

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

In the Matter of)	
)	
Unlicensed Operation in the TV Broadcast Bands)	ET Docket No. 04-186
)	
Additional Spectrum for Unlicensed Devices)	ET Docket No. 02-380
Below 900 MHz and in the 3 GHz Band)	

**COMMENTS OF THE
NATIONAL CABLE & TELECOMMUNICATIONS ASSOCIATION**

The National Cable & Telecommunications Association (“NCTA”), by its attorneys, submits the following comments on the introduction of unlicensed devices in the TV broadcast bands. NCTA is the principal trade association of the cable television industry. Its members provide video programming, broadband Internet, wireline phone, and other services throughout the United States. NCTA also represents programmers and suppliers of equipment to the cable television industry.

INTRODUCTION

The Commission’s Office of Engineering and Technology recently released two technical reports on initial studies conducted by its Laboratory on the operation of new devices in the TV broadcast spectrum in so-called “white spaces,” the areas where individual frequencies are not being used for broadcast services. The reports, which are entitled “Initial Evaluation of the Performance of Prototype TV-Band White Space Devices” (“Prototype Devices Report”) and “Direct-Pickup Interference Tests of Three Consumer Digital Cable Television Receivers Available in 2005” (“Direct Pickup Report”), validate the concerns expressed by the cable industry and other parties regarding the substantial risks of wide-scale interference from

unlicensed devices and the inadequacy of the signal sensing detection mechanism incorporated in prototype devices.

In previous filings in this proceeding, NCTA demonstrated the unique interference concerns of cable operators whose systems have no “white spaces,” *i.e.*, all channels in the broadcast TV band are used for the delivery of programming and other services to cable customers.¹ In particular, a technical paper by David Large Consultants, Inc. submitted by NCTA showed that television receivers and VCRs directly connected to cable systems are highly susceptible to “direct pickup” (“DPU”) interference from unlicensed devices operating in close proximity because of inadequate shielding in TV receivers. To address this concern, NCTA urged the Commission to limit the power output of new personal/portable devices to a range of 10-20 mW and prohibit their operation on channels 2 - 4 in order to preserve cable’s ability to cure any interference that occurs through the use of a well-shielded set top converter. The Laboratory test results show that rigorous testing even at a 5 mW output power level is warranted.

In addition, NCTA has expressed concern that the Commission’s emphasis on protecting a defined area around a broadcast transmitter does not address potential interference to cable headend antenna reception. Many cable systems receive distant broadcast signals beyond the protected Grade B contour and many of these signals have “must carry” status under the Commission’s rules. Therefore, we urged the Commission to not only restrict operation of personal/portable devices within the Grade B contour but require spectrum coordination before

¹ See Comments of NCTA, ET Docket No. 04-186 (filed April 30, 2007); Reply Comments of NCTA, ET Docket Nos. 04-186, 02-380 (filed March 2, 2007); Comments of NCTA, ET Docket Nos. 04-186, 02-380 (filed Jan. 31, 2007); NCTA Ex Parte, ET Docket Nos. 04-186, 02-380 (filed Oct. 5, 2006); Comments of NCTA, ET Docket Nos. 04-186, 02-380 (filed Nov. 30, 2004).

any unlicensed devices (fixed or portable) are permitted to operate outside the Grade B boundary.

NCTA also demonstrated that an interference-avoidance mechanism, such as signal sensing in the device, is highly imprecise and alone will not protect authorized services in the TV band from harmful interference. The signal sensing approach only shows promise if it were to be joined with some type of reliable geolocation/database technique.

As discussed below, the Laboratory's measurements confirm NCTA's technical analysis with respect to the potential for direct pickup interference to cable system operations. The measurements also confirm that signal sensing alone is insufficient to avoid interference.

DISCUSSION

Direct Pickup Interference

The Commission's "Direct Pickup Report" tests aimed to "identify the susceptibility of cable TV reception by a digital cable TV receiver connected directly to the cable TV system (without the use of a set-top box) to interference from devices that might operate within the TV broadcast spectrum on locally unused broadcast channels (TV white spaces) that overlap the frequencies of channels used by the cable TV system."² The Laboratory tested three digital LCD flat panel cable ready sets from three different manufacturers built in 2005. Each set's built-in QAM tuner was used to test unencrypted "clear QAM" channels over a live Verizon FIOS cable plant.

As described in the attached paper by David Large Consultants Inc., the Commission's direct pickup interference tests "correlate closely" with the predictions made in Large's technical

² Direct Pickup Report at iii.

analysis submitted with NCTA's Reply Comments in this proceeding filed in March 2007.³

Large's report concluded that a 100 mW (+20 dBm) unlicensed device equipped with a 0 dBi antenna would likely generate unacceptable interference levels in receivers in adjacent apartments with transmitter-to-receiver spacing as large as 70 feet. He further states:

If those calculations are extrapolated to the 10 meter (about 33 feet) spacing used in the FCC tests, the predicted unlicensed device power level that would cause interference is about +14 dBm. This matches closely the FCC's reported minimum transmission power level of +15.4 dBm (interior wall) or +15.3 (exterior wall), especially given a number of factors that likely result in allowing higher transmitter power in the FCC's test methodology. Those discrepancies are discussed below. If +6 dBi antennas had been allowed on the unlicensed transmitters, the transmit power level could not have exceeded +9.3 dBm without causing interference in these preliminary tests.⁴

This shows that direct pick up interference as measured by the FCC Laboratory is as great, if not greater, than the potential interference identified in the Large study. The three tested televisions went black at levels far below what the Commission proposed in its Notice of Proposed Rulemaking. The Direct Pickup Report establishes without a doubt that a 100 mW output power level will cause harmful interference to television viewing on cable systems and is therefore not a viable option for unlicensed TV band devices. Indeed, the test results show that unlicensed TV band devices operating as low as "6.3 dBm can cause interference to cable DTV reception at a distance of 2 meters."⁵

³ "Analysis of the FCC Laboratory's Report on Direct Pickup Interference Testing," David Large Consultants, Inc. ("Large Supplemental Paper"); Reply Comments of the National Cable & Telecommunications Association, ET Docket Nos. 04-186, 02-380, submitted March 2, 2007, n. 2 (using 0 dBi unlicensed device antenna gain and scaled to the distances used in the FCC tests). *See also* "The Potential Adverse Effects of Unlicensed Operation of New Devices in TV Broadcast Bands on Cable Customers' Reception of Cable Service," David Large Consultants, Inc. ("Large Paper"), Appendix I.

⁴ Large Supplemental Paper, attached at 1.

⁵ Direct Pickup Report at iii.

Moreover, the Commission recognizes that while “the tests provide an empirical demonstration of the potential for [direct pick up] interference at relatively low power levels” and are “a useful input to the decision process,”⁶ more rigorous testing is needed before these devices are permitted to operate on an unlicensed basis even at a 10 mW level, as suggested by NCTA and others in this proceeding. In particular, the report states that in light of the “limited scope of the tests (three TV sets, one cable-TV channel, and two primary test sites), the results are not intended to constitute a complete basis for defining criteria necessary to protect cable TV viewers from interference by devices operating in the TV white spaces.”⁷

In an effort to assist the Commission in defining criteria and policies to adequately protect cable customers from direct pickup interference in the event new prototype devices are put forth for testing, we have attached the recommendations of David Large Consultants for the development of any future tests. Large addresses such areas as the elevated level of desired signal, unknown quality of desired signal, lack of well-defined interference threshold, limited azimuth angle testing and interior wall structure of higher attenuation. We believe that it is critical for the Laboratory to take these areas into account as part of a full assessment of potential interference from any new devices.

Interference-Avoidance Methodology: Signal Sensing

As noted above, NCTA showed in its comments in this proceeding that detection methods, such as signal sensing, would be inadequate in ensuring interference-free operation of TV band devices, unless combined with some type of geo-location database system. As explained by Large, the wide variability of signal transmission, combined with lower signal levels in fringe areas – which would require extreme device sensitivity – make signal sensing a

⁶ *Id.*

⁷ *Id.*

poor technology for determining available spectrum for unlicensed device transmission.⁸ Again, the Commission's test results corroborated cable's concerns, as illustrated in the attached analysis.

The Laboratory tested two prototypes using actual DTV signals from broadcast stations for their ability to correctly identify available channels to transmit on and ability to correctly identify available frequencies when Part 74 wireless microphones were present. One of the devices (the only one capable of transmitting) was further tested for interference against a television set using an indoor antenna tuned to an available DTV channel. The report found the following:

Prototype "A" was not able to detect DTV signals at the Commission's required -116dBm/6MHz level on any of the tested channels. Further it was not able to detect these signals at the higher -114dBm level suggested by the manufacturer. Prototype "A" was able to detect DTV signals at the higher levels of -95dBm. The device often reports a channel to be available or vacant when a broadcast signal is present.

Prototype "B" performed better in that it could reliably detect DTV signals at -115dBm in single channel tests and at -114dBm in two-channel tests. But Prototype "B's" sensing performance "declines very rapidly" as signal levels are reduced.⁹

The Prototype Devices Report found that the devices "do not consistently sense or detect TV broadcast or wireless microphone signals."¹⁰ One of the prototype devices failed to sense operating TV signals 40% to 75% of the time. The performance of the other device, which was not tested outside the lab, "declined rapidly" as signals got weaker.¹¹

⁸ Section 3.3 of the Large Paper, appended to NCTA Comments in this proceeding, submitted January 31, 2007.

⁹ Prototype Devices Report at vii and viii.

¹⁰ *Id.* at page x.

¹¹ *Id.* at page viii.

NCTA also would like to point out that even if manufacturers succeed in producing devices that can reliably detect TV broadcast signals, there is no assurance that the -116 dBm level will be sufficiently low to protect reception at fringe-area cable system headends. As pointed out in the Large report, “cable’s antennas might be located hundreds of feet in the air while the off-air signal is virtually undetectable near the ground.”¹² Absent actual measurements at specific cable reception sites, there can be no assurance that -116dBm is a sufficiently low threshold to avoid harmful interference that would result in loss of signals to entire communities served by these headends. It is for this reason that signal sensing is only useful if combined with an auto-location capability and database lookup where the database includes protection areas around cable operators’ reception sites.

Wireless Microphones

Another area of concern to the cable industry is interference to wireless microphones if unlicensed devices with high output power are permitted to operate in the TV broadcast bands.¹³ Wireless microphones are used extensively by cable programmers in electronic newsgathering and coverage of live sports and entertainment productions. Low-powered wireless microphones are essential to television journalists covering breaking news events, particularly on-the-scene coverage of emergency situations. And they are ubiquitous tools for the distribution of audio in all major sports and entertainment events in large venues.

The Laboratory conducted wireless microphone testing on both prototype devices and they performed dismally.¹⁴ Prototype “A” was unable to detect wireless microphone signals and often incorrectly categorized the signals as DTV transmissions. Prototype “A” was tested in

¹² Section 1.2 of Large Paper, appended to the NCTA Comments in this proceeding, submitted January 31, 2007.

¹³ See NCTA Reply Comments; NCTA ex parte letter in ET Docket No. 04-186, ET Docket No. 02-380, filed Oct. 4, 2006.

¹⁴ Prototype Devices Report at iii.

“moderate” test conditions and due to its poor performance, no more stringent tests were performed. Prototype “B” had mixed results. It correctly sensed microphone transmissions in all scans in the center of a TV channel as low as -120dBm but it incorrectly identified some scans as channel 24, and at the -36.6dBm level incorrectly sensed wireless microphone signals on six additional channels.

In other words, wireless microphones operating in conjunction with unlicensed TV band devices, as currently proposed, would be rendered useless. Given this fact, any future prototypes put forth by manufacturers should undergo extensive and rigorous testing to ensure that adequate measures are in place to protect the functionality of this vital technology before TV band devices are authorized.

Technical and Operational Parameters

NCTA has put forth specific details technical and operational steps that we believe the Commission should take to ensure that unlicensed TV band devices do not interfere with cable’s delivery of high quality programming and services to its customers. However, in light of the Laboratory’s test results, a 10-20 mW output power level is not sustainable and, as noted above, even a 5 mW device is questionable depending upon the distance between an unlicensed TV band device and the DTV receiver.

In addition, we endorse two aspects of the technical and operational parameters of the proposed devices put forth by a coalition of manufacturers in this proceeding: making the transmit/receive antenna an omni-antenna with a maximum of 0 dBi gain and precluding the device from operating in channels 2 through 20 and channel 37.¹⁵ These parameters are helpful to the goal of avoiding interference.

¹⁵ Reply Comments of Dell, Inc., Google, Inc., The Hewlett-Packard Co., Intel Corp., Microsoft Corp., and Philips Electronics North America Group, ET Docket Nos. 04-186, 02-380 (filed March 2, 2007).

CONCLUSION

The Commission's two "white spaces" reports validate the cable industry's interference concerns stemming from the proposed authorization of new unlicensed TV band devices. It is crucial, therefore, that the Commission conduct comprehensive lab and field tests on direct pick-up interference on any future prototype devices to ensure that adequate technical rules and other protective measures are instituted to avoid harmful interference to cable systems.

Respectfully submitted,

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ANALYSIS OF THE FCC LABORATORY'S REPORT ON DIRECT PICKUP INTERFERENCE TESTING

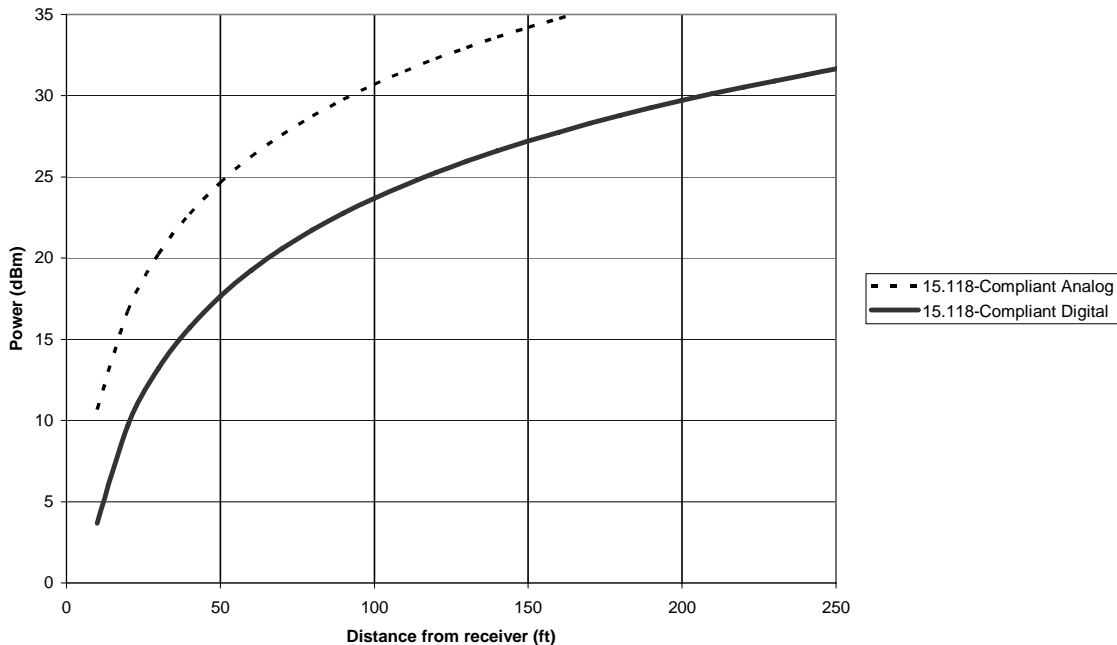
David Large Consultants, Inc.

August 9, 2007

The results reported by the FCC in their July 31, 2007 report entitled "Direct-Pickup Interference Tests of Three Consumer Digital Cable Television Receivers Available in 2005"¹ correlate closely with the predictions made in my earlier report which were summarized in the "Reply Comments of the National Cable & Telecommunications Association," filed with the Commission in March 2, 2007. Specifically, that report concluded that a 100 mW (+20 dBm) unlicensed device equipped with a 0 dBi antenna would likely generate unacceptable interference levels in receivers in adjacent apartments with transmitter-to-receiver spacing as large as 70 feet.

If those calculations are extrapolated to the 10 meter (about 33 feet) spacing used in the FCC tests, the predicted unlicensed device power level that would cause interference is about +14 dBm (see figure below). This matches closely the FCC's reported minimum transmission power level of +15.4 dBm (interior wall) or +15.3 (exterior wall), especially given a number of factors that likely resulted in allowing higher transmitter power in the FCC's test methodology. Those discrepancies are discussed below. If +6 dBi antennas had been allowed on the unlicensed transmitters, the transmit power level could not have exceeded +9.3 dBm without causing interference in these preliminary tests.

Transmit Power(dBm) vs Distance to Receiver for Maximum Tolerable DPU Reception Interference In Adjoining Apartment With One Intervening Wall w/0 dBi antenna



¹ OET Report FCC/OET 07-TR-1005

The authors of the FCC report recognize that:

Due to the limited scope of these tests (three TV sets, one cable-TV channel, and two primary test sites), the results are not intended to constitute a complete basis for defining criteria necessary to protect cable TV viewers from interference by devices operating in the TV white spaces. Nevertheless, the tests provide an empirical demonstration of the potential for such interference at relatively low power levels, and, as such, a useful input to the decision process.²

In the interest of providing guidance towards the development of more quantifiable results (and thus policies that will adequately protect television reception among cable subscribers), the following is a list of factors in the preliminary *in situ* tests that either resulted in uncertainty or influenced the FCC's test methodology:

A) Elevated level of desired signal.

In the FCC's tests, the level of the desired signal was set to -11 dBmV, whereas the Digital Cable Network Interface Standard (SCTE 40) allows the received level to be as low as -12 dBmV.³ This results in allowing interfering signal levels 1 dB higher for the same C/I ratio.

B) Unknown quality of desired signal

The FCC did not measure the quality of the desired signal as received from Verizon. This is essential, as the level of visual interference is determined by the ratio of the desired signal to the sum of noise and interference (C/(N+I)) from all sources, as well as the presence of other factors such as hum modulation, group delay variation, phase noise, in-channel amplitude variation, micro-reflections, and burst noise. The interference from the ingressing signal is added to whatever impairments are already present in the desired signal, as received from the multi-channel network operator. In essence, to the degree that the desired signal was "cleaner" than the maximum degradation allowed under SCTE 40, the interfering signal could be stronger for the same degree of interference. The unknown condition of the desired signal thus introduces a significant degree of uncertainty into the FCC's results.

C) Lack of well-defined interference threshold

In my calculations,⁴ I assumed typical end-of-line signal conditions, then allocated approximately half the operational margin between that signal quality and the minimum C/(N+I) of 33 dB (defined in Table B of SCTE 40) to the interfering signal. The result of this calculation was a defined maximum interfering signal level of -39 dBc at the receiver's detector input. By

² OET Report, page iii

³ SCTE 40, Table B

⁴ As detailed in paragraph 2.1.4 of "The Potential Adverse Effects of Unlicensed Operation of New Devices in TV Broadcast Bands on Cable Customer's Reception of Cable Service," David Large, appended to the *Comments of the National Cable & Telecommunications Association* in this matter and submitted to the FCC on January 31, 2007.

contrast, the FCC simply increased the interference until destructive interference occurred. Aside from the variation due to the unknown quality of the as-received signal, the results will also vary as a result of the varying “cliff” threshold of individual receivers. Thus, the FCC’s criterion does not retain an operational margin for the network operator, and varies in accordance with the characteristics of individual receivers, resulting in higher transmitter power and an additional degree of uncertainty in the results. I suggest that the Commission use methodology similar to that used in the Carl T. Jones study⁵ cited in my original report in order to eliminate these factors.

D) Limited azimuth angle testing

The FCC tested one receiver and determined that the sensitivity to interfering signals varied by at least 14.8 dB, depending on the azimuth of the interfering signals (with a constant transmitter antenna) height and over 17.7 dB when the transmitter antenna height was also varied. Despite this result, the remaining testing (on all receivers) was conducted with the interfering signal at only one or two azimuths – normal to the back of the set and sometimes normal to the front of the set.

By contrast, the Jones study previously cited found sensitivity variation as a function of azimuth to vary by more than 20 dB in some cases, with the azimuths of greatest sensitivity often at other angles than those tested by the FCC. Thus, to the degree that these tests did not measure sensitivity at the angles of greatest sensitivity, the results allow for higher unlicensed transmitter power.

D) Interior wall structure of higher attenuation

The interior wall through which interference was measured may have been appropriate for adjacent duplex units, but is not typical of those used between adjacent apartments in multiple dwelling units. Specifically, the wall through which the testing occurred had a heavy, metal-studded fire wall. As the FCC’s results show, the attenuation varied as the transmitter and receiver were moved horizontally along the wall. By contrast, apartment walls are often of simple wood construction, with additional sound isolation obtained by offset stud construction, insulation, additional layers of sheetrock, or similar methods which are unlikely to as severely attenuate the signal as the firewall used in the FCC’s tests. Thus, to the degree that the tested wall offered greater attenuation than a typical wall between adjacent apartments, the results allow higher unlicensed transmitter power.

E) Testing on a single UHF channel

The preliminary FCC tests were conducted only on CEA channel 70 (which overlaps over-air UHF broadcast channel 19). This may be appropriate if unlicensed device operation is restricted to UHF channels only. If, however, operation on VHF channels is allowed, then testing must

⁵ See In the Matter of Compatibility Between Cable Systems and Consumer Electronics Equipment, ET Docket No. 93-7, Comments of Joint Filers, CableLabs Report, “Customer Premises Equipment Performance and Compatibility Testing,” Section 3 (Carl T. Jones Corporation Study) (“Carl T. Jones Study”) attached as Appendix II to NCTA’s January 21, 2007 comments in ET Docket No. 04-186 and ET Docket No. 02-380.

also be conducted on those channels. The Jones study showed significant degradation in shielding effectiveness in most receivers at lower frequencies, and this would require a reduction in unlicensed device transmitter power for the same degree of reception interference.

F) Testing of a small sample of receivers of recent vintage, digital only

A related issue is that the FCC testing was restricted to three, relatively new, digital television receivers. Not only is this too small a sample to be statistically meaningful, these receivers are more likely to be compliant with the shielding requirements of C.F.R. 47 §15.118. In the field, however, receivers have a “half life” of at least 15 years, with the result that many cable subscribers are receiving signals on much older receivers. Secondarily, many cable operators will likely continue to provide analog television signals after the transition to all-digital over-air broadcasting to enable subscribers with NTSC receivers to continue to receive programming without the necessity of having a set-top converter or purchasing a new receiver. Thus, it would be prudent to expand the testing to include threshold of visibility (TOV) interference measurement for typical older analog receivers, as well as digital receivers.