Project	IEEE P802.16 Broadband Wireless Access Working Group		
Title	Technical Requirements for Local Multipoint Communication Systems (LMCS) Operating in the Band 25.35 – 28.35 GHz		
Date Submitted	22 June, 1999		
Source	Douglas Sward Industry Canada 300 Slater Street Ottawa, Ontario K1A 0C8 Canada	Voice: Fax: E-mail:	+1 613 990 4700 +1 613 952 5108 sward.doug@ic.gc.ca
Re:	Call for Contributions on Co-existence, posted on the 802.16 web site on June 21, 1999. Specifically, this document deals with inter-system coordination process and parameters.		
Abstract	This document is the draft Standard Radio System Plan (SRSP) for Local Multipoint Communication Systems (LMCS) in the band 25.35 – 28.35 GHz. The document addresses the Canadian frequency block arrangement, technical requirements, including maximum transmitter power, maximum effective isotropically radiated power (e.i.r.p.), maximum e.i.r.p. density, as well as inter-system coordination process and parameters.		
Purpose	To assist in the determination of appropriate co-existence criteria for LMCS/LMDS systems.		
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June 21, 1999

Spectrum Management and Telecommunications Policy

Standard Radio System Plan

Technical Requirements for Local Multipoint Communication Systems (LMCS) Operating in the Band 25.35 - 28.35 GHz

1. Intent

1.1 This Standard Radio System Plan (SRSP) states the minimum technical requirements for the efficient use of the frequency band 25.35 - 28.35 GHz for Local Multipoint Communication Systems (LMCS).

1.2 This SRSP is intended to be employed in the design and specification of radio systems and equipment.

1.3 This SRSP specifies equipment characteristics relating to efficient spectrum usage only, and is not to be regarded as a comprehensive specification for equipment design and/or selection.

2. General

2.1 Revision of this SRSP will be made as required.

2.2 Radio systems conforming to these technical requirements will be given priority in licensing over non-standard radio systems operating in this band.

2.3 The arrangements for non-standard systems are outlined in SP-GEN, *General Information Related to Spectrum Utilization and Radio Systems Policies*.

2.4 Even when a radio system conforms to the requirements of this SRSP, modifications may be required to the system whenever it causes harmful interference[1] to other radio stations or systems.

2.5 When potential conflict between radio systems cannot be resolved by the parties concerned, Industry Canada should be advised. After consultation with the parties concerned, Industry Canada will determine what modifications must be made and establish a schedule for these modifications in order to resolve the conflict.

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1 For the purpose of this SRSP, harmful interference means interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with regulations and technical requirements laid down by Industry Canada under the *Radiocommunication Act*.

2.6 Industry Canada may require licensees and/or applicants to use receiver selectivity characteristics that provide rejection of harmful interference.

2.7 It should be noted that the fixed terrestrial service shares this band with other services in accordance with the *Canadian Table of Frequency Allocations* and spectrum utilization policies.

2.8 Licensees will be expected to respect the International Telecommunication Union (ITU) *Radio Regulations* pertaining to the 25.35 - 28.35 GHz band and abide by any future arrangements/agreements established with other countries.

2.9 Industry Canada will require applicants and/or licensees to cooperate in the selection and use of the assigned frequencies in order to minimize interference, thereby obtaining the most effective use of the authorized spectrum.

2.10 LMCS implementations will require the equipment to be type approved in accordance with RSS-191.

2.11 Licensees are required to make available to Industry Canada, upon request, information on certain technical parameters of their hub and point-to-point stations.

1. Related Documents

3.1 The current issues of the following documents are applicable:

3.1.1 **Spectrum Utilization Policy GEN (SP-GEN)** - *General Information Related to Spectrum Utilization and Radio System Policies*

3.1.2 *Local Multipoint Communication Systems (LMCS) in the 28 GHz Range: Policy, Authorization Procedures and Evaluation Criteria*

3.1.3 *Policy and Licensing Procedures for the Auction of the 24 and 38 GHz Frequency Bands*

3.1.4 **Telecommunications Regulation Circular (TRC) 43** - *Notes Regarding Designation of Emission (Including Necessary Bandwidth and Classification), Class of Station and Nature of Service*

3.1.5 **Radio Standards Specification (RSS) 191** - *Local Multipoint Communication Systems at 28 GHz and Point-to-Point and Point-to-Multipoint Systems at 24 and 38 GHz*

3.1.6 **Client Procedures Circular (CPC) 2-1-16** - *Licensing Procedure for Local Multipoint Communications Systems (LMCS)*

3.1.7 **Client Procedures Circular (CPC) 2-0-03** - *Environmental Process, Radiofrequency Fields and Land-Use Consultation*

3.1.8 **Safety Code 6** - *Limits of Exposure to Radio frequency Fields at Frequencies from 10 kHz - 300 GHz*, available on the Internet at the Health Canada web site: http://www.hc-sc.gc.ca

3.1.9 *Canadian Table of Frequency Allocations*

3.1.10 Associated documents addressing coordination process for broadband fixed wireless systesms in the 24 GHz, 28 GHz, and 38 GHz bands are available on

the Radio Advisory Board of Canada (RABC) website:
http://www.rabc.ottawa.on.ca

3.2 Unless otherwise stated, the above documents are available electronically on the Internet at Industry Canada's web site: http://strategis.ic.gc.ca/spectrum.

2. Radio Frequency Block Arrangement Description

4.1 The band 25.35 - 28.35 GHz is divided into frequency blocks[2] of 500 MHz each and designated as follows:

Block A	27.85 - 28.35 GHz
Block B	27.35 - 27.85 GHz
Block C	26.85 - 27.35 GHz
Block D	26.35 - 26.85 GHz
Block E	25.85 - 26.35 GHz
Block F	25.35 - 25.85 GHz

4.2 In accordance with the publication entitled *Local Multipoint Communication Systems (LMCS) in the 28 GHz Range: Policy, Authorization Procedures and Evaluation Criteria*, Blocks C to F are reserved for future LMCS licensing.

4.3 LMCS providing interactive or two-way services will operate both forward and return communications links within the assigned block(s) of spectrum.

3. Technical Requirements

5.1 The transmitter power into the antenna must not exceed +10 dBW per carrier.

5.2 The effective isotropically radiated power (e.i.r.p.) density shall not exceed +30 dBW/MHz for subscriber stations, and +14 dBW/MHz for hubs. The maximum e.i.r.p. of a transmit station must not exceed +55 dBW per carrier.

5.3 In addition, international and domestic technical requirements for the use of the 25.35 - 27.5 GHz band by LMCS systems are as described in Appendix A.

6. Inter-System Coordination

6.1 Usage of the band 27.35 - 28.35 GHz near the Canada/U.S. border area is subject to the provisions of the *Interim Arrangement Concerning the Sharing between Canada and the United States of America on Local Multipoint Communication Systems / Local Multipoint Distribution Service and Other Systems in the Fixed Service in Parts of the Frequency Bands 27.35 - 28.35 GHz, 29.1 - 29.25 GHz, and 31.0 - 31.3 GHz*, included as Appendix B to this document.

6.2 Coordination is required between licensed service areas where the shortest distance

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[2] For the purpose of this SRSP, a frequency block is defined as a contiguous portion of spectrum a frequency band, typically assigned to a single operator. A frequency block may accommodate one or more channels. A channel is defined as a specified portion of the radio frequency spectrum which carries a specific radio signal.

between the respective service boundaries is less than[3] 60 km. Operators are encouraged to arrive at mutually acceptable sharing agreements that would allow for the provision of service of each licensee within its service area to the maximum extent possible.

6.3 In circumstances where a sharing agreement between operators does not exist or has not been concluded, and whose service areas are less than 60 km apart, the following coordination process shall be employed:

6.3.1 LMCS operators are required to calculate the power flux density (pfd) at the service area boundary of the neighbouring service area(s) for the LMCS transmitting facilities. Power flux density is calculated using accepted engineering practices, taking into account such factors as propagation loss, atmospheric loss, antenna directivity toward the service area boundary, and curvature of the Earth. The pfd level at the service area boundary shall be the maximum value for elevation points up to 500 m above local terrain elevation. (See Appendix D for a sample calculation of a pfd level.)

6.3.2 Deployment of facilities which generate a pfd less than or equal to -114 dBW/m^2 in any 1 MHz (pfd A) at the other LMCS service area boundaries are not subject to any coordination requirements.

6.3.3 Deployment of facilities which generate a pfd greater than pfd A (-114 dBW/m^2 in any 1 MHz), but less than or equal to -94 dBW/m^2 in any 1 MHz (pfd B) at the other LMCS service area boundaries, are subject to successful coordination between the affected licensees in accordance with the following coordination process:

6.3.3.1 The operator must notify the respective licensee(s) of its intention to deploy the facility(ies) along with the appropriate information necessary to conduct an interference analysis.

6.3.3.2 The recipient of the notification must respond within 30 calendar days to indicate any objection to the deployment. Objection may be based on harmful interference to existing systems[4] only.

6.3.3.3 If there is no objection raised, then the deployment may proceed.

6.3.3.4 If an objection is raised, the respective licensees must then work in collaboration to develop a suitable agreement between the licensees before the deployment of facilities. It is expected that the time frame to develop such an agreement should not exceed 30 calendar days.

6.3.3.5 Proposed facilities must be deployed within 120 calendar days from the conclusion of coordination, otherwise coordination must be reinitiated as per section 6.3.

6.3.4 Deployment of facilities that generate a pfd greater than -94 dBW/m^2 in any 1 MHz (pfd B) at the other LMCS service area boundaries are subject to successful coordination between the affected licensees.

6.3.5 The above process is described graphically in Appendix C of this document for

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3 In the event an operator uses sites of very high elevations relative to local terrain that could produce interference to LMCS service areas beyond 60 km, this operator shall coordinate with the affected licensee(s).

4 Existing systems include systems that are operational prior to the receipt of the notification, or systems that have been successfully coordinated previously.

illustration purposes.

6.4 In any event, licensees are expected to take full advantage of interference mitigation techniques such as antenna discrimination, polarization, frequency offset, shielding, site selection, and/or power control to facilitate the coordination of systems.

6.5 All results of analysis on pfd, or agreements made between licensees, must be retained by the licensees and be made available to the department upon request.

6.6 If a licence is transferred, the sharing agreement(s) developed between the former licensees shall remain in effect until superseded by a new agreement between the licensees.

6.7 In the event a satisfactory agreement or a successful coordination between the licensees is not reached, the department should be informed. In these cases, the department may impose appropriate technical limitations to facilitate reasonable implementation of LMCS systems.

6.8 While coordination between adjacent block licensees operating in the same vicinity may not be required in most cases, licensees may agree to coordinate certain installations to avoid interference.

Appendix A

Technical and Operational Requirements for LMCS

(as per Local Multipoint Communication Systems (LMCS) in the 28 GHz Range: Policy, Authorization Procedures and Evaluation Criteria with updates to ITU nomenclature)

ITU Requirements (25.25 - 27.5 GHz)

In the ITU *Radio Regulations*, the band 25.25 - 27.5 GHz is allocated on a co-primary basis to Fixed (FS), Mobile, and Inter-Satellite (IS) services. The current ITU regulations applicable to this band for the fixed service are as follows:

S21.1 § 1 Sites and frequencies for terrestrial stations and earth stations, operating in frequency bands shared with equal rights between terrestrial radiocommunication and space radiocommunication services, shall be selected having regard to the relevant ITU-R Recommendations with respect to geographical separation between earth stations and terrestrial stations.

S21.2 § 2 1) As far as practicable, sites for transmitting[1] stations, in the fixed or mobile service, employing maximum values of equivalent isotropically radiated power (e.i.r.p.) exceeding the values given in Table S21-1 in the frequency bands indicated, should be selected so that the direction of maximum radiation of any antenna will be separated from the geostationary-satellite orbit by at least the angle in degrees shown in the Table, taking into account the effect of atmospheric refraction[2]:

Excerpts from Table S21-1

Frequency band	e.i.r.p. value (dBW) (see also Nos. S21.2 and S21.4)	Minimum separation angle with respect to geostationary-satellite orbit (degrees)
25.25-27.5	+24 (in any 1 MHz band)	1.5

[1] S21.2.1 For their own protection receiving stations in the fixed or mobile service operating in bands shared with space radiocommunication services (space-to-Earth) should also avoid directing their antennae towards the geostationary-satellite orbit if their sensitivity is sufficiently high that interference from space station transmissions may be significant.

[2] S21.2.2 Information on this subject is given in the most recent version of Recommendation ITU-R SF.765 (see Resolution 27 (Rev. WRC-97)).

S21.2.3 Not used

S21.3 § 3 The maximum equivalent isotropically radiated power (e.i.r.p.) of a station in the fixed or mobile service shall not exceed +55 dBW.

S21.5 3) The power delivered by a transmitter to the antenna of a station in the fixed or mobile service shall not exceed +13 dBW in frequency bands between 1 GHz and 10 GHz, or + 10 dBW in frequency bands above 10 GHz.

The above regulations were based on the use of these bands by point-to-point systems in the fixed service. Since the band can also be used for high density point-to-multipoint systems, the following measures are needed to comply with the intent of these regulations.

Application of S21.2

It should be noted that this Radio Regulation (RR) is under review with a view to ensure protection to Intersatellite Data Relay Satellite (DRS) systems, operating on the geostationary orbit (GSO). These locations for DRS systems are: 174 degrees W, 171 degrees W, 170 degrees W, 160 degrees W, 139 degrees W, 79 degrees W, 62 degrees W, 46 degrees W, 44 degrees W, 41 degrees W, 16 degrees W, 16.4 degrees E, 59 degrees E, 85 degrees E, 90 degrees E, 95 degrees E, 121 degrees E, 153.8 degrees E.

In the case of LMCS, the e.i.r.p density limit of + 24 dBW/MHz should be considered as an aggregate of all co-channel transmission in a licensed service area to a DRS satellite location. The value of + 24 dBW/MHz required to protect DRS satellite operation is under review. Consideration is being given to developing a power limit on a per hub transmitter basis.

Application of S21.5

This RR restricts the transmitter power delivered to the antenna of a station in the fixed service to +10 dBW due to the assumption of the use of a high gain antenna in a point-to-point environment. Cases where a single hub transmitter power exceeds 10 watts over a large bandwidth may be permitted, subject to approval by the Department. LMCS operators are encouraged to contact the department as early as possible if they are planning to use such equipment.

Power flux density (pfd) limits for the inter-satellite service

ITU S21.16 specifies the pfd limits for the band 25.25 - 27.5 GHz for emissions from spacecraft in the inter-satellite service. These limits are as follows:

S21.16 § 6 1) The power flux-density at the Earth's surface produced by emissions from a space station, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limit given in Table S21-4. The limit relates to the power flux density which would e obtained under assumed free-space propagation conditions and applies to emissions by a space station of the service indicated where the frequency bands are shared with equal rights with the fixed or mobile service, unless otherwise stated.

Excerpts from Table S21-4:

-115 dB(W/m^2) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;

-115 + 0.5 (δ -5) dB(W/m^2) in any 1 MHz band for angles of arrival (δ) (in degrees) between 5 and 25 degrees above the horizontal plane;

-105 dB(W/m^2) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

LMCS operators should consider the above pfd values from inter-satellite systems in their system design.

Coordination Considerations

The following requirements should facilitate inter-system coordination of LMCS systems, and should allow compatibility with inter-satellite applications in the band 25.5 - 27.5 GHz. These requirements are based on current information available on LMCS technology.

In addition to accounting for aggregate levels, the maximum e.i.r.p density for a single station shall not exceed +8 dBW/MHz for clear sky conditions, but under any other condition, the value shall not exceed +24 dBW/MHz, except in cases of hub-to-hub interconnection, which will be considered on a case by case basis.

The above technical requirements in this appendix are subject to change in accordance with future changes to the ITU *Recommendations* and *Radio Regulations*, as well as any additional information from LMCS operators and equipment manufacturers.

Appendix B

Interim Arrangement Concerning the Sharing between Canada and the United States of America on Local Multipoint Communication Systems/ Local Multipoint Distribution Service and Other Systems in the Fixed Service in Parts of the Frequency Bands 27.35 - 28.35 GHz, 29.1 - 29.25 GHz, and 31.0 - 31.3 GHz

[to be provided by Industry Canada]

Appendix C

Process to determine whether coordination is required for cases where a sharing agreement between licensees has not been concluded

Appendix D

Sample calculation

The following example is provided to illustrate how the pfd level at the service area boundary can be determined[0]:

Proposed station parameters:

Parameter	Symbol	Value
Hub transmitter power into the antenna	P_T	-12 dBW
Channel bandwidth	B	40 MHz
Transmitter antenna height above ground	H_T	100 metres
Transmitter antenna gain (Maximum gain towards the service area boundary at any elevation point 0-500 m above average terrain)	G_T	21 dBi
Centre frequency of channel	F	28150 MHz
Distance from hub transmitter to the boundary of service area Y	D	10 km

[0] It should be noted that the example calculation assumes line-of-sight conditions due to the short path length and the height of the transmitting antenna. In other cases, where the distance is larger and/or the transmitting antenna height is small, line-of-sight conditions may not exist. In these cases, an appropriate propagation model that takes the non-line-of-sight situation into account should be used.

The spectral power density in dBW/MHz at the boundary of service area Y ($P_{\text{at the boundary of Service Area Y}}$) may be calculated using free space propagation, and taking into account such factor as atmospheric losses as follows:

$$P_{\text{at the boundary of Service Area Y}} = P_T' + G_T - 20 \log F_{MHz} - 20 \log D_{km} - 32.4 - L_a$$
$$= (-28 + 21 - 20 \log (28150) - 20 \log (10) - 32.4 - 0.1 \times 10) \text{ dBW/MHz}$$
$$= (-28 + 21 - 89 - 20 - 32.4 - 1) \text{ dBW/MHz}$$
$$= -149.4 \text{ dBW/MHz}$$

where: $P_T' = P_T - 10 \log B_{MHz}$
$= -12 - 10 \log (40)$
$= -28$ dBW/MHz

G_T = 21 dBi

F_{MHz} = 28150

D_{km} = 10

L_a = atmospheric losses = 0.1 dB/km

Then, the power flux density in dBW/m^2 in 1 MHz (pfd) may be calculated as follows:

$$\text{pfd} = P_{\text{at the boundary of Service Area Y}} - 10 \log A_r$$
$$= (-149.4 - 10 \log (9.038 \times 10^{-6})) \text{ dBW/m}^2 \text{ in 1 MHz}$$
$$= (-149.4 - (-50.4)) \text{ dBW/m}^2 \text{ in 1 MHz}$$
$$= -99 \text{ dBW/m}^2 \text{ in 1 MHz}$$

where: $A_r = \lambda^2/(4\pi)$
$= c^2/(4\pi F_{Hz}^2)$
$= (3 \times 10^8)^2 / (4\pi \times (28.15 \times 10^9)^2)$
$= 9.038 \times 10^{-6} \text{m}^2$