Before the
National Telecommunications and Information Administration
Washington, D.C. 20230

In Re: Request for Comment and Notice of Proposed Rules to Implement and Administer a Coupon Program for Digital-To-Analog Converter Boxes	**)** **)** **)** **)**	**Docket No. 060512129-6129-01**

COMMENTS OF THE METROPOLITAN TELEVISION ALLIANCE, LLC

The Metropolitan Television Alliance ("MTVA") hereby files its initial comments in response to the Notice of Proposed Rulemaking ("NPRM") published in the Federal Register on July 25, 2006 in the above-referenced proceeding. MTVA is an incorporated association of television broadcast stations that serve the New York City metropolitan area. Most of the MTVA member stations lost their primary analog and digital transmission facilities following the terrorist attacks against the World Trade Center on September 11, 2001.

The MTVA is quite concerned about those households within the New York Metropolitan area that will be adversely affected by the cessation of analog transmissions from its member stations. The loss of the primary analog and digital transmission facilities located on the World Trade Center from the events of September 11, 2001 has impacted the over-the-air reception of households that rely exclusively on free over-the-air television reception. While MTVA and its member stations have made great strides in providing service from the Empire State Building (ESB), the ESB transmission site has certain limitations that restrict the ability of stations to fully

cover the metropolitan area. Cessation of analog television service may further impair the ability of households to receive free and universal over-the-air television service.

With these concerns as a backdrop, the MTVA hereby comments on various aspects of the NTIA's D/A converter box NPRM.

Eligibility

In promulgating rules for a Coupon Program for Digital-To-Analog ("D/A") Converter Boxes, MTVA supports the positions of both the MSTV (Association for Maximum Service Television) and NAB (National Association of Broadcasters) that eligibility should be offered to all households without the exclusion of those households that subscribe to MVPD services such as cable television or satellite service. In many cases, these households have additional television sets that are not connected to an MVPD service. It is of utmost importance that these households not be abandoned without any access to free over-the-air-television service. Therefore, we do not support the NTIA proposal that Eligible Households should be strictly limited to those households that rely exclusively on free over-the-air television reception. However, given the limitation in availability of Coupons due to the financial limits of the Digital Television Transition and Public Safety Act of 2005 (the Act), if a restriction were to be adopted by the NTIA, we believe that the first priority for any coupons should be given to those households that rely exclusively on free over-the-air television reception. Given that these households would be left without free and universal television service without a D/A Converter Box, it would seem to be in the public interest to prioritize the eligibility of household to those that are not connected to cable, satellite, or other MVPD service. Presumably, households that are connected to cable, satellite, or other MVPD service will be provided with appropriate digital-to-analog converter boxes by the service provider from which they subscribe (for at least the "main" television set that is connected to the MVPD). Thus, providing coupons to all households should be a goal of the Coupon Program, with some priority given to those households that rely exclusively on free over-the-air television service.

In the NPRM, the NTIA asks specifically for comments regarding economic eligibility criteria for the coupon program. The Act does not require the NTIA to develop economic eligibility criteria for the coupon program. MTVA urges NTIA to not adopt economic eligibility criteria. This is particularly important since the economic statistics of the households that rely exclusively on free over-the-air television may not be available or known. Further, the economic criteria would have to be determined based upon the cost of living for a particular market area. With the cost of living in New York City being higher than average, it would be unfair to households in New York if an income criteria were to be established. It is of utmost importance for the NTIA to be concerned with providing those households that are totally reliant upon broadcast signals for critical news and information source to be availed of the opportunity to participate in the coupon program. This is particularly underscored by the importance of broadcast signals to these households during times of emergency or disaster. We urge NTIA to retain this critical "life-line" broadcast service to those households that solely rely on our off-air signals and not adopt criteria for eligibility that would render them ineligible, such as an economic or income eligibility requirement.

Digital-to-Analog Converter Box Requirements

In the NPRM, NTIA asks for Comments regarding performance criteria, features, and functions that should be required for the "Box" to be eligible for the coupon program. MTVA urges NTIA to adopt rules and specifications of the Converter Boxes that would ensure reliable and universal free over-the-air television service. This is particularly important to households that currently rely upon *indoor* antennas for reception of broadcast signals. In large metropolitan areas, many households are located in close proximity to the transmission facilities of the broadcast television stations. These households expect to continue using and relying upon indoor antennas for

reception of digital television signals after the cessation of analog television service. Thus, it is of utmost importance that the NTIA adopt rules and requirements for the D/A Converter Box that retain the ability of these households to continue using indoor antennas.

A Smart Antenna Interface Should Not Preclude Coupon Eligibility

Devices designed to convert the ATSC digital television format for viewing on analog (NTSC) television receivers that contain an interface and associated circuitry for use with a "smart antenna" should not be precluded from coupon eligibility based on the presence of such an interface. In addition, although the current standard for this interface is specified in EIA/CEA 909, eligibility should not be limited to only devices that comply with this standard since such a requirement could preclude or delay technological advances in this area that are now being considered. In addition, the use of a smart antenna interface as specified in the EIA/CEA 909 standard is also included in the ATSC Recommended Practice on Receiver Performance Guidelines (document A-74) in Section 4.2, which the NTIA recommends in the NPRM as a technical reference.

The smart antenna interface should not be viewed as an unneeded enhancement since its development was focused directly toward the segment of the population that is intended to benefit the most from the coupon program. Its specific purpose is to deal with the problems of off-air DTV reception in areas where signal reflections from nearby objects and terrain tend to impact the receiver's ability to properly decode the digital transmission. It is anticipated that many of the households in the segment of the population that could benefit the most from the coupon program live in urban environments where DTV reception is challenging due to the presence of large buildings. Unlike analog reception that is degraded but in many cases still

viewable in such an environment, DTV is generally an all or nothing proposition. In a difficult reception environment, the DTV video and audio is either perfect or nonexistent. In these situations, the use of a smart antenna can mean the difference between having good DTV service or no service.

Low cost smart antennas and interfaces have been developed and work in this area is ongoing. If the smart antenna interface is not excluded from the coupon program, then there will be added incentive to further develop these products. Such a decision would also very likely lower the incremental cost of the feature due to a larger potential market and, as a result, benefit those that have the greatest need for the technology.

Digital-To-Analog Converter Box Performance Requirements

While cost and ease of installation are to be considered by the NTIA (along with some other specific converter box features), acceptable RF *performance* is also of concern to the NTIA. Of course, the NTIA requires that these D/A converter boxes be compliant with the ATSC digital television standard used in the United States (FCC Part 73 and ATSC Standards A/52A, A/53C, and A/65B). However, the NTIA also indicates that D/A converter boxes be able to receive DTV signals from *only* an off-air antenna (i.e., no digital cable reception) in the same receiving configuration (e.g., same household antenna, same location, etc.) as used for existing analog signal reception. This presumes that the D/A converters box must have acceptable RF performance in order to provide reliable DTV reception (i.e., decoded video and audio signals to legacy analog TV sets) not only when used with outdoor antennas, but also when an *indoor* antenna of reasonable size and price is placed on or near the converter box and connected to its input. This should be a requirement since many households, in areas such as the New York City market, currently rely on indoor antennas for their analog reception. These households should not be burdened with the added expense of having to purchase and install an outside antenna in order to make up for deficiencies in the D/A converter box. In fact, in many cases installation of an outside antenna may not be practical or even permitted.

Self-Certification of Converter Box Performance

The NTIA asks for Comments regarding the proposal to allow manufacturers of D/A Converter Boxes to "Self Certify" compliance with the standards developed for the converter boxes in this proceeding. MTVA strongly urges the NTIA to *not* rely exclusively upon "Self-Certification" of compliance with the requirements of the program. We support the positions of both MSTV and

NAB with regard to verification of the performance of a converter box. Further, we suggest that the NTIA conduct its own independent testing of at *least* one sample unit for each model box in the program. In this way, NTIA can be assured that its funds are not wasted on units that do not operate correctly or do not have performance sufficient for proper operation (i.e., indoor reception) in households that will be using the boxes. MTVA notes that there are several organizations with available lab facilities that are both knowledgeable and appropriately equipped to conduct this RF performance testing. Use of these expert resources would significantly improve the speed and success of the testing and certification process. Some of these organizations are independent third-party laboratories (i.e., Consulting Engineering companies) while others are government organizations (i.e., FCC Labs, CRC Labs, etc.). MTVA recommends that compliance testing with specific emphasis on the RF performance of the boxes be conducted *prior* to the acceptance (i.e., certification) of the box into the program.

NTIA Should Consider Indoor Reception & Its Unique Requirements

NTIA also notes that a recent congressional hearing, GAO testimony has indicated that antenna reception of digital signals may vary based on a household's geography and other factors (e.g., building & insulation material, specific location within the structure, etc.). It is believed that in large urban areas, especially those close to downtown areas, many of these D/A converters will be used with indoor antennas. Therefore, some severe propagation environments and widely varying signal levels are sure to be encountered.

Therefore, MTVA urges NITA to adopt some minimum required RF performance specifications for these D/A converters in order to be certified by NTIA for use with the $40 government

coupons. However, the specific tests and their required test values that constitute these specs are not necessarily an easy task to decide. The current NTIA thinking is to reference the ATSC Recommended Practice: Receiver Performance Guidelines [standard (A/74)] in the coupon certification process. These recommended performance guidelines are intended to assure that reliable reception will be achieved by DTV receivers. In A/74, interference rejection guidelines are based loosely on FCC planning factors, while sensitivity and multipath guidelines reflect field experience accumulated in tests conducted by ATTC, MSTV, NAB, and various receiver manufacturers. While these recommended performance parameters are not mandated by the FCC in consumer DTV receivers, NTIA is considering using them as a *minimum* set of converter performance specs for certification and participation in the coupon program.

We agree with NTIA that the recommended A/74 performance guidelines be considered in the required minimum performance specifications, but with some *modifications* to some of the existing values, and inclusion of stringent but achievable values for those parameters that do not have specific performance values listed in the A/74 document.

It must be remembered that the current version of the ATSC A/74 document was published on June 18, 2004, more than two years ago, and addresses the front-end portion of a DTV receiver (antenna, tuner, carrier recovery, AGC, demodulation, clock recovery, channel filtering, equalization, and forward error correction). Since that time, the fifth generation of VSB decoder chips has come on the market (starting in Spring 2005) and new RF tuners have since been developed and placed into product. With these advances, some of the parameters of A/74 that have specific recommended values may have improved. Other parameters that have no guideline

values listed in A/74 should have these values reasonably defined in order for manufacturers to be able to test compliance to A/74 as well as for NTIA, or certified independent test laboratories, to be able to spot check converters for this RF performance compliance.

We recommend performance guidelines for consideration by NTIA as a minimum required specification for these D/A converter boxes for certification and inclusion in the government coupon program. The purpose of such enhanced performance guidelines and specifications is the increased probability of indoor DTV reception in highly urbanized areas.

ATSC document A/74 basically covers the following areas: Dynamic Range, Interference, Noise Impairments and Multipath Impairments. There are three basic areas under consideration:

1) Use of *existing* A/74 guideline values.
2) Use of *modified* A/74 guideline values that reflect technology improvements.
3) Use of *new* A/74 guideline parameters (and tests) if they currently don't exist.

The tables that follow contain the A/74 recommended parameters and their recommended values (if they exist) as well as any modified values that we are recommending. Also, many of the multipath tests do not have recommended performance values; MTVA will suggest recommended values based on the known performance of the 5th generation VSB decoder prototype chips. Finally, MTVA believes that there are other important parameters (and tests) that were not included in A/74 when it was completed in the 2004, but should be considered in the near future after DTV receiver performance parameters have been determined for them.

Table 1 describes recommended D/A converter *general* performance parameters. They are channel tuning, dynamic range (maximum and minimum RF signal levels for acceptable DTV reception), and AGC speed. Of these, only tuning and dynamic range are included in the ATSC A/74 document along with recommended values for these particular parameters.

We agree with NTIA regarding its suggestion that a terrestrial DTV converter box include Channels 2-69 in the tuning range since these converter boxes will be operating *prior* to the cessation of all analog operations (channels 52 – 69 will not cease completely with the cessation of all full service analog television stations, including low power television and translators). Every unimpaired channel (minimum signal level and above) should be tunable, with reasonable channel locking times (less than 2 seconds for MPEG pictures).

A maximum UHF signal level of -8 dBm (at the input of a receiver) reflects a field strength level of about 117 dBuV/m.[1] This level can occur in a line-of-sight reception scenario five miles from a 1 Megawatt maximized UHF DTV transmitter when using the standard FCC UHF planning factors of a 10 dBd gain antenna and 4 dB of coaxial feedline loss. A converter box should at *least* handle a 75-dB dynamic range (-83 dBm to -8 dBm), and MTVA recommends that an even larger dynamic range be handled, if possible. However, *multiple* undesired signals of -8 dBm may occur in a real environment, which would suggest that perhaps a maximum value of -2 dBm would be a better design goal for AGC circuits. This is especially relevant when broadband AGC is employed in a DTV receiver that includes any adjacent channel interference signal

[1] Derivation including antenna gain, line losses, VSWR adj. etc.

energy that passes through the finite bandwidth of the receiver's front-end tracking filter to determine the total signal energy that reaches the input of the first mixer.

In addition, MTVA believes that some additional basic parameters such as tuning frequency pull-in range and AGC speed should be considered as well in a minimum set of specifications. The pull-in range of ±100 kHz was a value easily achieved back in the ACATS era with the Grand Alliance (GA) prototype DTV receiver. However, while this GA receiver was designed with very slow AGC speed (about 10 Hz), modern day DTV receivers easily handle broadband fades well over 100 Hz, which allows for fast signal fades without loss of DTV reception.

Table 1 General Tests:

Specific Lab Tests	Conditions	A/74	MTVA	Units	Ref
Terrestrial Tuning Range	Single unimpaired ATSC signal; Reasonable acquisition (<2 second) CH 2-69 Signal Level: -68 dBm	Pass/Fail	Pass/Fail	-----	NTIA
Tuning Frequency Pull-In	Single unimpaired ATSC signal; Reasonable acquisition time & with ± 100 kHz frequency offset Signal Level: -68 dBm	None	> 100	kHz	ATTC
Maximum Desired Level	Single unimpaired ATSC signal TOV or Better	-8	-8	dBm	A 4.1
Minimum Desired Level	Single unimpaired ATSC signal TOV or better	-83	-83	dBm	A 4.1
AGC Tracking Speed	Max tracking speed (10 dB peak/valley) Signal: -12, -28, -53, -68, -77 dBm	None	> 100	Hz	

Table 2 and **Table 3** describe the recommended converter *interference* performance parameters. Both DTV-into-DTV and NTSC-into-DTV interference parameters are shown as MTVA recognizes that these converters will be deployed prior to the end of DTV transition when analog transmission will cease.

A/74 recommends values for co-channel and adjacent channel interference. These values are critical when DTV receivers are placed in reception environments (i.e., using either outdoor or indoor antennas) that have a large number of widely varying signal levels. This often happens in major metropolitan areas. The A/74 co-channel interference values for interference from either NTSC (+2.5 dB) or DTV (15.5 dB) signals essentially match the planning factors used by the FCC as described in its OET Bulletin #69 (OET-69). MTVA agrees with these values.

However, first adjacent channel NTSC-into-DTV performance described in A/74 does *not* match the OET-69 planning factor values used by the FCC in its channel allocation process in the 1990s. The A-74 D/U ratios for first adjacent NTSC-into-DTV fall at least 8 dB short and this has been a concern among many in the industry since the early DTV receivers came on the market and were subsequently lab-tested. More concern was raised since A/74 was published recommending only -40 dB D/U values for all future DTV receivers. MTVA believes that these values should meet the -48 dB (weak signal) and -45 dB (moderate signal) lower and upper first adjacent channel interference values.

First adjacent channel DTV-into-DTV performance is better than the FCC planning factors. However, this is due to the way that ATSC recommends these units be tested. The FCC planning factors for upper and lower first adjacent channel interference are -26 dB and -28 dB, respectively. These values are primarily limited by the FCC-allowed amount of intermodulation splatter from DTV transmitters. The A/74 document recommends -33 dB D/U ratio receiver performance from individual first adjacent channel signals (generated in the laboratory) that

essentially have no splatter (e.g., where the splatter "shelf" is > 43 dB below the DTV spectral flat-top). This recommended performance value then guarantees that the real-world limit of -26 dB or -28 dB will be primarily due to the equivalent co-channel interference from the first adjacent channel interference signal noise-like splatter and not due to the receiver's internally-created splatter (in the tuner) from the large first adjacent channel in-band signal. MTVA agrees with this philosophy.

The A/74 taboo interference parameter values have no equivalent in the OET-69 planning factors. Since the GA prototype receiver had -60 dB or better D/U interference ratios, the FCC did not account in OET-69 or its channel allocation process for taboo interference from either NTSC or DTV interferers. However, the A/74 document specifies recommended receiver performance values that are far worse than the -60 dB values obtained from the GA prototype receiver.

MTVA recognizes that there is a "disconnect" here between what was done to allocate both the original DTV channels as well as the post-transition DTV channels. This is an issue for the FCC to consider. However, MTVA believes that one philosophical change should be made to the A/74 document. It is believed that the taboo interference D/U ratios at the weak and moderate desired signal levels can be made equal through the use of broadband tuner AGC design. Therefore, these changes are reflected in **Table 2** and **Table 3**, except where the required undesired signal level would extend beyond –8 dBm (the current maximum individual signal level limit expected at the tuner input from an individual station).

Finally, MTVA believes in the importance of multiple interferer performance limits. It has come to the attention of the industry that certain pairs of interference signals can create third-order intermodulation components in the desired channel. These upper adjacent channel pairs are typically N+1/N+2, N+2/N+4, N+3/N+6, etc. The same is true for the equivalent lower adjacent channel pairs as well. Therefore, MTVA believes that some kind of reasonable requirements should be put on these D/A converters. However, reasonable interference values are not yet known at this time, but should be investigated (with lab testing) in the near future recognizing current tuner technology.

Table 2 DTV-into-DTV Interference Tests

Specific Lab Tests	Conditions	A/74	MTVA	Units	Ref
Co-Channel	Minimum D/U ratio @ -68 dBm	15.5	15.5	dB	A 4.4.1
Co-Channel	Minimum D/U ratio @ -53 dBm	15.5	15.5	dB	A 4.4.1
Adjacent Channel D±1	Minimum D/U ratio @ -68 dBm	-33	-33	dB	A 4.4.2
Adjacent Channel D±1	Minimum D/U ratio @ -53 dBm	-33	-33	dB	A 4.4.2
Adjacent Channel D±1	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel D±2	Minimum D/U ratio @ -68 dBm	-44	-44	dB	A 4.4.2
Adjacent Channel D±2	Minimum D/U ratio @ -53 dBm	-40	-44	dB	A 4.4.2
Adjacent Channel D±2	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel D±3	Minimum D/U ratio @ -68 dBm	-48	-48	dB	A 4.4.2
Adjacent Channel D±3	Minimum D/U ratio @ -53 dBm	-40	-45	dB	A 4.4.2
Adjacent Channel D±3	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel D±4	Minimum D/U ratio @ -68 dBm	-52	-52	dB	A 4.4.2
Adjacent Channel D±4	Minimum D/U ratio @ -53 dBm	-40	-45	dB	A 4.4.2
Adjacent Channel D±4	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel D±5	Minimum D/U ratio @ -68 dBm	-56	-56	dB	A 4.4.2
Adjacent Channel D±5	Minimum D/U ratio @ -53 dBm	-42	-45	dB	A 4.4.2
Adjacent Channel D±5	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel D±6 through D±13	Minimum D/U ratio @ -68 dBm	-57	-57	dB	A 4.4.2
Adjacent Channel D±6 through D±13	Minimum D/U ratio @ -53 dBm	-45	-45	dB	A 4.4.2
Adjacent Channel D±6 through D±13	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel D±14 or D±15	Minimum D/U ratio @ -68 dBm	-50	-50	dB	A 4.4.2
Adjacent Channel D±14 or D±15	Minimum D/U ratio @ -53 dBm	-45	-45	dB	A 4.4.2
Adjacent Channel D±14 or D±15	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2

Table 3 NTSC-into-DTV Interference Parameters

Specific Lab Tests	Conditions	A/74	MTVA	Units	Ref
Co-Channel	Minimum D/U ratio @ -68 dBm	+2.5	+2.5	dB	A 4.4.1
Co-Channel	Minimum D/U ratio @ -53 dBm	+2.5	+2.5	dB	A 4.4.1
Adjacent Channel N±1	Minimum D/U ratio @ -68 dBm	-40	-48	dB	A 4.4.2
Adjacent Channel N±1	Minimum D/U ratio @ -53 dBm	-35	-45	dB	A 4.4.2
Adjacent Channel N±1	Minimum D/U ratio @ -28 dBm	-26	-26	dB	A 4.4.2
Adjacent Channel N±2	Minimum D/U ratio @ -68 dBm	-44	-48	dB	A 4.4.2
Adjacent Channel N±2	Minimum D/U ratio @ -53 dBm	-40	-45	dB	A 4.4.2
Adjacent Channel N±2	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel N±3	Minimum D/U ratio @ -68 dBm	-48	-48	dB	A 4.4.2
Adjacent Channel N±3	Minimum D/U ratio @ -53 dBm	-40	-45	dB	A 4.4.2
Adjacent Channel N±3	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel N±4	Minimum D/U ratio @ -68 dBm	-52	-52	dB	A 4.4.2
Adjacent Channel N±4	Minimum D/U ratio @ -53 dBm	-40	-45	dB	A 4.4.2
Adjacent Channel N±4	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel N±5	Minimum D/U ratio @ -68 dBm	-56	-56	dB	A 4.4.2
Adjacent Channel N±5	Minimum D/U ratio @ -53 dBm	-42	-45	dB	A 4.4.2
Adjacent Channel N±5	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel N±6 through N±13	Minimum D/U ratio @ -68 dBm	-57	-57	dB	A 4.4.2
Adjacent Channel N±6 through N±13	Minimum D/U ratio @ -53 dBm	-45	--45	dB	A 4.4.2
Adjacent Channel N±6 through N±13	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2
Adjacent Channel N±14 or N±15	Minimum D/U ratio @ -68 dBm	-50	-50	dB	A 4.4.2
Adjacent Channel N±14 or N±15	Minimum D/U ratio @ -53 dBm	-45	-45	dB	A 4.4.2
Adjacent Channel N±14 or N±15	Minimum D/U ratio @ -28 dBm	-20	-20	dB	A 4.4.2

Table 4 describes the recommended converter *noise impairment* performance parameters. Interestingly enough, A/74 does not include a white noise threshold of video errors (TOV). However, MTVA believes this is important and has selected a value of 15.5 dB, which is in line with both the GA prototype test results as well as the FCC's recent testing of 28 consumer DTV sets in their OET laboratory in Columbia MD. The recommended bursted white noise parameter stated in A/74 (165 usecs), which reflects performance in impulse noise conditions, is worse than

that obtained with the GA prototype receiver (180 usec), and MTVA recommends that it should be more in line with what was tested at ATTC laboratories in 1995. Likewise, the recommended phase noise parameter (-80 dBc/Hz) in A/74 is worse than GA prototype test results and, therefore, MTVA recommends a value of -78 dBc/Hz.

Table 4 Noise Impairment Parameters

Specific Lab Tests	Conditions	A/74	MTVA	Units	Ref
White Noise SNR(TOV)	Single unimpaired ATSC signal Signal Level: -53 dBm/6 MHz Noise in 6 MHz BW	None	15.5	dB	ATTC
Bursted White Noise Duration	Added white noise (5 dB SNR) Variable noise burst intervals Repetition Rate: 10 Hz	165	180	usecs	A 4.4.4
Phase Noise Threshold	FM-modulated (white noise) carrier Sideband energy @ 20 kHz offset Signal Level: -53 dBm/6 MHz	-80	-78	dBc/Hz	A 4.3

Table 5 describes the recommended converter *laboratory-generated multipath* performance parameters. These are some of the more difficult performance parameters to define in terms of real world modeling, and it is even more difficult to recommend a value for each performance parameter. ATSC A/74 has a number of recommendations for multipath *tests,* both laboratory-generated and field-captured. However, A/74 has *few* recommended performance *values,* leaving many of the parameter performance limits up to individual DTV receiver manufacturers. Many people desire manufacturers to produce an "A/74 compliant" receiver, but this is not possible since a set of recommended performance values must be determined for these "missing" performance values. The goal of these performance criteria is to verify that the new D/A converters have at least 5G multipath performance, if not better, when they appear in 2008.

The tests described below are from the A/74 document, or they are referenced to the original ATTC laboratory testing of the GA receiver prototype, or the testing performed by Canadian

Research Center (CRC) in Canada. Whenever possible, values are selected based on some of the fifth generation (5G) VSB prototype receivers that CRC has tested and published the test results.

While A/74 recommends a minimum of -10 usecs to +40 usecs equalization range, current 5G technology allows a symmetrical range of more than ±40 usec to be implemented. MTVA recommends that this extended pre-echo range be included in the NTIA converter boxes. This provides much improved indoor reception in large urban areas (e.g. downtown areas with large high rises) as well as better performance in future distributed transmission systems (DTS).

The test of carrier recovery (when multipath reduces the pilot level compared to the rest of the spectrum) is required to make sure that carrier recovery is robust enough for indoor urban reception. MTVA recommends that an 80% amplitude, negative-phase echo be cancelable in NTIA compliant converter boxes.

The quasi-static single-echo cancellation profile illustrated in A/74 (Figure 4-3 in the A/74 document) provides a set of echo amplitudes versus echo delay. MTVA agrees with these values. Likewise, a minimum set of equalizer performance parameters for the Doppler speed of these same echoes would be beneficial for handling dynamic echoes. However, MTVA believes that a set of reasonable dynamic echo performance values (amplitude and speed) needs to be determined in the near future from laboratory testing of the current 5G receivers.

Document A/74 recommends a dynamic single echo (Test R.1) that represents a “bobbing” echo, that is, a single echo whose *amplitude* slowly increases and decreases. This time-varying echo

amplitude is created by using two echoes with the same delay, but using a slow Doppler frequency shift on one of them to create the amplitude variance. If the amplitude of the bobbing echo increases enough, the primary path and the echo path may reverse roles. This is a very difficult situation for the equalizer to handle error-free. MTVA recommends that a -7 dB or greater echo, which will approach the 100% echo amplitude point and then beyond, should be cancelable by the D/A converter boxes.

To stress the equalizers and verify that they have at least 5G performance, three static ensembles of echoes are used just as in past CRC laboratory tests. These are referred to as "Brazil Ensembles B, C, and D." Not only should the D/A converter box provide error-free video and audio for these ensembles, MTVA recommends that it should do so with a minimum amount of equalizer noise enhancement, i.e., at an SNR of 18 dB or less. While this last test determines the amount of noise enhancement, the CRC-modified Brazil Ensembles C & D provide information on the cancellation capability for the largest quasi-static amplitude echo (i.e., at all phases) in an already severe ensemble (but with minimal added white noise). The largest echo should be greater than 1.5 dBc amplitude. MTVA believes that most (perhaps all) 4G DTV receivers will not pass these tests while 5G receivers should easily handle it.

Again, to stress the equalizers and verify that they have 5G performance, two types of dynamic ensemble multipath tests are performed as described in A/74. The first two ensembles (described in Test R2.1) are "CRC Dynamic Ensembles" where one Doppler-generated echo has its amplitude increased until TOV is reached. The second two ensembles (described in Test R2.2) are "CRC Modified Ensembles" where one Doppler-generated echo with fixed amplitude has

noise added until TOV is reached. These dynamic tests are similar to the previously described static ensembles where a maximum echo or a minimum SNR values were determined. MTVA recommends that the values in Table 5 for all four of these ensembles, which have been selected based on past laboratory tests of 5G prototypes performed at the CRC, be cancelable by the NTIA compliant converter boxes.

Finally, another "bobbing" echo test can be performed (Special CRC-modified Brazil C Ensemble) to find the minimum noise enhancement (i.e., the minimum SNR at TOV), except this time the bobbing echo is part of a severe ensemble. Again, while this test is not part of the A/74 document, a performance parameter value was selected from past CRC laboratory tests of 5G receivers. MTVA recommends that converter boxes be able to handle these multipath conditions.

Table 5 Simulated Multipath Impairment Parameters

Specific Lab Tests	Conditions	A/74	MTVA	Units	Ref
Multipath Cancellation Range	Post-echo Equalizer **Delay Range** Amplitude: 10 dBc	-10	-40	usec	A 4.5.3.1.1
Multipath Cancellation Rang	Pre-echo Equalizer **Delay Range**	+40	+40	usec	A 4.5.3.1.1
Single Negative Echo affecting Pilot	Maximum single **Echo Level** Phase: 180 deg Null falling on pilot	None	-2	dBc	CRC,
Single Quasi-*Static* Echo Profile (Pre- & Post-Echo)	Maximum single **Echo Level** Doppler: 0.2 Hz Delay: - 0.2, - 2, - 8, - 15, - 30, - 40 usec Delay: +0.2, +2, +8, +15, +30, +40 usec	Chart	Chart	dBc	A 4.5.3.1.2
Single *Dynamic* Multipath (**R.1** "Bobbing")	Maximum single **Echo Level** Doppler: 0.5 Hz and 2 Hz Delay : 0.2, 1, 2 usec C/N: 25 dB	None	< 7	dBc	A 4.5.3.2
Ensemble *Static* Echo Multipath	Minimum **SNR** Brazil Ensembles B, C & D	None	< 18	dB	CRC
Ensemble *Quasi-Static* Echo Multipath	Maximum **Echo** CRC-modified Brazil Ensembles C & D C/N: 25 dB SNR	None	< 1.5	dB	CRC
Ensemble *Dynamic* Echo Multipath (**R2.1)**	Maximum **Echo level** Dynamic CRC-3 & 4 Ensemble C/N: 25 dB Doppler: 1 Hz Doppler: 5 Hz	None	 < 1.5 < 3.0	 dBc dBc	A 4.5.3.3
Ensemble *Dynamic* Echo Multipath (**R2.2)**	Minimum **SNR** Modified CRC-1,2,&3 Ensemble Doppler: 1 Hz Doppler: 5 Hz	< 18	 < 18 <21	 dB dB	A 4.5.3.3
Ensemble *Dynamic* Echo Multipath ("**Bobbing**")	Minimum **SNR** Special CRC-modified Brazil C Ensemble	None	< 16.5	dB	CRC

Table 6 describes the recommended converter *real-world multipath* performance parameters. These are not traditional recommended performance parameters that are determined from lab-generated echoes, but rather they are RF data captures from real-world environments. The ATSC offers 50 RF data captures, each capture lasting about 25 seconds, as a means for receiver manufacturers to design, simulate, and then laboratory test prototypes receivers. These ATSC RF field captures**,** obtained from both Washington DC and New York City, provide as realistic multipath field conditions as possible in the laboratory, yet in a reasonably *controllable* and *repeatable* fashion.

While 50 ATSC captures exist, not all of them were captured cleanly. Therefore, a subset of 21 of these captures was selected. These were carefully selected for laboratory testing a *subset* of the 50 ATSC RF data captures that included one relatively benign (i.e., reasonably "clean") capture used as a reference plus 20 "challenging" captures with varying levels of propagation severity (e.g., moderate, difficult, very difficult, and ultra difficult). Both indoor (6' AGL) and outdoor (30' AGL) test site captures were selected as well as captures from test sites varying in distance from 2 miles to 48 miles. Also, a variety of UHF DTV channels were captured on several different UHF receive antennas in the subset of selected data captures. *None* of the selected field ensembles recommended for laboratory testing had dropped symbols (DS), front-end non-linearities (NL), or a lack of video (NV). Therefore, the following RF data captures should have an opportunity of being fully decoded by a DTV receiver (ignoring the expected file wrap-around errors). The table progresses from the less severe at the top to more severe at the bottom (even within each subcategory of impairment descriptions).

MTVA recommends that the new D/A converters should be able to decode a vast majority of these 20 captures (in addition to the reference file). Acceptable reception should be deemed as having three or less "hits" (i.e., short video "breakups) for every capture file. A reasonable result to all these tests is to require the D/A converters to pass at least 18 of the 20 challenging test files in order to verify that the converters have at least 5G performance (most 4G receivers will *not* pass a majority of these captures).

Table 6 Field-Captured Multipath Impairment Parameters

File #	Data Capture Filename	Signal Description	Rx Antenna	Distance From Tx	A/74	MTVA	Units	Ref
19	WAS_23_34_06072000_OPT	Reference	Indoor, DBT	16.7 miles	None	= 3	"hits"	4.5.2
25	WAS_311_36_06052000_OPT	Moderate	Outdoor, LP	4.7 miles	None	= 3	"hits"	4.5.2
08	NYC_200_44_10272000_YAGI1	Moderate	Indoor, Y	2.0 miles	None	= 3	"hits"	4.5.2
45	WAS_81_36_06192000_OPT	Moderate	Indoor, DBT	9.6 miles	None	= 3	"hits"	4.5.2
14	NYC_200_56_10272000_MEGA1	Moderate	Indoor, M	2.0 miles	None	= 3	"hits"	4.5.2
43	WAS_75_39_06162000_OPT	Moderate	Indoor, DBT	10.5 miles	None	= 3	"hits"	4.5.2
03	NYC_200_44_102720_MEGA1	Difficult	Indoor, M	2.0 miles	None	= 3	"hits"	4.5.2
15	NYC_200_56_102720_RAB1	Difficult	Indoor, RAB	2.0 miles	None	= 3	"hits"	4.5.2
21	WAS_3_27_06022000_REF	Difficult	Outdoor, LP	48.4 miles	None	= 3	"hits"	4.5.2
18	WAS_06_34_06092000_REF	Difficult	Outdoor, LP	10.8 miles	None	= 3	"hits"	4.5.2
38	WAS_51_35_05242000_REF	Difficult	Outdoor, LP	20.3 miles	None	= 3	"hits"	4.5.2
31	WAS_34_48_06082000_OPT	Very Difficult	Indoor, DBT	9.6 miles	None	= 3	"hits"	4.5.2
27	WAS_311_48_06052000_REF	Very Difficult	Outdoor, LP	3.9 miles	None	= 3	"hits"	4.5.2
9	NYC_200_56_10272000_BWT1	Very Difficult	Indoor, BT	2.0 miles	None	= 3	"hits"	4.5.2
12	NYC_200_56_10272000_DSEN2	Very Difficult	Indoor, DSS	2.0 miles	None	= 3	"hits"	4.5.2
50	WAS_86_48_07122000_OPT	Very Difficult	Outdoor, LP	34.4 miles	None	= 3	"hits"	4.5.2
16	NYC_200_56_10272000_SSEN1	Ultra Difficult	Indoor, SS	2.0 miles	None	= 3	"hits"	4.5.2
39	WAS_63_34_06122000_OPT	Ultra Difficult	Indoor, DBT	12.7 miles	None	= 3	"hits"	4.5.2
20	WAS_23_48_06072000_OPT	Ultra Difficult	Indoor, DBT	15.5 miles	None	= 3	"hits"	4.5.2
41	WAS_75_35_06162000_OPT	Ultra Difficult	Indoor, DBT	10.0 miles	None	= 3	"hits"	4.5.2
02	NYC_200_44_10272000_LOOP1	Ultra Difficult	Indoor, L	2.0 miles	None	= 3	"hits"	4.5.2

Consumer Education

As noted in the NPRM, consumer education and the dissemination of information about the coupon program is critical to the success of the program. Given the extremely limited funds with which to conduct the education program, MTVA suggests that NTIA target those education efforts to households that rely exclusively on free over-the-air television service. Of course, the best way to reach these households is the very broadcast television stations that they watch on a regular basis. MTVA believes that an important component to any education effort will be

advertisements and public service announcements, as well as public information programs (such as the weekly public service programs that many stations produce locally) on local television stations. Broadcasters and Retailers have a vested interest in the successful dissemination of information regarding the program, and the NTIA may want to consider a Strategic Alliance or Partnership that provides mutual benefits to NTIA, broadcasters, and retailers. Such Alliances may include contribution of air-time by broadcasters in conjunction with promotions or other efforts by retailers with support from NTIA. The HD-Radio Alliance for the promotion of the new HD-Radio services may provide a suitable model for such a partnership.

Retailer Education

Given the importance of consumer education for the program, we note that many consumers rely upon their local electronics retailer to provide information about products and services. Educational programs that target consumers are important but NTIA should also target training programs for employees of electronics retailers. Specific information about the coupon program, household eligibility, application procedures, as well as eligible converter boxes, will likely be questions asked by consumers of their local electronics retailer. NTIA should develop educational efforts targeted specifically towards the retailers to ensure that the program is understood and to encourage participation by retailers in the program. Key program concepts and information can be provided in a variety of ways, including on-line web based information, educational seminars, and other efforts should be part of the comprehensive education program adopted by NTIA. Electronics retailers will play a large role in the guidance of consumers' choices of products and, therefore, they should not be left uninformed or misinformed about the program.

Conclusion

For these reasons, the NTIA should promulgate Digital-To-Analog Converter Box Coupon Program rules in accordance with the suggestions discussed above.

Respectfully submitted,

/s/

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September 25, 2006