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

In the Matter of	)	
	)	
Mass Media Bureau Seeks Comment on	)	MB Docket No. 04-210
Over-The- Air Broadcast Television Viewers	)	
	)	
	)	

COMMENTS OF INTEL CORPORATION

Introduction

Intel Corporation hereby submits this comment in response to the above referenced Public Notice. 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.

Intel supports the Mass Media Bureau's proposed plan to accelerate the digital television transition. By providing a date certain by which broadcasters would return their analog channels, this plan would enable consumers and other affected interests to plan towards a certain end date. It would also free valuable spectrum. Channels 52-69 represent 108 MHz in the 700 MHz band—24 MHz for use by public safety and 84 MHz for use by advanced wireless services. In channels 2-51, the analog channels would be available for auction. Indeed, if Intel were to recommend any change to the Mass Media

Bureau plan, it would be to move the date certain forward. 2009 is almost five years away.

This comment summarizes and excerpts from the June 9, 2004 testimony of Patrick Gelsinger, Chief Technical Officer of Intel, before the U.S. Senate Commerce Committee regarding the completion of the digital television transition. Mr. Gelsinger's testimony is appended to this comment and addresses several issues relevant to the Commission's implementation of the digital television transition including the promise of innovation in radio frequency technology, the impediment that artificial spectrum scarcity poses to such innovation, the opportunity for specific spectrum reforms and the unique value of the TV spectrum for wireless broadband uses. This last point bears special emphasis and comprises the balance of this comment.

The Value of the DTV Spectrum

Given its unique propagation characteristics the television spectrum would be particularly useful for wireless broadband communications. The frequencies currently available for wireless broadband are at or above 2 GHz. In contrast, TV channels are much lower in frequency—from 700 MHz all the way down to 76 MHz.[1]

The ability to use TV frequencies would accelerate the growth, expand the reach, reduce the cost and improve the quality of broadband wireless service. Even when compared to the 2.5 GHz frequencies—the best alternative available to WiMAX in the U.S.—the TV frequencies make it far more economical to serve rural areas and to

[1] 76 MHz, VHF Channel 5, is the lowest channel considered in the FCC Unlicensed Operation in the TV Broadcast Bands NPRM, and hence potentially available for wireless broadband. Broadcast television in the US begins at 54 MHz, channel 2.

compete with wireline broadband alternatives in urban areas. For a given level of quality to a given coverage area, these frequencies require fewer antennas and use less power.

Chris Knudsen, formerly of Vulcan Capital, estimated the capital and operational costs of providing wireless broadband service in Bellevue/ Seattle, Washington using 2.6 GHz. Then he estimated what happened to the capital and operating costs of providing wireless broadband service to the same territory using 700 MHz. He found that using TV frequencies required only 1/3 to ¼ of the cell sites. Even more importantly, it required about only ½ to 1/3 of the capital to reach positive free cash flow. [2]

Intel's analysis of the advantages of 700 MHz *vis a vis* 2.5 GHz frequencies are similar to those of Vulcan Capital. For a given level of quality to a given coverage area, the 700 MHz frequencies require fewer antennas and use less power than 2.5 GHz frequencies. To cover the same geographic area we estimate that using 2.5 GHz frequencies would approximately result in an 11db drop in signal strength. This drop in signal strength would require 4 to 5 times as many base stations to achieve equal geographic area coverage, for a given air interface and bandwidth. Of course, one could "make up" for this loss by introducing innovative antenna enhancements or increasing the transmit power at 2.5 GHz. The former is being done in the WiMAX standard but at increased system costs. The latter—a greater than ten-fold increase in transmit power--is not feasible. Receiving devices would have to exceed FCC power limitations to

[2] Chris Knudsen, "Lower Frequencies Improve the Subscriber Operating Model," June 3, 2004, WCA Convention, Washington, D.C. For interpretation and analysis of Knudsen's work see slides presented by Pierre de Vries, Chief of Incubation at Microsoft at the NTIA Spectrum Management Forum held in Santa Clara on March 8, 2004.

successfully transmit back to the base station.

Also, because TV frequencies better penetrate walls, they would be less dependent on line of sight transmission to outdoor antennas. Besides the value that consumers could derive from portability, indoor use would also facilitate self-installation, avoid expensive truck rolls and make it attractive to launch market wide marketing and advertising campaigns. And indoor service to untethered laptops will accelerate the integration of WiMAX radios into microprocessors thereby generating economies of scale in the production radios.

While perhaps obvious, the cumulative impact of these differences on the feasibility of providing wireless broadband in rural areas bears emphasis. The upshot for some rural areas is that opening the TV frequencies to wireless broadband use would likely make the difference between a high quality wireless broadband alternative and none at all. In simple terms, frequencies below 1GHz are premier beach front property. We believe the allocation of these frequencies for licensed and unlicensed use could dramatically accelerate broadband deployment with nationwide benefit but particular benefit toward rural and underserved areas.

The potential benefit of using the television spectrum for wireless broadband purposes can be illustrated by considering the specific case of WiMAX in more detail. Like Wi-Fi (802.11), WiMAX is an IEEE standard (802.16-REVd) that is expected to be accepted as a global standard. WiMAX is expected to be deployed for both licensed use (like Cellular) and unlicensed (like Wi-Fi) applications. With the latest in modulation techniques (such as OFDM) and antennae techniques (such as MIMO) WiMAX has been architected to cost effectively deliver broadband services. Before yearend we expect to

see radios using the WiMAX to provide wireless broadband access to fixed locations and in 2005 we expect the mobile version of the specification (IEEE 802.16e) to be complete. In clear, unobstructed conditions (line of sight), a WiMAX transmitter can reach users at distances up to 50 kilometers away using a fixed, outdoor-mounted antenna (similar to a small satellite dish). Portable broadband services targeted primarily at laptop users with integrated WiMAX radios will be provided using networks similar to those deployed for mobile voice today.

A wireless ISP using a small 802.16 installation could provide sufficient shared data rates (up to 75 Mbps) to simultaneously support more than 60 businesses with T-1 style connectivity and hundreds of homes DSL-speed connectivity.[3] In 2006 WiMAX will begin to be deployed in laptops. Intel has announced that it intends to put WiMAX radios in its chipsets by 2007—just as it has done with Wi-Fi in its Centrino ™ chipsets beginning in 2003.

WiMAX is expected to improve bandwidth and service while radically reducing radio costs. The result WiMAX should dramatically spur wireless broadband deployment as a third broadband pipe augmenting DSL and Cable. It holds special promise in rural areas or developing markets where service providers haven't deployed wired infrastructure. Countries around the globe are already beginning pre-standard trials of WiMAX.

Conclusion

In sum, Intel supports the Mass Media Bureau plan for expediting the DTV transition, because it would serve the larger public interest by fostering more highly

[3] WiMAX Press Teleconference Script, April 8, 2004.

valued use of this spectrum. In particular, the ability to use TV frequencies would accelerate the growth, expand the reach, reduce the cost, improve the quality of broadband wireless service and make it far more economical to serve rural areas and to compete with wireline broadband alternatives in urban areas.

Respectfully submitted,

INTEL CORPORATION

By: /s/ Peter Pitsch

Peter K. Pitsch

Intel Government Affairs
1634 I ST, N.W. Suite 300
Washington, DC 20006
(202) 628-3838

Before the
Committee on Commerce, Science and Transportation
United States Senate

Hearing on "Completing the Digital Television Transition"

Statement of Patrick P. Gelsinger
Chief Technical Officer
Intel Corporation

June 9, 2004

Patrick P. Gelsinger
Chief Technical Officer
Intel Corporation

"Completing the Digital Television Transition"

Executive Summary

I am Patrick Gelsinger, Chief Technical Officer of Intel Corporation. Today, I want to address four topics: the coming revolution in radio technology, the need for spectrum policy reform, the value of TV spectrum for wireless broadband applications, and three possible ways of making TV spectrum available for new uses.

The Coming Radio Revolution. Moore's Law is going to revolutionize Marconi's transmitter. Phenomenal "silicon" improvements will produce two profound effects in radio technology. First, radios will continue to get "digitized." The result will be that every electronic device will include a radio and more importantly there will be an explosion in the number of wireless devices used for communication, commercial, medical, entertainment and numerous other purposes. Radio communication, like music files or video DVDs, will become another function on your computer. Second, additional processing power will make radios much smarter and more flexible. Once the radio itself is primarily digital, it will be able to change radio air interface standards by downloading different software. One new radio technology Intel is particularly excited about is WiMAX, an IEEE standard (802.16-REVd) that has been architected to cost effectively deliver broadband services.

The Need for Spectrum Reform. The biggest obstacle facing the coming radio revolution is artificial spectrum scarcity created by over reliance on "command and control" spectrum management. Two promising spectrum management techniques can serve as a guide for reform— the grant of increasing flexibility to exclusive licensees and the creation of largely unregulated, unlicensed bands. The flexible licensed approach fostered enormous innovation and investment on the PCS spectrum and unlicensed use created the Wi-Fi revolution at 2.4 and now 5 GHz. These techniques have succeeded because they give users more freedom to innovate and respond to changing market forces without seeking government approval. Intel actively supports both types of reform.

The value of TV Frequencies. The ability to use TV frequencies would accelerate the growth, expand the reach, reduce the cost and improve the quality of broadband wireless service. Even when compared to the 2.5 GHz frequencies—the best alternative available to WiMAX in the U.S.—the TV frequencies make it far more economical to serve rural areas and to compete with wireline broadband alternatives in urban areas.

For a given level of quality to a given coverage area, the TV frequencies require fewer antennas and use less power than 2.5 GHz frequencies. To cover the same geographic area we estimate that using 2.5 GHz frequencies would

approximately result in an 11db drop in signal strength. (For non engineers, a simple rule of thumb is that every 3 dB of additional loss represents a factor of two difference in signal strength.) This drop in signal strength would require 4 to 5 times as many base stations to achieve equal geographic area coverage, for a given air interface and bandwidth. Of course, one could "make up" for this loss by introducing innovative antenna enhancements or increasing the transmit power at 2.5 GHz. The former is being done in the WiMAX standard but at increased system costs. The latter—a greater than ten-fold increase in transmit power--is not feasible. Receiving devices would have to exceed FCC power limitations to successfully transmit back to the base station.

Also, because TV frequencies better penetrate walls, they would be less dependent on line of sight transmission to outdoor antennas. Besides the value that consumers could derive from portability, indoor use would also facilitate self-installation, avoid expensive truck rolls and make it attractive to launch market wide marketing and advertising campaigns. And indoor service to untethered laptops will accelerate the integration of WiMAX radios into microprocessors thereby generating the efficiencies from Moore's Law.

<u>Three Possible Reforms of the TV Spectrum</u>. If the United States were to move forward expeditiously to make this spectrum available for new wireless broadband services, the resulting gains to American consumers, especially in rural areas, would be stupendous and U.S. based companies would achieve important first to market advantages.

1. **Intel supports the FCC's recently opened Notice of Proposed Rulemaking considering unlicensed use on vacant television channels. Given the current limitations of television receivers, most of the TV channels in any geographical area are unused. Advanced radio techniques, however, permit unlicensed use, without any adverse impact on the broadcasters. Indeed, because the channels "in use" seldom changes, agile radios may be able share these frequencies. Intel has and continues to do extensive due diligence to demonstrate exactly how unlicensed devices can access vacant TV channels with no significant risk to over-the-air broadcasters.**
2. **Intel believes that the Mass Media Bureau has proposed a very constructive plan. It would enable consumers and a myriad of other affected interests to plan towards a certain end date, January 1, 2009. It would also free valuable spectrum. Channels 52-69 represent 108 MHz in the 700 MHz band—24 MHz for use by public safety and 84 MHz for use by advanced wireless services. *Indeed, if I were to recommend any change to the Mass Media Bureau plan, it would be to move the date certain forward. 2009 is almost five years away.***
3. **Intel believes that the FCC should explore giving broadcasters incentives to turn back their channels in advance of the 2009 for a *pro rata* share of the auction proceeds. This approach would compensate broadcasters for clearing before they would be compelled to return their analog channels. Under this approach, they would have strong incentives to voluntarily clear their channels early. Their compensation would be set by the marketplace. If the**

Mass Media Bureau plan is the "stick," a linked auction could be the "carrot." The two approaches could be highly complementary.

Before the
Committee on Commerce, Science, and Transportation
United States Senate

"Completing the Digital Television Transition"

Statement of Patrick P. Gelsinger
Chief Technical Officer
Intel Corporation
June 9, 2004

Introduction

I am Patrick Gelsinger, Chief Technical Officer of Intel Corporation. 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. Our mission is to accelerate the convergence of computing and communications through silicon-based integration.

I manage much of Intel's research and development activities including those targeted at developing radio innovations. During my 24 years at Intel, I have worked in a variety of areas including microprocessor and computing platform (PC) design and the development of wired and wireless communications technologies. As CTO I also head Intel's technology policy and standards activities including content protection and digital rights management and spectrum policy and planning.

It is an honor to appear before this Committee to testify on whether and how the digital television (DTV) transition should be expedited. Let me begin by saying that Intel has long recognized the great potential of DTV and has invested significant R&D in DTV including the development of DTV tuners for PCs. In 1998

Intel **and the PBS teamed up to deliver "Frank Lloyd Wright"—the first digital television trial that allowed viewers to obtain Web-based content while watching TV. Also, Intel's experimental station KICU, broadcasting from Intel's headquarters in Santa Clara, was one of the first over-the-air DTV broadcasters in the Bay area.**

Today, I want to address four topics:

- **The coming revolution in radio technology,**
- **The need for spectrum policy reform,**
- **The value of TV spectrum for applications such as wireless broadband, and**
- **Three possible ways of making TV spectrum available for new uses.**

<u>Moore's Law and the Coming Radio Revolution</u>

Moore's Law is going to revolutionize Marconi's transmitter. Over 30 years ago, Intel founder Gordon Moore predicted that the density of transistors would double roughly every 18 months. These improvements in density increase speed and reduce cost. In the past 30 years, microprocessors have increased 1,000 times in speed and decreased 100 times in cost. If Moore's Law continues to hold, as we expect it will, by 2010 a single microprocessor will contain ten billion transistors and process a trillion instructions per second.

These phenomenal "silicon" improvements will produce two profound effects in radio technology. First, radios will continue to get "digitized." Increasingly, radios will encode information digitally, increasing the robustness of its

transmission and allowing it to be processed by general purpose microprocessors. Radio communication, like music files or video DVDs, will become just another standard function on your computer. As Moore's law produces still more powerful chips, the percentage of the chip needed to provide radio communications will become trivial. Only somewhat facetiously, I call it "Radio Free Intel." The result will be that every electronic device will include a radio and more importantly there will be an explosion in the number of wireless devices used for communication, commercial, medical, entertainment and numerous other purposes.

Second, additional processing power will make radios much smarter and more flexible. Separate circuits will not be needed to decode an AM, FM, GSM, CDMA, NTSC or DTV signal. Once the radio itself is primarily digital, these functions can be added by downloading different software. The FCC recognized this eventuality when it enabled these flexible "Software Defined" radios or SDRs.

In addition to making radios more flexible, additional processing power will enable radios to alter their operating parameters to make the most efficient use of the available frequencies. Today's cell phones can scan multiple frequencies, switch from GSM or CDMA air interfaces and when roaming choose which carrier offers the best business arrangement. Verizon states that its "CDMA transmitters adjust power levels 800 times per second—to ensure that only the minimum power necessary is used to maintain a connection."[4]

One new radio technology Intel is particularly excited about is WiMAX. Like Wi-Fi (802.11), WiMAX is an IEEE standard (802.16-REVd) that is expected to be

[4] Comments of Verizon Wireless in Facilitating Opportunities for Flexible, Efficient and Reliable Spectrum Use Employing Cognitive Radio Technologies; ET Docket No. 03-108, p. 3.

accepted as a global standard. WiMAX is expected to be deployed for both licensed use (like Cellular) and unlicensed (like Wi-Fi) applications. With the latest in modulation techniques (such as OFDM) and antennae techniques (such as MIMO) WiMAX has been architected to cost effectively deliver broadband services. Before yearend we expect to see radios using the WiMAX to provide wireless broadband access to fixed locations and in 2005 we expect the mobile version of the specification (IEEE 802.16e) to be complete. It will be deployed for Line of Sight at ranges of 50 kilometers or more and non-Line of Sight applications at somewhat shorter ranges.

A wireless ISP using a small 802.16 installation could provide sufficient shared data rates (up to 75 Mbps) to simultaneously support more than 60 businesses with T-1 style connectivity and hundreds of homes DSL-speed connectivity.[5] In 2006 WiMAX will begin to be deployed in laptops. Intel has announced that it intends to put WiMAX radios in its chipsets by 2007—just as it has done with Wi-Fi in its Centrino ™ chipsets beginning in 2003.

WiMAX is expected to improve bandwidth and service while radically reducing radio costs. The result WiMAX should dramatically spur wireless broadband deployment as a third broadband pipe augmenting DSL and Cable. It holds special promise in rural areas or developing markets where service providers haven't deployed wired infrastructure. Countries around the globe are already beginning pre-standard trials of WiMAX.

<u>General Spectrum Reform</u>

The biggest obstacle facing the coming radio revolution is artificial spectrum scarcity created by over reliance on "command and control" spectrum

[5] WiMAX Press Teleconference Script, April 8, 2004.

management. The current system is cumbersome, litigation-prone and politicized. Its tendency to "lock in" inefficient uses and technologies has become more costly with the burgeoning demand for diverse wireless uses and the increased ability of technology to minimize interference.

The FCC's Spectrum Policy Task Force identified two promising spectrum management techniques that can serve as a guide for reform— the grant of increasing flexibility to exclusive licensees and the creation of largely unregulated, unlicensed bands. The flexible licensed approach fostered enormous innovation and investment on the PCS spectrum, e.g., the creation of 147,719 cellular base stations.[6] Unlicensed use created the Wi-Fi revolution at 2.4 and now 5 GHz. In the fourth quarter of 2003 alone, worldwide Wi-Fi sales exceeded half a billion dollars—16 percent growth over the previous quarter.[7] These techniques have succeeded because they give users more freedom to innovate and respond to changing market forces without seeking government approval.

Importantly, these reforms need not be mutually exclusive and should be considered simultaneously. Some advocates of spectrum reform espouse a "property-rights" approach. They believe that we should spend all of our efforts in creating a license structure that better emulates markets for other resources such as land. Other spectrum reformers espouse only unlicensed reforms. These advocates of so-called "spectrum commons" believe unlicensed spectrum can meet most if not all of society's spectrum needs.

---

[6] Cellular Telecommunications & Internet Association, *Annualized Wireless Industry Survey Results* (June 2003).
[7] Dell'Oro Group Wireless LAN Report, 4Q03. www.delloro.com/feature_story.shtml

Intel does not take an "either/or" approach. In fact, you might say we are in the "and/both" camp. The reality is that over 80 percent of the radio spectrum from 300 to 3,000 MHz is managed under the "command and control" approach. Less than 10 percent is devoted to what could be called flexibly licensed and less than 10 percent is allocated to unlicensed. What we need are significant increases in the amount of spectrum available to exclusive but flexible use and unlicensed use. Intel has been active on both fronts.

I would like to give you an example of each kind of reform. On the licensed front, Intel supports reform of the 2.5-2.7 GHz frequencies under consideration in the MMDS/ITFS proceeding that the FCC has scheduled for consideration tomorrow. Currently, these frequencies are primarily allocated to 1-way video services by industry (MMDS) and educational (ITFS) licensees. While most ITFS spectrum is leased to commercial interests, the fragmented band plan has impeded developing new more valuable uses. Hopefully, the FCC will restructure the band to create contiguous blocks of spectrum—132 MHz in total—that could be used for several purposes including WiMAX.

Intel has also aggressively supported unlicensed reforms. For example, we were active in NTIA and FCC deliberations about whether the 5 GHz mid-band frequencies could be made available to Wi-Fi use. Intel and other high tech companies worked closely with NTIA to set parameters that would assure that a Wi-Fi system would reliably identify when a military radar begins to operate in its channel and rapidly move its operation to a different unused channel. Ultimately, this approach was adopted at the June 2003 World Radio Conference.

Reform of the TV Spectrum

The focus of today's hearing is whether and how the DTV transition can be expedited so that the analog channels currently used by broadcasters can be returned to the FCC and put to valuable new uses. I want to address how valuable this spectrum could be for wireless broadband service—a likely new use for the returned analog TV channels. I also want to speak briefly in favor of 3 possible reforms which could accelerate improved use of this spectrum.

1. The Value of the TV Spectrum

The television spectrum would offer enormous advantages for wide area wireless broadband services. The frequencies currently available for wireless broadband are up in the 2.5, 3.3 and even 5.8 GHz region. In contrast, TV channels are much lower in frequency—from 700 MHz all the way down to 76 MHz.[8]

It is true that technology has continually improved our ability to feasibly use higher frequencies. In Marconi's day, very low frequencies around 100 KHz were preferred because they hugged the earth. As technology advanced, it was discovered that short-wave frequencies, from about 2 to about 30MHz, could bounce off the ionosphere, giving them dramatically greater distance. In 1962, conquering distance changed again with the introduction of geostationary telecommunications satellites that use frequencies in the GHz range.

Notwithstanding these improvements, lower frequencies still travel farther at given power. This simple fact enables VHF television licensees to provide a better

[8] 76 MHz, VHF Channel 5, is the lowest channel considered in the FCC Unlicensed Operation in the TV Broadcast Bands NPRM, and hence potentially available for wireless broadband. Broadcast television in the US begins at 54 MHz, channel 2.

quality over the air signal with less power than its UHF television counterpart. Similarly, a cellular system operating at 800 MHz can provide better coverage than a PCS system operating in the 2 GHz range.

The ability to use TV frequencies would accelerate the growth, expand the reach, reduce the cost and improve the quality of broadband wireless service. Even when compared to the 2.5 GHz frequencies—the best alternative available to WiMAX in the U.S.—the TV frequencies make it far more economical to serve rural areas and to compete with wireline broadband alternatives in urban areas. For a given level of quality to a given coverage area, these frequencies require fewer antennas and use less power.

Chris Knudsen of Vulcan Capital estimated the capital and operational costs of providing wireless broadband service in Bellevue/ Seattle, Washington using 2.6 GHz. Then he estimated what happened to the capital and operating costs of providing wireless broadband service to the same territory using 700 MHz. He found that using TV frequencies required only 1/3 to ¼ of the cell sites. Even more importantly, it required about only ½ to 1/3 of the capital to reach positive free cash flow. [9]

For purposes of this testimony, we did our own analysis of the advantages of 700 MHz *vis a vis* 2.5 GHz frequencies. Our results were similar to those of Vulcan Capital. For a given level of quality to a given coverage area, the 700 MHz frequencies require fewer antennas and use less power than 2.5 GHz frequencies. To

[9] Chris Knudsen, "Lower Frequencies Improve the Subscriber Operating Model," June 3, 2004, WCA Convention, Washington, D.C. For interpretation and analysis of Knudsen's work see slides presented by Pierre de Vries, Chief of Incubation at Microsoft at the NTIA Spectrum Management Forum held in Santa Clara on March 8, 2004.

cover the same geographic area we estimate that using 2.5 GHz frequencies would approximately result in an 11db drop in signal strength. (For non engineers, a simple rule of thumb is that every 3 dB of additional loss represents a factor of two difference in signal strength.) This drop in signal strength would require 4 to 5 times as many base stations to achieve equal geographic area coverage, for a given air interface and bandwidth. Of course, one could "make up" for this loss by introducing innovative antenna enhancements or increasing the transmit power at 2.5 GHz. The former is being done in the WiMAX standard but at increased system costs. The latter—a greater than ten-fold increase in transmit power--is not feasible. Receiving devices would have to exceed FCC power limitations to successfully transmit back to the base station.

Also, because TV frequencies better penetrate walls, they would be less dependent on line of sight transmission to outdoor antennas. Besides the value that consumers could derive from portability, indoor use would also facilitate self-installation, avoid expensive truck rolls and make it attractive to launch market wide marketing and advertising campaigns. And indoor service to untethered laptops will accelerate the integration of WiMAX radios into microprocessors thereby generating the efficiencies from Moore's Law that I discussed at the outset.

While perhaps obvious, the cumulative impact of these differences on the feasibility of providing wireless broadband in rural areas bears emphasis. The upshot for some rural areas is that opening the TV frequencies to wireless broadband use would likely make the difference between a high quality wireless broadband alternative and none at all. In simple terms, frequencies below 1GHz are

premier beach front property. We believe the allocation of these frequencies for licensed and unlicensed use could dramatically accelerate broadband deployment with nationwide benefit but particular benefit toward rural and underserved areas.

2. Permit Unlicensed Use of Vacant TV Channels

Policymakers should consider three possible reforms that could increase the use of the TV spectrum. First, the FCC recently opened a Notice of Proposed Rulemaking considering unlicensed use on vacant television channels. Given the current limitations of television receivers, most of the TV channels in any geographical area are unused. Advanced radio techniques, however, permit unlicensed use, without any adverse impact on the broadcasters. Indeed, because the channels "in use" seldom changes, agile radios may be able share these frequencies. The technology required to use these frequencies without interference to existing stations is comparable to what is deployed in today's cell phone. Even inexpensive TV sets have the ability scan for over-the-air channels as part of their set-up routine. Intel has and continues to do extensive due diligence to demonstrate exactly how unlicensed devices can access vacant TV channels with no significant risk to over-the-air broadcasters.

Another method under consideration is to use Global Positioning System receivers built into the unlicensed devices to determine the device location relative to fixed broadcast transmitters. Again, rural communities could especially benefit from this approach. They have the greatest number of vacant TV channels and fewer wireline broadband alternatives. Rural deployments might also be accelerated

by allowing somewhat higher power levels to increase coverage with minimal capital costs required.

Ironically, by creating the incentive for millions of devices to be able to scan TV channels, unlicensed use of vacant TV channels could create, as Chairman Powell stated, "potentially an enormous opportunity for broadcasters."[10] Indeed, making it possible for millions of devices to interact with on air broadcasters could promote the FCC's second initiative in this area: the DTV Transition.

3. Expedite The DTV Transition

Currently, each broadcaster has two 6 MHz channels—one channel for analog distribution and one for digital distribution. Congress established a DTV transition plan that in essence requires a broadcasters return its analog channel to the FCC by 2006 or when 85% of the households in its market can receive digital television, whichever occurs later.

The Mass Media Bureau has proposed a plan that would accelerate this transition and provide a date certain by which broadcasters would return their analog channels. There are many details in the Bureau's proposal and I do not purport to be expert on "must carry" and other regulation.

Essentially, it provides that broadcasters' must-carry rights on cable systems would switch from their analog signals to their digital signals on January 1, 2009. At the same time cable operators would be required to make the digital must-carry signals available to all subscribers. They would have a "down conversion" or an "all

[10] Statement of Chairman Michael K. Powell regarding "Unlicensed Operation in the TV Broadcast Bands" (ET Docket No. 04-186)at FCC open meeting held May 13, 2004.

digital option."[11] Satellite operators in "local-into-local" markets would have analogous requirements.[12] The cumulative reach of cable and satellite providers together with the impact of the FCC's DTV tuner mandate and new "plug-and-play" DTV sets would almost certainly assure that the 85 percent metric would be met everywhere by January 1, 2009.

Intel believes that the Mass Media Bureau has proposed a very constructive plan. It would enable consumers and a myriad of other affected interests to plan towards a certain end date. It would also free valuable spectrum. Channels 52-69 represent 108 MHz in the 700 MHz band—24 MHz for use by public safety and 84 MHz for use by advanced wireless services. In channels 2-51, the analog channels would be available for auction.

As I indicated above, the benefits from making this spectrum available for wireless broadband could be enormous. *Indeed, if I were to recommend any change to the Mass Media Bureau plan, it would be to move the date certain forward. 2009 is almost five years away.*

4. Move Forward with Auctions of Channels 52-69

---

[11] The Mass Media Bureau's proposal provides that the cable operator could: (1)"down-convert" a single digital broadcast stream from digital to analog at the cable head-end so that all subscribers, including analog-only subscribers, could continue to view the programming or (2) pass through the digital must-carry signals to subscribers' homes, where the system has converted to "all digital" transmission and all subscribers have the ability to receive and display the digital signals (either on a digital set or down-converted by a set-top box for display on an analog set). Written Statement of W. Kenneth Ferree, Chief of the Mass Media Bureau, Federal Communications Commission, on "Advancing the DTV Transition: An Examination of the FCC Medial Bureau Proposal," before the Subcommittee on Telecommucnications and the Internet, U.S. House of Representatives, June 2, 2004, p. 4.

[12] The Mass Media Bureau's proposal provides that satellite operators in local-into-local markets would be required to make sure that its customers either: (a) to carry one standard-definition digital programming stream from each broadcaster in the market (down-converted from HDTV to standard-definition, if necessary); or (b) to pass through the digital broadcast signals to subscribers' homes, where all subscribers have the ability to receive and display the programming. *Id*.

That brings me to my third proposal. Once the date certain is set, it may be possible to provide incentive for broadcasters to vacate their channels even earlier. The FCC might be able to spur their movement by simply moving forward with the spectrum auctions of the unassigned spectrum for channels 52-69. The auction winners would have strong incentives to buy these broadcasters out and help them move to their digital channels. When the FCC proposed to auction these channels a few years back, several broadcasters appeared ready to move to their digital channels and vacate their analog channels earlier than they would have been required to under the law in exchange for compensation.

Now it may possible to structure the auctions to induce the broadcasters to voluntarily clear these channels much earlier than 2009. For example, FCC could give broadcasters incentives to turn back their channels in advance of the auction for a *pro rata* share of the proceeds. This approach would compensate broadcasters for clearing before 2009—the new date by which they would be compelled to return their analog channels. Under this approach, they would have strong incentives to voluntarily clear their channels early. Their compensation would be set by the marketplace. If the Mass Media Bureau plan is the "stick," a linked auction could be the "carrot." The two approaches could be highly complementary.

I have not worked out all the details. Nor have I fully considered all the legal ramifications. I leave those to the FCC and to the members of this Committee. But I do think this approach is worth considering. In fact, I am confident that if there is the will, a way could be found.

In the end I keep coming back to the benefits to our country of clearing this spectrum in 2005 instead of 2009 or beyond. Even if limited to channels 60-69, the benefits from clearing the 24 MHz that has been allocated for public safety use and the 30 MHz that could be used for wireless broadband use would be stupendous.

A Final Thought

I want to close by returning to the potential benefits of clearing the TV spectrum for new uses such as WiMAX. There could be significant first mover consequences in this market. If the United States were to move forward expeditiously to make this spectrum available for new uses, it could start a bandwagon effect. I believe the benefits of the new wireless broadband services would be so compelling that a critical mass of other countries would quickly move to clear spectrum in this range. The resulting gains in economies of scale would give American consumers still lower prices and U.S. based companies important first to market advantages.

On the other hand, the U.S. does not have a monopoly on spectrum reform. In particular, emerging countries have a special interest in developing wireless broadband alternatives because they have less wireline infrastructure. Also, they frequently face fewer transition costs because they have fewer broadcasters and other incumbent users.

In short, the opportunity is great and the challenge is equally great. The time to begin reform is now.

Thank you.