

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

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FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of

Amendment of Part 15 of the)
Commission's Rules to Permit Operation)
of Biomedical Telemetry Devices on)
VHF TV Channels 7-13 and on)
UHF TV Channels)

ET Docket No. 95-177

To: The Commission

**REPLY COMMENTS OF
THE CRITICAL CARE TELEMETRY GROUP**

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SUMMARY

The Critical Care Telemetry Group (“CCTG”), which includes virtually all manufacturers of U.S.-made low-power electrocardiogram and other medical telemetry devices, notes that the weight of the comments submitted in response to the Notice of Proposed Rule Making (“NPRM”) in this proceeding strongly supports adoption of the proposed rules. Adoption of these rules will ensure that the near term requirements of medical telemetry will be met without risking objectionable interference to current or future television broadcast reception.

Certain representatives of the broadcast industry filed comments opposing adoption of the proposed rules because, they asserted, telemetry systems operating in conformance with such rules will cause harmful interference to, and receive harmful interference from, broadcast transmissions.

Such assertions are without merit. CCTG’s technical submissions are based on sound, widely-accepted engineering principles and data that plainly demonstrate that telemetry operations and present and planned broadcast services can co-exist on an interference-free basis under the proposed rules. The Engineering Statement attached to these reply comments sets forth in detail the technical infirmities in the engineering assertions upon which the broadcasting parties’ objections are premised. In short, and contrary to the broadcasting parties’ assertions, the engineering assumptions underlying CCTG’s proposal are highly conservative and, in this regard, tend to overstate any potential for interference between broadcast and telemetry operations.

The Commission has found consistently that medical telemetry operations advance an important public interest. Hospitals and associations of health care providers, moreover, have filed comments in this proceeding demonstrating that operation and expansion of medical telemetry technologies are now jeopardized by a severe shortage of spectrum, which endangers the health and safety of the patients dependent on such technologies.

At present, there are no suitable frequencies available that can be dedicated to the exclusive use of medical telemetry, an action which would be consistent with Congress’ directive to the Commission. The proposals embodied in the NPRM represent the best available alternative to meet the near term needs of the health care community. Adoption of these proposals will not risk harmful interference to present or future television broadcast services. As such, these proposals should be adopted by the Commission as quickly as possible.

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Operation of Biomedical Telemetry)
Devices on VHF TV Channels 7-13)
and on UHF TV Channels)

To: The Commission

**REPLY COMMENTS OF THE
CRITICAL CARE TELEMETRY GROUP**

The Critical Care Telemetry Group ("CCTG") submits the following reply comments with respect to the Notice of Proposed Rulemaking ("NPRM") released in the above-captioned proceeding.¹ CCTG consists of Hewlett-Packard Company Medical Products Group, Marquette Electronics, Inc., Siemens Medical Systems, Inc., SpaceLabs Medical, Inc., and Vitalcom — companies that constitute the bulk of the medical telemetry manufacturing industry.

INTRODUCTION

The majority of parties commenting on the NPRM strongly endorse the Commission's proposal to amend Part 15 to expand the available frequencies and increase authorized power for biomedical telemetry devices operating on vacant VHF and UHF television channels. These parties concur with the Commission's finding that medical telemetry operations substantially advance the public interest² and, moreover, recognize that adoption of the proposed rules will meet the near term needs of telemetry users without jeopardizing reception of existing or planned broadcast services.

¹ Although reply comments were due initially on May 16, 1996, CCTG, on May 14, 1996, submitted a Motion for Extension of Time requesting that the reply comment deadline be extended to May 23, 1996. CCTG was informed orally by a member of the Commission's staff that such motion has been granted.

² NPRM at ¶ 5.

Notwithstanding the Commission's conclusion that adoption of the proposed rules will foster efficient spectrum use,³ and the recognition by the broadcast industry that the interference-free operation of medical telemetry devices serves an important public interest, representatives of the broadcast industry oppose the proposed rules. In short, the broadcast parties assert — without any sound technical basis or persuasive engineering data — that operation of telemetry devices in a manner consistent with the NPRM will create harmful interference to both broadcast and medical telemetry services.

As demonstrated below and in the Engineering Statement attached hereto, the comments filed in opposition to the NPRM are without technical merit. Specifically, CCTG has demonstrated that:

- the engineering calculations performed by CCTG were performed using "worst case" assumptions and, therefore, overstate any potential for objectionable interference to TV reception, which, in any event, is virtually nonexistent;
- the telemetry signals transmitted inside health care facilities will be sufficiently attenuated as to assure that there will not be objectionable interference to TV reception outside of such facilities;
- the proposed distance separation criteria are highly conservative and, in this regard, are more than adequate to ensure that telemetry and broadcast transmissions do not interfere with each other;
- operation of telemetry devices in the UHF band will not cause harmful interference to UHF transmissions, including on UHF taboo channels;
- adoption of the proposed rules will not adversely impact auxiliary broadcast facilities, including LPAS, LPTV, and TV translators and boosters; and
- CCTG's proposed out-of-band emissions standard is conservative and will not imperil broadcast operations.

Accordingly, CCTG — relying on widely-accepted testing techniques, sound engineering principles, and a large body of existing, reliable technical data developed in the context of telemetry as well as other communications services (*e.g.*, LPAS, cellular) — has demonstrated that adoption of the proposed rules will enable

³ Id.

telemetry devices to operate effectively on vacant broadcast channels without imperiling analog or digital television reception. As such, CCTG urges the Commission to follow through on the proposals set forth in the NPRM on an expedited basis.

I. ADOPTION OF THE PROPOSED RULES WILL NOT HAVE AN ADVERSE IMPACT ON CURRENT OR FUTURE BROADCASTING SERVICES

While nearly all the broadcast parties acknowledge the important public interests advanced by medical telemetry operations, they seek in their comments to conjure up technical objections to the proposed rules in an attempt to reserve exclusive use of the broadcast frequencies to themselves. It seems to matter little to the broadcast parties that, under the proposed rules, the interests of both broadcasters and telemetry users have been carefully balanced to permit sharing of frequencies by two compatible radio services. Simply stated, but elaborated on below and in the attached Engineering Statement, adoption of the proposed rules will not have an adverse impact on current or future broadcasting services.

A. Co-channel Separation Distances Are Based On Sound Engineering Principles and Data and Will Safeguard Broadcast Services From Interference From Telemetry Operations.

In order to ensure that the requested increase in operating power for telemetry devices does not result in interference to broadcast services, CCTG proposed in its Petition for Rulemaking that the Commission adopt conservative minimum co-channel separation requirements. Indeed, CCTG's proposed separation distances are so conservative that the Commission questioned whether such distances are overly restrictive for telemetry users.⁴ In raising this question, the Commission appropriately noted that the distances proposed by CCTG are closely analogous to those applicable to LPAS, notwithstanding the fact that LPAS are intended to transmit over much greater distances and at much higher power levels than medical telemetry devices.⁵

While CCTG agrees with the Commission that the proposed co-channel separation requirements are overly restrictive and that even reduced distances would ensure that telemetry operations do not interfere with broadcast facilities, CCTG is

⁴ *Id.* at ¶ 11.

⁵ *Id.* It is also worth noting that there is no requirement for structural shielding imposed on LPAS.

willing to live with the restrictive distances in order to assuage even the exaggerated concerns of the broadcast community. CCTG is committed to preventing interference to broadcast services and its willingness to comply with overly restrictive separation criteria is one indication of the depth of this commitment.

Despite the Commission's effort to craft rules that preserve the interference-free operation of both broadcast and telemetry services, the broadcast parties question whether the proposed co-channel separation distances are sufficient, notwithstanding their own experience with LPAS and the Commission's observation that the proposed requirements are likely overly restrictive. In this regard, MSTV takes issue with the use of industry-standard D/U signal ratios in determining the proposed separation distances. MSTV argues that broadcast NTSC signals may be more susceptible to interference from digital FM signals used in medical telemetry than from other NTSC signals on the same frequency and, in this regard, that each digital modulation scheme should be studied individually in order to develop specific D/U ratios.⁶

As explained in the attached Engineering Statement, however, the NTSC-to-NTSC D/U ratio employed to calculate the proposed co-channel separation distances actually overstates the potential for interference to broadcast services from telemetry operations and, for this reason, presents a worst-case scenario. It is a basic engineering principle that co-channel signals with similar modulation schemes are most susceptible to interference from each other. By assuming that the interfering telemetry signal would employ NTSC modulation techniques, therefore, CCTG's engineering studies overstate, rather than understate, the potential for interference. Additionally, because other sources of signal attenuation, such as terrain, were not considered when calculating the requisite separation criteria, the proposed separation distances are indeed overly restrictive.

Accordingly, suggestions that the proposed co-channel separation distances are not premised on sound, reliable engineering data and principles, or that a separate D/U ratio must be derived for each digital modulation scheme used by biomedical telemetry,⁷ are without any technical merit. As the Commission knows, the proposed separation distances, if anything, are overly restrictive. They tend to over-protect broadcast facilities and, for this reason, are more than adequate. Moreover, in the extremely unlikely event that, notwithstanding the overly-protective separation

⁶ Comments of the Association for Maximum Service Television ("MSTV") at 2-3.

⁷ Id. at 3.

requirements, a given medical telemetry operation interfered with a given broadcast facility, the telemetry operation, as a secondary user, would be required to cease the offending transmissions.

B. Telemetry Users and Manufacturers Can Ensure Compliance With Separation Distances.

Several parties express concern that there are no assurances that hospitals and other health care facilities caring for seriously ill patients will comply with the proposed separation distances.⁸ These concerns are misplaced.

First, as a practical matter, telemetry receivers are extremely sensitive. In most areas located within the specified separation distance, interference from the television signal itself would preclude the use of telemetry on that frequency. Accordingly, to ensure interference-free telemetry operations, users of telemetry systems, as a matter of self interest, will not select a frequency used by a broadcast facility located within the minimum separation radius.

Second, the selection of telemetry frequencies by health care institutions is a painstaking, highly deliberative process. Medical telemetry systems are sophisticated mini-networks that require professional installation and periodic maintenance. As such, manufacturers will work closely with health care institution personnel to locate suitable frequencies, both at the time of installation and thereafter. As is presently the case, health care personnel will have access to lists of available frequencies within their areas of operation and will be able to select appropriate frequencies from such lists. Again, as secondary users who, because of the use of sensitive receivers, are more likely to receive than inflict harmful interference, users of telemetry systems have every incentive to comply with the minimum separation requirements.

C. The Operation of Telemetry Devices In Critical Care Facilities Located Outside of Hospitals Will Not Adversely Impact Broadcast Operations.

The NAB asserts that, because non-hospital structures have less potential to attenuate signals than hospital structures, the operation of telemetry devices should be limited to the hospital setting.⁹ The NAB also asserts that the field test data CCTG presented in its previous engineering submissions is insufficient to support the

⁸ Comments of NAB at 6, 11; Comments of SBE at 4.

⁹ Comments of NAB at 11-14.

conclusion that a signal attenuation factor of 20 dB can be attributed to shielding resulting from building structures.¹⁰

As set forth in detail in the attached Engineering Statement, however, a 20 dB attenuation factor can, in fact, reliably be expected.¹¹ Still, CCTG agrees with the NAB that this attenuation factor cannot be attributed solely to building structures. In addition to building structures — which would always be present, as CCTG proposes that telemetry devices be permitted to operate only inside health care facilities in which patients require continuous monitoring of their vital signs (hereinafter “Critical Care Facilities”) — telemetry signal attenuation also is attributable to inefficiencies inherent in telemetry devices and to the fact that, because ECG electrode cables attached to the patient’s body serve as antennae, there is generally a negative antenna gain associated with telemetry devices.¹²

The fact is, regardless of the source of attenuation, telemetry transmissions are generally attenuated by a factor of 20 dB. Moreover, as CCTG pointed out in its initial comments in this proceeding, permitting telemetry devices to operate in non-hospital Critical Care Facilities will accommodate trends in the medical community to discharge patients from hospitals to appropriate lower-level care facilities, notwithstanding the fact that many of these patients will continue to require monitoring.¹³

In this regard, it is important to emphasize that these devices are used in the context of the provision of critical care health care services. As CCTG noted in its initial comments, the medical telemetry systems manufactured by CCTG’s members are “prescription devices” that may not be sold in general commerce and whose labeling limits their use to healthcare facilities.¹⁴ Telemetry systems, moreover, are expensive and require special receive antenna installation. Accordingly, authorizing their use in non-hospital Critical Care Facilities would not lead to the indiscriminate, or even widespread, operation of these devices throughout the country.

For the foregoing reasons, permitting medical telemetry operations in Critical Care Facilities — whether or not such facilities are located within a hospital setting —

¹⁰ Id. at 11.

¹¹ Engineering Statement at 1-4.

¹² Id. at 2.

¹³ Comments of CCTG at 11.

¹⁴ See 21 USC 352(f)(1); 21 CFR 801.109.

will ensure that all patients requiring critical care monitoring will benefit from this life-saving technology without adversely affecting broadcast services.

D. The Current Out-of-Band Emissions Limit Is Overly Restrictive.

As CCTG noted in its comments in this proceeding, the limit for out-of-band emissions proposed in the NPRM is unnecessarily stringent. To provide telemetry users with a degree of additional flexibility and to facilitate the development of next generation telemetry systems, CCTG proposed that the limit be raised to 630 $\mu\text{V}/\text{m}$ at 3 m, a standard that still would result in the RF emission mask being more restrictive than that imposed on the vastly more powerful LPAS stations operating on the same frequencies.¹⁵ The adoption of such proposal, as noted in the attached Engineering Statement, will not jeopardize broadcast transmissions.¹⁶

In discussing applicable out-of-band limits, the NAB correctly notes that certain medical devices are exempt from Part 15 Subpart B limits on unintentional radiators.¹⁷ However, NAB's suggestion that this exemption encourages poor design practices on the part of telemetry system manufacturers is unfounded.¹⁸ Because a number of telemetry transmitters are often used simultaneously in close proximity to one another, minimizing spurious emissions by the transmitters has always been an important design consideration.

NAB's request, moreover, that the FCC impose strict unintentional radiation limits on all medical devices, rather than authorizing an increase in the allowable power for medical telemetry transmitters, does not address the problems that gave rise to this NPRM and the need for prompt relief. As CCTG has demonstrated repeatedly, adoption of the proposed rules is necessitated by severe congestion in non-broadcast frequencies used by medical telemetry and low-level ambient noise levels in the broadcast spectrum, noise that can be overcome by allowing telemetry devices to operate at increased power levels or field strengths.

¹⁵ Comments of CCTG at 10.

¹⁶ Engineering Statement at 10-11.

¹⁷ 47 C.F.R. § 15.103(e). This exemption is limited to medical devices used directly in supervised medical treatment, but does not apply to a large number of electronic devices used in hospitals and health care facilities.

¹⁸ Comments of NAB at 4.

E. Adoption of the Proposed Rules Will Not Jeopardize the Operation of LPAS, LPTV, TV Translators, Or TV Boosters.

The Society of Broadcast Engineers (“SBE”) and the Community Broadcasters Association (“CBA”) have raised concerns over the impact adoption of the proposed rules would have on co-channel separation distances for TV translators and boosters and LPTV stations.¹⁹ In its initial comments in this proceeding and in the engineering statement attached thereto, CCTG demonstrated that LPTV stations and, by analogy, TV translators would be protected from interference from medical telemetry.²⁰ CCTG analyzed the current use of spectrum by LPTV stations in the top three television markets in the United States and found that LPTV stations in these major markets do not make intensive use of available UHF channels. As such, there will be an adequate number of frequencies to accommodate medical telemetry in all metropolitan areas.

With respect to TV boosters, as set forth in the attached Engineering Statement, because the coverage area of a TV booster is required to be within the Grade B contour of the primary broadcast transmitter, no additional protection for the booster is required.²¹ The separation distances ensure that it will not suffer harmful interference.

F. Availability of Channel 37 Will Reduce Further Any Possibility of Harmful Interference To TV Broadcasts.

As discussed above, certain of the broadcast parties assert that CCTG has not demonstrated sufficiently that adoption of the proposed rules will not create harmful interference to broadcast transmissions, including to UHF facilities. While CCTG’s submissions in this proceeding do in fact make plain that mutual interference-free operation can be achieved, it also is important to note that, to the extent that UHF channel 37 is available for biomedical telemetry use in a given service area, the demand for other UHF channels in that service area will be reduced by one. Indeed, for health care facilities with only a small number of telemetry beds, no additional UHF channels may be needed.

¹⁹ Comments of SBE at 3-4; Comments of CBA at 1-3.

²⁰ Appendix A to CCTG Comments at 2-6.

²¹ Engineering Statement at 9-10.

II. **ADOPTION OF THE PROPOSED RULES WILL MEET THE NEAR-TERM NEEDS OF MEDICAL TELEMETRY**

A. **Medical Telemetry Devices Can Operate Effectively On Vacant Broadcast Frequencies.**

A number of parties suggest that medical telemetry systems cannot safely or successfully operate in the television bands, even if the proposed rules are adopted, and, by implication, that telemetry manufacturers and users do not understand the technical requirements of their own systems.²² These suggestions, however, fly in the face of a long history of telemetry operation on broadcast frequencies, CCTG's numerous submissions in this proceeding, and the weight of the comments filed in response to the NPRM.

Try as they may to persuade the Commission that CCTG's members are incapable of identifying for themselves a technical solution that satisfies their own operational needs, the broadcast parties cannot ignore the fact that hospitals for years have been using medical telemetry systems that successfully operate in the upper VHF band at power levels below those proposed in the NPRM. Unfortunately, as CCTG pointed-out in its Petition for Rule Making that prompted the NPRM, the level of ambient RF noise in health care facilities is becoming so high as to threaten the continued usefulness of the broadcast frequencies for telemetry operations.²³ Adoption of the proposed rules will allow telemetry devices to overcome such noise.

CCTG's members and health care personnel using telemetry systems have considered their operational requirements carefully, and CCTG initiated this proceeding only after ascertaining that adoption of the proposed rules would enable telemetry users to realize their near-term telemetry needs. The fact that telemetry systems have operated on broadcast frequencies in the past and, moreover, that the majority of the comments submitted in response to the NPRM support the expedited adoption of the proposed rules, is strong evidence that adoption of such rules will meet the near-term requirements of medical telemetry users.

B. **Adoption of the Proposed Rules Will Not Compromise Patient Safety.**

SBE states — without offering any support — that the primary objectives of the proposed rules “are to allow greater distances between a health care professional and

²² See, e.g., Comments of MSTV at 4-5.

²³ CCTG Petition for Rule Making at 4.

patients, and to allow an increase in the number of patients that a health care professional would be expected to simultaneously monitor.”²⁴ Such statement reveals a fundamental lack of understanding regarding telemetry operations.

Contrary to SBE’s assertion, the purpose of higher power operation is to assure continuous error-free reception of critical patient data in health care facilities. Such increased power is required to overcome ambient RF noise levels originating from multiple sources in and outside of such facilities, multipath fading, and signal attenuation caused, in part, by flexible transmit antennae attached to patients’ bodies. CCTG has made this purpose clear in each of its submissions in this proceeding.

Equally implausible is SBE’s cynical view that any cost savings resulting from adoption of the proposed rules would go not toward improving the overall level of health care or reducing patients’ medical expenses, but toward improving the “bottom line of these forms of health care facilities.”²⁵ Leaving aside what SBE means by “these form of health care facilities” (as medical telemetry is employed in most large hospitals in the country), SBE’s unsupported comments are at odds with the Commission’s repeated findings that medical telemetry operations advance an important public interest. As the Commission noted in the NPRM, use of telemetry allows patients to be ambulatory early in their recovery stages (thereby shortening recovery time and hospital stays) and permits one health care worker to monitor effectively several patients remotely.²⁶ These phenomena, the NPRM notes, decrease health care costs.²⁷

Accordingly, rather than compromising patient safety, adoption of the proposed rules will enhance patient safety by substantially reducing the likelihood that telemetry signals will suffer from harmful interference. This, in turn, will contribute to the viability of telemetry operations, operations that ultimately reduce health care costs. All of society shares in these benefits.

²⁴ Comments of SBE at 7.

²⁵ *Id.* at n. 2.

²⁶ NPRM at ¶ 2.

²⁷ *Id.*

III. CCTG AGREES THAT THE OPTIMAL SOLUTION IS TO ALLOCATE DEDICATED SPECTRUM FOR MEDICAL TELEMETRY

With the exception of SBE, none of the parties commenting on the NPRM question the life-saving importance of medical telemetry operations. Indeed, many regard these operations as so vital that they urge the Commission to consider dedicated spectrum for medical telemetry.²⁸ This is precisely the solution that CCTG has urged the Commission to adopt from the outset of this proceeding and, moreover, that Congress has directed the Commission and NTIA to consider.²⁹

Unfortunately, there appear to be no suitable frequencies at present that can be dedicated to medical telemetry's use. While the NAB suggests that medical telemetry operate above 900 MHz or in the 1-3 GHz bands,³⁰ these suggestions are unworkable for the reasons CCTG has discussed in detail in this proceeding. In short, the 900 MHz band already is severely congested and will become even less hospitable to Part 15 telemetry operations if the Commission's proposals in the "Reforming Proceeding"³¹ are ultimately adopted, as telemetry operations presently in the 450-470 MHz band may be forced to migrate to 900 MHz. Moreover, in light of medical telemetry's operational and design constraints (*i.e.*, the requirements of low-power, continuous transmission with lightweight transmitters to enable cardiac-compromised patients to move within rooms and corridors of health care facilities), telemetry systems must operate in portions of the spectrum well below 1 GHz with a minimum of intermittent or mobile users.

Until suitable dedicated frequencies are made available to telemetry operations, the critical needs of telemetry users can best be met by adoption of the proposed rules.

²⁸ See, e.g., Comments of MSTV at 5.

²⁹ The Conference Report to the Budget Act notes that "biomedical telemetry systems may greatly improve the quality and significantly decrease the cost of certain health care services," and that, therefore, "NTIA and the FCC should carefully consider the needs of hospitals and other health care providers for interference-free radio spectrum in their respective allocation decisions made pursuant to this Act." See Conference Report on the Omnibus Budget Reconciliation Act of 1993, 103d Cong., 1st Sess., Rpt. No. 103-213 (1993) at 479.

³⁰ Comments of NAB at 6.

³¹ Notice of Proposed Rulemaking, PR Docket No. 92-235 (1992).

CONCLUSION

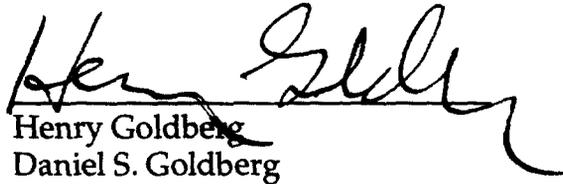
The majority of the parties commenting on the NPRM strongly support adoption of the proposed rules. While the broadcast parties have raised a number of technical concerns regarding the Commission's proposal, those objections — as demonstrated above and in the attached Engineering Statement — are without merit. The fact is, adoption of the proposed rules will meet the near term requirements of telemetry users without jeopardizing in any way current or planned broadcast operations.

While dedicated frequencies for medical telemetry would be the optimal solution to the spectrum crisis telemetry users presently confront and, moreover, would be consistent with Congress' directive to the Commission, suitable frequencies are not available at this time. Accordingly, to ensure that this life-saving technology and the patients that rely on its availability are not jeopardized, the CCTG urges the

Commission to adopt the proposed rules, consistent with CCTG's submissions regarding the NPRM, on an expedited basis.

Respectfully submitted,

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May 23, 1996

ENGINEERING STATEMENT

RUBIN, BEDNAREK & ASSOCIATES, INC.

COMMUNICATIONS ENGINEERING AND ECONOMICS

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ENGINEERING STATEMENT

The firm of Rubin, Bednarek & Associates, Inc. ("RBA") has been retained by the Critical Care Telemetry Group ("CCTG") to provide on its behalf technical support regarding the Federal Communication Commission's Notice of Proposed Rulemaking ("NPRM") in ET Docket 95-177. The NPRM proposes the amendment of Part 15 of the Rules to allow operation of Biomedical Telemetry Devices ("BTDs") in the frequency bands 174 - 216 MHz and 470 - 806 MHz (television channels 7 through 69) with a maximum power of 5 milliwatts.

A number of parties have raised certain technical objections to adoption of the proposed rules. Fundamentally, these parties assert that engineering studies offered in support of the proposed rules do not demonstrate that BTDs can operate on vacant television channels without creating harmful interference to both broadcast reception and telemetry operations. In this regard, they take issue with the methodology and technical assumptions underlying the engineering studies (including modulation techniques and signal attenuation factors), question the efficacy of the separation criteria, and raise concerns regarding the potential for interference to broadcast auxiliary facilities.

As discussed in detail below, however, these assertions and concerns are without merit. Moreover, based on established engineering practice, operation of BTDs in the proposed television band would not result in objectionable interference to other services operating on these frequencies.

Field Test Data

In their comments to the Commission, Maximum Service Television, Inc. ("MSTV") and the National Association of Broadcasters ("NAB") call into question the results of a field study conducted by CCTG. Specifically, the parties argue that the aforementioned tests do not show that a signal attenuation factor of 20 dB can be attributed to shielding due to the building structure. Therefore, they maintain, reliance should not be placed on a shielding factor in determining interference to television signals from BTDs. MSTV also states that insufficient information has been provided by CCTG regarding the units tested in its field study and, therefore,

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ENGINEERING STATEMENT (continued)

adequate conclusions cannot be drawn from the field data. Finally, MSTV suggests that a more reliable test program be undertaken.

As discussed more fully below, CCTG's field studies do indeed show that significant attenuation of telemetry signals occurs, both indoors and outdoors. Further, the test data support a signal attenuation factor of 20 dB. CCTG also did specify in its original filing all available information regarding the units tested. Lastly, as discussed later in this section, there currently exists additional body of data with respect to another existing service operating in the television band which can be used to augment CCTG's own tests.

CCTG, in its original filing, included field measurement data taken at four hospitals in the Washington, D.C. - Baltimore area. A description of the test procedure and test results were included in Appendix A of the Engineering Statement. The objective of the tests was to characterize the general field strength levels of the telemetry units under real life conditions. The tests included indoor and outdoor signal strength measurements of units being worn by patients at the hospitals. For reference purposes the signal level of nearby television stations were also recorded. Signal strength measurements of an unused unit were also taken at distances ranging between 1 to 3 meters. The make, model and the rated field strength levels of the units were recorded and are listed in Appendix A to the Engineering Statement.

For the tests, the antenna gain factors of the units could not be measured, since the units were being worn by the patients. In general, however, the radiators of BTDs worn by patients exhibit negative antenna gains. Measurements taken at distances less than 3 meters showed that the signal strength levels of the units tested were approximately 9.2 dB below the rated values. These latter tests demonstrate the typical efficiencies associated with such devices.

Measurements of the telemetry transmissions at the four hospitals showed that a great deal of scattering of the signal took place within the confines of the hospital

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ENGINEERING STATEMENT (continued)

buildings¹. However, in considering all the data taken, the tests showed that indoors, the signals from the telemetry units were on average below the predicted free-space levels by approximately 20 dB.

In order to determine the potential for interference to the reception of television signals outside of the hospital grounds, outdoor measurements of the telemetry signal were also taken. The results of these tests showed that the signal levels of the telemetry units were approximately 20 to 35 dB below predicted free-space values². In Suburban Hospital, no readings of the telemetry signal could be detected outside of the building.

With regard to the UHF television signal measurements, these were meant to serve as general reference with which the telemetry signal levels could be compared. The TV signal measurements taken are not as extensive as those for the telemetry units, since the thrust of the investigation was to determine the signal propagation characteristics of BTDs, not TV stations. It was not the intent of the tests to replicate the body of work done by other groups with respect to building attenuation. In general the field tests showed that whether due to shielding effects of the building or that of the human body on which the device is attached or the inefficiency of the units or a combination of all these factors, the signal levels indoors and, more importantly, outdoors were attenuated by an average of 20 dB when compared to free-space predictions.

¹ In its comments to the Commission regarding the NPRM, the NAB notes that the field test data taken at Calvert Hospital show that the indoor signal level for the telemetry unit operating on channel 10 was higher than that measured outdoors. This is most likely a result of the scattering of the signal inside from the internal architecture of the building and the furnishings therein. It should be noted, however, that for the specific cases cited by NAB, the indoor signal level for such telemetry unit was still below predicted levels by approximately 20 dB.

² In a "White Paper" published by Motorola, Inc. titled "Frequency Band Selection Analysis", February 21, 1996 and submitted to the Public Safety Advisory Committee, it is shown that based on measured data, the predicted building penetration loss at UHF frequencies (400-800 MHz) is approximately 15 to 17 dB and at VHF frequencies (170-220 MHz) is approximately 19 dB (see page 13 of "white paper"). In light of the field tests conducted in support of the proposed rules, the operating history of LPAS and the data compiled by engineers in the context of other services (e.g. the "white paper"), it is plain that BTD signals will undergo substantial attenuation.

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Contrary to MSTV's proposal, additional testing is not required. The tests conducted by CCTG accurately characterize the propagation characteristics of telemetry signals. However, an additional body of data exists which can be used to augment CCTG's own findings. These are contained in the current operation of LPAS. These stations are currently permitted to operate with greater powers than those specified in the NPRM at the proposed frequencies. Importantly, as noted in the NPRM, the Commission has not noted any significant increase in interference to other television stations from the operation of these stations³.

Distance Separation Criteria

NAB, in its comments to the Commission, implies that valid engineering has not been used in the calculation of the minimum separation distances with respect to other nearby television stations. Furthermore, it asserts that the potential for interference to the reception of an ATV signal would be increased if biomedical telemetry units were to operate on the TV channel's guard band.

As discussed more fully below, valid engineering methodology was utilized by CCTG in determining the minimum separation requirements to television stations. Moreover, the proposed separations would provide protection to the entire 6 MHz bandwidth of a television channel, whether NTSC or ATV.

In determining the minimum separation requirements to other cochannel television stations, the interference protection criteria contained in Section 74.705 of the Rules pertaining to the operation of LPTVs were employed. As specified in this section, a D/U ratio of 45 was considered to provide adequate protection to TV stations. Furthermore, no attenuation factor due to intervening obstructions was employed, and it was assumed that the protected television stations would be operating with the maximum facilities permitted under section 73.614 of the Rules. Using the Commission's methodology specified in section 73.684 of the Rules, the distance to the protected television contour and the BTD interfering contour were determined.

³ See *Notice of Proposed Rulemaking (NPRM)* in MM docket 86-12

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From these distances, a minimum distance separation criteria was derived. Validation of the protection criteria and the methodology used can be found in the current operation of low power television stations, that operate at power levels several magnitudes higher than that proposed for BTDs.

With respect to the operation of BTDs on ATV channel guard bands, the proposed separation requirements specified in the NPRM are intended to provide protection to other cochannel stations over their entire channel bandwidth, not just portions of it. The methodology used leads to separation requirements which are more stringent than those specified for LPAS in section 74.802 of the Rules. These stations are permitted to operate with much higher powers than those proposed for BTDs. Separation requirements with respect to television stations operating on first adjacent channels were not considered to be necessary, since as noted earlier the area of potential interference was determined to be small. Finally, just as television stations have to attenuate their signals at the band edges in order to protect other adjacent channel stations, BTDs would have to do the same. It is currently proposed that spurious signals from BTDs be attenuated by at least 50 dB with respect to its inband emissions. As discussed more later in this report, the proposed out-of-band emission requirements for BTDs are more stringent than those specified for LPTVs and would provide adequate protection to television stations operating on an adjacent channel. Accordingly, operation of biomedical telemetry units as proposed in the NPRM would not cause objectionable interference with the reception of ATV (or NTSC) television signals transmitted from other nearby stations.

Modulation Schemes

MSTV and the NAB, in their comments to the Commission, state that the proposed distance separation requirements specified in the NPRM are inadequate because the BTD transmissions employ modulation schemes different from those used for the transmission of television signals. MSTV suggests that each modulation scheme be evaluated separately.

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As discussed more fully below, because the proposed separation requirements were derived using NTSC-to-NTSC modulation technique, they are overprotective and, therefore, would provide more than satisfactory protection to nearby TV stations regardless of the modulation scheme used by BTDs.

At a television receiver, the severity of interference from one station to another is dependent on the level of the undesired signal with respect to that of the desired signal --- that is to say the desired to undesired ("D/U") signal ratio. In general, the required D/U level effectively decreases as the modulation schemes of the desired and undesired signals become increasingly different. The reason for this phenomena is that the amplitude demodulator inside a television receiver is less sensitive to frequency and phase modulation than to the intended amplitude modulations.

Currently, television stations transmitting in NTSC format employ a vestigial sideband modulation scheme, which is a type of amplitude modulation. Current FCC rules pertaining to the protection of full service television stations by Low Power Television ("LPTV") stations, specify that the level of a cochannel interfering signal utilizing NTSC type modulation must be at least 45 dB below that of the protected station employing the same type of modulation.

It should be emphasized that the modulation scheme employed with the transmitted signal has no effect on its propagation characteristics, contrary to the assertion of MSTV. Signal propagation is dependent on a number of factors including transmission frequency, terrain, atmospheric features and transmitted power -- not modulation.

In its engineering statement, MSTV cites the results of field tests conducted by the Advanced Television Test Center ("ATTC") in connection with the proposed ATV system currently under consideration by the Commission. Specifically, it notes the tests revealed that at the threshold of interference visibility, a D/U ratio of 48 dB corresponded to the case where the signal interfering with a NTSC television signal utilized 8VSB modulation. This is only 3 dB different from the 45 dB value specified in section 74.705 of the Rules. Such a close value would be expected,

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since 8VSB is a type of vestigial side band modulation which, although different from the current NTSC standard, is nevertheless a type of amplitude modulation, involving a discrete number of amplitudes --- rather than digital modulation.

It should be noted that MSTV has not indicated whether the subjective interference visibility criteria applied during the ATV field tests (and which correspond to the D/U level of 48 dB) are the same criteria the Commission considers to be acceptable under its current rules, with respect to NTSC-to-NTSC interference. The current NTSC co-channel (and adjacent channel) D/U ratios were based on subjective viewing tests conducted by the Television Allocation Study Organization (TASO). In determining the applicable D/U ratios the Commission used TASO's 6 level picture rating system. Level 3 was used as the baseline by the Commission and corresponds to the subjective determination that the NTSC picture is of acceptable quality and interference is not objectionable^{4,5}. In conducting subjective picture quality tests on the proposed ATV system, the 5 level CCIR grading scale was employed. A CCIR rating of 3, which corresponds to slightly annoying picture would approximate the TASO grade 3 rating. In its tests the Advanced Television Test Center (ATTC) used the CCIR rating 3 as its baseline threshold for a viewable picture. Neither MSTV nor NAB have provided the cochannel D/U levels measured during the ATV field tests which would correspond to a CCIR grade 3 NTSC picture. In the final technical report of the Advisory Committee on Advanced Television Service (ACATS), however, a D/U level of 34.44 dB corresponded with a CCIR grade 3 NTSC picture, when the cochannel interfering signal was that generated by the proposed ATV system⁶. This is approximately 10.5 dB better than the 45 dB value used by CCTG in its cochannel interference analysis.

⁴ Information on the TASO rating used by the Commission was obtained from Mr. Robert Bromery, chief of the FCC allocations and Standards Division, OET.

⁵ Gordon L. Fredendall and William L. Behrend, "Picture Quality - Procedures for Evaluating Subjective Effects of Interference"; Proceedings of the IRE, Volume 48, Number 6, Part I, pp. 1030-1034, June 1960.

⁶ Final Technical Report, Advisory Committee on Advanced Television Service, pp. 15, October 31, 1995.

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Currently most manufacturers of BTDs do not employ amplitude modulation but rather phase or frequency modulation for the transmission of their unit's telemetry signal. Consequently, it would be expected that the potential for interference from these devices to the signal of cochannel television stations would be reduced, since the required D/U ratio below which objectionable interference would be expected to occur would be less than the 45 dB value currently specified in the Rules.

In determining the minimum cochannel separation distances, it was assumed, however, that the BTD signal characteristics were exactly like that of an NTSC signal, a modulation scheme which is unlikely to be used by manufacturers of these devices and could be considered to correspond to a worst case interference condition. Accordingly, the corresponding D/U ratio of 45 dB was deemed to provide adequate protection to other cochannel television stations, even if BTDs were to utilize some type of amplitude modulation. Using this ratio, a minimum distance separation criteria was arrived at. As noted above, it is expected that for most current (and very likely future) BTDs, the D/U level at which objectionable interference to the reception of a cochannel television signal would be caused would be less than 45 dB. Hence, the proposed requirements specified in the NPRM are likely to be overly protective.

A similar procedure was employed in evaluating the potential for interference by BTDs to other television stations operating on first adjacent channels. To arrive at a worst case, albeit unrealistic scenario, it was assumed that tested BTDs employed a NTSC type transmission scheme, in which case the protection criteria contained in section 74.705 of the Rules could be applied. Under this section of the Rules, a D/U signal ratio of -6 dB was considered to provide adequate protection to other first adjacent channel stations operating in the VHF frequencies and -15 dB for those operating in the UHF frequencies⁷. As in the cochannel case, it would be expected that the D/U level at which objectionable interference would be caused to the reception of signals from television stations operating on first adjacent channels

⁷ In the Final Technical Report by ACATS, October 31, 1995, for adjacent channel ATV-into-NTSC interference a D/U ratio of -11 dB corresponds to an CCIR level 3 NTSC picture.