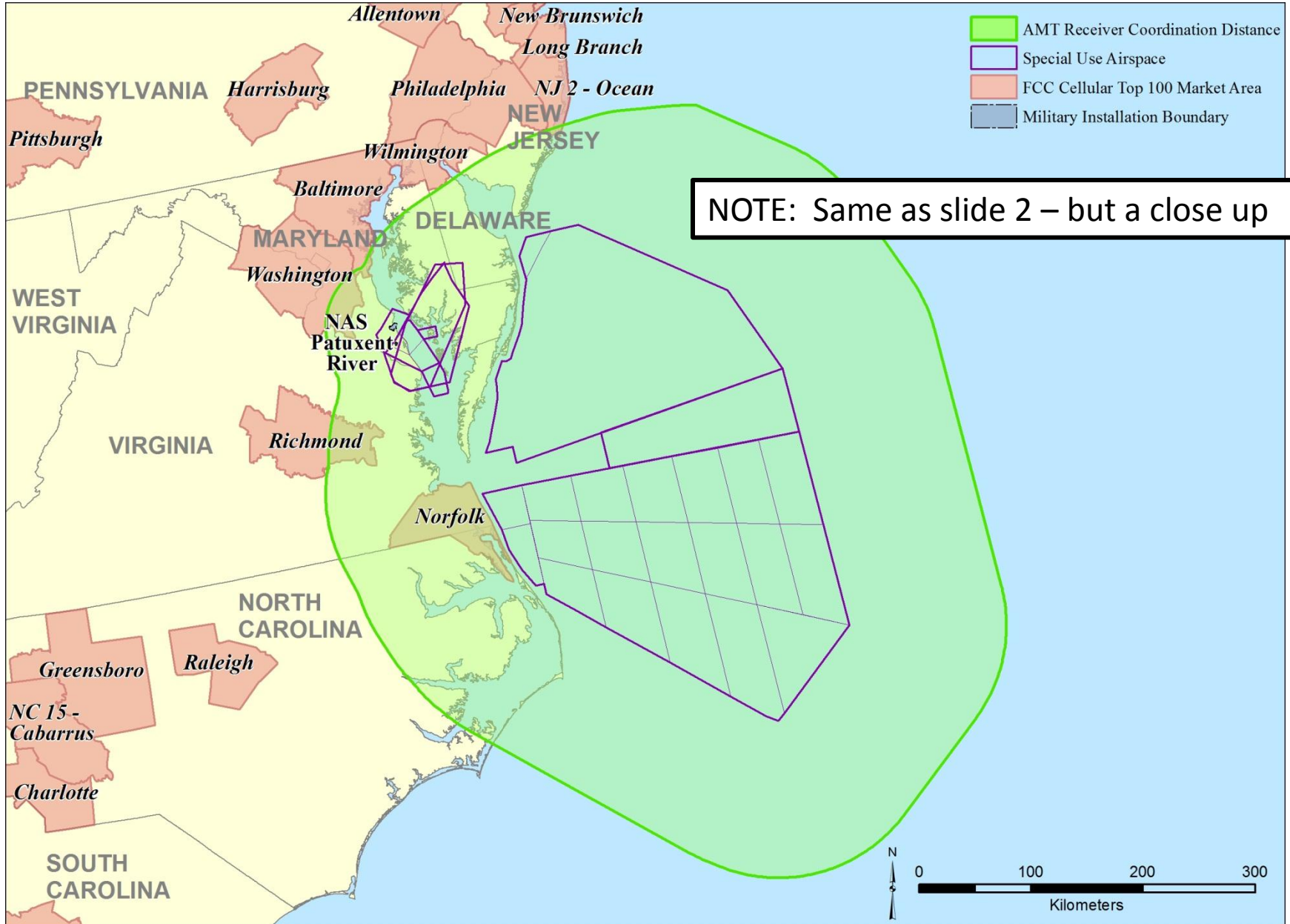
NOTE: These are the new AMT “coordination zones” that resulted from a deep-dive with industry to try and reduce the large AMT exclusion zones. Industry will not be allowed to place any cell towers or mobile handsets in the green zones without prior coordination in order to eliminate any possibility of interference **FROM-THEM-TO-US**.

(These distances are measured from the boundary of our military controlled airspace vice from the boundary of the authorized area of mobility within the actual frequency assignment)

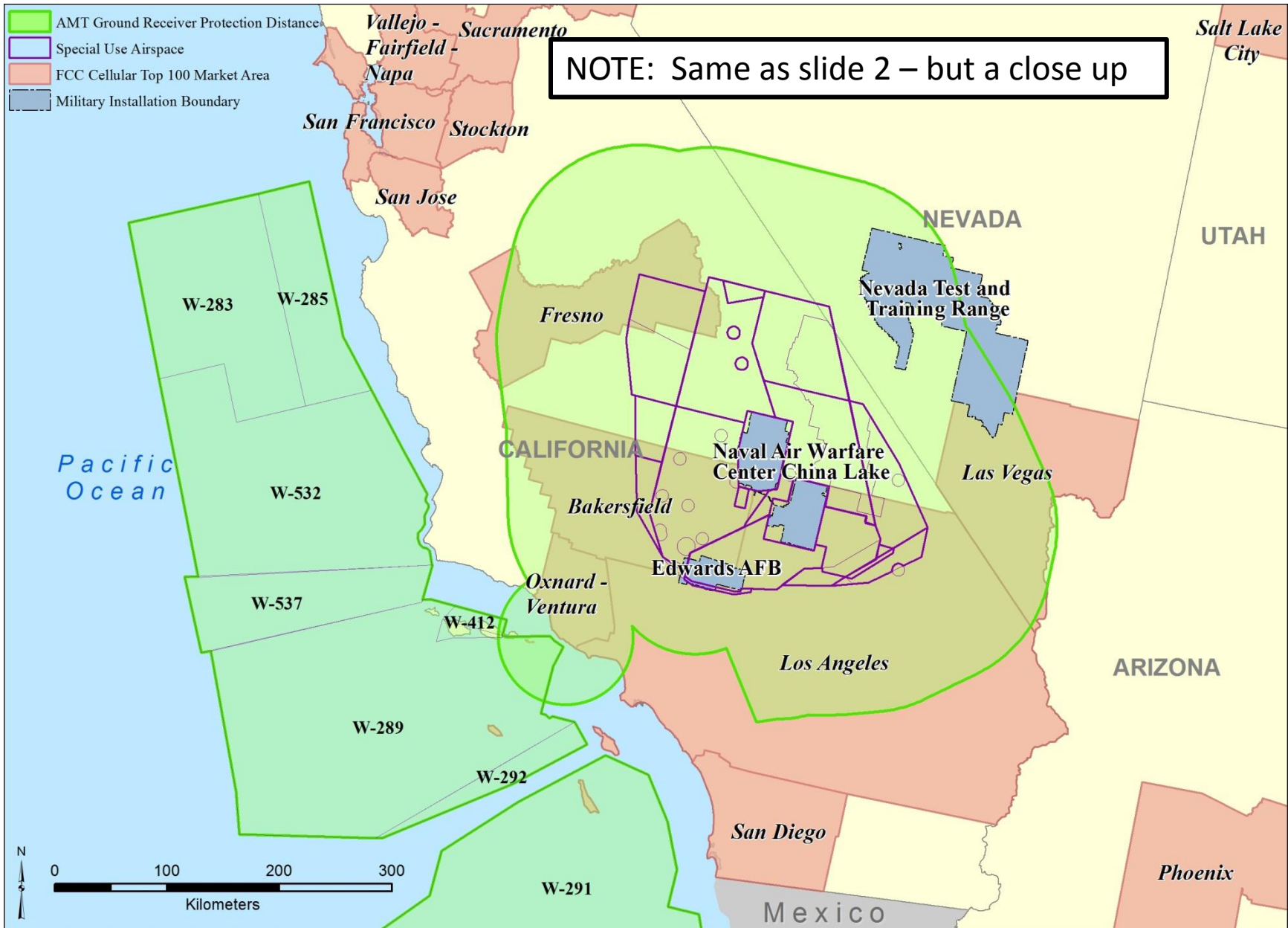


***NOTE: Coordination is also required on all off-shore islands in Southern CA (e.g., Channel Islands, Catalina Island)

Northeast - AMT Receiver Coordination Distances - Five and Ten Year Plans



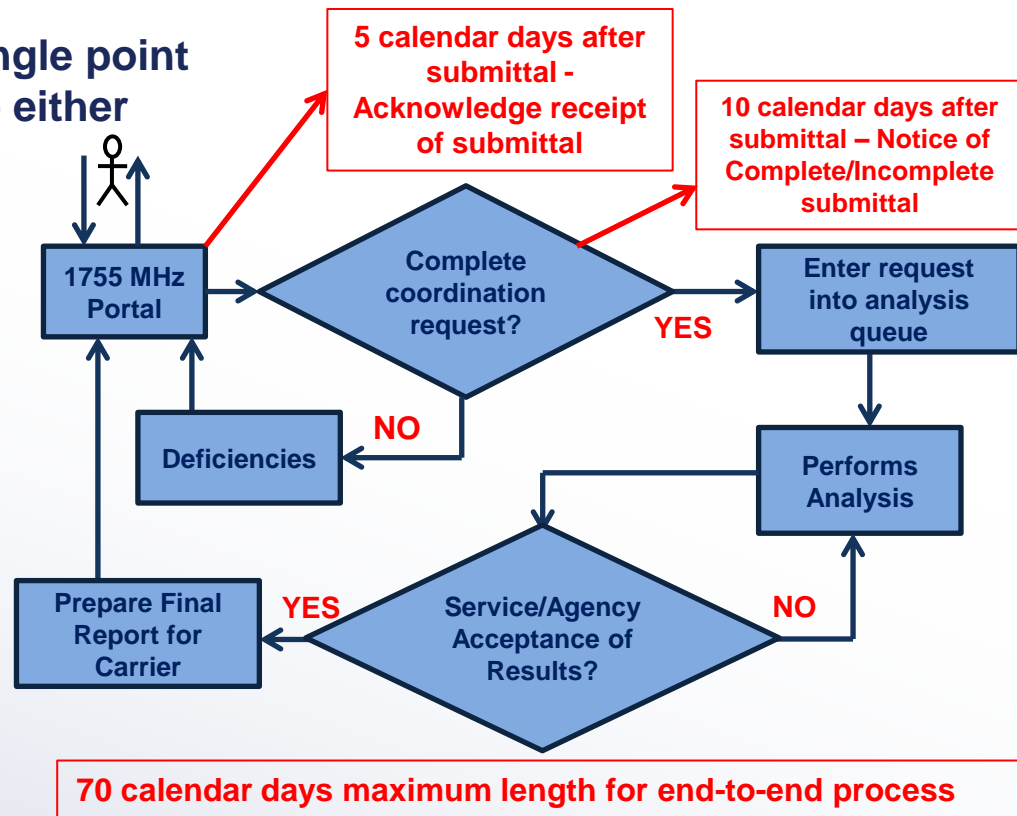
West Coast - AMT Receiver Coordination Distances - Five and Ten Year Plan



**** NOTE: Coordination is also required on all off-shore islands (e.g., Channel Islands, Catalina Island)

AWS-3 Portal Overview

- FCC Public Notice (DA 14-1023, July 18, 2014) provided guidance regarding coordination between Federal and non-Federal shared use for AWS-3. Coordination will be done through portals
 - The ITS Portal will support coordination for all Federal incumbents in the 1695-1710 MHz band
 - The DoD Portal will support coordination for all DoD incumbents in the 1755-1780 MHz band and may over time accommodate other Federal incumbent systems
- On-going discussions to enable a single point of entry which would then split off to either the 1755 band or the 1695 band
- Portals to be operational ~9 months after auction closing
- Federal agencies have 70 calendar days to coordinate with internal entities, complete EMC analysis, and post the AWS-3 concurrence, partial concurrence with operating conditions, or denial
- Users manual will be provided



Testing

- **DoD Spectrum Sharing Test and Demonstration (SST&D) Program established to further assess and validate engineering models**
- **DoD will continue to work with industry to explore ways to increase access to the 1755-1780MHz band as early as possible through forward-leaning techniques for sharing the band during transition period and beyond**
- **Testing will begin as early in the process as possible to inform engineering models and analysis**
 - **Validate assumptions regarding clutter, thresholds, etc.**
- **National Advanced Spectrum and Communications Test Network (NASCTN)/Center for Advance Communication in Boulder, Colorado to support effort**