

**Before the  
Federal Communications Commission  
Washington, DC 20554**

In the Matter of

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  
RM-10371

**COMMENTS OF MOTOROLA, INC.**

Motorola, Inc. ("Motorola"), respectfully submits these comments in support of the FCC's Notice of Proposed Rulemaking ("NPRM") in the above proceeding.<sup>1</sup> Motorola commends the Commission for its timely issuance of these proposed regulations providing for an additional 255 MHz of U-NII spectrum, and urges the agency to move swiftly towards completion of a Report and Order with rules that incorporate the minor modifications discussed herein. Indeed, the FCC recognizes that the current 5 GHz unlicensed spectrum allocation is insufficient to support the long-term growth for wireless local area networks ("WLANs").<sup>2</sup>

Motorola appreciates the tremendous efforts of the U.S. government agencies that worked to shape the recently approved U.S. proposals for the World Radiocommunication Conference 2003 ("WRC-03"), modifying the existing band plan to provide for an additional 255 MHz of spectrum at 5 GHz for U-NII operations. The United States' WRC-03 efforts

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<sup>1</sup> FCC 03-110, rel. June 4, 2003 ("NPRM"). Motorola also submitted comments in support of the Wireless Ethernet Compatibility Alliance's (WECA, now the Wi-Fi Alliance) Petition for Rulemaking, which led to the NPRM. WECA's Petition received overwhelming support. *See* NPRM ¶¶ 1, 5.

<sup>2</sup> NPRM ¶¶ 11-12.

coupled with the Commission's timely issuance of a Report and Order in this proceeding will provide extensive public interest benefits.

**I. The Additional U-NII Spectrum Offers Widespread Public Interest Benefits To Unlicensed Wireless Users And Equipment Makers**

The Commission's proposed allocation at 5.470-5.725 GHz will position our nation's wireless information infrastructure for future growth and provide long-lasting public benefits.<sup>3</sup> The additional unlicensed spectrum will promote more robust broadband wireless deployments, seamless mobility, and enhanced data connectivity. It will also provide for enhanced spectrum sharing options for U-NII systems and increased system throughput thereby enabling truly broadband multimedia applications. Motorola, for example, expects to use the additional spectrum to enhance services and applications supported by its unlicensed wireless Canopy™ system, which currently operates in the 5 GHz U-NII bands providing wireless communications services (including Internet access) to residential communities and educational campuses alike.<sup>4</sup>

In addition, the global harmonization of the 5 GHz allocation not only allows consumers to use the same products when traveling overseas, but it also provides increased economies of scale for equipment manufacturers, thereby lowering end-user equipment costs.<sup>5</sup> The opening of greater global markets to U.S. manufacturers will benefit the plethora of U.S. industries that increasingly rely on unlicensed wireless communications capabilities. Motorola commends the Commission for its commitment to move swiftly on items of national importance such as this significant spectrum allocation and governing U-NII rules.

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<sup>3</sup> See NPRM ¶¶ 11-12.

<sup>4</sup> Information on the Canopy™ system, including detailed technical specifications, are available on Motorola's website at <<http://motorola.canopywireless.com/>>.

<sup>5</sup> See NPRM ¶¶ 2, 6-9.

**II. The Proposed Regulations Provide A Solid Foundation Upon Which Advanced 5 GHz Services and Equipment Can Be Developed.**

Motorola offers these comments on the issues identified in the Commission's NPRM.

**A. Modifications to the Table of Frequency Allocations**

Motorola supports the proposed changes to the table of frequency allocations that allow for U-NII device operation at 5.470-5.725 GHz<sup>6</sup> with an appreciation of the cooperative efforts of many spectrum stakeholders in the federal government and wireless industry that worked on this spectrum allocation. Motorola agrees with the FCC's proposed modification to upgrade the status of the current incumbent users to primary and secondary status as noted in the NPRM.<sup>7</sup> These status upgrades coupled with the interference mitigation mechanisms proposed for U-NII operations in the new spectrum allocation will adequately protect incumbent users.<sup>8</sup>

**B. The Rules That Apply Generally to the 5.25-5.35 MHz Band Should Be Applied to the Newly Allocated Unlicensed Spectrum.**

Motorola supports the FCC's proposal to apply the rules governing the middle 5.25-5.35 GHz U-NII band to the proposed 5.470-5.725 GHz band, including the 1 W EIRP power limit.

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<sup>6</sup> See NPRM ¶ 14.

<sup>7</sup> See *id.*

<sup>8</sup> See NPRM ¶ 10. Motorola provides specific comments on the interference mitigation mechanisms under consideration, *i.e.*, DFS and TPC, later in these comments.

The FCC notes that most amateur operations in this band at 5.650-5.725 GHz use fixed high-power, high gain systems that are unlikely to be impacted by the proposed low-power U-NII operations. See also NPRM ¶ 19. (“[A]mateur use of this band is limited to propagation beacons and possibly some limited satellite use. [T]here are only a few rare mountain top users of this band [and] amateurs already share the 5.725-5.825 GHz band with U-NII devices and we are unaware of any complaints of interference.”). Additionally, U-NII devices are Part 15 devices, which must eliminate any harmful interference caused to incumbents, including amateur service.

The Commission's proposal allows for shorter distance applications such as those provided by Motorola's Canopy system, which can support links of up to two (2) miles at 1 W EIRP. However, Motorola recognizes that the proposed 1 W EIRP power level is not able to meet the demands of Wireless Internet Service Providers (WISPs) offering larger cell deployments and backhaul transport. Motorola's Canopy system provides these higher power unlicensed operations using the U-NII high-band at 5.725-5.825 GHz, which allows 4 W EIRP for point-to-multipoint applications and 200 W EIRP for point-to-point applications.

Indeed, the 5.725-5.825 GHz band is increasingly being used for higher power applications to provide broadband services in rural locations. Consequently, this band is becoming congested. As the FCC's proposed rules were based solely upon analyses with devices operating at power levels not greater than 1 W, Motorola encourages the Commission to undertake further analysis in the near future with higher power systems to determine whether operations in excess of 1 W incorporating the interference avoidance mechanisms being placed on the new U-NII band, such as Dynamic Frequency Selection ("DFS"), allow for successful spectrum sharing. If the results of these studies are positive, Motorola would strongly encourage the Commission to permit higher power unlicensed operations in the band. In the event these studies indicate the new 5.47-5.725 GHz U-NII band cannot support higher power operations, the Commission should allocate additional spectrum for such operations.

**C. Radar Detection with DFS Will Ensure Successful Spectrum Sharing In the New Band.**

Motorola supports implementation of DFS in the newly expanded U-NII mid-band. The proposed DFS rules, which require a mid-band U-NII device to listen before initially transmitting and during the transmission sequence, will provide adequate protection to incumbent users.

## 1. Proposed definition of DFS

Motorola recognizes that the proposed definition of Dynamic Frequency Selection (DFS) also includes the principle of radar detection. Therefore, the proposed definition should be modified to explain that radar detection is a mechanism that detects and avoids co-channel operation with other systems, especially radar systems. In addition, the concept of uniform spreading is not needed in the definition for DFS, because DFS does not provide a uniform spreading of the transmission loading over *all* available channels. Uniform spreading was devised to avoid the situation where many devices could operate on channels that overlap with satellite systems. DFS will likely provide a uniform use of the channels only where there is a very dense deployment of devices; here, interactions with multiple cells will naturally distribute spectrum usage uniformly.

Accordingly, the definition for DFS should simply explain that it is a mechanism that allows a U-NII mid-band device to select available channels; a further requirement is the need to ensure uniform use of the bands. Motorola proposes the following definitions for radar detection, DFS, and uniform spreading:

- “Radar detection” is a mechanism that detects signals from other systems, most notably radar systems, and avoids co-channel operations with those systems.
- “Dynamic frequency selection (DFS)” is a mechanism that is used to dynamically select the operating channel of the device based on radar detection in the current and proposed channels of operation.
- “Uniform spreading” is a mechanism that uniformly utilizes spectrum over a large population of devices.<sup>9</sup>

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<sup>9</sup> The rules should also explain that, upon startup, devices will randomly select a channel of operation from the available channels designed into the device.

## 2. Implementation of Radar Detection with DFS

Motorola recognizes that an informal DFS working group, chaired by NTIA and consisting of representatives from NTIA, the FCC, DoD, and the wireless industry, is developing bench and field tests to verify DFS operation in accordance with the FCC's proposed rules.<sup>10</sup> The results of these tests, which are expected next year, should provide further confidence that radar detection with DFS as a means to protect radar systems is reliable and effective.

Motorola agrees with the Commission's tentative conclusion that only the central controller device be required to implement DFS functionality. Notwithstanding, the agency requests comment on whether all devices operating in the new unlicensed spectrum band should be required to implement DFS.

Motorola has analyzed the channel selection issues in a wireless system that is managed by a central controller and/or client devices. Based on Motorola's analysis, it has determined that if either the central controller or the client devices incorporate DFS functionality, the interference is mitigated below acceptable levels. While it is clearly valuable to understand systems and protocols where all RF devices (*i.e.*, the central controller and client devices) incorporate DFS functionality, imposing that requirement at this time is unduly burdensome and unnecessary since either approach will protect radar systems. The critical component is that DFS functionality is present somewhere within the network. The analysis performed in preparation

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<sup>10</sup> Motorola, which is part of the industry representation of the informal DFS working group, understands that the group will submit a report to the FCC detailing its findings and recommendations. Motorola will continue its participation in the DFS working group, and, if necessary, Motorola will provide separate additional comments to the Commission regarding DFS implementation

for the ITU activities to determine the radar detection thresholds (to protect radar systems) relied only on the central controller incorporating this functionality.<sup>11</sup>

The Commission's rules should be clarified to require that either the central controller or client devices implement DFS.

### 3. Bandwidth Correction Factor

The FCC recognizes that for the Received Signal Strength (RSS) to be measured correctly by a U-NII device with a receive bandwidth less than 1 MHz, a bandwidth correction factor must be implemented.<sup>12</sup> The proposed  $10 \cdot \log(BW/1 \text{ MHz})$  bandwidth correction factor for U-NII devices with receive bandwidths less than 1 MHz is reasonable in view of the Commission's goal of encouraging broadband U-NII systems while not precluding technologies that provide applications with bandwidth less than 1 MHz.

### 4. Radar Detection by DFS systems

The Commission well recognizes the difficulty of reliably detecting a radar's presence in the channel, as it depends on the radar's pulse characteristics and the dwell time. When the dwell time is short, reliable detection becomes very difficult.<sup>13</sup> Any requirement to vacate the channel upon the receipt of a single pulse seem unreasonable and unnecessary since the device

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<sup>11</sup> Further study is needed to assess the impact of ad hoc operations without DFS/Radar Detection capability. The ITU-R studies did not specifically address ad hoc communications. Because ad hoc communications are used infrequently and can be performed with significantly less transmit power, such operations may have minimal impact upon radar signals.

<sup>12</sup> See NPRM ¶ 21.

<sup>13</sup> See Annex 3 of BRAN31d034rev4, Liaison from ETSI BRAN HL Spectrum Group to CEPT JPT5G, "DFS Detection Threshold." The ability to detect a single pulse and initiate corrective measures to switch operations to another channel is not very reliable. The ETSI analysis assumed that the radar signal was a white Gaussian signal process. This assumption created a worst-case detection failure performance, *i.e.*, approximately 50% detection failure on a single pulse. A more precise description of the radar signals would provide more accurate estimates of detection reliability.

performing the radar detection functionality will be typically presented with multiple pulses, as confirmed in Annex 4 of ITU-R Recommendation M.1652.

Motorola respectfully requests that the Commission's rules permit relaxing the DFS thresholds for systems that use antenna gains greater than 0 dBi. With this relaxation the higher gain antenna systems provide the same interference potential to radar systems as other users based on the same reference EIRP. Notably, the ITU Recommendation M.1652 permits the DFS detection threshold to be relaxed (on a dB-for-dB basis) for antenna gains that exceed 0 dBi. Accordingly, the Commission should add this provision to its proposed rules in Section 15.407(h)(2).

**D. Transmit Power Control Will Enable Successful Spectrum Sharing With Incumbent Uses And With Other WLAN Equipment.**

The FCC has proposed requiring U-NII devices operating at 5.47-5.725 GHz to implement TPC. The agency requests comment the appropriate triggering mechanism for TPC.

Where TPC is required, the FCC should only specify a minimum power control range. Motorola requests that the Commission allow the equipment designer and manufacturers to decide what the appropriate triggering mechanism(s) should be. Otherwise, the Commission may unnecessarily inhibit experimentation and technological innovation in the band. Indeed, it is in each manufacturer's interest to use the least amount of power to ensure reliable transmissions, as it lowers equipment power drain and increases the overall system capacity by reducing the self-interference effects.

In addition, the Commission should clarify how TPC and DFS interact. For example, under the proposed rules, if a device lowers its transmit power to below 200 mW EIRP, it should be permitted to raise its DFS threshold by 2 dB.

Last, because TPC is being implemented to ensure that the aggregate signal power is 3 dB less than the maximum permitted power, Motorola respectfully requests that the Commission not require power control mechanisms for devices that already have a transmit power that is 3 dB less than the maximum permitted power.

#### **E. Test Procedures**

In addition to the informal DFS working group (discussed above) that is working on verification of the DFS functionality, ETSI is in the process of finalizing ETSI standard EN 301 893, which covers DFS test procedures. Both DFS and TPC requirements were imposed when the 5.47-5.725 GHz band was allocated in Europe several years ago. Because of this, a substantial amount of work has been completed in the development of conformance testing to these DFS and TPC requirements under the auspices of ETSI with participation by industry and European regulatory bodies. These detailed conformance test procedures developed in Europe have been supplied to the informal DFS working group with the hope that it will speed the test plan development process and lead to common testing requirements in the U.S.<sup>14</sup>

#### **F. Transition Period**

Motorola supports the Commission's proposal to require all U-NII equipment operating in the new spectrum at 5.470-5.725 GHz to meet all the technical requirements on the date that the promulgated rules are made effective.

A transition period for existing U-NII equipment operating at 5.25-5.35 GHz should be implemented, as the current offerings do not support DFS. Motorola supports the Commission's proposed rule amendment at Section 15.37(l), including the requirements that:

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<sup>14</sup> See ETSI EN 301 893 V1.2.2 (2003-06). Any test procedures must include realistic interference scenarios and allow for realizable equipment applications.

U-NII Equipment operating in the 5.25 – 5.35 GHz band that are authorized under the certification procedure 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 requirement specified in Section 15.407 of this part. [and]

All U-NII Equipment operating in the 5.25 – 5.35 GHz band that are manufactured or imported on or after [2 years from publication of R&O in ET Docket No. 03-122 in the Federal Register] shall comply with the DFS requirement specified in Section 15.407 of this part.<sup>15</sup>

This should allow sufficient time to permit manufacturers to redesign existing equipment to comply with the new rules at 5.25-5.35 GHz.

### **G. Additional Comments**

The FCC also requests comment on related issues that were not explicitly addressed in the NPRM. In this regard, Motorola asks the Commission to reconsider its proposed thirty (30) minute non-occupancy requirement in Section 15.407(h)(2)(d). Motorola understands that the proposed time period was based on the scanning characteristics of certain weather radars operating in the 5.6-5.65 GHz band.<sup>16</sup> Because of this, the FCC should only apply this overly burdensome requirement to operations at 5.6-5.65 GHz, rather than the current 5.25-5.35 GHz and proposed 5.47-5.725 GHz U-NII mid bands.

Also, the proposed definition in Section 15.403(q) for the term “RLAN” should be deleted because the term does not appear in any of the other proposed rules and only describes one of the many technologies that may be deployed in the U-NII bands.

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<sup>15</sup> Proposed rule 15.37(l).

<sup>16</sup> See ITU-R Recommendation M.1638. Radar C, which all of the radar detection/DFS studies used, is the key system to be protected.

**CONCLUSION**

Motorola respectfully requests that the Commission move forward with the timely issuance of a Report and Order in this proceeding subject to the minor modifications discussed in these comments. The internationally harmonized spectrum allocation will provide increased economies of scale for equipment manufacturers and lower end-user equipment costs. The opening of greater global markets to U.S. manufacturers will benefit the many U.S. industries that increasingly rely on unlicensed wireless services.

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