Industry Canada Industrie Canada

BPR, Part 6
Provisional
September 1999

Spectrum Management and Telecommunications Policy

Broadcasting Procedures and Rules

Part 6:
Application Procedures and Rules for Multipoint Distribution Television Broadcasting Undertakings (MDS-TV)

Contains the following Amendments:

Canada

Aussi disponible en français - RPR, partie 6

Table of Contents Page

SECTION A INTERNATIONAL AGREEMENTS

Multipoint Distribution Television Systems (MDS-TV) in the 2596 - 2686 MHz frequency band, that are within 80 km of the Canada/USA border, shall comply with the domestic criteria and the agreement of understanding between Canada and the USA. The terms of the agreement are contained in the document entitled ***"General FCC/Industry Canada Understanding Concerning the Coordination of the 2500 - 2686 MHz Band within 80 km (50 miles) of the USA/Canada Border"***, dated 1997. In certain border city locations, the number of channels available for use in Canada may be limited. In these areas, assignments may use parameters which differs from those set out in the General FCC/Industry Canada Understanding and will have to be coordinated.

SECTION B MULTIPOINT DISTRIBUTION TELEVISION BROADCASTING UNDERTAKINGS (MDS-TV) IN THE 2596 - 2686 MHz BAND

B-1 GENERAL

This procedure specifies the requirements for the certification of Digital and Analogue MDS-TV services.

The standard television channel is 6 MHz (refer to Table 1 in **APPENDIX 1**). Applications may be submitted for multiple channels to transmit analogue NTSC/M signals (one analogue program channel per 6 MHz) or a large number of digital program channels.

The licensing and the certification procedure are the same as that presently followed for other broadcasting undertakings, i.e., a license will be required from the CRTC and a broadcasting certificate from the Department (refer **BPR-1**, **Section 1**).

Conditions for the use of the band are contained in the ***Spectrum Utilization Policy SP 2500 MHz "Spectrum Utilization Policy for the Fixed and Broadcasting Services in the Band 2500 - 2686 MHz"***.

The 2596 - 2686 MHz band is allocated to several terrestrial and space services. The broadcasting service in this band has similar technical characteristics to that of the fixed services operating in the band 2500 - 2596 MHz (see document SRSP 302.5 ***"Technical Requirements for Stations in the Fixed Services Operating in the 2500 to 2686 MHz Band"***). The allocation and designation of channels for the broadcasting service is shown in Table 1 of **APPENDIX 1**.

The assignment of undertakings near the Canada/USA border is subject to the terms of the understanding with the Federal Communications Commission (FCC) in the USA (refer to **Section A**).

The Department will soon be issuing a document entitled ***"2500 MHz Multipoint Communications Systems, Policy and Licensing Procedures"*** to provide guidelines for the assignment of Multipoint Communication Systems (MCS).

B-2 DEFINITIONS

B-2.1 Power

The Effective Isotropic Radiated Power (EIRP) is equal to the transmitter power (in dBW) plus the gain (relative to isotropic) of the antenna minus any line losses due to the transmission line. The maximum effective isotropic radiated power (EIRP) at the beam tilt in any direction and for either vertical or horizontal polarization shall not exceed 32 dBW for each 6 MHz channel (–35.8 dBW/Hz).

B-2.2 Effective Antenna Height (EHAAT)

The effective antenna height above average terrain (EHAAT) is the height of the radiation centre of the antenna above the average terrain as averaged for eight radials. The average terrain is the average level of the ground elevation between 3 and 16 km from the transmitter as averaged for eight evenly spaced radials starting from true north.

B-2.3 Centre of Radiation above Ground Level (RCagl)

The Centre of Radiation of an antenna above ground level is the height of the antenna's radiation centre above the actual ground level on which the antenna structure is built.

B-2.4 Maximum Parameters

The maximum parameters of MDS-TV undertakings are an EIRP of 32 dBW and a EHAAT of 200 metres. A 200 m antenna will produce a radio horizon distance of about 70 km over smooth earth, when K = 4/3 and the receiving antenna height above ground is 9 metres using:

$$D = 4.12[\sqrt{Ht} + \sqrt{Hr}]$$

Where: D is the distance to the radio horizon in km
Ht is the height of the transmitter in metres
Hr is the height of the receiver in metres.

EHAATs above 200 metres will be considered as special cases.

B-2.5 Service Area

The service area is defined as the geographic area where an applicant intends to provide MDS-TV programming services to potential customers.

B-2.6 Coverage Area

The coverage area is the area where an MDS-TV undertaking provides actual MDS-TV services. The coverage area is limited by the estimated minimum field strength contour that provides an adequate MDS-TV service.

B-2.7 Gap Fillers

Gap fillers are secondary low power stations that provide local service to areas not adequately served by the main transmitter of the MDS-TV service. These areas can be between the coverage areas of two main stations or within the coverage area of a main station. Gap fillers can use horizontal or vertical polarization.

B-2.8 Coverage Extenders

Coverage extenders are secondary low power stations that extend the service of a main transmitter. Coverage extenders are located outside the coverage area of a main station. Coverage extenders can use horizontal or vertical polarization.

SECTION C PREPARATION OF TECHNICAL SUBMISSIONS SUPPORTING APPLICATIONS FOR MULTIPOINT DISTRIBUTION TELEVISION BROADCASTING UNDERTAKINGS (MDS-TV) IN THE 2596 - 2686 MHz BAND

C-1 APPLICATION REQUIREMENTS

C-1.1 Forms and Documents

All necessary information may be obtained from any of the Department's Regional Offices (Vancouver, Winnipeg, Toronto, Montreal or Moncton) or from the Departmental headquarters in Ottawa. All applications and related forms listed in **Section C-1.1.2** below, unless otherwise specified, shall be submitted to the Director, Broadcast Applications, Radiocommunications and Broadcasting Regulatory Branch, Industry Canada, 300 Slater Street, Ottawa, Ontario, K1A 0C8.

C-1.1.2 A complete technical submission shall include the following:

a) two copies of completed **Form IC-2374** ***"Notice of Retention of Broadcasting Engineering Consultant"*** advising the Department of the retention of a broadcasting engineering consultant in respect to technical design and brief preparation, should be submitted by the applicant prior to or with the filing of an application, (refer to **BPR-1**, **Section 1.2**),

b) two copies of completed application **Form IC-2671** "***Application For a Broadcasting Certificate Multipoint Distribution Television (MDS-TV) New Undertaking***" should be submitted when applying for new undertaking(s) and **IC-2672** "***Application for a Broadcasting Certificate Multipoint Distribution Television (MDS-TV) Change of Facilities***" for change of technical facilities for existing undertaking(s),

c) one copy of the **Form IC-2586** ***"Preliminary Environmental Information, Municipal/Land-Use Consultation and Aeronautical Site Clearance Attestation"*** reproduced in **BPR-1, APPENDIX 3**.

d) five copies of an engineering brief in suitable loose-leaf binders with identifying labels. The brief shall include all the detailed technical information as outlined in **Section C-2**.

e) one reproducible copy of a map showing the proposed coverage area (refer to **Section C-2.6** and **BPR-1**, **Section 3**) and another one showing the comparative coverage area for the change of facilities.

C-1.1.3 Three copies of Transport Canada (TC) **Form 26-0427** entitled ***"Aeronautical Obstruction Clearance Form"*** shall be completed. Topographic maps showing the elevation contours and the exact location of the antenna site as set forth in section 2 or **BPR-1** shall be attached. All shall be submitted directly to the Regional Office of TC for clearance. A copy of TC's letter of aeronautical approval shall be sent to Industry Canada.

Form 26-0427 is obtainable from the Regional Office of Transport Canada or Industry Canada.

C-2 ENGINEERING BRIEF

The order of material presented in the engineering brief shall be maintained as listed below to simplify processing in the Department. The metric system known as SI (Système International) shall be used throughout the engineering brief.

C-2.1 Title Page

This will show the submission title, type of undertaking proposed, name and address of applicant, name of broadcasting consultant, location of proposed broadcasting undertaking and submission date. In addition, the title page should indicate:

- **S** The frequency(ies) (channels)
- **S** The maximum and average effective isotropic radiated power (EIRP) at the beam tilt and the effective antenna height above average terrain (EHAAT)
- **S** The radiation centre above ground level (RCagl) and the radiation centre above sea level (RCasl) for every transmitting antenna within the service area[1] (**Section B-2.5**)
- **S** Geographical co-ordinates of every transmitting antenna within the service area[1] (**Section B-2.5**)
- **S** Polarization of every transmitting antenna within the service area[1] (**Section B-2.5**)
- **S** Offset information for analogue systems
- **S** Bandwidth and Emission designation (refer to **Section C-2.5**) for every channel used.

Note: The maximum or the average EIRP for the analogue systems refer to the envelope power at the peak of the synchronizing pulses of the television video signal. For digital systems, they refer to the average power in a 6 MHz digital channel.

C-2.2 Introduction and/or Purpose

This will consist of a general statement of the purpose of the brief relative to the application.

C-2.3 Transmitting Channel(s)

A brief description of the coordination to be conducted with other MDS-TV and MCS users (refer to **Section C-2.7**) of the area. The description should include any interference analysis undertaken for the coordination of the proposed service with other services.

For analogue systems, channels may be assigned with a frequency offset of 0, –10 or +10 kHz with respect to the nominal visual carrier frequency. Various densities of QAM and VSB modulation can be used for digital signals.

[1] New or modified installations only.

C-2.4 System-Description and Design

A description of the major components of the system, including a block diagram shall be provided.

For certain applications, the Department may require changes to the design to improve spectrum utilization.

C-2.5 Equipment

(a) Transmitting Antenna(s)

Non-directional or directional transmitting antennas may be used. The antenna(s) shall employ linear polarization. Either horizontal or vertical polarization may be used subject to any co-ordination restraints in the border zone with the USA (refer to **Section A**). Non-directional antennas are to have a horizontal radiation pattern with variations of less than ± 2 dB from a circular reference.

The planned coverage area may require one or more transmitting sites. For every transmitting site, the antenna specification shall include the type, manufacturer, polarization, average and maximum gains (relative to an isotropic antenna) and the radiation pattern in the horizontal and vertical planes.

To improve the spectrum utilization, the Department may require the use of directional antennas.

(b) Transmitting Equipment

The transmitter used shall be such that the resulting emissions have the following characteristics:

(i) Analogue MDS-TV Services (NTSC Standard)

The harmonics of the emitted visual and aural carriers shall be attenuated at least 60 dB below the level of the visual peak power output. All other emissions appearing on frequencies outside its channel bandwidth, shall be attenuated at least 40 dB at the edges of the band falling linearly to 50 dB at frequency separation of 0.5 MHz and 1.0 MHz beyond upper and lower band edges respectively and 50 dB thereafter, with the exception that intermodulation products at ± 920 kHz and + 2.66 MHz, with respect to the visual carrier shall be attenuated at least 46 dB below the visual peak output emitted power.

The visual carrier frequency shall be maintained to ± 500 Hz of its assigned frequency.

The Department may consider an application for analogue service, proposing the use of a transmitter which has a reduced frequency tolerance, providing the rated visual power of the transmitter does not exceed 5 W per 6 MHz channel. However, in case of interference to other undertakings, or when a better channel utilization is needed, the equipment shall be upgraded to meet the ± 500 Hz standard frequency tolerance. In the case of analogue NTSC transmissions within 80 km of the Canada/USA border, the transmitter(s) shall meet the standard frequency stability (within ± 500 Hz) to permit offset frequency assignments.

(ii) Digital MDS-TV Services

For digital MDS-TV services, the Department requires that out-of-band emissions of the highest and lowest channels used in the multichannel system comply with the spectral mask of Figure 1 of **APPENDIX 2**. In addition, to achieve a uniform spectrum across the channel, the digital signal input must be suitably randomized before being modulated. Energy dispersal shall ensure that substantially uniform power spectral density across the occupied bandwidth (within 3 dB from the average) of the signal.

The Department requires a commitment from the applicant that the proposed equipment will be in compliance with the relevant requirements above relating to the spectrum of the emitted field and the frequency tolerance. Furthermore, following the implementation of the MDS-TV service, the operator shall perform the necessary measurements to verify compliance with the above provisions. The operator should keep the measurement data for future reference.

(c) Transmission Lines - Antenna line specifications shall be supplied including manufacturer, type, length and loss in dB. When combiners/filters are used, any loss resulting from the use of these components shall be included.

(d) Down Converters - Emissions in the aeronautical frequency bands 108 - 137 MHz and 332.6 - 335.4 MHz should be avoided. However, if the above bands are used by the down converter, emissions in these bands should be controlled. The use of these bands is regulated by the provision of Section 17 of Radiocommunication Regulations**.** Section 17 stipulates that explicit authorization is required from Industry Canada before these frequencies are used, and that they must be used subject to and in accordance with all conditions specified in the system's broadcasting certificate. The purpose of these conditions is to protect aeronautical radionavigation and radiocommunication signals. ***The conditions for authorization and use of these frequencies are under development at Industry Canada .***

(e) Modulation - For digital systems, a description of the type of modulation (QAM, VSB, etc) shall be provided. Emission designators are 6M00D7W for QAM and 6M00C7W for VSB

(f) MDS Receivers - The technical standards and requirements for radio apparatus capable of receiving MDS-TV broadcasting are in **Section 3.6** (Supplementary Television Broadcasting Receiving Apparatus) of ***Broadcasting Equipment Technical Standard no. 7 (BETS-7)***.

C-2.6 Coverage Area Map

A map showing the estimated coverage area (as per **Section B-2.6**) shall be submitted.

C-2.7 Interference Analysis

The EIRP and the antenna height should be selected such that the power flux density produced at the edge of the service area does not exceed –80 dBW/m^2 (66 dBµV/m) using the free-space propagation model.

$$pfd(dBW/m^2) = 10\log\frac{EIRP}{4\pi D^2}, \qquad EIRP = 1.64\times ERP$$

Where: EIRP is the power relative to an isotropic radiator in Watts at the azimuth of interest,
ERP is the power relative to a dipole in Watts at the azimuth of interest,
The EIRP and ERP for analog systems refers to the envelope power at the peak of the synchronizing pulses of the television video signal. In the case of digital systems, the ERP or EIRP values refer to the average power in a 6 MHz digital channel;
D is the distance in metres.

For the purpose of this analysis, the expression “services in the same and adjacent areas” means all existing MDS-TV/MCS services and, holders of CRTC licences who are in the process of implementing services. Services in the same area refers to MCS services. Whereas services in the adjacent area refers to MDS-TV and MCS services.

Applicants of MDS-TV services shall coordinate their proposal with the services in the same and adjacent areas. The Department is prepared to accept applications for MDS-TV undertakings provided that there is an agreement between the parties involved.

The Department recognizes that the power flux density limit at the border of the service area does not always provide interference free service when coverage is considered near the border between adjacent service areas. When service implementation near the border of the service area is contemplated, it is required that MDS-TV operators/applicants coordinate coverage objectives among themselves.

MDS-TV undertakings that intend to make service implementations based on a change of facilities (increase of antenna height or EIRP) or higher densities of modulation should coordinate with the services in the same and adjacent areas. Such implementations shall provide the new parameters and a map outlining the new coverage.

For QAM or VSB modulation, an increase in density will result in an increase in program capacity but a reduction of coverage for the same emitted power. Also, higher densities require higher C/I ratios for protection. Proposals to increase the density of an existing undertaking will be approved provided that the undertaking continues to protect services in the same and adjacent areas, and conversely, services in the same and adjacent area will not be required to take measures to protect the new coverage.

Where MDS-TV coverage is hampered by natural obstructions such as hills, wooded areas, etc, coverage extender and gap fillers transmitters may be used to meet coverage objectives. The applicant shall coordinate the addition of these transmitters with the services in the same and adjacent areas if the proposal does not meet the conditions of **Section C-2.9**.

All existing MDS-TV undertakings in the adjacent areas to the proposed MDS-TV service and all Multipoint Communication Services (MCS) on channel D4 in the same and adjacent areas shall be considered for coordination. Co-sited MCS operations on channel D4 with similar operating parameters to those of MDS-TV do not need coordination.

In all case, the technical details of any agreement shall be submitted to the Department for consideration and approval.

In case of disagreement among the parties involved, the Department may use the criteria in **APPENDIX 2** to resolve the problem. It is to be noted that the technical assumptions in **APPENDIX 2** are made to facilitate coordination among various services. These assumptions do not guarantee interference free reception within any coverage area.

The criteria for interference analyses relative to US assignments near the Canada/USA border are described in the Canada/US Understanding (refer to **Section A**). Where the protected contour crosses the Canada/USA border, or extends over a domestic body of water, that portion of the border or the shore line lying within the contour shall be treated as the protected contour.

C-2.8 Special Analysis and Commitments

C-2.8.1 Relative to Interference to Other Broadcasting Undertakings

Analysis shall be submitted with appropriate commitments made in regard to all potential interference situations with other broadcasting undertakings as a result of the operation of the proposed MDS-TV facility. The following are some examples of interference possibilities with other broadcasting services that shall be explored:

(a) Ghost reflections of television signals from the new MDS-TV antenna structure(s) (refer to **Section C-7**, **BPR-4)**;

(b) Distortion of AM radiation patterns by the new MDS-TV tower(s) located in the vicinity of an AM antenna array.

C-2.8.2 RF Exposure Analysis

The applicant shall provide an RF exposure analysis (refer to **BPR-1, Section 8.2**).

C-2.8.3 Environmental Assessment

The applicant shall comply with the requirements of the environmental assessment procedure of **BPR-1, Section 8.1**.

C-2.8.4 Notification to Municipalities/Land-Use Authorities

The applicant shall notify the municipalities/land-use authorities. The applicant shall submit a completed copy of the ***"Preliminary Environmental Information, Municipal/Land-Use Consultation and Aeronautical Site Clearance Attestation"*** reproduced in **BPR-1, APPENDIX 3.**

An applicant for a new MDS-TV undertaking or for changes to an existing undertaking shall submit a notice to the local municipality(ies) where transmitters are located stating his or her intention to operate an MDS-TV undertaking in the area. The purpose of this notice is to provide the municipal authority with an opportunity to consider the implication of the proposed antenna structure(s) and site. The municipal authority may file a written objection to the proposed facilities with the appropriate Departmental District Office. The applicant and the municipal authority shall resolve all municipal problems and objections. Failing this, the Department will consider all factors pertaining to the application, as well as the municipal comments, and render a final decision.

C-2.8.5 Notification to the CRTC

The applicant shall submit a map showing the coverage (refer to **Section B-2.6**) of all individual transmitters within the service area. The coverage may be calculated using the values of protected contours and the field strength prediction method described in **APPENDIX 2**.

C-2.9 Gap Fillers and Coverage Extenders

A detailed engineering brief (as per **Section C-1.1.2 d**) is not required for gap fillers and coverage extenders that produce less a than –115 dBW/m^2 (31 dBµV/m) at the edge of the service area using the free-space propagation model. However, the applicant shall notify to the Department the operating parameters of the low power station that conforms to the above condition and provide a map showing the estimated coverage. The required parameters for notification are listed in **Section C-2.1**. In addition, for coverage extenders, a copy of this notification shall also be sent to the service providers in the adjacent service areas. Gap fillers and coverage extenders are subject to all applicable analyses and commitments under **Section C-2.8** above.

All gap fillers and coverage extenders within 80 km from the Canada/US border are subject to the provisions of the Canada/US Understanding.

C-3 DATA USING EXCESS CAPACITY

MDS-TV broadcasting undertakings wishing to transmit data using the excess capacity of the individual digital channels shall submit a description of the data to the Department for an amendment to the broadcasting certificate. If the data service is intended for the reception of the general public, an approval is required by the CRTC.

In addition to broadcast related applications, the excess data capacity may be used for communication services. Data communication using excess capacity is authorized under the *Radiocommunication Act* and *Radiocommunication Regulations* and is subject to the applicable authorization fee and to any requirements under the *Telecommunications Act*.

APPENDIX 1
MDS-TV CHANNEL ALLOCATIONS

Normal Channel Freq.	Channel No.
2596-2602	E1
2602-2608	F1
2608-2614	E2
2614-2620	F2
2620-2626	E3
2626-2632	F3
2632-2638	E4
2638-2644	F4
2644-2650	G1
2650-2656	H1
2656-2662	G2
2662-2668	H2
2668-2674	G3
2674-2680	H3
2680-2686	G4

Table 1: Channel Designations

Note 1: For analogue systems, a frequency offset channel may be designated by the addition of a “+”, e.g. E1+.

Note 2: The frequency offset of an analogue channel is +10 or –10 kHz with respect to the normal channel visual carrier frequency.

APPENDIX 2
ASSIGNMENT CRITERIA

General Assumptions

This appendix contains the technical requirements for the establishment of multipoint distribution television broadcasting undertakings (MDS-TV Broadcasting) in the 2596 - 2686 MHz frequency band. These requirements are intended to be used in conjunction with the document on Spectrum Utilization Policy SP 2500 MHz *"Spectrum Utilization Policy for the Fixed and Broadcasting Services in the Band 2500 - 2686 MHz"*.

Technical Parameters

Typical Receiver Characteristics

Protection and assignment criteria are based on the following assumptions concerning the minimum characteristics of the receiving system:

Antenna gain for edge-of-coverage sites:	22 dBi
Antenna horiz. pattern 3 dB beamwidth:	12°
Antenna front-to-back ratio:	28 dB
Orthogonal polarization discrimination:	26 dB in the main beam and 7 dB at other azimuths
Down-converter[2] noise figure:	3 dB for analogue 1.5 dB for digital

It should be noted that the above antenna characteristics are the same as the ones in *"General FCC/Industry Canada Understanding Concerning the Co-ordination of the 2500 - 2686 MHz Band"* shall be used (refer to **Section A**).

Protection of the Service Area

When applicants and/or incumbents cannot agree on mutually acceptable protection criteria (**Section C-2.7**), the Department may intervene to resolve potential interference problems. The resolution may be based on the following assumptions.

S An unobstructed, line-of-sight propagation path between transmitting antenna and receiver is normally necessary. For the purpose of protection, the field strength value of the service contour, at 9 m above ground, delimiting the coverage area is to be provided by the applicant (as per **Section B-2.6**), including the percentage of time that the field strength level will be exceeded. Examples of service contour values for the protected service area are given in the table below. Protection may only be afforded to unobstructed line-of-sight locations up to a distance of 70 km from any transmitting antenna.

[2] Refer to **Section C-2.5 (d)** for the frequency bands that need to be avoided by down converters.

Protected field strength Contour (dBμV/m)	Modulation
66	NTSC
35	16-QAM/4-VSB
42	64-QAM/8-VSB
48	256-QAM/16-VSB

Table 1: Typical Protected Service Contours

S Protection ratios depend on the type of receiving equipment supplied by the provider of the MDS-TV service. It is therefore difficult to specify a single set of D/U field strength ratios (at 9 m above ground) to cover all the possible variations of MDS-TV emissions. Moreover, D/U ratios depend on cross-polarization and directional characteristics of the receiver antenna. Instead, radiofrequency carrier to interference C/I ratio are specified at the input terminals of a typical receiver setup located at the protected contour of the undertaking are used. The C/I ratios for various combinations of digital and analogue services are as follows:

Channel relationship	C/I RATIO (in dB)	
	No offset	Offset
Co-channel - analogue into analogue	+45	+28
Adjacent Channel - analogue into analogue	0	0

Table 2: Analogue Systems

Channel relationship	C/I RATIO (in dB)
Co-channel - digital into digital	29
Adjacent - digital into digital	-11

Table 3: Digital Systems

Channel relationship	C/I RATIO (in dB)
Co-channel - analogue into digital	29
Co-channel - digital into analogue	45
Adjacent - analogue into digital	–11
Adjacent - digital into analogue	0

Table 4: Mixed Systems

Note 1: When the desired signal is analogue, the C/I ratio is to be applied at the input of the analogue NTSC/M receiver. When the desired signal is digital, the C/I ratio is to apply at the down converter entry point.

Note 2: The co-channel C/I ratios in the tables above for digital systems are theoretical. The adjacent channel ratios are derived from the co-channel ratios and the emission mask of the present appendix (Figure 1).

– Interference can be calculated by using the following relationship:

$F_D - F_U + G_D + XPD + FOA \geq C/I$

Where:

F_D = The desired field strength in dBµV/m

F_U = The undesired field strength in dBµV/m

G_D = Receiver antenna discrimination in dB

XPD = Orthogonal polarization advantage in dB when orthogonal polarization is used

FOA = Frequency off-set advantage (analogue only) in dB

C/I = Carrier to interference ratio in dB as per the above tables

– The calculation of the service contour and the interfering field strength may be based on CRC-PREDICT 2.08. The program takes into account the system parameters and the actual topography. The curvature of the earth is to be K = 4/3. The estimate of the service contour should be based on 90 % of the time for digital and 50 % of the time for analogue. Whereas, the interfering field strength should be based on 10 % of the time. Other recognized methods may also be used to predict the location of the protected contour. The height of the receiving antenna is normally 9 m above ground.

Digital MDS-TV Service Contour

The Digital MDS-TV coverage (the location of the service contour) depends upon the digital modulation scheme used. For example, 16-QAM digital modulation with appropriate Forward Error Correction (FEC), the Threshold Of Viewing (TOV)[3] is typically 17 dB to 22 dB above the receiver noise threshold at the down converter entry point.

The TOV will increase with increased digital modulation schemes such as 64-QAM and 256-QAM, or their VSB equivalents. Based on current information, the median digital MDS-TV receiver TOV is derived as per Table 5.

Digital Modulation Type	Median Receiver Threshold Of Viewing (TOV)
16-QAM / 4-VSB	17 dB
64-QAM / 8-VSB	24 dB
256-QAM / 16-VSB	30 dB

Table 5: Typical Receiver Threshold of Viewing Levels

The power of the Receiver Noise Threshold (N_T) in dBm is[4],

$$N_T = -114 + 10\log IF_{MHz} + N_F \qquad (1)$$

where,"IF_{MHz}" is the receiver IF bandwidth in Megahertz assumed to be 6 MHz based on the information received to define the digital Spectral Mask (see the present appendix), and "N_F" is the receiver Noise Figure in dB.

Digital MDS-TV manufacturers' equipment specifications show the typical receiver or down convertor N_F to be 1.5 dB.

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[3] Digital TOV is equivalent to Analogue Carrier to Noise Ratio (CNR). Typical CNR for analogue MDS-TV receiver is 43 dB.

This TOV value allows a viewed CCIR Grade 4 picture value which corresponds to "perceptible but not annoying" impairment.

Also called Threshold of Visibility in the United States of America.

[4] "Engineering Considerations for Microwave Communications Systems", GTE Lenkurt Incorporated, 1972, page A3.

Substituting the appropriate values into equation (1) yields,

$$N_T = -114 + 10\log 6 + 1.5 = -105\ dBm \quad (2)$$

The required signal level at the Digital MDS-TV Receiver is defined as,

$$V = N_T + TOV \quad (3)$$

The required field strength to meet the derived required signal level of Equation 3 is a function of the receive antenna gain, per

$$E = V + K \quad (4)$$

where, “E” is the field strength in dBµV/m, “V” is the required signal level and “K” is the Antenna Factor.

The Antenna Factor is defined as,

$$K = 20\log F_{MHz} - AntennaGain_{dB} - 30 \quad (5)$$

where, “F_{MHz}” is the antenna receive frequency which is considered to be the median of the MDS-TV band of 2596 to 2686 MHz or 2640 MHz and “$AntennaGain_{dB}$ ” is the receive antenna gain in dB.

Digital MDS-TV manufacturers equipment specifications show the typical receive antenna gain to be 22 dBi.

Substituting the appropriate values into Equation 5 yields,

$$K = 20\log 2640_{MHz} - 22 - 30 = 16 dB/metre \quad (6)$$

For 16-QAM/4-VSB, 64-QAM/8-VSB and 256-QAM/16-VSB digital modulation.

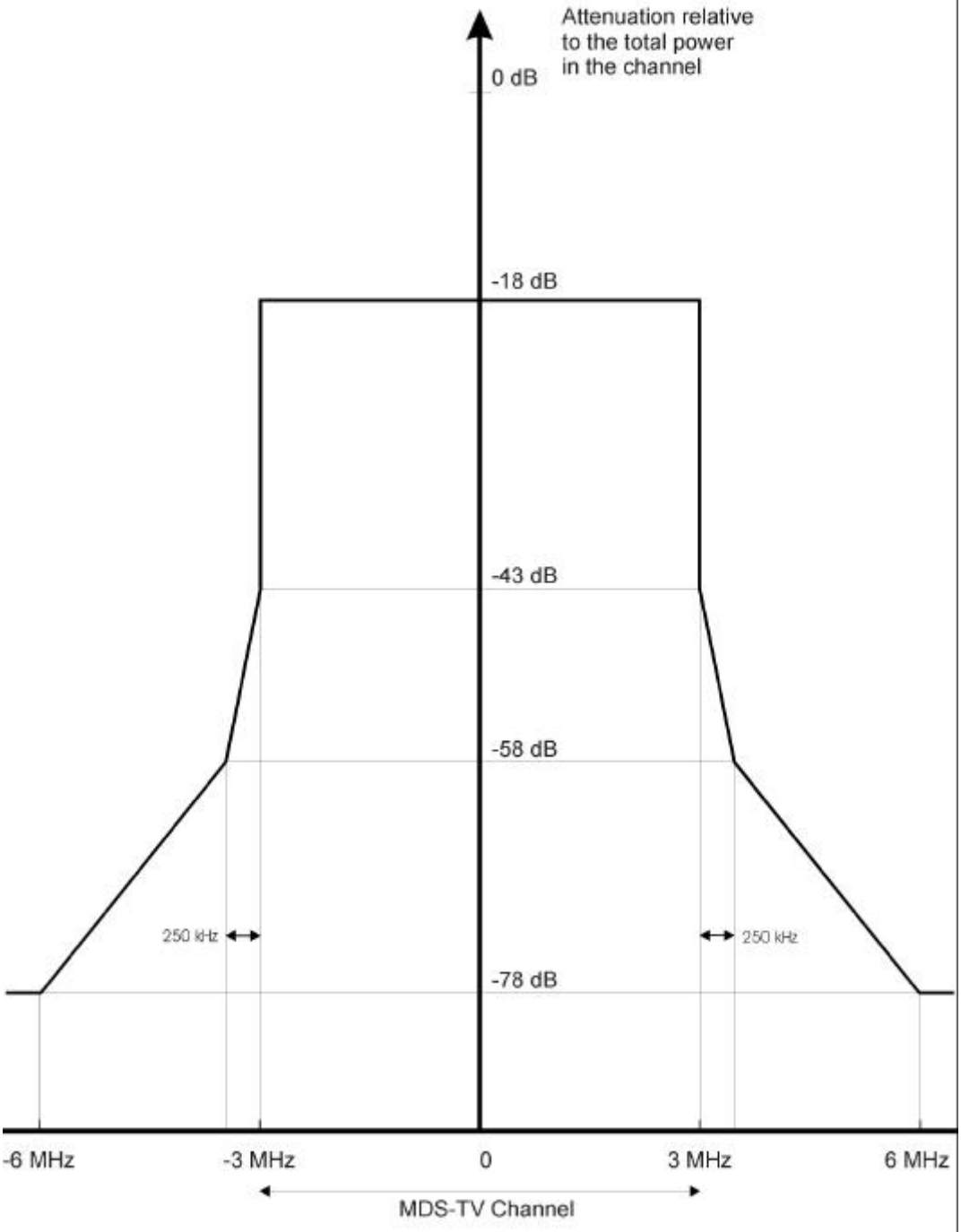
$$\begin{aligned} E_{16-QAM} &= V + K \\ &= N_T + TOV_{16-QAM} + K \\ &= -105\ dBm + 17\ dB + 16\ dB/m \\ &= -72\ dBm/m \\ &= -72\ dBm/m + 107 \\ &= 35\ dB\mu V/m \end{aligned} \tag{7}$$

$$\begin{aligned} E_{64-QAM} &= V + K \\ &= N_T + TOV_{64-QAM} + K \\ &= -105\ dBm + 24\ dB + 16\ dB/m \\ &= -65\ dBm/m \\ &= -65\ dBm/m + 107 \\ &= 42\ dB\mu V/m \end{aligned}$$

$$\begin{aligned} E_{256-QAM} &= V + K \\ &= N_T + TOV_{256-QAM} + K \\ &= -105\ dBm + 30\ dB + 16\ dB/m \\ &= -59\ dBm/m \\ &= -59\ dBm/m + 107 \\ &= 48\ dB\mu V/m \end{aligned}$$

Figure 1

Spectral Mask for the Digital MDS-TV Channel



Note: The attenuation is relative to the total power in the 6 MHz digital channel
Resolution Bandwidth = 100 kHz