BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION

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

TECHNICAL REPLY COMMENTS OF NEW AMERICA FOUNDATION

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Introduction

These Reply Comments are submitted to the Commission by New America Foundation and the expert parties listed on the first page (collectively "NAF, *et al.*"). The Appendix gives a brief summary of each of the parties signing these comments. NAF, *et al.* has participated in this proceeding since its formal initiation and prior to that recommended reallocating the TV band "white space" for unlicensed access in dialogue with FCC staff and in workshop testimony before the FCC Spectrum Policy Task Force that preceded the initial NPRM.

A great deal of the material in the comments to the FNPRM recycles concepts that have already been discussed repeatedly in this proceeding. However, it is interesting to note that two issues raised by the opponents of this proceeding have disappeared from this round of comments, apparently because they have been thoroughly rebutted. These are the allegations of interference due to TV band device signal ingress into poor indoor CATV cabling and the allegation that there is minimal "white space." In this latter matter, Charles L. Jackson and Dorothy Robyn (in their comments for Qualcomm, hereinafter the "Brattle/Qualcomm" comments) have made an extensive effort to quantify the available white space under various assumptions. Motorola has demonstrated that there would be so much white space in channels 14-to-20 that it could be a valuable resource for public safety communications – indeed, it should be a valuable resource for wireless communications and services more generally, even while protecting (during a reasonable transition period) the legacy public safety devices operating in 13 metro markets. While NAF, *et al.* disagrees with the policy conclusions of these last two pleadings, the arguments present show how bankrupt the initial pleadings of the opponents in this proceeding were.

In their filed comments, we note that the incumbent industry interests have mounted a concerted effort to exclude as many unused and under-utilized channels as possible from productive use by new services and devices. In aggregate, these incumbents would maintain the "vast wasteland" of spectrum inefficiency within the current TV band. It is imperative that the Commission consider the enormous social and economic opportunity costs of accommodating the unnecessarily restrictive (and spectrally inefficient) recommendations of NCTA, Motorola, Shure Inc., Qualcomm, and other self-interested spectrum incumbents. The general public interest in promoting wireless broadband ubiquity and other innovative uses of the airwaves is too great.

General Issues

First, we will explore three general issues that address points made by several of the commenting parties.

Performance-based standards and Technical Neutrality

A recurring theme among the opponents of this rulemaking is that technology *X* will never work and therefore the Commission should not authorize anything related to it. Another is that entire bands of grossly underutilized spectrum (e.g., VHF channels, adjacent channels, and co-channels) should continue to be warehoused and wasted

because of fears that today's technology might not adequately protect a dwindling number of TV receivers, or other types of legacy devices, from harmful interference. By contrast, NAF, *et al.* urges the Commission to set performance goals consistent with the need to protect licensed users from interference based on long standing precedents. We believe the Commission should simply define objective criteria for measuring harmful interference, and for detecting and avoiding use of a licensed frequency, and then allow technology and industry to evolve to meet this challenge through the FCC's traditional device certification process.

Can DTV detection at, say, -114 dBm be made to work in a consumer device? At what power level can an efficient transmission mask allow an unlicensed device to operate on an unused DTV channel without causing harmful interference to DTV reception on the first or second adjacent channel? These are fascinating questions, but *not* the right policy questions here. They are certainly not questions the Commission should strive to resolve now for all time. While the opponents may be well-intentioned in trying to prevent multibillion-dollar corporations such as Microsoft and Google from spending R&D resources to develop innovative technology, a better government role is to say "how high the bar is" and tell such corporations they can sell products if they can "get over the bar." The "bar" should be set high enough to prevent harmful interference, and the challenge to show feasibility left to the proponents.

All parties in this proceeding agree that initial equipment should not be sold until the FCC's Laboratory has verified compliance. Perhaps such equipment can be submitted in 2008 per the Commission's schedule; perhaps not. But that should be up to the developers to achieve—not to self-interested opponents to reject out of hand using questionable feasibility arguments.

Repeatedly, the opponents of this proceeding have challenged the geolocate/database option, saying that GPS does not work indoors. Of course, this ignores the inconvenient fact that a significant fraction of today's cellphones comply with the Commission's E911 rules by using Assisted GPS. Thus, it was refreshing to see that the very same Communications Research Centre Canada (CRCC) that the Association for Maximum Service Television (MSTV) hired as an expert to draft an attachment to their pleading has recently filed comments in this proceeding *pro se,* stating that they have developed a new geolocation system based on DTV signals with known transmitter locations that is capable of working both indoors and outdoors. CRCC states:

> The technique described in this paper will work as well indoor or outdoor. An effective geo-location technique implementation is critical to the development of the simple rules to prevent unlicensed devices from interfering with the general public enjoyment of television broadcast stations.[1]

Again, NAF, *et al.* believes that the Commission should set the standards for TV band devices strictly to prevent interference, but framed in such a way to give designers a "bottom line" to meet rather than multiple implementation limits. Thus, for example,

[1] Comments of Communications Research Centre Canada, Docket 04-186, at p. 9.

there is no need to set a specific accuracy limit for geolocation if the TV band device must add a safety factor to the protection distance from the TV transmitter to compensate for the accuracy of the geolocation technology used. The primary issue concerning geolocation is not whether it can work reliably – of course it can, if not now then soon – but whether it should be elevated over other potential technologies that can both prevent harmful interference *and* that can be deployed at lower cost and/or to support competing business models (distributed sensing/DFS would be a primary example of such a superior and perhaps even more reliable technology). The Commission should not engage in industrial policy by anointing one particular technology or standard over others.

Misuse of Free Space Propagation Models

We commend the Commission for doing its own testing, since so many of the technical claims of incumbent licensees (and their proxies) are so patently unfounded or based on manipulated, hypothetical and worst-case scenarios. In the record of this proceeding, there are allegations of interference from TV band devices to TV receivers as much as 270 miles away! What is the root cause of such unrealistic predictions (which are reminiscent of the claims of homeopathic pharmaceutical manufacturers that their products do something even when they don't contain a single molecule of active ingredient)?

The concept of free space propagation applies to light and other electromagnetic waves going in direct paths with good clearance.[2] It applies to satellite uplinks and downlinks when antennas with high gain/focus are used. It approximately applies to terrestrial microwave when high gain/focused antennas are used. However, its applicability to low gain terrestrial systems in which one or both of the antennas are close to the ground is simply unrealistic. A standard engineering reference states:

> Frequencies above 50 MHz allow for line-of-sight space wave propagation ("free space" in this discussion), FM radio and TV channels, radar and navigation systems, and so on. In this band, due consideration must be given to reflection from the ground, refraction by the troposphere, scattering by atmospheric hydrometeors, and **multipath** effects of buildings, hills, trees, etc.[3]

In an exhibit of MSTV/NAB's comments, there is even a claim that free space propagation could apply to terrestrial signals at a distance of 607 miles or 976 km.[4] If this modeling was applied to all unlicensed devices that shared spectrum with licensed or Federal Government systems, there would be no possible interference-free sharing! Yet millions of unlicensed devices, including meshed WiFi networks and cordless phones, already share the 900 MHz unlicensed band. From time to time, NTIA and IRAC have raised similar issues to FCC for sharing considerations, and the Commission has wisely pointed out to them that free space modeling is limited in applicability. MSTV/NAB

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[2] Technically speaking, Fresnel zones.
[3] Richard Dorf, ed., *The Electrical Engineering Handbook*, CRC Press, 1993, p. 837.
[4] Comments of MSTV/NAB, Docket 04-186, at Exhibit A, p. 9.

fails to explain why we have so many TV stations in this country if such propagation is realistic.

The opponents of unlicensed use further use assumptions to their advantage by unrealistic applications of antenna gain (e.g., assuming that the TV band device has 6 dB or more of gain and is pointed exactly in the worst possible direction). Indeed, in the original CRCC tests in this proceeding, the TV band device was assumed to have 6 dB gain and the TV receiver antenna was assumed to have another 6 dB pointed exactly at the TV band device for a total of 12 dB gain.

The opponents compound their misuse of free space propagation in the case of the DFS option by consistently assuming free space propagation from the TV band device transmitter to a TV receiver, sometimes hundreds of miles away, while at the same time assuming that the DFS DTV signal detector's antenna gets the worst possible propagation and the highest path loss. In the real world, this corresponds to a situation in which the unlicensed device using DFS/sensing would have its detector located underground while its transmit antenna is hundreds of feet in the air.

The Commission could lay this issue to rest once and for all by specifying a maximum distance between the DFS receive antenna and the transmit antenna. NAF, *et al.* propose a maximum distance of 1 meter.

Docket 20780 Precedent

NAF, *et al.* has repeatedly mentioned[5] the 1979 precedent of Docket 20780 that successfully set limits on home computer emissions to protect television reception[6] and other licensed services. No other party has mentioned this precedent and it appears that the opponents of this rulemaking would like to set the emission limits of TV band devices so that they cause no interference at distances less than 1 meter. It is unclear whether existing regulated devices, such as 800 MHz cellular telephones, would meet such a limit, and it is clear that widely used home appliances such as vacuum cleaners can not meet such a limit.[7] Considering the enormous opportunity cost of losing any channels that could be used for low-power home, enterprise, and neighborhood networking, it would be unproductive and paternalistic to set an emission limit at any distance that was not

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[5] Technical Comments of NAF, *et al.* (Jan. 31, 2007), Docket 04-186, at p. 8; NAF Issue Brief #19, "Why Unlicensed Use of Vacant TV Spectrum Will Not Cause Interference with Television Reception, July 2006 at p. 4, available at: http://www.newamerica.net/files/IssueBrief19.UnlicensedTVBand.MarcusKolodzyLippman.Final_.pdf

[6] Some people falsely assume that since computer clock speeds are above 1 GHz at present, that the risk to TV reception from personal computers is historical only. However, as testing records from the Commission's laboratory will confirm, today's personal computers have unintentional emissions at lower frequencies than the well publicized clock rate. Thus, the limits established in Docket 20780 still serve a real role in protecting receivers.

[7] While the Commission does not presently regulate home appliances that are unintentional emitters, §302(a) of the Communications Act of 1934, as amended, clearly gives it such jurisdiction. Thus, the failure to regulate such interference sources is implicit recognition that short range interference is acceptable in a household.

considered essential to protect the use of licensed services in *neighboring* households or businesses – certainly not those on the consumer's own premises.

In Docket 20780, the Commission based its emission limit for digital devices/personal computers on the assumption that "the home computing device is at least 10 meters from the receiver. The separation distance is a basic parameter in computing tolerable levels of signal that may be radiated by a computer." The Commission then stated, "(w)e are most interested in protecting an individual who is receiving interference from his neighbor's computer. To a lesser extent, we are concerned about devices in the same household."[8]

It is important to note that 10 meters was considered a very conservative and cautious limit. In the same Report and Order, the Commission left the door open for minimum protection distances greater than 10 meters, in cases such as the instant proceeding, where the transmissions have communications value, by stating:

> We believe that in most cases interfering radiation from computing devices is a less valuable use of spectrum than the radio and television services that would be interfered with. Therefore, we consider it appropriate that our regulations deny to computing devices an interfering use of the spectrum (except where the interference is to other equipment of the computer owner). We have made this judgment by comparing the benefits of allowing current uses of spectrum to continue without interference from computing equipment with the costs of denying interfering use of the spectrum to computers.[9]

But, since the communications signals of the TV band devices under consideration are not unintentional noise without content as referred to in Docket 20780, the same logic would indicate that higher emissions would be appropriate.

MSTV/NAB has stated, "whenever any device is in proximity to any television receiver, the risk of interference will increase." [10] While this is technically true, it ignores the longstanding approach of Docket 20780 and the fact that many regulated *and* unregulated devices "in proximity to any television receiver" will and do cause interference. In a similar vein, the TV Transmission Antenna Group (TVTAG) states that a "portable device ('TV band device' in the nomenclature of the FNPRM), especially in apartments, could be as close as 0.5m to the nearest indoor TV antenna."[11]

MSTV/NAB, TVTAG, and other opponents seem not to be aware of the Docket 20780 precedent and the success it has had in virtually eliminating interference complaints from digital devices. They advocate an impractical protection standard that, if implemented consistently among electrical and electronic products sold for home use, would escalate consumer costs and restrict spectrum and product availability for no real benefit. This is not the approach the Commission has taken in the past 28 years.

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[8] Report and Order, Docket 20780, 79 F.C.C.2d 28 (1979) at para. 53-54.
[9] *Ibid*., para. 67.
[10] Comments of MSTV/NAB at p. 8.
[11] Comments of TVTAG at p. 8.

DFS Specification

The FNPRM suggests a DFS sensitivity of -116 dBm but never defines this precisely. MSTV/NAB correctly point out that there is an ambiguity here. NAF, *et al.* agree. The specified sensitivity of a DFS detector must be specified in an unambiguous way. Some types of DFS detectors focus on the DTV pilot tones, while others look at the whole DTV signal. NAF, *et al.* urges the Commission to set the sensitivity level with reference to a DTV signal average receive power level as measured over a 5.38 MHz bandwidth, as is typical practice.

Since the DFS detector should be omnidirectional, it is tempting to assume a 0 dBi antenna. However, since TV signals are not transient in time, antennas that scan in azimuth[12] should be allowed and should be given credit for additional antenna gain if the equipment designer decides to use such a feature.

Specific Issues

In this section we will address several specific issues raised by individual commenting parties.

Hospital Telemetry Issue

Two parties have filed comments expressing concerns about unlicensed medical telemetry systems operating in Channels 7-to-46 (the 174-216 MHz and 470-668 MHz bands) pursuant to §15.242. In 2000, the FCC provided new licensed spectrum for these devices, although the radio astronomy band equivalent to TV channel 37 would continue to be available. Thus, the new spectrum in which these devices would have primary status would be the 608-614 MHz (TV channel 37), 1395-1400 MHz, and 1427- 1432 MHz bands.

For the past seven years, manufacturers have been allowed to manufacture grandfathered equipment in the UHF-TV band and users have been allowed to continue using any FCC approved equipment.

GE Healthcare (GEHC) requests:

> that any new unlicensed use of channels 33 through 36 be delayed one year, until February 18, 2010. This will provide much needed additional time for healthcare providers to become aware of the new unlicensed usage and to plan replacement systems. In addition, it will provide additional time for medical telemetry manufactures to complete the design and introduction of new products into the marketplace that will provide for the migration of all channels to WMTS frequencies, while protecting a

[12] Such scanning in azimuth could be either physical or electronic, with electronic being more practical. But the rules for TV band devices need not deal with how the scanning is implemented, just that it receives credit for additional gain.

significant portion of healthcare providers' existing investments in legacy equipment.[13]

GEHC also requests 1) that fixed operations in channels 7-46 be required to notify nearby hospitals before commencing operations, 2) that the out-of-band emissions near channel 37 be reduced, and 3) that use of channel 36 and 38 also be prohibited.

The American Society for Healthcare Engineering (ASHE) also proposes notification to nearby medical facilities by TV band devices, but appears to ask this only if the Commission decides to license such devices. ASHE urges the Commission to require that a database be constructed of all TV band devices.[14]

Despite the characterization of this equipment as safety-of-life by both ASHE and GEHC, this is not explained further. The devices in question are **not** devices that must receive a signal continuously in order to maintain the patient's life. They are passive monitors that report on the patient's condition to medical personnel and that are used to identify life threatening situations promptly. Momentary interference is not life threatening *per se*, otherwise these devices would not have been designated unlicensed Part 15 systems subject to the general conditions of §15.5(b) of accepting interference. Nevertheless, the Commission has shown a strong interest in protecting these devices.

The requested delay until 2010 and other restrictions on unlicensed channel availability requested by GEHC are unreasonable considering that (a) the operators of these Part 15 devices have had alternative and exclusively dedicated spectrum available for over six years; (b) they have been on notice of the possible outcome since the 2002 NOI and 2004 NPRM – and even under this FNPRM, the 2009 DTV transition deadline is adequate time to adjust; and (c) hospitals and other operators of these devices that choose to continue to operate as unlicensed devices in the TV band can, at low cost, take self-help measures to safeguard against potential interference from unlicensed devices.

Hospitals and similar medical facilities can *and do* restrict use of wireless equipment within their facilities. This is apparent to anyone visiting a hospital these days. The devices considered here are critical care devices, so restrictions in such areas are more practical to enforce. Thus, the scenario portrayed by GEHC of unlicensed users operating "within only a few meters of a WMTS receive antenna"[15] are difficult to credit and can be prevented by normal hospital practice of restricting transmitters within hospitals.

Another alternative to protecting medical telemetry systems would be to permit hospitals to use beacons that emulate the pilot tone of DTV transmitters. NAF, *et al.* has previously mentioned in its comments[16] in this proceeding another possible use of this

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[13] See Comments of GE Healthcare (GEHC) at p. 5.

[14] See Comments of American Society for Healthcare Engineering.

[15] Comments of GEHC at p. 9.

[16] Comments of NAF, *et al.* at p. 22. NAF, *et al.* would prefer a DFS solution to protecting wireless microphones during the transition period and hope that this technology can be demonstrated to the Commission's satisfaction. But if direction detection of wireless microphones at levels low enough to prevent interference can not be demonstrated during this rulemaking, the beacon system proposed by Shure

technology, by wireless microphone licensees, as a voluntary means of self-protection. If medical facilities choosing to continue use of these devices beyond early 2009 desire to ensure stronger safeguards, then those operators can employ a beacon device to transmit a signal over a relatively short distance that mimics the DTV pilot tone. NAF, *et al.* believes that such beacons can be employed voluntarily by eligible medical device operators, thereby announcing that the devices are in operation. Unlicensed devices will detect the DTV pilot tone, even with a high degree of attenuation, and avoid using the frequency within a reasonable distance of the medical facility. NAF, *et al.* believes that such beacons can also be used to prevent adjacent channel use of TV channels 7-to-46 in the immediate vicinity of medical telemetry devices if the Commission does not believe that the other alternatives are acceptable. While no such beacons are presently available, such development is straightforward and the technology is simple. If this was the back-up means for voluntary, self-protection by legacy devices in the TV band, the market for a simple device to emit a DTV pilot tone should easily ensure their availability before 2009, and at a low price. There is certainly no need to waste entire channels of spectrum nationwide when medical (or wireless microphone) operators operating intermittently and in a highly-localized manner can, at low cost, engage in self-protection.

NAF, *et al.* urges the Commission to reject the one year delay of the use of channels 33-to-36 requested by GEHC. This proceeding was initiated in 2004, so the projected February 2009 date is almost five years after the NPRM. The equipment involved is grandfathered from 2000, nine years by the proposed effective date. Two more years remain before this could conceivably be a problem. Further, with the other measures NAF, *et al.* have proposed, there should be no additional need to protect the medical devices through continued warehousing of valuable spectrum or costly regulation of unlicensed devices.

NAF, *et al.* agrees with the GEHC proposals that nearby hospitals be notified of fixed TV band facilities with greater than 100 mW power and that such systems could be registered in some way (e.g., via a simple online database self-registry). However, the other concerns of GEHC and ASHE would become moot with continued prohibitions of transmitter use within hospitals and the optional use of beacons to simulate DTV pilot tones.

Would Licensing Affect White Space Availability?

The comments of the Charles L. Jackson and Dorothy Robyn of the Brattle Group, submitted for Qualcomm, contain the surprising conclusion:

> • Under interference-protection rules appropriate to a licensed regime, 97% of the population lives in locations at which there will be at least 24 MHz of spectrum available in the white space following the DTV transition.
>
> • There is dramatically less (about half as much) spectrum available in the white space

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is a simple alternative for interim protection of wireless microphones. As a means of voluntary self-help, medical and wireless microphone licensees can, at low cost, achieve the same protection as DTV transmissions by announcing their presence over a reasonable radius from their location.

> under interference-protection rules that correspond to those the FCC is most likely to impose in an unlicensed regime.[17]

Thus, the Brattle/Qualcomm Comments imply that a change from an unlicensed regime to a licensed regime makes a 50% reduction in spectrum availability!

The assumptions for this analysis are given in the filing and shown in Figure 1:

	Included Facilities	Co-Channel Protection	Adjacent-Channel Protection	*Total MHz-Pops in White Space (Millions)* 2-51	5-51	14-51	*Percent of MHz-Pops in White Space* 2-51	5-51	14-51
Scenario X	All US, Canadian, and Mexican regular and Class A stations and land systems in the UHF TV spectrum	FCC Radius	None	53,678	49,232	37,829	64%	63%	60%
Scenario Y	All US, Canadian, and Mexican regular and Class A stations and land systems in the UHF TV spectrum	FCC Radius	FCC Radius	28,266	24,532	17,379	34%	31%	27%
Scenario Z	All US, Canadian, and Mexican regular and Class A stations, land systems in the UHF TV spectrum, and all TV translators.	FCC Radius	FCC Radius	27,156	23,523	16,547	32%	30%	26%
Scenario UL-1	All US, Canadian, and Mexican regular and Class A stations and land systems in the UHF TV spectrum	FCC Radius plus 46, 30, and 17 miles for low VHF, high VHF, and UHF	FCC Radius plus 5 miles	21,028	18,093	12,752	25%	23%	20%
Scenario UL-2	All US, Canadian, and Mexican regular and Class A stations and land systems in the UHF TV spectrum. Channels 2-4 and 14-20 excluded.	FCC Radius plus 46, 30, and 17 miles for low VHF, high VHF, and UHF	FCC Radius plus 5 miles	15,160	15,160	9,820	18%	19%	16%

Note: Channel 37 excluded from analysis.

Figure 1: Brattle/Qualcomm Assumptions (p. 73 of comments)

The Brattle/Qualcomm Comments assume that if the TV band devices were unlicensed, the Commission would require an extra 17-to-46 miles protection around each TV transmitter than in the licensed case. Thus, even if a TV band device used DFS technology with a lower detection threshold and TPC, somehow its licensed counterpart would have relaxed standards and be able to find more white space.

Finally, Brattle/Qualcomm indicates that broadcast licensees might be willing to negotiate with TV band device licensees:

> Licensed access creates the incentive and opportunity for white-space licensees and

[17] Brattle/Qualcomm Comments at p. i.

broadcasters to engage in negotiations to expand licensed service. [18]

Negotiate what, exactly? The only "negotiation" that would increase the useable spectrum for a licensed service, as compared to a low-power unlicensed regime, would come at the expense of localism by disenfranchising some portion of a local station's viewing audience! Is the Commission really prepared to use this proceeding to facilitate a recommendation that TV licensees, who are bound by statute to provide at least a primary stream of free over-the-air programming, should be encouraged to negotiate away the interference protection of all or some substantial portion of their viewing audience? Even if the Commission determined it had the authority to indirectly subvert the Communications Act to pursue this pragmatic tradeoff, the entire premise of the Qualcomm/Brattle proposal for "negotiations" to relax interference protections for local TV viewers is irrelevant since that issue has not been noticed in this proceeding. It is an argument premised on a red herring that has no legally or politically viable basis.

Furthermore, a casual reading of the comments filed by the broadcasting interests in this proceeding show how unlikely this assumption is vis-à-vis the incumbent licensees. There has never been the slightest indication that local broadcasters are willing to negotiate away their "birthright" (and, possibly, their must-carry rights) for incremental income rather than directly serving the public with their signals.

Brattle/Qualcomm does state that "(u)ncertainty about the FCC's interference rules is another limiting factor, although we have taken account of that by estimating white space under alternative interference rules (our five different scenarios)."[19] The conclusion about spectrum availability differences is critically tied to assumptions about ultimate FCC policies and described as a "limiting factor." Thus, while the Brattle/Qualcomm analysis is technically proficient, it is based on an assumption that is at best speculative and at worst fatally flawed. No direct explanation is ever given about why all conceivable uses of unlicensed TV band devices must have an extra margin of 17-to-46 miles of protection around each TV station. This doesn't make any sense in the DFS case, the beacon case, or in the geolocate/database case. Indeed, because the vast majority of uses for unlicensed devices are low power, the more credible assumption is that *licensed* services in the TV band would operate at higher power and require an extra margin of protection around TV stations (not to mention the possible need to protect wireless microphone and medical telemetry, which are not even registered as they don't have site-based licenses). These constraints, compounded by uncertainty, would undoubtedly reduce the amount of spectrum in use on a licensed basis compared to an unlicensed regime, and make the licenses far less valuable than Brattle/Qualcomm assumes.

[18] *Ibid.* at p. ii.
[19] *Ibid.* at p. 100

MSTV/NAB Comments

Because of the detailed technical nature of the MSTV/NAB comments, we will review their points in detail here.

MSTV/NAB's Nine Principles

First, on p. 9, MSTV/NAB give nine principles that they say "at a minimum, the Commission must ensure that its final rules incorporate."[20]

We will address them one by one in the order they are given.

As the Commission has rightly decided, no TV band devices should be permitted to operate before the end of the DTV transition.
NAF, *et al.* have filed a Petition for Reconsideration,[21] asking the Commission to reconsider its determination to prohibit marketing or sale of products until after February 17, 2009. Consistent with our position above, urging that the Commission simply set a technologically neutral bar for interference protection and strictly administer the traditional FCC device certification process, the conclusion of the DTV transition is simply not relevant to all of the technologies that can enable unlicensed devices to avoid interference. The DTV transition schedule may have some impact on the certification of devices relying on geolocation/database – if, for example, the allocation tables remain too much in flux – but for technologies relying on sensing/DFS, the current location of TV station licensees, or whether they are analog or digital, or whether they are low power or high power, is irrelevant. The study that NAF, *et al.* filed in this docket with its Technical Comments on January 31, 2007 (the "Sturza Study") proves that these licensees can be detected and avoided as easily next year as they will be in 2009.

This decision also has significant impact on the open source development community, which generally must wait until chipsets become available on the market before beginning to develop open source alternatives to proprietary products. Needless delay in production of devices will delay the development of open source alternatives and thus delay deployment by community wireless organizations bringing affordable broadband to poor urban or rural areas.

MSTV and NAB agree with the Commission that any operation of TV band devices should be limited to fixed operations only.
NAF, *et al.* disagree with the broadcasters on this point. Portable devices that meet strict interference prevention standards through any of the three options proposed should be allowed at least up to 100 mW power. As noted just above, the Sturza Study published by the New America Foundation and attached to the Technical Comments of NAF, *et al.* in this docket prove that detection sensing can work with a high degree of reliability. Companies (e.g., Microsoft and Adaptrum) have already built prototypes for unlicensed personal/portable devices that incorporate workable sensing/DFS interference avoidance.

[20] Comments of MSTV/NAB, p. 9.
[21] Petition for Reconsideration, New America Foundation and Champaign Urbana Community Wireless Network, ET Docket No. 04-186, Dec. 18, 2006.

Moreover, if a geolocate/database method can work for fixed devices, then those fixed devices can also serve as base stations in a master-client relationship with personal/portable devices. If these interference protection options prove to be adequate – now or in the near future – and the FCC's device certification process is workable, as it has been historically, why would the Commission prohibit portable use? No one has presented a cogent argument against the geolocate/database option for either portable or fixed use, nor has anyone shown evidence that sensing/DFS cannot work in the TV band, as it has – to the satisfaction of the Pentagon – in the 5 GHz band. If the ongoing Commission testing of a DFS device shows that it does not cause interference, it should be allowed for fixed or mobile use.

Protection of DTV operations should be based on Desired-to-Undesired (D/U) ratios. NAF, *et al.* agrees as this is the only possible type of protection. MSTV/NAB states, "Any rules adopted for TV band devices must assure that appropriate D/U ratios are maintained to ensure that interference is not caused to TV viewers throughout the TV station service area." With the qualification that this only apply to viewers who receive an adequate signal in the first place – e.g., that they are within the license area and receiving a signal above the threshold of visibility – NAF, *et al.* agrees with this also. It makes no sense to protect potential viewers who don't actually get a useable signal within a theoretical service area. Nor is it required, or make sense considering the opportunity costs, to protect potential viewers who reside in a different Designated Market Area (DMA) outside the broadcast licensee's service area, whether or not they can receive a viewable signal (for what is typically a redundant network affiliate), since their reception of local stations is protected.

To avoid interference to TV viewers, all TV band devices must operate outside the protected contour on both co- and adjacent channels.
As mentioned above, MSTV/NAB have never acknowledged the Docket 20780 precedent that unlicensed devices need not protect TV receivers less than 10 meters away. We have urged that the Commission clearly state that this applies to TV band devices as well as digital devices/personal computers and that the Commission consider a modest increase of the 10 meter distance based on the nature of the TV band device signal, which is valuable communication content.

If a broadcast licensee's "protected contour"[22] is actually the useable service area within the DMA where they have a site-based license, then this is perfectly reasonable. The key issue then is how "protected contour" is defined.[23] This term is generally meant to mean a circular station coverage area based on the flat earth curves in §73.699. This has little to do with reality, although stations might like to use it in selling advertising. The

[22] MSTV/NAB repeatedly use the phrase "protected contour" in their comments but neither define it nor reference its definition. A search of the Commission's Rules shows that this term is only used in §73.6010 and only in the context of a Class A low power television station. We assume they are referring to their licensed service area within the DMA, which does not, of course, include rights to operate on the same frequency in an adjacent market (i.e., co-channel).

[23] In their comments at p. 12, MSTV/NAB acknowledge, "TV signal levels are not uniformly distributed throughout a station's service area; consequently, there are locations where television receivers may not receive a television signal that is adequate for viewing."

"service area" predicted by using the Longley-Rice Model in OET Bulletin 69[24] is a more realistic estimate of actual coverage, although for SHVIA determinations, the Commission uses a different approach – the ILLR model[25]. It is important to clearly define what constitutes the "protected contour," and MSTV/NAB have just "fuzzified" the issue.

As noted above, broadcast stations should have no reasonable expectation that unlicensed devices will protect potential viewers who reside in a different DMA outside the broadcast licensee's contour and DMA, whether or not certain individuals with special antennas can receive a viewable signal (for what is typically a redundant network affiliate), since reception of their own local stations is protected. Principles of localism and site-based licensing govern the reasonable expectations of broadcast licensees, not potential viewability of distant signals.

NAF, *et al.* does acknowledge that 100 mW transmitters occupying a full 6 MHz channel immediately adjacent to a weak TV signal may cause interference, particularly if the device does not employ an especially efficient transmission mask (the ability of devices to do so, now or in the future, should be left to the FCC's device certification process). It would not cause interference to a strong signal, however. It would not cause interference if it was offset by half a channel as is often done in Part 90 systems. In our comments in this proceeding, we urged the Commission to adopt a model that weights the total power in the bands on either side of the TV band device emission by a reasonable representation of the frequency response of a TV receiver.[26]

The sensing threshold proposed in the FNPRM does not provide adequate co-channel protection and misinterprets IEEE's approach.

MSTV/NAB have not shown why the proposed sensitivity is inadequate. Their analysis is based on assuming bad propagation for the TV band device sensing antenna but great propagation for the TV band device transmit antenna. The previous proposal in this filing to limit the distance between sensing antenna and transmit antenna should eliminate any chance of the extreme difference that MSTV/NAB postulates.

While MSTV/NAB may prefer the exact details of the present IEEE 802.22 draft approach (over which it has exerted a great deal of influence), the Commission has not delegated – and cannot delegate – its public interest determinations to an outside group that operates on consensus and that is designed to represent narrow industry interests, not the broader public interest.

The proposed out-of-band emission limits are inadequate to protect DTV viewers and must be amended.

NAF, *et al.* has previously stated that the continued use of 120 kHz measurements and 120 kHz limits for out-of-band emissions to protect TV receivers is anachronistic. TV

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[24] OET Bulletin No. 69, Longley-Rice Methodology for Evaluating TV Coverage and Interference (February 6, 2004).

[25] OET Bulletin Number 72, The ILLR Computer Program, July 2, 2002.

[26] Technical Comments of NAF, *et al.* at p. 29-30.

receivers are vulnerable to the total power in adjacent bands weighted by the frequency response to that band. We urge the Commission to adopt this approach to regulating all wideband emitters near TV bands.

The Commission must conduct testing to ensure that the final rules sufficiently protect television viewers.
The Commission has stated it will do this and NAF, *et al.* supports this decision. However, it is not practical to test every possible configuration and we urge the Commission as the expert agency to extrapolate from its testing to other situations that can reasonably be predicted by theory. This testing should also be completely transparent to the public and invite input from all interested parties.

Any new devices allowed to operate in the broadcast spectrum should be exclusively licensed; no unlicensed operation should be allowed.
We have discussed this already in our Legal and Economic Comments in this proceeding and above in addressing the Brattle/Qualcomm comments. We remind the Commission that should it decide to license all TV band devices, it would be impractical to do so while keeping Part 74, Subpart H systems like wireless microphones as primary status in the same band. Any licensees would have no idea of when these Part 74 systems might show up in his service area and disrupt the spectrum use he has bought at auction. Unlike unlicensed systems, the licensed services may not have access to enough spectrum to employ DFS and simply continue operating on a different channel.

Therefore, if the Commission agrees with MSTV/NAB on this point, it should either relocate the Part 74 users elsewhere or subordinate them to the new TV band device licensee including payment of fees like any other user. The same would need to be true for medical telemetry, which licensed business models could not readily accommodate, unless – like unlicensed devices – licensed services are willing to shut down in the presence of a DTV pilot tone beacon. The Commission should then also give strong rights to the new licensees vis-à-vis incumbent broadcasters who, after all, have not paid for their access to the band. Secondary broadcast licensees, like wireless microphone systems, should be relocated or subordinated and begin paying for spectrum access.

The Commission must enact a rigorous enforcement program.
We agree fully. Over the years, chairman after chairman has stated that the Commission should eliminate unnecessary rules but strongly enforce the ones that it finds necessary. OET and EB have not been as vigorous as they could have been in enforcing the rules on the books and have not been given adequate resources. There has been little or no active marketing surveillance program and too much reliance on complaints. These issues are real problems regardless of how this proceeding is resolved. The Commission must put real teeth into its equipment marketing program comparable to the large fines it is imposing in other areas.

While MSTV/NAB advocate a "rigorous enforcement program," they are silent on the issue of the massive illegal use of wireless microphones in TV spectrum by parties not eligible under Part 74, but who could use Part 90 alternatives. It can even be seen in the

record of this proceeding that many of the opponents of these proposals state that they are current users and describe their use of wireless microphones — use that clearly indicates that they are ineligible and do not hold valid licenses. Such users are in criminal violation of 47 USC 301. Will the Commission use these admissions to initiate enforcement actions? But since they are "fellow travelers" with MSTV/NAB in this proceeding, MSTV/NAB "winks" at their illegal activities even though it is co-channel with their members' use and would cause interference if free space propagation analysis was used.

MSTV/NAB's full wrath is reserved for very low power FM transmitters that exceed Part 15 power limits even though there was no history of interference complaints from consumers about such devices. We urge MSTV/NAB to join us in advocating increased FCC enforcement resources, improved market surveillance, increased sampling of commercially available intentional and unintentional emitters subject to equipment authorization and rigorous enforcement of all Title III technical rules—not just the ones that are convenient for their members and their allies.

"Operations On N+7 And On 'Image' Frequencies N+14 And N+15"

Analog NTSC receivers were well known to have extreme sensitivity on certain channels relative to the one being received. This resulted in the UHF taboos enumerated in §73.698. However, in implementing DTV, the Commission considered such taboos,[27] but rejected them except for the co-channel and adjacent channel restrictions in §73.623(c)(2). Suddenly MSTV/NAB has discovered a need for taboo protection! Of course, this discovery does not apply to MSTV and NAB members who can continue to build and operate full power DTV transmitters on N+7, N+14, and N+15 and presumably will not cause interference even in their immediate neighborhood.

This discovery is based upon data not from previous extensive FCC tests of receivers, but from a new CRCC test attached to the filing.

New CRCC Report

MSTV/NAB include as Exhibit B to their comments a new report by CRCC entitled "Laboratory Evaluation of Five VSB Television Receivers in DTV Adjacent Channel Interference – Laboratory Test Report and Calculations" The 49-page report is full of data but short on details that would allow independent confirmation of the test results. CRCC has moved away from the radiated tests with antennas spaced so closely to suggest mutual coupling and possible crossmodulation of the desired and undesired signals. CRCC now uses signals that propagate through more controllable cables, similar to what University of Kansas did for the tests supported by NAF, *et al.* Two striking absences in the CRCC report are the absence of any photographs and the absence of any spectrum analyzer plots showing the shapes and the spacing of the undesired and desired signals.

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[27] "The evaluation of service and interference in Appendix B of the *Sixth Report and Order* considered taboo channel relationships for interference into DTV. However, the D/U ratios (approximately -60 dB) were such that they rarely if ever had an effect on the results, and the FCC rules adopted in the *Sixth Report and Order* do not require attention to UHF taboo interference to DTV stations." OET Bulletin 69, *op. cit.* p. 8.

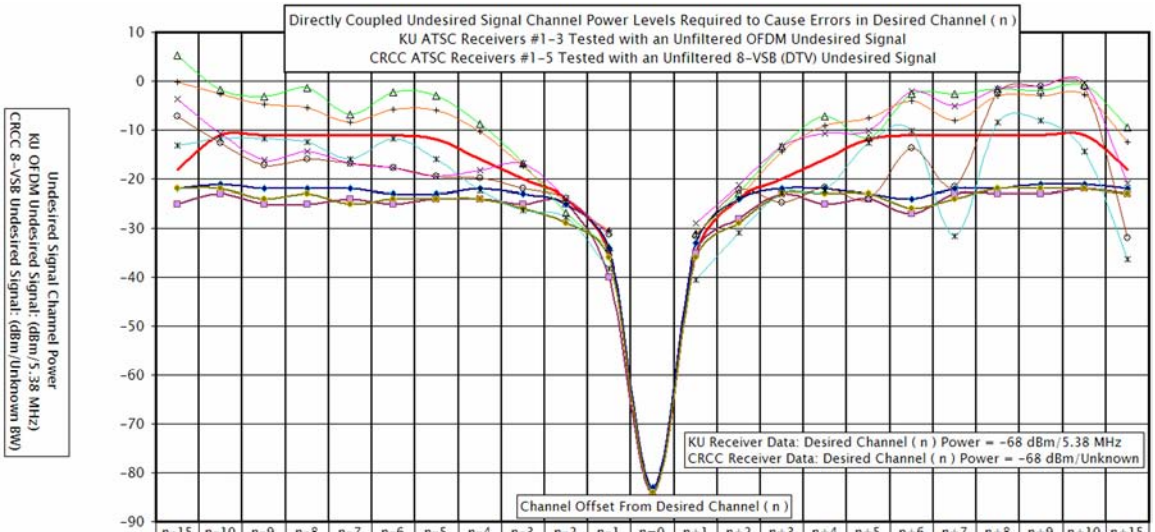
The CRCC report claims a taboo-like problem at N+7 (i.e., a frequency 7 TV channels higher than the desired signal). This is the same phenomenon that FCC rejected in drafting the present §73.623(c)(2) and when it decided not to include restrictions on N+7. During the DTV transition presently underway, the UHF-TV spectrum is unusually crowded with both NTSC and DTV transmitters. Have there been many recorded cases of interference to DTV due to stations with hundreds of kilowatts of power located 7 channels higher as permitted by §73.623(c)(2)?

Absent spectrum analyzer photographs of CRCC's test signals, there is an alternative explanation of the results here that must be considered. The simulated TV band devices were actually DTV signal generators with the FCC specified VSB modulation used in the U.S. for DTV.[28] For one of the signal generators, CRCC used a Ktech VSB-ENC-150E VSB modulator. This device uses a 44 MHz intermediate frequency in generating its final output frequency. NAF, *et al.* is concerned that leakage from this intermediate frequency could have created a spurious signal 44/6 = 7.33 TV channels away that could have been a factor in the N+7 results. In the ongoing FCC Laboratory testing for this proceeding, we urge that this possibility be considered and checked in the FCC's setup.

Figure 2, below, shows a comparison between the University of Kansas data and the CRCC data. For reference, the ATSC A/74 standard is also shown. The data is shown in the form of how much undesired power is necessary to disrupt a weak DTV signal of -68 dBm.[29] Generally, the receivers tested by CRCC were better than the A/74 standard, while the KU receivers were a little worse.

[28] By contrast, the University of Kansas tests used a European standard DTV signal generator that uses OFDM, the same basic modulation used in WiMAX and the newer forms of Wi-Fi. While both are varieties of DTV, the OFDM format is more representative of terrestrial data signals than the VSB format which is used mainly in broadcasting.

[29] Unfortunately, the CRCC study did not specify how they measured the DTV signal strength. KU used the industry standard bandwidth of 5.38 MHz. If CRCC used a different measurement bandwidth, the net signal was not the same as the KU signal strength.



	n-15	n-10	n-9	n-8	n-7	n-6	n-5	n-4	n-3	n-2	n-1	n=0	n+1	n+2	n+3	n+4	n+5	n+6	n+7	n+8	n+9	n+10	n+15
ATSC A/74	-18	-11	-11	-11	-11	-11	-12	-16	-20	-24	-35	-83.5	-35	-24	-20	-16	-12	-11	-11	-11	-11	-11	-18
KU Receiver #1	-25	-23	-25	-25	-24	-25	-24	-24	-25	-25	-40	-84	-35	-28	-23	-25	-24	-27	-23	-23	-23	-22	-23
KU Receiver #2	-22	-21	-22	-22	-22	-23	-23	-22	-23	-25	-34	-83	-33	-24	-22	-22	-23	-24	-22	-22	-21	-21	-22
KU Receiver #3	-22	-22	-24	-23	-25	-24	-24	-24	-26	-29	-36	-84	-36	-29	-23	-23	-23	-26	-24	-22	-22	-22	-23
CRCC Receiver #1	-13.2	-11.7	-11.7	-12.4	-15.9	-11.8	-16	-22.3	-26.4	-27.8	-38.3		-40.5	-30.8	-22.8	-22.2	-12.6	-10.1	-31.6	-8.5	-8	-14.3	-36.4
CRCC Receiver #2	5.3	-1.7	-3.2	-1.4	-6.9	-2.3	-3	-8.8	-16.9	-26.8	-33.8		-31	-22.8	-13.3	-7.2	-11.6	-2.6	-2.6	-1.5	-2	-0.8	-9.4
CRCC Receiver #3	-7.2	-12.7	-17.2	-15.9	-16.9	-17.8	-19.5	-19.8	-21.9	-23.8	-31.3		-31.5	-22.3	-24.8	-21.7	-24.1	-13.6	-21.6	-2.5	-1	-1.3	-31.9
CRCC Receiver #4	-3.7	-10.7	-16.2	-14.4	-16.9	-17.8	-19.5	-18.3	-16.9	-23.8	-30.8		-29	-21.3	-13.3	-10.7	-10.1	-2.1	-5.1	-1.5	-1	-0.3	-20.9
CRCC Receiver #5	-0.2	-2.7	-4.7	-5.4	-8.4	-5.8	-6	-10.3	-17.4	-24.8	-30.3		-31	-23.8	-14.3	-9.2	-7.6	-4.1	-8.1	-3	-3	-2.8	-12.4

Figure 2: Comparison of KU and CRCC data

Nevertheless, NAF, *et al.* believe that this data confirms our previous analysis that with this type of receiver performance, 100 mW portable use is possible within the Docket 20780 precedent.[30]

NCTA Comments

In its comments, NCTA raises two basic issues: direct pickup interference (DPI) to consumer TV receivers and CATV headend interference. NAF, *et al.* is concerned particularly about the DPI VHF-TV band issue and the high sensitivity to co-channel signals that NCTA alleges. It seems more than odd that this does not seem to impact cable subscribers living near high-power TV transmitters today, nor cable users in communities with TV/land mobile sharing on channels 14-to-20. Indeed, interference to a cabled system from a low-power device in another household (or even more than 10 meters distant) seems implausible. We expect the FCC labs will rigorously test this under realistic conditions. NAF, *et al.* is undertaking additional testing at the University of Kansas to explore this issue.

With respect to CATV headend interference, we believe device testing will show that DFS systems will be able to protect such systems in reasonable geometries. We note that

[30] See "Final Results of University of Kansas TV White Space Interference Study," filed as an attachment to Comments of New America Foundation, ET Docket 04-186, Jan. 31, 2007.

geolocate/database systems and beacon systems would face a difficulty in today's environment: There is no reliable information on where headends are located and which channels they are receiving. The National Translator Association has previously observed the same for translators and urged the Commission to establish a database of translators and their input channels, as existing licensing databases only give transmit frequencies. NAF, *et al.* urges the Commission to do likewise for CATV headends and notes that such information will be of use not only for TV band devices, but in future FCC actions dealing with this important band.

NCTA states:

> Although cable companies sometimes have direct links to television stations, many cable systems receive terrestrial broadcast signals through tower-mounted, high gain directional terrestrial antennas, particularly in fringe areas. Cable systems then combine the terrestrially-delivered broadcast programming with satellite-delivered cable programming for retransmission over the cable network to the customer.

NCTA fails to provide any information on how prevalent such direct links are, what the trends are, and what the costs are. The Commission has generously provided the CATV industry with access to Cable Television Relay Service, Part 78, spectrum independent of auctions and other marketplace forces. It is ironic to limit TV band device spectrum availability for broadband access for rural residents over a wide area – and at tremendous opportunity costs to those communities – in order to protect an isolated CATV headend that has access to Part 78 spectrum. Cable operators are certainly able to take self-help measures to protect their reception in those handful of circumstances where they may be vulnerable (see additional argumentation on this issue in the NAF, *et al.* coalition Reply Comments filed concurrently in this docket).

Appendix: Commenting Parties and Individuals

Michael Marcus is a native of Boston and received S.B. and Sc.D. degrees in electrical engineering from MIT. Prior to joining the FCC in 1979, he worked at Bell Labs on the theory of telephone switching, served in the Air Force where he was involved in underground nuclear test detection research, and analyzed electronic warfare issues at the Institute for Defense Analyses.

At FCC his work focused on developing policies for cutting edge radio technologies such as spread spectrum/CDMA and millimeterwaves. The FCC rules that are the basis of Wi-Fi and Bluetooth are one outcome of his early leadership. Awarded a Mike Mansfield Fellowship in 1997, he studied the Japanese language and spent at year at the FCC's Japanese counterpart.

He retired from FCC in March 2004 after servicing a senior technical advisor to the Spectrum Policy Task Force and codirecting the preparation of the FCC's cognitive radio rulemaking. He is now Director of Marcus Spectrum Solutions, an independent consulting firm in wireless technology and policy. He was recognized as a Fellow of the IEEE "for leadership in the development of spectrum management policies". (*Technical Advisor for NAF, et al.*)

New America Foundation (NAF) is a nonpartisan, non-profit public policy institute based in Washington, DC, which, through its Wireless Future Program, studies and advocates reforms to improve our nation's management of publicly-owned assets, particularly the public airwaves. www.newamerica.net

Media Access Project (MAP) is a 30 year-old non-profit tax exempt public interest telecommunications law firm which promotes the public's First Amendment right to hear and be heard on the electronic media of today and tomorrow. MAP's work is in the courts, the FCC, and in active outreach as a coalition builder among other public interest organizations. MAP is the only Washington-based organization devoted to representing listeners' and speakers' interests in electronic media and telecommunications issues before the Federal Communications Commission, other policy-making bodies, and in the courts. www.mediaaccess.org (*Counsel for NAF, et al.*)

Robert Brodersen is the John Whinnery Chair Professor and Co-Scientific Director of the Berkeley Wireless Research Center at the University of California, Berkeley, where he has taught since 1976. Professor Brodersen's research is focused in the areas of low power design and wireless communications and the CAD tools necessary to support these activities. He has won several awards over the last two decades from IEEE, including being named one of the top ten contributors in the last 50 years to the IEEE International Solid-State Circuits Conference. http://bwrc.eecs.berkeley.edu/People/Faculty/rb/

Paul Kolodzy is the former head of the FCC's Spectrum Policy Task Force and is now Director of the Center for Wireless Network Security at Stevens Institute of Technology.

Prior to his time with the FCC, Dr. Kolodzy was a tenured professor at MIT and a manager for the development of advanced technology and communications with the Defense Department's Advanced Technology Office of the Defense Advanced Research Projects Agency (DARPA).

Haiyun Tang is the Chief Technology Officer of Adaptrum, Inc., a Silicon Valley company developing state-of-the-art spectrum sharing technologies for military and commercial applications.