high performance receiving antenna standard specification for an ATV receiving antenna, perhaps under EIA auspices.

3. ATV Spectrum Allotment/Assignment Plan Principles

PS/WP-3 previously endorsed and forwarded a set of principles to be used in the formulation of ATV allotments/assignments. PS/WP-3 again endorses these principles which are set forth in Section VII-B of this report.

Specialist Group 11 is charged with developing a methodology and a computer model for evaluating the coverage and interference characteristics of proposed ATV transmission systems. The purpose of the model is to calculate and to plot service and interference contours as quantitative and visual aids for:

* The evaluation of ATTC and ATEL test data
* The comparison of proponent transmission systems
* The evaluation of proposed channel allotment plans

The Specialist Group has developed a methodology for:

* Evaluating limits on the minimum separation distances, maximum antenna heights and maximum permissible powers of ATV stations.
* Calculating the noise-limited service areas of ATV stations
* Calculating the interference-limited service areas of ATV and NTSC stations

The Specialist Group is preparing a technical report which is intended as a reference for those interested in developing or using mathematical models of television coverage and interference. This report discusses the relevant theory and practice underlying the methodology. Formulae and computational algorithms have been

developed in sufficient detail to guide implementation by computer programmers versed in numerical methods.

As a result of its work in this area, PS/WP-3 recommends that ATTC/ATEL perform subjective evaluations of NTSC-NTSC cochannel interference, including the 28 dB desired-to-undesired signal ratio, as a basis for determining the level of ATV system cochannel interference that is subjectively equivalent to any given level of NTSC cochannel interference. Furthermore, since interference to NTSC from digital ATV is claimed to be noise-like, subjective tests of the effect of noise on NTSC reception would be useful input for studying the impact of ATV on NTSC.

With regard to the overall time table, a discussion with a representative of the Broadcasters' Caucus provided this information. The allotment/assignment plans will result from a series of activities that are now underway. The key, and most important aspect of these activities is obtaining the processed information from the ATTC tests. This information needs to go to Canada and, subsequently, to PS/WP-3, where it will be formatted for use in the software presently under development as described above. The software development is on schedule. Once this information is processed, it should not take long to provide results from the coverage and allotment/assignment programs. More specifically, the time frame is as follows:

* The software should be ready for use in March, 1992.

* The ATTC has finalized the MUSE tests and is now working on the GI system. This test information, plus more from the Zenith/AT&T system, should be available for analysis in late April or May, 1992.

* Based upon the above, some preliminary results should be available on the first systems in the May/June time frame. If it is necessary that all systems be individually evaluated, it is not expected that this would be accomplished until the end of September, 1992. However, if comparable coverage and 100 percent allotment/assignment are demonstrated with the early tests, it is expected that it will not be necessary to complete all of the tests before it is possible to recommend an allotment/assignment plan.

In summary, with respect to schedule, of critical importance is the data reduction necessary for analysis in the computer program under development.

II. BACKGROUND AND INTRODUCTION

This document constitutes the Fifth Interim Report of the Spectrum Utilization and Alternatives Working Party (Working Party 3) of the Planning Subcommittee of the Federal Communications Commission's Advisory Committee on Advanced Television Service. As described in detail in its four earlier reports, Working Party 3 (PS/WP-3) was given primary responsibility for providing the Planning Subcommittee and, ultimately, via the Advisory Committee, the FCC with advice concerning spectrum utilization and alternatives as related to the Advanced Television Service (ATS). The meetings of the Working Party continued to be well attended during the reporting period, albeit with a noticeable drop in participation by land mobile radio interests. Attendance by name and affiliation is summarized in the appendices.

Also, as previously reported, PS/WP-3 initially divided its work into three fundamental parts. The first part was to deal with the various alternatives for accommodating an Advanced Television (ATV) system within the existing VHF and/or UHF television allo-

cations. This part of the work was subsequently expanded to include consideration of United States - Canada and United States - Mexico cross-border allotment issues. The second part of PS/WP-3's efforts was to deal with the issues surrounding the alternative of accommodating ATV in the region of the spectrum above 1 GHz. The third and final part dealt with the possible impact of ATS on the spectrum utilization of various broadcast support and non-broadcast services.

Again, as previously reported, PS/WP-3 organized itself into specialist groups in order to more effectively carry out its work in each of the three areas noted above. During the current reporting period, Specialist Group 3 continued its work of analyzing the impact of ATV on broadcast support services spectrum and non-broadcast services spectrum, and the results of their efforts are described in Section III. The work of Specialist Group 4 relating to accommodating ATV in the spectrum above 1 GHz has, for the most part, continued to be deferred for reasons described in earlier reports. This is elaborated on briefly in Section IV. Also during this reporting period, Specialist Group 6 on Spectrum Analysis, and Specialist Group 7 on Taboos, continued to work on a combined basis. The results of their activities are described in Section V. The work of Specialist Group 9 dealing with cross-border allotment issues is described in Section VI. Specialist Group 10 continued its work relating to planning factors and the results of their efforts are described in Section VII.

During the reporting period, a new Specialist Group (Specialist Group 11) was formed and charged with the objective of developing a methodology and computer model for evaluating the coverage and interference characteristics of proposed ATV transmission systems. Further information on the objectives of their work and the results obtained during the reporting period are described in Section VIII. Finally, Section IX contains a description of future work planned by PS/WP-3.

In another development during this reporting period, the Chairman of the SS/WP-4 Task Force on Report Drafting, in a letter dated 10 October 1991, asked to have a member of PS/WP-3 join his Task Force to act as an official liaison between the two groups. Recognition was given to the fact that input relating to spectrum issues had to come from PS/WP-3. The Task Force had suggested what it believed would be appropriate data from PS/WP-3, but the closer liaison achievable by representation on the Task Force appeared to be desirable. Accordingly, a delegate and alternate were appointed to represent PS/WP-3 on the Task Force on Report Drafting. Both participated in the October 31 meeting of the Task Force. The delegate agreed, in that meeting, to merge into a single paper three contributions directed to the formulation of Section 7.2.1, the paragraph providing background in the Spectrum Utilization Criteria section of the Final Report draft. The paper was prepared in draft form and delivered to the newly appointed joint chairmen of the Task Force on November 14.

III. BROADCAST SUPPORT SPECTRUM (SPECIALIST GROUP 3)

A. Introduction and Conclusions

Specialist Group 3 (SG-3) is aware, of course, of the FCC's tentative decision in the October 24, 1991 NPRM that no additional spectrum should be made available for auxiliary broadcast use, based on the assumption that licensees will be able to take advantage of digital compression and fiber optic links. SG-3 is well aware of the promise held by these new technologies, and has commented on these items in its previous interim reports. The specialist group believes, however, that it will be many years before these techniques will be available for implementation for technical and/or economic reasons. For this reason, Specialist Group 3 continues to believe that additional Broadcast Auxiliary Service (BAS) spectrum will be needed in the major markets. Our current state of work has brought us to the following conclusions:

1. The future ATV industry cannot function without adequate Broadcast Auxiliary Service spectrum.

2. It is recognized that, at least in the major markets, new and innovative spectrum solutions will be required to ensure adequate capacity for studio contribution and distribution functions.

3. The fact that different NTSC and ATV signals will be transmitted in many circuit segments will mean that additional BAS capacity will be required.

4. Pursuit of other BAS spectrum should be initiated at the present time.

5. The FCC should institute a dialogue with the NTIA to consider the availability of additional shared spectrum to accommodate these needs.

6. Needs of the new ATV service should be considered in the pending legislation that would transfer 200 MHz of government spectrum to the private sector.

7. The bands 4.40-4.99 GHz and 7.75-7.90 GHz are the best possibilities for providing additional ATV-BAS support spectrum on a shared government/non-government basis.

8. More efficient BAS frequency coordination and the use of BAS equipment (e.g., antennas) with higher efficiencies and accuracies should be encouraged.

9. Fiber optic technology will become increasingly important to the industry.

10. The FCC should be sensitive to the costs of fiber optic technology in its consideration of the suitability of that technology for satisfying the need for expanded BAS services.

11. "Lossless" or low-loss compression technology will be required for, at the least, interplant distribution in an ATV program production/broadcast system. Without it, television production cannot be conducted.

SG-3 believes that the following specific solutions should be considered when looking for methods to provide facilities for Broadcast Auxiliary use:

- Where possible, use fiber optic systems to replace or augment fixed microwave circuits.

- Employ improvements in equipment and operating techniques, including FM deviation optimization, larger and shrouded antennas, and lower noise figures for pre-amps and receivers.

- Consider better utilization of the currently allocated but lightly used 18, 23, 30 and 40 GHz bands.

- Consider the possible use of the 20/30 GHz bands for satellite service.

- As they become available, employ better digital compression techniques to reduce per-TV-signal bandwidth.

The above conclusions are based on the following critical issues which were discussed in detail in the Fourth Interim Report. Because of their importance, these critical issues are repeated at the beginning of Subsection B, below.

B. Critical Issues

As identified by SG-3, the critical issues relating to BAS spectrum are as follows:

- STL and other auxiliary spectrum circuits are critical to broadcasters, and their need will likely expand for ATV.
- An ATV station must be able to operate independently of the NTSC station, including STL's, TSL's and other auxiliary circuits.
- The location where an ATV signal will be encoded will determine some auxiliary spectrum needs.
- Program contribution circuits Intercity Relay, Satellite Entrance Links, and Transmitter-Studio Links (ICR, SEL, and TSL) generally require better performance than the STL.
- NTSC to ATV upconversion and ATV to NTSC downconversion will take place either at the studio or at the transmitter, and during the transition period, it will be necessary to translate from one format to another.
- A new STL will be needed if the ATV transmitter is not co-sited with the existing NTSC transmitter.
- In the long term, digital compression techniques may have a major impact on the design of the next generation of broadcast auxiliary circuits. While digital modulation is less susceptible to interference than analog modulation, the use of high performance multi-phase digital modulation may actually require more protection.

In its Third Interim Report, SG-3 reported on the results of an extensive survey of station chief engineers in the top 50 markets, with supplementary information on the usage of broadcast auxiliary spectrum provided by the Society of Broadcast Engineer's frequency coordinators. These results indicate that approximately 80% of the respondents currently face congestion with respect to STL frequencies. SG-3 believes that if this data were adjusted for the top 30 markets, where it is believed that the most severe

shortages exist, the percentages would be even higher. As indicated in footnote 33 of the FCC's Notice of Proposed Rulemaking (NPRM), one study predicts stations in the top 10 markets will build an ATV facility in the first year of the transition to ATV. It seems probable that others within the top 30 would follow shortly thereafter. Within this relatively short time frame, it is unlikely that compression techniques and fiber optic systems will be able to accommodate all STL spectrum demand.

The aforementioned survey did show much less congestion in the auxiliary bands at 18 Ghz and above. However, since the average STL path length is over 14 miles, these frequencies, in general, would not be suitable for STL use.

The Commission's Notice suggests the possibility of some separate programming being authorized under the 'simulcasting' definition and indicates that the two signals, ATV and NTSC, might be transmitted in the same microwave channel from the studio to transmitter using a 'lossless' compression technique. At this point, it is not known whether such a possibility is viable. And of course, this arrangement would not help the channel shortage where two different transmitter or studio locations are involved.

With respect to optical fiber cable, the telecommunication companies are rapidly expanding their fiber networks. Television transmitter locations, however, are frequently on remote mountain tops or antenna farm areas that are unlikely to be passed by these networks. Although custom designed buried fiber to such sites is possible, the costs involved are usually prohibitive. Another high

quality circuit requirement is for satellite entrance links (SELs), where studio and earth station are not collocated. Here again, such sites may be located in remote locations, not passed by fiber networks.

In conclusion, SG-3 strongly believes that consideration must be given to the need for auxiliary spectrum, at least during a transition period, primarily for STL and perhaps SEL use. SG-3 urges the Commission to consider this requirement, and review the many microwave allocations, in the 4 - 8 GHz band, which might be reallocated, on a shared basis, during the transition period, to the broadcast auxiliary service. Although PS/WP-3 intends to pursue its own investigation as to the possibility of shared use of government spectrum in this band, the Commission's own initiative in this endeavor would, of course be invaluable.

Of similar importance, SG-3 believes that further sharing of any of the existing broadcast auxiliary spectrum could impede the implementation of ATV and disrupt current methods of electronic news gathering. In short, frequency congestion in the TV auxiliary bands is a major concern for broadcasters today, and congestion will likely get worse with the additional load caused by advanced television. Additional background information on BAS spectrum congestion is contained in Subsection C which follows:

C. Spectrum Congestion

Based on a 1989 NAB survey of the top markets, in many instances, currently allocated microwave channels are used to the fullest extent with the likelihood of additional capacity within

the current structure being almost nil. For example, in Los Angeles, there are 15 TV transmitters atop Mt. Wilson each with at least two microwave circuits between the studio and this site, one STL and one TSL. These microwave circuits are directed to the same general area limiting the use of antenna discrimination to permit frequency reuse. Most of the stations are heavily involved in ENG operations, involving the use of one or more microwave channels on the ENG vehicle and typically several microwave channels from repeater points to Mt. Wilson. It should also be noted that ENG activity tends to originate from a common location, e.g., a major news event, thereby compounding the interference problem. Generally, several repeater sites are required because of the mountainous terrain and the wide area served by the Los Angeles stations. There is also extensive use of Cable Television Relay Service (CARS) stations in the Los Angeles area that share the same frequencies used by the broadcasters.

Moreover, because an unobstructed transmission path from the remote site to the ENG receiver often cannot be found, the 2 GHz band, because of its reflective propagation characteristics, is regarded by broadcasters as being best suited for ENG operations. Broadcasters frequently "bounce" the 2 GHz signal off available solid surfaces, such as buildings, in order to obtain a transmission path to the receiver. The success of this technique is less sensitive to the scattering produced by the roughness of the reflector at 2 GHz than at higher frequencies. In addition, the increased path length incurred with this approach makes use of

spectrum above 13 GHz less suitable because of rain attenuation and other factors.

As discussed earlier, spectrum studies to determine spectrum congestion have been conducted. These studies were aimed at determining (1) the amount of congestion in the BAS bands in the top 50 markets, (2) the possibility of ATV accommodations in current auxiliary bands, again in the top 50 markets, and (3) the level of usage in the STL, ENG, and the ICR bands. Frequency coordinators were also surveyed with some questions.

The findings of these studies were as follows:

1. The 2, 7 and 13 Ghz bands used for STL, ENG and ICR functions are congested.

2. Many of the responding stations will be requesting more frequencies in these three bands.

3. Frequency coordinators found the 2 & 7 GHz bands to be most heavily used; 2 GHz has the biggest coordination problem.

4. Studies have demonstrated the severity of the congestion facing users of auxiliary spectrum.

5. Problems are compounded by sharing within some bands, e.g., 13 GHz CARS.

D. Possible New Auxiliary Spectrum For ATV

The FCC's original NOI requested information on the 2.5 - 2.69 GHz and 12.2 - 12.7 GHz bands, which roughly bracket the spectrum of interest, 1-13 GHz. Work to date is briefly summarized in the subsections below:

1. 2.5 - 2.69 GHz Band

Allocated to ITFS/OFS/MDS/MMDS services and is used primarily in the major markets. Recent FCC actions, designed to foster MMDS development, make this band almost unusable for BAS.

2. 4.4 - 4.99 GHz Band

Allocated domestically to the government Fixed and Mobile Services, but currently set aside for high-powered military troposcatter systems. Most systems are warehoused. Peacetime use is for training in limited, remote geographic areas.

3. 7.5 - 7.9 GHz Band

Allocated domestically to the government Fixed Service only. Used by up to three agencies for non-military microwave relay systems of intermediate length. Usage is not known. Good possibility for shared use with BAS.

4. 12.2 - 12.7 GHz Band

Broadcast Satellite Service (BSS) downlink band. Service was authorized over eight years ago, there are many authorizations extant but there are currently no operating systems.

E. Secondary Spectrum Possibilities

The FCC has suggested several frequencies for possible use for a Digital Audio Broadcast (DAB) service, including 1493-1525 MHz, 2390-2450 MHz, and other bands. If these bands are not selected for DAB, this spectrum is a good candidate for ATV BAS. It is also noted that there are other ongoing studies of possible spectrum for DAB, which could be suitable for broadcast-support channels.

F. Fiber Optic Systems

1. Introduction

Fiber for ATV (or NTSC) broadcast auxiliary use may be possible in certain circumstances. However, in many locations, fiber facilities are not yet sufficiently available or economical

to provide a viable alternative for displacing the activity on a significant portion of the spectrum now used in support of ATV broadcast auxiliary operations. Fiber transmission may provide additional capacity in distribution channels, but only where these facilities are available, economically viable, and where mobility is not required. In many circumstances today, availability and economics favor the use of radio-based technologies over fiber optic transmission means.

2. Availability

For news events, existing circuits would be available only in the most fortuitous circumstances where a fiber optic cable with idle capacity already exists at the venue, or where the predictability and demand for coverage has justified the installation of permanent circuits. Generally it is not feasible to extend fiber to a particular site for a single or occasional television broadcast.

3. Economics

For service provision where special assembly or new construction is required, telecommunications common carrier tariffs provide for both lease of the transmission capacity and recovery of the cost of construction. Private carriers furnishing capacity with fiber optic facilities are also obliged to recover their costs, which are passed on to the customer in one form or another. In addition, many building owners are demanding payment for the physical penetration of their properties with fiber cable and for running conduit inside the building. The effect of the costs

discussed has, in many cases, made short-haul transmission by satellite more affordable.

IV. ACCOMMODATING ATV IN THE SPECTRUM ABOVE 1 GHZ (SPECIALIST GROUP 4)

Since the last Interim Report there has been no activity by SG-4 and the work of WP-3 has been dedicated entirely towards accommodating ATV within the existing VHF/UHF broadcast spectrum, which, of course, from a propagation point of view, would be far superior to the use of spectrum above 1 GHz for implementing ATV. The propagation tests conducted by the ATTC in the 2.5 and 12 GHz bands, which approximately bracket the major band of interest of the SG-4 study, i.e., the 1-13 GHz band, produced a considerable amount of data which awaits analysis. Since the question of terrestrial broadcasting of ATV in the spectrum above 1 GHz might still have some relevance, SG-4 will remain intact, although temporarily inactive. If proposals involving the VHF/UHF bands are definitely established as the appropriate and viable approach to accommodating ATV, no further activity by SG-4 would be contemplated.

V. SPECTRUM ANALYSIS AND TABOOS (SPECIALIST GROUPS 6 AND 7)

Since spectrum analysis and the consideration of the impact of taboos likely to be needed in considering allotments for ATV systems are inextricably related, the work of Specialist Groups 6 (Spectrum Analysis) and 7 (Taboos) has been combined.

Efforts since the Fourth Interim Report have been concentrated on preparing for the time when reports are available disclosing the results of both objective and subjective tests being conducted by

laboratories in the United States and Canada. Based on those reports, and the determination of planning factors by Specialist Group 10, analyses will be required to provide conclusions as to the coverage to be expected from use of each of the proposed simulcast ATV systems, and the degree to which existing NTSC authorized stations can be accommodated with a second channel for ATV service.

The magnitude of the effort involved in the foregoing analyses requires that computer facilities be available with suitable software. Although programs have been available to conduct some of the allotment analyses required, a greater degree of sophistication in these programs was believed necessary, in addition to the ability to generate interference and coverage studies. Such studies are required both on a nationwide basis and for individual stations.

Specialist Group 11 developed Service and Interference Models that constituted partial specifications for the computer program required. The Broadcasters' Caucus has provided the funding for program development and for a work station with sufficient power to run the program. A contract has been negotiated for writing the program, and work has begun. Completion of the program is expected by the Spring 1992.

Reports of ATV coverage and accommodation statistics will be prepared system by system as the data become available. Results will be provided through the Working Party to Systems Subcommittee Working Party Four as elements to be factored into that Working

Party's determination of what system it will propose that the Advisory Committee recommend for implementation.

VI. CROSS BORDER ISSUES (SPECIALIST GROUP 9)

This specialist group has been concerned with the coordination of spectrum activities with respect to Canada and Mexico. During this period there has been some progress in this area. The Commission sent a letter to and had personal discussions with Mexican officials inviting participation in the U.S. ATV Spectrum Planning activities. However, to date there has not been any contact from Mexico in this regard.

However, it appears that a basis for good cooperation with Canada has now been established. In November, PS/WP-3 received correspondence from the Chairman, Joint Technical Committee on Advanced Broadcasting (Doc. PS/WP-3-187), which stated in part:

> "In Canada, we foresee that a single terrestrial ATV transmission standard will be chosen for North America once the cooperative evaluation work by the Advanced Television Test Center (ATTC) and the Canadian Advanced Television Evaluation Laboratory (ATEL) has been completed. We envisage ATV allotment plans for Canada and the U.S. that are fully integrated within the coordination zone now defined in the Canada-US TV agreement. In short, we anticipated developing ATV allotment plans more or less in the same way as we have created plans for existing NTSC services.
>
> Once basic ATV technical allotment criteria are agreed upon, we see each country determining its own service requirements. Discussion would occur and any necessary trade-offs would be made in the border areas until we arrived at mutually acceptable allotment plans for both countries.
>
> Regarding the possible frequency bands, we anticipate that both Canada and the US will eventually implement ATV in the UHF bands that are currently allocated for television services. As a consequence, current NTSC services may have to co-exist with ATV for a substantial

period of time. We expect that any ATV allotment plan would have to ensure that NTSC stations would not experience an increase in interference within their current protected contours.

We also anticipate that any ATV allotment plans will have to be designed to facilitate the transfer of existing NTSC services to an ATV mode. This may involve the need for plans that can accommodate substantial periods of simulcasting. It would be reasonable to conclude that existing licensees would want to ensure that simulcast ATV services are capable of providing interference-free service over areas that are at least as large as those afforded by their NTSC transmitters.

As for the implementation of the necessary technical rules and standards, we would expect that Canada would follow its normal consultative and regulatory processes. This usually means that standards are proposed by a government/industry advisory body and an opportunity is then given for public input before any rules or regulations are adopted."

In addition, it is understood that the FCC has had analogous contacts. Specialist Group 9 will continue to coordinate the work of PS/WP-3 with Canada and Mexico as appropriate.

VII. PLANNING FACTORS DEVELOPMENT (SPECIALIST GROUP 10)

A. Planning Factors

The Fourth Interim Report outlined the functions of planning factors, similar to those that led to the development of the Grade A and Grade B service contours for NTSC. Also outlined were the parameters that will be needed to estimate the extent of co-channel, adjacent channel, and taboo-type interference that will be created to and from the new ATV stations. The Report listed a table of 22 such planning factors, with taboo parameters deferred for separate consideration, along with explanatory notes on these factors. It is anticipated that a separate table for each of the proponent systems would be prepared to assist in the comparative

analysis, which would lead to a single set of planning factors for subsequent administrative purposes.

Since interference will vary from system to system, and since this interference data has not been available, SG-10 has concentrated on the system-independent planning factors, and has tentatively adopted the values shown in the next table.

Interim Estimates of System-Independent Planning Factors For Outer ATV Service Contour

Planning Factor	Low VHF	High VHF	UHF
Geometric mean frequency (MHz)	69	194	615
Dipole factor (dBm-dBu) dB (K_d)	-111.8	-120.8	-130.8
Thermal noise (dBm) (N_t)	-106.2	-106.2	-106.2
Antenna gain (dB) (G)	4	6	10
Downlead line loss for 50' of coax (dB) (L)	1	2	4
Front-to-back ratio (dB) (ratio of forward gain to maximum response over rear 180°)	10*	12*	14*
Receiver noise figure (dB) (N_R)	5**	5**	10**
Time probability factor for 90% availability (dB) (ΔT)			***
Location probability factor for (ΔL) 50% availability (dB)	0	0	0

* For the receiving antenna manufacturer's objectives the values are 14, 16, and 20.

** Possible changes in the VHF figures are still under consideration by SG-10.

*** The time probability factor is defined as the difference F (50, 10) minus F (50, 50), where these two values are determined from the FCC charts in Section 73.699. This factor is a function of the distance between the transmitting and receiving antennas.

Notes:

1. The equation relating the required field strength (E) to the factors follows:

$$E = N_t + N_R + C/N(\text{see note 4}) + L - G - K_d + \Delta L + \Delta T$$

2. Antenna gain actually lessens the field strength requirements, hence these values are subtracted in the summation of the three columns.

3. The values shown for front-to-back ratio are <u>not</u> added in the column summation, but will have the effect of lowering the undesired co-channel signal and will be used in determining the ATV interference-limited contour (ILC).

4. When appropriate time probability factors, and the C/N ratios required for a specified quality of service, are added in the summation of the above three columns, excluding F/B ratio, the result will be the field strength requirements for the ATV noise-limited contour (NLC).

These planning factors will have two basic functions: 1) for use in the comparative analysis of the candidate systems, where different C/N values can be expected, and 2) after a single system has been selected they can form the basis for a unified set of factors that can be used for administrative purposes, similar to the values associated with the NTSC Grade A and Grade B contours.

Note that the values of receiving antenna front-to-back ratios represent a "derating" with respect to the listed manufacturer's objectives, which the Specialist Group believes are reasonable state-of-the-art possibilities, as measured on the antenna testing range. The derating results from the consideration that the rejection of unwanted co-channel signals will be somewhat less than these objectives in actual home installations because of the effects of local reflecting surfaces. Since the receiver noise

performance can be adversely affected by any antenna impedance mismatch over the frequency band, it is recommended that the antenna VSWR be kept as close to unity as possible, with a value of 2.0 as an outer limit, corresponding to a reflection coefficient of 33%, or a return loss of 9.5 dB.

In view of the fact that closer co-channel mileage separations will be required to accommodate all, or nearly all, existing stations with a six megahertz simulcast channel, the Specialist Group believes that a high performance receiving antenna will be required to meet these gain, VSWR, and front-to-back specifications. The Specialist Group plans to develop a voluntary standard specification for an ATV receiving antenna, perhaps under EIA auspices.

In the Fourth Interim Report it was reported that in response to a request from the chairman of SS/WP-4, PS/WP-3 prepared a paper outlining how to judge the spectrum-related aspects of a particular system. Because of the importance of the paper it was included in the Report. Since that time a new Specialist Group was established (SG-11, see below) to develop the specifications for a computer program that could produce receiver noise-limited and interference-limited service contours, based on all possible parameter inputs. SG-10 has worked very closely with this new group.

During the last work period a list of spectrum allotment/assignment plan principles was developed which included the "pairing" concept for channel allotments and channel assignments. As will be described, this computer program will also facilitate

the development of possible pairing plans. This list of principles follows.

B. ATV Spectrum Allotment/Assignment[1] Plan Principles

Previously PS/WP-3 has carried out analyses on various scenarios regarding the development of an allotment plan for accommodating advanced television systems in the same VHF and UHF allocations presently supporting existing VHF and UHF stations. It is now necessary to establish a set of guidelines or principles which can be recommended to the FCC to be used to generate an allotment/assignment plan for the envisioned ATV simulcast stations. The principles set forth below are desirable objectives for a nationwide plan. The spectrum principles are as follows:

1. Pair ATV Allotments with Existing NTSC Allotments

An ATV channel should be identified and associated with each of the existing VHF and UHF allotments. This provides the fundamental basis for an ATV plan, and serves as a baseline for implementation. Such a Plan, based on these principles, should be prepared for comment by the FCC, following resolution of assignment policy in the Spring of 1992. This principle is based upon the 9/1/88 Tentative Decision and Further Notice of Inquiry which said that: "Benefits of ATV technology will be realized by the public most quickly if existing broadcasters are permitted to implement ATV."

---

[1]An assignment is an ATV channel associated with each existing VHF/UHF licensee.

2. Comparable Coverage

The Allotments in the Plan, when implemented to become actual assignments, should be capable of providing a service area comparable to the calculated interference-limited service[2] area of the NTSC station to which it is paired. The uniform methodology should be applied to each existing station to determine the comparable coverage.

3. Use Existing Sites

To the extent possible, the assignment plan should use the existing transmitter locations for the transmission of the ATV signal.

4. Separation Limits

The Allotment Plan should be developed primarily on the basis of minimum separation distances between co-channel stations.

5. Allotment Models

Since there are many millions of possible pairings of ATV allotments with NTSC allotments, a computerized procedure is required for determining a feasible distribution of allotments.

6. ATV/NTSC Interference

An ATV station should not cause any greater interference penetration into the service area of existing NTSC stations or other ATV stations than is presently permitted.

7. NTSC Assignment Data Base

The NTSC data base will be premised on the locations of NTSC authorized stations on a date to be determined.

---

[2]Termed as interference free in previous documents.

8. Vacant Allotments

Spectrum presently allotted, but not used, may be needed to obtain full ATV accommodation for all existing on-the-air stations. The affected number of vacant allotments should be kept as small as possible, being used only when an operating assignment would be prevented.

9. Receiving System

The characteristics of a typical ATV Receiving System should be taken into account in determining the comparable interference-limited service area. These characteristics would include antenna parameters such as front-to-back ratio, and system parameters such as tuner/decoder rejection capability.

Given the information available today, it is recommended that the Commission adopt the principles set forth above as the nexus for development of an ATV Allotment Plan.

C. ATV/Land-Mobile Interference

The ATV allotment plan must take into account potential interference to land-mobile operations directly below television channel 14 and directly above television channel 69, as well as to various land-mobile operations between television channels 14 and 20, in certain cities.

D. Future Activities

The next task of SG-10 will be to participate in the analysis of the objective and subjective test data, as it becomes available, and to "fill in" the appropriate values in the planning factors charts, directed towards the goals of the comparative systems anal-

ysis, and eventually a suggested Table of Allotments and Assignments that will be derived from this data. As part of its future activities, SG-10 will examine what, if any, additional analysis of the ATTC data needs to be planned in order to assure that possible differences in the spectrum efficiencies of the proponent systems after the NTSC transition period are uncovered.

VIII. SERVICE AND INTERFERENCE MODELING (SPECIALIST GROUP 11)

A. Introduction

1. Background

Working Party 3 (WP-3) of the Planning Subcommittee of the FCC Advisory Committee has primary responsibility for providing the Planning Subcommittee and, through the Advisory Committee, the FCC with advice concerning spectrum utilization relating to the Advanced Television Service. Specialist Group 11 (SG-11) is charged with developing a methodology and a computer model for evaluating the coverage and interference characteristics of proposed Advanced Television (ATV) transmission systems.

The computer model will calculate and plot service and interference contours as quantitative and visual aids for:

- The evaluation of ATTC test data
- The comparison of proponent transmission systems
- The evaluation of proposed channel allotment plans

At any given location, current NTSC reception is limited by propagation factors, natural and man-made noise, receiving antenna, receiver characteristics and interference from other NTSC stations. The amounts of interference from other NTSC stations is limited by