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

In the matter of	)	
	)	
Revision of Parts 2 and 15 of the Commission's	)	
Rules to Permit Unlicensed National Information	)	ET Docket No. 03-122
Infrastructure (U-NII) devices in the 5 GHz band	)	RM - 10371

REPORT AND ORDER

Adopted: November 12, 2003 **Released: November 18, 2003**

By the Commission: Chairman Powell and Commissioner Abernathy issuing separate statements.

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INTRODUCTION

1. By this action, we are amending Part 15 of our rules to make an additional 255 megahertz of spectrum available in the 5.470–5.725 GHz band for unlicensed National Information Infrastructure (U-NII) devices, including Radio Local Area Networks (RLANs).[1] This action will align the frequency bands used by U-NII devices in the United States with bands in other parts of the world, thus decreasing development and manufacturing costs for U.S. manufacturers by allowing for the same products to be used in most parts of the world. We believe that the increased demand that will result from expanding the markets for U-NII devices, coupled with the operational flexibility provided by the U-NII rules, will lead manufacturers to develop a wide range of new and innovative unlicensed devices and thereby increase wireless broadband access and investment.[2]

2. There has been tremendous growth in demand for unlicensed wireless devices in recent years,[3] particularly for devices used for wireless local area networking and broadband access to the internet.[4] Sales of wireless local area network equipment have grown more than 150% since the year 2000. Companies are now offering broadband access at "hot-spots" in restaurants, hotels, airports and other public gathering places by using unlicensed wireless devices. In cities across the nation, new start-up businesses are offering broadband services using unlicensed wireless devices. In rural areas, entrepreneurs and small businesses have introduced broadband service using unlicensed devices where no service was available before. We anticipate that the additional spectrum we are making available for U-NII devices will allow the continued growth in marketing, deployment and use of unlicensed devices. It will help meet the needs of businesses and consumers for fixed and mobile high-speed digital communications. We believe it will also stimulate the availability of broadband service to those who do not yet have it, and will increase competitive choices for those who do.

3. In addition to making more spectrum available for use by U-NII devices, we are taking steps to minimize the potential for these devices to cause interference to existing operations. Specifically, we are amending the Table of Frequency Allocations in Part 2 of the rules by:[5] 1) upgrading the Federal Government Radiolocation Service in the 5.46-5.65 GHz band and the non-Federal Government Radiolocation Service in the 5.47-5.65 GHz band to primary status; and 2) adding primary Federal Government allocations and secondary non-Federal Government allocations for the Space Research Service (active) (SRS) in the 5.35-5.57 GHz band and for the Earth Exploration-Satellite Service (active)

[1] *See* 47 C.F.R. Part 15 Subpart E – Unlicensed National Information Infrastructure Devices. U-NII devices are "[i]ntentional radiators operating in the frequency bands 5.15-5.35 GHz and 5.725-5.825 GHz that use wideband digital modulation techniques and provide a wide array of high data rate mobile and fixed communications for individuals, businesses, and institutions." 47 C.F.R. § 15.403(i).

[2] The *Spectrum Policy Task Force Report* (*Task Force Report*), released on November 15, 2002, recommended that the Commission act to promote more flexible, innovative, and market driven uses of the radio spectrum. This report specifically recommended that the Commission allocate additional spectrum for unlicensed use. *See Task Force Report*, ET Docket No. 02-135, *Report* (rel. Nov. 15, 2002). We note that because unlicensed devices may operate in any unrestricted spectrum band, the FCC does not allocate spectrum for them. However, the policies articulated by the *Spectrum Policy Task Force Report* are advanced by the rules changed by this Report and Order.

[3] *See Spectrum Policy Task Force Report*, ET Docket No. 02-135, November 15, 2002, at page 12.

[4] *Id. See also* Kenneth R. Carter, Ahmed Lahjouji, and Neal McNeil, *Unlicensed and Unshackled: A Joint OSPOET White Paper on Unlicensed Devices and Their Regulatory Issues,* OSP Working Paper Series No. 39 (May 2003).

[5] The U.S. Table of Frequency Allocations is set forth in Section 2.106 of the Commission's rules, 47 C.F.R. § 2.106.

(EESS) in the 5.46-5.57 GHz band.[6] In addition, we are modifying certain technical requirements for U-NII devices. The amendments made herein are generally consistent with the U.S. proposals for the World Radiocommunication Conference 2003 (WRC-03), and with the resolutions adopted at WRC-03, pertaining to these bands.[7]

BACKGROUND

4. Under the current FCC Part 15 rules, U-NII devices are permitted to operate in 300 megahertz of spectrum in the 5.150-5.250 GHz, 5.250-5.350 GHz and 5.725-5.825 GHz bands. The technical and operational requirements for each of these bands differ.[8] Many of the devices currently operating under these rules are designed to meet an industry standard for wireless local area networks known as IEEE 802.11(a), and sometimes also referred to as Wi-Fi (Wireless-Fidelity).[9]

5. On January 15, 2002, the Wireless Ethernet Compatibility Alliance (formerly known as WECA – now known as the Wi-Fi Alliance) submitted a petition for rule making requesting that the Commission allocate an additional 255 megahertz of spectrum for use by U-NII devices in the 5.470-5.725 GHz band.[10] WECA argued that this additional spectrum is needed to accommodate growing demand for unlicensed RLANs. Additionally, WECA stated that its proposal would align the U.S. U-NII spectrum with the European allocations for High Performance Radio Local Area Networks (HiperLANs), thereby permitting the use of common products in the U.S. and Europe and increasing economies of scale.[11]

6. On June 4, 2003, the Commission released a *Notice of Proposed Rulemaking*[12] (*Notice)* to consider implementing allocations and rules for the 5 GHz band consistent with the U.S. position on

[6] In a related matter, the Commission has recently adopted primary Federal Government SRS (active) and EESS (active) allocations in the 5.25-5.35 GHz band and a Federal Government EESS (active) allocation in the 5.35-5.46 GHz band. *See Amendment of Parts 2, 25, and 87 of the Commission's Rules to Implement Decisions from World Radiocommunication Conferences Concerning Frequency Bands Between 28 MHz and 36 GHz and to Otherwise Update the Rules in this Frequency Range, Amendment of Parts 2 and 25 of the Commission's Rules to Allocate Spectrum For Government and Non-Government Use in the Radionavigation-Satellite Service*, ET Docket No. 03-305, *Report and Order*, FCC 03-269 (rel. Nov. 4, 2003) (*Above 28 MHz Report and Order*).

[7] *See* U.S. Department of Commerce, National Telecommunications and Information Administration, "Agreement Reached Regarding U.S. Position on 5 GHz Wireless Access Devices," (WRC-03 Agreement), rel. Jan. 31, 2003, (available at http://www.ntia.doc.gov/ntiahome/press/2003/5ghzagreement.htm.) WRC-03, which convened June 9 - July 4, 2003, in Agenda Item 1.5, considered spectrum allocations for the mobile, fixed, SRS, EESS, and the radiolocation service for the frequency range 5.150-5.725 GHz. *See also*, World Radiocommunication Conference Provisional Final Acts, Geneva, 2003, Part 1/2, pages 27-30 and Part 2/2, pages 493-496. (WRC-03 Final Acts)

[8] *See* 47 C.F.R. Part 15 Subpart E.

[9] The term Wi-Fi was originally applied to unlicensed wireless devices operating in the 2.4 GHz region of the spectrum in accordance with the Institute of Electrical and Electronics Engineers (IEEE) 802.11(b) standard. More recently, the term has also been applied to unlicensed wireless devices operating in the 5 GHz region in accordance with IEEE 802.11(a). The Commission does not require devices operating in either the 2.4 GHz or 5 GHz bands to meet the IEEE standards.

[10] *See* WECA Petition for Rulemaking, RM-10371, filed on January 15, 2002, Public Notice Report No. 2527; Jan. 29, 2002.

[11] The European High Performance Radio Local Area Networks (HiperLANs) operate in the 5.150-5.350 GHz and 5.475-5.725 GHz bands.

[12] *See 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*, ET Dkt No. 03-122, *Notice of Proposed Rulemaking*, 18 FCC Rcd 11581 (2003) (*Notice)*.

WRC-03 Agenda Item 1.5 (WRC-03 Agreement).[13] The Commission, noting evidence of enormous growth in the demand for unlicensed wireless broadband devices and networks, and the numerous benefits that would accrue to the public from increased deployment, agreed with WECA that more spectrum would be needed to support their long-term growth.[14] To protect incumbent operations, the Commission proposed that U-NII devices operating in the 5.25-5.35 GHz and 5.470-5.725 GHz bands be required to employ dynamic frequency selection (DFS).[15] The Commission, disagreeing with WECA, did not propose a mobile allocation for U-NII devices in the 5.150-5.350 GHz and 5.470-5.725 GHz bands, but instead proposed to simply add the 5.470-5.725 GHz band to the existing U-NII rules.[16]

7. The provisions adopted at WRC-03 are generally consistent with those in the *Notice*.[17] In total, WRC-03 allocated 455 MHz of spectrum in the 5 GHz band of the spectrum for mobile devices, including RLANs. Several of the existing U-NII bands in the United States, specifically, 5.15-5.25 GHz and 5.25-5.35 GHz, did not previously have international mobile allocations. With the additional spectrum that was allocated at 5.47-5.725 GHz, after the WRC, much of the spectrum available for RLAN operations in the world and in the United States is coextensive. (In the United States, an additional 100 MHz is available at 5.725-5.825 GHz, but this band was not the subject of WRC negotiations.) As we noted in the *Notice*, while RLANs in the United States operate on an unlicensed basis in accordance with the provisions of Part 15 of the Commission's rules and spectrum is not allocated for their use, internationally, many countries require a mobile allocation for operation of these devices.

8. As part of the same WRC-03 agenda item, several other allocations at 5 GHz were also agreed to, including the allocations to the EESS and SRS addressed in the *Notice*. At the same time, consistent with the *Notice*, WRC-03 agreed that the radiolocation service would be upgraded to primary status in the 5 GHz band. Once implemented throughout the world, this service will now have primary status for its operations in the band. Also, several additions were made to the footnotes of the Table of Frequency Allocations regarding the relative protection levels afforded to services in the 5 GHz band.

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[13] In preparing for WRC-03, the National Telecommunications and Information Administration (NTIA), FCC, National Aeronautical and Space Administration (NASA) and Department of Defense (DoD), working closely with industry, reached the following agreement on U.S. proposals for WRC-03 Agenda Item 1.5: 1) upgrade the Radiolocation service to primary status within the 5.35-5.65 GHz band to protect sensitive DoD operations; 2) add primary allocations for the SRS in the 5.35-5.46 GHz band and for the EESS and SRS in the 5.46-5.57 GHz band; 3) add a Mobile allocation to the 5.15-5.35 GHz and 5.470-5.725 GHz bands; and 4) require U-NII or HiperLAN users in the 5.25-5.35 GHz and 5.470-5.725 GHz bands to employ dynamic frequency selection (DFS), a mechanism that detects the presence of signals from other systems, notably radar systems, and avoids co-channel operation, and additional measures to protect other systems.

[14] *See Notice* ¶¶ 11-12. *See also* Joint Office of Engineering and Technology and Office of Spectrum Policy White Paper on Unlicensed Spectrum Devices and the Associated Regulatory Issues (*OET-OSP Unlicensed White Paper*). Available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-234741A1.pdf

[15] Dynamic frequency selection (DFS) is a mechanism that dynamically detects signals from other systems and avoids co-channel operation with these systems, notably radar systems.

[16] We note that the Commission supported the U.S. position for WRC-03 which sought a mobile allocation in the international Table of Frequency Allocations for the 5.15-5.35 GHz and 5.470-5.725 GHz bands because such an allocation would be needed, by some administrations, for RLANs and HiperLANs to operate throughout the world. The United States supported a regional proposal to the WRC-03 adopted at the CITEL (Inter-American Telecommunication Commission) conference held in Orlando, Florida in February 2003. In addition to DFS, this proposal included requirement that devices operating in the 5.470-5.725 GHz band employ transmit power control (TPC) as an interference protection mechanism for EESS and other satellite systems.

[17] The 5.350-5.460 GHz band is used for aeronautical radionavigiation. Because it is used for a critical safety communication service, it is a restricted band under Part 15, *i.e.* unlicensed devices are not allowed to transmit in this band. The 5.350-5.470 GHz band is not used in Europe for U-NII type devices and was not the subject of WRC-03 issues.

9. Twenty-nine comments and twelve reply comments were filed in response to the *Notice*.[18] The majority of these comments strongly support the Commission's proposals. We are adopting rule changes to effect those proposals, as discussed below.

DISCUSSION

10. We continue to believe, and the comments support, our position in the *Notice*, that the spectrum currently available for U-NII devices is insufficient to support long-term growth for unlicensed wireless broadband devices and networks. We believe that the additional spectrum we are making available for unlicensed wireless broadband devices and networks should provide sufficient spectrum to meet consumers' needs, thereby stimulating investment. Ample evidence exists of the enormous growth in the demand for such devices and services.[19] For example, a number of service providers are currently offering or have announced plans to deploy commercial unlicensed wireless broadband networks.[20] Such networks offer significant benefits for American consumers and businesses, including increased competition with other providers of broadband service, such as cable and digital subscriber line (DSL) broadband services, and additional options in areas unserved by other broadband providers. We also believe that additional spectrum will give U-NII devices and networks more flexibility to avoid interference with other services sharing the existing U-NII bands, thereby improving the quality of service experienced by consumers. For these reasons, we are making an additional 255 megahertz available under the U-NII rules to meet the growing demand for new high data rate devices and services and to enable equipment to use spectrum that is harmonized internationally.

A. Changes to the Table of Frequency Allocations.

11. *Proposals*. As noted in the *Notice*, no change is needed to the Table of Frequency Allocations to make an additional 255 megahertz of spectrum available under the U-NII rules.[21] However, we proposed several changes to the Table of Frequency Allocations to accommodate the spectrum requirements of other radio services.[22] Specifically, we proposed to upgrade the allocations for the Federal Government Radiolocation Service in the 5.46-5.65 GHz band and the non-Federal Government Radiolocation Service in the 5.47-5.65 GHz band from secondary to primary.[23] We further proposed to add primary Federal Government allocations and secondary non-Federal Government allocations for the SRS in the 5.35-5.57 GHz band and for the EESS in the 5.46-5.57 GHz band.[24]

12. *Comments.* The Information Technology Industry Council (ITI), Microsoft Corporation (Microsoft), Proxim Corporation (Proxim), Cisco Systems, Inc. (Cisco), Motorola, Inc. (Motorola), and the Wi-Fi Alliance support the allocations for the Federal Government and non-Federal Government Radiolocation Service, SRS, and EESS as proposed.[25] NTIA also supports the proposed allocations,

[18] *See* Appendix E for list of parties filling comments.

[19] *See Notice* ¶ 11. *See also* Joint Office of Engineering and Technology and Office of Spectrum Policy White Paper on Unlicensed Spectrum Devices and the Associated Regulatory Issues (*OET-OSP Unlicensed White Paper*). Available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-234741A1.pdf

[20] *See OET-OSP Unlicensed White Paper* at 34-35.

[21] *See Notice* ¶ 14.

[22] In addition, we proposed technical requirements such as DFS and TPC to protect incumbent services. *See* ¶¶ 22-24 and ¶ 33, *infra*.

[23] *See Notice* ¶ 13.

[24] *See Notice* ¶ 13.

[25] *See* ITI comments at 4-5; Microsoft comments at 8; Proxim comments at ¶ 2; Cisco comments at 2-3; Motorola comments at 3; Wi-Fi Alliance comments at 4.

stating that these actions would be consistent with allocations adopted internationally and would provide the necessary protection to Federal Government systems supporting national defense as well as Federal and non-Federal Government commercial and scientific operations.[26] In addition, NTIA recommends that the modifications to the Table of Frequency Allocations include associated additional and modified footnotes consistent with those adopted at WRC-03, because of the complex sharing arrangements between the diverse Federal and non-Federal Government services operating in the 5 GHz bands.[27]

13. *Decision*. Consistent with the outcome of WRC-03, we are adopting the allocations proposed in the *Notice*. These allocations are needed to meet the Federal Government's requirements for increased interference protection and additional spectrum for certain services. First, we modify the U.S. Table of Frequency Allocations in Part 2 of the rules to upgrade the Federal Government Radiolocation service to primary in the 5.46–5.65 GHz band.[28] We similarly upgrade the non-Federal Government Radiolocation Service to co-primary in the 5.47–5.65 GHz band. We note that the Federal Government Radiolocation Service already has a primary allocation in the 5.35-5.46 GHz band. The elevation in status of the Radiolocation Service along with the technical rules adopted herein will protect operations in that service against interference from U-NII devices. Further, we are adding primary Federal Government allocations and secondary non-Federal Government allocations for the SRS in the 5.35-5.57 GHz band and the EESS in the 5.46-5.57 GHz band.[29] In making these changes to the Table of Frequency Allocations, we are also adopting the additional and modified international, Government, and U.S. footnotes, as generally recommended by NTIA.[30] These footnotes set out the protection status of each of the services. Specifically, these footnotes are:

> 5.448A The Earth exploration-satellite (active) and space research (active) services in the frequency band 5250-5350 MHz shall not claim protection from the radiolocation service.
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> 5.448B The Earth exploration-satellite service (active) operating in the band 5350-5570 MHz and space research service (active) operating in the band 5460-5570 MHz shall not cause harmful interference to the aeronautical radionavigation service in the band 5350-5460 MHz, the radionavigation service in the band 5460-5470 MHz and the maritime radionavigation service in the band 5470-5570 MHz.
>
> US50 In the band 5470-5650 MHz, the radiolocation service may be authorized for non-Federal Government use on the condition that harmful interference is not caused to the maritime radionavigation service or to the Federal Government radiolocation service.

[26] *See* NTIA comments at 4-5.

[27] *See* NTIA comments at 5-7.

[28] The band 5.35–5.46 GHz is allocated on a secondary basis for radiolocation internationally; however, radiolocation is already allocated on a primary basis in the United States.

[29] *See* § 2.106 Table of Frequency Allocations in Appendix B.

[30] Our adoption of these footnotes is consistent with the general proposals we set forth in the *Notice*. Footnotes G130, G131, and US390, which stipulate limitations on Federal Government systems, are being adopted at NTIA's request. We are also modifying footnotes US50 and US51 in order to maintain the relative status of the non-Federal Government radiolocation service in the band 5600-5650 MHz with respect to the maritime radionavigation service. Footnotes 5.448A and 5.448B stipulate limitations on both Federal and non-Federal Government systems. We adopt these international footnotes because they were part of the overall U.S. position at WRC-03 and because NTIA states that they are a vital component in providing primary allocations to the EESS (active), SRS (active), and the radiolocation services in the 5 GHz frequency range. Our adoption of these footnotes is necessary and sufficient to protect incumbent services from the new services that we first proposed in the *Notice* and that we are authorizing in this *Report and Order*.

US390 Federal Government stations in the space research service (active) operating in the band 5350-5460 MHz shall not cause harmful interference to nor claim protection from Federal Government and non-Federal Government stations in the aeronautical radionavigation service nor Federal Government stations in the radiolocation service.

G130 Federal Government stations in the radiolocation service operating in the band 5350-5470 MHz, shall not cause harmful interference to, nor claim protection from, Federal stations in the aeronautical radionavigation service operating in accordance with No. 5.449.

G131 Federal Government stations in the radiolocation service operating in the band 5470-5650 MHz, with the exception of ground based radars used for meteorological purposes operating in the band 5600-5650 MHz, shall not cause harmful interference to, nor claim protection from, Federal Government stations in the maritime radionavigation service.

Allocations and Spectrum Available for Unlicensed Use in the United States in the Range 5350-5725 MHz		
Existing Allocations and Unlicensed Use	**Additional Allocations and Unlicensed Use Adopted in the Report and Order (R&O)**	**Remarks**
The 5350-5460 MHz Band--		
Federal and non-Federal AERONAUTICAL RADIO-NAVIGATION (ARNS) 5.449 (ARNS use of 5350-5470 MHz is limited to airborne radars and associated airborne beacons) Federal RADIOLOCATION (RL) G56 (Federal RL use of 5350-5650 MHz is primarily for military services) Federal EARTH EXPLORATION-SATELLITE (EESS) (active) 5.448B (EESS shall not cause harmful interference to, or constrain the development of, ARNS) non-Federal radiolocation & Earth exploration-satellite (active)	Federal SPACE RESEARCH (active) US390 (Federal SRS (active) shall not cause harmful interference to, nor claim protection from, Federal and non-Federal ARNS nor Federal radiolocation) non-Federal space research (active) G130 (Federal RL use of the band 5350-5470 MHz, shall not cause harmful interference to, nor claim protection from, Federal ARNS)	The R&O allocates an additional 110 megahertz of spectrum for SRS (active) with Federal use on a primary basis and with non-Federal use on a secondary basis. Note: The EESS (active) allocations and footnote 5.448B were recently adopted in the *Above 28 MHz Report and Order*, ET Docket No. 02-305.
The 5460-5470 MHz Band--		
Federal and non-Federal RADIONAVIGATION 5.449 US65 (Use of 5460-5650 MHz by the maritime radionavigation service is limited to shipborne radars) Federal radiolocation G56 non-Federal radiolocation US49 (non-Federal RL may be authorized on the condition that it does not cause harmful interference to ARNS, the maritime radionavigation service, or to Federal RL)	Federal RADIOLOCATION G130 Federal EARTH EXPLORATION-SATELLITE (active) and SPACE RESEARCH (active) **MOD 5.448B** (EESS (active) in 5350-5570 MHz and SRS (active) in 5460-5570 MHz shall not cause harmful interference to ARNS in 5350-5460 MHz, radionavigation in 5460-5470 MHz and maritime radionavigation in 5470-5570 MHz) non-Federal Earth exploration-satellite (active) and space research (active) 5.448B	In this 10 megahertz of spectrum, the R&O (1) elevates the secondary radiolocation service allocation to primary status for Federal use; and (2) allocates this spectrum for active spaceborne sensors with Federal use on a primary basis and with non-Federal use on a secondary basis.
The 5470-5600 MHz Band--		
Federal and non-Federal MARITIME RADIONAVIGATION US65 Federal radiolocation G56 non-Federal radiolocation US50 (non-Federal RL may be authorized on the condition that it does not cause harmful interference to the maritime radionavigation service or to the Federal RL)	**5470-5570 MHz** Federal and non-Federal RADIOLOCATION G131 (Federal RL in 5470-5650 MHz, with the exception of ground-based radars used for meteorological purposes operating in 5600-5650 MHz, shall nor cause harmful interference to, nor claim protection from, Federal maritime radionavigation) Federal EARTH EXPLORATION-SATELLITE (active) and SPACE RESEARCH (active) 5.448B non-Federal Earth exploration-satellite (active) and space research (active) 5.448B U-NII devices	In this 100 megahertz of spectrum, the R&O (1) elevates the secondary radiolocation service allocation to primary status for both Federal and non-Federal use; (2) allocates this spectrum for active spaceborne sensors with Federal use on a primary basis and with non-Federal use on a secondary basis; and (3) makes this spectrum available for use by U-NII devices. Footnote US50 will continue to apply in both the 5470-5570 MHz and 5570-5600 MHz bands.
	5570-5600 MHz Federal and non-Federal RADIOLOCATION G131 U-NII devices	In this 30 megahertz of spectrum, the R&O (1) elevates the secondary radiolocation service allocation to primary status for both Federal and non-Federal use; and (2) makes this spectrum available to U-NII devices.
The 5600-5650 MHz Band--		
Federal and non-Federal MARITIME RADIONAVIGATION US65 Federal and non-Federal METEOROLOGICAL AIDS Federal & non-Federal radiolocation G56 US51 (non-Federal RL shall not cause harmful interference to Federal RL) 5.452 (ground-based radars used for meteorological purposes are authorized to operate on a basis of equality with maritime radionavigation)	Federal and non-Federal RADIOLOCATION US50 (non-Federal RL shall not cause harmful interference to the maritime radionavigation service or to the Federal RL) G131 U-NII devices	In this 50 megahertz of spectrum, the R&O (1) elevates the secondary radiolocation service allocation to primary status for both Federal & non-Federal use; and (2) makes this spectrum available for use by U-NII devices. Footnote US51 is replaced by footnote US50.
The 5650-5725 MHz Band--		
Federal RADIOLOCATION G2 (Federal RL use is limited to the military services) Amateur 5.282 (amateur-satellite service (Earth-to-space) may operate in 5650-5670 MHz subject to not causing harmful interference to other services)	U-NII devices	The R&O makes an additional 75 megahertz available for use by U-NII devices.

B. Technical Requirements

1. Additional Spectrum for U-NII Devices

14. *Proposals*. In the *Notice*, we proposed to modify our Part 15 rules by adding the 5.470-5.725 GHz band to the U-NII bands with the same technical requirements that apply to the existing 5.250-5.350 GHz U-NII band. U-NII devices operating in the 5.25-5.35 GHz band may be used indoors and outdoors and are limited to 1 watt equivalent isotropically radiated power (e.i.r.p.). This proposal was consistent with the U.S. position for the WRC-03.

15. *Comments*. Most commenters enthusiastically support our proposal to allow U-NII devices to operate in the 5.470-5.725 GHz band.[31] For example, Cisco states that the additional spectrum would support the growth in use of U-NII devices, as well as better enable U-NII devices to co-exist with the Radiolocation Service, SRS, and EESS.[32] Microsoft agrees that the additional spectrum for U-NII would provide vitally important capacity and security for innovators to further the reach and potential of unlicensed broadband networks.[33] Motorola states that the additional spectrum would provide increased system throughput enabling truly broadband multimedia applications. Motorola further submits that because this change would make the U-NII spectrum globally harmonized, it would enable economies of scale to reduce product costs and allow consumers to use the same products when traveling overseas.[34] The License-Exempt Alliance (LEA) applauds our proposal to provide the additional spectrum for U-NII devices, noting that this should relieve congestion in the U-NII bands.[35] NTIA also supports additional spectrum for U-NII devices under Part 15, on a non-interference basis.[36] NTIA submits that the additional 255 megahertz for U-NII devices along with other proposed mitigation measures will provide protection to vital Federal Government systems that use 5 GHz frequencies. Some commenters, while generally supportive of our proposal, make the point that these unlicensed networks will not eliminate the need for licensed networks.[37]

16. The IEEE Local and Metropolitan Area Networks Standards Committee (IEEE 802) requests that we consider a primary allocation dedicated for U-NII devices in the 5.15-5.35 GHz and 5.47-5.725 GHz U-NII bands, as adopted by WRC-03 internationally.[38] IEEE 802 asserts that such

[31] Cingular states that, to the extent the Commission has statutory authority to authorize unlicensed use of spectrum, it supports such use in the 5 GHz band. Cingular asserts that unlicensed operations should be band-specific and argues that underlays or easements in licensed bands, such as those used by CMRS providers, would raise significant interference concerns. Regarding the 5 GHz band, we note that unlicensed operations already are permitted in this band and our action here merely expands such use in this band. Cingular's concerns regarding underlays or easements in licensed bands is beyond the scope of this proceeding. *See* Cingular reply comments.

[32] *See* Cisco comments at 2-3.

[33] *See* Microsoft comments at 7.

[34] *See* Motorola comments at 2-3.

[35] *See* LEA comments at 2.

[36] *See* NTIA comments at 7.

[37] *See* Telecommunications Industry Association (TIA) comments at 1-2,4 (cautioning that U-NII networks should not replace the ubiquitous, reliable, and feature-rich solutions offered by licensed networks); American Petroleum Institute (API) comments at 7-8 (cautioning that unlicensed operations will not eliminate the need for licensed operations and spectrum); Cellular Telecommunications & Internet Association (CTIA) comments at 1 (urging caution before extending the unlicensed underlay approach into bands where more flexible service rules, designed to facilitate innovation, apply to licensed incumbent services such as CMRS), 5 (urging that any additional spectrum for unlicensed services be based on demonstrated need and convey no right to protection from interference)

[38] *See* IEEE comments at 20-21. *See also* WRC-03 Final Acts, Part 1/2, pages 27-28; part 2/2, pages 468-469 resolves 1; part2/2, page 495, resolves 1.

systems have become exceptionally important to society and the U.S economy. It is concerned about the vulnerability of U-NII deployment under Part 15 to interference from, and recurrent challenges to, the right to operate U-NII devices due to alleged interference to a secondary service such as the Amateur Radio Service, particularly in light of that service's low use of these bands.[39]

17. The majority of commenters support our proposal to apply the same technical rules that apply to the 5.250-5.350 GHz U-NII band, *i.e.,* 1 watt e.i.r.p. limit, to the new 5.470-5.725 GHz band. Nine commenters disagree with our statement in the *Notice* regarding power limits for the 5.470-5.725-GHz band that "[w]e expect that the 100 MHz of spectrum that is already available at 5.725-5.825 GHz will remain sufficient for higher power operations."[40] These commenters argue that the 5.725-5.825 GHz band is, or will soon be, congested due to growth. They state that for 802.11-based systems, the current high power U-NII band only provides four non-overlapping channels, which is not adequate to accommodate Wireless Metropolitan Area Networks (MANs) or broadband access in all rural areas.[41] Consequently, they ask that we make additional spectrum available for higher power point-to-point and point-to-multipoint U-NII devices in other parts of the 5 GHz U-NII spectrum or in other bands, either in this rulemaking or in a separate proceeding. In addition, LEA requests that we clarify that our statement in the *Notice* does not represent a reversal of our position on unlicensed high power operation, in light of other on-going proceedings at 900 MHz, 2.4 GHz, 2.5 GHz, and 3.65 GHz.[42] Finally, the American Petroleum Institute (API) urges that we allow unlicensed spread spectrum operations in the 5.470-5.725-GHz band to ease congestion in the adjacent 5.725-5.825 GHz band, the 902-928 MHz band, and the 2.4 GHz band available for spread spectrum.[43]

18. ARRL states that it is concerned about potential aggregate interference from U-NII devices in the 5.470-5.725 GHz band to Amateur Radio space stations in the 5.65-5.67 GHz band. ARRL is supportive of other elements of our proposals for the new band (*e.g.,* DFS, TPC[44] and power limited to 1 Watt e.i.r.p.).[45] ARRL states that it is willing to cooperate with the RLAN industry on sharing related issues regarding this band.[46] It nonetheless urges that we not allow U-NII equipment to use the 5.65-5.67 GHz band segment, as it believes this is the only practical means of avoiding interference to the Amateur-Satellite service.[47] Additionally, ARRL requests modifications to our proposed rules in order to further protect Amateur facilities. These modifications include expanding the DFS requirements to take into

[39] *See* IEEE 802 comments at ¶¶ 116-123. *See also* IEEE 802.18 Radio Regulatory Technical Advisory Group (IEEE RR-TAG) reply comments at ¶ 21.

[40] *See Notice* ¶ 18.

[41] S*ee* Cisco comments at 3, reply comments at 7. The commenters offer various justifications for the additional high power spectrum, such as increased congestion in the 5.725-5.825 GHz band in dense urban environments (*see* NextWeb, Inc., and the Wireless Bay Area Network Coordination Group (NextWeb/BANC) reply comments at 2-4,7) and in rural areas (*see* Microsoft comments at 9, reply comments at 4, Motorola comments at 4, reply comments at 2-3).

[42] *See* LEA comments at 4-6, reply comments at 2-3; *see also* IEEE 802.18 Radio Regulatory Technical Advisory Group (IEEE RR-TAG) reply comments at ¶ 9.

[43] *See* API comments at 6. API believes that spread spectrum systems implemented in rural and industrial areas can co-exist with U-NII devices.

[44] In addition to DFS, our proposals included the requirement that U-NII devices operating in the 5.470-5.725 GHz band employ transmit power control (TPC) to further protect EESS and SRS operations. *See* ¶ 33, *infra.*

[45] *See* ARRL comments at 2, 4, and 9-10.

[46] *See* ARRL comments at 5.

[47] *See* ARRL comments at 9.

account more than just radar devices,[48] and requiring all new U-NII devices operating in the 5.650-5.825 GHz band to have TPC capability to further protect Amateur facilities.[49]

19. *Decision*. We continue to believe, as evidenced by the support in the record, that there is need to make the 5.470-5.725 GHz band available for unlicensed U-NII devices. This additional spectrum will relieve the developing congestion in the existing 5.725-5.825 GHz band and provide opportunities for further development of U-NII technologies and system capabilities. We therefore are adopting our proposal to modify the Part 15 rules to allow U-NII devices to operate in the 5.470-5.725 GHz band with 1 watt e.i.r.p. This is consistent with the outcome of WRC-03. We decline to adopt a mobile allocation, as suggested by IEEE 802 and instead will treat these devices similar to all other unlicensed intentional radiators (*i.e.*, they will operate on a non-interference basis under Section 15.15(c) of the rules). Based on the growth of similar unlicensed mobile devices operating in the 2.4 GHz band which also operate on a non-interference basis, we do not believe that such treatment will hinder the development or deployment of U-NII devices. In addition, as this action is consistent with the adoption of a mobile allocation by the ITU, manufacturers will benefit from economies of scale and consumers will benefit by having mobile, interoperable devices on a global basis.[50]

20. We are not persuaded that we should either add or modify our proposed rules as requested by ARRL. As recognized by ARRL, our DFS and TPC requirements, while not specifically designed to protect amateur operations, will in fact protect amateur operations. In addition, because of the large

[48] *See* ARRL comments at 9-10. For example, ARRL requests that the definition of "Available Channel" in Section 15.403 be modified to read as follows: "A radio channel on which a *Channel Availability Check* has not identified the presence of a signal above the DFS detection threshold."

[49] *See* ARRL comments at 9-10. *See also* Leggett comments at 2-3 (requesting that the Commission modify its rules so that amateur radio operators can use especially high power levels on specified segments of amateur radio microwave bands in order to compensate for the expected increase in interference from U-NII devices in the band).

[50] At WRC-03, the general technical and operational requirements set forth for RLAN operations in the 5.25-5.35 GHz and 5.47-5.725 GHz bands were not identical. The WRC-03 provisions, however, provide administrations with the flexibility to adopt the approach we set forth in the *Notice*. We note that direct comparisons between the decisions from WRC-03 and the *Notice* are not precise due to the fact that RLANs operate internationally pursuant to a primary mobile allocation and, domestically in the U.S., pursuant to our Part 15 rules.

The relevant WRC resolution permits outdoor operation of RLANs in for the 5.25-5.35 GHz band, but requests that countries take "appropriate measures" that will result in the "predominant number of stations" being operated indoors. Resolution 229 (WRC-03), Resolves 4. In the United States, where this particular band is already available for use, many of the devices manufactured are intended for indoor use, including laptops and PDAs. Thus, this WRC-03 provision is consistent with current utilization of the band.

In addition to the issue of indoor versus outdoor operation, within the relevant WRC resolution for this band there are two applicable technical operational provisions. The first permits RLAN operation up to a maximum mean e.i.r.p. of 1 W, provided the stations comply with a particular emissions mask. *Id*. at Resolves 4. The second provides administrations with "flexibility" as to the particular mitigation techniques they adopt, in lieu of the emissions mask, as long as the techniques employed ensure equivalent protection to EESS and SRS. *Id*. at Resolves 5. We elect to implement the provision giving administrations flexibility and will use an alternative mitigation technique. As we have previously observed, the vast majority of the operations in this band will be significantly lower powered than the maximum permissible power limit. Moreover, most of the devices operating in this band will be used primarily for indoor operations. Furthermore, to optimize system operation and maximize range for higher-powered outdoor RLANs, system designers have strong incentives to minimize the RF energy radiated above the horizon. Through monitoring the U-NII equipment authorizations, in terms of the numbers and types of devices certified (*e.g.*, whether the antennas are weatherized), we believe that we can ensure that applicable protection levels will be achieved. Indeed, we have permitted RLAN operations in this band for almost six years and have not yet had any interference issues brought to our attention.

amount of spectrum we are adding for U-NII devices along with the existing 300 MHz of U-NII spectrum, we expect the density of devices throughout the spectrum to be relatively low. We believe that this low density of devices coupled with our technical requirements will provide adequate protection to all incumbent systems in the band, including amateur satellite uplink systems.

21. Finally, we note that several commenters take exception to our statement in the *Notice* regarding the sufficiency of 100 megahertz of spectrum to support higher powered use in the future. We recognize the demand for more spectrum for higher powered unlicensed operations; however, higher powered operation in the bands under consideration in this proceeding is not feasible without causing undue risk of interference to other radio services. The Commission plans to initiate a proceeding in the near future to consider provisions for cognitive radios that will address the possibility of higher powered unlicensed operations in various frequency bands. We encourage interested parties to participate.

2. Dynamic Frequency Selection

22. *Proposals*. To ensure protection of Federal Government radar systems, we proposed to require that U-NII devices operating in the 5.25-5.35 GHz and 5.470-5.725 GHz bands employ Dynamic Frequency Selection.[51] DFS is a feature that dynamically instructs a transmitter to switch to another channel whenever a particular condition (such as, for example, the prevailing ambient interference level on a channel) is met. Prior to initiating a transmission, a U-NII device's DFS mechanism would monitor the available spectrum in which it could operate for a radar signal. If a signal is detected, the channel associated with the radar signal would either be vacated and/or flagged as unavailable for use by the U-NII device.

23. We proposed to require that U-NII devices continuously monitor their environment for the presence of radar both prior to and during operation. We further proposed to require that U-NII devices use two detection thresholds to ascertain whether radar signals are present. The proposed threshold levels were -62 dBm for devices with a maximum e.i.r.p less than 200 mW and -64 dBm for devices with a maximum e.i.r.p between 200 mW and 1 W averaged, over 1 μs.[52] Because these levels are referenced to a 1 megahertz bandwidth, we also proposed to require that U-NII devices with less than a 1 megahertz bandwidth use a correction factor when determining whether signals are over or below the threshold.[53] In addition, we sought comment on the minimum number of radar pulses necessary, and the observation time required for, reliable detection of a radar signal.[54] We also proposed a definition of DFS that would require a uniform spreading of loading over all available channels.[55] Our proposals were based on an agreement on the use of DFS that was reached by industry, the National Telecommunications and Information Administration (NTIA), and the Department of Defense prior to WRC-03.[56]

24. We also sought comment on the proper treatment of U-NII systems where multiple devices operate under the control of a central controller or "master". Specifically, we proposed to require only the

[51] *See Notice* at ¶ 20.

[52] *See Notice* at ¶ 21. The DFS detection threshold is defined as the received signal strength in dBm, referenced to the output of a 0 dBi receive antenna and signal bandwidth of 1 MHz, averaged over 1 μs. *See* Appendix C, pages 8 for information on use of antennas having gains greater than 0 dBi.

[53] The proposed correction factor was $10*\text{Log}_{10}$ (BW/1MHz) (where BW is the U-NII device's bandwidth).

[54] *See Notice* at ¶ 23.

[55] *See* proposed rule Section 15.403(g) in *Notice*.

[56] *See* U.S. Department of Commerce, National Telecommunications and Information Administration, "Agreement Reached Regarding U.S. Position on 5 GHz Wireless Access Devices," (WRC-03 Agreement), rel. Jan 31, 2003, (available at http://www.ntia.doc.gov/ntiahome/press/2003/5ghzagreement.htm.)

central controller to have DFS capability. We also requested comment on how to identify remote units that operate only under the control of a central controller and whether DFS should be required for devices that operate in absence of controller, *i.e.,* on an *ad hoc* basis.

25. *Comments.* The majority of commenters view DFS as an integral part of successful U-NII operations on the new frequencies and therefore support the adoption of the proposed threshold levels and parameters. For example, Cisco notes that the DFS detection threshold levels and technical parameters that we proposed are the same as those adopted in an ITU Recommendation during the WRC-03, and, as a result, are likely to be adopted globally.[57] Arcwave asserts that implementation of DFS would be problematic because the current wireless broadband cable protocol, DOCSIS, is not compatible with DFS.[58] Arcwave claims that the DFS proposal would render unusable any system based on the DOCSIS protocol.[59] Works D'Arndt also opposes a DFS requirement, arguing that implementation of DFS will affect the operational reliability of RLANs. It argues that DFS, as well as TPC, would not guarantee a communication link that can sustain high levels of consistent throughput without interruption.[60]

26. Comments regarding our proposal to require devices using less than 1 megahertz bandwidth to use a correction factor when detecting the presence of a radar were somewhat mixed. Proxim and Motorola state that the proposed correction factor is appropriate for U-NII devices having a receiver bandwidth less than 1 MHz.[61] However, Proxim further states that it would seem counter to the spirit of this proceeding to allow devices with bandwidths narrower than 1 MHz. Other commenters argue that we should not adopt rules that could encourage narrowband applications. Instead, they urge that we explicitly prohibit narrowband operations in the new band.[62] The WiFi Alliance argues that the bandwidth correction factor should be abandoned because allowing narrowband Part 15 signals in the 5 GHz bands is at odds with the concept of "wideband" U-NII operations. It states that Part 15 operations within the current and proposed U-NII bands should be restricted to "wideband" U-NII devices consistent with the actions of WRC-03 in making a globally harmonized allocation. On the other hand, Alvarion states that future devices based on 802.16a will have the ability of operating in narrower bandwidths than those required by the current 802.11a standard.[63]

27. The proponents of DFS support our proposal to exempt remote stations under control of a central station from having a DFS capability.[64] Some commenters state that the exclusion of remote, *i.e.,* "client" devices from the radar detection and DFS functions is an integral part of the industry/Government pre-WRC-03 agreement,[65] which we note is also consistent with the final ITU Recommendation[66] and European regulations.[67] Proxim states that it shouldn't be necessary to identify

[57] *See* Cisco at 4 and ITU-R M.165, "*Dynamic frequency selection in wireless access systems including radio local area networks for the purpose of protecting the radiodetermination service in the 5 GHz band.*"

[58] Data over Cable Service Interface Specification is the cable industry's standard for broadband cable modems. Virtually all contemporary CATV systems delivering two-way broadband data utilize DOCSIS.

[59] *See* Arcwave Comments at 5.

[60] *See* Works D'Arndt comments at 2.

[61] *See e.g.,* comments by: Proxim at 5 and Motorola at 7.

[62] *See e.g.,* comments by: Agere at 4, Airespace at 1, IEEE 802 at 30-34, WiFi Alliance reply-comments at 4.

[63] *See* Alvarion comments at 3.

[64] *See* comments by: Motorola at 6, Atheros at 2, Agere at 4, Cisco at 4.

[65] *See* Atheros comments at 2.

[66] ITU Recommendation M.1652.

[67] ETSI Conformance Test Standard EN 301 893 version 1.2.3 (2003-8).

remote devices operating under control of a master other than at the time of product certification, since any devices operating without the control of a master would have the DFS capability as required for product certification.[68] Proponents argue that if were to require devices not under the control of a master, *i.e., ad hoc* devices, to operate at power levels much lower that the maximum allowable U-NII limit, such devices would not pose any risk of harmful interference to incumbent systems. They recommend that *ad hoc* devices operating at such power levels be exempted from the DFS requirement. Proponents of *ad hoc* devices propose various power levels at which devices should be permitted to operate.[69] However, Motorola notes that *ad hoc* operations in the 5.470-5.725 GHz band have not yet been studied to determine the appropriate power levels and other parameters needed to protect incumbent services.

28. In the *Notice*, we sought comment on the minimum number of radar pulses and the observation time required for reliable detection. As noted by IEEE, the fundamental requirements for radar detection and other DFS performance parameters are specified in ITU-R Recommendation M.1652. IEEE further states that the minimum number of pulses needed for reliable detection is likely to be implementation dependent and need not be codified in the Commission's rules. It states that allowing this flexibility would avoid constraining the future development of innovative approaches that may provide superior performance. Cisco similarly states that codifying the minimum number of pulses and the observation time required to detect the radar's signal reliably before the work on compliance testing procedures is completed could lead to rules that are overly burdensome or that limit the flexibility for DFS implementations in particular devices. Instead, Cisco recommends that these parameters – once developed – be written into compliance test procedures.[70] With respect to our request for comments on other specific DFS parameters,[71] the majority of commenters strongly recommend that any further refinement to the technical rules occur within the context of the development of compliance testing procedures.[72]

29. *Decision*. We are adopting our proposal to require that U-NII devices operating in the 5.25-5.35 GHz and 5.470-5.725 GHz bands employ DFS at the threshold levels proposed in the *Notice*. We agree with the commenters that DFS is a key element in enabling unlicensed U-NII devices to share spectrum with important U.S. Government radar operations. It is also an ITU accepted mechanism that will allow U-NII devices to be globally marketed. With respect to Arcwave's objection to the DFS requirement on DOCSIS compatibility grounds, we are providing, as explained below, a transition period for implementing the DFS requirement in U-NII devices that operate in the 5.25-5.35 GHz band.[73] Thus, all of Arcwave's existing products that have been certified to be used in the 5.25-5.35 GHz band can continue to be sold during this period and can be used indefinitely, which minimizes many of the potential economic hardships asserted by Arcwave. Moreover, the voluntary standards-making bodies, like IEEE, routinely update their standards to reflect Commission requirements. Thus, Arcwave can pursue changing the DOCSIS standard through the relevant standard-making body, Cable Television Laboratories. Also, we disagree with Works D'Arndt's characterization of the effects of DFS implementation. DFS will determine the RLANs' transmit frequency, but will not incrementally impair the reliability of RLAN communications. Moreover, we note that, as unlicensed devices, RLANs operate on a non-interference basis and must cease their operations should they interfere with other licensed or authorized services.

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[68] *See* Proxim comments at 6.

[69] *See* Atheros comments at 3 and IEEE 802 comments at 11.

[70] *See* Cisco comments at 6.

[71] *See Notice* at ¶ 23.

[72] *See e.g.,* comments by: Cisco at 6 and Proxim at 6.

[73] *See* ¶ 42, *infra.*

30. We are not requiring U-NII devices to have bandwidths of 1 megahertz or greater as requested by some commenters.[74] The current rules for U-NII operations in the 5.25-5.35 GHz band, which will now extend to the new 5.470-5.725 GHz band, allow U-NII operations with bandwidths of less than 1 megahertz with a penalty in the form of reduced power levels for such devices.[75] This approach provides incentives for manufacturers to develop broadband applications as was intended, but does not foreclose the ability for manufacturers to produce U-NII devices having bandwidths less than 1 MHz.[76] The requirement that such devices operate with reduced power also diminishes their ability to cause interference.

31. We are adopting our proposal to exempt remote devices that are under the control of a central controller from the DFS requirement. The exclusion of such "client" devices from the radar detection and DFS functions is an integral part of the industry/Government pre-WRC-03 agreement and is also consistent with the final ITU Recommendation.[77] However, we are not exempting controller devices or "masters" from the DFS requirement. We note that exempting a controller device from the DFS requirement would be both inconsistent with both pre-WRC-03 agreements and WRC-03 resolutions. We also agree with Proxim that it shouldn't be necessary to identify remote devices operating under control of a master other than at the time of product certification, since any devices operating without the control of a master will have the DFS capability as required for product certification.[78] With respect to *ad hoc* U-NII devices, we agree with commenters that these devices should not be exempt from the DFS requirement in the 5.25-5.35 GHz and 5.470-5.725 GHz bands at this time because no analyses have been performed to determine the impact this may have on radio services in this spectrum.

32. Finally, we agree with Cisco that codifying requirements for a minimum number of pulses and observation time required to reliably detect the radar signals before the work on compliance testing procedures is completed could be overly burdensome and limit the flexibility for DFS implementations in particular devices. These parameters will be addressed under the compliance test procedures, as described below. Additionally, several commenters also requested that we distinguish between the DFS "mechanism" and the "radar detection" function.[79] We are clarifying the rules in Appendix B to indicate that radar detection (sub-function) is part of the overall DFS function.[80] Finally, we are adopting rules to clarify DFS detection that require a master device and associated client devices to dedicate periods of no transmissions before, during, or after each packet or frame. During these listen periods, successive averaging periods, not to exceed 1 microsecond, will be used and any power level above the detection threshold found in any one of these averaging periods will trigger the DFS detection circuit.

3. Transmit Power Control

33. *Proposals.* TPC can generally be defined as a mechanism that regulates a device's transmit power in response to an input signal or a condition (*e.g.,* a command signal is issued by a controller when the received signal falls below a predetermined threshold). In the *Notice*, we proposed to require U-NII devices operating in the 5.470-5.725 GHz band to employ a transmit power control (TPC) mechanism to

[74] As an established policy, the FCC laboratory has been authorizing U-NII devices with a minimum data rate rating of 1 Mbps.

[75] *See* § 15.407(a)(2).

[76] We note that the FCC laboratory has an established policy that requires U-NII equipment to have a minimum data rate of 1 Mbps. This policy ensures the U-NII spectrum is used efficiently.

[77] ITU Recommendation M.1652.

[78] *See* Proxim comments at 6.

[79] *See* WiFi Alliance comments at 6. *See* Motorola comments at 5.

[80] *See* § 15.403(g) and § 15.407(h)(2) in Appendix B.

further protect EESS and SRS operations.[81] We also proposed to require that when TPC is triggered, the U-NII device's power level be reduced by 6 dB and requested comments on identifying a suitable triggering mechanism for TPC. In addition, we requested comments on whether TPC is necessary for U-NII devices that operate at maximum e.i.r.p less than or equal to 500 mW, *i.e.,* ≥ 3 dB below maximum e.i.r.p. of 1 Watt. Further, we requested comments on how TPC should be applied to system configurations where multiple devices may operate under the control of a central device.

34. *Comments.* The overwhelming majority of commenters support TPC as an integral part of U-NII devices that would operate in the 5.470-5.725 GHz band. In addition, the general consensus among these parties is that TPC should only be required for U-NII devices that operate at power levels higher than 500 mW**.**[82] The majority of the commenting parties also oppose a rule requiring use of any specific TPC algorithm or trigger mechanism, *e.g.,* received signal strength indication or bit error rate (BER) into the rules. Several parties argue that codifying a particular TPC algorithm is unnecessary and would be detrimental to U-NII devices in this part of the spectrum.[83] Intel and Cisco state that manufacturers have strong incentives to employ TPC in their systems, *e.g.,* handheld and portable devices are battery operated and therefore need to be designed to be power efficient[84], and that equipment manufacturers have already developed a variety of algorithms and architectures to implement TPC.[85]

35. *Decision.* We will require TPC for U-NII devices operating in the 5.250-5.350 GHz and 5.470-5.725 GHz bands. Although we did not propose applying the TPC requirement to the 5.250-5.350 GHz band in the *Notice*, we believe that this requirement is also appropriate for U-NII devices in that band. At the time the *Notice* was issued, there was no call to require TPC for the 5.25-5.35 GHz band.[86] However, at WRC-03, there was strong support to require TPC for this band and the United States partners agreed to support this new requirement after consulting with their representatives from industry and Government who were present at the conference. [87] The current 802.11 standards require TPC in the 5 GHz band.[88] We are therefore adopting a requirement that U-NII devices operating in the 5.25-5.35 GHz band have TPC. We believe that the majority of devices that will be affected by this rule will already have the TPC feature built into them, since only TPC equipped devices will be able to take advantage of the new band. Also, requiring TPC for the 5.25-5.35 GHz band is also consistent with some commenters' call for uniform rules for the U-NII bands both domestically and internationally. We agree with the commenters arguments that there is no need to require TPC for low-power U-NII devices and therefore will only require TPC for U-NII operating at power levels higher than 500mW.

36. We recognize that the benefits of requiring a well defined TPC algorithm must be weighed against the burden it would impose. We agree with commenters that codifying a specific TPC algorithm into our rules is likely to hinder innovation, and therefore, eventually, increase equipment costs. We, therefore, decline to adopt requirements for a specific TPC triggering mechanism into our rules. Instead, we will require applicants seeking equipment authorization for U-NII devices to provide a statement in their certification application explaining how the equipment complies with our TPC rules.

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[81] *See Notice* at ¶ 24.

[82] *See e.g.,* comments by Cisco at 8, Intel at 3, Atheros at 5, Motorola at 9, Microsoft at 8, AMD at 1, Airespace at 1.

[83] *See e.g.,* comments by: Agere at 5, Cisco at 8, and Atheros at 4-5, Intel at 3.

[84] *See* Intel comments at 4.

[85] *See* Cisco comments at 8.

[86] *See* outcome of Inter-American Telecommunication Commission (CITEL) conference, held in Orlando in February 2003.

[87] *See* IEEE 802.18 reply comments at ¶¶ 7-8.

[88] *See* IEEE website: IEEE802.org (P802.11h/d3.3).

4. Test Procedures

37. *Proposals.* In the *Notice*, we requested comments on the test procedures needed to ensure compliance with the DFS and TPC requirements adopted herein. Specifically, we requested comments on how U-NII devices can be tested for compliance with TPC requirements to implement reduced power without placing unnecessary restrictions on device design. In addition, we requested comments on the extent to which devices under development may have unique or novel transmission waveforms that may require special measurement instrumentation settings, *e.g.*, integration times, that differ from those used for measuring compliance of previous U-NII band devices.

38. *Comments.* The commenters recommend that our DFS test procedure be based on ETSI test procedures and be implemented after industry has had an opportunity to review and reach consensus on the procedures.[89] The commenters also note that a joint industry/U.S. Government 5 GHz Project Team has been established to develop DFS test procedures. This informal team has drafted an initial version of a test procedure for DFS based on ETSI test procedures.[90]

39. *Decision.* In order to allow the immediate implementation of U-NII devices in accordance with the rules adopted herein, we are providing an interim test procedure drafted by the 5 GHz Project Team to be used in obtaining equipment certifications for U-NII devices.[91] We have reviewed this draft procedure and believe its provisions are adequate to provide satisfactory testing and certification of U-NII devices containing DFS capabilities. We recognize that this procedure may need to be modified as equipment is developed and as the testing methodologies are refined. Therefore, consistent with existing practice, our Laboratory may issue updated measurement procedures in the future. The interim test procedure is set forth in Appendix C.

5. Transition Period.

40. *Proposals.* In the *Notice*, we proposed transition rules for the U-NII equipment operating in the 5.250-5.350 GHz and 5.470–5.725 GHz bands. Specifically, we proposed to require that U-NII equipment, operating in the new 5.470–5.725 GHz band meet all of the technical requirements, including DFS and TPC, on the effective date of these rules. In addition, we proposed that in the 5.25-5.35 GHz band, U-NII equipment comply with the DFS requirement effective one year from the date of publication of the Report and Order in this proceeding in the Federal Register. We also proposed that all U-NII devices operating in the 5.25-5.35 GHz band that are imported or shipped in interstate commerce on or after two years from the date of publication in the Federal Register comply with these standards. We requested comments on our proposed transition provisions.[92]

41. *Comments.* The majority of commenters strongly recommend that we either lengthen the transition period or tie it to the availability of acceptable conformance testing procedures.[93] Furthermore, commenters state that there have been no reports of harmful interference that would lead us to adopt an aggressive transition time schedule for equipment operating in the current U-NII frequency bands.[94] Additionally, Proxim proposes that we apply the transition period only to new certifications in order to

[89] *See e.g.,* comments by: Nokia at 4, Microsoft at 9, Proxim at ¶ 7.

[90] *See* NTIA comments in Appendix B.

[91] *See* DFS Interim Test Procedure contained in Appendix C.

[92] *See Notice* ¶ 26.

[93] *See e.g.,* comments by: IceFyre at 2, Cisco at 10, AMD at 1, Airespace at 1.

[94] *See* Microsoft comments at 9.

prevent creating burdensome recording requirement.[95] Proxim argues that the life cycle of unlicensed wireless products is relatively short and therefore old products are quickly replaced with new products. It submits that this life cycle coupled with the transition policy it proposes would accomplish our objective to bring all new U-NII devices operating on 5.250-5.350 GHz and 5.470-5.725 GHz frequencies into compliance with the DFS and TPC requirements.

42. *Decision*. We are requiring that any product that has the capability to operate in the new spectrum at the 5.470-5.725 GHz band, including equipment designed to operate in both the 5.25-5.35 GHz and 5.470-5.725 GHz band, must meet all the rules contained in this Report and Order in accordance with the specified measurement procedures to obtain equipment certification. For all other equipment, we will provide a transition period. This will minimize economic hardships on manufacturers by allowing them, during the transition period, to continue producing and selling existing equipment while modifying their products to meet the new requirements. Thus, we are adopting our proposal to implement a cut-off date of one year from date of publication of this Report and Order in the Federal Register for applications for equipment certification of products that operate under the current rules in only the 5.25-5.35 GHz band. That is, equipment designed to operate in only the 5.25-5.35 GHz band may continue to obtain certification without having DFS and TPC so long as the application for equipment certification is filed prior to the cut-off date of one year. After that time, all devices for which an application for equipment certification is filed for U-NII equipment operating in the 5.25-5.35 GHz band must meet the rules adopted herein. In addition, we are adopting a two-year cutoff date for marketing and importation of equipment designed to operate in only the 5.23-5.35 GHz band.[96] This will prevent equipment that may be built in countries which do not have DFS and TPC requirements from continuing to be imported and marketed indefinitely. Finally, we note that users who obtain equipment prior to any of these cut-off dates may continue to use that equipment indefinitely.

PROCEDURAL MATTERS

A. Final Regulatory Flexibility Analysis

43. Final Regulatory Flexibility Analysis. The Final Regulatory Flexibility Analysis for the Report and Order, pursuant to the Regulatory Flexibility Act, *see* 5 U.S.C. § 604, contained in Appendix A.

B. Final Paperwork Reduction Act of 1995 Analysis

44. This Report and Order contains a new or modified information collection subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3705(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment on the new or modified information collection contained in this proceeding.

45. In addition to filing comments with the Secretary, a copy of any comments on the information collection(s) contained herein should be submitted to Judith B. Herman, Federal Communications Commission, Room 1-C804, 445 12th Street, SW, Washington, DC 20554, or via the Internet to jboley@fcc.gov and to Kim Johnson, OMB Desk Officer, Room 10236, 725 17th Street, NW, Washington, DC 20503 or via the Internet to Kim A. Johnson@omb.eop.gov.

[95] *See* Proxim comments at 8.

[96] *See* § 15.37(l) in appendix B.

C. Contact

46. For further information concerning this Report and Order, contact Ahmed Lahjouji at (202) 418-2061, Ahmed.lahjouji@fcc.gov, Office of Engineering and Technology.

ORDERING CLAUSES

47. Accordingly, IT IS ORDERED that pursuant to Sections 1, 4, 301, 302(a), 303, 307, 309, 316, and 332 of the Communications Act of 1934, as amended, 47 U.S.C. Sections 151, 154, 301, 302(a), 303, 307, 309, 316, 332, 334, and 336, this Report and Order is hereby adopted.

48. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this Report and Order, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

FINAL REGULATORY FLEXIBILITY ANALYSIS

1. As required by the Regulatory Flexibility Act of 1980 as amended,[97] an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Notice of Proposed Rule Making, 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.*[98] The Commission sought written public comment on the proposals in the Notice, including comment on the IRFA. The comments received are discussed below. This Final Regulatory Flexibility Analysis conforms to the RFA.[99]

A. Need for, and Objectives of, the Report and Order.

2. This Report and Order amends Part 15 of our rules governing the operation of unlicensed National Information Infrastructure (U-NII) devices, including Radio Local Area Networks (RLANs), to make available an additional 255 megahertz of spectrum in the 5.47–5.725 GHz band for the growth and development of unlicensed wireless broadband networks. This action responds to the petition for rule making submitted by the Wireless Ethernet Compatibility Alliance (WECA – now known as Wi-Fi Alliance).[100]

3. In addition to making more spectrum available for use by U-NII devices, the Report and Order also makes several other rule changes in the 5 GHz band that will further facilitate the use of this band for U-NII devices, while at the same time ensuring sufficient protection for various incumbents in the band. Specifically, it modifies the U.S. Table of Frequency Allocations in Part 2 of the rules to upgrade the status of the Federal Government Radiolocation service to primary in the 5.46–5.65 GHz band. It similarly upgrades the non-Federal Government radiolocation service to primary in the 5.47-5.65 GHz band. It further adds primary allocations for the Federal Government and the non-Federal Government Space Research Service (active) (SRS) in the 5.35-5.46 GHz band and the Earth Exploration-Satellite Service (active) (EESS) and SRS (active) in the 5.46-5.57 GHz band..

4. The Report and Order also modifies certain technical requirements for U-NII devices in the Part 15 rules. In addition to applying the existing technical requirements for the 5.250-5.350 GHz sub-band to the new 5.470-5.725 GHz band, it requires that U-NII devices operating in both the existing 5.25-5.35 GHz sub-band and the new 5.470-5.725 GHz sub-band employ a listen-before-talk mechanism called dynamic frequency selection (DFS). DFS is an interference avoidance mechanism. Prior to the start of any transmissions, and through constant monitoring, the device (*e.g.*, RLAN) equipped with such a mechanism monitors the radio environment for the presence of radar. If the U-NII device determines that a radar signal is present, it either moves to another channel or enters a sleep mode if no channels are available.

5. The Report and Order also requires a transmit power control (TPC) mechanism in both the existing 5.25-5.35 GHz sub-band and the new 5.470-5.725 GHz sub-band to further reduce the potential for impact on EESS and SRS operations. TPC can generally be defined as a mechanism that regulates a device's transmit power in response to an input signal or a condition (*e.g.,* a command signal may be

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[97] *See* 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Public Law 104-121, Title II, Stat. 857 (1996).

[98] *See* Notice of Proposed Rulemaking, ET Docket No. 03-122, 18 FCC Rcd 11581(2003).

[99] *See* 5 U.S.C. § 604(a).

[100] *See* WECA Petition for Rulemaking, RM-10371, filed on January 15, 2002, Public Notice Report No. 2527, January 29, 2002.

issued by a controller when the received signal falls below a predetermined threshold). TPC will allow the transmitter to operate at less than the maximum power for most of the time. As the signal level at the receiver rises or falls, the transmit power will be decreased or increased as needed. Because TPC equipped devices adjust their transmit power to the minimum necessary to achieve the desired performance, the average interference power from a large number of devices is reduced, the power consumption is minimized and network capacity is increased.

6. U-NII devices currently operate in the 5.25-5.35 GHz band without DFS capability. As a result, some period of time will be needed to implement the new DFS requirement for U-NII equipment operating in the 5.25-5.35 GHz band. The Report and Order requires U-NII equipment operating in the 5.25-5.35 GHz band that are authorized under the certification procedures on or after [**1 year after publication of R&O in ET Docket No. 03-122 in the Federal Register**] to comply with the DFS and TPC requirements specified in Section 15.407 of the rules. U-NII equipment operating in the 5.25-5.35 GHz band that are imported or marketed [**2 years after publication of R&O in ET Docket No. 03-122 in the Federal Register**] shall comply with the DFS and TPC requirements in Section 15.407 of the rules.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA.

7. We received no comments directly in response to the IRFA in this proceeding. We did, however, receive a comment from one small business, ArcWave, which stated that its use of the DOCSIS protocol will be compromised by the imposition of the DFS feature.[101] On consideration of Arcwave's comment regarding DFS and DOCSIS, we find their comment is unpersuasive. We believe that the beneficial value of DFS far outweighs the possible, but unproven, negative impact of DFS on a single commenter, Arcwave. However, as explained in the text and below, we have taken action in the form of a transition period that will ease any economic impact to entities, including small entities, that develop products in the 5.25-5.35 GHz band.[102]

C. Description and Estimate of the Number of Small Entities to Which the Rules Will Apply.

8. The RFA directs agencies to provide a description of, and, where feasible, an estimate of the number of small entities that may be affected by the rules adopted herein.[103] The RFA defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[104] In addition, the term "small business" has the same meaning as the term "small business concern" "under the Small Business Act.[105] A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[106]

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[101] *See* ¶ 25, *infra*.

[102] *See* ¶ 12 of the FRFA, supra.

[103] *See* U.S.C. § 604(a)(3).

[104] *Id.* § 601(6).

[105] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

[106] *Id.* § 632.

9. The Commission has not developed a definition of small entities applicable to unlicensed communications devices manufacturers. Therefore, we will utilize the SBA definition application to manufacturers of Radio and Television Broadcasting and Communications Equipment. According to the SBA regulations, unlicensed transmitter manufacturers must have 750 or fewer employees in order to qualify as a small business concern.[107] Census Bureau indicates that there are 858 U.S. companies that manufacture radio and television broadcasting and communications equipment, and the 778 of these firms have fewer than 750 employees and would be classified as small entities.[108] We do not believe this action would have a negative impact on small entities that manufacture unlicensed U-NII devices. Indeed, we believe the actions should benefit small entities because it should make available increased business opportunities to small entities.

D. Description of Projected Reporting, Record keeping and Other Compliance Requirements for Small Entities.

10. Part 15 transmitters are already required to be authorized under the Commission's certification procedures as a prerequisite to marketing and importation. Under the amendments in the *Notice*, manufacturers will be required to demonstrate that U-NII devices operating in the bands 5.250-5.350 GHz and 5.470-5.725 GHz have Dynamic Frequency Selection (DFS) Capabilities and transmit power control (TPC) capabilities. The reporting and recordkeeping requirements associated with these equipment authorizations would not be changed by the rule revisions in this Report and Order.

E. Steps taken to Minimize Significant Economic Impact on Small Entities and Significant Alternatives Considered.

11. The RFA requires an agency to describe any significant alternatives that it has considered in reaching its approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.[109]

12. We have taken a significant step to minimize economic impact to small entities. As described in the Report and Order, we have provided a transition period for the U-NII devices operating in the 5.25-5.35 GHz band.[110] This period will provide entities with time to redesign existing products to comply with the rules while permitting them to continue manufacturing and marketing existing products. In addition, we note that one commenter, Works D'Arndt opposed the adoption of a requirement that equipment possess a DFS and a TPC requirement. We rejected this alternative because the DFS and TPC requirement will ensure that all entities can share the band with a minimal risk of causing harmful interference. All entities, including small entities, having an interest in this band will benefit from this requirement.

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[107] *See* 13 C.F.R. § 121.201, NAICS Code 334220 (SIC Code 3663). Although SBA now uses the NAICS classifications, instead of SIC, the size standard remains the same.

[108] *See* U.S. Dept. of Commerce, *1992 census of Transportation, Communications and Utilities* (issued May 1995), SIC category 3663 (NAICS Code 334220).

[109] *See* 5 U.S.C. § 603(c).

[110] *See* ¶ 42, *supra.*

F. Report to Congress.

13. The Commission will send a copy of the Report and Order, including the FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act, *see* 5 U.S.C. § 801(a)(1)(A). In addition, the Commission will send a copy of the Report and Order, including the FRFA, to the Chief Counsel for Advocacy of the Small Business Administration. A copy of the Report and Order and FRFA (or summaries thereof) will also be published in the Federal Register. *See* 5 U.S.C. § 604(b).

APPENDIX B

FINAL RULES

For the reasons discussed in the preamble, the Federal Communications Commission amends 47 C.F.R. parts 2 and 15 as follows:

PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

1. The authority citation for part 2 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

2. Section 2.106, the Table of Frequency Allocations, is amended as follows:

a. Revise pages 55, 56, 57, and 58.

b. In the list of International footnotes, add footnotes 5.446A, 5.446B, 5.447E, 5.447F, 5.448C, 5.448D, 5.450A, and 5.450B; and revise footnotes 5.447, 5.448, 5.448A, 5.448B, 5.450, 5.453, 5.454, and 5.455.

c. In the list of United States (US) footnotes, add footnote US390.

d. In the list of Federal Government (G) footnotes, revise footnotes US50 and US51; and add footnotes G130 and G131.

§ 2.106 Table of Frequency Allocations.

The revisions and additions read as follows:

* * * * *

5150-5250 AERONAUTICAL RADIONAVIGATION FIXED-SATELLITE (Earth-to-space) 5.447A MOBILE except aeronautical mobile 5.446A 5.446B 5.446 5.447 5.447B 5.447C	5.367 US211 US307 US344 US370	5150-5250 AERONAUTICAL RADIO-NAVIGATION US260 FIXED-SATELLITE (Earth-to-space) 5.447A US344 5.447C US211 US307	RF Devices (15) Satellite Communications (25) Aviation (87)
5250-5255 EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION SPACE RESEARCH 5.447D MOBILE except aeronautical mobile 5.446A 5.447F 5.448 5.448A 5.447E	5250-5255 EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION G59 SPACE RESEARCH (active) 5.447D 5.448A	5250-5255 Earth exploration-satellite (active) Radiolocation Space research 5.558A	RF Devices (15) Private Land Mobile (90)
5255-5350 EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION SPACE RESEARCH (active) MOBILE except aeronautical mobile 5.446A 5.447F 5.448 5.448A 5.447E	5255-5350 EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION G59 SPACE RESEARCH (active) 5.448A	5255-5350 Earth exploration-satellite (active) Radiolocation Space research (active) 5.448A	
5350-5460 EARTH EXPLORATION-SATELLITE (active) 5.448B SPACE RESEARCH (active) 5.448C AERONAUTICAL RADIONAVIGATION 5.449 RADIOLOCATION 5.448D	5350-5460 EARTH EXPLORATION-SATELLITE (active) 5.448B SPACE RESEARCH (active) AERONAUTICAL RADIO-NAVIGATION 5.449 RADIOLOCATION G56 US390 G130	5350-5460 AERONAUTICAL RADIO-NAVIGATION 5.449 Earth exploration-satellite (active) 5.448B Space research (active) Radiolocation US390	Aviation (87) Private Land Mobile (90)
5460-5470 RADIONAVIGATION 5.449 EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active) RADIOLOCATION 5.448D 5.448B	5460-5470 RADIONAVIGATION 5.449 US65 EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active) RADIOLOCATION G56 5.448B US49 G130	5460-5470 RADIONAVIGATION 5.449 US65 Earth exploration-satellite (active) Space research (active) Radiolocation 5.448B US49	Private Land Mobile (90)
5470-5570 MARITIME RADIONAVIGATION MOBILE except aeronautical mobile 5.446A 5.450A EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active) RADIOLOCATION 5.450B 5.450 5.451 5.452 5.448B	5470-5570 MARITIME RADIONAVIGATION US65 EARTH EXPLORATION-SATELLITE (active) SPACE RESEARCH (active) RADIOLOCATION G56 5.448B US50 G131	5470-5570 MARITIME RADIONAVIGATION US65 RADIOLOCATION Earth exploration-satellite (active) Space research (active) US50	RF Devices (15) Maritime (80) Private Land Mobile (90)

International Table			United States Table		FCC Rule Part(s)
Region 1	Region 2	Region 3	Federal Government	Non-Federal Government	
5570-5650 MARITIME RADIONAVIGATION MOBILE except aeronautical mobile 5.446A 5.450A RADIOLOCATION 5.450B			5570-5600 MARITIME RADIONAVIGATION US65 RADIOLOCATION G56 US50 G131	5570-5600 MARITIME RADIONAVIGATION US65 RADIOLOCATION US50	RF Devices (15) Maritime (80) Private Land Mobile (90)
			5600-5650 MARITIME RADIONAVIGATION US65 METEOROLOGICAL AIDS RADIOLOCATION G56	5600-5650 MARITIME RADIONAVIGATION US65 METEOROLOGICAL AIDS RADIOLOCATION	
5.450 5.451 5.452			5.452 US50 G131	5.452 US50	
5650-5725 RADIOLOCATION MOBILE except aeronautical mobile 5.446A 5.450A Amateur Space research (deep space) 5.282 5.451 5.453 5.454 5.455			5650-5925 RADIOLOCATION G2	5650-5830 Amateur	RF Devices (15) ISM Equipment (18) Amateur (97)
5725-5830 FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur 5.150 5.451 5.453 5.455 5.456	5725-5830 RADIOLOCATION Amateur 5.150 5.453 5.455			5.150 5.282	
5830-5850 FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.451 5.453 5.455 5.456	5830-5850 RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.453 5.455			5830-5850 Amateur Amateur-satellite (space-to-Earth) 5.150	ISM Equipment (18) Amateur (97)
5850-5925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.150	5850-5925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Amateur Radiolocation 5.150	5850-5925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Radiolocation 5.150	5.150 US245	5850-5925 FIXED-SATELLITE (Earth-to-space) US245 MOBILE NG160 Amateur 5.150	ISM Equipment (18) Private Land Mobile (90) Amateur (97)
5925-6700 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE			5925-6425	5925-6425 FIXED NG41 FIXED-SATELLITE (Earth-to-space)	International Fixed (23) Satellite Commun. (25) Fixed Microwave (101)

	6425-6525 5.440 5.458	6425-6525 FIXED-SATELLITE (Earth-to-space) MOBILE 5.440 5.458	Auxiliary Broadcasting (74) Cable TV Relay (78) Fixed Microwave (101)
5.149 5.440 5.458	6525-6700 5.458 US342	6525-6700 FIXED FIXED-SATELLITE (Earth-to-space) 5.458 US342	Satellite Communications (25) Fixed Microwave (101)
6700-7075 FIXED FIXED-SATELLITE (Earth-to-space) (space-to-Earth) 5.441 MOBILE	6700-7125	6700-6875 FIXED FIXED-SATELLITE (Earth-to-space) (space-to-Earth) 5.441 5.458 5.458A 5.458B	
		6875-7025 FIXED NG118 FIXED-SATELLITE (Earth-to-space) (space-to-Earth) 5.441 MOBILE NG171 5.458 5.458A 5.458B	Satellite Communications (25) Auxiliary Broadcasting (74) Cable TV Relay (78)
5.458 5.458A 5.458B 5.458C		7025-7075 FIXED NG118 FIXED-SATELLITE (Earth-to-space) NG172 MOBILE NG171 5.458 5.458A 5.458B	
7075-7250 FIXED MOBILE		7075-7125 FIXED NG118 MOBILE NG171 5.458	Auxiliary Broadcasting (74) Cable TV Relay (78)
	7125-7190 FIXED 5.458 US252 G116	7125-7190 5.458 US252	
	7190-7235 FIXED SPACE RESEARCH (Earth-to-space) 5.458	7190-7250	
5.458 5.459 5.460	7235-7250 FIXED 5.458	 5.458	

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INTERNATIONAL FOOTNOTES

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5.446A The use of the bands 5150-5350 MHz and 5470-5725 MHz by the stations in the mobile service shall be in accordance with Resolution 229 (WRC-03).

5.446B In the band 5150-5250 MHz, stations in the mobile service shall not claim protection from earth stations in the fixed-satellite service. No. 5.43A does not apply to the mobile service with respect to fixed-satellite service earth stations.

5.447 Additional allocation: in Israel, Lebanon, Pakistan, the Syrian Arab Republic and Tunisia, the band 5150-5250 MHz is also allocated to the mobile service, on a primary basis, subject to agreement obtained under No. 9.21. In this case, the provisions of Resolution 229 (WRC-03) do not apply.

* * * * *

5.447E Additional allocation: The band 5250-5350 MHz is also allocated to the fixed service on a primary basis in the following countries in Region 3: Australia, Korea (Rep. of), India, Indonesia, Iran (Islamic Republic of), Japan, Malaysia, Papua New Guinea, Philippines, Sri Lanka, Thailand and Viet Nam. The use of this band by the fixed service is intended for the implementation of fixed wireless access (FWA) systems and shall comply with Recommendation ITU-R F.1613. In addition, the fixed service shall not claim protection from the radiodetermination, Earth exploration-satellite (active) and space research (active) services, but the provisions of No. 5.43A do not apply to the fixed service with respect to the Earth exploration-satellite (active) and space research (active) services. After implementation of FWA systems in the fixed service with protection for the existing radiodetermination systems, no more stringent constraints should be imposed on the FWA systems by future radiodetermination implementations.

5.447F In the band 5250-5350 MHz, stations in the mobile service shall not claim protection from the radiolocation service, the Earth exploration-satellite service (active) and the space research service (active). These services shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendations ITU-R M.1638 and ITU-R SA.1632.

5.448 Additional allocation: in Azerbaijan, Libyan Arab Jamahiriya, Mongolia, Kyrgyzstan, Slovakia, Romania and Turkmenistan, the band 5250-5350 MHz is also allocated to the radionavigation service on a primary basis.

5.448A The Earth exploration-satellite (active) and space research (active) services in the frequency band 5250-5350 MHz shall not claim protection from the radiolocation service. No. 5.43A does not apply.

5.448B The Earth exploration-satellite service (active) operating in the band 5350-5570 MHz and space research service (active) operating in the band 5460-5570 MHz shall not cause harmful interference to the aeronautical radionavigation service in the band 5350-5460 MHz, the radionavigation service in the band 5460-5470 MHz and the maritime radionavigation service in the band 5470-5570 MHz.

5.448C The space research service (active) operating in the band 5350-5460 MHz shall not cause harmful interference to nor claim protection from other services to which this band is allocated.

5.448D In the frequency band 5350-5470 MHz, stations in the radiolocation service shall not cause harmful interference to, nor claim protection from, radar systems in the aeronautical radionavigation service operating in accordance with No. 5.449.

* * * * *

5.450 Additional allocation: in Austria, Azerbaijan, Iran (Islamic Republic of), Mongolia, Kyrgyzstan, Romania, Turkmenistan and Ukraine, the band 5470-5650 MHz is also allocated to the aeronautical radionavigation service on a primary basis.

5.450A In the band 5470-5725 MHz, stations in the mobile service shall not claim protection from radiodetermination services. Radiodetermination services shall not impose on the mobile service more stringent protection criteria, based on system characteristics and interference criteria, than those stated in Recommendation ITU-R M.1638.

5.450B In the frequency band 5470-5650 MHz, stations in the radiolocation service, except ground-based radars used for meteorological purposes in the band 5600-5650 MHz, shall not cause harmful interference to, nor claim protection from, radar systems in the maritime radionavigation service.

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5.453 Additional allocation: in Saudi Arabia, Bahrain, Bangladesh, Brunei Darussalam, Cameroon, China, Congo, Côte d'Ivoire, Korea (Rep. of), Egypt, the United Arab Emirates, Gabon, Guinea, Equatorial Guinea, India, Indonesia, Iran (Islamic Republic of), Iraq, Israel, Japan, Jordan, Kenya, Kuwait, Lebanon, the Libyan Arab Jamahiriya, Madagascar, Malaysia, Nigeria, Oman, Pakistan, the Philippines, Qatar, the Syrian Arab Republic, the Dem. People's Rep. of Korea, Singapore, Sri Lanka, Swaziland, Tanzania, Chad, Thailand, Togo, Viet Nam and Yemen, the band 5650-5850 MHz is also allocated to the fixed and mobile services on a primary basis. In this case, the provisions of Resolution 229 (WRC-03) do not apply.

5.454 Different category of service: in Azerbaijan, Georgia, Mongolia, Uzbekistan, Kyrgyzstan, the Russian Federation, Tajikistan and Turkmenistan, the allocation of the band 5670-5725 MHz to the space research service is on a primary basis (*see* No. 5.33).

5.455 Additional allocation: in Armenia, Azerbaijan, Belarus, Cuba, Georgia, Hungary, Kazakhstan, Latvia, Moldova, Mongolia, Uzbekistan, Kyrgyzstan, the Russian Federation, Tajikistan, Turkmenistan and Ukraine, the band 5670-5850 MHz is also allocated to the fixed service on a primary basis.

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UNITED STATES (US) FOOTNOTES

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US50 In the band 5470-5650 MHz, the radiolocation service may be authorized for non-Federal Government use on the condition that harmful interference is not caused to the maritime radionavigation service or to the Federal Government radiolocation service.

US51 In the band 9300-9500 MHz, the radiolocation service may be authorized for non-Federal Government use on the condition that harmful interference is not caused to the Federal Government radiolocation service.

US390 Federal Government stations in the space research service (active) operating in the band 5350-5460 MHz shall not cause harmful interference to, nor claim protection from, Federal and non-Federal Government stations in the aeronautical radionavigation service nor Federal Government stations in the radiolocation service.

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GOVERNMENT (G) FOOTNOTES

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G130 Federal Government stations in the radiolocation service operating in the band 5350-5470 MHz, shall not cause harmful interference to, nor claim protection from, Federal stations in the aeronautical radionavigation service operating in accordance with ITU Radio Regulation No. 5.449.

G131 Federal Government stations in the radiolocation service operating in the band 5470-5650 MHz, with the exception of ground-based radars used for meteorological purposes operating in the band 5600-5650 MHz, shall nor cause harmful interference to, nor claim protection from, Federal Government stations in the maritime radionavigation service.

* * * * *

PART 15 – RADIO FREQUENCY DEVICES

3. The authority citation for part 15 continues to read as follows:

AUTHORITY: 47 U.S.C. 154, 302, 303, 304, 307 and 544A.

4. Section 15.37 is amended by adding paragraph (l), to read as follows:

§15.37 Transition provisions for compliance with the rules.

*****

(l) U-NII equipment operating in the 5.25-5.35 GHz band for which applications for certification are filed on or after [**1 year after publication of R&O in ET Docket No. 03-122 in the Federal Register**] shall comply with the DFS and TPC requirements specified in Section 15.407 of this part. U-NII equipment operating in the 5.25-5.35 GHz band that are imported or marketed [**2 years after publication of R&O in ET Docket No. 03-122 in the Federal Register**] shall comply with the DFS and TPC requirements in Section 15.407 of this part.

*****

5. Section 15.401 is amended as follows:

§15.401 Scope.

This subpart sets out the regulations for unlicensed National Information Infrastructure (U-NII) devices operating in the 5.15 - 5.35 GHz, 5.47 - 5.725 GHz and 5.725 - 5.825 GHz bands.

*****

6. Section 15.403 is revised to read as follows:

§15.403 Definitions.

(a) Access Point (AP). A U-NII transceiver that operates either as a bridge in a peer-to-peer connection or as a connector between the wired and wireless segments of the network.

(b) Available Channel. A radio channel on which a *Channel Availability Check* has not identified the presence of a radar.

(c) Average Symbol Envelope Power. The average symbol envelope power is the average, taken over all symbols in the signaling alphabet, of the envelope power for each symbol.

(d) Channel Availability Check. A check during which the U-NII device listens on a particular radio channel to identify whether there is a radar operating on that radio channel.

(e) Channel Move Time. The time needed by a U-NII device to cease all transmissions on the current channel upon detection of a radar signal above the DFS detection threshold.

(f) Digital modulation. The process by which the characteristics of a carrier wave are varied among a set of predetermined discrete values in accordance with a digital modulating function as specified in document ANSI C63.17-1998.

(g) Dynamic Frequency Selection (DFS) is a mechanism that dynamically detects signals from other systems and avoids co-channel operation with these systems, notably radar systems.

(h) DFS Detection Threshold. The required detection level defined by detecting a received signal strength (RSS) that is greater than a threshold specified, within the U-NII device channel bandwidth.

(i) Emission bandwidth. For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

(j) In-Service Monitoring. A mechanism to check a channel in use by the U-NII device for the presence of a radar.

(k) Non-Occupancy Period. The required period in which, once a channel has been recognized as containing a radar signal by a U-NII device, the channel will not be selected as an available channel.

(l) Operating Channel. Once a U-NII device starts to operate on an *Available Channel* then that channel becomes the *Operating Channel*.

(m) Peak Power Spectral Density. The peak power spectral density is the maximum power spectral density, within the specified measurement bandwidth, within the U-NII device operating band.

(n) Peak Transmit Power. The maximum transmit power as measured over an interval of time of at most 30/B (where B is the 26 dB emission bandwidth of the signal in hertz) or the transmission pulse duration of the device, whichever is less, under all conditions of modulation. The peak transmit power may be averaged across symbols over an interval of time equal to the transmission pulse duration of the device or over successive pulses. The averaging must include only time intervals during which the transmitter is operating at its maximum power and must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level

(o) Power Spectral Density. The power spectral density is the total energy output per unit bandwidth from a pulse or sequence of pulses for which the transmit power is at its peak or maximum level, divided by the total duration of the pulses. This total time does not include the time between pulses during which the transmit power is off or below its maximum level.

(p) Pulse. A pulse is a continuous transmission of a sequence of modulation symbols, during which the average symbol envelope power is constant.

(q) RLAN. Radio Local Area Network.

(r) Transmit Power. The total energy transmitted over a time interval of at most 30/B (where B is the 26 dB emission bandwidth of the signal in hertz) or the duration of the transmission pulse, whichever is less, divided by the interval duration.

(s) Transmit Power Control (TPC). A feature that enables a U-NII device to dynamically switch between several transmission power levels in the data transmission process.

(t) U-NII devices. Intentional radiators operating in the frequency bands 5.15 - 5.35 GHz and 5.470 - 5.825 GHz that use wideband digital modulation techniques and provide a wide array of high data rate mobile and fixed communications for individuals, businesses, and institutions.

7. Section 15.407 is amended by revising paragraphs (a)(2), by redesignating paragraphs (b)(3)-(7) as paragraphs (b)(4)-(8), by adding a new paragraph (b)(3), and by adding paragraph (h) to read as follows:

§15.407 General Technical Requirements.

(a) Power limits:

*****

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the peak transmit power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

*****

(b) Undesirable Emission Limits:

*****

(3) For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of -27 dBm/MHz**.**

*****

(h) Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS).

(1) Transmit power control (TPC). U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

(2) Radar Detection Function of Dynamic Frequency Selection (DFS). U-NII devices operating in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W is -64 dBm. For devices that operate with less than 200 mW e.i.r.p. the minimum detection threshold is -62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna. The DFS process shall be required to provide a uniform spreading of the loading over all the available channels.

(i) Operational Modes. The DFS requirement applies to the following operational modes:

(A) The requirement for channel availability check time applies in the master operational mode.

(B) The requirement for channel move time applies in both the master and slave operational modes.

(ii) Channel Availability Check Time. A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed above is detected within 60 seconds.

(iii) Channel Move Time. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(iv) Non-occupancy Period. A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

APPENDIX C

INTERIM MEASUREMENT PROCEDURES FOR DFS-EQUIPPED U-NII DEVICES

I. INTRODUCTION

The purpose of this appendix is to define procedures for testing of the radar detection capability referred to as Dynamic Frequency Selection (DFS) of unlicensed U-NII equipment operating in the frequency bands 5250 MHz to 5350 MHz and 5470 MHz to 5725 MHz. These procedures will be used to test the efficacy of DFS as an interference mitigation mechanism as formulated by the International Telecommunication Union-Radiocommunications Sector (ITU-R) and documented in Recommendation ITU-R M.1652 and called for in the U-NII Notice of Proposed Rulemaking (*Notice*).[1] A major source for the content of this document is the European Telecommunication Standards Institute (ETSI) draft EN 301 893 version 1.2.2, which is the approved final European conformance standard for 5 GHz operation. Using ETSI EN-301-893 and its associated reference documents as baseline for developing this test plan does not infer that the United States confers with all of the standards, practices, procedures, and tolerances set within them.

II. SCOPE

The scope of this document includes an overview of DFS operational requirements, the detection and response criteria and methods of measuring compliance with these criteria. The methods include calibration and test procedures for conducted and radiated measurements. Conducted measurements are preferred over radiated measurements because they are more precise and contain less measurement errors. Equipment with an integral antenna may be equipped with a temporary antenna connector in order to facilitate the conducted tests. When the antenna can not be separated from the device and a radio frequency (RF) test port is not provided, radiated measurements may be performed.

General information about test sites and measurement techniques are assumed to be known and not covered here.

Procedures for equipment submission; certification and other regulatory aspects are not covered in this document.

III. REFERENCES

[1] Draft New Recommendation ITU-R M.1652

[1] *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*, Notice of Proposed Rulemaking, ET Docket No. 03-122, (released June 4, 2003) (U-NII *Notice*).

[2] Draft EN 301 893 ETSI (RLAN Radio Conformance Test standard)

IV. DEFINITIONS, SYMBOLS AND ABBREVIATIONS

Definitions

For the purposes of the present document, following terms and definitions apply.

5 GHz U-NII bands: Frequency ranges: 5150-5250 MHz, 5250-5350 MHz, 5470-5725 MHz and 5725-5825 MHz.

Association: an active relationship between two wireless devices in which one device (referred to as "Master device" in this document) exercises certain control functions to which the other device (referred to as "Client device" in this document) has to respond.

Burst: a period during which radio waves are intentionally transmitted, preceded and succeeded by periods during which no intentional transmission is made.

Channel: amount of spectrum used by a single unlicensed U-NII device operating on one of the specified carrier frequencies

Channel Availability Check Time: the time during which a channel shall be checked for the presence of a radar signal with a level above the Interference Detection Threshold. No transmissions shall occur during this time.

Channel Closing Transmission Time: the aggregate duration of transmissions of control information by unlicensed U-NII devices during the Channel Move Time which starts upon detection of an interfering signal above the Interference Detection Threshold. The aggregate duration of all transmissions shall not count quiet periods in between transmissions.

Channel Move Time: the time taken by an unlicensed U-NII device to cease all transmissions on the current channel upon detection of an interfering signal above the Interference Detection Threshold.

Client Device: an unlicensed U-NII device operating in Client mode.

Client mode: operating mode in which the transmissions of the unlicensed U-NII device are under control of the Master. An unlicensed U-NII device in Client mode is not able to initiate a network.

In-Service Monitoring: a mechanism to check a channel in use by the unlicensed U-NII device for the presence of a radar signal with a level above the Interference Detection Threshold.

Interference Detection Threshold is the level to be used by the DFS function to detect radar interference.

Master Device: an unlicensed U-NII device operating in Master mode.

Master mode: operating mode in which the unlicensed U-NII device has the capability to transmit without receiving an enabling signal. In this mode it is able to select a channel and initiate a network by sending enabling signals to other unlicensed U-NII devices. An unlicensed U-NII network always has at least one unlicensed device operating in Master mode.

Simulated Radar burst: a series of periodic radio wave pulses, separated by a period during which no pulses are transmitted.

Symbols

For the purposes of the present document, the following symbols apply:

A	Measured power output (dBm)
B	Radar burst period
Ch_f	Channel free from radars
Ch_r	Channel occupied by a radar
D	Measured power density
E	Field strength
E_o	Reference field strength
f_c	Carrier frequency
G	Antenna gain (dBi)
L	Radar burst length
n	Number of channels
P_H	Calculated EIRP at highest power level
P_L	Calculated EIRP at lowest power level
PD	Calculated power density
R	Distance
R_o	Reference distance
S0	Signal power
T0	Time instant
T1	Time instant
T2	Time instant
T3	Time instant
W	Radar pulse width
x	Observed duty cycle

Abbreviations

For the purposes of the present document, the following abbreviations apply:

DFS	Dynamic Frequency Selection
EMC	Electro-Magnetic Compatibility
EIRP	Equivalent Isotropic Radiated Power
LV	Low Voltage
PRF	Pulse Repetition Frequency
RE	Radio Equipment
UUT	Unit Under Test

V. TECHNICAL REQUIREMENTS FOR DFS

DFS Overview

An unlicensed U-NII network shall employ a DFS function to:

- detect interference from other systems and to avoid co-channel operation with these systems, notably radar systems.
- provide on aggregate a uniform loading of the spectrum across all devices by selecting at startup, at random, on one of the channels that the unlicensed device is capable of operating.

The DFS function as described in the present document is not tested for its ability to detect frequency agile radars. Within the context of the operation of the DFS function, an unlicensed U-NII device shall operate in either Master mode or Client mode. Unlicensed devices operating in Client mode (Client device) can only operate in a network controlled by a unlicensed U-NII device operating in Master mode (Master device).

The operational behavior and individual DFS requirements that are associated with these modes are as follows:

Master Devices

a) The Master device shall use a Radar Interference Detection function in order to detect radar signals with a level above the *Interference Detection Threshold* in the frequency ranges 5250 – 5350 MHz and 5470 – 5725 MHz. Radar detection is not required in the frequency range 5150 – 5250 MHz or 5725 – 5825 MHz.

b) The Master device initiates an unlicensed U-NII network by transmitting control signals that will enable other unlicensed U-NII devices to Associate (participate in a wireless network) with the Master device.

c) Before initiating a network on a Channel, the master shall perform a C*hannel Availability Check* for a certain duration (*Channel Availability Check Time*) to ensure that there is no radar operating on the Channel, using the Radar Interference Detection function described under a).

d) During normal operation, the Master shall monitor the operating channel *(In-Service Monitoring)* to ensure that there is no radar operating on the channel, using the Radar Interference Detection function described under a).

e) If the Master device has detected a radar signal, during In-Service Monitoring as described under d), the operating Channel of the unlicensed U-NII network is made unavailable. The Master shall instruct all associated devices to stop transmitting on this Channel, which they shall do within the *Channel Move Time*. The Aggregate Transmissions during the *Channel Move Time* should be limited to the *Channel Closing Transmission Time*.

f) A Master device shall not attempt to initiate a network on a Channel in the frequency range 5600-5650 MHz during a period defined as the *Non-Occupancy Period* after a radar has been detected in that Channel, regardless of the outcome of any In-Service

Monitoring or Channel Availability Check procedures. The *Non-Occupancy Period* commences at the time the radar was detected in the Channel.

Client devices

a) An unlicensed U-NII Client device shall not transmit before having received an appropriate enabling signal from a Master device.

b) An unlicensed U-NII Client device shall stop all its transmissions whenever instructed by a Master device to which it is associated. The device shall not resume any transmissions until it has again received enabling signals from a Master device.

c) An unlicensed U-NII Client device that incorporates a Radar Interference Detection function shall inform the Master device and stop its networks transmission if it detects a radar.

The Master device may implement the Radar Interference Detection function referred to under a) using another device Associated with the Master. In such a case, the combination should be tested against the requirements applicable to the Master.

Applicability

In Tables 1 and 2 shown below, the applicability of DFS requirements prior to use of a channel *(Channel Availability Check)* and during normal operation *(In-Service Monitoring)* for each of the above mentioned operational modes.

The manufacturer shall state whether the UUT is capable of operating as a Master and/or as a Client. If the UUT is capable of operating in more than one operating mode then each operating mode shall be tested separately.

Table 1: Applicability of DFS requirements prior to use of a channel

Requirement	**Operational Mode**		
	Master	**Client (without radar detection)**	**Client (with radar detection)**
Non –occupancy period (required for band 5250-5350 MHz and 5470-5725 MHz)	√	Not required	√
Interference Detection Threshold	√	Not required	√
Channel Availability Check Time	√	Not required	Not required
Uniform Spreading	√	Not required	Not required

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode		
	Master	**Client** (without radar detection)	**Client** (with radar detection)
Interference Detection Threshold	√	Not required	√
Channel Closing Transmission Time	√	√	√
Channel Move Time	√	√	√

Detection Threshold values

The following tables give the DFS thresholds for Master devices and for Client devices.

Table 3A: Interference Threshold values, Master

Maximum Transmit Power	**Value (see note)**
≥ 200 mW	-64 dBm
< 200 mW	-62 dBm
Note: This is the level at the input of the receiver assuming a 0 dBi receive antenna	

Table 3B: Interference Threshold values, Client

Maximum Transmit Power	**Value**
≥ 200 mW	-64 dBm
< 200 mW	-62 dBm
Note: This is the level at the input of the receiver assuming a 0 dBi receive antenna	

Response Requirements

The following table gives the response requirements for DFS implementation.

Table 4: DFS Response requirement values

Parameter	Value
Non-occupancy period	30 minutes
Channel Availability Check Time	60 s
Channel Move Time	10 s
Channel Closing Transmission Time	260 ms

VI. TESTING FOR COMPLIANCE WITH TECHNICAL REQUIREMENTS

Radar Test Signals

The DFS test signals shown in Table 5 shall be used.

Table 5: Parameters of DFS test signals

Radar test signal	Pulse repetition frequency PRF [pps]	Pulse width W [µs]	Burst length L [ms] / No. of pulses (Note 1)	Burst Period B [sec] (Note 2)	Hopping Rate (Note 4)
Fixed Frequency Radar signal 1	700	1	26 / 18	10	Na
Fixed Frequency Radar signal 2	1800	1	5 / 10	2	Na
Frequency Hopping Radar	3000	1	100/300	10	1 kHz

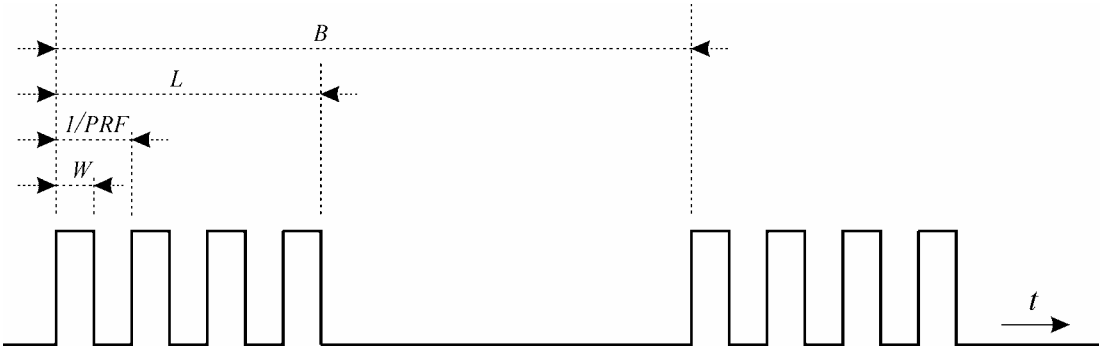
Note 1: This represents the number of pulses seen at the unit under test (UUT) per radar scan N = [{antenna beamwidth (deg)} x {pulse repetition rate (pps)}] / [{scan rate (deg/s)}]

Note 2: Burst period represents the time between successive scans of the radar beam B = 360/{scan rate (deg/s)}

Note 3: Radar bandwidth is less than that of the unlicensed U-NII device.

Note 4: The characteristics of this frequency hopping radar do not correspond to any specific system. It can hop across the 5250-5725 MHz band. The frequencies will be selected by using a random without replacement algorithm until all 475 frequencies have been used. After all have been used, the pattern is reset and a new random set is generated.

Figure 1: General structure of the DFS test transmission sequences



Test Procedures

DFS Testing

Conducted Test conditions

The conformance requirements given in the section on Technical Requirements for DFS shall be verified under normal operating conditions, and in each of the stated frequency range(s), and with each of the applicable radar signals defined in Table 5.

For a UUT with antenna connector(s) and using external antenna(s), or for a UUT with integral antenna(s) but with a temporary antenna connector provided, conducted measurements shall be used. In this case, and if the UUT has a Radar Interference Detection Function, the output power of the signal generator producing the radar test signals shall provide a received signal power at the antenna connector of the UUT with a level equal to (*Interference Detection Threshold* + G), see Tables 3A and 3B. Parameter G [dBi] corresponds to the gain of the antenna assembly stated by the manufacturer. If more than one antenna assembly is intended, the gain of the antenna assembly with the lowest gain shall be used.

For a UUT with integral antenna(s) and without temporary antenna connector, radiated measurements shall be used. In this case, and if the UUT has a Radar Interference Detection Function, the output power of the signal generator shall provide a signal power at the antenna with a level equal to *Interference Detection Threshold.*

Some of the tests may be performed more readily if the channel selection mechanism for the uniform spreading requirement can be disabled, for example, to ensure selection of a channel outside the 5150-5250 MHz and 5725-5825 MHz bands.

It should be noted that once a UUT is powered on, it will not start its normal operating functions immediately, as it will have to finish its power-up cycle first (T_{power_up}). As such, the UUT, as well as any other device used in the set-up, may be equipped with a feature that will indicate its status during the testing, including, for example, power-up mode, normal operation mode, channel check status and radar detection event.

Conducted Test Configurations

The sections below contain simplified block diagrams that focus on the radar signal injection path for each of the different conducted set-ups to be used. The basic set-up is identical for all cases. Full details of this setup, including calibration, can be found in Annex B to this document.

Test of the DFS functions of the Master

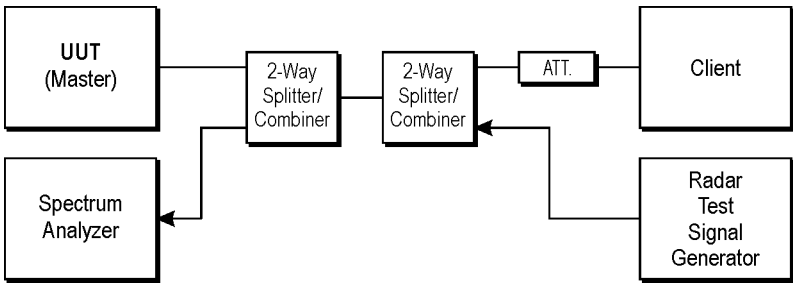
Set-up A: Master with injection at the Master

When the UUT is an unlicensed device operating as a Master, the test set-up, further referred to as *"Set-up A"* shall be used.

"Set-up A" consists of a signal generator connected to the UUT and an unlicensed device operating as a Client. The latter is assumed to associate with the UUT (Master).

Figure 2 shows a block diagram for *'Set-up A.'*

Figure 2: Conducted Set-Up where UUT is a Master and Radar Test Signals are injected into the Master



Test of DFS functions of the Client

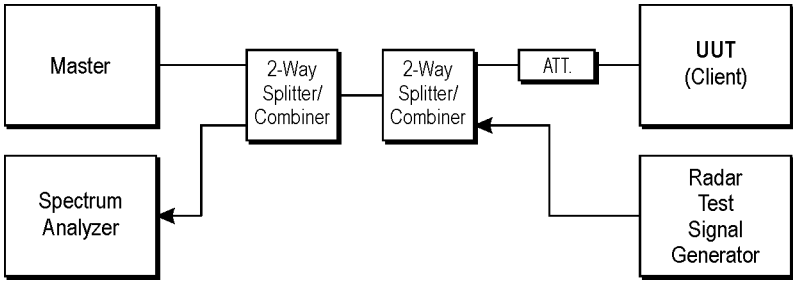
Set-up B: Client with injection at the Master

When the UUT is an unlicensed device operating as a Client, with or without a Radar Interference Detection Function (RIDF), the test set-up, further referred to as "*Set-up B"* shall be used.

"Set-up B" consists of a signal generator connected to an unlicensed device operating as a Master and the UUT. The latter is assumed to associate with the Master.

Figure 3 shows an example for *''Set-up B".* The set-up used shall be documented in the test report.

Figure 3: Conducted Set-Up B where UUT is a Client and Radar Test Signals are injected into the Master

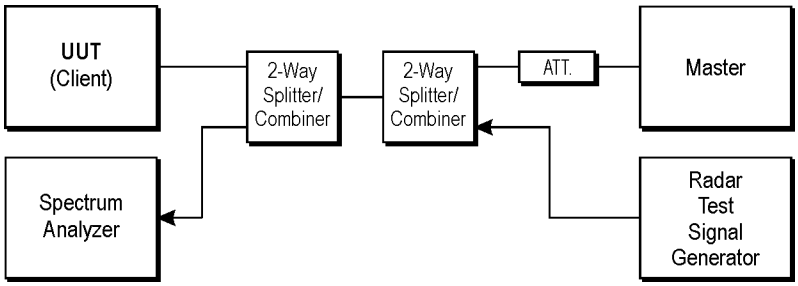


Set-up C: Client with injection at the Client

When the UUT is an unlicensed device operating as a Client with a Radar Interference Detection Function (RIDF), the tests described in the section on Test of DFS Function of the Client need to be repeated using a set-up, further referred to as '*Set-up C.'*

'Set-up C' consists of a signal generator connected to the UUT (Client).
Figure 4 shows an example for *'Set-up C.'*

Figure 4: Conducted Set-Up C where UUT is a Client and Radar Test Signals are injected into the Client



For the purposes of the test, the UUT as well as other unlicensed U-NII devices used in the set-up may be equipped with a specific user interface to allow monitoring of the behavior of the different devices of the set-up during the tests.

The UUT is capable of transmitting a test transmission sequence. The signal generator is capable of generating any of the radar test signals defined in Table 5. Adequate measurement equipment, *e.g.*, spectrum analyzer, shall be used to measure the aggregate transmission time of the UUT.

Radiated Test conditions

The conformance requirements given in the section on Technical Requirements for DFS shall be verified under normal operating conditions, and in each of the stated frequency range(s), and with each of the applicable radar signals defined in Table 5.

For a UUT with integral antenna(s) and without temporary antenna connector, radiated measurements shall be used. In this case, and if the UUT has a Radar Interference Detection Function, the output power of the signal generator shall provide a signal power at the antenna with a level equal to *Interference Detection Threshold* .

Some of the tests may be performed more readily if the channel selection mechanism for the uniform spreading requirement can be disabled, for example, to ensure selection of a channel outside the 5150-5250 MHz and 5725-5825 MHz bands. It should be noted that once a UUT is powered on, it will not start its normal operating functions immediately, as it will have to finish its power-up cycle first (T_{power_up}). As such, the UUT, as well as any other device used in the set-up, may be equipped with a feature that will indicate its status during the testing, including, for example, power-up mode, normal operation mode, channel check status and radar detection event.

Radiated Test Configurations

The sections below contain simplified block diagrams that focus on the radar signal injection path for each of the different radiated set-ups to be used. The basic set-up is identical for all cases. Full details of this setup, including calibration, can be found in Annex C to this document.

Test of the DFS functions of the Master

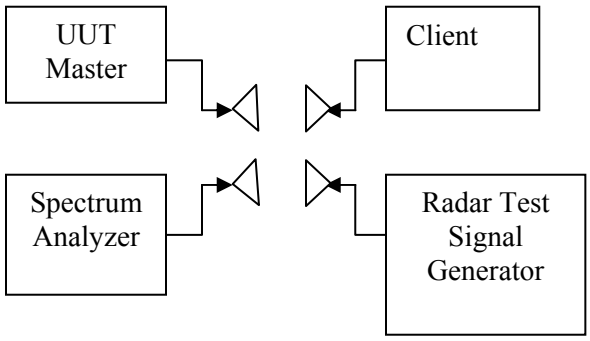
Set-up A: Master with injection at the Master

When the UUT is an unlicensed U-NII device operating as a Master, the test set-up, further referred to as *'Set-up A'* shall be used.

'Set-up A' consists of a signal generator connected to the UUT and an unlicensed U-NII device operating as a Client. The latter is assumed to be associated with the UUT (Master).

Figure 5 shows a block diagram for *'Set-up A.'*

Figure 5: Radiated Set-Up where UUT is a Master and Radar Test Signals are injected into the Master



Test of DFS functions of the Client

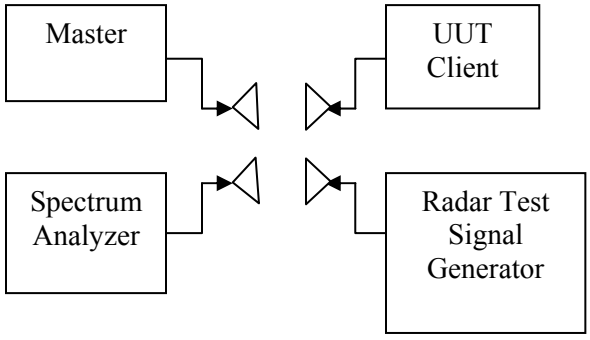
Set-up B: Client with injection at the Master

When the UUT is an unlicensed U-NII device operating as a Client, with or without a RIDF, the test set-up, further referred to as '*Set-up B'* shall be used.

'Set-up B' consists of a signal generator connected to an unlicensed U-NII device operating as a Master and the UUT. The latter is assumed to be associated with the Master.

Figure 6 shows an example for *'Set-up B.'* The set-up used shall be documented in the test report.

Figure 6: Radiated Set-Up B where UUT is a Client and Radar Test Signals are injected into the Master

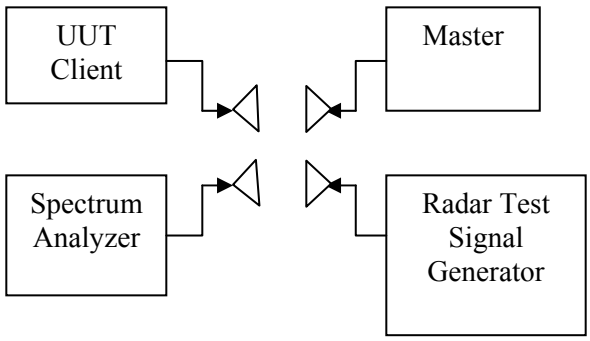


Set-up C: Client with injection at the Client

When the UUT is an unlicensed U-NII device operating as a Client with a RIDF, the tests described in Test of DFS Functions as the Client need to be repeated using a set-up, further referred to as '*Set-up C.'*

'Set-up C' consists of a signal generator connected to the UUT (Client).
Figure 7 shows an example for *'Set-up C.'*

Figure 7: Radiated Set-Up C - where UUT is a Client and Radar Test Signals are injected into the Client



For the purposes of the test, the UUT as well as other unlicensed U-NII devices used in the set-up may be equipped with a specific user interface to allow monitoring of the behavior of the different devices of the set-up during the tests.

The UUT is capable of transmitting a test transmission sequence. The signal generator is capable of generating any of the radar test signals defined in Table 5.

Adequate measurement equipment, *e.g.*, spectrum analyzer, shall be used to measure the aggregate transmission time of the UUT.

Radar Signal Generation and Calibration

Detailed set-up and instructions for calibration are given in Annexes B and C.

Unlicensed U-NII device initialization

This section describes the verification procedure for the Channel Availability Check to be performed at initialization of an unlicensed U-NII device. See section on DFS overview.

One channel, outside the 5150-5250 MHz and 5725-5825 MHz range, is selected from the stated operating frequency range(s) of the UUT. This channel is designated as Ch_r (channel occupied by a radar).

The UUT shall be configured to select Ch_r as the first operating channel.
$T_{ch\_avail\_check}$ is the minimum Channel Availability Check Time as specified in Table 4.

The different steps below define the procedure to verify the response behavior parameters when a radar burst is generated on the selected channel at the beginning or at the end of the Channel Availability Check Time.

Radar burst at the beginning of the Channel Availability Check Time

The steps below define the procedure to verify successful radar detection on the selected channel during a period equal to the *Channel Availability Check Time* and avoidance of operation on that channel when a radar burst with a level equal to the *Interference Detection Threshold* occurs at the beginning of the Channel Availability Check Time.

a) The signal generator and UUT are connected using the applicable test set-ups described in section on Conducted Tests and the power of the UUT is switched off.

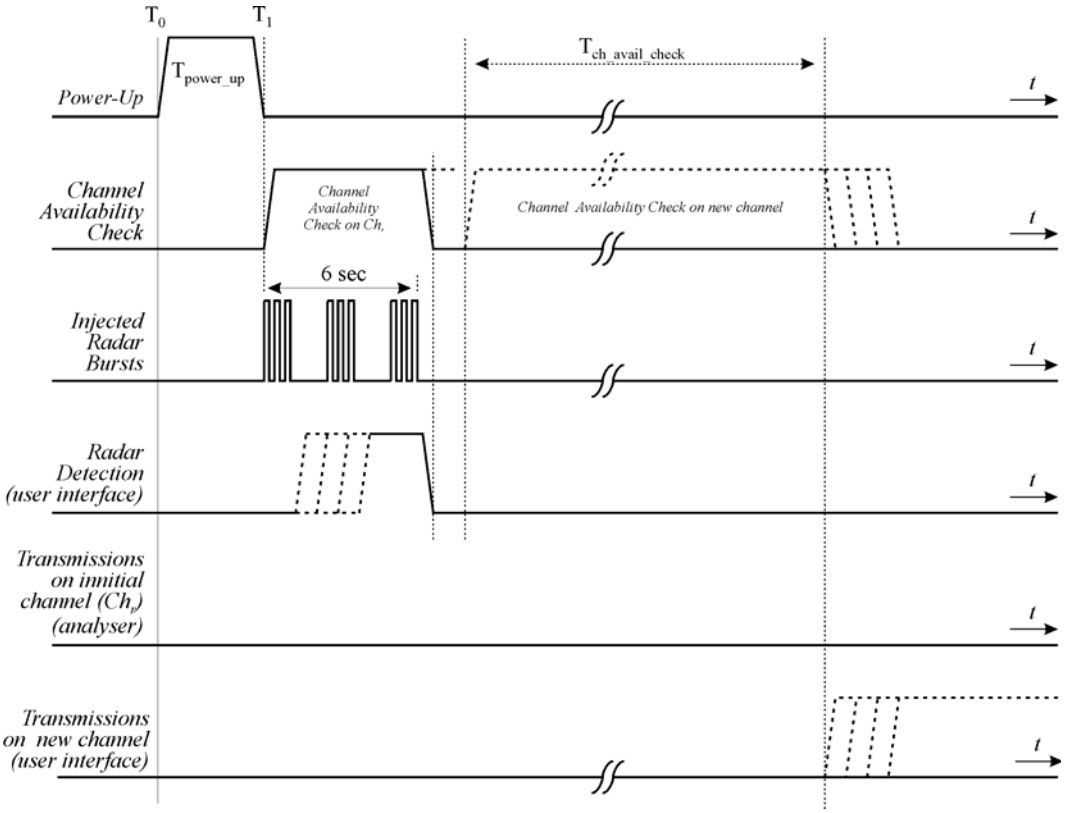
b) The UUT is powered on at T0. T1 denotes the instant when the UUT has completed its power-up sequence (T_{power_up}). The channel availability check is expected to commence on Ch_r at instant T1 and is expected to end no sooner than T1 + $T_{ch\_avail\_check}$ unless a radar is detected sooner.

c) Radar bursts are generated on Ch_r using one of the test patterns defined in Table 5. Radar bursts should commence at time T1 and should continue for approximately 6 seconds.

d) Visual indication on the UUT of successful detection of the radar burst (if indication is available) should be recorded. Observation of Ch_r shall continue until the UUT starts transmitting on another channel. *(In the example given below, the UUT performs a channel availability check on a new channel after it has detected a radar on Ch_r).* It shall be verified and recorded that during the above steps no transmissions occurred on Ch_r.

e) A timing trace or description of the observed timing and behavior of the UUT should be reported.

Figure 8: Example of timing for radar testing at the beginning of the Channel Availability Check Time



Radar burst at the end of the Channel Availability Check Time

The steps below define the procedure to verify successful radar detection on the selected channel during a period equal to the *Channel Availability Check Time* and avoidance of operation on that channel when a radar burst with a level equal to the *Interference Detection Threshold* occurs at the end of the Channel Availability Check Time.

a) The signal generator and UUT are connected using the applicable test set-ups referred to in section on Conducted Test Configurations and the power of the UUT is switched off.

b) The UUT is powered up at T0. T1 denotes the instant when the UUT has completed its power-up sequence (T_{power_up}). The channel availability check is expected to commence on Ch_r at instant T1 and is expected to end no sooner than T1 + $T_{ch\_avail\_check}$ unless a radar is detected sooner.

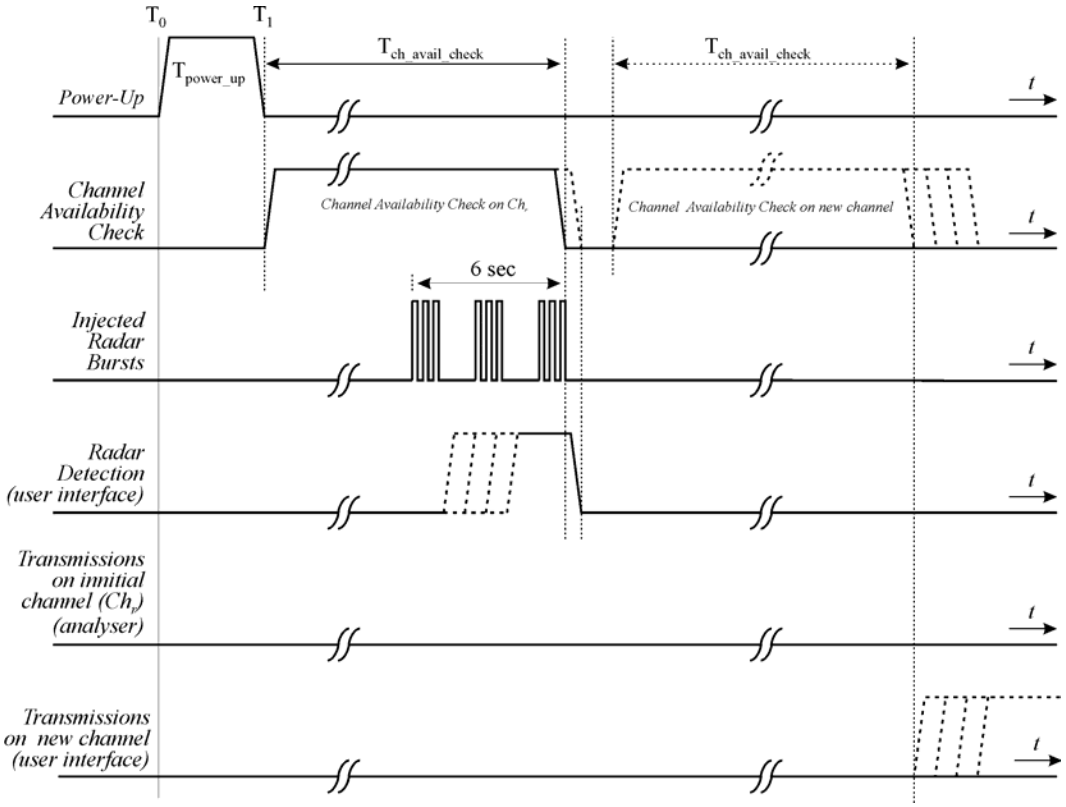
c) Radar bursts are generated on Ch_r using one of the test patterns defined in section 5.1 at a level defined in the DFS Overview section. Radar bursts should commence near the end of the minimum required Channel Availability Check Time at time T1 + $T_{ch\_avail\_check}$ − 6 [sec] and should continue for the duration of this test.

d) Visual indication on the UUT of successful detection of the radar burst (if indication is available) should be recorded. Observation of Ch_r shall continue until the UUT

starts transmitting on another channel. *(In the example given below, the UUT performs a channel availability check on a new channel after it has detected a radar on Ch_r).* It shall be verified and recorded that during the above steps no transmissions occurred on Ch_r.

e) A timing trace or description of the observed timing and behavior of the UUT should be recorded.

Figure 9: Example of timing for radar testing towards the end of the Channel Availability Check Time



In-Service Monitoring

These tests define how the following DFS parameters can be verified during In-Service Monitoring

- Interference Detection Threshold
- Channel Closing Transmission Time
- Channel Move Time
- Non-Occupancy Period

The steps below define the procedure to determine the above mentioned parameters when a radar burst with a level equal to the *Interference Detection Threshold* is generated on the channel of operation of the unlicensed U-NII device *(In- Service Monitoring).*

a) A channel outside 5150-5250 MHz and 5725-5825 MHz bands is selected from the stated operating frequency range(s).

b) In case the UUT is an unlicensed U-NII device operating as a Client (with or without Radar Interference Detection Function), an unlicensed U-NII device operating as a Master will be used to allow the UUT to associate with the Master. In case the UUT is a Master, an unlicensed U-NII device operating as a Client will be used and it is assumed that the Client will associate with the UUT (Master). In both cases, the signal generator shall be connected to the Master.

c) The UUT transmits a test transmission sequence on the selected channel.

d) At a certain time T0 the signal generator starts generating one of the radar test patterns defined in Table 5 at a level defined in the section on Response Requirements on the selected channel. T1 denotes the end of the first radar burst.

e) The transmissions of the UUT following instant T1 on the selected channel shall be observed for a duration of at least 10 seconds. The aggregate duration of all transmissions from the UUT during the observation time (*Channel Closing Transmission Time)* shall be noted and compared to the limit defined in Table 4.

Note: the aggregate duration of all transmissions of the UUT does not include quiet periods in between transmissions of the UUT.

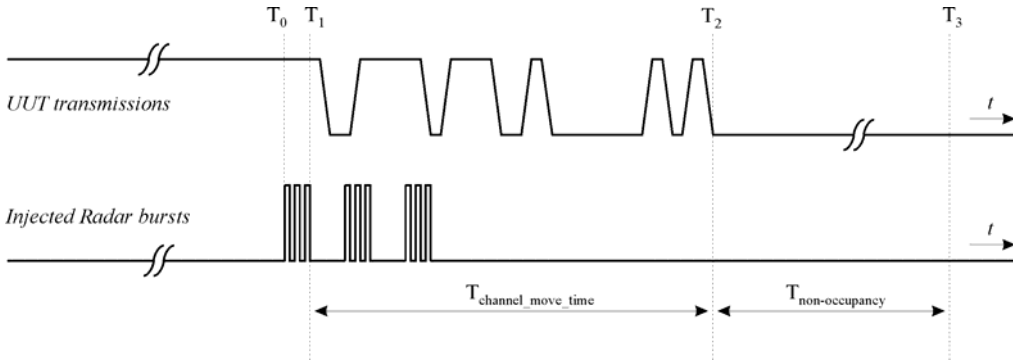
f) T2 denotes the instant when the UUT has ceased all transmissions on the channel. The time difference between T1 and T2 shall be measured. This value *(Channel Move Time*) shall be noted and compared with the limit defined in Table 4.

g) When the UUT is an unlicensed U-NII device operating as a Master, following instant T2, the selected channel shall be monitored for an additional 30 minutes (*Non-Occupancy Period*) until instant T3, to verify that the UUT does not resume any transmissions on this channel.

h) The test shall be repeated using each of the radar signals defined in the section on Testing for Compliance with Technical Requirements;

i) In case the UUT is an unlicensed U-NII device operating as a Client with a Radar Interference Detection Function, the steps a) to h) shall be repeated with the generator connected to the UUT.

Figure 10: Channel Closing Transmission Time & Channel Clearing Time



Annex A

General Requirements

Product information

The following information shall be stated by the manufacturer in order to facilitate the execution of the test suites:

a) the operating frequency range(s) of the equipment;

b) the operating modes (Master and/or Client)

c) the highest and the lowest possible power level (equivalent isotropically radiated power (EIRP)) of the equipment;

d) the intended antenna assemblies and their corresponding gains;

e) the test sequences or messages used for communication between Master and Client devices.

Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in the present document shall be as follows:

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in Table A.1;
- the shared risk approach shall be applied for the interpreting of all measurement results.

Table A.1: Maximum measurement uncertainty

Parameter	Uncertainty
RF frequency	$\pm 1 \times 10^{-5}$
RF power conducted	±1.5 dB
RF power radiated	±2 dB
Spurious emissions, conducted	±3 dB
Spurious emissions, radiated	±2 dB
Time	±5 %

Channel Loading

The data test file that is used for transmissions to/from the master and the client should be constructed so that the data packets are representative of the weighting factors shown in Table A2 for packet size and data rate (Annex 4 Table 4 of Recommendation ITU-R M. 1652).

Table A2
Weighting of data test file

Packet size (bytes)	Weight
64	0.6
538	0.2
1 500	0.2

Data rate (Mbit/s)	Weight
6	0.1
12	0.1
18	0.1
24	0.3
36	0.3
54	0.1

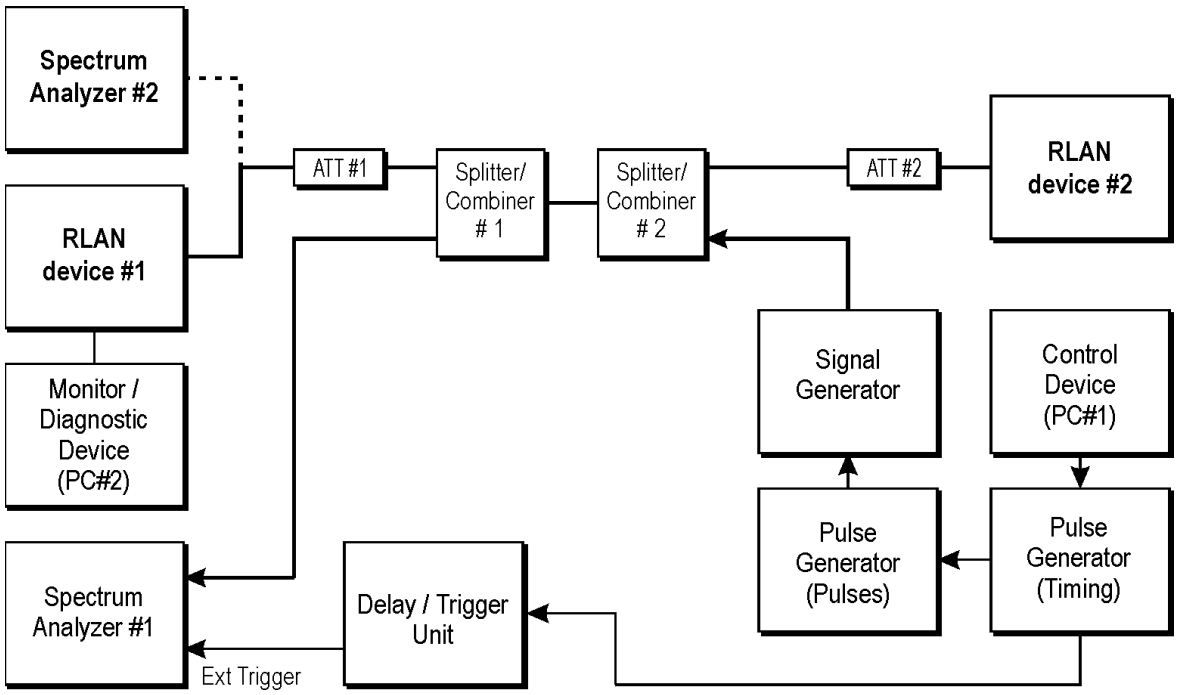
Annex B

Conducted Test Set-up and Calibration

Block Diagram

Conducted measurements are the preferred method to perform these tests. In this method, cables are used to supply the unlicensed U-NII device signals to/from the devices under test and the test equipment. Equipment with an integral antenna may be equipped with a temporary antenna connector in order to facilitate the conducted tests. Figure B1 shows a detailed set-up for performing conducted measurements.

Figure B1: Conducted DFS Measurements - Test Set-Up



It is important to note that the Signal Generator used should have the 'Short Pulse' option to guarantee that the Automatic Level Control circuitry can also deal with short pulses (this will be verified during the calibration part.). It might be possible that the function of the Delay/Trigger unit is part of the features of Spectrum Analyzer #1.

The value of the attenuator #1 and attenuator #2 are chosen in such a way that the received unlicensed U-NII signal (unlicensed U-NII device #2) at the input of the UUT (unlicensed U-NII device #1) is minimum about 20 dB above the threshold level to be tested (the received unlicensed U-NII device signal should be much stronger than the radar test signals).

The duty cycle of the unlicensed U-NII device transmissions should be sufficiently high. Also the duration of the unlicensed U-NII device transmissions should be sufficiently high to allow the measurements to be repeated a number of times (*e.g.*, 10 times). In order to allow some of the tests to be repeated on the same channel, it may be required for the diagnostic software to disable the 'move to a new channel feature' after a radar pulse was detected the first time, otherwise the whole set-up need to be re-calibrated on the new frequency.

Calibration procedure

1) During this calibration, there are no transmissions initiated by the UUT.
2) For calibrating the test set-up (exact threshold level at the UUT, unlicensed device #1), the UUT is replaced by a Spectrum Analyzer with an accurate power level measurement feature.
3) The Spectrum Analyzer #2 is switched to "Zero Span" mode and to the 'Time Domain' mode and it shall be verified if the level of each of the Radar pulses is identical. This is required to verify the proper functioning of ALC circuit of the Signal Generator for short pulses. For each of the tests (different radar test signals), the level of the Signal Generator is adjusted until the appropriate level (*e.g.,* -62 dBm) is measured by the Spectrum Analyzer #2.
4) The Spectrum Analyzer #1 is switched to 'Zero Span' mode and to the 'Time Domain' mode with an adaptive sweep time. The time base of the Spectrum Analyzer is externally triggered by the Pulse Generator through a delay circuit so that the sweep is already started a few ms before the first pulse of the Signal Generator appears. This will bring the radar burst clearly within the view window of the analyzer.
5) A reference point, indicating the start of the first pulse of the radar test signal (often equal to the time of the external trigger) should be set (marker T1) before any UUT transmissions are initiated.
6) The Radar Test Signal is switched off.

Taking Measurements

- The Monitor/Diagnostic Device (PC#2) starts transmissions between the 2 unlicensed U-NII devices.
- The Control Device #2 will switch on the Radar Test Signal at the instances indicated in the procedures in section 5
- The screen will now show the behavior of the unlicensed U-NII devices to the Radar Test Signal.

Note: it should be possible, with the above described set-up, to distinguish (on the spectrum analyzer screen) (1) the Radar Test Signals, (2) U-NII signal.

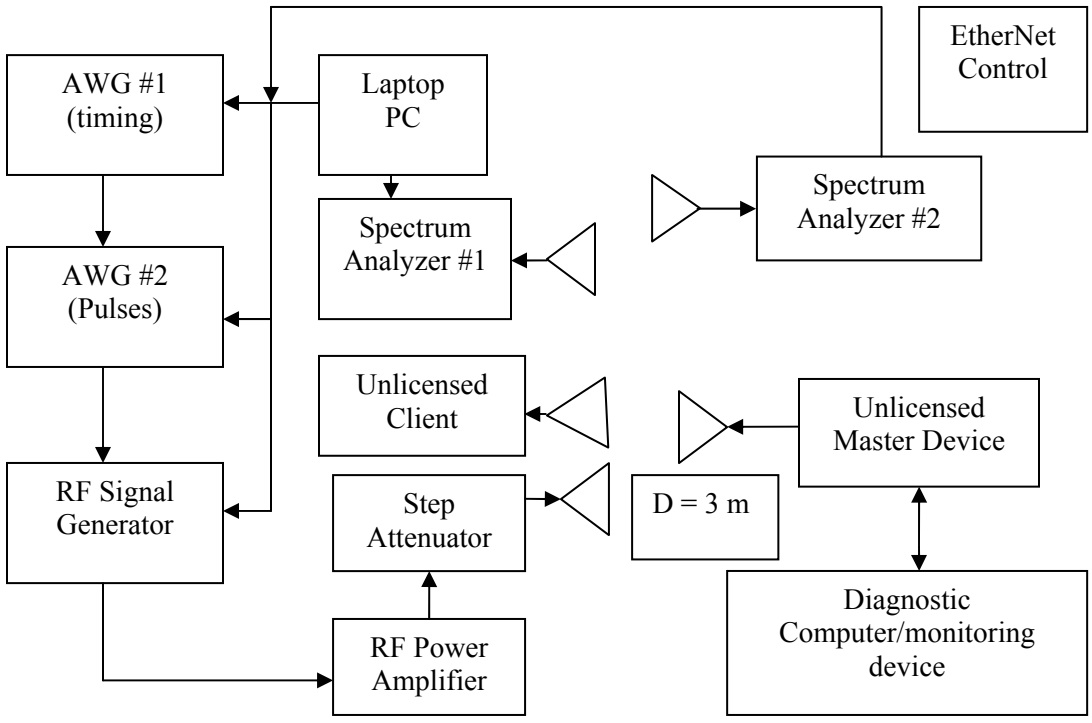
Annex C

Radiated Test Set-up and Calibration

Block Diagram

Radiated tests may be performed when the antenna of the unlicensed U-NII device is integral (*i.e.*, the antenna cannot be separated from the device) and an external antenna port is not provided. Figure C1 shows a detailed set-up for performing the radiated test measurements.

Figure C-1.



Calibration procedure

During this calibration, there are no transmissions initiated by the UUT.

1) For calibrating the test set-up (exact threshold level at the UUT) Spectrum analyzer #2 will be used to measure the power output of the radar signal simulator for each type of signal in Table 5.
2) Spectrum Analyzer #2 will be set to Zero Span mode with the RMS detector at the frequency of the chosen unlicensed device channel. The resolution and video bandwidth will be set to 1 MHz. The unlicensed device integration time as defined by the ITU is 1 microsecond. In order to achieve this integration time, the sweep time of the analyzer must

be set appropriately as follows. If the analyzer has 1000 points or "bins" across its display, the sweep time is equal to that number multiplied by 1 microsecond, or 1 millisecond. For 8000 points the sweep time would be set to 8 milliseconds.

3) The radar signal generator will be turned on (for each radar type) and be allowed to "free run." The pulses will be constantly on and not generated in bursts. Note that the frequency hopping radar will be set to a fixed frequency.

4) The step attenuator will be used to adjust the power level at Spectrum Analyzer #2 to the level that is required for the tests. This value must be adjusted for the gain of the horn antenna connected to the analyzer and adjusted once again if the antenna on the unlicensed U-NII device has gain. The techniques for measuring pulsed emissions from radars can be found in ITU-R-M.1177-2.

5) After the attenuator has been adjusted to achieve the proper power level, the RF output of the simulator will be turned off.

Taking Measurements

Fixed Frequency Radar Simulator

1) The power level (-64, -62, -55 dBm) of the radar signal will be calibrated for the appropriate radar signal type in Table 5 at the antenna of the unlicensed U-NII device. The higher power level (-55 dBm) will be used to test the DFS functionality of the unlicensed device before the ITU detection thresholds are tested.

2) The unlicensed U-NII devices will be turned on and be instructed to operate on the appropriate unlicensed U-NII channel that must incorporate DFS functions. Attenuators or some type of power control will be used to set the power of the unlicensed link [to be determined] dB above the radar simulator power.

3) The radar simulator will be turned on and emulate one of the two fixed frequency radars in Table 5 with the appropriate parameters (pulsewidth, burst length, and burst period).

4) Spectrum analyzer #1 and a diagnostic computer/monitor will be used to monitor the output of the unit under test (UUT) to observe that its behavior is consistent with the channel occupancy and move times of ITU-R M.1652.

5) If the UUT does not properly detect the simulated radar pulses in [to be determined][1] minutes, the device will not pass the test.

Note that both types of fixed frequency radars from Table 5 will be tested.

Frequency Hopping Radar Simulator

[1] This value is still under discussion within the government/industry project team and will be determined as part of finalizing the measurement procedures.

1) The power level (-64, -62, -55 dBm) of the radar signal will be calibrated for the frequency hopping radar signal type in Table 5 at the antenna of the unlicensed U-NII device. The higher power level (-55 dBm) will be used to test the DFS functionality of the unlicensed device before the ITU detection thresholds are tested.
2) The unlicensed U-NII devices will be turned on and be instructed to operate on the appropriate U-NII channel that must incorporate DFS functions. Attenuators or some type of power control will be used to set the power of the unlicensed link [to be determined][2] dB above the radar simulator power.
3) The radar simulator will be turned on and emulate the frequency hopping radar in Table 5 with the appropriate parameters (pulsewidth, burst length, burst period, and hopping rate).
4) Spectrum analyzer #1 and a diagnostic computer/monitor will be used to monitor the output of the unit under test (UUT) to observe that its behavior is consistent with the channel occupancy and move times of ITU-R M.1652.
5) The UUT will be monitored for [to be determined][3] minutes to determine if it can detect the frequency hopping radar.

[2] *Id.*

[3] *Id.*

APPENDIX D

SCHEDULE OF PROJECTED MILESTONES FOR FINALIZED DFS MEASUREMENT PROCEDURES

Task_Name	Duration	Start_Date	Finish_Date	Status
Bench Test Procedures	116 days	9-Jun-03	14-Nov-03	Incomplete
Draft Bench Test Procedures	39 days	9-Jun-03	31-Jul-03	Yes
Draft Deadline	1 day	31-Jul-03	31-Jul-03	Yes
DFS Project Team Meeting	1 day	15-Aug-03	15-Aug-03	Yes
Finalize Bench Test Procedures	11 days	18-Aug-03	31-Aug-03	Yes
Bench Test Procedure Deadline	1 day	31-Aug-03	31-Aug-03	Yes
FCC *Notice* Comment Reply Deadline	1 day	3-Sep-03	3-Sep-03	Yes
Bench Testing	10 days	3-Nov-03	14-Nov-03	Confirmed
Bench Test Report	76 days	17-Nov-03	1-Mar-04	Incomplete
Draft Report	66 days	17-Nov-03	16-Feb-04	Pending
DFS Project Team Meeting	1 day	15-Jan-04	15-Jan-04	Pending
DFS Project Team Meeting	1 day	2-Feb-04	2-Feb-04	Pending
Submit to FCC	1 day	1-Mar-04	1-Mar-04	Pending
Field Test Procedures	100 days	1-Mar-04	15-Jul-04	Incomplete
Outline Field Test Procedures	34 days	1-Mar-04	15-Apr-04	Pending
Draft Field Test Procedures	22 days	16-Apr-04	16-May-04	Pending
Draft Deadline	1 day	16-May-04	16-May-04	Pending
DFS Project Team Meeting	1 day	5-May-04	5-May-04	Pending
Radar Asset Confirmation Deadline	1 day	31-May-04	31-May-04	Pending
DFS Project Team Meeting	1 day	1-Jun-04	1-Jun-04	Pending
Finalize Field Test Procedures	11 days	1-Jun-04	15-Jun-04	Pending
Field Test Procedures Deadline	1 day	15-Jun-04	15-Jun-04	Pending
Field Testing	11 days	1-Jul-04	15-Jul-04	Pending
Field Test Report	66 days	16-Jul-04	15-Oct-04	Incomplete
Draft Report	13 days	16-Jul-04	3-Aug-04	Pending
DFS Project Team Meeting	1 day	31-Jul-04	31-Jul-04	Pending
DFS Project Team Meeting	1 day	3-Aug-04	3-Aug-04	Pending
Submit to FCC	1 day	15-Oct-04	15-Oct-04	Pending
Comprehensive NTIA Report	65 days	19-Oct-04	17-Jan-05	Incomplete
Draft Report	57 days	19-Oct-04	5-Jan-05	Pending
Report Deadline	1 day	3-Jan-05	3-Jan-05	Pending
Submit to FCC	1 day	17-Jan-05	17-Jan-05	Pending

APPENDIX E

Comments

1 Advanced Micro Devices, Inc. (AMD)
2 Agere Systems
3 Airespace, Inc.
4 Airrunner Technologies Inc.
5 Alvarion
6 American Petroleum Institute (API)
7 ARCWAVE
8 The National Association for Amateur Radio (ARRL).
9 Atheros Communications Inc.
10 Cellular Telecommunications & Internet Association
11 Cisco Systems, Inc.
12 D'ARDNT
13 Ensemble Communications
14 IceFyre Semiconductor, Inc.
15 IEEE 802
16 Information Technology Industry Council
17 Intel Corporation
18 License-Exempt Alliance
19 Magis Networks, Inc.
20 Microsoft Corporation
21 Microteq Corp.
22 Motorola, Inc.
23 Nickolaus E. Leggett
24 Nokia, Inc.
25 NTIA
26 Proxim Corporation
27 Telecommunications Industry Association
28 The Wi-Fi Alliance
29 TowerStream Corp.

Reply Comments

1 AT&T Corp
2 Atheros Communications, Inc.
3 Cingular Wireless LLC
4 Cisco Systems, Inc.
5 Hewlett-Packard Company
6 IEEE 802.18
7 Intel Corporation
8 License-Exempt Alliance
9 Microsoft Corporation
10 Motorola, Inc.
11 Nextweb, Inc.
12 The WiFi Alliance

Ex-Parte Comments

1 Paul Hastings
2 Atheros Communications, Inc.
3 Atheros Communications, Inc.

SEPARATE STATEMENT OF
CHAIRMAN MICHAEL K. POWELL

Re: 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, ET Docket No. 03-122 and RM-10371, Report and Order (R&O)

Wireless broadband is increasingly a reality in the marketplace. As demonstrated by our recent WISP forum, making more spectrum available for this important application will foster facilities based broadband competition and significantly advance the public interest. Moreover, additional unlicensed spectrum was a key recommendation of the Spectrum Policy Task Force. Today we deliver on the promise.

The adoption of the Unlicensed National Information Infrastructure (U-NII) Report and Order is another successful step towards fostering the development of a broad range of new devices and services. By amending Parts 2 and 15 of the Commission's rules we make an additional 255 megahertz of spectrum available for unlicensed devices in the 5.470-5.725 GHz band. This proposal is consistent with the U.S. proposals for the 2003 World Radiocommunication Conference (WRC-03) and with the resolutions adopted by the ITU at WRC-03. This action will harmonize the spectrum available for U-NII devices throughout the world.

Making this additional spectrum available will ensure the continued deployment of unlicensed wireless broadband networks by affording U-NII devices and networks greater certainty and flexibility to avoid interference with other services sharing the existing band. Further, it will provide significant benefits for American consumers and businesses including, improved quality of service, and increased competition with other providers of internet service.

I would also like to thank NTIA, DOD, other government agencies, and the industry for helping to make sharing among users of this spectrum possible. Together, we worked long and hard to forge an agreement that provides the opportunity for new commercial services while ensuring protection for existing Federal government operations. I hope that we can continue to build upon this success.

SEPARATE STATEMENT OF
COMMISSIONER KATHLEEN Q. ABERNATHY

Re: Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Infrastructure (U-NII) Devices, ET Docket No. 03-122 and RM-10371,Report and Order, ET Docket No. 03-122

Adoption of this order, only six months after we initiated this proceeding and in conjunction with our adoption of the ESV NPRM, is a further demonstration of the Commission's commitment to move swiftly when acting on items of national significance addressed at the World Radiocommunications Conference (WRC). Substantively, today's order makes available an additional 255 MHz of spectrum on an unlicensed basis – spectrum that has the potential to be used for broadband networks on an internationally harmonized basis.

As I have previously stated, the true key to achieving Congress's objective of a deregulatory and procompetitive framework lies in moving beyond duopoly towards a world where *multiple* facilities-based providers compete in the broadband arena. Last week's Rural WISP forum demonstrates that unlicensed wireless technology is tremendously valuable in promoting the core statutory goals of broadband deployment and facilities-based competition. Specifically, rural WISPs shared success stories of their deployment of broadband services over unlicensed technologies from Washington State to Maryland. I am hopeful that use of the unlicensed 5 GHz band will lead to even greater consumer benefits.

I also want to thank the staff and other members of the U.S. Delegation to WRC 2003, with whom I had the honor to serve with, for working so diligently at the Conference to achieve international consensus on this issue. Thanks to this joint effort, U.S. manufacturers will be able to capture the synergies of developing equipment in these frequency bands on a global basis. This should result in lower costs to consumers of broadband services and the availability of increasingly innovative equipment.