T-Band Update Report

May 31, 2016

The National Public Safety Telecommunications Council is a federation of organizations whose mission is to improve public safety communications and interoperability through collaborative leadership.

The member organizations of the National Public Safety Telecommunications Council are grateful to the Department of Homeland Security's Science and Technology Directorate, Office for Interoperability and Compatibility (OIC), and the National Protection and Programs Directorate, Office of Emergency Communications (OEC), for their support.

Executive Summary

This report provides an update to the previous T-Band Report issued by the National Public Safety Telecommunications Council (NPSTC) on March 15, 2013.[1] Given the 3-year time span, NPSTC wanted to determine if there have been any significant changes in the public safety demand for T-Band spectrum or the viability of potential relocation options. As detailed in this Update Report, only minimal numbers of public safety T-Band licenses have been cancelled or allowed to expire without renewal since the previous NPSTC study. Also, various jurisdictions have indicated their T-Band systems and spectrum are still essential to effective communications and interoperability.

Although the Federal Communications Commission (FCC) has released 24 reserve channels from the 700 MHz band earmarked for T-Band relocation, the number of additional channels pales in comparison to the T-Band channels in use, especially in the top five T-Band areas, as shown in Table 4.1 of this report. Also, while there has been progress in related standards, much work remains to provide a viable mission critical voice-over-LTE solution with coverage, guaranteed voice capacity, and local control equivalent to that of current T-Band systems. The initial focus of FirstNet for the Nationwide Public Safety Broadband Network (NPSBN) is to provide broadband data and imaging capabilities that are not supported on current land mobile networks. It is premature to determine whether equivalent broadband coverage would be in place and mission critical voice-over-LTE could be proven reliable in the public safety stressed environment, both key requirements to substitute the NPSBN for current T-Band operations.

While most of Public Law 112-96 is positive for public safety, Section 6103 of that law which requires auction of the T-Band spectrum will impose a negative impact on public safety communications and interoperability. In turn, this also could negatively impact the operations of public safety agencies that provide emergency response to a population of more than 90 million people in the 11 T-band areas. This Update Report addresses the area and population contained within each T-Band area that could be negatively impacted by the requirement that public safety vacate the T-Band spectrum.

This spectrum also supports critical industrial and business systems on T-Band channels outside the public safety spectrum, not addressed in Section 6103 of Public Law 112-96. These channels support the efficient and safe operation of numerous small and large businesses that contribute to the U.S. tax base and economy. The Update Report also provides additional detail on the 325 full power and Class A television stations on TV channels 14-20, i.e., the 470-512 MHz T-Band spectrum. The presence of these stations could seriously impair use of the T-Band spectrum for nationwide commercial wireless operations even if public safety systems were cleared from the band.

The update study confirms the conclusions from the original NPSTC T-Band Report remain valid.

[1] The T-Band is comprised of spectrum in the 470-512 MHz band.

1. Introduction

On February 22, 2012, President Obama signed Public Law 112-96 which, in part, requires the Federal Communications Commission (FCC) to begin auctioning the public safety T-Band spectrum by February 2021 and clear all public safety operations from the band within 2 years of auction close (i.e., by early 2023). The T-Band spectrum is used in 11 metropolitan areas to support critical public safety communications and provide regional interoperability among first responders. These 11 areas include Boston, Chicago, Dallas, Houston, Los Angeles, Miami, New York, Philadelphia, Pittsburgh, San Francisco, and Washington, D.C. The law provides that auction revenues can be used toward the cost of relocating public safety operations out of the band, through grants to be made by the Department of Commerce. In response to the law, the FCC placed a freeze on new and expanded T-Band operations for all licensees, including both public safety and industrial/business entities.

In June 2012, the National Public Safety Telecommunications Council (NPSTC) chartered a T-Band Working Group to study the issue. The Working Group performed a study that assessed and documented the impact of the legislation and the FCC freeze on public safety and evaluated the viability and cost of potential relocation options. NPSTC released its T-Band Report on March 15, 2013, which provided the results of its comprehensive study. That original T-Band Report and its conclusions about the alternative spectrum and cost impact can be reviewed on the NPSTC website.[2]

Given the 3-year time span since that comprehensive study was completed, NPSTC decided to develop the T-Band Update Report (Update Report). In Section 2 of this Update Report, NPSTC examines whether the public safety demand for T-Band spectrum has changed during that 3-year span. Section 3 highlights the extent the public could be impacted by removal of public safety spectrum from the T-Band and resulting changes in public safety communications reliability and/or interoperability in the 11 T-Band areas. Section 4 of the Update Report covers any changes in spectrum relocation options. Finally, Section 5 provides a more detailed picture of the television broadcast use of the T-Band spectrum, i.e., channels 14 through 20, throughout the country. The presence of these stations is likely to prevent nationwide commercial operations on the T-Band spectrum, even if public safety were removed from the band as dictated under Public Law 112-96. Also, as noted in the original NPSTC T-Band report, business and industrial operations also utilize T-Band spectrum in the 11 designated T-Band metropolitan areas. This would impact commercial use of the band.

[2] NPSTC T-Band Report, March 15, 2013
http://www.npstc.org/download.jsp?tableId=37&column=217&id=2678&file=T_Band_Report_20130315.pdf

2. Demand for T-Band Spectrum

In its original T-Band Report of March 2013, NPSTC detailed public safety usage of the T-Band by analyzing and summarizing FCC license information. For this Update Report, NPSTC first re-examined FCC license information to determine the scope of licenses that public safety agencies specifically cancelled or merely let lapse without renewal.[3] Cancelling the license is an intentional action a licensee can request the FCC take if it no longer needs that license. In contrast, letting a license expire without renewal can be either intentional or accidental.

Analysis of FCC licensing records shows only 6 out of a total of 925 licensees, i.e., fewer than 1%, cancelled a T-Band license. License expirations are higher with 68 of 925, i.e., 7.4% of licensees allowed a T-Band license to expire without renewal. However, that needs to be placed into context. Thirteen of those 68 licensees have pending applications for replacement authorizations. That indicates these expirations without renewal could have been accidental rather than intentional. Furthermore, a number of the licensees with expired licenses also already have other T-Band licenses. Therefore, they cannot be counted as no longer relying on the T-Band spectrum. In addition, the FCC has issued a few Special Temporary Authorities (STAs) to cover continued T-Band operations pending any issuance of replacement licenses.

Table 2.1 summarizes the results of the analysis for each of the 11 T-Band areas.

[3] NPSTC thanks Rinehart Spectrum Solutions Group, LLC, a NPSTC volunteer participant, for assisting with this license analysis.

Table 2.1: T-Band Licensees with Cancelled or Expired Authorizations since the 2013 NPSTC T-Band Report

T-Band Region	Licensees, as reported in March 2013 Report	Licensees with System Authorizations Cancelled	Licensees with System Authorizations Expired	Applications Pending to Re-license Expired Authorizations
Boston	209	0	12	4
Chicago	114	0	6	0
Dallas	19	1	5	1
Houston	6	0	1	0
Los Angeles	50	0	0	0
Miami	15	0	2	0
New York	222	0	14	6
Philadelphia	150	2	19	1
Pittsburgh	30	0	3	1
San Francisco	54	2	2	0
Washington, D.C.	22	1	4	0
Totals	925	6	68	13

Since the 2013 NPSTC T-Band Report, various jurisdictions have indicated their T-Band systems and spectrum are still essential to effective communications and interoperability. For example, in addressing the T-Band issue, Fire Chief Gerald R. Reardon from the City of Cambridge, Massachusetts, stated the following:

> The Metro Boston region has expended tens of millions of dollars on equipment and infrastructure, and has developed a common interoperable channel plan that is consistent with our public safety partners. The greater Metro Boston area has over 200 licensees on the T-Band spectrum, many of which are system licenses with multiple channels. To relocate all of the public safety users operating on T-Band at this time would reverse progress and diligent work

> achieved over more than 40 years…. To undo over forty years of diligent, battle-tested, and proven successes marked by our interoperability system—a system built on the T-Band spectrum—would not be in the interest of public safety or citizens of the constituency that we protect. To do so, would be to dismantle a success story that most strive to achieve.[4]

As further evidence of the importance of the T-Band in the Boston Metropolitan area, the Greater Boston Police Council which implemented the Boston Area Police Emergency Radio Network (BAPERN) on T-Band spectrum has stated the following:

> …BAPERN was utilized in the week following the Boston Marathon Bombings by all responding law enforcement agencies to effectively and immediately communicate critical information across local, state, and federal lines of government.
>
> Today, BAPERN is used by 166 local, state, county, campus, and federal law enforcement agencies and spans a coverage area of over 2,000 square miles from the New Hampshire border to the Cape Cod Canal….Like most of local Massachusetts public safety agencies, BAPERN utilizes T-Band channels.
>
> As public safety executives across the Greater Boston area continue to process the law enforcement response to the Marathon bombings during the week of April 15th, one constant has emerged– police radio communications could not have worked any better….As BAPERN is a T-Band system, considerable measures need to be taken to ensure this essential public safety interoperable communications system is not discarded in favor of implementing the current mandate.[5]

During testimony before Congress on March 15, 2016, New York City Mayor Bill de Blasio responded to a question concerning the impact of the T-Band issue on New York City. Mayor de Blasio addressed the impact in part as follows:

> T-Band is a critical part of the work we do in terms of emergency communications. Disrupting that reality could prove to be very dangerous. We have, as you know, a very highly developed apparatus in New York City to protect our people and protect again the 60 million people who visit every year. It has to do with a number of agencies constantly working together in a very crowded complex environment and the current communications

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[4] Metro Boston Area Public Safety T-Band Dilemma, Chief Gerald R. Reardon, City of Cambridge, Massachusetts, May 22, 2015. https://www.dhs.gov/safecom/blog/2015/05/22/metro-boston-area-public-safety-t-band-dilemma

[5] How the Boston Area Police Emergency Radio Network (BAPERN) Successfully Delivered Interoperable Public Safety Communications During the Response to the Boston Marathon Bombings, Greater Boston Police Council. http://gbpc.org/files/BAPERN%20Marathon%20Brief.pdf

> structure allows us to do that work. If Congress doesn't act and we have to relinquish the current approach, we fear a situation that's really disruptive.[6]

These are just two examples expressed by officials concerning public safety's need for continued availability of the T-Band spectrum.

There could even be increased demand for T-Band operations in some areas. However, that increased demand would not show up in the license data NPSTC uses for analysis because the Commission implemented a freeze on new and expanded T-Band licenses in April 2012.[7] The freeze prevents jurisdictions from responding to any increase in demand for additional T-Band coverage or capacity unless they successfully pursue a waiver of the T-Band freeze.

Given the minimal changes in T-Band licensed facilities since the original NPSTC T-Band Report in March 2013, NPSTC did not pursue any update of the comprehensive cost analysis presented in that original report. That analysis estimated the cost of relocating all public safety T-Band operations to be $5.9 billion.

3. Impact to the Public

Reallocating the public safety T-Band spectrum, as Section 6103 of Public Law 112-96 mandates, negatively affects public safety communications, which in turn can have a negative effect on regional interoperability and members of the public who first responders strive to protect and serve. The area in which public safety base stations using T-Band spectrum can be located nominally extends for a 50-mile (80-kilometer) radius from the center of a given T-Band metropolitan area.[8] For this T-Band Update Report, a NPSTC volunteer mapped the counties and partial counties encompassed by the T-Band area in each of the 11 metropolitan areas in which public safety T-Band spectrum is allocated.[9][10] This provides a picture of the scope of regional interoperability and public impact that could result from the removal of the public safety T-Band

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[6] Hearing before the Emergency Preparedness, Response and Communications Subcommittee of the House Homeland Security Committee. March 15, 2016, 10:00 AM. Mayor Bill de Blasio's comments were made in response to a question from Ranking Member Payne. See video stream of hearing at https://homeland.house.gov/hearing/state-of-emergency/ at 41 minutes, 18 seconds to 44 minutes 24 seconds.

[7] WIRELESS TELECOMMUNICATIONS BUREAU AND PUBLIC SAFETY AND HOMELAND SECURITY BUREAU SUSPEND THE ACCEPTANCE AND PROCESSING OF CERTAIN PART 22 AND 90 APPLICATIONS FOR 470-512 MHz (T-BAND) SPECTRUM, Public Notice DA 12-643, released April 26, 2012

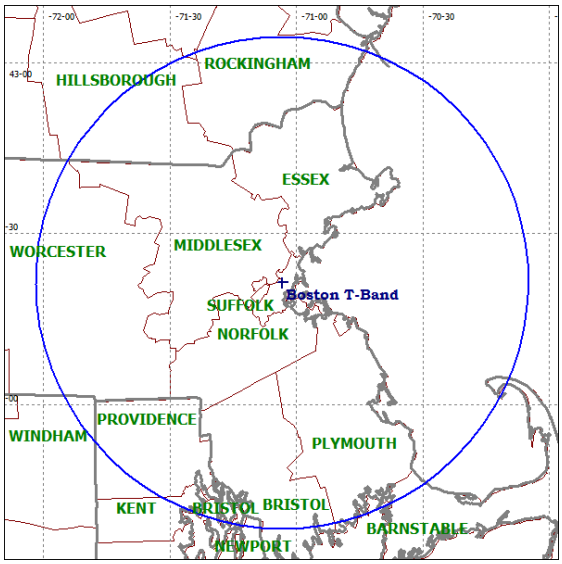
[8] This is described in greater detail in Section 1.1 of the original March 2013 NPSTC T-Band report.

[9] NPSTC thanks RadioSoft for assistance in providing mapping and population count information.

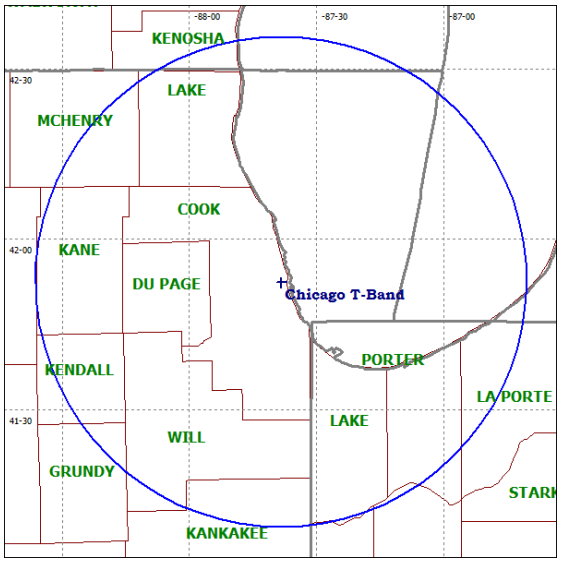
[10] For purposes of this mapping and associated population counts, the nominal 50-mile radius was used. However, there are instances in which public safety agencies have T-Band base stations beyond the 50-mile radius, pursuant to an FCC waiver, expanding the impact even further.

spectrum. Following is a map for each of the 11 T-Band areas. These maps demonstrate the extent of disruption which will occur if public safety agencies can no longer access these frequencies.

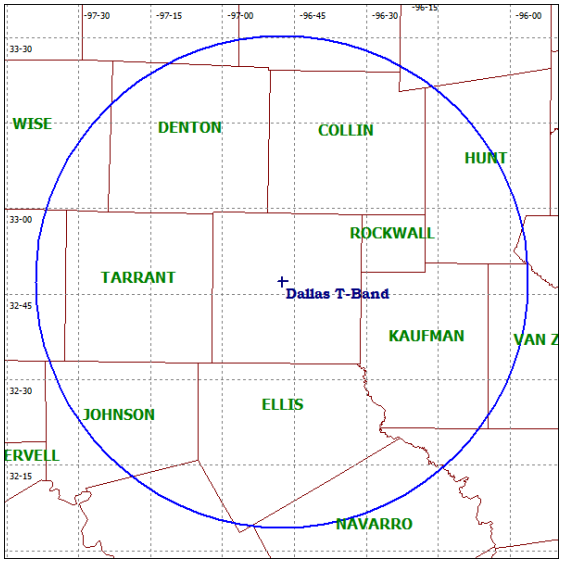
Boston Metropolitan T-Band



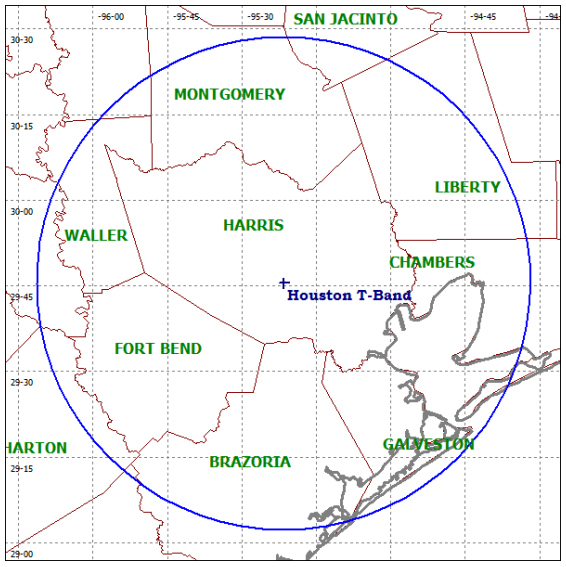
Chicago Metropolitan T-Band



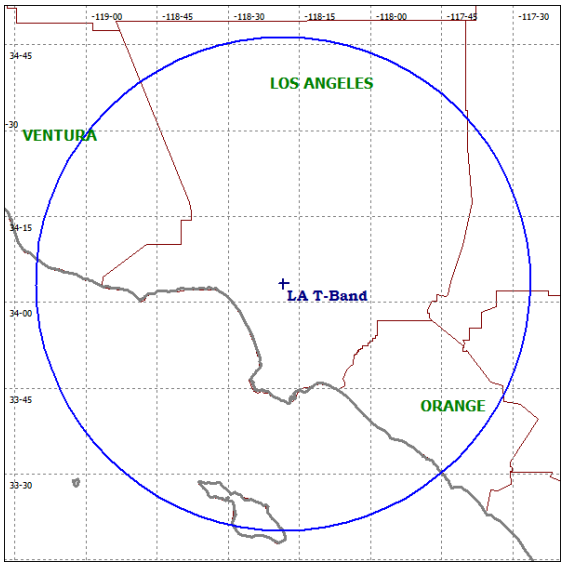
Dallas Metropolitan T Band



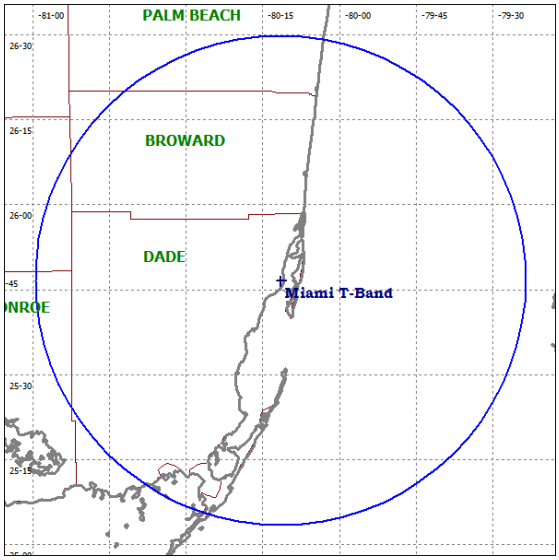
Houston Metropolitan T-Band



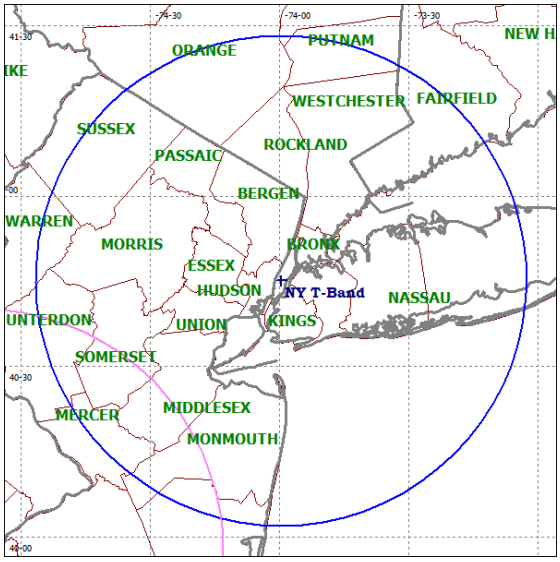
Los Angeles Metropolitan T-Band



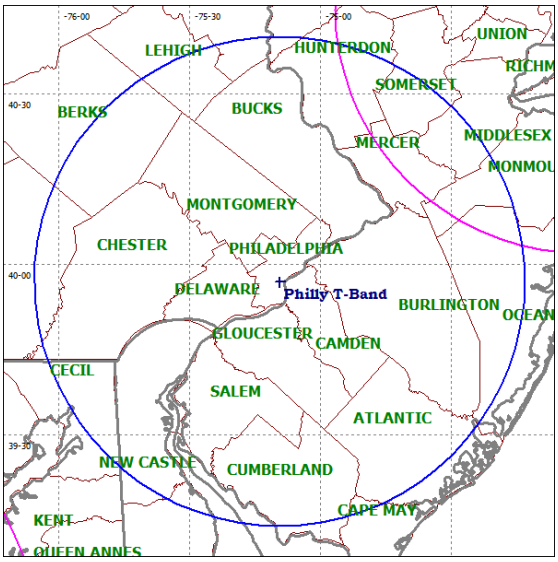
Miami Metropolitan T-Band



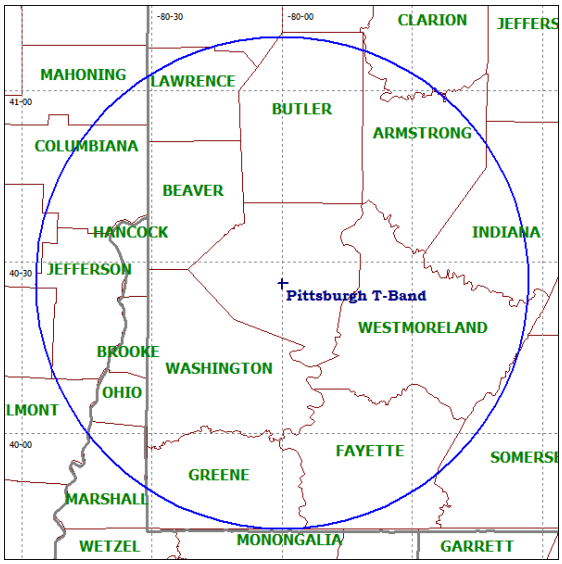
New York Metropolitan T-Band



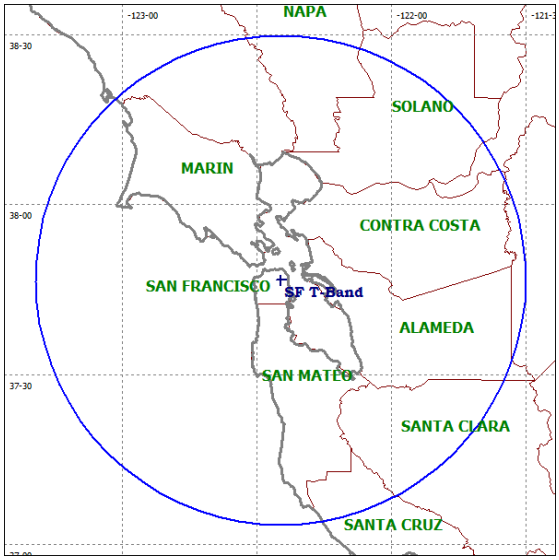
Philadelphia Metropolitan T-Band



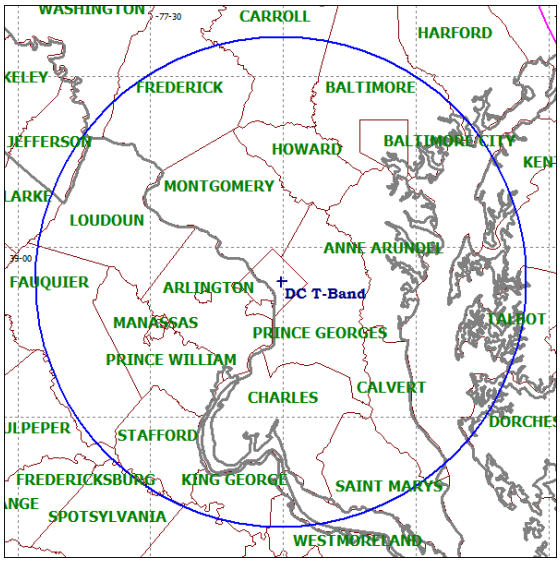
Pittsburgh Metropolitan T-Band



San Francisco Metropolitan T-Band



Washington/Baltimore Metropolitan T-Band



As discussed more fully in Section 4 of this Update Report, these maps also depict the general area within which the NPSBN would need to be built out with equivalent or better coverage than current LMR T-Band systems, if jurisdictions are to consider moving T-Band operations to the broadband network.

NPSTC also examined the population served by public safety agencies in these 11 T-Band areas.[11] The following table provides the approximate population with the T-Band areas shown in the maps above. Where all of a county falls within the T-Band 50-mile radius, the population of that county was included in the calculations. For situations in which only a portion of a county falls within the T-Band 50 mile radius, an estimated pro-rated population for that county is used. As shown, over 90 million people reside in the T-Band areas. This does not include the many visitors and work force commuters who further expand the number of people public safety serves in T-Band areas.

Table 3.1 Approximate Population within T-Band Areas

T-Band Region	Approximate Population within 50-mile Radius T-Band Area
Boston	6,623,694
Chicago	9,168,303
Dallas	6,256,515
Houston	5,833,654
Los Angeles	14,229,004
Miami	4,566,920
New York	18,645,602
Philadelphia	7,699,691
Pittsburgh	2,830,016
San Francisco	6,839,939
Washington, D.C./Baltimore, MD	7,934,812
Total Approximate Population	90,628,150

[11] Population analysis is based on the 2010 U.S. census.

4. Update on T-Band Relocation Options

In its 2013 T-Band Report, NPSTC examined the options for public safety T-Band systems to relocate out of the T-Band spectrum as mandated by Public Law 112-96. Those options include basically two approaches. First, if sufficient alternative spectrum and funding were available, jurisdictions could relocate their T-Band operations to other public safety land mobile bands. Alternatively, if the NPSBN were in place and capable of supporting mission critical voice operations with the coverage, capacity, reliability, and features public safety requires, jurisdictions may move their T-Band operations to the broadband network to be deployed by FirstNet. Neither move would be a simple task and would require careful planning and execution.

The NPSTC March 2013 T-Band Report provided significant background information on the alternative bands considered and analyzed. Such background information provides a foundation for the analysis that was provided in the original T-Band Report. Given that information is still available, this T-Band Update Report focuses primarily on what has changed since the original T-Band Report was issued. NPSTC recommends that readers of this T-Band Update Report also review the background information in the original March 2013 T-Band Report.

The following subsections provide an update on the two basic approaches for potential relocation of public safety T-Band operations: 1) move to an alternative public safety land mobile band or 2) relocate to the Nationwide Public Safety Broadband Network (NPSBN) currently being planned by FirstNet.

4.1 Move to an Alternative Public Safety Land Mobile Band

In the March 2013 T-Band Report NPSTC examined the VHF, UHF, 800 MHz, and 700 MHz public safety spectrum bands, relative to the T-Band operations that would need to be relocated. In summary, NPSTC found that there is insufficient alternative public safety land mobile spectrum available to support operations already in those bands and prospective relocations from the T-Band. The 700 MHz band provided the greatest potential availability; however, analysis showed that even that band did not have sufficient numbers of available channels to accommodate T-Band operations in all T-Band metropolitan areas. Following is the summary of the 700 MHz band analysis from the 2013 T-Band report [original footnotes omitted]:

> If all these [700 MHz band] channels thought to be available were in fact available, the Boston, Chicago, Los Angeles, New York, and Philadelphia metro areas would still face a shortfall in the number of channels needed to re-accommodate their T-Band operations. Dallas, Houston, Miami, Pittsburgh, San Francisco, and Houston might have sufficient channels to accommodate their displaced T-Band systems if all channels were available. NPSTC believes, based on interviews with user agencies and frequency advisors, that many

of these "available" channels are already designated to support expansion of existing systems.[12]

The primary change that has occurred since the original T-Band report was issued is release of the 700 MHz band reserve channels with earmarks for T-Band users. On October 24, 2014, the FCC released a Report and Order that made available 24 channels formerly held in reserve.[13] In the T-Band markets, the FCC stated that all 24 of these formerly reserve channels will be available for General Use with priority given to relocating T-Band incumbents that commit to return an equal amount of T-Band channels.[14] Therefore, there are now 24 additional 700 MHz channels for potential T-Band relocation that were not available when the original NPSTC T-Band Report was developed and issued in March 2013. In many T-Band areas that means that all 24 of those reserve channels will be available. However, when T-Band areas are in relatively close proximity, e.g., those along the northeast corridor, the applicable 700 MHz Regional Planning Committees will need to take steps to ensure these 24 channels, like all 700 MHz channels, are distributed among the eligible agencies in a way to avoid co-channel interference. In those situations, availability of all 24 channels can depend on transmitter site locations within the region.

Although these 24 additional 700 MHz band channels are certainly beneficial, the number of additional channels pales in comparison to the T-Band channels in use that would need to be relocated to alternative spectrum, especially in the top five T-Band areas, i.e., Boston, Chicago, Los Angeles, New York, and Philadelphia.

In any given region, the 700 MHz Regional Planning Committee allots the available channels by county. NPSTC reported the allotments that had been made to counties within the T-Band 50-mile radius in the March 2013 T-Band Report, as of the time the analysis was conducted for that report.[15] Prior to the regional plan amendments required by release of the 24 reserve channels, the only Region that had filed a substantive amendment to its Plan was Region 5, southern California. That amendment, which allotted additional channels to Riverside County, brought the total number of allotments in the T-Band counties around Los Angeles to 366, compared to 342 channels previously. The allotments made to the counties in the other 10 T-Band areas remained the same. Given the allotments reported in the March 2013 report and adjusting for the change in Region 5, as well as the additional 24 channels released from the reserve that will be added to the allotments in all the T-Band areas, provides for a slightly revised allotment table.

Also, there has been strong 700 MHz band licensing activity in many of the T-Band areas since the NPSTC March 2013 Report was issued. For example, in the March 2013 Report analysis showed that there were 153 channel 700 MHz General Use channel pairs allotted but not yet licensed to counties within a 50-mile radius of the T-Band center for the Chicago T-Band area. Our updated

[12] T-Band Report, March 15, 2013, Section 3.6, page 31.
[13] Report and Order, PS Docket No. 13-87, released October 24, 2014.
[14] See Report and Order, paragraph 40.
[15] See Table 3.7 from the NPSTC March 2013 T-Band Report.

analysis shows that number of channels not yet licensed has reduced to 114 as of early 2016. Similarly, the Houston T-Band area had 90 channels not yet licensed in 2013 and that number has dropped to 1 channel in early 2016.

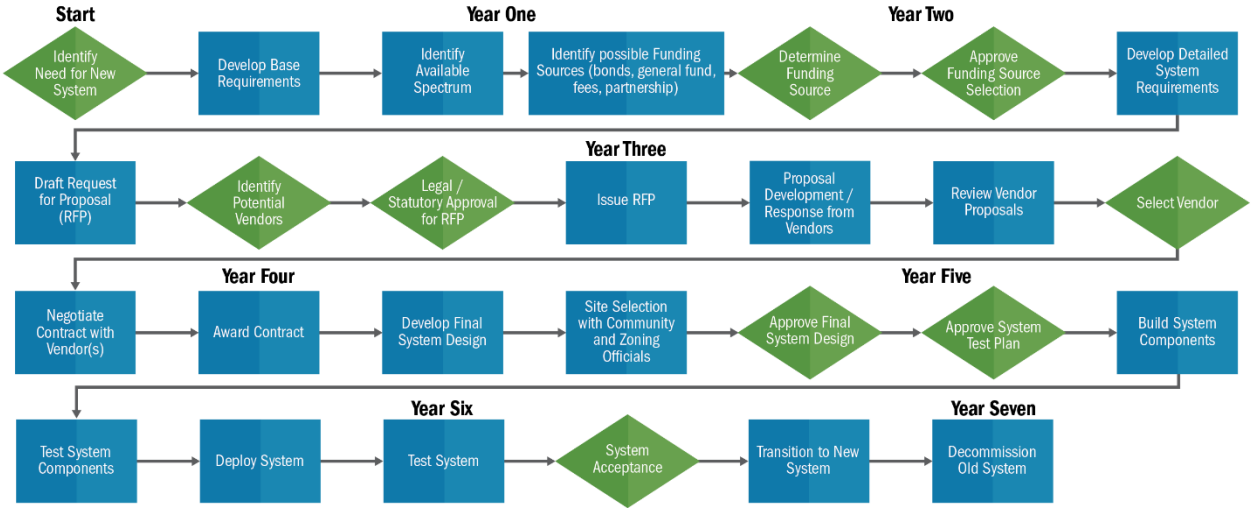
Table 4.1 shows the updated number of 700 MHz band General Use channel allotments for the counties within the 50-mile radius of the center of each T-Band area in the first numeric column. The number of unassigned 700 MHz channels that remain is shown in the second numeric column. The third numeric column in Table 4.1 shows the number of T-Band channel pairs that would need to be re-accommodated. This analysis shows that for most of the T-Band areas, the number of channels that would need to be re-accommodated substantially exceed those 700 MHz General Use Channels not yet licensed. As noted in the 2013 T-Band report, more detailed engineering would be needed to determine whether a specific channel not yet licensed can be used at a particular transmitter site. Also, NPSTC acknowledges there may be some additional channel efficiencies in transitioning from conventional to trunked systems. Such detailed engineering analysis and redesign of each T-Band system is beyond the scope of this NPSTC T-Band Update.

Table 4.1: Updated 700 MHz Channel Analysis

T-Band Market	Updated 700 MHz General Use Channel Pairs Allotted in Plan to Counties within 50- Mile Radius (Based on 12.5 kHz CH Pairs)	Updated 700 MHz General Use Channel Pairs Allotted in Plan to Counties within 50-Mile Radius but Not Yet Licensed (based on 12.5 kHz CH Pairs)	T-Band Channel Pairs Licensed in Market that Need to Be Re-accommodated
Boston	188	188	596
Chicago	207	114	279
Dallas	116	34	55
Houston	225	1	7
Los Angeles	390	50	546
Miami	160	58	43
New York	392	94	1054
Philadelphia	599	232	790
Pittsburgh	164	164	107
San Francisco	370	150	216
Washington, D.C./Baltimore, MD	244	79	129

SAFECOM and the National Council of Statewide Interoperability Coordinators (NCSWIC), organizations that include public safety practitioners from around the country and which are

sponsored by the Department of Homeland Security (DHS), jointly studied the T-Band issue.[16] SAFECOM and NCSWIC published a briefing entitled "The T-Band Giveback, Implications for the Public Safety Community."[17] The briefing, released in October 2015, highlights some of the findings from the NPSTC T-Band Report conducted in 2013. As part of that briefing, SAFECOM and NCSWIC also included a Sample T-Back Transition Timeline which summarizes the process in which public safety agencies would need to engage to relocate their T-Band operations to other public safety land mobile spectrum, if it were available. This Sample T-Band Transition Timeline spans a period of 7 years, as the reprint below shows.



One of the key steps in year one is to "Identify Available Spectrum." Unfortunately, that step in the process is not yet available for many public safety agencies operating in the T-Band, especially those in the top five T-Band metropolitan areas. As addressed in the previous NPSTC T-Band Report and in this T-Band Update, sufficient alternative public safety land mobile spectrum has not been identified, so this process cannot even be started.

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[16] SAFECOM, established in 2001 as a Presidential E-Government Initiative, is a mission guided and stakeholder supported public safety communications program of the United States Department of Homeland Security (DHS). Through collaboration with emergency responders and policymakers across all levels of government, the SAFECOM Program works to improve multi-jurisdictional and intergovernmental communications interoperability. Its membership includes more than 70 members representing local, tribal, and state government, including elected and appointed officials, state emergency responders, and major intergovernmental and national public safety associations, who provide input on the challenges, needs, and best practices involving emergency communications.

[17] https://www.dhs.gov/sites/default/files/publications/T-Band%20Slick%20Sheet_102015_508%202216.pdf

4.2 Relocate to the Nationwide Public Safety Broadband Network (NPSBN)

Since NPSTC released its original T-Band report in March 2013, the 3rd Generation Partnership Program (3GPP) has made significant progress on a mission critical voice over LTE standard.[18] Reports indicate that Release 13 of the LTE standard will include mission critical voice and that commercial equipment complying with the standard should be available as early as 2018.[19] That standard is the first step in assessing whether the NPSBN might have mission critical voice capability. The technical capability is a necessary, but not a sufficient, condition to abandon proven and battle-tested T-Band operations and move them to the NPSBN, a network still in the planning stages.

The Public Safety Communications Research (PSCR[20]) center in Boulder, Colorado, is in the early stages of testing how mission critical voice may be accommodated on LTE technology. Their work, which was mandated in Public Law 112-96, will take several years to complete. Finally, any transition of public safety operations from the T-Band to the NPSBN must include an interoperability component to allow users on both networks to communicate with each other. Standards work on this LMR to LTE interconnection has not been finalized by 3GPP. Once 3GPP adopts a global standard for this interconnection, then work will begin on a parallel standard that will address the LMR equipment interconnection. All of this work must be completed before testing can take place to validate the safety and efficiency of an LTE mission critical voice system.

Public safety looks forward to the further development of the NPSBN, which is envisioned as a supplement to current public safety land mobile systems for some time in the future. Making the decision to rely only on the NPSBN and dismantle a system already in place on which public safety has relied upon for years in a given jurisdiction or region, is a more serious matter that requires careful consideration.

There are many factors jurisdictions with T-Band have to consider. Many of the applicable questions have answers that are unavailable today and still reside somewhere into the future. For example:

- Does the NPSBN have the coverage for my jurisdiction equivalent to or better than the coverage I have on T-Band?
- Is there commercially available mission critical voice over LTE equipment designed to meet the needs of my law enforcement officers, firefighters, emergency medical service personnel, and other local government functions?

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[18] The 3rd Generation Partnership Project (3GPP) is an international standards organization that focuses on LTE technologies.
[19] 3GPP approves standard for mission-critical PTT (MCPTT) over LTE in Release 13, Urgent Communications, March 16, 2016.
[20] Operated by the Department of Commerce, National Institute of Science and Technology (NIST).

- Has the equipment and the network been sufficiently tested in actual public safety tactical environments to warrant the necessary confidence in the system?
- Are the control and operational functions needed by my jurisdiction available with mission critical voice over the NPSBN?
- Is training available for any functions which are different but still acceptable?
- What is the annual cost of moving all my jurisdiction's T-Band voice traffic to the NPSBN, and are the necessary funds budgeted on a sustained basis?
- How will my agency maintain interoperability with other public safety agencies operating in the 450-470 MHz UHF band (with which I can communicate today on T-Band)?

SAFECOM and NCSWIC have expressed concerns about the potential abandonment of T-Band spectrum. In addition to noting the lack of alternative spectrum and the significant cost that would be incurred to relocate public safety T-Band operations, SAFECOM and NCSWIC observed the following:[21]

> Planning, coordinating, and implementing a successful migration from T-Band to a new public safety communications system is a multi-year (4-5 budget cycle) process and a large commitment of resources – one that cannot be made without more concrete information and guidance on migration schedules, costs, and technical capabilities.

NPSTC concurs with this assessment and believes it is premature at this stage to make the assumption that all T-Band operations simply can be re-accommodated on the NPSBN.

5. TV and B/ILT Operations in the T-Band

5.1 The Law is Silent on TV and Business/Industrial Land Transportation (B/ILT) Operations

As noted previously, Section 6103 of Public Law 112-96 requires the FCC to reallocate the T-Band spectrum currently used by public safety and to auction the spectrum. Specifically, Section 6103 states the following:

> **SEC. 6103. 470–512 MHZ PUBLIC SAFETY SPECTRUM**
>
> *(a) IN GENERAL.—Not later than 9 years after the date of enactment of this title, the Commission shall—*
> *(1) reallocate the spectrum in the 470–512 MHz band (referred to in this section as the "T-Band spectrum") currently used by public safety eligibles as identified in section 90.303 of title 47, Code of Federal Regulations; and*

[21] See: T-Band Executive Briefing, SAFECOM and NCSWIC, December 2015. https://www.dhs.gov/sites/default/files/publications/Final_T-Band%20Executive%20Briefing_031716FINAL508.pdf

(2) begin a system of competitive bidding under section 309(j) of the Communications Act of 1934 (47 U.S.C. 309(j)) to grant new initial licenses for the use of the spectrum described in paragraph (1).

(b) AUCTION PROCEEDS.—Proceeds (including deposits and upfront payments from successful bidders) from the competitive bidding system described in subsection (a)(2) shall be available to the Assistant Secretary to make grants in such sums as necessary to cover relocation costs for the relocation of public safety entities from the T-Band spectrum.

(c) RELOCATION.—Relocation shall be completed not later than 2 years after the date on which the system of competitive bidding described in subsection (a)(2) is completed.

In NPSTC's view, auction winners would face a challenging environment for deployment in the T-Band, given current operations in the band not addressed in this section of Public Law 112-96. Those current operations include approximately 325 television stations throughout the country. The T-Band also supports critical industrial/business and land transportation (B/ILT) systems on T-Band channels outside the public safety spectrum, not addressed in Section 6103 of Public Law 112-96. The following provides additional information about these operations.

5.2 Television Operations in the T-Band

NPSTC has determined that the band supports approximately 325 full power TV and Class A TV stations across the 470-512 MHz band, i.e., TV Channels 14-20.[22]

Public Law 112-96 that addresses public safety relocation and auction of the public safety T-Band spectrum also includes separate unrelated sections addressing "incentive auctions" of broadcast spectrum. Since the law was adopted, the FCC has been fully engaged in developing an incentive auction process designed to clear TV operations from spectrum in the 600 MHz area to make way for commercial broadband use.

As noted by the FCC Notice of Proposed Rulemaking regarding incentive auctions involving broadcast spectrum, Congressional authority for such incentive auctions requires that they be voluntary:

"Section 6402, codified at 47 U.S.C. § 309(j)(8)(G), authorizes the Commission to conduct incentive auctions in which licensees may voluntarily relinquish their spectrum usage rights in order to

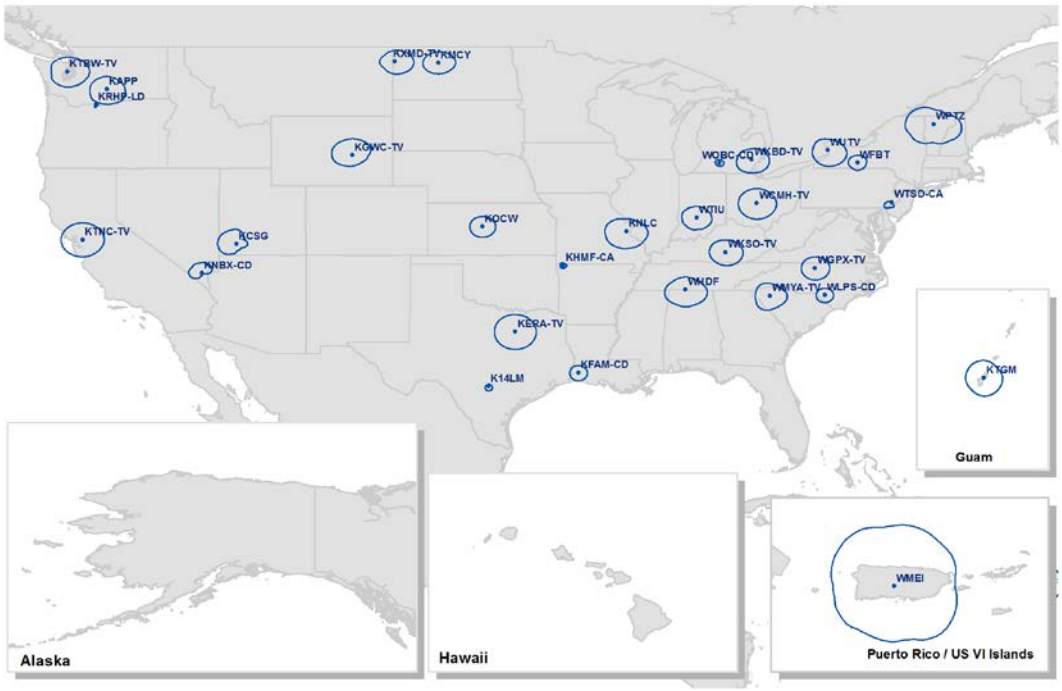
[22] Class A stations generally operate at a lower power level than that of Full Power TV stations, but still have facilities to originate programming.

permit the assignment by auction of new initial licenses subject to flexible use service rules, in exchange for a portion of the resulting auction proceeds." [*emphasis added]*[23]

Therefore, Public Law 112-96 only mandates auction of the public safety T-Band spectrum, not the same spectrum in other areas used by the television stations shown on the following maps.[24]

As noted in the 2013 NPSTC T-Band Report, NPSTC does not believe it is practical to mix commercial broadband services with existing television services in the same spectrum in the same area, as evidenced by the necessary transition of TV operations out of TV channels 52-69 (698-806 MHz) to make way for both commercial and public safety operations in the 700 MHz band. This likely means any commercial services that were to emerge from auction of the T-Band spectrum would incur numerous holes in coverage across the country. The following maps show the location across the country of full power and class A TV stations on the T-Band spectrum, i.e., TV channels 14-20. While these maps were developed in 2012, NPSTC believes they are still applicable as of the time this report was developed.

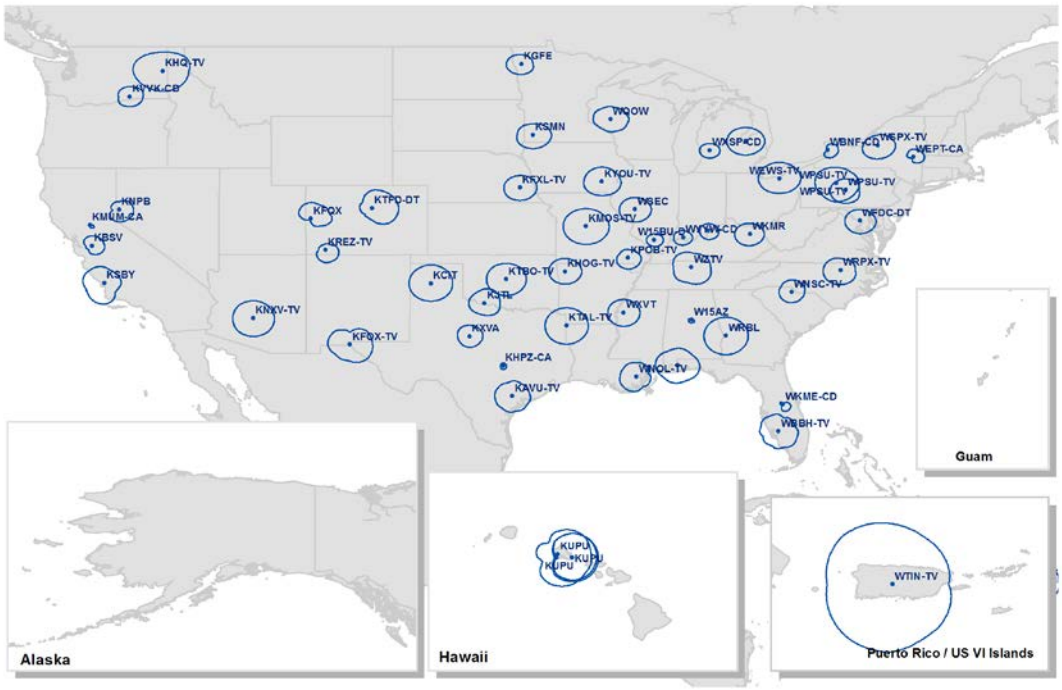
Protected Contours of Full-Power and Class A Stations Operating as of February 22, 2012
Channel 14



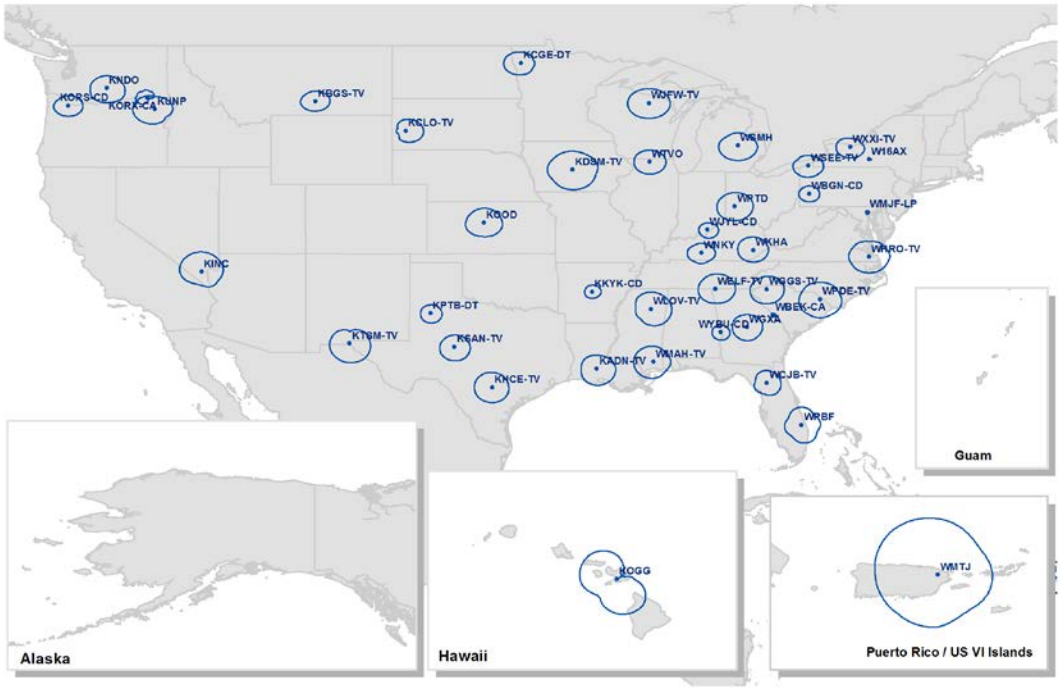
[23] Notice of Proposed Rulemaking, In the Matter of Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, Docket NO. 12-268, released October 2, 2012, at paragraph 27.

[24] NPSTC appreciates the assistance of the National Association of Broadcasters in providing information about television operations in the T-Band. These maps were developed originally in support of activity surrounding incentive auctions, and therefore, depict the situation as of enactment of Public Law 112-96, i.e., February 22, 2012.

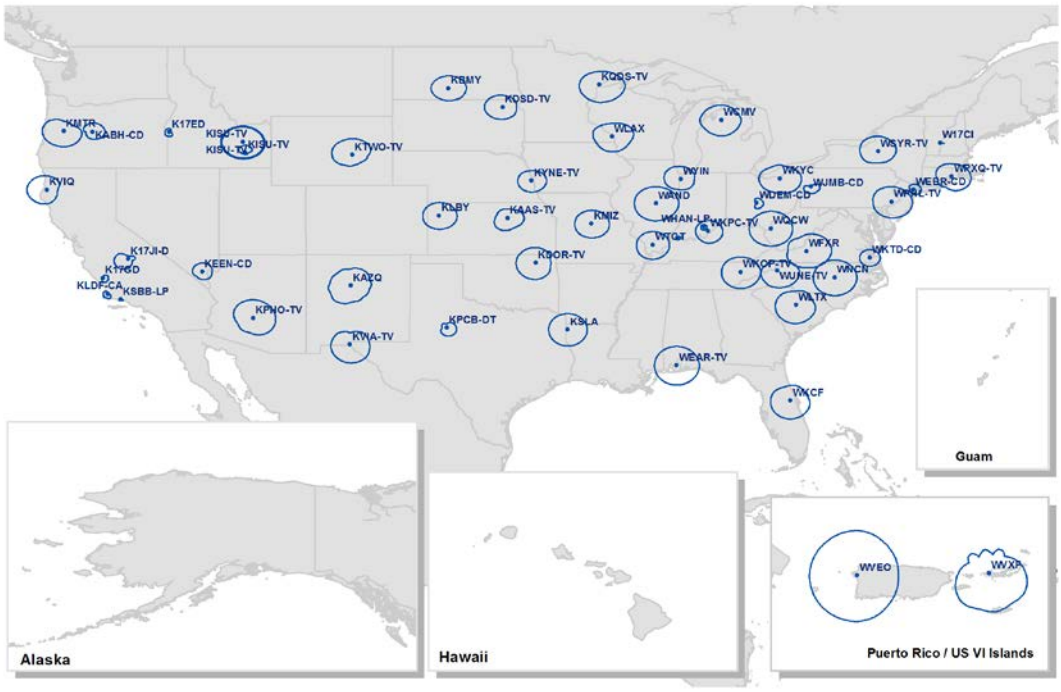
Protected Contours of Full-Power and Class A Stations Operating as of February 22, 2012
Channel 15



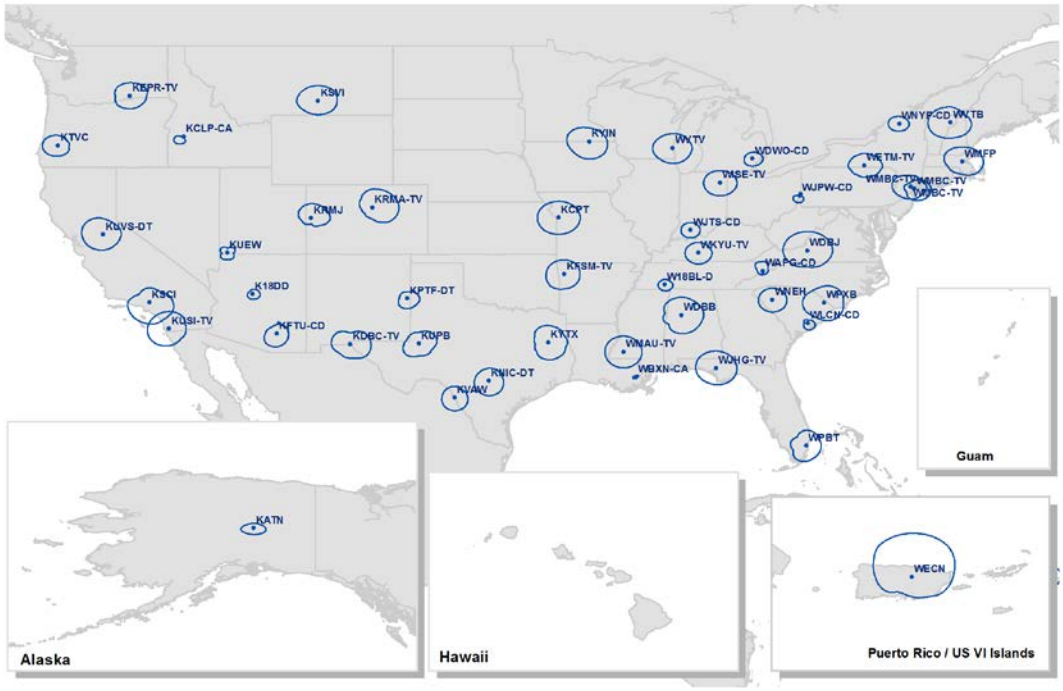
Protected Contours of Full-Power and Class A Stations Operating as of February 22, 2012
Channel 16



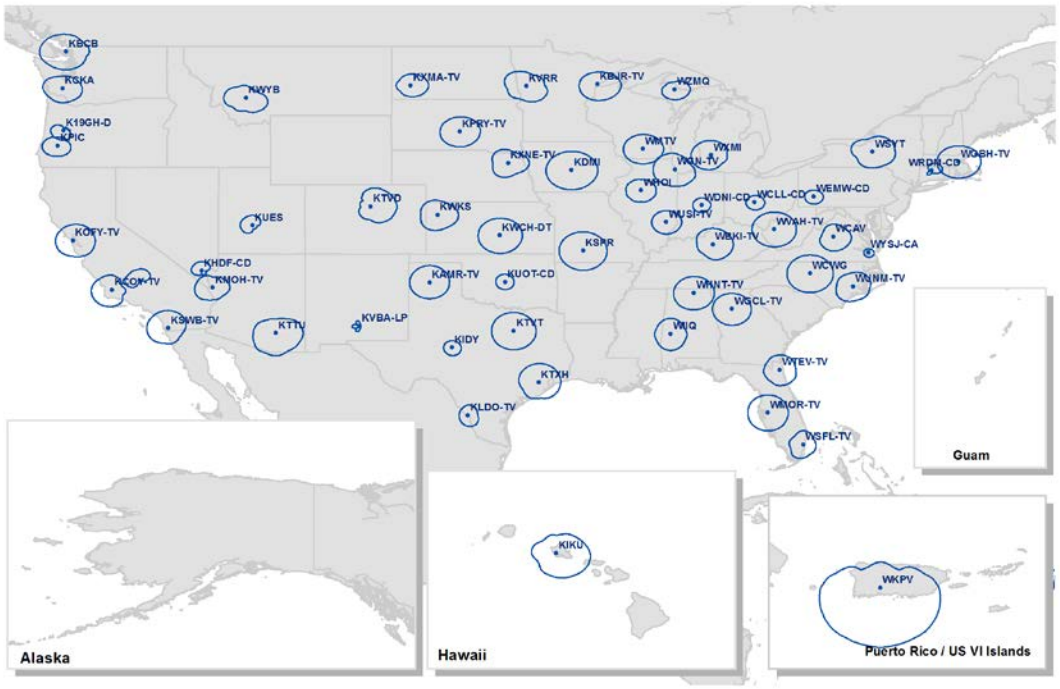
Protected Contours of Full-Power and Class A Stations Operating as of February 22, 2012
Channel 17



Protected Contours of Full-Power and Class A Stations Operating as of February 22, 2012
Channel 18



Protected Contours of Full-Power and Class A Stations Operating as of February 22, 2012
Channel 19



Protected Contours of Full-Power and Class A Stations Operating as of February 22, 2012
Channel 20

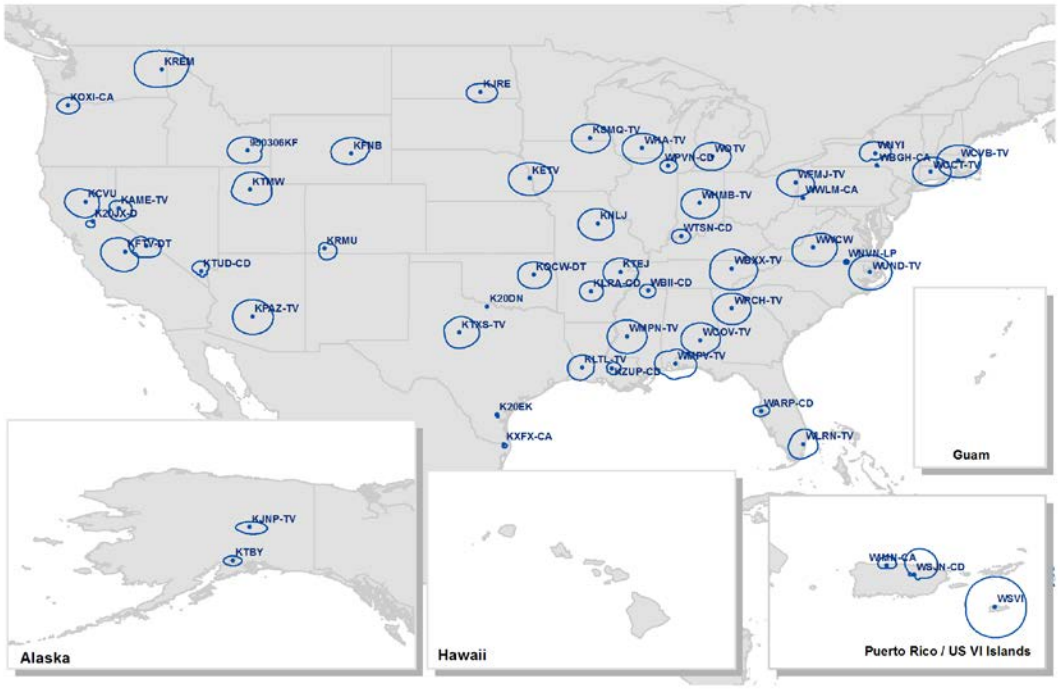


Table 5.1 also lists the Full Power and Class A TV stations in the T-Band spectrum by state and city. This listing includes an indication of the general population served by each station.

Table 5.1 Full Power and Class A Television Stations Operating in the T-Band

Channel	Service	City	State	Call Sign	Population Served
20	DT	ANCHORAGE	AK	KTBY	346,562
18	DT	FAIRBANKS	AK	KATN	97,128
20	DT	NORTH POLE	AK	KJNP-TV	98,097
15	CA	ALABASTER	AL	W15AZ	100,485
18	DT	BESSEMER	AL	WDBB	1,620,185
19	DT	DEMOPOLIS	AL	WIIQ	315,470
14	DT	FLORENCE	AL	WHDF	1,227,086
19	DT	HUNTSVILLE	AL	WHNT-TV	1,433,978
15	DT	MOBILE	AL	WPMI-TV	1,457,678
20	DT	MOBILE	AL	WMPV-TV	1,387,428
20	DT	MONTGOMERY	AL	WCOV-TV	831,872
14	CA	BENTONVILLE	AR	KHMF-CA	160,674
15	DT	FAYETTEVILLE	AR	KHOG-TV	691,311
18	DT	FORT SMITH	AR	KFSM-TV	883,587
20	DT	JONESBORO	AR	KTEJ	416,929
16	DC	LITTLE ROCK	AR	KKYK-CD	610,613
20	DC	LITTLE ROCK	AR	KLRA-CD	775,509
18	CA	CAMP VERDE	AZ	K18DD	106,874
19	DT	KINGMAN	AZ	KMOH-TV	184,283
15	DT	PHOENIX	AZ	KNXV-TV	4,172,832
17	DT	PHOENIX	AZ	KPHO-TV	4,175,148
20	DT	PHOENIX	AZ	KPAZ-TV	4,171,614
18	DC	TUCSON	AZ	KFTU-CD	855,864
19	DT	TUCSON	AZ	KTTU	1,028,780
19	DC	BAKERSFIELD	CA	KBBV-CD	685,827
20	DT	BISHOP	CA	KVME-TV	21,907
15	DT	CERES	CA	KBSV	1,262,280
14	DT	CONCORD	CA	KTNC-TV	9,214,106
17	DT	EUREKA	CA	KVIQ	126,807
17	DC	FRESNO	CA	K17JI-D	1,177,432
20	DT	HANFORD	CA	KFTV-DT	1,793,228
17	CA	LOMPOC	CA	KLDF-CA	57,254
18	DT	LONG BEACH	CA	KSCI	15,875,092
18	DT	MODESTO	CA	KUVS-DT	4,007,363
20	DT	PARADISE	CA	KCVU	613,754
17	CA	PASO ROBLES	CA	K17GD	81,615

15	CA	SACRAMENTO	CA	KMUM-CA	512,959
20	DC	SACRAMENTO	CA	K20JX-D	358,134
18	DT	SAN DIEGO	CA	KUSI-TV	3,230,505
19	DT	SAN DIEGO	CA	KSWB-TV	3,565,519
19	DT	SAN FRANCISCO	CA	KOFY-TV	6,827,873
15	DT	SAN LUIS OBISPO	CA	KSBY	495,495
17	CA	SANTA BARBARA	CA	KSBB-LP	96,991
19	DT	SANTA MARIA	CA	KCOY-TV	457,692
15	DT	BOULDER	CO	KTFD-DT	3,640,240
18	DT	DENVER	CO	KRMA-TV	3,599,599
19	DT	DENVER	CO	KTVD	3,561,694
15	DT	DURANGO	CO	KREZ-TV	105,121
20	DT	DURANGO	CO	KRMU	72,485
15	DT	GRAND JUNCTION	CO	KFQX	163,637
18	DT	GRAND JUNCTION	CO	KRMJ	159,511
19	DC	HARTFORD	CT	WRDM-CD	1,267,601
20	DT	WATERBURY	CT	WCCT-TV	4,094,464
17	DT	CLERMONT	FL	WKCF	4,030,171
15	DT	FORT MYERS	FL	WBBH-TV	2,046,391
16	DT	GAINESVILLE	FL	WCJB-TV	975,086
19	DT	JACKSONVILLE	FL	WTEV-TV	1,627,638
15	DC	KISSIMMEE	FL	WKME-CD	541,501
19	DT	LAKELAND	FL	WMOR-TV	5,267,621
18	DT	MIAMI	FL	WPBT	5,442,134
19	DT	MIAMI	FL	WSFL-TV	5,316,261
20	DT	MIAMI	FL	WLRN-TV	5,447,399
18	DT	PANAMA CITY	FL	WJHG-TV	982,940
17	DT	PENSACOLA	FL	WEAR-TV	1,517,774
20	DC	TAMPA-ST. PETERSBURG	FL	WARP-CD	2,065,311
16	DT	TEQUESTA	FL	WPBF	3,169,595
19	DT	ATLANTA	GA	WGCL-TV	5,940,672
20	DT	ATLANTA	GA	WPCH-TV	5,859,786
16	CA	AUGUSTA	GA	WBEK-CA	245,857
15	DT	COLUMBUS	GA	WRBL	1,288,093
16	DC	COLUMBUS	GA	WYBU-CD	419,324
16	DT	DALTON	GA	WELF-TV	1,307,164
16	DT	MACON	GA	WGXA	757,799
19	DT	HONOLULU	HI	KIKU	841,403
16	DT	WAILUKU	HI	KOGG	161,310

15	DD	WAIMANALO	HI	KUPU	943,879
16	DT	DES MOINES	IA	KDSM-TV	1,094,892
19	DT	DES MOINES	IA	KDMI	1,140,265
18	DT	MASON CITY	IA	KYIN	573,611
15	DT	OTTUMWA	IA	KYOU-TV	585,286
18	CA	BOISE	ID	KCLP-CA	525,353
20	DT	IDAHO FALLS	ID	950306KF	241,920
17	CA	PAYETTE	ID	K17ED	53,121
17	DD	POCATELLO	ID	KISU-TV	305,253
19	DT	CHICAGO	IL	WGN-TV	9,809,467
20	DC	CHICAGO	IL	WPVN-CD	6,057,637
17	DT	DECATUR	IL	WAND	1,378,640
15	DT	JACKSONVILLE	IL	WSEC	516,896
15	DC	JOHNSON CITY	IL	W15BU-D	207,622
17	DT	MARION	IL	WTCT	583,381
19	DT	OLNEY	IL	WUSI-TV	304,740
19	DT	PEORIA	IL	WHOI	691,566
16	DT	ROCKFORD	IL	WTVO	1,401,044
14	DT	BLOOMINGTON	IN	WTIU	1,127,742
15	DC	CLARKSVILLE	IN	WWJS-CD	1,185,543
15	DC	EVANSVILLE	IN	WYYW-CD	464,353
17	CA	EVANSVILLE	IN	WAZE-LP	138,942
20	DC	EVANSVILLE	IN	WTSN-CD	452,558
18	DT	FORT WAYNE	IN	WISE-TV	1,089,665
17	DT	GARY	IN	WYIN	6,946,832
19	DC	INDIANAPOLIS	IN	WDNI-CD	1,555,795
20	DT	INDIANAPOLIS	IN	WHMB-TV	2,828,206
18	DC	JASPER	IN	WJTS-CD	152,914
16	DC	JEFFERSONVILLE	IN	WJYL-CD	1,188,652
17	CA	SALEM	IN	WHAN-LP	5,884
17	DT	COLBY	KS	KLBY	34,274
19	DT	COLBY	KS	KWKS	39,289
16	DT	HAYS	KS	KOOD	112,599
14	DT	HOISINGTON	KS	KOCW	83,789
19	DT	HUTCHINSON	KS	KWCH-DT	881,673
17	DT	SALINA	KS	KAAS-TV	219,864
16	DT	BOWLING GREEN	KY	WNKY	371,435
18	DT	BOWLING GREEN	KY	WKYU-TV	407,059
19	DT	CAMPBELLSVILLE	KY	WBKI-TV	2,135,727

16	DT	HAZARD	KY	WKHA	366,235
17	DT	LOUISVILLE	KY	WKPC-TV	1,416,267
15	DT	MOREHEAD	KY	WKMR	348,848
14	DT	SOMERSET	KY	WKSO-TV	572,277
20	DC	BATON ROUGE	LA	KZUP-CD	706,237
16	DT	LAFAYETTE	LA	KADN-TV	878,126
14	DC	LAKE CHARLES	LA	KFAM-CD	252,105
20	DT	LAKE CHARLES	LA	KLTL-TV	423,574
15	DT	NEW ORLEANS	LA	WNOL-TV	1,633,769
18	CA	NEW ORLEANS	LA	WBXN-CA	293,732
17	DT	SHREVEPORT	LA	KSLA	994,000
19	DT	BOSTON	MA	WGBH-TV	7,565,923
20	DT	BOSTON	MA	WCVB-TV	7,463,665
18	DT	LAWRENCE	MA	WMFP	6,779,083
16	CA	TOWSON	MD	WMJF-LP	466,216
15	DT	BAD AXE	MI	WDCQ-TV	1,183,489
14	DC	BATTLE CREEK	MI	WOBC-CD	123,457
20	DT	BATTLE CREEK	MI	WOTV	2,203,473
17	DT	CADILLAC	MI	WCMV	407,228
14	DT	DETROIT	MI	WKBD-TV	4,971,829
18	DC	DETROIT	MI	WDWO-CD	4,069,246
16	DT	FLINT	MI	WSMH	1,879,393
15	DC	GRAND RAPIDS	MI	WXSP-CD	1,087,925
19	DT	GRAND RAPIDS	MI	WXMI	1,896,149
19	DT	MARQUETTE	MI	WZMQ	72,945
20	DT	AUSTIN	MN	KSMQ-TV	507,786
16	DT	CROOKSTON	MN	KCGE-DT	123,930
17	DT	DULUTH	MN	KQDS-TV	302,227
15	DT	WORTHINGTON	MN	KSMN	320,808
17	DT	COLUMBIA	MO	KMIZ	548,332
20	DT	JEFFERSON CITY	MO	KNLJ	641,397
18	DT	KANSAS CITY	MO	KCPT	2,506,139
15	DT	POPLAR BLUFF	MO	KPOB-TV	143,674
15	DT	SEDALIA	MO	KMOS-TV	802,798
19	DT	SPRINGFIELD	MO	KSPR	1,057,854
14	DT	ST. LOUIS	MO	KNLC	2,939,859
16	DT	BILOXI	MS	WMAH-TV	1,059,522
18	DT	BUDE	MS	WMAU-TV	635,478
15	DT	GREENVILLE	MS	WXVT	270,089

20	DC	HOLLY SPRINGS	MS	WBII-CD	89,626
20	DT	JACKSON	MS	WMPN-TV	850,369
16	DT	WEST POINT	MS	WLOV-TV	607,624
16	DT	BILLINGS	MT	KBGS-TV	156,657
18	DT	BILLINGS	MT	KSVI	174,193
19	DT	BUTTE	MT	KWYB	69,602
14	DT	BURLINGTON	NC	WGPX-TV	1,911,433
20	DT	EDENTON	NC	WUND-TV	1,502,927
17	DT	GOLDSBORO	NC	WNCN	3,201,386
19	DT	JACKSONVILLE	NC	WUNM-TV	1,025,090
19	DT	LEXINGTON	NC	WCWG	5,108,147
17	DT	LINVILLE	NC	WUNE-TV	1,472,023
14	DC	LUMBERTON-PEMBROKE	NC	WLPS-CD	482,563
20	CA	ROANOKE RAPIDS	NC	WNVN-LP	15,536
15	DT	ROCKY MOUNT	NC	WRPX-TV	2,217,671
17	DT	BISMARCK	ND	KBMY	119,918
19	DT	DICKINSON	ND	KXMA-TV	31,907
20	DT	ELLENDALE	ND	KJRE	16,170
19	DT	FARGO	ND	KVRR	356,578
15	DT	GRAND FORKS	ND	KGFE	114,564
14	DT	MINOT	ND	KMCY	71,777
14	DT	WILLISTON	ND	KXMD-TV	36,552
15	DT	LINCOLN	NE	KFXL-TV	1,143,495
19	DT	NORFOLK	NE	KXNE-TV	297,214
17	DT	OMAHA	NE	KYNE-TV	936,201
20	DT	OMAHA	NE	KETV	1,349,828
17	CA	CLAREMONT	NH	W17CI	89
18	DD	NEWTON	NJ	WMBC-TV	18,443,974
19	CA	ALAMOGORDO	NM	KVBA-LP	38,070
17	DT	ALBUQUERQUE	NM	KAZQ	1,084,327
14	DC	LAS VEGAS	NV	KNBX-CD	1,885,855
16	DT	LAS VEGAS	NV	KINC	1,906,462
17	DC	LAS VEGAS	NV	KEEN-CD	1,898,200
19	DC	LAS VEGAS	NV	KHDF-CD	1,892,834
20	DC	LAS VEGAS	NV	KTUD-CD	1,887,337
15	DT	RENO	NV	KNPB	463,563
20	DT	RENO	NV	KAME-TV	460,629
14	DT	BATH	NY	WFBT	111,537
20	CA	BINGHAMTON	NY	WBGH-CA	3,117

14	DT	BUFFALO	NY	WUTV	1,376,138
15	DC	BUFFALO	NY	WBNF-CD	957,819
18	DT	ELMIRA	NY	WETM-TV	598,827
16	CA	ITHACA	NY	W16AX	55,410
20	DT	ITHACA	NY	WNYI	632,278
15	CA	KINDERHOOK	NY	WEPT-CA	768,898
17	DC	MANHATTAN	NY	WEBR-CD	10,418,646
18	DC	MASSENA	NY	WNYF-CD	85,240
14	DT	PLATTSBURGH	NY	WPTZ	652,790
16	DT	ROCHESTER	NY	WXXI-TV	1,134,066
15	DT	SYRACUSE	NY	WSPX-TV	959,866
17	DT	SYRACUSE	NY	WSYR-TV	1,241,056
19	DT	SYRACUSE	NY	WSYT	1,624,932
15	DT	CLEVELAND	OH	WEWS-TV	4,052,872
17	DT	CLEVELAND	OH	WKYC	4,085,937
14	DT	COLUMBUS	OH	WCMH-TV	2,712,110
17	DC	COLUMBUS	OH	WDEM-CD	1,143,323
19	DC	COLUMBUS	OH	WCLL-CD	1,665,093
16	DT	DAYTON	OH	WPTD	3,414,982
17	DT	PORTSMOUTH	OH	WQCW	1,236,991
20	DT	YOUNGSTOWN	OH	WFMJ-TV	3,222,857
17	DT	BARTLESVILLE	OK	KDOR-TV	1,156,163
20	DT	MUSKOGEE	OK	KQCW-DT	1,118,143
15	DT	OKLAHOMA CITY	OK	KTBO-TV	1,569,625
19	DC	OKLAHOMA CITY	OK	KUOT-CD	1,183,004
17	DC	BEND	OR	KABH-CD	169,979
17	DT	EUGENE	OR	KMTR	520,941
19	DC	EUGENE, ETC.	OR	K19GH-D	324,456
16	DT	LA GRANDE	OR	KUNP	43,849
16	DC	PORTLAND	OR	KORS-CD	2,279,190
18	DT	ROSEBURG	OR	KTVC	100,007
19	DT	ROSEBURG	OR	KPIC	94,186
14	DC	THE DALLES	OR	KRHP-LD	14,148
17	DC	BUTLER	PA	WJMB-CD	355,107
15	DD	CLEARFIELD	PA	WPSU-TV	796,336
16	DT	ERIE	PA	WSEE-TV	527,229
19	DC	GREENSBURG	PA	WEMW-CD	1,447,310
14	CA	PHILADELPHIA	PA	WTSD-CA	1,547,676
17	DT	PHILADELPHIA	PA	WPHL-TV	10,133,061

16	DC	PITTSBURGH	PA	WBGN-CD	2,007,859
20	CA	WASHINGTON	PA	WWLM-CA	32,539
17	DT	AGUADILLA	PR	WVEO	920,837
14	DT	ARECIBO	PR	WMEI	3,332,250
20	CA	ARECIBO	PR	WIMN-CA	115,077
16	DT	FAJARDO	PR	WMTJ	2,640,775
18	DT	NARANJITO	PR	WECN	2,586,840
15	DT	PONCE	PR	WTIN-TV	3,367,080
19	DT	PONCE	PR	WKPV	1,708,593
20	DC	SAN JUAN	PR	WSJN-CD	1,252,566
17	DT	BLOCK ISLAND	RI	WPXQ-TV	3,051,707
14	DT	ANDERSON	SC	WMYA-TV	1,513,461
18	DC	CHARLESTON	SC	WLCN-CD	604,046
17	DT	COLUMBIA	SC	WLTX	1,489,726
16	DT	FLORENCE	SC	WPDE-TV	1,723,672
16	DT	GREENVILLE	SC	WGGS-TV	1,770,901
18	DT	GREENWOOD	SC	WNEH	1,234,938
18	DT	MYRTLE BEACH	SC	WFXB	1,493,835
15	DT	ROCK HILL	SC	WNSC-TV	2,064,005
17	DT	ABERDEEN	SD	KDSD-TV	59,632
19	DT	PIERRE	SD	KPRY-TV	42,420
16	DT	RAPID CITY	SD	KCLO-TV	132,141
18	DC	ADAMSVILLE	TN	W18BL-D	82,878
20	DT	CROSSVILLE	TN	WBXX-TV	1,996,121
18	DC	GREENEVILLE	TN	WAPG-CD	200,970
17	DT	KNOXVILLE	TN	WKOP-TV	1,373,544
15	DT	NASHVILLE	TN	WZTV	2,253,608
15	DT	ABILENE	TX	KXVA	185,146
15	DT	AMARILLO	TX	KCIT	382,053
19	DT	AMARILLO	TX	KAMR-TV	366,362
18	DT	BLANCO	TX	KNIC-DT	2,383,798
20	CA	BROWNSVILLE	TX	KXFX-CA	202,567
14	DT	DALLAS	TX	KERA-TV	6,707,830
18	DT	EAGLE PASS	TX	KVAW	73,450
15	DT	EL PASO	TX	KFOX-TV	1,018,028
16	DT	EL PASO	TX	KTSM-TV	1,013,331
17	DT	EL PASO	TX	KVIA-TV	1,011,264
18	DT	EL PASO	TX	KDBC-TV	1,015,162
18	DT	FARWELL	TX	KPTF-DT	84,512

19	DT	FORT WORTH	TX	KTVT	6,908,693
19	DT	HOUSTON	TX	KTXH	6,091,098
20	CA	KINGSVILLE-ALICE	TX	K20EK	10,147
19	DT	LAREDO	TX	KLDO-TV	250,832
16	DT	LUBBOCK	TX	KPTB-DT	317,203
18	DT	MIDLAND	TX	KUPB	318,914
18	DT	NACOGDOCHES	TX	KYTX	891,261
15	CA	ROUND ROCK	TX	KHPZ-CA	412,521
16	DT	SAN ANGELO	TX	KSAN-TV	135,032
19	DT	SAN ANGELO	TX	KIDY	116,592
14	CA	SAN ANTONIO	TX	K14LM	1,087,624
16	DT	SAN ANTONIO	TX	KHCE-TV	2,344,223
17	DT	SNYDER	TX	KPCB-DT	30,839
20	DT	SWEETWATER	TX	KTXS-TV	246,754
15	DT	TEXARKANA	TX	KTAL-TV	1,107,822
15	DT	VICTORIA	TX	KAVU-TV	313,481
15	DT	WICHITA FALLS	TX	KJTL	372,380
20	CA	WICHITA FALLS	TX	K20DN	42,386
14	DT	CEDAR CITY	UT	KCSG	164,762
19	DT	RICHFIELD	UT	KUES	25,978
20	DT	SALT LAKE CITY	UT	KTMW	2,144,875
18	DT	ST. GEORGE	UT	KUEW	120,411
15	DT	ARLINGTON	VA	WFDC-DT	7,690,918
19	DT	CHARLOTTESVILLE	VA	WCAV	711,960
16	DT	HAMPTON-NORFOLK	VA	WHRO-TV	2,149,410
20	DT	LYNCHBURG	VA	WWCW	1,176,372
17	DC	PORTSMOUTH	VA	WKTD-CD	1,510,777
17	DT	ROANOKE	VA	WFXR	1,261,363
18	DT	ROANOKE	VA	WDBJ	1,404,039
19	CA	YORKTOWN	VA	WYSJ-CA	737,989
17	DT	CHARLOTTE AMALIE	VI	WVXF	11,107
18	DT	ST. JOHNSBURY	VT	WVTB	254,176
19	DT	BELLINGHAM	WA	KBCB	1,195,506
20	CA	CAMAS	WA	KOXI-CA	2,127,671
19	DT	CENTRALIA	WA	KCKA	681,343
15	DC	KENNEWICK, ETC.	WA	KVVK-CD	287,293
18	DT	PASCO	WA	KEPR-TV	422,965
15	DT	SPOKANE	WA	KHQ-TV	774,754
20	DT	SPOKANE	WA	KREM	753,589

14	DT	TACOMA	WA	KTBW-TV	4,107,346
16	CA	WALLA WALLA	WA	KORX-CA	70,908
14	DT	YAKIMA	WA	KAPP	283,607
16	DT	YAKIMA	WA	KNDO	265,676
15	DT	EAU CLAIRE	WI	WQOW	357,496
17	DT	LA CROSSE	WI	WLAX	478,398
19	DT	MADISON	WI	WMTV	1,475,946
20	DT	MADISON	WI	WHA-TV	1,482,837
18	DT	MILWAUKEE	WI	WVTV	2,849,879
16	DT	RHINELANDER	WI	WJFW-TV	267,135
19	DT	SUPERIOR	WI	KBJR-TV	271,543
19	DT	CHARLESTON	WV	WVAH-TV	1,295,881
18	DC	WEIRTON	WV	WJPW-CD	176,631
14	DT	CASPER	WY	KGWC-TV	80,004
17	DT	CASPER	WY	KTWO-TV	79,891
20	DT	CASPER	WY	KFNB	79,844

The foregoing maps and spreadsheet show the full extent of full power and class A TV operations in the T-Band spectrum, which reach across the entire U.S., and whose presence may disrupt meaningful usage of this spectrum for other purposes. Accordingly, clearing public safety users from the T-Band does not result in an attractive scenario for potential auction bidders. These 325 full power and Class A television broadcast stations on those channels would remain throughout the U.S., even if public safety operations could be relocated. In addition, as the incentive auction to clear spectrum in the 600 MHz area plays out, NPSTC understands the FCC will need to repack television into the remaining spectrum (including the T-Band). Although the number of stations will not be known until the auction is concluded, the FCC may need to relocate additional TV stations to Channels 14-20, i.e., the T-Band spectrum, as part of his repacking process. The FCC has taken steps to minimize the number of stations relocated to Channel 14, but has taken no steps to minimize the number of stations to be relocated to the other T-Band channels.

5.3 Industrial/Business Operations in the T-Band

The T-Band also supports critical industrial and business (I/B) operations. These channels support the efficient and safe operation of numerous small and large businesses that contribute to the U.S. tax base and economy. These I/B T-Band operations were not addressed in Section 6103 of Public Law 112-96. However, as addressed more fully in Section 1.1 of the NPSTC March 2013 T-Band Report, the categorization of the T-Band spectrum between public safety and I/B operations is defined on a land mobile channel-by-channel basis. This means I/B T-Band channels are intermixed with the public safety T-Band channels. An I/B channel may be directly adjacent to a public safety channel. Therefore, clearing public safety T-Band operations does not necessarily result in clearing

the overall T-Band spectrum for other uses.

In May 2013 the Enterprise Wireless Alliance (EWA) commissioned Televate, LLC to study and assess the impact of the legislation on I/B T-Band licensees, including an estimate of the cost to repack I/B operations into a more confined portion of the T-Band. Televate's study found that:

> …573 I/B licensees and 764 separate systems would be impacted at a cost of $449,200,000 if the FCC were to require auction winners to move the I/B licensees to a dedicated portion of the T-Band spectrum. [25]

Accordingly, I/B operations would continue to impact any commercial use of the T-Band spectrum negatively. Given there is no requirement for I/B licensees to move out of the spectrum, the repacking studied by Televate, LLC for EWA may be an approach the FCC would consider. The $449.2M cost of that approach as estimated by Televate, LLC would be a cost that commercial operators participating in an auction would need to consider in determining appropriate spectrum bids. That cost would be in addition to the cost to relocate public safety stations, estimated to be $5.9 billion in the original NPSTC T-Band Report released in March 2013.

6. Conclusion

The NPSTC T-Band Report, issued March 15, 2013, detailed the lack of alternative spectrum and significant cost impact public safety entities on T-Band would face as a result of the provisions in Section 6103 of Public Law 112-96. As shown in this T-Band Update Report, little has changed over the last 3 years. Public safety's strong demand for T-Band spectrum is virtually unchanged, as indicated by analysis of FCC T-Band licensing records. On the spectrum supply side, the Commission has made an additional 24 narrowband channels available in the 700 MHz band. However, the resulting 700 MHz narrowband channels available to licensees for potential T-Band relocation still pales in comparison to the channels to be re-accommodated in at least the top five T-Band areas.

Although there has been significant progress in the development of mission critical voice standards for LTE broadband technology, much work remains to provide a viable broadband mission critical voice-over-LTE solution with sufficient coverage and reliability. As detailed in Section 4.2, many unanswered questions remain, and it is premature for public safety to plan to abandon battle-tested T-Band voice systems.

Finally, even if public safety was to vacate the T-Band, it is unclear what public interest benefit would be gained by reallocating the T-Band spectrum for commercial use. The T-Band also supports critical industrial and business systems on T-Band channels outside the public safety spectrum, not addressed in Section 6103 of Public Law 112-96. As shown in Section 5 of this report, approximately

[25] Industrial and Business T-Band Relocation Costs, Prepared for the Enterprise Wireless Alliance. Prepared by Televate, LLC, June 11, 2013.

325 full power and Class A Television stations throughout the country also operate on the T-Band spectrum. The presence of these stations could seriously impair use of the 470-512 MHz band for nationwide commercial wireless operations even if public safety systems were cleared from the band.