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October 3, 1996

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

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

Re: IB Docket No. 95-91
Gen Docket No. 90-357
RM No. 8610
PP-24
PP-86
PP-87

Dear Mr. Caton:

Yesterday, we filed with the Commission, on behalf of Primosphere Limited Partnership ("Primosphere"), materials which Primosphere requested be sent to the review panel that the Commission has convened with regard to the above-captioned pioneer's preference proceedings.

Because of the press of yesterday's 5:30 p.m. deadline and the implementation of new word processing software at this firm, the document submitted contained several typographical errors and omitted several paragraphs. A corrected copy, so labelled, is submitted herewith. We hereby request that this corrected copy be substituted for the version submitted yesterday and sent to the review panel.

No. of Copies rec'd 0+2
List A B C D E

Please address any questions concerning this submission to undersigned counsel for Primosphere.

Very truly yours,

Howard M. Liberman

Howard M. Liberman
Robert J. Ungar

cc (w/encl.):

FCC:

Donald Gips
John Stern (5 copies)
Rosalee Chiara
Ronald Repasi
Rodney Small
Dan Phythyon
Peter Tenhula

Parties:

Carl Frank (attorney for Satellite CD Radio Inc.)
Lon Levin (American Mobile Radio Corp.)
Bruce Jacobs (attorney for American Mobile Radio Corp.)
Doug Minster (Digital Satellite Broadcasting Corp.)
Diane Killory (attorney for Digital Satellite Broadcasting Corp.)

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October 2, 1996

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

Re: IB Docket No. 95-91
Gen Docket No. 90-357
RM No. 8610
PP-24
PP-86
PP-87

Dear Mr. Caton:

Transmitted herewith, on behalf of Primosphere Limited Partnership ("Primosphere"), are materials which Primosphere requests be sent to the review panel that the Commission has convened with regard to the above-captioned pioneer's preference proceedings.

These materials are submitted pursuant to procedures adopted by the Commission and described in a Public Notice, DA 96-1650, released September 30, 1996. In accordance with those procedures, Primosphere hereby requests that the enclosed materials be submitted to the members of the review panel. Extra copies are being included in the copy being sent concurrently herewith to John Stern of the International Bureau.

In addition, Primosphere hereby requests that the Commission send to the review panel a complete copy of the original application of Satellite CD Radio, filed in May 1990, for authorization for a satellite DAR system, so the panel can see the differences between Satellite CD Radio's original proposal and its current proposal.

Please address any questions concerning this submission to undersigned counsel for Primosphere.

Very truly yours,

Howard M. Liberman

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Doug Minster (Digital Satellite Broadcasting Corp.)
Diane Killory (attorney for Digital Satellite Broadcasting Corp.)

CORRECTED COPY

BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

In the Matter of	)	
	)	**IB Docket No. 95-61**
Establishment of Rules and Policies	)	**Gen. Docket No. 90-357**
for the	)	**RM Docket No. 8610**
Digital Audio Radio Satellite Service	)	**PP-24**
in the 2310-2360 MHz Frequency Band	)	**PP-86**
	)	**PP-87**

PRIMOSPHERE LIMITED PARTNERSHIP
SUBMISSION TO REVIEW PANEL

Primosphere Limited Partnership ("Primosphere") hereby submits the following for consideration by the review panel which the Commission has convened in the above-captioned proceeding.

I. The Commission Should Not Grant a Pioneer's Preference in this Proceeding

Primosphere herein demonstrates why no pioneer's preference should be awarded in this proceeding. Moreover, Primosphere demonstrates why neither Satellite CD Radio ("CD Radio") nor Digital Satellite Broadcasting Corporation ("DSBC") has met the Commission's requirements for a preference.

The Peer Review Panel is engaged in evaluating pioneer's preference requests filed by the applicants for Satellite Digital Audio Radio licenses. In the checkered history of pioneer's preference there has been only one previous peer review panel. The present one is sure to be the last. If, as a result of the panel's work, a preference is awarded, it will be the last. In five short years, what began as a brave, if novel attempt to reward and

promote innovation has proved to be an administrative nightmare and has aroused the Congress to the point where it has mandated the end of the pioneer's preference process by 1998.[1]

The fortunes of pioneer's preference have changed so rapidly for two reasons. First is the advent of competitive bidding -- auctions -- as a method of choosing who shall use the spectrum. The process of licensing by auction has become a lucrative revenue source that is being used whenever permitted by law. Indeed, auctions have become so attractive that consideration is being given to permit their wider use. The award of a pioneer's preference and competitive bidding are both supposed to occur only in cases where there is mutually-exclusive demand for spectrum. Where all applicants can be accommodated, competitive bidding has no role. However, in cases of mutual exclusivity, where competitive bidding is used, the grant of a pioneer's preference can undermine the working of the marketplace. As the Commission noted in its Notice of Proposed Rulemaking to examine the effect of the newly-authorized competitive bidding law on pioneer's preference:

> Establishment of competitive bidding authority creates a new dynamic for the assignment of licenses. Specifically, a bidder, who may also happen to be an innovator, through its bidding efforts would primarily control whether it obtains the desired license. It may obtain the license directly by outbidding other mutually exclusive applicants, whether by using its own financial resources or by soliciting the aid of financial institutions and venture capitalists. One may conclude, therefore, that under this new scheme, the value of innovation may be considered in the marketplace and measured by the ability to raise the funds necessary to

[1] When it adopted the pioneer's preference rules, the Commission believed that some technologies had been stifled because their developers feared exposing innovations during the administrative process without some guarantee of a license. This was not the case. It is difficult to imagine any worthy technology that was unable to come to fruition because of Commission processes. Still the concept of rewarding innovation had intuitive appeal and the Commission adopted the pioneer's preference rules. It was a bad idea whose time had come.

> obtain the desired license(s). Thus, we are concerned that competitive bidding authority may have undermined the basis for our pioneer's preference rules.[2]

The handwriting was on the wall. Once the Commission adopted the auction concept, it assured that what was perceived as the best (and possibly most innovative) technical and business plans would attract the most investment. An innovator no longer needed the advantage of a preference.[3] The marketplace could determine the true worthiness of an innovator's proposals and reward it with funds necessary to participate in the auction.[4] As the Commission has explained:

> In services in which we use competitive bidding to assign licenses, the need to guarantee a license may not be as strong as in services where another assignment method is used. For example, if an innovator has a valuable idea and can capitalize on it by obtaining a license in a service in which licenses are awarded by competitive bidding, it should not be eligible for a pioneer's preference. Such an applicant is able to obtain the financing for both the innovative research and the license acquisition cost. Further, if the rewards of the innovation do not cover both the research and the license costs, the innovation may not be socially beneficial, and it may be undesirable for the Commission to subsidize these costs by awarding pioneer's preference licenses at below market values.[5]

The second reason that the pioneer's preference has fallen into disfavor is that we have grown to appreciate that innovation is generally the end product of years of work by

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[2] Notice of Proposed Rulemaking, In the Matter of Review of the Pioneer's Preference Rules, 8 FCC Rcd. 7692, 7692-93 (1993).

[3] Significantly, Henry Geller, whose Petition for Rulemaking in 1989 led to the adoption of pioneer's preference rules, argued a few years later that, with the advent of auctions, a pioneer's preference is unnecessary. See Second Report and Order and Further Notice of Proposed Rulemaking, In the Matter of Review of the Pioneer's Preference Rules, 10 FCC Rcd 4523, 4526 (1995) ("Second Report and Order").

[4] Indeed, in rejecting CD Radio's argument that a preference should be given to enhance one's competitive edge in the investment markets, the Commission stated that "the financial community will generally be able to judge whether an applicant's proposal is sufficiently innovative and valuable to warrant investment, just as it is generally able to judge whether a proposed business venture in other areas is viable." See Third Report and Order, In the Matter of Review of the Pioneer's Preferenec Rules, 10 FCC Rcd 13183, 13185 (1995) ("Third Report and Order").

[5] Second Report and Order, 10 FCC Rcd at 4532.

many diverse groups. Development is evolutionary. Progress in any field occurs because of preceding events. Thus (as in the present case), it is difficult to label as innovator an applicant whose "inspiration" derives largely from work performed by others.. It is difficult to label incremental steps as innovations. Like the infamous broadcast comparative hearing process, determining whether an applicant is a pioneer, particularly within the Commission's broad definition, has become a time consuming forum for dispute.

Although the strategies of the administrative process virtually compelled the applicants in this proceeding to claim pioneer's preference status, Primosphere does not believe that a preference should be awarded to any applicant. First, of course, Primosphere's position has always been that there is sufficient spectrum to license all four applicants. There is no need for either a pioneer's preference award or, for that matter, an auction. On the other hand, if, as has been widely rumored, the Commission does not make sufficient spectrum available and uses an auction to grant licenses to only two of the four applicants, there is still no justification for a pioneer's preference in this proceeding.

II. CD Radio Has Not Met the Commission's Requirements for a Pioneer's Preference

The Commission cannot lawfully grant a pioneer's preference to CD Radio because CD Radio has not met the criteria required for such a grant as set out in the Commission's rules. To qualify for a pioneer's preference, an applicant must demonstrate:

(1) "that it (or its predecessor in interest) has developed the capabilities or possibilities" of a new service or technology "or has brought them to a more advanced or effective state," 47 C.F.R. § 1.402(a);

(2) "the technical feasibility of its proposal, by summarizing its experimental results in its preference application, unless it instead submits an acceptable showing of technical feasibility," 47 C.F.R. § 5.207; and

(3) that the "rules, as adopted, are a reasonable outgrowth of the [applicant's] proposal and lend themselves to a grant of a preference." 47 C.F.R. § 1.402(a).

Moreover, the Commission has stated that "an applicant for a pioneer's preference will have a significant burden to persuade the Commission that its proposal has sufficient merit." With regard to technical showings, the Commission has stated: "We intend to analyze technical showings as rigorously as the results of experiments to ensure that a preference applicant's proposed new service or technology is viable and worthy of a preference."[6] CD Radio has not met this burden. As detailed below, CD Radio has not demonstrated that it has met the criteria prescribed by the Commission.

A. CD Radio's Technical Claims Do Not Satisfy the Commission's Standards for Grant of a Pioneer's Preference.

In its application for a pioneer's preference, and related supplements, CD Radio, claims that it has made significant contributions to the development of satellite digital audio radio, that it has conducted experiments which demonstrate that CD Radio chosen technologies will overcome the technical challenges of operating in a mobile communications environment, and that it has demonstrated the feasibility of its technical concept. CD Radio has not succeeded in meeting any of these objectives and should not receive a pioneer's preference. The following is a detailed analysis which fully refutes CD Radio's claims.

[6] Memorandum Opinion and Order, 7 FCC Rcd 1808 (1992) at ¶ 10.

1. CD Radio has not made a significant contribution that leads to the establishment of a new or substantially improved communications service or technology.

Although CD Radio asserts that its singular actions were responsible for the creation of the Satellite Digital Audio Radio Service, this characterization overplays significantly CD Radio's rather limited role in the development of SDARS. Although in 1990 CD Radio was the first company to file an application for satellite-based radio, the concept had previously been developed and advanced by others. The National Research Council of the National Academy of Sciences proposed a space-based high quality radio service for the Voice of America in June 1986.[7] This followed two studies performed by TRW and Martin Marietta for VOA in 1984. NASA/JPL also supported the VOA initiative through testing with AUSSAT and Japanese ETS-V in late 1989. In addition to these U.S. Government funded initiatives, a number of papers[8] describing such systems were published from 1988 to 1990. Also, Radio Satellite Corporation, a private Pasadena California based company, began development of a virtually identical satellite radio service in early 1988. This service was subscriber funded, used audio compression algorithms, was integrated into the car radio and had a small patch type receive antenna. Radio Satellite Corporation planned to operate its service using leased capacity on American Mobile Satellite Corporation satellites in L-band.[9]

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[7] Modern Audio Broadcasting Facilities (study conducted for the Voice of America) (June 1986).

[8] See G. Waters, and F. Kosamernik, "Plans and Studies in the EBU for Satellite Broadcasting of Sound Radio" proceedings 13th AIAA international Communication Satellite Systems Conference, Los Angeles, CA, March 1990, pp 176-185; J. E. Miller, "Application of Coding and Diversity To UHF Satellite Sound Broadcasting Systems" IEEE Transactions on Broadcasting, Vol. 34, No. 4, December 1988, pp 465-475; T. Rogers, "Some Important Advances in international Direct Audio Broadcasting" proceedings 13th AIAA international Communication Satellite Systems Conference, Los Angeles, CA, March 1990, pp 205-208; N. Golshan, and A. Vaisnys, "Satellite Sound Broadcasting System, Portable Reception "Proceedings 13th AIAA international Communication Satellite Systems Conference, Los Angeles, CA, March 1990, pp 186-204; D. K. Banks and D. Robson, "The Use of Orthogonal FDM for Sound Broadcasting by Satellites in Highly inclined Orbits to Overcome Multipath Fading" paper presented at the 13th AIAA international Communication Satellite Systems Conference, Los Angeles, CA, March 1990.

[9] See "Mobile Satellite Service: A North American Perspective," Michael Zulieni and Gary K. Noreen, 29th IAF, Bangalore, India, October, 1988; "Mobile Satellite Broadcast System Design," Gary K. Noreen,

2. CD Radio's Current System Design is Dramatically Different from that on Which Its Pioneer's Preference Request is Based

CD Radio cannot receive a pioneer's preference for a system which it no longer plans to implement. Its current system does not utilize many of the claimed innovations on which the preference application is based. The following identifies some of the changes in the CD Radio design over the past six years.

CD Radio has submitted four Supplemental Pioneer's Preference filings to the Commission on the subject of satellite based radio and the design of its system. CD Radio system designs, as described in their filings, show a pattern of substantial and sporadic change and misleading and false claims with each new filing. Even as recently as March 1996, CD Radio made a significant change by abandoning its highly touted TDMA/frequency diversity based design for one based on CDMA. This was a very substantial change, but nothing that could be called innovative or even new. Each CD Radio system design has been built on existing technology that was currently used in operating satellite systems. The CD Radio experiments were flawed and did not yield any new technology or innovation applicable to satellite radio. At no point did CD Radio develop new or innovative technology.

In its original filing, CD Radio proposed a two-satellite 66 channel system. Each satellite would possess a multibeam antenna which would produce three separate beams, each covering approximately one-third of CONUS. The two satellites would transmit 33 different channels, thus customers would receive 66 distinct channels from one or the other satellite. Each channel would be transmitted on its own frequency, much like terrestrial radio communications. Feederlink transmissions from the earth stations were to be at Ka-Band (27 - 30 GHz) and the mobile link was to occupy 60 MHz (1.47 - 1.53

Proceedings of the 40th IEEE Vehicular Technology Conference, May 6-9, 1990, Orlando, Florida at pp. 233-236.

GHz) at L-Band. The audio signal would be compressed to 256 Kbps using Dolby AC-2, high power terrestrial repeaters would be employed to fill coverage outage areas.

Recognizing that the original design could not provide service in a multipath environment, CD Radio amended its filing in late 1990 to propose a system with slow frequency hopping implementation and time interleaving. This modification retained the single channel per carrier concept but each of 12 channels was now transmitted at a different frequency in a 3.5 MHz band every 2 msec.

By the end of 1992, the mobile communications link had changed once more to time division multiplexing. Now 33 channels in each satellite were multiplexed together in time to produce a single data stream on each satellite occupying 8 MHz. The same data stream was simultaneously transmitted from each satellite on different frequencies. At this time CD Radio begins to tout a 9 to 15dB link improvement due to spatial diversity. CD Radio also states that transmitting on different frequencies allowed a "major advantage in reducing satellite power" identifying a 3dB improvement.

More recently, in March 1996, CD Radio once again modified its approach. Rather than transmitting on two separate frequencies to achieve the critical "frequency diversity" it now proposes to use code division multiplexing whereupon channels are transmitted at the same frequency on both satellites and are kept isolated by different codes.

In addition to the changes in the basic communication link structure the present CD Radio system differs from their December 1990 filing in the following ways.

- Feederlink frequencies were changed from Ka-Band to C-Band to avoid the large transmission losses associated with rainfall
- Audio compression algorithm was changed from Dolby AC-2 at 256 Kbps to AT&T PAC at 128 Kbps

- Antenna beams were reduced from three to one per satellite. The frequency reuse plan that was heralded in the original filing has been dropped.
- Terrestrial repeaters have been eliminated.

Since CD Radio has abandoned many of the innovations claimed in its pioneer's preference request, these innovation cannot be used to support the request.

3. CD Radio Is Not Responsible for Any Significant Technical Innovations Warranting Grant of a Pioneer's Preference.

CD Radio takes credit for developing several technical innovations which, it asserts, has made satellite DARS possible. These claimed innovations include:

- use of spatial diversity
- use of frequency diversity
- development of a small S-band planar array antenna
- development of audio compression algorithms
- development of a method for delivering audio programming via satellite directly to an end user.

CD Radio, however, was not responsible for any of these "innovations" and did not contribute in any significant way to the improvement of these well-established technologies and techniques for use in satellite DARS. Rather, CD Radio has simply applied what is, in many cases, off-the-shelf technology in a manner that is quite commonplace in the satellite industry.

Spatial Diversity

Space or spatial diversity (i.e., transmitter or orbital diversity) are also well known techniques for mitigating fade and blockage that have been well understood and used for years. In 1982, Dr. Emilio Matricciani of the Polytechnic Institute of Milan completed an experiment[10] using two geostationary satellites, separated by 25°, to transmit identical signals to one ground station. This test, completed over 14 years ago, successfully demonstrated that spatial or orbital diversity can be used to mitigate the effects of signal blockage and fading. The Propagation Effects Handbook for Satellite Systems Design

[10] Orbital Diversity in Resource-Shared Satellite Communications Systems, IEEE Journal, May 1987.

published by NASA in 1996[11] describes the concept of using two geostationary satellites separated by an arc and both transmitting identical signals to one ground station to reduce the effects of signal blockage and fading. The well known GPS system of satellites was designed with spatial diversity; i.e. there would always be a widely dispersed set of 4, 5 or 6 satellites visible to a user at any given time to protect against possible signal blockage. The concept of spatial diversity to mitigate signal fading and blockage was not invented by CD Radio, as proven by the listed references, and therefore should not be used as part of the basis for granting a Pioneer's Preference.

Frequency Diversity

Frequency diversity and cross polarization isolation are well known techniques that have been used in terrestrial and satellite communications systems for many, many years. It should be noted that after many years of promoting frequency diversity and cross polarization CD Radio has now dropped these techniques with their latest system design change[12].

Small Planar Array Antenna

Small planar array antennas were developed and available in the 1970s. Consequently, at the time CD Radio conducted its experiments, it was able to use "off-the-shelf"technology. CD Radio has provided no details regarding its claimed innovation or how its antenna was an improvement over existing antennas.

Audio Compression Algorithms

CD Radio did not conceive of audio compression nor contribute to the development of an audio compression algorithm. Audio compression algorithms were in extensive use in satellite radio distribution years before CD Radio was even formed. For example, audio compression algorithms have been used by DMX and other providers of multi-channel stereo music service. The two music compression algorithms used in CD Radio tests, Musicam and PAC, were independently developed without CD Radio

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[11] Propagation Effects Handbook for Satellite Systems Design, by Louis J. Ippolita, NASA Publication 082 (04) (1986).

[11] Letter from Robert Briskman, President, CD Radio, to William Caton, Acting Secretary, Federal Communications Commission, Gen. Docket Nos. 95-91, 90-357 (Mar. 22, 1996).

participation. In fact, CD Radio's design uses an algorithm devised by AT&T and described in an article in the IEEE Journal in June 1992.[13] Further, as discussed later, experimentation conducted by CD Radio failed to demonstrate any innovation in the development or use of audio compression algorithms.

4. CD Radio's experiments fail to validate its claimed innovations or the technical feasibility of its proposed system.

CD Radio conducted several experiments for the purpose of demonstrating both its claimed innovations and the technical feasibility of its proposal. These experiments, however, fail to support the ambitious claims CD Radio attributes to them.

Satellite Diversity Experiment

CD Radio did not test a satellite to mobile link. CD Radio conducted a misleading experiment which does not simulate the actual blocking or satellite multipath environment. Thus, the experiments did not validate CD Radio's proposal to reduce blockage and multipath to the extent required for a high-quality audio service received by a mobile receiver. CD Radio points to a set of experiments performed in 1992 and 1993 that it claims proves the concept of receiving radio signals from two satellites and provided the basis for validating its claim of 9-15dB improvements due to spatial diversity. By examining the test in detail, it can be seen that a carefully chosen set of elevation angles and link line-of-sights were used which do not replicate the proposed user-satellite geometry. Thus, while communications links were established and improvements noted, the test conditions were not consistent with the quoted claims.

One should note that although a satellite was used in these tests to transmit signals to individual rooftop transponders, the satellite signal was itself not received by the mobile receiver. This experiment is not a satellite system validation at all, since the audio information could have just as easily been sent to the rooftop transponders via terrestrial links. In addition, the signal levels from the transponders used in the experiment are far

[13] "Signal Compression: Technology Targets and Research Directions," Nikil Jayant, IEEE Journal, Vol. 10, No. 3, June 1992.

higher than are planned from the satellite in the CD Radio system, on the order of 16dB. Although this could be considered when evaluating the final results it does not appear to have been made a consideration.

In evaluating reception of a satellite signal by a mobile terminal in an urban/suburban area, the primary signal blockage and multipath would be from the buildings lining the street fronts. In CD Radio's field test, however, the multiple transmit antennas were placed at the top of these very buildings (Figure 1), providing direct line-of-sight coverage to their receive locations. Thus, the test actually demonstrated receipt of signal in a near perfect condition. It is especially misleading without building blockage to claim that elevation angles are a true indicator of actual system operation. Low elevation angles without obstructions between the transmitter and receiver will provide excellent results, but are meaningless as a measure of building blockage mitigation.

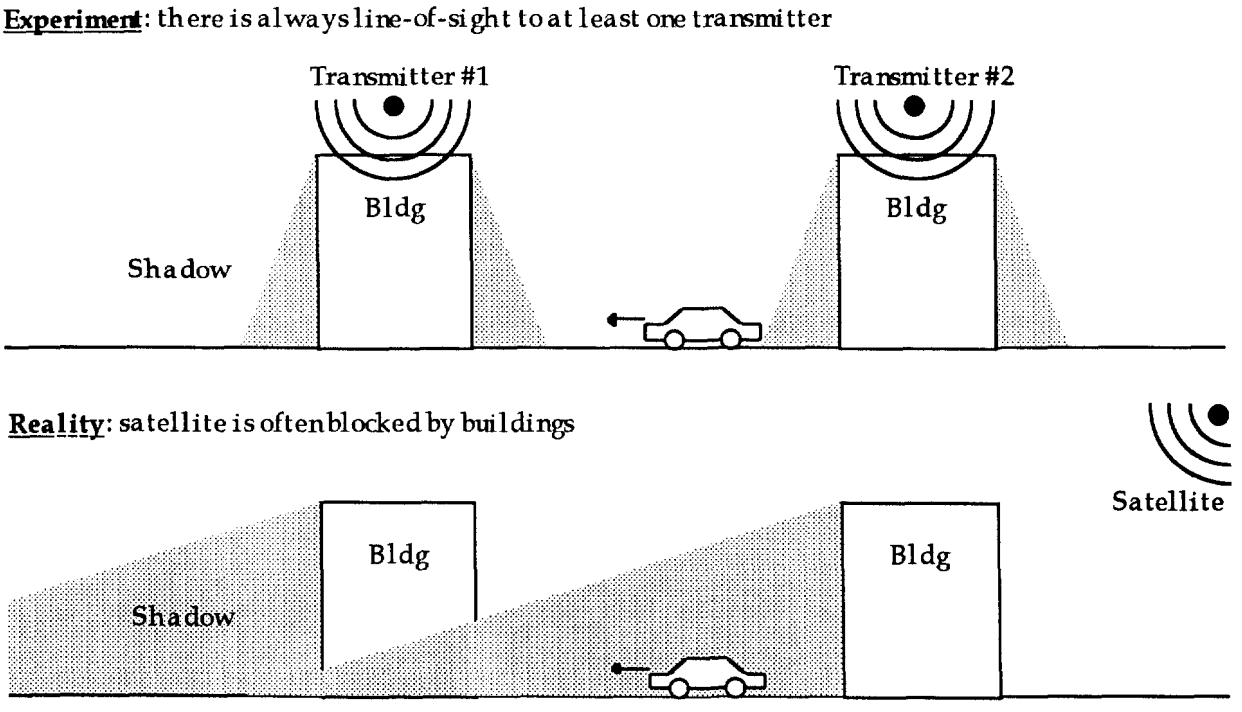

Figure 1. The CD Radio experiment does not emulate real building blockage at low elevation angles

In this same experiment, fading caused by trees was supposedly shown to be significantly mitigated by a dual satellite. However, no information is given on the actual

density or probability of blockage by trees on the route, and no pictures are presented to enable a qualitative assessment. Although there may have been sufficient trees for such a test, the report as it exists does not validate the CD Radio system.

Much of CD Radio's report is related to a highway overpass experiment. To test the spatial diversity afforded by two satellites during an overpass event, a single 4-lane overpass was chosen and transmitters were placed at near right angles to the overpass on opposite sides and very low elevation angles (15°,18°). As shown in Figure 2 this is the most favorable geometry imaginable for keeping at least one link unblocked; despite CD Radio's claim that their experiment "represents a near worst case in terms of blockage length and of anomalous propagation". Thus it is not surprising that in measuring signal strength, one of the two lines was always received at full strength because there was no region that was shadowed from both transmitters.

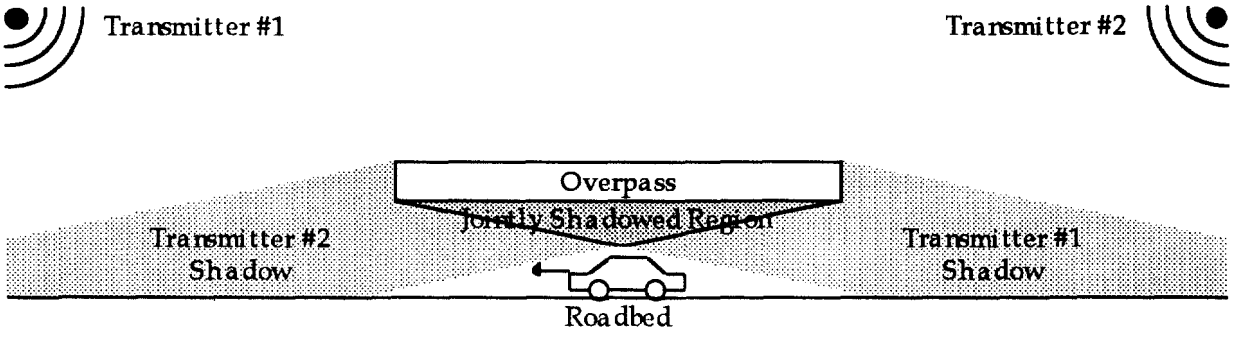

Figure 2. In the CD Radio overpass experiment, the transmitters are never simultaneously blocked

For an actual two-satellite geosynchronous system at longitudes 80° and 110° west, the angular satellite separation over the continental US is no greater than 34°, much smaller than the approximately 150° used in the experiment. By examining Figure 3, the probability of both satellites simultaneously blocked at 34° separation is seen to be much greater than for the 150° separation. At high elevation angles, most of the underpass will be in a "jointly shadowed region".

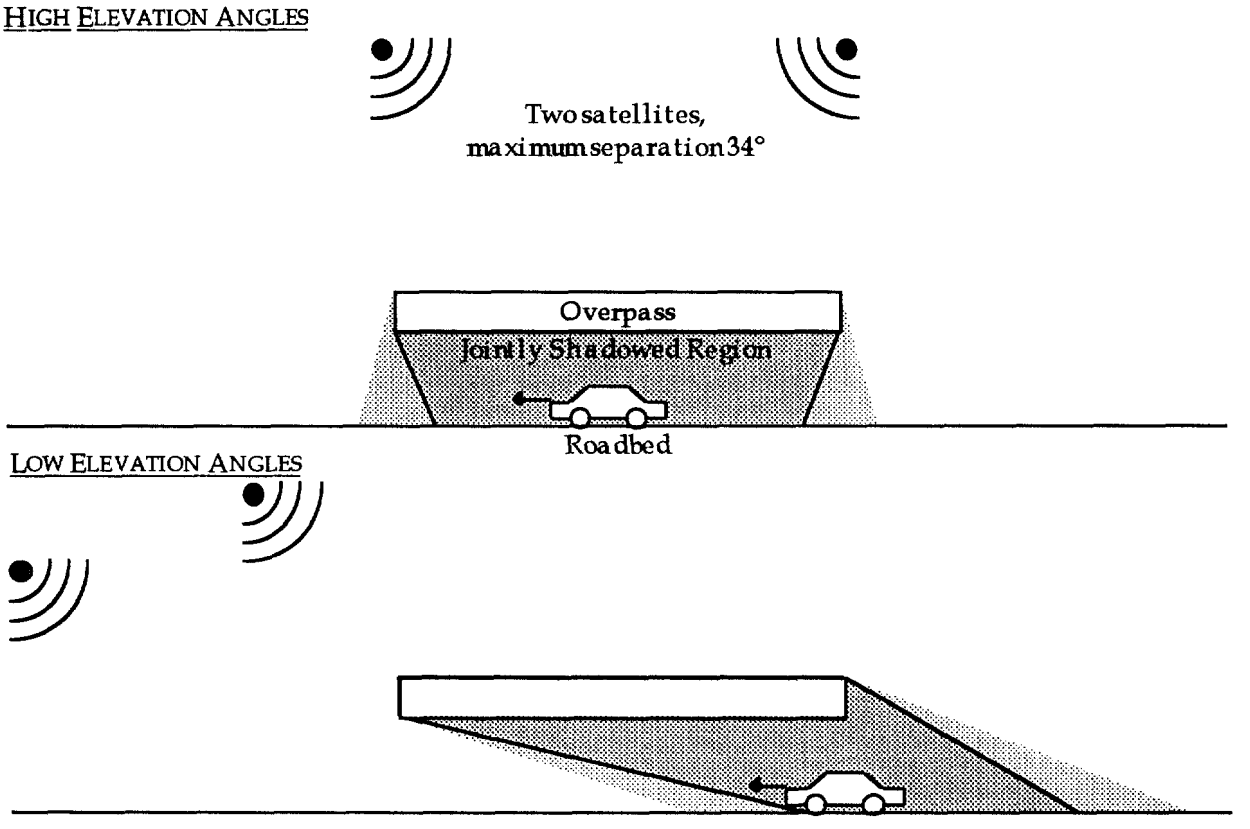

Figure 3. With a real geosynchronous system, there will always be a location where both satellites are simultaneously blocked

Cross Polarization Experiment- 1990 - present

CD Radio claims to have completed an experiment of "wide area spatial diversity and cross polarization measurements ... " in conjunction with NASA using TDRS[14] and notes that "details of the initial test and data have been submitted to the FCC.[15]" The results of this CD Radio experiment were in the form of a paper published at IMSC '95[16]. This paper contains the only published results from this experiment.

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[14] Summary of Experimental Results, at 3, Exhibit to Supplement of CD Radio to Pioneer's Preference Request, Gen. Docket No. 90-357 (filed Sept. 26, 1995).

[15] Id. at 5.

[16] NASA and CD Radio's TDRSS Industrial Test Program, International Mobile Satellite Conference June 1995, Ottawa, Canada, pages 451-454.

Although the paper alludes to more extensive testing no further results have been filed with the Commission. The paper itself is mostly devoted to a discussion of instrumentation and presents little in the way of experimental data or analysis. Only two paragraphs of this four page dual columned paper are devoted to discussion of cross polarization isolation results. The paper presents no measurements or discussion of results supporting the CD Radio claims for spatial diversity.

Cross polarization measurements were not taken over a variety of terrain and satellite look angles, rather the paper notes that measurements were taken on just two runs over roads in "... downtown Washington, DC, suburban Virginia and suburban Virginia."[17] This is hardly representative of what one might expect across the United States. The paper briefly discusses cross polarization isolation in the urban environment and concludes that "most of the time when the direct signal is blocked the cross polarization component is significant."[18]

Further, the paper states that the published results are from a "preliminary partial analysis of the data..." and in the last paragraph of the paper states that ".... CD Radio will reduce the data obtained and issue a formal report summarizing the results of the testing."[19] Fifteen months have now passed since this paper was published and this formal report has not been issued.

In summary, this experiment is at best incomplete, demonstrates no innovation and does not support the CD Radio's claims as stated in the its Summary of Experimental Results. This fact was recognized by the Commission in its NPRM where the Commission states that the "record is insufficient for us to analyze the benefits of potential capacity

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[17] Id. at 454.

[18] Id.

[19] Id.

increases, if any, that may result from use of cross-polarized transmissions." In addition, CD Radio has chosen not to use cross-polarization in its system.

Compression Algorithm Tests, June 1992 - November 1993

In its Summary of Experimental Results dated September 19, 1995,[20] CD Radio claims to have completed an experiment in audio compression technology. This document notes that "using special audio listening facilities and over 100 listeners, evaluated 3 compression techniques."[21] The CD Radio report goes on to state that PAC, an audio compression algorithm developed by AT&T Bell Laboratories was the preferred compression technique.

Audio compression algorithms were in use and under development long before the birth of CD Radio. The performance testing of one set of audio compression algorithms by CD Radio is not innovative nor likely to further the state of this art. More extensive testing has been on-going on a world-wide basis for many years. The results of these tests have been well documented in literally hundreds of technical papers. CD Radio has not claimed to be a developer of, nor a contributor to, the AT&T PAC music compression algorithm. It simply ran some form of listener comparison testing; this is hardly innovative.

Further, CD Radio provides no basis for its test conclusions. The report fails to provide any information as to the nature of its tests. There is no reference to a test report, there are no test results, no test methods, no test procedures, no test material, no list of the competing algorithms. The conclusion is simply stated.

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[20] Summary of Experimental Results, at 2, Exhibit to Supplement of CD Radio to Pioneer's Preference Request, Gen. Docket No. 90-357 (filed Sept. 26, 1995).

[21] Id. at 3.

Fixed Location Tests - June, 1991 - February, 1992

In its Summary of Experimental Results dated September 19, 1995[22], CD Radio claims to have completed an experiment in " ... the first-ever delivery in the United States of multiple channel CD quality stereo music directly from a satellite into a notebook size consumer type indoor antenna[23]." CD Radio goes on to claim that the experiment was a first-ever demonstration of a fully automated subscription satellite radio service. The full report, entitled Early Bird Experimental Results, documenting these tests was filed by CD Radio in January 1992.[24]. The contents of this report do not support these CD Radio claims.

In the early 1980's Equatorial Communications[25] fielded a small receive only satellite terminal for a subscription data service carrying stock quotes and other real-time financial data. This terminal was specifically designed for inside office desktop installation and had a small notebook sized antenna. Subscribers to the service opened their account through a telephone based automated process.

By the time CD Radio performed its experiment, Equatorial had demonstrated the technical viability of its technology on an operational basis for several years with thousands of subscribers. Equatorial fielded its system almost 10 years prior to this CD Radio experiment.

In the mid-1980's several corporations began marketing centrally prepared program material for AM and FM radio stations across the United States. Multiple channels of talk radio and CD quality stereo music were distributed to the radio stations by satellite using sophisticated audio compression technology, usually Musicam operating

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[22] Id. at 2.

[23] Id. at 3.

[24] Supplement to Request for Pioneer's Preference, Gen. Docket No. 90-357, (filed Jan. 23, 1996).

[25] Equatorial Communications was acquired several years ago by GTE and has discontinued this service.

at 256 Kbps, and received at the stations by a very small aperture satellite terminal (VSAT). In late 1989 or early 1990 one VSAT supplier, ComStream[26], began volume production of terminals with very small notebook size antennas.

Again, by the time CD Radio performed this experiment, literally hundreds of AM and FM radio stations were receiving multiple channels of CD quality stereo music directly from an actual satellite into a notebook size antenna.

In summary, CD Radio neither invented nor improved upon any of the technologies upon which its system design is based. Space/frequency diversity, audio compression, small patch type antennas and the concept of subscriber supported satellite radio were all either in wide use in other satellite systems, discussed in the literature or planning to be used in other satellite systems before CD Radio applied for its Pioneer's Preference.

5. CD Radio's proposed system will not work.

CD Radio's proposed use of satellite diversity, on which it bases its pioneer preference claims, <u>will not</u> permit receipt of an acceptable high-quality audio signal in a mobile vehicle.

Although the CD Radio experimental results cannot be used to evaluate the performance increase with spatial diversity, there have been other experiments which have shown spatial diversity is only of marginal advantage. In a University of Texas Report[27] the blockage autocorrelation in rural, suburban, and urban Austin, Texas was found to be 30-50% for azimuth separations of 30 degrees, decreasing to 5-10% at an angle of 60 degrees. This means that if one of CD Radio's satellites is blocked, the probability that a

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[26] ComStream Corporation currently manufactures this equipment and is located in San Diego, CA.

[27] "Photogrammetric Mobile Satellite Service Prediction," Riza Akturan and Wolf Vogel, EERL-94-A12R1, 30 Dec. 1994.

second satellite 30 degrees away is blocked is often as large as 50%. Thus, the spatial diversity afforded by two satellites is of marginal worth, since half of the time one satellite is blocked and the other satellite is of no use. Separation on the order of 60 degrees is necessary to produce significant benefit.

CD Radio's potential pioneer status depends heavily on these validation field tests. After careful review, it is clear what these tests do and do not prove. The tests **do** prove that by optimizing the location of the two terrestrial transmitters with respect to an underpass (at each end of the underpass) an acceptable signal strength can be maintained as the car antenna passes through the underpass - a result that was never in question.

The tests **do not** prove that an S-band audio link can be maintained between two terrestrial transmitters and an omnidirectional antenna on a car in the vicinity of buildings, trees and underpasses. More importantly, the tests **do not** indicate in any way that an S-band audio link can be maintained between one or more geostationary satellites and an omnidirectional antenna mounted on a car in the vicinity of buildings, trees and underpasses.

In summary, the experiment undertaken by CD Radio proved very little as to the adverse effects that mobile vehicles will experience due to blockage and multipath conditions occurring en route. A more meaningful approach would have been to take measured data from a satellite, either directly or from published data, and from that data and the physical environment in which the vehicle traveled, determine the characteristics of the signal fades that would be experienced.

B. CD Radio's Purported Contributions to the Regulatory Process for Satellite DARS Do Not Merit a Pioneer's Preference.

Apart from its failure to comply with the Commission's requirements for technical demonstrations of innovation and feasibility, CD Radio's claims of contributing to the regulatory process similarly must be rejected, and do not merit the guarantee of a license

that would be accorded through a preference. CD Radio's claim that it deserves a preference because it was the first to file an application for satellite DARS and initiated the rulemaking for the service do not meet the burden established in the Commission's rules. In fact, the Commission, in its Third Report and Order on the Pioneer's Preference Rules, rejected CD Radio's proposal that it adopt new rules addressing regulatory aspects of the applicant's proposal.[28]

Moreover, certain of CD Radio's claims regarding the regulatory process are not valid. With regard to CD Radio's claim that it spearheaded the effort to find and clear S-band spectrum for satellite DARS, the Commission need only turn to the record of preparation for the 1992 World Administrative Radio Conference (WARC-92), as recently pointed to by the American Mobile Radio Corporation (AMRC), to refute such a claim. Within the WARC-92 preparatory process, American Mobile Satellite Corporation, the parent corporation of AMRC, on February 21, 1991, proposed that the United States seek an allocation in the S-band for satellite-based DARS. [29] With regard to achieving the allocation at WARC-92, an allocation adopted only by India and the United States, the credit belongs primarily to efforts of U.S. government officials, particularly those from NASA and Voice of America.

Finally, in its most recent update to its pioneer's preference application, CD Radio also has failed to meet the requirements of the Commission's rules. The pioneer applicants, in September 27, 1995, were required to file supplements to their pending requests, demonstrating:

> that the Commission's public rulemaking process inhibits it from capturing the economic rewards of its innovation unless it is granted a pioneer's preference license. The applicant must show that it may lose its intellectual property protection because of the Commission's public process; that the damage to its intellectual property is likely to be more significant than in other contexts, such as

[28] Third Report and Order, 10 FCC Rcd 25 (1995), at para. 13.

[29] See, Letter of Lon C. Levin, American Mobile Radio Corporation, to John Stern, International Bureau, dated September 18, 1996.

the patent process; and that the guarantee of a license is a significant factor in its ability to capture the rewards from its innovation.[30]

Incredibly, CD Radio argues that "the long delay in licensing satellite DARS is itself reason to declare CD Radio a pioneer."[31] If so, all the pending satellite DARS applicants, including Primosphere, should be named pioneers, for persisting in this process for the past four years. CD Radio's claims about the damages it has incurred from the delays in the process are equally applicable to all the other applicants. Then, CD Radio also complains that, if licenses are awarded by auction, CD Radio will have "forfeited its head start."[32] CD Radio's claims about loss of its intellectual property through the Commission's processes -- and delay -- are similarly unspecific and unsupported. The Commission must reject these unsupported claims, as well as the equally unsupported assertion by CD Radio that, absent a preference, "there is a substantial chance CD Radio will not receive full value for its innovations." [33]

C. CD Radio Pioneer's Preference Filings Are a Moving Target.

During the SDARS licensing process CD Radio has filed five documents with the Commission requesting or supplementing their request for a Pioneer's Preference. With each of these filings there is a new justification for the award as the system architecture of the CD Radio system changes. However, name of these filings contains technology development or innovation performed by CD Radio. Rather the filings and their experimental basis are a compendium of widely known and available technology.

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[30] 47 C.F.R. § 1.402(i).

[31] Supplement of Satellite CD Radio, Inc. to Pioneer's Preference Request, PP-24, GEN Docket No. 90-357, filed September 26, 1995.

[32] CD Radio ignores the fact that the Commission previously rejected proposals to confer formal head starts to preference recipients. Report and Order, 6 FCC Rcd at 3492.

[33] CD Radio Supplement, at p. 6.