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 THE WI-FI ALLIANCE

SUMMARY

The Wi-Fi Alliance commends the Commission for its timely issuance of proposed regulations providing for an additional 255 MHz of spectrum for 5 GHz U-NII operations. The Alliance strongly supports the FCC's general proposal to apply the current rules for the U-NII mid-band at 5.25-5.35 GHz to the proposed allocation at 5.470-5.725 GHz, including the current mid-band power limit of 1 W EIRP. The Alliance agrees with the Commission's conclusion that U-NII equipment implementation of Dynamic Frequency Selection (with Radar Detection) and Transmit Power Control interference mitigation mechanisms in the proposed expanded mid-band will provide adequate protection to incumbent RF systems, especially government radars. The Alliance respectfully requests that the Commission move swiftly towards issuance of a Report and Order with the minor clarifications to the proposed rules offered herein.

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The Wi-Fi Alliance ("the Alliance")[1] respectfully submits these comments in strong support of the Notice of Proposed Rulemaking ("NPRM") in the above-referenced proceeding.[2] The Alliance, which comprises about 200 companies that design, manufacture, and market WLAN equipment, filed the Petition for Rulemaking that led to the FCC's issuance of this NPRM. As the Commission recognized, the Petition has garnered overwhelming support.[3] The Alliance applauds the Commission for its timely issuance of these proposed regulations providing an additional 255 MHz of spectrum at 5 GHz for U-NII equipment, consistent with the recommendations of the Spectrum Policy Task Force. The Alliance also commends the FCC for

[1] The Wi-Fi Alliance, formerly known as the Wireless Ethernet Compatibility Alliance, is an international trade association formed in 1999 with the goal of promoting the adoption and commercialization of IEEE 802.11-compatible products. These products may be used to support Wireless Local Area Networks in the 5 GHz frequency band.

Membership in the Alliance is open to all companies that support the IEEE 802.11x standards. Current members include nearly every major radio manufacturer that produces wireless network equipment for the U.S. market. Alliance membership, with about 200 companies, continues to grow. A complete membership listing may be found on our website, www.wi-fi.org.

[2] FCC 03-110, rel. June 4, 2003 ("NPRM").

[3] NPRM at ¶¶ 1, 5.

its recognition that internationally harmonized operations will strongly benefit the long-term growth of wireless local area network ("WLAN") equipment, which, in turn, has substantial benefits for the American public.[4] The Alliance recognizes the tremendous efforts of NTIA, the Department of Defense ("DoD"), and NASA, working in conjunction with the Commission and the WLAN industry to develop the U.S. Proposals for the World Radiocommunication Conference 2003.[5] As discussed in greater detail below, the Alliance recommends that the FCC expeditiously adopt the proposed rules with minimal clarification.

I. The Commission's Proposed Rules Provide Enhanced Public Interest Benefits to Unlicensed Spectrum Users and Equipment Manufacturers.

In the NPRM, the FCC recognizes that the spectrum "currently available for U-NII devices is insufficient to support the long term growth for unlicensed wireless broadband devices and networks," and further that "[a]mple evidence exists of the enormous growth in the demand for such devices and services."[6]

The Alliance strongly supports the Commission's conclusion that "an additional 255 MHz should be made 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 with European HiperLAN standards."[7]

A. The Public Benefits of Unlicensed Operations

The Commission's proposed spectrum allocation will position our nation's wireless information infrastructure for future growth and provide long-lasting public benefits. The

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[4] NPRM at ¶¶ 11-12.

[5] A similar proposal to what is presented by the Commission in the NPRM was approved at the WRC-03 conference in early June 2003 in Geneva.

[6] NPRM at ¶ 11.

[7] NPRM at ¶ 12.

additional unlicensed spectrum will promote more robust broadband wireless deployments with enhanced throughput and greater mobility in both business and residential locations.

B. Global Harmonization For Unlicensed 5 GHz Operations

The Alliance has been active in both the United States and international regulatory arenas requesting additional – and internationally compatible – 5 GHz spectrum for WLAN devices, recognizing that additional unlicensed spectrum is needed to provide the information infrastructure to support future demands for broadband wireless access. Indeed, the increasing demand for WLAN services at 5 GHz is global. Notably, at the recent World Radiocommunication Conference 2003 ("WRC-03"), the global allocation of Wireless Access Systems (WAS) (including Radio LANs, *i.e.*, "RLANs") operating at 5.150-5.350 GHz and 5.470-5.725 GHz was created. Significantly, the WRC-03 Resolution ("Resolution COM 5/16") and the corresponding changes to the Table of Frequency Allocations were adopted unanimously.

This global harmonization of spectrum offers U.S. wireless equipment manufacturers a broader market and an increased advantage of economies of scale. Moreover, the broader 5 GHz equipment market will encourage manufacturers to increase investment in the future operational capabilities of their devices, which in turn will increase demand by end-users and lead to lower equipment costs. In this way, the opening of greater global markets to U.S. manufacturers will benefit the multitude of U.S. industries that increasingly rely on unlicensed wireless services. Also, once the Commission authorizes the proposed operations, U.S. end-users – including business and industrial users – will be able to use the same wireless device when traveling overseas to Europe and Asia.

Accordingly, the Alliance encourages the Commission to move swiftly on this item of national importance and authorize the proposed 5 GHz operations.

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

The Alliance provides these specific comments on the following issues as requested in the NPRM.

A. The FCC's 5.470-5.725 GHz Allocation is Appropriate.

The Wi-Fi Alliance strongly supports the proposed modification to the Part 15 rules to expand U-NII device operation to include the 5.470-5.725 GHz spectrum.[8] The Alliance finds very workable the proposed modifications to the Table of Frequency Allocations in Part 2 allowing unlicensed RLANs to share spectrum with (i) Federal Government and non-Federal Government radiolocation uses at 5.46-5.65 and 5.47-5.57 GHz, (ii) Federal Government and non-Federal Government Space Research Service at 5.35-5.57 GHz, and (iii) Earth Exploration Satellite Service at 5.46-5.57 GHz.[9] The Alliance concurs with the FCC's proposed modification to upgrade the status of these incumbent uses to primary and secondary as noted in the NPRM.[10] Further, the Alliance agrees that the interference avoidance mechanisms being proposed for U-NII operation at 5.47-5.725 GHz will afford incumbent users ample protection from harmful interference.[11]

In light of this shared spectrum environment, the Alliance encourages the Commission to restrict the permitted Part 15 operations within the current and proposed U-NII bands to

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[8] *See* NPRM at ¶ 14.

[9] *See* NPRM at ¶¶ 2, 13-15.

[10] *See id*.

[11] NPRM at ¶ 10.

"wideband" U-NII devices consistent with the goals of the U-NII regulations.[12] Section 15.403(i) of the current Unlicensed National Information Infrastructure Device rules defines U-NII devices as "intentional radiators" that utilize "wideband digital modulation techniques and provide a wide array of high data rate mobile and fixed communications."[13] Moreover, the FCC has explicitly restricted other types of Part 15 operations, such as those in the 174-216 MHz band under Section 15.241 and in the 890 MHz band under Section 15.243 of the agency's rules.[14] Allowing only wideband 5 GHz operations (*i.e.*, signal bandwidths greater than or equal to 1 MHz) in the U-NII bands is fully consistent with the Commission's original intent in establishing its U-NII regulations.

B. The Rules That Apply to the 5.25-5.35 GHz Band – With The FCC's Proposed Modifications – Should Be Applied to the New Unlicensed Spectrum.

The Alliance strongly supports the Commission's proposal to apply the rules that currently govern the U-NII mid-band at 5.25-5.35 GHz to the proposed allocation at 5.470-5.725 GHz. Specifically, the power limit of 1 W EIRP should be applied to operations in the proposed spectrum. The Alliance also concurs with the Commission's conclusion that the interference mitigation mechanisms being placed on operations in the new mid-band will provide adequate protection to incumbent uses.[15] The Alliance offers specific comments below on these

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[12] In this regard, the Commission's proposal to implement a "bandwidth correction factor" for U-NII devices with a receive bandwidth less than 1 MHz should be abandoned. *See* NPRM at ¶ 21. Indeed, the concept of allowing narrowband Part 15 signals in these 5 GHz bands is at odds with the concept underlying the U-NII bands, which were established to support "wideband" operations.

[13] 47 C.F.R. § 15.403(i) (2003).

[14] 47 C.F.R. §§ 15.241, 15.243 (2003).

[15] As the FCC notes, U-NII devices are Part 15 devices, which are required to eliminate any harmful interference caused to incumbent uses, including the Amateur Radio service at 5.650-5.725 GHz. *See* NPRM at ¶ 19. The Commission also notes that "amateur use of this band is

mechanisms, *i.e.*, Dynamic Frequency Selection ("DFS"), Radar Detection, and Transmit Power Control ("TPC"), as requested by the FCC.

C. Dynamic Frequency Selection With Radar Detection Will Ensure Successful Spectrum Sharing In the Proposed Band.

The Wi-Fi Alliance supports the Commission's proposal to implement DFS (with Radar Detection) in the proposed expanded U-NII mid-band. The proposed rules, which require a mid-band U-NII device to both listen before using a channel and listen during normal operation, will provide adequate protection to incumbent radar systems.

1. Proposed definitions of DFS and Radar Detection

The Commission proposes the following definition for Dynamic Frequency Selection (DFS):

> Dynamic Frequency Selection (DFS) is a mechanism that detects signals from other systems and avoids co-channel operation with these systems, notably radar systems. The DFS process shall be required to provide a uniform spreading of the loading over all the available channels. Proposed Rule Section 15.403(g).

The above definition is potentially confusing as it is ambiguous with respect to applicable bands and also intermixes the separate concept of radar detection.[16] Therefore, the Alliance requests that the FCC separately define "radar detection" as follows:

> Radar Detection is a mechanism that detects signals from other systems, most notably radar systems, and avoids co-channel operation with those systems;

and revise the definition of DFS as follows:

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limited to propagation beacons and possibly some limited satellite use" and further that "amateurs already share the 5.725-5.825 GHz band with [higher-powered] U-NII devices and we are unaware of any complaints of interference. *See id*.

[16] DFS is implemented *in conjunction with* radar detection to enable the efficient assignment of frequency use within a WLAN system.

Dynamic Frequency Selection (DFS) is a mechanism that is used to provide a uniform spreading of the loading over all available channels in the 5.25-5.35 GHz and 5.47-5.725 GHz bands.

In addition, the Commission should consider revising the "DFS Detection Threshold" definition title in Proposed Rule Section 15.403(h) to "Radar Detection Threshold," and likewise revise any cross-reference to "DFS Detection Threshold" in the other rule sections. *See, e.g.*, Proposed Rules Section 15.403(e), "Channel Move Time."

2. Proposed DFS/Radar Detection Implementation Requirement

In view of the foregoing discussion, the Alliance respectfully requests that the Commission also revise the DFS implementation requirement in Proposed Rule Section 15.407(h)(2), as shown below. The regulation should more clearly state the practical effect of the statement: "referenced to a 0 dBi antenna." In this regard, the detection threshold must be adjusted during conformance testing (*i.e.*, where a device's antenna is removed and the simulated radar signal is injected into the antenna port via conducted means) so that the threshold is increased by an amount in dB equal to the antenna gain in dB.[17] Thus, the Alliance requests amending the proposed rule to reflect increasing the detection threshold set during conformance testing by an amount equal to the antenna gain.

The Alliance's suggested revisions are as follows:[18]

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[17] If multiple antennae are to be certified for a product, the *lowest* antenna gain value should be used for "conducted" radar detection testing. Using the lowest antenna gain value in this case will determine whether the device can meet the radar detection performance requirements in its most demanding configuration. Notably, this concept was agreed upon internationally and is reflected in the first European conformance test standard. ITU Recommendation M.1652 explicitly permits the DFS detection threshold to be relaxed (on a dB-for-dB basis) for antenna gains that exceed 0 dBi.

[18] In these comments, the Alliance includes suggested edits on the FCC's proposed rules using the following conventions: Deletions are shown with ~~strikethrough~~ text, and additions are shown with double-underlined text.

The 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. 'Conducted' radar detection conformance testing (*i.e.*, with the device's antenna removed) requires an increase of the detection threshold by an amount equal to the antenna gain, but 'Radiated' radar detection conformance testing (with the device's antenna in place) does not require this adjustment.

3. Devices required to implement DFS/Radar Detection

The Alliance supports the FCC's proposal to require only the central controller device to implement the Radar Detection Function of DFS where there are multiple U-NII devices operating under the control of the central controller.[19] This will keep WLAN equipment costs down, as these systems typically operate with many client devices interfacing with a single central controller or access point, which manages the client devices' access to the spectrum.[20] The FCC's proposal is supported by ITU-R Recommendation M.1652, which states: "it may not be necessary for each device to implement full DFS with Radar Detection functionality, provided that such devices are only able to transmit under the control of a device that ensures that all requirements are fulfilled."

[19] NPRM at ¶ 22.

[20] Because there are often many client devices associated with an access point in WLAN systems, the access points are better able to bear the additional processing load and cost involved in implementing the radar detection function (and would lower the total system cost). In addition, access points are generally powered by a local AC power source, whereas client devices are more likely to be battery-powered and need to limit power consumption – which would dramatically increase if radar detection functionality were required in client devices as well.

The Commission also requests comment on whether devices not under the supervision of a central controller should be required to implement DFS. While the vast majority of 5 GHz systems operation in the proposed mid-band will be under the control of a central controller, the following scenarios are envisioned for operations that do not occur in this manner: (1) ad hoc operation where a small number (*e.g.*, less than 10) of low-powered WLAN devices operate in a geographically-limited area for a limited amount of time; and (2) decentralized mesh networking, not currently standardized, but conceivably used by larger numbers of quasi-permanent users.

Because mesh network operations at 5 GHz are still being defined, further study of Radar Detection and DFS implementation by such networks will be needed once this technology is better understood. Ad hoc operation, however, is already being implemented in the existing U-NII bands (*e.g.*, 5.25-5.35 GHz) and is a very useful tool for WLAN users in need of impromptu and temporary networking. It is therefore highly desirable to allow such operations to continue without the burden of DFS requirements in the 5.25-5.35 GHz band, as defined by current IEEE 802.11 standards, and also be similarly permitted in the proposed 255 MHz band. Requiring DFS/Radar Detection for such ad hoc communication sessions would lead to excessive session start-up delays and intolerable battery drain on mobile devices, such as notebook computers and handheld devices such as PDAs (*i.e.*, Personal Digital Assistants) for which the ad hoc feature is deemed by many end-users to be highly useful.

Therefore, ad hoc operations must be permitted within the newly expanded mid-band (as they are currently permitted in U-NII spectrum at 5.25-5.35 GHz). In permitting such operations, the Commission should consider capping the transmit power for ad hoc operations to some amount substantially less than the maximum allowed in the 5.25-5.35 and 5.47-5.725 GHz

bands.[21] Based on this reduced power level, the DFS/Radar Detection rules would not apply to this operating mode. The permitted power level must provide protection to incumbent spectrum users while permitting current ad hoc communications capabilities at realistic transmission distances, which tend to be about 10 meters or less.

4. Radar Detection by U-NII systems

The Alliance recognizes that the successful implementation of DFS capability depends on the ability of the U-NII device to detect the presence of radar signals reliably. Radar detection requirements must limit the probability of false detects and maximize the likelihood of correct detection.[22] The ability of a U-NII device to detect the presence of radar signal in the channel depends heavily on the radar's pulse characteristics and (to a lesser degree) on the radar's dwell time. Detection becomes difficult when the dwell time is short, such as with frequency hopping radar systems.

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

The Commission is also proposing Transmit Power Control ("TPC") as an interference mitigation mechanism from U-NII equipment operating at 5.47-5.725 GHz. TPC is being used to ensure that the aggregate signal power is 3 dB less than the maximum permitted power. Therefore, the Commission should not require power control mechanisms for devices that already transmit with a power level that is 3 dB less than the maximum allowed power. This is consistent with the new ITU Radio Regulations and the WRC-03 Resolution COM 5/16, which

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[21] Ad hoc operations typically are used incidentally for exchange of information between hand-held user devices. The interference contribution of such operations is a small fraction (*e.g.*, 1% or less) of the total interference load created by RLAN operations considering that most wireless networks are used in connection with wired networks.

[22] *See* ITU-R Recommendation M.1652.

states that TPC shall be employed "to provide, on average, a mitigation factor of at least 3 dB on the maximum average output power of the systems, or if [TPC] is not in use, then the maximum mean e.i.r.p. shall be reduced by 3 dB."[23]

In addition, the FCC should not require a specific implementation approach for TPC, which would be tantamount to applying a prescriptive standard.[24] The only requirement for TPC should be a required performance characteristic, such as a minimum power control range, or a simple verification that a device's maximum transmit power capability is already 3 dB below the regulatory maximum for the new U-NII band. This approach will allow equipment manufacturers to decide what mechanism (if any) should be used to trigger the required power level mitigation.[25] Indeed, most equipment designers already strive to use the least amount of transmit power to ensure reliable transmissions, as low transmit-power translates into increased system capacity by limiting interference to other devices.[26]

Indeed, because many WLAN client devices are battery powered, equipment designers are further encouraged to design their networks to use less transmit power to maximize the battery life of host equipment, which is typically a notebook computer or PDA. The Alliance

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[23] *See* WRC-03 Resolution COM 5/16, Resolves 7.

[24] Indeed, it is a policy of nearly every federal government agency – including the FCC – that prescriptive standards, such as a strict design requirement, should generally be avoided where performance standards can be developed to accomplish the same purpose. In fact, the Regulatory Flexibility Act requires U.S. Government agencies promulgating new regulations to consider using performance-based rather than prescriptive, design-based standards. *See* 5 U.S.C. § 603(c) (federal agencies' rulemaking analysis must discuss "significant alternatives such as – … the use of performance rather than design standards").

[25] In a practical sense, because the European rules require the use of DFS and TPC, it is reasonable to expect that manufacturers will implement the DFS/TPC extensions due to the economic advantage of having one product implementation that is acceptable globally.

[26] *See* NPRM at ¶ 24 ("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.").

expects that the wide majority of non-infrastructure, mobile 5 GHz WLAN devices will have a maximum EIRP capability well below the regulatory limit, and easily provide the desired 3 dB mitigation over the full population of U-NII devices operating at 5.47-5.725 GHz.

E. Test Procedures and Equipment Authorization

The Commission also requests input on test procedures to ensure compliance with DFS (with Radar Detection) and TPC requirements.[27] The Alliance notes that an informal working group, chaired by NTIA and including representatives from DoD, the FCC, and the unlicensed wireless communications industry, is working on developing a test procedure for the radar detection function of DFS.

The Alliance also recognizes that the 5.47-5.725 GHz band, allocated several years ago in Europe, imposed similar requirements,[28] and that a substantial amount of conformance testing of the radar detection function has been already developed under the auspices of ETSI with participation by both industry members and European regulatory bodies. The detailed testing procedures based on these efforts have been supplied to the informal NTIA working group in the U.S. with the hope that it will speed the test plan development process and result in compatible testing requirements in the U.S.[29]

As the vast majority of WLAN equipment will be subject to a new burden of DFS and Radar Detection conformance testing shortly after the FCC issues a Report and Order in this proceeding,[30] the Alliance encourages the Commission to implement conformance test

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[27] *See* NPRM at ¶ 25.

[28] *See* ERC (99)23 Decision.

[29] *See* ETSI EN 301 893 V1.2.2 (2003-06).

[30] Market pressures will likely result in the need for WLAN vendors to demonstrate that existing and pending designs can be certified to the new conformance test requirements shortly

procedures that are effective and simple in order to limit the impact of the procedures on equipment costs and time to market. For example, implementing procedures that can be readily practiced with commonly available laboratory test equipment will smooth the conformance test procedures, prevent test lab bottlenecks, and allow equipment manufacturers to perform in-house design verification and quality checks. Furthermore, the well-planned and early introduction of the new test procedures into the existing Part 15 equipment authorization regime for TCBs and recognized test labs will prevent costly backlogs that unnecessarily hinder the time to market.

F. Transition Period

The Alliance concurs with the time periods in the Commission's proposed transition provisions for compliance with the new rules.[31] However, the Alliance proposes tying the start dates of the transition periods to the availability of accepted test procedures for Radar Detection and DFS conformance testing rather than to the publication of the Report and Order in the Federal Register. The latter proposal could lead to a situation where manufacturers may be unable to obtain any equipment authorizations for U-NII equipment designed to operate in the proposed band.

Thus, the Alliance's suggested revisions to Proposed Rule 15.37(l) are as follows:

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after such test requirements are available – stressing the need for the new conformance testing procedures to incorporate the new requirements in a seamless and timely manner.

[31] Proposed rule Section 15.37(l). As the Commission recognizes, because the existing equipment at 5.25-5.35 GHz does not support DFS, a transition period for compliance with the new rules is needed for equipment designed to operate in this existing U-NII mid-band. *See* NPRM at ¶ 26.

The Alliance recognizes that the NPRM contains at least three different transition periods. *Compare* NPRM at ¶ 26 (equipment "imported or shipped in interstate commerce [must comply] on or after **two** years" of Federal Register publication of new rules) *to* NPRM at page 15 (equipment "imported or shipped in interstate commerce [must comply] on or after **three** years" of Federal Register publication of new rules) *to* Proposed Rule 15.37(l) at page 21 (quoted above) (emphases supplied).

U-NII Equipment operating in the 5.25 – 5.35 GHz band that are authorized under the certification procedure on or after [1 year from the release of a Public Notice announcing the availability of approved conformance test procedures for Radar Detection and DFS] ~~[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. All U-NII Equipment operating in the 5.25 – 5.35 GHz band that are manufactured or imported on or after [2 years from the release of a Public Notice announcing the availability of approved conformance test procedures for Radar Detection and DFS] ~~[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. Equipment authorized, imported or manufactured prior to these dates shall comply with the requirements for U-NII Equipment operating in the 5.25-5.35 GHz band that were in effect immediately prior to [60 days after publication of R&O in ET Docket No. 03-122 in the Federal Register].

The sooner the FCC promulgates these proposed rules and a conformance test procedure is approved, the less non-DFS legacy equipment will be deployed at 5.25-5.35 GHz, thereby limiting the potential for incompatibilities and enabling the timely deployment of systems that can mitigate interference to other spectrum users.

CONCLUSION

The Alliance respectfully requests that the Commission move swiftly towards issuance of a Report and Order authorizing U-NII operations at 5.47-5.725 GHz incorporating the minimal modifications presented above. The proposed allocation has received overwhelming support from the industry and, in light of U.S. efforts at WRC-03, is consistent with international spectrum allocations.

The expanded U-NII allocation will substantially benefit the American public, which is increasingly relying upon unlicensed wireless networks for broadband communications, including wireless Internet access. The economic benefits of these products to American businesses, government, education, and healthcare are tremendous.

Respectfully submitted,

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