ORIGINAL ORIGINAL FILE

RECEIVED

JUN 1 0 1987

FCC
OFFICE OF THE SECRETARY

BEFORE THE

# Federal Communications Commission

WASHINGTON, D.C.

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| The Impact of Advanced | ) | |
| Television Technologies on Local | ) | RM-5811 |
| Television Broadcasting | ) | |

To: The Commission

COMMENTS OF HUGHES COMMUNICATIONS GALAXY, INC. ON "PETITION FOR NOTICE OF INQUIRY"


HUGHES COMMUNICATIONS GALAXY, INC.

Ben C. Fisher
Grover C. Cooper

Fisher, Wayland, Cooper and Leader
1255 Twenty-Third Street NW
Washington, DC 20037
(202) 659-3494


June 10, 1987

Its Attorneys

# of Copies 0+5

## SUMMARY OF ARGUMENT

AMST proposes a broad Commission inquiry into the potential development of HDTV and, as a concededly inferior allocation proposal, suggests the possible use of the direct broadcast satellite service band, 12.2-12.7 GHz, for the provision of supplemental HDTV service. HCG strongly opposes the initiation of any inquiry into the use of the 12 GHz band for supplemental HDTV terrestrial service. The 12 GHz band is totally unsuited from a technical point of view for the provision of HDTV service. The use of this band for HDTV terrestrial service would also be prohibitively expensive and impractical.

Contrary to the wholly unsupported assumptions of AMST, the utilization of one-half of the DBS band for supplemental HDTV service would not provide a sufficient number of channels to meet service needs. Because of propagation characteristics in the 12 GHz band, as many as 25 transmitters (not 10, as AMST assumes) would be needed to provide equivalent coverage to the service area of a single existing local TV station. Also, the amount of bandwidth needed in the 12 GHz band to provide supplemental HDTV service is perhaps three times greater than AMST assumes.

Because of the multiple transmission facilities needed, perhaps several hundred per market, and the amount of bandwidth needed, the total number of available 12 GHz channels will in all probability be wholly inadequate or at the very best, will require

incredibly complicated frequency re-use plans to avoid intrasystem interference. When these inherent difficulties are coupled with the difficulty of finding suitable and available multiple transmitter sites and providing for the necessary microwave facilities to connect the 25 or so transmitting locations for each local station, the total impracticality of the plan is further demonstrated.

HCG also submits that the cost implications of using 12 GHz frequencies are profound. The complex AMST proposal for supplemental HDTV service would be so costly as to destroy the economic viability of HDTV. The cost implications stem from the following factors. In each market, hundreds of transmitters could well be required, all connected by costly microwave systems. At each site, relatively high powered transmitters would be necessry to overcome propagation characteristics in the 12 GHz band, and specifically to overcome rain attentuation and blockage from foliage. It is likely that the receiver installations would have to be above the treetop level in order to assure the necessary line of sight service, which installation, in turn, would require a costly rigid receiving antenna supporting structure. The multiple transmitting towers and the millions of above-treetop receiving installations also involve serious zoning problems and environmental and aesthetic concerns.

All of these factors in combination make the use of 12 GHz band for supplemental HDTV service totally impractical and unsuitable. The 12 GHz band is currently allocated exclusively for the brand new direct broadcast satellite service. This new DBS industry should be encouraged and given the opportunity to develop with full Commission support.

Table of Contents


| | | |
|---|---|---|
| I. | Introduction | 1 |
| II. | The 12 GHz Band is Technically Unsuited for Supplemental HDTV Service. | 4 |
| III. | The AMST Proposal to Utilize the 12 GHz Band is Economically Unsound. | 9 |
| IV. | Conclusion | 12 |
| | Engineering Statement | |

ORIGINAL FILE

BEFORE THE

# Federal Communications Commission

WASHINGTON, D.C.

| | | |
|---|---|---|
| In the Matter of | ) | |
| | ) | |
| The Impact of Advanced | ) | |
| Television Technologies on Local | ) | RM-5811 |
| Television Broadcasting | ) | |

To: The Commission

## COMMENTS OF HUGHES COMMUNICATIONS GALAXY, INC. ON "PETITION FOR NOTICE OF INQUIRY"

Hughes Communications Galaxy, Inc. ("HCG"), by its attorneys, hereby files its Comments on the "Petition for Notice of Inquiry," filed by the Association of Maximum Service Telecasters, Inc. ("AMST") and others, on February 13, 1987. By Order released May 8, 1987, the Commission gave parties until June 10, 1987 the opportunity to respond to the AMST Petition. In support of its Comments and Opposition HCG shows as follows:

### I. Introduction

The AMST Petition for Notice of Inquiry requests that the Commission initiate a broad inquiry "into the issues arising from the introduction of HDTV and other advanced television technologies" and specifically requests that the Commission consider the critical question of spectrum allocations for such service. It is AMST's position that should the Commission fail to initiate such an inquiry, the fate of local broadcast HDTV may have been determined by default. Fundamental to AMST's concerns

is its belief that the present 6 MHz channel bandwidth will not and can never be sufficient to accommodate a true HDTV quality service (Petition, pp. 15, 20-21; AMST Reply to Oppositions, p. 8). AMST's objective is to provide HDTV service which is compatible with existing transmission standards. Hence supplemental or additional spectrum space to that now employed is essential if local broadcasters are to be able to offer true HDTV.

Equally fundamental to AMST's position is its belief that the "UHF band is the prime and perhaps only viable source of supplementary broadcast spectrum" (Petition, pp. 27-28; AMST Petition for Special Relief, p. 3). Almost as a throw-away and certainly with very little analysis or support, AMST also suggests that the Commission should inquire alternatively into the possible use of other spectrum outside the UHF band for the supplemental HDTV capacity. Specifically, AMST proposes the possible reallocation of part of the direct broadcast satellite service band, 12.2-12.7 GHz.

It is this DBS reallocation proposal on which HCG will focus its Comments and objections. The Commission in its Direct Broadcast Satellite Decision in 1982 expressly allocated the entire 500 MHz bandwidth to direct broadcast satellite development and expressly declined to allocate any of this spectrum to terrestrial broadcasting.[1/] HCG is one of five

---

1/ Direct Broadcast Satellite Service, 90 FCC 2d, 676, 704 (1982).

permittees which now have full authority to proceed with the construction of a direct broadcast system utilizing all or portions of the 12.2-12.7 GHz band.[2/] HCG proposes to utilize the entire 500 MHz of bandwidth. There are also two other conditional permittees who are in the process of finalizing their DBS plans and securing necessary financing.[3/]

HCG strongly opposes the initiation of any Inquiry by the Commission into the possible reallocation of a portion of the 12 GHz band for supplemental HDTV terrestrial service. As is described in greater detail infra, it is HCG's basic position that the 12 GHz band is totally unsuited from a technical point of view for use as a supplemental HDTV service. This is so regardless of potential "technological breakthroughs." Second, it is HCG's position that the use of the 12 GHz band for HDTV supplementary service would be prohibitively expensive and impractical and hence not economically viable.

The strongest support for the HCG conclusions lies in the concessions AMST itself has made. AMST states (Petition, pp. 30-31):

> The undersigned wish to emphasize that many broadcasters feel that it will never be technically feasible to use the 12 GHz band for terrestrial broadcasting. Signals in

---

2/ Hughes Communications Galaxy, Inc., Satellite Television Corporation, United States Satellite Broadcasting Company, Inc., Dominion Video Satellite, Inc., and Advanced Communications Corporation.

3/ Direct Broadcast Satellite Corporation and Tempo Enterprises, Inc.

> this band have an extremely limited range. For example, even assuming a signal-radius of twenty miles, it could require as many as ten transmitters to cover the service area now covered by a single VHF or UHF transmitter and the problems of frequency coordination and mutual interference might be too expensive or even impossible to overcome. Moreover, this service would be vulnerable to terrain and foliage blockage and rain attenuation. At best, substantial technical breakthroughs would be required to make this band usable for terrestrial broadcasting, and even then cost considerations might make this option wholly unfeasible.

AMST's candor in discounting the viability of the 12 GHz band is refreshing. It certainly undercuts an argument that simply because local broadcasters may need additional HDTV spectrum the Commission ought to explore the possible use of the 12 GHz band. Yet, that is AMST's sole argument (Petition, p. 31). HCG believes it is wholly inappropriate to institute an Inquiry into what would be a fruitless pursuit of a proposal to misuse valuable spectrum. Whatever may be the merits of providing supplemental service in the UHF band, there is absolutely no corresponding benefit for the provision of such service in the 12 GHz band.

## II. The 12 GHz Band is Technically Unsuitable for Supplemental HDTV Service.

HCG submits that AMST has totally failed to establish the potential technical suitability of the 12 GHz band for the supplemental HDTV service it contemplates. Attached is the Engineering Statement of du Treil-Rackley, Engineering Consultants for HCG, which describes in detail the technical problems involved in utilizing the 12 GHz band.

As the Engineering Statement clearly demonstrates, the AMST Petition as to the use of 12 GHz is based upon two fundamentally flawed conclusions:

(1) Were the Commission to allocate one-half the DBS band to local broadcasters (250 MHz), this would provide "over forty 3 MHz-wide channels and fourteen 8.1 MHz-wide channels for local broadcasting."

(2) If supplemental terrestrial HDTV services are offered in the 12 GHz band such services would require as many as ten transmitters to cover the service area now covered by a single VHF or UHF station (Petition for Notice of Inquiry, p. 30).

The first conclusion is seriously flawed, if not totally erroneous. Because of differences in propagation characteristics between the UHF and 12 GHz bands and because of probable differences in modulation modes, the supplemental HDTV bandwidth requirements in the 12 GHz band would likely be considerably greater than the 3 MHz-wide channels estimated by AMST. (See Engineering Statement, pp. 3-5). The only support for the use of 3 MHz as a supplemental service is found on page 15 of the AMST Petition; where reference is made to a proposed system being developed at New York Institute of Technology (NYIT). Under the purely theoretical NYIT proposal, a NTSC signal would be sent over the existing 6 MHz broadcast channel (VHF or UHF) and then a second channel "approximately 3 MHz wide" would be used to send the supplemental information necessary to complete the HDTV transmission.

AMST uncritically and erroneously takes this fragmentary showing and concludes (p. 30) that were the 12 GHz DBS band to be utilized (rather than the UHF band) such band could provide over forty 3 MHz-wide channels and fourteen 8.1 MHz-wide channels. As the attached engineering fully demonstrates, this is highly unlikely (Statement, p. 5). The assumption in the NYIT study is that the second or supplementary channel would operate in the UHF band, probably utilizing a form of amplitude modulation format. This assumption is supported by the Comments of CBS, Inc. in Support of the Petition for Notice of Inquiry (p. 7).

However, the supplemental HDTV service contemplated in the DBS 12 GHz band, as suggested by CBS and supported in the attached Engineering Statement, would most likely <u>not</u> use the amplitude modulation format but rather would employ frequency modulation so as to provide sufficient signal quality (Engineering Statement, pp. 4-5). As the Engineering Statement indicates, utilization of the frequency modulation mode will require substantially greater bandwidth than utilizing the AM format. CBS concludes and the Engineering Statement agrees, that utilizing the 12 GHz band for a full service HDTV station could require as much as 24 MHz of channel bandwidth or three times the channel bandwidth necessary in the UHF band (CBS Comments, p. 7). The equivalent of 3 MHz of supplementary bandwidth in the UHF band could be as much as 9 MHz in the 12 GHz band (Engineering Statement, p. 5). Thus contrary to AMST's conclusions on page 30, if half of the DBS band were allocated local broadcasters, there would be available only thirteen 9 MHz channels for

supplemental HDTV service (rather than forty) and only five 24 MHz channels available for complete HDTV transmission service (rather than fourteen)[4/].

This also introduces the second major flaw in the AMST Petition, namely its conclusion that "as many as ten transmitters" would be necessary to cover the service area now covered by a single VHF or UHF station (Petition, p. 30). AMST and HCG are in agreement that because of the propagation characteristics in the 12 GHz band, multiple transmitters would have to be employed to provide equivalent area service to that of a single VHF or UHF station. However, the AMST conclusion that as many as 10 transmitters would be needed overlooks the reality that the coverage areas of these 12 GHz supplemental stations would have to overlap quite substantially in order to avoid interstitial pockets with no satisfactory reception service. As the attached Engineering Statement demonstrates, it is probable that at least twenty-five 12 GHz supplemental stations would be necessary to provide the coverage equivalence of a single local station. (See Engineering Statement, p. 6, Figure 1.)

The demonstrated incorrectness of these two fundamental AMST conclusions, standing alone, goes far to destroy the validity of AMST's claim to the use of any portion of the 12 GHz band. As indicated earlier, there could be as few as thirteen 9 MHz

---

4/ A serious question exists as to whether 3 MHz bandwidth would be adequate even in the UHF band. A recent NAB HDTV Task Force, as reported in the trade press, has set tentative quality standards that may not be attainable using only a total of 9 MHz bandwidth. Communications Daily, June 2, 1987, page 2.

channels available in the 12 GHz band for HDTV service. If, as HCG believes would be the case, there would have to be as many as twenty-five transmitters to provide equivalent service for one local station, then essentially only one existing station in the community could be assigned the necessary channels for HDTV service, assuming that the station employed a complicated frequency re-use plan to transmit HDTV supplemental signals over several of the same channels. The provision of HDTV service by all of the local TV stations in a medium to major sized market would be impractical if not totally impossible (Engineering Statement, p. 7). Further underlining the total impracticality of such a plan, HCG needs only to emphasize the incredibly complex and expensive process of designing frequency re-use plans, avoiding intrasystem interference, finding suitable and available transmitter sites and providing for the necessary microwave facilities to connect the twenty-five or so transmitting locations for each local station.

Even if the conclusion of AMST is entirely accurate as to the amount of supplemental HDTV spectrum needed, i.e., only 3 MHz-wide channels are needed, the AMST proposal is still impractical. Using AMST's assumptions, there would be available some forty supplemental 3 MHz channels. Since at least twenty-five transmitters are needed per station, the available HDTV channels could well be exhausted before even two local televisions could fully implement HDTV service. Again, only a most complicated frequency re-use plan could substantially increase this number. Considering that there are probably seven

to eight local services in any major market, and up to as many as eighteen in Los Angeles, the prospects of ever providing total market HDTV service are almost totally out of the question. (See Engineering Statement pp. 6-7).

## III. The AMST Proposal to Utilize the 12 GHz Band is Economically Unsound

HCG believes the analysis described above virtually destroys the engineering viability of using the 12 GHz band for HDTV. But in addition, the cost implications of using 12 GHz frequencies are profound. AMST's first preference is to obtain additional UHF spectrum for supplemental service. AMST Petition for Special Relief, p. 3. Using those UHF frequencies as a model suggests the following practical consequences:

(1) The main local station, utilizing 6 MHz of bandwidth in the VSB-AM format, could be supplemented in theory by only 3 MHz of UHF bandwidth, utilizing the same format, operating from the same tower and covering essentially the same area.

(2) Such an HDTV system would be compatible with the current NTSC system.

(3) The UHF band is currently available and allocated to local television service.

Compare this scenario to the utilization of the 12 GHz DBS band where the following costly components would be essential: (a) hundreds of transmitters, (b) significantly smaller service areas, (c) increased bandwidth requirements per channel, (d) Sufficient transmitter power to overcome rain attenuation in the

12 GHz band, (e) sophisticated system design and (f) above tree-top receive sites. Most significantly, spectrum would have to be taken away from a brand new service just now in the developmental stage.

In short, it is hard to avoid the conclusion that the AMST proposal to utilize the 12 GHz band was not advanced in good faith and certainly was not carefully considered. For example, whether the HDTV supplemental service would require ten or twenty-five transmitting installations, the plain fact is that anywhere from 100 to 200 towers would have to be constructed or elaborate sharing arrangements established. Multiple transmissions from as many as 200 local installations would require as yet unknown state-of-the-art design to avoid intrasystem interference and interference-free reception. An undeveloped microprocessor would have to be designed to combine the VHF/UHF and Ku bands. The expense of the multiple transmission installations, the difficulties and costs of finding a suitable site and obtaining the necessary zoning, and the need to provide microwave facilities (even now in short supply) to connect the cell sites--all of these factors would create an engineering and cost nightmare. (See Engineering Statement, p. 7.)

In addition to the transmitter site problems, there are equally troublesome concerns in connection with the home receiver locations. The propagation characteristics in the 12 GHz band are such that the normal television reception generally available today in residential neighborhoods would not be possible in that

band. As the Engineering Statement indicates, p. 8, terrestrial 12 GHz reception would require a line-of-sight path from the nearest transmitting antenna to the home receiving antenna. Hence, the receiving antenna would generally have to be mounted above tree-top level for satisfactory reception. (See Engineering Statement, Figure 2.) In addition, because the orientation of the antenna would be critical, due to its directional characteristics, a rigid receiving antenna supporting structure would probably be necessary to maintain stability. This substantial structure would involve additional cost as well as environmental and aesthetic concerns. Moreover, each receiving antenna would probably be highly directive and be able to look at only one transmitter. To the extent that the cell locations are not identical--and clearly this would be the case in almost every city in America--then either the homeowner would have to install multiple receiving antennas to receive the different stations in the community or would have to mount the receiving antenna on rotators. The cost of millions of these receiving antennas would be substantial even without regard to the hidden costs of damage to the environment from increased clutter. Indeed, it seems unreasonable to expect that any significant number of the general public would invest in such complicated and expensive systems.

Rain attenuation is a severe problem in the 12 GHz band for terrestrial microwave. For terrestrial links in the order of ten to twenty miles the path attenuation for rain could exceed many

tens of decibels (Engineering Statement, p. 9). This in turn would require an increase in transmiter power at each transmitter site.

Finally, it is likely that there would be many homes which would simply not be capable of obtaining line-of-sight service at any reasonable cost. Even if a tall enough receiving antenna could be installed to clear tree-top level, such installations would introduce considerable visual clutter. The environmental and aesthetic concerns would be formidable obstacles to obtaining the necessary approvals to install the receiving antenna.5/

## IV. Conclusion

HCG concludes that the AMST Petition to utilize the 12 GHz band for supplemental HDTV service has not been advanced as a truly viable alternative for HDTV. Certainly AMST did not carefully analyze its proposal. AMST's own concession that "many broadcasters feel that it will never be technically feasible to use the 12 MHz band for terrestrial broadcasting" is both accurate and fatal. HCG submits that based upon the compelling engineering reality and cost concerns, no Notice of Inquiry whatsoever should be initiated regarding the potential of the 12 GHz band for terrestrial HDTV service. The 12 GHz band is not

---

5/ Conversely, the 12 GHz band is well suited for the direct broadcast satellite service. In the DBS service the transmitting signals arrive via satellite to relatively inexpensive receiving equipment and antennas mounted on the roof or near ground level. Also, rain attenuation, while a problem, has a path length of about one mile, as opposed to ten or twenty miles (Engineering Statement, pp. 9-10).

suitable for terrestrial supplemental HDTV service and no useful purpose would be served by initiating such a counterproductive inquiry. The nascent DBS industry should be encouraged to proceed on course with full Commission support.

Respectfully submitted,

HUGHES COMMUNICATIONS
GALAXY, INC.

By: Ben C. Fisher (GCC)
Ben C. Fisher

Grover C. Cooper
Grover C. Cooper

Its Attorneys

Fisher, Wayland, Cooper
and Leader
1255 23rd Street, N.W.
Suite 800
Washington, D.C. 20037
(202) 659-3494

Dated: June 10, 1987

*du Treil - Rackley*
Consulting Engineers • Washington, D.C.

ENGINEERING STATEMENT
IN SUPPORT OF COMMENTS
HUGHES COMMUNICATIONS GALAXY, INC.
GENERAL DOCKET 85-172

## INTRODUCTION

This engineering statement and attached figures have been prepared on behalf of Hughes Communications Galaxy, Inc. (herein "Hughes") in response to a Petition for Special Relief and the accompanying Petition for Notice of Inquiry filed by the Association of Maximum Service Telecasters, Inc. (herein "AMST") and others on February 13, 1987. These petitions concerned possible options for the implementation of HDTV service by existing local television stations in such a way as to be compatible with existing transmission standards. As no means exist now for accomplishing this objective using only the 6 MHz bandwidth assigned for each VHF and UHF television station, the petitions suggest several options for making additional spectrum available for use in the event there is no technological breakthrough to permit HDTV transmission within the 6 MHz bandwidth.

The AMST objective is to provide for additional spectrum it claims might be required if new technology for HDTV service will permit the broadcast of supplemental transmission on new channels in addition to the present channel utilized. Such a method would require delivery of the two signals to receivers, which

would then perform the necessary processing functions to combine information from both the main channel signal and the supplementary signal to produce an HDTV picture. The main channel signal, under such a plan, would remain compatible with existing receivers.

Even though AMST recognizes that spectrum at 12 GHz cannot be utilized for such a use with existing technology, one of their suggestions was that at least part of the band now assigned for Direct Broadcast Satellite (herein "DBS") service, 12.2 GHz to 12.7 GHz, should be taken from DBS and set aside to serve for supplemental HDTV channels, just in case the admittedly "major technological breakthroughs"/1 necessary for such use may someday be realized. It is this aspect of the AMST petitions to which the instant statement is addressed.

Baseband Bandwidth and Modulation Systems

In the following discussion of bandwidth requirements as related to possible methods of transmission, it should be understood that the frequency bandwidths necessary for the various methods of HDTV transmission are dependent on the bandwidth necessary for the baseband signal and upon the method of modulation to be employed. The baseband bandwidth would be the bandwidth required if the information were transmitted directly, such as over cables, rather than modulated (or superimposed) by some method on a radiofrequency carrier, as is required for over-the-air transmission.

The most bandwidth-efficient modulation system is single sideband (herein "SSB") modulation. Ideal SSB transmission would require an amount of radiofrequency spectrum equal to the baseband bandwidth, although practically realizable SSB modulation generally requires somewhat more. Other amplitude modulation (herein "AM") and frequency modulation (herein "FM") techniques require considerably more spectrum for a given baseband bandwidth.

The existing method for transmitting television signals serves as a good example of the relationship between baseband bandwidth and transmitted signal bandwidth for a fairly frequency-efficient modulation system.

Television signals with baseband video bandwidths of 4.5 MHz are transmitted by existing stations using an approximation to ideal SSB transmission, vestigal sideband (herein "VSB") transmission, within channels which are 6 MHz wide. For simple AM modulation, at least 9 MHz of spectrum bandwidth would be required for the 4.5 MHz video baseband information and, if FM modulation were employed, the spectrum requirements would be much greater.

## Method of Transmission and Bandwidth Requirements

The suitability of spectrum near 12 GHz for the transmission of signals to supplement broadcasts of VHF

and UHF television stations in order to achieve HDTV does not appear to have been thought out by AMST. The only tried and proven system for HDTV at this time, the "MUSE" system developed by NHK, has 8.1 MHz baseband bandwidth and is not compatible with the existing 6 MHz VHF and UHF television channels.[2] AMST mentions one other system which is under development, that of the New York Institute of Technology (herein "NYIT"), which, when fully developed, might make it possible to send some form of HDTV signal compatibly utilizing a 6 MHz television channel and another separate channel with baseband bandwidth of approximately 3 MHz operating in the UHF band.

AMST suggests that using the yet to be realized NYIT system 3 MHz channels might be carved out of the 12 GHz DBS band for transmitting the supplemental signals with approximately 3 MHz baseband bandwidth to provide HDTV service. Although the approximately 3 MHz wide baseband supplementary signals could be transmitted with only slightly wider bandwidth using the latest SSB techniques, CBS suggests and we agree that this modulation mode would not be suitable for terrestrial transmission at 12 GHz. FM is the preferred modulation method.

CBS, the only concern known to the undersigned to have experimented with terrestrial television transmission in the 12 GHz band, indicates that the NHK "MUSE" system, which has been transmitted with an 8 MHz baseband signal using two adjacent UHF television channels, would require "at least 24 MHz of channel

bandwidth" at 12 GHz to transmit the same information since "In the 12 GHz transmission system, it becomes desirable to employ frequency modulation (to achieve sufficient signal quality to overcome propagation and link losses)."/3 The fact that at least 24 MHz of spectrum would be required for transmission at 12 GHz of the same information which would require only about 8 MHz of that amount in the UHF television band certainly calls into question all of the assumptions made by AMST concerning the suitability of the 12 GHz band for supplementary HDTV service. It would appear from the CBS report that, for transmission at 12 GHz, an FM signal occupying three times the baseband bandwidth would be required for satisfactory HDTV reception.

HDTV Spectrum Requirements at 12 GHz

AMST suggested that "an allocation of half of DBS band to local broadcasters would provide over forty 3 MHz-wide channels and fourteen 8.1 MHz-wide channels for local broadcasting . . ."/4 As discussed previously, the experience of CBS indicates otherwise. CBS, through actual experience, has found that roughly three times as much spectrum is necessary for HDTV transmission at frequencies near 12 GHz than at the VHF and UHF frequencies utilized by television stations, or 9 MHz bandwidth rather than 3. This suggests that only thirteen 9 MHz channels would be available instead of the forty 3 MHz channels suggested by AMST for supplemental HDTV service and that five 24 MHz channels, rather than the fourteen 8.1 MHz-wide channels suggested by AMST, would be available for complete HDTV transmission.

Nevertheless, whichever of the two spectrum requirement estimates is correct, terrestrial distribution of HDTV signals within the service areas of existing VHF and UHF television stations to the extent envisioned by AMST does not appear possible in practical applications. AMST assumed that ten 12 GHz transmitters, each providing nondirectional service to a radius of approximately 20 miles, could be used to provide equivalent coverage within the area now served by a typical television station. AMST apparently divided the Grade B area served by a typical full service television station, approximately 13,000 square miles, by the assumed service area of a single 12 GHz station, approximately 1,300 square miles, to reach this conclusion. This approach ignores the fact that the coverage areas of the 12 GHz stations would have to overlap in order to avoid interstitial pockets with no service. In reality, many more transmitter sites are necessary in order to provide complete service. As shown on Figure 1, twenty-five precisely located 12 GHz stations providing the coverage radius assumed by AMST, 20 miles, would be required to completely serve all of the area within a typical 65 mile radius Grade B contour of a full service television station.

Assuming AMST is correct about the spectrum requirements, i.e., only 3 MHz of bandwidth is needed for the supplemental service, the 40 supplemental HDTV channels would be exhausted before two television stations in a market could implement HDTV service. Relying on estimates that are based on CBS

recommendations 9 MHz would be needed; therefore, a single TV station would run out of channels and would have to employ a complicated frequency reuse plan to transmit HDTV supplemental signals on the 13 channels available. An attempt to provide HDTV service by all of the full service television stations in a medium or large market using 12 GHz supplemental channels, as suggested by AMST, would be very impractical, if not impossible, from a spectrum utilization standpoint.

Transmitter Site Difficulties

As has been shown, typically twenty-five precisely located 12 GHz transmitting installations would be required for each local television station wishing to provide HDTV service. Since local stations typically are not located at the same site, each station would need its own grid of 25 installations thus increasing the total number of transmitting sites potentially to several hundred. It must be noted that, even in areas of uniform terrain, each of the transmitting antennas would have to be mounted at least 200 feet above ground level in order to realize 20 miles of coverage over the radio horizon. In a typical large market with 8 television stations, as many as 200 such towers would have to be constructed unless arrangements were made to permit shared use of the sites. To try to develop the large number of sites required in a market would be an engineering nightmare in terms of system design and interference, not to mention the large expenses involved, the difficulties in finding available land for the sites, and the difficulties of obtaining zoning for such use.