Conclusions

- The aggregate sidelobe power from CPE return link transmissions reduce more than the SV power during power control at minimum range.

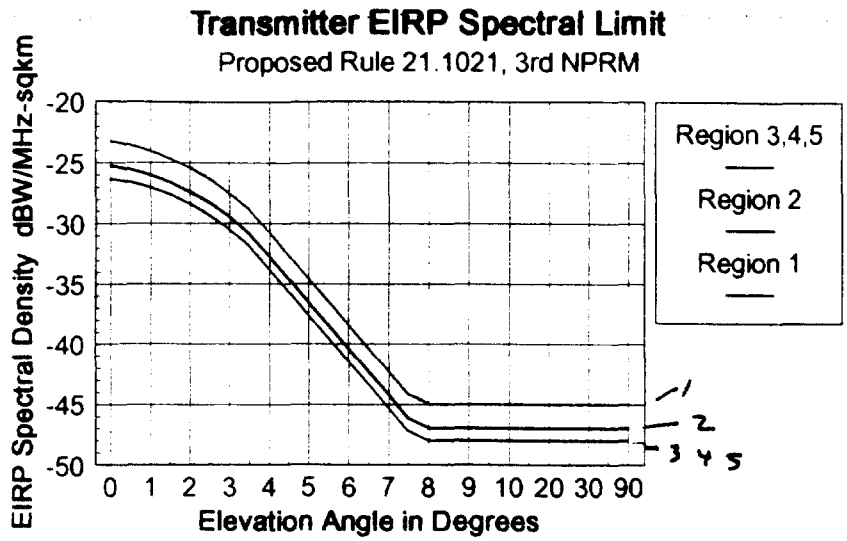
- At 90 degrees elevation, a CPE transmitter with maximum rule power increase that results in main beam coupling only has 0.2 dB Eb/(no+Io) and does not significantly degrade satellite bit error performance, 1E-7 to 2E-7.

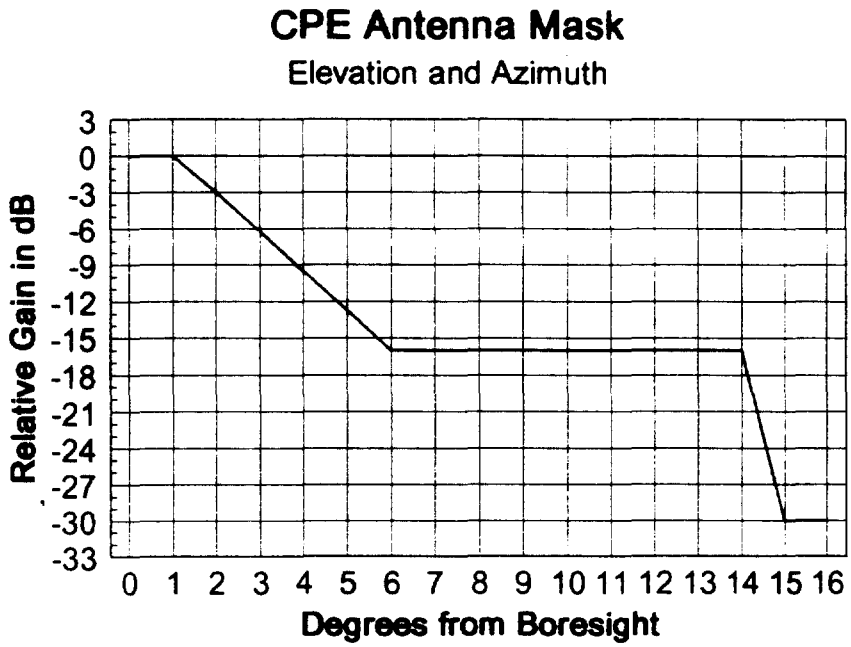
Analysis of CPE Tx's Fit to Proposed Rules, 21.1020 & 21.1021 per 3rd NPRM for 28 GHz using Proposed Rules for CPE Tx's in 150 MHz Band

Doug Gray, Hewlett-Packard Co.

HEWLETT PACKARD

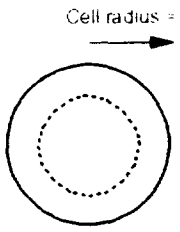
ATTACHMENT K


Transmitter EIRP Spectral Limit
Proposed Rule 21.1021, 3rd NPRM
EIRP Spectral Density dBW/MHz-sqkm
-20
-25
-30
-35
-40
-45
-50
0 1 2 3 4 5 6 7 8 9 10 20 30 90
Elevation Angle in Degrees
Region 3,4,5
Region 2
Region 1
1
2
3 4 5


CPE Antenna Mask
Elevation and Azimuth
Relative Gain in dB
3
0
-3
-6
-9
-12
-15
-18
-21
-24
-27
-30
-33
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Degrees from Boresight

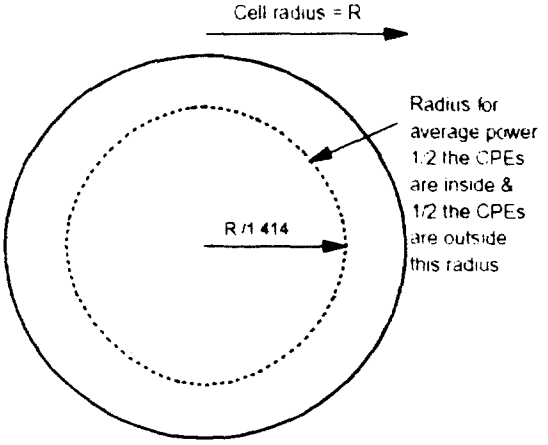
Total power spectral density is dependent only on Maximum EIRP (EIRP at the cell periphery) assuming uniform housing density

Small Cell Case



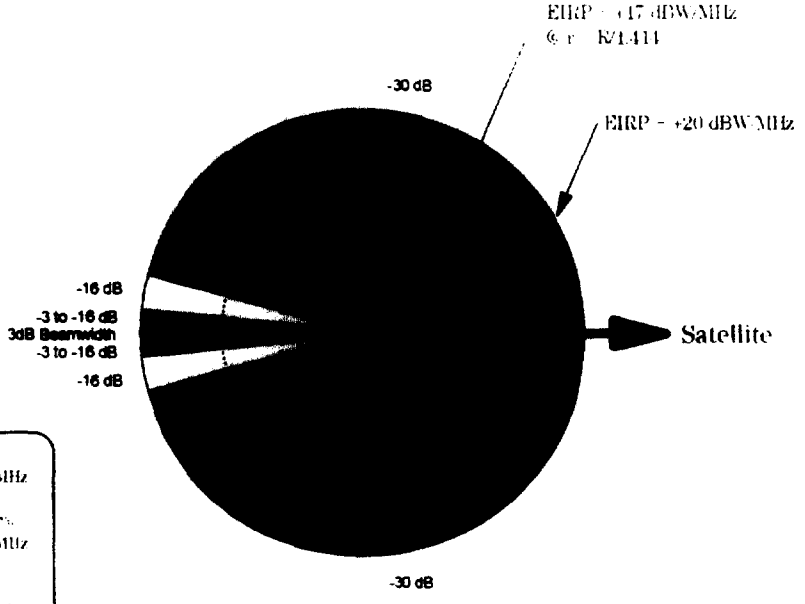
Cell Area = a = $(rR)^2$ x A
Max EIRP = P
Avg EIRP = P/2 (assuming adaptive pwr control)
PSD Cell = h x a x P/2
Number of cells to achieve same coverage as large cell = A/a
Total PSD = h x (a x (P/2)) x (A/a)
= h x (P/2) x A
where h = housing density in households/sq-km

Large Cell Case



Cell Area = a = A
Max EIRP = P
Avg EIRP = P/2 (assuming adaptive pwr control)
PSD Cell = h x A x P/2
where h = housing density in households/sq-km

Composite CPE Tx Satellite Interference Potential at 0 Degrees Elevation



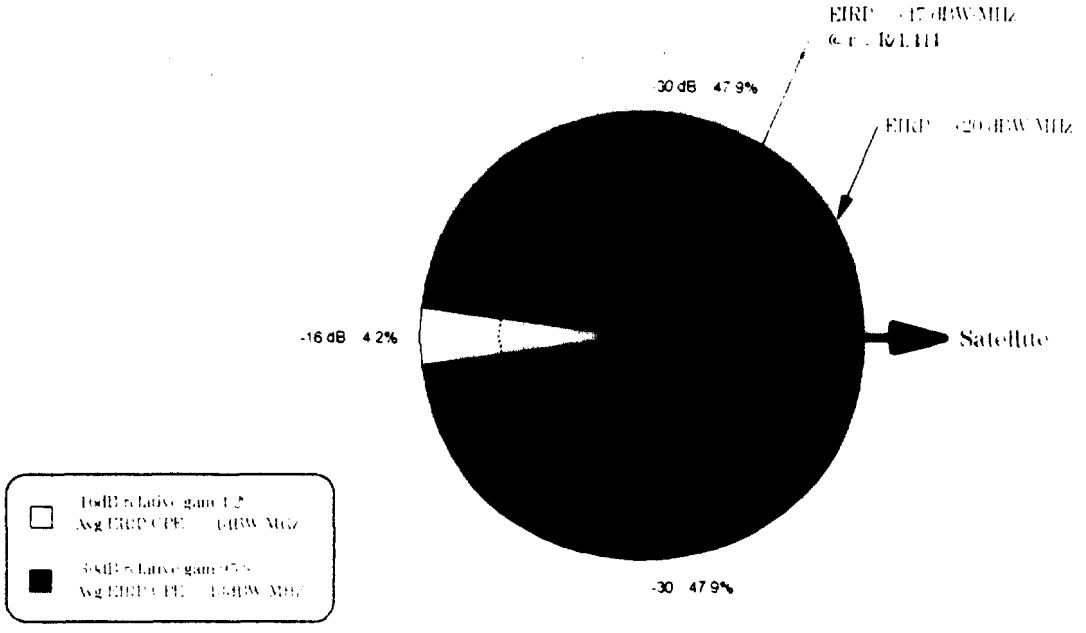
3dB Beamwidth 1.1%
Avg EIRP/CPE = 17dBW/MHz

-3 to -16dB relative gain 2.2%
Avg EIRP/CPE = +11dBW/MHz

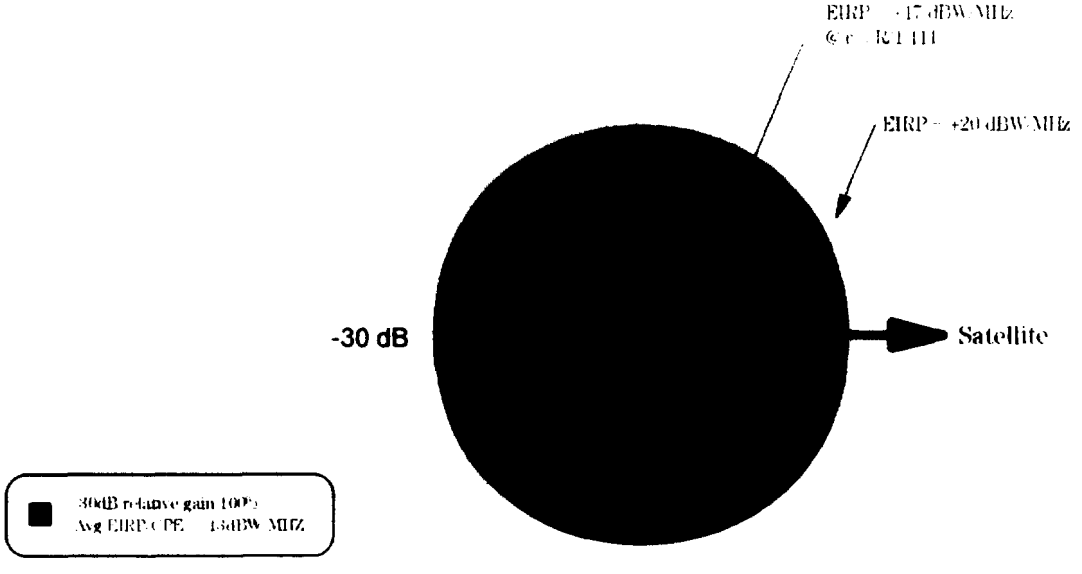
-16dB relative gain 5.[illegible]
Avg EIRP/CPE = [illegible]dBW/MHz

-30dB relative gain 91.6%
Avg EIRP/CPE = [illegible]dBW/MHz

Composite CPE Tx Satellite Interference Potential at 6-15 Degrees Elevation



Composite CPE Tx Satellite Interference Potential at 15-90 Degrees Elevation



Calculation of Total EIRP

Equivalent Power per Antenna Sector =

10Log(S) + 10Log(Sector Beamwidth) - 10Log(360) + (Avg EIRP/CPE)

Where S = total number of active subscribers

Demographic Data — 15 Northeast/Mid-Atlantic States

			Column A	Column B	
1	Population	millions	75	75	
2	Surface Area	sq-km	825,700	825,700	
3	Households	millions	25	25	
4	Household Density	HH/sq-km	30	30	
5	Dwelling Units	millions	25	20	Note A.
6	Suitable for LMDS	%	80%	50%	Note B.
7	Take	%	25%	25%	
8	Total Subscribers		5,000,000	2,500,000	
9	Subscribers/MHz	1/150	33,333	16,667	
10	Peak Demand	%	25%		
11	Average Demand	%		10%	Note C.
12	# Active CPEs	@64kbits/s	8,333	1,667	
13	Modulation Efficiency		1	1.5	Note D.
14	Net Active CPEs		533	71	
15	Circuit Efficiency	%	60%	60%	
16	Active CPEs		889	119	
17	Active CPEs/sq-km		0.001077	0.000144	

Column "A" summarizes the numbers used in previous analysis and was generated to represent a "worse" case scenario.

Column "B" represents a more realistic scenario. It would be appropriate to apply a distribution to the final result to account for the effects of non-uniform CPE Tx densities and the effects of varying demand.

Notes:

A. Number of households include those in multiple dwelling units (MDUs), these housholds would not have 1 CPE per household. Individual dwelling units are a better indication of the number of possible subscribers.

B. LMDS will not be economically viable in all geographic areas due to the need for line-of-sight or near" line-of-sight conditions. The density of trees, buidings of different heights, mountains, etc. will affect the suitability of a given area. Housing density will also affect the economic viability of LMDS as a delivery system versus other alternatives. The percent suitable for LMDS will vary from region to region.

C. Peak demand will occur for only short periods of time. Average demand is a better measure for calculating average EIRP.

D. This reflects the use of QPSK modulation which has a typical modulation efficiency of at least 1.5 bits per Hz.

Demographic Data By Region

			Northeast	South	Midwest	West		U.S. Total
1	Population	millions	58.93	78.83	59.83	53.66		251.25
2	Surface Area	sq-km	515,434	2,171,282	1,950,893	4,543,136		9,180,745
3	Households	millions	21.79	28.98	22.12	19.84		92.73
4	Household Density	HH/sq-km	42	13	11	4		10
5	Dwelling Units	millions	17.43	23.18	17.70	15.87		74.18
6	Suitable for LMDS	%	50%	30%	70%	70%	←	53%
7	Take	%	25%	25%	25%	25%		25%
8	Total Subscribers		2,179,000	1,738,800	3,096,800	2,777,600		9,792,200
9	Subscribers/MHz	1/150	14,527	11,592	20,645	18,517		65,281
10	Average Demand	%	10%	10%	10%	10%		10%
11	# Active CPEs	@64kbits/s	1,453	1,159	2,065	1,852		6,528
12	Modulation Efficiency		1.5	1.5	1.5	1.5		1.5
13	Net Active CPEs		62	49	88	79		279
14	Circuit Efficiency	%	60%	60%	60%	60%		60%
15	Active CPEs		103	82	147	132		464
16	Active CPEs/sq-km		0.0002	0.000038	0.000075	0.000029		0.000051

Source: 1992 Rand-McNally Commercial Atlas

EIRP per Hub at 0 Degrees Elevation — 15 Northeast/Mid-Atlantic States

Active CPE's #	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polariza-tion in dB	Blocking in dB	Area of 15 NE States sq-km	PSAD dBW/MHz/ sq-km	Region 2 EIRP Spec dBW/MHz/ sq-km
119	-2.6	-5.6	-12.0	-13.4	-0.26	20.47	-38.63	-3.00	-3.00	825,700	-44.[illegible]	-25
200	-2.6	-5.6	-12.0	-13.4	-0.26	22.73	-37.27	-3.00	-3.00	825,700	-42.44	-25
300	-2.6	-5.6	-12.0	-13.4	-0.26	24.49	-35.51	-3.00	-3.00	825,700	-40.68	-25
400	-2.6	-5.6	-12.0	-13.4	-0.26	25.74	-34.26	-3.00	-3.00	825,700	-39.43	-25
500	-2.6	-5.6	-12.0	-13.4	-0.26	26.71	-33.29	-3.00	-3.00	825,700	-38.46	-25
600	-2.6	-5.6	-12.0	-13.4	-0.26	27.50	-32.50	-3.00	-3.00	825,700	-37.67	-25
700	-2.6	-5.6	-12.0	-13.4	-0.26	28.17	-31.83	-3.00	-3.00	825,700	-37.00	-25
800	-2.6	-5.6	-12.0	-13.4	-0.26	28.75	-31.25	-3.00	-3.00	825,700	-36.42	-25
900	-2.6	-5.6	-12.0	-13.4	-0.26	29.26	-30.74	-3.00	-3.00	825,700	-35.91	-25
1000	-2.6	-5.6	-12.0	-13.4	-0.26	29.72	-30.28	-3.00	-3.00	825,700	-35.45	-25

EIRP per Hub at 7.5 Degrees Elevation

Active CPE's #	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polariza-tion in dB	Blocking in dB	Area of 15 NE States sq-km	PSAD dBW/MHz/ sq-km	Region 2 EIRP Spec dBW/MHz/ sq-km
119			-9.8	-13.4	-8.23	12.63	-47.47	-3.00	0.00	825,700	-[illegible]	-46
200			-9.8	-13.4	-8.23	14.78	-45.22	-3.00	0.00	825,700	-47.39	-46
275			-9.8	-13.4	-8.23	16.17	-43.83	-3.00	0.00	825,700	-46.00	-46
400			-9.8	-13.4	-8.23	17.79	-42.21	-3.00	0.00	825,700	-44.38	-46
500			-9.8	-13.4	-8.23	18.76	-41.24	-3.00	0.00	825,700	-43.41	-46
600			-9.8	-13.4	-8.23	19.55	-40.45	-3.00	0.00	825,700	-42.61	-46
700			-9.8	-13.4	-8.23	20.22	-39.78	-3.00	0.00	825,700	-41.94	-46
800			-9.8	-13.4	-8.23	20.80	-39.20	-3.00	0.00	825,700	-41.36	-46
900			-9.8	-13.4	-8.23	21.31	-38.69	-3.00	0.00	825,700	-40.85	-46
1000			-9.8	-13.4	-8.23	21.77	-38.23	-3.00	0.00	825,700	-40.40	-46

EIRP per Hub at 90 Degrees Elevation

Active CPE's #	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polariza-tion in dB	Blocking in dB	Area of 15 NE States sq-km	PSAD dBW/MHz/ sq-km	Region 2 EIRP Spec dBW/MHz/ sq-km
119				-13.0	-13.00	7.76	-52.24	-3.00	0.00	825,700	-54.41	-47
200				-13.0	-13.00	10.01	-49.99	-3.00	0.00	825,700	-52.16	-47
300				-13.0	-13.00	11.77	-48.23	-3.00	0.00	825,700	-50.40	-47
400				-13.0	-13.00	13.02	-46.98	-3.00	0.00	825,700	-49.15	-47
500				-13.0	-13.00	13.99	-46.01	-3.00	0.00	825,700	-48.18	-47
600				-13.0	-13.00	15.17	-44.83	-3.00	0.00	825,700	-47.00	-47
700				-13.0	-13.00	15.45	-44.55	-3.00	0.00	825,700	-46.72	-47
800				-13.0	-13.00	16.03	-43.97	-3.00	0.00	825,700	-46.14	-47
900				-13.0	-13.00	16.54	-43.46	-3.00	0.00	825,700	-45.63	-47
1000				-13.0	-13.00	17.00	-43.00	-3.00	0.00	825,700	-45.17	-47

EIRP per Hub at 0 Degrees Elevation

Northeast as defined in Rand-McNally Commercial Atlas

Active CPE's #	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polarization in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/sq-km	Region 2 EIRP Spec dBW/MHz/sq-km
163	-2.6	-5.6	-12.0	-13.4	-0.28	19.85	-46.15	-3.00	-3.00	515,434	-43.38	-25
200	-2.6	-5.6	-12.0	-13.4	-0.28	22.73	-37.27	-3.00	-3.00	515,434	-40.30	-25
300	-2.6	-5.6	-12.0	-13.4	-0.28	24.49	-35.51	-3.00	-3.00	515,434	-38.63	-25
400	-2.6	-5.6	-12.0	-13.4	-0.28	25.74	-34.26	-3.00	-3.00	515,434	-37.38	-25
500	-2.6	-5.6	-12.0	-13.4	-0.28	26.71	-33.29	-3.00	-3.00	515,434	-36.41	-25
600	-2.6	-5.6	-12.0	-13.4	-0.28	27.50	-32.50	-3.00	-3.00	515,434	-35.62	-25
700	-2.6	-5.6	-12.0	-13.4	-0.28	28.17	-31.83	-3.00	-3.00	515,434	-34.95	-25
800	-2.6	-5.6	-12.0	-13.4	-0.28	28.75	-31.25	-3.00	-3.00	515,434	-34.37	-25
900	-2.6	-5.6	-12.0	-13.4	-0.28	29.26	-30.74	-3.00	-3.00	515,434	-33.88	-25
1000	-2.6	-5.6	-12.0	-13.4	-0.28	29.72	-30.28	-3.00	-3.00	515,434	-33.40	-25

EIRP per Hub at 7.5 Degrees Elevation

Active CPE's #	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polarization in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/sq-km	Region 2 EIRP Spec dBW/MHz/sq-km
163			-9.8	-13.4	-8.23	11.90	-48.10	-3.00	0.00	515,434	-46.22	-46
172			-9.8	-13.4	-8.23	14.13	-45.87	-3.00	0.00	515,434	-45.99	-46
300			-9.8	-13.4	-8.23	16.54	-43.46	-3.00	0.00	515,434	-43.58	-46
400			-9.8	-13.4	-8.23	17.79	-42.21	-3.00	0.00	515,434	-42.33	-46
500			-9.8	-13.4	-8.23	18.76	-41.24	-3.00	0.00	515,434	-41.36	-46
600			-9.8	-13.4	-8.23	19.55	-40.45	-3.00	0.00	515,434	-40.57	-46
700			-9.8	-13.4	-8.23	20.22	-39.78	-3.00	0.00	515,434	-39.90	-46
800			-9.8	-13.4	-8.23	20.80	-39.20	-3.00	0.00	515,434	-39.32	-46
900			-9.8	-13.4	-8.23	21.31	-38.69	-3.00	0.00	515,434	-38.81	-46
1000			-9.8	-13.4	-8.23	21.77	-38.23	-3.00	0.00	515,434	-38.35	-46

EIRP per Hub at 90 Degrees Elevation

Active CPE's #	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polarization in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/sq-km	Region 2 EIRP Spec dBW/MHz/sq-km
163				-13.0	-13.00	7.13	-52.87	-3.00	0.00	515,434	-52.00	-47
200				-13.0	-13.00	10.01	-49.99	-3.00	0.00	515,434	-50.11	-47
300				-13.0	-13.00	11.77	-48.23	-3.00	0.00	515,434	-48.35	-47
400				-13.0	-13.00	13.12	-46.88	-3.00	0.00	515,434	-47.00	-47
500				-13.0	-13.00	13.99	-46.01	-3.00	0.00	515,434	-46.13	-47
600				-13.0	-13.00	14.78	-45.22	-3.00	0.00	515,434	-45.34	-47
700				-13.0	-13.00	15.45	-44.55	-3.00	0.00	515,434	-44.67	-47
800				-13.0	-13.00	16.03	-43.97	-3.00	0.00	515,434	-44.09	-47
900				-13.0	-13.00	16.54	-43.46	-3.00	0.00	515,434	-43.58	-47
1000				-13.0	-13.00	17.00	-43.00	-3.00	0.00	515,434	-43.12	-47

EIRP per Hub at 0 Degrees Elevation

South as defined in Rand-McNally Commercial Atlas

Active CPE's S	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polariza-tion in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/ sq-km	Region 1 EIRP Spec dBW/MHz/ sq-km
82	-2.6	-5.6	-12.0	-13.4	-0.28	18.86	-41.14	-3.00	-3.00	2,171,282	-56.51	-23
200	-2.6	-5.6	-12.0	-13.4	-0.28	22.73	-37.27	-3.00	-3.00	2,171,282	-48.64	-23
300	-2.6	-5.6	-12.0	-13.4	-0.28	24.49	-35.51	-3.00	-3.00	2,171,282	-44.88	-23
400	-2.6	-5.6	-12.0	-13.4	-0.28	25.74	-34.26	-3.00	-3.00	2,171,282	-43.83	-23
500	-2.6	-5.6	-12.0	-13.4	-0.28	26.71	-33.29	-3.00	-3.00	2,171,282	-42.86	-23
600	-2.6	-5.6	-12.0	-13.4	-0.28	27.50	-32.50	-3.00	-3.00	2,171,282	-41.67	-23
700	-2.6	-5.6	-12.0	-13.4	-0.28	28.17	-31.83	-3.00	-3.00	2,171,282	-41.20	-23
800	-2.6	-5.6	-12.0	-13.4	-0.28	28.75	-31.25	-3.00	-3.00	2,171,282	-40.62	-23
900	-2.6	-5.6	-12.0	-13.4	-0.28	29.26	-30.74	-3.00	-3.00	2,171,282	-40.11	-23
1000	-2.6	-5.6	-12.0	-13.4	-0.28	29.72	-30.28	-3.00	-3.00	2,171,282	-39.65	-23

EIRP per Hub at 7.5 Degrees Elevation

Active CPE's S	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polariza-tion in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/ sq-km	Region 1 EIRP Spec dBW/MHz/ sq-km
82			-9.8	-13.4	-8.23	10.81	-49.00	-3.00	0.00	2,171,282	-55.46	-44
200			-9.8	-13.4	-8.23	14.78	-45.22	-3.00	0.00	2,171,282	-51.58	-44
300			-9.8	-13.4	-8.23	16.54	-43.46	-3.00	0.00	2,171,282	-49.82	-44
400			-9.8	-13.4	-8.23	17.79	-42.21	-3.00	0.00	2,171,282	-48.57	-44
500			-9.8	-13.4	-8.23	18.76	-41.24	-3.00	0.00	2,171,282	-47.60	-44
600			-9.8	-13.4	-8.23	19.55	-40.45	-3.00	0.00	2,171,282	-46.81	-44
700			-9.8	-13.4	-8.23	20.22	-39.78	-3.00	0.00	2,171,282	-46.14	-44
800			-9.8	-13.4	-8.23	20.80	-39.20	-3.00	0.00	2,171,282	-45.56	-44
900			-9.8	-13.4	-8.23	21.31	-38.69	-3.00	0.00	2,171,282	-45.05	-44
1000			-9.8	-13.4	-8.23	21.77	-38.23	-3.00	0.00	2,171,282	-44.59	-44

EIRP per Hub at 90 Degrees Elevation

Active CPE's S	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polariza-tion in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/ sq-km	Region 1 EIRP Spec dBW/MHz/ sq-km
82				-13.0	-13.00	6.14	-53.86	-3.00	0.00	2,171,282	-56.23	-45
200				-13.0	-13.00	10.14	-49.86	-3.00	0.00	2,171,282	-52.23	-45
300				-13.0	-13.00	11.77	-48.23	-3.00	0.00	2,171,282	-54.60	-45
400				-13.0	-13.00	13.02	-46.98	-3.00	0.00	2,171,282	-53.35	-45
500				-13.0	-13.00	13.99	-46.01	-3.00	0.00	2,171,282	-52.38	-45
600				-13.0	-13.00	14.78	-45.22	-3.00	0.00	2,171,282	-51.59	-45
700				-13.0	-13.00	15.45	-44.55	-3.00	0.00	2,171,282	-50.92	-45
800				-13.0	-13.00	16.03	-43.97	-3.00	0.00	2,171,282	-50.34	-45
900				-13.0	-13.00	16.54	-43.46	-3.00	0.00	2,171,282	-49.82	-45
1000				-13.0	-13.00	17.00	-43.00	-3.00	0.00	2,171,282	-49.37	-45

EIRP per Hub at 0 Degrees Elevation

Midwest as defined in Rand-McNally Commercial Atlas

Active CPE's S	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polariza-tion in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/ sq-km	Region 2 EIRP Spec dBW/MHz/ sq-km
100	-2.6	-5.6	-12.0	-13.4	-0.28	19.72	-40.28	-3.00	-3.00	1,950,893	-49.18	-25
147	-2.6	-5.6	-12.0	-13.4	-0.28	21.39	-38.61	-3.00	-3.00	1,950,893	-47.51	-25
300	-2.6	-5.6	-12.0	-13.4	-0.28	24.49	-35.51	-3.00	-3.00	1,950,893	-44.41	-25
400	-2.6	-5.6	-12.0	-13.4	-0.28	25.74	-34.26	-3.00	-3.00	1,950,893	-43.16	-25
500	-2.6	-5.6	-12.0	-13.4	-0.28	26.71	-33.29	-3.00	-3.00	1,950,893	-42.19	-25
600	-2.6	-5.6	-12.0	-13.4	-0.28	27.50	-32.50	-3.00	-3.00	1,950,893	-41.40	-25
700	-2.6	-5.6	-12.0	-13.4	-0.28	28.17	-31.83	-3.00	-3.00	1,950,893	-40.73	-25
800	-2.6	-5.6	-12.0	-13.4	-0.28	28.75	-31.25	-3.00	-3.00	1,950,893	-40.15	-25
900	-2.6	-5.6	-12.0	-13.4	-0.28	29.26	-30.74	-3.00	-3.00	1,950,893	-39.64	-25
1000	-2.6	-5.6	-12.0	-13.4	-0.28	29.72	-30.28	-3.00	-3.00	1,950,893	-39.18	-25

EIRP per Hub at 7.5 Degrees Elevation

Active CPE's S	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polariza-tion in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/ sq-km	Region 2 EIRP Spec dBW/MHz/ sq-km
100			-9.8	-13.4	-8.23	11.77	-48.23	-3.00	0.00	1,950,893	-54.13	-46
147			-9.8	-13.4	-8.23	13.46	-46.56	-3.00	0.00	1,950,893	-52.46	-46
300			-9.8	-13.4	-8.23	16.54	-43.46	-3.00	0.00	1,950,893	-49.38	-46
400			-9.8	-13.4	-8.23	17.79	-42.21	-3.00	0.00	1,950,893	-48.11	-46
500			-9.8	-13.4	-8.23	18.76	-41.24	-3.00	0.00	1,950,893	-47.14	-46
600			-9.8	-13.4	-8.23	19.55	-40.45	-3.00	0.00	1,950,893	-46.35	-46
650			-9.8	-13.4	-8.23	19.90	-40.10	-3.00	0.00	1,950,893	-46.00	-46
800			-9.8	-13.4	-8.23	20.80	-39.20	-3.00	0.00	1,950,893	-45.10	-46
900			-9.8	-13.4	-8.23	21.31	-38.69	-3.00	0.00	1,950,893	-44.59	-46
1000			-9.8	-13.4	-8.23	21.77	-38.23	-3.00	0.00	1,950,893	-44.13	-46

EIRP per Hub at 90 Degrees Elevation

Active CPE's S	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polariza-tion in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/ sq-km	Region 2 EIRP Spec dBW/MHz/ sq-km
100				-13.0	-13.00	7.00	-53.00	-3.00	0.00	1,950,893	-58.90	-47
147				-13.0	-13.00	8.67	-51.33	-3.00	0.00	1,950,893	-57.23	-47
300				-13.0	-13.00	11.77	-48.23	-3.00	0.00	1,950,893	-54.13	-47
400				-13.0	-13.00	13.02	-46.98	-3.00	0.00	1,950,893	-52.88	-47
500				-13.0	-13.00	13.99	-46.01	-3.00	0.00	1,950,893	-51.91	-47
600				-13.0	-13.00	14.78	-45.22	-3.00	0.00	1,950,893	-51.12	-47
700				-13.0	-13.00	15.45	-44.55	-3.00	0.00	1,950,893	-50.45	-47
800				-13.0	-13.00	16.03	-43.97	-3.00	0.00	1,950,893	-49.87	-47
900				-13.0	-13.00	16.54	-43.46	-3.00	0.00	1,950,893	-49.36	-47
1000				-13.0	-13.00	17.00	-43.00	-3.00	0.00	1,950,893	-48.90	-47

EIRP per Hub at 0 Degrees Elevation

West as defined in Rand-McNally Commercial Atlas

Active CPE's S	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polarization in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/ sq-km	Reg. 3,4,5 EIRP Spec dBW/MHz/ sq-km
100	-2.6	-5.6	-12.0	-13.4	-0.26	19.72	-40.28	-3.00	-3.00	4,543,136	-52.86	-26
132	-2.6	-5.6	-12.0	-13.4	-0.26	20.92	-39.08	-3.00	-3.00	4,543,136	-51.65	-26
300	-2.6	-5.6	-12.0	-13.4	-0.26	24.49	-35.51	-3.00	-3.00	4,543,136	-48.08	-26
400	-2.6	-5.6	-12.0	-13.4	-0.26	25.74	-34.26	-3.00	-3.00	4,543,136	-46.83	-26
500	-2.6	-5.6	-12.0	-13.4	-0.26	26.71	-33.29	-3.00	-3.00	4,543,136	-45.87	-26
600	-2.6	-5.6	-12.0	-13.4	-0.26	27.50	-32.50	-3.00	-3.00	4,543,136	-45.07	-26
700	-2.6	-5.6	-12.0	-13.4	-0.26	28.17	-31.83	-3.00	-3.00	4,543,136	-44.40	-26
800	-2.6	-5.6	-12.0	-13.4	-0.26	28.75	-31.25	-3.00	-3.00	4,543,136	-43.82	-26
900	-2.6	-5.6	-12.0	-13.4	-0.26	29.26	-30.74	-3.00	-3.00	4,543,136	-43.31	-26
1000	-2.6	-5.6	-12.0	-13.4	-0.26	29.72	-30.28	-3.00	-3.00	4,543,136	-42.86	-26

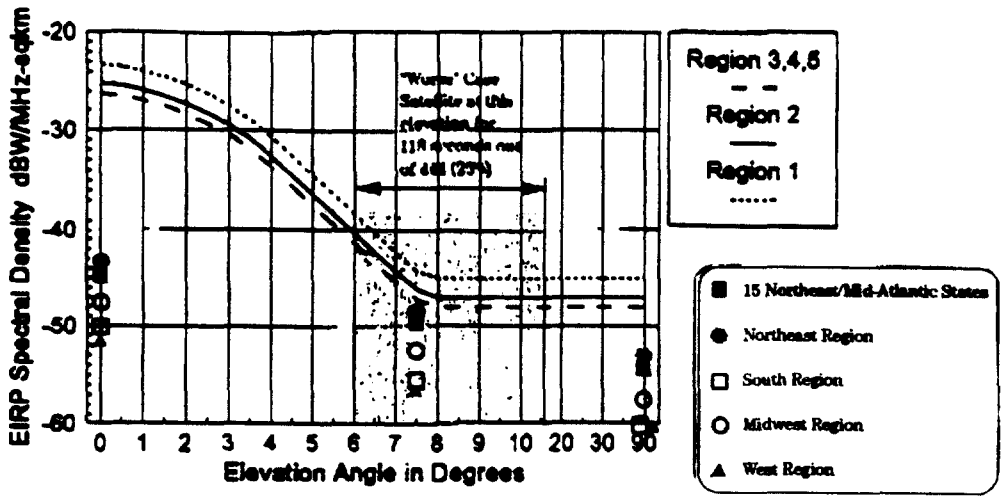
EIRP per Hub at 7.5 Degrees Elevation

Active CPE's S	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polarization in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/ sq-km	Reg. 3,4,5 EIRP Spec dBW/MHz/ sq-km
100			-9.6	-13.4	-8.23	11.77	-48.23	-3.00	0.00	4,543,136	-57.80	-47
132			-9.6	-13.4	-8.23	12.96	-47.02	-3.00	0.00	4,543,136	-56.59	-47
300			-9.6	-13.4	-8.23	16.54	-43.46	-3.00	0.00	4,543,136	-53.03	-47
400			-9.6	-13.4	-8.23	17.79	-42.21	-3.00	0.00	4,543,136	-51.78	-47
500			-9.6	-13.4	-8.23	18.76	-41.24	-3.00	0.00	4,543,136	-50.81	-47
600			-9.6	-13.4	-8.23	19.55	-40.45	-3.00	0.00	4,543,136	-50.02	-47
700			-9.6	-13.4	-8.23	20.22	-39.78	-3.00	0.00	4,543,136	-49.35	-47
800			-9.6	-13.4	-8.23	20.80	-39.20	-3.00	0.00	4,543,136	-48.77	-47
900			-9.6	-13.4	-8.23	21.31	-38.69	-3.00	0.00	4,543,136	-48.26	-47
1000			-9.6	-13.4	-8.23	21.77	-38.23	-3.00	0.00	4,543,136	-47.80	-47

EIRP per Hub at 90 Degrees Elevation

Active CPE's S	Equiv. Pwr Ant. Sect 1 dBW/MHz	Equiv. Pwr Ant. Sect 2 dBW/MHz	Equiv. Pwr Ant. Sect 3 dBW/MHz	Equiv. Pwr Ant. Sect 4 dBW/MHz	Tot. Equiv. EIRP dBW/MHz	Total EIRP dBW/MHz	Total EIRP dBW/Hz	Antenna Polarization in dB	Blocking in dB	Area in sq-km	PSAD dBW/MHz/ sq-km	Reg. 3,4,5 EIRP Spec dBW/MHz/ sq-km
100				-13.0	-13.00	7.00	-53.00	-3.00	0.00	4,543,136	-62.57	-48
132				-13.0	-13.00	8.21	-51.79	-3.00	0.00	4,543,136	-61.37	-48
300				-13.0	-13.00	11.77	-48.23	-3.00	0.00	4,543,136	-57.80	-48
400				-13.0	-13.00	13.02	-46.98	-3.00	0.00	4,543,136	-56.55	-48
500				-13.0	-13.00	13.99	-46.01	-3.00	0.00	4,543,136	-55.58	-48
600				-13.0	-13.00	14.78	-45.22	-3.00	0.00	4,543,136	-54.79	-48
700				-13.0	-13.00	15.45	-44.55	-3.00	0.00	4,543,136	-54.12	-48
800				-13.0	-13.00	16.03	-43.97	-3.00	0.00	4,543,136	-53.54	-48
900				-13.0	-13.00	16.54	-43.46	-3.00	0.00	4,543,136	-53.03	-48
1000				-13.0	-13.00	17.00	-43.00	-3.00	0.00	4,543,136	-52.57	-48

Transmitter EIRP Spectral Limit as per Proposed Rule 21.1020 & 21.1021, 3rd NPRM with Projected EIRP Levels for U.S. Regions



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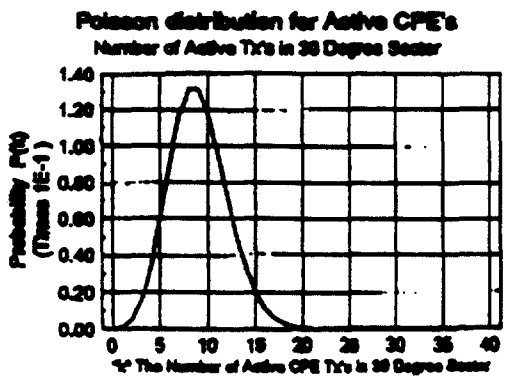
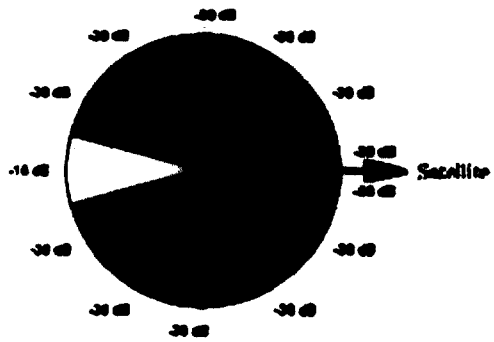
Composite CPE Tx Satellite Interference Potential at 6-15 Degrees Elevation





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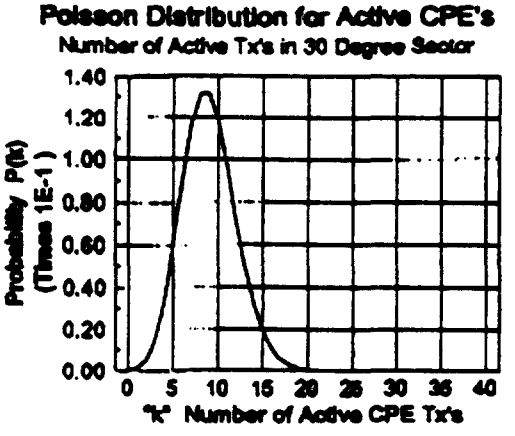
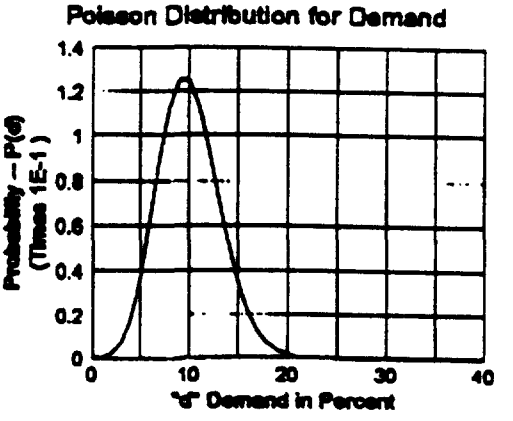
Probability Distribution for Demand and Active CPE Tx's in 30 Degree Sector





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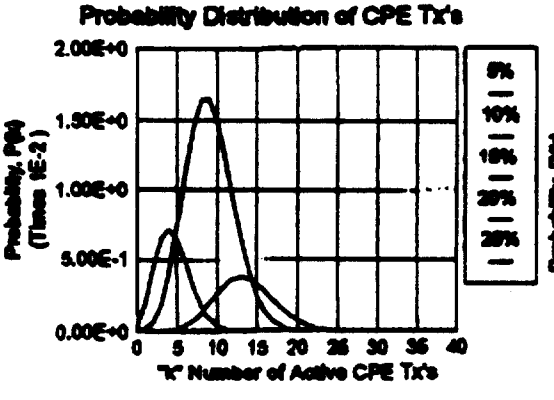
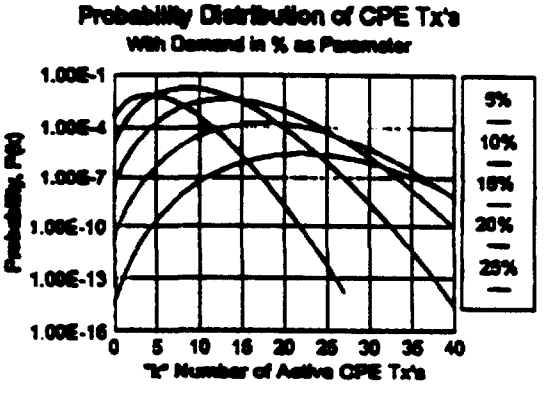
Joint Probability Distribution for Demand and Active CPE Tx's in 30 Degree Sector





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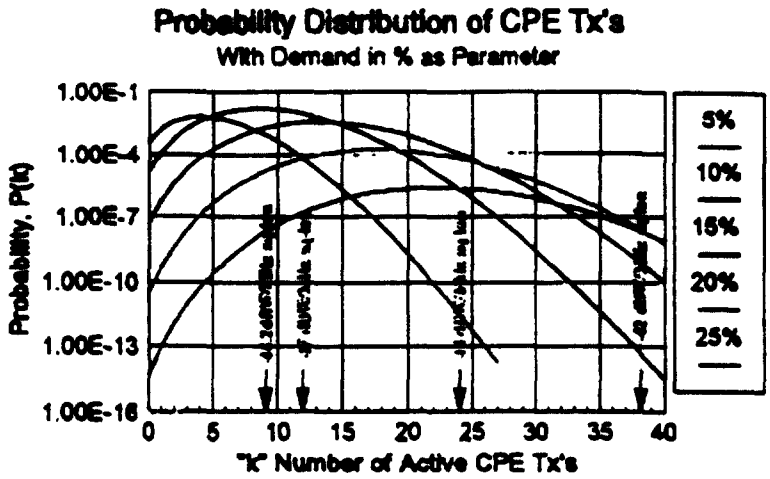
Joint Probability Distribution for Demand and Active CPE Tx's in 30 Degree Sector



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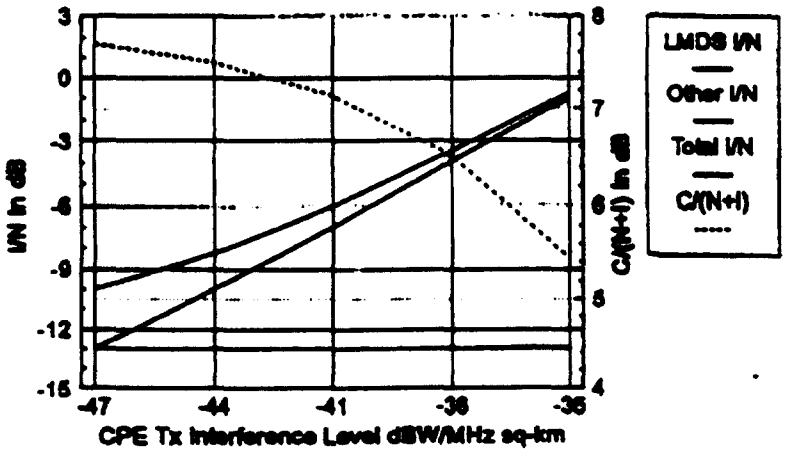
Effect of Interference Level on C/(N+I)



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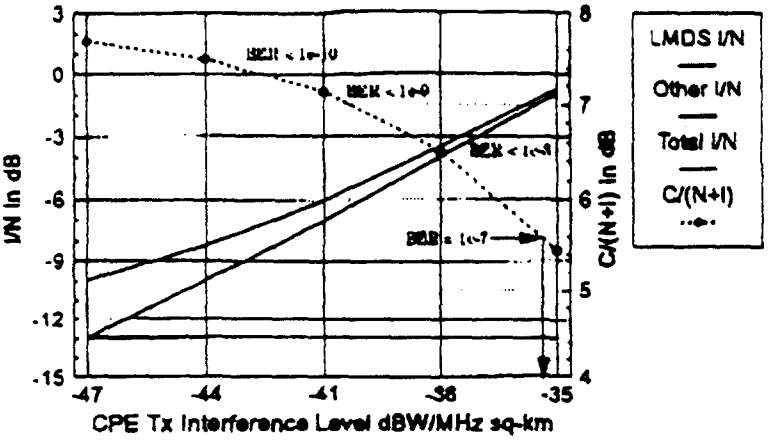
Effect of Interference Level on C/(N+I) and BER



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Summary

- In the major geographical regions in the continental U.S., assuming a uniform distribution of active CPE Tx's pointing in their intended direction, the PSAD can be expected to be:
  - At 0 degrees elevation, 17dB to 27dB below the level specified in proposed Rule 21.1021, 3rd NPRM.
  - At 5.0 to 15 degrees elevation, 2dB to 11dB below the level specified in proposed Rule 21.1021, 3rd NPRM.
  - At 15 to 90 degrees elevation, 0dB to 15dB below the level specified in proposed Rule 21.1021, 3rd NPRM.
- Statisical spread in PSAD due to demand and non-uniformly distributed active CPE Tx's will result in higher PSAD and in the Northeast could result in levels exceeding proposed Rule 21.1021, 3rd NPRM, but with very low probabilities.
  - Assuming a Poisson distribution, the probability of sufficient interference to cause BER to drop to 1e-8 is < 1e-7.

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DISTRIBUTION

November 28, 1995

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