Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Options for 470-512 MHz (T-Band) Spectrum	)	PS Docket No. 13-42
	)	

To: Chief, Wireless Telecommunications Bureau
Chief, Public Safety and Homeland Security Bureau

REPLY COMMENTS OF THE ENTERPRISE WIRELESS ALLIANCE

The Enterprise Wireless Alliance ("EWA" or "Alliance"), in accordance with Section 1.45 of the Federal Communications Commission ("FCC" or "Commission") rules, respectfully submits its Reply Comments in response to the Public Notice[1] issued jointly by the Wireless Telecommunications Bureau ("WTB") and the Public Safety and Homeland Security Bureau ("PSHSB") (WTB and PSHSB, collectively, "Bureaus") requesting recommendations regarding the FCC's implementation of Section 6103 of the Middle Class Tax Relief and Job Creation Act of 2012.[2] The Act requires the Commission, within nine years after the date of its enactment to (1) "reallocate the spectrum in the 470-512 MHz band…currently used by public safety eligibles," and (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 use of the spectrum."[3] Further, the Act states that public safety entities must be relocated from the T-Band not later than two years after the auction has been completed and that auction proceeds may be

[1] Wireless Telecommunications Bureau and Public Safety and Homeland Security Bureau Seek Comment on Options for 470-512 MHz (T-Band) Spectrum, *Public Notice*, PS Docket No. 13-42, 28 FCC Rcd 1130 (rel. Feb. 11, 2013) ("Public Notice").
[2] Pub. L. No. 112-96, 126 Stat. 156 (2012) ("Act").
[3] Act § 6103(a).

distributed by the Commerce Department through grants to cover the costs of relocating public safety systems from T-Band spectrum.[4] The legislation says nothing about the disposition of T-Band spectrum used by Industrial/Business ("I/B") licensees. There are no provisions in the legislation that would require their T-Band channels to be vacated and auctioned.

In its Comments, the Alliance urged the FCC to abandon any effort to relocate I/B licensees from their operationally critical T-Band spectrum that has been intensively used for decades in the most spectrum congested markets in the county. It recommended that the Commission limit its efforts to implementing the statutory directive to auction public safety frequencies in the band, unless further legislative action relieves the FCC from the obligation to auction any Part 90 T-Band spectrum, as EWA hopes will be the case. It explained that this spectrum plays a vital role in meeting non-public safety communications requirements and that there is no available, comparable spectrum to which these licensees could be relocated. It suggested that if the FCC were to determine that I/B licensee relocation was unavoidable in implementing the Act, then these systems should be moved to a contiguous portion of T-Band spectrum, with all costs paid by the auction winner(s). Finally, the Alliance repeated its objections to the T-Band Freeze adopted by the Commission,[5] objections it has raised in numerous previous filings with the FCC.[6] The freeze is neither mandated by the Act nor

[4] *Id*. § 6103(b), (c).

[5] *See* "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*, 27 FCC Rcd 4218 (WTB/PSHSB 2012) ("Freeze PN"); *see also* "Wireless Telecommunications Bureau and Public Safety and Homeland Security Bureau Clarify Suspension of the Acceptance and Processing of Certain Part 22 and 90 Applications for 470-512 MHz (T-Band) Spectrum," *Public Notice*, 27 FCC Rcd 6087 (WTB/PSHSB 2012) (collectively "T-Band Freeze").

[6] *See e.g.*, "Public Safety and Homeland Security Bureau Seeks Comment on Request for Waiver Filed by Somerset County, New Jersey to Upgrade Its Public Safety Communications System by Modifying Its Sites and Adding Frequencies in the Television Channel 19 (500-506 MHz) Band and a Part 22 Frequency," *Public Notice*, 27 FCC Rcd 10907 (PSHSB 2012); Comments of EWA filed on Sept. 20, 2012; *see also* "Public Safety and Homeland Security Bureau Seeks Comment on Request for Waiver Filed by the Township of Woodbridge, New Jersey to Operate a Trunked Public Safety Communications System Using Part 90 and Part 22 Frequencies in the Television

consistent with the public interest, and is particularly objectionable in both the timing of its implementation and its scope. The Alliance recommended that, if not lifted entirely, the T-Band Freeze should be modified to mirror the FCC freeze on I/B spectrum in the 900 MHz band.[7]

All Comments filed in this proceeding agree with each of EWA's positions. The public safety community pointed to the National Public Safety Telecommunications Council ("NPSTC") Report[8] as confirmation for the extraordinary disruption and cost that will be incurred if even public safety T-Band spectrum is recovered and auctioned.[9] That report detailed the almost $6 billion dollars that would be needed to relocate existing public safety T-Band systems to 700 MHz public safety spectrum, as well as the impact on vital public safety services, a point made graphically in the filing of the Greater Boston Police Council that relied heavily on T-Band spectrum in responding to the recent terrorist attack in that city. Additionally, the NPSTC Report explained that, irrespective of cost, there was not sufficient available 700 MHz (or other comparable spectrum) in New York, Los Angeles, Chicago, Boston or Philadelphia to accommodate the systems that would need to be migrated, and that spectrum availability in Dallas, Houston, Miami, Washington, DC, Pittsburgh, and San Francisco would require further analysis to determine whether it would be adequate. Many of these entities also voiced strong objection to the T-Band Freeze and urged the FCC to reconsider that decision – one that, unlike the Act, is entirely within the FCC's discretion.

Channel 19 (500-506 MHz) Band" Public Notice, 27 FCC Rcd 8238 (PSHSB 2012); Comments of EWA filed on Aug. 7, 2012.

[7] Improving Public Safety Communications in the 800 MHz Band, *Report and Order, Fifth Report and Order, Fourth Memorandum Opinion and Order, and Order*, WT Docket No. 02-55, 19 FCC Rcd 14969 at ¶ 204 (2004).

[8] NPSTC T-Band Report dated Mar. 15, 2013, filed May 13, 2013.

[9] *See, e.g.*, Comments of the NPSTC; Association of Public – Safety Communications Officials International; California Public-Safety Radio Association; Los Angeles and Marin Counties, CA; Morris County, NJ; Westchester County, NY; Cities of Los Angeles, Burbank, and Pasadena, CA; City of Yonkers NY Fire Department; Greater Boston Police Council; Interagency Communications Interoperability System; New York City Department of Information Technology and Telecommunications; and Southern California APCO; Northern California APCO; and Los Angeles Regional Interoperable Communications System Joint Powers Authority.

The Land Mobile Communications Council ("LMCC"), an organization representing not only public safety entities but the memberships of EWA, the American Association of State Highway and Transportation Officials, the American Automobile Association, the American Petroleum Institute, Association of American Railroads, Aviation Spectrum Resources, Inc., the Central Station Alarm Association, the Energy Telecommunications and Electrical Association, the Forest Industries Telecommunications, the Intelligent Transportation Society of America, Inc., MRFAC, Inc., PCIA – The Wireless Infrastructure Association, the Telecommunications Industry Association, and the Utilities Telecom Council filed Comments expressing the objections of the I/B community to the forced relocation of their members in response to the Act. In particular, the LMCC addressed the already seriously adverse impact of the T-Band Freeze on the operations of its members. It advised in the strongest terms that the FCC reverse that decision at least until a later date when rules implementing the Act have been proposed, at which time an auction arguably was more imminent. The LMCC provided specific details regarding the impact on the operations of both the freeze and the potential loss of T-Band spectrum on several representative I/B licensees: Channel Industries Mutual Aid; NSTAR Electric Company; Highland Wireless Services, LLC; Atlantic Telecommunications; and RF Design Consultants, Inc.[10]

Individual I/B T-Band licensees also filed Comments alerting the Commission to the devastating impact on their operations should they lose their T-Band spectrum. They detailed the impact even this possibility, plus the T-Band freeze, has had on their operations to date. For example, the Pacific Gas and Electric Company described its efforts to migrate multiple, discrete operations into an integrated, interoperable network designed to meet the growing needs of its utility customers and explained that the T-Band channels for which it has applied, but which are

[10] LMCC Comments at 4-9.

subject to the freeze, are essential to achieving the grade of service capabilities required for this critical work.[11] NSTAR Electric Company was recently granted a waiver of the T-Band Freeze to enable it to finish deployment of a multi-area T-Band system.[12] However, it reminded the Commission that the company's recent, very significant investment in its upgraded network is at risk should the FCC mandate relocation of I/B licensees. It echoed EWA's position that, if relocation is unavoidable, I/B licensees should be "repacked" into a portion of T-Band spectrum since there is no alternative, comparable spectrum to which these systems can be moved.[13] Mobile Relay Associates, which employs T-Band spectrum to serve a variety of users in the Los Angeles market, described the many types of niche, but commercially vital, services that are accommodated on its systems and highlighted the importance of T-Band for these purposes in a highly spectrum-limited market.[14]

The attached report prepared for the Alliance by Televate, LLC ("Televate") quantifies the estimated cost of repacking I/B T-Band licensees into a single portion of contiguous T-Band spectrum.[15] Based on a high-level review of I/B T-Band systems using both ULS data and information from licensees and vendors, it is Televate's estimate that moving the 764 I/B systems it identified would cost at least $449,200,000. It is EWA's expectation that this cost would be borne by the auction winner(s) as it has been in other FCC auctions of encumbered spectrum and presumably would be factored into the amount they would bid for the spectrum itself.

For all the reasons described herein and in the record already compiled in this proceeding, the Alliance submits that the FCC need not and should not go beyond the legislative directive to

[11] See Comments of the Pacific Gas and Electric Company.
[12] In the Matter of NSTAR Electric Company, Request for Waiver of the Suspension of Acceptance and Filing of Certain Applications for 470-512 MHz (T-Band) Spectrum, *Order*, 27 FCC Rcd 15774 (WTB 2012).
[13] NSTAR Energy Company Comments at 5-6.
[14] Mobile Relay Associates Comments.
[15] See Attachment A.

relocate public safety T-Band licensees and auction their spectrum. If the Commission concludes that I/B licensees must be moved as well, then EWA sees no comparable spectrum to which they can be relocated and recommends that the FCC pursue the option in the Public Notice to consolidate all such licensees in a contiguous portion of T-Band spectrum. Critically, and irrespective of the Commission's decision regarding the ultimate disposition of this spectrum, the Alliance again urges the FCC to rescind the T-Band Freeze, at least until such time as the imminence of an auction requires a defined spectrum landscape, or modify it consistent with the freeze applicable to 900 MHz I/B spectrum.

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Industrial and Business T-Band Relocation Costs

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TELEVATE

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TELEVATE

EXECUTIVE SUMMARY

The signing of Public Law 112-96 on February 22, 2012 requires the Federal Communications Commission (FCC) to begin auctioning the public safety T-Band spectrum (470MHz – 512MHz) by February 2021 and to move public safety operations from the band within two years of auction close (estimated to be by early 2023). While the law addresses the public safety users of the T-Band, it is silent on the status of Industrial / Business ("I/B") licensees who utilize spectrum that is intermingled with public safety frequencies. The spectrum is used in 11 metropolitan areas by 573 I/B independent licensees. Many of these entities provide vital supporting services to public safety entities. As a consequence of the law, the FCC has placed a freeze on new and expanded T-Band operations for all licensees.

On behalf of the Enterprise Wireless Alliance (EWA), Televate was engaged to study and assess the cost impact of the legislation on I/B licensees. Specifically, Televate was engaged to determine the cost of relocating all I/B users within the T-Band. EWA determined that there was no comparable spectrum in other bands available for T-Band I/B licensees. Assuming the FCC's objective is to auction the greatest amount of T-Band spectrum possible, then the most viable solution would be to move and repack the I/B licensees to a contiguous portion of the T-Band spectrum. 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.

1 INTRODUCTION

In May 2013, Televate was engaged by Enterprise Wireless Alliance (EWA) to assess the cost impact of recent legislation that impacts I/B users in the T-Band spectrum. The T-Band spectrum is a significant spectrum resource that is utilized by I/B incumbents and shared with public safety licensees. In February 2012, the Middle Class Tax Relief and Job Creation Act of 2012 specifically called for the FCC to auction the public safety T-Band spectrum and relocate public safety users operating within the band. The Act, however, is silent on the I/B users in the band.

The cost associated with spectrum relocation is highly dependent on the target frequencies – the frequencies to which a system will move. The more substantial the shift in frequency, the more impactful it is to the equipment and systems. Unlike the public safety T-Band licensees who have access to multiple bands, I/B licensees do not have comparable, alternative spectrum for relocation. As a result, this report is premised on the relocation of I/B operators to a dedicated subset of the T-Band spectrum. In this scenario, the I/B allocations would be concentrated into a dedicated spectrum block and allow for the remainder of the T-Band spectrum to be auctioned.

The model assumes that the I/B licensees will be moved to the most utilized TV channel. In two markets, the aggregate I/B usage exceeds that of a single channel.

2 INDUSTRIAL / BUSINESS T-BAND USE

The majority of the I/B licensees are commercial, non-interconnected, dispatch operators who provide wireless communication service to a variety of entities including the following: government agencies, public utilities, contractors, hospitals, emergency services (ambulance services), security companies, school districts, freight companies and service organizations. There also are a significant number of private, internal systems used by entities providing utility, transportation, and other enterprise services to the American public. The critical nature of these operations on a day-to-day basis underscores the importance of minimizing outages and the development of transition plans that do not leave users without service for more than the minimum amount of time.

The marketplace for T-Band systems is very diverse with multiple standards in use. Licensees operate analog conventional and trunked systems as well as digital trunked systems. It is not uncommon for licensees to operate multiple technologies side-by-side within the same market, since many licensees were in the process of transitioning from analog to digital service when the T-Band freeze was adopted.

2.1 Methodology

The FCC Universal Licensing System (ULS) data was the foundation for determining what systems exist in the marketplace, and therefore, what systems may become obligated to move from their current location in the T-Band to another portion of the T-Band. The model uses the ULS data combined with market research collected from I/B licensees and equipment vendors.

2.2 Summary of ULS Data

The cost estimates use as a primary source of data the publicly available licensing records from the ULS. Televate preformed additional work to aggregate all of the I/B license data to individual systems with a count of each system's channels, sites, base stations, and mobiles. Televate combined licensee data into systems by cross-referencing the license name with the FRN (FCC Registration Number) and combining other similar spellings of a licensee name. The following table represents a summary of the findings across all 11 T-Band markets.

Table 1: T-Band ULS Statistics

Markets	Licensed Systems	Channels	Sites	Repeaters	Mobiles
Boston	111	303	220	909	17,623
Chicago	57	314	156	942	20,062
Dallas/Ft. Worth	58	318	152	954	15,322
Houston	47	294	115	882	14,085
Los Angeles	64	552	378	1,656	65,200
Miami	51	305	103	915	13,298
New York	137	416	353	1,248	20,521
Philadelphia	66	277	141	831	17,758
Pittsburgh	24	49	36	147	3,211
San Francisco	87	471	331	1,413	44,157
Washington	62	278	133	834	18,019
Grand Total	**764**	**3,577**	**2,118**	**10,731**	**249,256**

The "Licensed Systems" column includes all systems that have been licensed by the 573 unique I/B licensees. A number of licensees had systems in multiple markets, and licensees often operated both conventional and trunked systems in an individual market. The "Channels" total is a summation of the unique channel pairs (transmit and receive) that have been licensed for each system. The "Sites" total is a count of distinct transmitter locations per licensee. Based on an analysis of the data and feedback from the stakeholder group, each channel is reused an average of three times in a market; hence, the number of "Repeaters" is three times the number of channels.

The estimated number of mobiles is taken by aggregating the maximum number of mobiles reported by the licensee of all the licenses of that system. In some cases this method significantly underreports the number of mobiles per licensee as, based on interviews with I/B licensees, a significant number of licensees tend to report only the necessary 90 mobiles required to secure an exclusive license for that channel. The mobile count may be a very conservative rendering of the T-Band mobile population if many licensees followed the same reporting approach to the Commission.

Commercial systems make up the largest groups of I/B licensees: 601 commercial systems versus 163 private systems. The three largest markets are Los Angeles, San Francisco and New York. The next seven markets are roughly the same size; these include Boston, Chicago, Dallas, Houston, Miami, Philadelphia, and Washington. The smallest market is Pittsburgh, where 17% of a single TV channel has been utilized.

3 Cost Model

The premise for the cost estimate is that current T-Band I/B licensees would relocate to another, contiguous portion of the band. Given this premise, the cost estimates are predicated on the capability of the system, the base stations and the mobiles to be relocated to other T-Band spectrum.

The project team utilized two sources for estimating the costs of relocating the T-Band licensees to a common and condensed portion of the spectrum: stakeholder interviews and the FCC's ULS data. Taken together, these sources are reasonable for addressing the rough order costs for the relocation of T-Band I/B systems. A more accurate cost assessment would require an in-depth look at each individual system in each market along with detailed engineering of individual sites.

The cost model groups the costs into four discrete areas related to the contents of the ULS database. They are:

1. **System Costs:** Costs attributed to the "centralized" costs associated with one system.
2. **Site Costs**: Costs attributed to the number of unique transmitter sites for each system.
3. **Base Station Costs**: Costs attributed to the number of individual base stations for each system.
4. **Subscriber (Mobile) Costs:** Costs attributed to the number of subscribers for each system.

The model uses the numbers from the FCC ULS database except where a licensee provided specific information. A more detailed inventory process would be required to enable greater refinement of the actual costs. The model envisions that this enhancement of the cost estimate would occur during a planning process phase.

3.1 System Costs

The model considers each unique licensee as having its own system. When a single licensee has licenses for both conventional and trunking systems, that licensee is considered to have two systems. The ULS database lists a total of 573 unique I/B licensees and a total of 764 systems in the 11 markets. The following table provided the high-level assumptions made with regard to the system-related costs:

Table 2: System Cost Assumptions

System Components	Cost Assumptions Made
System Engineering & Administration	Some overall system engineering required. Most engineering costs are built into sites, base stations, and subscribers, but the model envisions additional overall engineering and administration costs.
Planning and Project Management	Upfront planning will be required to determine the cost and plan out the transition. While project management costs are built into the individual piece parts (subscriber reconfiguration, base station (combiner, filter, etc.) reconfiguration, and site based activities), overall project management will be required.
Legal/Negotiations	The licensee will need to negotiate a deal with the funding entity for the transition based on the plan and estimated costs.
Total Blended Cost Per System	**$70,300**

3.2 Site Costs

The site-related costs are those associated with the ancillary support systems to house the site components and those costs that are incurred on a site basis. There are three category of expenses assessed:

- Intermodulation Analysis
- FCC Licensing
- Tower Top Amplifiers

As the channel assignments will change on a site basis, a full intermodulation analysis will be required to design the proposed configuration. Applications for modified FCC licenses will need to be submitted. Lastly, the stakeholder group has indicated that for certain tower sites tower top amplifiers (TTA) are used. It was estimated that 10% of the sites use TTAs. A summary of the assumptions made on a site basis is given in the table below:

Table 3: Summary of Site Assumptions

Site Components	Cost Assumptions Made
Tower Top Amplifiers (TTA)	10% of sites are assumed to be towers with TTAs; 100% replacement rate for these sites is assumed
Engineering / Intermodulation Analysis	Set cost for each site. Required for combining system engineering and overall site intermod analysis.
FCC & Licensing Fee	Set cost for each site (assumed one license per site)
Administration	Assumed coordination with landlord for access to site as well as lease amendment
Total Blended Cost Per Site	**$5,000**

3.3 Base Station Costs

The stakeholder group indicated that nearly all sites have unique configurations with regard to the combining and filtering requirements. Between each site, the channel assignments and channel spacing per licensee vary dramatically. Furthermore, a change in a single channel can have a drastic impact across the entire filtering, combining, duplexing, and splitting system. Furthermore, during discussions with I/B system operators, it was learned that many of the radio frequency (RF) systems at these T-Band sites are so complex that field modifications for an in-service system are problematic and that replacing the systems may be more economical and result in tolerable levels of system downtime for mission critical operations. Therefore, the model assumes that the following RF components are replaced:

- Combiners
- Receiver Multi-Couplers
- Isolators
- Duplexers and Filters

These RF components can vary from highly elaborate filtering and combining systems to more rudimentary systems. A blended cost of $9,500 per base station was used to estimates the cost of the filtering and combining system. This figure includes hardware, engineering, installation labor, project management, and coordination of the work.

Most T-Band base stations can be retuned to support the replacement frequencies. However, some manufacturers have low and high UHF frequency support, splitting their equipment at 480 MHz – roughly in the middle of the T-Band. From the ULS data, there are licensees that are licensed to operate in the two separate ranges. Televate calculated the percentage of base stations that would need to be reconfigured across 480 MHz below:

Table 4: Percent Base Stations Across Band Split

Market	Percentage
Boston	45%
Chicago	10%
Dallas/Ft. Worth	0%
Houston	0%
Los Angeles	48%
Miami	0%
New York	19%
Philadelphia	0%
Pittsburgh	0%
San Francisco	0%
Washington	0%

This table is based on the premise that the I/B licensees would move to the heaviest use channel. Based on discussions with equipment vendors and licensees, Televate estimates that 25% of the base stations that would need to be reconfigured across the band split would need to be replaced. Therefore, 25% of the percentage referenced in the above table requires replacement while the remaining base stations can be reconfigured.

A summary of the remaining assumptions made on a base station basis is given in the table below:

Table 5: Summary of Base Station Assumptions

Site Components	Blended Cost	Notes
Reconfigure Base Station	$10,900	Includes combining and filtering system replacement and base station reconfiguration, project management, installation, labor, and coordination.

Site Components	Blended Cost	Notes
Replace Base Station	$13,800	A new RX multi-coupler is assumed for all sites. A blended cost per channel is used to accommodate the new equipment and its engineering and configuration.

3.4 Subscriber (Mobile) Costs

The main cost driver with regard to aggregation and relocation of the I/B licensee to new T-Band spectrum is reprograming of the mobile devices. For this we considered two labor estimate scenarios: a one-touch and a two-touch scenario. Over-the-air programming is very rare with I/B licensees and, as a result, is not assumed in the model. In all cases, the system operator would need to program, or touch, each mobile in order to program the subscriber device to operate on both the new frequencies and the legacy frequencies. Once the subscriber devices have been programmed, the infrastructure can be reconfigured. At that point, the users of the system can utilize the new frequencies. The philosophy regarding one or two "touches" or programming efforts follows:

- A two-touch scenario assumes that the operator must first reprogram to add the new channels and then must remove the old channels later in order to eliminate the risk of operation on the previously licensed frequencies and performance or quality of service degradation.
- A one-touch scenario assumes that no performance detriment would result in having the old channels remain in the mobile and that the older channels can be removed later as per the normal servicing schedule without risk of interference or performance and quality of service degradation.

It was assumed that for roughly half of the trunked mobiles, the system operator can delay the removal of the old channels without impact to interference, performance, or quality of service. Therefore, only one touch is assumed for these mobiles. In addition, 10% of the subscribers overall are expected to require replacement. These subscribers are expected to require only one touch. The following table provides a summary of the subscriber costs:

Table 6: Summary of Mobile Assumptions

Site Components	Cost (Per Subscriber)	Cost Assumptions Made
Conventional Mobiles	$1,200	100% of the reconfigurable conventional mobiles will require 2 touches.
Trunked Mobiles	$1,200 $600	50% of the reconfigurable trunked mobiles will require 2 touches; 50% of the reconfigurable trunked mobiles will require 1 touch.
Replacements	$900	10% of the mobiles will need replacement (unable to be retuned). The cost excludes programming costs (one touch applied).

The disruption to the services provided by commercial I/B licensees will have a significant and detrimental impact on their customer base. A certain percentage of the customer base will cancel their service contracts rather than incur the disruption associated with the relocation to replacement frequencies. The percentage of churn is expected to vary dramatically between licensees. Based on commercial licensee discussions, an average of 25% was chosen for this estimate. Churn is only applied to commercial subscribers; i.e., it does not apply to mobiles associated with private systems. The assumptions for the churn estimate are given in the following table.

Table 7: Summary of Churn Cost

Site Components	Cost Assumptions Made
Churn Percentage	25% of the existing customer base will be lost due to the disruption associated with rebanding.
Churn Costs	$900 per customer for wireless communications service based on a typical 3-year contract at $25 per unit, per month.

The model assumes that any "churned" mobile does not require programming or replacement.

4 Potential Additional Costs

The model may not capture all of the actual costs associated with the transition of the I/B licensees within the T-Band. Additional scopes of work and unforeseen costs could substantially increase the total cost of the transition. Some of the potential costs include:

- Parallel System Costs: In the event that the transition cannot occur without substantial disruption to service, it may become necessary to create a parallel system that will be in service while the legacy system continues operations. This could trigger substantial costs in new equipment and potential additional costs on supporting systems such as towers, shelters, and backup power.
- Difficult-to-Reach Mobiles: The model assumes relatively easy access to subscriber devices. If the subscriber devices are difficult to reach, or if they are integrated with existing systems that make reconfiguration or replacement time consuming, the costs will increase commensurately. These additional costs are not included in the model.
- Inadequate Subscriber Devices: The model assumes that the subscriber devices can "hold" both the old and new frequencies at the same time. Some older subscriber devices may not be able to do so and, therefore, may require replacement. These costs are not included in the model.
- Other Lost Revenue: The model includes wireless communication airtime service revenue loss; however, commercial carriers provide other related services. For example, many commercial operators provide subscriber device related services that also generate revenue. These revenues are tied to commercial wireless service and, therefore, would be lost revenues associated with churn. This additional loss, depending on the percentage of carriers that provide these value add services, could be substantial.

- Other Ancillary Systems: Other costs could be incurred as a result of the transition. For example, SCADA (supervisory control and data acquisition) systems, shelter space, HVAC impacts, and other subtending elements of the system could require reconfiguration or replacement.
- The model assumes that backhaul, antennas, main transmission lines, trunking controllers, centralized switches, and dispatch consoles are not impacted by the transition. To the extent wireless dispatch consoles are used, these are assumed to be included in the subscriber counts and are assumed to be no greater cost. To the extent that these systems are impacted or are otherwise not included in the ULS data, the modeled costs underestimate the overall costs.
- Distributed Antenna Systems (DAS)-related costs are not included in the model based on market research conducted by Televate. However, if required, the DAS costs could be substantial.

5 CONCLUSIONS

The cost of the transition of the I/B licensees to a contiguous portion of the T-Band spectrum is estimated to be approximately $449,200,000. This estimate is a rough order of magnitude cost. Highly accurate estimates would require a more detailed investigation and inventory – something envisioned during the planning phase of an I/B T-Band rebanding program.

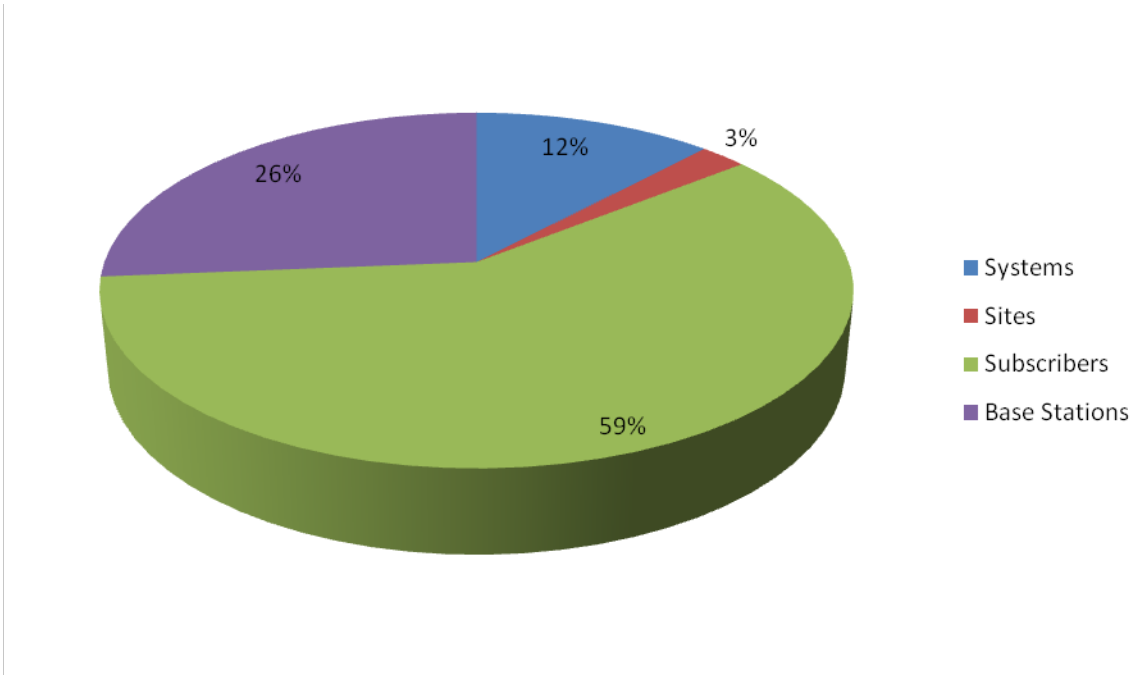
A breakdown of costs is provided in the following table:

Table 8: Cost Estimate for Licensee Transition

Cost Components	Totals
1. System Costs	$ 53,800,000
2. Site Costs	$ 10,600,000
3. Base Station Costs	$ 118,200,000
4. Subscriber (Mobile) Costs	$ 266,600,000
Total	**$ 449,200,000**

As indicated above, base station costs include the costs for combining and filtering systems that are generally a function of the number of base stations. Likewise, the subscriber/mobile costs include the churn costs that are a function of the number of commercial subscriber devices.

Figure 1: Cost Estimate Breakdown



The chart above shows that more than half of the costs for relocation are subscriber related. Following subscriber-related costs, the next largest group is the base station cost representing more than one-quarter of the total relocation costs. System and site costs represent the smallest group of costs at 12% and 3% of the total cost respectively.

The model excludes a number of potential costs that could substantially increase the overall transition cost. These could include parallel system requirements, distributed antenna system impacts, additional lost revenue and other factors.