thorough review of the public interests at stake in the 28 GHz band . . . as quickly as possible." SBA Comments, February 14, 1995, page 6.

Despite the informed opinion of the SBA about the numerous public interest benefits of LMDS in the 28 GHz band, the FSS interests seek to evict LMDS from the 28 GHz band and bury this promising competitive technology in the unusable 40 GHz band in order to extinguish the competitive threat of LMDS and to preserve the 28 GHz band for their possible use in the future. While the FSS interests have tried hard to convince the Commission (and the press) that their proposal is a "win-win" for both FSS and LMDS, the record developed in the instant proceeding and in the LMDS rulemaking proceeding simply does not support this proposition.[17]

In contrast to LMDS in the 28 GHz band, which can offer its numerous public interest benefits to the vast majority of the world's population, the paper FSS proposals of Hughes and Teledesic suffer from fundamental system capacity constraints that would severely limit the number of persons they could serve. For example, while Teledesic claims that it would provide broadband services to "all the

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Hughes, as a primary partner in a Direct Broadcast Satellite system, "has a direct interest in reducing competition in the multichannel video program delivery service." Id., page 6.

[17] While some interests represented as the "Educational Parties" and GHz Equipment Co, Inc. generally supported the allocation of the 40 GHz band for the laudable goal of educational services, it should be noted that they did not offer their support of 40 GHz LMWS in lieu of LMDS at 28 GHz. See Educational Parties Comments; GHz Equipment Co., Inc. Comments. Moreover, Steve Copold, Director of Information Resources at The University of Texas - Pan American, a pioneer in developing the educational uses of LMDS in the 28 GHz band, has conducted substantial technical analysis and has concluded that the 40 GHz band simply is not an option for the educational community. See supra, note 2.

world's citizens" (Teledesic Comments, Summary, i), its total system capacity is so limited that it could not even provide service to one percent of the world's population. See Technical Review of 40 GHz Comments, page 22.[18] In addition to claiming to serve "all the world's citizens" with its limited capacity system, Teledesic also has claimed that its system is designed to provide "services to people in rural and remote parts of the United States and the world." Teledesic Application, Executive Summary, page 4. However, if Teledesic's limited system capacity was consumed by providing service to populated metropolitan areas, there would be no capacity remaining to serve rural and remote areas.[19] While Teledesic speaks of its proposed system in terms of the NII and the GII, its low capacity design can hardly be characterized as "universal service."

If the Commission were to banish LMDS to the 40 GHz band, and provide FSS

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[18] The total worldwide capacity of Teledesic's paper FSS system is limited to 2 million simultaneous 16 kb/s service links or 20,000 T-1 service links. See Technical Review of 40 GHz Comments, page 22. In the U.S., Teledesic could provide telephone service simultaneously to only 0.18% of the population in the densest areas covering 90% of the total U.S. population, and T-1 service to only 0.0018% of this same population of approximately 234 million. See CellularVision Comments, Appendix 3, Spectrum Allocation Considerations, para. 7. In addition, because Teledesic's system design uses "earth fixed cells," which would allow the system to offer "coverage of every place on earth" (Teledesic Comments, page 6), system capacity is directed to places where it is not needed, and sufficient capacity is not directed to places where it is needed. See Technical Review of 40 GHz Comments, page 24.

[19] For example, service to the approximately 700,000 households in the New York PMSA not passed by cable would consume over one-third of Teledesic's system capacity, if it was possible for Teledesic to serve those households; unfortunately, Teledesic's self-limiting system capacity would restrict it to serving only about 3,000 of those 700,000 households. See Technical Review of 40 GHz Comments, pages 22-23.

with exclusive use of the 28 GHz band, the Commission should be prepared for the following results:

- LMDS will die in its infancy, as a viable nationwide LMDS in the 40 GHz band is an illusion created by the FSS interests;
- the 28 GHz band will continue to be unused, possibly well into the 21st Century, as the untested, multi-billion dollar paper proposals of Hughes and Teledesic may or may not prove to be technically feasible for licensing, or sufficiently economically feasible to attract the mammoth Wall Street financing necessary to be deployed; and
- the enormous spectrum auction revenues which are projected from the nationwide licensing of LMDS in the 28 GHz band will not be realized, as no revenue will be generated from the ripe 28 GHz spectrum, with or without FSS use of this valuable national resource.

Far from "ensuring the orderly development and deployment of terrestrial LMDS for the benefit of the citizens of the United States," as Teledesic piously claims (Teledesic Comments, Summary at i), the exile of LMDS to the 40 GHz band by the Commission simply will eliminate the deployment of LMDS in the United States, to the obvious detriment of the citizens of this country.

VII. Conclusion

Accordingly, based on the foregoing, the Commission should reject the misguided and unsubstantiated assertions of the satellite commenters in this proceeding to evict LMDS to the 40 GHz band, where it cannot be a viable service in the U.S. and in most areas of the world. Instead, the Commission should refocus its efforts on the prompt deployment of LMDS nationwide in the 28 GHz band, where the Commission already has concluded it can and will flourish for the benefit of all

Americans seeking access to an immediate and affordable video, voice and data lane on the proposed Information Superhighway.

Respectfully submitted,

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APPENDIX 1

LMDS is Not Viable in the Frequency Bands above 40 GHz: A Technical Review of Comments Filed in Response to the 40 GHz Notice of Proposed Rule Making

Prepared by

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March 1, 1995

LMDS is Not Viable in the Frequency Bands above 40 GHz: A Technical Review of Comments Filed in Response to the 40 GHz Notice of Proposed Rule Making

I. INTRODUCTION

The purpose of this paper is to review key points made in the Comments of parties which responded to the January 30, 1995 comment date in the Notice of Proposed Rule Making (NPRM) for commercial development and use of the frequency bands above 40 GHz. In its comments filed on January 30, 1995, CellularVision asserted that LMDS is not viable in the Frequency Bands above 40 GHz.

Predictably, parties which stand to benefit from the elimination of LMDS as a viable, broadband communications alternative by relocating LMDS from the 28 GHz band to the bands above 40 GHz have represented that LMDS is "operationally and technically similar" in both bands. Nothing could be further from the truth. Below, CellularVision reviews the comments made by parties wishing to misrepresent the impact of a potential LMDS move from 28 GHz to 40 GHz. Close examination of these comments reveals mischaracterizations, subjective conclusions without empirical basis, and misleading representations which distract the Commission from the truth--that LMDS is not viable above 40 GHz. In the detailed reviews that follow, we reiterate the following points, which represent the technical and economic reality about LMDS viability above 40 GHz:

- The cost increase associated with operation of LMDS above 40 GHz in the United States is prohibitive to LMDS viability. CellularVision estimated a cost increase of 30 to 40 times in its January 30, 1995 comments. All attempts by the satellite parties to characterize the costs as "similar" can be demonstrated to have no rational basis. Additionally, the use of 40 GHz in the U.S. for LMDS would, in addition to prohibitive cost and operational problems, require four times as much spectrum as LMDS at 28 GHz. Thus, LMDS is not a viable broadband, interactive communications alternative at 40 GHz.

- Many claims by parties commenting in the 40 GHz NPRM that LMDS is viable above 40 GHz are completely unsubstantiated. Other such claims that are "supported" by analyses are in fact not supported by the corresponding analyses at all. Still other claims indicate that, if left to stand unchallenged, LMDS opponents will have accomplished their goal to mislead regarding 40 GHz LMDS viability. The analyses that purport to represent LMDS viability above 40 GHz are fundamentally flawed and misleading, and will not be sustainable if

subjected to vigorous technical scrutiny by the Commission.

- The proposed 40 GHz European Multipoint Video Distribution System is not "transferable" to the United States from Europe, and is inferior to the American LMDS with regard to availability, cost, service flexibility, and interactive capability. Severe operational problems would result from any "translation" of the 28 GHz equipment to 40 GHz without accounting for differences which arise from the shift in frequency. The European 40 GHz MVDS specification is a "special case" applicable only to a small portion of the populated world due to the low rain-tolerance of the MVDS system architecture--it is not viable in the United States due to climate differences.

- There is an acute public need for LMDS at 28 GHz in the United States given that there is no other viable broadband wireless alternative to cable and switched broadband systems. The public policy benefits associated with LMDS far outweigh the alternative service proposed for the 28 GHz band--Fixed Satellite Service (FSS). Moreover, utilization of the largely fallow 28 GHz band now for LMDS is likely to generate billions of dollars for the U.S. Treasury from spectrum auctions -- auctions that will not take place from the proposed FSS usage of the 28 GHz band. Fundamental FSS system capacity problems associated with 28 GHz FSS paper proposals clearly indicate that to allocate the 28 GHz band to FSS uplinks only would be an unfortunate waste of the public spectrum resource. LMDS is in commercial service now, while the proposed paper FSS systems are years away and probably not possible until the twenty-first century.

- FSS systems, already proven above 40 GHz, suffer from no degradation in moving from 28 GHz to the 40 GHz band. Additionally, point-to-point systems, which differ architecturally from LMDS as satellite systems do, are proven at frequencies close to those under consideration in the 40 GHz NPRM. Thus, while LMDS is not practical at 40 GHz and above at any cost, satellite and point-to-point terrestrial systems are proven to be practical above 40 GHz. The key reason for this is the system architecture differences between satellite, point-to-point and LMDS point-to-multipoint systems.

II. COST INCREASE MAKES LMDS UNVIABLE ABOVE 40 GHZ

CellularVision exhaustively addressed the issue of LMDS system cost in its January 30, 1995 comments. A cost increase factor associated with the hypothetical move from 28 GHz to 41 GHz of 30 to 40 was detailed. Seven to fifteen times as many cells will be required, and costs will approach double the 28 GHz cost for service transmission. Differences in rain attenuation, foliage losses and reflection of the LMDS signal are the key issues along with equipment manufacturability and tolerances. Additionally, it was demonstrated that the operation of the LMDS system architecture above 40 GHz may not be possible at any cost due to the inability to achieve frequency reuse in every cell--a key component of the LMDS system's high frequency reuse efficiency--and thus four times the spectrum would

be required.

LMDS proponents have supported the CellularVision view--that cost would make 40 GHz LMDS unviable. Other commenters have skirted the issue by resorting to subjective characterizations of costs to avoid facing the reality that 40 GHz LMDS would be cost-prohibitive when viewed "by the numbers."

A. Texas Instruments Estimates a Hardware Cost Multiplier of 100

Texas Instruments, a communications hardware and systems supplier key to the communications industry and the U.S. Economy, and a member of the 28 GHz Negotiated Rule Making Committee, has noted that precipitation attenuation at 40 GHz is more than twice as severe as at 28 GHz for the same rain rate, and that precipitation attenuation becomes the principal design and cost driver for the system. Texas Instruments further points out that the reduced range at 40 GHz compounds the difficulty and expense of a system, giving the example that with expected transmitter power available in the 28 GHz and 40 GHz bands that *100 times more discrete devices will be required to operate at 40 GHz* and above as at 28 GHz. This cost factor far exceeds the conservative factor of 30 to 40 arrived at by CellularVision. Texas Instruments underscores that cost alone makes 40 GHz unattractive for LMDS (Texas Instruments Comments, p. 1)

Endgate Technology, a participant in the 28 GHz Negotiated Rule Making Committee along with Texas Instruments, notes in its comments that the gain per amplifier stage decreases with a move to 40 GHz, and estimates a 15 to 20 % cost increase based on *this factor alone*. (Endgate Technology, p. 2). This is but one of the many cost increase issues that have been considered by CellularVision in developing its projection of total cost increase associated with a hypothetical move to 40 GHz.

Endgate further observes that *rain propagation alone* shortens the effective maximum distance for LMDS links by 30% during heavy rain conditions (Endgate Technology, p. 1), which will have a direct impact on system cost. This factor *alone* indicates an increase in the number of cells required by a factor of more than two. Taken in combination with the changes in performance and implementation losses associated with the change in frequency, the effective maximum distance is reduced by more than 60%. This indicates an increase in the number of LMDS cells required by a minimum factor of 7.3 based on line-of-sight considerations alone.

B. 40 GHz LMDS Equipment is Nonexistent or Prohibitively Expensive

Pacific Bell Mobile Services and the Telesis Technologies Laboratory are concerned about the use of spectrum "for which technology is in a very early developmental stage. *Equipment that operates at these frequencies is virtually nonexistent or prohibitively expensive.*" (emphasis added; Pacific Bell Mobile Services and Telesis Technologies Laboratory, p. 4). This is indeed a significant statement

regarding the viability of LMDS above 40 GHz given that 28 GHz LMDS is in service *today*.

C. Hardware Suppliers Doubt 40 GHz LMDS Viability

Hewlett-Packard, in its comments, has recognized that problems reaching subscribers by specular reflection at 40 GHz, which CellularVision detailed as a concern, makes buildout requirements proposed for LMDS impractical in the millimeter wave band since "provision of millimeter-wave service to many subscribers would be impossible" without line-of-sight or near line-of-sight access. In fact, Hewlett-Packard favors the hybrid service approach of subscriber service by wireless, fiber or coaxial cable (Hewlett-Packard, p.2) which is what the European MVDS franchise system allows in recognition of the severe limitations on serving subscribers wirelessly at 40 GHz and above. Hewlett-Packard favors allowing the service provider to make a choice on the basis of technical and economic considerations without buildout requirements (Hewlett-Packard, p. 3), apparently in recognition of deep concern about economic viability of 40 GHz wireless multipoint systems.

Further concern about the combination of inadequate performance of equipment and severe rain attenuation rendering 40 GHz LMDS unviable is reflected in Hewlett-Packard's assertion that the 16 dBW EIRP limit is too low. This is because with such power levels the service areas for LMDS transmitters would be so small that they would become unviable. (Hewlett-Packard, p. 8).

Comments supporting the deep concern of CellularVision about 40 GHz LMDS viability, as represented above, are countered by predictably upbeat comments from satellite proponents, whose apparent goal is to "kill" LMDS as a low-cost, viable, spectrum-efficient, broadband competitor. However, these comments of the satellite proponents are glaring in their lack of substantiation.

D. FSS Interests Skirt the Issue of 40 GHz LMDS Cost

For example, TRW comments without offering any support that 40 GHz technology for LMDS is not only available but there is "no appreciable cost difference" when compared with 28 GHz equipment. (TRW, pp. 7-8) This is in contrast to Pacific Bell's statement (referenced above) that indicates that "*Equipment that operates at these frequencies is virtually nonexistent or prohibitively expensive.*"

Teledesic claims that the "equipment differences between a 41 GHz LMDS system and a 28 GHz system are minimal." (Teledesic, p. 15). This is not true, and moreover, Teledesic ignores the fact that seven to fifteen times as many LMDS transmitters are required above 40 GHz as at 28 GHz for comparable service. Thus, even if the cost per item was identical, the system cost for providing LMDS service would increase by 7 to 15 times. The impact of this cost increase on LMDS viability is obvious.

E. Technical Viability is Not Economic Viability

TRW further skirts the viability issue by claiming that 40 GHz LMDS is "technologically viable" (TRW, p. 8), but ignores economic issues which are fundamental to viability. For example, while it may be "technologically viable" to run 100 fiber pairs to every residence and business on the face of the earth (satisfying any imaginable fixed communications needs), it would cost several trillion dollars to do so--technological viability is meaningless if economic considerations are ignored.

Teledesic, like TRW, distracts attention from the real issues by claiming that because LMDS operation above 40 GHz is "readily achievable from both a propagation standpoint and an equipment standpoint" (Teledesic, p. iii, p. 13) that the operation of LMDS in the 40 GHz band will not impose additional "economic burdens on LMDS operators." (Teledesic, p. iii, p.13) This conclusion does not follow from the assumption that operation is *possible* at 41 GHz. An increase in cost by a factor of 30 to 40 to operate at 41 GHz instead of 28 GHz is expected for LMDS. This is obviously an "additional economic burden" and it renders LMDS unviable above 40 GHz. Just because something is possible from a technical standpoint does not mean it would not cause "additional economic burden." Teledesic sets forth the same illogic that TRW has embraced.

The Telecommunications Industry Association states that for economic reasons, many communications systems have only one local oscillator. TIA also states that the cost reduction from using only one local oscillator is greater in millimetric bands than in lower frequency bands (TIA, p. 10) Why is this true? Because 40 GHz equipment simply would be more expensive than 28 GHz equipment.

F. FSS Claims About Equipment Cost are Unsubstantiated

FSS proponent Hughes Communications Galaxy, in an unsubstantiated attempt to skirt the equipment cost issue states "Moreover, based on a survey of manufacturing companies, it appears that the types of microwave equipment required at 28 GHz and at 40 GHz are quite similar in nature and in cost when produced in comparable quantities" (Hughes Communications Galaxy, p. 8). This statement is a typical example of the unsubstantiated, misleading statements that Hughes and other FSS proponents rely on to support their "opinion" regarding LMDS viability at 40 GHz. What survey? What nature? How close are the costs? What quantities? It is not apparent that Hughes has done any assessment of costs. Hughes simply makes an unsubstantiated statement which serves its position.

Another business unit of Hughes makes a recognition which more accurately characterizes the problems with 40 GHz LMDS when it states that "The only way to achieve the wide area, high capacity coverage envisioned for the Licensed Millimeter Wave Service (LMWS) in the NPRM is to *use a large number of distribution points to the subscribers*." (emphasis added; Hughes Communications

Products Business Unit, p. 8) This admission by Hughes indicates that there is at least some understanding of the lack of viability of LMDS at 40 GHz. In fact, the number of distribution points would be so large for LMDS at 40 GHz that the current commercial success of LMDS at 28 GHz simply could not be achieved.

G. Hughes Support for LMDS at 40 GHz is More Accurately a Validation of FSS Viability in the 40 GHz Band

Hughes addresses 40 GHz LMDS feasibility by stating, without legitimate substantiation, that "For a given system design, the 40 GHz band offers essentially the same performance characteristics as the 28 GHz band." (Hughes Communications Galaxy, p. 4, and p. 1 of STEL paper). This statement may be valid for satellite communications, which is, after all, the area of expertise of Hughes. But this statement reflects poor understanding of the LMDS system architecture. Hughes then reinforces its assertion of satellite viability above 40 GHz by noting that "Any minor differences that may occur would not significantly affect performance, and...could be mitigated through minor design or operational changes." (Hughes Communications Galaxy, p. 4). Again, this is absolutely true for satellite communications architectures, but simply wrong for the cellular LMDS.

Then Hughes qualitatively acknowledges the problem with rain attenuation at 40 GHz but fully ignores cost viability issues by noting that "Although the effects of rain are somewhat more severe at 40 GHz than they are at 28 GHz, rain losses at 40 GHz can be overcome through maintaining flexibility in system designs." (Hughes Communications Galaxy, p. 5, and p. 2 of STEL paper). Again, this is a statement with no support, and "flexibility in system designs" cannot reasonably mean the flexibility to accept a cost increase by a factor of 30 to 40; or to accept availability reduced below competitive levels for primary telephone, video and digital service.

H. LMDS Equipment Designs are Not Directly Scalable to the 40 GHz Band

NASA, like other FSS proponents, assumes on the way to the conclusion that moving to 40 GHz has no negative consequences for LMDS that the hub and receiver antenna gains can simply increase with frequency. This conclusion is either naive or stubbornly indifferent to the operational problems that would result, such as reduced elevation plane coverage of the hub antenna and pointing problems in residential installations and the electrical and manufacturing-tolerance related losses associated with such a move in frequency. As Pacific Bell has noted, "Equipment that operates at these frequencies is virtually nonexistent or prohibitively expensive." (Pacific Bell Mobile Services and Telesis Technologies Laboratory, p. 4) The CellularVision analysis, as presented in its initial comments in the 40 GHz NPRM, establish a realistic basis for examining link budgets. There are simply more implementation losses and operational issues to consider at 40 GHz. These issues become even more acute when other LMDS proponents' architectures are considered given that they use higher-gain hub antennas and push the limits of solid state power.

I. Hughes Comments Reveal Differences between 28 GHz and 40 GHz

Hughes Communications Galaxy deals with the problems associated with a move to 40 GHz by suggesting the alternative of a low-power solid-state power amplifier (SSPA) for each video channel (Hughes Communications Galaxy, p. 10, and p. 3 of Edward Reinhart "Technical Statement"). The drawbacks of such an approach have already been acknowledged by the U.K. MVDS Working group--this approach would require an antenna for each amplifier (50 or more at every transmitter site, perhaps hundreds accounting for outbound digital data traffic) because there is no practical way to combine 50 or more output stages into a single antenna. The problem is further magnified for the two-way, broadband interactive LMDS. The other key question raised by the suggestion of an alternative approach to generating the necessary transmitter power for 40 GHz LMDS is: why is an alternative needed at all if, as Hughes has suggested, that from a technical standpoint there is no difference between LMDS at 28 GHz and LMDS at 40 GHz and above? This inconsistency is resolved by observing that *there are key differences which FSS proponents have not acknowledged.*

J. LMWS Does not Mean LMDS

TRW's statement that the fact that the Commission is *proposing* to model LMWS rules after LMDS rules indicates that moving LMDS from 28 GHz to 40 GHz is feasible (TRW, p. 5) is reflective of the way in which the satellite interests are trying to use this proceeding to accomplish something the Commission did not contemplate. The Commission *proposal* does not indicate anything about creating 40 GHz LMWS <u>as an alternative</u> to 28 GHz LMDS.

K. Cost Increase makes LMDS Unviable Above 40 GHz--Summary

From the above statements, which substantiate the CellularVision position, it is clear that LMDS is not viable above 40 GHz. Where FSS proponents have attempted to refute reality, they have only been able to attempt to do so by illogic or unsubstantiated statements, which in some cases are refuted by business units within their own companies.

III. ANALYSES OF 40 GHZ LMDS BY FSS INTERESTS ARE NON-EXISTENT, FLAWED, OR MISLEADING

A detailed technical review of the comments in the 40 GHz proceeding demonstrates that many claims by the commenters, particularly those of the FSS interests, that LMDS is viable above 40 GHz are completely unsubstantiated. Other such claims that are "supported" by analyses are in fact not supported by the corresponding analyses at all. The analyses that purport to represent LMDS viability above 40 GHz are fundamentally flawed and misleading. As the following detailed analysis of these comments and related discussion below clearly show, many parties have attempted to distort the view of LMDS viability in the bands above 40 GHz. LMDS *is not viable* above 40 GHz in the United States.

A. There is No GE American Communications Analysis!

GE American Communications is typical of the FSS interests in dealing with LMDS viability in the frequency bands above 40 GHz when it comments "GE Americom believes LMDS is capable of using the 40 GHz band without detriment to the provision of LMDS." (GE American Communications, p. 5). This statement is *completely* unsubstantiated and the motivation for it is transparent: FSS interests would like nothing more than to suppress the attractive, spectrum-efficient LMDS. While, as noted above, GE alludes to an analysis which "is in accord with this (the Commission's) conclusion" (GE American Communications, pp. 6-7), no such analysis is provided. Apparently, no such analysis exists. Where other FSS proponents have assembled an "analysis," it can be demonstrated to be flawed or misleading. Numerous examples are in order.

B. The Hughes Numbers Do Not Support the Hughes Conclusions

Hughes claims that the "...slight increase in foliage loss at 40 GHz will be inconsequential." (Hughes Communications Galaxy, p.4) This is a qualitative statement without support, and it is, in fact, contradicted by the basis for the statement in the Stanford Telecom report filed with the Hughes comments (p. 5 of STEL report). If, as Stanford Telecom reports, the foliage losses are only 10% higher than in the 28 GHz band (underestimated in our view) and the loss can exceed 20 dB, then the increase can amount to 2 dB or more--this can reduce the LMDS range by an additional 0.4 km beyond the rain-induced range reductions, shrinking the cell coverage by 3.9 km^2, or 36 percent from the rain-only case. This is precisely the reason for the need to increase the number of hubs beyond that indicated by rain effects alone as discussed by CellularVision in its initial comments in the 40 GHz NPRM. Hughes repeatedly makes statements which are contradicted by the facts or leave out the "punch line."

C. Subjective Basis Leads to Misleading Conclusions -- Experiment Details Not Revealed

As another example, Hughes claims "..there is nothing unique about the way in which radio waves "bounce" at 28 GHz." (Hughes Communications Galaxy, p. 5) Further, Stanford Telecom has reported that the levels of reflected signals at 40 GHz are 1 to 3 dB below the levels at 28 GHz. This conclusion is presented without any disclosure of the test conditions that led to it. (p. 7 of STEL report) The reality is that there is a *direct* wavelength-to-surface roughness relationship on reflection coefficient--28 is different than 27 or 29 or 40 GHz. This is a consequence of physics, so to say there is nothing unique about a given frequency is simply inaccurate and misleading. Additionally, notwithstanding the questionable value of Stanford Telecom's conclusions about a lab experiment when translated to the real world, they fail to point out that not only will the reflectivity of a surface be lower as the frequency increases, the signal incident at the surface of reflection will also be lower in power and the reflected signal will be attenuated at a more rapid rate at 40 GHz than at 28 GHz. Taken together, these factors make the potential to serve a subscriber by specular reflection much poorer at 40 GHz than at 28 GHz. Again, Hughes and Stanford Telecom have chosen to present only part of the story--which leads to *flawed and misleading* conclusions.

NASA, in describing the experiment referred to by Stanford Telecom (NASA pp. 7-10), also fails to address the "real-world" factors affecting service by reflection that go far beyond characterizing the reflectivity of various surfaces in a laboratory environment. NASA provides no test data, insufficient detail regarding the test setup, and provides no numerical results. Instead, NASA merely states that some surfaces provided "only slightly greater reflection" of signals at 28.5 GHz compared to 39 GHz. It is unknown what that means, but NASA provides unsubstantiated conclusions in spite of its apparent lack of rigor. One can only assume that the 1 to 3 dB difference in reflectivity cited by Hughes results from its privileged review of NASA's data which has not been disclosed to the Commission and interested parties in this proceeding.

D. "Insignificant Differences" in System Availability -- LMDS is Not MVDS

Hughes and Stanford Telecom claim that the amount of time in a given year that the users at the edge of a typical LMDS "cell" can expect to receive a signal that is below the optimal level would be about 9 hours per year at 28 GHz versus 14 hours per year at 40 GHz. These values, according to Hughes, correspond to 99.9% and 99.84% availability respectively. These amounts of "service outage" are then further adjusted down by Hughes using statistics regarding television viewing in the U.S. (Hughes Communications Galaxy, pp. 5-6, p. 3 STEL). NASA also refers to the same numbers in reference to an "insignificant difference in the availability of LMDS." (NASA, p. 6).

There are several flaws in these assessments. First, the analyses are flawed due to assumptions about available transmitter power and antenna gains at the transmitter

and receiver. Second, LMDS is not just a video entertainment delivery system--it is a much-needed wireless, interactive, broadband local-loop alternative-- so "lost" entertainment time is not a valid issue. Third, even if lost entertainment hours were an issue, the characterization of the threshold-level signal at the edge of the cell as "optimal" indicates a clear lack of understanding of the engineering issues in LMDS: the cell edge signal is *never* "optimal"--it is designed to be just above the minimal acceptable quality. Hughes and NASA apparently do not understand the LMDS system architecture.

Stanford Telecom, in a discussion aimed at illustrating that a move to 40 GHz would be "inconsequential" to LMDS by dealing with the availability issue, also points out that the 41.5 GHz LMDS system "would therefore perform better than the European 40 GHz MVDS system specification (by about 12.3 hours per year)." (STEL p. 3). This statement is a perfect illustration that Hughes and Stanford Telecom are engaged in an apples-to-oranges comparison--LMDS and its architecture as well as its purpose are radically different from the European MVDS.

E. These Hughes Assertions About Tradeoffs are All Flawed or Factually Incorrect

Hughes makes five specific points relative to the "insignificant" tradeoff in availability of LMDS above 40 GHz. Each can be refuted:

(1) Hughes claims that the increase in time below "optimal" signal level occurs *only* near the edge of the cell. (Hughes Communications Galaxy, p. 6, p. 3 STEL). This is simply wrong: *any rain at any range* drops the signal below the clear air level -- which is still not optimal, but better than any alternative level in rain.

(2) Hughes claims that decreased availability does not mean a total signal loss (Hughes Communications Galaxy, p. 6, p. 5 STEL). This is simply wrong as well. For digital two-way traffic or even (eventual) digital video, the power decrease at the receiver could result in loss of link synchronization and total loss of signal. The inability to recognize this is surprising from "digital" proponents such as Hughes.

(3) Hughes claims that 99.84% availability is still above the "demonstrated commercially acceptable" value of 99.7% for DBS. (Hughes Communications Galaxy, p. 7, p. 3 STEL). As noted above in the immediately preceding section (II.D.) of this paper, Hughes' conclusions about "acceptable" system availability are based on flawed assumptions about system components and the LMDS service itself, so they are fundamentally incorrect. Comparisons of LMDS to one-way, non-interactive, inflexible (no local content) DBS are not valid--LMDS is the opposite of all these things. Finally, cable providers are currently using this poor availability associated with the inferior DBS in advertising campaigns against DBS--an indicator that such availability, which is already overstated due to flawed assumptions, would not position the public to benefit from LMDS as a

broadband alternative.

(4) Hughes claims that 99.84% availability is achievable without changing the basic LMDS system parameters (size of transmit and receive antennas, transmitter power, or cell size) (Hughes Communications Galaxy, p. 7, p. 3 STEL). In fact, all must change--the antennas must both change to maintain gain, not size, for coverage and operational practicality; the necessary TWT amplifiers are not available at practical cost; and the cell size must shrink due to additional rain loss (simple physics) and constraints on system components.

(5) Hughes claims that climate differences between New York and Miami at 28 GHz cause larger changes in the LMDS design than the change from 28 to 40 GHz would require. (Hughes Communications Galaxy, p. 7, p. 4 of STEL). This is simple "sleight of hand" on the part of Hughes and is *just plain wrong*. What they are really saying is that location specific issues, which may be challenging at 28 GHz, are likely impossible to deal with at 40 GHz. They have essentially stated that 40 GHz will not work in high rain rate areas given the increase in rain attenuation at 40 GHz and the cell size reduction which may be experienced at 28 GHz in such areas. Note that in composing this illogical juxtaposition of facts, Stanford Telecom fails to point out that operating at 40 GHz in Miami would likely be impossible--this is exactly the point of LMDS proponents. Additionally, making the dual-city, dual-band comparison assumes that the LMDS system could employ components with the same performance at both frequencies--again a flawed assumption. The practical system gain in the 28 GHz system is higher than in a hypothetical 40 GHz system due to differences in implementation and electrical losses.

Aside from the Hughes and Stanford Telecom bizarre attempts at logic, *they are also factually incorrect:* At 41 GHz, the range of the LMDS system in New York collapses to 1.85 km from the 5 km range at 28 GHz. The range of the 28 GHz LMDS system in Miami is 2.7 km. Thus, the impact of moving from 28 GHz to 41 GHz in New York (a range reduction of 3.15 km) exceeds the impact of moving 28 GHz LMDS from New York to Miami (a range reduction of 2.3 km). Hughes and Stanford Telecom have misrepresented the technological and economic realities of 40 GHz LMDS.

F. Hughes Options for LMDS are All Impractical

Hughes also lists options for "achieving the same or equivalent performance at" at 40 GHz as at 28 GHz. (Hughes Communications Galaxy, p. 9) While Hughes is evasive about the definition of "same or equivalent," they claim "These options include:

(a) maintaining the same transmit power (100W), transmit antenna size, cell size, and receive antenna size, but accepting a slightly lower availability

(Option A);

(b) maintaining the same transmit power (100W), cell size, receive antenna size, and availability, but increasing the transmit antenna gain from 10 to 18 dB (Option B); and

(c) maintaining the same transmit power (100W), cell size, transmit antenna size, and availability, but increasing the receive antenna size from 6.9 to 12 inches (Option C)."

Each option identified by Hughes is fundamentally flawed. Option A is not viable because of the lack of availability and potential cost (if available) of a 100 W 40 GHz TWT Amplifier. Additionally, the same transmit antenna size would result in a reduction in elevation-plane coverage of the antenna, denying service, ironically, to subscribers close to the transmitter site. Also, the same-size receiver antenna, ignoring cost issues related to manufacturing yield and electrical losses, would produce too-narrow a beamwidth for residential installation due to platform stability problems. Option B is unviable for the same reasons regarding the transmitter power and receive antenna, and would suffer from even more acute reduction of elevation plane coverage of the transmitter than under Option A. These facts are consequences of fundamental antenna design physics and practice. Finally, Option C is unviable due to transmitter power and transmitter elevation coverage issues, and would result in such a narrow beamwidth for the receive antenna that manufacturing tolerances may render it impossible to build in quantity and such that it would be impossible to use for residential installation. Thus, these options are totally impractical from an LMDS system architecture standpoint--it is readily apparent that Hughes suggests unworkable solutions to the LMDS problem at 40 GHz.

G. NASA Also Ignores the Realities of 40 GHz LMDS Design

NASA's analysis suffers from the same lack of understanding of LMDS system design as Hughes'. NASA remarks that "An examination of the design of a leading contender for LMDS proves conclusively that there is virtually no difference in the operation of LMDS at the higher frequency." (NASA, p. 5--the "leading contender" is referred to as Suite 12 in the related footnote). NASA also notes that "The propagation environment at 40 GHz is similar to that in the nearby 28 GHz band as are the equipment parameters. Only the name has changed from LMDS to LMWS." (NASA, p. ii). These statements are grossly ignorant of the details of the 40 GHz NPRM and the architecture of LMDS systems--shocking given NASA's long history of technical excellence. These statements are made with no technical support. The differences in propagation and equipment available for LMDS between 28 and 40 GHz are as striking as they are clear. As was the case with Hughes, the firmly held beliefs about similarity must be based on the satellite communications context--with which both Hughes and NASA are familiar.

NASA refers to the effect of moving LMDS to the band from 40.5-42.5 GHz as

creating a band with "virtually the same conditions as that proposed at 27.5-29.5 GHz." (NASA, p. 4). This statement is valid for licensing considerations only, and is dangerous and misleading. LMDS cost, operations and service capacity would be sharply different at 40 GHz--rendering LMDS unviable as a broadband alternative to cable.

NASA, when referring to its attachment to its comments (the Propagation Handbook), states that the frequencies above 40 GHz offer advantages (e.g., lack of congestion--so FSS can operate without interference there), but it also acknowledges that such "advantages can be rapidly offset, however, unless propagation impairments are understood and taken into account during system design." (NASA, p. 14). Had NASA conducted an objective analysis accounting for these issues in examining the potential for viable LMDS above 40 GHz, it would have concluded that the concerns expressed by CellularVision, Texas Instruments, Pacific Bell and others are real, and that they threaten the viability of the attractive LMDS technology. This sober (and accurate) view is unfortunately far different from the other, contradictory representation of NASA which states that "there is virtually no difference in the operation of LMDS at the higher frequency." The admission that propagation impairments must lead to system design changes directly contradicts the self-serving statement that there is "virtually no difference" at 40 GHz. NASA is fully aware of the differences and will ignore the public interest benefits of LMDS to posture for an intellectual legacy for its experimental ACTS technology.

H. Teledesic Analysis is Flawed and Inconsistent with Hughes and NASA

Teledesic states that the impact of operating LMDS in New York at 41 GHz instead of 28 GHz is a reduction in availability from 99.9 percent to 99.75 percent. (p. 2, p. 4, Teledesic, Appendix A). This conclusion is based on the same flawed assumptions used by Hughes and NASA to arrive at a different availability number (99.84%), including invalid assumptions for 41 GHz transmitter power, transmitter antenna gain, receiver antenna gain and noise figure. In addition to the flaws it shares with the Hughes and NASA analyses, Teledesic has also incorporated another error that exacerbates the "apples-and-oranges comparison" situation. It has used the CCIR rain model, while Hughes and NASA apply the Crane/Global model as agreed to by both LMDS and FSS interests in the 28 GHz Negotiated Rule making (July-September, 1994). It is interesting to note that Lou Ippolito, author of the "Propagation Handbook" attached to the NASA filing notes that the Crane/Global model "is the recommended form for use by system designers" (p 3-18 , Propagation Handbook). This may account for the difference in system availability as determined by various FSS proponents, but since the rain rate assumed by Teledesic using the CCIR model is lower than that assumed by NASA or Hughes, their projected availability should be higher not lower. This is a clear indicator that there are other flaws in the Teledesic analysis as well.

I. Basic Economic Constraints are Not Understood by Teledesic

Another indicator of Teledesic's lack of understanding of the LMDS system and market is the discussion on 40 GHz equipment on page 7 of Appendix A of the Teledesic comments. The receiver in Figure 3-1 on that page shows a dual-downconversion scheme with two local oscillators in the receiver. It is commonly accepted that the attractive, practical way to minimize cost is to operate with a single local oscillator. Even the TIA recognized this in its comments (TIA, p. 10). The credibility of any comments by Teledesic about the potential cost of 41 GHz LMDS components has to be called into question given this obvious breach of common sense by Teledesic.

J. Teledesic Excerpts the MVDS Specification in Selective Pieces in Misleading Fashion

Teledesic concludes its comments regarding the practicality of 41 GHz LMDS by composing a treatise on the European MVDS system on pages 8 through 11 of Appendix A of its comments. While Teledesic does an admirable job of abstracting several published documents on the MVDS system, it certainly does not make a convincing argument that just because an MVDS (not LMDS) specification has been created there is also a positive indication of the viability of 41 GHz LMDS in the United States. In fact, the opposite is true. Teledesic points out that TWTA power limitations may cause one to seek a solid-state power transmitter solution--resulting in a large number of antennas (which would have a severe cost impact) or the acceptance of a "complex and lossy combiner." (p. 9, Teledesic Appendix A).

Teledesic also correctly points out that the "advantage of the sector antenna" in the European MVDS system is "efficient frequency reuse compared to omnidirectional antennas" (p. 10, Teledesic Appendix A). What Teledesic *omits* is the fact that even with sector antennas and their cost impact, the European MVDS suffers from a frequency reuse efficiency that is AT LEAST 3 times poorer than the U.S. 28 GHz LMDS. The reuse efficiency is about 4 times poorer than LMDS if interactive services are considered. Finally, Teledesic presents a link budget for the European MVDS architecture (Table 3-1, page 11, Teledesic Appendix A) which shows a rain attenuation of 2.22 dB/km and a transmission range of 4.1 km, both of which contradict the values used earlier in the Teledesic analysis. This both adds to the Teledesic confusion and degrades the credibility of Teledesic.

Regarding Teledesic's Table 3-1 (p. 11, Teledesic Appendix A), a close examination of the table and its source reveals much about Teledesic's misleading characterization of prospects for 40 GHz *LMDS* by citing the European 40 GHz *MVDS* standard. The top of Figure 1 on the following page shows the Teledesic Table 3-1 reproduced from the Teledesic appendix.

FIGURE 1

Table 3-1: Link Budget for MVDS (From Teledesic Comments, Appendix A, Page 11)

MVDS LINK BUDGET		64° Sector Coverage Antenna
Transmitter power	(dBW)	-7
Transmit antenna gain	(dBi)	15
EIRP	(dBW)	8
KTB in 26 MHz	(dBW)	-129.7
Receiver noise figure	(dB)	9
C/N required	(dB)	12
Receive antenna gain	(dBi)	32
Receiver pointing error	(dB)	-2
Minimum received level	(dBW)	-138.7
Propagation loss to service boundary	(dB)	146.7
Gaseous absorption (0.14 dB/km)	(dB)	0.6
Rain attenuation (2.22 dB/km)	(dB)	9.1
Free space path loss	(dB)	137.0
Transmission distance to service boundary	(km)	4.1

TABLE 1 *

MVDS LINK BUDGET		64° Sector Coverage Antenna	Omnidirectional Antenna
Transmitter power	(dBW)	-7	-7
Transmit antenna gain	(dBi)	15	8
EIRP	(dBW)	8	1
KTB in 26 MHz	(dBW)	-129.7	-129.7
Receiver noise figure	(dB)	9	9
C/N required	(dB)	12	12
Receive antenna gain	(dBi)	32	32
Receiver pointing error	(dB)	-2	-2
Minimum received level	(dBW)	-138.7	-138.7
Propagation loss to service boundary	(dB)	146.7	139.7
Gaseous absorption (0.14 dB/km)	(dB)	0.6	0.4
Rain attenuation (2.22 dB/km)	(dB)	9.1	6.0
Free space path loss	(dB)	137.0	133.3
Transmission distance to service boundary	(km)	4.1 (diameter)	2.7 (radius)
Coverage area (assuming circular coverage)	(km²)	13.2	22.9

* From "The UK Technical and Regulatory Framework Established Analogue Multipoint Video Distribution Systems at 40GHz," by A.V. Harris, Radio Communications Agency, UK, Crown Copyright 1994, Page 5.

The bottom half of Figure 1 shows the original table (from the paper, "The UK Technical and Regulatory Framework Established for Analogue Multipoint Video Distribution Systems at 40 GHz," by A.V. Harris, Radiocommunications Agency, UK, Crown Copyright 1994, p.5). It is interesting to note first that Teledesic did not properly reference the original work of the UK Radiocommunications Agency (UKRA) and appears to be claiming the work as its own. It is obvious at first glance that Teledesic has chosen to excise many key pieces of information from the original table in concocting its distorted view of LMDS viability at 40 GHz, and has exploited those omissions to mislead. Five glaring examples include:

(1) The UKRA Table 1 shows an *entire additional column* for an omni-directional antenna MVDS system (pointer number 1 in the UKRA Table 1). The column was omitted from the Teledesic Table 3-1. Why? Because the link budget for the omni-directional antenna system bears a striking resemblance to the link budget in the CellularVision comments (January 30, 1995, Appendix 2, page 5, Table 1) filed in the 40 GHz NPRM. Including the table for the omni-directional system would "legitimize" the CellularVision position regarding the lack of viability of LMDS at 40 GHz in the U.S.

(2) As pointer number 2 in both tables in Figure 1 shows, Teledesic omitted the notation "(diameter)" from its Table 3-1. Why? Because doing so leads the reader to believe that the 4.1 km "distance to service boundary" is a radius, not a diameter. This makes the area covered by the 40 GHz MVDS transmitter appear to be four times larger than it really is.

(3) As pointer number 3 in the UKRA Table 1 indicates, Teledesic omitted the entire row of the table showing "coverage area" of the MVDS transmitter? Why? Because the coverage area for the sector antenna in the low-rain-rate climate (7 mm/hour rain) is so small and would not correlate with the perception that the *radius* of the coverage area is 4.1 km (a perception which Teledesic tried to misleadingly create); and also because the coverage of the omni-directional system is so much larger than the sector system. The omni-directional approach is precisely the approach used by CellularVision, and Teledesic apparently will stop at nothing to create the impression that the LMDS concept is flawed.

(4) As pointer 4 in both tables indicates, the transmission ranges and coverage areas are for a rain attenuation of 2.22 dB/km. This corresponds to the rain rate of 7 mm/hour, which is associated with the Western/Northern European "drizzle" climate. What Teledesic has omitted in its discussion (and what has been CellularVision's key assertion all along) is that in the United States the appropriate rain rate for such link budgets is 15 mm/hour of rain or more, which more than doubles the rain attenuation to a minimum 4.5 dB/km. Teledesic presents a *partial* story for Europe and conveniently neglects to point out that the numbers change drastically in the United States--to values consistent with those set forth by CellularVision in its January 30, 1995 comments.

(5) As pointer 5 in UKRA Table 1 shows, Teledesic has also elected not to point out the close correlation between the "minimum received level" in the UKRA link budget and the same parameter in the CellularVision link budget in its comments. To do so would "legitimize" the CellularVision point of view and refute Teledesic's position that CellularVision is being unrealistic about available technology at 40 GHz. In fact, CellularVision projects the need for a minimum received level of -136.4 dBW and the UKRA projects -138.7 dBW. The difference is due to the change in FM signal processing gain in the FM demodulator in the two systems--since the UK 40 GHz system is not capable of producing the same power level as the U.S. 28 GHz system, it must use a broader FM bandwidth and make up the difference in picture quality in that manner. These are all facts that Teledesic chooses to omit from its slanted view--to sell an unsubstantiated, unrealistic position--that the U.S. LMDS is viable above 40 GHz.

These five examples alone of misleading statements and omissions by Teledesic establish that any claims by it that LMDS is viable in the 40 GHz band are completely devoid of credibility.

K. Analyses of 40 GHz LMDS By FSS Interests are Missing, Flawed or Intentionally Misleading -- Summary

There are many examples of flawed, inaccurate or misleading comments by FSS interests in their effort to convince the reader that LMDS would be viable in the 40 GHz band. Some claims by FSS interests are completely unsubstantiated by any analysis. Other such claims that are "supported" by analyses are in fact not supported by the corresponding analyses at all--as a closer examination has revealed. The analyses that purport to represent LMDS viability above 40 GHz are fundamentally flawed and in some cases appear to be misleading. At the end of the day, the valid conclusion remains the same: LMDS is not viable in the United States above 40 GHz.

IV. THE EUROPEAN 40 GHZ MVDS SYSTEM IS NOT TRANSFERABLE TO THE U.S. MARKET

The 40 GHz European Multipoint Video Distribution System is not "transferable" to the United States from Europe, and is inferior to the American LMDS with regard to availability, cost, service flexibility, and interactive capability. Severe operational problems would result from any "translation" of the 28 GHz equipment to 40 GHz without accounting for differences which arise from the shift in frequency. The European 40 GHz MVDS specification is a "special case" applicable only to a small portion of the populated world due to the low rain tolerance of the MVDS system architecture--it is not viable in the United States due to climate differences, as the comments below indicate.

A. The Commission Has Rejected LMDS as Unviable above 30.5 GHz -- European MVDS at 40 GHz is a Special Case Based on Climate

As even TRW has observed, the Commission has provisionally rejected consideration of the 30.5 - 42.5 GHz band for LMDS as unsupported by evidence of the band's utility for such a service (TRW, p. 5). What has changed since the Commission established this rational position? Nothing. There still is no evidence that the 40 GHz band offers promise for LMDS in the U.S. or elsewhere--Europe is a special case given its climate dominated by "drizzle". A pragmatic view of the interests of LMDS advocates is enlightening: if LMDS interests were convinced that simply moving the concept to the frequency bands above 40 GHz was viable, they would seize the opportunity to move forward unimpeded and to focus capital resources on building infrastructure instead of on regulatory issues which have burdened the deployment of LMDS for several years. Instead, LMDS interests necessarily remain focused on the 28 GHz band in the United States simply because LMDS viability and the public interest are at stake.

B. If 40 GHz Worked for LMDS, MVDS would become LMDS -- But It Doesn't and It Won't

If simply moving the cellular, interactive LMDS design from 28 GHz to 41.5 GHz would result in a system that performs better than the European MVDS specification, why wouldn't the European MVDS be more like the American LMDS? LMDS is unviable at such frequencies because the coverage, frequency reuse efficiency and interactive capabilities are NOT AVAILABLE. The U.K. MVDS Working Group realizes this. At 40 GHz and above, the commercial LMDS interactive capability is not a viable broadband alternative for the consumer, and the public spectrum resource would be utilized at a less-than-possible efficiency for LMDS. Hughes varies its characterizations of LMDS and MVDS for its own purposes, at one point claiming that LMDS at 28 GHz and LMDS at 40 GHz are "similar and equivalent", at another that LMDS at 40 GHz is "better" than MVDS at the same frequency, and at another that LMDS is "equivalent to MVDS". These inconsistent conclusions by Hughes are a direct result of a lack of a firm understanding of LMDS and MVDS system architectures.

C. The Telecommunications Industry Association Sees Problems with 40 GHz LMDS

Even the Telecommunications Industry Association observes that "In the NPRM, (para. 23), the Commission assumes that, in general, the assignment of millimeter wave spectrum is likely to be technically and operationally similar to the contemplated 28 GHz LMDS. This assumption is incorrect." (TIA, p. 9) Some parties believe that the well-documented and severe increase in rain attenuation in moving from 28 GHz to 40 GHz can be overcome with increased transmitter power or by increasing the size and/or gain of the antennas in the system (Endgate Technology, p. 2). This is not practical since there is less power available at 40 GHz than at 28 GHz, not more. LMDS at 28 GHz already uses all available power.

Satellite systems, on the other hand, operate with a ten to twenty dB margin against available power, even in heavy rain as discussed elsewhere in this paper.

While it recognizes, as quoted above, that assumptions of technical and operational similarity between 28 GHz and 40 GHz LMDS are incorrect, the TIA is apparently confused about the differences between the 28 GHz U.S. LMDS and the European MVDS when it says "...CEPT has recognized that the 40.5-42.5 GHz allocation is well suited for LMDS.." (TIA, p. 9) The CEPT has *never* claimed any such thing, and acknowledges the differences between LMDS and MVDS. These differences center on, among other elements, the inferiority of MVDS frequency reuse (by a factor of three relative to LMDS), MVDS one-way video service versus LMDS two-way interactive services, and inferior MVDS transmitter coverage due to rain attenuation.

As a result of its confusion, TIA notes that adopting rules dissident with global standards jeopardizes export opportunities (TIA, p. 12). This is simply not true. As already noted, the 40 GHz MVDS system is a "special case" for Europe that is not viable in most other populated areas of the world due to climate differences. As an example, 40 GHz LMDS would work in absolutely no populated areas of Latin America. With its population of 400-500 million (depending on which countries are included), Latin America offers a broader market than Europe for wireless broadband systems and services. Asia and the rest of the world, where 40 GHz also is not viable for LMDS, further expand the opportunities for U.S. companies in the 28 GHz LMDS industry. To insist that the European MVDS proposal is the justification for the rest of the world to "fall in line" at 40 GHz is technologically and economically unsound and is a surprisingly Eurocentric view in today's world economy.

D. The 40 GHz Band is Suitable for Point-to-Point Links, but Not Suitable for LMDS

Hughes says that other countries outside the U.K. are "turning to the millimeter wave bands above 40 GHz as a means to serve their terrestrial broadband needs." (Hughes Communications Galaxy, p. 12) The bands above 40 GHz are workable for point-to-point links, as point-to-point advocates and international regulatory bodies have recognized, but not workable for the point-to-multipoint LMDS. Western/Northern Europe is the only region that is considering 40 GHz for point-to-multipoint services--the rest of the world will need frequencies below 30 GHz to serve populated areas with LMDS. The bands below 30 GHz offer a workable compromise between frequency reuse efficiency and degradation due to rain. Both fall apart above 40 GHz.

E. The Proposed Eurobell System -- Reality

More than one FSS interest has pointed to the proposed Eurobell 40 GHz video delivery system in the U.K. as evidence supposedly confirming the viability of 40 GHz LMDS in the United States. The Eurobell plan is simply not transferable, as we have noted more generally regarding any claims that the 40 GHz MVDS