Northpoint Technology

Presentation to the Federal Communications Commission

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May 12, 1998

Outline

- Northpoint Technology is Different than Microwave Point-to-point
- Sharing with DBS
  - Northpoint tests and technical filings demonstrate compatibility with DBS
- Sharing with NGSO FSS
  - Northpoint and NGSO-FSS are co-primary
  - Northpoint and NGSO FSS can co-exist
  - Each bear burden of co-existence

Northpoint Technology is Low Power -- Different from Fixed Point-to-Point Microwave Relay

Characteristic	Units	Microwave*	Northpoint*
Transmit EIRP	dBW	45	-17.5
Transmit 3 dB Beamwidth	degrees	2	110
Required BER	BER	10^{-8} or higher	10^{-6}
Transmit Distance	km	10 - 50 (per link)	< 16
Noise Floor	Kelvin	1000-5000	300
Required Availability	%	99.999+	99.7

*Typical Values

Sharing with DBS - Outline

- FIXED and BROADCAST are Primary Services according to both domestic and international allocations
  - Constrained by footnote S5.490 not to cause Harmful Interference to BSS
- Northpoint technical filings demonstrate compatibility with DBS
  - DIRECTV overestimates Northpoint interference by 10-20 dB
  - Effect of natural shielding must be taken into account

INTERNATIONAL TELECOMMUNICATION UNION

Radio Regulations

Edition of 1998

1 *Articles*

Geneva 1998

11.7-14.25 GHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
11.7-12.5 FIXED BROADCASTING BROADCASTING-SATELLITE MOBILE except aeronautical mobile S5.487 S5.487A S5.492	**11.7-12.1** FIXED S5.486 FIXED-SATELLITE (space-to-Earth) S5.484A Mobile except aeronautical mobile S5.485 S5.488	**11.7-12.2** FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE S5.487 S5.487A S5.492
	12.1-12.2 FIXED-SATELLITE (space-to-Earth) S5.484A S5.485 S5.488 S5.489	
	12.2-12.7 FIXED MOBILE except aeronautical mobile BROADCASTING BROADCASTING-SATELLITE S5.487A S5.488 S5.490 S5.492	**12.2-12.5** FIXED MOBILE except aeronautical mobile BROADCASTING S5.484A S5.487 S5.491
12.5-12.75 FIXED-SATELLITE (space-to-Earth) S5.484A (Earth-to-space) S5.494 S5.495 S5.496	**12.7-12.75** FIXED FIXED-SATELLITE (Earth-to-space) MOBILE except aeronautical mobile	**12.5-12.75** FIXED FIXED-SATELLITE (space-to-Earth) S5.484A MOBILE except aeronautical mobile BROADCASTING-SATELLITE S5.493
12.75-13.25	FIXED FIXED-SATELLITE (Earth-to-space) S5.441 MOBILE Space research (deep space) (space-to-Earth)	
13.25-13.4	EARTH EXPLORATION-SATELLITE (active) AERONAUTICAL RADIONAVIGATION S5.497 SPACE RESEARCH (active) S5.498A S5.499	
13.4-13.75	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION SPACE RESEARCH S5.501A Standard frequency and time signal-satellite (Earth-to-space) S5.499 S5.500 S5.501 S5.501B	
13.75-14	FIXED-SATELLITE (Earth-to-space) S5.484A RADIOLOCATION Standard frequency and time signal-satellite (Earth-to-space) Space research S5.499 S5.500 S5.501 S5.502 S5.503 S5.503A	
14-14.25	FIXED-SATELLITE (Earth-to-space) S5.484A S5.506 RADIONAVIGATION S5.504 Mobile-satellite (Earth-to-space) except aeronautical mobile-satellite Space research S5.505	

-SC-

S5.485 In Region 2, in the band 11.7-12.2 GHz, transponders on space stations in the fixed-satellite service may be used additionally for transmissions in the broadcasting-satellite service, provided that such transmissions do not have a maximum e.i.r.p. greater than 53 dBW per television channel and do not cause greater interference or require more protection from interference than the coordinated fixed-satellite service frequency assignments. With respect to the space services, this band shall be used principally for the fixed-satellite service.

S5.486 *Different category of service:* in Mexico and the United States, the allocation of the band 11.7-12.1 GHz to the fixed service is on a secondary basis (see No. **S5.32**).

S5.487 In the band 11.7-12.5 GHz in Regions 1 and 3, the fixed, fixed-satellite, mobile, except aeronautical mobile, and broadcasting services, in accordance with their respective allocations, shall not cause harmful interference to broadcasting-satellite stations operating in accordance with the provisions of Appendix **S30**.

S5.487A *Additional allocation:* in Region 1, the band 11.7-12.5 GHz, in Region 2, the band 12.2-12.7 GHz and, in Region 3, the band 11.7-12.2 GHz, are also allocated to the fixed-satellite service (space-to-Earth) on a primary basis, limited to non-geostationary systems and subject to the provisions of Resolution **538 (WRC-97)**. (WRC-97)

S5.488 The use of the bands 11.7-12.2 GHz by the fixed-satellite service in Region 2 and 12.2-12.7 GHz by the broadcasting-satellite service in Region 2 is limited to national and subregional systems. The use of the band 11.7-12.2 GHz by the fixed-satellite service in Region 2 is subject to previous agreement between the administrations concerned and those having services, operating or planned to operate in accordance with the Table, which may be affected (see Articles **S9** and **S11**). For the use of the band 12.2-12.7 GHz by the broadcasting-satellite service in Region 2, see Appendix **S30**.

S5.489 *Additional allocation:* in Peru, the band 12.1-12.2 GHz is also allocated to the fixed service on a primary basis.

S5.490 In Region 2, in the band 12.2-12.7 GHz, existing and future terrestrial radiocommunication services shall not cause harmful interference to the space services operating in conformity with the broadcasting-satellite Plan for Region 2 contained in Appendix **S30**.

S5.491 *Additional allocation:* in Region 3, the band 12.2-12.5 GHz is also allocated to the fixed-satellite (space-to-Earth) service on a primary basis, limited to national and sub-regional systems. The power flux-density limits in Article **S21**, Table **S21-4** shall apply to this frequency band. The introduction of the service in relation to the broadcasting-satellite service in Region 1 shall follow the procedures specified in Article 7 of Appendix **S30**, with the applicable frequency band extended to cover 12.2-12.5 GHz.

S5.492 Assignments to stations of the broadcasting-satellite service in conformity with the appropriate regional Plan in Appendix **S30** may also be used for transmissions in the fixed-satellite service (space-to-Earth), provided that such transmissions do not cause more interference or require more protection from interference than the broadcasting-satellite service transmissions operating in conformity with this Plan. With respect to the space services, this band shall be used principally for the broadcasting-satellite service. (WRC-97)

S5.493 The broadcasting-satellite service in the band 12.5-12.75 GHz in Region 3 is limited to a power flux-density not exceeding -111 dB(W/m^2)/27 MHz for all conditions and for all methods of modulation at the edge of the service area. (WRC-97)

Standard of Harmful Interference

- "Accepted Interference" is not "Harmful Interference"
- Harmful Interference:
  - "Interference which … seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service..."
- DirecTV 1994 report to the FCC suggests 20% increase in unavailability would be serious degradation.

Northpoint Does Not Cause Harmful Interference

- Northpoint will not cause repeated interruption
  - Northpoint will never cause a loss of signal in clear air -- This fact is not disputed by any party.
- Northpoint will not cause serious degradation
  - Northpoint will not cause a 20% increase in unavailability

Fair and Equitable Sharing Criteria

- Northpoint will never degrade BSS availability below the BSS target of 99.7%.
- Northpoint will not decrease the average availability more than 0.006% (0.5 hours per year)
- Northpoint will not decrease the availability more than 0.06% in any case. (5 hours per year)
- Accounts for near-far variation in C/I ratio

Northpoint Technical Filings Demonstrate Compatibility with DBS

- DIRECTV overestimates Northpoint interference by 10 to 20 dB
- Most serious error: BSS receive gain towards Northpoint
  - DirecTV erroneously uses 0 dBi
  - Actual gain towards Northpoint averages minus 10 dBi
- This erroneous antenna gain is used in all of DIRECTV's analysis resulting in wholly erroneous conclusions
- Other DIRECTV technical errors totaling 3-6 dB as described in Northpoint filings to the Commission

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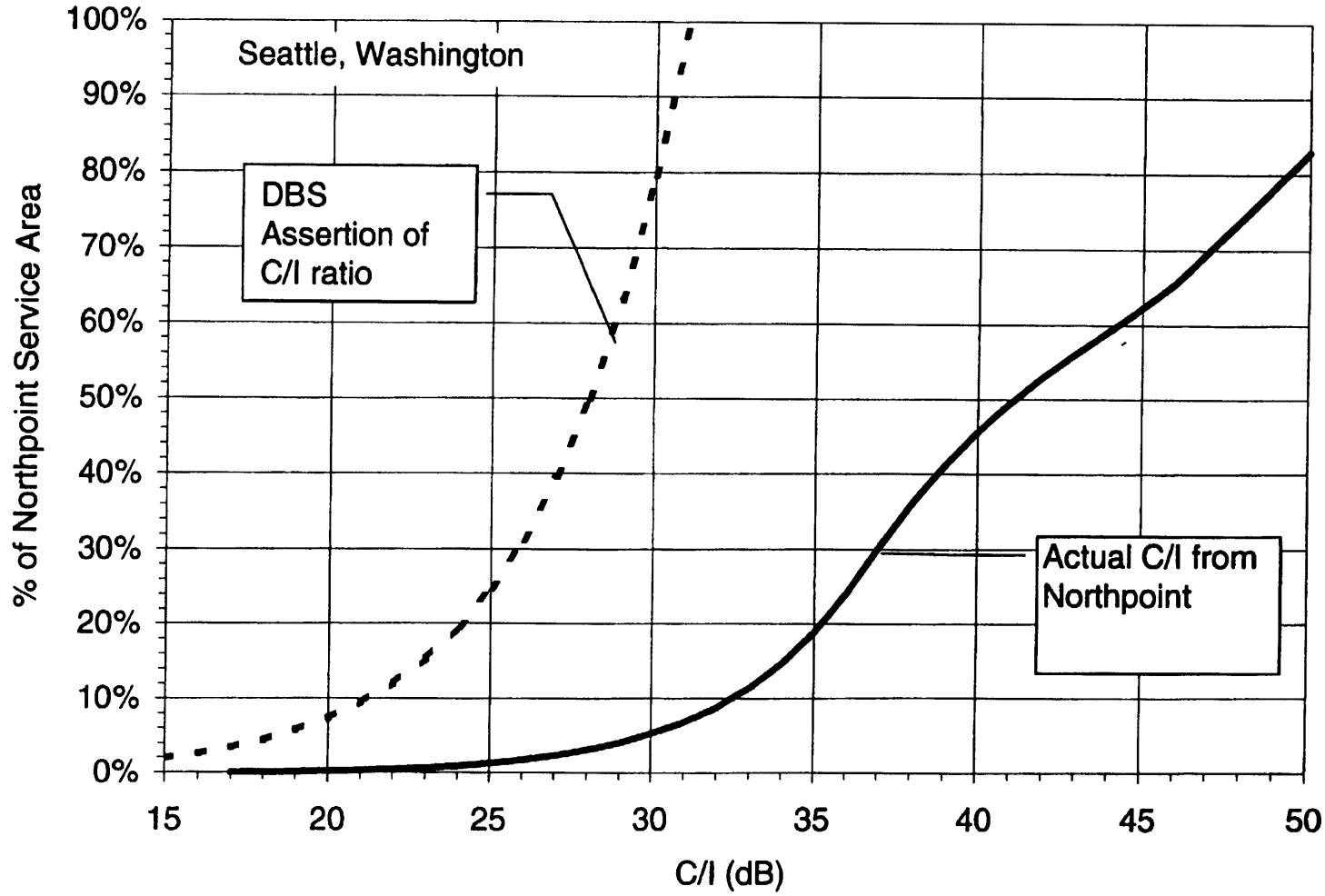
Table 2.2.2-1 DIRECTV calculation of BSS earth station receive antenna horizon gain

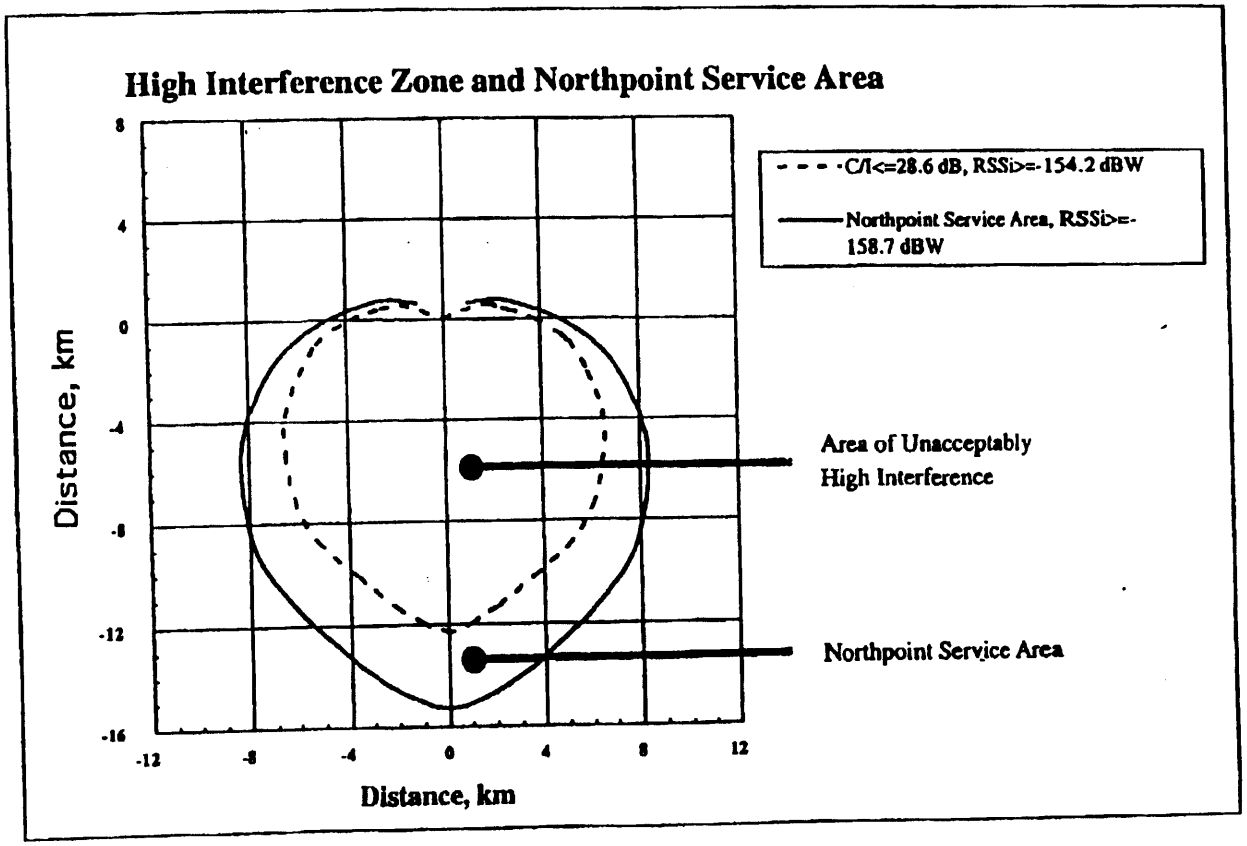
			Difference in Longitude, Degrees																												
	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	-10	-5	-1	1	5	10	15	20	25	30	35	40	45	50	55	60	65			
Great Circle, radians	1.267	1.208	1.153	1.099	1.047	0.998	0.953	0.912	0.875	0.844	0.819	0.800	0.788	0.786	0.786	0.788	0.800	0.819	0.844	0.875	0.912	0.953	0.998	1.047	1.099	1.153	1.208	1.267			
Sat El Angle, degrees	8.8	12.2	15.6	18.8	21.9	24.9	27.7	30.3	32.5	34.5	36.1	37.2	37.9	38.2	38.2	37.9	37.2	36.1	34.5	32.5	30.3	27.7	24.9	21.9	18.8	15.6	12.2	8.8			
Sat Az Angle, degrees	108.2	112.2	116.3	120.7	125.3	130.1	135.3	140.8	146.6	152.8	159.2	166.0	172.9	179.6	179.6	172.9	166.0	159.2	152.8	146.6	140.8	135.3	130.1	125.3	120.7	116.3	112.2	108.2			
NPT to BSS ES Az Angle deg																	BSS Rcv Antenna Gain (Horizon)														Maximum Gain
60	-12	-12	-12	-14	-14	-14	-12	-12	-14	-14	-16	-16	-10	-10	-10	-10	-10	-10	-9	-9	-7	-7	-8	-8	-8	-4	-4	-4			-4
70	-12	-14	-14	-14	-12	-12	-14	-14	-16	-16	-10	-10	-10	-10	-10	-10	-9	-9	-7	-7	-6	-6	-6	-4	-4	-2	-2	-2			-2
80	-14	-12	-12	-12	-14	-14	-14	-16	-16	-10	-10	-10	-10	-10	-10	-10	-9	-7	-7	-6	-6	-4	-4	-2	-2	-2	-12	-12			-2
90	-12	-12	-14	-14	-14	-16	-16	-10	-10	-10	-10	-10	-10	-9	-9	-7	-7	-6	-6	-4	-4	-2	-2	-12	-12	-12	-16	-16			-2
100	-14	-14	-16	-16	-16	-10	-10	-10	-10	-10	-10	-9	-9	-7	-7	-7	-6	-4	-4	-2	-2	-12	-12	-12	-12	-12	-16	-16			-2
110	-16	-16	-16	-10	-10	-10	-10	-10	-10	-10	-9	-9	-7	-6	-6	-6	-4	-4	-2	-2	-12	-12	-16	-16	-16	-16	-16	-16			-2
120	-10	-10	-10	-10	-10	-10	-10	-10	-9	-9	-7	-7	-6	-6	-4	-4	-2	-2	-12	-12	-16	-16	-16	-16	-16	-16	-12	-12			-2
130	-10	-10	-10	-10	-10	-10	-9	-9	-7	-7	-6	-6	-4	-4	-4	-2	-12	-12	-16	-16	-16	-16	-16	-12	-12	-16	-16	-16			-2
140	-10	-10	-10	-10	-9	-9	-9	-7	-7	-6	-6	-4	-2	-2	-2	-12	-12	-16	-16	-16	-16	-16	-16	-12	-12	-16	-16	-16			-2
150	-10	-10	-9	-9	-9	-7	-7	-6	-6	-4	-4	-2	-2	-12	-12	-16	-16	-16	-16	-16	-16	-12	-12	-16	-16	-16	-16	-16			-2
160	-9	-9	-7	-7	-7	-9	-9	-4	-4	-2	-2	-12	-12	-16	-16	-16	-16	-12	-12	-16	-16	-16	-16	-16	-16	-16	-12	-12			-2
170	-7	-7	-7	-6	-6	-4	-4	-4	-2	-2	-12	-12	-16	-16	-16	-16	-12	-12	-16	-16	-16	-16	-12	-12	-2	-2	-2	-2			-2
180	-6	-6	-6	-4	-4	-4	-2	-2	-12	-12	-16	-16	-16	-16	-12	-12	-16	-16	-16	-16	-12	-12	-2	-2	-2	-4	-4	-4			-2
190	-6	-4	-4	-4	-2	-2	-12	-12	-16	-16	-16	-16	-12	-12	-12	-16	-16	-16	-12	-12	-2	-2	-2	-4	-4	-6	-6	-6			-2
200	-4	-2	-2	-2	-12	-12	-12	-16	-16	-16	-16	-12	-16	-16	-16	-16	-16	-12	-12	-2	-2	-4	-4	-6	-6	-6	-7	-7			-2
210	-2	-2	-12	-12	-12	-16	-16	-16	-16	-12	-12	-16	-16	-16	-16	-12	-12	-2	-2	-4	-4	-6	-6	-7	-7	-7	-9	-9			-2
220	-12	-12	-16	-16	-16	-16	-16	-12	-12	-16	-16	-16	-16	-12	-12	-12	-2	-4	-4	-6	-6	-7	-7	-7	-9	-9	-9	-10			-2
230	-16	-16	-16	-16	-16	-12	-12	-12	-16	-16	-16	-16	-12	-2	-2	-2	-4	-4	-6	-6	-7	-7	-9	-9	-10	-10	-10	-10			-2
240	-16	-16	-16	-12	-12	-12	-16	-16	-16	-16	-12	-12	-2	-2	-4	-4	-6	-6	-7	-7	-9	-9	-10	-10	-10	-10	-10	-10			-2
250	-16	-12	-12	-12	-16	-16	-16	-16	-12	-12	-2	-2	-4	-4	-4	-6	-7	-7	-9	-9	-10	-10	-10	-10	-10	-10	-10	-10			-2
260	-12	-16	-16	-16	-16	-16	-16	-12	-12	-2	-2	-4	-6	-6	-6	-7	-7	-9	-9	-10	-10	-10	-10	-10	-10	-10	-10	-10			-2
270	-16	-16	-16	-16	-16	-12	-12	-2	-2	-4	-4	-6	-6	-7	-7	-9	-9	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10			-2
280	-16	-16	-12	-12	-12	-2	-2	-4	-4	-6	-6	-7	-7	-9	-9	-9	-10	-10	-10	-10	-10	-10	-10	-16	-16	-16	-14	-14			-2
290	-12	-12	-12	-2	-2	-4	-4	-4	-6	-6	-7	-7	-9	-10	-10	-10	-10	-10	-10	-10	-16	-16	-18	-18	-14	-14	-14	-12			-2
300	-2	-2	-2	-4	-4	-4	-6	-6	-7	-7	-9	-9	-10	-10	-10	-10	-10	-10	-10	-16	-16	-14	-14	-14	-12	-12	-12	-14			-2

SOURCE: COMMENTS OF DIRECTV 2 MAR 1999

Comparison of Accurately Calculated C/I Ratios to DIRECTV's Assertion



High Interference Zone Within Northpoint Service Area



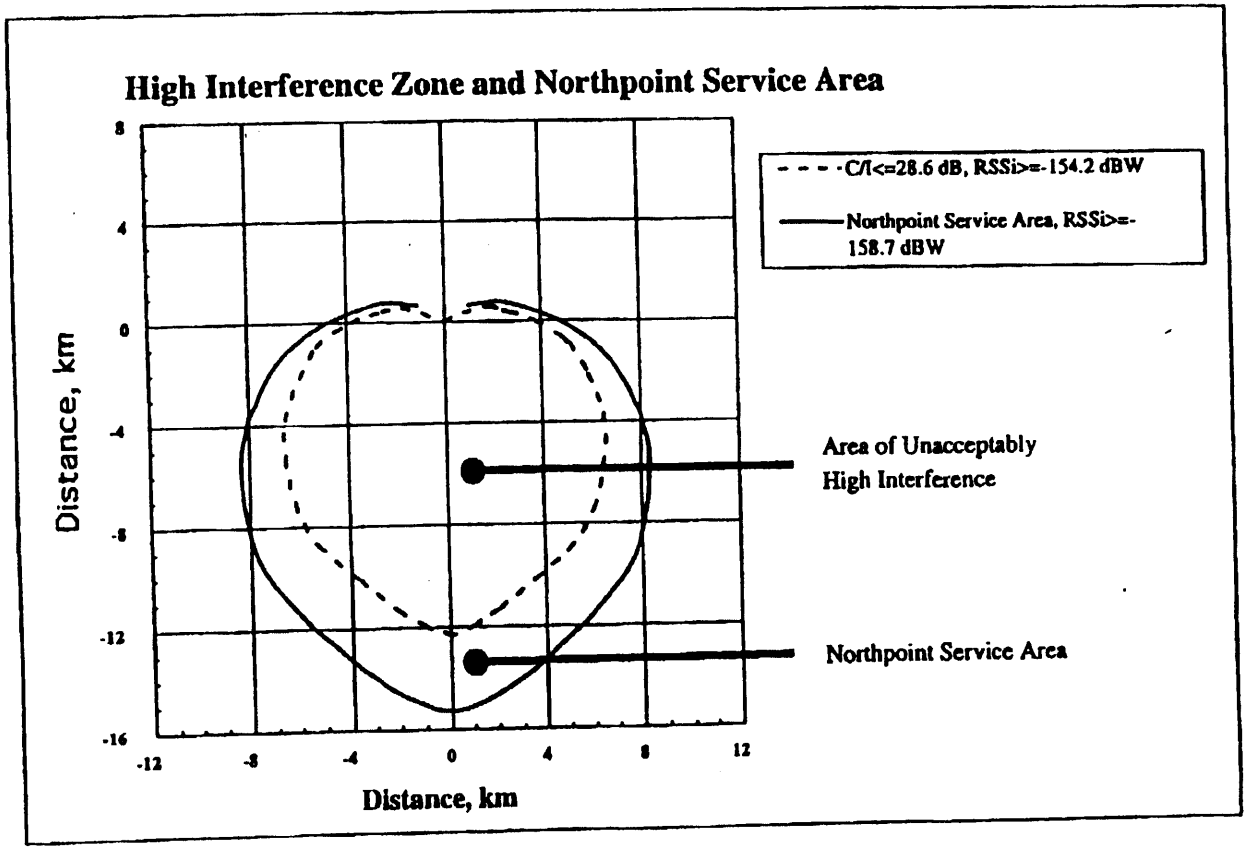
Seattle, Required C/I = 28.6 dB (n=5)

4/8/99

SOURCE: DIRECTV PRESENTATION TO THE FCC 8 APR 99

High Interference Zone Within Northpoint Service Area

DIRECTV.



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4/8/99

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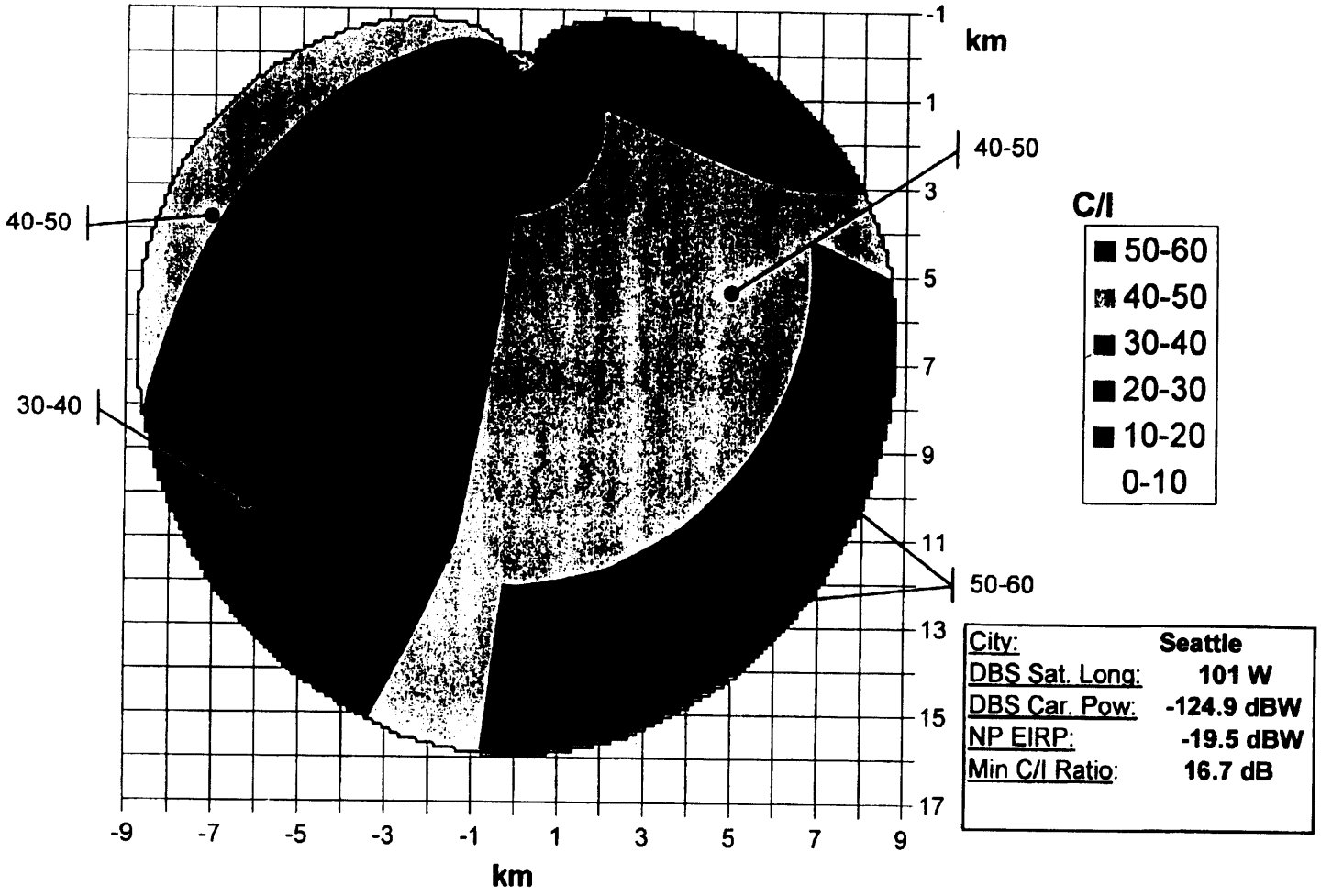
C/I into DBS

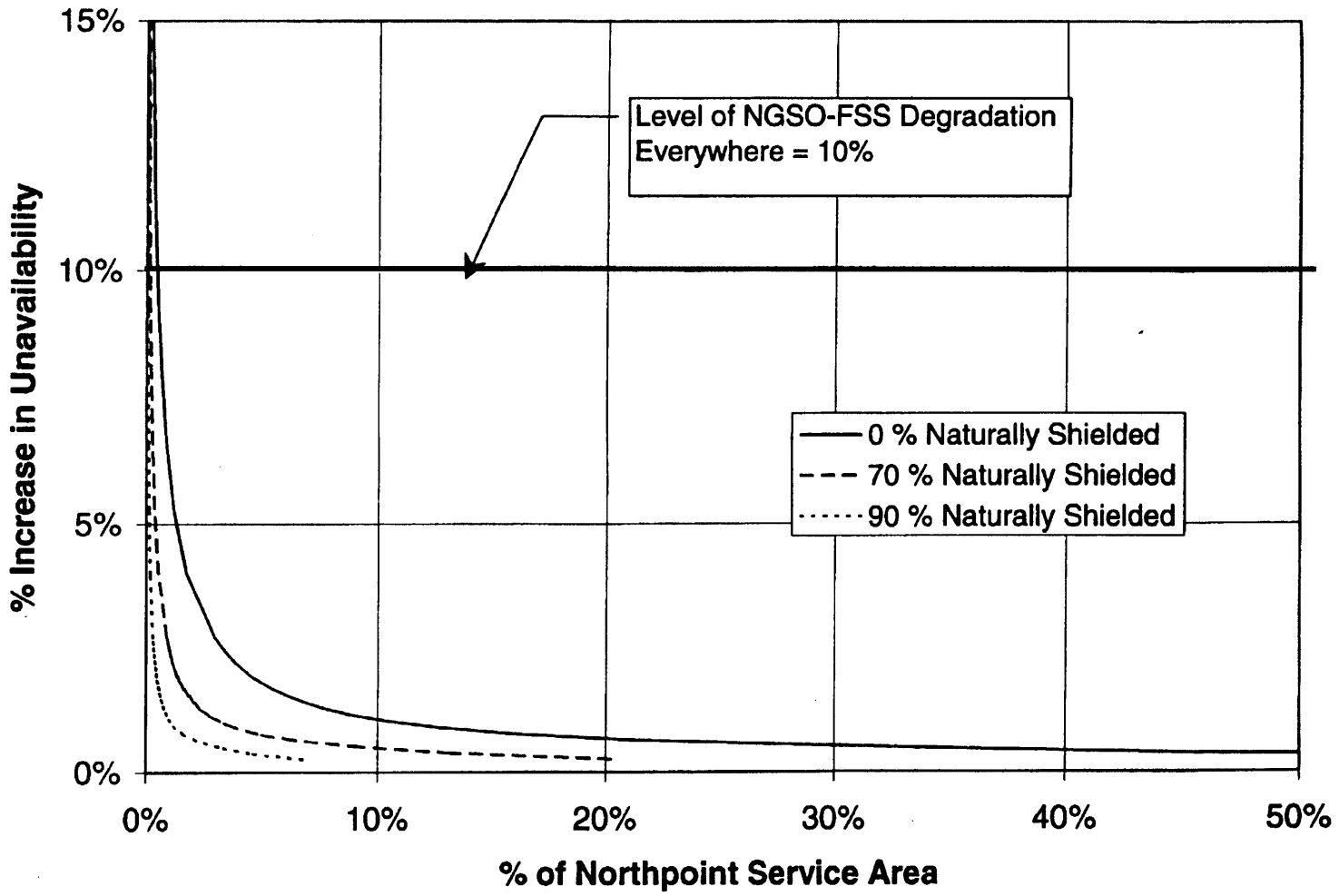


City:	Seattle
DBS Sat. Long:	101 W
DBS Car. Pow:	-124.9 dBW
NP EIRP:	-19.5 dBW
Min C/I Ratio:	16.7 dB

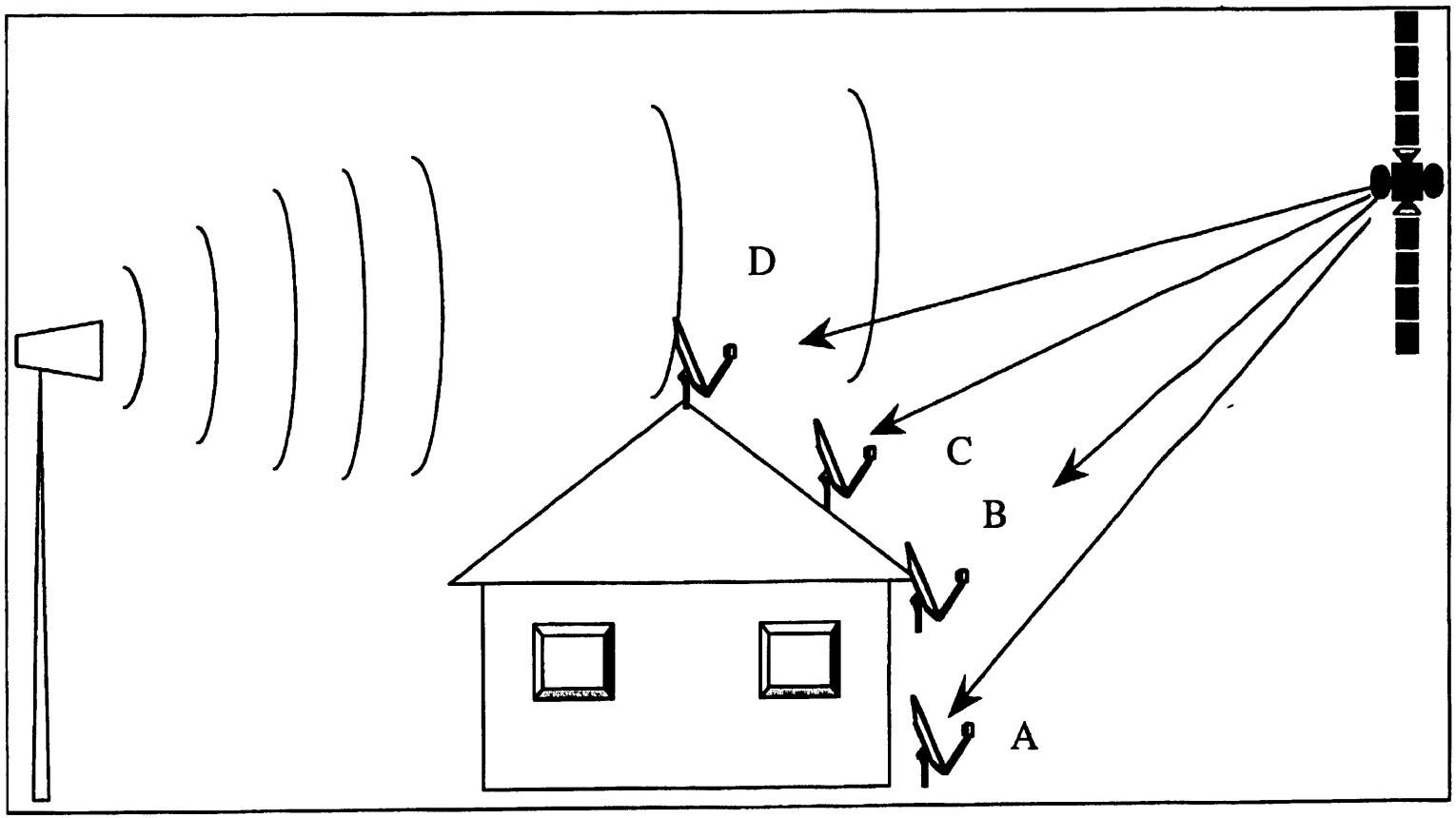
Aggregate Effect of Multiple Northpoint Transmitters

- Overlap of Northpoint service areas will not cause significant increase in interference
- Average C/I ratio into DBS is over 40 dB
- Aggregate effect is insignificant
- Example:
  - C/I of 40 dB overlap area with C/I of 20 dB
  - Aggregate C/I is 19.95 dB

Northpoint Impact on DBS

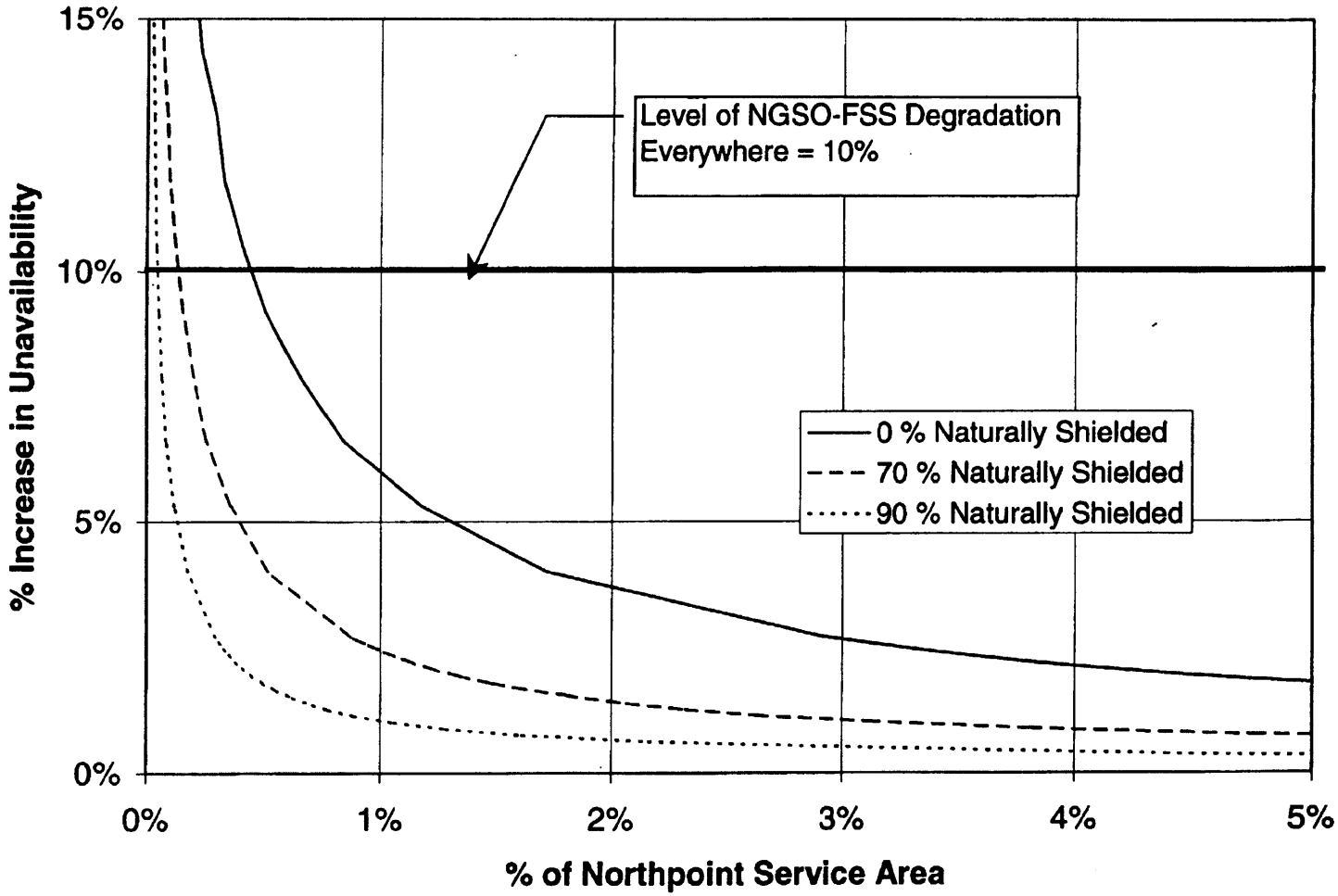


Natural Shielding



Most Common Installations (A, B, C) Naturally Shielded

Effect of Natural Shielding



Summary of Sharing with DBS

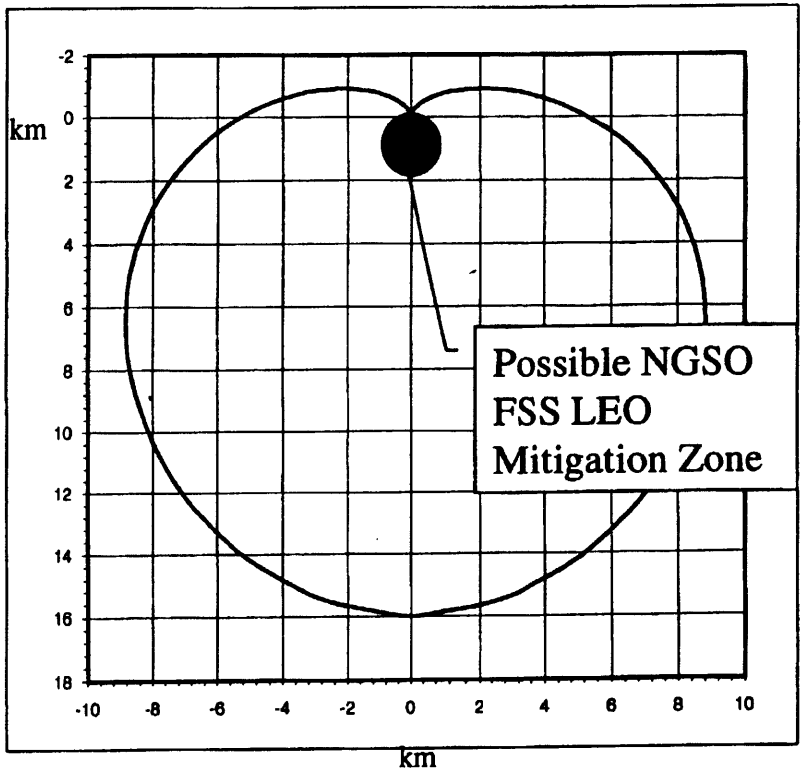
- Far from causing harmful interference, Northpoint has very little effect on DBS
  - DIRECTV's claims to the contrary are based upon flawed assumptions
- Northpoint meets proposed sharing criteria
- Authorization of Northpoint will create at least 105 GHz of new spectrum capacity for services in the United States

Northpoint Sharing with NGSO FSS

- Northpoint and NGSO FSS are both primary services
- Each service assumes burden of sharing
- There are no exclusion zones for NGSO FSS with use of alternate beam assignment
- Alternate Beam Assignment allows interference free operation of NGSO FSS
  - ABA is not a burden for NGSO FSS operations

Alternate Beam Assignment

- NGSO FSS Propose 11.7 - 12.7 GHz for service links using 6-10 beams
- NGSO FSS select frequencies for each customer up to 100 times per day -- as a matter of course during satellite hand-over.
- Location of Northpoint transmitter is fixed, and may be surrounded by a small NGSO FSS mitigation zone.
- Through ABA, NGSO FSS utilize 11.7 - 12.2 GHz in mitigation zone
- Note: NGSO FSS LEO systems have the largest mitigation zones. Zones for MEO and HEO systems are much smaller



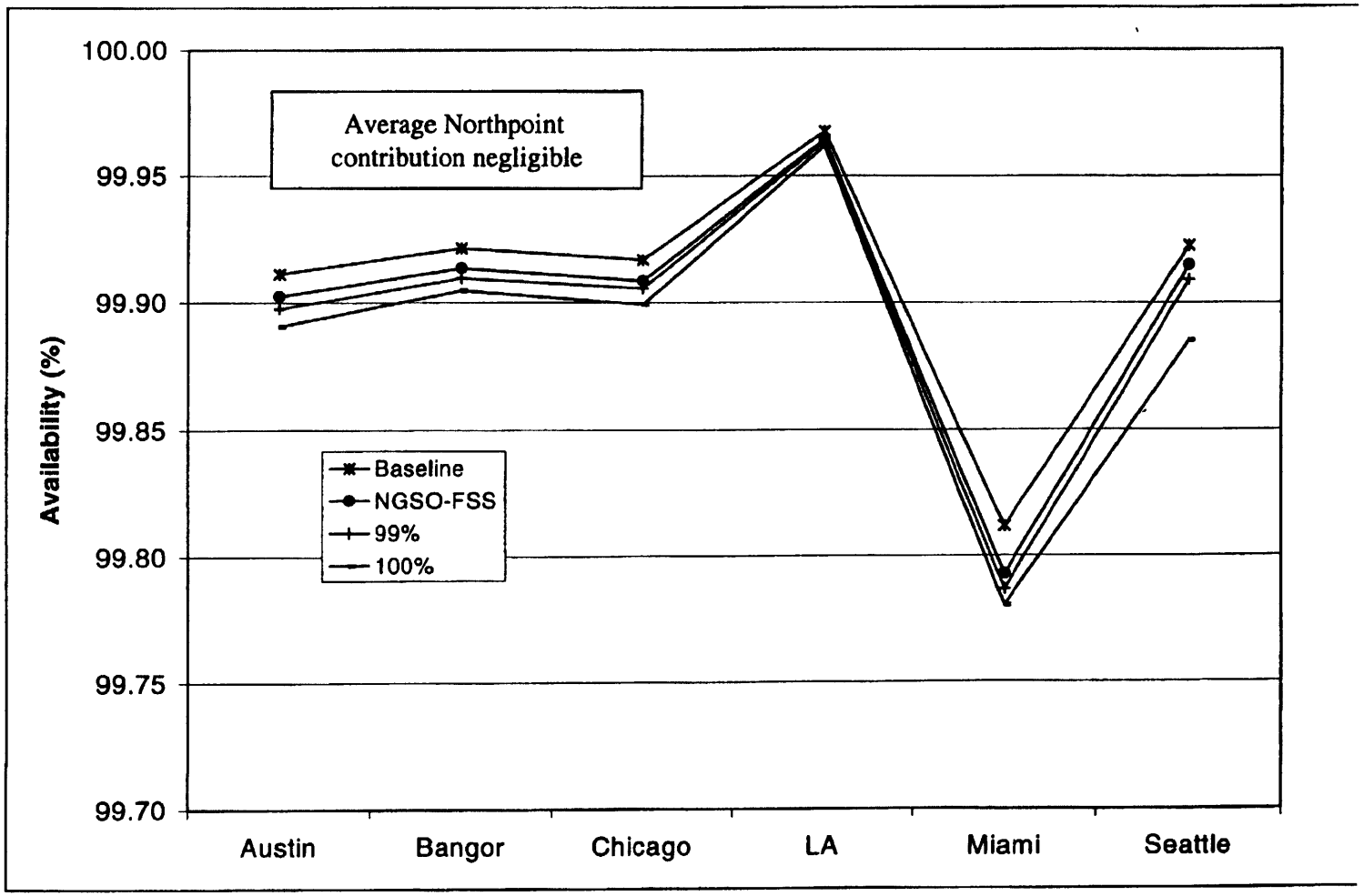
Summary of Sharing with NGSO FSS

- With alternate beam assignment, the Commission can have flexibility to:
  - Authorize both Northpoint and NGSO FSS applicants
  - Regardless of system design
- Northpoint will support ITU studies on sharing between Northpoint type systems and the NGSO FSS (All studies to date focus on point-to-point microwave relay type systems.)
- Conclusion: Northpoint and NGSO FSS are not mutually exclusive

Composite Sharing
BSS / Northpoint / NGSO FSS

- BSS has accepted a 10% increase in unavailability from NGSO FSS
- Northpoint average increase in DBS unavailability is much less than 0.5%
- Northpoint contribution to increased unavailability is insignificant compared with other sources of interference

Composite Availability - Northpoint/BSS/NGSO FSS



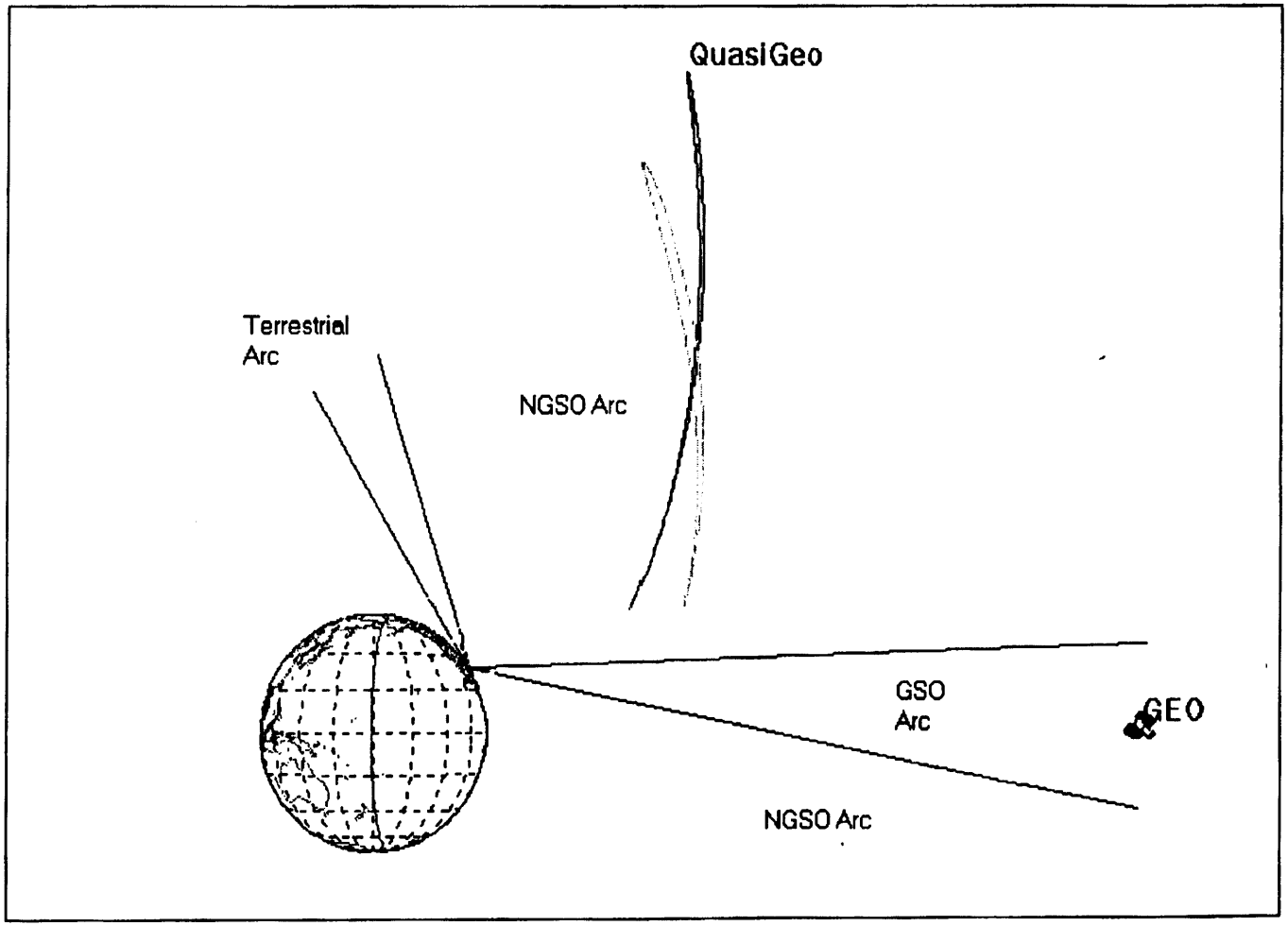
* Data and source calculations from Northpoint comments in the NPRM

Summary

- Northpoint is a new, low-power terrestrial technology
- Compatible with BSS
  - Does not cause harmful interference
  - Interference highly overestimated by DIRECTV
- Compatible with NGSO FSS

Back-Up Material

Global View of Sharing

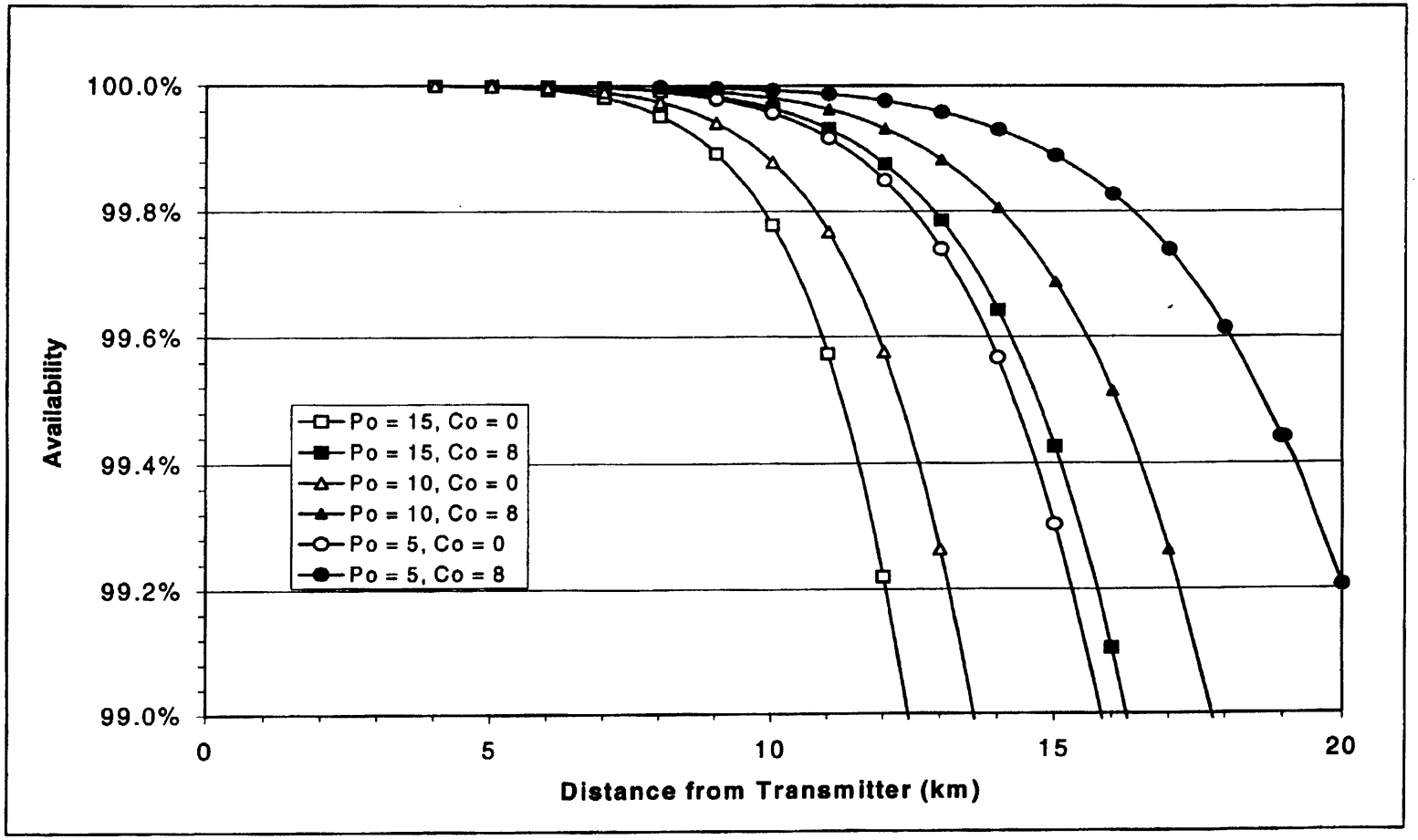


Coordination Area for various NGSO FSS Systems

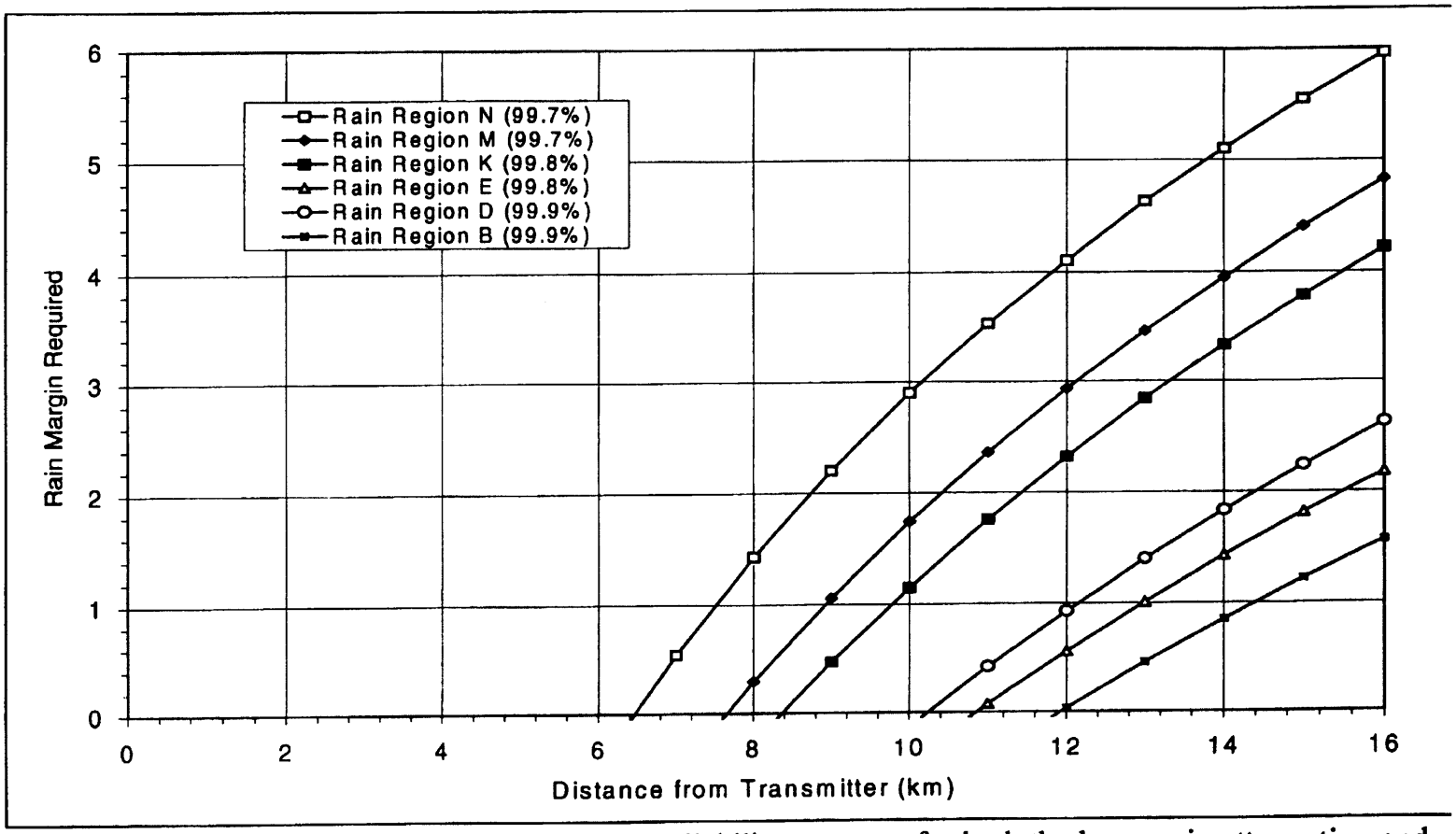
System	Area (km^2)	% of Northpoint Service Area
Skybridge	19.46	8.3 %
Hughes NET	10.87	4.6 %
Hughes LINK	3.72	1.6 %
Teledesic	1.34	0.6 %
Denali	0.16	0.07 %
Boeing IDS	0.13	0.06 %
Boeing BDS	0.13	0.06 %
Virgo	0.12	0.05 %

Northpoint Service Area = 230 km^2

Northpoint Availability in fading conditions



Northpoint Rain Margin Requirements



The rain margin required to meet specified availability accounts for both the lower rain attenuation and change in path loss over 16 km distance.

Worst-Case C/I Ratios: Variation DBS Gain Towards Northpoint