

**Defense Spectrum Organization (DSO)  
Department of Defense (DOD) Chief Information Officer (CIO)  
Transition Plan for the 1755-1780 MHz Band**

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**Certification regarding Classified and Sensitive Information:**

I, Timothy G. Sullivan, certify that this transition plan is cleared for release to the public and contains no classified or sensitive information.

**SULLIVAN.TIMOTHY.G.10**  
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DN: c=US, o=U.S. Government, ou=DoD, ou=PKI,  
ou=DISA, cn=SULLIVAN.TIMOTHY.G.1013585098  
Date: 2014.06.26 14:52:06 -0400

**Name: Timothy G. Sullivan**  
**Title: Chief of Security and Counterintelligence**  
**Organization: DISA Manpower, Personnel and Security**

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DOD Transition Plan for 1755-1780 MHz Band

Tab B: General Information

1	This Transition Plan includes pre-auction planning costs, as defined in Section O.2 of Annex O:		
	a. Total pre-auction planning costs:		\$23.900
	b. The subtotal amount, if any, of pre-auction planning costs requested for pre-auction transfer:		\$17.444
	c. The subtotal amount, if any, of pre-auction planning costs incurred after June 28, 2010, but before February 22, 2012:		\$2.544
	d. This organization attests that:		
	[1] To the fullest extent possible, this transition plan provides for sharing and coordination of eligible frequencies with non-federal users, including reasonable accommodation for the use of eligible frequencies by non-federal users during the transition period.	Yes	
	[2] This transition plan provides for non-federal users to be able to use eligible frequencies during the transition period in geographic areas where this organization does not use such frequencies.	Yes	
	[3] During the transition period, this organization will make itself available for negotiation and discussion with non-federal users not later than 30 days after a written request.	Yes	
	[4] During the transition period, this organization will make available to a non-federal user with appropriate security clearances any classified information regarding the relocation process, on a need-to-know basis.	Yes	
	[5] (Only applicable if the amount in 1b above is greater than \$0.00.) Funds transferred before an auction likely allow for timely implementation of relocation or sharing, thereby increasing net expected auction proceeds by an amount not less than the time value of the amount of funds transferred.	Yes	
2	There is additional information required to be included in the Transition Plan that is not included in this document because it is classified information, as defined in Section O.7 of Annex O.	No	
3	There is additional information required to be included in the Transition Plan that is not included in this document because it is sensitive information, as defined in Section O.7 of Annex O.	No	
4	a. Name of Responsible Officer: Robert Higginbotham		
	b. (Optional) Office: Defense Information Systems Agency (DISA)/Defense Spectrum Organization (DSO)		
	c. (Optional) Telephone Number:		
	d. (Optional) E-mail: robert.l.higginbotham23.civ@mail.mil		
5	Total Transition Plan Cost (\$M):		\$247.000

DOD Transition Plan for 1755-1780 MHz Band

Tab C: Abstract

Serial Number	Center Freq./ Lower Band Limit (MHz)	Upper Band Limit (MHz) (if appl)	Emission Bandwidth (20 dB) (MHz)	Rx IF Bandwidth (3 dB) (MHz)	Bureau	System Use	System Name	Authorized Area of Operation	TX State	TX Latitude	TX Longitude	RX State	RX Latitude	RX Longitude	Sharing/ Relocation	Alternate Frequency Assignment	Transition Timeline (Months)
<p>In accordance with Title 10, U.S.C. Section 111, which states that the DoD is an Executive Department of the United States and composed of the Department of the Army, the Department of the Navy, and the Department of the Air Force and Title 47 U.S.C., Section 923 which defines “eligible federal entities” and “eligible frequencies”, the DoD submits the enclosed DISA Transition Plan for costs related to “planning for or managing a relocation or sharing arrangement (including spectrum coordination with auction winners)”. Authorized use of the eligible band is documented in the Services' Plans.</p>																	

DOD Transition Plan for 1755-1780 MHz Band  
Tab D: Transition Timeline

Serial Number	Geographic Location	Timeline (Months after Transition Start)		
		Temporary Sharing	Indefinite Sharing	Vacate Assignment
N/A	N/A	N/A	N/A	N/A

DOD Transition Plan for 1755-1780 MHz Band  
 Tab E: Plan and Timeline for using Funds (SRF)

System Name	System ID	Total Pre-Auction Costs (\$M)	Pre-Auction Transfer Requested (\$M)	Pre-Auction Costs Incurred between 6-28-2010 and 2-22-2012	Equipment-Related Costs (\$M)	Deployment-Related Costs (\$M)	Total Cost for System (\$M)	Begin Expenditure of Funds	End Expenditure of Funds	Costs Associated with Expanded Capability	Description of Expanded Capability	Explanation/ Justification
1755-1780 MHz Band Portal (Early Entry Portal)	DISA1	0.600	0.600	0.000	0.000	20.100	\$ 20.700	0	84			An automated interface between Fed and industry to exchange coordination data for sharing arrangements. Includes business process; enhancing analysis models relative to LTE; visualization; and performing the engineering analysis. Required to enable and expedite deployment of wireless services in the 1755-1780 band prior to DoD being able to vacate. Funds documented in this Transition Plan to be provided to DISA to conduct this initiative through 2021. The function will migrate to NTIA under FSMS (DISA 2) beginning in 2022 (See Tab I for Additional Details)
1755-1780 MHz Band Portal (FSMS Portal)	DISA2	0.000	0.000	0.000	0.000	22.900	\$ 22.900	6	84			Migrate the Early Entry Portal into NTIA's FSMS capability for indefinite sharing coordination. Required for NTIA, as the Federal regulator, to facilitate and improve upon permanent sharing arrangements between Fed and wireless. (See Tab I for Additional Details) Funding documented in this Transition Plan to be provided to DISA for implementation of this initiative through 2021. NTIA will assume funding responsibility beginning in 2022.

DOD Transition Plan for 1755-1780 MHz Band  
 Tab E: Plan and Timeline for using Funds (SRF)

System Name	System ID	Total Pre-Auction Costs (\$M)	Pre-Auction Transfer Requested (\$M)	Pre-Auction Costs Incurred between 6-28-2010 and 2-22-2012	Equipment-Related Costs (\$M)	Deployment-Related Costs (\$M)	Total Cost for System (\$M)	Begin Expenditure of Funds	End Expenditure of Funds	Costs Associated with Expanded Capability	Description of Expanded Capability	Explanation/ Justification
1780-1850 MHz Band Compression and Optimization Tool	DISA3	1.800	1.800	0.000	0.000	24.900	\$ 26.700	0	120			An engineering tool to evaluate freq assignment options (en masse) within a band – allows whole bands to be repacked relatively quickly in order to facilitate optimal spectrum usage of the band. This capability will be integrated into SXX1-O (and FSMS) as the standard for frequency assignments nominations. Required for enabling DoD systems in the 1755-1780 band to relocate in a timely fashion (especially in the case of compressing into the 1780-1850 band). (See Tab I for Additional Details) Funds to be provided to DISA for implementation this initiative.



DOD Transition Plan for 1755-1780 MHz Band  
 Tab E: Plan and Timeline for using Funds (SRF)

System Name	System ID	Total Pre-Auction Costs (\$M)	Pre-Auction Transfer Requested (\$M)	Pre-Auction Costs Incurred between 6-28-2010 and 2-22-2012	Equipment-Related Costs (\$M)	Deployment-Related Costs (\$M)	Total Cost for System (\$M)	Begin Expenditure of Funds	End Expenditure of Funds	Costs Associated with Expanded Capability	Description of Expanded Capability	Explanation/ Justification
2025-2110 MHz Band Spectrum Management System	DISA4	0.600	0.600	0.000	0.000	42.200	\$ 42.800	0	120			This capability provides the necessary tools for co-existence between DoD systems and other services (e.g., ENG) in the 2025-2110 MHz band. Includes business process; visualization; enhancing analysis models; interference mitigation testing; interference monitoring; enforcement agreements; and usage thru 10 years. / Required to relocate DoD systems from 1755-1780 to 2025-2110 band, which requires the ability to coexist with incumbents and future non-federal users. (See Tab I for Additional Details) Funds to be provided to DISA for implementation of this initiative.

DOD Transition Plan for 1755-1780 MHz Band  
 Tab E: Plan and Timeline for using Funds (SRF)

System Name	System ID	Total Pre-Auction Costs (\$M)	Pre-Auction Transfer Requested (\$M)	Pre-Auction Costs Incurred between 6-28-2010 and 2-22-2012	Equipment-Related Costs (\$M)	Deployment-Related Costs (\$M)	Total Cost for System (\$M)	Begin Expenditure of Funds	End Expenditure of Funds	Costs Associated with Expanded Capability	Description of Expanded Capability	Explanation/ Justification
1755-1780 MHz Band Spectrum Sharing Test & Demonstration (SST&D) Program	DISA5	11.400	11.400	0.000	19.400	75.100	\$ 105.900	0	66			<p>A test program to assess, improve, and demonstrate spectrum sharing between LTE and DoD systems in the 1755-1780 MHz band. Includes testing to characterize interference; evaluating existing and future mitigation techniques available to LTE devices; and demonstrating the value of a coordination database approach. / Required to provide the verification needed by both the DoD and Industry that interference due to sharing (temporary and permanent) in the 1755-1780 band will be minimized; and to enable reduction of sharing arrangement restrictions thus facilitating early entry and permanent sharing with DoD. (See Tab I for Additional Details)</p> <p>Funds to be provided to DISA for implementation of this initiative.</p>

DOD Transition Plan for 1755-1780 MHz Band  
 Tab E: Plan and Timeline for using Funds (SRF)

System Name	System ID	Total Pre-Auction Costs (\$M)	Pre-Auction Transfer Requested (\$M)	Pre-Auction Costs Incurred between 6-28-2010 and 2-22-2012	Equipment-Related Costs (\$M)	Deployment-Related Costs (\$M)	Total Cost for System (\$M)	Begin Expenditure of Funds	End Expenditure of Funds	Costs Associated with Expanded Capability	Description of Expanded Capability	Explanation/ Justification
DoD Spectrum Relocation Management Team (DSRMT) / Pre-auction studies leading to Transition Plan	DISA6 / DISA7	9.500	3.044	2.544	0.000	18.500	\$ 28.000	0	120			Government personnel needed to oversee the DoD initiatives (DoD1 through DoD5): 2 FTEs for DISA1; 2 FTEs for DISA5; 1 FTE for each of DISA2, 3, and 4; and a group lead, admin support, and documentation support for DISA6. (See Tab I for Additional Details) Funding documented in this Transition Plan to be provided to DISA for implementation of this initiative i.e., management of the DoD reallocation. DoD/DISA funding within this initiative related to the oversight of DoD initiatives DISA1 and DISA2 ceases at the end of 2021 as NTIA will take on that responsibility beginning in 2022. Costs incurred since June 2010 for conducting feasibility studies and planning leading to the 1755-1780 auction. (See Tab I for Additional Details) Funds to be provided to DISA.

DOD Transition Plan for 1755-1780 MHz Band

Tab F: NTIA Interactions

<b>Interaction required with NTIA to implement this Transition Plan</b>	
1	<p><b><u>Spectrum Certification:</u></b> This Transition Plan is based on the DoD Alternative Proposal for the 1755-1780 MHz band. As part of the Transition Plan, some DoD systems will be modified to operate in both the 1780-1850 MHz and the 2025-2110 MHz bands, while other systems will be modified or replaced and relocated to operate in other bands. All modified equipment will be required to undergo the spectrum certification process through the NTIA Spectrum Planning Subcommittee (SPS) IAW OMB Circular A-11, Section 31.12(c). This certification is required before agencies can "submit estimates for the development or procurement of major radio spectrum-dependent communications-electronics systems". The spectrum certification process through the NTIA Spectrum Planning Subcommittee can require months to complete for routine equipment developments. It is anticipated that due to the numerous concurrent certification requests required to enable the modification and/or replacement of the systems identified in the DoD and other agencies' Transition Plans, there is the potential for a significant backlog within the SPS process leading to extended timelines for programs to receive approved spectrum certifications. It should also be noted that the spectrum certification process is required at each stage of a program's development and thus some of the modified or relocated systems may be required to undergo the SPS review process multiple times. These interactions will begin soon after this Transition Plan is approved and will continue until all affected systems receive spectrum certification approval from the SPS.</p>
2	<p><b><u>Frequency Authorization:</u></b> All systems that require either different frequency assignments in the 1780-1850 MHz band, or new authorizations to operate in the 2025-2110 MHz frequency band or other federal bands will have to complete the frequency authorization process. It is understood that NTIA intends to essentially "reserve" frequency assignments in the alternate spectrum bands based on the data provided in this Transition Plan; however, the formal frequency authorization process through the NTIA Frequency Assignment Subcommittee (FAS) must still be completed and this must occur subsequent to the associated SPS certification process for the systems/equipments and prior to actual operations in the alternate bands and verification/validation of comparable technical capability. These interactions will begin soon after this Transition Plan is approved and will continue until all affected systems become operational in dual or alternate frequency bands as defined by the Transition Plan.</p>
3	<p><b><u>Integration of DoD Portal into NTIA FSMS:</u></b> As described in Tab I, the DoD coordination portal capability will be integrated in the NTIA FSMS over time. This integration process and effort will require significant interactions between DoD and NTIA.</p>

DOD Transition Plan for 1755-1780 MHz Band  
Tab G: Identification of Excluded Classified and Sensitive Information

Serial Number	Description of Classified or Sensitive Information	Reason for Exclusion	Reference
	None		

DOD Transition Plan for 1755-1780 MHz Band  
 Tab H: Factors that could Impact Fulfillment of Transition Plan

	<b>Factor</b>	<b>Impact on Fulfillment of Transition Plan</b>
1	Availability of Spectrum Relocation Fund (SRF) Funding	All timelines in this plan are based on the assumption that funding will be received three months after the close of the auction. Should the receipt of funds change, timelines may need to be adjusted accordingly.
2	Availability of Frequency Assignment Authorizations	This Transition Plan is based heavily on the DoD Alternative Proposal and its success is critically dependent on the interaction of a number of interdependent elements including those activities of other federal agencies (e.g. DOJ Transition Plan). A number of these elements involve either replacing or modifying systems that will operate in alternate frequency bands. There will be a very large number of new frequency authorizations required in order to support the new operations. New authorizations must be in place prior to existing operations being able to be terminated from the 1755-1780 MHz band. Given the large number of new frequency proposals that must be worked through the process and completed, there is concern that all necessary actions can be completed in time to support all of the new operations.
3	Licensee Coordination With DoD organizations	To preclude any misunderstanding or misinterpretation, potential licensees must be advised that the DoD will provide direction to the military Services and other defense agencies to refer all requests for spectrum relocation information initiated by commercial wireless providers or their agents to the DoD CIO, Spectrum Policy and Program Directorate. The DoD CIO will establish a single focal point that will be responsible for establishing and overseeing procedures to facilitate information exchange between the DoD and wireless licensees. This single focal point is planned to be the DSO Early Entry Portal (DISA-1) described in Tab I (Additional Information).

# DOD Transition Plan for 1755-1780 MHz Band

## Tab I: Additional Information

### Additional Information addressing DISA initiatives DISA-1 through DISA-7

#### Executive Summary - DISA Initiatives

The Defense Information Systems Agency (DISA) will be responsible for overseeing and reporting the implementation of the DoD Transition Plan. As such, DISA will establish a team within the Defense Spectrum Organization (DSO) to coordinate activities among the Services; to coordinate interaction between the wireless industry and the Services; and to conduct engineering (i.e., analysis, modeling, test, and demonstration) activities to facilitate increasingly less restrictive sharing arrangements for both early entry and permanent spectrum sharing. In addition, the team will develop the spectrum management/coordination capabilities needed to facilitate the relocation of DoD operations from the 1755-1780 MHz band into the agreed upon destination bands (e.g., 1780-1850 MHz, 2025-2110 MHz, etc). These DSO activities do not alleviate the responsibility for the Services to account for their increased efforts that are required to support the management of the frequency assignment changes and to provide the approval of the coordination recommendations of DISA for their Service.

The coordination capabilities consist of developing and operating a 1755-1780 MHz Early Entry Portal, a 1755-1780 MHz FSMS Portal for use by NTIA, and a 2025-2110 MHz Spectrum Management/Coordination System (SM/CS). The Early Entry Portal will support the wireless services entering the 1755-1780 MHz band during the transition of the DoD systems from the band. The objectives of the Early Entry Portal are to provide an efficient way to coordinate early entry LTE deployment designs from industry, and to vacate assignments consistent with the proposed timelines for each assignment. The portal will support the performance of accurate analyses to assess the potential for interference with current DoD operations, coordination of results with the Service and provide the results back to the submitting carrier in a timely fashion. All wireless deployments will be registered and maintained in the DoD Early Entry Portal. This is necessary to consider aggregate interference from all carriers as background Electromagnetic Environment (EME) records when addressing proposed early entry deployment designs. Proposals to deploy will also provide the trigger for DoD systems to vacate assignments. This will allow systems to remain in the 1755-1780 MHz band in regions where there is little or no commercial interest, consistent with Commerce Spectrum Management Advisory Committee's (CSMAC) Working Group recommendations. CSMAC protection distances will be used to establish initial coordination zones within which wireless deployments must coordinate for early entry.

The FSMS Portal will be designed for long-term sharing vice early entry activities. Functionality will be similar to the early entry portal except that early entry analyses performed by engineering personnel will be replaced under the FSMS portal by automation. The analysis and report are prepared automatically. The 2025-2110 MHz band SM/CS capability will be a web-based tool to be used by the Broadcast Auxiliary Service (BAS) Electronic News Gathering (ENG) and DoD users to facilitate sharing the band. Given that DoD will be entering the band as a co-primary user, it is essential that access is as painless as possible for the incumbents. Therefore DoD plans to provide a state-of-the-art, user friendly, fast, spectrum management tool to facilitate band sharing.

The engineering activities needed to assess the potential for interference with current DoD operations will inform sharing arrangements proposed for coordination between: wireless services and DoD systems in the 1755-1780 MHz band; DoD systems and ENG (and other incumbents) in the 2025-2110 MHz band; and DoD systems being compressed into the 1780-1850 MHz band. These activities involve significant analysis, modeling, test, and demonstration in order to prove the viability of both temporary and permanent sharing with DoD systems. The activities address interference thresholds to be used, capabilities to rapidly optimize frequency assignment nominations (i.e., repack) within congested environments, and identification of interference mitigation techniques.

Each of the activities DISA is requesting to be funded via the 1755-1780 MHz auction is described below. For each activity a brief description, objective, approach, cost (per FY), and schedule is provided. Each of the activities will be necessary in order to successfully implement the DoD Alternate Proposal \* for accommodating wireless services in the 1755-1780 MHz band; and collectively they are designed and scheduled to expedite wireless deployments while also reducing the risk to DoD operations. It should be noted that the methods, techniques, and information gained, as well as the spectrum sharing "infrastructure" that is developed from these activities will be extensible to other bands, thus will support future sharing arrangements between wireless services and DoD operations.

# DOD Transition Plan for 1755-1780 MHz Band

## Tab I: Additional Information

### Additional Information addressing DISA initiatives DISA-1 through DISA-7

#### DISA 1: 1755 – 1780 MHz Early Entry Portal

1.0 Background. The auction of the 1755-1780 MHz band is currently scheduled for the end of FY14. DoD agencies have submitted transition plans that indicate vacating the band will take from 5 to 10 years, after the auction. However, DoD will face tremendous pressure to allow the wireless industry to obtain early access well before transition to alternative spectrum is complete. DoD must develop a methodology for being responsive to industry requests for early access, yet one that ensures that critical DoD test and training capabilities are protected. To address similar challenges associated with the 2006 auction of the 1710-1755 MHz band, the DoD created a web-based portal under the Defense Spectrum Relocation Management Activity (DSRMA), through which wireless industry requests for early entry could be received. Once the information was received via the portal, a team of engineers performed analyses to determine if restrictions on the wireless deployment were needed to mitigate interference to/from DoD systems. These results were then provided to industry via the portal. Therefore, the DSO proposes that a similar construct be used for the 1755-1780 MHz band effort. This capability will be called the 'Early Entry Portal' and will consist of a web-based interface for information exchange, improved engineering algorithms, visualization tools, and conducting analyses. By developing this capability, early access to the 1755-1780 band can be accelerated, ultimately increasing revenues to the federal government.

2.0 Objective. The objectives of the Early Entry Portal are to provide an efficient way to assess and coordinate early entry LTE deployment designs from industry, and to track and trigger assignment vacation consistent with the proposed timelines for each assignment.

3.0 Approach. The DSO will stand up a web-based portal incorporating lessons learned from the DSRMA with updated workflow requirements. Existing tools will be used to perform early entry analyses while enhanced tools are being developed. The enhanced analysis tools would focus on improvements in fidelity and speed. Development would require:

- A comprehensive requirements definition stage with inputs from DoD and industry
- Construction of enhanced databases leveraging expertise and data from current DSO compression/relocation studies
- Reuse and enhancements of algorithms from Spectrum XXI Online, Engineering Services, and the Mass Relocation Tool
- Integration, testing, and validation

All wireless deployments will be registered and maintained in the DoD Early Entry Portal. This is necessary to consider aggregate interference from all carriers as background EME records when addressing proposed early entry deployment designs. Proposals to deploy outside designated coordination zones will also provide the trigger for DoD systems to vacate assignments. This will allow systems to remain in the 1755-1850 MHz band in regions where there is little or no commercial interest, consistent with Commerce Spectrum Management Advisory Committee's (CSMAC) Working Group recommendations. CSMAC protection distances will be used to establish initial coordination zones within which wireless deployments must coordinate for early entry. Applicable CSMAC protection distances were addressed by Working Groups 3, 4, and 5.

Work flow would allow for submission of wireless industry design, immediate feedback with maps illustrating tower lay down and consequential military bases and protection zones, and a request for confirmation that the design was properly uploaded. Work flow would progress to DSO engineers who would perform compatibility analyses using the enhanced analysis tools. Composite coverage charts would be generated to assist with analytical functions and to provide visualization to Service representatives who would review the results and provide approval or rejection. Upon confirmation with the Services, DSO engineers would post the results back to the portal with email notification to the submitting industry that the analysis was complete.

To improve analysis fidelity, results from the DISA 5 1755-1780 MHz Spectrum Sharing Test & Demonstration (SST&D) Program which will determine the susceptibility of LTE equipment to EMI from DoD equities, and the susceptibility of DoD assets to EMI from LTE equipment, will be used to determine interference thresholds used in early entry analyses.

Portal development will begin in Q4FY14. The objective is to have the Early Entry Portal available to begin coordination 12 months following the close of auction. The enhanced analysis tools will be available Q2FY16, with analyses performed using existing tools in the interim period. Software sustainment and engineering analyses will continue through FY218. NTIA will assume responsibility for sustainment funding beginning in 2022.



DOD Transition Plan for 1755-1780 MHz Band

Tab I: Additional Information

**Additional Information addressing DISA initiatives DISA-1 through DISA-7**

**DISA 2: 1755-1780 MHz FSMS Portal**

1.0 Background. To facilitate long-term sharing of the 1750-1780 MHz band where possible, the DoD proposes the development of a long-term sharing portal that will ultimately be integrated into NTIA's Federal Spectrum Management System (FSMS). This FSMS Portal will be designed for long-term sharing vice early entry activities. To preclude cost burdens to the DoD after expiration of the SRF, it will be fully automated and hosted by the NTIA and will be designed for integration into FSMS (the DSO is currently building the FSMS for NTIA). Functionality will be similar to the Early Entry Portal except that engineering users will be replaced by automation, a significant software development undertaking. Successful development and implementation of a fully automated web-application operated by the Federal Regulator will:

- Provide cost sharing opportunities between DOC and DoD
- Reduce long term costs for DoD after SRF are exhausted
- Leverage existing FSMS capabilities such as the cross domain solution

2.0 Objective. The objective of the FSMS Portal is to provide a platform through which frequency assignment requests can be processed in an automated and timely fashion, and that can be integrated into FSMS and hosted by the NTIA.

3.0 Approach. Portal design will commence upon availability of SRF and will include a requirements definition phase with inputs from the Services, NTIA, and wireless industry. The analysis tool would be developed using modules from Spectrum XXI Online (SXXIO), engineering services, the MRT, and the Early Entry Portal. A substantial effort will involve decisions involving tradeoffs between schedule, functionality, and fidelity. Enhanced databases developed for the Early Entry Portal and previous spectrum relocation/compression analyses will be converted to Pub 8 format for use by the analysis tools. Periodic releases will be provided and integration tested with current releases of FSMS.

While work on the FSMS Portal will begin Q1FY16, it will leverage the algorithms developed in support of the Early Entry Portal, and the DISA 3 activity (i.e., 1780-1850 MHz Compression and Optimization Tool). It will be used by both the DoD and the wireless industry to coordinate frequency requests for shared spectrum. Functionality will be similar to the Early Entry Portal except that engineering users will be replaced by automation. The analysis and report are prepared automatically. FOC is planned for Q3FY20.

To improve analysis fidelity, results from the DISA 5 (LTE Spectrum Sharing Technology) effort which will determine the susceptibility of LTE equipment to EMI from DoD equities, and the susceptibility of DoD assets to EMI from LTE equipment, will be used to establish interference thresholds.

SRF funded sustainment activities will last through FY21. NTIA will assume responsibility for ongoing funding beginning in FY22.

## DOD Transition Plan for 1755-1780 MHz Band

### Tab I: Additional Information

#### Additional Information addressing DISA initiatives DISA-1 through DISA-7

##### DISA 3: 1780 – 1850 MHz Compression and Optimization Tool

1.0 Background. While some of the DoD equities will be relocating to alternative spectrum, one of the keys to successful implementation of DoD's Alternative Plan is compression of many systems into the upper 70 MHz of the 1755-1850 MHz band and to optimize frequency use in the 2025-2110 MHz band.

The DSO has developed an engineering prototype tool—the Mass Relocation Tool (MRT), which has been successfully used by DSO engineers to evaluate the feasibility of compressing/relocating whole classes of systems to alternative spectrum. As an engineering prototype, usage requires experts and knowledge of scripting routines to extract datasets for manual analysis. To perform the many compression/optimization studies required for successful implementation of the DoD's Alternate Proposal, enhancements to the MRT will be necessary. Such enhancements will include adding visualization tools to decrease analysis time and increase reporting capabilities, making the MRT more user-friendly to allow for its use by other than expert users, and adding capabilities and optimization algorithms.

The ability to perform repacking/relocation studies rapidly will provide spectrum engineers the ability to rapidly evaluate alternative spectrum plans to address reduced spectrum availability and to improve spectral efficiency so as to increase DoD's access to this critical resource. Critical to performing accurate repacking studies is a comprehensive knowledge of the susceptibility of DoD assets to electromagnetic interference so that accurate interference thresholds can be established and used by the MRT. This will require a rigorous testing program to establish these interference thresholds. Moreover, spectrum monitoring activities will assist with efforts to validate the effectiveness of EMI deconfliction and to validate model accuracy.

2.0 Objective. The objectives of the 1780-1850 MHz Compression and Optimization Tool effort are to perform EMI measurements for the development of precise interference thresholds for DoD equipment, to develop the MRT from a prototype analysis tool into a robust, user friendly platform that will be used to perform compression/optimization studies, and to perform these studies to ensure successful implementation of the DoD's Alternative Plan.

3.0 Approach. DSO engineers will develop a test matrix to prioritize testing efforts to determine appropriate interference thresholds for various DoD equities including SUAS, ACTS, AMT, TTNT, et al. To reduce cost, DSO will leverage equipment acquisition from the DISA 5 1755-1780 MHz Spectrum Sharing Test & Demonstration (SST&D) Program. Comprehensive test plans and procedures will be developed and coordinated with stakeholders prior to conducting the tests. Tests will be performed and the results will be documented and coordinated with appropriate stakeholders. Testing will include the determination of receiver selectivities, emission spectra, and interference susceptibility levels for waveforms that simulate the emissions from other DoD equities. The interference thresholds determined during the testing will be used by the MRT for spectrum compression/optimization studies.

The MRT will be converted from an engineering prototype tool into a user friendly platform from which band compression/spectrum optimization studies may be conducted. Enhancements/engineering algorithms developed under DISA 1 will be reused where possible. Work will begin with an extensive requirements definition task. Multiple database/algorithm optimizations will be included to improve run times. Much of the optimization will focus on the reuse of calculations as spectrum relocation studies are computationally intensive. Various hardware configurations will be evaluated to improve speed. Substantial effort will be placed on adding visualization tools and adding intuitive user friendly GUIs to improve user productivity and increase reporting capabilities. The software will be rigorously tested, with periodic releases provided throughout the sustainment cycle.

Upon delivery of the FOC, analyses will be performed using the MRT and the interference thresholds obtained through the measurement effort to evaluate various spectrum repacking/optimization scenarios. Inputs from stakeholders (range personnel, frequency management offices, etc.) will be solicited such that spectrum repacking scenarios can be evaluated, not just from a spectral efficiency perspective, but also from an implementation and operational impact point of view. Concurrently with the software development efforts, spectrum monitoring activities will also be performed to validate analysis assumptions regarding the electromagnetic environment, and as spectrum compression implementation occurs, to validate the spectral efficiency improvements and model accuracy.

Work will begin in Q4FY14. FOC is scheduled for Q4FY19, with maintenance and spectrum repacking studies continuing through FY24. System measurements will be completed by Q2FY16 to facilitate spectrum repacking studies. Spectrum monitoring will occur through Q4FY18.

# DOD Transition Plan for 1755-1780 MHz Band

## Tab I: Additional Information

### Additional Information addressing DISA initiatives DISA-1 through DISA-7

#### DISA 4: 2025-2110 MHz Spectrum Management/Coordination System (SM/CS)

1.0 Background. Access to alternative spectrum is the cornerstone of DoD's Alternative Plan. Consequently, DoD plans to modify selected systems to operate in the 1780-1850 MHz and the 2025-2110 MHz band. The latter is primarily used by the Electronic News Gathering (ENG) service to relay news including video via fixed and mobile sites. Current FCC licensed functions operating in the band include intercity relay, studio-to-transmitter, TV translators, TV pickup Video, Data Return Links, and Earth Exploration Satellite Services (EESS). ENG transmitters may include mobile vans for on-the-scene reporting, and helicopters and blimps used for traffic reports and sporting events. Typical receiver functions may include one or more fixed receive sites in metro areas with antennas located on tall towers, buildings, and mountain tops and are typically high gain steerable antennas. For most cities, each TV station has uncoordinated use of one "home channel." For additional channels, or in non-home city assignments, ENG users typically perform a manual coordination process. Given that DoD will be entering the band as a co-primary user, it is absolutely essential that access is as painless as possible for the incumbents. Therefore DoD plans to provide a state-of-the-art, user friendly, fast, spectrum management tool to that:

- Provides access to alternative spectrum for critical DoD test and training operations
- Enables cooperation from incumbent users of the band

2.0 Objective. The objective of this effort is to provide a web-based spectrum management tool to be used by ENG and DoD users wishing to share the 2025-2110 MHz band. It must be fast, accurate, user friendly, and should simplify the process of frequency coordination..

3.0 Approach. DSO will develop business processes by working with the ENG community, NTIA, and FCC to facilitate establishment of coordination agreements, rules, interference resolution procedures, and enforcement. This will include:

- Tracking FCC proposed rulemaking activities, prepare/file comments and reply comments, and provide ex parte presentations to the FCC
- Identifying key organizations participating in rule making and make contacts, socialize DoD position and develop consensus approach
- Once rules are effected, coordinating with FCC licensees and organizations to develop efficient working relationships and problem resolution procedures

DSO engineers and DoD operations personnel will coordinate with ENG and DoD users of the band to develop a set of well-defined software requirements. DSO engineers will leverage appropriate modules from SXXIO, MRT, the ES, and DISA 1 (1755-1780 MHz Early Entry Portal), DISA 2 (1755-1780 MHz FSMS Portal) and DISA 3 (1780-1850 MHz Compression and Optimization Tool). Enhanced databases will be developed that contain DoD equipment characteristics, ENG equipment characteristics, and the specifications/characteristics for DoD equipment being redesigned to operate in the band. Visualization tools will be provided that include coverage maps and equipment density plots. Algorithms will be developed and coded, that will optimize run times and increase analysis fidelity. All capabilities will be integrated into a web-application for IOC release. Periodic releases will follow as required. DSO engineers will develop a test matrix to prioritize testing efforts to determine the susceptibility of DoD equities to EMI from ENG emitters and from DoD emitters to ENG receivers. Comprehensive test plans and procedures will be developed and coordinated with stakeholders prior to conducting the tests. Tests will be performed and the results will be documented and coordinated with appropriate stakeholders. Testing will include the determination of receiver selectivities, emission spectra, and interference susceptibility levels for waveforms that simulate the emissions from other DoD equities. The interference thresholds determined during the testing will be used by the MRT for spectrum compression/optimization studies. Prior to entry into the 2025 – 2110 MHz band, DSO will perform spectrum monitoring of the affected band to characterize the EME and compare the findings with FCC databases. Coordination with DSO operations branch will be accomplished to leverage lessons learned from on-going spectrum monitoring activities. As DoD's use of the band increases at various installations throughout CONUS, DSO will establish a spectrum monitoring team that will periodically conduct spectrum usage measurements to feed enforcement mechanisms and provide feedback for improvements in modeling capabilities. As the sharing program matures, the spectrum monitoring activities will be scaled back such that measurement/monitoring activities are only conducted following non-random incidents of EMI.

Outreach activities to the ENG community will begin in Q4FY14 with FOC scheduled for Q4FY20. Software sustainment/ maintenance will run through FY24.

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**Additional Information addressing DISA initiatives DISA-1 through DISA-7**

**DISA 5: 1755-1780 MHz Spectrum Sharing Test & Demonstration (SST&D) Program**

1.0 Background. A SST&D program is needed to prove the viability of both temporary and permanent sharing between LTE and DoD systems in the 1755-1780 MHz band. Such a program is responsive to the President's vision, and is consistent with CSMAC recommendations to "Develop a testing program to demonstrate the viability and effectiveness of interference protection/mitigation methods before commercial licensees commence deployments in Protection Zones." More importantly, testing is necessary to convince Federal system users and potential auction bidders that sharing is possible and that operational restrictions due to sharing arrangements can be minimized. The methods and techniques gained from 1755 MHz band experiments – and the Spectrum Sharing "infrastructure" that is developed will be extensible to other bands, and can demonstrate commercial LTE and Federal user co-use for future bands that will be auctioned.

2.0 Objective. The objectives of the SST&D program are to demonstrate near-term techniques that LTE can use to ensure compatibility during temporary sharing, thus accelerating early entry during the transition period and to facilitate less restrictive sharing arrangements for both early entry and permanent spectrum sharing by performing analyses of future techniques and subsequently influencing the development of future LTE standards.

3.0 Approach. To facilitate timely sharing between commercial and federal systems, the SST&D program will focus an initial, Pre-Auction Phase on baseline interference measurement and characterization. This phase will use existing DoD laboratory resources and test ranges, and COTS transportable LTE test capability. This Pre-Auction measurement phase will characterize interference between nominally configured LTE Release 10 equipment operating in the 1755-1780 MHz band (which is a subset of the E-UTRA operating bands 3 and 9, used internationally) and two of the legacy DoD 1755 MHz systems. The results and demonstration of this testing will advance the analysis done by the CSMAC working groups, and is expected to begin to demonstrate the potential viability of shared spectrum operation.

While initial interference characterization tests are being performed, integrated product teams (IPTs) will begin providing systems engineering oversight including requirements and metrics definition, mitigation strategy development and refinement, and test concept planning. Engineering teams will develop potential mitigation methods and perform initial analysis to inform the IPTs. The engineering teams will formulate test plans/procedures and develop needed simulators and emulators.

Fixed and mobile test range activities will include baseline testing with additional legacy DoD 1755 MHz equipment, and demonstration of candidate mitigation techniques. LTE vendors will be invited to participate on the IPTs. The SST&D program includes modest resources to develop and implement technical solutions of the most promising mitigation techniques using, for example, standards-based Application Program Interfaces (APIs) to implement optimized Self Organizing Network (SON) techniques without hardware modification or impact to compliance with 3GPP standards.

The SST&D program also includes a plan to prototype two methods to share usage data information between the commercial LTE systems and legacy DoD systems in order to demonstrate potential benefit (e.g. reduced separation requirements) of cooperative sharing: 1. A secure database approach with obfuscation that interfaces directly into the LTE system Core Network to adjust LTE UE transmissions to minimize interference, and 2. A spectrum sensing technique to automatically adjust LTE UE transmissions based on sensing legacy DoD system transmissions.

FY14 activity funded under Pre-Auction Planning rules, will develop initial test bed capability, and do preliminary testing with one high priority legacy Federal 1755-1780 MHz systems prior to the 2014 auction. FY15-FY18 activity will include completion of full scale mobile test capability, integration at DoD and Federal test ranges, S/W Radio modeling and implementation of future LTE capabilities, and spectrum database/sensing pilot development and demonstration.

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**Additional Information addressing DISA initiatives DISA-1 through DISA-7**

**DISA6: DoD Spectrum Relocation Management Team (DSRMT)**

1.0 Background. There is no existing organizational entity with the mission or resources to provide integrated oversight of Service relocation efforts; tracking, monitoring, and reporting the progress of DoD's relocation efforts; and managing the geographically based interaction with the wireless industry to accomplish the transition of DoD systems out of the affected band and enable early entry and a rapid national build-out of wireless services. Having a single focal point for these functions proved critical during the last relocation effort (1710-1755 MHz band) and will be even more critical for the 1755 1780 MHz band due to the complexity of the course of action required to reallocate this band.

2.0 Objective. The objective of this effort is to establish the DoD Spectrum Relocation Management Team (DSRMT) within the DISA Defense Spectrum Organization in order to provide a single focal point for interface to NTIA, OMB, and Industry; facilitating the requests for and release of SRF funds; responding to queries for site and spectrum access to commercial market areas during the transition from exclusive federal use to sharing and the termination of incumbent DoD 1755-1780MHz frequency authorizations; and ensuring the successful and timely implementation of the DoD's Alternate Proposal to accommodate wireless services in the 1755-1780 MHz band.

3.0 Approach. The approach used for the 1710-1755 MHz reallocation effort, along with lessons learned, will be used to establish the DSRMT for the 1755-1780 MHz reallocation effort. The DSRMT will be chartered to oversee the 1755-1780 MHz cost reimbursement and spectrum relocation process to its full completion for all affected DoD systems. The DSRMT will be responsible for coordinating activities among the Services; coordinating interaction between the wireless industry and the Services; and overseeing the DISA activities being conducted to enable and validate the spectrum sharing required to implement the DoD Alternate Proposal. The DISA activities include developing coordination capabilities and conducting analysis, modeling, test, and demonstration activities. The DSRMT will be staffed with government reimbursable billets. The oversight responsibilities related to the DISA1 and DISA2 initiatives will cease at the end of FY21 as they will be assumed by NTIA beginning in FY22.

**DISA7: Pre-Auction Studies**

Background:

47 U.S.C. § 928 (Spectrum Relocation Fund) (d) Fund availability (3) Transfers for pre-auction costs (A) In general states,

Subject to subparagraph (B), the Director of OMB may transfer to an eligible Federal entity, at any time (including prior to a scheduled auction), such sums as may be available in the Fund to pay relocation or sharing costs related to pre-auction estimates or research, as such costs are described in section 923(g)(3)(A)(iii) of this title.

The costs incurred since June 2010 for conducting feasibility studies and planning leading to the 1755-1780 auction comply with the provisions of 923(g)(3)(A)(iii) .