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February 22, 2001

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

BY HAND DELIVERY

Ms. Magalie Salas, Secretary
Federal Communications Commission
445 12th Street SW
Washington DC 20554

Re: ET Docket No. 00-258 Amendment of Part 2 of the Commission's Rules to Allocate
Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of
New Advanced Wireless Services, Including Third Generation Wireless Systems

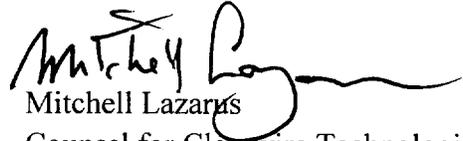
Dear Ms. Salas:

I submit herewith for filing with the Commission the original and four copies of Comments of
Clearwire Technologies, Inc., in the above-referenced proceeding.

Kindly date-stamp and return the extra copy provided.

If there are any questions about this submission, please contact me directly at the number above.

Respectfully submitted,



Mitchell Lazarus
Counsel for Clearwire Technologies, Inc.

ML:deb

Enclosures

cc: Thomas F. Daley, Esq.
David Chauncey
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Before the
Federal Communications Commission
Washington DC 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of)	
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Amendment of Part 2 of the Commission's)	
Rules to Allocate Spectrum Below 3 GHz for)	
Mobile and Fixed Services to Support the)	ET Docket No. 00-258
Introduction of New Advanced Wireless)	
Services, including Third Generation)	
Wireless Systems)	
)	
Petition for Rulemaking of the Cellular)	
Telecommunications Industry Association)	
Concerning Implementation of WRC-2000:)	RM-9920
Review of Spectrum and Regulatory)	
Requirements for IMT-2000)	
)	
Amendment of the U.S. Table of Frequency)	
Allocations to Designate the 2500-2520/)	RM-9911
2670-2690 MHz Frequency Bands for the)	
Mobile-Satellite Service)	

COMMENTS OF CLEARWIRE TECHNOLOGIES, INC.

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February 22, 2001

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COMMENTS OF CLEARWIRE TECHNOLOGIES, INC.

Clearwire Technologies, Inc. (Clearwire) hereby files these comments in the above-captioned proceeding.¹

Clearwire is a provider of wireless high speed Internet access, and manufactures equipment for two-way fixed wireless Internet access in the 2500-2690MHz band.

Clearwire explains below why the proposal to reallocate 2500-2690MHz to 3G is ill-advised and must be abandoned.

¹ *Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, Including Third Generation Wireless Systems*, ET Docket No. 00-258, Notice of Proposed Rule Making and Order, FCC 00-455 (released Jan. 5, 2001).

A. Summary

Reallocation of the fixed MDS/ITFS band to 3G mobile services would necessarily entail at least one of the following: (1) operating fixed and mobile services on the same frequencies; (2) relocating fixed services to some other band; or (3) segmenting the band between fixed and mobile. None of these options is practicable.

1. Co-Channel Sharing. The Commission acknowledges that sharing is not feasible in the same geographic region, given the need for large separation distances. Yet the highest demand for both MDS/ITFS fixed and 3G mobile will coincide in the same population centers. Sharing the spectrum is not workable.

2. Relocation. The second option requires replacing more than 124,000 transmitters and a million school and consumer receivers, which would be wholly impracticable. Moreover, relocation depends on finding spectrum to relocate to. The Commission looked for suitable spectrum in 1992, and found none. It would be even more difficult to find suitable spectrum today.

3. Segmentation. This option requires replacing only about half of the 124,000 transmitters and million receivers now in use, but that is no more feasible than replacing all of them. Instead of needing new spectrum, segmentation would entail squeezing 31 channels' worth of capacity into about 15. That would end any prospect of two-way MDS/ITFS as a viable competitor to the DSL/cable broadband Internet access duopoly.

Even if it were practicable, reallocation of the spectrum would inevitably obstruct MDS/ITFS operations. This is contrary to the public interest, for several reasons:

Growing demand for fixed Internet access. Increased *mobile* broadband access will not cut into the growing demand for access to *fixed* services, any more than wireless phones reduced the demand for wireline handsets. The Commission notes that DSL and cable will be unable to keep up with the demand for fixed broadband. MDS/ITFS wireless will have to take up the slack, serving an expected 7 million subscribers by 2005 -- but not if its spectrum is impaired.

Investment. The MDS industry has already invested *several billion dollars* in reliance on the current rules to develop broadband fixed wireless data systems in the band, including high-speed Internet access, and has plans to invest billions more. Specific investments include research and development in advanced delivery technologies; licensed and leased spectrum acquisitions in the band; and construction of systems on this spectrum. Reallocation would not only strand much of this investment, but would chill continuing investment by signaling the markets that investment in any radio-based technologies will be burdened with the risks of unexpected regulatory U-turns.

Development of technology. Finally, continued provision of fixed Internet access in the band will act as a proving ground for advanced radio technologies, some of which will be useful for effective 3G implementation. Not only is development easier and less expensive in a fixed wireless setting, but some of these technologies might never be affordable in a mobile environment without the opportunity to mature (and recover early investment) in the fixed wireless environment.

In short, reallocation of the band would be both infeasible, as a practical matter, and contrary to the public interest as a matter of policy.

B. Introduction

The Notice proposes to reallocate part or all of the 2500-2690MHz band to 3G services.

Yet the Notice itself, along with the Interim Report it relies on, identifies several reasons why this proposal is unworkable:

- 2,175 ITFS and 2,570 MDS licenses in place,² operating over 124,000 transmitters;³
- 70,000 registered ITFS receive sites and *over one million* wireless cable (MDS) customers;⁴
- ITFS channels used in furtherance of educational missions;⁵
- MDS "white space" auctioned in reliance on the current rules;⁶
- complex MDS/ITFS leasing and sharing arrangements;⁷
- MDS spectrum used for high speed Internet access by 25 licensees in at least 43 markets, plus plans for offerings in numerous additional markets;⁸

² *Spectrum Study of the 2500-2690 MHz Band*, Federal Communications Commission at 18-19 (November 15, 2000) (Interim Report).

³ The average number of licensed transmitters exceeds 4,000 for each of 31 channels. Interim Report at 60.

⁴ Interim Report at 18-19.

⁵ Notice at para. 59.

⁶ Notice at para. 58.

⁷ Notice at para. 64.

⁸ Notice at para. 60. The Commission approved two-way service only recently. *Amendment of Parts 21 and 74 to Enable Multipoint Distribution Service and Instructional Television Fixed Service Licensees to Engage in Fixed Two-Way Transmissions*, 13 FCC Rcd 19112 (1998), *recon.*, 14 FCC Rcd 12764 (1999), *further recon.*, FCC 00-244 (released July 21, 2000) ("*Two-Way Transmissions*").

- 2,267 pending applications to offer two-way service;⁹ and
- billions of dollars invested by MDS interests in broadband fixed wireless services, in reliance on the current rules.¹⁰

This evident high level of activity in the band results from two successful Commission policies. First, the Commission has long promoted MDS as an alternative to traditional franchised cable, as part of the Commission's ongoing efforts to develop a competitive market in multichannel video services.¹¹ Second, the Commission has actively encouraged the deployment of fixed, two-way, broadband Internet services in the MDS/ITFS bands:

A new, competitive group of players will now enter the market for high speed two-way communications service. Both individual and business consumers will be able to use the new high-speed and high-capacity data transmission and Internet service that will be available through the new systems. Also, consumers will be able to take advantage of new video-conferencing, distance learning and continuing education opportunities. . . . Most importantly from a consumer perspective, there will be another choice of provider for these services, helping to drive down the costs in a more competitive market.¹²

The Commission wrote those words less than three years ago. But even that short time has proved the Commission right. Today, MDS/ITFS is the most realistic alternative to the DSL/cable duopoly for delivery of broadband services, and is expected to account for 7 million

⁹ Notice at para. 60.

¹⁰ Interim Report at ii.

¹¹ See, e.g., *Declaratory Ruling on the Use of Digital Modulation by Multipoint Distribution Service and Instructional Television Fixed Service Stations*, 11 FCC Rcd 18839, 18841-45 (1996); *Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service*, 9 FCC Rcd 7665, 7666 (1994).

¹² *Two-Way Transmissions*, 13 FCC Rcd at 19116-17.

fixed wireless broadband subscribers in the United States by 2005.¹³ Clearwire, and many other participants, are investing their energy and resources in the development of equipment to make the Commission's vision a reality.

This is not the first time the Commission has considered reallocating MDS spectrum for other technologies. The same idea failed to find approval nine years ago.¹⁴ There were too many ongoing operations in the band, the Commission decided -- and too many subscribers, and too many pending applications. The Commission also was unable to find alternative spectrum that could support MDS.¹⁵ Use of the band has grown since that decision, both in raw numbers and in types of services offered, and alternative spectrum has only become more scarce. Reallocating the band makes even less sense today than in 1992.

C. Reallocation of the 2500-2690MHz to 3G is Not Feasible.

Reallocating an occupied band necessarily entails one or more of the following: (1) operating the incumbent service and the new service together on the same frequencies; (2) relocating the incumbent service to some other band; or (3) segmenting the band between the incumbent service and the new service. As we show below, all three options are clearly impractical.

¹³ Interim Report at 22 & n.28.

¹⁴ *Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies*, 7 FCC Rcd 6886, 6889 at para. 17 (1992).

¹⁵ *Id.*

1. Co-channel fixed and mobile operation is not technically feasible.

Fixed and mobile providers both have methods to facilitate coexistence among fixed and mobile users, respectively, but no method works for both categories simultaneously. A mobile transmitter located in the antenna pattern of a fixed service receiver on the same frequency will generally cause interference to that receiver. Conversely, a mobile receiver will likely experience co-channel interference while located within the beamwidth of a fixed service transmitter. Because mobile users operate from unpredictable locations, these problems are impossible to prevent.

Even if coordination between mobile and fixed users could be achieved within a license area, there would still be problems at license area boundaries. Suppose Licensee *A* provides fixed services, while its immediate neighbor, Licensee *B*, uses the same part of the band for mobile services. Nothing stops *B*'s mobile end users from attempting to operate their equipment on *A*'s side of the boundary, or even deep into *A*'s territory. Whenever a mobile transmitter licensed to *B* passes through the antenna pattern of *A*'s fixed receiver, or *B*'s mobile receiver passes within range of *A*'s fixed transmitter, interference will be likely.

The Notice acknowledges that large separation distances would be required between 3G and MDS/ITFS systems to allow co-channel sharing.¹⁶ Inasmuch as MDS/ITFS systems are licensed and operating in the Nation's significant population centers,¹⁷ it follows that co-channel sharing is impossible as a practical matter. In the words of the Interim Report, "[S]haring

¹⁶ Notice at para. 62.

¹⁷ See the maps on pages 27 and 28 of the Interim Report.

between 3G systems and ITFS/MDS operations is extremely problematic. *At this point, there does not appear to be enough spectrum in the 2500-2690 MHz band in the populated areas to support a viable 3G service.*"¹⁸

2. *Relocation of fixed MDS/ITFS providers and users is not feasible.*

Moving existing MDS/ITFS to a different band is not a useful option, for two reasons.

First, the incumbent providers and users are far too numerous. The Commission's only experience with relocation involved point-to-point providers exclusively, and no end users at all.¹⁹ Yet even that relatively simple effort proved to be slow and contentious. The present band, in contrast, is occupied by 2,175 ITFS and 2,570 MDS licenses operating over 124,000 licensed transmitters.²⁰ These serve 70,000 registered ITFS received sites and over one million wireless cable customers.²¹ Relocation would require not only replacing each affected transmitter, but also entering every one of these school buildings and homes to replace instructional and consumer equipment. This is not a realistic proposal.

Second, there is no suitable spectrum to relocate to. The Commission found none in 1992,²² and there is still none today.

¹⁸ Interim Report at 53 (emphasis added).

¹⁹ *Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies*, 7 FCC Rcd 6886 (1992) (extensive subsequent history omitted).

²⁰ Interim Report at 18-19, 60.

²¹ Interim Report at 18-19.

²² *Redevelopment of Spectrum*, 7 FCC Rcd at 6889, para. 17.

3. *Segmentation of the 2500-2690MHz band is not feasible.*

Segmentation of the band has almost the same impracticalities as relocation: too many user sites, and not enough spectrum. Moreover, the difficulties are almost as great. All three segmentation proposals would entail clearing 90MHz of MDS/ITFS spectrum.²³ Although this requires replacement of only half the 124,000 licensed transmitters and one million receivers in the band, this is hardly more feasible, as a practical matter, than replacing all of them.

Moreover, segmentation would entail squeezing 31 channels into about half as much capacity. This might have been feasible for video services only, if executed as part of a changeover from analog to digital modulation. But no comparable compression is possible for Internet services, which are digital to begin with. Segmentation would thus end any realistic hope of two-way MDS/ITFS continuing to exert competitive pressure on DSL and cable Internet access.

D. *Impairing Fixed MDS/ITFS is Contrary to the Public Interest.*

Reallocation of the 2500-2690MHz band to 3G would require co-channel fixed/mobile operation, or relocation of fixed MDS/ITFS, or band segmentation. None of these is feasible. If the Commission were to overlook these facts and attempt reallocation anyway, it would inevitably obstruct MDS/ITFS operations. This is contrary to the public interest, for the reasons set out below.

1. *Demand for fixed broadband access will continue to increase.*

There is no reason to believe that increased *mobile* broadband access will come at the expense of demand for access to *fixed* services. People who acquire mobile broadband devices

²³ Interim Notice at 56-59.

will not, for that reason, give up their desktops, any more than most people who acquire wireless phones give up their wireline handsets. Moreover, the Commission acknowledges that DSL and cable will be unable to keep up with the demand for broadband, so that wireless will have to take up the slack,²⁴ with MDS/ITFS serving 70% of the 10,000,000 fixed wireless broadband subscribers expected by 2005.²⁵ Considering that mobile deployment will not significantly reduce the demand for fixed services, it makes no sense to displace fixed providers from the spectrum they now use.

Ongoing development in fixed technology for this band promises important advances in Internet access:

- Data rates in excess of 2Mbps, required for advanced Internet applications such as video conferencing and streaming video. This is much faster than the practical rates attainable with DSL or cable, and also faster than the IMT-2000 specifications for 3G.
- Greater frequency reuse. Each channel can be reused two or three times per cell by giving each receiver only the power it needs, and no more. Mobile systems today are not capable of such extensive reuse.
- Advanced directional technologies using spatial processing techniques, namely, adaptive beam forming and multiple-input multiple-output (MIMO) antenna systems. These technologies put the energy where it is needed -- at the subscribers' receivers -- with minimum interfering emissions elsewhere. They are not used for mobile systems today because of their complexity.
- Less interference between licensees. The use of directional antennas at the subscribers' premises allows for better coexistence between adjacent licensees. This also is not possible today with mobile systems.

²⁴ Interim Report at 21.

²⁵ Interim Report at 22 n.28.

2. *Providers of fixed service have committed and invested billions in reliance on the present rules.*

The components of MDS/ITFS fixed broadband investment include:

- research and development in the creation of advanced technologies specific to this band for the delivery of broadband fixed services;
- licensed and leased spectrum acquisitions in the band, with the expectation of recovering these costs through the provision of fixed services; and
- construction of systems on this spectrum, with full nationwide build-out currently in progress.

The Commission acknowledges the MDS industry has invested *several billion dollars* to develop broadband fixed wireless data systems in the band, including high-speed Internet access.²⁶ That fact simply does not square with a proposed reallocation.

Reallocation would also signal to the technology investment community that innovative radio services lack any stable regulatory platform. As a rule, new services require both innovative technologies and dedicated spectrum. But technologies and spectrum both require substantial investment. And investment requires regulatory stability. Market participants expect some degree of confidence that sudden rule changes will not strand an otherwise prudent investment. Here, the Commission invited two-way fixed services into the band less than three years ago.²⁷ To undercut that investment now, by reallocating the band to an incompatible service while fixed services are still attempting to deploy, threatens to chill future investment in radio-based technologies generally.

²⁶ Interim Report at ii.

²⁷ *Two-Way Transmissions, supra.*

3. *Fixed operation offers a proving ground for technologies that will ultimately be necessary for effective 3G operation.*

Adequate 2500-2690MHz fixed spectrum will help to advance the state of the art in both fixed and mobile radio system technology. It is much easier to develop and deploy advanced technology in a fixed wireless setting, where the RF environment is relatively stable. Some of these new technologies will be deployed within the next year for fixed service in this band, but might never be affordable in a mobile environment without the opportunity to mature (and recover early investment) in the fixed wireless environment. These include MIMO, smart phased array antennas, adaptive modulation and coding, advanced processing technologies, greatly improved dynamic power control (for maximum frequency re-use), and software defined radios, discussed below.

Clearwire is an active participant in the IEEE 802.16.3 standards development process, which is expected to produce an industry standard for 2500-2690MHz equipment by early 2002. This standard should allow for significant reductions in the cost of consumer equipment through economies of scale. Although the IEEE activity is working toward a generic standard for 2-11GHz, many of the decisions made to date rely on the existing rules for the 2500-2690MHz band. A change in these rules would have a significant negative impact on the standards development process.

The view cited in the Notice that software defined radios will take more than ten years for commercially viability is incorrect.²⁸ Clearwire is a strong proponent of software defined radios,

²⁸ See Notice at para. 30.

whose development is well underway.²⁹ Software defined radios will greatly ease the conflict of disparate standards that otherwise threatens to confuse deployment of 3G services in the United States,³⁰ and will facilitate global roaming even if the United States does not reallocate the 2500-2690MHz band for 3G.³¹ Moreover, such techniques as adaptive modulation, coding, and error correction can significantly improve the data throughput of a radio system and improve spectrum efficiency by tailoring each communication to the individual RF channels available at that instant. These technologies promise to reduce the amount of spectrum required to deploy 3G services.

Advanced radios can also handle two-way communication through time division duplexing (TDD). The upstream vs. downstream asymmetry of Internet traffic varies dramatically depending on the type of user and type of application. For consumers and most non-Internet-related businesses, downloads typically far exceed uploads, while the reverse may be true for an Internet content provider or web-hosting service. For some users, the asymmetries shift back and forth from hour to hour, or even minute to minute. TDD can easily handle these dynamic differences.³² In contrast, the relative capacities of a conventional frequency division

²⁹ See *Authorization and Use of Software Defined Radios*, ET Docket No. 00-47, Notice of Proposed Rule Making, FCC 00-430 (released Dec. 8, 2000).

³⁰ See Notice at para. 21 (suggesting the Commission is unlikely to establish technical interface standards for 3G).

³¹ See Notice at para. 24 (desirability of global roaming).

³² In a TDD system, the same channel takes turns carrying communications in both directions. The equipment at each end must cooperate to agree on the direction of traffic at each instant. The precise timing can easily be obtained through the use of modern digital signal processing and/or GPS time synchronization.

multiplexed system are set at the time the frequency allocation is made, which inevitably wastes a lot of spectrum. These considerations aside, TDD is also less expensive for systems operating at frequencies below about 6GHz.

3G mobile services will not be able to share the 2500-2690MHz band with these fixed technologies. Mobile services require omni-directional antennas at the consumer terminal. This calls for relatively high transmitter power at the base station, which impedes sharing with a precisely targeted, minimum-power fixed service. In addition, the transmissions from mobile handsets using omni-directional antennas impinge on all fixed wireless end-user receivers pointing in that general direction, decreasing their sensitivity and triggering power increases at the fixed base station. The net result is extremely inefficient use of scarce spectral resources.

CONCLUSION

Reallocation of the 2500-2690MHz band to 3G is both technically infeasible and unwise as a matter of policy. From a technical standpoint, sharing, relocation, and segmentation of the band are all equally unworkable. As a policy matter, reallocation would hinder the ability of MDS/ITFS to compete with the DSL/cable broadband duopoly, strand old investments and chill new ones, and impede the development of technology needed for 3G.

For all of these reasons, the Commission must place the important 3G services elsewhere in the spectrum.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Mitchell Lazarus". The signature is fluid and cursive, with a large initial "M" and a long, sweeping underline.

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February 22, 2001

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