

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
)	
Amendment of Part 101 of the Commission's Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses and to Provide Additional Flexibility to Broadcast Auxiliary Service and Operational Fixed Microwave Licensees)	WT Docket No. 10-153
)	
)	
Request for Interpretation of Section 101.141(a)(3) of the Commission's Rules Filed by Alcatel-Lucent, Inc., <i>et al.</i>)	WT Docket No. 09-106
)	
)	
Petition for Declaratory Ruling Filed by Wireless Strategies, Inc.)	WT Docket No. 07-121
)	
)	
Request for Temporary Waiver of Section 101.141(a)(3) of the Commission's Rules Filed by Fixed Wireless Communications Coalition)	

COMMENTS OF MOTOROLA, INC.

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COMMENTS OF MOTOROLA, INC.

I. INTRODUCTION AND SUMMARY

Motorola, Inc. (“Motorola”) submits these comments in response to the Federal Communications Commission’s (“Commission”) Notice of Proposed Rulemaking and Notice of Inquiry (“NPRM/NOI”) that seeks input on increasing the efficient use of spectrum for wireless backhaul.¹ As detailed below, Motorola agrees with the Commission’s conclusion that

¹ *In the Matter of Amendment of Part 101 of the Commission’s Rules to Facilitate the Use of Microwave for Wireless Backhaul and Other Uses and to Provide Additional Flexibility to Broadcast Auxiliary Service and Operational Fixed Microwave Licensees; Request for Interpretation of Section 101.141(a)(3) of the Commission’s Rules Filed by Alcatel-Lucent, Inc., et al.; Petition for Declaratory Ruling Filed by Wireless Strategies, Inc.; Request for Temporary Waiver of Section 101.141(a)(3) of the Commission’s Rules Filed by Fixed Wireless*

“providing for the more flexible use of microwave frequencies for backhaul may help promote access to backhaul solutions that are critical to the deployment of wireless broadband and other services.”² Motorola therefore supports many proposals in the NPRM/NOI and believes that the careful implementation of these proposals will increase opportunities for users of point-to-point and point-to-multipoint backhaul services, while protecting established license holders.³

II. MOTOROLA STRONGLY SUPPORTS THE COMMISSION’S OVERARCHING GOAL OF PROVIDING ADDITIONAL SPECTRUM FOR WIRELESS BACKHAUL.

A. The Need for Additional Spectrum Below 10 GHz for Wireless Backhaul Is Beyond Dispute.

Additional spectrum is desperately needed to satisfy the current and future wireless backhaul demands of next generation wireless broadband services. As the Commission explains, “[s]everal studies suggest that within the next five years, the amount of mobile data traffic in North America will increase by a factor of twenty to over forty times the level of data traffic in 2009.”⁴ And, as mobile data traffic increases, carriers will need to increase their backhaul

Communications Coalition, WT Docket No. 10-153; WT Docket No. 09-106; WT Docket No. 07-121, FCC 10-146 (2010) (“NPRM/NOI”).

² *Id.* at ¶ 1.

³ Specifically, the Commission asks whether it should: (1) make 750 additional megahertz of spectrum available for FS uses by maximizing the opportunity for FS to share existing bands reserved for BAS and CARS; (2) eliminate the “final link” rule, which will provide the broadcast industry with additional flexibility in using Part 101 spectrum as the final RF link in the chain of distribution of the program material to broadcast stations; (3) permit adaptive modulation, which would allow FS licensees to temporarily drop below minimum payload capacity requirements when adverse propagation characteristics would otherwise force communications to be terminated; (4) allow FS licensees to operate “auxiliary stations” in conjunction with existing microwave links, subject to frequency coordination; (5) lower the current efficiency standards in rural areas; and (6) allow FS licensees to use smaller antennas. *Id.* at ¶ 5.

⁴ *Id.* at ¶ 3.

capacity to accommodate that traffic.⁵ While fiber backhaul will be invaluable,⁶ wireless backhaul will be similarly important. In fact, microwave may be the “only practical high-capacity backhaul solution available to serve certain rural and remote locations.”⁷ By enabling more flexible and cost-effective microwave services, the Commission can foster the rapid nationwide deployment of wireless broadband.⁸

Unfortunately, the existing fixed bands available to non-Federal users for long-haul traffic—the Lower and Upper 6 GHz bands—are congested and will not satisfy growing wireless backhaul needs in many parts of the country.⁹ Motorola therefore supports allocating additional spectrum for wireless backhaul and, particularly, spectrum below 10 GHz, which is preferred for long-link backhaul because signals can overcome the rain fading effects that limit transmission distances at higher frequencies.¹⁰ As detailed below, the best opportunities for backhaul below 10 GHz are in the 6875-7125 MHz band and federal spectrum between 7125-8500 MHz.

⁵ *Id.*

⁶ The importance of copper circuits will continue to decrease going forward. As the Commission notes, “while copper circuits currently serve as the predominant choice for backhaul, fixed wireless (including microwave) solutions are gaining popularity.” *Id.* at ¶ 2.

⁷ *Id.*

⁸ *See also* Federal Communications Commission, National Broadband Plan, at Section 5.1, p. 77, Exhibit 5-B (2010).

⁹ *Amendment of Part 101 of the Commission’s Rules to Accommodate 30 Megahertz Channels in the 6525-6875 MHz Band; Amendment of Part 101 of the Commission’s Rules to Provide for Conditional Authorization on Additional Channels in the 21.8-22.0 GHz and 23.0-23.2 GHz Band; Fixed Wireless Communications Coalition Request for Waiver*, Notice of Proposed Rulemaking and Order, WT Docket No. 09-114, RM-11417, FCC 09-58 (rel. June 29, 2009).

¹⁰ Rain attenuation is a critical operational factor for backhaul spectrum. Rain attenuation begins to affect propagation at frequencies above 10 GHz and gets progressively worse at higher frequencies. As a result, links in the bands 10 GHz and higher must be designed for shorter distances to meet reliability objectives in the presence of rain attenuation. Because of their

B. Motorola Supports the Commission’s Proposal to Permit FS Operations in the 6875-7125 MHz and 12700-13200 MHz Bands.

Motorola agrees with the Commission that it is “vital” to open up additional spectrum for wireless backhaul.¹¹ Accordingly, Motorola supports the Commission’s proposal to allow FS systems to share the 6875-7125 MHz and 12700-13200 MHz bands with existing BAS and CARS licensees. As the Commission explains, the 6875-7125 MHz band—which is adjacent to existing FS operations in the 6525-6875 MHz band—is well-suited for long-haul wireless backhaul.¹² And the 12700-13200 MHz band is well suited for short- and medium-length wireless backhaul and, in fact, was available to certain relocated FS systems prior to 1988.¹³ Although this spectrum, by itself, will not satisfy the expected surge in wireless backhaul, the Commission should nevertheless seize this opportunity given the rapidly approaching transition to 4G technologies.

The Commission’s proposal, however, is not without problems. In particular, sharing between fixed wireless backhaul operations and temporary, mobile Electronic News Gathering (“ENG”) operations in the 6875-7125 MHz band may give rise to harmful interference. ENG operations frequently deploy at the site of late-breaking news events and, by virtue of the fleeting nature of news, are temporary. As such, coordination in the 6875-7125 MHz band is “not as formalized” as in other bands.¹⁴ Without formal coordination of all links in this band, harmful

superior propagation characteristics, frequencies below 10 GHz can provide the long path lengths necessary for backhauling rural cell sites to switching centers in urban cores.

¹¹ NPRM/NOI at ¶ 11.

¹² *Id.* at ¶¶ 9, 15.

¹³ *Id.* at ¶ 16.

¹⁴ *Id.* at ¶ 15.

interference may likely occur between new fixed wireless links and temporary ENG transmissions. Given the critical traffic transmitted over wireless backhaul—and the fact that interference to a backhaul link impacts service to a significant number of users—the Commission should fully vet these interference concerns before adopting its proposal. The Commission’s current proposal to prevent interference—mandating the identification of receive-only sites associated with TV pickup stations¹⁵—is likely insufficient. To reduce the potential for interference in shared spectrum, it is vital that parties know the complete path of a transmission, not just its end-point.

C. Motorola Supports Opening FCC-NTIA Discussions Regarding the Non-Federal Use of the 7125-8500 Band.

The need for additional spectrum for wireless backhaul below 10 GHz is beyond dispute. As explained above, however, permitting wireless backhaul in the 6875-7125 MHz band will not adequately address spectrum needs because of interference concerns with existing broadcast users. Given this, the Commission must look for additional spectrum opportunities. In particular, the Commission should approach NTIA about the possible sharing of the 7125-8500 MHz band between non-federal users and existing federal users.

The Commission already solicited comments on this proposal in a recent proceeding based on a Petition for Rulemaking filed by the Fixed Wireless Communications Coalition (“FWCC”) requesting that the Commission cooperate with the NTIA in launching a

¹⁵

Id.

rulemaking on non-Federal use of the 7125-8500 MHz band.¹⁶ There, the record evidence strongly supported this proposal. As Motorola explained in its comments endorsing the FWCC Petition, the proposed sharing is feasible, as evidenced by the successful federal/non-federal sharing in the 23 GHz band. Further, sharing will necessarily involve deference to the federal government users of the band, and mutually satisfactory coordination procedures can be used to protect against the risk of harmful interference.

III. MOTOROLA SUPPORTS THE USE OF ADAPTIVE MODULATION.

Motorola supports the Commission's "adaptive modulation" proposal, which would permit fixed microwave licensees to temporarily drop below minimum payload capacity requirements when a link would otherwise be temporarily out of service, such as during short, atmospherically-caused decreases in received signal strength.¹⁷ Adaptive modulation provides many benefits for the both the wireless industry and regulators. The use of adaptive modulation allows fixed microwave links to reduce the modulation order and corresponding data rate, thereby avoiding service outages during atmospherically induced fading. Maintaining the link during propagation fades also avoids the additional outage time required to resynchronize the network. The use of adaptive modulation reduces the additional transmitter power that has to be included in a link budget for a fixed link to counter a specified amount of atmospherically induced fading. By using more robust modulation and reducing the data rate, the link can be

¹⁶ See Consumer and Governmental Affairs Bureau Reference Information Center Petition for Rulemakings Filed, *Public Notice*, Report No. 2908 (rel. June 4, 2010); see also Petition for Rulemaking of the Fixed Wireless Communications Coalition, RM-11605 (filed March 16, 2010) ("FWCC Petition").

¹⁷ Adaptive modulation is now a mature technique that is used to improve the availability of a radio link when it is subject to adverse propagation conditions that increase the radio path loss to such an extent that the link could otherwise become unavailable. During periods of increased path loss, the receiver sensitivity is improved by moving (adapting) to a lower order modulation and/or applying more FEC coding to the transmission.

maintained with lower transmitter power levels than would otherwise be required during faded conditions.¹⁸ Thus, the link's interference potential will be reduced. The Commission's proposal will be particularly beneficial for service provided in rural areas, where wireless backhaul often is the only means to connect remote base stations to a wireless provider's network.

The Commission, however, should not give licensees so much latitude that they deploy inefficient systems inconsistent with good engineering practices. To this end, the Commission should not adopt rules that rely on subjective definitions to define when the minimum payload requirement must be met—such as “on average” and “during normal operation.”¹⁹ Motorola supports a more precise definition. For example, it is standard industry practice to design links to typically achieve availabilities of 99.95% or higher.²⁰ Here, the Commission could require that a receiver operate at a modulation level that supports the minimum payload requirements of FCC Part 101.141 at a defined link availability. In the above example,²¹ this would ensure that the payload only falls below the currently regulated minimum for less than 0.05% of the time in

¹⁸ The improvement in link budget comes mainly from the improved sensitivity of the lower order modulations and therefore there is less need to use automatic power control to increase the transmitted power (and hence interference).

¹⁹ The NPRM seeks comment on the terms used to define when the minimum payload requirement must be met—such as “on average” and “during normal operation.” NPRM at ¶ 38. Motorola agrees with the Commission that the term “on average” is not helpful in this context as it might be perceived as permitting a link to be designed to be compliant with Part 101.141 payload rates for 50% of the time.

²⁰ A link is designed to ensure that this availability can be achieved with the received signal strength remaining high enough for the receiver to operate at the required modulation level (to meet 101.141) for the specified availability even in the case of the predicted fading environment.

²¹ The 99.5% availability metric is simply an example. Motorola is not wedded to a specific metric at this time and would be open to additional discussions among interested parties.

any month, which would amount to no more than 21 minutes. Using this approach, defined time limits or other timer means would not be required.²²

Additional protections should also be implemented to prevent spectral inefficiency and defend against harmful interference. Licensees wishing to use modulations below the minimum payload capacity in Section 101.141 should state this in their prior coordination notices. Further, the minimum link availability figure used in the link design to meet Section 101.141 criteria should also be stated. And to avoid increased interference to other links in the area when the link adapts to a lower modulation order, the transmitted EIRP density should not be permitted to increase above the licensed value defined for full capacity operation.

IV. THE COMMISSION SHOULD ADOPT SIGNIFICANT PROTECTIONS FOR EXISTING OPERATIONS AND FUTURE PRIMARY LICENSEES IF IT DECIDES TO PERMIT AUXILIARY STATIONS.

Given the success of the existing fixed wireless licensing regime, the Commission is correct to proceed with caution with respect to “auxiliary stations.” Although Motorola supports the flexibility inherent in the auxiliary station concept, the Commission must be vigilant about constructing sufficient safeguards to prevent harmful interference from auxiliary stations. For these reasons, further review of the auxiliary station proposal should occur before any rules are adopted.

If the Commission permits the use of auxiliary stations, it must adopt rules that prohibit any incremental interference to primary links. First, the rules should require that licensees alternate transmissions in time between the primary station and the auxiliary stations.²³ Second,

²² It should be noted that the advantage of allowing this relaxation in terms of availability is that the interference levels can be reduced as the EIRP allowed in the licensing process does not have to allow for the “anomalous fading” conditions.

²³ NPRM/NOI at ¶ 52. The FCC may also want consider specifying when an auxiliary link will be permitted. For example, should auxiliary links only be allowed if the link loss is within a

auxiliary stations should be granted secondary status and should not be able to claim protection from interference from any primary stations, including primary stations in other services and primary stations deployed after the auxiliary stations.²⁴ Third, auxiliary stations should be restricted—at least initially—from communicating directly with each other, as auxiliary-to-auxiliary communications would raise additional interference concerns.²⁵

Motorola also supports decreasing certain fixed service requirements for auxiliary stations. Specifically, auxiliary stations should not be subject to the antenna standards or minimum path length requirements that apply to main links. Additionally, auxiliary stations should be exempt from the loading requirements. Licensees, however, should be allowed to aggregate loading on the main link and auxiliary stations.²⁶

V. MOTOROLA SUPPORTS LOWERING EFFICIENCY STANDARDS IN RURAL AREAS.

Motorola supports allowing operators in rural areas to deploy links with longer path lengths.²⁷ Reducing the minimum payload requirement of Section 101.141 in rural areas would permit operators to use lower modulations. For example, at 6 GHz using a 10 MHz bandwidth channel, the payload limit implies a minimum modulation of 128QAM. Reducing the modulation will provide both higher receive sensitivity and allow higher transmit power. In turn,

few dB of FSPL? Should the auxiliary links operate at lower EIRP levels than primary links to reduce interference risks, given that auxiliary links will likely operate at lower ranges?

²⁴ *Id.*

²⁵ However, requiring that auxiliary stations only communicate with the primary link's transmitter/receiver is an unnecessary limitation. Motorola believes it is sufficient to ensure that one of the auxiliary stations is co-located with the primary link's transmitter/receiver provided that there are safeguards in the authorization process (*e.g.*, limited EIRP for the auxiliary links).

²⁶ If the links time-share the spectrum, then double counting issues will not arise.

²⁷ *Id.* at ¶ 60.

this will improve the link budget and increase the range by a significant factor depending on the designed link availability.

Examples of the improvement in link budget that can be obtained by moving to lower modulation types, using 128QAM as a reference, is shown in Table 1 below.

TABLE 1

Modulation Type	Increase in Tx Power (dB)	Rx Sensitivity Improvement (dB)	Link Budget Improvement (dB)
128QAM	ref	ref	0
64QAM	0	+5	+5
32QAM	+4	+7	+11
16QAM	+4	+10	+14
QPSK	+6	+14	+20

VI. MOTOROLA SUPPORTS ALLOWING FIXED SERVICES LICENSEES TO USE SMALLER ANTENNAS.

The Commission should permit fixed services licensees to use smaller antennas. Smaller antennas reduce link ownership costs by lowering the purchase cost of the antenna and shipping charges. Smaller antennas also lower the cost of tower rental. Smaller antennas require less structural strength (*i.e.*, tower girth) to protect against wind loading and therefore can be mounted higher and give a greater link range. Ultimately, this decreases the need for additional towers and facilitates more collocation.

With respect to implementation, the Commission should only relax the antenna parameters for rural area use in spectrum at 11 GHz and below. For the 6 GHz and 11 GHz bands, Part 101.115 requires a minimum gain of 38dB. This invariably drives link designers to deploy antennas with diameters of at least 6 feet. As Table 2 below shows, while six foot antennas satisfy the 38db minimum gain requirement, four foot antennas do not. But four foot antennas are widely available and could prove cost-effective and reliable in rural areas where the

narrow beamwidth and lower sidelobe gain provided by a larger diameter antenna are not needed to protect adjacent links from interference. Further, Motorola anticipates that non-federal use will be permitted in the 7 GHz and 8 GHz bands in the near future. Motorola hopes that any minimum gain requirement for these bands also will be relaxed in rural areas. As Table 2 shows, antennas with as low as two foot diameters are available.

TABLE 2

Dia feet	Freq GHz	Gain, dBi			Beamwidth degs	XPD dB	F/B dB
		Bot	Mid	Top			
4	5.925 - 7.125	34.0	35.0	36.0	2.9	30	61
6	5.925 - 7.125	37.8	39.0	39.8	1.8	30	65
2	7.125 - 8.5	29.5	30.7	31.9	4.7	32	57
2.5	7.125 - 8.5	33.2	33.9	34.4	3.3	32	60
4	7.125 - 8.5	36.8	37.3	37.7	2.2	32	63
6	7.125 - 8.5	40.1	40.8	41.1	1.5	32	67
2	10.7 - 11.7	34.0	34.4	35.0	3.3	30	60
2.5	10.7 - 11.7	36.8	37.5	38.1	2.1	30	63
4	10.7 - 11.7	40.0	40.4	40.8	1.5	30	67
6	10.7 - 11.7	43.3	43.8	44.4	1.1	30	70
1	12.70 - 13.25	30.8	30.9	31.0	4.7	30	56
2	12.70 - 13.25	35.6	35.8	36.0	2.7	30	62
2.5	12.70 - 13.25	38.2	38.4	38.6	2.1	30	65
4	12.70 - 13.25	41.9	42.0	42.1	1.3	30	68
6	12.70 - 13.25	44.8	45.2	45.5	0.9	30	72

Table: Typical antenna performance

VII. CONCLUSION

Motorola stresses that the Commission can speed the deployment of 4G wireless broadband networks by enabling more flexible and cost-effective microwave services. To this end, Motorola supports many of the proposals in the NPRM/NOI, which will increase

opportunities for users of point-to-point and point-to-multipoint services, while protecting established license holders.

Respectfully submitted,

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