Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Allocations and Service Rules for the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands	)	WT Docket No. 02-146

PETITION FOR RECONSIDERATION

THE WIRELESS COMMUNICATIONS
ASSOCIATION INTERNATIONAL, INC.

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TABLE OF CONTENTS

SUMMARY

WCA hereby petitions for reconsideration of the Commission's *Report and Order* in this proceeding, adopted October 16, 2003. The *Report and Order* correctly resolved the "big picture" issues relating to the 71-76 GHz and 81-86 GHz bands, but there are a number of more detailed technical issues on which the overwhelming consensus among commenting parties seems to have been overlooked. Because the Commission's good work in this proceeding may be wasted without remedial action on these items, WCA hereby requests reconsideration on the following issues:

- The registration process should include a requirement that each new user of the 70/80 GHz bands verify *in advance* that the proposed link will not cause harmful interference to any existing link previously registered in either the government or non-government database. Current technology permits real-time, electronic interference analysis as a component of the registration process, so the cost of prevention is negligible. By contrast, the consequences of harmful interference discovered only after the fact could be catastrophic.
- The Commission should reconsider its segmentation and channel-loading rules, preferably eliminating them but at the very least reducing the minimum throughput at which a designated assignment will be eligible for interference protection. These two requirements will constrain early deployment efforts and raise equipment costs without any corresponding public interest benefit. Nor is there any competition-related or interference-related rationale for their adoption.
- The Commission should reconsider a trio of issues related to antenna and power requirements, including

- the power/gain tradeoff that was developed by the industry;
- a requirement for certain radios to use Automatic Transmitter Power Control; and
- the power spectral density limits suggested by the commenters.

Each of these proposals would make a significant contribution to the prevention of interference in the band, and each was unanimously endorsed by industry.

- The Commission should adopt language making conditional operating authority available to first-time 70/80 GHz applicants who have successfully coordinated their proposed link(s) but are awaiting their non-exclusive nationwide license.
- The Commission should adopt the draft text on interference protection criteria proffered by WCA, rather than the text on interference protection that the Commission placed in section 101.147(z).

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PETITION FOR RECONSIDERATION

In the *Report and Order* released last November in this proceeding,[1] the Commission took several giant steps toward successful development of the 71-76 GHz and 81-86 GHz bands, revising the Table of Allocations and adopting a streamlined licensing procedure. However, while the Commission correctly resolved the "big picture" issues relating to these bands, there are a number of more detailed technical issues on which the overwhelming consensus among commenting parties seems to have been overlooked. Because the Commission's good work in this proceeding may be wasted without remedial action on these items, WCA hereby requests reconsideration.

There are seven areas in which reconsideration is warranted. First, the registration process should include a requirement that each new user of the 70/80 GHz bands verify *in advance* that the proposed link will not cause harmful interference to any existing link previously registered in either the government or non-government database. Second, the Commission should reconsider its segmentation and channel-loading rules, preferably eliminating them but at the very least reducing the minimum throughput at which a designated assignment will be

[1] *Report and Order*, FCC 03-248, __ F.C.C. Rcd. ____ (Nov. 4, 2003).

eligible for interference protection. Third, the Commission should reconsider a trio of issues related to antenna and power requirements, including its rejection of the power/gain tradeoff that was developed by the industry, its rejection of a requirement for certain radios to use Automatic Transmitter Power Control, and its failure to adopt the power spectral density limits suggested by the commenters. Fourth, the Commission should adopt language making conditional operating authority available to first-time 70/80 GHz applicants who have successfully coordinated their proposed link(s) but are awaiting their non-exclusive nationwide license. Finally, the Commission should adopt the draft text on interference protection criteria proffered by WCA, rather than the text on interference protection that the Commission placed in section 101.147(z).[2]

Before discussing each of these areas, it is important to recall the reasons why the Commission correctly adopted such an innovative regulatory approach for these frequencies in the first place. The two most salient characteristics of the 70/80 GHz frequencies are the potential for fiber-equivalent throughput, and the fact that this tremendous capacity can be transmitted in very narrow beams – "pencil beams" – rather than the wider beams in lower bands. The first of these characteristics means that 70/80 GHz links will be used by sophisticated customers who will demand fiber-equivalent reliability. It is therefore imperative that the level of interference protection available to users of these frequencies – both legally and as a purely practical matter – be commensurate with the importance of the mission-critical applications for which the links will be used. The second factor means that preventing interference in these frequencies – as well as facilitating robust competitive entry – will largely be achieved by adjusting the spatial characteristics of the links rather than by using different frequencies. The Commission's *Report and Order* largely implemented this new regulatory

[2] All of the rule changes sought by the WCA are collected in Appendix A.

paradigm. WCA believes the areas suggested for reconsideration will complete this scheme and greatly expedite the deployment of these links.

I. THE COMMISSION SHOULD REQUIRE ALL NON-GOVERNMENT USERS TO VERIFY IN ADVANCE THAT THEY WILL NOT INTERFERE WITH PREVIOUSLY REGISTERED NON-GOVERNMENT USERS.

The *Report and Order* adopted a flexible licensing regime according to which each prospective user of the 70/80 GHz bands would receive a non-exclusive nationwide license for an unlimited number of links, conditioned upon (1) *coordination* of each proposed link with previously authorized *government* stations; and (2) *registration* of each proposed link in a database of *non-government* stations.[3] However, the registration procedure does not require new non-government users to ensure in advance that their proposed links will be compatible with existing non-government stations. Instead, the Commission adopted procedures for resolving interference complaints after the fact, procedures which are triggered when a user notifies the third-party database manager that it is experiencing harmful interference.[4] Unfortunately, this approach substantially reduces the long-term reliability of 70/80 GHz stations, primarily by making interference events both unpredictable and long in those few cases in which they will occur. The Commission should reconsider its decision and require all prospective users of these bands to ensure in advance that their operations will not adversely affect previously authorized users.

The *Report and Order* does not explain why no advance analysis of interference with previously registered non-government links is required, but presumably the Commission was trying to minimize overall burdens on deployment, and concluded that interference will be so

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[3] *Report and Order* ¶¶ 54-55.

[4] *Report and Order* ¶ 58.

rare that requiring traditional coordination in each and every case is not justified. For example, one might imagine that the cost of resolving interference after the fact in 2 to 5 cases out of 100 is less than the cost of coordinating all 100 ahead of time. However, WCA has worked closely with Comsearch throughout this proceeding and is confident that an advance determination of RF compatibility can be made *in real time* in most cases if it is incorporated into the non-government registration process.[5] The cost of interference prevention is therefore quite low.

The advantage of before-the-fact interference analysis is particularly clear when one considers the consequences of interference discovered after the fact, which are potentially catastrophic. When potential interference is discovered before the fact, the problem is usually easy to overcome. Before any radio has been installed, it is easy enough to try a new position on the roof, or to move around a shielding wall, or to point in a slightly different direction, or even to design the link to go through a window on a lower floor. Not only are these solutions inexpensive, they are fast; and they improve overall link density because they facilitate intelligent design rather than purely random link placement and frequency selection. In the very worst case, a user who finds it impossible to site a new link is able to change course and find another way of meeting its capacity needs – before spending tens of thousands of dollars on equipment and installation. By contrast, the after-the-fact approach requires the user first to ascertain that the failure is due to RF interference (rather than an equipment malfunction), and then to notify the database manager so the manager can identify the source of the RF interference. The Commission expects parties to resolve the matter informally, but because the problem does not arise until after equipment has been purchased and installed, an agreement may

[5] The type of process the WCA has in mind is described in the WCA *ex parte* presentation filed August 7, 2003. Such a process can be put in place with only a minor amendment to section 101.1523(b), as set forth in Appendix A to this petition.

require a substantial amount of dickering regarding the severity of the problem and the extent of the necessary remediation. If a complaint to the Commission is necessary, it cannot be filed for at least thirty days, and there is no guarantee how long it will take for the Commission to rule. For any application that requires gigabit-per-second speeds, a network outage of thirty *minutes* is catastrophic, let alone thirty days. Businesses tend to avoid catastrophic risks, so a small but measurable risk of a total and prolonged (*e.g.*, two-month) network outage will cause demand for 70/80 GHz radios to fall precipitously.

In addition, the *post hoc* approach makes it much more difficult to identify the source of the interference. Under the Commission's rules, a link can be installed up to twelve months after registration.[6] Interference may be worse during rain events, so if the link is installed during the dry season there may be an additional six months or so before harmful interference occurs. Consequently, a user who suddenly experiences network-crippling interference might have to look back 18 months or more in the database to find the source of the problem.

The problem of delay could perhaps be avoided, or substantially reduced, if each registrant paid the database manager an additional fee to review each new registration and notify any adversely affected incumbents if any new link appeared likely to produce harmful interference. This solution, however, would call into question the presumed rationale for the *post hoc* approach, which was that the cost of interference analysis could be avoided in the vast majority of cases. If interference analysis must still be performed in the vast majority of cases, then the cost has not been avoided; it has only been delayed *and shifted*, in a way that seems dubious on a number of grounds. It is difficult to understand why, for example, pioneers in the 70/80 GHz band should pay in perpetuity to protect themselves from interference that might be

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6 *Report and Order* ¶ 80.

caused by later entrants who are already enjoying the lower equipment costs that the pioneers made possible. Moreover, the *post hoc*, perpetual monitoring approach shifts the cost away from the party in the best position to avoid the harm, and places it on the party whose ongoing operations in reliance on the link leave few practical alternatives once the problem arises. This violates the principle that costs are most efficiently borne by the entity with the greatest practical opportunity to avoid them.

Finally, it should be noted that the Commission's approach is even more costly than the analysis above suggests, because before-the-fact coordination with government users is still required. Thus, the Commission's approach involves the one-time burden of coordinating with government users *plus* the continuing burden of monitoring new registrations indefinitely. Whatever merit a true *post hoc* regime might have in a band that is exclusively devoted to non-government services, it makes little sense to impose it in a band where the need for before-the-fact coordination with at least some existing (government) stations is inescapable. It would be easy, and far less costly in the long run, for non-government users to finish all interference analysis prior to installation, since a new non-government registrant will have already produced an interference profile to satisfy government coordination requirements.

WCA's membership includes virtually every company with current plans to develop the 70/80 GHz bands. While WCA appreciates the Commission's deregulatory instincts, the unanimous opinion of those companies is that the *post hoc* procedure for resolving interference provides, as a practical matter, insufficient protection against future catastrophic network outages. The risk of interference between users in these bands is remarkably low, but not low enough that any customer will be willing to risk an outage of 30 days or longer at some

unspecified time in the indefinite future. The ounce of prevention is in this case worth infinitely more than the pound of cure.

II. THE COMMISSION SHOULD RECONSIDER ITS CHANNELIZATION OF THE 70/80 GHZ BANDS AND ELIMINATE OR REDUCE THE CHANNEL LOADING REQUIREMENT

The overwhelming majority of commenters expressed the view that the 71-76 GHz and 81-86 GHz bands should not be channelized, and that licensees should be permitted to use bandwidths of up to 5 gigahertz in each direction – or less, depending on their capacity needs.[7] The metaphor used many times in the record was that of a "spatial pipe" – a radio link between two points – within which users would be permitted to use some or all of the spectrum, for a single pair of radios or multiple pairs, using any modulation scheme the licensee desired. Commenters urged the Commission to define such "spatial pipes" and protect them without reference to the type or quantity of traffic they carry, for two main reasons: to give network architects maximum flexibility in the way they design their links, and to facilitate a smooth "upgrade path" as a user's data needs expand. In addition, commenters pointed out that because interference between two such spatial pipes will be rare, there is no reason for the Commission to ration the spectrum before the service is even launched.

The Commission ultimately decided to divide the 71-76 GHz and 81-86 GHz bands into eight "segments" of 1.25 gigahertz each, citing competition, efficiency, and interference concerns.[8] Under the Commission's rules, there is no aggregation limit, so that all eight segments are available for authorization even if initial needs are modest. However, 70/80 GHz licensees would be required to meet the 1 bps per Hertz loading requirement of section 101.141.

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[7] This consensus is reflected, for example, throughout the August 7, 2003 *ex parte* submission by WCA.

[8] *Report and Order* ¶¶ 31-32.

"If it is determined that a licensee has not met the loading requirements, then the database will be modified to limit coordination rights to the spectrum that is loaded and the licensee will lose protection rights on spectrum that has not been loaded."[9]

Together, the segmentation of the band and the channel loading requirement significantly constrain the ability of early adopters to establish a viable service in the 70/80 GHz frequencies, for several reasons. First, the segmentation scheme may as a practical matter force manufacturers to make their radios conform to the 1.25-gigahertz increments so that licensed users occupy precisely the bandwidth for which they are authorized. Because some modulation schemes do not "fit neatly" into 1.25-gigahertz increments (and the same is true of any other standardized increment), this would complicate equipment design and raise the cost of equipment. Second, it is in the public interest to facilitate the use of the simplest possible modulation schemes in this new band, in order to stimulate initial deployments. Yet a 1 bps/Hz loading requirement would prohibit the use of binary signaling such as OOK and BPSK. Third, depending on how the loading requirement is applied (*i.e.*, depending on whether it is measured across the occupied channel(s) or across the emission bandwidth specified in the emission designator), the joint operation of the two rules might discourage or even prevent flexible and low-cost frequency plans within a given spatial pipe. For example, users authorized for less than 5 gigahertz in each direction would presumably be prevented from locating their center frequencies in the middle of each 5-gigahertz segment and leaving "guard bands" at the edges, even though there was no other demand for that particular "spatial pipe."[10]

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9 *Report and Order* ¶ 81.

10 WCA would normally assume that channel loading is to be measured across the bandwidth specified in the emission designator, but here the Commission's discussion makes clear that the channel loading rule is bound up with the question of protection rights and database

The discussion of segmentation and channel loading in the *Report and Order* suggests a preoccupation with making sure that users do not occupy more spectrum than absolutely necessary. This perspective makes sense in an environment of pervasive scarcity, but not in the 70/80 GHz band. As the commenters and the Commission agree, actual cases of interference will be rare in these frequencies, and unless there are competing requests for use of the same "spatial pipe" there is simply no public interest benefit to be gained by regulating the width of the channels, the number of channels used, or the data rate transmitted. In the 70/80 GHz bands, very dense deployments will be facilitated by the extremely narrow beamwidth of the transmissions and the opportunity to make spatial adjustments as part of the interference analysis that accompanies registration. Thus, using a 2 x 5 gigahertz authorization for "only" one OC-48 signal (2.488 Gbps) is not a "waste of spectrum," because it is unlikely to prevent any other user from being authorized for a second 2 x 5 gigahertz "spatial pipe" just a few yards away. What *would* be wasteful would be to take the one and only fixed-service allocation wide enough for multi-gigabit speeds and encumber it with rules more appropriate for sub-gigabit links. The public does not benefit from higher bps/Hz numbers in themselves; spectrum efficiency is only important when it facilitates more intensive use of the spectrum. The Commission should not require manufacturers to incur significant additional hardware, engineering, or regulatory costs for a purely statistical bps/Hz improvement that yields no real-world benefit.

Thus, if there is any justification for the segmentation and channel loading rules, it could only be in those rare cases in which there *are* competing requests for the same "spatial pipe." WCA believes that such instances will be rare based on the narrow beamwidths of the

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Continued . . .

entries. *Report and Order* ¶ 81. That suggests that perhaps whole channels will be deemed either protected or unprotected based on whether they are fully loaded.

transmitted energy and the spatial harmonization that will occur if interference analysis is required as part of the registration process. In most instances, WCA envisions that potentially competing users will be accommodated not by channelizing the spectrum, but by simply increasing the modest spatial diversity needed between systems. However, even in those rare cases in which spatial solutions alone cannot harmonize competing requests, the Commission's segmentation plan does no good, and may do some harm. If User A and User B both want to use the very same spatial pipe, then in the absence of any channelization or segmentation plan, a frequency coordinator would try to find a way to accommodate both users based on the actual emission bandwidths they propose to use. This might require one or both to choose different center frequencies, but they can do this with or without fixed segment boundaries and channel loading rules from the Commission. In fact, having fixed segment boundaries may actually complicate the resolution of the conflict because the best available solution may not correspond to the Commission's pre-established boundaries (as would be the case, for example, if User A operated in the middle of the band and User B used two narrower bandwidths on the edges). Thus, the segmentation plan is at best irrelevant, even in the only class of cases where it could possibly do any good. And in the much more numerous cases of non-scarcity, the segmentation plan adds needless complexity and uncertainty with no corresponding benefit.[11] The

[11] It is illuminating to compare the Commission's segmentation decision with its approach to before-the-fact interference analysis. As discussed in Part I, the Commission opted to avoid a very minor cost in all cases, even though the consequences of doing so would be disastrous in the small minority of cases where interference occurs. Yet with respect to segmentation and channel loading rules, the Commission seems ready to impose real costs on users in all cases even though the rules do not make the rare cases of interference either less likely or easier to resolve. The Commission's treatment of the two cases is puzzling because the hardware costs imposed by the segmentation and channel loading rules dwarf the marginal cost of requiring the registrant to analyze potential interference with non-government links at the time of the pre-installation coordination with NTIA.

Commission should therefore eliminate the "soft channelization" of the 70/80 GHz band into 1.25-gigahertz segments.

In addition, the Commission should either eliminate or reduce the channel loading requirement. Given the fact that the FCC's rules for 70 and 80 GHz stations will ensure that the interference among users will be minimized, it is unclear why any loading requirement is necessary for these bands. The technical rules already adopted will produce extremely tight "pencil beams," and WCA's proposed modifications to those rules (discussed in Parts III and IV below) will reduce the likelihood of interference even further. It will be impossible to "occupy" any significant amount of spectrum for warehousing purposes because the spectrum must be occupied one narrow pipe at a time. The buildout requirement – which the Commission placed at 12 months and which WCA proposes to shorten to 180 days[12] – makes this impossible as a practical matter, because radios in these frequencies will not be inexpensive. The *Report and Order* makes one unexplained reference to "competition" concerns, but there is no plausible way for any one entity to accumulate so many pencil beams as to confer market power.

Furthermore, this is not an issue on which the Commission must regulate either now or never. The highly localized nature of interference in the 70/80 GHz band ensures that the Commission will have plenty of time to amend its rules to impose a channel loading requirement later if significant numbers of applicants begin to find themselves precluded from deploying radios.

Rather than attempting to mandate a minimum level of spectrum efficiency for each link, the Commission should instead allow the marketplace to dictate the appropriate balance among spectral efficiency, equipment cost, and bandwidth. Retention of the 1 bps/Hz requirement will

[12] Appendix A contains a proposal to modify section 101.63 to this effect.

unnecessarily delay or prohibit the introduction of millimeter wave equipment because it will preclude manufacturers from using radio technology that has already been developed for the 60 GHz band, forcing them instead to launch initial products in the 70 and 80 GHz bands with more costly and experimental modulation schemes. Several 60 GHz radio systems are being sold today using either OOK or BPSK modulation, which provides 0.5 bps/Hz efficiency. A proposed efficiency requirement of 1 bps/Hz will prevent the use of this currently available millimeter wave technology, and will force manufacturers instead to enter the 70 and 80 GHz market with higher-order modulation schemes, which will be more expensive and time-consuming to develop. Further, using the more complex digital modulation schemes that would be necessary to meet a 1 bps/Hz loading requirement would reduce system gain and therefore reduce the path lengths that could be used.

However, if the Commission concludes that some efficiency standard is necessary nonetheless, it should designate ? bps/Hz as the standard. This efficiency level will permit the use of the OOK and BPSK signaling noted above, as well as the FSK modulation scheme, which is somewhat less efficient than OOK or BPSK. (FSK typically exhibits efficiency of approximately 0.35-0.4 bps/Hz.) In addition, rate ½ encoding schemes are common in the microwave band, which, if employed in the 70/80 GHz band would reduce the spectral efficiency below 0.25bps/Hz. Other digital communication techniques such as encryption, packet headers and control channels in the data stream could further reduce the spectral efficiency.

A reduction of the loading requirement is particularly critical if the Commission retains the adopted band segmentation scheme. If licensees use equipment that occupies one 1.25-gigahertz band segment and part of another (or two full segments and part of a third), they may fail the loading requirement based on their authorized bandwidth. For example, one of the 60

GHz products manufactured by Terabeam Corporation transmits and receives in "channels" with radiated bandwidths of greater than 1.25 gigahertz. The equipment employs OOK modulation, which provides approximately 0.5 bps/Hz efficiency across each "channel." If this equipment were operated in the 70 or 80 GHz bands, it would require the use of one full 1.25-gigahertz channel plus a portion of the adjacent 1.25-gigahertz segment, so that its efficiency over the combined 2.5 gigahertz would be considerably less than 0.5 bps/Hz.

In order to overcome this issue, the FCC would need to reduce any spectral efficiency requirement in order to accommodate actual transmission bandwidths that spill over the 1.25 gigahertz channel boundaries that the FCC's current rules impose. A better solution, however, would be to simply specify spectral efficiency of at least ? bps/Hz measured over the bandwidth specified in the emission designator of the equipment employed. While WCA requests elimination of the band segmentation scheme, this spectral efficiency limitation would also be appropriate if the segmentation plan is retained – so long as the FCC applied the limitation across bandwidth used rather than bandwidth authorized.

In summary, the segmentation and channel loading rules adopted in the *Report and Order* introduce more cost, complexity, and constraint than can be justified by the actual likelihood of two users wanting to use the same "spatial pipe." The 1.25-gigahertz channel boundaries should be eliminated, and the channel loading requirement should either be eliminated or reduced to ? bps/Hz.

III. THE COMMISSION SHOULD EMBRACE THE INDUSTRY'S PROPOSALS FOR A POWER/GAIN TRADEOFF, ATPC, AND A SPECTRAL POWER DENSITY RULE

The *NPRM* in this proceeding contained power and antenna gain proposals based on very early technical work by Loea Communications Corp. that was later superseded by work

conducted first by the individual commenters and then jointly under the auspices of WCA's Above 60 GHz Committee. During the reply phase of the comment cycle, six different WCA members filed joint comments announcing that the industry had achieved consensus on several important improvements in the technical specifications that had originally been proposed.[13] Among these were: (1) a more flexible power/gain tradeoff, according to which a manufacturer would be permitted to use lower-gain antennas provided that EIRP was also reduced, at a ratio of 2 dB power for 1 dB gain; (2) a proposal to require ATPC for higher-power radios, with a specified amount of dynamic range; and (3) a proposal for a power spectral density rule. Nonetheless, the Commission adopted its original proposal to require 50 dBi minimum antenna gain and a 0.6 degree half-power beamwidth.[14]

Despite the fact that the *Joint Reply Comments* were signed by Loea and most other WCA members who were active on this issue at the time, the discussion of this issue in the *Report and Order* seemed to rely for technical support on the initial comments filed by Loea and WCA without any recognition that their comments had been superseded by their later participation in the *Joint Reply Comments*.[15] Since the basis in the record for the Commission's decisions has been repudiated by the commenters who initially put it there, the Commission should take a fresh look at the constellation of power and antenna issues. If it does so, it will conclude that it can best serve the public interest in the 70/80 GHz band by embracing the industry's unanimous proposals on these subjects.

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[13] Joint Reply Comments of Loea Communications Corporation, Cisco Systems, Inc., Ceragon Networks, Endwave Corporation, Stratex Networks, Bridgewave Communications, Inc. (filed February 3, 2003) (hereafter "*Joint Reply Comments*").

[14] *Report and Order* ¶ 96.

[15] *Report and Order* ¶ 96.

A. The Commission Should Embrace the Power/Gain Tradeoff

The Commission's 50 dBi antenna gain requirement necessitates the use of antennas that are a minimum of 2 feet in diameter, which are less marketable, more costly, and more sensitive to tower siting issues than smaller antennas. The use of larger antennas is problematic for two principal reasons. First, the use of larger antennas limits available tower structures because of loading limitations. Towers are designed to support a predetermined level of antenna loading, taking into consideration the weight of the antennas and wind resistance characteristics. Many towers, particularly guyed towers and monopoles used by cellular and PCS providers, cannot support the loads that 2 foot or greater diameter dishes would create, with the result that wireless backhaul and otherwise logical applications for 70 and 80 GHz technologies will be unavailable. Conversely, the smaller the antennas, the greater the number of towers that may be available to support millimeter wave systems. Moreover, the smaller the antennas, the greater the number of those antennas that can be mounted on a structure.

The second problem with the existing minimum antenna gain rule is that the sway and twist of many towers are too great to be compatible with antennas with 0.6° or less beamwidth. These towers would exhibit too much movement to ensure that the transmitter and receiver at either end of a link would remain in communication during windy conditions; this problem is exacerbated when mounting a millimeter wave antenna at the top of such an antenna structure, where the sway is even greater.

As the FCC is aware, tower siting continues to be a challenge for telecommunications providers. Therefore, the FCC should adopt regulations that encourage the use of new technologies on existing antenna structures. The antennas that would be mandated by the beamwidth specifications contained in the rules could only be reliably mounted as building

attachments or on pedestals mounted in concrete in the ground (a very high-cost installation method). Less restrictive rules on beamwidth would maximize the use of existing antenna structures and promote the deployment of 70 and 80 GHz systems while still ensuring that the potential for interference among those systems remains extremely low.

Fortunately, simulations conducted and reviewed by WCA members (and submitted for the record in this proceeding) demonstrate that it is possible to relax the minimum gain to 43 dBi, with a half-power beamwidth of 1.2 degrees, without significantly degrading the interference environment – provided that for antennas with gain of less than 50 dBi, the maximum EIRP is decreased by 2 dB for every dB of reduction in gain. This more flexible specification makes it possible to use lower-cost, lower-power products, thus lowering barriers to entry and producing less interference.[16]

The power/gain tradeoff was itself part of a larger agreement among the commenting parties on antenna standards. In addition to the power/gain tradeoff cited above, the members of WCA's Above 60 GHz Committee also agreed on a set of co-polar and cross-polar discrimination standards,[17] as follows:

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[16] WCA recognizes that the use of smaller antennas will necessarily result in wider transmitted beamwidths, but in the context of the other technical rules advanced by WCA this will not unduly reduce frequency re-use opportunities. Even 1.2 degree beamwidths,when combined with the pre-registration interference analysis WCA recommends, will ensure that the use of smaller antennas will not preclude frequency re-use.

[17] See 47 C.F.R. § 101.115.

Frequency (MHz)	Category	Maximum beamwidth to 3dB points (incl. angle in degrees)	Minimum antenna gain (dBi)	Minimum radiation suppression to angle in degrees from center-line of main beam in decibels								
				0° to 1.2°	1.2° to 5°	5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
71,000 to 76,000 (co-polar)	A	1.2	43*	N/a	L_1**	35	40	45	50	50	55	55
71,000 to 76,000 (cross-polar)	A	1.2	43*	25	25	45	50	50	55	55	55	55
81,000 to 86,000 (co-polar)	A	1.2	43*	N/a	L_1**	35	40	45	50	50	55	55
81,000 to 86,000 (cross-polar)	A	1.2	43*	25	25	45	50	50	55	55	55	55

* Antenna gain less than 50 dBi (but greater than 43 dBi) is permitted only with a proportional reduction in maximum authorized EIRP in a ratio of 2 dB of power per 1 dB of gain, so that the maximum allowable EIRP (in dBW) for antennas of less than 50 dBi gain becomes +55 – 2(50-G), where G is the antenna gain in dBi.

** $L_1 = G - 28$, where G is the antenna gain in dBi.

These antenna performance requirements were notable for the cross-polarization discrimination requirement, and also for their attention to angles less than 5 degrees off boresight. Attention to these angles is essential in the 70/80 GHz band because of the need to control interference to a narrow, spatial pipe. Indeed, in any analysis of potential interference between two 70/80 GHz stations, a frequency coordinator who based his calculations on the way antennas perform 5 degrees off boresight would calculate an exclusion zone (or more precisely, an "exclusion pipe") that would be at least an order of magnitude larger than that yielded by the statistics for 1.2 degrees off boresight.[18]

[18] The table above presents the agreed-upon numbers in the most readable format, but unfortunately this involved the use of two columns – the 0-1.2 degree column and the 1.2-5 degree column – that do not currently exist in section 101.115 because they are not used in other frequency bands. In Appendix A, which collects all of the rule changes sought by the WCA on reconsideration, this same information is presented in a format that can readily be imported into the table in section 101.115.

The Commission did not adopt the proposed radiation suppression mask, but it also gave no reason for rejecting it. A discussion in the *Report and Order* of the industry proposal for Automatic Transmitter Power Control suggests that the Commission may have been attemp ting to balance antenna costs against receiver costs, ultimately concluding that it would be in manufacturers' best interests to spend their money on antenna technology and keep the electronics as inexpensive as possible. However, WCA's antenna proposals were developed by a group of hardware manufacturers who sought, received, and considered information from antenna manufacturers before finalizing their proposal. WCA therefore urges the Commission to take a fresh look at these standards in connection with its consideration of the proposed power/gain tradeoff.

B. The Commission Should Require Automatic Transmitter Power Control for Links with EIRP Greater than 23 dBW

After extensive technical consultations, the commenters in this proceeding agreed unanimously that transmitters in the 71-76 GHz and 81-86 GHz bands with EIRP in excess of +23 dBW should be capable of using ATPC over a dynamic range in dB of at least EIRP-23, with EIRP expressed in dBW.[19] Simulations conducted and reviewed by WCA members confirm that such a requirement will make a very significant positive contribution toward managing interference in the 70/80 GHz bands.

As with the power/gain tradeoff, the *Report and Order* gives some indication that the Commission's rejection of ATPC was influenced by practical financial judgments about where flexibility is most needed in order to make 70/80 GHz radios as economically as possible – judgments that are at odds with those of the manufacturers themselves. Moreover, the *Report and Order* does not make it entirely clear whether the Commission even considered the industry

[19] WCA *ex parte* submission of Sept. 30, 2003, at 6.

consensus reflected in the *Joint Reply Comments* or in the September 30, 2003 *ex parte* letter WCA's Above 60 GHz Committee submitted on this subject. For example, the Commission stated that it "concur[red] with Loea, that, under heavy rain circumstances, neighboring links would be using the maximum power triggered by the ATPC, and the antenna pattern might not give enough attenuation to avoid inter-system interference."[20] However, the position attributed to Loea in this portion of the *Report and Order* was one that Loea had abandoned more than six months earlier, when it signed onto the *Joint Reply Comments*. And it is not clear what antenna pattern the Commission was referring to: the one adopted in the *Report and Order*, or the one proposed by the industry.

Computer modeling of various interference environments has demonstrated that ATPC is one of the most important factors in facilitating high-density deployment of 70/80 GHz radios, and those studies are part of the record in this proceeding. ATPC is especially critical in hub-and-spoke deployments, and it materially increases potential link density in random deployments. The Commission should therefore reconsider its rejection of an ATPC requirement.

C. The Commission Should Adopt a Power Spectral Density Limit

In what seems like a simple oversight, the Commission failed to adopt any rule whatsoever regarding power spectral density. The absence of a rule on this would make it perfectly legal for a device to transmit an EIRP of 55 dBW in an arbitrarily small bandwidth (*e.g.*, 1 megahertz). Such a device would have significantly different spectral and spatial properties from the "virtual fiber" radios for which the 70/80 GHz band is uniquely well suited. Interference between narrowband and wideband devices would be difficult to predict with C/I

[20] *Report and Order* ¶ 96.

calculations. Narrowband devices would have much longer ranges and much larger exclusion zones, significantly reducing potential deployment densities.

There are already many bands at lower frequencies in which narrower bandwidths can be used. The 70/80 GHz band should be preserved for high bandwidth radios as a wireless alternative for fiber-equivalent services. Accordingly WCA asks the Commission to adopt the industry proposal to restrict spectral density to no more than 150 mW/100 MHz.[21]

IV. THE COMMISSION SHOULD ADOPT WCA'S PROPOSED INTERFERENCE PROTECTION CRITERIA

In new section 101.147(z), the Commission states that each link will be guaranteed a *minimum* of 36 dB C/I. At an *ex parte* discussion of this issue in early December, WCA's Above 60 GHz Committee suggested that 36 dB should be the *maximum* rather than the minimum.[22] During that discussion, there was much to support the view that the question was strictly a semantic one. Specifically, everyone seemed to understand and agree that no link should have any right to be protected above 36 dB C/I; in that sense 36 dB is a maximum. On the other hand, it also became clear during the meeting that the Commission believes at least some "victim" links should be permitted to object to any new link that will reduce their C/I to below 36 dB; in that sense, the number can be conceived as a minimum. Thus, the 36 dB figure functions as either a minimum or a maximum, depending on context.

While this issue surely has a semantic element, there is at least one respect in which a difference of real substance may be involved: namely, what happens if coordination shows that the new link would reduce the old link's C/I to 20 dB (for example) but the old link would not

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[21] *Joint Reply Comments* at 9.

[22] *Ex Parte* presentation of Cisco Systems, Comsearch, Endwave, LOEA Communications, and Terabeam dated December 11, 2003.

suffer harmful interference at that level. The language submitted by the industry in the *ex parte* letter filed September 30, 2003 would have placed the 36 dB limit in section 101.105 (governing interference criteria), in which context it would be clear that each link gets only what it needs, but no more than 36 dB. We are concerned that the Commission's alternative approach, placing the limit in section 101.147(z), protects every link at the 36 dB level whether it needs it or not, unless the victim link agrees to less protection. Because we expect the vast majority of early and mature deployments in these bands to use digital modulation, particularly in densely populated areas, we believe this will substantially overprotect many links, possibly giving first movers unneeded and unwarranted preemption rights. We therefore ask the Commission to adopt WCA's proposal for amending section 101.105,[23] and to remove the 36 dB reference from section 101.147(z).

V. THE COMMISSION SHOULD AUTHORIZE CONDITIONAL OPERATION FOR APPLICANTS AWAITING THEIR NONEXCLUSIVE NATIONWIDE BLANKET LICENSE

As noted above, the nonexclusive nationwide license that the Commission will offer in these frequency bands is a streamlined version of a Part 101 license, and the additional flexibility that it provides will be a boon to the development of virtual fiber radios. However, the Commission did not amend section 101.31(b), dealing with conditional operation, in order to add the new frequencies to the list of frequencies for which conditional operation is available.[24]

Conditional operation is an important element of licensing under Part 101, and it should be available to 70/80 GHz licensees. Conditional operation enables new applicants to get links up and running as soon as coordination and registration have been completed, which is very

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[23] WCA *Ex Parte* Submission dated September 30, 2003, at 2-3.

[24] *See* WCA *Ex Parte* Submission filed August 7, 2003, at 1.

much in keeping with the overall licensing philosophy adopted in this item. WCA therefore asks the Commission upon reconsideration to amend section 101.31 to add the 71-76 GHz and 81-86 GHz frequencies to the list of bands in which conditional operation is available.

VI. CONCLUSION

The 70/80 GHz bands have the potential to expand the reach of existing fiber networks dramatically, and the Commission has taken great strides toward the adoption of service rules that are conducive to near-term development. WCA now urges the Commission to finish the job by reconsidering the issues raised in this petition, lest all the Commission's good work be wasted.

Respectfully submitted,

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APPENDIX A

FINAL AMENDMENTS TO PART 101 [PROPOSED BY WCA]

For the reasons discussed in the preamble, the Federal Communications Commission hereby amends 47 C.F.R. Part 101 as follows:

PART 101 – FIXED MICROWAVE SERVICES

1. The authority citation for Part 101 continues to read as follows:

AUTHORITY: 47 U.S.C. 154 and 303, unless otherwise noted.

2. Section 101.31 is amended by revising subparagraph (b)(1) to read as follows:

§ 101.31 Temporary and Conditional Authorizations.

* * * * *

(b) * * *

(1) An applicant for a new point-to-point microwave radio station(s) or a modification of an existing station(s) in the 3,700-4,200; 5,925-6,425; 6,525-6,875; 10,550-10,680; 10,700-11,700; 11,700-12,200; 12,200-12,700; 12,700-13,200; 13,200-13-250; 17,700-19,700; 21,200-23,600; 71,000-76,000; and 81,000-86,000 MHz bands (see § 101.147 for specific service usage) may operate the proposed station(s) during the pendency of its application(s) upon the filing of a properly completed formal application that complies with subpart B of part 101 if the applicant certifies that the following conditions are satisfied:

(i) The frequency coordination procedures of § 101.103 have been successfully completed; or for the 71 – 76 and 81 – 86 GHz bands, the government coordination procedures of § 101.1523 have been successfully completed and a pre-registration interference analysis of non-government links has shown that operation of the proposed facility will not cause harmful interference to any previously registered station.

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3. Section 101.63 is amended by revising paragraph (b) to read as follows:

§ 101.63 Period of Construction; Certification of Completion of Construction

* * * * *

(b) For the 70 GHz, 80 GHz, and 90 GHz bands, the period of construction shall be 180 days, commencing on the date of each registration of each individual link; adding links will not change the overall renewal period of the license.

* * * * *

4. Section 101.105 is amended by adding a new subparagraph (a)(6) and revising subparagraph (c)(2)(ii) to read as follows:

§ 101.105 Interference protection criteria

(a) * * *

*** * * * ***

(6) *71-76 GHz and 81-86 GHz band.* In these bands the interference analysis shall be conducted on a full-band basis (71-76 or 81-86 GHz). Thus for comparison to the following criteria, the carrier-to-interference ratio (C/I) shall be calculated as the ratio of the total carrier power to the total interference power in the 71-76 GHz or 81-86 GHz band. C/I objectives in excess of 36 dB shall not be protected in these bands.

(i) For receivers employing digital modulation: based upon manufacturer data and following TSB 10 or other generally acceptable good engineering practice, for each potential case of interference a threshold-to-interference ratio (T/I) shall be determined that would cause 1.0 dB of degradation to the static threshold of the protected receiver. For the range of carrier power levels (C) between the clear-air (unfaded) value and the fully-faded static threshold value, in no case shall interference cause C/I to be less than the T/I so determined unless it can be shown that the availability of the affected receiver would still be acceptable despite the interference.

(ii) For receivers employing analog modulation: manufacturer data or industry criteria will specify a baseband signal-to-noise requirement (S/N) of the receiver that will result in acceptable signal quality for continuous operation. Following TSB 10 or other generally acceptable good engineering practice, for each potential case of interference a C/I objective shall be calculated to ensure that this S/N will not be degraded by more than 1.0 dB. For the range of carrier power levels (C) between the clear-air (unfaded) value and the fully-faded threshold value, in no case shall interference cause C/I to be less than the objective so determined unless it can be shown that the signal quality and availability of the affected receiver would still be acceptable despite the interference.

* * * * *

(c) * * *

* * * * *

(2) * * *

* * * * *

(ii) *Adjacent Channel Interference.* Applicable to all bands except the 71-76 GHz and 81-86 GHz bands because those bands are unchannelized: the existing or previously authorized system must be afforded a carrier to interfering signal protection ratio of at least 56 dB.

* * * * *

5. Section 101.109 is amended by revising two entries in the table in paragraph (c), and note 3 to that table, as follows:

§ 101.109 Bandwidth

* * * * *

(c) * * *

Frequency band (MHz)	Maximum authorized bandwidth
*	*
71,000-76,000	5,000 MHz
81,000-86,000	5,000 MHz
*	*

* * *

[3]To be specified in authorization. For the band 92 to 95 GHz, maximum bandwidth is licensed in one segment of 2 GHz from 92-94 GHz and one 0.9 GHz segment from 94.1 to 95 GHz, or the total of the loaded band if smaller than the assigned bandwidth.

* * * * *

6. Section 101.113 is amended by adding a new note 11 to two entries in the table in paragraph (a), and revising paragraph (b) to read as follows:

§ 101.113 Transmitter power limitations

(a) * * *

Frequency band (MHz)	Maximum Allowable EIRP	
	Fixed (dBW)	Mobile (dBW)
*	*	*
71,000-76,000[11]	+55	+55
81,000-86,000[11]	+55	+55
*	*	*

* * * * *

[11] The 55 dBW limit applies per polarization. The maximum transmitter power is limited to 3 watts (5 dBW) and the maximum transmitter power spectral density is limited to 150 mW per 100 MHz.

(b) (1) The power of transmitters that use Automatic Transmitter Power Control shall not exceed the power input or output specified in the instrument of station authorization. The power of non-ATPC transmitters shall be maintained as near as practicable to the power input or output specified in the instrument of station authorization.

(2) Transmitters operating in the 71-76 GHz and 81-86 GHz bands with EIRP in excess of +23 dBW must possess capability for Automatic Transmitter Power Control over a dynamic range in dB of at least {EIRP in dBW of the radiating device} – 23, or 0 dB, whichever is greater. Transmit power for these stations must be adjusted such that one of the following two conditions is met at all times: (i) C/N at the receiver is no greater that 10 dB above the threshold specified in § 101.105(a)(6); or (ii) the transmitter has reduced its output power to the required minimum specified in this subparagraph.

* * * * *

7. Section 101.115 is amended by adding four new entries to the table following paragraph (b)(2) and adding a new explanatory note immediately following the table, and by deleting the existing entries pertaining to the 71-76 GHz and 81-86 GHz bands, as follows:

§ 101.115 Directional Antennas

* * * * *

(b) *** * ***

(2) * * *

Frequency (MHz)	Category	Maximum beamwidth to 3dB points (incl. angle in degrees)	Minimum antenna gain (dBi)	Minimum radiation suppression to angle in degrees from center-line of main beam in decibels						
				5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
*	*	*	*	*	*	*	*	*	*	*
71,000 to 76,000 (co-polar)	A	1.2	43[15]	35	40	45	50	50	55	55
71,000 to 76,000 (cross-polar)	A	1.2	43[15]	45	50	50	55	55	55	55
81,000 to 86,000 (co-polar)	A	1.2	43[15]	35	40	45	50	50	55	55
81,000 to 86,000 (cross-polar)	A	1.2	43[15]	45	50	50	55	55	55	55
*	*	*	*	*	*	*	*	*	*	*

* * * * *

[15] Antenna gain less than 50 dBi (but greater than 43 dBi) is permitted only with a proportional reduction in maximum authorized EIRP in a ratio of 2 dB of power per 1 dB of gain, so that the maximum allowable EIRP (in dBW) for antennas of less than 50 dBi gain becomes +55 – 2(50-G), where G is the antenna gain in dBi. In addition, antennas in these bands must meet two additional standards for minimum radiation suppression: (1) at angles of between 1.2 and 5 degrees from the centerline of main beam, co-polar discrimination must be G – 28, where G is the antenna gain in dBi; and (2) at angles of between 0 and 5 degrees from the centerline of main beam, cross-polar discrimination must be at least 25 dB.

* * * * *

8. Section 101.147 is amended by deleting subparagraphs (z)(2) and (z)(3), and renumbering subparagraph (z)(1) as paragraph (z).

9. Section 101.1505 is amended by revising paragraphs (a) and (b) to read as follows:

§ 101.1505 Segmentation plan.

(a) An entity may request any portion of the 71-76 GHz and 81-86 GHz bands, up to 10 GHz. Licensees are also permitted to register segments less than 10 GHz.

(b) The 92-95 GHz band is divided into three segments: 92.0-94.0 GHz and 94.1-95.0 GHz for non-government and government users, and 94.0-94.1 GHz for Federal Government use. Pairing is allowed and segments may be aggregated without limit. The bands in paragraph (a) of this section can be combined in a single authorization with those in paragraph (b), for a possible 12.9 GHz maximum aggregation. Licensees are also permitted to register smaller segments than provided here.

10. Section 101.1523 is amended by revising paragraph (b) to read as follows:

§ 101.1523 Sharing and coordination among non-government licensees and between non-government and government services.

* * * * *

(b) The licensee or applicant shall (1) complete coordination with Federal Government links according to the coordination standards and procedures adopted in Report and Order, FCC 03-248, and as further detailed in subsequent implementation public notices issued consistent with that order; and (2) certify that it has analyzed the potential for harmful interference to or from all previously registered non-government links according to the standards of section 101.105 and generally accepted good engineering practice, and has determined that it will neither cause harmful interference to, nor receive harmful interference from, any previously registered non-government link. Protection of individual links against harmful interference from other links shall be granted to first-in-time registered links. Successful completion of coordination via the NTIA automated mechanism shall constitute successful non-Federal Government to Federal Government coordination for that individual link.

* * * * *