# U.S. Department of Justice


## 1755-1850 MHz Band Study

## Phase II RFI Guidance / Feasibility Analysis

*Redacted for Public Posting*

## September 29, 2011

Redacted version for public posting.

# Executive Summary

The Department of Justice (DOJ) supports the President's goal of making 500MHz of spectrum available for sale to the private sector. The DOJ and its law enforcement components (ATF, DEA, FBI, USMS) focused the assessment in this document on the specific frequency bands, agreed upon with NTIA, for the potential relocation of operations currently in the 1755-1850 MHz spectrum band ("L-Band"). The potential bands identified by DOJ and NTIA following the DOJ Comparable Bands Assessment dated April 1, 2011 include the following bands: 2200-2290 MHz, 1675-1695 MHz, 1435-1525 MHz, 4400-4940 MHz, 7125-8500 MHz, and for DOJ to retain use of up to a 30 MHz portion between 1780-1850 MHz until DOJ operations are successfully relocated out of the L-Band.

The DOJ's law enforcement components currently have extensive operations in the 1755-1850 MHz band to support unique investigative functions and other field operations, many of which are critical to the Nation's national security and law enforcement interests. With the qualified exception of the 2200-2290 MHz band, all other bands which are technically feasible to support these DOJ operations (assuming sufficient capacity exists) would still require significant investment funding in R&D, special sourcing, etc, and time to develop, produce, and deploy the transportable and fixed devices that DOJ requires. DOJ's overall plan for relocating key capabilities from the 1755-1850 MHz band to other spectrum bands, if required to do so, is summarized below.

| **Operations** | **Current Band** | **Destination Band (0-5 Years)*** | **Destination Band (5-10 Years)*** |
|---|---|---|---|
| Transportable Surveillance | 1755-1850 | 1780-1810**, 2200-2290 | 1435-1525, 1675-1695 |
| Transportable Robotics | 1755-1850 | 2200-2290 4400-4940 | 1435-1525 |
| Fixed Surveillance | 1755-1850 | 1780-1810**, 2200-2290, 4400-4940, 7125-8500 | 1435-1525 |

** 0-5 and 5-10 Years indicate timeframes following successful auction of federally owned spectrum to the private sector. Destination Bands for the 5-10 year timeframe are tentative, pending the results of interference testing and other factors that will be examined in more detail after production of this report. Operations moved to the 0-5 Year destination bands will not necessarily be moved to the 5-10 Year destination bands in later years, unless further spectrum auctions make this necessary. Destination bands in the 0-5 year timeframe will continue to be used in the 5-10 year timeframe, unless specified otherwise.*
*** Assumes that up to 30MHz will be retained for DOJ use in the L-Band until DOJ operations can be successfully relocated to other destination bands. This 30 MHz can be anywhere between 1780-1850, and is listed here as 1780-1810 as a placeholder.*

The estimated total cost for DOJ to relocate from the 1755-1850 MHz band is $3.21 billion over 12 years. This total cost includes ongoing operations in other destination bands after the

relocation is complete, and the 12 year timeframe begins two years before the date when the spectrum is auctioned. This total cost includes $43 million for spectrum relocation planning, R&D, testing, and other costs that will be incurred prior to the spectrum auction. It should be emphasized that this total cost is an *estimate*. As DOJ moves forward with planning, R&D, and testing, the cost estimates provided in this report may change as more information becomes available. For example, the results of R&D and testing might provide future options which have not been identified yet. This total cost also assumes a phased plan will be followed to relocate from the band:

- Phase 1 – relocate DOJ operations from 1755-1780 MHz within 5 years
- Phase 2 – relocate DOJ operations from the remaining 1780-1855 MHz within 10 years (assumes DOJ surveillance operations are successfully relocated to different spectrum band)

If the DOJ must vacate the *entire* 1755-1850 MHz band *on an accelerated timeframe* (i.e., in the next two years before the auction takes place), as has been stated in some draft legislation before Congress in 2011, then DOJ's relocation costs will increase and will be incurred sooner than planned in this document (see Section 2).

There are many assumptions in this plan, including the timely availability of necessary technology improvements which can reduce the amount of spectrum needed for DOJ operations (i.e., "narrowbanding"), further improvements in miniaturization of digital transmitters, availability of funding to test and procure equipment, that DOJ surveillance operations will be successfully relocated to different spectrum bands in the timeframe, and others.

The DOJ, and key components (ATF, DEA, FBI, USMS) will continue to work with the NTIA and other federal agencies to ensure that any relocation from part or all of the 1755-1850 band is completed with minimal impact to current operations (both DOJ's and other agencies'), and to complete any such relocation on schedule and within budget.

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# Department of Justice 1755-1850 MHz Band Study, Phase II RFI Guidance / Feasibility Analysis

## 1. Background

The Department of Justice (DOJ) is committed to supporting the President's Spectrum Initiative while ensuring that the Department continues to execute its critical mission to protect our Nation's security and people. The DOJ has worked in concert with the National Telecommunication and Information Administration (NTIA) and other Federal agencies, to evaluate several candidate spectrum bands for possible relocation of its current operations in the 1755-1850 MHz band. This document continues the analysis that was started in the Comparable Band Analysis delivered to NTIA on April 1, 2011. That document "narrowed the field" of alternative bands that DOJ could relocate to, based primarily on technical characteristics of the bands themselves and the operations the bands can support. This document includes further analysis of the operational needs, cost and time estimates, and technical characteristics of relocating DOJ operations from the 1755-1850 band to other potential bands. The candidate bands were agreed upon with NTIA, following delivery of DOJ's Comparable Band Analysis. This document continues that analysis in more detail, and supersedes all prior versions of this document.

The DOJ supports the President's goal of making 500MHz of spectrum available for sale to the private sector. The DOJ and its law enforcement components (ATF, DEA, FBI, USMS) focused this assessment on the specific frequency bands, agreed upon with NTIA, for the potential relocation of operations currently in the 1755-1850 MHz spectrum band. The potential bands identified by DOJ and NTIA following the DOJ Comparable Bands Assessment dated April 1, 2011 include the 2200-2290 MHz band, the 1675-1695 MHz band, the 1435-1525 MHz band, the 4400-4940 MHz band, the 7125-8500 MHz band, and for DOJ to retain use of up to a 30 MHz portion of the existing 1755-1850 MHz band until surveillance operations can be successfully relocated to another band.

The general methodology used in the analysis included identifying and categorizing current DOJ operations in the band, defining the technical characteristics of the systems supporting DOJ operations, identifying potential conflicts (i.e., interference) with existing operations in the proposed relocation bands (and possible solutions to those issues), and identifying critical assumptions/contingencies that will need to be met in order for the relocation to take place according to the schedule and cost estimates laid out in this document.

DOJ will continue to work with our law enforcement components (ATF, DEA, FBI, USMS) as well as other Federal agencies (DHS, Commerce, NASA, others), to further refine timeframe estimates, cost estimates, operational compatibilities, and other details in this report. DOJ will continue to refine estimates and work with NTIA and our other partners until the official NTIA decision date of October 1, 2011, when the Final 1755-1850 MHz Relocation Report for the U.S. Government will be officially completed.

# 2. DOJ Relocation Plan for 1755-1850 MHz Band

This section lays out DOJ's overall plan for relocating current operations in the 1755-1850 MHz band to other spectrum bands, in the event of an Administration decision to require DOJ to relocate from part or all of the band. DOJ plans to use a phased approach, which will clear the lower end of the 1755-1850 MHz band first, then eventually clear the higher end of the band, while retaining up to 30 MHz of continuous spectrum in the middle of the band for DOJ video surveillance operations for up to 10 years. A basic view of DOJ's phased relocation plan out of the 1755-1850 MHz band is shown in Figure 1 below.

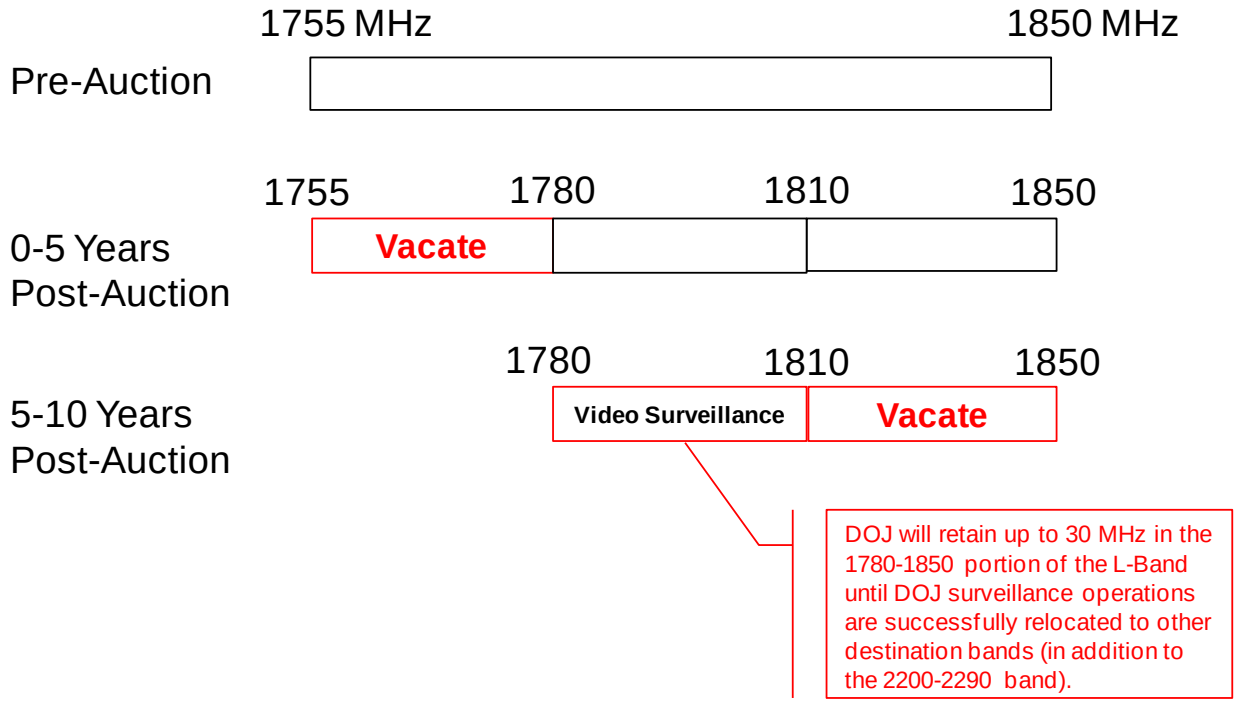


**Figure 1. Phased DOJ Relocation from 1755-1850 MHz Band**

DOJ operations will be moved to a variety of other bands, based on the type of operation to be relocated from the 1755-1850 MHz band. The general types of DOJ operations to be relocated from the 1755-1850 MHz band include (see section 2 for detailed descriptions of each):

- **Transportable Surveillance** – this includes audio, video, and related telemetry.
- **Transportable Robotics** – ground robots for video surveillance and bomb/explosives disposal, as well as some UAVs.
- **Fixed Surveillance** – this includes audio, video, and related telemetry. This includes fixed "point-to-point" operations which support surveillance backhaul activities.

These operations will vacate the 1755-1850 MHz band according to the phased approach shown in Figure 1 above. These operations will be relocated to other spectrum bands according to the phased plan shown in Table 1 below. Assumptions are described in detail in section 2.1 after the

table. Rationale for selecting the destination bands for each operation type in Table 1 is further described in section 4 of this document. See Attachment 3 for a more detailed summary of which DOJ operations and equipment types are planned for relocation to each of these destination bands.

**Table 1. Destination Bands for DOJ Operations**

| Operations | Current Band | Destination Band (0-5 Years)* | Destination Band (5-10 Years)* |
|---|---|---|---|
| Transportable Surveillance | 1755-1850 | 1780-1810**, 2200-2290 | 1675-1695, 1435-1525 |
| Transportable Robotics | 1755-1850 | 2200-2290 4400-4940 | 1435-1525 |
| Fixed Surveillance | 1755-1850 | 1780-1810**, 2200-2290, 4400-4940, 7125-8500 | 1435-1525 |

** 0-5 and 5-10 Years indicate timeframes following successful auction of federally owned spectrum to the private sector. Destination Bands for the 5-10 year timeframe are tentative, pending the results of interference testing and other factors that will be examined in more detail after production of this report. Operations moved to the 0-5 Year destination bands will not necessarily be moved to the 5-10 Year destination bands in later years, unless further spectrum auctions make this necessary. Destination bands in the 0-5 year timeframe will continue to be used in the 5-10 year timeframe, unless specified otherwise.*
*** Assumes that up to 30MHz will be retained for DOJ use in the L-Band until DOJ operations can be successfully relocated to other destination bands. This 30 MHz can be anywhere between 1780-1850, and is listed here as 1780-1810 as a placeholder.*

### *2.1 Assumptions*

Several assumptions/dependencies have been made in planning for and estimating the costs of any relocation of DOJ operations from the 1755-1850 MHz band:

1. Technology will continue to improve and will provide the same or better service while using less spectrum
    - Amount of spectrum required for surveillance and other operations will be further narrowbanded (i.e., ultra-narrowbanding) in order to continue operating effectively in less spectrum
    - "Smart radios" will continue to evolve, enabling more flexibility in efficient use of limited spectrum by finding available channel(s) rather than always requiring pre-planned channel assignments in specific geographic areas
    - Dynamic spectrum management will become widely deployed, and will allow for more active supervision and flexibility in managing limited spectrum resources among many federal users operating in the same, crowded bands

2. Results of Interference Testing determine feasible co-existence with incumbents in destination bands. While some restrictions might be necessary, DOJ's surveillance operations and other incumbent or recently relocated operations do not interfere with each other in the band, or with adjacent band users.

3. Regulatory and/or policy and/or legislative change will be made to ensure co-primary status for surveillance operations in the destination band. For example, transportable surveillance operations will officially be given at least equal primary status to incumbent operations in the 1675-1695 band, if interference testing shows this to a suitable destination band. This will be necessary in order for DOJ and other federal law enforcement to effectively access and share the band with other types of non-surveillance operations.

4. Incumbent operations already in the band will be modified or relocated as necessary, to avoid interference with relocated surveillance operations. If DOJ operations cannot co-exist with incumbent operations or other operations recently relocated to a shared band, then DOJ will need to consider other destination bands, or a decision will need to be made about which federal operation has a more critical need for this spectrum, and which will need to relocate to a different band.

5. DOJ will retain up to 30 MHz in the 1780-1850 portion of the L-Band until DOJ surveillance operations are successfully relocated to other destination bands. In Figure 1, Table 1, and section 4.1 of this document, 30MHz between 1780-1810 is identified for continued DOJ use in the 1755-1850 MHz band, but any 30 MHz in the 1780-1855 portion of the band will suffice until DOJ operations can be successfully relocated to a band (or bands) in which DOJ is not already performing surveillance operations. DOJ is already performing extensive surveillance operations in the 2200-2290 MHz band, and due to crowding in this band, the 2200 band cannot be the only destination band for DOJ surveillance. This is consistent with recent discussions between NTIA and DOJ.

Other assumptions/dependencies made when evaluating the feasibility of destination bands for DOJ's 1755-1850 MHz operations are listed in section 4.

### *2.2 Plan with Timeframes*

The general plan for relocating DOJ operations from the 1755–1850 MHz band is shown below in Figure 2, which summarizes information from sections 2, 3, and 4 of this document. See Attachment 3 for a more detailed summary of which DOJ operations and equipment types are planned for relocation to each destination band.

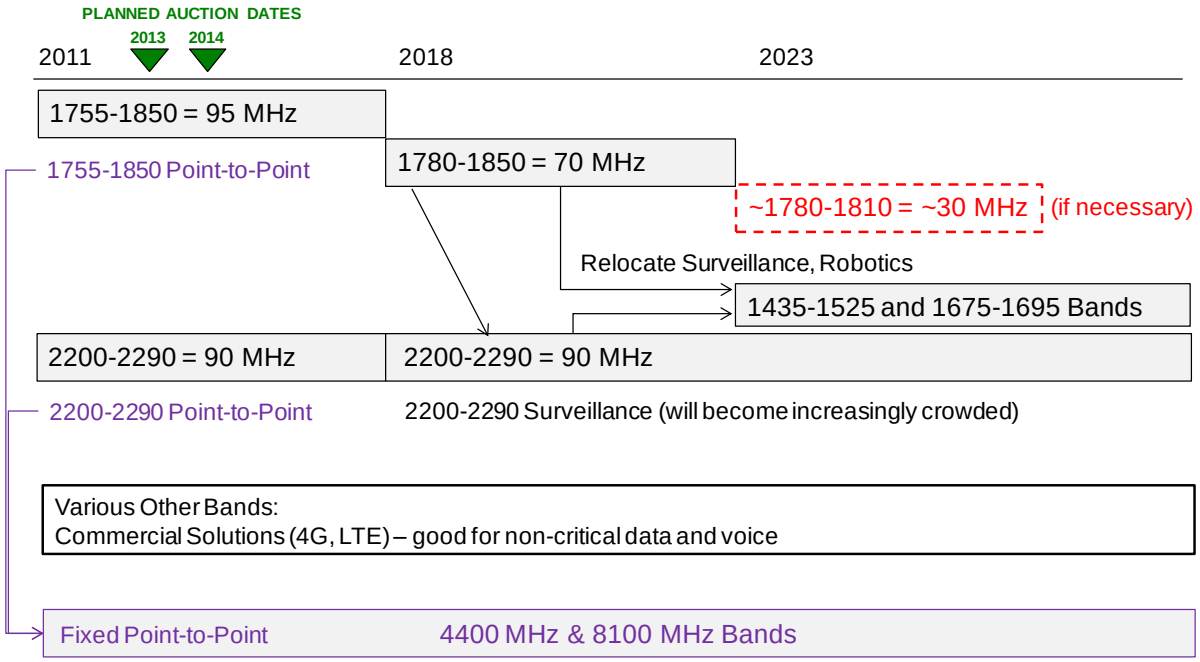


**Figure 2. High Level DOJ Relocation Plan from 1755-1850 MHz Band**

### *2.3 Cost Estimates*

DOJ made several assumptions in developing this cost estimate, these assumptions can be found in Sections 2.1 and 4.0 of this report. It should be noted that it is extremely difficult to prepare accurate estimates for the later stages of this plan simply because this requires an understanding of the state of technology 10-12 years out. Also, if the DOJ must vacate the *entire* 1755-1850 MHz band *on an accelerated timeframe* (i.e., in the next two years before the auction takes place), as has been stated in some draft legislation before Congress in 2011, then DOJ's relocation costs will increase and will be incurred sooner than planned in this document

Total costs for DOJ relocation from the 1755-1850 MHz band will be $3.21 billion. This estimate includes relocation costs for the ATF, DEA, FBI, USMS, and DOJ headquarters.

The estimate includes **Pre-Auction** (FY 2012-2013) cost estimates for research & development, as well as testing & evaluation of new technologies, commercial networks, and planning DOJ's relocation to destination bands. It is our expectation that results from this pre-auction research, testing, and evaluation will help DOJ refine the relocation cost and timeframe estimates as we move forward. Pre-Auction costs for FY2012-2013 are included in the sub-total cost for Phase 1 below.

**Phase 1** (FY 2014-2018) cost estimates are for continued development leading to deployment of new systems and alternate technologies in order to vacate the 1755 – 1780 portion of the L band. Costs in Phase 1 include recurring commercial service costs, FTEs, SMEs, contract support and equipment, operations & maintenance, and disposal costs.

During the Pre-Auction and Phase 1, we anticipate making selected investments in new technologies, including commercial services. For example, during the Pre-Auction and/or Phase 1, DOJ plans to conduct a pilot project in which the components share a "mesh" network consisting of shared L/S bands assignments along with assignments in the 4400-8100 MHz bands and commercial services. The success of this pilot may help reduce relocation costs.

A long term goal is for DOJ components to move much of our operations onto commercial services and spectrum efficient technologies. A portion of Phase 1 funding will be utilized as seed money to start the procurement process for new narrow-band replacement technologies. Our past relocation experience has taught us that the procurement process for such technology can take several years to put in place.

**Phase 2** (FY 2019-2023) cost estimates are for new replacement technologies that we believe will take years to develop, and for continued operations and maintenance as we vacate the remaining 1780-1855 MHz portion of the L band (DOJ will retain up to 30 MHz for sensitive operations if these cannot be relocated to a band other than the 2200-2290 MHz band). As we continue to evaluate the proposed destination bands, commercial networks, and new technologies, our cost and timeframe estimates may need to be adjusted as we refine our relocation strategy. (See Table 2 below)

**Table 2. Spectrum Relocation Cost Estimate**

| | **Pre-Auction** | **Phase 1 Relocation** | **Phase 2 Relocation** | **TOTAL** |
|---|---|---|---|---|
| | **2012-2013** | **0-5 Years Post Auction (2014-2018)** | **5-10 Years Post Action (2019-2023)** | **10 Years** |
| **Estimated DOJ Relocation Costs*** | $ 43 million | $ 1.71 billion | $ 1.50 billion | $ 3.21 billion |

** Estimated DOJ Relocation Costs are sum total for ATF, DEA, FBI, US Marshals, and DOJ headquarters. Pre-Auction costs for 2012-2013 are included in the $3.21 billion total cost as part of 'Phase 1'.*

Phase 2 (FY 2019-2023) cost estimates, will be dependent on funding for replacement equipment, alternate technology availability, recurring commercial service fees and equipment operations and maintenance costs. A substantial portion of the Phase 2 estimates are a "rough order of magnitude" (ROM) estimate until technology matures and more final estimates can be made. Much of the cost estimate for Phase 2 (and the latter part of Phase 1) is for replacement equipment that has not been developed yet, and will likely be unavailable until sometime between 2016 and 2023.

Although it is not a direct "relocation" cost, the DOJ strongly emphasizes that ongoing fee compensation should be addressed as part of this overall effort, commensurate with the capabilities lost as a result of the relocation. Fees such as recurring commercial service, recurring site, operation/maintenance, FTEs, SMEs and contractor support costs are all major cost increases that DOJ will incur as a result of spectrum relocation. These increased costs will

be a reality for the lifecycle of the relocated operations, and compensation must be considered through either the spectrum relocation funds (SRF) or through the annual budget process.

# 3. Categorization of DOJ Operations in 1755-1850 MHz

The DOJ currently conducts unique law enforcement and investigative functions on numerous frequency assignments throughout the entire 1755-1850 band. These spectrum dependent activities include primary evidence and intelligence collection, the transmission and/or receipt, management and control of data and information from various surveillance platforms, unmanned aircraft, and remotely controlled robotic devices, as well as supporting high capacity point-to-point communication systems. Currently the Department has authority to operate on 91 assignments in the 1755-1850 MHz band, as identified in Attachment 1 to this report.

All DOJ system applications within the 1755-1850 MHz band can be functionally categorized as being either transportable or fixed in nature. In most cases however, either operation requires the coordinated use of multiple systems/equipment which work together to support the overall mission requirement. These individual system functionalities may all be resident within the 1755-1850 MHz band, or more likely, supplemented, integrated and/or translated somewhere along the overall process by similar functionalities within other frequency bands or alternative communications media (ex. Commercial Services). Due to the large variety, unpredictability, and sensitivity of specific equipment, device(s), or service(s) which may be used, this report purposely limits its descriptive characterization of devices used in the 1755-1850 MHz band to within the basic functional categories identified earlier (transportable or fixed). The system technical characteristics presented however, are those that will provide the most dramatic or demanding Radio Frequency (RF) signature created by its use, so that "worst case" potential interference analysis can be performed on that particular function within its intended environment.

### *3.1 Transportable Surveillance and Robotics*

From a planning and implementation standpoint, transportable surveillance includes some of DOJ's most sensitive operations – i.e., highly sensitive national security and law enforcement interests, with the greatest risk for agent loss of life or casualty. These types of operations are often the least flexible in operational methodology and device application due to their highly concealable, portable, and/or rapidly deployable support criteria. Transportable operations typically involve a device which exhibits limited or pre-tuned channel selection capability which is designed to support low profile, undercover operations. As such, these devices are usually miniaturized or compact in physical size and supported by battery powered low-level signals (3W or less) fed into an Omni-directional radiator. In its simplest form, video information is transmitted within the 1755-1850 MHz band from a transportable device via a one-way communications link to an established fixed collection point (if available), or associated transportable collection platform (see Figure 3).

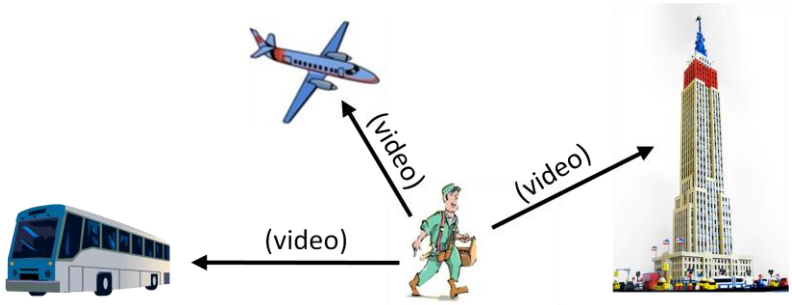


**Figure 3. Transportable One-Way Video Collection**

Within the more complex surveillance and robotic based transportable operations, device applications typically involve two-way communication requirements to allow real time device management. Similar to the previous example, the video component of the operation is typically one way within the 1755-1850 MHz band, while the device's return path command, control, voice, and/or telemetry are usually accomplished via various out-of-band signaling methodologies (see Figure 4).


**Figure 4. Controlled Transportable Video Collection**

Missions supported through transportable RF based devices in the 1755-1850 MHz band typically occur with little advance notice of the operational location, duration, or time of operation. Although these types of operations are typically short in duration (hours versus days/weeks), the organic uncertainty and criticality associated with their operational requirements dictate an availability and authority for their operations on a 24/7, nationwide geographic basis. The DOJ currently possesses 6 Land Mobile (ML) assignments in support of transportable video operations which are authorized on a USP basis (see attachment 2). Although one of these assignments is in support of standard digitized video capture within an 8 MHz channel, the remaining assignments exploit 17-22 MHZ channel bandwidths in support of high definition analog video capture, with in-band target audio return, due to current limitations in technical capability on these particular systems. Technical specification sheets associated with these systems are provided in attachment 4 to this report.

### *3.2 Fixed Surveillance*

The vast majority of DOJ surveillance operations are currently authorized and supported via fixed system applications and infrastructure. This authority however encompasses two distinctly different operational profiles in reference to how video information (data) is currently collected, transported and/or processed within the 1755-1850 MHz band. In its simplest form, data is transmitted via point-to-point links from fixed transmit and receive locations. The systems operate on a continuous basis, and predominantly use highly focused low power emitters (see Figure 5). Although the exact location of these emitters is and will remain relatively indeterminate due to the variability in operational profiles, the low power levels and limited link

propagation geometries associated with their use create an environment relatively conducive to integration within/around other operational users in the area. Technical specification sheets associated with these systems are provided in attachment 4 to this report.

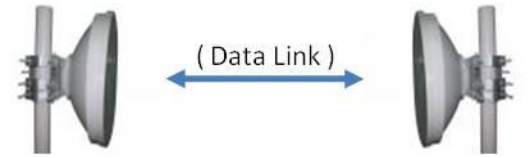


**Figure 5. Fixed Point to Point Links**

The most common use of DOJ fixed applications in the 1755-1850 MHz band involves the combined use of a variety of hardware that collectively provides the needed surveillance capability. This often involves different transmitters, receivers, cross-band repeaters, microwave and commercial services to form an integrated architecture. Although DOJ's assignment authorities are all designated as "FX" station class, they are all caveated with an "S362" note which identifies the potential for "one or more transmitting and/or receiving stations" utilizing the assignment within a specified geographic area; typically a coordinate point reference with a 30 km operating radius (see below Figure 6).

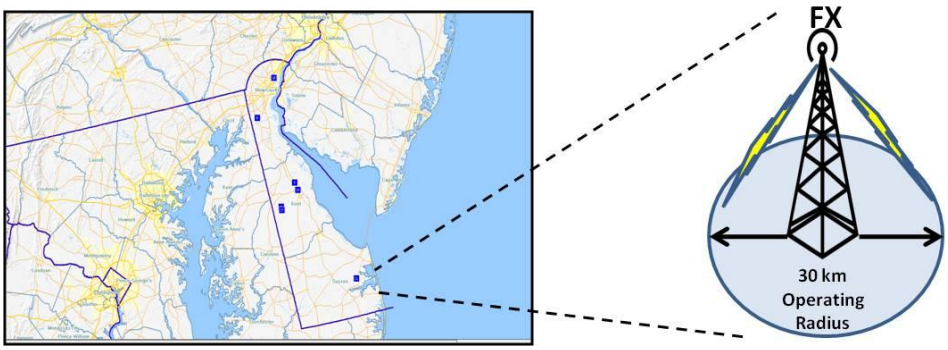


**Figure 6. "FX" Operations with S362 Note**

Missions supported under current "FX" authorities are typically longer in duration (days/weeks/months), and 24/7 in nature, but can routinely change based on real time dynamic operational requirements. As the core architecture changes (see Figure 7) within each operating area, the specific application of 1755-1850 MHz dependent devices may also change in accordance with the aggregate ability to apply other in-band and associated out-of band devices to support overall data capture, routing, backhaul, and recording/storage capabilities. Although all 1755-1850 MHz dependent devices can be operated independently or in association with other peripheral devices within the overall network, the RF signature(s) produced from these devices is no different than that already identified in the previous transportable and point-to-point discussions. The DOJ currently possesses 85 Fixed Station (FX) assignments in support of surveillance operations, 26 which are authorized on a nationwide USP basis (see attachment 2). NOTE: The newer assignments (post 2005) which reflect digital devices based on technology acquired and integrated as a result of the previous Advance Wireless Services (AWS) auction

demonstrate channel bandwidths of 10 MHz or less. Analog legacy equipment not impacted by previous AWS efforts however, still require channel bandwidths up to 22 MHz.

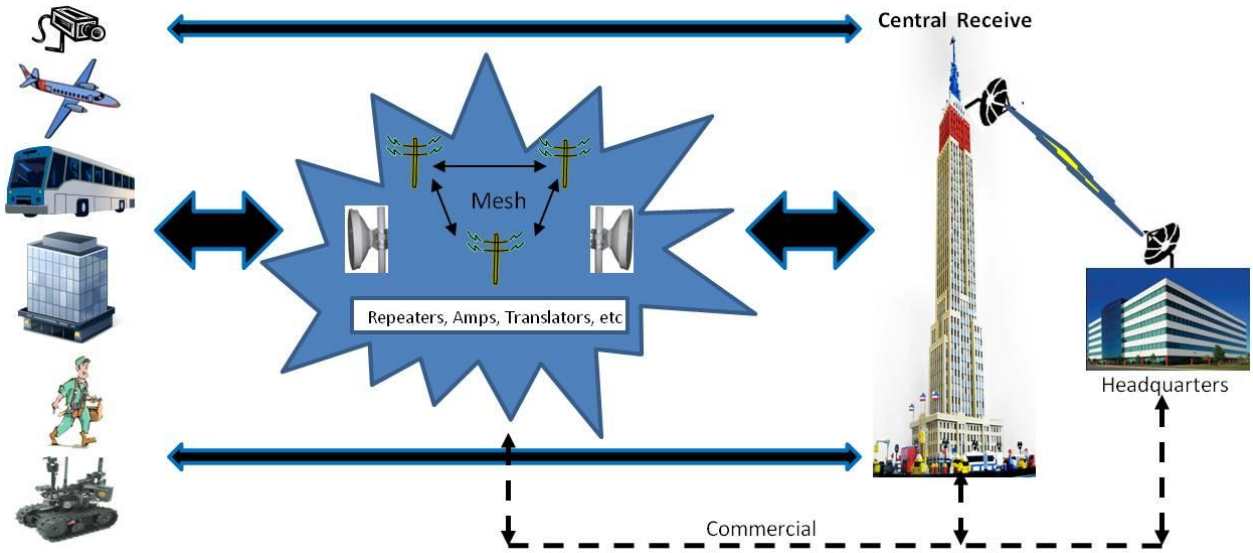


**Figure 7. FX Operations Architecture**

Table 3 below provides a broad summary of devices currently used by the DOJ within the 1755-1850 MHz band.

**Table 3. DOJ Systems Summary, 1755-1850 MHz Band – *Redacted for public posting.***

# 4. Feasibility Analysis of Preferred Bands

As identified earlier in the report, DOJ surveillance operations routinely involve the use of a variety of RF dependent devices, potentially operating within several frequency bands, which can change in specific configuration based on real time operational requirements. It is through the joint integration of all these devices, across all bands, which enable the overall surveillance capability to be accomplished. The DOJ's intended approach for relocating its surveillance operations out of the 1755-1850 MHz band is to maintain various specific functionalities across several frequency bands in order to preserve diversity in potential operational configurations. This is necessary based on the environmental conditions which may be encountered during any particular mission requirement. In addition, it is believed that functional diversification within several bands will also help mitigate some of the congestion anticipated in select bands due to the relocation efforts of all Federal Agencies. It is anticipated this will also better support the integration of "compatible" activities within existing legacy user bands and activities.

The DOJ selection of preferred bands is predicated on several assumptions and dependencies in order to be able to effectively integrate its relocated operations, yet maintain required mission operational integrity, capacity, and diversity, both during and post relocation efforts. Those assumptions and dependencies include:

- Sufficient R&D funding is granted, in a timely manner, to initiate efforts to support the technological development of capabilities necessary to support the relocation of activities into alternative frequency bands.
- R&D efforts result in the timely identification and development of new spectrally efficient modulation techniques and/or compression technologies in support of overall surveillance operations; especially within a miniaturized application environment.
- Regulatory criteria is clarified and/or modified to support primary allocation status of relocated DOJ operations in bands currently not authorized for such operations.
- Regulatory criteria is clarified and/or modified to support the coordination and authorization of a "shared" operational environment between relocated and incumbent legacy operations within each band.
- All preferred bands are protected from future relocation actions so that planning, development, and deployment/employment efforts can be effectively implemented on a timely basis

If any of these assumptions are incorrect, (e.g., sufficient, timely R&D funding is not made available), the DOJ selection of preferred bands may need to be revised.

### *4.1 30 MHz Contiguous Capacity Within the 1780-1850 MHz Band*

Initial DOJ intentions are to maintain 30 MHz of contiguous capacity within the overall L-Band until the department can successfully relocate to a suitable destination band. The emphasis here is to be able to maintain certain miniaturized legacy operations, to include wideband analog video surveillance activities, under existing assignment authorities that are already resident within the band. This will be necessary in order to support continuing operations during the overall relocation process, and to also support early departure transition efforts from the 1755-

1780 MHz portion of the band. Eventually as R&D efforts produce new miniaturized covert capabilities in video capture and data transport in alternative bands, these capabilities will be relocated to those alternative bands consistent with overall departmental relocation efforts outlined throughout the remainder of this report.

### *4.2 Analysis of the 2200-2290 MHz Band*

DOJ intentions within the 2200-2290 MHz band include maintenance of current legacy operations, to include wideband analog video surveillance activities, with the eventual integration of additional capability and/or capacity lost from the 1755-1850 MHz relocation effort. Since the DOJ already has significant and pervasive assignment authority throughout the entire band in support of video surveillance activities, any early integration of new and/or relocated assignments will consist of nothing more than an overlay of similar capability onto existing assignment authorizations (i.e. a "zero" net increase in capability) until new spectrum efficient "ultra-narrow band" technology can be developed, tested, procured and deployed. As a consequence, the maintenance of legacy assignments are necessary to support continuing operations during the overall relocation process, and then the integration of new assignments will be dependent on system/technology upgrade, modernization, and/or expansion efforts as R&D investments produce increased efficiencies in video capture and data transport.

There are currently 2884 incumbent frequency assignments authorized for operation within the 2200-2290 MHz band which represent a broad mix of station classes and applications. Of these assignments, 60 are authorized on a US/USA/USP basis, of which 16 are directly in support of DOJ surveillance operations. The remainders of the US/USA/USP assignments are predominantly in support of other Federal agency surveillance and aeronautical telemetry activities, with a few (8 each) authorized for Non-Government aeronautical telemetry activities. Only the Federal US/USA/USP assignments are limited in operating time duration ("TME 3" – For occasional use and not limited to work week), while the Non-Federal US/USA/USP assignments are only restricted from US-Canadian Border Zone operations (S-366 Note). The emphasis here on US/USA/USP assignments is that not only do current US/USA/USP assignments already exist across the entire 90 MHz of spectrum between 2200-2290 MHz, they also demonstrate numerous overlaps in operational authority. As a consequence, any type of specific EMC analysis within this environment would obviously demonstrate serious interference potential between current users and devices. Obviously, if an analysis of the current environment demonstrates interference potential, any influx of new assignment into the band would only exacerbate the situation. Similar to the above review of the 1780-1810 MHz band however, it should be reiterated that despite the numerous "overlays" of assignment authorities, the aggregate reality of actual assignment uses and timing have historically resulted in minimum to no interference issues being experienced by any users to date. It is in recognition of this situation why the DOJ currently has, and intends to maintain, USP assignments across the band in support of its video surveillance operations. These type assignments not only support the DOJ nationwide "anytime-anywhere" operational requirement, but in the aggregate, they provide favorable statistical probability that at least one clear channel can be identified for use regardless of the local operating location and environment. Localized assignments can and would continue to be determined via an EMC analysis of specific channel requirements within the identified local environment.

Assumptions made for assessing the potential for operational usage within the 2200-2290 MHz band are very similar to those made in the 1780-1810 MHz band. They include:

- It is assumed that congestion within the 2200-2290 MHz band will only **increase** as Federal activities migrate their operations out of the overall 1755-1850 MHz band
- Anticipated system technical efficiencies will eventually decrease individual user spectral requirements alleviating some congestion and potentially creating additional available capacity for shared use between users.
- The realities of user geographic site and operations timing will continue to allow flexibility for spectrum sharing and interference avoidance within a USP authorized operation or any given geographic area.
- The DOJ will continue to rely on alternative and/or supplemental capabilities in this band, as well as other frequency bands, in order to off-set the potential "statistical availability" of assignments based on local conditions and other user operations.

DOJ operations intended for this band will continue to be heavily focused on the "capture" of surveillance based information, with backhaul and storage capabilities predominantly being accomplished via other mechanisms and frequency bands. The "capture" activity will typically involve emitters encompassed within concealment platforms, with only relatively minor variations in power and bandwidth associated between those various platforms. Under legacy authority and system characteristics outlined previously, it is anticipated that the DOJ will maintain its current 16 USP operational assignments, with their associated 10-20 MHz channel bandwidths, that are already present within this band. Although the specific technical characteristics for the newer, more efficient system applications the DOJ intends to deploy within the band are not yet available, the following provides the general RF fingerprint anticipated for the future employment of these devices in the band.

### *4.3 Analysis of the 4400-4940 MHz Band*

DOJ intentions within the 4400-4940 MHz band encompass the maintenance of their current legacy operations with the eventual integration of additional point-to-point capabilities lost from the 1755-1850 MHz relocation effort. As with the previous 1780-1810 MHz and 2200-2290 MHz bands, the maintenance of legacy assignments are necessary to support continuing operations during the overall relocation process, with the hopeful integration of new point-to-point and Mesh networking capabilities being able to capitalize on R&D investments for increased efficiencies in overall data transport methodologies.

There are currently 3690 incumbent frequency assignments authorized for operation within the 4400-4940 MHz band which represent a mix of fixed, mobile, and fixed satellite (space-to-earth) station classes and applications. It should be noted that the fixed satellite operations are predominantly restricted to the 4500-4800 MHz portion of the band. Of all assignments within the entire band, 584 are authorized for the DOJ, of which 66 operate under USP authority. There are a total of 123 authorized USA/USP assignments currently authorized throughout the entire band. Similar to the review of previous bands, numerous overlays already exist within the band, yet actual assignment uses and timing have historically resulted in minimum to no interference issues being experienced by any users to date. Again, it is in recognition of this situation why the DOJ intends to maintain its assignments across the band in support of its overall operational

requirements. Since the integration of point-to-point assignments lend themselves to a relatively controlled consideration of more focused propagation geometries within a localized area, it is not considered to be too terribly problematic to incorporate additional point-to-point capabilities being relocated from the 1755-1850 MHz band. In regards to DOJ Mesh networking intentions, these networks will also be localized within the immediate environment, and ground based in deployment. As a consequence, localized assignments can and would continue to be determined as required via an EMC analysis of specific channel requirements within the identified local environment.

Assumptions made for assessing the potential for operational usage within the 4400-4940 MHz band are as follows:

- Although it is anticipated that congestion within the 4400-4940 MHz band will **increase** as Federal activities migrate their operations out of the overall 1755-1850 MHz band, this increase will be more constrained based on the reduced propagation characteristics associated with this band versus those predominant within the 1755-1850 MHz band.
- Anticipated system technical efficiencies will decrease individual user spectral requirements alleviating some congestion.
- The realities of user geographic site and operations timing will continue to allow flexibility for spectrum sharing and interference avoidance within a USP authorized operation or any given geographic area.
- The DOJ will continue to rely on alternative and/or supplemental capabilities in this band, as well as other frequency bands, in order to off-set the availability of assignments based on local conditions and other user operations.

DOJ operations intended for this band are predominantly focused on point-to-point, backhaul and other focused capture and microwave based capabilities. It is anticipated that the DOJ will maintain its current legacy authorities and system characteristics, and initially incorporate new assignments being relocated from the 1755-1850 MHz band under this same legacy criteria. Although the specific technical characteristics for the newer, more efficient system applications the DOJ intends to deploy within the band are not yet available, the following provides the general RF fingerprint anticipated for the future employment of these devices in the band. A more specific technical specifications sheet is provided as attachment 5 to this report.

### *4.4 Analysis of the 7125-8500 MHz Band*

DOJ intentions within the 7125-8500 MHz band encompass the maintenance of their current legacy operations with the eventual integration of additional point-to-point capabilities lost from the 1755-1850 MHz relocation effort. As with the previous 4400-4940 MHz band, the maintenance of legacy assignments are necessary to support continuing operations during the overall relocation process, with the hopeful integration of new point-to-point capabilities being able to capitalize on R&D investments for increased efficiencies in overall data transport methodologies.

There are currently 15,220 incumbent frequency assignments authorized for operation within the 7125-8500 MHz band which represent a mix of fixed, mobile, and satellite based (space-to-

earth) station classes and applications. Of all assignments within the entire band, 400 are currently authorized for the DOJ, of which 39 operate under USP authority. There are a total of only 55 authorized USA/USP assignments currently authorized throughout the entire band. Similar to the review of previous bands, numerous overlays already exist within the band, yet actual assignment uses and timing have historically resulted in minimum to no interference issues being experienced by any users to date. Again, it is in recognition of this situation why the DOJ intends to maintain its assignments across the band in support of its overall operational requirements. Since the integration of point-to-point assignments lend themselves to a relatively controlled consideration of more focused propagation geometries within a localized area, it is not considered to be too terribly problematic to incorporate additional point-to-point capabilities being relocated from the 1755-1850 MHz band. As a consequence, localized assignments can and would continue to be determined as required via an EMC analysis of specific channel requirements within the identified local environment.

Assumptions made for assessing the potential for operational usage within the 7125-8500 MHz band are as follows:

- Although it is anticipated that congestion within the 7125-8500 MHz band will **increase** as Federal activities migrate their operations out of the overall 1755-1850 MHz band, this increase will be more constrained based on the reduced propagation characteristics associated with this band versus those predominant within the 1755-1850 MHz band.
- Anticipated system technical efficiencies will decrease individual user spectral requirements alleviating some congestion.
- The realities of user geographic site and operations timing will continue to allow flexibility for spectrum sharing and interference avoidance within a USP authorized operation or any given geographic area.
- The DOJ will continue to rely on alternative and/or supplemental capabilities in this band, as well as other frequency bands, in order to off-set the availability of assignments based on local conditions and other user operations.

DOJ operations intended for this band are predominantly focused on point-to-point backhaul and other focused microwave based capabilities. It is anticipated that the DOJ will maintain its current legacy authorities and system characteristics, and initially incorporate new assignments being relocated from the 1755-1850 MHz band under this same legacy criteria. Although the specific technical characteristics for the newer, more efficient system applications the DOJ intends to deploy within the band are not yet available, the following provides the general RF fingerprint anticipated for the future employment of these devices in the band. A more specific technical specifications sheet is provided as attachment 5 to this report.

### *4.5 Analysis of the 1675-1695 MHz Band*

Initial DOJ intentions within the 1675-1695 MHz band encompass the potential exploitation of R&D efforts to develop and produce efficient capabilities in video capture and data transport methodologies. These capabilities, once developed will serve as replacement applications in centralized video channel control activities, bidirectional based link operations, and MESH network applications.

There are currently 253 incumbent frequency assignments authorized for operation within the 1675-1695 MHz band which represent a mix of meteorological aide (radiosonde) and meteorological satellite (space-to-earth) station classes and applications. It should be noted that band is currently **not** allocated for fixed and mobile station class operations. Although interference potential can theoretically exist between downlink meteorological satellite transmissions and planned DOJ device deployments in the band, it is anticipated that between the establishments of basic protection zones around primary earth station receivers and the selective signal capture geometries associated with those earth station receivers, the threat for interference potential can be diminished. Conclusive interference avoidance cannot be assured however, due to limited bandwidth for identifying alternative DOJ assignment use and the absence of positive planning and control on DOJ roaming surveillance profiles. In addition, this situation may be additionally aggravated by National Oceanic and Atmospheric Administration (NOAA) plans to move some additional Geostationary Operational Environmental Satellite (GOES-R) downlink operations into the 1675-1695 MHz band.

The primary potential for incompatibility and mutual interference between NOAA and DOJ systems would predominantly be between the myriad of radiosonde receivers operating throughout the national area. With the exception of established National Weather Service facilities, the location of any given radiosonde receiver (academic, commercial, etc) is an unknown, and difficult to both quantify and predict. Given the relative close operating proximity of DOJ surveillance devices and the regimented integrity for maintaining link assurety between these devices, it is anticipated that interference potential will be more problematic from DOJ devices to radiosonde receivers versus the other way around (airborne radiosonde transmitters to DOJ ground based surveillance receivers). It is acknowledged and recommended that specific field testing should be established to test this type scenario. Mitigating options could include the establishment of a more regimented operational schedule, channel selection, and site collection criteria for overall radiosonde operations. It might also be recommended that radiosonde operations be relegated to the 400 MHz band where they also possess a primary service allocation for their operation.

Assumptions made for assessing the potential for DOJ operational usage within the 1675-1695 MHz band are as follows:

- It is anticipated that the allocation of operations within the 1675-1695 MHz band will be modified to allow primary service status for fixed and mobile applications. NTIA should consider relegating radiosonde operations to the 406-420MHz band where they already have primary service status.
- Anticipated system technical efficiencies will decrease individual user spectral requirements alleviating some congestion.
- The realities of user geographic site and operations timing will continue to allow flexibility for spectrum sharing and interference avoidance between intended DOJ devices and legacy operations for any given geographic area.
- The return on DOJ R&D investments will support the development and production of miniaturized devices capable of efficiently and effectively operating in the band.

DOJ operations intended for this band are predominantly focused on peripheral surveillance devices intended to support ground based backhaul, networking, and other focused capabilities. Although the specific technical characteristics for the newer, more efficient system applications the DOJ intends to deploy within the band are not yet available, the following provides the general RF fingerprint anticipated for the future employment of these devices in the band. A more specific technical specifications sheet is provided as attachment 5 to this report.

### *4.6 Analysis of the 1435-1525 MHz Band*

Initial DOJ intentions within the 1435-1525 MHz band encompass the potential exploitation of R&D efforts to develop and produce efficient capabilities in video capture and data transport methodologies. These capabilities, once developed will serve as replacement applications in centralized video channel control activities, MESH network applications, robotic based operations, and audio surveillance systems.

There are currently 984 incumbent frequency assignments authorized for operation within the 1435-1525 MHz band which predominantly consist of the Mobile-Aeronautical Telemetry station class and applications. It should be noted that band is currently **not** allocated for fixed and mobile station class operations. Although interference potential can theoretically exist between aeronautical telemetry based transmissions and planned DOJ device deployments in the band, it is anticipated that interference potential can be diminished based on the timing (scheduling) of aeronautical telemetry operations, their localized activities (primarily range areas), and propagation geometries associated with typical aeronautical based activities. In addition, the relative close operating proximity of DOJ surveillance devices, the regimented integrity for maintaining link assurety between these devices, and predominant ground based application of these devices would provide additional mutual interference mitigation potential. Given the wide diversity, variability, and numerous profile dynamics associated with aeronautical telemetry and DOJ surveillance operations, it is estimated that scenario modeling for specific EMC analysis would be too diverse, making the assertion of broadly applicable results generally intangible and inconclusive. As a consequence, it is recommended that specific field testing should be established to test various scenarios. It is anticipated that similar to conditions that currently exist in just about every RF band, despite the numerous "overlay" of assignment authorities, the aggregate reality of actual assignment uses and timing will have a minimum to no interference issue being experienced by either user.

Assumptions made for assessing the potential for DOJ operational usage within the 1435-1525 MHz band are as follows:

- It is anticipated that the allocation of operations within the 1435-1525 MHz band will be modified to allow primary service status for fixed and mobile applications.
- Anticipated system technical efficiencies will decrease individual user spectral requirements alleviating some congestion.
- The realities of user geographic site and operations timing will continue to allow flexibility for spectrum sharing and interference avoidance between intended DOJ devices and legacy operations for any given geographic area.

- The return on DOJ R&D investments will support the development and production of miniaturized devices capable of efficiently and effectively operating in the band.

DOJ operations intended for this band are predominantly focused on the localized "capture" of video surveillance information by robotic devices, and the use of peripheral surveillance support devices intended to provide ground based backhaul, and networking based capabilities. Although the specific technical characteristics for the newer, more efficient system applications the DOJ intends to deploy within the band are not yet available, the following provides the general RF fingerprint anticipated for the future employment of these devices in the band. A more specific technical specifications sheet is provided as attachment 5 to this report.

### *4.7 Commercial Services in other Spectrum Bands*

Initial DOJ intentions with respect to the exploitation of commercial services is to critically review various commercial capabilities primarily as to their potential for supporting lower priority operations, and more "enduring" and static peripheral data links within the overall surveillance system operational architecture. The primary challenges with respect to use of commercial services are: 1) the dynamically changing, circumstantial, instantaneous, and/or mobile environmental requirements which national security and law enforcement surveillance operations must react too, and 2) the sensitivity/security issues associated with typical operational surveillance activities. Although many commercial activities may have the overall capacity and service area coverage to support many general surveillance activities, they do not meet real world DOJ requirements to ensure agent safety and the needed flexibility to support rapid response operations. Mobile broadband services promises potential in several areas, but issues of latency, security, and control remain a concern for many operations. Cost and available funding for commercial services is and will also remain a long term concern.

Assumptions made for assessing the potential for DOJ operational usage of commercial services are as follows:

- It is anticipated that funding will be available in the long term for commercial service use.
- Technical solutions will be made available for the appropriate management of security and control of commercial service operational support activities
- Response times for the acquisition and deployment/utilization of commercial services will be commensurate with surveillance based operational and system architectural requirements.
- FTEs with unique skill sets will be available to aid DOJ Component Agencies throughout the relocation effort, and in the implementation and management of the next generation Broadband Network related systems.

Specific DOJ operations intended for commercial service applications will become more solidified as overall direction in alternative band applications and R&D results are specifically determined.

# 5. Coordination with Other Federal Agencies

The DOJ continues to share technical characteristics and operational parameters of surveillance and other operations in the 1755-1850 band with other federal government spectrum users, including the incumbents in the destination bands identified in this report. NTIA has assisted with these efforts through various meetings, and spectrum working groups focused on establishing coordination between incumbents and users potentially relocating to those frequency bands.

DOJ has met and shared information with DHS, Treasury, Commerce / NOAA, NASA, DOE, and DOD in recent weeks. Other agencies with operations that are less of a presence in DOJ's proposed destination bands and/or which are very similar to DOJ operations (e.g., DOI surveillance) will be coordinated with as we move forward, but time did not allow for detailed coordination with all federal users prior to the deadline for this report.

Ongoing cross-agency coordination includes:

- Field testing of surveillance and other operations in *crowded destination bands*, to determine the real world effects these operations will have on one another. While theoretical technical analysis in a lab and/or comparison of technical specifications on paper is a good start, it will not be sufficient.
    - **1435-1525 MHz Band** – DOJ has shared information with DOD to ensure DOJ relocation to this band does not disrupt incumbent operations or DOJ operations. DOD is currently making progress on their internal coordination efforts, and DOJ will continue to work with DOD as their internal efforts progress.
    - **1675-1695 MHz Band** – DOJ is initiating joint analytical / testing efforts with NASA and NOAA to ensure DOJ relocation to this band does not disrupt incumbent operations or DOJ operations.
    - **2200-2290 MHz Band** – DOJ's operations in this band already co-exist with many other incumbent operations. DHS and DOJ are considering a possible joint sharing plan for this band, to make efficient use of remaining spectrum for surveillance activities (this would also include Treasury, DOI, and other agencies).
    - **4400-4940 MHz Band** – DOJ operations to be relocated to this band are primarily fixed point to point and airborne surveillance. Interference issues, particularly for fixed point to point operations, are not expected to be significant.
    - **7125-8500 MHz Band** – DOJ operations to be relocated to this band are primarily fixed point to point. Interference issues are not expected to be significant.
- Coordinate with other federal agencies, to speak with a *clear voice to the vendor marketplace*, about our impending need for technology advances described in the assumptions/dependencies in sections 2 and 4 above. Also speak with a coordinated voice to the vendor community regarding technical standards that will be required for government purchases. In this regard, the DOJ, DHS, Treasury, and other Federal Agencies, who share similar interest in surveillance based activities are working cooperatively in the joint investigation, testing and development of technological

capabilities required from "specialized" venders in order to preserve and advance both present and future surveillance based activities.

- *Collaborate on investment and R&D efforts* across multiple agencies, to get the best value for investment dollars and to reuse shared research, testing, and deployment efforts across the federal government. As often as possible, coordinate and test something once rather than multiple times. Currently, investment and R&D efforts are being apportioned and shared between the various DOJ Component activities where commonality of function and application exists in the conduct of their respective surveillance missions. In addition, similar cooperative and sharing efforts are being pursued between the DOJ, DHS, Treasury, and other Federal Agencies that are responsible for conducting similar surveillance based operations.

The DOJ, and key components (ATF, DEA, FBI, USMS) will continue to work with the NTIA and other federal agencies to ensure that any relocation from part or all of the 1755-1850 band is completed with minimal impact to current operations (both DOJ's and other agencies'), and to complete any such relocation on schedule and within budget.

## Attachment 1. Summary of DOJ's Comparable Band Analysis

The below chart (Figure 8) provides a top level visual summary of DOJ's alternate band evaluation, to include a ranking of each band in its expected ability to support DOJ relocation activities. Since the DOJ does not expect the relocation of its fixed point-to-point systems to be terribly problematic, the ranking levels and order preferences for each band are predominantly based on the expectations for relocating DOJ USP type operations and assignments.[1] This graphic and the accompanying text show DOJ's initial evaluation of these bands which was delivered to NTIA on April 1, 2011. This initial analysis has been further refined in this document for the bands that were determined to have the best relocation potential for DOJ's 1755-1850 MHz operations.

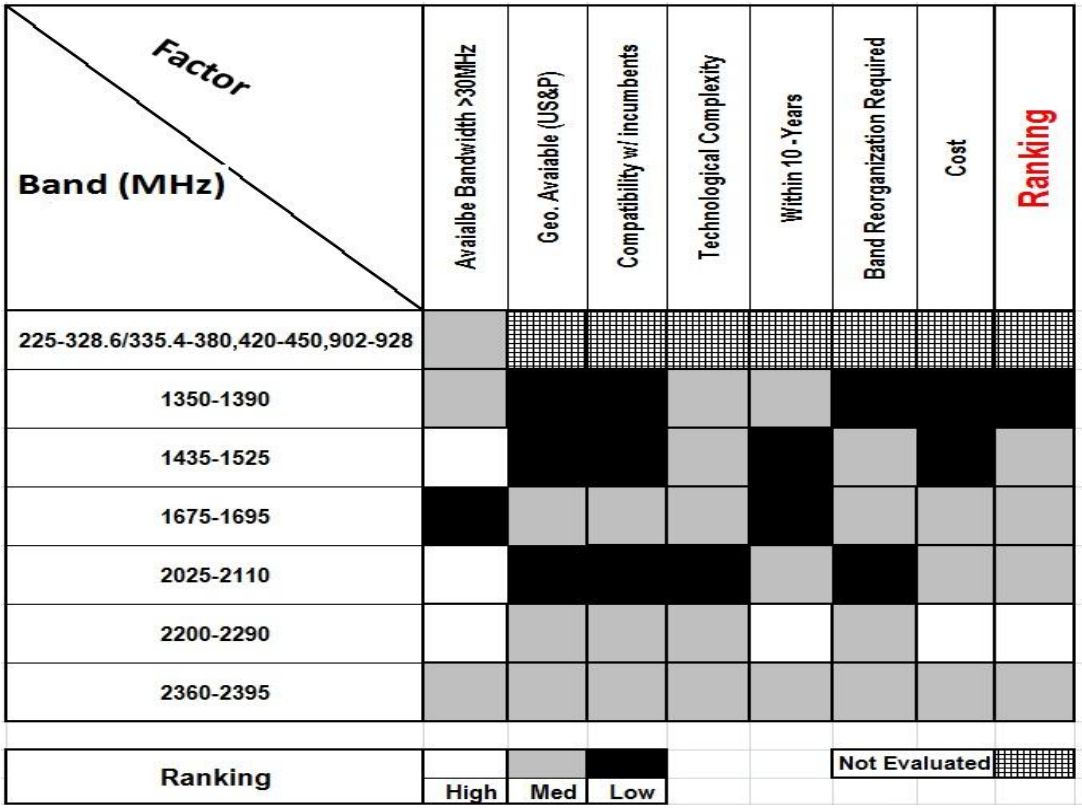


**Figure 8. Alternate Band Evaluation Summary & Risk**

The following provides a summary and rationale for DOJ perspectives and priority ranking of comparable bands and associated supportability of current DOJ 1755-1850 MHz operations.

[1] USP type operations and assignments refer to DOJ's tactical, mobile operations in the "United States and Possessions".

- **225-328.6/335.4-380 MHz, 420-450 MHz, and 902-928 MHz Bands**
  **Non-select.** Too low in order to efficiently/effectively support "miniaturized" low-profile operations.

- **1350-1390 MHz Band**
  **Low Probability/Ranking.** Band is essentially too low in order to efficiently and effectively support "miniaturized" low-profile operations, only 40 MHz Bandwidth available, and currently congested with highly incompatible primary radar surveillance activities.

- **1435-1525 MHz Band**
  **Medium Probability/Ranking**. Band is borderline in order to efficiently and effectively support "miniaturized" low-profile operations and current congestion with incompatible aeronautical telemetry activities prohibits effective deployment of USP based activities.

- **1675-1695 MHz Band**
  **Medium Probability/Ranking**. Demonstrates potential due to technical strengths associated with system design capabilities, but functionally will be a challenge due to limited bandwidth and potential interference with resident satellite and radiosonde operations.

- **2025-2110MHz Band**
  **Medium Probability/Ranking**. Demonstrates potential due to technical strengths associated with system design capabilities, but will be functionally problematic due to congestion throughout the band, particularly in/by commercial and private based activities.

- **2200-2290 MHz Band**
  **High Probability/Ranking**. Demonstrates potential due to technical strengths associated with system design capabilities, ready availability of proven/supportable technology, and presence of similar operations already resident within the band. Problematic issues include current congestion within the band which could lead to net loss of capabilities, potential aggravated congestion with influx of new users, band's potential for future auctioning, and protection that can be afforded to new/existing authorized users in the band.

- **2360-2395 MHz Band**
  **Medium Probability/Ranking**. Demonstrates potential due to technical strengths associated with system design capabilities, but functionally very problematic due to very limited bandwidth and congestion/incompatibility with pervasive aeronautical telemetry operations throughout the band.

## Attachment 2. Current DOJ Assignments in the 1755 - 1850 MHz Band – ***Redacted for public posting.***

# Attachment 3. Characteristics of DOJ Operations to be Relocated to Destination Bands – ***Partially redacted for public posting.***

## PROPOSED DESTINATION BANDS FOR DOJ OPERATIONS

| Operation | Types of Systems | Proposed Destination Band (MHz) |
|---|---|---|
| Transportable Surveillance | Miniature Concealment | 2200 - 2290; 1675 - 1695 |
| | Airborne | 4800 - 4940 |
| | Audio Surveillance Covert | No new bands anticipated |
| | UAS | 1435 - 1525; [ 2025-2110 * ] |
| | Robotics | 1435 - 1525 |
| Fixed Surveillance | Small Concealment | 2200 - 2290 |
| | Large Concealment | 2200 - 2290 |
| | MESH Networks | 2200 - 2290; 4400 - 4800 |
| | Video Repeaters (in-band and X-band) | 1435 - 1525 |
| | Fixed Point-to-Point | 4400 - 4800; 8100 - 8500 |
| | Central Receiver | 1435 - 1525 |

**NOTES**:

***** Has been identified as a potential destination band for similar functionalities by other Federal agencies to which the DOJ could also use for similar purposes

| | |
|---|---|
| | Would establish additional presence in 1675-1695 MHz Band |
| | Would establish additional presence in 1435-1525 MHz Band |
| | Establishes additional presence in current DOJ operating Bands |

## Attachment 4. Technical Characteristics of Legacy Systems in the 1755-1850 MHz Band – ***Redacted for public posting.***