Before the
Federal Communications Commission
Washington, D.C. 20554

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

REPLY COMMENT OF INTEL CORPORATION

May 16, 2003

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REPLY

I. INTRODUCTION AND SUMMARY

Intel Corp. (Intel) hereby submits the following reply comment in response to the Notice of Inquiry released in the Federal Communications Commission's ("FCC" or "Commission") above-captioned proceeding. Intel is the world's largest semiconductor manufacturer and a leader in technical innovation. Intel is also a leading manufacturer of communications and networking chips and equipment.

In its comment, Intel commended the FCC for initiating this proceeding examining the possibility of permitting unlicensed devices to operate in the television broadcast and other frequency bands. Intel stated:

- The current allocation process results in many channels being unassigned at the local level.

- The fixed and well understood nature of the TV transmitters made it possible for unlicensed devices based on existing technology to coexist even using conservative operating assumptions.

- Given the attractive propagation characteristics of the TV broadcast bands, their use by unlicensed devices would quickly generate substantial benefits to consumers and businesses including the acceleration of the deployment of broadband services.

- Preliminary technical analysis conducted by Intel, and testing performed by the Communications Research Centre Canada, on Intel's behalf, demonstrated that technically viable broadband services can be operated on a non interfering basis with both analog and digital TV broadcast services in a major metropolitan area.

Overall, the comments filed in this proceeding and the new information provided in this reply comment demonstrate:

- Use of the TV broadcast spectrum by unlicensed devices would generate important benefits.

- In particular, the general benefits of unlicensed use—low opportunity cost, rapid development and user funding—hold special promise given the probable synergies with DTV and the good propagation characteristics of the VHF and UHF bands.

- A significant amount of low risk, vacant spectrum is available. Even by initially focusing on channels 5-13 and 21-51 (excluding 37), the FCC could free up significant spectrum for unlicensed use.

- For example, these frequencies in the San Francisco Bay area would provide 11 channels which could increase to 23 channels as analog TV is phased out.

- The contrary conclusions of various groups representing TV broadcasters rely on analysis of separation distance and receiver interference that is based on unrealistically conservative assumptions.

- The operating parameters for unlicensed use by a cognitive device should be defined by its operating environment not the rural or non-rural nature of the environment in which it is located.

- The technology necessary to avoid harmful interference to broadcasting

either exists or is feasible and would not be too expensive.

- For example, most WLAN devices and even low cost TV receivers have long had the built-in capability to monitor a set of frequencies and identify those that are active.

- Notwithstanding some commenters' fears, unlicensed devices could accelerate the DTV transition by creating complementary benefits for consumers from ancillary DTV products and services.

- Unlicensed devices will not create significant harm to TV broadcasting, because use of these bands by unlicensed devices will be premised on non-interference to the TV broadcasters.

- For example, because the unlicensed device would continuously monitor the spectrum for broadcast services, any change in channel usage by a broadcaster would cause the unlicensed device to move to a different channel.

Accordingly, Intel recommends that the Commission expeditiously begin a rulemaking proposing to permit unlicensed use of the broadcast television frequencies. At a minimum, the rulemaking should consider authorizing unlicensed operation within the bands 76-216 MHz (5-13), 512-608 MHz (21-36), and 614-698 MHz (38-51), by cognitive devices whose operating parameters are defined as a function of their broadcast TV environment.

II. UNLICENSED USE WOULD GENERATE IMPORTANT BENEFITS.

"Unlicensed" use of the TV broadcasting spectrum could be beneficial for several reasons. First, the creation of unlicensed bands is a spectrum management technique that complements the current exclusive licensing system. As Intel stated in its comment, "The opportunity cost of unlicensed use has been low because the use of unlicensed devices has not foreclosed or harmfully interfered with authorized uses."[1] Some

[1] Intel at 4.

commenters claim that unlicensed use of the TV broadcast spectrum is not necessary[2] or would have diminishing returns[3] and that devices would be high cost.[4] As discussed in Section IV below, the record belies these contentions.

But more fundamentally, these contentions are moot, because unlicensed devices would be using vacant or "white-space" TV spectrum, which currently provides zero economic benefit.

Second, the relatively unregulated environment created by the Commission's Part 15 rules fosters rapid development and deployment of products based on industry standards. As Intel showed, the pace of innovation for unlicensed wireless LAN devices has been dramatic.[5]

Third, unlicensed use can rely on user funding, which is important given current low levels of corporate capital expenditure. Recently, Craig Mundie, Chief Technical Officer of Microsoft, highlighted this advantage in testimony before the Senate Commerce Committee.[6]

Finally, the unique aspects of this spectrum-- the probable synergies with DTV and the good propagation characteristics of the VHF and UHF bands—could generate

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[2] Satellite Industry Association at 12, Shure at 4.
[3] Joint Comments of the Association for Maximum Service Television, National Association of Broadcasters and the Association of Public Television Stations (NAB), Attachment B at 16.
[4] Shure at 13, IEEE at 7.
[5] In 1999, 802.11 PC cards and enterprise access points were available. Today, users can choose between 802.11a, 802.11b, 802.11g or dual-band products for enterprise, small offices, or homes. Jupiter Research reports that .57% of U.S. companies already support 802.11 networks, with an additional 22% planning to implement and support this technology in the next 12 months....[S]mall businesses (with less than $10 million in annual revenue) are leading deployment, with 83% stating that they either support 802.11 networks today or plan to in the next 12 months… 71% of U.S. large businesses (defined as those generating $100 million or more in annual revenue) are supporting 802.11 networks or will do so in the next 12 months. Intel at 5.
[6] Testimony of Craig J. Mundie, Microsoft Corporation, before the Senate Committee on Commerce, Science and Transportation, Hearing on "The Government's Role in Promoting the Future of the Telecommunications Industry and Broadband Deployment," October 1, 2002, p. 6.

important benefits[7] including the acceleration of the DTV transition,[8] "last mile" broadband services;[9] and new service to rural consumers.[10]

Contrary to the suggestion of some commenters,[11] unlicensed use on these bands should not be associated solely with Wi-Fi. As the New American Foundation (NAF) explains:

> [T]he spectrum allocated to radio and TV broadcasters is extremely well suited for passing through objects such as buildings, weather, and foliage… Consider a potentially common unlicensed application: wirelessly linking a next-generation (very-high-speed) broadband connection from the street curb into every nook and cranny in the house…. if every physical obstacle such as a wall or person inside a house, or a tree or rain storm outside slows down or stops a wireless signal from getting from the street curb to the communications device in the home, then the value of unlicensed wireless is seriously diminished. … Similarly, consider unlicensed wireless as a last-mile rural broadband solution. If the signals cannot easily pass through trees, houses, and bad weather the way broadcast signals can then the value of unlicensed wireless as a last-mile solution is significantly reduced. Unlicensed wireless Internet Service Providers report that this is a huge barrier to service provision in many rural areas.[12]

III. SIGNIFICANT SPECTRUM IS AVAILABLE.

A. LOW RISK VACANT CHANNELS ARE AVAILABLE.

Even by initially focusing on channels 5-13 and 21-51 (excluding 37) the FCC could free up significant spectrum for use by unlicensed devices and address many of the concerns raised by the commenters. For example, in the San Francisco Bay Area limiting

[7] CEA at 2, AT&T at 2, Radio Shack at 3, NAF at 3, ITI at 2, Wi-Fi at 2, Intersil at 2, Intel at 4.
[8] CEA at 7, Intel at 6.
[9] AT&T at 3, NAF at 3, 7.
[10] Intel at 8, NAF at 3, 7.
[11] Satellite Industry Association at 12, Shure at 4.
[12] NAF at 6-7.

use to the above channels would still provide 11 vacant channels which could increase to 23 channels as analog TV is phased out.[13]

Also, many commenters expressed concerns about potential interference to non-TV broadcast licensees. The above approach would address these concerns. Recommending an approach similar to that stated above, Motorola suggested that the primary focus for unlicensed use should be the 76-216 MHz, (5-13) and 512-698 MHz (21-51) bands.[14]

B. SEPARATION DISTANCE AND RECEIVER INTERFERENCE REQUIRE REALISTIC ASSUMPTIONS.

1. Separation distance.

Intel's calculations demonstrate that in the UHF range separation distances are less than 3 miles. Determination of separation distance must be based on realistic RF characteristics of devices designed for the use in the broadcast TV environment, and not upon the RF characteristics of devices used in other environments. Intel's estimate of vacant channels appropriately considers that unlicensed devices would operate at separation distances significantly less than the separation distances of distant co-channel TV receivers.15

In contrast, in its technical appendix, the NAB calculates the separation distance required around an unlicensed device using margins and

[13] Within a typical Metropolitan area multiple vacant TV channels will exist, therefore before two or more unlicensed devices can communicate they will need to select the same vacant channel. In general the set of channels identified as vacant will be similar but not necessarily identical. To facilitate selection of the same channel a protocol similar to the Automatic Link Establishment (ALE) a protocol used by HF communication systems for many years could be used.

[14] Motorola at 1.

[15] As any unlicensed systems must use vacant channels the devices must be suitably designed to mitigate interference to and from adjacent TV channels. As a result arguments against the use of unlicensed devices

assumptions that are unrealistically conservative. The very large separation distance that it says is required around an unlicensed device is the main technical issue NAB raises.[16]NAB provides the following separation distances:[17]

NAB Separation Distance Calculations	
Channel # and Frequency	Separation Distance
2 @ 54 MHz	336 Miles
13 @ 210 MHz	213 Miles
14 @ 470 MHz	129 Miles
69 @ 800 MHz	76 Miles

But these calculations are based on the following misleading and unnecessarily restrictive NAB assumptions:

- Transmitter power of 100 milliwatts (40 milliwatts within a TV channel). The devices envisioned by this proceeding will have operating parameters defined by their operating environment, including transmitting power. For many applications Intel believes a more realistic value for TX power will be 1 milliwatt. This is 14 dB less than the values used by NAB.

- Line of sight propagation. The radio horizon is at most 13.6 miles, but the NAB calculated ranges are in excess of 76 miles.

- A location variability factor of 10db at VHF and 15 dB at UHF. The location variability factor is only applicable when terrain factors are considered. It should not be applied to LOS range calculations where by definition there is no terrain obstruction.

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based on co-channel interference are largely irrelevant and confusing when applied to the TV channels utilized within the coverage area of the unlicensed devices.

[16] As any unlicensed systems must use vacant channels the devices must be suitably designed to mitigate interference to and from adjacent TV channels. As a result arguments against the use of unlicensed devices based on co-channel interference are largely irrelevant and confusing when applied to the TV channels utilized within the coverage area of the unlicensed devices.

[17] NAB, Attachment A, Table 3-6.

The unrealistic nature of the NAB's assumptions is illustrated by its contention that a 100 milliwatt unlicensed wideband device operating at 54 MHz requires a separation range of 336 miles.[18]

This estimate of the necessary separation distance is substantially greater than the separation range of only 284 miles for a class VL transmitter, which transmits at 100,000 watts and has a power 60 dB greater than the hypothetical unlicensed device. In addition, the class VL transmitter operates with an antenna height of 492 feet (150 meters) versus 20 feet for the unlicensed device.

Intel has recalculated separation distances using the adjusted values for power (–30 dBW) and location variability (0dB and the classic LOS propagation loss formula

Loss = 36.6 + 20 Log Frequency (MHz) + 20 Log Distance (Miles)

Intel Separation Distance Calculations	
Channel # and Frequency	Separation Distance
2 @ 54 MHz	12.23 Miles
13 @ 210 MHz	7.9 Miles
14 @ 470 MHz	2.8 Miles

[18] NAB, Attachment A, para. 3.4.3.

69 @ 800 MHz	1.65 Miles

With separation ranges of 1.7 to less than 13 miles and a TV Grade B coverage contour of typically 85 miles, an unlicensed device, within the protection distance of a TV receiver, would operate in a signal environment similar to the TV receivers that are to be protected.

Therefore, a co-channel monitor could prevent transmission by the unlicensed device whenever a TV signal is detected on the channel selected by the unlicensed device.

2. Receiver Interference.

To address the case where an unlicensed device is hidden from the TV transmitter (but not from the receiver) or that the TV receiver has a high gain antenna, the unlicensed device could be equipped with a co-channel monitor. This co-channel monitor could be designed with a narrowband IF or baseband filter centered on a carrier or subcarrier of the TV signal. This design would provide enhanced sensitivity for detection of active TV channels. An easily implemented 6 KHz filter could give 30 dB greater sensitivity relative to the 6 MHz bandwidth of the TV signal. This 30 dB value would more than compensate for a high-gain antenna on a TV receiver.

The NAB also suggests an additional interference protection margin is necessary because of the cumulative interference of multiple unlicensed devices.

The margins suggested by NAB are based on the simultaneous operation of all unlicensed devices that could be located equidistant around a circle of diameter equal to the separation distance. Intel believes this situation is easily avoided and hence cumulative interference does not require an additional interference margin.

In an appropriately designed system the system parameters can be set so that any unlicensed devices would only operate on vacant TV channels at ranges sufficiently in excess of the separation distance so that they would not contribute to the TV receiver interference.

This would require that the detection threshold of the narrow band channel monitoring capability be adjusted to detect, and thereby avoid, TV channels beyond the range from a TV transmitter at which an acceptable TV picture can be received. As an example setting the detection threshold to allow detection of TV stations at a range 20% beyond the coverage contour of a TV station would allow detection when the unlicensed device is 17 miles distant from a co channel TV receiver. This is greater than the required separation distance of 1.7 to 13 miles and accumulative effects will be insignificant.

The NAB analysis also unrealistically assumes that unlicensed devices would use a waveform compatible with 802.11b Wi Fi devices. By recognizing the need to operate in channels adjacent to active TV channels, a modulation waveform could be selected to minimize emissions in the adjacent channel. This

effect could be achieved with an OFDM signal similar to that used in 802.11a or g, but scaled to the narrower bandwidth of a TV channel. Undesired emissions in the adjacent TV channel could then be easily reduced to a level at least 35 dB below the level of the intended emissions.

C. UNLICENSED DEVICES SHOULD BE FREE TO OPERATE BASED ON THE CHARACTERISTICS OF THEIR SPECIFIC LOCATIONS.

Some commenters suggest a regulatory differentiation between either urban and rural devices or indoor and outdoor devices as a means to allow higher power devices to be used for economical long range coverage in rural areas where there is a high predominance of trees.[19]

Intel agrees that allowing higher power operation is desirable in some cases. However, the increasing use of wireless interconnect capabilities within mobile devices used a variety of ways, such as laptop computers, makes it highly undesirable to limit the operation of unlicensed devices to particular locations. Such restrictions would negate the great value of having context-aware radio technology in the first place.

Therefore, Intel recommends that regulatory treatment of unlicensed devices not vary with their location. Instead, the rules authorizing the use of devices should be based on the broadcast TV operating environment. The rulemaking should address and determine what the specific operating parameters should be used for a given TV broadcast environment.

For example, due to favorable propagation characteristics, the lower frequencies are preferred for operation in the rural applications. Also in the rural areas it is claimed

that VHF TV frequencies are not fully utilized and they are therefore readily available. Channel monitoring capability built into the unlicensed device could be used to determine the availability of VHF channels to permit higher power transmission on VHF channels when available.

IV. THE NECESSARY TECHNOLOGY IS FEASIBLE.

A. THE NECESSARY TECHNOLOGY IS COST EFFECTIVE AND EXISTS TODAY.

Unlicensed devices will need to be able to identify which TV channels in a particular location are vacant. The technology to accomplish this is cost effective and exists today. (From a technical perspective, the problem is actually the inverse, i.e., the reliable identification of active channels.) Several commenters assert that reliable detection of vacant TV channels is problematic. These assertions are evaluated below.

- Some Commenters argue that the necessary smart technology is not yet Ready.[20]

Actually, most WLAN devices and even low cost TV receivers have long had the built-in capability to monitor a set of frequencies and identify those that are active. In addition ,many wireless receivers including unlicensed devices have a built-in Received Signal Strength Indicator (RSSI) that can be used to measure the strength of the signal in each TV channel. This technology is mature, readily available and affordable.[21]

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[19] See the comments of New Gen Wireless, David Hughes, Barry Buchholz, Kerry Penland and Keith Schmidt.

[20] Shure at 2, 11, AMTA at 5, Lans at 6.
[21] IEEE at 7, Wi-Fi at 3.

- GPS will not work.[22]

This argument is misplaced, because most unlicensed devices need not know the precise location to prevent interference to TV receivers. Other techniques such as channel scanning and real time channel monitoring are equally if not more effective. But location based solutions will likely be well suited to those applications requiring the maximum possible range.

GPS or any other available technology should not be precluded as a means of determing vacant channels and set power levels for unlicensed devices when establishing a communications channel.

- Smart radios and other technology are too expensive.[23]

Many of the attributes required for a smart radio can be found in low cost devices today.

For example, the channel scanning function used to set up local channels in TV receivers requires a digital frequency synthesizer that can rapidly scan the entire band and mark the appropriate channels. This scanning function is standard in virtually all modern TV receivers regardless of price as well as in all WLAN devices.

NAB tries to demonstrate that unlicensed devices having a capability to monitor occupancy of the TV spectrum would make the unlicensed devices too costly to be economically viable.[24] Its analysis assumes that an additional TV tuner and associated glue electronics will be required in the unlicensed receiver. This additional tuner is assumed to be of the same nature as the TV cards that are available to plug into a

[22] Shure at 13, IEEE at 7, Motorola at 2, 5-,7, San Francisco at 5, LMCC at 8, PA at 8), Intersil at 8.
[23] NAB,Attachment A ,GPS at 9, Shure at 13.

personal computer. These boards are estimated to cost $100 at the retail level. But the functionality of these boards, which require real time conversion from a raster scan TV signal to the bit map use by the PC, is much greater than required of a spectrum monitoring device. The NAB analysis also ignores the fact that the agile receiver used by the unlicensed device could also be used in a time-shared manner with the spectrum monitoring function.

Thus, the incremental cost could be small and easily justified based on the increased range that would be achievable due to the favorable propagation characteristics of the TV broadcast band.

The NAB estimate is noteworthy because it contradicts earlier estimates. In another study prepared for the NAB by the same consultant, specifically studying the cost of DTV tuners, the cost of a DTV tuner is projected to drop from $100 to $9 by 2006.[25]

- Listen before talk (LBT) will not work for TV bands.[26]

The contention that LBT will not work assumes that the licensed user's signal may be excessively attenuated at the unlicensed receiver with respect to the signal received by the licensed user. It then assumes that the channel monitoring capability of the unlicensed device operates at the same bandwidth as the licensed signal and that detection of the attenuated signal will not be possible. As a result some respondents claim that LBT would not work. Given the short range over which an unlicensed device can

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[24] NAB, Attachment A.

[25] Assessment of the Impact of DTV on the Cost of Consumer Television Receivers" submitted by Maximum Service Television (MSTV) and National Association of Broadcasters (NAB) as Written Ex Parte Presentation in MM Docket No. 00-39 http://www.lipoff.org".

[26] GPS at 4.

cause interference to a TV receiver, this scenario would occur as a result of localized deep shadowing or moderate shadowing combined with multipath fading. Both propagation theory and practice indicate that the differential path loss due to localized deep shadowing would be less than 30 dB for at least 99% of locations.

The use of narrowband signal monitoring alone can yield a 30 dB gain which would be sufficient to enable a device to detect TV transmissions in locations in which there is deep shadowing. Multipath fading is time and position dependent and the low detection threshold combined with the time averaging technique advocated by Shared Spectrum can be used to increase sensitivity by a further 10 dB thereby ensuring detection of faded TV signals for at least 99% of time at 99% of locations.

Intel does not agree that listen before talk protocols would be insufficient when the spectrum holes would normally be filled by TV broadcast stations, or other wideband signals with well defined signal characteristics, as these can be easily monitored with highly sensitive narrow band monitors. Other commenters agree that LBT will work.[27]

Multiple commenters state that the technology needed to implement sharing of TV bands by unlicensed devices is modest and exists today.[28] Contrary to commenters who believe that the existing technology is inadequate to the task, the SDR Forum, the leading industry organization on SDR technology states:

[27] SharedSpectrum at 1,3, IEEE at 6, Wi-Fi at 3.
[28] IEEE at 7; Wi-Fi Alliance at 3, Intel at, SDR Forum at 5, 6.

> Opportunistic use requires, first, the identification of white space in which to operate. As identified in the Notice, this can be accomplished by having radios (or the network) determine their geographic location, and cross-check that location with known radio transmissions through a centrally-located database. This can also be accomplished by having radios themselves monitor the RF environment to detect the interference environment around them. Once white space is identified, radios would adopt their performance (frequency, power, etc.) accordingly. Advanced radio technologies—and, increasingly, SDR technologies—are already performing many of these tasks[29]

The SDR Forum also states that "the technology required to implement the kinds of sharing mechanisms envisioned in the Notice are quite modest compared to the technology already incorporated in radio devices today."[30]

B. INTERFERENCE TEMPERATURE IS NEITHER NEEDED NOR APPLICABLE.

Some commenters mistakenly contend that problems with "interference temperature" represent an obstacle to use of the TV bands by unlicensed devices.[31]

They state that reliance on interference temperatures would require the Commission to "conduct comprehensive studies of the noise floor"[32] before authorizing such devices.

[29] SDR Forum at 5.
[30] Id at 6.
[31] NAB, Attachment B at 19, LMCC at 5, Alaska Broadcasters Association et al at 5.
[32] Cingular at 5.

The interference temperature is a proposed technique that would ensure that additional users of common spectrum do not cause an increase in the ambient interference level that would be detrimental to existing users of that same spectrum. However, because the current situation will rely on avoidance of a common channel, the interference temperature concept is not applicable here.

The TV bands at issue in this proceeding are a primary service that has been analyzed and characterized for half a century of operation.

This means that parameters can be readily crafted to assure non-interfering operation. As LMCC puts it, the television broadcast stations:

> are transmitting continuously at a constant power and, therefore, presumably would be detectable by the opportunistic unlicensed devices envisioned by the FCC[33]

Motorola also recognizes the obvious difference between the "interference temperature" proposal and this proceeding.

While it believes "that the concept of interference temperature proposed in the Task Force Report is fraught with difficulty,"[34] As stated by NAF, "The Commission should not delay the deployment of new unlicensed uses in order to develop the concept of Interference Temperature."[35]

V. UNLICENSED DEVICES COULD ACCELERATE THE DTV TRANSITION.

[33] LMCC at 6.
[34] Motorola at 9.

Notwithstanding some commenters' fears, unlicensed devices could accelerate the DTV transition by creating complementary benefits for consumers from ancillary products and services. Such fears underestimate the flexibility of digital technology in contrast to the fixed, single service nature of its predecessor, analog TV. With DTV, broadcasters will have great flexibility to deliver "ancillary services" over their digital channel. This flexibility means that DTV could interact and benefit from a raft of new devices in addition to DTV receivers.

Similarly, DTV manufacturers could also benefit from numerous additional sources of DTV signals to receive and interact with in addition to over-the-air DTV stations.

Ironically, it is the "Open Architecture"[36] of broadcast DTV, similar to that of the PC industry, which will likely facilitate "interlinking" innovation. Interlinking is a feature of many high tech markets such as the PC industry where there are strong complementarities between related products and services.

For example, PC manufacturers and manufactures of peripheral devices such as printers, scanners, digital cameras, etc., all benefit from an increase in variety and quantity of complementary products.

This interlinking of the products of multiple suppliers can generate a "bandwagon effect."[37] As articulated by NAB's economic consultant, Mr. Rohlfs:

> Interlinking always bestows direct benefits on consumers, who thereby enjoy bandwagon benefits with respect to a larger population. These benefits are almost always quite large.[38]

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[35] NAF at 19.
[36] NAB, Attachment B at 9.
[37] Bandwagon Effects in High-technology Industries; MIT Press 2001, Jeffery H. Rohlfs at 34.
[38] Id. at 35.

Importantly, CEA representing the TV set manufacturers recognizes such win/win benefits could apply in the DTV case:

> If the Commission allows unlicensed use of vacant TV channels it could provide a win-win-win for broadcasters, TV manufacturers, and new 700 Mhz licensees by enabling and providing support for new service, including some of which are complementary to DTV. For example, CEA is eager to explore the technical feasibility of services such as interactivity through a return path for broadcast station or wireless video program home distribution."… "There are innovative potential uses for unlicensed devices that could foster new functionalities for broadcast DTV in particular.[39]

VI. HARM TO TV BROADCASTING WOULD BE INSIGNIFICANT.

Some commenters contend that the current "fluid and fragile" state of the DTV transition is the wrong time to introduce unlicensed devices.[40]

In particular, they contend "unlicensed devices could derail the digital transition"[41] and that "the Commission should be focusing on way to facilitate the DTV transition, not exploring new shared uses of broadcast spectrum"[42] Some commenters also state that the public good characteristics of broadcasting make it difficult to estimate its value and argue against creating any additional risk from interference.[43]

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[39] CEA at 7.
[40] NAB at 8, Cox at 2, Shure at 11, Rural 700 at 7, Sinclair at 1, Alaska at 1.
[41] NAB at 8.
[42] Sinclair Broadcast Group at 1.
[43] Id at 5-7.

Such arguments ignore the fact that most U.S. households get their primary reception of broadcast signals from cable or satellite systems. [44] But more fundamentally, they ignore that use of these bands by unlicensed devices will be premised on non-interference to the TV broadcasters.

These devices will be able to readily accommodate any or multiple changes of the frequencies used by a particular TV broadcaster.

Because the unlicensed device would continuously monitor the spectrum for broadcast services, any change in channel usage by a broadcaster would cause the unlicensed device to move to a different channel.

The feasibility of developing parameters to share this space is demonstrated by the experience of shared use of these bands by landmobile and wireless microphones. LMCC observed:

> there is a more than thirty-year track record confirming that land mobile facilities licensed and operated in accordance with the well-established regulatory structure of Subpart L of the Part 90 rules can co-exist compatibly with television broadcast stations.
> To the best of LMCC.s knowledge, there has not been a single reported, much less proven, instance of land mobile interference to broadcast operations in any market during the entire thirty-year sharing period. The reverse also is true. The numerous public safety, business and industrial systems sharing the use of this spectrum have enjoyed interference-free operation. In that sense, these services have been able to operate on an effectively transparent basis; neither is aware of the other and together they make more intensive use of valuable spectrum resources in key urban areas.[45]

Similarly, wireless microphones also demonstrate the ability of devices to coexist in the TV bands. As stated by the NAF:

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[44] Tom Hazlett wrote:

> Lost in the tragic events of Sept. 11 was an inadvertent experiment in radio spectrum policy: Virtually every New York City television station was knocked off the air.Emergency workers issued an urgent call to replace downed communications. But there was no need to get broadcast

> It's not unusual to have a large event where many dozens of wireless microphones are used, each operating on a different frequency. At a professional football game, for example, coaches (e.g., to talk to a quarterback's in-helmet receiver), vendors, security personnel, half-time performers, reporters, referees, and maintenance crew may all use wireless microphones on different unused channels. These wireless microphones can transmit up to 1,000 feet (close to a half mile in diameter), farther than the typical unlicensed Wi-Fi transmitter. Success of this limited use provides adequate "proof of concept" necessary to justify expanding unlicensed wireless uses within the band. Indeed, the Commission itself recently took further steps to expand the uses in this band. On November 13, 2002, the FCC released a Report and Order granting similar capabilities, but for audio and video, to Wireless Assist Video Devices (WAVD).[46]

VII. CONCLUSION

For the reasons set forth above, Intel recommends that the Commission expeditiously begin a rulemaking proposing to permit unlicensed use of the broadcast television frequencies.

At a minimum, the rulemaking should consider authorizing unlicensed operation within the bands 76-216 MHz (5-13), 512-608 MHz (21-36), and 614-698 MHz (38-51), by cognitive devices whose operating parameters are defined as a function of their broadcast TV environment.

Mike Chartier
Director of Regulatory Policy

TV back; local residents watching cable or satellite feeds were unaware of disruption. [44] Thomas W. Hazlett, "We Don't Want Our DTV;" Wall Street Journal August 8, 2002.

[45] LMCC at 9.

[46] NAF at 13.

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