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UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and
Information Administration
Washington, D.C. 20230
May 7, 2003

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

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

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

Dear Ms. Dortch:

Enclosed please find an original and four (4) copies of the late-filed Comments of the National Telecommunications and Information Administration, U.S. Department of Commerce. A copy of the filing and a diskette with a Word file of the comments is also enclosed to the attention of Mr. Hugh L. Van Tuyl with the Commission's Office of Engineering and Technology.

Please direct any questions you may have regarding this letter to the undersigned. Thank you for your cooperation.

Respectfully submitted,

Kathy D. Smith
Chief Counsel

Enclosures

cc: Hugh L. Van Tuyl, Office of Engineering and Technology

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

COMMENTS OF THE NATIONAL TELECOMMUNICATIONS
AND INFORMATION ADMINISTRATION

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May 7, 2003

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
EXECUTIVE SUMMARY	iii
I. INTRODUCTION	2
II. UNLICENSED DEVICE OPERATIONS SHOULD NOT BE PERMITTED IN THE 608-614 MHz BAND	3
III. THE EMISSION LIMIT FOR UNLICENSED DEVICES OPERATING IN THE TELEVISION BROADCAST FREQUENCY BANDS SHOULD INCLUDE A PROVISION FOR HARMONICS THAT ARE GENERATED IN THE 1559-1610 MHz RADIONAVIGATION SATELLITE SERVICE BAND	4
IV. UNLICENSED DEVICE OPERATIONS THAT EMPLOY INTERFERENCE MITIGATION TECHNIQUES CAN FACILITATE SHARING WITH FEDERAL RADARS IN THE 3650-3700 MHz BAND	7
V. SUMMARY	11

EXECUTIVE SUMMARY

The National Telecommunications and Information Administration (NTIA) commends the Federal Communications Commission (Commission) for initiating this proceeding to expand the options for unlicensed device use, and particularly, linking such expanded use to adoption of new technologies for active interference-avoidance. NTIA agrees with the Commission regarding the significant benefits to the economy, businesses, consumers, and government agencies that could be gained by allowing unlicensed devices to operate in other bands at power levels higher than those currently permitted, provided that such operation is tied to effective implementation of active interference-avoidance techniques. However, NTIA is concerned with the potential impact that the expansion of unlicensed devices at higher power levels may have on critical Federal systems used for scientific research, aviation, and national defense.

NTIA agrees with the Commission that unlicensed device operation in the 608-614 MHz band would not be appropriate because of the interference concerns associated with the sensitive nature of radio astronomy reception and the critical function of Wireless Medical Telemetry Service (WMTS) equipment in the band. As such, NTIA strongly recommends that the Commission prohibit unlicensed device operations in the 608-614 MHz band. Furthermore, to protect radio astronomy reception and WMTS equipment, NTIA also recommends that emissions in the 608-614 MHz band from unlicensed devices operating in adjacent bands be limited in accordance with Subsection 15.205 of the Commission's Rules, 47 C.F.R. §15.205.

In exploring the authorization of unlicensed devices in the television broadcast frequency bands, the Commission should recognize and address the effect of harmonics

of such use on critical systems in other bands. Specifically, coarse/acquisition code receivers of the Global Positioning System L1 operating in the 1559-1610 MHz band are very susceptible to narrowband interfering signals. NTIA strongly recommends that the emission limits developed for the unlicensed devices permitted to operate in the television broadcast bands include a provision for harmonic signals that may be generated in the 1559-1610 MHz radionavigation satellite service band.

Finally, NTIA supports the Commission's efforts to permit the operation of unlicensed devices in the 3650-3700 MHz band, including the possible relaxation of restrictions on the operating characteristics of the unlicensed devices to allow higher power and antenna gains than the maximum levels currently permitted for such devices. However, in order to ensure that Federal operations in the 3650-3700 MHz band are not adversely impacted, NTIA recommends that any relaxation of the restrictions on power level and antenna gain be tied to the mandatory adoption of effective frequency and/or geographic avoidance technologies, as suggested by the Commission. NTIA recommends that a project team be formed to examine the merits of the proposed interference-mitigation techniques and to develop the recommended technical requirements to allow compatible unlicensed device usage in the 3650-3700 MHz band.

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

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

**COMMENTS OF THE NATIONAL TELECOMMUNICATIONS
AND INFORMATION ADMINISTRATION**

The National Telecommunications and Information Administration (NTIA), an Executive Branch agency within the Department of Commerce, is the President's principal adviser on domestic and international telecommunications policy, including policies relating to the nation's economic and technological advancement in telecommunications. Accordingly, NTIA makes recommendations regarding telecommunications policies and presents Executive Branch views on telecommunications matters to the Congress, the Federal Communications Commission (Commission), and the public. NTIA, through the Office of Spectrum Management, is also responsible for managing the Federal Government's use of the radio frequency spectrum. NTIA respectfully submits the following comments in response to the Commission's Notice of Inquiry (NOI) in the above-captioned proceeding.¹

¹ *In the Matter of Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band*, Notice of Inquiry (NOI), ("hereinafter NOI"), ET Docket No. 02-380, FCC 02-328 (rel. Dec. 20, 2002), 68 Fed. Reg. 2730 (Jan. 21, 2003).

I. INTRODUCTION

In this NOI, the Commission seeks comments on the feasibility of allowing unlicensed devices to operate in additional frequency bands. Specifically, the Commission seeks comments on allowing unlicensed devices to operate in the television (TV) broadcast spectrum at locations and times when spectrum is not being used, and on the technical requirements that would be necessary to ensure that such devices do not cause interference to authorized services operating within the TV broadcast bands. In addition, the Commission seeks comments on the feasibility of permitting unlicensed devices to operate in other bands, such as the 3650-3700 MHz band, at power levels significantly higher than the maximum levels currently authorized for unlicensed devices in other frequency bands with only minimal technical requirements.

NTIA commends the Commission for initiating this proceeding to expand the options for unlicensed use, and particularly, linking such expanded use to adoption of new technologies for active interference-avoidance. NTIA agrees with the Commission regarding the significant benefits to the economy, businesses, consumers, and government agencies that could be gained by allowing unlicensed devices to operate in other bands at power levels higher than those currently permitted, provided that such use is tied to effective implementation of active interference-avoidance techniques.

However, NTIA is concerned with the potential impact that the expansion of unlicensed devices at higher power levels may have on critical Federal systems. Accordingly, NTIA provides comments to this NOI in three areas: unlicensed device operations in the 608-614 MHz band used for Federal scientific observations; potential interference to receivers operating in the 1559-1610 MHz radionavigation satellite service band used for aviation

and safety related applications; and unlicensed device operations in the 3650-3700 MHz band used to support military radiolocation operations.

II. UNLICENSED DEVICE OPERATIONS SHOULD NOT BE PERMITTED IN THE 608-614 MHz BAND.

The 608-614 MHz band is used by Federal radio astronomers for Very Long Baseline Interferometry (VLBI), which links radio telescopes together across long distances. Scientists use VLBI to study continental drift, rotation of the Earth, earthquakes, and space navigation. The National Radio Astronomy Observatory (NRAO) operates the VLBI Array of telescopes at ten sites in the United States and its territories that use the 608-614 MHz band. To make VLBI continuum measurements, data from the antennas are combined synthesizing a single telescope 5000 miles in diameter.² In order for these continuum observations to be useful, it is essential that background noise in the 608-614 MHz band remains limited.

The 608-614 MHz band is also one of the three bands allocated to the Wireless Medical Telemetry Service (WMTS). WMTS equipment is permitted only in health care facilities and eligibility to operate such equipment is strictly limited to health care personnel. Frequency coordination is required by Commission-selected entities that record and monitor the locations and frequencies of WMTS equipment for interference-control purposes.

NTIA agrees with the Commission that unlicensed device operation in the 608-614 MHz band would not be appropriate because of the interference concerns associated with the sensitive nature of radio astronomy reception and the critical safety function of

² Observations of radio continuum emissions establish frequency dependence of the cosmic emissions, which requires the observation of the emission intensity at a number of frequencies. Observations of radio continuum emissions are only performed by Federal radio astronomers and associated universities.

WMTS equipment.³ The current sharing relationship between radio astronomy and WMTS is successful because of the required coordination process. It is not possible to coordinate unlicensed device operations, thus increasing the potential for interference to radio astronomy continuum observations. NTIA therefore recommends that the Commission prohibit unlicensed device operations in the 608-614 MHz band.

Furthermore, to protect sensitive scientific and medical equipment, NTIA recommends that emissions in the 608-614 MHz band from unlicensed devices operating in adjacent bands be limited in accordance with Subsection 15.205 of the Commission's Rules, 47 C.F.R. §15.205.

III. THE EMISSION LIMITS FOR UNLICENSED DEVICES OPERATING IN THE TELEVISION BROADCAST FREQUENCY BANDS SHOULD INCLUDE A PROVISION FOR HARMONICS THAT ARE GENERATED IN THE 1559-1610 MHz RADIONAVIGATION SATELLITE SERVICE BAND.

The Commission also seeks comments on the feasibility of permitting unlicensed devices to operate in the TV broadcast frequency bands.⁴ The TV broadcast bands refer to the 402 MHz of spectrum allocated to the broadcast services at 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz, and 614-806 MHz. One of the most common undesirable effects of non-linearity in communications systems is the generation of harmonics. Aside from interfering signals whose fundamental frequencies⁵ may fall into the passband⁶ of a receiver, harmonics of out-of-band signals may also fall into the

³ NOI, at ¶14.

⁴ *Id.*

⁵ The fundamental frequency is the principal component of a wave. For example, the component with the lowest frequency or the greatest amplitude.

⁶ The passband is the band of frequencies which will pass through a receive filter with essentially no attenuation.

receiver passband.⁷ Depending upon the transmit frequency, unlicensed devices that operate in the TV bands may have harmonic signals that fall within the radionavigation satellite service (RNSS) band of 1559-1610 MHz.

The RNSS systems operating in the 1559-1610 MHz band include the Global Positioning System (GPS) L1 signal operating in the 1563.42-1587.42 MHz segment of the band and the Russian Federation Global Navigation Satellite System (GLONASS) operating in the 1598-1605 MHz segment of the band. GPS and GLONASS are components of the Global Navigation Satellite System (GNSS).⁸ The European Union is also planning to operate an RNSS system, Galileo, in the 1559-1610 MHz band. It is envisioned that Galileo will also become a component of the GNSS. Table 1 gives the relationship between the TV channel number and the harmonic of the carrier that falls nearest to the GPS and GLONASS signals. For example, TV channel 23 has a frequency assignment of 525.25 MHz. The third harmonic of this frequency is 1575.42 MHz, which is the center frequency of the GPS L1 signal.

⁷ A harmonic is a sinusoidal wave having a frequency that is an integral multiple of the fundamental frequency. For example, a wave with twice the frequency of the fundamental is called the second harmonic.

⁸ The GNSS is a satellite navigation system which provides a world-wide position determination, time and velocity capability for multi-modal use. As currently envisioned, the GNSS will encompass aviation, maritime, and terrestrial navigation.

**TABLE 1
PROXIMITY OF TV BAND CARRIER HARMONICS TO GPS
AND GLONASS CARRIERS**

Channel Number	Frequency Allocation (MHz)	Harmonic Number
6	82-88	19
7	174-180	9
10	192-198	8
11	198-204	8
22	518-525	3
23	524-530	3
24	530-536	3
66	782-788	2
67	788-794	2

Harmonics are in many instances narrowband signals. GPS receivers using the L1 coarse/acquisition (C/A) code are known to be susceptible to narrowband interference primarily because of the relatively short period of the C/A code.⁹ With a period of 1 millisecond, the C/A code spectrum is not continuous, but rather it is a line spectrum with discrete lines at 1 kHz intervals. In addition, there are some “strong lines” in each C/A code that can deviate significantly from a $[\sin(x)/x]^2$ envelope. This makes a C/A code receiver vulnerable to continuous wave (CW) or very narrowband interfering signals since they can mix with a strong C/A code line and affect the code and carrier tracking loops.

Based on the susceptibility of GPS L1 C/A code receivers to narrowband interference, NTIA strongly recommends that the emission limits developed for unlicensed devices permitted to operate in the TV broadcast bands should include a provision for harmonic signals that may be generated in the 1559-1610 MHz RNSS band.

⁹ RTCA DO-235, *Assessment of Radio Frequency Interference Relevant to the GNSS*, at C-4 (Jan. 27, 1997).

IV. UNLICENSED DEVICES THAT EMPLOY INTERFERENCE MITIGATION TECHNIQUES CAN FACILITATE SHARING WITH FEDERAL RADARS IN THE 3650-3700 MHz BAND.

Pursuant to the Omnibus Budget Reconciliation Act of 1993 (OBRA-93),¹⁰ NTIA identified 235 MHz of spectrum previously allocated for Federal Government use for reallocation to the private sector.¹¹ One of the frequency bands identified, 3650-3700 MHz, was reallocated on a mixed-use basis effective January 1999.¹² Under the mixed-use allocation, the Federal Government retained systems and operations at three sites indefinitely.¹³ Full use of the 3500-3700 MHz by the Department of the Navy (Navy) will be required at these sites on a primary basis. The locations of these sites are provided in Table 2. Based on available information, observance of the 80 km radius of operation around these sites should provide adequate identification of spectrum conflicts.

**TABLE 2
SITES AT WHICH FEDERAL SYSTEMS AND OPERATIONS IN THE 3650-3700 MHz BAND WILL BE RETAINED INDEFINITELY**

Location	Coordinates	Radius of Operations (km)
St. Inigoes, MD	38° 10' 00"N 76° 23' 00"W	80
Pascagoula, MS	30° 22' 00"N 88° 29' 00"W	80
Pensacola, FL ¹⁴	30° 21' 28"N 87° 16' 26"W	80

¹⁰ See *Omnibus Budget Reconciliation Act of 1993*, Pub. L. No. 103-66, Title VI, § 6001, 107 Stat. 312, 379 (1993) (amending the NTIA Organization Act to add a new part B) (codified at 47 U.S.C. §921 et seq.).

¹¹ National Telecommunications and Information Administration, NTIA Special Publication 95-32, *Spectrum Reallocation Final Report* (hereinafter "NTIA Final Report") (Feb. 1995).

¹² For a frequency band to be qualified as "mixed-use" band, OBRA-93 specified that "Federal Government stations are limited by geographic area, by time, or by other means so as to guarantee that the potential use to be made by such Federal Government stations is substantially less (as measured by geographic area, time, or otherwise) than the potential use to be made by non-federal stations.", See 47 U.S.C. 923(b)(2).

¹³ See NTIA Final Report at 4-21.

¹⁴ As a result of base realignment and closures, the Memphis Tennessee site originally identified for continued Federal system operations was closed, and the relevant facilities were subsequently moved to the Pensacola, Florida site. See The Department of the Navy (B. Swearingen, Navy IRAC Representative)

The AN/SPN-43 is an air traffic control radar system that operates in the 3500-3700 MHz band at these three sites. Normally, the AN/SPN-43 is deployed on medium and large carriers and large amphibious assault ships for simultaneous control and identification of aircraft in a terminal area. The three “grandfathered sites” support the land-based facet of the AN/SPN-43 Program. These sites provide unique functions, which are not duplicated anywhere in the United States. For example, the St. Inigoes site is used for maintenance, test-calibration and pre-setting of crystals on the AN/SPN-43 system. The Pascagoula site is used to conduct test and evaluation, while the Pensacola site is used for littoral or in-port training.¹⁵ Fifteen or more frequencies are used at each site to adequately support their respective requirements. Table 3 shows key technical characteristics of the AN/SPN-43.

**TABLE 3
KEY TECHNICAL CHARACTERISTICS OF THE AN/SPN-43**

ELEMENT	VALUE
Frequency Range	3500-3700 MHz
Peak Power	1 Megawatt
Antenna Gain	32 dBi
Antenna Scan Coverage	360°
Necessary Bandwidth	10 MHz

The Navy has expressed concern about the authorization of unlicensed devices in the 3650-3700 MHz band at power levels significantly higher than those currently

Memo, *Navy's Protected Sites in the 3650-3700 MHz Band*, to the Department of Commerce (E. Cerezo/NTIA-OSM) (Nov. 19, 1998).

¹⁵ Littoral operations are operations close to land that is presumed to be occupied, at least in part, by hostile forces.

allowed under the Commission's Part 15 rules.¹⁶ Navy states that allowing higher power unlicensed operation in the 3650-3700 MHz band with minimal technical requirements could potentially introduce additional interference sources to the grandfathered federal operations within the band as well as to incumbent federal systems in the lower adjacent band.¹⁷ The Navy reiterates the constraint associated with the original identification of the 3650-3700 MHz band for reallocation as follows: "To achieve a satisfactory commercial service which is immediately adjacent to a band used by multi-megawatt mobile radar systems, the adoption of effective transmitter emission and receiver selectivity standards are essential to minimize interference to and from the federal system operating in this band."¹⁸

The Department of Army (Army) has similarly raised concerns regarding higher-powered unlicensed device operation. The Army states that the increased number of unlicensed devices that could result when new Part 15 bands are authorized have the potential to add to the electromagnetic noise floor, which can contribute to an increase in electromagnetic interference.¹⁹ The Army further states that, without adequate safeguards, operation of higher-powered unlicensed devices in this band could potentially negatively impact military operations at the grandfathered federal sites.²⁰

¹⁶ The Department of the Navy (B. Swearingen Navy IRAC Representative) Memorandum for the IRAC Chairman, *Comments on the Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band. Notice of Inquiry (ET Docket No. 02-380, Released Dec. 20, 2002)* (March 24, 2003).

¹⁷ *Id.*

¹⁸ *Id.* (quoting NTIA Final Report at 4-20).

¹⁹ The Department of the Army (LTC Clinton Burrell, Deputy Director, Army Spectrum Management Office) Memo for the IRAC Chairman (K. Nebbia), *Review of the FCC's Notice of Inquiry on the Subject of Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band* (March 24, 2003).

²⁰ *Id.*

NTIA agrees with the Navy and Army that operation of higher-powered unlicensed devices in the 3650-3700 MHz band, without adequate control mechanisms, could potentially adversely impact federal operations in this shared/mixed-use allocated band. Accordingly, NTIA recommends that any authorization of higher-powered Part 15 use in this band be linked with mandated use of effective frequency and/or geographic avoidance technologies. As the Commission has suggested, such technologies could include, but would not be limited to, dynamic frequency selection, listen before transmit protocols, and/or GPS-assisted geographic avoidance methods.²¹ NTIA also believes that certain unlicensed device applications can facilitate sharing. For example, similar to the situation in the 5 GHz band, unlicensed local area networks that employ frequency and/or geographic interference-mitigation techniques could reduce interference to the radar operations in the 3650-3700 MHz band.

Assuring that the application of the interference mitigation technologies is effective for the specific frequency band and incumbent systems will require further engineering study. In this regard, the recent successful analysis and agreement within the United States addressing sharing arrangements for an international allocation of mobile devices in the 5 GHz band could serve as a useful model to address and resolve the technical details.²² A Government/Industry project team, as was used in the 5 GHz band preparing for the 2003 World Radio Conference, could be used to provide technical guidance on the sharing conditions required for the 3650-3700 MHz band. Such a project team could address emission limits, receiver interference immunity performance

²¹ NOI, at ¶ 21.

²² See U.S. department of Commerce, National Telecommunications and Information Administration, *Agreement Reached Regarding U.S. Position on 5 GHz Wireless Access Devices* (rel. Jan. 31, 2003), (available at <http://www.ntia.doc.gov/ntiahome/press/2003/5ghzagreement.htm>).

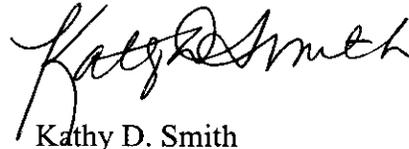
specifications, and interference-avoidance techniques for unlicensed devices to facilitate sharing in the 3650-3700 MHz band.

V. SUMMARY

NTIA agrees with the Commission that potential economic benefits could be gained by permitting unlicensed operations in frequency bands not currently authorized for unlicensed devices. However, NTIA recommends that unlicensed device use not be expanded in such a way as to adversely impact critical Federal systems used to support scientific research, aviation, and defense. Specifically, NTIA urges the Commission not to permit the operation of unlicensed devices in the 608-614 MHz band. Second, based on the susceptibility of GPS L1 C/A code receivers to narrowband interference, NTIA strongly recommends that the emission limits developed for unlicensed devices permitted to operate in the TV broadcast bands include a provision for harmonic signals that may be generated in the 1559-1610 MHz RNSS band. Finally, although NTIA supports the Commission's effort to allow higher-powered unlicensed devices in the 3650-3700 MHz band, NTIA recommends that any such relaxation of the restrictions on power levels and antenna gains be tied with mandatory adoption of effective frequency and/or geographic avoidance technologies, as suggested by the Commission, to protect incumbent systems. Further, in order to conduct the study needed to identify specific details of any adopted technologies, NTIA recommends that a project team be formed to examine the merits of

the proposed mitigation techniques and to develop the recommended technical requirements to allow compatible unlicensed device usage in the 3650-3700 MHz band.

Respectfully Submitted,



Kathy D. Smith
Chief Counsel

Nancy J. Victory
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