RioVision of Texas, Inc.

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September 28, 1994

Susan Magnotti, Esquire
Designated Federal Official
28GHz Negotiated Rulemaking Committee
c/o Common Carrier Bureau
Federal Communications Commission
1919 M Street NW
Washington, D.C. 20554

Dear Susan,

Kindly consider this letter for insertion into the appendix of the 28GHz NRMC formal report to the FCC.

As evidenced by the co-frequency sharing agreement reached between Motorola SatCom and Suite 12 - it is clear that sharing is feasible between LMDS and MSS space-based systems.

It is equally clear - after two months of listening to both sides - that sharing between LMDS and FSS is also feasible without band segmentation.

Nevertheless - I must express to you the feeling that Steve Copold of UT-Pan American and I share that the intent of certain FSS parties involved in the NRMC was to ensure that no consensus agreement would be reached.

Although we remain optimistic that LMDS will be a viable delivery system of entertainment, data and education - we find the NRMC's outcome to be cruelly disappointing to our efforts to provide such services to South Texas within a reasonable time frame. Such services as we, and others, propose can only be delivered via LMDS and will never be offered by those satellite entities whose rigidity in our negotiations was nothing short of disgusting.

We are grateful for the opportunity to have participated in the NRMC proceedings and we continue to look forward to the Commission's positive actions on behalf of LMDS.

Thank you and warm regards from your friends in South Texas.

Sincerely,

Jon Schill

Jon Schill
Vice President

THE LAW OFFICES OF
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September 29, 1994

By Hand

Susan Magnotti, Esq.
Domestic Radio Branch
Common Carrier Bureau
Federal Communications Commission
2025 M Street, N.W., Room 6310
Washington, D.C. 20554

Re: Suite 12 Group/CellularVision of New York, L.P.
Annex to Report of 28 GHz NRMC

Dear Ms. Magnotti:

On behalf of Suite 12 Group/CellularVison of New York, L.P. ("Suite 12/CVNY"), enclosed for the inclusion as an Annex to the Report of the LMDS/FSS 28 GHz Negotiated Rulemaking Committee are the following documents:

(1) "Suite 12/CVNY Proposed Rule For LMDS Co-Frequency Sharing With FSS: Assignment Of Spectrum to FSS Earth Stations." This document, which is dated September 20, 1994 and was assigned document number NRMC/92, proposes methods to prevent objectionable interference from FSS earth stations to LMDS receivers, and thus permit LMDS/FSS co-frequency sharing in the 27.5-29.5 GHz band.

(2) "Suite 12 Group/CVNY Proposed Rules For LMDS Co-Frequency Sharing With FSS." This document, which is dated September 20, 1994 and was assigned document number NRMC/92.1, proposes rules to prevent interference from LMDS transmitters to FSS receivers, and thus permit LMDS/FSS co-frequency sharing in the 27.5-29.5 GHz band.

Please direct any questions regarding this submission to the undersigned.

Sincerely,

Michael R. Gardner

Michael R. Gardner
Charles R. Milkis
Counsel for Suite 12/CVNY

Enclosures

NRMC/92
September 20, 1994

SUITE 12 GROUP/CELLULARVISION OF NEW YORK, L.P.
PROPOSED RULE FOR LMDS CO-FREQUENCY SHARING WITH FSS:
ASSIGNMENT OF SPECTRUM TO FSS EARTH STATIONS

1. An LMDS licensee will make available a portion of its assigned spectrum for use by FSS earth stations in each LMDS cell, as a method to prevent interference from FSS earth stations into LMDS receivers. This spectrum may be either pre-assigned or dynamically assigned, at the option of the LMDS licensee. Alternatively, or in addition, the LMDS licensee and affected FSS operators may use such other methods as may be sufficient to protect against interference from FSS earth stations into LMDS receivers, including mitigation techniques.

1(a). If the LMDS licensee selects pre-assignment of spectrum for FSS use, the LMDS operator will designate at least 2 MHz of spectrum in each of its cells. The LMDS licensee shall notify each affected FSS operator of the designated blocks of spectrum. The LMDS licensee may designate different blocks of spectrum for use by FSS earth stations in each of its cells. All FSS operators that are authorized to operate in the 27.5-28.5 GHz band shall use the same block of spectrum in each Band A LMDS cell. All FSS operators that are authorized to operate in the 28.5-29.5 GHz band shall use the same block of spectrum in each Band B LMDS cell. FSS operators shall coordinate their satellite antenna patterns and channel plans so as to assure that all FSS operators are able to employ the same blocks of spectrum in each LMDS cell.

1(b). An LMDS licensee may select dynamic assignment of spectrum for use by FSS operators. If the LMDS licensee selects dynamic assignment of spectrum for FSS use, FSS operators may use any 2 MHz of frequencies or channels from within their assigned frequencies, at any locations within LMDS cells. In such case, FSS operators shall provide such LMDS operator with real-time data identifying its actual assignment of spectrum capacity to FSS earth stations in the LMDS service area. It shall be the responsibility of the LMDS operator to avoid the use of frequencies being used by the FSS operator. The LMDS licensee will accept any interference caused by FSS earth stations operating pursuant to this dynamic assignment option.

NRMC/ 92.1
September 20, 1994

SUITE 12 GROUP/ CELLULARVISION OF NEW YORK, L.P.
PROPOSED RULES FOR
LMDS CO-FREQUENCY SHARING WITH FSS

1. Hub Transmitter EIRP Spectral Area Density Limit for Certain Elevation Angles. LMDS applicants shall demonstrate that for all elevation angles above 15 degrees, under clear air operating conditions, the maximum aggregate of LMDS transmitting hub stations in a Basic Trading Area in the 27.5 - 29.1 GHz band will not transmit a co-frequency hub-to-subscriber EIRP spectral area density in any azimuthal direction in excess of X dBW/(MHz-KM^2), where X is defined in Table 1.

The EIRP aggregate spectral area density is calculated as follows:

$$10\log\left[\frac{1}{A}\sum_{i=1}^{N} EIRP(a_i)\right] dBW/(MHz\text{-}km^2)$$

where:
N = number of co-frequency hubs in BTA
A = area of BTA in km^2
EIRP(a_i) = equivalent isotropic radiated power density of the i-th hub (in Watts per MHz) at elevation angle a.

Table 1

Elevation Angle (a)	EIRP Spectral Area Density in the 27.5-28.6 GHz band (dBW/(MHz-km^2))	EIRP Spectral Area Density in the 28.6-29.1 GHz band (dBW/(MHz-km^2))
$15 \leq a < 20$	-21.9	-30.6
$20 \leq a < 30$	-21.9	-29.9
$30 \leq a < 40$	-21.9	-28.7
$40 \leq a \leq 90$	-21.9	-31.9

where a is angle in degrees of elevation above horizon. To test compliance in the 27.5 - 28.6 GHz band, average levels will be used for angles beyond 15^0, where average levels are calculated by sampling the antenna patterns in 1^0 intervals between 15^0 and 90^0, and dividing by 76. To test compliance in the 28.6 - 29.1 GHz band, average levels will be used for angles beyond 15^0, where average levels are calculated by sampling the antenna patterns in 1^0 intervals between and inclusive of the two elevation angles shown in Table 1 for the four different limits

and dividing by the number of samples. This rule imposes no limits on EIRP Spectral Area Density below elevation angles of 15 degrees.

2. Power Reduction Techniques. LMDS hub transmitters in the band 28.6 - 29.1 GHz may employ methods to reduce average power levels received by FSS satellite receivers by employing the methods set below:

(a) Alternative Polarizations. LMDS hub transmitters may employ vertical and horizontal linear polarizations such that 50 percent (plus or minus 10 percent) of the hub transmitters shall employ vertical polarization and 50 percent reduction (plus or minus 10 percent) shall employ horizontal polarization.

(b) Frequency interleaving. LMDS hub transmitters may employ frequency interleaving such that 50 percent (plus or minus 10 percent) of the hub transmitters shall employ center frequencies which are different by one-half the channel bandwidth of the other 50 percent (plus or minus 10 percent) of the hub transmitters.

(c) Alternative Methods. As alternatives to (a) and (b) above, LMDS operators may employ other methods as may be shown to achieve equivalent reductions in average power density received by FSS satellite receivers.

3. LMDS Subscriber Transmissions. LMDS applicants shall demonstrate that under all operating conditions and where spectral peaking is the highest in any one megahertz, LMDS subscriber transmitters in the 27.5 - 28.6 GHz band will not exceed an average EIRP spectral density of +25.0 dBWI/MHz, and LMDS subscriber transmitters in the 28.6 - 29.1 GHz band will not exceed an average EIRP spectral density of +20.9 dBWI/MHz, where EIRP spectral density is defined as the power spectral density into the subscriber transmitter antenna (dBW/MHz) plus the peak subscriber transmitter antenna gain (dBi).

4. LMDS Subscriber Transmitter Antenna Discrimination. LMDS applicants shall demonstrate that subscriber transmitter antennas, operating in the 27.5 - 29.1 GHz band, will provide an average discrimination of at least -24 dB for angles between 15 and 90 degrees from boresight, where the averaging is done over the angles from 15 degrees from boresight. This limit shall apply to antenna discrimination in any two orthogonal planes.

5. Amend proposed rule section 21.1007(c)(i) by substituting the following language:

21.1007(c)(i) The boundaries of the GSA must include 25% of the population of the BTA.

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2025 M Street, N.W., Room 6310
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Re: Suite 12 Group/CellularVision of New York, L.P.
Annex to Report of 28 GHz NRMC

Dear Ms. Magnotti:

On behalf of Suite 12 Group/CellularVison of New York, L.P. ("Suite 12/CVNY"), enclosed for the inclusion as an Annex to the Report of the LMDS/FSS 28 GHz Negotiated Rulemaking Committee is a report entitled "Co-Frequency Sharing between FSS Teledesic, Hughes Spaceway Transmitters and LMDS Receivers."

This Suite 12/CVNY report, in conjunction with a study prepared and submitted to the FCC by Bellcore entitled "Interference from FSS Uplinks into LMDS Receivers: The Impact of Improved Antenna Patterns," indicates that if FSS systems use conventional antennas, co-frequency sharing between LMDS and FSS is possible in 97-99.9% of cases without the requirement of ancillary mitigation techniques. Thus, despite the inability of the NRMC to reach a consensus, Suite 12 has shown that co-frequency sharing between LMDS and FSS is possible without a financial burden on either service. The Suite 12 report relies on and includes as attachments several documents, several of which were submitted to the Negotiated Rulemaking Committee and Working Groups.

Please direct any questions regarding this submission to the undersigned.

Sincerely,

Michael R. Gardner

Michael R. Gardner
Charles R. Milkis
Counsel for Suite 12/CVNY

Enclosures

Co-Frequency Sharing between FSS Teledesic, Hughes Spaceway Transmitters and LMDS Receivers

September 29, 1994

It has been shown that LMDS transmitters do not interfere with FSS satellite receivers. This is due to the control of LMDS EIRP in the direction of all possible satellites located at angles greater than 15° above the horizon.

Moreover, all LMDS FM, digital, omni, and sector antenna systems (or combination thereof) are able to effectively operate without reduction in coverage area by slight adjustments which do not affect the FSS satellite receiver interference from LMDS (NRMC 115) or the FSS transmitter interference into the LMDS receiver.

A solution to coexistence between MSS LEO satellite receivers and LMDS receivers was jointly presented by both Motorola Satellite Communications, Inc. (Iridium) and Suite 12 (LMDS).

Bellcore in its submission to the FCC the week of September 26, 1994, entitled *Interference from FSS Uplinks into LMDS Receivers: Impact of Improved Antenna Patterns* by Dr. Scott Y. Seidel, indicated the co-sharing possibilities between Teledesic transmitters and CellularVision LMDS receivers based upon antenna performance supplied by Andrew Corporation (NRMC/104) is possible in 97% of the worst cases (fringe area). LMDS reception is better than 99.9% in all cases with maximum separation distance of only 105 feet. Further reductions are possible by using building blockage, and other techniques which should reduce the distance to 50 feet. Suite 12/CellularVision has demonstrated co-frequency in band interference co-sharing performance at distances of less than 100 feet even with LMDS receivers pointed to within 5° of simulated satellite transmitters.

Table 2 of the Bellcore report is shown below:

Reduction in Separation Distance Under Clear Sky Conditions

Required Separation (miles) T1 TST -> CellularVision Subscriber Receiver	ITU-699 38 dB (miles)	Conservative Improvement 63 dB (miles)	Optimistic Improvement 78 dB (miles)
5 degree Sidelobe	3.88	0.23	0.04
45 degree Sidelobe	1.96	0.11	0.02
180 degree Sidelobe	0.10	0.01	0.00

Note that the separation distance between FSS transmitters and LMDS receivers in 97% (5° to 180°) of the worst cases (fringe area for LMDS) is typically less than 0.02 mile (105.6 feet). This is without use of shrouds, special antennas, or building blockage. Note that the LMDS receiver will probably never be pointed at boresight since higher gain offset LMDS antennas will be employed in those cases. This 3% will probably reduce to less than 0.1% for multiple satellite transmitters in a three dimensional full cell analysis. CellularVision has introduced sidelobe control in order not to interfere with both FSS and MSS satellite receivers in the Hub, backbone, and subscriber transmitters. Similar low cost techniques could be introduced by the satellite proponents in order to reduce potential interference from their transmitters into LMDS receivers. The CellularVision presentations from WG1/37 and WG2/35 indicate the overall system performance.

The FSS satellite proposal uses frequency agile transmitters; hence, 100% co-frequency sharing is possible by a combination of the results of the Bellcore study and The Suite 12 plan A or B (NRMC/115) in which frequency assignments are given by sub-regions within the satellite footprints in portions of the spectrum where the LMDS/FSS protection rations are 5 to 10 dB as opposed to the assumed 25 dB and/or in a pre-determined 2 MHz frequency gap located between LMDS video channels. This is a further reduction of 10 to 1 in separation distance which reduces the boresight case to 169 feet and off boresight (angles greater than 5°) to less than 15 feet. Note the CellularVision design uses intra-cell isolation techniques (polarization and frequency interweaving) which result in maximun frequency reuse.

Cable companies are planning to add services to the basic analog 60 channel video platform per the following Scientific Atlanta presentation which utilizes a full 1000 MHz of bandwidth. In order to effectively compete with cable and offer comsumers a viable alternative, LMDS must have a similar opportunity to deliver the same number of low cost channels (analog), and like the cable expansion plan, the ability to offer more expensive services as they may become available.

In sum, despite the inability of the NRMC to reach consensus on co-frequency sharing, it is clear that co-frequency sharing between LMDS and FSS is possible without any financial burden to either LMDS or satellite interests.

encl:

CellularVision Services WG1/37, WG2/35 8/12/94
Interference Calculations Observation, WG1/89 9/7/94
Aggregate Effective Radiated Flux as Function of Cell Size, WG1/90, NRMC/92.3 9/20/94
Sector Antenna and Composite Omni-Directional Gain, WG1/91, NRMC/ 92.2 9/20/94
Comments Concerning Earth Station to LMDS Interference Predictions, NRMC/104 9/23/94
Suite 12 Group, NRMC/115 9/23/94
Scientific Atlanta Cable Proposal: The Full Service Network Coaxial Telecommunications Spectrum

CellularVision Services

For Consumers

- Broadcast video programming—a competitive alternative to cable
- Narrowcast video programming—for specific local demographics
- Point cast services—individualized on-demand programming.
- Interactive services
    - -Sports with viewer-controlled camera angles
    - -Multiplayer remote games
    - -Higher-speed access to computer online services
        - > catalog shopping, travel, general online interactions

For Business, Education, and Medical Users

- Primary or emergency backup data transport
- Two-way distance education and corporate training
- High-capacity switched data for image transfers and remote consultation.

CellularVision Capacity

With 1000 MHz, LMDS can carry either:

- 50 studio quality broadcast video channels
- 17,000 to 136,000 (GMSK) simultaneous telephone calls
- 518 to 2500 (GMSK) Full Duplex switched T1s or
- 8,300 Full Duplex video teleconferencing links @ 384 kb/s

...in <u>each cell</u>

Market demand will guide operators' allocation of spectral capacity.

CellularVision Cell Structure
Design Criteria

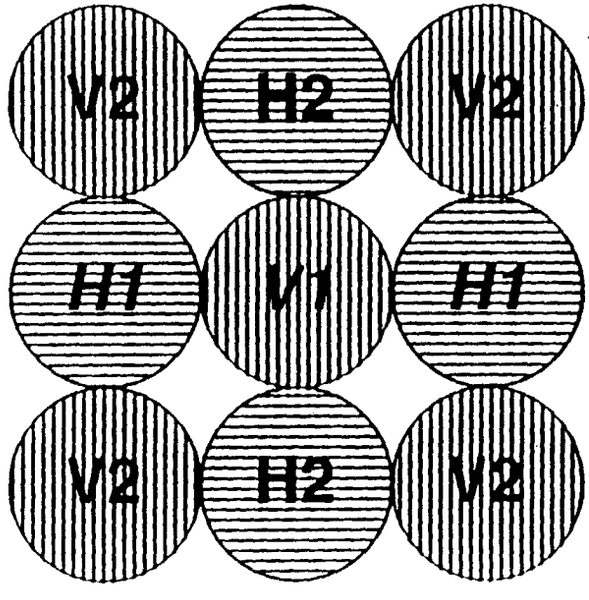
- 99.9% Availability
- RS-250c "studio quality" video with 54dB S/N
- Rain-faded S/N 45 dB ("cable quality")
- C/I = 28 dB
- Cell radius is rain-rate dependent:
  - 3 miles in New York City (CCIR rain rate D2)
  - Link margin and cliff effect
  - EIRP = constant (without rain)
- Fade Margin

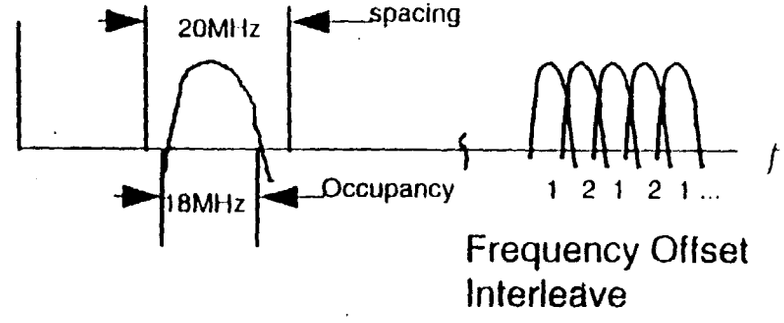
CellularVision Engineering

- 1000 MHz spectrum at 28GHz (27.5 - 28.5 GHz)
- "Line-of-sight" with usable bounced signals
  - Natural reflectors, e.g., buildings
  - Engineered passive or active repeaters
- Omni-directional, compact transmitters
- Highly directional, compact receivers
- Frequency reuse techniques:
  - Polarization
  - Frequency offset & interleave
  - Cellular transmitter siting with sectorization
- Rain-fade margin engineered into design

CellularVision Frequency Plan

Vertical Polarization: V Primary channel assignment, no offset: 1
Horizontal Polarization: H Primary channel assignment + 10MHz: 2





Frequency Offset Interleave

Channel spacing (and video quality) can be traded-off for additional channel capacity

CellularVision Cell-to-Cell Isolation Factors

Cell-Cell Type	Example	Geometry (dB)	Cross-Pol. (dB)	Frequency Interleave (dB)	Antenna Sidelobe (dB)	C/I (dB)
Lat-Long adjacent						
Mainlobe	V1/H1	10	25	0	0	35
Sidelobe	V1/H1	25	0	0	5	30
Mainlobe	V1/H2	10	25	10	0	45
Sidelobe	V1/H2	10	25	10	5	50
Lat-Long Non-adjacent						
Mainlobe	V2/V2'	14	0	0	14*	28
Sidelobe	V2/V2'	14	0	0	15	29
Diagonal Adjacent						
Mainlobe	V1/V2	10	0	10	14*	34
Sidelobe	V1/V2	10	0	10	15	35
Diagonal Non-adjacent						
Mainlobe	V2/V2'	14	0	0	14	28
Sidelobe	V2/V2'	14	0	0	15	29

Obtainable Picture Quality Level (CCIR 'Q') is in all cases a 5 = excellent

CellularVision - Components

- **Transmitter**
  - 120 watt travelling wave tube amplifier (7 dB backoff)
  - Sited about every six miles for coverage in a grid pattern
  - Typically located atop a 12 - 15 story (or higher) building
  - Suitcase-sized transmitter and power supply
- **Receiver**
  - Phased-array, 6" square, directional, 26dB gain antenna
  - Antenna typically mounted on outside wall, may be inside
  - Set-top unit looks, functions like a cable converter box
  - Encryption module to be added in 4Q94
- **Head End**
  - An FM version of a standard cable head end facility

Cellularvision - The "rain issue"

- **Heavy rain attenuates 28GHz transmissions**
- **Cell sizing incorporates a rain fade margin:**

For 99.9% availability, cell designs vary significantly ...

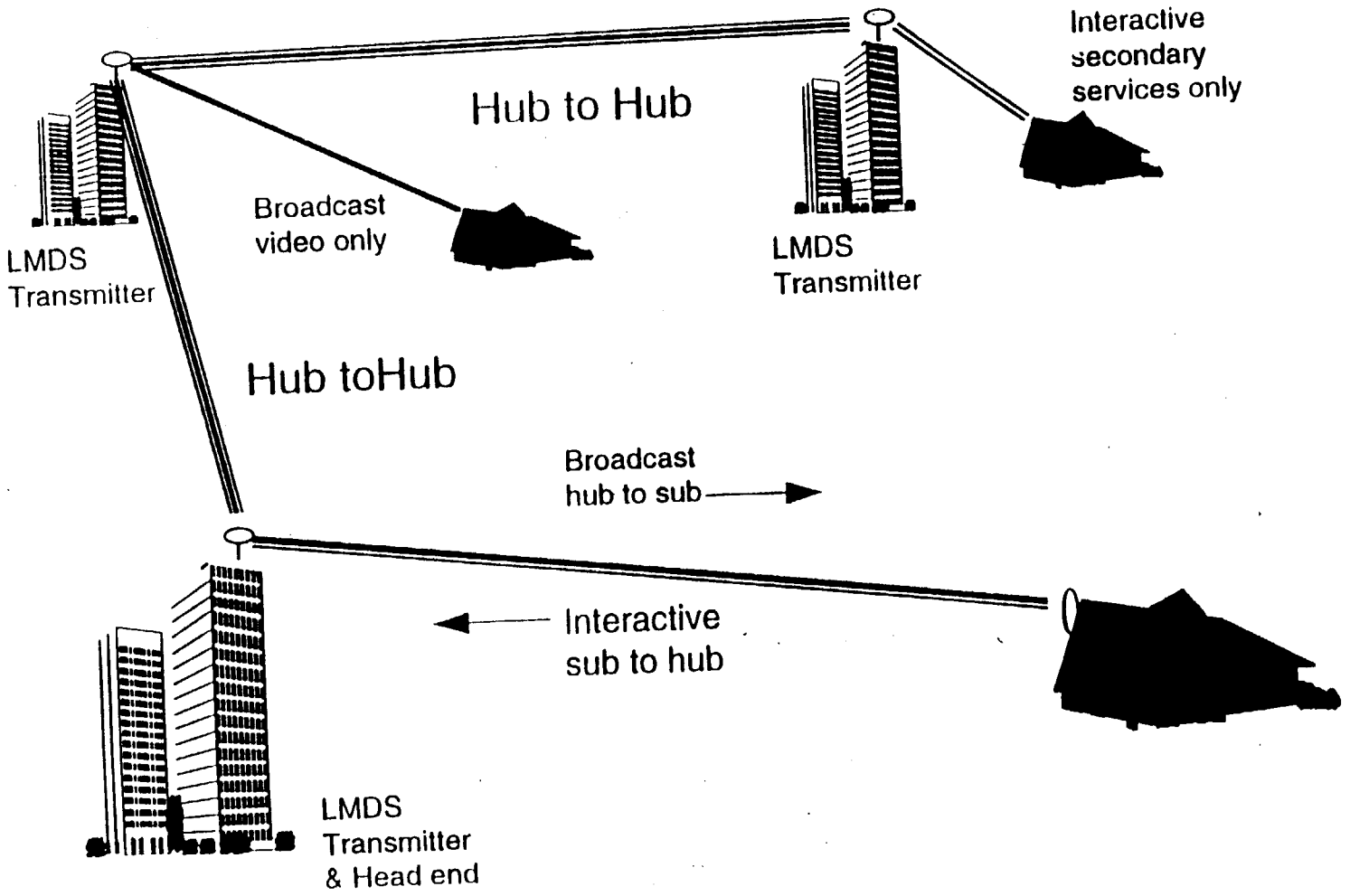
CCIR region	Example city	rain, mm / hr	attenuation per mile (dB)	Cell area (sq. mi.)
F	Los Angeles	5.5	1.5	109
B	Denver	6.8	1.8	92
C	San Francisco	7.2	2.0	82
D1	Minneapolis	11	3.2	48
D2	New York City	15	4.6	30
D3	Memphis	22	6.7	20
E	Miami	35	11.0	9

Statistical rain fade allowance (Crane) is less conservative
U.S. weighted average LMDS cell area is 53 square miles

CellularVision Demographics

- **Average Cell in U.S. implementation**
  - Hubs deployed to illuminate 10% of geography
  - Addresses 90% of population
  - Average cell area is 53 square miles
  - Approximately 5,700 cells are economic to deploy
  - Average cell contains ~20,000 households
- **Minimum Cell in U.S. Implementation**
  - Operators may decide to deploy cells with a minimum density threshold of ~5000 households per cell
    - » Threshold based on deployment economics and revenues with 10% LMDS subscriber penetration

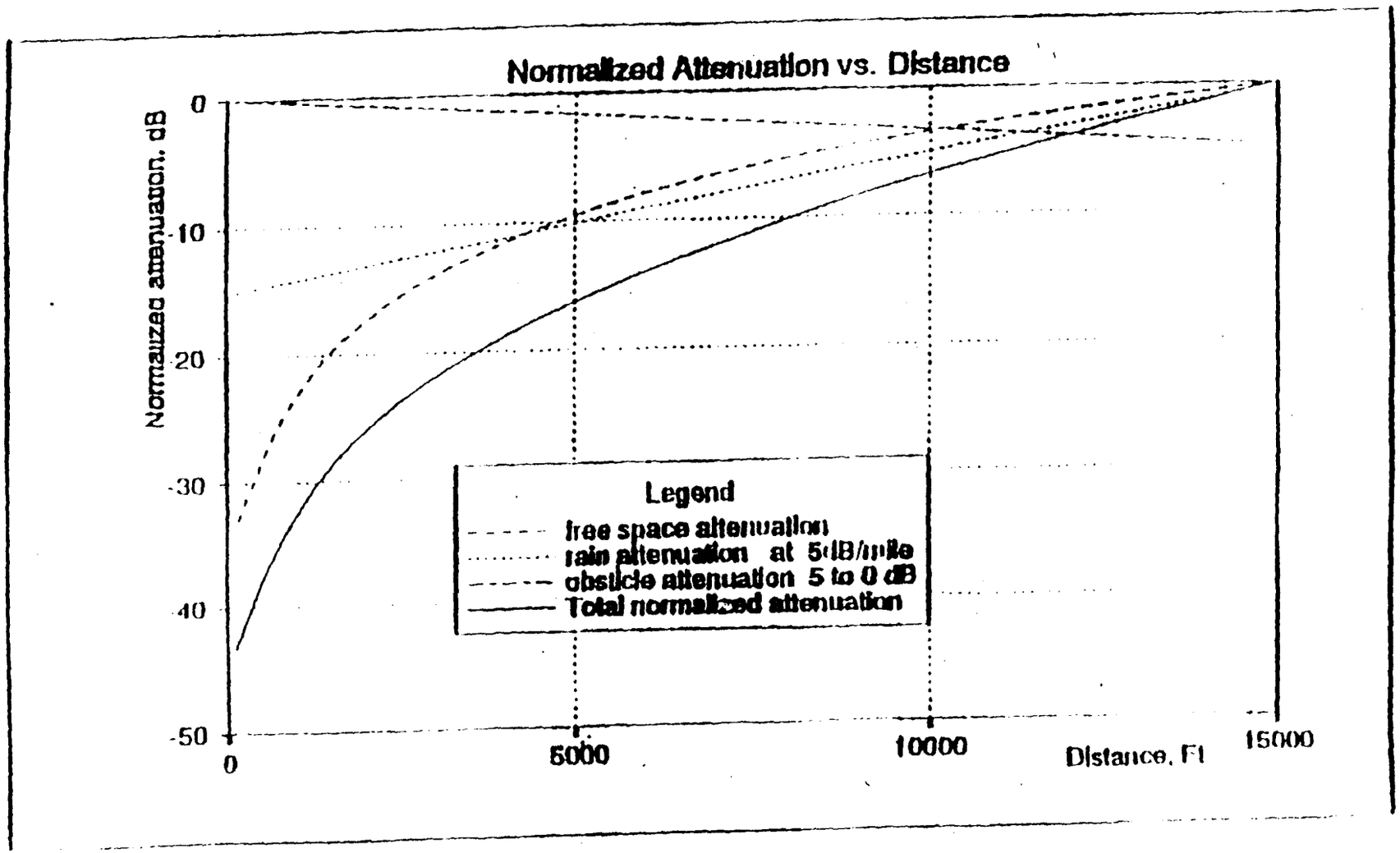
Wireless Links in CellularVision LMDS Implementations



CellularVision Antennas

- **Hub to Subscriber transmitter antennas**
  - **Horns:** typically, 60°, 120°, 180° horizontal coverage
  - **Bi-conicals:** typically, omnidirectional coverage
  - Vertical main beam width typically 10° to 15°
  - Gains typically 10dBi to 18dBi
- **Subscriber receive & Transmit antennas**
  - **Phased-array:** typically, 6 inch square, 26dB gain
  - **Parabolic:** typically, 8 inch diameter, 32dB gain
  - Integral low-noise block converter can support return channel
  - Main beam width typically symmetrical and ~3° to 5°
- **Hub to Hub Backbone transmission antennas**
  - **Parabolic:** typically 24 inch diameter, 42dB gain
  - Main beam width typically symmetrical and ~1.5°

FIGURE 3


Normalized Attenuation vs. Distance
Normalized attenuation, dB
0
-10
-20
-30
-40
-50
0
5000
10000
15000
Distance, Ft
Legend
free space attenuation
rain attenuation at 5dB/mile
obstacle attenuation 5 to 0 dB
Total normalized attenuation

CellularVision Subscriber-to-Hub (Upstream) Transmission

- System Design supports narrow to wideband
- Experimental results developed at three rates:

Transmitting Amplifier Power		
Service	Data rate	Average Transmit power
Interactive TV - Upstream	16 kb/s	.0001 W
Voice Telephony	64 kb/s	.00044 W
Video Teleconferencing	384 kb/s	.00266 W
Business Primary Rate ISDN	1.544 Mb/s	.0107 W

CellularVision Two-way Services
(U.S. configuration - no voice services)

- **<u>Initial service offering: TV control channel</u>**
  - Deployed among nearly all subscribers
  - Low bit rate (9.6 kb/s to 16 kb/s typical)
  - Low utilization (1 to 5 minutes per day typical)
  - Typical early consumer applications:
    - » ordering on-demand pay-per-view programming
    - » making home shopping transactions

CellularVision Two-way Services
Future Potential Domestic Services

- **Video Telephony**
  - Moderate penetration (5% in 5 years)
  - Use the 384 kb/s full duplex defacto standard
  - Moderate utilization (20 minutes/day, BHBS)
  - Serving hubs connected with fiber to the PSTN
- **T1 (1.544 Mb/s) Data Transport**
  - Indefinate market demand for wireless 1.544 Mb/s links
    - » Average of 50 links per cell in 5 years is optimistic
    - » Market may be for *backup data links* - low utilization

INTERFERENCE CALCULATIONS OBSERVATION

The initial attempts at calculating the interference effects of satellite earth transmitter into LMDS receivers have utilized basic path loss equations which result in areas in which the LMDS service is more impaired (worse C/(N+I)) than that required for a high quality picture. In fact certain calculations indicate that a total LMDS cell is inoperative for a single Teledisic transmitter. This is clearly not comprehensible since as an LMDS receiver only 50 feet below an LMDS node transmitter receives no signal.

It is also interesting that when these same equations are applied to a television station or a 6 GHz satellite earth terminal, the separation distance for a C/I = 40 dB is 209,866 miles (TV Station) and 9,851,416 miles for a 6 GHz earth terminal with a required C/I = 25 dB.

Appendix A and B review this analysis.

But realistic separation distances are far less than this. Consequently, there are many natural mitigating effects that occur and should be taken into account.