Broadcast Spectrum Incentive Auctions White Paper

February 15, 2011

Prepared by:

1. Overview

CTIA – The Wireless Association® ("CTIA") and the Consumer Electronics Association ("CEA") are united in support of the National Broadband Plan's recommendations to reallocate spectrum from broadcast television services for mobile broadband services and, with this White Paper, seek to advance the discussion and implementation of this vital effort through facts, not speculation.

This White Paper estimates the auction revenues and costs associated with a voluntary incentive auction of television broadcast spectrum and a repacking of broadcast stations from channels 2-51 to 2-30. As described below, CTIA and CEA demonstrate how an auction of 120 MHz of reclaimed broadcast television spectrum can be expected to produce over $33 billion in net proceeds for the U.S. Treasury and to fulfill the National Broadband Plan's vision of wireless innovation and U.S. global technology leadership. This White Paper makes the following findings:

- CTIA and CEA developed a model from the past Commercial Mobile Radio Service ("CMRS") spectrum auctions to analyze the historical drivers of spectrum price and estimate their effect on an auction of repurposed television spectrum. Under conservative assumptions, the model forecasts that licenses auctioned in the broadcast TV band could be valued at approximately $0.978 per MHz-POP and that estimated auction revenues would be approximately $36 billion. Indeed, the paper notes that revenue may indeed be ***much higher*** – up to $48 billion -- if valuations are consistent with recent auctions for similar spectrum rights.

- CTIA and CEA estimate that in the Continental United States outside the Top-30 markets, no stations will need to exit their over-the-air channels. Within the Top-30 markets, some mechanism, such as incentive auctions, will be needed to clear sufficient spectrum. In the majority of those Top-30 markets, only a handful of stations will need to be addressed, and that could possibly be accomplished through channel sharing or other mechanisms. This paper conservatively assumes that in the markets where clearing is necessary, participating broadcasters will be paid to exit.

- CTIA and CEA estimate that the enterprise value of broadcast TV licensees that may voluntary surrender their channels ranges from $1.2 billion to $2.3 billion. This conservatively assumes that all stations that volunteer to participate in the incentive auction surrender their licenses rather than accepting lower-cost options such as channel sharing or cellularization.

- Remaining broadcast facilities operating on TV channels 31-51 would need to be relocated to the new core channels at TV channels 7-30 (repacked). Based on NTIA data, CTIA and CEA estimate repacking would cost approximately $565 million.

- After deducting the costs of voluntary exits and repacking, the estimated net proceeds of incentive auctions of 120 MHz of broadcast TV spectrum ranges from $33 billion to $34 billion. However, in light of spectrum valuations in recent FCC auctions, this number

may be much higher. Further, while incumbent broadcasters may require a price over their market value to exit (which is not considered in the analysis), the net revenues from a TV spectrum auction would still be considerable.

CTIA and CEA believe that this analysis provides a foundation for evaluating the important issues inherent in the auction process, and believe that this analysis is grounded in a sound and common understanding of the facts.

2. Introduction

The National Broadband Plan submitted by Federal Communications Commission Chairman Julius Genachowski to Congress on March 16, 2010, determined that 500 megahertz of spectrum should be made available for mobile broadband over the next ten years to "meet growing demand for wireless broadband services, and to ensure that America keeps pace with the global wireless revolution."[1] In addition, the National Broadband Plan found that "[i]f the U.S. does not address [the spectrum shortage] promptly, scarcity of mobile broadband could mean higher prices, poor service quality, an inability for the U.S. to compete internationally, depressed demand and, ultimately, a drag on innovation."[2]

In a June 28, 2010, Presidential Memorandum, President Obama concluded that "[t]his new era in global technology leadership will only happen if there is adequate spectrum available to support the forthcoming myriad of wireless devices, networks, and applications that can drive the new economy."[3] President Obama therefore directed the National Telecommunications and Information Administration ("NTIA"), together with the FCC, to make available a total of 500 MHz of spectrum over the next ten years that would be suitable for mobile and fixed broadband use.[4]

To achieve the 500 MHz goal, the National Broadband Plan focused heavily on reallocating 120 MHz of spectrum from broadcast television services for wireless broadband uses. This piece of the spectrum puzzle is the critical linchpin to the success or failure of the vision defined in the National Broadband Plan as well as by Chairman Genachowski, Assistant Secretary Strickling, and the President of the United States. Without this spectrum, there is no realistic way to meet the wireless broadband needs of the country. With this spectrum, the NBP can become a reality for the American public.

---

1 Federal Communications Commission, *Connecting America: The National Broadband Plan* at 84 (2010) ("*National Broadband Plan*").

2 *Id.* at 77.

3 Presidential Memorandum: Unleashing the Wireless Broadband Revolution (June 28, 2010), *available at* http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution ("Obama Wireless Memorandum").

4 *Id.*

The National Broadband Plan sets forth a clear path for realizing the immense benefits of wireless broadband for the country:

- ***Voluntary Incentive Auctions***. Incent some TV broadcasters in some major markets to voluntarily cease operating on their existing TV channels in exchange for compensation from resulting spectrum auction revenues. This requires that incentive auction legislation be passed by Congress.

- ***Freeing TV Channels without Significant Loss of Over the Air TV Services***. For those station licensees wishing to voluntarily surrender their channels, the NBP contemplates a variety of ways for some of them to continue over the air operations through channel sharing, "cellularization" and relocation to lower band TV channels.

- ***Implementing a Spectrum Efficient Allocation Plan Though TV Channel Swaps***. Once TV channels are cleared in some major markets, a "repacking" can occur that moves stations across the country occupying the higher UHF TV channels to lower channels to create an efficient allocation plan and clear the 120 MHz for wireless broadband use.

The National Broadband Plan has provoked a number of important threshold questions about how all this will work in the real world. Policymakers must now carefully consider how the National Broadband Plan goals will be implemented and how this plan ultimately will benefit the public.

To begin the process of examining the National Broadband Plan's assumptions in light of facts rather than speculation, CTIA and CEA have undertaken an effort to move the discussions down the path of data driven decision-making rather than posturing and rhetoric. As representatives of the wireless communications and consumer electronic industries for the United States, CTIA and CEA provide below analyses that show: (1) estimated revenues from auctioning 120 MHz of broadcast TV spectrum; (2) an estimate of the number of markets where broadcast TV channels would have to exit (either through voluntary incentive auctions, channel sharing, moving to cellularization or relocating to VHF channels); (3) the total business enterprise value of TV licensees operating on channels that would be needed; (4) the costs of channel swaps needed to repack existing TV stations into lower channels; and (5) the net resulting revenues from reallocating and auctioning the broadband TV spectrum for wireless broadband uses.

In presenting these analyses, CTIA and CEA emphasize that the purpose is to provide a foundation for evaluating the important issues that is grounded in a sound and common understanding of the facts. CTIA and CEA believe that this analysis accurately details both the potential difference between auction revenues and relocation costs, as well as the scope of the reallocation and repacking effort. This analysis is based on a number of baseline assumptions, each of which are detailed in this White Paper. In such respects, CTIA and CEA anticipate and welcome critical comment that tests the assumptions, inputs and conclusions described below**.**

3. Executive Summary

A Conservative Estimate of Proceeds from Auctioning 120 MHz of Broadcast TV Spectrum Is Over $36 Billion. To determine the potential revenue that could be realized by the auctioning of 120 MHz of TV broadcast spectrum, an analysis was conducted that attempted to look at all the relevant factors that affect prices paid at auction for spectrum licenses. In particular, a model was developed that utilized 6,048 data points from 13 previous Commercial Mobile Radio Service ("CMRS") spectrum auctions to analyze the historical drivers of spectrum price and to estimate their probable effect on an auction of repurposed television spectrum. When all pertinent factors are gathered and aggregated, this model estimates that under certain, practical assumptions, spectrum licenses auctioned in the broadcast television band can be expected to be valued at $0.978 per MHz-POP. Based on the more conservative assumptions used in developing this model and a careful analysis of the facts, CTIA and CEA estimate that the auction revenues from 120 MHz of broadcast television spectrum would be approximately $36.3 billion. This part of the analysis is discussed in more detail below.

While this paper focuses on the estimates yielded by conservative assumptions about pertinent factors and data, recent auction results suggest that auction revenues from 120 MHz of broadcast television spectrum may be much higher. For example, in the Commission's 2008 auction of 700 MHz spectrum, the average value of all licenses auctioned was $1.29 per MHz-POP.[5] If this valuation was achieved, then 120 MHz of broadcast television spectrum would generate approximately $48 billion in revenue. Additionally, an even higher amount would be raised if the values were consistent with the 12 MHz B Block spectrum in Auction No. 73, which was the block most similar to the assumptions we have provided—the other spectrum auctioned included the Lower 700 MHz A Block, where values may have been discounted because of the proximity of the spectrum to high power broadcast operations, the Upper 700 MHz C Block, which was subject to unique open network conditions, and the Lower 700 MHz E Block, which was unpaired. The B Block generated slightly over $9 billion in net bids, implying a valuation of approximately $2.67 per MHz-POP – which would provide an estimate of approximately $99 billion for 120 MHz of reclaimed broadcast television spectrum.

A Conservative Estimate Of Enterprise Value of Broadcast TV Licensees That May Voluntarily Surrender their Channels Ranges from $1.2 to $2.3 Billion. A key consideration in determining the net proceeds of an incentive auction is an estimate of the enterprise value of stations that would participate in the auction. The first step in this analysis is a determination of the scope of stations that would have to be moved, either through voluntary incentive auction, channel sharing, moving to cellularization or relocating to VHF channels, to free up spectrum for reallocation. This paper conducts this analysis for the entire United States and determines that a comparatively small number of broadcast licenses would need to be surrendered for a successful incentive auction. Indeed, an analysis of TV channel usage in the Continental United States shows that outside the Top-30 markets, sufficient spectrum should exist such that, in general, no stations will need to surrender their over-the-air channels. In the Top 30 markets, in all but a

[5] *See* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-281550A2.pdf (last visited February 7, 2011). Of note, these values are based on the population at the time of the Auction 73 auction, 285 million pops.

small number of markets, only a handful of stations will need to addressed, and that could possibly be accomplished through channel sharing or other mechanisms.

As noted above, there are a number of ways to allow many of these stations that need to surrender their channels to continue existing over the air operations through channel sharing, cellularization and other alternatives. However, for purposes of conducting this analysis (*i.e.*, for calculating an upper bound valuation), CTIA and CEA have assumed that all of the station licensees holding channels needed would exit the over the air business entirely in those markets. Accordingly, CTIA and CEA developed estimated valuations for the enterprise values for such stations to identify the range of the potential financial compensation incentives that might be needed to make the voluntary auction plan work.

The analysis utilized two alternative approaches to determine valuation—one based on gross revenue and one based on cash flow, both of which are generally accepted valuation methodologies for industry transactions. As described in detail below, the analysis finds that the business enterprise values of the television licensees needed to surrender their licenses would range from $1.214 billion to $2.02 billion under the Gross Revenue Valuation Model and $2.299 billion under the Cash Flow Valuation Model.

However, not all stations may be willing to surrender their licenses at their projected market value. Rather, broadcast licensees may hold out for a higher exit price above their current projected market value. As noted below, the valuations generated under the Gross Revenue Valuation Model and Cash Flow Valuation Model do not attempt to estimate what additional incentives, if any, would be required to induce TV licensees to voluntarily cease operating over the air. Should a higher exit price be required or allowed by the government, these figures would need to be grossed up by the increased amount provided to incumbent broadcasters. On the other hand, a competitive incentive auction could very well result in even lower costs from broadcasters if more broadcasters are willing to voluntarily participate in the auction.

Estimated Costs of Transitioning to a New Spectrum Efficient Digital TV Core Through Channel Swaps Are $565 Million. If a sufficient number of broadcasters are financially incented to exit, share, or adopt assignments in the lower band to permit the reallocation of 120 MHz for mobile broadband, any financial assessment of a potential transition must also consider the cost of channel swaps to move remaining broadcast facilities from channels 31-51 to the new core channels at 7-30. It should be noted, in this context, a "channel swap" involves modifying the radiofrequency ("RF") channel used by a broadcaster, but that would not impact the "virtual" channel that the public associates with a particular station. Since the DTV transition, a station's public channel and its RF channel have been separate. From a consumer standpoint, a change in a station's RF channel should have no real impact, other than the need to cause the television or receiver to perform a one-time channel "re-scan" at a set cut-over date.

In determining the number of channel swaps required to clear channels 31-51, the analysis assumed different scenarios for the Top-30 markets and those markets outside the Top-30. For markets outside the Top-30, the analysis assumed that every broadcaster in the channel range 31-51 would have to undergo a swap. In the Top-30 markets, the number of swaps is

calculated in a similar fashion, however, some percentage of the broadcasters above channel 30 will choose to exit the market, share spectrum, or move to low VHF. As a result, the number of swaps should be considerably less than the number of broadcasters that currently occupy channels 31-51.

Based upon those assumptions, the analysis estimates that swaps could be required for approximately 629 of the existing TV stations. Using NTIA data, the average cost for a television transmitter, antenna and installation would be $898,000. Multiplying that figure by the number of swaps required yields a total swap cost for the band of approximately $565 million.

The Estimated Net Proceeds from Incentive Spectrum Auctions of 120 MHz of Broadcast TV Spectrum Range from $33 Billion to $34 Billion. Given the anticipated auction revenues; valuations of the enterprise values of the broadcast stations; and channel swap (or repacking costs), the bottom line ranges of estimated net proceeds are as follows:

	Revenue Model			Cash Flow Model
	Low End	**Mid-Range**	**High End**	
Gross Value of 120 MHz	$36,300,000,000	$36,300,000,000	$36,300,000,000	$36,300,000,000
Aggregate Broadcaster Value	$ 1,213,000,000	$ 1,617,000,000	$ 2,021,000,000	$ 2,299,000,000
Repacking Costs	$ 565,000,000	$ 565,000,000	$ 565,000,000	$ 565,000,000
Net:	$34,522,000,000	$34,118,000,000	$33,714,000,000	$33,436,000,000

Thus, the estimated net revenues from an auction of 120 MHz of reclaimed television spectrum would range from $33 billion to $34 billion, after deducting the costs of voluntary exits and repacking. This figure does not include any explicit increase in the exit price for broadcasters choosing to exit, but those costs could easily be included by adding a percentage of the line for aggregate broadcaster value.

4. CMRS Spectrum Valuation Projection

An auction of broadcast spectrum to Commercial Mobile Radio Service ("CMRS") providers has the potential to generate billions of dollars in revenue for the US Treasury. But the price paid for spectrum can be heavily affected by a variety of market, regulatory, and auction design characteristics. It is important to note that the more the spectrum is auctioned free of regulatory obligations, the greater the certainty for all potential bidders and the greater the valuation. To determine the potential revenue that could be realized by the auctioning of 120 MHz of TV broadcast spectrum, CEA and CTIA conducted an analysis that attempts to look at all the relevant factors that affect prices paid at auction for spectrum licenses. In particular, 6,048 data points from winning bids from 13 previous CMRS spectrum auctions[6] were analyzed

[6] The auctions analyzed included the March 1995 broadband PCS A and B Block auction (Auction No. 4); the May 1996 broadband PCS C Block auction (Auction No. 5); the July 1996 broadband PCS C Block reauction (Auction No. 10); the January 1997 broadband PCS D, E and F Block Auction (Auction No. 11); the April 1999 broadband PCS C, E and F Block reauction (Auction No. 22); the January 2001 broadband PCS C and F Block reauction (Auction No. 35); the September 2002 Lower 700 MHz auction (Auction No. 44); the June 2003 Lower 700 MHz auction (Auction No. 49); the February 2005 broadband PCS A, C, D, E and F Block auction (Auction No. 58); the

to determine the historical drivers of spectrum price and to estimate their probable effect on an auction of repurposed television spectrum.[7] When the factors discussed below are aggregated, the model predicts spectrum licenses auctioned in the broadcast television band to be valued at $0.978 per MHz-POP. Using an estimated U.S. population of 310 million and the 120 MHz the National Broadband Plan suggests must be recovered from the TV band would estimate gross auction revenues of over $36 billion.

As previously noted, the valuation predicted is far less than the average value for 700 MHz spectrum licenses in Auction 73.[8] In this auction, 700 MHz spectrum was valued, on average at $1.29 per MHz-POP. If this valuation was achieved, then 120 MHz of broadcast television spectrum would generate approximately $48 billion in revenue. Additionally, an even higher amount would be raised is the values were consistent with the 12 MHz B Block spectrum in Auction No. 73, which was the block most similar to the assumptions we have provided above.[9] The B Block generated slightly over $9 billion in net bids, implying a valuation of approximately $2.67 per MHz-POP – which would provide an estimate of approximately $99 billion for 120 MHz of reclaimed broadcast television spectrum. For this reason, CTIA and CEA believe the valuation derived herein is very conservative.[10]

September 2006 Advanced Wireless Services-1 auction (Auction No. 66); the May 2007 broadband PCS reauction (Auction No. 71); the March 2008 700 MHz auction (Auction No. 73); and the June 2003 Lower 700 MHz reauction (Auction No. 78).

[7] *See* FCC Auctions page for all data used. http://wireless.fcc.gov/auctions/default.htm?job=auctions_home. See end of Section I for summary statistics from the auctions analyzed.

[8] *See* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-281550A2.pdf (last visited February 7, 2011). Of note, these values are based on the population at the time of the Auction 73 auction, 285 million pops.

[9] Of the contemporaneously auctioned spectrum, the Lower 700 MHz A Block spectrum is likely to have been discounted by the presence of immediately adjacent high power broadcast operations, while the Upper 700 MHz C Block was subject to a new and unique open network condition. The Lower 700 MHz E Block, moreover, was unpaired. While the B Block licenses were both smaller in terms of bandwidth and market size than the model, in both cases that would imply a lower valuation for the B Block spectrum, arguing even more that the model valuations are conservative.

[10] This regression analysis uses auction data rather than private market transactions for several reasons. First, not all spectrum transactions involve publicly available price data. Second, even where public available sale prices are released, the deals may not involve greenfield (unbuilt) spectrum and may include facilities or customers. Finally, private spectrum transactions typically do not involve spectrum nationwide, and thus would require adjustments based on the regions involved, a task rendered even more difficult by the variety of licensing regions used by the FCC.

We do note, however, that a recent market transaction—the AT&T acquisition of certain Qualcomm licenses—involves 700 MHz spectrum, is national in scope, and does not include facilities or subscribers. According to news reports, AT&T agreed to purchase D and E Block Lower 700 MHz license assets from Qualcomm for $1.925 billion. *See* http://www.qualcomm.com/news/releases/2010/12/20/att-agrees-acquire-wireless-spectrum-qualcomm. The licenses included 12 MHz over 70 million POPs, including a number of major metropolitan areas, and 6 MHz over 230 million POPs. Using those figures, the deal would nominally generate a value of $0.867/MHz-POP. However, the D and E Blocks are unpaired, and, based on Auction Nos. 44 and 49, a 20 percent premium would be

4.1 Factors Influencing Auction Price

To determine the impact of a number of different factors, the analysis uses Ordinary Least Squares ("OLS") regressions. An OLS regression was run on a number of market and regulatory variables against the natural log of price, which was measured in CPI-adjusted November 2010 dollars per megahertz per POP.[11] The following regressors were used:

- *s&p:* The 12-month total return on the S&P 500 at the time of the auction.
- *lnmob*: The natural log of the size of the mobile phone market (in number of subscribers) at the time of an auction.
- *lnmhz-pop:* The natural log of the size of the license being sold, in MHz-POPs.
- *ust:* The yield on 10-year US Treasury bonds at the time of auction.
- *incumbent:* Ranged from 0 to 1 depending on the prevalence of incumbents on auctioned spectrum, and the expected difficulty auction winners would have in making them exit.[12]
- *bid credits:* A dummy variable set equal to 1 if bidding credits were made available to small businesses.
- *buildout:* Ranged from 0 to 1 depending on the severity of build-out requirements set by the FCC on a license.

The resulting regression output featured an r-squared value of 47.7 percent, meaning that almost half of the value was predicted by the application of the regressors. In a vastly complex scenario such as this, the r-squared figure subjectively appears to predict value well. In addition, all variables were statistically below the 1 percent level typically considered the threshold for significant regressors, except *bid credits* (p-value = 0.0199) and *buildout* (p-value = .088). The results can be seen in Attachment 1. As shown in that attachment, a number of input variables, including *s&p, lnmob, lnmhz-pop, ust,* and *incumbent* were found to be significant at better than the 1 percent level. Each variable, and possible reasons for its correlation with price, is discussed below.

expected for paired spectrum. On that basis, this deal implies a valuation of $1.04/MHz-POP for the AT&T/Qualcomm deal which is very close to the $0.978/MHz-POP the model predicts.

[11] *See* http://www.bls.gov/cpi/#tables.

[12] *See* end of Section I for a table of incumbent and buildout values assigned by auction..

4.2 Market Factors

4.2.1 S&P 500 12 Month Total Return (coefficient = -1.49, p-value < 0. 01 percent)

Stock market returns for the prior twelve months have a negative relationship with price such that an increase of 1 percent in market returns correlates with a 1.49 percent decrease in spectrum price while controlling for other variables in the model as specified. This relationship likely has several reasons including a company's decision on the timing of capital expenditures and investment allocation choices.

4.2.2 US Treasury 10-Year Bond Yields (coefficient = 59.47, p-value < 0. 01 percent)

An increase in U.S. Treasury yields tends to signify that investors are leaving "safe" US bonds in order to pursue riskier investments. Thus, the positive correlation between bond yield and spectrum price (a 0.1 percent rise in yield correlates with 5.95 percent rise in price) likely indicates that as investors' risk appetite increases, investment in additional spectrum seems more attractive.

4.2.3 US Cellular Market Size (coefficient = 0.70, p-value < 0. 01 percent)

The positive relationship between spectrum price and cellular market size is in line with normal supply-demand relationships. As the size of the US market increases, demand increases for the radio spectrum required to meet consumers' needs. Thus, a 1 percent rise in mobile market size—a one percent increase in the number of subscribers—correlates with a 0.7 percent jump in spectrum price.

4.3 Regulatory and Auction Characteristics

4.3.1 Bidding Credits (coefficient = 0.06, p-value = 2 percent)

The FCC offers a variety of small business bidding credits in certain spectrum blocks. These discounts range from 15 percent to 35 percent, depending on business size and auction number. The conditions are similar enough in all auctions, however, that no distinctions for credit type were made in this analysis.

4.3.2 Incumbent Clearing Issues (coefficient = -1.31, p-value < 0. 01 percent)

The level of risk presented by having to clear incumbent users occupying a given license was subjectively ranked on a 0 to 1 scale, with 1 being the most severe. The highest values were assigned to spectrum encumbered by US Government agencies, which have historically proven the most difficult to clear. But private incumbents have a major impact on pricing as well, since uncertainty is high for the new licensee and negotiations can be costly. The result is a 131

percent decrease in price when moving from unencumbered licenses to ones with the most severe incumbent clearing issues. As such, perhaps the single most effective way for the FCC to ensure a high price for spectrum at future auctions is to clear incumbent users beforehand, or provide a robust mechanism for the speedy and predictable resolution of relocation negotiations.

Because there was no empirical method to assign a precise quantity to the severity of incumbent clearing issues, the exact value of the coefficient is very subjective. Nonetheless, the underlying assumptions were made carefully, and the direction and approximate magnitude of the effect are robust. The model also assumes that no incumbent issues will exist for the repurposed broadcast television spectrum—in other words, that incumbent broadcasters in the reallocated spectrum would already have been repacked, or the mechanism and payments for repacking would have been determined, such that new mobile licensees would have no additional negotiations to clear the spectrum they acquired at auction.

4.3.3 Build-out Requirements (coefficient = 0.08, p-value = 8.8 percent)

The severity of each set of build-out requirements was also subjectively ranked on a 0 to 1 scale, with 1 being the most stringent. While the regression establishes a small positive correlation between build-out requirements and price (an 8 percent difference in price between spectrum with the strongest requirements and spectrum with none at all), the high p-value and the inexact metric used to rank auctions means some caution should be used when using the coefficient generated. However, as with other regulatory requirements, the lighter the restrictions, the greater the certainty, and therefore the greater the confidence in investing.[13]

4.3.4 License Size (MHz-POPs in License) (coefficient = 0.155, p-value < 0. 01 percent)

The positive correlation between license size and unit price (a 1 percent jump in size correlates with a 0.155 percent rise in price) seems to reflect two competing forces. The first is that larger licenses appear to contain more valuable customers, likely because they are based around denser urban areas that may have lower per-person build-out costs and freer-spending consumers. The second is that buying an asset in bulk tends to decrease its unit price, due to increased purchasing power for the buyer, reduced competition for the contract, and an increased aversion to tying up large amounts of capital in the transaction. But it seems that the first force is larger than the second in spectrum auctions—and that it can correlate with significantly increased prices in larger markets.

[13] For example, the Commission's application of open access regulation to the Upper 700 MHz C Block demonstrates that the uncertainty injected into the market by such rules has grave consequences on wireless investment. The C Block, which was auctioned as a 22 MHz band made up of four licenses covering the continental United States, sold for approximately half the price of the B Block, even though the B Block was licensed with far less spectrum (12 MHz) covering far smaller license areas (734 covering the continental U.S.).

4.4 Model Projections for Hypothetical Television Spectrum Auction

A series of assumptions was used to model spectrum as if an auction were held in August 2011. To ensure maximum efficiency in the auction, no incumbent clearing issues or bidding credits were considered present. A 3.5 percent UST yield, 5 percent S&P 500 return, 310 million population and CMRS market size of 300 million were used.[14] All new spectrum was divided into 20 MHz blocks in equal geographic areas approximating the number of Economic Areas ("EAs"). Under these conditions, the model projects an average price of $0.978 per MHz-pop, which generates a total market value of $36.3 billion for 120 MHz of CMRS spectrum. We note that ultimately licenses auctioned would likely include a range of geographic area sizes and spectrum blocks which may affect the revenues produced.[15]

There are several additional factors that could influence this valuation. The first is the recent explosive growth in the market for mobile broadband, which has placed additional usage demands on the licenses currently designated for CMRS providers. This in turn has the potential to put significant upward pressure on spectrum valuations. Price elasticity of demand, however, may counteract some of this pressure, as a jump in spectrum supply without a corresponding shift in demand may push prices downward. Information on population density, regulatory uncertainty, and differences in auction design could also help strengthen the regression. However, the relatively high r-squared value of the current model means that it is still a highly useful tool for estimating spectrum price in future auctions.

5. Enterprise Value Projections for Broadcasters Most Likely to Participate in an Incentive Auction

CTIA and CEA have welcomed proposals to use incentive auctions to clear broadcast spectrum for mobile broadband use. In this paper, we seek to provide empirical data that will enable a comparison of expected auction revenues with an estimate of potential payments to incumbent licensees. Thus, in this section, we provide a fact-based analysis of the enterprise value of broadcast stations that would most likely be surrendered through incentive auctions to free up 120 MHz of spectrum for mobile broadband use. This analysis presents a conservative scenario, for example, assuming the maximum number of stations participating in incentive auctions, and relies on two independent and respected valuation methods which are currently used in the marketplace. As detailed below, the analysis demonstrates that the enterprise value of the surrendered licenses would be between $1.2 to 2.3 billion.

Under the most likely FCC plan, freeing 120 MHz of television spectrum for mobile broadband use will require existing broadcasters to be shifted out of the channel 31-51 range nationwide.[16] In the vast majority of markets, this will not require any broadcast stations to

[14] Figure based on CTIA mid-year annual survey using linear interpolation for December 2010 value based on June 2009 and June 2010 growth.

[15] We note that this White Paper does not seek to establish a particular band plan.

[16] While channels 31-51 actually comprise 126 MHz, channel 37 is reserved for radio astronomy use, is not presently used by broadcasters, and presumably would not be used for mobile broadband.

participate in an incentive auction. In a limited number of markets, the number of licensed broadcasters will exceed the channels that will remain available for TV use following a reallocation. As a result, a number of potential voluntary avenues to freeing additional channels have been proposed that rely on commercial incentives, including "paying" broadcasters to exit the market through an incentive-based auction mechanism, paying broadcasters to share channels, paying broadcasters to adopt a cellularized architecture, and paying broadcasters to relocate to low VHF spectrum. Non-exit options, such as paying to share, cellularize or relocate to low VHF, would allow a broadcaster to continue to operate and to retain certain "must carry" rights that require the station to be made available on local cable television systems and satellite systems, and therefore appear to be options that would be attractive at a lower price than it would cost for a broadcaster to voluntarily exit the market entirely. Thus, a model that assumes only that an exit option would be available should be a financial worst-case—that any scenario permitting lower cost non-exit options would result in a lower cost of clearing.

To determine the total cost of relying solely on voluntary exits to free 120 MHz, even though lower cost clearing options like sharing may exist, the analysis used published, but proprietary revenue data, for the Top-30 television markets.[17] The data used is a recognized source for television transactions, including actual and estimated revenues for stations in the Top-30 markets. It was also generally assumed that the low VHF band would remain unaltered—no stations would be relocated to the low VHF band, but stations in the low VHF band would not be relocated from that spectrum. The analysis also considered the impact of channels dedicated for Public Safety/Land Mobile sharing designated in Section 90.303 of the FCC's rules and assumed such use would be retained.[18]

With those assumptions, the calculations assumed channel occupancy by broadcasters of only one out of every two channels. In other words, 13 channels were generally deemed available in a market, with four in the upper VHF band and nine in the UHF band. That number was decreased in the markets where Public Safety/Land Mobile sharing was designated, although it was presumed that users under Section 90.303 could occupy adjacent channels. To determine which stations were most likely to exit, stations were prioritized by certain classes, with non-U.S. stations, public broadcasters, and "big four" broadcasters assumed to remain. All other full power and Class A broadcasters were then ranked by revenue, and the broadcasters with the lowest revenue in each market presumed to be mostly likely to exit. Non-Class A low power television ("LPTV") stations, which operate on a secondary basis, were not considered. With these assumptions, the modeling predicts that in all but a few Top-30 markets, very few stations must voluntarily exit or adopt a non-exit alternative to free a channel.

The analysis utilizes two alternative approaches to determine valuation—one based on gross revenue and one based on cash flow, both of which are generally accepted valuation methodologies for industry transactions. Notably, however, both of these approaches are used to

---

[17] BIA/Kelsey, "2010 Investing in Television Market Report, 1st Edition" (2010) ("*BIA/Kelsey TV Report*") (available commercially at http://www.bia.com/publications_reference_tv.asp#tv1).

[18] 47 C.F.R. § 90.303. The analysis did not attempt to address the requests for waivers that have permitted public safety and land mobile use of other television channels in areas other than those designated in Section 90.303.

derive a station's *market value*, not a station's *exit price* in an incentive auction. Depending upon expectations that may be created by the regulatory process or perceptions of risk, stations may not be willing to exit at their projected market value and may hold out for some amount above that value. Notably, the analysis raises all gross revenues upwards by 7 percent to reflect the rebounding ad market—a figure that is a midline in the range provided by a May 2010 *Wall Street Journal* article covering the recovery of TV advertising.[19] Those stations listed without revenue data in the *BIA/Kelsey TV Report* are assumed to be willing to move if compensated in line with stations earning $1,000,000 in annual gross revenue. The $1,000,000 revenue figure represents, in general, a substantially larger enterprise value than the class of stations typically omitted from the *BIA/Kelsey Report* and therefore should be a conservative (*i.e.*, overvalued) assessment of enterprise value for those stations.

5.1 Gross Revenue Valuation Approach

The gross revenue valuation approach estimates enterprise value using a methodology set forth in a study published by Peachtree Media Advisors.[20] In effect, Peachtree Media Advisors, a well-recognized media valuation group, advocates assessing market value for television properties by applying a multiplier to the station's revenue stream. Specifically, Peachtree Media established multipliers to be applied against the mid-level gross revenues (plus the 7 percent correction detailed above) to find an estimated enterprise value, using a multiplier of 1.2x. For purposes of this analysis, we have generated low end, mid-range, and high end estimates using multipliers of 1.2x, 1.6x and 2.0x:

Model	Multiplier	Enterprise Value
Low End	1.2x	$1,213,000,000
Mid-Range	1.6x	$1,617,000,000
High End	2.0x	$2,021,000,000

Table 1: Enterprise Valuation Using Gross Revenue for Stations Required to Exit to Clear 120 MHz

As previously noted, if the incentive auction process is set up to explicitly provide broadcasters with a price over market value to exit, these numbers will need to be grossed up by the additional amount of the exit price. In addition, if a single exit price auction is used,[21] that methodology results in paying out more than enterprise value to certain exiting broadcasters.

---

[19] Suzanne Vranica and Sam Schechner, "Freer Ad Spending Buoys TV's Upfront" (May 27, 2010), *available at* http://online.wsj.com/article/SB10001424052748704032704575268770369592154.html.

[20] *See* John Doyle, "Digital Media Valuations Q1 2009," *located at* http://peachtreemediaadvisors.wordpress.com/2009/04/28/digital-media-valuation-update-q1-2009/.

[21] As previously noted, it has been suggested that an incentive auction might establish a single exit price per market for broadcasters established by the highest per station cost needed to meet demand for mobile spectrum. Thus, even if a broadcaster in a market committed to exit at $X, if it was necessary to secure the exit of another broadcaster who would only commit to leave at $(X + Y), both would be paid $(X + Y) to exit.

5.2 Cash Flow Valuation Approach

The second valuation approach, the cash flow valuation approach, was derived after discussions with industry valuation experts, particularly regarding estimating specific cash flow percentages and market multipliers. The crux of this analysis is to base valuation on multiples of cash flow, rather than revenue. It is notable that, under this analysis, no affiliates of the "big four" broadcasters (ABC, CBS, Fox, and NBC) would surrender their licenses and therefore none of these estimates include any big four data. Rather, based on enterprise value, only non-"big four" stations were considered.[22] For those, the cash flow figure was estimated at 27 percent of revenue; this figure is larger than typical cash flow percentages used and thus should be conservative (*i.e.*, err on the side of a higher valuation). Multiples applied to the cash flow varied by market size, reflecting higher valuations for properties in larger markets, and were conservatively set at 8.5x for Top-10 Markets, 8x for Top-25 markets, and 7.5x for markets outside the Top-25.

Model	Enterprise Value
Cash Flow Model	$2,299,000,000

Table 2: Enterprise Value Based on Cash Flow Analysis for Stations Required to Exit to Clear 120 MHz

Notably, the valuations provided in Table 1 and Table 2 represent combined enterprise value, not the amount of money that would be required to cause the station owner to exit the market. As the paper notes in Section 4, economic theory suggests that broadcasters should be willing to exit for any price nominally above their market value, but that given perceptions of auction risk and expectations of a windfall, they may be unwilling to actually terminate operations at that price. In addition, as we have noted, the cost of securing clear spectrum would increase above market value in the event of a single exit price auction.

5.3 Sensitivity Analysis

To consider the impact of some of the assumptions herein, the analysis also varies key assumptions to assess the cost impact of those changes. For example, assuming that the lowest valued broadcaster chooses to remain, forcing the exit of a broadcaster with higher revenues, the aggregate enterprise value to achieve the desired spectrum clearing increases by 51 percent—in the revenue model, the aggregate value increases to a low end value of $1.827 billion, has a mid-range value of $2.436 billion, and a high end value of $3.045 billion. Similarly, the cash flow model increases 51 percent to $3.466 billion. At the same time, if two broadcasters in each market elected to share a channel, thus decreasing the number of required exits by one, the aggregate value would decrease by one–third—the value would drop to $0.826 billion, $1.102 billion, and $1.377 billion for the low end, mid-range and high end revenue model, and $1.567 billion for the cash flow model. The analysis also tested a different assumption regarding the ability to pack broadcasters into remaining channels. Recognizing that major metropolitan areas

[22] Most analysts would consider that any "big four" broadcaster would command a premium in terms of the multiple used. Because no "big four" stations were implicated, such a premium was not considered.

typically exhibit a much higher channel density than represented by the use of only every alternate channel, the analysis also considered a scenario where the number of available channels post-transition was represented by a density that was the same as the density in that market exhibited pre-transition.[23] In such a model, the aggregate enterprise value based upon the revenue models was increased by 14 percent to $1.1385 billion, $1.846 billion and 2.308 billion for the low end, mid range and high end, and by 18 percent, to $2.562 billion, for the cash flow model.

6. Cost for Transitioning to a New Digital Core

In addition to inducing a sufficient number of broadcasters to exit, share, or adopt assignments in the lower VHF band to permit the reallocation of 120 MHz for mobile broadband, any financial assessment of a potential transition must also consider the cost of channel swaps to move broadcast facilities from channels 31-51 to the new core from 7-30. To estimate that cost, the number of actual swaps must be estimated, as well as the average cost to perform a channel swap. Each of those factors is discussed below.

Importantly, a "channel swap" involves modifying the RF channel used by a broadcaster, but that would not impact the "virtual" channel the public typically associates with a particular station. Since the DTV transition, a station's public channel and its RF channel have been separate. From a consumer standpoint, a change in a station's RF channel should have no real impact, other than the need to cause the television or receiver to perform a one-time channel "re-scan" at a set cut-over date.

In determining the number of channel swaps required to clear channels 31-51, the analysis assumed different scenarios for the Top-30 markets and those markets outside the Top-30. For markets outside the Top-30, the analysis assumed that every broadcaster in the channel range 31-51 would have to undergo a swap. While it is possible that some swaps may be required for incumbents necessary to accommodate the influx of broadcasters from above channel 31, the number should be minimized by judicious channel selection for the users moving below channel 30. In the Top-30 markets, the number of swaps is calculated in a similar fashion, however, some percentage of the broadcasters above the channel 30 will choose to exit, share, or move to low VHF. As a result, the number of swaps will be less than the number of broadcasters that currently occupy from channels 31-51; there was an assumption that presumed a proportionate number of the broadcasters in each band opt for financial incentives. Based upon

[23] While using the pre-existing channel density seems reasonable for major markets, modeling in that manner may overstate the number of stations required to clear. For example, if a theoretical market had only one station, it would have a very low density prior to the transition, and therefore a very low post-transition density as well. In other words, in the case of a market with a low number of stations, the number may not be representative of the density that could be achieved post-transition because the number is not representative of the maximum density that could be achieved pre-transition. Using a model that strives to achieve an equivalent average density for the top-10 markets may be a better measure.

those assumptions, the analysis estimates, as a worst-case, conservative value, that 629 swaps could be required.[24]

Additionally, to estimate the financial impact of a channel swap, NTIA broadcaster cost data was used.[25] The NTIA data was prepared to provide interested parties with a comprehensive estimate of the costs of operating a public broadcast television station, using several different potential output power scenarios. A review of this data suggests that the only channel dependent elements are the radio transmitter and the antenna. Notably, many transmitters and antennas can be used across a range of channels, so assuming that every swap implicates a transmitter and antenna replacement is very conservative. This analysis takes that conservative approach.

Band	Power	Transmitter	Antenna			Installation
			Low	High	Average	
High VHF	**10 kW Avg SS**	$ 690,000.00	$ 40,000.00	$ 200,000.00	$ 120,000.00	$ 70,000.00
UHF	**2.5 kW Avg SS**	$ 325,000.00	$ 60,000.00	$ 200,000.00	$ 130,000.00	$ 70,000.00
	15 kW Avg SS	$ 680,000.00	$ 80,000.00	$ 250,000.00	$ 165,000.00	$ 70,000.00
	60 kW Avg IOT	$ 950,000.00	$ 120,000.00	$ 375,000.00	$ 247,500.00	$ 75,000.00
Average		$ 661,250.00			$ 165,625.00	$ 71,250.00

Table 3: Average Television Transmitter/Antenna Replacement Cost

Based on the NTIA data, the average cost for a television transmitter, antenna and installation would be $898,000. Multiplying that figure by the number of swaps required (629 times $898,000) yields a total swap cost for the band of approximately $565,000,000.

7. Overall Financial Impact of an Incentive Auction

As a final step, the parts of the analysis gathered above should be combined to attempt to assess the overall revenue picture for an auction of 120 MHz of broadcast television spectrum, while compensating the underlying incumbent broadcast operations through an incentive-based auction mechanism. The analysis has estimated the following figures: (1) the revenue that could be expected from an auction of 120 MHz of broadcast television spectrum under a set of particular assumptions; (2) an estimate of the enterprise value for broadcast television properties that, under a worst case scenario, would need to exit the Top-30 markets for 120 MHz of spectrum to be made available for mobile broadband services; and (3) an approximate cost for TV stations that would require a channel swap from TV 31-51 channels to the new core channels of TV 7-30.

[24] Given the uncertainty in how the incentive auction will be structured, the number of channel swaps could be significantly less than 629. For example, assuming the FCC allows all TV markets (not just those that require some manner of channel solutions to be resolved) to participate in the auction, a number of the TV stations operating between TV 31 and 51 may either exit or elect to channel share.

[25] http://www.ntia.doc.gov/ptfp/application/EquipCost_tv.html

Combining these elements of the analysis, we can estimate the total net revenues an auction of 120 MHz would generate, less the costs of transitioning the band.

	Revenue Model			Cash Flow Model
	Low End	**Mid-Range**	**High End**	
Gross Value of 120 MHz	$36,300,000,000	$36,300,000,000	$36,300,000,000	$36,300,000,000
Aggregate Broadcaster Value	$ 1,213,000,000	$ 1,617,000,000	$ 2,021,000,000	$ 2,299,000,000
Repacking Costs	$ 565,000,000	$ 565,000,000	$ 565,000,000	$ 565,000,000
Net:	$34,522,000,000	$34,118,000,000	$33,714,000,000	$33,436,000,000

Table 4: Estimated Net Auction Proceeds

Thus, an auction of 120 MHz of reclaimed television broadcast spectrum should be expected to range from $33B to $34B. While the table above does not include any explicit increase in the exit price for broadcasters that may be permitted, that factor could easily be added by applying a multiplier to the aggregate broadcast value prior to determining net auction revenues.

8. Conclusion

CTIA and CEA have presented above an attempt to model and estimate the impact of an incentive auction for 120 MHz of broadcast television spectrum. While the analysis concludes that substantial revenue would be realized from such an auction, the estimates are not intended to foreclose any potential refinements to the auction process or to create assumptions about how such an auction would be conducted. As previously noted, the purpose of this analysis is to provide a foundation for evaluating the important issues that is grounded in a sound and common understanding of the facts. In such respects, CTIA and CEA anticipate and welcome critical comment that tests the assumptions, inputs and conclusions described above.

* * *

REGRESSION ANALYSIS

Regression Statistics	
Multiple R	0.690452644
R Square	0.476724854
Adjusted R Square	0.476031659
Standard Error	0.469871824
Observations	6048

Analysis of Variance (ANOVA)					
	df	***SS***	***MS***	***F***	***Significance F***
Regression	8	1214.678999	151.8348749	687.7217013	0
Residual	6039	1333.28759	0.220779531		
Total	6047	2547.966589			

	Coefficients	***Standard Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***	***Lower 95.0%***	***Upper 95.0%***
intercept	-18.43708878	0.52227078	-35.30178115	2.3634E-248	-19.46092588	-17.41325169	-19.46092588	-17.41325169
s&p	-1.49057169	0.092404527	-16.13093785	2.40952E-57	-1.671717537	-1.309425843	-1.671717537	-1.309425843
lnmob	0.702525967	0.024012408	29.25679001	4.3783E-176	0.65545308	0.749598854	0.65545308	0.749598854
lnmhz-pop	0.154828309	0.004711437	32.8622259	4.7748E-218	0.145592211	0.164064406	0.145592211	0.164064406
ust	59.46945558	2.006383693	29.64012107	2.236E-180	55.5362276	63.40268356	55.5362276	63.40268356
incumbent	-1.306925706	0.039540006	-33.05325002	2.288E-220	-1.384438227	-1.229413185	-1.384438227	-1.229413185
bid credits	0.059861374	0.025709496	2.328375985	0.019924992	0.009461587	0.110261161	0.009461587	0.110261161
buildout	0.079049574	0.046285663	1.707863046	0.087713153	-0.011686842	0.16978599	-0.011686842	0.16978599