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March 2, 1995

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

BY HAND DELIVERY

William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Room 222
Washington, D.C. 20554

Re: Local Multipoint Distribution Services ("LMDS")
CC Docket No. 92-297; Ex Parte Presentation

Dear Mr. Caton:

This letter is to advise you that on March 1, 1995, Hughes Communications Galaxy, Inc. filed Reply Comments in response to the Commission's Notice of Proposed Rulemaking in ET Docket 94-124 (the "HCG Reply Comments"), and, today, provided courtesy copies of the HCG Reply Comments to the persons named on the list attached hereto. A copy of the HCG Reply Comments is also attached. The HCG Reply Comments contain information related to the above-referenced proceeding.

Please contact the undersigned if there are any questions regarding this matter.

Respectfully submitted,

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of LATHAM & WATKINS

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MAR 31 1995

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

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

In the Matter of	)	
	)	
Amendment of Parts 2 and 15	)	
of the Commission's Rules to Permit	)	ET Docket No. 94-124
Use of Radio Frequencies Above 40 GHz	)	RM-8308
for New Radio Applications	)	

REPLY COMMENTS OF HUGHES COMMUNICATIONS GALAXY, INC.

Hughes Communications Galaxy, Inc. ("Hughes") submits these Reply Comments on the Commission's Notice of Proposed Rulemaking in the above-captioned proceeding ("NPRM").[1/]

I. Introduction

In its Comments in this proceeding filed on January 30, 1995 ("Hughes Comments"), Hughes expressed its support for the Commission's proposal to license wide-area broadband services in the 40.5-42.5 GHz band ("40 GHz band"). Hughes also provided a technical analysis that confirmed the Commission's belief that the use of the 40 GHz band could be operationally similar to the planned use of the 28 GHz band for LMDS and also demonstrated that an LMDS-type system architecture that has been proposed for 28 GHz would be transferable to the 40 GHz band. Hughes further explained how licensing LMDS-type services at 40 GHz would facilitate the resolution of the current frequency conflicts in

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1/ 9 FCC Rcd 7078 (1994).

the 27.5-29.5 GHz band ("28 GHz band"),[2] and maximize the variety of services that can be made available to the public. Hughes Comments at 1-2.

The submissions of Hughes and most of the other commenters in this proceeding who address the issue support the conclusion that LMDS systems now designed for 28 GHz can operate at 40 GHz without adverse technical or economic consequences. The vast majority of these commenters recommend that the Commission license LMDS, or an LMDS-type of wide-area video delivery technology, in that band. These include: fixed satellite service ("FSS") providers,[3] mobile satellite service ("MSS") providers,[4] satellite equipment manufacturers,[5] terrestrial equipment manufacturers,[6] distributed educational services proponents,[7] and a Regional Bell Operating Company.[8]

Against this tide of support for licensing LMDS at 40 GHz, only CellularVision, Texas Instruments[9] and Comtech Associates, Inc.[10] express opposition to

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2/ See LMDS Notice of Proposed Rulemaking, 8 FCC Rcd 557 (1993), LMDS Second Notice of Proposed Rulemaking, 9 FCC Rcd 1394 (1994) ("LMDS Second NPRM").

3/ See Comments of: Hughes; NASA; Teledesic Corporation; GE American Communications, Inc.

4/ See Comments of TRW, Inc. ("TRW").

5/ See Comments of Martin Marietta; Rockwell International.

6/ See Comments of Endgate Technology Corporation ("Endgate"); GHz Equipment Corporation; Hewlett-Packard; Telecommunications Industry Association; Harris Corporation-Farinon Division; Alcatel Network Systems.

7/ See Comments of The Educational Parties; Troy University; the Clarendon Foundation.

8/ See Comments of Pacific Bell Mobile Systems.

9/ Texas Instruments, in a one page comment, claimed that 40 GHz was not suitable for LMDS because: (i) rain loss is twice as high at 40 GHz as 28 GHz, and (ii) solid state power sources currently available for 28 GHz, at 1 watt, are one hundred times

licensing LMDS at 40 GHz. CellularVision, an affiliate of Suite 12 Group and a proponent of LMDS technology, filed comments (the "CellularVision Comments") arguing that LMDS should not be licensed at 40 GHz because it is not viable in that frequency range.[11/]

Attached is a detailed technical study authored by Stanford Telecom ("STEL Study"), which clearly refutes CellularVision's groundless assertion that LMDS is not viable at 40 GHz. CellularVision's conclusions are based on inaccurate information and on faulty or nonexistent analysis. Hughes' January 30 Comments and the STEL Study clearly show that LMDS systems can be as robust at 40 GHz as they can be at 28 GHz. Moreover, a broad range of equipment manufacturers and end users have supported the opening of the 40 GHz band and the feasibility of commercial use of those frequencies. In light of the documented technical analyses in the record that show how LMDS works at 40 GHz, CellularVision's opposition to considering 40 GHz as an option for LMDS licensing appears to be nothing more than an attempt to protect its existing pioneer's preference at 28 GHz.

Comments in this proceeding, and the replies now being submitted, will provide the record needed to demonstrate that the LMDS designs now proposed at 28 GHz

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more powerful than those available for 40 GHz use, at 0.01 watt. Neither of these claims is correct. First, rain attenuation increases in going from 28 to 40 GHz need not have a significant effect on LMDS availability and cost. See Hughes Comments at 5-7. Second, STEL has been informed by vendors that both 1 watt and 1.5 watt solid state power sources are commercially available at 40 GHz today, costing as little as 20 percent more than similar-powered 28 GHz equipment. STEL Study at 20.

10/ Comtech expresses concern about additional delay in licensing if the Commission now considers LMDS at 40 GHz instead of 28 GHz.

11/ CellularVision's procedural arguments against considering licensing LMDS at 40 GHz should be disregarded because the Commission has asked for the broadest possible comments on how the millimeter wave bands should be used, including proposals "that would enhance the use of specific bands for particular services." NPRM at 7.

can be feasibly implemented at 40 GHz. CellularVision's concerns that LMDS must "lose" if other services "win" at 28 GHz is based solely on its misplaced conviction that LMDS cannot be implemented, at reasonable cost, at 40 GHz. As demonstrated below, this is simply not the case.

II. LMDS Is Technically and Economically Feasible in the 40 GHz Band

The CellularVision Comments are the latest in a series of entirely unsupported assertions that CellularVision and its affiliates have made in this and the 28 GHz proceeding in CC Docket No. 92-297 ("28 GHz Rulemaking"). Similar speculative claims by CellularVision were demonstrated to be wrong in the past. For example, in the 28 GHz Rulemaking, CellularVision's affiliate, Suite 12, claimed until the end that satellite uplinks in the 28 GHz band did not pose an interference threat to LMDS receivers.[12/] All of these "analyses" were proven wrong by a group of industry experts in the 28 GHz Negotiated Rulemaking. See Report of the LMDS/FSS 28 GHz Band Negotiated Rulemaking Committee (September 23, 1994). The CellularVision Comments continue this pattern of denial and obfuscation, filling the record with claims about the viability of LMDS at 40 GHz that do not withstand scrutiny.[13/] These myths are addressed below.

12/ See, e.g., "Satellite Earth Stations Operating in the 28 GHz Band Will Not Interfere With LMDS Receivers" (filed in CC Docket No. 92-297 on January 10, 1994) (claiming that neither Hughes' Spaceway, NASA's ACTS, nor Motorola's Iridium uplinks will cause degraded performance of LMDS receivers).

13/ See LMDS is Not Viable in the Frequency Bands Above 40 GHz ("Cellularvision Paper"), attached to the CellularVision Comments as Appendix 2.

Myth: "The cost of an LMDS system at 40 GHz is projected to be 30 to 40 times the cost at 28 GHz" CellularVision Comments at 6.

Reality: LMDS at 40 GHz would cost about 1.05 to 1.1 times as much as it would at 28 GHz.

The assumptions underlying CellularVision's cost analysis, and the analysis itself, are fundamentally flawed. Contrary to CellularVision's claims: (i) the same system architecture that would be employed at 28 GHz can be employed at 40 GHz with only a slight reduction in signal availability; and (ii) while certain LMDS equipment will cost more at 40 GHz than it will cost at 28 GHz, the overall cost impact on an LMDS system is relatively small, in the range of a 5 to 10 percent increase. See STEL Study at 3-24.

Myth: "LMDS Operation above 40 GHz Will Require a Minimum of 7 Times as Many Cells." CellularVision Paper at 6.

Reality: LMDS can be operated at 40 GHz with cell sizes that are identical to those at 28 GHz and provide essentially the same grade of service.

The CellularVision 28 GHz point design (including the 3.0 mile cell radius) can be replicated at 40 GHz at only a 5 to 10 percent additional cost and with only a minor tradeoff in system availability near the edge of the cell. This slight decrease in availability with the same cell size means that LMDS users, at the edge of a cell, could expect service to be below the optimal level about 1.5 hours more per year at 40 GHz than they could expect at 28 GHz. See Hughes Comments at 5-6. Moreover, the system availability that can achieved at 40 GHz with the same LMDS point design is well within accepted performance standards for the video delivery systems. Id. at 7. Finally, should certain applications require higher availability, minor system adjustments can be made to satisfy such a requirement. STEL Study at 14-15.

Myth: "40 GHz LMDS Transmission Equipment Cost is Double the 28 GHz Cost." CellularVision Paper at 6-8.

Reality: The increased equipment costs at 40 GHz represent only a fraction of total system cost, which would increase only by 5 to 10 percent at 40 GHz.

While the costs of certain equipment needed to operate at 40 GHz would be greater than that used at 28 GHz, these costs represent only a small portion of the total costs of constructing and operating an LMDS cell site through its entire life cycle. When combined with other costs, such as those related to real estate, back-bone infrastructure, RF equipment, construction, warranty, and maintenance, the increase in initial outlay for equipment actually represents an increase of only 5 to 10 percent of total system costs. Id. at 24.[14] Moreover, this differential is likely to decrease to near zero within a few years, as increased demand for millimeter wave components makes the market more competitive.[15]

Myth: Propagation factors at 40 GHz make that band unworkable for LMDS. CellularVision Paper at 8-11.

Reality: The propagation effects at 40 GHz need not have a significant effect on LMDS signal quality or cost.

First, there is no significant difference between 40 GHz and 28 GHz in LMDS system performance due to signal reflection, diffraction or scattering. STEL Study at 25-32.

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[14] See also Comments of TRW at 7-8 ("technology that would drive LMDS at 28 GHz is not only available for 40 GHz, there is no appreciable cost difference"); Comments of Endgate at 2 (40 GHz equipment initially will cost 15 to 20 percent more than 28 GHz equipment, although, over time, "this price differential will become insignificant").

[15] Cf. NPRM at 3 (noting that opening new spectrum for personal communications services has "stimulated investment and technological development . . . that promise to bring tremendous benefits . . . in the form of new communications services, lower costs and a more competitive industry").

Indeed, contrary to CellularVision's assertions, analysis indicates that these effects do not provide any meaningful improvement in non-line-of-sight operation, even at 28 GHz.[16]

Second, CellularVision's estimate that foliage losses would increase significantly at 40 GHz is refuted by studies showing there is no significant difference between the two bands in propagation through leafy trees, STEL Study at 33-35, and that even a single tree could effectively block an LMDS signal at either 28 or 40 GHz. Id.

Finally, the increased signal attenuation due to rain at 40 GHz can be overcome by minor system modifications, such as accepting slightly lower system availability. Hughes Comments, Exhibit A at 2-5; STEL Study at 4, 14-15.

In sum, the currently proposed LMDS architecture at 28 GHz is fully transferable to 40 GHz with a nominal increase in total system cost.

III. Licensing FSS Systems in the 28 GHz Band is Essential to the Development of the NII/GII.

CellularVision's Comments are replete with attempts to show why the proposed LMDS service is a more efficient or more valuable use of spectrum than FSS services. While CellularVision's claims are unsupported and, Hughes believes, insupportable, comparing the merits of these two services is not within the scope of this proceeding. Hughes intends to address these matters in response to the Commission's Second Notice of Proposed Rulemaking in CC Docket No. 92-297, which requests comment on the tradeoffs involved in choosing one service over the other.

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[16] Id. at 25, 32. While CellularVision claims that service to non-line-of-sight subscribers through signal reflection has been demonstrated using its New York system (CellularVision Comments at 9), it provides absolutely no test data to support this assertion. In view of the above findings, the touted efficacy of reflected signal operation at 28 GHz versus 40 GHz is doubtful at best.

Nonetheless, as the Commission determines how to license the 40 GHz band, Hughes urges the Commission to consider that satellite systems will be able to provide a role in the Clinton Administration's vision of an NII/GII only if there is adequate spectrum that is uniformly available for satellites on a worldwide basis. Satellites are uniquely suited to serving the rural and remote parts of the United States and the world. In fact, the launch of a single geostationary satellite provides the opportunity to provide sophisticated services to individuals in these parts of the United States many years before the terrestrial networks such as LMDS ever will reach them.

LMDS proponents who balk at the small increased cost of implementing LMDS at 40 GHz instead of 28 GHz hardly can be expected to construct multiple, small diameter cells that cost hundreds of thousands of dollars in areas of low population density. If service to these parts of the United States is to be provided, it is satellite technology, not terrestrial technology, that will fill the role.

IV. Conclusion

LMDS is both technically and economically viable in the 40 GHz band and the band is currently allocated for these types of fixed terrestrial services. Licensing LMDS at 40 GHz provides an attractive way to break the current "logjam" in the 28 GHz Rulemaking and ensure that sufficient spectrum will be available for global FSS systems to provide their essential role in the GII/NII. Allowing LMDS and FSS service to be developed with the full amount of spectrum that each service requires will do more to "create opportunities for economic growth and jobs" (NPRM at 4) than excluding one of these incompatible services from operating at the 28 GHz band. Finally, relocating LMDS to 40 GHz will allow both

satellite and LMDS providers to proceed with their respective business plans without wasteful delays and loss of market share that are the consequence of further protracted proceedings.

Respectfully submitted,

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By: _____

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March 1, 1995

CERTIFICATE OF SERVICE

I, Raymond B. Grochowski, do hereby certify that true and correct copies of the foregoing Reply Comments of Hughes Communications Galaxy, Inc. were served this 1st day of March, 1995, by first class mail, upon the following:

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EXHIBIT A

ASSESSMENT OF RELATIVE PERFORMANCE AND COSTS BETWEEN LMDS IN THE 28 AND 40 GHz BANDS

LMDS IS VIABLE IN THE 40 GHz FREQUENCY BAND

prepared by

Stanford Telecom

March 1, 1995

ASSESSMENT OF RELATIVE PERFORMANCE AND COSTS BETWEEN LMDS IN THE 28 AND 40 GHz BANDS

LMDS IS VIABLE IN THE 40 GHz FREQUENCY BAND

Stanford Telecom

1. INTRODUCTION

A major proponent of 28 GHz LMDS service, CellularVision, has claimed, in thier comments to the Commission on ET Docket No. 94-124, RM-8308, that LMDS is not viable in the frequency bands above 40 GHz[1]. The basis of their conclusion rests in the assertion that operation at 41 GHz "will require ***7.3 times*** as many hub transmitters as required for operation at 28 GHz", and further, that "operation of the LMDS system at 40 GHz results in a direct increase in system cost by a ***factor of thirty to forty (30 to 40)***." [italics added]

There is extensive experimental and analytical evidence, which was not discussed or even acknowledged in the CellularVision report, that shows conclusively that LMDS operation at 41 GHz is viable within the **same cell size** as that proposed for LMDS operation at 28 GHz, thereby completely refuting the cell size "7.3 factor" and the relative costs factor "30 to 40". The objective of this paper is to set the record straight, present the relevant and accurate evidence and analysis related to the relative performance and costs of LMDS operation in the 28 and 41 GHz bands, and demonstrate that LMDS operation at 41 GHz is viable and can be accomplished with

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[1]Comments of CellularVision, to ET Docket No. 94-124, RM-8308, dated January 30, 1995.

overall system differential costs of no more than 5 to10%, that is, **a differential cost factor of 1.05 to 1.10**, not the completely arbitrary and unsupported factor of "30 to 40" claimed by the CellularVision report.

The "30 to 40" factor claimed by CellularVision is composed of the following elements:

CELLULARVISION CLAIMED ADDITIONAL COST FACTORS BETWEEN LMDS IN THE 28 AND 41 GHZ BANDS									
Maximum Cell Size Factor		Component Costs Factor		Non Line-Of-Site Factor		"Additional Cost Factors"		Total Differential Cost Factor
7.3	x	**2**	x	**2**	x	**(~ 1.33)**	=	**"30 to 40"**

This report will show conclusively that the **correct** factors related to the differential costs between the two bands are:

CORRECT COST FACTORS BETWEEN LMDS IN THE 28 AND 41 GHZ BANDS								
Maximum Cell Size Factor		Component Costs Factor		Non Line-Of-Site Factor		"Additional Cost Factors"		Total Differential Cost Factor
1	x	**1.05 to 1.10**	x	**1**	x	**1**	=	**1.05 to 1.10**

The basis and justification for the corrected cost factors is discussed in the following sections of this report. Section 2 discusses the Maximum Cell Size factor, Section 3 the component costs, Section 4 the non-line of site considerations, and Section 5 the additional costs factors. Section 6 discusses some additional considerations involved

in the comparitive assessment of the two bands. The report conclusively demonstrates the viability of LMDS in the 40.5 - 42.5 GHz band as an attractive alternative for consideration by the Commission.

2. MAXIMUM CELL SIZE

The link budgets presented in Table 1 of Appendix 2 of CellularVision's comments to the NPRM [2] attempt to validate the claim that operation at 41 GHz "will require 7.3 times as many hub transmitters as required for operation at 28 GHz". This factor is the major component of the claim that "operation of the LMDS system at 40 GHz results in a direct increase in system cost by a factor of thirty to forty (30 to 40)."

In this section each of the items of the link budget for LMDS systems is discussed, and corrected values are presented for two example viable options which allow operation at 41 GHz with a 3.00 mile maximum range (cell radius), the same as that proposed for the 28 GHz system.

Exhibit 1 presents a summary of link budget system parameters. The columns labeled "CellularVision Values" are those claimed by CellularVision in Table 1 of Appendix 2 of their comments. The columns labeled "Corrected Values for 41 GHz Systems" present two optional point designs which provide viable 41 GHz service with 3 mile cell ranges, based on corrected and validated system parameters. The shaded items indicate those parameters which have been corrected from the values claimed by CellularVision. The rationale and justification for the corrected parameter values are presented in the following sections.

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[2]see "LMDS is Not Viable in the Frequency Bands Above 40 GHz," prepared by CellularVision, Appendix 2, in Comments of CellularVision, to ET Docket No. 94-124, RM-8308, dated January 30, 1995.

Exhibit 1. Link Budget Summary

System Parameter	Units	CellularVision Values		Corrected Values for 41 GHz Systems	
		28 GHz System	41 GHz System	41 GHz Option 1[1]	41GHz Option 2[2]
Transmitter Power	watts	100	~~**45**~~	**80**	**80**
Output Backoff	dB	7	7	7	7
50 Channel factor	dB	-17	-17	-17	-17
Output Power/channel	dBw/ch	-4.0	-7.5	-5.0	-5.0
Transmitter Line Loss	dB	1.0	1.5	1.5	1.5
Transmit Antenna Gain	dBi	12.0	~~**11.0**~~	**15.3**	**15.3**
EIRP/channel	dBw	7.0	2.0	8.8	8.8
Maximum Range (Cell Radius)	miles	3.00	~~**1.15**~~	**3.00**	**3.00**
Free Space Path Loss	dB	135.2	130.2	138.5	138.5
Link Availibility	%	99.9	99.9	99.8	99.9
Total Path Loss	dB	148.4	138.4	154.0	160.8
Isotropic Receive Level	dBw/ch	-141.4	-136.4	-145.2	-152.0
Receive Antenna Size	inches	6.9	?[3]	**6.9**	**15**
Receive Antenna Gain	dBi	32.0	~~**29.0**~~	**34.6**	**41.4**
Receiver Carrier Level	dBw/ch	-109.4	-107.4	-110.6	-110.6
Receiver Noise Figure	dB	6.0	~~**8.0**~~	**6.0**	**6.0**
Receiver Noise Level	dBw/ch	-125.4	-123.4	-126.5	-126.5
Receiver C/N	dB	16.0	16.0	16.0	16.0

[1] Option 1 - Same size hub and subscriber antennas, slightly reduced link availability
[2] Option 2 - Increase Receive antenna size to maintain 99.9% link availability
[3] Antenna size not stated
Note: Bold and large font items indicate corrected parameters and values.

Power Transmitter

The CellularVision link budget assumes a 100 watt transmitter for the 28 GHz link, but reduces the value to 45 watts at 41 GHz, claiming that the availability of cost -effective comparible devices at 41 GHz is "highly questionable". The reduction of the transmitter power from 100 to 45 watts is unwarranted, and is not based on the current market conditions, as we here demonstrate.

High power amplifier (HPA) vendors in the U.S. and Europe were surveyed recently, and several were found that can offer 41 GHz power devices at 80 watt levels, and at reasonable costs[3]. The cost information was asked for in rough order of magnitude (ROM), for lot sizes up to 10,000 units, and for both frequency bands.

It should also be pointed out that there are several options available to the cell site integrator to provide a cost effective configuration for the cell site transmit system. The first configuration option is the single HPA which amplifies all 50 channels, and is the configuration described above in the link budget summary. A second configuration option is to use two lower power HPA's, for example 45-50 watt devices, with each device servicing half of the channels. This configuration may result in a lower total cost, since, based on preliminary vendor discussions, the 50 watt device may cost less than 1/2 of the 100 watt device. A third configuration option avoids the need for HPA's and utilizes a single Solid State Power Amplier (SSPA) for each channel. The second and third configuration options are being implemented by the United Kingdom MVDS systems; the second option is implemented for tower cell sites while the third option is implemented for building roof top cell sites.

A transmitter power value of 80 watts for the 41 GHz options described in Exhibit 1 is entirely reasonable and justified, based on an assessment of vendor responses, and

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[3] see Section 3 of this report for details of the vendor cost survey.

on active developments for the 41 GHz MVDS systems in the UK and elseware.

Conclusion for 41 GHz Transmitter Power:

CellularVision assumed value:	~~45 watts~~
Correct value:	80 watts

Transmitter Line Loss

Transmitter line loss is dependent on specific wave guide or coaxial cable chosen. Line losses should not be significantly higher at 41 GHz for the system configurations and line lengths used for LMDS services. The value of 1.5 dB for 41 GHz may be high, but it is carried over in the link budgets at the current time, pending specific hub configuration designs.

Transmitter Antenna Gain[4]

CellularVision claims an overall reduction of 1 dB in antenna gain and a doubling of costs for the 41 GHz antenna, over the 28 GHz design![5] This is claimed as resulting from two factors; (1) the elevation beamwidth must be maintained, and, (2) a 1 dB "implementation loss." Neither claim is justified (which may explain why no supporting evidence was provided). Each of these claims is refuted below.

Transmit Antenna Beamwidth The claim by CellularVision that the same elevation beamwidth must be maintained to ensure coverage of close-in and distant subscribers is not valid. An analysis of the impact of hub antenna beamwidth on close-in subscriber was accomplished. Using antenna patterns provided by

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[4] transmitter antenna costs are discussed in Section 3.

[5]see page 6 of Appendix cited in footnote 2.

CellularVision and TI (Exhibits 2 and 3), it was found that there is no exclusion zone around the transmitter and no loss of signal to near-in subscribers for either the CellularVision antenna with 12.1 dB gain or the TI antenna with 14 dB gain. The loss in antenna pattern is more than made up for by excess margin for rain and path loss, margins designed for communication at the cell edge. In fact, for neither antenna pattern is the situation on the edge of creating a problem, so further small increases in gain cannot make or break the link for near-in subscribers.

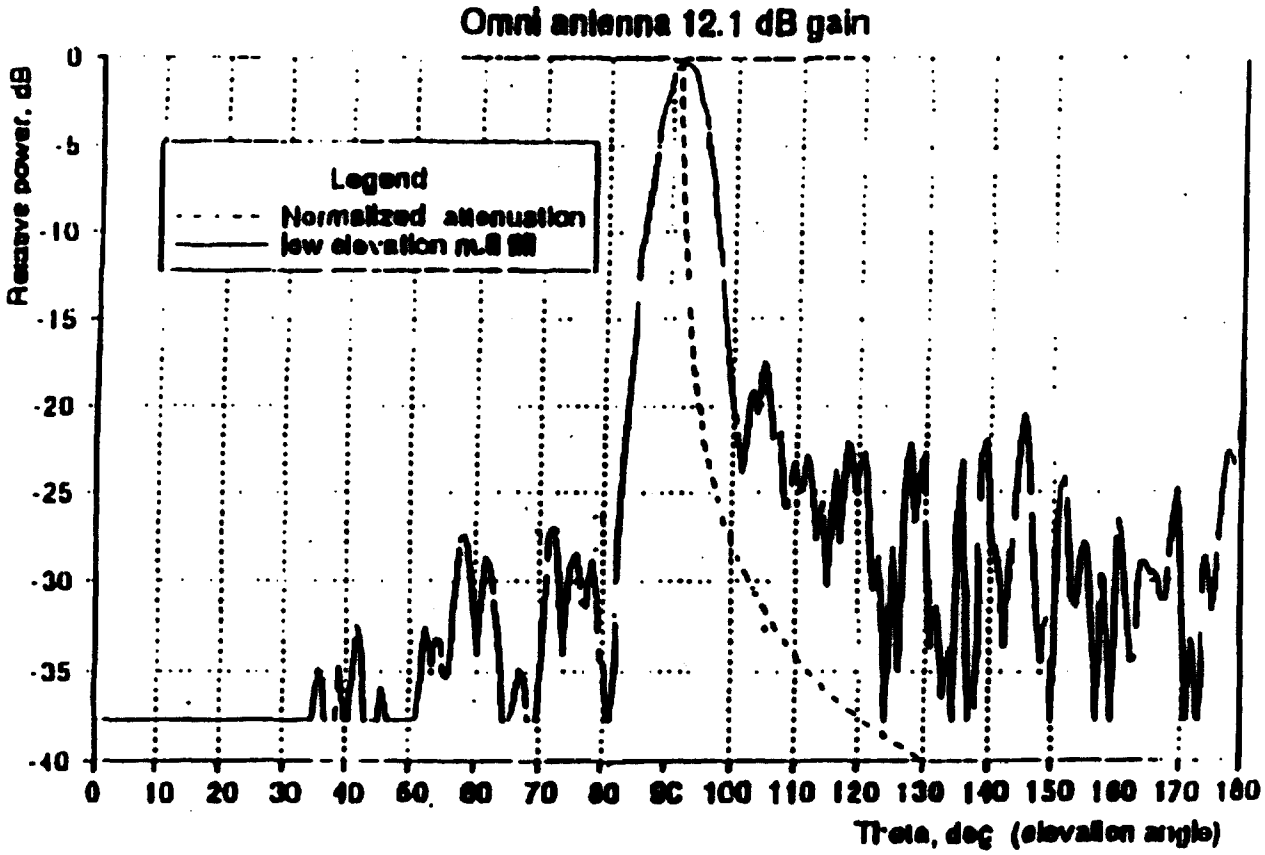

Exhibit 2. CellularVision 12.1 dB gain hub antenna pattern

[Source: CellularVision Services, 8/12/94, Appendix B]