Coalition for Spectrum Integrity

April 8, 2005

The Honorable Ted Stevens
Chairman
Senate Committee on Commerce, Science and Transportation
508 Dirksen Senate Office Building
Washington, DC 20510

Dear Chairman Stevens:

The undersigned trade associations, organizations, businesses, manufacturers, and public safety organizations are writing to you to express our deep concern over an extremely troubling proposal by the Federal Communications Commission that would permit the operation of higher powered unlicensed devices in the band of frequencies used for television broadcasting. We have formed the Coalition for Spectrum Integrity ("COSI") in response to the threat that the FCC's proposal poses to the viewing public.

COSI members represent communications industries that have invested billions of dollars in this band. Also, billions of dollars in the American economy are generated by COSI members. The FCC's proposal places this investment, and the benefits that flow to the public, in grave jeopardy. In our view, authorizing unlicensed devices by the Commission based on the record compiled to date would be precipitous, and would result in adverse consequences that would far outweigh any potential benefits from permitting unlicensed interfering devices in these frequencies.

In order to avoid spectrum chaos, Congress wisely enacted the Communications Act of 1934. Its fundamental precept is found in Section 301:

> "It is the purpose of this Act, ...to *maintain the control of the United States over all the channels of radio transmission*; and to provide for the use of such channels, but not the ownership thereof, by persons for limited periods of time, *under licenses granted by Federal authority*....
>
> No person shall use or operate any apparatus for the transmission of energy or communications or signals by radio...except under and in accordance with this Act and *with a license* in that behalf granted under the provision of this Act." (Emphasis supplied.)

The FCC's proposal tears at the basic fabric of the Act. This proposal is much more than the simple authorization of unlicensed low powered, short-range electronic

devices, such as a garage door opener, microwave oven or a TV remote "clicker." To the contrary, the FCC's proposal contemplates the establishment of an entirely new communications system, with unlicensed radio transmissions supposedly reaching 10 to 35 miles. There will be no federal licensing or control. The entire policy rests on the simple belief that this unlicensed equipment can be manufactured so as not to cause interference, and that these manufacturers and unlicensed services will have sufficient incentives to avoid interfering with other communications systems. Both of these assumptions have never been tested in the real world.

Without so much as a single Congressional hearing, the proposal alters 70 years of federal spectrum management and ignores the Congressional requirement to license spectrum users. It is based on a regulatory model that has been employed for short-range products such as garage door openers, and now seeks to extend that model to full powered communications systems that are claimed to cover large, highly populated geographic areas. The consequences of the FCC's proposal may be devastating to the American public. Some major concerns are as follows.

Interference to 73 million television sets: According to an NAB study, there are more than 73 million television sets in the United States that rely exclusively on the reception of over-the-air signals. A recent laboratory study found that under the power levels proposed in the FCC's rules, an unlicensed portable device located within 75 feet of a television set could overload a television tuner, causing interference to the reception of *all* channels. This means that consumers living in townhomes or apartments could lose their over-the-air TV service as a result of the interference received from their neighbors.

Impairing the digital transition: Interference to newly purchased DTV receivers may cause consumers to return their new TV sets. Undermining consumer acceptance of digital television will delay the digital transition, and prevent recovery of broadcast spectrum on TV channels 52-69.

Interference with public safety communications: Public safety currently shares TV channels 14-20 with television broadcasters in major markets. The FCC proposes to permit unlicensed devices on these channels in medium and small markets, creating interference problems in adjacent overlapping areas.

Undermining newsgathering and sports programming production: Local television stations, broadcast networks, cable news networks, sports networks, sports leagues, and video production companies depend on wireless microphones and wireless video assist devices. The channels used by wireless microphones are very congested, especially in major markets. The FCC's proposal permits unlicensed devices on these same channels, making wireless microphones and wireless video assist devices unreliable. It will become increasingly difficult, if not impossible, to produce live news and sporting events.

Interference with theaters, churches and school events: Theaters and churches often use wireless microphones in their performances and services, respectively. Unlicensed devices may very well interfere with these microphones.

Permanently chills investment and impairs the value of the spectrum for the public: The FCC proposes to give unlicensed services access to this prime spectrum, free of charge, for commercial services. Some have proposed giving free access for unlicensed operations to Channels 52 to 69, even though some of these channels have already been auctioned for the deployment of new wireless services upon conclusion of the DTV transition. Such a give-away of prime licensed spectrum, particularly the channels within the Lower 700 MHz band that have already been auctioned, would be fundamentally unfair and would chill investment and reduce the value of licensed spectrum. Businesses have already spent millions of dollars to buy licenses for the Lower 700 MHz spectrum based on the existing FCC rules, which do not allow unlicensed operations on their spectrum and in the adjoining TV bands. These businesses are investing large sums of money to launch innovative services on their frequencies. The FCC should not change its rules now, years after the auctions, and give away free access to the adjacent TV spectrum, as proposed by the FCC, or free access to the same Lower 700 MHz licensed spectrum that the FCC has already auctioned, as others have proposed. Moreover, in future auctions, bidders may well bid far less if there is a real prospect that, after the auction, the government could force them to share the spectrum with millions of unlicensed devices, whose manufacturers obtained access to the spectrum from the government for free. Finally, once unlicensed devices are permitted into a licensed band, there is no way to remove them in order to cure the interference so that the licensed services can continue unimpaired or to accommodate future, more advanced licensed services.

Interference to cable service: Introducing unlicensed base stations into the broadcast band may have an adverse impact on the reception of broadcast television signals at a cable headend. As a result, subscribers to that cable system may be unable to see certain broadcast channels and programs. In addition, portable unlicensed devices may interfere with "in-home" cable wiring and connections. All of the factors are likely to confuse consumers, who will not know who or what is causing the interference they are suffering, much less how to stop it.

Proponents of unlicensed devices argue that new advanced technology ensures there will be no interference. This simply has not been the case in the real world. A recent example of interference to military radar underscores the dangers posed by unlicensed devices operating in licensed spectrum bands. On January 27, 2005, United States Air Force officials reported that wireless Internet connections in the 5 GHz band were interfering with military radar at the Eglin Air Force Base in Florida.[1] According to Master Sgt. Dawn Hart, "The sources of interference show up as targets on tracking

[1] *See, e.g.*, Associated Press, *High Speed Net, Wi-Fi Interfering with Military Radar*, USA Today (Jan. 28, 2005).

radars because of their strong signals."[2] Officials from the county, which is home to the base, mistakenly (but understandably) opined: "There are evidently people who are firing up [wireless Internet] hotspots without [FCC] licensing."[3] In fact, those Wi-Fi hotspots are in the *unlicensed* U-NII band. It is unclear when, or even if, officials will be able to locate and remedy the unlicensed sources of harmful interference to the radar tests. Indeed, the FCC recently announced that the federal government and the unlicensed device manufacturers have found it so difficult to solve these interference problems that the FCC cannot yet adopt measurement procedures to authorize unlicensed devices to operate in 255 MHz of spectrum in the 5 GHz band reallocated for unlicensed operations in November 2003.[4] Yet, the parties who favor allowing unlicensed devices in the TV bands seek to rely on many of the very same techniques that are not working now in the 5 GHz bands to mitigate interference in the TV bands.

The FCC's response to a similar situation can be found in the attached *Public Notice*.[5] The *Public Notice* indicates there is no effective way to prevent interference from taking place: "It is not possible to predict in advance which specific users or locations near military bases may experience interference, because of the variety of technical characteristics of garage door controls and configuration of the mobile radio systems."

Our concern is magnified by the fact that the FCC is proposing that television receivers and unlicensed devices share the same frequencies.[6] Unlicensed interfering devices are portable, and there won't be any database of licensees who can be contacted by the Commission once television viewers begin to complain that their sets periodically go dark. The same is true for interference from unlicensed devices with police radios and wireless microphones. There is no practical way to control their use once interference commences. Moreover, it is impossible for the government to confiscate these unlicensed, interfering devices once they are in the hands of the public.

Permitting such devices in the broadcast television band, at this time, is premature. It will undermine the digital transition. Significantly more work, including real world testing, needs to be accomplished before such devices can be authorized to share spectrum. The services provided to the American public by the undersigned organizations are too important to be subject to potential significant interference.

---

[2] Associated Press, *High Speed, Wi-Fi Internet Messing with Eglin AFB Radar*, South Florida Sun-Sentinel (Jan. 28, 2005).

[3] *Id.*

[4] *Order,* Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz Band, FCC 05-43, February 23, 2005 at Pg. 4.

[5] *Public Notice*, Consumers May Experience Interference to Their Garage Door Opener Controls Near Military Bases, DA 05-424, February 15, 2005.

[6] Under FCC rules, consumers have a *right* to install and operate antennas up to one meter in length for the operation of unlicensed transmitting or receiving equipment. *See Public Notice*, Commission Staff Clarifies FCC's Role Regarding Radio Interference Matters, DA 04-1844, June 24, 2004.

Sincerely,

David L. Donovan
President
Association for Maximum Service Television, Inc.

Participating Organizations

Trade Associations

Association for Maximum Service Television, Inc.
Association of Public Television Stations
Community Broadcasters Association
National Translator Association
National Systems Contractors Association (NSCA)
Society of Broadcast Engineers, Inc.
SW Colorado TV Translator Assn.

Individual Companies

QUALCOMM Incorporated

Total RF, Inc

The ABC Television Network
The ABC Owned Television Stations
CBS Television Network
Fox Television Stations, Inc.
NBC Universal and NBC Telemundo License Co.
UPN Television Network
Viacom Television Stations Group
Belo Corp.
Capitol Broadcasting Co., Inc.
Clear Channel Communications, Inc.
Cox Broadcasting
Emmis Communications
Entravision Holdings, LLC
Fisher Broadcasting Company
Gannett Broadcasting
Hearst-Argyle Television, Inc.
Hubbard Broadcasting, Inc.
Liberty Corporation
LIN Television, Inc.
Morgan Murphy Stations
Mid-State Television, Inc.
WMFD-TV DT, Mansfield, OH
Morris Network of Mississippi, Inc.
WXXV-TV DT, Gulfport, MS
WCBI-TV, LLC, WCBI-TV DT Columbus, MS
Morris Network, Inc.
WMGT-TV DT, Macon, GA
Guenter Marksteiner
WHDT-DT, Stuart, FL
New York Times Broadcast Group
Pappas Telecasting Companies
Paxson Communications Corporation
Sarkes Tarzian, Inc.
Tribune Television, Inc.

Hammett & Edison, Inc.

NEWS, SPORTS AND ENTERTAINMENT PRODUCTION COALITION

March 11, 2005

The Honorable Michael Powell
Chairman
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

RE: ET Docket 04-186 (unlicensed use of TV broadcast bands)

Dear Chairman Powell:

We are concerned about the future of our newsgathering and live sports and entertainment coverage operations. Tens of millions of Americans rely on, and have come to expect, high quality production in live news, sporting and entertainment events. The ability of local radio and television stations, broadcast networks and cable networks to provide a good quality product has been in jeopardy for quite some time. But the Commission's proposed plan in the above-captioned docket to allow new users in the broadcast spectrum poses the most severe threat yet. We ask that before the Commission make any determinations in this docket that it first initiate a rule making proceeding that seeks to dedicate spectrum to services relied upon by those in live newsgathering, sports and entertainment production and broadcast and cable delivery.

The undersigned are representatives of local radio and television stations, broadcast networks, cable networks, sports leagues, news operations, video production companies and manufacturers (as well as trade associations whose members include those entities) actively involved in the production of sporting and news events for the benefit of American television viewers (collectively the "News, Sports and Entertainment Production Coalition"). We have always supported an approach to spectrum policy that marries innovation with respect for the goals and requirements of both established and emerging services. But it is becoming nearly impossible to do our jobs in the face of diminishing spectrum in the Broadcast Auxiliary Service (BAS). We are specifically concerned that the Commission should not allow higher power Part 15 devices to operate on so-called "unused" TV channels, because of the interference and denial of service threats that would be caused to licensed, Part 74, Subpart H, Low Power Auxiliary stations.

At this point, the television channels assigned for use by wireless microphone and wireless video assist devices are highly congested in all metropolitan areas. Interference is the inevitable result of further overcrowding of these existing channels.

Advances in digital technology are not a solution to this problem because digital technology is already being incorporated in wireless microphone use. The limited allocations remain severely overcrowded. The channel bandwidth has been reduced thereby, but the number of channels is nonetheless far too small. The problem is that there are no other bands for wireless microphones available for use in most markets across the United States for providing coverage of breaking news, outdoor sporting events and live entertainment events, in the manner that the public has grown accustomed to viewing.

We believe that the FCC has overlooked the impact of higher power Part 15 devices on so-called "unused" TV channels to Part 74, Subpart H, Low Power Auxiliary stations. These include widely used wireless microphone stations, which operate on the ever scarcer locally vacant VHF and UHF TV channels. Spectrum for wireless microphones and wireless video assist devices, which operate in unused UHF television channels, has been reduced dramatically by use of those channels for DTV, and the loss of UHF channels 52-69. The small guard bands remaining would not be enough by any means. The wireless microphone is one technology that may not necessarily benefit from a move to digital technology. As licensed, Part 74 stations, they are entitled to protection from interference from unlicensed Part 15 devices. We recommend that a permanent and exclusive spectrum allocation be made for these devices so that they can be used reliably in the future.

Wireless microphones are extensively used by broadcasters and cable programmers in support of sports events and electronic news gathering (ENG) operations, and because ENG venues are ever changing, it appears that even "cognitive" or "smart" higher power Part 15 devices attempting to also operate on locally vacant TV channels would never be able to know the location of licensed wireless microphones. Further, because FM wireless microphones do not transmit continuously, but rather only when needed at a news or sporting event venue, allowing higher power Part 15 devices to share the same spectrum could create a denial of service problem to the licensed, higher-priority wireless microphone stations. Licensed users could easily be placed at the mercy of an unlicensed Part 15 device, waiting for the Part 15 device to momentarily "power down."

In most major metropolitan areas there are virtually no vacant TV channels, due to those channels also being used by DTV, Class A, TV translator, LPTV, and some point-to-point TV translator relay stations. The drastically reduced number of "unused" TV channels makes it all the more likely that higher power Part 15 devices operating on TV channels would cause interference to, or denial of service problems to, higher-priority, licensed, stations. If the Commission were to grant the use of broadcast spectrum to unlicensed devices, we could have situations in which: a local radio or TV station or cable news channel covering a local emergency, such as the hurricanes in Florida, would

suddenly lose the picture and audio of its reporters on the scene; interviews with athletes and coaches would be lost and irretrievable, as would be referee calls and coaches' communications with each other during a game; and live news interviews of public officials and others at breaking events might also be lost. The flexibility and creativity that wireless microphones and wireless video assist devices bring to production is invaluable.

In conclusion, we understand the goals of broadening the uses of spectrum, but we ask that you first consider our plight and seek to address it before going forward in this proceeding. We request that you initiate a rule making proceeding that seeks to dedicate a portion of spectrum to devices we use to bring live sports, news and entertainment to American viewers in their homes.

We would appreciate the opportunity to provide further information and demonstrations of the issues discussed above to you and your staff.

Sincerely,

Stacy Brady
Vice President, Field &
Satellite Operations
NBC Network News

Jeffrey Birch
Vice President of Engineering
Viacom Television Stations Group

Shaun Sheehan
Vice President
Tribune Company

Glynn Walden
Senior Vice President, Engineering
Infinity Broadcasting

Barbara Cochran
President
RTNDA

Byron Marchant
EVP, Chief Administrative Officer
BET

Andrew G. Setos
President, Engineering
FOX GROUP
FOX Broadcasting Company
FOX Sports
FOX News
FOX Sportsnet
FOX Television Stations

Bruce D. Collins, Esq.
Corporate VP & General Counsel
C-SPAN

Fred Fellmeth
General Counsel
Total RF, Inc.
TRF Helicopters, Inc.

Ken Goss
Director, Sports, Production
Planning & Operations
NBC Sports

Susan Fox
VP, Government Relations Disney/ABC
ABC Radio
ABC Sports
ABC News
ESPN

Frank Governale
Vice President, News Operations
CBS News

Steve Kaufman
Senior Vice President, Production,
Operations & Technology
MTV Networks Inc.

Michael S. Meehan
VP, Sports Operations &
Production Planning
NBC Universal

Peter Homes
Director of Broadcasting & Recording
IBEW

Daniel L. Brenner
SVP, Law and Regulatory Policy
NCTA

Gil Kerr
Senior Vice President, Broadcasting,
Programming & Production
PGA Tour

Steve Hellmuth
SVP, Operations and Technology
NBA Entertainment

David Donovan
President
MSTV

Greg Shaheen
VP, Division I Men's Basketball
NCAA

Louise S. Sams
EVP, General Counsel and Secretary
Turner Broadcasting System, Inc.
On its own behalf and that of its subsidiaries.
Cable News Network LP, LLLP,
Turner Sports, Inc.

Justin Smith
Vice President of Legal Affairs
The Golf Channel

Russell Gabay
Executive Producer
Major League Baseball International

Michael Cohen
Executive Producer
Major League Soccer

Gunther Meisse
President
Mid-State Television, Inc.
WMFD-TV DT
Mansfield, Ohio

Dean Hinson
President
Morris Network of Mississippi, Inc.
WXXV-TV DT
Gulfport, Mississippi
WCBI-TV, LLC
WCBI-TV DT
Columbus, Mississippi
Morris Network, Inc.
WMGT-TV DT
Macon, Georgia

Gunter Marksteiner
Individual Licensee and Chief Engineer
WHDT-DT
Stuart, Florida

John Tortora
Director, Team Television and
Business Affairs
National Hockey League

Frank Hawkins
Senior Vice President, Business Affairs
National Football League

Ahren J. Hartman
Technology Director
Shure Incorporated

Edgar C. Reihl, P.E.
Technology Director
Shure Incorporated

cc: Commissioner Kathleen Abernathy
cc: Commissioner Jonathan Adelstein
cc: Commissioner Michael J. Copps
cc: Commissioner Kevin J. Martin

PUBLIC NOTICE

Federal Communications Commission
445 12th St., S.W.
Washington, D.C. 20554

News Media Information 202 / 418-0500
Internet: http://www.fcc.gov
TTY: 1-888-835-5322

PRESS CONTACT:
Bruce Romano: 202-418-2124

DA 05-424
February 15, 2005

Consumers May Experience Interference To Their Garage Door Opener Controls Near Military Bases

Consumers near certain military installations have recently experienced interference to their garage door opener controls that may reduce the operating distance or cause the device to stop operating. This public notice is issued to explain the cause of the interference and the steps being taken to alleviate this problem. The vast majority of consumers will not experience any interference to their garage door opener controls.

Garage door openers operate, legally under Part 15 of the Commissions rules, at very low power on an "unlicensed basis," and have been permitted to operate on frequencies that have been reserved for the federal government since WWII for air/ground communications systems, but received limited use by the government for many years. As unlicensed devices, there is no right to protection from interference. However, because of this limited use, the risk of interference was similarly limited, so manufacturers of garage door openers chose these frequencies for their transmit and receive devices. In response to the increased needs of homeland security, the Department of Defense now must make more use of these frequencies to deploy new mobile radio systems on and around certain military bases.

Some consumers near these bases may experience interference to their garage door openers that can reduce operating range or cause the remote control to cease functioning. This interference will not cause the garage doors to open or close on their own. Inside the garage, wall-mounted push buttons will not be affected by any interference that might occur, and will continue to operate normally.

It is not possible to predict in advance which specific users or locations near military bases may experience interference, because of the variety of technical characteristics of garage door controls and configuration of the mobile radio systems. The Department of Defense is working with the National Telecommunications and Information Administration to make reasonable effort consistent with their mission requirements, and the Federal Communications Commission is working with the garage door opener industry to make every effort on their part, to minimize the impact to consumers.

For security reasons, the Department of Defense cannot make information broadly available in advance as to the deployment of the new mobile radio systems. Individual base commanders may make some information available to their local communities when appropriate.

Garage door opener manufacturers stand ready to help consumers resolve any interference to their systems, including, in some cases, making available for purchase, a replacement transmitter and receiver that operate on a different frequency that is not used by the new mobile radio systems.

Consumers experiencing interference should contact the manufacturer of the door opener control or their local installer for information on available immediate solutions.

For further information on this Public Notice, please contact the FCC Call Center at 1-888-CALL-FCC (1-888-225-5322).

Associated Press

January 28, 2005, 12:30 PM EST

EGLIN AIR FORCE BASE -- High speed and wireless Internet connections are interfering with radar used here for weapons testing by creating false targets, a spokeswoman for this Florida Panhandle base said Friday.

The problem appears confined to Eglin, which sprawls across 724 square miles. It is home to the Air Force's Air Armament Center, which develops and tests ``smart'' bombs and other high-tech weapons over the Gulf of Mexico and ranges on the base.

The sources of interference show up as targets on tracking radars because of their strong signals, said Master Sgt. Dawn Hart. She said only three other bases, all in remote desert areas, use the same type of radar.

Eglin officials earlier notified Okaloosa County officials, who responded Thursday by warning that if the interference is intentional violators would be fined and their equipment confiscated.

The troubled frequency band is in the 5.6 gigahertz to 5.8 gigahertz range. ``There are evidently people who are firing up (wireless Internet) hot spots without (Federal Communications Commission) licensing,'' County Manager Chris Holley said.

He said Air Force officials told him the interference is infrequent but that they hope to stop the trouble before it becomes widespread.

The interference seems to coming from Internet access lines being installed in new apartments, hotels and condominiums or buildings being retrofitted for Internet service.

The Defense Department and technology companies two years ago struck a compromise designed to prevent such interference. Manufacturers agreed to build new computer gear with technology to detect and actively avoid interfering with military radars that operate on similar frequencies.

In exchange, defense officials endorsed proposals to nearly double the amount of lucrative wireless frequencies available for Internet use.

Copyright (c) 2005, South Florida Sun-Sentinel

Philadelphia DMA

City/State	Call	NTSC	DTV
Philadelphia, PA	WCAU	10	67
Vineland, NJ	WUVP	65	66
Philadelphia, PA	WPVI	6	64
Allentown, PA	WLVT	39	62
Wilmington, DE	WHYY	12	55
Philadelphia, PA	WPHL	17	54
Atlantic City, NJ	WWSI	62	49
Allentown, PA	WFMZ	69	46
Atlantic City, NJ	WMCN	53	44
Trenton, NJ	WNJT	52	43
Philadelphia, PA	WTXF	29	42
Wildwood, NJ	WMGM	40	36
Philadelphia, PA	WYBE	35	34
Philadelphia, PA	WPSG	57	32
Wilmington, DE	WPPX	61	31
Burlington, NJ	WGTW	48	27
Philadelphia, PA	KYW	3	26
Reading, PA	WTVE	51	25
Camden, NJ	WNJS	23	22
Bethlehem, PA	WBPH	60	9

Public safety (62-65, 67-69)
Out-of core (52-61, 66)
In-core (2-51)

New York DMA

City/State	Call	NTSC	DTV
Newark, NJ	WNET	13	61
Riverhead, NJ	WLNY	55	57
New York, NY	WCBS	2	56
Newark, NJ	WFUT	68	53
Bridgeport, CT	WEDW	49	52
New York, NY	WABC	7	45
New York, NY	WNYW	5	44
Bridgeport, CT	WSAH	43	42
Paterson, NJ	WXTV	41	40
Secaucus, NJ	WWOR	9	38
Linden, NJ	WNJU	47	36
New York, NY	WPXN	31	30
West Milford, NJ	WFME	66	29
New York, NY	WNBC	4	28
Poughkeepsie, NY	WTBY	54	27
New York, NY	WNYE	25	24
Smithtown, NY	WFTY	67	23
Garden City, NJ	WLIW	21	22
Kingston, NY	WRNN	48	62
Newton, NJ	WMBC	63	18
New York, NY	WPIX	11	12
Montclair, NY	WNJN	50	51
New Brunswick, NJ	WNJB	58	8

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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
	)	

COMMENTS OF
ASSOCIATION OF PUBLIC-SAFETY COMMUNICATIONS OFFICIALS-INTERNATIONAL, INC.

The Association of Public-Safety Communications Officials-International, Inc. ("APCO") hereby submits the following comments in response to the Commission's *Notice of Proposed Rulemaking*, FCC 04-113, released May 25, 2004, in the above-captioned proceeding. APCO urges the Commission not to allow unlicensed operations in the 470-512 MHz band (TV channels 14-20), which is used for emergency radio communications in our nation's largest metropolitan areas.

Founded in 1935, APCO is the nation's oldest and largest public safety communications organization. Most of its 16,000 members are state or local government employees who manage, design, maintain and operate communications systems for police, fire, emergency medical, highway maintenance, forestry conservation, disaster relief, and other public safety agencies. APCO is a FCC-certified frequency coordinator

for Part 90, Public Safety Pool channels, and regularly participates in Commission proceedings regarding public safety communications.

The Commission is proposing that unlicensed operations be permitted in the television broadcast band, including channels 14-20 (470-512 MHz) that are also allocated for public safety and land mobile use in New York, Los Angeles, San Francisco, Philadelphia, Boston, Washington, Chicago, Miami, Pittsburgh, Dallas, Houston, Cleveland and Detroit.[1] Some of the nation's largest public safety agencies make use this band for their principal portable and mobile radio communications systems (*e.g.*, the New York City Police Department, Los Angeles Police Department and Los Angeles County Sheriff's Department).

The Commission has proposed restricting unlicensed operations on channels 14-20 to locations outside of the metropolitan areas in which those channels are allocated for land mobile operations.[2] APCO believes that the Commission's proposed restrictions are insufficient, and could lead to destructive interference to essential public safety radio communications. The proposed unlicensed operations include personal/portable and temporary fixed operations. While the Commission proposes technological controls on the areas in which such devices can operate, the required technology is untested in a real world environment. Public safety cannot be the "guinea pig" for this spectrum sharing

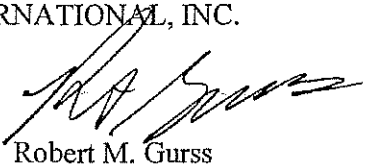
[1] *See* Part 90, Subpart L. Note that there are no actual operations in Detroit or Cleveland due to coordination issues with Canada.

[2] *NPRM* at ¶35.

technology. Therefore, we urge the Commission to prohibit *any* unlicensed operations on channels 14-20, regardless of location.

Respectfully submitted

ASSOCIATION OF PUBLIC-SAFETY COMMUNICATIONS OFFICIALS-INTERNATIONAL, INC.

By: 

Robert M. Gurss
Director, Legal & Government Affairs
1725 DeSales Street, NW
Suite 808
Washington, DC 20036
(202) 833-3800

November 29, 2004

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

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

COMMENTS OF
THE NATIONAL CABLE & TELECOMMUNICATIONS ASSOCIATION

William A. Check, Ph.D.
Senior Vice President
Science & Technology

Andy Scott
Senior Director of Engineering

Steven L. Mace
Director, Systems Technology

Daniel L. Brenner
David L. Nicoll
Counsel for the National Cable & Telecommunications Association
1724 Massachusetts Avenue, N.W.
Washington, D.C. 20036-1903
(202) 775-3664

November 30, 2004

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

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

COMMENTS OF
THE NATIONAL CABLE & TELECOMMUNICATIONS ASSOCIATION

The National Cable & Telecommunications Association ("NCTA") hereby submits its comments on the Notice of Proposed Rulemaking ("Notice") in the above-captioned proceeding.

NCTA is the principal trade association representing the cable television industry in the United States. Its members include cable operators serving more than 90 percent of the nation's cable television subscribers. In addition to providing multi-channel video programming services, cable operators also provide high-speed Internet services, and are increasingly offering facilities-based voice services. NCTA members also include more than 200 cable programming networks, and suppliers of equipment and services to the cable industry.

INTRODUCTION

The cable industry generally supports the Commission's efforts to free up broadcast television spectrum for use by unlicensed devices that can promote competition and consumer choice in the ever-growing area of wireless access to the Internet and other

multi-media offerings. However, these efforts must not prevent cable customers from continuing to enjoy the rich and diverse products and services offered on cable systems. There are several areas of concern that must be addressed if unlicensed devices are to operate in conjunction with cable systems, terrestrial broadcast television stations, and the consumer's home electronics devices.

I. BROADCAST TELEVISION INTERFERENCE

Cable systems receive cable and local broadcast television programming at the cable headend for distribution to cable customers. In the case of broadcast television programming, most cable headends receive terrestrial broadcast signals by using tower-mounted high-gain directional terrestrial antennas, subsequently combining them with cable programming for retransmission within the cable system. While these broadcast signals are generally received at the cable headend within the Grade B contour defined by the FCC, and therefore are protected under the proposed rules, there are many instances where broadcast signals are received at the cable headend at locations outside of the Grade B contour, many of which signals are deemed "must carry." Under the proposed rules, unlicensed devices will be able to transmit on channels used for receipt of distant broadcast television signals, therefore increasing the likelihood that there will be interference with a local broadcast signal received from outside the Grade B contour, particularly in rural markets.

For example, if a distant television station transmitting on a 1,000 foot tower with a transmit power of 316kW EIRP and 65 miles from the cable headend, the calculated carrier to interference (C/I) ratio, assuming an unlicensed personal/portable device within one-tenth of a mile of the receive antenna, is approximately 2dB, during unfaded conditions.

Using the same assumptions, an unlicensed fixed device at a distance of one mile from the receive antenna yields a C/I ratio of 5dB. With this small but consequential difference between the desired signal strength and the undesired signal strength, interference is certain to occur. Moreover, interference is even more likely due to anomalous propagation conditions which cause fades in the distant broadcast signal, but does not affect the unwanted signal from a nearby unlicensed device. Under the proposed rules, protection from harmful interference will be afforded to receivers within the Grade B contour, but not to receivers located outside of the Grade B contour. NCTA urges the Commission to extend this protection to those circumstances where local broadcast signals are received from outside the Grade B contour. Cable headends should be able to reliably receive broadcast signals, regardless of whether the signal is inside or outside the Grade B contour.

Furthermore, it is unclear how interfering devices would be identified, and resulting interference ameliorated. This is potentially problematic because these devices are likely to proliferate in a fashion similar to currently operational IEEE 802.11 wireless devices. Even assuming that these devices are able to signal their presence by means of a unique identifier, the process of detecting and alerting the owner or owners of interfering device(s) is not set forth. This is particularly troublesome in the case of must carry broadcast signals, where Commission rules already impose regulatory requirements on broadcasters and cable operators. In urban areas, the presence of hundreds or thousands of the devices could create an electromagnetic cloud making it nearly impossible to identify a single source of interference in the presence of many such sources.

Moreover, it is unclear how detection and identification of an interfering device can be accomplished. This capability assumes the party experiencing the interference has the necessary equipment and trained personnel to remedy the interference, even though the method to be used and the technology required is unknown. Prior to authorizing the unlicensed devices, the Commission should first adopt a procedure to prevent this unacceptable risk to cable operators and their subscribers.

II. INTERFERENCE MITIGATION

The Notice discusses various approaches by which providers of unlicensed devices will be able to determine what broadcast spectrum is unused for a given geographical area. Among the methods discussed: sensing and detecting the presence of incumbent signals; transmission of available frequency information over-the-air to unlicensed devices; and identification of geographic location in conjunction with a centrally maintained database. These methods, however, raise a number of questions as to the most efficient means of preventing harmful interference, particularly when distant terrestrial broadcast signals are received at cable headends outside the Grade B contour.

With the sensing and detection method, for example, at the periphery of the Grade B contour or beyond, it is possible that the signal strength of a television transmitter may be equal to or below the signal strength necessary for an unlicensed device to accurately sense and detect the presence of a legitimate terrestrial broadcast transmission. Because of the high gain and high tower mounting of the directional receive antennas used at cable headends, it is likely that a broadcast signal that provides adequate quality to the cable operator will be undetectable to the unlicensed device. Should this occur and an

unlicensed device begins transmitting, a cable headend may no longer be able to reliably receive the broadcast signal.

If unlicensed devices utilize mitigation methods involving receipt of available frequency control information from a remotely transmitted source, it is unclear how a given device would be able to determine what control source to adhere to if more than one signal exists for a given geographic location. This may be particularly problematic given the likelihood that in some areas of the country frequency control information would overlap for a specific location.

The Notice discusses the utilization of a centrally maintained database and professional installation for tracking and identification of the location of the unlicensed device. While this method might effectively be used to identify unlicensed devices at a fixed location, it is uncertain how it could be used in the tracking of portable devices. It also raises the question of who will be responsible for operating and maintaining this database.

It will be challenging to develop the necessary methods to prevent harmful interference. If the Commission elects to use any of the proposed methods, we urge the agency to reevaluate its proposal to limit the application of these methods within a Grade B protected contour, so that cable systems continue to reliably receive broadcast signals.

III. DIRECT PICKUP

NCTA is also concerned that harmful interference may occur when unlicensed devices are situated in close proximity to existing consumer electronics devices, such as television receivers and VCRs. Television devices that are connected to cable systems will be especially susceptible to direct pickup of interference from these unlicensed devices.

As noted in the Consumer Electronics Association's "Test Plan for Unlicensed Operation in TV Bands,"[1] the allowed signal strength from unlicensed devices is likely to exceed the 100mV/m direct pickup immunity specified for analog cable-ready devices in Section 15.118 of the Commission's rules. These devices typically tune cable channels across the entire cable spectrum. While an unlicensed device may find a section of the TV band which is unused for terrestrial broadcast, this spectrum will typically be used by the cable operator to deliver programming or other services. As a result, unlicensed devices would be operating on the same channels that the consumer is using within their home for receiving cable channels. For the millions of television receivers and VCRs connected to cable, this will result in uncorrelated direct pickup noise, and an impediment to reliable reception of products and services that cable customers enjoy today.

NCTA urges the Commission to adopt procedures to constrain the signal strength output of these unlicensed devices in order to mitigate the potential for harmful interference to consumer electronics receivers connected to cable systems.

CONCLUSION

Operation of unlicensed devices in the unused broadcast television spectrum, while potentially facilitating more widespread use of the spectrum for new services, carries with it many technological and operational challenges that must be resolved prior to deployment. The public expectation of high quality broadcast television signals and other services from cable operators should not be compromised. NCTA urges the Commission to adopt standards and methods to deter interference with a cable operator's receipt and transmission of terrestrial broadcast television for retransmission to its customers. In addition, NCTA urges the Commission to develop processes for determining available

[1] CEA Notice of Ex Parte Presentation, ET Docket Nos. 04-180, 02-380, Oct. 14, 2004.

frequencies and specific plans to discover interfering devices, and to ameliorate the effects of direct pickup noise of unlicensed devices in consumer electronics receivers connected to cable facilities

Respectfully Submitted,

/s/ Daniel L. Brenner

Daniel L. Brenner
David L. Nicoll
Counsel for the National Cable & Telecommunications Association
1724 Massachusetts Avenue, N.W.
Washington, D.C. 20036-1903
(202) 775-3664

William A. Check, Ph.D.
Senior Vice President
Science & Technology

Andy Scott
Senior Director of Engineering

Steven L. Mace
Director, Systems Technology

November 30, 2004

SWIDLER BERLIN LLP

THE WASHINGTON HARBOUR
3000 K STREET, NW, SUITE 300
WASHINGTON, DC 20007-5116
PHONE (202) 424-7500
FAX (202) 424-7643

WWW.SWIDLAW.COM

April 28, 2005

VIA ELECTRONIC FILING

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: *Ex Parte* Submission of Shure Incorporated
ET Docket No. 04-186; Unlicensed Operation in the TV Broadcast Bands

Dear Ms. Dortch:

Shure Incorporated ("Shure"), by undersigned counsel, hereby submits this filing in response to Intel Corporation's ("Intel") March 29, 2005 *ex parte* presentation[1] to correct inaccuracies and misimpressions in Intel's filing summarizing the status of this proceeding.

Intel's filing erroneously suggests that this proceeding is uncontested and without significant unresolved technical issues. Contrary to Intel's assertions, however, unlicensed devices operating under the rules as proposed in the NPRM[2] would cause significant harmful interference to a variety of important licensed services relied upon by the American public. The record is replete with discussion and technical analysis by Shure and others of the harmful interference that will occur to wireless microphones, rural television reception, DTV receivers, and other services relied upon by millions of Americans if unlicensed devices are introduced to the TV broadcast bands as proposed. To date, no proven solutions have been developed to remedy this harmful interference.

Shure has supported an open-minded and critical analysis of the Commission's proposals in the NPRM. However, Intel's zeal to gain free access to the "beachfront" spectrum in the TV broadcast bands is both transparent and unproductive, and it does not serve the Commission's overall public interest goals. In pushing the FCC to "move forward without delay,"[3] Intel

---

1 *Ex Parte* Presentation of Intel Corporation filed in ET Docket No. 04-186 on March 29, 2005 ("*Intel Ex Parte*"). A complete copy of Intel's *ex parte* presentation was not received by the FCC until March 31, 2005.

2 *Unlicensed Operation in the TV Broadcast Bands*, ET Dockets 04-186, 02-380, Notice of Proposed Rulemaking, released May 25, 2004 ("NPRM").

3 *Intel Ex Parte*, at p. 5.

ignores, and urges the Commission to ignore, the extensive record demonstrating both the substantial risk of widespread interference and the absence of proven mitigation solutions. It is premature for the Commission to move forward to adopt the rules it has proposed in the NPRM. More study is needed to resolve the complex interference issues presented by the NPRM to ensure that existing spectrum users and the American public are not harmed.

I. THERE ARE NO PROVEN REAL-WORLD INTERFERENCE SOLUTIONS.

The filings and technical studies on the record demonstrate that numerous licensed services will experience harmful interference if unlicensed devices are introduced in the TV broadcast bands as proposed by the NPRM. Shure's technical study demonstrates that unlicensed devices will cause harmful interference to wireless microphones.[4] Motorola's technical study confirms that television receivers within the Grade B contour are not adequately protected.[5] MSTV's technical analysis shows that NSTC and DTV receivers will experience desensitizing interference, which may also adversely affect cable and satellite television reception.[6] The National Translator Association's technical analysis demonstrates that the NPRM fails to "protect television reception out to the limits of practical and useful reception,"[7] which would particularly and disproportionately harm rural viewers.

Despite ongoing industry discussions, there is no credible technical analysis on the record (or elsewhere) which refutes this evidence. Intel fails to address these studies, let alone convincingly rebut them. Intel's "technical analysis" is woefully inadequate and misguided, and does not provide the Commission a reasonable basis upon which to conclude to move forward with the proposals in the NPRM.[8]

---

[4] *See, e.g.*, Notice of *Ex Parte* Filing of Shure Incorporated filed in ET Docket No. 04-186 on July 21, 2004 and Notice of *Ex Parte* Meeting of Shure Incorporated filed in ET Docket No. 04-186 on August 5, 2004.

[5] *See* Comments of Motorola Corporation filed in ET Docket No. 04-186 on Nov. 30, 2004 at p. 12 ("Motorola Comments").

[6] *See* Joint Comments of the Association for Maximum Service Television, Inc. and the National Association of Broadcasters filed in ET Docket 04-186 on Nov. 30, 2004 at pp. 8-9 (citations omitted).

[7] *See* Comments of the National Translator Association filed in ET Docket No. 04-186 on Nov. 30, 2004 at p. 3 ("NTA Comments") ("the principal source of over-the-air television in rural portions of the United States is by means of translator service").

[8] For example, Intel grossly underestimates direct pickup interference and protections needed for out-of-band emissions. Laboratory tests have shown that direct pickup interference will produce harmful interference to co-channel cable television reception from simulated personal/portable devices operating 10 meters away from a cable television at the NPRM's power levels. Intel attempts to discount this risk by pointing to a mobile phone as an example of a noninterfering device, however, this example is unpersuasive because mobile phones do not operate co-channel to cable television frequencies. On out-of-band emissions, Intel uses unrealistic assumptions to conclude that these levels should be *raised* 20 dB from that proposed in the NPRM. Motorola, however, proves via statistical Monte Carlo simulation that these limits must be reduced below NPRM levels to protect television reception in suburban and urban areas. Perhaps most disturbing of all is Intel's proposal – clearly contrary to the NPRM – to allow unlicensed devices to communicate with each other on *occupied* television channels without regard to the

For the past several months, Shure and other affected parties participating in IEEE and other working groups have constructively examined the scope of harmful interference from unlicensed devices and thoughtfully considered possible mitigation techniques. Important work is continuing but no meaningful consensus has yet been reached to resolve the numerous and varied destructive interference problems presented by the NPRM.

Although there is no clear resolution to the interference issues, what is clear is that the record shows it is premature for the FCC to move forward with the NPRM proposals at this time. It would be unreasonable for the Commission to permit unlicensed devices in the TV broadcast bands unless the Commission were assured that any harmful interference would be effectively mitigated. There are no such assurances. Real-world solutions have not been developed – let alone tested and proven – to remedy the harmful interference that unlicensed devices would cause. Intel would have the Commission use Intel's flawed and agenda-driven analysis to run roughshod over the grave and substantiated concerns of existing spectrum users in TV broadcast bands. The Commission cannot simply close its eyes – as Intel does – to the important public interests at stake and proceed with the NPRM absent proven solutions to mitigate potential interference.

II. ABSENT PROVEN SOLUTIONS, NUMEROUS IMPORTANT USERS OF THIS BAND WILL BE HARMED IF THE FCC MISSTEPS IN THIS PROCEEDING.

The NPRM's stated objectives are to allow unlicensed devices to operate in the TV broadcast bands as long as no harmful interference occurs to licensed services.[9] However, numerous and varied existing licensed users of the TV broadcast bands – wireless microphone users, broadcasters, translator operators, 700 MHz interests, and public safety – are on the record expressing grave concerns about the harm unlicensed devices will cause to their operations.

Shure and other wireless microphone interests have analyzed and demonstrated that wireless microphones will experience harmful interference from unlicensed devices if the NPRM proceeds as proposed. In a recent filing, the News, Sports and Entertainment Coalition stated that millions of Americans have come to rely on the high quality production in live news, sporting and entertainment events made possible by wireless microphones and described how the viewing public would be harmed if wireless microphone operations were impaired.[10]

---

harm such transmissions could cause licensed services. *See* Comments of Intel Corporation filed in ET Docket No. 04-186 on Nov. 30, 2004 at App. B, p. 3.

9 *See, e.g.*, NPRM, ¶ 2.

10 *See* Letter to Chairman Powell filed in ET Docket No. 04-186 on March 11, 2005 at pp. 2-3. The News, Sports and Entertainment Coalition includes NBC Sports, the NFL, Fox, C-Span, CBS News, Shure, among others.

In an area with even more far-reaching implications, broadcasters fear that allowing unlicensed devices as proposed by the NPRM would wreak havoc on the DTV transition.[11] They uniformly urge the Commission, to the extent it decides to proceed with this item at all, to wait until after the DTV transition to take any action. "The next 2-3 years are critical in ensuring an efficient and successful DTV transition."[12] Fundamental spectrum assignment issues and DTV operational issues are currently unsettled and in a state of flux. Moreover, the "cliff effect" of DTV means that it is an all-or-nothing technology, interference and loss of service means not just a poor picture, but no picture at all. As CEA succinctly states, "[e]nsuring that TV broadcast reception is fully protected must be the [Commission's] primary objective."[13] "Until the transition is over, there are significant risks to introducing unknown elements."[14] Knowingly introducing interference without proven means to mitigate it needlessly threatens long-standing Commission and Congressional goals to institute DTV service.

In addition to threatening DTV service, the record shows that the proposed rules, if adopted, would jeopardize rural television reception. Millions of people in rural areas live outside the Grade B contours of broadcast stations and rely on broadcast service from low power television stations and translators. The NPRM, however, fails to protect service outside the Grade B contour and would expose these viewers to harmful interference that would jeopardize their television reception. This is especially unfair because over-the-air television is the primary source of emergency information and quality of life information available to rural America, a need unfulfilled by satellite television with its limited local channel offerings.[15] Nothing in the record effectively addresses these potential risks.[16]

The record also shows that unlicensed device operation as proposed would threaten 700 MHz spectrum and public safety communications. 700 MHz auction winners are concerned that introducing unlicensed devices in Channels 2 – 51 will delay the DTV transition, thereby postponing receipt of their auction licenses. Also, by making prime spectrum available for free, albeit on an unlicensed basis, the Commission is likely to chill investment in licensed spectrum

---

11 *See* Comments of Pappas Telecasting Companies filed in ET Docket No. 04-186 on Nov. 30, 2004 at p. 7. See also Martin Statement on NOI ("I fear that these unlicensed devices will create additional interference problems when digital television gets underway. Interference already threatens to impede the introduction of digital television.").

12 *See* Comments of Harris Corporation filed in ET Docket No. 04-186 on Nov. 30, 2004 at p. 4.

13 *See* Comments of Consumer Electronics Association filed in ET Docket 04-186 on Nov. 30, 2004 at p. 2.

14 *See* Comments of Cox Broadcasting, Inc. filed in ET Docket No. 04-186 on Nov. 30, 2004 at p. 2 ("Cox Comments").

15 National Translator Association Comments at p 2.

16 *See* Separate Statement of Commissioner Kevin J. Martin, *Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Bands*, ET Docket No. 02-380, Notice of Inquiry, rel. Dec. 11, 2002 at p. 1 ("Martin NOI Statement") ("I fear that such unlicensed devices could interfere with the broadcast stations many rural viewers watch and that rural viewers would lose the few broadcast signals upon which they rely.").

and depress future auction prices for 700 MHz spectrum.[17] With respect to public safety, the NPRM proposes only limited protection for public safety entities operating in channels 14-20.[18] Numerous public safety interests urge the Commission to exempt these channels from unlicensed operation nationwide because the risk of interference to mission-critical operations is just too great.[19]

Introducing unlicensed devices only to have them interfere with existing licensed services will not serve the public interest. The Commission in the NPRM recognized that, if approved, unlicensed devices have the potential for ubiquitous and uncontrolled deployment. Once unlicensed devices are introduced to the mass market, it will be impossible to recall them and resolve any interference issues.[20] Given the risks described above that the proposed operations pose not only to a wide variety of licensed services, but to millions of users who rely upon those services, the Commission certainly cannot afford to act hastily as Intel urges and proceed with anything short of absolute certainty in this proceeding.

III. THE POTENTIAL HARMS OF PROCEEDING WITH THE NPRM AT THIS TIME FAR OUTWEIGH ITS PURPORTED BENEFITS

If the Commission rules on this matter now – as Intel urges – it should find that the record to date does not reveal a compelling need to make this particular spectrum available for unlicensed use, in light of the significant harm such use would cause to licensed services. The Spectrum Policy Task Force Report specifically recommended that the Commission be careful not to disturb broadcast spectrum because of the historic reliance on broadcast services by the American public and the significant operational changes required by the DTV transition: "[i]n the case of broadcasting, evolution towards greater flexibility is governed for the time being by the statutorily-mandated DTV transition process, making additional regulatory changes impractical at least until that process is complete."[21] Certainly the significant documented interference issues in the record do not support departing from this established policy.

It is worth noting that the Commission has already allocated a significant amount of spectrum to unlicensed use and to wireless Internet service providers ("WISPs"). The Commission's recently released Wireless Broadband Task Force Report observes that several spectrum bands are currently used for the provision of wireless broadband services using unlicensed devices, including the 902-928 MHz band, the 2.4 GHz band, the 5 GHz band, and

---

17 *See* Comments of Qualcomm Incorporated filed in ET Docket No. 04-186 on Nov. 30, 2004 at p. 2.

18 *See* NPRM at ¶ 35.

19 *See, e.g.,* Motorola Comments at pp. 5-6.

20 Even more disturbing is that, with respect to DTV, harmful interference is very unlikely to be recognized as such by average consumers. If average consumers have their DTV sets go blank as a result of harmful interference, they are likely to blame new DTV technology for their reception problems.

21 Spectrum Policy Task Force Report, ET Docket No. 02-135, rel. Nov. 15, 2005, at pp. 45-46.

the upper-millimeter wave bands (including spectrum at 60 GHz and 90 GHz).[22] Significantly, the Commission just authorized 50 MHz of spectrum at 3.65 GHz for use by WISPs and other entities for wireless broadband services. Moreover, the Commission is considering changes to its Secondary Markets rules to facilitate provision of services similar to those currently being provided on an unlicensed basis, but with the benefit of interference protection. Clearly, there is no compelling need for the Commission to give short shrift to the numerous interference issues in the record in a rush to open new spectrum for unlicensed services and WISPs.

To the extent this proceeding is motivated by a desire to make more efficient use of the TV broadcast bands, Shure reminds the Commission that Broadcast Auxiliary Services already fulfill this goal. Wireless microphones and other devices operate on a secondary basis in existing "white spaces." Hastily squeezing too many users in the "white spaces" risks causing a "tragedy of the commons" which would render the "white spaces" unusable by all users.

In light of the above, the record shows no compelling need to rush to judgment and risk causing widespread interference to numerous existing licensed services. While many WISPs and providers of unlicensed services have a seemingly insatiable desire for additional spectrum, it would be unwise to threaten not only the broader Commission and Congressional public policy goals promoting DTV but also the rights of existing spectrum users by adopting the currently proposed rules.

IV. CONCLUSION

The record reveals that this proposal raises many complex technical issues currently under active study and debate in industry groups. Many important questions remain unanswered. As such, there is much work that the affected industries should be allowed time to accomplish. The only clear-cut conclusion to be drawn at this time is that the Commission is not in a position to permit unlicensed devices in the TV bands without risking harmful interference to multiple uses of this spectrum affecting millions of people. The risk of such widespread harmful interference simply cannot be justified.

The Commission should reject Intel's unsupported rosy view of the interference issues and its unreasonable demand that the FCC "move forward without delay" to amend its rules in a way that has been shown by many to cause harmful interference to important existing uses of the band. It is premature for the Commission to move forward. With the "error risk so high and the error cost so great,"[23] the Commission should defer consideration of rules allowing unlicensed devices to share spectrum with TV broadcast bands until there is greater certainty that any harmful interference can be effectively mitigated.[24] Time is needed to resolve important

---

22 Wireless Broadband Task Force Report, GN Docket No. 04-163, rel. Mar. 8, 2005, at p. 14.

23 Cox Comments at p. 2.

24 Indeed, then-Commissioner Martin's observations in 2002 still hold true today: "In balance, the speculative benefits of opening the broadcast band up, the risk to the digital transition, the potential harm to rural areas, ... weigh against conducting this inquiry at this time." Martin NOI Statement at p. 2.

contentious issues, and to develop and test real-world solutions to ensure that existing spectrum users and the American public are not harmed.

If you have any questions regarding these matters, please do not hesitate to contact the undersigned.

Very truly yours,

/s/

Catherine Wang
Jeanne W. Stockman

Notice of Oral *Ex Parte* Presentation

March 3, 2005

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: In the Matter of
Unlicensed Operation in the 3650-3700 MHz, ET Docket No. 04-151;
Additional Spectrum for Unlicensed Devices Below 900 MHz and the 3 GHz Band, ET Docket No. 02-380; and
Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band, ET Docket No. 98-237.

Dear Ms. Dortch:.

On March 3, 2005, Peter Pitsch of Intel met with Bryan Tramont, Chief of Staff to Chairman Michael Powell, regarding the above proceedings.

In the course of this meeting, Mr. Pitsch made the following statements:

The 3650 to 3700 MHz spectrum should be allocated in a manner which would provide expeditious, low cost access to this spectrum for rural WISPs and promote efficient use of this spectrum in congested MSAs. Specifically, the FCC should prescribe unlicensed use (with no contention etiquettes) in rural areas (*i.e.*, outside the Top 50 MSAs) and licensed use in the Top 50 MSAs. Intel believes that this compromise proposal addresses the needs of WISPs in rural areas without sacrificing efficient spectrum use in the congested MSAs.

Indeed, exclusive licensing is the best way to foster long range, wireless broadband deployment, especially in congested areas. Exclusive licensing

would foster the optimal QoS and business investment certainty in these markets – results not possible with self-coordination.

In addition, contention etiquettes – as a means to solve "tragedy of the commons" problems inherent in unlicensed spectrum use for long range services – would be problematic from both a theoretical and a practical standpoint. Such etiquettes would promote gamesmanship among competing providers and cause administrative delay. That is, if the approval process for the contention etiquette has any "teeth," it would likely lead to significant delay.

Moreover, "listen before talk," or sensing, techniques only work well for short range, low power applications; they do not work well for long range, high power services such as those envisioned in the 3650 to 3700 MHz spectrum. Contention etiquettes also preclude the use of directional antennas, which are a key component of long range broadband applications.

Finally, a licensing approach should not create significant market power problems in the Top 50 MSAs. In these markets, there are or will likely be several wired and wireless broadband alternatives, including DSL and cable modem and advanced wireless services at the 1.5, 1.7, 2.1, and 2.5 GHz bands.

Pursuant to Section 1.1206 of the Commission's Rules, 47 C.F.R. § 1.1206, a copy of this submission is being provided to the above mentioned party. Please contact the undersigned with any questions in connection with this filing.

Respectfully submitted,

/s/ Peter Pitsch

Peter Pitsch
Intel Corporation
Director, Communications Policy

cc:

Bryan Tramont

Notice of Oral *Ex Parte* Presentation

February 22, 2005

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: In the Matter of
Unlicensed Operation in the 3650-3700 MHz, ET Docket No. 04-151;
Additional Spectrum for Unlicensed Devices Below 900 MHz and the 3 GHz Band, ET Docket No. 02-380; and
Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band, ET Docket No. 98-237.

Dear Ms. Dortch:

On February 17, 2005, Peter Pitsch of Intel met by telephone with Office of Engineering and Technology Chief, Ed Thomas and OET Deputy Chiefs, Julius Knapp, Jim Schlichting and Alan Scrime regarding the above proceedings. On February 18, 2005, he met by telephone with Chief of Staff Bryan Tramont regarding the above proceedings.

In the course of those meetings, Mr. Pitsch expressed Intel's continuing concern that the 3650 to 3700 spectrum, especially in the affected MSAs, should be licensed on an exclusive basis to foster efficient use of this spectrum for long range applications. He stated that the best way to foster long range, wireless broadband deployment in areas where congestion is likely is to provide the protection for QoS and business certainty

afforded by exclusivity. He stated that the goal of expediting wireless broadband deployment could be advanced by permitting rural applicants to apply for site licenses outside the MSAs during a 6 month window before the auction was held. Applications could be granted on a first come basis subject to meeting reasonable build out benchmarks. Alternatively, the spectrum outside of the MSAs could be made unlicensed.

Pursuant to Section 1.1206 of the Commission's Rules, 47 C.F.R. § 1.1206, a copy of this submission is being provided to each of the above parties. Please contact the undersigned with any questions in connection with this filing.

Respectfully submitted,

/s/ Peter K. Pitsch

Peter K. Pitsch
Intel Corporation
Director, Communications Policy

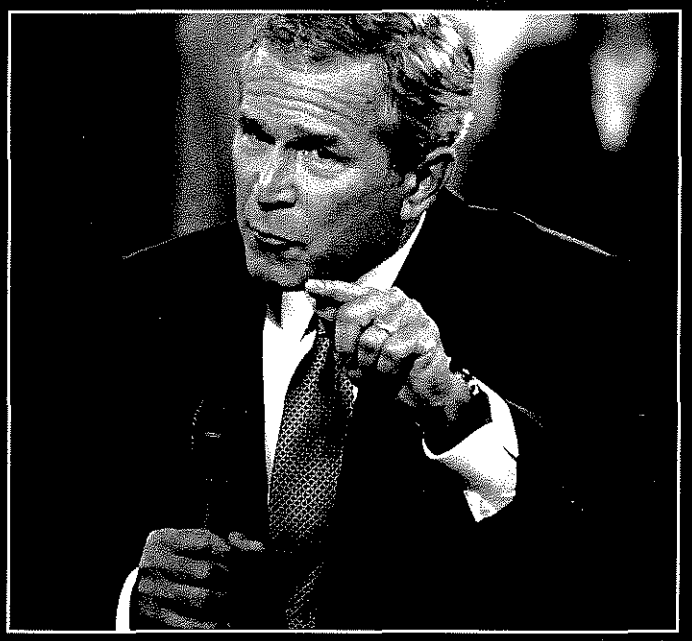
cc:

Bryan Tramont
Ed Thomas
Julius Knapp
Jim Schlichting
Alan Scrime

Wireless Microphones
Enable Modern Communications

The biggest industries in the United States
– from television and movies to sports and politics –
rely on wireless microphones to connect with their audiences.

Political Events



On the campaign trail, whether stopping for an impromptu speech or rallying the masses in giant convention halls – politicians and public speakers rely on wireless microphones to help them motivate audiences and rally supporters.

Wireless microphones are critical for...

- Mobile Speaking and Interviewing
- Reporting and Newsgathering
- Recording and Intercom Communications

News Organizations

News happens in an instant – reporting teams around the country are our first-responders to distribute information and awareness to the American public when it happens.

Electronic newsgathering organizations use wireless microphones for...

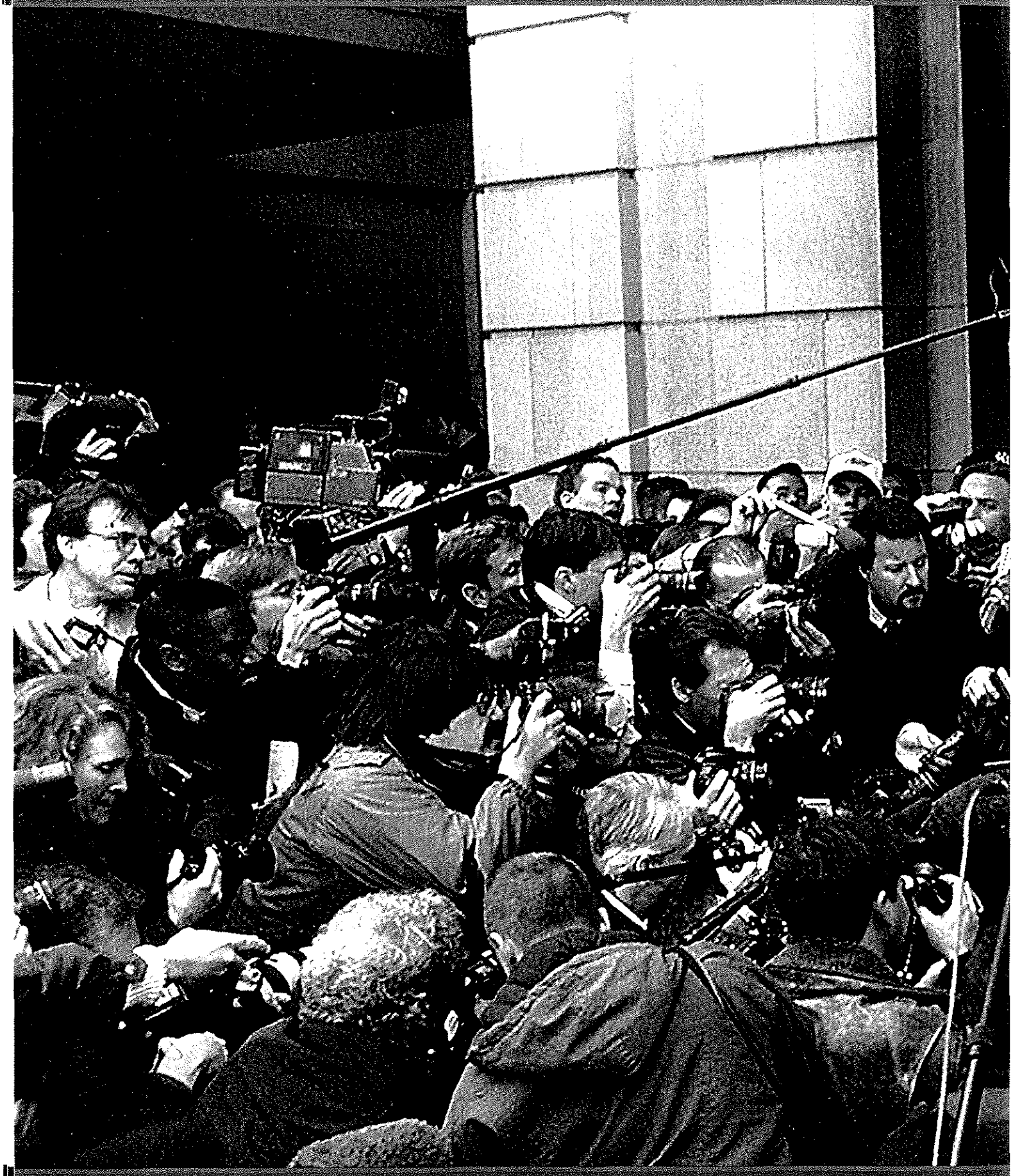
- Mobile Reporting and Newsgathering
- Studio and Intercom Communications
- Speaking and Interviewing

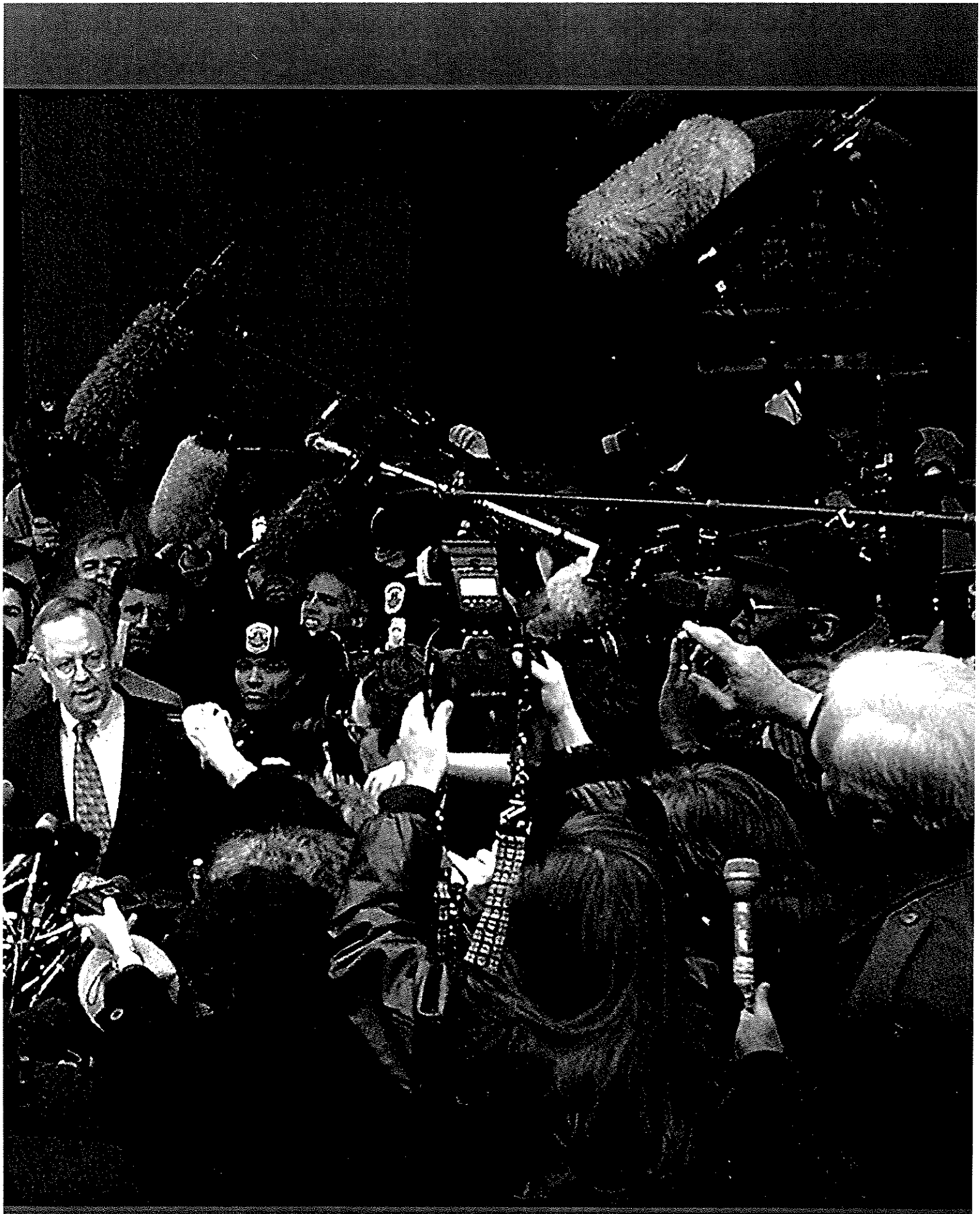
Wireless Microphones
Enable Modern Communications

The biggest industries in the United States
– from television and movies to sports and politics –
rely on wireless microphones to connect with their audiences.

Communication is vital — to communicate means being heard, being felt, and being understood. Businesses, houses of worship and governments communicate with the American people every day through broadcasting — they nurture economies, provide entertainment, connect people with their faith, and inform them about political, local and public safety events. Performers, newscasters, athletes, spiritual and social leaders all use wireless microphones to magnify their message and connect with their audience.

It has been said that the best technology is transparent to the user. Wireless microphones are often seen and heard but rarely noticed by the hundreds of millions of people in the audiences of America. Wireless microphones allow the message to be delivered from where it is generated — from the cockpit of a racecar, the scene of an accident, a press conference on the street, the head of a parade, to the airfield of Air Force One. Wireless microphones are not only part of the medium of modern broadcasting and movie production, they are a mission critical element to the continued success of these industries and the businesses that depend on them.





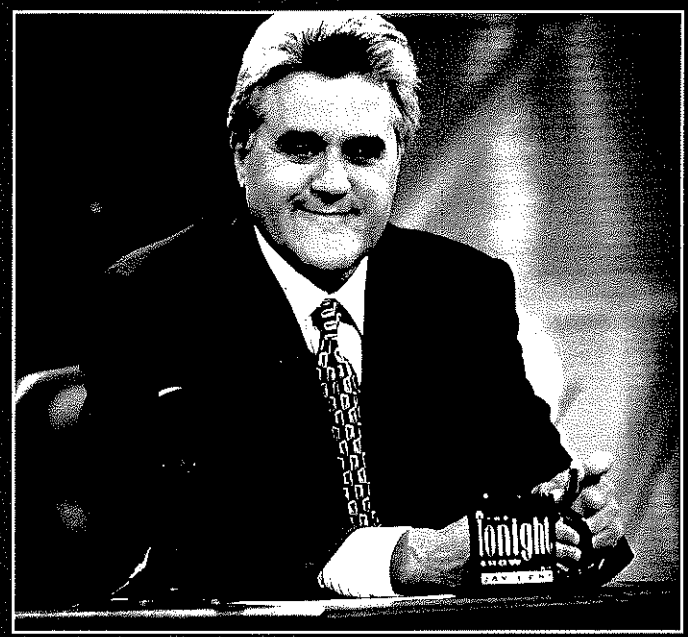
Sporting Events

Broadcasters innovatively use wireless microphones to bring sports into America's living rooms. They are hidden under second base, attached inside the helmets of players and used for amplifying the national anthem.

From the press box to the playing field, wireless microphones are essential for...

- Athlete and Coach Communications
- Mobile Announcer Reporting and Interviewing
- Crowd and Ambience Mixing
- Musical Performances and Intercom Communications

Television Inside the Studio



In the studio environment, television production has relied on wireless microphones as essential components for the casual, relaxed atmosphere of today's most popular talk shows and interview-heavy news programs.

Whether handheld or lavaliere, wireless microphones are essential for...

- Speaking and Interviewing
- Audience and Ambience Mixing
- Musical Performances and Intercom Communications

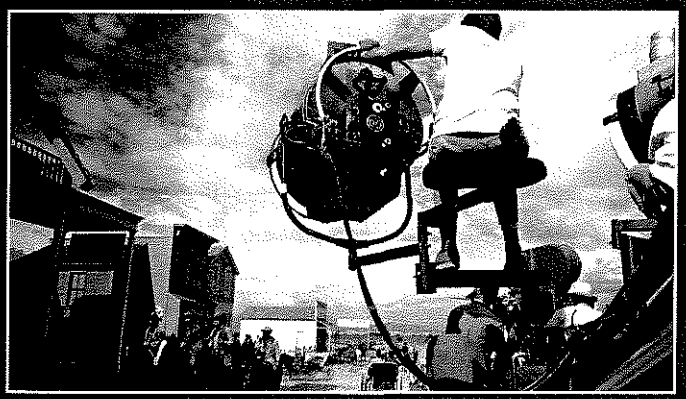
abc CBS CNN FOX NEWS channel NBC

Television Outside the Studio

With the burgeoning popularity of reality TV and the perennial success of industry award shows like the Oscars® and GRAMMY®s, the television industry is reliant on wireless technologies that free performers and participants to communicate and express themselves without wires.

Front and center or tucked away and nearly invisible, wireless microphones are used for…

- Musical Performances and Intercom Communications
- Speaking and Interviewing
- Parade Coverage and Remote Holiday Events
- Crowd and Ambience Mixing
- Movie production and Recording



Thousands of businesses use wireless microphones every day to reach millions of people across the country. Since 1952 – when the wireless microphone was first created – businesses, governments, and individuals have depended on wireless technology to bring information and comfort to the American public.

As wireless technology advances, wireless microphones will become less visible but more essential to the businesses and people that use them – and transparent to the people that hear them.

Provided by Shure Incorporated

5800 West Touhy Avenue
Niles, IL 60714-4608 USA
www.shure.com

©2004 Shure Incorporated

Interference from the Operation of Unlicensed Devices in the Broadcast TV Bands

Engineering Study

(Docket 4-186)

Victor Tawil
Senior Vice-President
Maximum Service Television, Inc.

Charles W. Einolf, Jr., Ph.D.
RF Consultant

November 2004

Table of Contents

1. Introduction 3
2. Laboratory Evaluation of Interference from Unlicensed Devices in the Broadcast TV Band 9
3. Assessment of Available Spectrum for Unlicensed Devices 14
4. Conclusions 22
5. Engineering Credentials 24

Table of Contents 28

Executive Summary 29

Introduction 30

Laboratory Test Set-up 30

Results Of The Laboratory Test 35

1.1 De-Sensitisation of DTV Receivers In An Indoor Environment 35
1.2 De-Sensitisation of DTV Receivers by UD Sideband Signals Transmitted Through A Wall 36
1.3 De-Sensitisation of NTSC Receivers in an Indoor Environment 37
1.4 De-Sensitisation of NTSC Receivers with the Narrowband Signal Transmitted Across NTSC Band 38
1.5 Cable Ingress Created by the UD Sideband Signals 39

Findings & Observations 40

ANNEX 1: TEST PROCEDURE 41

ANNEX 2: LIST OF RECEIVERS 43

ANNEX 3: OFFICE DRY WALL AND PHOTOS OF TEST EQUIPMENT 44

1. Introduction

The Commission has proposed to amend its rules to allow unlicensed devices to operate in the broadcast television spectrum at locations where the spectrum is "unused" by television stations.[1] Although the Commission's proposal implies that potential interference to the public's television service can be managed, there is serious concern for the theoretical and practical aspect of the Commission's proposal. The proposal does provide some specifics on power limitations for the unlicensed devices but falls short on technical details which would permit a full assessment of interference mechanisms and levels of impact to broadcast television. This engineering study attempts to mitigate the lack of information available in the proposal by addressing more general spectrum and interference issues. There may, however, be subtle mechanisms specific to spectrum masks, modulation techniques, network management strategies, device locations, and other factors that would render significant interference to broadcast television.[2]

The NPRM proposes several mechanisms intended to prevent interference. However, these mechanisms are deemed ineffective in controlling interference. For example, the Commission proposed that a fixed unlicensed device would either use a GPS receiver or have a "professional" installer determine its location relative to the surrounding TV stations using a public or private database. The use of GPS may be problematic if installations are made indoors or in shadowed areas where the satellite signals cannot be reliably received. In either case, a database of occupied TV channels must be provided to the fixed unlicensed device. The database of occupied TV channels may also be problematic since it needs to be accurate and must be updated frequently, if not continuously. This is

[1] *Unlicensed Operation in the TV Broadcast Bands*, Notice of Proposed Rulemaking, ET Docket No. 04-186, FCC 04-113 (released May 25, 2004) (hereinafter *"NPRM"*).

[2] Attempting to address these concerns, MSTV filed a Request for Clarification on June 21, 2004. A response to the Request for Clarification was received on July 27, 2004 offered little guidance to clarify these concerns.

especially true during the roll out of the digital TV and the transition to an all digital service, and the possible implementation of new enhancements such as on-channel DTV repeater systems, distributed transmission systems and Enhanced VSB.

The NPRM proposes that portable unlicensed devices monitor a "positive" control signal from a fixed unlicensed transmitter to ascertain which TV channels are vacant. It is possible for the portable unlicensed device to receive a control signal from outside of the operating contour of a fixed transmitter and thus cause interference in a neighboring contour. Since the propagation characteristics between the fixed and portable unlicensed devices are indeterminate, there may be significant discrepancies in signal conditions between the fixed and portable unlicensed devices. This problem may prevent positive control of an unlicensed device network and lead to hidden nodes. Propagation uncertainties at the TV receiver, especially in the case of indoor reception, would lead to incorrect assumptions of the signal conditions at the TV receiver. Signal measurements at the fixed unlicensed devices may not reflect the signal conditions at the TV receiver.

The management of spectrum in the TV broadcast bands would no longer be viable. Since the devices are unlicensed, there is no way for broadcasters and other licensed users of the TV bands to establish ownership of a source of interference. The NPRM does require devices to periodically and automatically transmit a unique identification signal. The uniqueness of the signal, however, is not clear. Unless each unlicensed device has its own unique identification signal, the source of interference could not be identified. If unlicensed devices are part of a network, it is likely that the unlicensed device would be operating intermittently. Even with an identification signal, the lack of licensing makes it difficult, if not impossible, to physically locate the device and identify ownership. The problem is compounded since the TV receiver locations are also indeterminate. It is unlikely that an

installer of an unlicensed device could know with precision, the location of TV receivers within the service area of the unlicensed device.

In order to better understand the impact of unlicensed devices on broadcast television service, MSTV commissioned two studies. The first study focused on a laboratory evaluation of interference to both analog and digital broadcast television caused by a portable unlicensed device operating in a close vicinity of television receivers or other licensed devices in this band. The second focused on the availability of so called "vacant channels" for unlicensed fixed/access operation in a number of regions within the continental United States.

The NPRM proposes that the unlicensed device be allowed to operate in a broadcast channel provided that the emissions into other broadcast channels complies with §15.209(a)[3]. §15.209 requires that the field strength in the UHF band at 3 meters must not exceed 200 μV/m (or 46 dBμV/m) within a 120 kHz bandwidth. This interference when transferred from a half-wave dipole to a matched impedance receiver input would provide an input power to the receiver of between –82.6 dBm (on channel 14) and –85.9 dBm (on channel 51) within a 120 kHz bandwidth. The power levels from a directional receive antenna may be higher. These power levels are of concern. If the emission from the unlicensed device is broadband and occupies 5.6 MHz of the 6 MHz TV channel, the total interference power in the channel will be 16.7 dB higher (-65.9 dBm at channel 14 and –69.2 dBm at channel 51). The emissions from a nearby unlicensed device could cause the AGC circuit in the TV receiver to reduce its tuner gain, and thus, de-sensitize the receiver and impair its reception of weak TV signals. The ATSC Recommended Practice for Receiver Performance Guidelines recommends a DTV receiver sensitivity of –83 dBm

[3] 47 C.F.R. § 15.209 (a)

(measured over 6 MHz without noise or multipath)[4]. Since a DTV receiver typically requires a 15 dB S/N, the noise floor of the receiver is –98 dBm. The proposed level of interference is significantly higher than the noise floor of a typical DTV receiver.[5]

The establishment of DTV service in the Sixth NPRM[6] and calculation of service areas in the OET Bulletin 69[7], involve a series of planning factors used to delineate the limits of a DTV service area. These planning factors imply that the DTV receiver will be operating at the limit of its sensitivity of –84.2 dBm (based on the thermal noise floor, required S/N, and Noise Figure of the receiver). In addition, the calculation of service area implies that the DTV receiver will be protected to the limit of its sensitivity. This protection from interference is further emphasized in the Reconsideration of the Sixth Report and Order[8]. The RF emission mask for DTV transmitters was tightened to explicitly address adjacent channel interference concerns. Since no allowance has been made for additional interference within the broadcast television band, there is great concern that unlicensed devices will adversely impact the performance of the TV receiver.

The Commission proposes the use of these portable unlicensed devices within the television service contours of adjacent and taboos channels. Specifically, the NPRM asserts that at a distance less than 10 meters from a TV receiver, unlicensed devices will be under the control of the operator and if they cause interference they could be turned off. The NPRM goes on to infer that beyond 10 meters interference will not be an issue. The

---

[4] ATSC Recommended Practice: Receiver Performance Guidelines, Advanced Television Systems Committee Document A/74, p. 11, 18 June 2004.

[5] Similar results were derived for an NTSC receiver.

[6] Sixth Further Notice of Proposed Rule Making, MM Docket No. 87-268, "Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service," Released: August 14, 1996.

[7] Longley-Rice Methodology for Evaluating TV Coverage and Interference, OET Bulletin No. 69, July 2, 1997.

[8] Memorandum Opinion and Order on Reconsideration of the Sixth Report and Order. MM Docket No. 87-268, "Advanced Television Systems and Their Impact upon the Existing Television Broadcast Service, Paragraph 91, Released: February 23, 1998.

Commission is incorrect on both issues. First, it is unrealistic to assume that the operator will control the interference within 10 meters of a TV receiver since in many urban settings such as apartments, condominiums, office buildings, and suburban homes, a television receiver located 10 meters away from an unlicensed radiator may likely be in an adjacent dwelling. Second, portable operation within the TV service contours of adjacent and taboos channels *will* cause interference to TV receivers at distances beyond 10 meters. Depending on the channel relationship between the unlicensed device and the TV taboo channel, the unlicensed device could cause interference to a TV receiver as far as 138 meters away for NTSC and 25 meters for DTV. Moreover, operating on an adjacent channel could cause interference as far as 1550 meters for DTV and 439 for NTSC.[9] Unfortunately, the Proposal did not take into account the potential for interference from the operation of these devices on taboo channels.

The NPRM proposes the same NTSC-to-DTV and DTV-to-DTV co-channel and adjacent channel interference protection rules (D/U ratios) to allow unlicensed transmitters to operate in the TV bands. The applicability of these TV protection rules for an unlicensed device service is inappropriate. Unlike television transmitters, unlicensed fixed transmitters could be placed anywhere, including within the TV service area of an adjacent channel. NTSC transmitters on the other hand can not be located within the adjacent TV service areas, they must be at least 55 miles- away, while DTV transmitters operating on adjacent channels where intentionally co-located or near co-located as a means of

---

[9] Using the DTV-to-NTSC D/U ratios in Bulletin OET-69, the following separation distances were computed using a maximum 400 mill watts ERP for the unlicensed transmitter and a free space propagation model: For N+8, 55 meters; N-7, 39 meters; N-4, 44 meters; N-3, 69 meters; N-2, 138 meters; N+2, 87 meters; N+3, 44 meters; N+4, 123 meters; N+7, 16; N+8, 16 meters; N+8, 16 meters; N+14, 49 meters, N+15, 62 meters; N-1, 309 meters; N+1, 437. Using the ATSC A-74 Recommended Practice DTV-to-DTV ratios for taboos, the following separation distances were also computed: For N+1, 1550 meters; N-1, 1231 meters; N+1, 1550 meters; N-2, 25 meters; N-3, 16 meters; N+(6-14), 14 meters; N+15, 13 meters.

controlling propagation characteristics so that proper Desired-to-Undesired (D/U) levels are maintained independent of the DTV receiver location. The propagation path and characteristics for the desired TV channel will be very different from the interfering unlicensed device. These characteristics are sure to vary greatly over a given service area.

The purpose of the laboratory study is to assess the impact that the out-of-channel emission from an unlicensed device would have on a broadcast receiver. Specifically, the laboratory tests consider the potential for de-sensitization of the TV receiver by the unlicensed device at various separation distances through obstructions, such a wall.

The second study is an analysis of potential sites for unlicensed device operation based upon the proposed Commission's rules for co-channel and adjacent channel interference D/U ratios. Specifically, the study looks at the number of available or "vacant" TV channels that could be utilized for unlicensed transmitters in major urban regions of the United States.

2. Laboratory Evaluation of Interference from Unlicensed Devices in the Broadcast TV Band

The goal of the laboratory evaluation is to objectively measure the potential for interference to broadcast TV from unlicensed devices out of band emission. The Communications Research Centre Canada (CRC) performed the tests. The test bed illustrated in Figure 1 was used to create the interference scenario. A broadcast signal is transmitted on either a low UHF channel for NTSC and a high UHF channel for DTV. The laboratory study includes a simulated "unlicensed device" with a "noise-like" emission in the broadcast television channel. The power of the unlicensed device emission is conservatively adjusted so that the power into the broadcast channel is at least 3 dB below

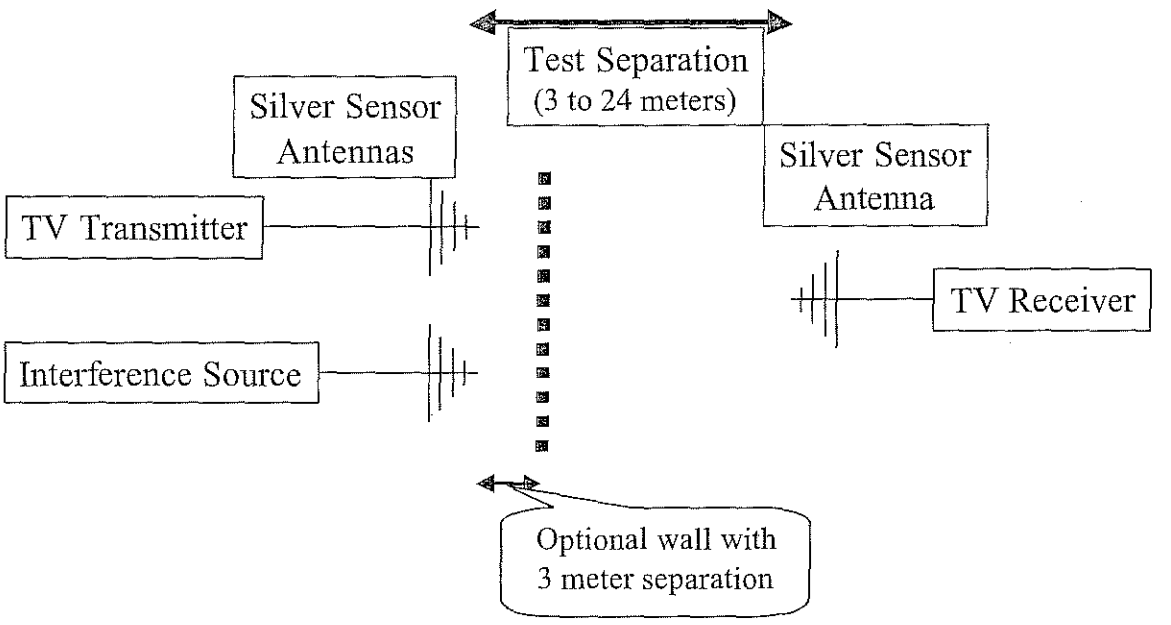


Figure 1 – Laboratory test setup used to evaluate TV receiver de-sensitization resulting from the emission of an "unlicensed device" into the TV channel.

the FCC rule[10] of 200 μV/m (46 dBμV/m) within a 120 kHz bandwidth at 3 meters. The test used a "noise-like" signal with various bandwidths of 0.43, 1.3, and 5.6 MHz to represent bandwidths that may be encountered with "unlicensed-devices." In addition, the unlicensed device antenna was separated from the television receiver antenna at varying distances from 3 to 24 meters – either line-of-sight or with an intervening wall constructed of drywall plaster board with steel studs (typical of apartment or office fire protection walls).

The results and test procedures are presented in detail in Appendix 1 of this report. The findings demonstrate that there is a definite de-sensitization of the TV receiver caused by emission of the unlicensed device into the TV channel. The tests were performed on both NTSC and DTV receivers. Five DTV receivers were tested on channel 48 at distances of 3, 12, and 24 meters from the interfering source. The results are illustrated in Figure 2. It is important to note that the de-sensitization of the DTV receiver continues to be significant

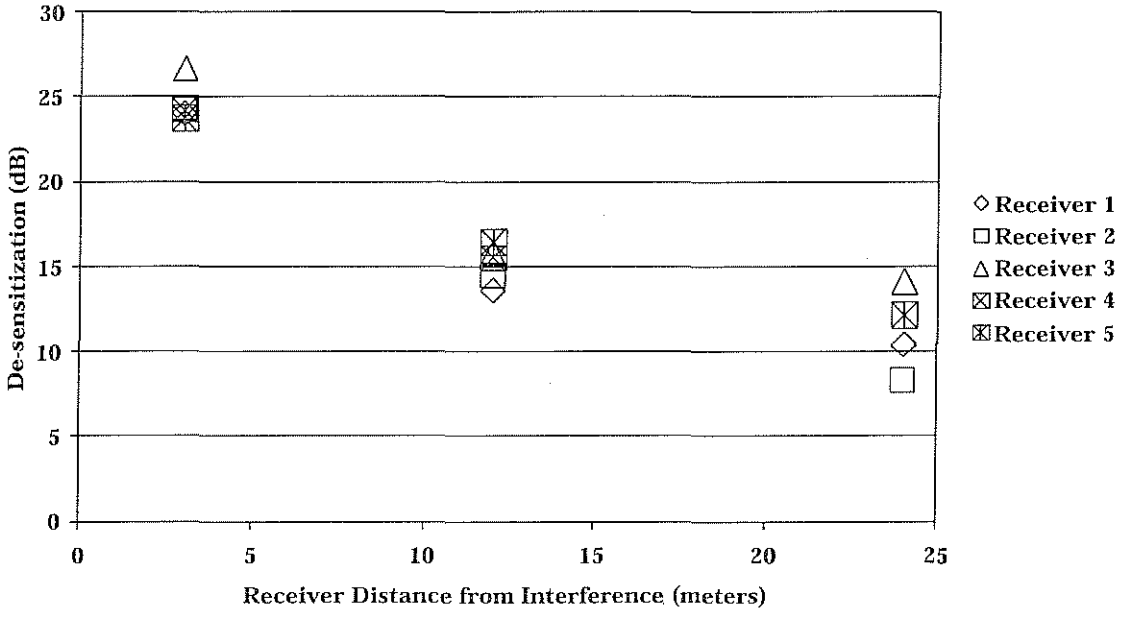


Figure 2 - De-sensitization of DTV receivers by out-of-band interference from a single unlicensed device with a wideband (5.6 MHz) emission into the TV channel.

[10] 47 C.F.R. § 15.209 (a)

even at 24 meters by more than 10 dB. Any DTV receiver operating near the limit of its sensitivity, as may be encountered indoors, would be adversely affected by the interference from an "unlicensed device".

A narrowband emission into the TV channel was also found to desensitize the DTV receiver. Figure 3 illustrates the effect of a 0.43 MHz narrowband emission on the five DTV receivers. Although the total power in the TV channel is 11.2 dB less than the 5.6 MHz case, there still remains a significant impact on the sensitivity of the TV receiver even 24 meters from the unlicensed device.

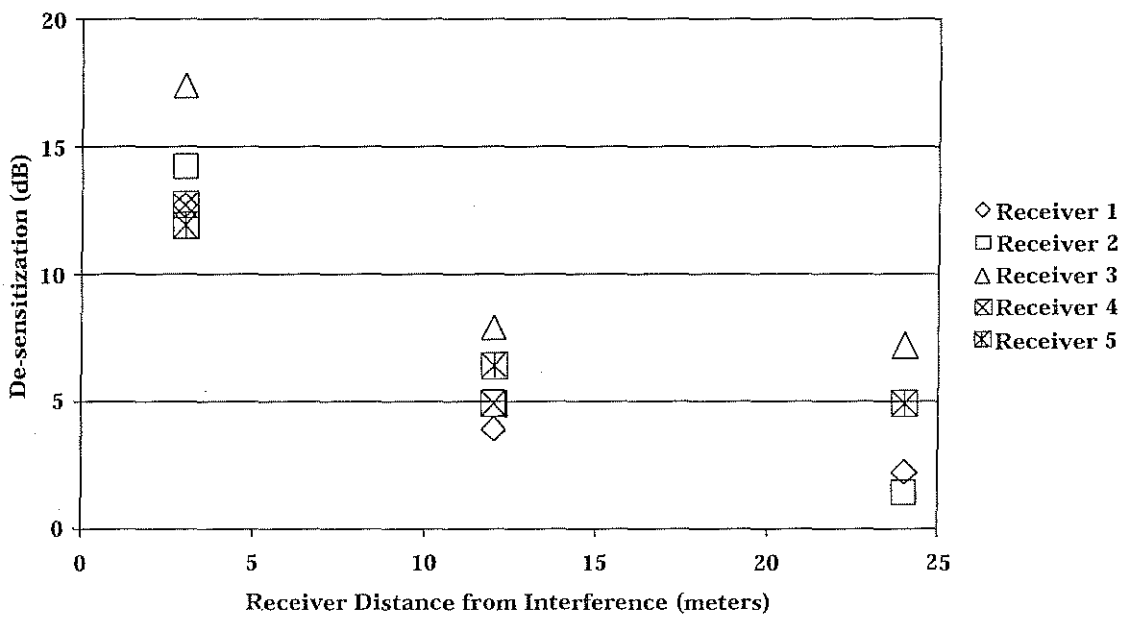


Figure 3 - De-sensitization of DTV receivers by out-of-band interference from a single unlicensed-device with a narrowband (0.43 MHz) emission into the TV channel.

The TV receiver is susceptible to interference even if there is an intervening wall as may be encountered in an office environment or apartment. Figure 4 illustrates the impact of a wall placed between the source of interference and the TV receiver at 12 meters.

Although the wall does attenuate the signal, the DTV receiver is still desensitized by more than 10 dB.

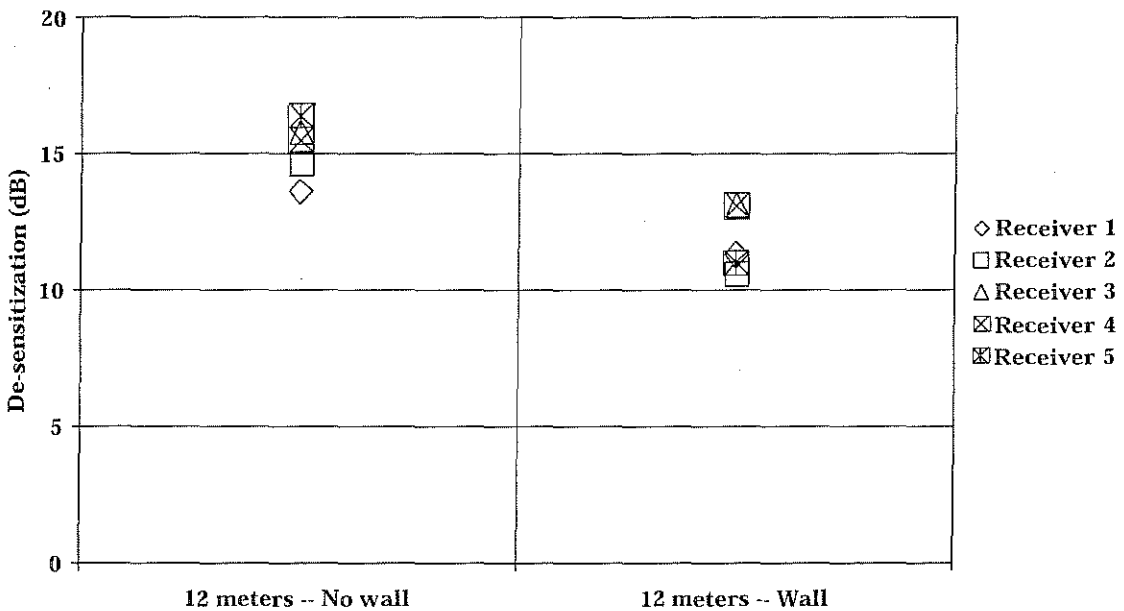


Figure 4 - De-sensitization of DTV receivers by out-of-band interference through a wall from a single unlicensed device with a wideband (5.6 MHz) emission into the TV channel.

The impact of interference on the desensitization of an NTSC receiver is even greater than that for DTV. The interference is so pronounced that the test bed could not provide sufficient desired power to determine the desensitization at the threshold of visibility (TOV). Consequently, the ITU-R Grade 3 ("slightly annoying") criterion was used in the NTSC tests. It should be noted in the test results that the desensitization at TOV is at least 10 dB higher than at ITU-R Grade 3. Figure 5 illustrates the level of desensitization for three NTSC receivers at 6 and 18 meters from the interfering source

using ITU-R Grade 3. Even when the NTSC receiver is placed 18 meters from the interfering source, there is a significant adverse impact on TV reception of at least 15 dB.

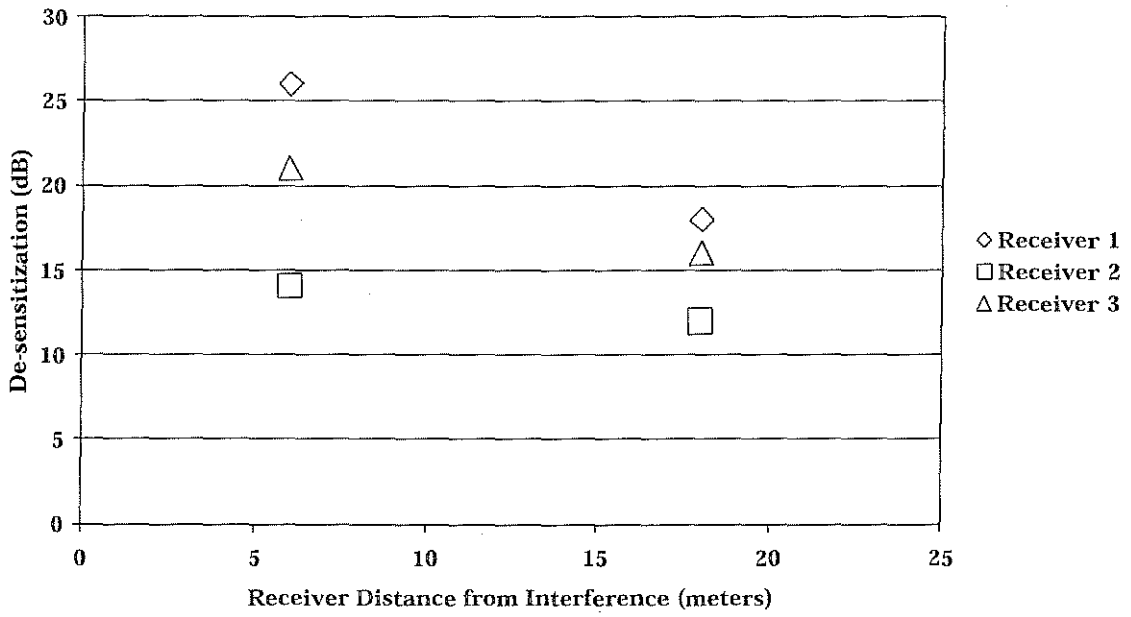


Figure 5 – De-sensitization of NTSC receivers by out-of-band interference from a single unlicensed device with a wideband emission (5.6 MHz) into the TV channel.

3. Assessment of Available Spectrum for Unlicensed Devices

The goal of the spectrum assessment is to objectively determine the geographical range over which spectrum could be available within the broadcast TV bands for use by unlicensed devices. The NPRM proposes to allow fixed unlicensed transmitters to operate in "vacant" TV channels provided various desired-to-undesired (D/U) signal ratios are met at all points within the service area of the unlicensed transmitter. The desired signals are the broadcast TV stations either on co-channel or adjacent channels to the undesired unlicensed transmitter.

TechWare, Inc. of Chantilly, Virginia, was commissioned by MSTV to conduct a study to determine the availability of vacant spectrum within the TV bands for use by these unlicensed devices. The study uses the same propagation curves (FCC broadcast curves) proposed in the NPRM to compute the field strengths for both the desired and the undesired signals to identify the areas where these unlicensed transmitters could be placed. The study modeled a grid of fixed unlicensed transmitters representing a network of unlicensed devices that was superimposed at different geographic regions within the US to determine the number of vacant channels available at these locations. The study used a four watts Effective Radiated Power (ERP) for the unlicensed transmitter with an omni-directional antenna placed at every intersection of a 30-second grid (latitude and longitude) across major populated regions of the United States. The unlicensed transmitter height was set at a **modest height of 30 meters (HAAT)** and the number of available channels was determined for each 30-second grid (i.e. approximately a one square mile area). The proposed protection ratios and service contours describe in Appendix B of the NPRM, §15.244(g) and §15.244(h) were incorporated into the software model and computed on 30-second grid (latitude and longitude) intervals.

Figures 6, 7, 8 and 9 presents maps that show the availability of TV channels for unlicensed devices for the North East region of the US, the states of California, Florida and North Carolina respectively. The maps are color-coded to identify the number of TV channels available for unlicensed device operation in a given location and an olive green-colored background to identify the areas where the software model did not determine the availability of vacant channels. Figure 6 shows that, while some TV channels are available for unlicensed fixed operation in certain rural areas, little if any TV channels are available in congested areas, primarily along the Boston-Richmond corridor.[11] Figures 7, 8 and 9 also show similar results.[12] These maps show that while a limited number of TV channels are available in the rural areas, no channels are available in Los Angeles, San Diego, San Jose, San Francisco, Miami-Fort Lauderdale or the Tampa-Orlando urban areas, as well as Charlotte and Raleigh-Durham urban areas. Other urban areas such as Dallas (Figure 10) and Phoenix (Figure 11) showed similar results. Moreover, the spectrum availability in these states and urban areas varies significantly from one geographical grid to another. As shown in the North East region and the state of North Carolina maps, it is nearly impossible to establish large enough areas with sufficient channels to permit operation of unlicensed device networks in the television broadcast spectrum. Furthermore, identifying these white spaces require complex engineering evaluation and analysis to determine where these devices will be allowed to be located. It will also require the proper design and careful installation of these fixed transmitters. These requirements make it extremely

---

[11] Our analysis indicates that approximately two-thirds of the population in the Boston-Richmond corridor (Figure 6) will not have access to any spectrum. Another 14% will only have access to one TV channel. At 60 meters HAAT, the number of population without access to spectrum is *significantly* higher.

[12] Our analysis further indicates that approximately three-quarters of the population in the state of California (Figure 7) will not have access to any spectrum. An additional 7% will only have access to one TV channel. At 60 meters HAAT, the number of population without access to spectrum is *significantly* higher.

difficult, if not impossible, for untrained unlicensed device operators to conduct these analysis and/or install these transmitters without proper guidance and/or oversight by the Commission or responsible entities.

Similar findings were observed in other regions of the United States. The Techware analysis generally concluded that, using the FCC proposed parameters for protecting TV reception, little if any TV channels are available for unlicensed device operation within the broadcast TV band in the major metropolitan areas of the United States. Television channels are only available in the less populated and rural areas of the country.

Figure 6: Map Depicts Availability of Unlicensed Devices Channels in the North East Region of the United States

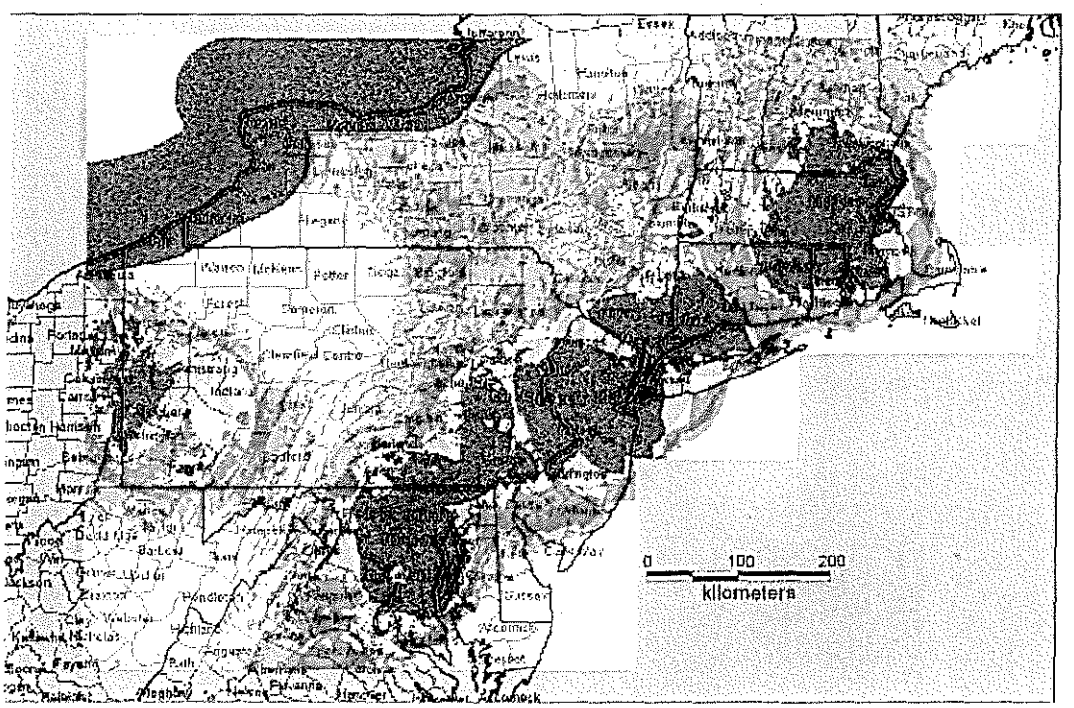


Figure 7: Map Depicts Availability of Unlicensed Devices Channels in the State of California

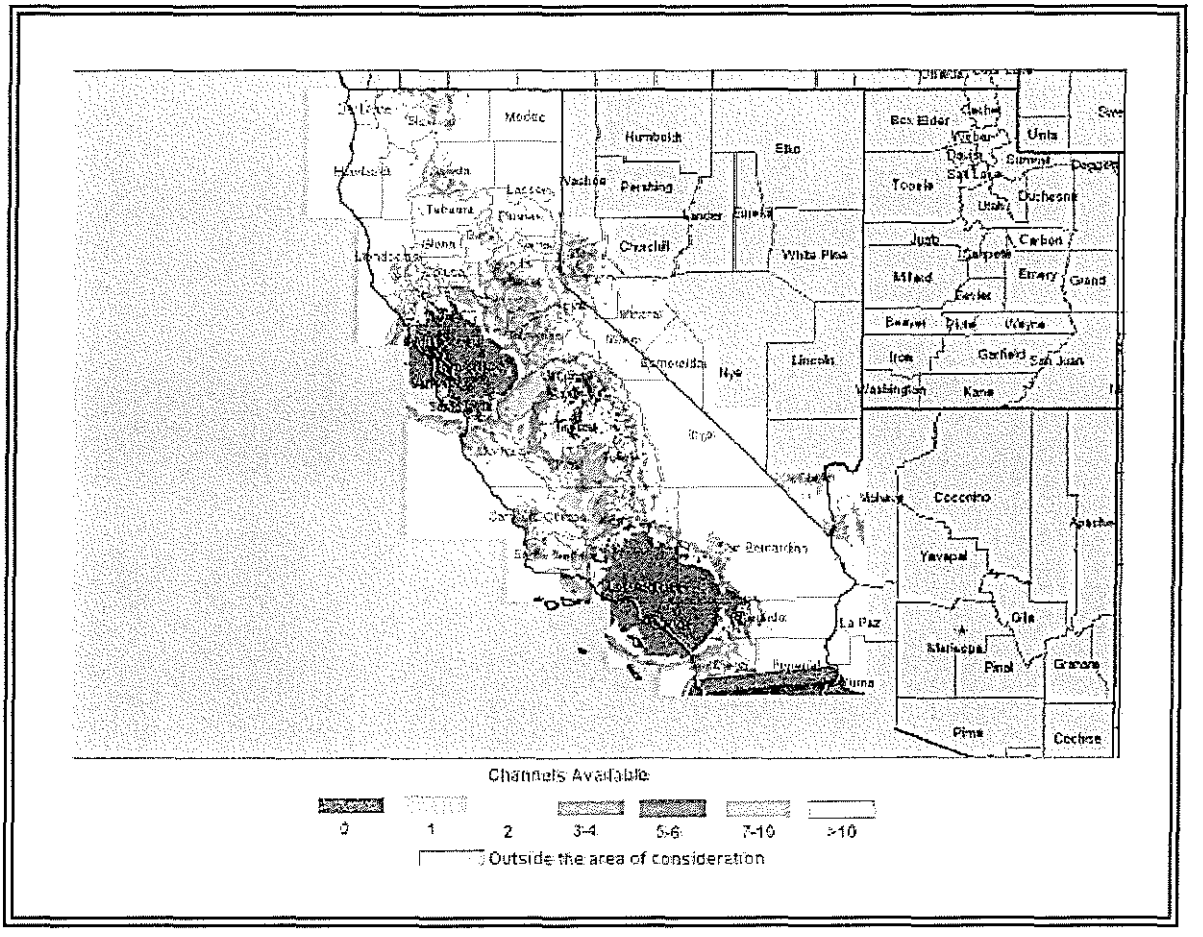


Figure 8: Map Depicts Availability of Unlicensed Devices Channels in the State of Florida

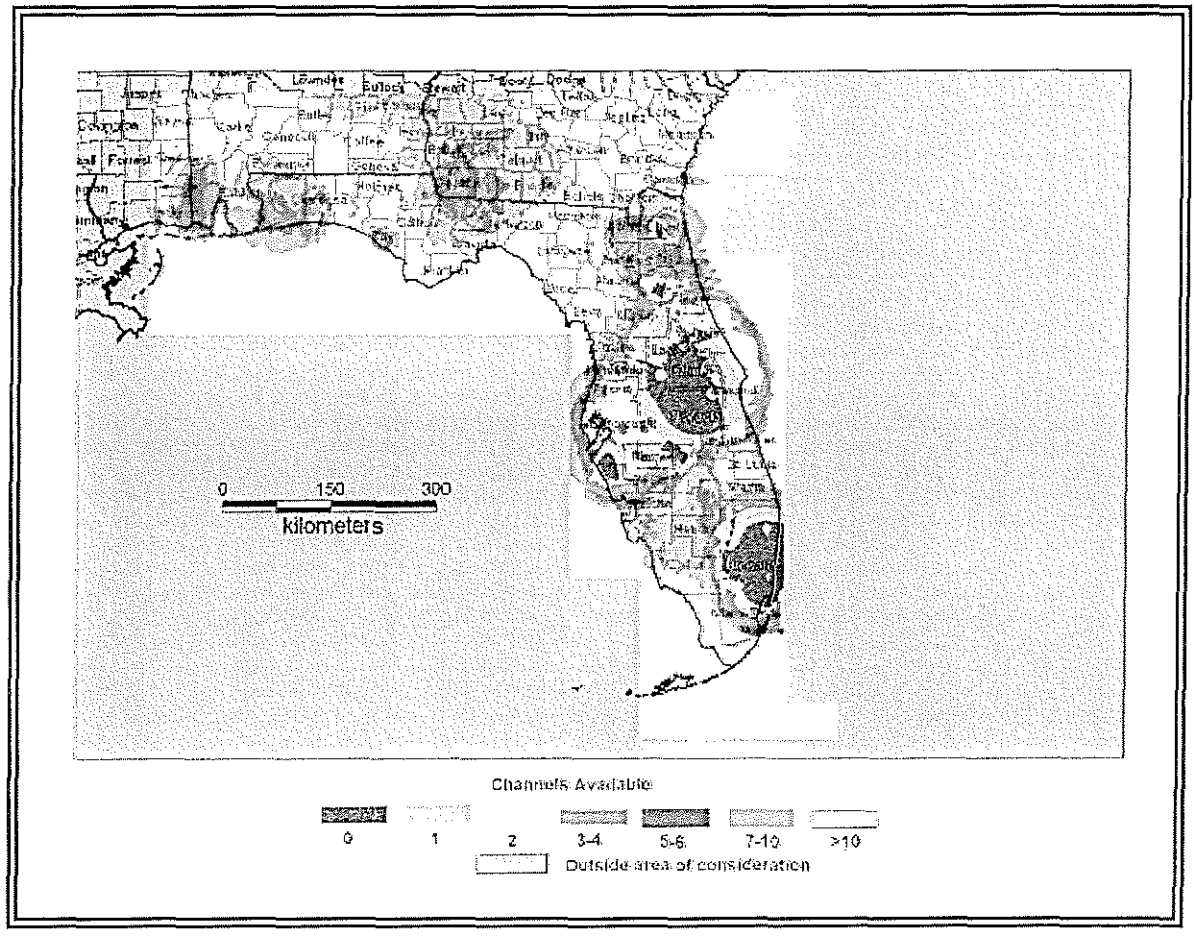


Figure 9: Map Depicts Availability of Unlicensed Devices Channels in the State of North Carolina

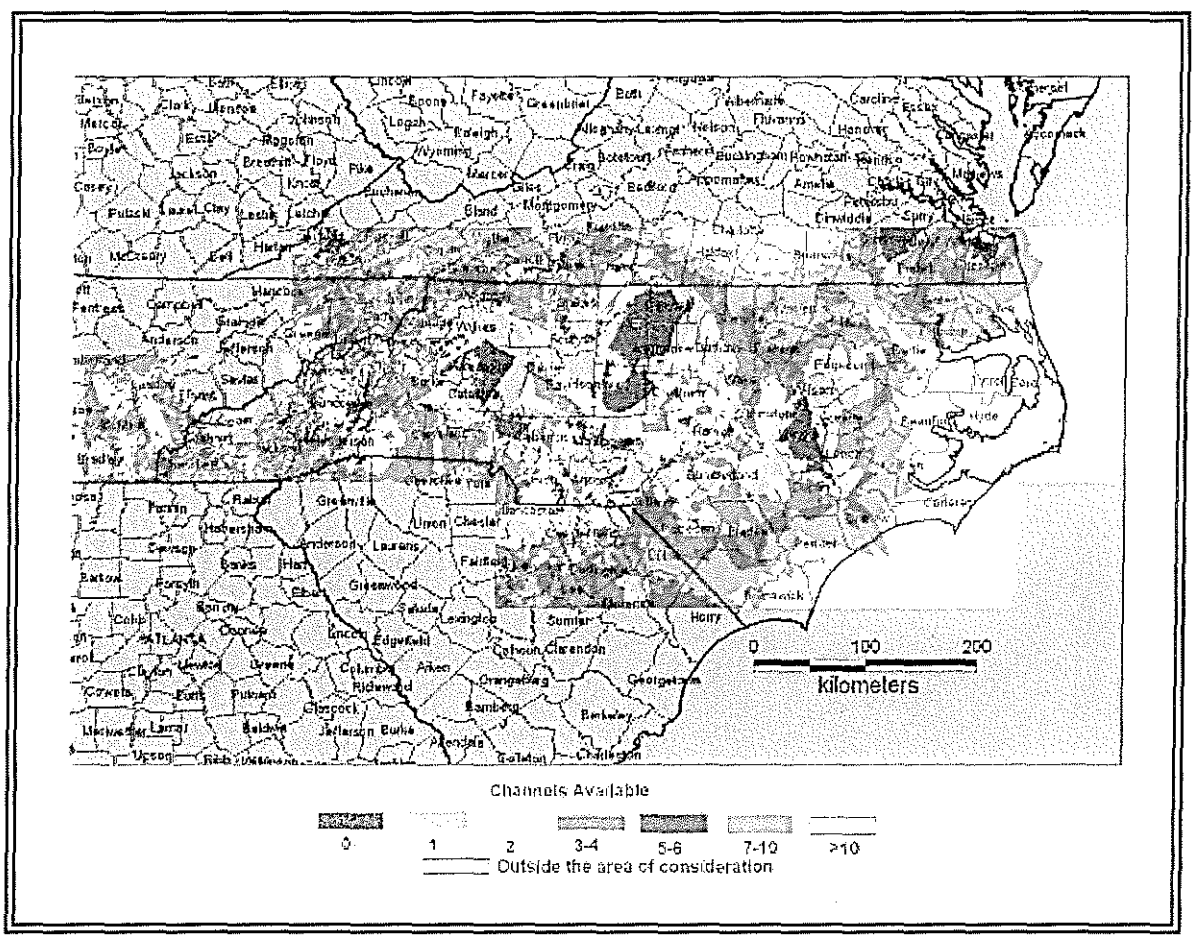


Figure 10: Map Depicts Availability of Unlicensed Devices Channels in the Dallas Urban Area

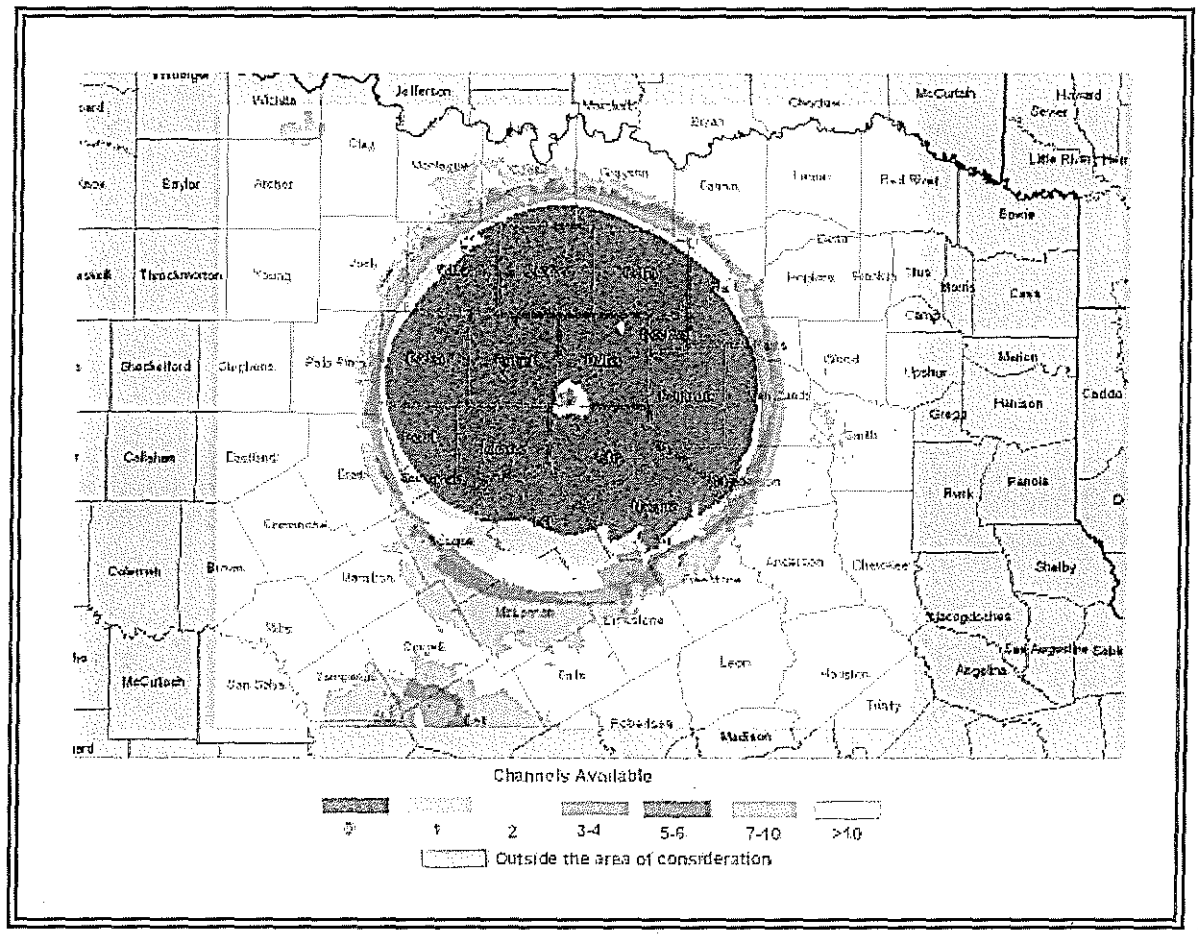
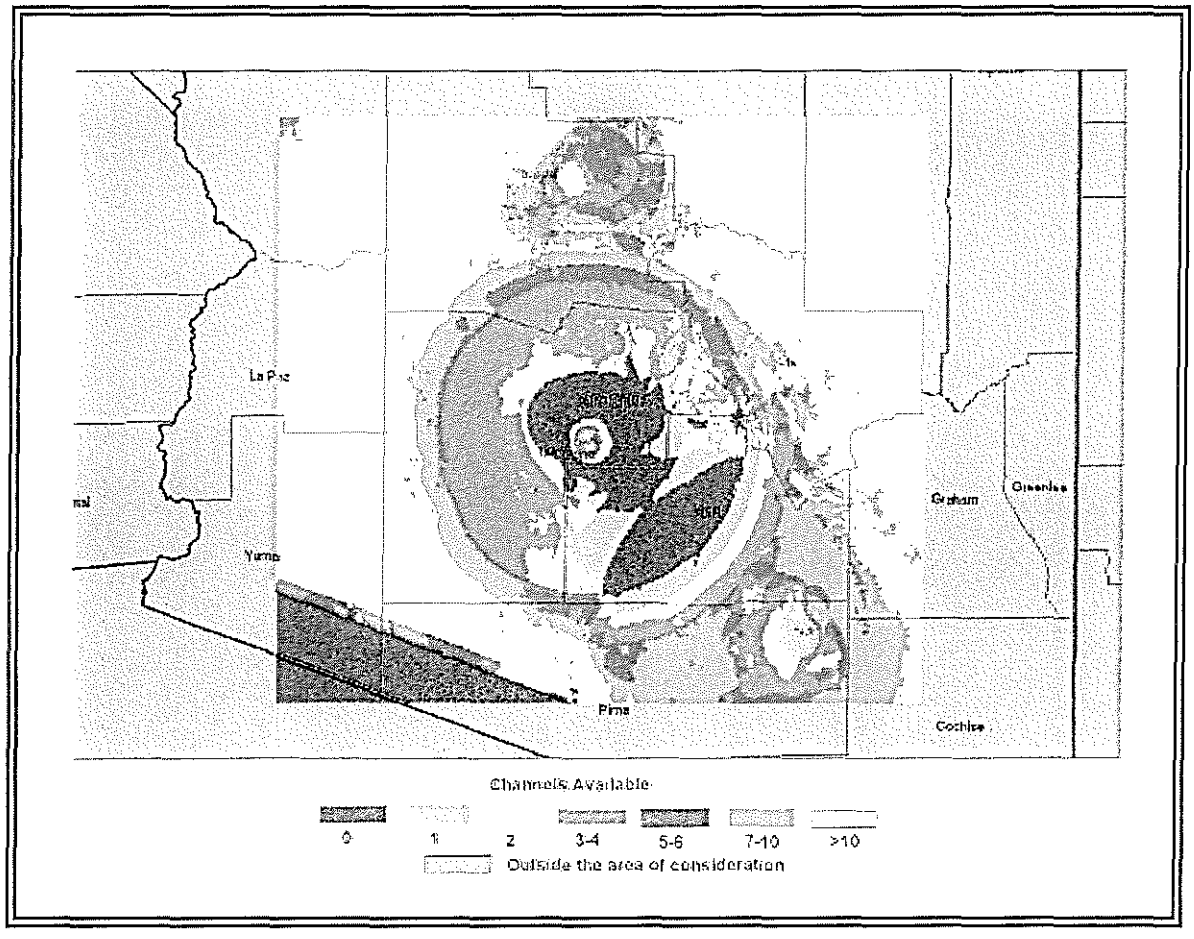


Figure 11: Map Depicts Availability of Unlicensed Devices Channels in the Phoenix Urban Area



4. Conclusions

Unlicensed devices operating in the broadcast TV bands with the proposed levels for out-of-band emissions will cause interference to TV reception. The interference is particularly prevalent for indoor reception where the TV receiver is operating near the limits of its sensitivity. The interference from an unlicensed device desensitizes the TV tuner, thereby reducing the margin for successful reception.

Unlicensed devices operating in the broadcast TV bands are not appropriate for major urban areas. Interference, in the form of receiver desensitization, was found to occur at separation distances likely to be found in office situations, apartments, condominiums, and even suburban environments.

The availability of spectrum within the broadcast TV bands is severely limited for unlicensed devices. It was found that in order to meet the FCC rules for protection contours and protection ratios, there is no spectrum available within major metropolitan areas of the United States.

5. Engineering Credentials

Victor Tawil

Senior Vice-President, Association for Maximum Service Television

Mr. Tawil is Senior Vice President of the Association for Maximum Service Television, Inc. (MSTV), providing technology and telecommunication policy guidance and support to MSTV and its more than 400 member television stations. He was Chairman of the Digital Television Station Project (WHD-TV), sponsored by the television and consumer electronics manufacturing industries and is a member of the Board of Directors of the Advanced Television Systems Committee (ATSC).

Prior to joining MSTV in 1988, Mr. Tawil was with the Federal Communication Commission for fourteen years. He held various positions in a number of Bureaus and the Office of Science and Technology, specializing in the fields of spectrum management, tropospheric propagation and system engineering. He has worked extensively in the areas of broadcasting, satellite, wireless communications and new communication technologies. During his tenure at the FCC, he served as a US delegate on a number of International and ITU Plenipotentiary Conferences, and bilateral negotiations.

Mr. Tawil holds an MSE in Electrical Engineering from the University of Rochester, and a BSE from New York University. He is a member of the International Union of Radio Scientist (URSI), Institute of Electrical and Electronic Engineers (IEEE) and the Society of Motion Picture and Television Engineers (SMPTE) and Tau Beta Pi.

Charles W. Einolf, Jr.

RF Consultant

Dr. Einolf is currently a consultant for the television broadcast industry. He has 36 years of experience in the field of electrical and electronics engineering with extensive experience in the design and development of advanced electronic systems incorporating sensor, computer, communication, and signal processing techniques. Dr. Einolf has provided leadership in broadcast systems, digital TV transmitters, CATV systems, digital microwave, satellite communications, local area networks, personal communication networks, ATM, ISDN, FDDI, analog and digital circuit design, and instrumentation.

Dr. Einolf was the Deputy Executive Director of the Advanced Television Technology Center (ATTC) until the completion of its mission in 2003 to facilitate the transition to Digital Television in the United States. At the ATTC, he was responsible for technical programs that included the improvement of DTV system performance, characterization of signal propagation, and evaluation of audio and video quality.

Dr. Einolf holds the Ph.D. and M.S. degrees in Electrical Engineering from the University of Rochester and a B.S. degree in Electrical Engineering from the Massachusetts Institute of Technology. He has published numerous papers and holds 14 U.S. patents.

Dr. Einolf is a Fellow in the Institute of Electrical and Electronics Engineers and has been awarded the IEEE Centennial and Millennium medals. He is Vice-President of the IEEE Broadcast Technology Society. Dr. Einolf is a Life AdCom member and President-Elect of the IEEE Industrial Electronics Society.

APPENDIX 1

Laboratory Evaluation of Unlicensed Devices Interference to NTSC and ATSC DTV Systems in the UHF Band

REPORT

By

The Communication Research Centre Canada
(CRC)

For

The Association of Maximum Service Television
(MSTV)

November 29, 2004

Table of Contents

Table of Contents....28
Executive Summary....29
1. Introduction....30
2. Laboratory Test Set-up....30
3. Results Of The Laboratory Test....35
3.1 De-Sensitisation of DTV Receivers In An Indoor Environment....35
3.2 De-Sensitisation of DTV Receivers with UD Sideband Signals Transmitted Through A Wall....36
3.3 De-Sensitisation of NTSC Receivers in an Indoor Environment....37
3.4 De-Sensitisation of NTSC Receivers with the Narrowband Signal Transmitted Across NTSC Band....38
3.5 Cable Ingress Created by the UD Sideband Signals....39
4. Findings & Observations....40
ANNEX 1: TEST PROCEDURE....41
ANNEX 2: LIST OF RECEIVERS....43
ANNEX 3: OFFICE DRY WALL AND PHOTOS OF TEST EQUIPMENT....44

Executive Summary

This report presents the results of measurement made to assess the interference potential to DTV and NTSC television reception from the side-lobe emissions of an Unlicensed Device (UD) operating in the UHF band, which comply with the Section §15.209(a) of the FCC Rules. Section §15.209 (a) of the FCC Rules specify a radiated emission limit of 200 uV/m at a measurement distance of 3 meters over frequency range of 215-960 MHz. The emission limit is based on measurement employing an International Special Committee on Radio Interference (CISPR) quasi-peak detector with a measurement bandwidth of 120 kHz.

In general, today's ATSC DTV receiver minimum signal level is in the range of −78 dBm to −83 dBm (over 6 MHz BW), which is equivalent to a noise floor of −93 dBm to −98 dBm. Measurement results show that the proposed Unlicensed Device side-lobe emission limit will cause significant de-sensitisation to DTV and NTSC receivers over a wide area. This is because the proposed emission limit is much higher than the receiver equivalent noise floor (−60 dBm to −70 dBm over a 6 MHz BW). The level of de-sensitisation depends on the interference signal power bandwidth, distance to the interference source, receiver performance, and test environment (indoor, outdoor, etc.).

Tests were conducted in an indoor environment to determine the desensitisation to digital television reception from unlicensed device side-lobe radiated emissions in the clear and when the side-lobe radiated emissions are transmitted through a wall. The data shows that for a distance of 3 meters, an unlicensed device operating with signal bandwidths of 5.6 MHz and 0.43 MHz will de-sensitise DTV receivers an average of 24.5 dB and 13.8 dB, respectively. Similarly, at a distance of 12 meters, the average de-sensitisation is 15.2 dB and 5.6 dB respectively. At 24 meters, the average de-sensitisation is 11.4 and 4.1 dB respectively. Moreover, even when a dry wall is separating an unlicensed device and a DTV receiver, an average de-sensitisation of 19.7 dB and 15.2 dB were measured at distances 5 and 12 meters respectively, when the unlicensed device is operating with a signal bandwidth 5.6 MHz.

Similar test were also conducted for NTSC receivers. The data shows that an even greater desensitisation for NTSC, when compared to DTV. For a wideband interference signal (5.6 MHz) at 18meters from an analog television receiver, assuming ITU-R Grade 3 picture quality, the average desensitisation is 15.3 dB. For a narrowband signal (0.43 MHz), the desensitisation will depend on the location of the interference signal relative to the video and colour carrier of the NTSC signal and generally follows the traditional behaviour of the "S" curve. When placed in the middle of the TV channel, the average de-sensitisation at 18 meters is 5.6 dB. At a 6 meters distance, the desensitisation ranges from 5 dB to 18 dB depending on the location of the interference signal relative to the video and colour carrier of the NTSC signal. If the Threshold Of Visibility (TOV) is used as the picture quality threshold, a 10 dB correction (more desensitisation) should be added over the ITU-R Grade 3 case.

The UD could also cause cable ingress, especially for a single shielded RG-59 cable. The ingress level can be up to −44 dBm regardless of whether the cable is terminated or not.

Introduction

On May 25, 2004, the FCC released a Notice of Proposed Rule Making (NPRM) that proposes to allow unlicensed radio transmitters to operate in the broadcast television spectrum at locations where that spectrum is not being used. CRC was contracted by MSTV to conduct measurements to investigate the possible impact of interference from the unlicensed devices on the current DTV and NTSC services.

Based on the FCC NPRM, the proposed Unlicensed Devices (UD) "radiated emissions that fall outside the TV broadcast channel(s) where the device operates must comply with the radiated emission limits specified in §15.209(a)". Section 15.209(a) of the FCC rules state that *"the radiated emission limits over frequency band of 215-960 MHz is 200 dBuV/m at a measurement distance of 3 meters"*. The emission limit is based on measurement employing a CISPR quasi-peak detector with a *measurement bandwidth of 120 kHz.*

Based on the Commission proposal, CRC conducted measurement to characterise the de-sensitisation of ATSC DTV and NTSC receivers from the side-lobe radiated emissions of an unlicensed portable device. Specifically the following laboratory evaluations were performed:

- De-sensitisation of DTV receivers in an indoor environment.
- De-sensitisation of DTV receivers with UD sideband signals transmitted through a dry wall.
- De-sensitisation of NTSC receivers in an indoor environment.
- De-sensitisation of NTSC receivers with the narrowband signal transmitted across the NTSC channel.
- Cable ingress created by the UD signals.

Laboratory Test Set-up

The Unlicensed Devices interference emissions signals were generated using a COFDM modulator provided by CRC. The UD emission signals were generated by CRC in such a way as to meet the FCC emissions requirement. (i.e. 200 uV/m, or 46 dBuV/m within a 120 kHz bandwidth). The interfering emissions signals were measured at 3 m from the unlicensed devices, within a 120 kHz bandwidth. The UD interfering emitted signal power level was adjusted to 3 dB below the FCC emission requirement to avoid any impact of measurement error on the measurement results. The generated unlicensed devices interference emission signals were up-converted, filtered and inserted on the desired DTV or NTSC channel. List below is a summary of the relevant parameters and calculations used to conduct these tests:

FCC emission limit: 200 uV/m, or 46 dBuV/m within 120 kHz

Convert to dBm: P (dBm) = −75.5 + 46 dBuV/m − 20 log(Frequency in MHz)

= −29.5 − 20 log (Frequency in MHz)

Interference signal parameters:

- Modulation: 64QAM-OFDM;
- 3-dB bandwidth: 5.57 MHz (wideband), 1.29 MHz (mediumband), 3 x 0.43 MHz, and 0.43 MHz (narrowband)
- Number of OFDM carriers: 5616, 324, 324, and 108;
- Guard interval: 1/16; 64QAM modulation.

To avoid measurement error, the interference level is set at 3 dB below the FCC specified limit, thus:

- For CH-48 (677 MHz), the interference level is –29.5 – 20 log (677) – 3 = –89.1 dBm within 120 kHz.
- For CATV CH-66 (477 MHz), the interference level is –29.5 – 20 log (477) – 3 = –86.1 dBm within 120 kHz. (Note: a CATV NTSC modulator is used in the NTSC system test. CATV and off-air TV have different frequency range, but they all use the same 6 MHz NTSC signal. CATV CH-66 is equivalent to UHF off-air Channel 14 and 15.)

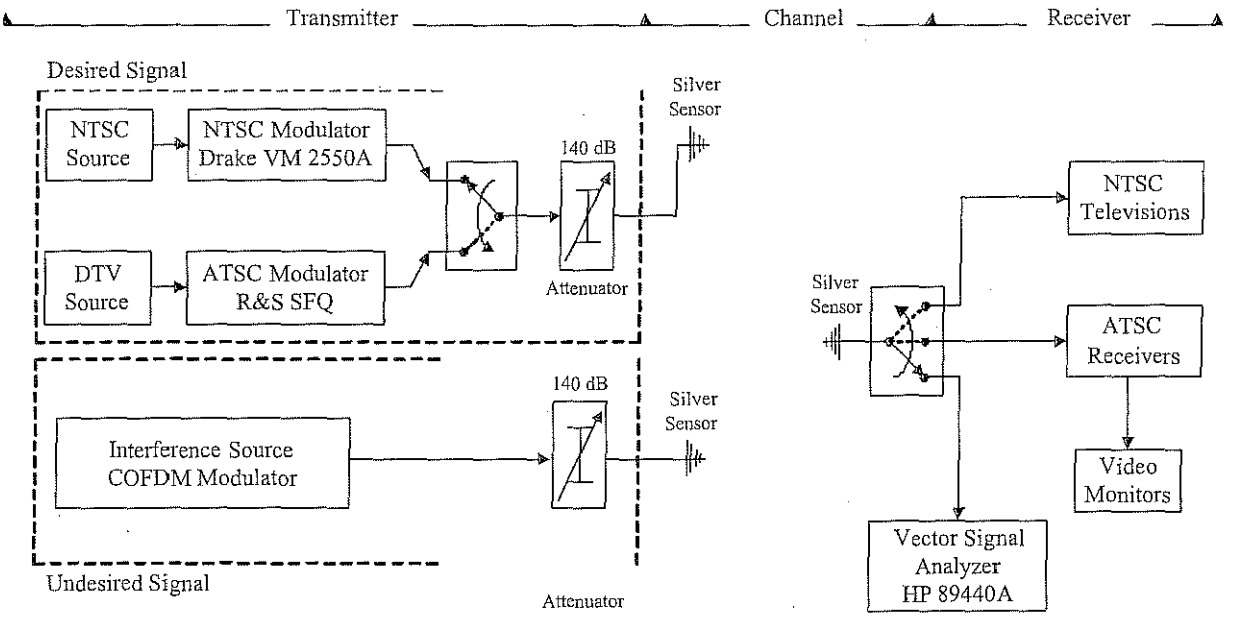


Figure 1 - Laboratory Test Set-up for the Evaluation of UD Emissions Impact on TV Signals.

In the above calculation, a simple dipole antenna is assumed. The emission limit field strength is converted into signal power (dBm). In the laboratory test, the interference power level is adjusted by varying the transmission power. The receiving power calibration is done at 3m from the emission point for the power levels calculated above.

The laboratory set-up for the evaluation of the ATSC 8-VSB receiver is presented in Figure 1. The set-up is divided into three sections: Transmitter, Channel and Receiver.

The laboratory measurements were conducted for distances between the UD and the DTV receivers of 3 m, 12 m and 24 m; for the NTSC case, the distances were 6 m and 18 m. (Note: Since the NTSC signal is more sensitive to interference, the test points for NTSC system is further away than for the DTV system). Tests were also conducted with the undesired signals transmitted through a wall (typical commercial office dry-wall) and the resulting receiver de-sensitisation measurement recorded. The test procedures are attached (Annex 1).

The Threshold of Visibility (TOV) was recorded for viewing DTV pictures over a 20 seconds period. The ITU-R Grade 3 performance (slightly annoying audio, video, colour) for NTSC was also recorded. The power levels recorded were in 1-dB step-size.

The tests were conducted using one video sequence for DTV and one video test pattern for NTSC (colour bar). The tests investigated the de-sensitisation effects due to UD interference using five different DTV receivers and three different NTSC receivers.

The tests were done on Off-Air Channel 48 (674-680 MHz) for DTV. Since only a cable TV NTSC modulator was available, the NTSC tests were performed in the 474 to 480 MHz band (CATV Channel located in the off-air Channel 14 and 15). All NTSC receivers used in the test have cable ready tuner. There are no over-the-air signals on Channel 14 and 15 in the Ottawa area where the tests were conducted.

As a reference, Figure 2 shows the off-air spectrum plots of 674-680 MHz and 474-480 MHz. It is noteworthy that there is no other interference source detected in these spectrum bands.

Four different UD interference signals were used with a 3 dB bandwidths of 5.6 MHz, 1.3 MHz, 3 x 0.43 MHz and 0.43 MHz. The spectrums of the signals are presented in Figures 3, 4, 5 and 6. Based on the spectrum plots, there is little, if any, multipath distortion at a 3m site.

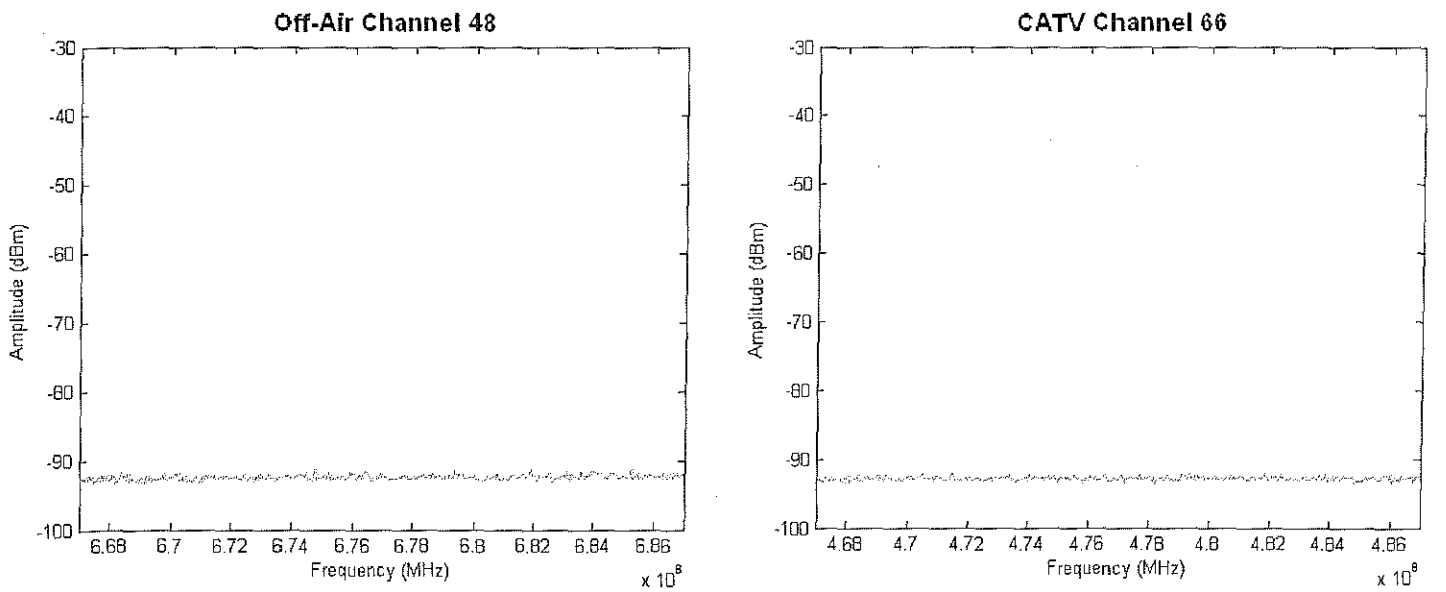


Figure 2. Off-Air Spectrum Plots of 674-680 MHz (DTV Tests) and 474-480 MHz (NTSC Tests)

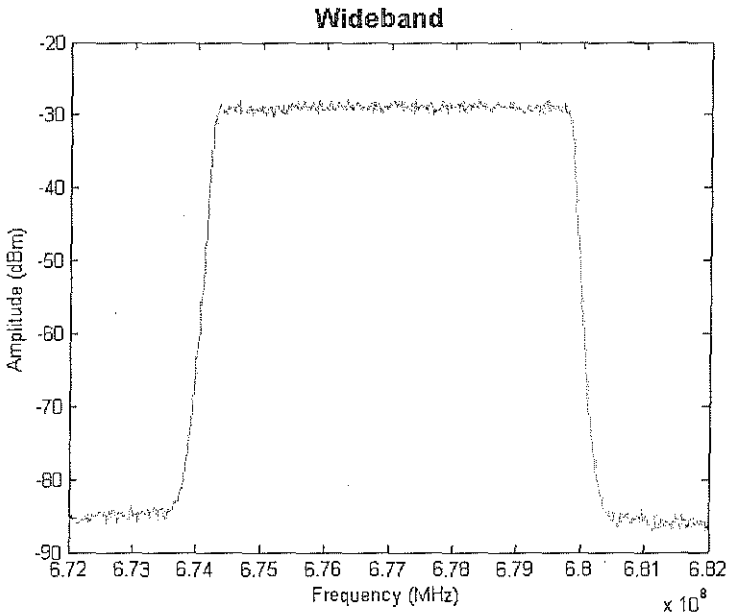


Figure 3. Spectrum of the Wideband Signal with a 3 dB Bandwidth of 5.6 MHz Received at 3 Meters.

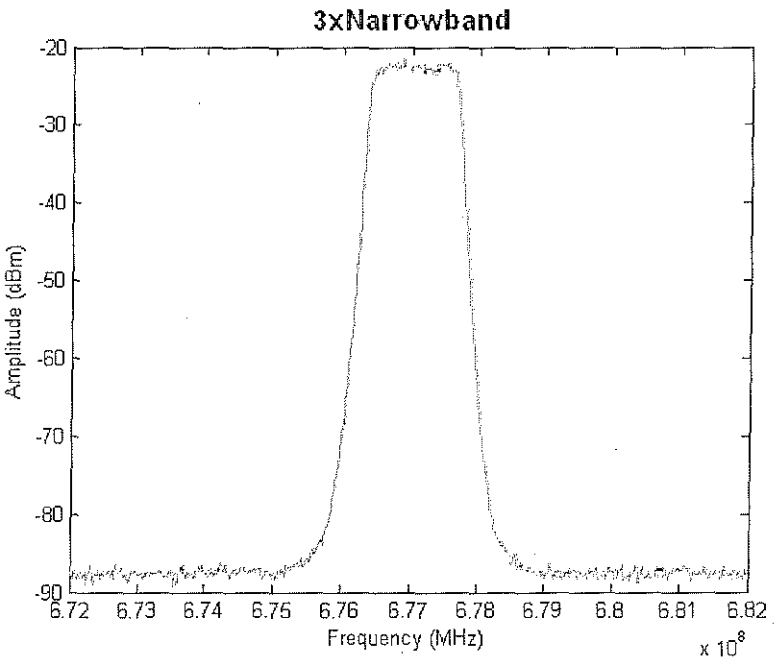


Figure 4. Spectrum of Mediumband Signals with a 3 dB Bandwidth of 1.3 MHz Received at 3 Meters.

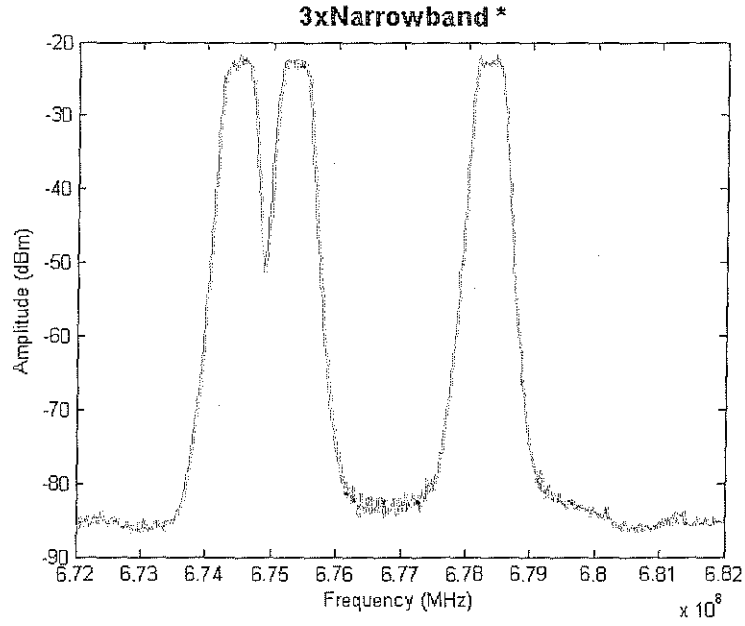


Figure 5. Spectrum of 3 x 0.43 MHz Narrowband Signals Distributed over the DTV Channel Received at 3 Meters.

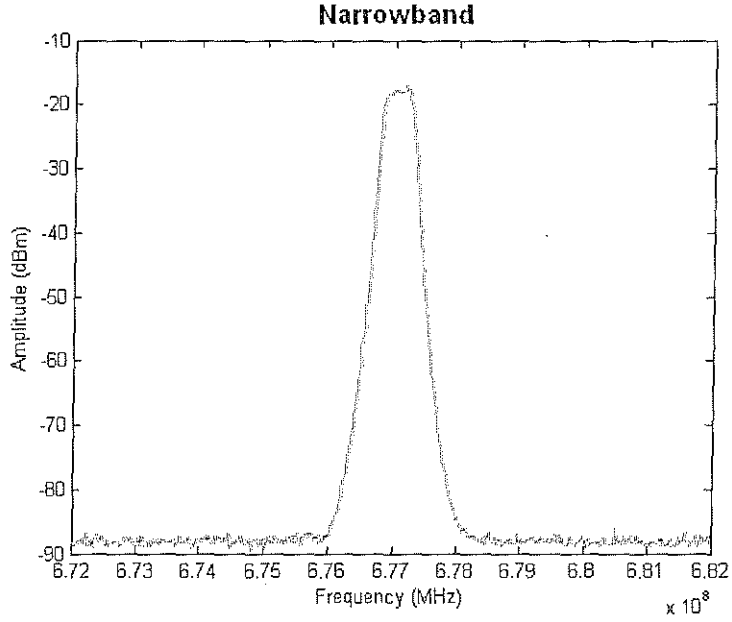


Figure 6. Spectrum of the Narrowband Signal with a 3 dB Bandwidth of 0.43 MHz Received at 3 Meters.

Results Of The Laboratory Test

The results of the following laboratory experiments listed below are presented in this section:

- De-sensitisation of DTV receivers in an indoor environment.
- De-sensitisation of DTV receivers with UD sideband signals transmitted through a dry wall.
- De-sensitisation of NTSC receivers in an indoor environment.
- De-sensitisation of NTSC receivers with the narrowband signal transmitted across the NTSC channel.
- Cable ingress created by the UD signals.

1.1 De-Sensitisation of DTV Receivers In An Indoor Environment

The DTV signal and the UD sideband signals were transmitted and received in the same room. The calibration was done at a distance of 3 m from the DTV receiver as specified by the FCC NPRM and explained in the test procedure in Annex 1. The interference signal power was adjusted to obtain -89.1 dBm/120 kHz at 3 meters.

For the 5.6 MHz wideband signal, the total interference power can be calculated as $-89.1 + 10 \log (5.6/0.12) = -72.4$ dBm. For the 1.3 MHz and 3 x 0.43 MHz bandwidth signals, the total interference power is $-89.1 + 10 \log (1.3/0.12) = -78.8$ dBm. For the 0.43 MHz narrow-band signal, the total interference power is $-89.1 + 10 \log (0.43/0.12) = -83.6$ dBm. In all cases, the interference power levels were more than 50 dB below the recommended portable UD indoor power level at 3m-reference point.

A total of five DTV receivers were used in these tests.

The tests were conducted on Off-Air channel 48 (674 – 680 MHz). The results are presented in Table 1, 2 and 3 for the tests conducted at 3 m, 12 m and 24 m respectively.

Table 1. De-Sensitisation of DTV Receivers At 3 Meters.

Off-Air Channel 48	DTV Receiver #1	DTV Receiver #2	DTV Receiver #3	DTV Receiver #4	DTV Receiver #5
Rx Sensitivity	-80.5 dBm	-81.0 dBm	-81.9 dBm	-80.6 dBm	-80.1 dBm
De-sensitisation at 3 meters					
Wideband	24.0 dB	24.3 dB	26.6 dB	24.2 dB	23.7 dB
Mediumband	17.7 dB	18.6 dB	21.7 dB	17.7 dB	16.9 dB
3 x Narrowband*	18.1 dB	18.6 dB	22.5 dB	18.3 dB	17.2 dB
Narrowband	12.7 dB	14.2 dB	17.4 dB	12.7 dB	11.9 dB

*Three 0.43 MHz carriers distributed over the 6 MHz TV channel

Table 2. De-Sensitisation of DTV Receivers At 12 Meters.

Off-Air Channel 48	DTV Receiver #1	DTV Receiver #2	DTV Receiver #3	DTV Receiver #4	DTV Receiver #5
Sensitivity	-81.3 dBm	-82.2 dBm	-84.9 dBm	-82.6 dBm	-85.0 dBm
De-sensitisation at 12 meters					
Wideband	13.6 dB	14.5 dB	15.8 dB	15.5 dB	16.4 dB
Mediumband	8.8 dB	9.2 dB	13.2 dB	9.6 dB	10.9 dB
3 x Narrowband*	7.4 dB	7.4 dB	11.7 dB	8.7 dB	9.6 dB
Narrowband	3.9 dB	4.9 dB	7.9 dB	4.9 dB	6.4 dB

*Three 0.43 MHz carriers distributed over the 6 MHz TV channel

Table 3. De-Sensitisation of DTV Receivers At 24 Meters.

Off-Air Channel 48	DTV Receiver #1	DTV Receiver #2	DTV Receiver #3	DTV Receiver #4	DTV Receiver #5
Sensitivity	-81.4 dBm	-79.2 dBm	-84.3 dBm	-83.2 dBm	-83.9 dBm
De-sensitisation at 24 meters					
Wideband	10.4 dB	8.3 dB	14.1 dB	12.1 dB	12.1 dB
Mediumband	6.9 dB	4.7 dB	11.9 dB	8.3 dB	8.9 dB
Narrowband	2.2 dB	1.4 dB	7.2 dB	4.9 dB	4.9 dB

It was noticed that the receiver sensitivity varies in a +/-1 dB range for different test points. This is attributed to one or all of these factors: multipath distortion, noise floor variation and other interference mechanisms. It was also noticed that DTV Receiver #3 always showed a higher de-sensitisation than other DTV receivers. This is attributed to Receiver 3 having a more sensitive tuner and being more susceptible to the multipath distortion (requiring a higher S/N under multipath environment).

It was also observed that signal reflection within the building created standing waves. The result of this phenomenon was that the received signal could be up to 3 dB higher than what it would be for free-space propagation. There were also signal "nulls" in the room, which could result in signal level drops of several dB over small changes in location. Moreover, multipath effects were observed to increase as the distance from the transmitter was increased.

1.2 De-Sensitisation of DTV Receivers by UD Sideband Signals Transmitted Through A Wall.

In these tests, the interference signals were transmitted through one wall before reaching the DTV receivers. The walls are typical interior office fire protective dry wall.

The calibration was done at 3 m as explained in the test procedure in Annex 1. Tests were conducted on Off-Air channel 48 (674 – 680 MHz). The interfering signal power was adjusted to be at -89.1 dBm/120 kHz at 3 meters from the receivers. The receivers tested using this interference source are listed in Annex 2.

The results of the test using the various DTV receivers each separated from the interference source by one wall such that the DTV receiver was 5 m from the interference source, which was 3m from the wall, are presented in Table 4.

Table 4. De-Sensitisation of DTV Receivers for Interfere nce Signals Transmitted through One Dry Wall at a Distance of 5 Meters.

Off-Air Channel 48	DTV Receiver #1	DTV Receiver #2	DTV Receiver #3	DTV Receiver #4	DTV Receiver #5
Sensitivity	-80.2 dBm	-81.5 dBm	-82.8 dBm	-80.7 dBm	-82.7 dBm
De-sensitisation at 5 meters (1 wall)					
Wideband	18.1 dB	19.4 dB	21.6 dB	18.6 dB	20.9 dB
Mediumband	11.6 dB	12.6 dB	15.8 dB	11.9 dB	13.6 dB
Narrowband	7.6 dB	8.8 dB	12.6 dB	7.5 dB	9.1 dB

Similarly, tests were conducted at 12 m the results of which are shown in Table 5. For this case the test were conducted with and without a wall between the interference source and the DTV receivers.

The test results show that the interference signal is attenuated by about 3-6 dB, when going through a typical fire rated office drywall.

Table 5. De-Sensitisation of DTV Receivers for Interference Signals Transmitted and Not Transmitted Through One Dry Wall at a Distance of 12 Meters.

Off-Air Channel 48	DTV Receiver #1	DTV Receiver #2	DTV Receiver #3	DTV Receiver #4	DTV Receiver #5
Sensitivity	-80.8 dBm	-81.1 dBm	-82.4 dBm	-82.0 dBm	-81.1 dBm
De-sensitisation at 12 meters (No wall)					
Wideband	13.6 dB	14.6 dB	15.8 dB	15.5 dB	16.4 dB
De-sensitisation at 12 meters (1 wall)					
Wideband	11.3 dB	10.6 dB	13.1 dB	13.1 dB	11.0 dB

1.3 De-Sensitisation of NTSC Receivers in an Indoor Environment

The NTSC and the interference signals were transmitted and received in the same room. The calibration was done at 3m as explained in the test procedure in Annex 1. The interference signal power was adjusted to obtain -86.1 dBm/120 kHz at 3 meters. The lists of the NTSC receivers used in the tests are also presented in Annex 2.

The de-sensitisation tests were carried out on CATV channel 66 (474 – 480 MHz) equivalent to UHF off-air Channel 14 and 15. (Note: a cable TV NTSC modulator was used in the test, as an off-air NTSC modulator was not available. However, this should have no impact on the test results, since there is only a slight frequency range difference, the signal modulation is the same). The results are presented in Tables

6 and 7 for tests conducted for distance of 6m and 18m respectively. The greater than sign ">" indicates that de-sensitisation was beyond the limits of the test-bed.

Table 6. De-Sensitisation of NTSC Receivers at 6 Meters.

CATV Channel 66	NTSC Receiver #1		NTSC Receiver #2		NTSC Receiver #3	
	TOV	ITU-R Grade 3	TOV	ITU-R Grade 3	TOV	ITU-R Grade 3
Sensitivity	-51.5 dBm	-61.5 dBm	-41.5 dBm	-51.5 dBm	-45.5 dBm	-58.5 dBm
De-sensitisation at 6 meters						
Wideband	> 23 dB	26 dB	> 13 dB	14 dB	> 17 dB	21 dB
Narrowband	14 dB	15 dB	2 dB	3 dB	14 dB	14 dB

Table 7. De-Sensitisation of NTSC Receivers at 18 Meters.

CATV Channel 66	NTSC Receiver #1		NTSC Receiver #2		NTSC Receiver #3	
	TOV	ITU-R Grade 3	TOV	ITU-R Grade 3	TOV	ITU-R Grade 3
Sensitivity	-51.5 dBm	-61.5 dBm	-41.5 dBm	-51.5 dBm	-45.5 dBm	-58.5 dBm
De-sensitisation at 18 meters						
Wideband	> 8 dB	18 dB	> 4 dB	12 dB	> 7 dB	16 dB
Narrowband	8 dB	8 dB	2 dB	1 dB	7 dB	8 dB

The test results show that there is more desensitisation for NTSC than that of DTV. This is most likely because the NTSC system requires a higher S/N to operate.

The test also shows that the NTSC Receiver 2 requires 5-10 dB more power (sensitivity) than Receiver 1 and 3 for TOV and ITU-R Grade 3.

1.4 De-Sensitisation of NTSC Receivers with the Narrowband Signal Transmitted Across NTSC Band

The purpose of this test was to study the impact of a narrowband interfering signal positioned at various frequencies across the NTSC channel would have on the NTSC signal itself.

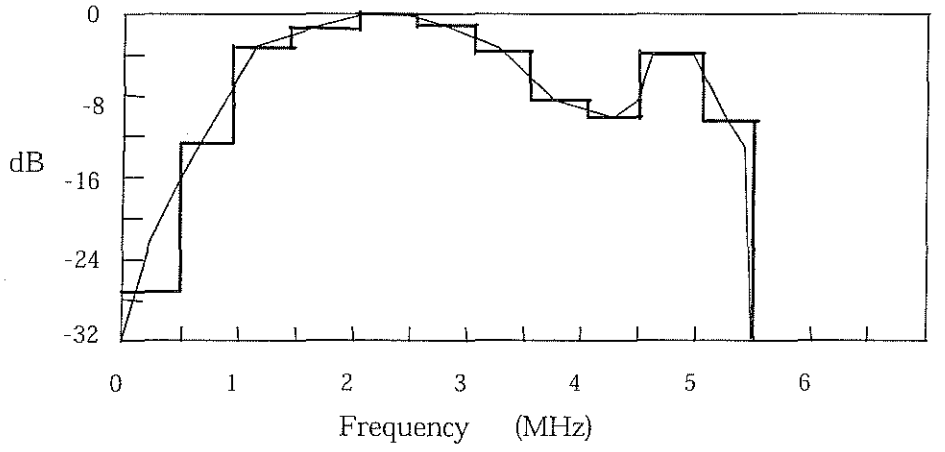
The NTSC signal and the narrowband interference signal were transmitted and received in the same room. The calibration was done at 3m as in previous cases. The interference signal power was then adjusted to obtain -86.1 dBm/120 kHz at 3 meters. The test for this case was completed with only the NTSC receiver #1 (see the list of the NTSC receivers in Annex 2).

Again, CATV Channel 66 (474 – 480 MHz), which is equivalent to UHF off-air Channels 14 and 15, was used for the test. Table 8 presents the test results at 6m and at different frequencies across the NTSC channel. An NTSC visual signal RF subjective weighting curve shown in Figure 7 was used as reference for the interference calculation. Figure 7 shows that the NTSC visual signal is most sensitive to interference positioned between 1.5 and 2.5 MHz above the lower channel edge.

Table 8. De-Sensitisation of NTSC Receivers At 6 Meters For The Narrowband Signal Transmitted Across The NTSC Band

CATV Channel 66	NTSC Receiver #1				
	Center Frequency of the narrowband interference signal				
	474.5 MHz (At 0.5 MHz)	476 MHz (At 2.0 MHz)	477 MHz (At 3.0 MHz)	478 MHz (At 4.0 MHz)	478.75 MHz (At 4.75 MHz)
De-sensitisation at 6 meters					
TOV	4 dB	16 dB	14 dB	14 dB	18 dB
ITUR-3	5 dB	18 dB	15 dB	15 dB	18 dB

Figure 7. NTSC Visual Signal RF Subjective Weighting Curve ("S" Curve).



The test results match well with the NTSC visual signal weighting curve ("S" curve), except at the colour sub- carrier location (about 4.75 MHz from the lower channel edge), where it is more sensitive to the interference. This is because the colour-bar test pattern, which is very sensitive to the colour sub-carrier interference, was used for the subjective assessment.

1.5 Cable Ingress Created by the UD Sideband Signals

The purpose of these tests was to determine the possible cable ingress created by the interfering signals.

For these tests, an indoor portable UD was assumed. This UD was set to transmit a 100-mW wideband signal through a Silver Sensor antenna with about 5-dB gain. The closest distance between the antenna and the cable was about 1 meter. Two types of cable were used. One being an RG-6 double shielded cable; and the other an RG-59 single shielded cable. The length of the cable used in the test was about 10 meters. The cable was stretched across a room with one end connected to a Vector signal analyser for ingress signal power measurement. Tests were conducted with the other end of the cable either terminated in its characteristic impedance or un-terminated. The results of the tests are presented in Table 9.

Table 9. Cable Ingress Created by Wideband Emission Signal.

CABLE INGRESS MEASURED POWER				
FREQUENCY	RG-6 CABLE		RG-59 CABLE	
	NOT TERMINATED	TERMINATED	NOT TERMINATED	TERMINATED
195 MHz	-46 dBm	-69 dBm	-44 dBm	-48 dBm
515 MHz	-55 dBm	-68 dBm	-44 dBm	-46 dBm

The results confirmed, as expected, that the double-shielded RG-6 cable will pick up interference, if it is not terminated (in our test the un-terminated cable end is about 5m away from the transmitting antenna). RG 6 cable is probably the most widely used cable for home installation of cable TV and Satellite TV systems. For the case of the single shielded RG-59 cable, the test show that regardless of weather it is terminated or not, significant ingress interference was detected. Non-professionals to install additional cable outlet at home often use RG 59.

Findings & Observations

1. To avoid measurement errors, the interference signal level was set at 3 dB below the FCC recommended emission limit, thus, the actual receiver desensitisation could be up to 3 dB higher than the measurement results.

2. For different interfering signal bandwidth, the results are very much proportional to the interference signal bandwidth. For example, the wideband interference signal, 5.6 MHz BW, will cause 10 log (5.6/0.43) = 11.1 dB more desensitisation than narrowband interference signal with a 0.43 MHz bandwidth. Test results show that, for each DTV receiver, the discrepancy is within +/- 1 dB over calculated results (see Table 1, 2, and 3). When desensitisation is small as shown in Table 3, the power calculation method is not accurate, since the receiver noise floor will impact the desensitisation. For example, if the interference is at the same level as the receiver noise floor, the desensitisation will be 3 dB rather than 0 dB.

3. It is interesting to note that a 1.3 MHz bandwidth interfering signal has almost the same impact as three individual 0.43 MHz (3 x 0.43 = 1.29 MHz) interference signals (+/- 1 dB accuracy) spread across a TV channel as shown in Tables 1 and 2.

4. Indoor multipath reflection forming standing waves, which results in signal peaks and nulls over few inches distance (RF frequency dependent) were observed. The peak can be 3 dB above free space propagation curve, while nulls can easily cause several dB of signal loss. The further away from the UD, the greater the potential for multipath reflection, which could cause possible desensitisation in extended areas.

5. There was more desensitisation for the case of NTSC than for that of DTV. This result is expected, since the NTSC system requires higher S/N than the DTV system to operate.

6. A narrow band interference signal located in an NTSC channel follows the behaviour of the "S" curve.

ANNEX 1: TEST PROCEDURE

Test Procedure for Unlicensed Devices Interference Signal Emissions into the ATSC DTV and NTSC Channel.

Set Up:

- Select an RF channel between CH14 and 51.

-Make sure there is minimum off-air interference in co- and first adjacent channels.

- Interference emissions signals:
  1. Wideband emission signal, 5.6 MHz BW
  2. Narrowband emission signal, 0.429 MHz BW
  3. Mediumband emissions signals, 1.3 MHz BW
  4. Three narrowband emissions signals distributed over the 6 MHz channel, 3x0.43 MHz
- Interference signal power level set up:
  - FCC emission requirement: 200 uV/m, or 46 dBuV/m within a 120 kHz BW.
  - Convert to dBm: P(dBm) = -75.5 + dBuV/m – 20 log(Frequency in MHz)
  - The emission signal level should be measured at 3m from the unlicensed devices, within a 120 kHz BW.
  - The signal level should be 3 dB below the above calculated emission level P(dBm) to avoid possible measurement errors. Since allowed interference signal power is calculated and fed to the receiver directly, the type of antenna used for transmission and reception is irrelevant.

- Wanted signal:
  - ATSC DTV and NTSC.
  - TOV is used as the test threshold.
  - Test point: 3m, 12m and 18m away from the unlicensed devices.
  - Tests will also be done with signals transmitted thought a wall.
  - Television channel multipath distortion should be minimum.

DTV TEST

1. Test at 3m with wideband and narrowband interference emissions signals:

- At 3m, measure the off-air interference level (co- and first adjacent-channels), and the equipment noise level in 6 MHz and in 120 kHz bandwidth;
- Adjust interference emission signal power level, measured 3m away, to be P(dBm) – 3 dB over the 120 kHz BW;
- Turn off the interference, transmit ATSC DTV, and find TOV, record the transmitted signal power level in 6 MHz and in 120 kHz bandwidth;
- Turn on the interference emission signal. If DTV reception is not possible, increase the DTV signal power level until TOV, record the DTV Tx signal power level in 6 MHz and 120 kHz bandwidth. The difference between the DTV signal power level with and without the interference emission signal is the receiver de-sensitisation.

2. Test at 12m:

- Keep the interference emission signal power unchanged and moves the test point to 6m.
- Repeat the 3m tests.

- The result will be the de-sensitisation at 6m.

3. **Test at 24m:**

- Keep the interference emission signal power unchanged and moves the test point to 24m,
- Repeat the 3m tests.
- The result will be the de-sensitisation at 24m.

NTSC TEST

- Keep the interference emission signal power unchanged, repeat test at 6m, and 18m with NTSC as the wanted signal.
- For narrowband interference test, the interference emission signal should be transmitted at several in-band frequency locations across 6 MHz channel.
- NTSC signal power is measured as peak average power.

ANNEX 2: LIST OF RECEIVERS

DTV Receiver #	Type
1	Consumer
2	Professional
3	Consumer
4	Consumer
5	Consumer

NTSC Receiver #	Type
1	Consumer
2	Consumer
3	Consumer

ANNEX 3: OFFICE DRY WALL AND PHOTOS OF TEST EQUIPMENT

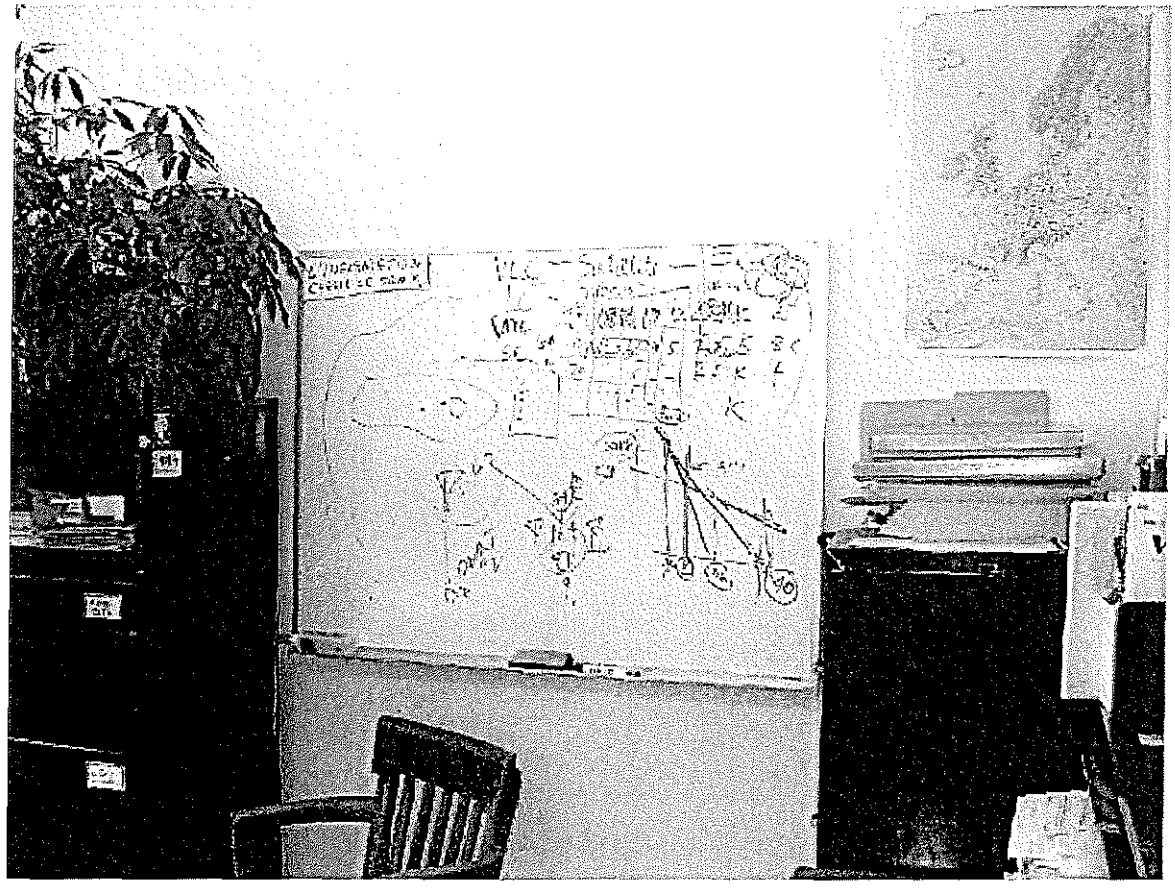


Figure A3-1: Office dry wall Side A (signal goes through white-board).

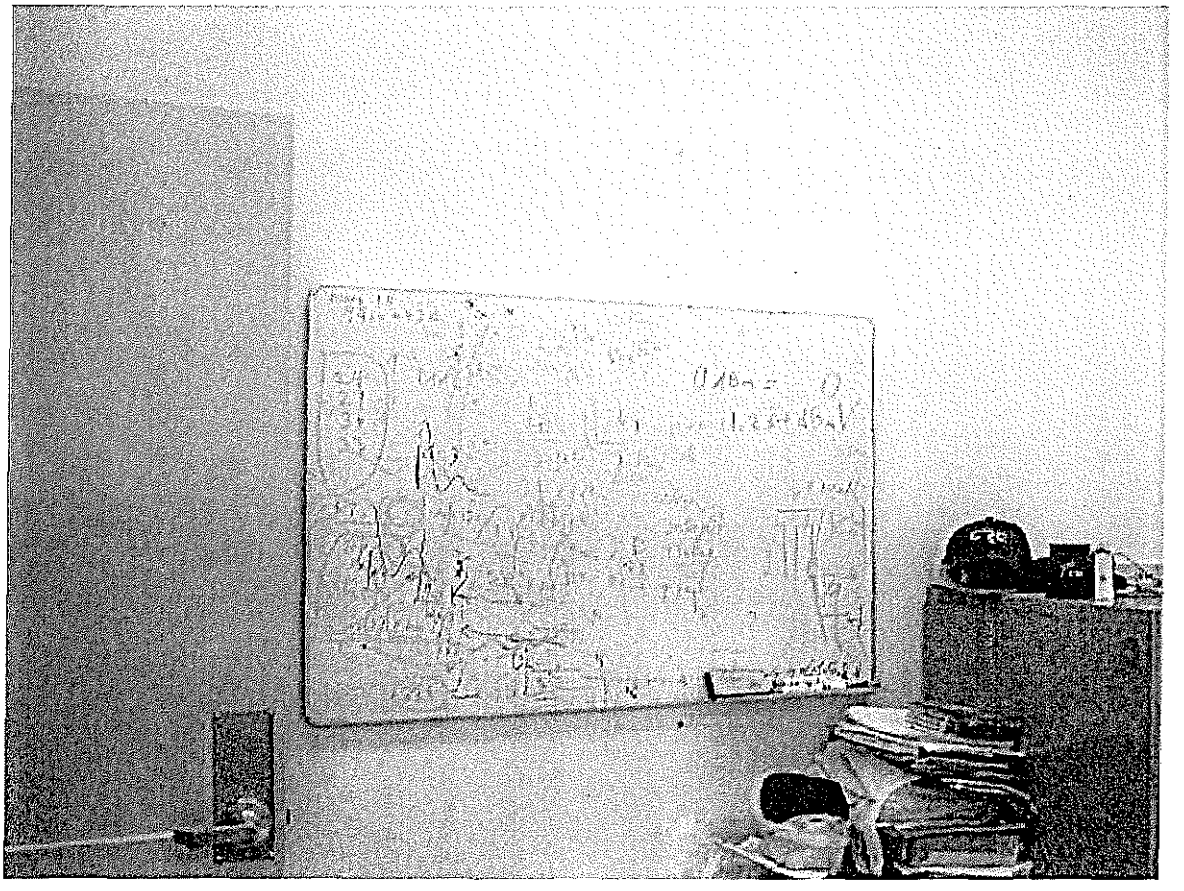


Figure A3-2: Office dry wall Side B (signal goes through white-board).

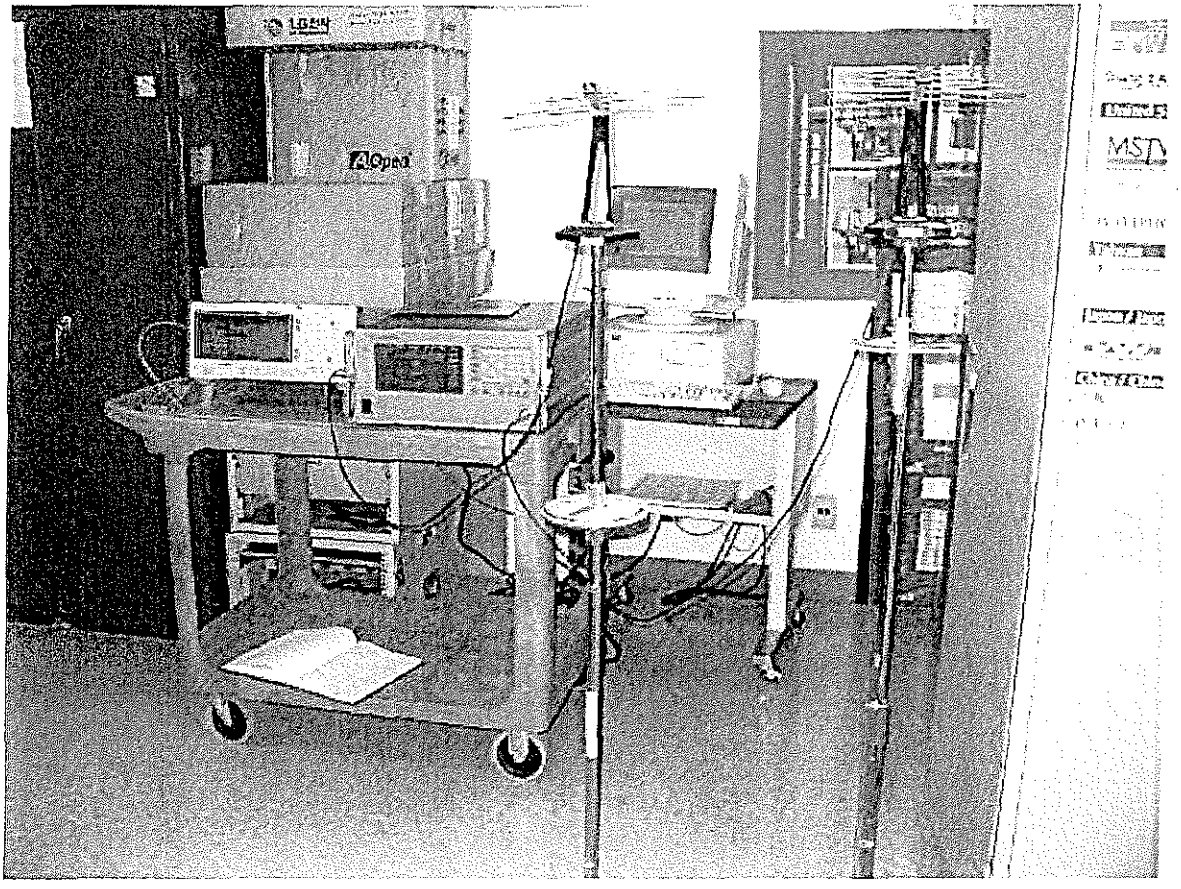


Figure A3-3: UD and DTV/NTSC Transmission Systems.

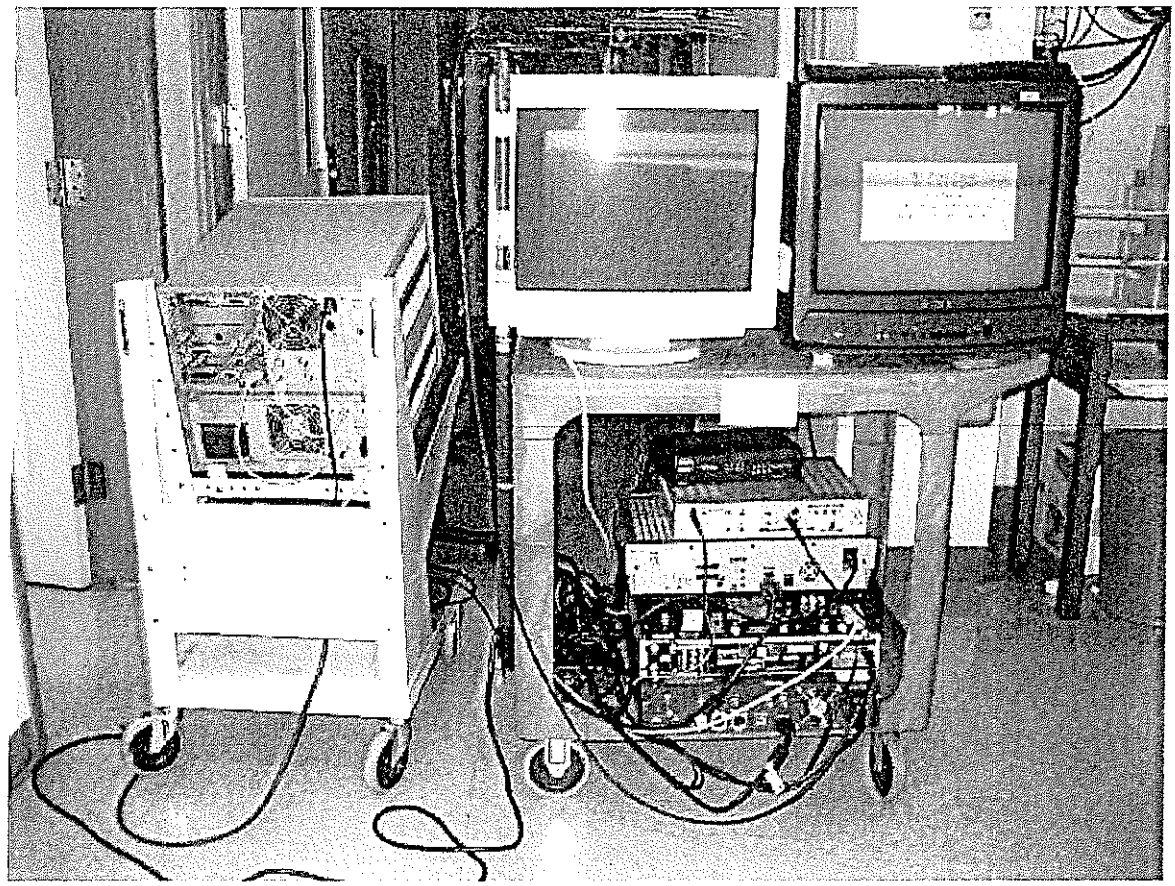


Figure A3-4: Five DTV Receivers and Reception System Set Up.