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

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

Comments of Navini Networks, Inc.

Navini Networks, Inc. ("Navini"), by its counsel, hereby submits these comments in the above-captioned proceedings. Navini is a leading manufacturer of licensed and unlicensed wireless internet access systems and has been an active participant in previous Commission rule makings involving wireless services.[1] Navini systems use time division duplex ("TDD") digital modulation technology to provide non-line-of-sight, high-speed internet access to residences, home offices and small to medium size business establishments. Using advanced digital signal processing techniques and adaptive phased array "smart" antennas, Navini base stations generate simultaneous, customized, highly directional "beamformed" transmissions to multiple user locations.[2]

Whether used for licensed or unlicensed services, Navini's beamforming technology offers significant enhancements over conventional wireless offerings by enhancing the

[1] *See e.g.*, Comments of Navini in ET Docket No. 03-201 filed January 23, 2004; Reply Comments of Navini in ET Docket No. 03-201 filed February 9, 2004; and Reply Comments of Navini in ET Docket No. 03-66 filed October 23, 2003.

[2] Navini's adaptive phased array antennas utilize power more efficiently than conventional antennas to maximize the signal-to-noise ratio at a specific customer premises location. The term "beamformed" refers to a technology, such as Navini's, in which multiple point-to-point directional beams can be formed simultaneously.

signal-to-noise ratios at specific sites, thereby improving performance of customer premises equipment ("CPE") while minimizing interference to other spectrum users. The Commission is well aware of the spectral efficiencies and unique capabilities of Navini's beamforming technology. Indeed, earlier this month, the Commission observed that these "advanced antenna systems will benefit service providers in both rural and high-density areas…allow providers to re-use spectrum more efficiently and thereby serve multiple clients with minimal interference risk."[3] Navini, therefore, supports the Commission's efforts in this proceeding to open the 3650-3700 MHz band (the "3650 MHz band") to new and advanced services that can be offered using beamforming technology.

I. Summary of Navini's Position

Navini supports allocation of the 3650 MHz band for licensed use provided TDD technology is permitted throughout the band.

If the 3650 MHz band is allocated for unlicensed use, the Commission should ensure that beamforming systems are permitted to operate in the band under the same terms and conditions as are allowed under Section 15.247.

Navini supports the proposed 25W EIRP limit for fixed unlicensed omni-directional devices; however, for fixed unlicensed point-to-point (*e.g.*, beamforming) devices, Navini supports limits that are based on the approach taken under Section 15.247(b) for 2.45 GHz systems using high gain antennas.

Navini supports the harmonization of measurement procedures for digital modulation devices and thus, supports the use of average measurements for determining EIRP limits for 3650 MHz base station transmitters and CPE.

Navini supports the proposal to require professional installation of fixed unlicensed devices provided that CPE sold for use with PCs are not classified as fixed devices.

Navini opposes any proposal to have unlicensed CPE transmit IDs or monitor Fixed Satellite Services ("FSS") signals; instead Navini supports the proposed geo-location option for such equipment.

[3] In the Matter of Modification of Parts 2 and 15 of the Commission's Rules for Unlicensed Devices and Equipment Approval, *Report and Order*, ET Docket No. 03-201, FCC 04-165, released July 12, 2004 at ¶ 17.

Navini opposes the proposal to require mobile devices to incorporate a dynamic frequency selection ("DFS"), "listen before talk" technology to avoid interfering with FSS systems.

II. Navini Supports Allocation of the 3650 MHz Band for Licensed Use Provided TDD Technology is Permitted Throughout the Band.

The Commission's goals in this proceeding are admirable – to make more efficient use of the 3650 MHz band for new and advanced services, particularly in rural areas that are not currently served by conventional wireless providers.[4] If spectrum is made available on an unlicensed basis, the Commission reasons, wireless internet service providers will be encouraged to provide broadband offerings to consumers who might not otherwise have access to such technology. Although Navini fully supports these laudable goals, it does not believe that an unlicensed approach is the best way to proceed.

Clearly, unlicensed spectrum will attract the most competition and diversity of service offerings. However, these benefits will come at a cost that must be carefully considered. First, because unlicensed devices cannot be frequency coordinated, they will likely be forced to operate at reduced power levels creating potential coverage issues in sparsely populated rural areas. In addition, radio interference among unlicensed devices, which is bound to occur, will have to be tolerated by end users operating in unprotected spectrum. Finally, the high cost of unlicensed CPE, which must provide "cognitive" features to avoid interference to existing FSS receive sites, may prove to be unaffordable to consumers. For these reasons, and because beamforming systems tend to perform better in an ordered (*i.e.*, licensed) environment,[5] Navini urges the Commission to allocate the 3650 MHz band, at least in part, for licensed use. By authorizing licensed services in the band, the Commission will facilitate higher transmission levels (and greater geographic

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[4] *Notice of Proposed Rule Making*, ET Docket Nos. 04-151, 02-380 and 98-237, FCC 04-100, released April 23, 2004 ("*Notice*") at ¶¶ 1-2.

[5] One of the advantages of Navini system is extended coverage resulting from beam forming. In an unlicensed environment, the interference may be high and may result in a considerable increase of the base station receiver noise floor. This in turn, requires CPE to transmit at a much higher power to overcome the noise floor. In an unlicensed environment, where the CPE output power is capped, the distance between CPE and BTS has to be reduced considerably; thus the coverage advantage of the beam forming can be defeated.

coverage) without undue risk of interference; economies of scale will become more feasible for rural markets; and the spectrum will be used efficiently by beamforming systems that do not have to contend with multiple high power emitters.

It is equally important for the Commission to ensure that the service rules adopted in this proceeding are technology neutral. As noted above, Navini systems use a TDD architecture which allows an operator to decide how much capacity to allocate for downlink versus uplink traffic. This, in turn, results in better efficiency and use of spectrum assets because the traffic patterns for data are typically heaviest going downstream. Therefore, as long as the service rules adopted by the Commission permit the use of TDD technology, the full benefits of the 3650 MHz band can be realized through the use of beamforming systems.

III. Unlicensed Device Rules for the 3650 MHz Band Should Accommodate Beamforming Technologies Just as they do for the 2.45 GHz and 5.8 GHz Bands.

A. The 25 Watt EIRP Limit.

The Commission proposes to permit fixed stations to operate at a maximum EIRP of 25 Watts (14 dBW) using any combination of transmitter power/antenna gain. The Commission claims (incorrectly) that this is "more than double the signal range of an unlicensed device."[6] Any type of antenna system would be permitted as long as devices using "sectorized, scanning spot-beam or other antenna types with multiple beam capability" meet the EIRP limit <u>in any direction</u>.[7] The Commission questions how it should determine compliance with such rules.

Although Navini fully supports the Commission's effort to re-allocate the 3650 MHz band for broadband operations, it does not support the proposed 25W (44 dBm) EIRP limit for beamforming systems. Contrary to the Commission's assertion, a 25W EIRP

[6] *Notice* at ¶ 43.

[7] *Notice* at ¶ 44. In Docket No. 02-301, the Commission required overlapping beams in advanced antenna systems to reduce their power levels to ensure that the point-to-point limit for a single beam is not exceeded. Navini supports the same approach for the 3650 MHz band.

limit does not represent an increase in signal range for unlicensed devices, but in fact, provides less coverage than permitted for devices authorized under the existing spread spectrum rules. For example, assume a 1W (30 dBm) point-to-point 2.45 GHz digital modulation system with a 24 dBi antenna. Under the spread spectrum rules (Section 14.247(b)(4)), the maximum transmitter output power would be 30dBm, reduced 1 dB for each 3dB that the antenna gain exceeds 6 dBi. Total power, in this example, would be the sum of 24 dBm for the transmitter plus 24 dBm for the antenna or 48dBm EIRP – which is 4dB higher than the proposed 25 W EIRP limit for the 3650 MHz band.

Moreover, for an unlicensed beamforming transmitter operating in the 5.8 GHz band, there is no required "1dB for 3dB" reduction for antenna gain. Thus, devices in the 5.8 GHz band using 24dBi antennas would be allowed to operate at EIRP levels that are 10dB higher than the proposed limit in the 3650 MHz band.

For these reasons, Navini urges the Commission to establish EIRP limits in the 3650 MHz band that are based on Section 15.247 policies, which govern spread spectrum devices. Navini believes it is appropriate to set limits for unlicensed devices based on antenna gain because high EIRP devices cause less interference if their beamwidths are narrow. To give effect to the Commission's 25W (44dBm) EIRP proposal, Navini suggests that omni directional transmission systems be limited to a maximum of 38 dBm with a 6 dBi antenna gain (44dBm total), whereas point-to-point systems be allowed to exceed this limit based on the "1dB for 3dB" scheme currently permitted in the 2.45 GHz band. As an alternative, the Commission should consider the approach used under the Part 21 rules which limits EIRP based on beamwidth using the formula: 44dBm +10*log10 (360/beamwidth).

B. Harmonization and Average Measurement Limits.

With respect to the measurement procedures used for determining device compliance in the 3650 MHz band, the Commission recently decided that average measurements should be an option for digital modulation devices operating in the spread spectrum bands provided that out-of-band levels are at least 30dB below such limits, although not lower

than provided by Section 15.209 of the Commission's rules.[8] Navini believes that harmonization of test procedures is an important continuing regulatory goal. Navini therefore urges the Commission to adopt averaging for unlicensed devices including CPE operating in the 3650 MHz band.[9]

C. Professional Installation Requirements.

Navini generally supports the requirement for professional installation of unlicensed fixed devices as outlined in the *Notice* to protect FSS installations.[10] However, CPE that connects to desktop computers should not be classified as fixed devices. As Navini and other wireless manufacturers have discovered, a professional installation requirement negatively affects customer acceptance and adds significant additional cost to customer acquisition, operations, and maintenance. In order for wireless internet access solutions to be deployed on a mass market basis, CPE installation costs must be eliminated. In other words, CPE must be sold "zero install" to consumers. If the Commission were to impose a professional installation requirement on CPE that connects to desktop computers, wireless internet service providers, particularly those serving or proposing to serve rural markets, will simply not be able to offer affordable services.

D. Identification and Monitoring Requirements.

While Navini generally supports the use of cognitive radio designs to protect FSS from CPE interference, it urges the Commission to consider other less costly means, such as geo-location, discussed below. In this respect, Navini opposes any requirement for CPE to transmit ID information or monitor FSS transmissions, as both options will significantly increase the cost of CPE and hamper widespread use of the 3650 MHz band. As the Commission is well aware, FSS systems are located primarily in coastal areas where CPE deployment will likely be low. Imposing an ID/monitoring function on CPE will largely go unused for the majority of devices on the market. In addition, by design,

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[8] *See* In the Matter of Parts 2 and 15 of the Commission's rules for unlicensed devices, Report and Order in Docket 03-201, released July 12, 2004.

[9] The Commission proposes a peak limit of 1W EIRP for 3650 MHz CPE. *Notice* at ¶ 49. For the reasons stated above, averaging should be permitted for CPE.

[10] *Notice* at ¶ 41.

non-fixed CPE will always be associated with fixed base stations that will already safeguard FSS from interference under proposed rules prohibiting such stations from operating within 180 km of an FSS installation if they are within the +/-15 degree arc of the FSS main antenna beam.[11]

For non-fixed CPE, Navini supports a geo-location option as a more cost-effective means of protecting FSS sites. Specifically, Navini proposals that all fixed base stations be required to broadcast nearby FSS location information to all CPE, which will be required to listen (to the fixed station) before transmitting. Based on signal strength and properties of the base station transmission, the CPE will be able to estimate the distance and bearing of the base station. Based on the transmitted FSS information, the CPE will then be able to calculate its distance to the FSS site. From this data, the CPE will be able to set an output power limit that protects the FSS against interference.[12] This approach, which can be implemented largely with software, will have very little cost impact on CPE, the great majority of which will be well beyond any FSS protection zone.

E. DFS Listen before Talk Technology.

The Commission is proposing to require all non-fixed (mobile) devices to feature a DFS mechanism that automatically adjusts EIRP levels based on the received signal strength of a nearby FSS uplink. However, to ensure that these devices do not interfere with the FSS downlink (in the 3650 MHz band), the Commission is proposing to require the devices to "listen before talk" in the uplink bands of 5.8 and 6.4 GHz.[13] Navini firmly opposes this requirement because it will unnecessarily complicate the design and add to

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[11] *Notice* at ¶ 46. To understand how conservative this safeguard is, consider that one FSS and one fixed station separated by 180 km would both need be 900 meters above average terrain in order to interfere with each other. Typically, however, these systems will not rise above a height of 100 meters. Thus, they will not cause interference if separated by 60 km in distance. Since the 180 km protection zone is very conservative, the fixed station does not need to take any extra measures except that, as any newly constructed station the operator will need to send written notice to the nearby (within certain km) FSS informing of its operations.

[12] If no bearing information is available (*i.e.*, worst case) the CPE will assume it is between, and on the line connecting, the FSS and the fixed station. For example, if a CPE knows there is an FSS 200 km away from the fixed station by listening to the fixed station's broadcast information and it calculates its distance to the fixed station as 10km, then the worst case distance to the FSS would be 190 km.

[13] *Notice* at ¶ 50.

the cost of 3560 MHz mobile devices. To provide a DFS feature in the uplink FSS bands, a mobile device will be required not only to operate in 3650 MHz band but also to constantly monitor the 5.8 GHz and 6.4 GHz bands. Such a requirement will add hardware and software development costs to 3560MHz mobile devices and render mobile operations in this band non-competitive with other wireless services. The result will be to undermine the Commission's goal of establishing a complementary band to the 2.45 and 5.8 GHz allocations already established.

Navini submits that a geo-location feature, such as the one proposed above, is a preferable option to uplink monitoring. FSS systems can be adequately safeguarded from mobile operations by geo-location, a much less expensive and performance-limiting alternative to band monitoring. For this reason, Navini urges the Commission to permit manufacturers to implement a geo-location alternative for the protection of FSS systems from mobile 3650 MHz band devices.

IV. Conclusion

Based on the foregoing, Navini requests the Commission to consider and adopt the comments submitted herein for the allocation of the 3650 MHz band and development of service rules for fixed and mobile device operations.

Respectfully Submitted

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