Approved by OMB
3060-0440
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FEDERAL COMMUNICATIONS COMMISSION

FEE PROCESSING FORM

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Please read instructions on back of this form before completing it. Section I MUST be completed. If you are applying for concurrent actions which require you to list more than one Fee Type Code, you must also complete Section II. This form must accompany all payments. Only one Fee Processing Form may be submitted per application or filing. Please type or print legibly. All required blocks must be completed or application/filing will be returned without action.

SECTION I

APPLICANT NAME (Last, first, middle initial)
Satellite CD Radio, Inc.

58-DSS-AMEND-90

MAILING ADDRESS (Line 1) (Maximum 35 characters - refer to instruction (2) on reverse of form)
Wiley, Rein & Fielding (M. Yourshaw)

RECEIVED
AUG 3 1990
Domestic Facilities Division
Satellite

MAILING ADDRESS (Line 2) (if required) (Maximum 35 characters)
1776 K Street, N.W.

CITY
Washington

STATE OR COUNTRY (if foreign address)	ZIP CODE	CALL SIGN OR OTHER FCC IDENTIFIER (if applicable)
D.C.	20006	

Enter in Column (A) the correct Fee Type Code for the service you are applying for. Fee Type Codes may be found in FCC Fee Filing Guides. Enter in Column (B) the Fee Multiple, if applicable. Enter in Column (C) the result obtained from multiplying the value of the Fee Type Code in Column (A) by the number entered in Column (B), if any.

	(A) FEE TYPE CODE	(B) FEE MULTIPLE (if required)	(C) FEE DUE FOR FEE TYPE CODE IN COLUMN (A)	FOR FCC USE ONLY
(1)	C W Y		$1,000.00	

SECTION II — To be used only when you are requesting concurrent actions which result in a requirement to list more than one Fee Type Code.

	(A) FEE TYPE CODE	(B) FEE MULTIPLE (if required)	(C) FEE DUE FOR FEE TYPE CODE IN COLUMN (A)	FOR FCC USE ONLY
(2)			$	
(3)			$	
(4)			$	
(5)			$	

ADD ALL AMOUNTS SHOWN IN COLUMN C, LINES (1) THROUGH (5), AND ENTER THE TOTAL HERE. THIS AMOUNT SHOULD EQUAL YOUR ENCLOSED REMITTANCE. →

TOTAL AMOUNT REMITTED WITH THIS APPLICATION OR FILING	FOR FCC USE ONLY
$	

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FCC Form 159
May 1990

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

In the Matter of the Application of	)	
SATELLITE CD RADIO, INC.	)	File No. SS-DSS-AMEND-90
For Authority to Construct, Launch and Operate a Space Station in the Satellite Sound Broadcasting Service	)	

AMENDMENT TO SATELLITE SYSTEM PROPOSAL AND APPLICATIONS TO CONSTRUCT, LAUNCH AND OPERATE SPACE STATIONS IN THE SATELLITE SOUND BROADCASTING SERVICE AT 121° WEST LONGITUDE

SATELLITE CD RADIO, INC.

Peter J. Dolan
President

Techworld Plaza
800 K Street, N.W.
Suite 750
Washington, D.C. 20001-8000
(202) 408-0080

July 17, 1990

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

In the Matter of the Application of	)	
SATELLITE CD RADIO, INC.	)	File No.
For Authority to Construct, Launch and Operate a Space Station in the Satellite Sound Broadcasting Service	)	

AMENDMENT TO SATELLITE SYSTEM PROPOSAL

Satellite CD Radio, Inc. hereby amends the above-captioned Satellite System Proposal filed on May 18, 1990 in connection with two applications to construct, launch and operate two satellites in geostationary orbit, including one at 121° West Longitude, providing nationwide digital, CD-quality radio service in the 1470-1530 MHz band. The Satellite System Proposal is amended as follows:

1. Section VI, "Legal Qualifications," is amended by replacing subsections A and B on pages 6-7 with the following:

VI. LEGAL QUALIFICATIONS

A. Ownership

Satellite CD Radio, Inc. ("CD Radio, Inc.") is a corporation organized under the laws of Delaware for the primary purpose of entering the domestic broadcasting satellite (sound) business. 100 percent of the stock of CD Radio, Inc. will be held by Era-Mar, Inc., a Delaware

corporation engaged primarily in the technology development business.

MARCOR, a District of Columbia corporation engaged primarily in the technology and market development business, will hold 75 percent of the stock of Era-Mar, Inc. 100 percent of the stock of MARCOR is held by Martin A. Rothblatt, who is a U.S. citizen.

New Era Corp., a Delaware corporation engaged primarily in the business of technology development, will hold 25 percent of the stock of Era-Mar, Inc. and warrants exercisable to purchase an additional 25 percent of the corporation's stock on a fully-diluted basis. Upon exercise of the warrants held by New Era Corp., it would hold 50 percent of the stock of Era-Mar, Inc., and MARCOR would hold the remaining 50 percent.

100 percent of the stock of New Era Corp. is held by Jean-Jacques Poutrel, who is a citizen of France. Grant of this application is not subject to the alien ownership restrictions of Section 310(b) of the Communications Act of 1934, as amended, because CD Radio, Inc. will be licensed as a private carrier. Even if the service to be offered by CD Radio, Inc. were to be determined to be subject to Section 310(b), however, New Era Corp.'s 25 percent stock holding in Era-Mar, Inc. would be in full compliance with Section 310(b)(4). The warrants to be held by New Era, Inc., which will include standard investor protection provisions, will not be exercisable if to ~~do so~~ would result in aggregate stockholdings by non-U.S. persons in violation of the limitations of Section 310(b).

B. FCC Form 430

CD Radio, Inc.'s legal qualifications are demonstrated in the FCC Form 430, "Common Carrier and Satellite Radio Licensee Qualification Report," attached hereto as revised Appendix 2.

2. Section IV, "Technical Qualifications," on page 4, is amended by incorporating the "Supplement to Petition for Rule Making" filed by CD Radio, Inc. on June 22, 1990, a copy of which is attached hereto as new Appendix 4. The Supplement contains additional information pertaining to CD Radio,

Inc.'s proposed frequency plan, sharing between broadcasting-satellite sound and aeronautical telemetry, the design of the vehicular receiver, and advance publication under RR 1042.

3. Section V, "Financial Qualifications," is amended by replacing it with the following:

V. FINANCIAL QUALIFICATIONS

The Board of CD Radio, Inc., represents a cross section of successful business interests in the satellite and radio fields. The principals of CD Radio have a track record of successfully financing the projects they undertake.

CD Radio, Inc.'s financial plan is attached hereto as revised Appendix 1.

Capital Costs

Total capital costs for the CD Radio System are $384.5 million, as follows:

Satellite Construction and Launch Services	$ 300 million
Launch Insurance	60 million
Terrestrial Station Network	1.5 million
Ground Uplink Station	5 million
CD Radio Development	3 million
Contingency	15 million
Total	$ 384.5 million

Source of Funds

CD Radio, Inc. will obtain its funds from a mix of debt and equity capital, most structured through a $ 384.5 million project financing facility. The financing will be leveraged upon pre-sales contracts with CD Radio, Inc. customers. Additionally, early stage financing will come from private placement and subordinated debt financing.

SATELLITE CD RADIO, INC.

By: _____
Peter J. Dolan
President

Techworld Plaza
800 K Street, N.W.
Suite 750
Washington, D.C. 20001-8000
(202) 408-0080

July 17, 1990

Satellite CD Radio, Inc.
Private Digital Satellite
Sound Broadcasting Application
Revised July 17, 1990

Appendix 1

Financial Plan

CD RADIO, INC.
Return to Investors
(in millions)

Exit Year	1996	Low Case	High Case
Exit year EBIT		145.08	145.08
Exit Multiple		6.00	8.00
Company Value		870.50	1,160.67
Add: Excess Cash		117.40	117.40
Total		987.90	1,278.06
Less:			
Senior Debt		329.57	329.57
Subordinated Debt		4.29	4.29
Working Capital Line		2.00	2.00
Available Cash		660.61	950.78
Split:			
Debt financing	20.00%	132.12	190.16
Common Shareholders	80.00%	528.49	760.62

CD RADIO, INC.
Income Statement
(In millions)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Revenues																	
Channel sales	0.00	0.00	0.00	0.00	53.46	106.92	178.20	178.20	178.20	178.20	178.20	178.20	178.20	178.20	178.20	178.20	178.20
Facility Maintenance Fee	0.00	0.00	0.00	0.00	1.80	3.60	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Revenues	0.00	0.00	0.00	0.00	55.26	110.52	184.20	184.20	184.20	184.20	184.20	184.20	184.20	184.20	184.20	184.20	184.20
Operating Expenses																	
Satellite System	0.00	0.00	0.00	0.00	1.59	2.66	4.09	4.09	4.09	4.09	4.09	4.09	4.09	4.09	4.09	4.09	4.09
General & Admin	0.00	0.70	0.94	1.20	2.24	2.49	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99
Depreciation	0.02	0.05	2.63	10.88	24.13	29.54	32.04	32.04	32.04	32.04	32.04	32.04	32.03	31.99	29.42	21.17	7.92
Total Operating Expenses	0.02	0.75	3.57	12.08	27.96	34.69	39.12	39.12	39.12	39.12	39.12	39.12	39.10	39.07	36.49	28.24	14.99
EBIT	-0.02	-0.75	-3.57	-12.08	27.30	75.83	145.08	145.08	145.08	145.08	145.08	145.08	145.10	145.13	147.71	155.96	169.21
Non-Operating Expenses																	
Interest	0.00	0.03	1.78	5.80	19.07	39.37	47.45	43.83	36.32	28.81	21.42	14.28	7.14	0.00	0.00	0.00	0.00
Amortization	0.00	0.00	0.00	0.00	0.40	0.40	0.40	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Non-Operating Expenses	0.00	0.03	1.78	5.80	19.47	39.77	47.85	44.23	36.72	28.81	21.42	14.28	7.14	0.00	0.00	0.00	0.00
Pre-Tax Income	-0.02	-0.77	-5.34	-17.87	7.83	36.06	97.24	100.85	108.36	116.28	123.66	130.80	137.96	145.13	147.71	155.96	169.21
Income Taxes	0.00	0.00	0.00	0.00	0.00	18.28	34.03	35.30	37.93	40.70	43.28	45.78	48.29	50.80	51.70	54.59	59.22
NET INCOME	-0.02	-0.77	-5.34	-17.87	7.83	17.78	63.20	65.55	70.44	75.58	80.38	85.02	89.67	94.34	96.01	101.37	109.99

ASSUMPTIONS:

1	Satellite channel loading	
	1st yr	30%
	2nd yr	60%
	3rd yr	100%
2	Number of satellites	2
3	Satellite channel capacity	99
4	Channel sale/lease price	9.00
	Annual installments	0.90
5	System equipment useful life	12
6	Income tax rate	35%
7	Facility maintenance fee (total)	6.00

CD RADIO, INC.
Cash Flow Statement
(in millions)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Begining Cash	0.00	2.25	11.03	7.81	3.89	33.82	79.11	117.40	158.04	203.56	254.82	312.31	374.45	441.22	567.55	692.97	815.51
Sources Of Funds																	
Net Income	-0.02	-0.77	-5.34	-17.87	7.83	17.78	63.20	65.55	70.44	75.58	80.38	85.02	89.67	94.34	96.01	101.37	109.99
Non- Cash Items																	
Depreciation	0.02	0.05	2.63	10.88	24.13	29.54	32.04	32.04	32.04	32.04	32.04	32.04	32.03	31.99	29.42	21.17	7.92
Amortization	0.00	0.00	0.00	0.00	0.40	0.40	0.40	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Funds From Operations	0.00	-0.72	-2.72	-7.00	32.36	47.72	95.65	97.99	102.88	107.62	112.42	117.06	121.70	126.33	125.43	122.54	117.90
Founders Capital	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mezzanine Capital	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Subordinated Debt Financing	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Senior Debt Financing	0.20	0.40	30.90	99.00	159.00	65.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Working Capital Line	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Sources	2.95	9.68	28.18	97.01	191.36	112.72	125.65	97.99	102.88	107.62	112.42	117.06	121.70	126.33	125.43	122.54	117.90
Uses Of Funds																	
Capital Asset Acquisition	0.20	0.40	30.90	99.00	159.00	65.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Organizational Costs	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Debt Amortization	0.00	0.00	0.00	1.43	2.43	2.43	57.36	57.36	57.36	56.36	54.93	54.93	54.93	0.00	0.00	0.00	0.00
Working Capital Requirements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Uses	0.70	0.90	31.40	100.93	161.43	67.43	87.36	57.36	57.36	56.36	54.93	54.93	54.93	0.00	0.00	0.00	0.00
Ending Cash	2.25	11.03	7.81	3.89	33.82	79.11	117.40	158.04	203.56	254.82	312.31	374.45	441.22	567.55	692.97	815.51	933.42

CD RADIO, INC.
Capital Asset Acquisitions
(in millions)

Capital Asset	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Satellite Construction and Launch Services:																	
System I	0.00	0.00	15.00	45.00	45.00	30.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
System II	0.00	0.00	15.00	45.00	45.00	30.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	30.00	90.00	90.00	60.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Launch Insurance	0.00	0.00	0.00	0.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Terrestrial Station Network	0.10	0.20	0.20	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ground Uplink Station	0.00	0.00	0.00	2.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CD Radio Development	0.10	0.20	0.70	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Contingency	0.00	0.00	0.00	5.00	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Capital Costs	0.20	0.40	30.90	99.00	159.00	65.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ASSUMPTIONS:

1	Satellite hardware and launch costs	150.00
2	Satellite purchase schedule:	
	1992	10%
	1993	30%
	1994	30%
	1995	20%
	1996	10%
3	Launch Insurance - % of cost	20%

Assumptions:

1	Interest rate-Senior	13%
	Interest rate-Subordinated	17%
2	Debt term-years	7
3	Senior Debt Terms:	
	Interest only 1990 - 1996	

CD RADIO, INC.
Schedule of Operating Expenses
(in thousands)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Control Center																	
Salaries & Wages	0	0	0	0	250	250	250	250	250	250	250	250	250	250	250	250	250
Taxes & Benefits	0	0	0	0	75	75	75	75	75	75	75	75	75	75	75	75	75
Telephone & Utilities	0	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100
Information Systems	0	0	0	0	50	50	50	50	50	50	50	50	50	50	50	50	50
In-orbit Insurance	0	0	0	0	1,069	2,138	3,564	3,564	3,564	3,564	3,564	3,564	3,564	3,564	3,564	3,564	3,564
Other	0	0	0	0	50	50	50	50	50	50	50	50	50	50	50	50	50
Total	0	0	0	0	1,594	2,663	4,089	4,089	4,089	4,089	4,089	4,089	4,089	4,089	4,089	4,089	4,089
General & Administrative																	
Management fee	0	0	0	0	750	1,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Salaries & Wages	0	150	300	500	720	720	720	720	720	720	720	720	720	720	720	720	720
Taxes & benefits	0	45	90	150	216	216	216	216	216	216	216	216	216	216	216	216	216
Insurance	0	0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Professional fees	0	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Telephone & Utilities	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Office Expense	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Other	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Total	0	695	940	1,200	2,236	2,486	2,986	2,986	2,986	2,986	2,986	2,986	2,986	2,986	2,986	2,986	2,986

ASSUMPTIONS

		Pres	Eng	F&A	Mkt	Total
1	Compensation - Headquarters					
	Executive #	1	1	1	1	4
	Executive $	125	90	75	75	365
	Staff #	1	2	3	2	8
	Staff $	30	125	120	80	355
	Total	155	215	195	155	720
	Compensation - Control Center					
	Staff #	0	4	0	0	4
	Satff $	0	250	0	0	250
2	In-orbit Insurance - % of annual installments		2%			

CD RADIO, INC.
Balance Sheet
(in millions)

ASSETS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Cash	2.25	11.03	7.81	3.89	33.82	79.11	117.40	158.04	203.56	254.82	312.31	374.45	441.22	567.55	692.97	815.51	933.42
Other Current Assets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Current Assets	2.25	11.03	7.81	3.89	33.82	79.11	117.40	158.04	203.56	254.82	312.31	374.45	441.22	567.55	692.97	815.51	933.42
Communications Equipment	0.20	0.60	31.50	130.50	289.50	354.50	384.50	384.50	384.50	384.50	384.50	384.50	384.50	384.50	384.50	384.50	384.50
Accumulated Depreciation	-0.02	-0.07	-2.69	-13.57	-37.69	-67.23	-99.28	-131.32	-163.36	-195.40	-227.44	-259.48	-291.51	-323.50	-352.92	-374.08	-382.00
Organization Costs	0.50	1.00	1.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Accumulated Amortization	0.00	0.00	0.00	0.00	-0.40	-0.80	-1.20	-1.60	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00	-2.00
Total Fixed Assets	0.68	1.53	30.31	118.93	253.41	288.47	286.03	253.58	221.14	189.10	157.06	125.02	92.99	61.00	31.58	10.42	2.50
TOTAL ASSETS	2.93	12.56	38.12	122.82	287.22	367.58	403.42	411.62	424.70	443.92	469.37	499.47	534.21	628.55	724.56	825.93	935.92
LIABILITIES AND EQUITY																	
Senior Debt	0.20	0.60	31.50	130.50	289.50	354.50	329.57	274.64	219.71	164.79	109.86	54.93	0.00	0.00	0.00	0.00	0.00
Subordinated Debt	0.00	10.00	10.00	8.57	7.14	5.71	4.29	2.86	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Working Capital Line	0.00	0.00	0.00	5.00	4.00	3.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Liabilities	0.20	10.60	41.50	144.07	300.64	363.21	335.86	278.50	221.14	164.79	109.86	54.93	0.00	0.00	0.00	0.00	0.00
Common Stock	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Retained Earnings	-0.02	-0.79	-6.13	-24.00	-16.17	1.61	64.82	130.37	200.81	276.39	356.77	441.79	531.46	625.80	721.81	823.18	933.17
Total Equity	2.73	1.96	-3.38	-21.25	-13.42	4.36	67.57	133.12	203.56	279.14	359.52	444.54	534.21	628.55	724.56	825.93	935.92
TOTAL LIABILITIES & EQUITY	2.93	12.56	38.12	122.82	287.22	367.58	403.42	411.62	424.70	443.92	469.37	499.47	534.21	628.55	724.56	825.93	935.92

CD RADIO, INC.
Debt Service Schedule
(in millions)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Senior Debt																	
Begining Balance	0.00	0.20	0.60	31.50	130.50	289.50	354.50	329.57	274.64	219.71	164.79	109.86	54.93	0.00	0.00	0.00	0.00
Additions	0.20	0.40	30.90	99.00	159.00	65.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Required Principal	0.00	0.00	0.00	0.00	0.00	0.00	54.93	54.93	54.93	54.93	54.93	54.93	54.93	0.00	0.00	0.00	0.00
Additional Principal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ending Balance	0.20	0.60	31.50	130.50	289.50	354.50	329.57	274.64	219.71	164.79	109.86	54.93	0.00	0.00	0.00	0.00	0.00
Subordinated Debt																	
Begining Balance	0.00	0.00	10.00	10.00	8.57	7.14	5.71	4.29	2.86	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Additions	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Required Principal	0.00	0.00	0.00	1.43	1.43	1.43	1.43	1.43	1.43	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Additional Principal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ending Balance	0.00	10.00	10.00	8.57	7.14	5.71	4.29	2.86	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Working Capital Line																	
Begining Balance	0.00	0.00	0.00	0.00	5.00	4.00	3.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Additions	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Required Principal	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Additional Principal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ending Balance	0.00	0.00	0.00	5.00	4.00	3.00	2.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest Expense																	
Senior Debt	0.00	0.03	0.08	4.10	16.97	37.64	46.09	42.84	35.70	28.56	21.42	14.28	7.14	0.00	0.00	0.00	0.00
Subordinated Debt	0.00	0.00	1.70	1.70	1.46	1.21	0.97	0.73	0.49	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Worling Capital Line	0.00	0.00	0.00	0.00	0.65	0.52	0.39	0.26	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.03	1.78	5.80	19.07	39.37	47.45	43.83	36.32	28.81	21.42	14.28	7.14	0.00	0.00	0.00	0.00
Principal Payments																	
Senior Debt	0.00	0.00	0.00	0.00	0.00	0.00	54.93	54.93	54.93	54.93	54.93	54.93	54.93	0.00	0.00	0.00	0.00
Subordinated Debt	0.00	0.00	0.00	1.43	1.43	1.43	1.43	1.43	1.43	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Worling Capital Line	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	1.43	2.43	2.43	57.36	57.36	57.36	56.36	54.93	54.93	54.93	0.00	0.00	0.00	0.00

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

In the Matter of

Amendment of Parts 2 and 25 of the Commission's Rules to Establish a Satellite and Terrestrial CD Quality Broadcasting Service	))))	RM-7400

COMMENTS OF THE NATIONAL ASSOCIATION OF BROADCASTERS

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August 20, 1990

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EXECUTIVE SUMMARY

NAB strongly opposes Petitioner's request for spectrum allocation and inauguration of a proposed, hybrid, space satellite and terrestrial system for digital audio broadcasting. The issues raised by Petitioner are but a few of the many matters which are the subject of: (1) the agency's newly initiated inquiry proceeding on digital radio; (2) this country's preparatory activities relating to the 1992 World Adminstrative Radio Conference (WARC-92), where digital radio broadcasting is one of the key issues for international decisionmaking; and (3) the study of a blue ribbon NAB Committee charged with the responsibility to review digital radio and aid the Association in our own assessment of the technology.

In light of the domestic inquiry and the pendency of WARC-92, any positive action on petitioner's request simply would be premature. Moreover, NAB's comments today point to myriad policy and technical infirmities in the Satellite CD plan. These problems range from transmission system uncertainties and receiver complexities to a basic conflict with the fundamental precepts of Section 307 (b) of the Communications Act -- a statutory provision which has guided the establishment of universal yet locally oriented broadcast service in this country.

We recommend that the agency dismiss or simply defer consideration of the subject petition. The Commission should focus its energies, instead, on the broad range of domestic and international policymaking and allocations planning which must precede any consideration of an actual domestic spectrum reallocation for any such digital service.

Before the
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In the Matter of

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COMMENTS OF THE
NATIONAL ASSOCIATION OF BROADCASTERS

I. INTRODUCTION

On June 18, 1990, the Commission placed on public notice a Petition for Rule Making ("Petition"), submitted by Satellite CD Radio, Inc. ("Satellite CD" or "Petitioner"), that seeks the allocation of spectrum for a satellite-delivered digital sound broadcasting service.[1/] Especially in light of the Commission's subsequent inauguration of a broad inquiry on digital audio broadcasting ("DAB"),[2/] the National Association of Broadcasters ("NAB")[3/] finds the request by Petitioner to be

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[1/] Public Notice, "Office of the Secretary: Petitions for Rule Making Filed," June 18, 1990. Subsequently, the Commission acknowledged Petitioner's filing of a June 22, 1990, Supplement to Request for Rule Making, Public Notice "Office of the Secretary: Petition for Rule Making Filed," July 9, 1990.

[2/] See Notice of Inquiry in Gen. Docket No. 90-357, FCC 90-281, adopted August 1, 1990. NAB applauds the initiation of this inquiry as a meaningful first step in determining whether a DAB system would be beneficial to the public.

[3/] NAB is a nonprofit, incorporated association of radio and television broadcast stations and networks. NAB serves and represents America's radio and television stations and all the major networks. NAB's comments today are filed timely in light of the agency's grant of extension of time requests submitted by NAB and by the Aircraft Flight Test Radio Coordinating Council. (Order Granting Extension of Time (DA 90-943) adopted by the FCC Chief Engineer on July 12, 1990.)

inappropriate and premature. NAB urges the Commission to dismiss the Petition without prejudice or, in the alternative, hold the Petition in abeyance until after completion of the Inquiry and the World Administrative Radio Conference ("WARC") proceedings slated for 1992.[4/]

As explained below, NAB considers digital radio to be among the most important topics currently being discussed among broadcasters and government regulators. Consequently, we are taking several steps to ensure full broadcaster participation in those proceedings and in international conferences where digital radio is at issue. Key to domestic and international decisionmaking is thorough technical and policy assessment. These factors would be compromised were the Commission to grant petitioner's request here.

II. GOVERNMENT AND INDUSTRY RESOURCES SHOULD BE DEDICATED TO POLICY DEVELOPMENT AND INTERNATIONAL CONFERENCE PREPARATION, NOT TO THE PREMATURE INAUGURATION OF AN UNTRIED SERVICE.

NAB has given high priority status to the matter of digital radio. A major facet of NAB's approach to digital radio is our view that this technology should be considered as yet another potentially useful enhancement of the existing radio service -- in the same manner that reasonable power increases,[5/]

[4/] See, e.g., Notice of Inquiry in Gen. Docket No. 89-554, 4 FCC Rcd 8546 (1989).

[5/] See Report and Order in BC Docket No. 79-265, 55 R.R.2d (P&F) 1015 (1984) (Class IV AM power increase); Report and Order in MM Docket No. 87-131, 2 FCC Rcd 7113 (1987) (Class III daytimer nighttime operation); and Report and Order in MM Docket No. 88-375, 4 FCC Rcd 2792 (1989) (Class A FM power increase).

stereophonic sound[6/] and the AM NRSC standards[7/] have improved the public's radio service. The agency's plan for additional AM Improvement and prospective migration of existing stations to the expanded AM band[8/] should continue this progression. Petitioner's plan for FCC adoption of an entirely new scheme for a new service runs counter to long-standing Commission policies of enhancing public service through existing services and licensees. Also, it is unnecessary for the Commission to consider adopting any radical departures from its very successful and statutorily based policies for authorizing broadcast service and enhancements to this service.[9/]

A related, key element in the NAB position -- and one which will be the touchstone for most of our decisionmaking and advocacy on digital radio -- is NAB's opposition to space satellite delivery of digital radio transmission directly to the

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[6/] See, e.g., Report and Order in Docket No. 13506, 21 R.R. (P&F) 1605 (1961)(FM Stereo authorization); and Report and Order in Docket No. 21313, 51 R.R.2d (P&F) 1 (1982) (AM Stereo authorization). See also Notice of Proposed Rule Making in MM Docket No. 87-267, adopted April 12, 1990.

[7/] See, e.g., Report and Order in MM Docket No. 88-376, 4 FCC Rcd 3835 (1989).

[8/] See Notice of Proposed Rule Making in MM Docket 87-267, supra note 6.

[9/] In this regard, we believe the Commission should reject the tortured Title II/Title III regulatory approach advanced by Petitioner. Its complexity and structure are simply unnecessary to afford a possible CD quality enhancement of the public's radio broadcast service. As NAB will address more fully in its comments in the Commission's digital radio inquiry, we believe that a potential move toward terrestrial-only digital transmission can be accomplished using much the same procedures and underlying allocations/assignment policies as have been employed by the agency for some time.

listener. Such a proposal -- as advanced by Petitioner here -- would be in direct contravention of the principles of broadcast localism,[10/] that have guided the development of the American system of radio broadcasting. Moreover, and as explained below, space satellite delivery would be far less spectrum efficient than potential terrestrial delivery of a digital broadcast signal to the consumer.

Demonstrating NAB's resolve to participate fully in government activities relating to digital radio, NAB already has filed comments in the Commission's WARC-92 inquiry proceeding.[11/] Also, we are represented on the Industry Advisory Committee for the 1992 ITU World Administrative Radio Conference and are participating in several informal working party meetings. We consider these preparatory and policymaking efforts to be critical to our industry and to our nation as we approach the 1992 WARC conference. NAB will continue to play an active role in these government-related activities.

In order to foster NAB's evaluation of the myriad digital radio issues that now are emerging -- and are encompassed in the Commission's Notice of Inquiry -- NAB has established a blue ribbon committee to conduct such assessment and help guide the Association. On the recommendation of that Task Force, NAB has decided to conduct an in-depth technical analysis of the

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[10/] See § 307(b) of the Communications Act of 1934, 47 U.S.C. § 307(b).

[11/] See Comments of NAB in Gen. Docket No. 89-554, filed February 16, 1990.

spectrum demands that would be created were all existing, domestic AM and FM radio stations granted digital facilities.

Just as NAB has decided to dedicate significant resources to the newly initiated digital radio inquiry proceeding -- and to this country's preparations for WARC-92 -- we believe the Commission should adopt the same priorities. To grant Petitioner's request in the midst of this fundamental domestic and international decisionmaking would be at odds with rational communications policy and common sense.

Although, as of today, the Commission has not released the full text of its Notice of Inquiry in Gen. Docket 90-357, NAB expects the inquiry proceeding to subsume the other digital-related applications and petitions filed thus far,[12/] as well as the Satellite CD petition we are addressing here. Again, the Commission should not grant any of these applications or petitions at least until it has completed its domestic inquiry and WARC-92 preparation. Indeed, the better and recommended course would be for it to forgo action on any of these petitions and applications until the conclusion of the WARC conference itself and any associated, regional satellite planning conferences.

[12/] See, e.g., Application of Radio Satellite Corp. for Authority to Construct and Operate a 3.5 Meter KU-Band Transmit-Receive Earth Station, filed May 22, 1990; Application for Authority to Construct or Make Changes in an International or Experimental Broadcast Station, filed May 23, 1990, by Strother Communications, Inc. ("Strother"); and Petition for Rule Making filed by Strother on July 26, 1990.

The Notice of Inquiry, as well as the Commission's proceedings in preparation of WARC-92, are perfect vehicles for exploring the issues embodied in the instant petition. In these proceedings, Satellite CD will have a forum to advocate its proposals. Its rights -- and the rights of other current and potential users of these frequencies -- will be fully protected.

Moreover, the Industry Advisory Committee, which includes the participation of Satellite CD, is assisting in the preparation of a U.S. position for WARC-92. Arriving at a final position as to what U.S. policy should be regarding proposals in this frequency band will be difficult and time consuming. NAB again urges the Commission to complete the WARC-92 preparatory activities before making any decisions as to which new services in this band should have priority and be the subject of specific rule making. Indeed, notions of reasoned domestic policymaking militate in favor of awaiting the results of WARC-92 to determine where, how, and if at all, a satellite-delivered broadcasting service would fit into the world picture. While the U.S. is not bound by WARC decisions, it certainly can benefit from the information and experience gained at WARC-92.

Proceeding independently of the WARC-92 process would be unsound; there is no technical or policy basis sufficient to support an immediate domestic spectrum allocation to a broadcast satellite sound service. The proposed satellite service is totally untested and unevaluated. As the past has shown, faulty and inadequate information, that could result from premature rule making, can lead to unnecessary and perhaps fallow spectrum

allocations.[13/] Furthermore, there has been no Commission determination of need for broadcast satellite digital sound which might justify a rush to judgment for the benefit of the public interest. Thus, the Commission should not act in haste to allocate the spectrum sought.

While some countries are experimenting with DAB,[14/] they have different broadcasting systems and different needs. Some countries may desire expanded radio service -- and more nationwide radio service -- because their current over-the-air broadcasting service is either underdeveloped or cannot adequately serve the entire population of the country due to geography and/or population densities. The United States is not in either predicament. Today, radio stations bring service to our entire population, with 26.4 stations reaching an average county.[15/] Our nation has come to rely on local broadcasters bringing news, information and entertainment of local interest to

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[13/] This very result occurred in Europe in 1977, when at a World Administrative Radio Conference on direct broadcast satellite service, the European countries insisted on adopting a DBS plan for all of Europe. The U.S. declined to do so, believing that new technological developments would, over the near term, change underlying regulatory assumptions. The U.S. was correct. The European plan is badly flawed, is not being used and clearly requires reexamination.

[14/] We point to, for example, the European Broadcasting Union's Eureka project, which has been ongoing for several years in Europe, and current testing of DAB by a number of Canadian organizations.

[15/] E. Cohen, "NAB National Radio Listening Study," NAB, November 2, 1988, at 3.

their local communities.[16/] This ubiquitous broadcasting infrastructure reflects a sound U.S. policy commitment to localism in radio broadcasting, which is wholly at odds with the concepts embodied in the instant Petition.[17/]

III. THERE ARE SERIOUS POLICY AND TECHNICAL INFIRMITIES IN THE SATELLITE CD PLAN.

There are many other technical and policy questions that have not been adequately addressed or, in some cases, not even addressed at all by Petitioner. First, major uncertainties surround Petitioner's proposed use of its suggested digital broadcasting technology, whether delivered terrestrially or by satellite. Satellite CD seeks a precise allocation for satellite delivered audio with specific channel plans and spectrum requirements. Yet, there have been no satellite-based experiments of any kind involving the power levels required for a true DAB satellite, either by itself or in connection with terrestrial repeaters or boosters.[18/] The experiments in Europe

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[16/] As an example, 65 percent of respondents to the 1989 Television Information Office ("TIO")/Roper Study said they get most of their news about what is going on the world from television. America's Watching, TIO/Roper Report, at 14. Also, radio listeners want to hear news on the radio, particularly local news. See, e.g., "Listener Perceptions of Radio News," John W. Wright, II and Lawrence A. Hosman. 63 Journalism Quarterly 802-14 (Winter, 1986).

[17/] In this regard, NAB believes that the Commission should place a higher priority on determining the efficiency and quality of a more localized terrestrial DAB service than a nationwide satellite-delivered service.

[18/] By contrast, terrestrial DAB demonstrations are now occurring in Canada. Further U.S. study and demonstrations are planned for 1991. With this objective in mind, and as noted above, the NAB

(continued...)

and Canada involve terrestrial transmissions; satellite testing is in the future. However, Satellite CD concedes that a terrestrial component is absolutely critical if satisfactory service is to be provided to urban areas.

Moreover, the Satellite CD proposals regarding modulation and compression techniques are largely in the theoretical stage only. The details of the proposed encoding system compression capability are unclear. The Satellite CD application proposes use of an encoding and transmission technology developed by Dolby Laboratories; however, important details of this encoding algorithm technology are not presented.[19/] If a proprietary encoding method is proposed for essentially a monopoly system, this could, in effect, give the Petitioner a government-sanctioned technology monopoly. Further, given the availability of EBU/Eureka technology, there is a

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[18/] (...continued)
Radio Board has established a Task Force on Digital Audio Broadcasting, which has already held two meetings and has scheduled a third to coincide with next month's NAB Radio Conference in Boston. That Task Force will explore the question of whether a terrestrial DAB service can be provided to portable units and moving vehicles at a quality level significantly higher than now available on AM or FM and, if so, what impact such service might have on the existing providers and consumers of local service.

[19/] Application of Satellite CD Radio, Inc., filed May 18, 1990, at 3. Dolby AC-2, as with all data compression systems, performs subjective analysis on the incoming program, removing "inaudible" information in the encoding process. Since the proprietary mathematical algorithm for the system is not presented, no certainty exists regarding the system's purported capability of true "CD quality" performance. This is noteworthy in that the quoted AC-2 system parameters significantly fall short of typical compact disc specifications in frequency response and distortion performance.

question whether Petitioner's particular system would be adopted in Europe and elsewhere, thus frustrating one objective of the WARC-92 efforts: to achieve world-wide allocations for DAB.[20/] Clearly, these issues need clarification and additional information, public comment, investigation and analysis.

Petitioner requests simultaneous FCC action on at least four very complex issues. But decisions as to frequency spectrum, channel plan, licensing and technical standards should not be conducted in an application process and must, instead, be in the context of thorough rulemaking proceedings. A proceeding on technical standards alone could be very time consuming, as the Commission's experience with the HDTV standardization process shows. The Commission cannot simply grant Petitioner's application, foreclose a public standard-setting process, and permit Petitioner, alone, to determine and control a new broadcasting technology. Given the public interest obligations of broadcasters, improvements to broadcasting technology require open proceedings, where consensus can be sought among the industries most likely to be affected.

Other technical aspects of the Satellite CD proposal are either unclear or unsupported. We first point to Petitioner's proposed terrestrial repeater power requirements. Petitioner states that "[T]he equipment used for the terrestrial

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20/ The usefulness of worldwide allocations depends in significant part on the kind of technical system planned for use. Allocation and channeling decisions require specifications for bandwidth of emission, interference resilience, and power requirements, among others.

repeaters and the transmitters is virtually identical."[21/] In fact, if the repeaters carry up to 66 channels and the transmitters a single channel, the power output of each would have to be far different if all channels were to have equal capability.

Moreover, the proposed satellite transponder antenna performance suggests the use of a 7-9 meter diameter antenna, that implies use of an unfurlable/deployable antenna. Petitioner thus presents two serious technical issues. First, to NAB's knowledge, antennas of this size have not yet been used for any commercial satellites, let alone a satellite designed for broadcast service; second, shaped beams using large-sized unfurlable antennas still need to be developed.

Satellite CD states that the system it proposes would be most efficient, because additional channels can be added one at a time, instead of in blocks of 8 or 16.[22/] But because the capacities of any and all broadcast sound satellites must be predefined before they are launched, no possibility at all exists for the addition of channels once this limit has been reached. If the bandwidth efficiency of transmission is improved after the service is implemented and initial limits are reached, receivers then on the market could be made obsolete.

[21/] Supplement to Satellite CD Petition, supra note 1, at 2.

[22/] Id. at 6.

Satellite CD also claims a frequency re-use factor of 3.[23/] However, in any one region, Petitioner proposes the use of 100 channel receivers configured to receive 66 channels from a satellite and the remainder from terrestrial links. With the proposed available spectrum divided into thirds, any one region could re-use only 10.2 MHz of the remaining 39.8 MHz for terrestrial use, especially in areas of satellite signal overlap. This calculates to much less than the quoted re-use factor of 3, with most remaining spectrum lying fallow outside its satellite-covered area. Also, we note that the proposed link budget power flux density limits in the 1525-1530 MHz band apparently exceed those limits established by the International Telecommunications Union.[24/]

These are but a few of a parade of flaws contained in Petitioner's application. Together with some of petitioner's "quick fixes" to otherwise serious technical and policy issues,[25/] these flaws invite the observer to conclude that Petitioner should be held to a least a minimum standard of due diligence in preparing and filing its papers with the Commission.

Also, it seems clear that one reason for the uncertain nature of Petitioner's operational and technical plans -- and the premature filing of the Petition -- is the rush to obtain a

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[23/] Id. at 20.

[24/] See ITU Radio Regulations: Article 28, Section IV, and CCIR Report 955-1.

[25/] E.g., Petitioner's proposed solution to multipath -- for antenna space diversity -- is unrealistic and impractical. See infra.

"pioneer's preference." This pioneer preference concept, advanced in a separate FCC proceeding[26] was opposed by NAB[27] on several grounds, including the expectation that the pioneer preference scheme would elicit prematurely filed applications and petitions, such as the materials submitted by Satellite CD.

Of further concern are multipath problems in satellite-based transmissions to moving vehicles and other mobile receivers. Although some modulation schemes, such as EBU/Eureka, offer good prospects for overcoming these problems, testing is needed to determine specific design parameters. Many variables enter into this decision, including bandwidth, frequency and power. The transmission technology suggested by Petitioner does not appear to have an inherent ability to reduce or eliminate the effects of multipath or terrain/building shadowing. Thus, terrestrial repeaters operating on the same channels as satellite downlink channels may interfere with each other, reducing potential spectrum efficiency. If the terrestrial repeaters operate on different channels, spectrum efficiency is even further reduced because a single DAB program would be receivable on more than one channel at a particular location.

Petitioner's suggested use of a complex four-antenna space diversity system[28] as a means to reduce multipath/fading

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[26] See, e.g., Notice of Proposed Rule Making in Gen. Docket No. 90-217, 5 FCC Rcd 2766 (1990).

[27] See Comments of NAB in Gen. Docket No. 90-217, filed June 29, 1990.

[28] Petition, supra note 1, at 10.

effects is hardly a viable solution. Except for a very few high-end model receivers, even two-antenna space diversity systems for FM broadcast reception have not proven to be economical for the mass market of consumer receivers. Four-antenna space diversity is a "blue sky" technical response, offered "free" by Petitioner, in the hope that unsophisticated policymakers would believe that Petitioner's proposal is technically sound.

It is much too early in the debate -- a truly global debate -- to decide on a single set of key parameters. We have no agreement in the United States as to the amount of bandwidth necessary per channel, nor as to the total amount of bandwidth needed or the location of the band to be used for any satellite or terrestrially delivered DAB service. In fact, the policy proposals of Petitioner in these areas are completely arbitrary. Satellite CD proposes only one such band and one service configuration (service to three geographical areas from two satellites).[29/] The Commission should not proceed with any allocation of spectrum until more information is obtained as to frequency options and bandwidth requirements. Whether or not spectrum sharing with other services is a viable possibility also needs consideration. Satellite CD acknowledges that its satellite service needs totally new spectrum and that it cannot share with existing communications systems. But further study is needed. Petitioner's application is simply premature.

[29/] Id. at 9-10.

There is also a question as to whether a digital satellite service would be able to deliver a satisfactory service to urban areas. If not, a number -- perhaps hundreds or thousands -- of terrestrial "repeaters" would have to be installed in order to fill in the service gaps and ensure the availability of broadcast-quality coverage. It seems that creating a separate terrestrial broadcast system simply to provide the identical service to urban areas that would theoretically be offered to rural areas would be uneconomic and a waste of spectrum. Urban populations constitute approximately 74 percent of the total U.S. population[10/] and advertiser supported broadcasting must be able to serve that audience.

Hence, by definition, perhaps as much as 74 percent of the population would have to be served primarily by terrestrial transmitters -- not by satellite. The satellite signals to those areas -- and the spectrum that would be used -- would be largely wasted and could become potential sources of interference to other services. The efficiencies and impact of this necessary but duplicative service and the problems of coordination, need careful study.

Indeed, a decision to offer digital radio by space satellite automatically amounts to a decision to use spectrum inefficiently from the perspective of providing diverse programming to listeners. Whereas a space satellite channel of

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10/ 1980 Census of Population, Volume I, Characteristics of Population, Chapter C, General Social and Economic Characteristics, Part I, U.S. Summary, Document No. PC 80-1-C1, 1-15.

programming would yield only a single programming choice over a wide geographic area, terrestrial use of the same channel would yield additional choices, because the channel could be "reused" across the region. NAB plans to offer additional discussion of this spectrum efficiency issue in its comments in the Commission's DAB inquiry.

On a related issue, the actual Satellite CD proposal appears to impose a severe limitation on existing aeronautical telemetry operations now occupying this band.[31] Aeronautical telemetry operations currently use the proposed frequencies in major urban areas that includes Annapolis, Pensacola, Dayton, Boston and Washington, D.C. The Satellite CD Supplement to Petition for Rule Making provides some further information on how it intends to displace these facilities with "minimal disruption."[32] However, this allegation needs more careful analysis, as do the claims regarding aeronautical telemetry facilities listed in the government Master Frequency File.[33]

Indeed, the Satellite CD proposal might even require a displacement and relocation of existing service. NAB, whose members are existing users of valuable spectrum, is most sensitive to the risks created by applicants for new spectrum who extol the virtues of untried and untested services. NAB suggests that an extremely high threshold showing of compelling need be

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[31] Petition at 15-17.

[32] Supplement to Petition for Rule Making, supra note 1, at 4-6.

[33] Id.

demonstrated before commencing rulemaking on a new service. Such a showing has clearly not been demonstrated here.

Another important consideration, as to whether to initiate rulemaking, is the fact that this is a very attractive band, heavily used at present and subject to many new demands. These new demands, however, would be ignored by the rule making sought by Satellite CD.

Finally, NAB notes the proposal by Satellite CD to allocate 10 MHz of bandwidth for exclusive terrestrial broadcast use. This terrestrial proposal has no relevance to the Satellite CD proposal for a satellite-delivered service (supplemented by terrestrial repeaters).

NAB urges that any Commission consideration of petitioner's proposal for a satellite system be on its own merits, and separately from consideration of a terrestrial system. However superficially attractive a "hybrid" system appears, satellite and terrestrial joint use of L-band frequencies would significantly discriminate in favor of the satellite service, and against a terrestrial service. While L band may be useful for satellites, it is very unsatisfactory, and perhaps unusable, for terrestrial service. Viable terrestrial

service should be attempted, if at all, at lower frequencies.[34/] The Commission must carefully analyze the technical and policy consequences of a hybrid service at L-band. With current technology, there is no reason to compel the use of the same frequency band for both satellite and terrestrial uses.

Studies of the kinds of issues discussed above are critical preconditions to the institution of any kind of rule making. The broadcast industry has long favored improvements in technology designed to better serve its audience. It is possible that terrestrial digital audio may provide another such opportunity. But an adequate record of testing and experimentation is a prerequisite for spectrum allocation. The Commission's Notice of Inquiry[35/] is but a first step to creating such a record; granting the instant Petition would place the cart well before the horse.

IV. CONCLUSION

For the reasons stated above, and which will be expanded upon in the comments NAB will be filing in the Commission's inquiry on DAB, we urge the agency to dismiss or

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[34/] See, e.g., Reference Data for Radio Engineers, Recommendations and Reports of the CCIR, Volume V, "Propagation in Non-ionized Media." This volume is replete with data showing superior propagation and performance, ideal factors for wide area coverage by broadcasting systems, at lower frequencies. See, e.g., Rec. 370 and Report 239-6. See also Longley, A.G. [May, 1976] "Location variability of transmission loss . . . land mobile and broadcast systems," Office of Telecommunications, Rep. PB 254472, National Technical Information Service.

[35/] Notice of Inquiry, supra note 2.

simply defer consideration of Petitioner's requests. Indeed, we urge the Commission to defer any such considerations of domestic spectrum allocation or authorization of service pending not only completion of the digital radio inquiry and WARC-92 preparatory activities but also completion of the WARC-92 conference and any associated planning conferences. To do otherwise would compromise considerations of reasoned spectrum planning and rational communications policy development; a decision to establish a new broadcasting service is not to be taken lightly or on a piecemeal basis.

Respectfully submitted,

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August 20, 1990

CERTIFICATE OF SERVICE

I, Harriett Coulbourn, do hereby certify that a true and correct copy of the foregoing "Comments of the National Association of Broadcasters" was handcarried, on this 20th day of August, 1990, to the following:

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Federal Communications Commission
1919 M Street, N.W.
Room 814
Washington, D.C. 20554

The Honorable James H. Quello
Commissioner
Federal Communications Commission
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APPENDIX A

TERRESTRIAL COVERAGE CONSIDERATIONS FOR DIGITAL AUDIO BROADCASTING SYSTEMS

Michael C. Rau
Lynn D. Claudy
Stanley Salek

National Association of Broadcasters
Science and Technology Department

Presentation For: IEEE Broadcast Technology Society,
September 6, 1990

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Terrestrial Coverage Considerations for Digital Audio Broadcasting Systems

Michael C. Rau
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Abstract

Terrestrial delivery of DAB is receiving an increasing amount of attention with scenarios being considered ranging from a supplement to existing AM and FM broadcasts to complete replacement of current services.

Practical implementation of a terrestrial DAB service requires a system-level examination of relevant technical factors including receiver technology, propagation characteristics, reliability of service and so forth. This paper identifies some of the considerations necessary for designing an allocation and allotment system. The Eureka/EBU DAB proposal is used as a model for a candidate DAB service. Planning factors required for predicting coverage are examined. Example calculations of coverage under certain assumptions are presented and tradeoffs are identified.

Assuming a 1 kW ERP, at 100 MHz it is estimated that a Eureka-type of DAB broadcasting system will provide a maximum coverage of approximately 43 miles. At 500 MHz, the coverage is estimated to be approximately a maximum of 31 miles. The graphs contained in this presentation are starting points for the design of suitable allocation systems for digital broadcasting that use VHF or UHF frequencies. Use of VHF and UHF propagation graphs with more rigorous location and time probability factors than the current F(50,50) curves is strongly suggested. Frequencies above 1 GHz should also be studied.

Washington, D.C.
September, 1990

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Terrestrial Coverage Considerations for Digital Audio Broadcasting Systems

Michael C. Rau
Lynn D. Claudy
Stanley Salek

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Good Afternoon. I'd like to thank the IEEE Broadcast Technology Society for the opportunity to participate in this conference. The title of this presentation is Terrestrial Coverage Considerations for Digital Audio Broadcasting Systems. This is a summary of ongoing work at the NAB Science & Technology department. We plan to submit a full report for publishing consideration in the IEEE Broadcast Technology Society Transactions.

Terrestrial delivery of DAB is receiving an increasing amount of attention. Implementation scenarios range from a supplement to existing AM and FM service to complete replacement of these services. And a large number of frequency spectrum bands have been identified as potential candidates to host a new DAB service.

To actually plan on implementing a digital audio broadcasting system, there are many issues that must first be considered. Among these issues are technical considerations necessary to plan an allocation and allotment system. But even before an allotment plan can be precisely discussed, it is necessary to analyze and understand the problems and techniques inherent in attempting to predict the coverage of digital audio broadcasting systems.

Today we can identify some of the considerations necessary for designing a DAB terrestrial broadcasting system. We use the Eureka/EBU DAB proposal as a model for a candidate DAB service. We perform some example calculations of DAB link budgeting under identified assumptions as a function of receiver sensitivity. Finally, we will discuss the necessary planning factors and suggests a model for calculating terrestrial DAB coverage.

Let's begin with a brief review of DAB technology and focus on the EBU/Eureka 147 DAB system. The EBU/EUREKA project No. 147 DAB system is currently considered to be the most highly developed and sophisticated DAB system proposal. Consequently,

we can use EBU/Eureka as a model system for purposes of analyzing the considerations inherent in predicting terrestrial DAB coverage.

In this slide we have collected some of the technical advantages of the EU-147 DAB system. They are (1) 20 kHz audio bandwidth; (2) COFDM multiplexing; (3) low C/N requirements for full quality transmissions; (4) immunity to multipath; and (5) high spectrum efficiency.

The first step in EBU/Eureka encoding is to substantially reduce the data rate of the source audio. The data rate begins at 768 kB/s, equivalent to sixteen bit parallel data sampled at 48 kHz. EU-147 uses the MUSICAM bit rate reduction system. This compression scheme was originally developed by the IRT in Germany; MUSICAM stands for "Masking pattern-adapted Universal Sub-band Integrated Coding and Multiplexing." MUSICAM takes advantage of the psychoacoustic properties of human hearing and eliminates irrelevant information. The bit rate is ultimately reduced to 128 kB/s, for a reduction ratio of 6:1. Further development is underway that would reduce the data rate to 96 kB/s, for an 8:1 ratio. Beyond that, further data rate reduction is not envisioned at present.

The source audio is divided into 32 frequency bands or sub-bands and digitally processed. Exploiting the psychoacoustical phenomenon of auditory masking, the information to be transmitted associated with a given sub-band may be reduced or eliminated according to its likelihood of being psychoacoustically masked by either (1) higher amplitude audio energy in the same or nearby frequency bands, or (2) if the audio is below the threshold sensitivity of the ear.

The resulting data stream is then coded using a powerful convolutional coding method called COFDM.

This sophisticated modulation method uses frequency division multiplexing to split the coded information into a large number of closely spaced, low data rate channels.

To illustrate the technique, in this slide 32 carriers are used to carry 8 separate programs. Each program is transmitted on 4 widely separated carriers. The highlighted carriers transmit redundant information.

Specific carrier frequencies are generated using FFT techniques and satisfy orthogonal relationships, allowing their spectra to overlap, increasing spectral efficiency. The carrier arrangement and resulting spectrum is shown here. 4-state phase shift keying modulation is used. The program data is interleaved in time and frequency with large enough spacing to use portions of the propagation channel that are statistically independent. This technique enables the EU-147 system to reduce and even eliminate

multipath interference.

Now, let's see how coverage for a Eureka-type system could be estimated. In this presentation, we are using a EU-147 configuration of 14 stereo audio channels in a 3.5 MHz wide channel. In this bandwidth, there will be several hundred carriers. Based on our best information from Europe, this configuration is the design target for EU-147 terrestrial implementations. This is the system EBU and Eureka is bringing to Las Vegas for NAB '91. We shall use this configuration as a basis for our calculations in this presentation.

Specifying the service area for a digital audio broadcasting service will require a somewhat different analysis than conventional AM and FM allocations planning for analog transmission services. Among other considerations, the perceived degradation of a digital service may evidence itself in an entirely different manner than an analog service. Because of this, the traditional notion of what constitutes a broadcasting service area requires re-examination for a digital system. It is necessary to use a different approach to defining the coverage area for DAB systems. For the EU-147 system, specific recommended parameters have yet to be finalized, pending selection of a frequency band and implementation scenario. However, the planning factors that must be considered in determining an allocation plan for systems such as EU-147 are generic and important to consider at this time.

Before we get to the actual link budget and service area calculations, we must first consider the important matter of propagation and service definitions.

The service areas of conventional AM and FM broadcast radio systems are ultimately based on a reasonable determination of minimum acceptable performance. This can be a difficult concept to define precisely due to the subjective nature of what specific signal-to-noise ratio constitutes "minimum acceptable performance." As we are about to discuss, the treatment of digital systems such as EU-147 must be somewhat different.

U.S. AM allocations are based on contour protection techniques where service decreases linearly with distance from the transmitter. Primarily, AM is an interference-limited service. For co-channel satisfactory reception, about 26 dB C/I is necessary to provide AM service.

FM radio performance, on the other hand is somewhat insensitive to diminishing field strength until a threshold point is reached beyond which degradation proceeds rapidly with further signal level decreases. The nature of the degradation depends on receiver characteristics. Ultimately, based on CCIR reports, service is limited by an interference threshold that is approximately 37 dB C/N for mono service, and higher for stereo service.

Propagation curves provided in the FCC Rules and CCIR documents allow allocations engineers to predict the field strength for a given power output, antenna configuration and height at a given distance from the transmitter. Because factors such as terrain roughness, multipath effects and daily and seasonal changes in atmospheric propagation are involved, predictions of received field strength must be characterized in statistical terms. The FCC's well-known F(50,50) curves indicate expected levels of time and location variability in terms of percentage of locations and time for which the field strength values will be accurate. These curves present field strength values that will be exceeded by at least 50% percent of the locations for at least 50% of the time. To insure a given level of service for a higher percentage of locations or a higher percentage of time, corrective factors must be added.

Conventional AM and FM analog services are somewhat forgiving in this regard, because slight degradations beyond the F(50,50) field strength values calculated generally produce only modest degradations in system performance. Digital systems, however, are not so forgiving.

In predicting the coverage of terrestrial DAB systems, the first question is, should we use the existing FCC F(50,50) curves for VHF and UHF? We believe they should not be used, at least not without the addition of more rigorous time and location probability factors.

Of course, the physical mechanisms of signal attenuation due to propagation effects identically apply to digital as well as analog transmission systems. However, the result of degraded digital signal transmission produces very rapid reduction of service quality compared with the relatively soft degradation of analog systems.

In the EU-147 DAB system, service area planning is tied directly to system tolerable bit error rates. In simpler digital transmission systems, decreasing signal strength can be directly related to increased bit error rate (BER) and consequent degradation of service. As digital transmission systems become more complicated, such as by the addition of error correction and convolutional coding, increasing BER is more likely to not correspond to a gradual increase of noise floor level as is otherwise typical of analog system degradation. For these types of digital transmission systems, the loss of service quality associated with incorrect data reception may be severe and unpredictable. Thus, a very rigorously defined maximum allowable BER can be used to define the limits of complex-system digital service areas. Because small data errors can cause catastrophic loss of service quality, the use of Channel Coding schemes that provide protection against errors is virtually mandatory, at least for the design of broadcast-quality service areas. Without such coding protection, the resulting useful service area of a digital transmission system may be very small. Thus, digital systems have a need for coding

schemes with error correction that allow larger bit error rates to be tolerated in transmission without incurring overall degradation of service. The necessary added bits raise a difficult series of design tradeoffs, because they decrease system throughput and affect spectral efficiency.

This slide shows the BER performance of the coded and un-coded COFDM signal for the Eureka 147 system without error correction. The curves labeled C sub c and C sub d represent a range based on alternative decoding schemes. c represents coherent detection, and d represents differential detection. In the final system design only one method, of course, would be selected, and economics of manufacturing will play a major role. The graph itself plots acceptable bit error rate versus Eb/No, the energy per useful bit, divided by the noise spectral density that, for this case, is proportional to C/N within a couple of dB. In contrast the dotted lines represent uncoded data -- straight OFDM, not coded. So the use of coding can preserve low bit error rates at low C/N ratios. Recall that the C/N for AM is about 26 dB and for FM better than 37 dB.

In this slide we show what happens when error correction techniques are added to the bit stream. The straighter the Cc and Cd lines the closer we are to the ultimate coding efficiency for acceptable bit error rate under the lowest C/N characteristics. Note that the margin between full service and no service is a very thin brick wall -- the width of one of the C sub c or C sub d lines.

In AM, FM and TV broadcasting the specified threshold for C/N is tied to subjectively-evaluated minimum standards of audio or video quality. Carrier-to-noise ratios below these thresholds still provide service, albeit degraded broadcast service. Compared to the more gradual nature of AM, FM or TV service degradation in the presence of increasingly weaker C/N ratios, the abrupt nature of digital service degradation, as clearly indicated in this slide, strongly suggests the consideration of propagation curves that use more rigorous location and time probability standards.

The "forgiveness" of analog systems and relatively slow changes of propagation characteristics insures that some level of service will exist at most of the other locations most of the time. With error-protected digital transmissions, however, continuous data recovery above a minimum C/N threshold is required. So in the prediction of digital audio broadcasting coverage, service definitions are less forgiving at the limits of coverage, and, accordingly, use of higher probability location and time variability factors are warranted. Thus in the development of propagation curves for a digital broadcasting service, it is advisable to develop and plan curves at the F(90,90) or even F(99,99) level to insure the existence of service within the predicted coverage pattern. For a stand-alone transmitter, F(99,99) would provide the most reliable indicator of broadcast service. Since the EBU/Eureka DAB system is capable of employing on-channel

boosters without service degradation, perhaps the use of F(90,90) curves is more appropriate as an allocations planning tool. Using these curves, service everywhere within the coverage pattern would be virtually error-free while service outside the coverage pattern would be virtually non-existent. For those in the audience interested in the calculation details, our upcoming propagation calculations for VHF and UHF are based on CCIR Rec. 370-5.

Now let's take a look at the other factors that comprise the calculation of a digital broadcasting station's service area.

Here is the link budget model we are using at the receiver end to develop estimates of DAB coverage. Given a minimum tolerable carrier-to-noise ratio and the equivalent input noise of the receiver, the minimum signal field strength E that must exist at the receiving antenna can be determined. In conjunction with appropriate propagation loss curves and planning assumptions of receive antenna height, the transmitted power level required for any given service area can then be defined. E is the minimum field strength necessary at the receiver's antenna for satisfactory operation. For purposes of today's presentation, we are ignoring line losses and assuming the receive antenna is a half-wave dipole. These assumptions provide a best case DAB coverage scenario.

In this slide we have the basic thermal noise calculation, kTB.

And here we have the calculation with noise expressed in dB relative to 1 microvolt. R is input resistance of the receiver.

Finally, the intrinsic thermal noise at the receiver input turns out to be about 2 microvolts, or 6 dBu.

Nr, the total noise at the receiver input can be computed as the ideal input noise level plus the noise figure of the receiver. This noise figure represents the noise generated at the receiver input above and beyond an ideal input. Using a receiver noise figure of 6 dB as a typical value, the total receiver input noise would then be 12 dBu.

Now we are ready to consider C/N. As we have shown, the range of potential C/N ratios lies between 5 and 30 dB, or more, and depends on the selected coding schemes and error correction modes. A minimum carrier-to-noise ratio of 9 dB has been suggested for the Eureka DAB system, and this is what we will use for planning purposes.

Up until now we have been talking about voltage at the receiver antenna terminals, and also about field strength at the antenna. To continue with the link budget these two must be related to each other, and this can be done by use of the so-called dipole factor.

Transforming to an impedance of 300 ohms, we have this formula for calculation of the dipole factor, K sub d.

For purposes of today's presentation we have picked two frequencies in the VHF and UHF bands, 100 and 500 MHz. Carrying the calculations through for these frequencies, For 100 MHz, K_d = .965 or -.3 expressed in dB. At 500 MHz, K_d = -14.3 dB. Now we can calculate necessary field strength, E. For 100 MHz, E= 21.3 dBu. For 500 MHz, E= 35.3 dBu.

Knowing the desired field strength E, propagation curves can be used to determine the extent of service area for a DAB system at a given power output level. As noted earlier, we tentatively recommend use of field strength levels that can be insured for a high percentage of locations and a high percentage of time for planning a DAB service. We have calculated the estimated coverage of DAB systems based on F(50,50), F(90,90) and F(99,99) service models.

This slide shows our coverage estimates for a DAB system operating at 100 MHz. The graph portrays ERP, in dB above 1 kilowatt, vs. radius of anticipated service in kilometers with miles in parenthesis. This is based on average terrain, and 150 meters transmit antenna height, and a receive antenna height of 10 meters. We are aware, of course, of the relative appropriateness of using these factors.

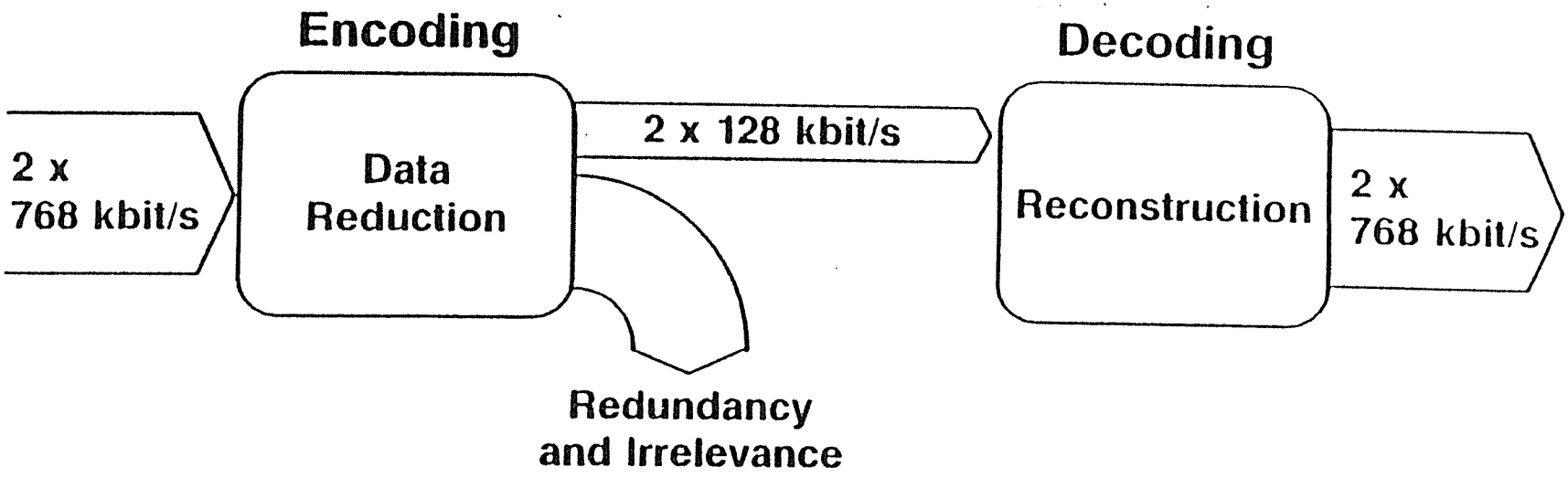
Here are the same set of conditions at 500 MHz. Here are the two graphs combined.

Assuming a 1 kW ERP, at 100 MHz we estimate that a Eureka-type of DAB broadcasting system will provide a maximum coverage of approximately 43 miles. At 500 MHz, the coverage is estimated to be approximately a maximum of 31 miles. We feel these graphs are starting points for the design of suitable allocation systems for digital broadcasting that use VHF or UHF frequencies. We recognize that frequencies above 1 GHz should also be studied.

Obviously there are a great many difficult policy decisions that confront the industry. It is critical that the industry have as much technical information as possible about how a DAB system could be implemented and the nature of its performance characteristics. This is the goal of our studies.

I'd like to thank Lynn Claudy and Stan Salek of NAB's Science & Technology department for their help in the preparation of this paper. We are very open to comments and suggestions, and we would be happy to answer any questions. Thank you, it is a pleasure to be here today.

Source Coding

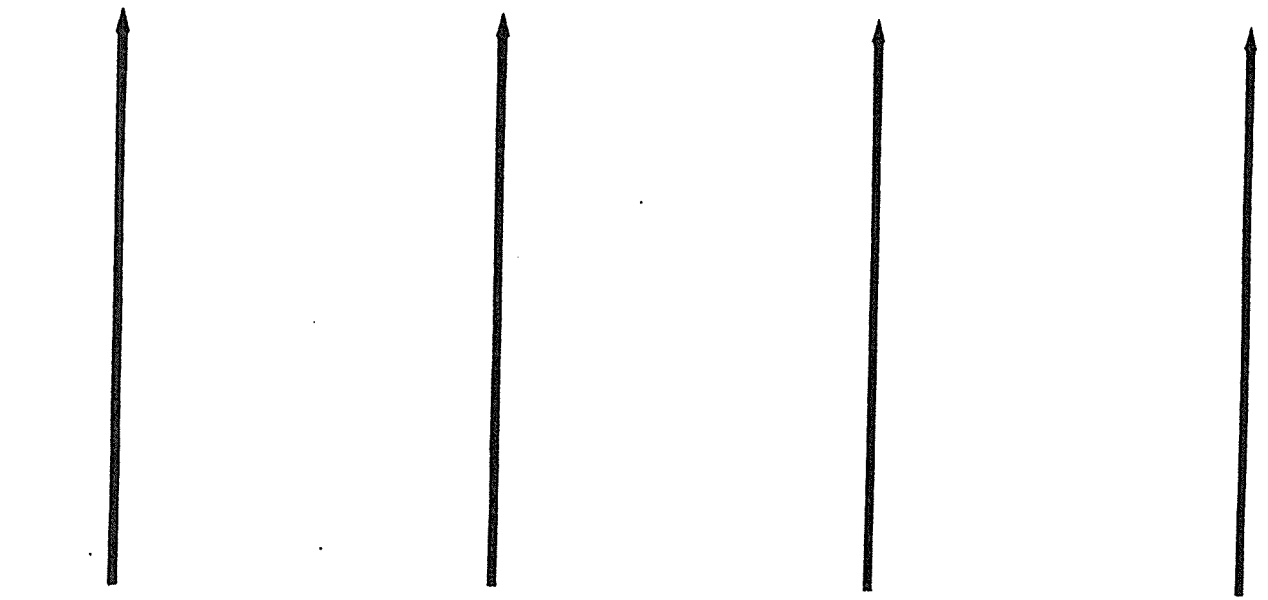


AF Bandwidth:	20 kHz
Sampling Rate:	48 kHz
Resolution	16 bit

Source: EBU

Distribution of Carriers for One Program

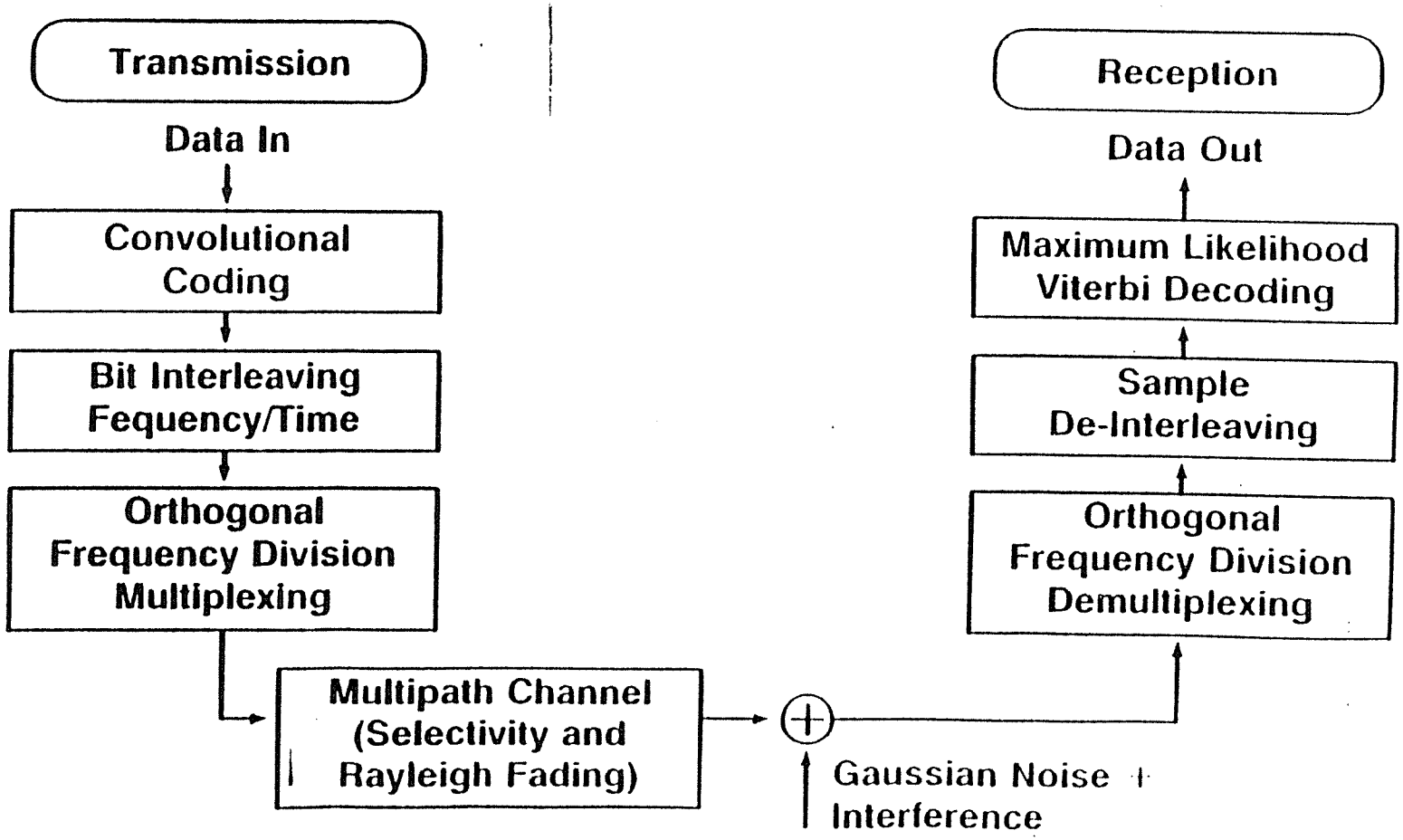
(32 Carriers: 8 Programs, 4 Carriers Each)



—— Carrier of Program Considered
Carriers of Other Programs

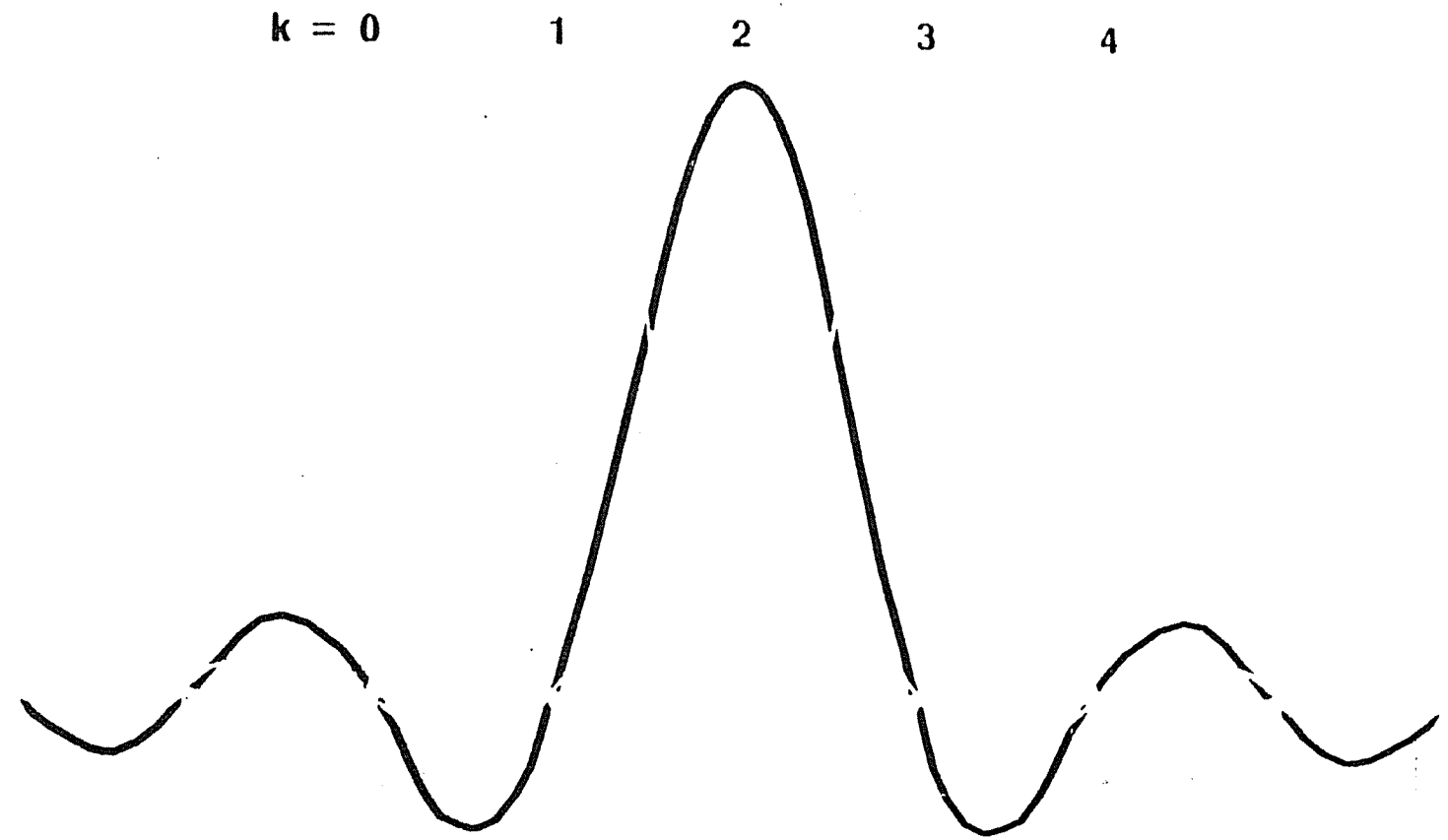
Source: CCETT

COFDM Modulation And Coding System In The Multipath Environment



Source: EBU

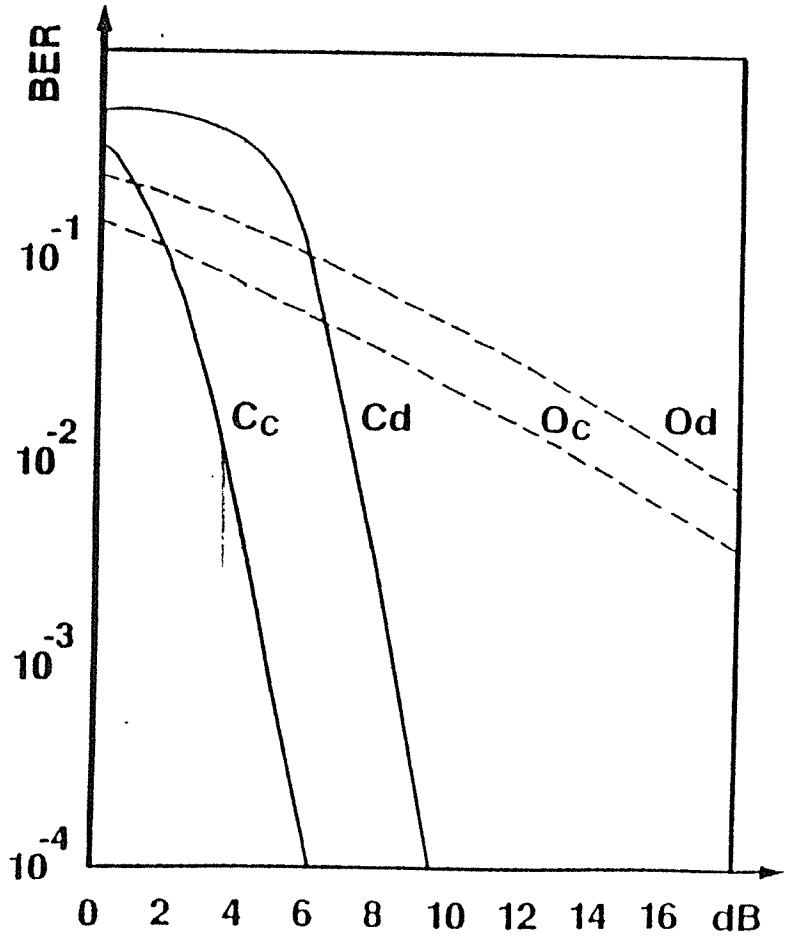
OFDM Signal Spectrum



Source: CCETT

Bit-Error Ratio Performance

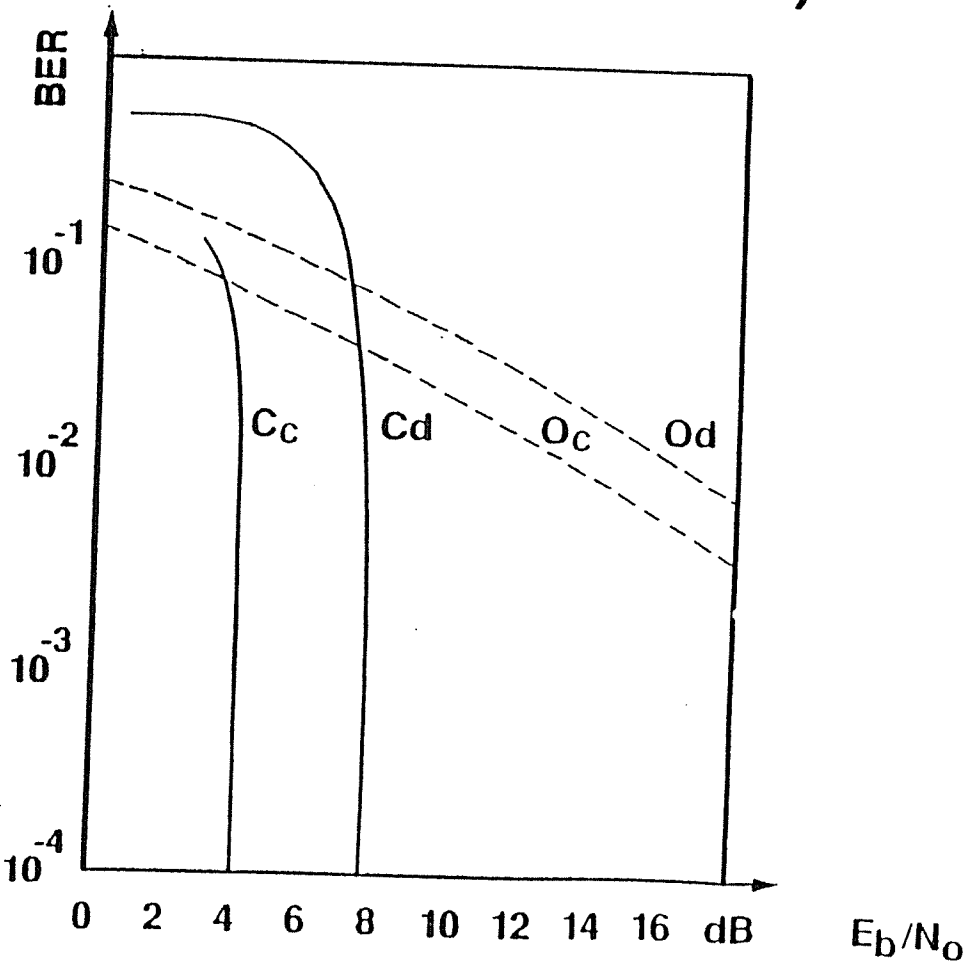
(No Error Correction)



Source: CCETT

Bit-Error Ratio Performance

(With Error Correction)



Source: CCETT

LINK BUDGET AND THERMAL NOISE CALCULATIONS

A model for use calculating service area is as follows:

$$E = V_I + N_R + CNR - K_D - G + L + T_F + L_F$$

where E = minimum acceptable field strength at a receiver (in dBu, or dB above 1 microvolt/m)

V_I = thermal noise of receiver input (in dBu, or dB above 1 microvolt

N_R = noise figure of receiver input

CNR = minimum carrier to noise ratio for acceptable service

K_D = dipole factor (in dB)

G = receive antenna gain (in dB)

L = transmission line loss (in dB)

T_F = time variability factor (in dB)

L_F = location variability factor (in dB)

For purposes of this discussion, antenna gain for the receiver will be assumed to be unity and transmission line loss will be assumed to be negligible.

Thermal noise power generated at the input of an ideal receiver is equal to kTB where

k = Boltzmann's constant = 1.38×10^{-23} W/K-Hz
T = temperature in degrees Kelvin
B = bandwidth of input

In terms of noise voltage, with input resistance R,

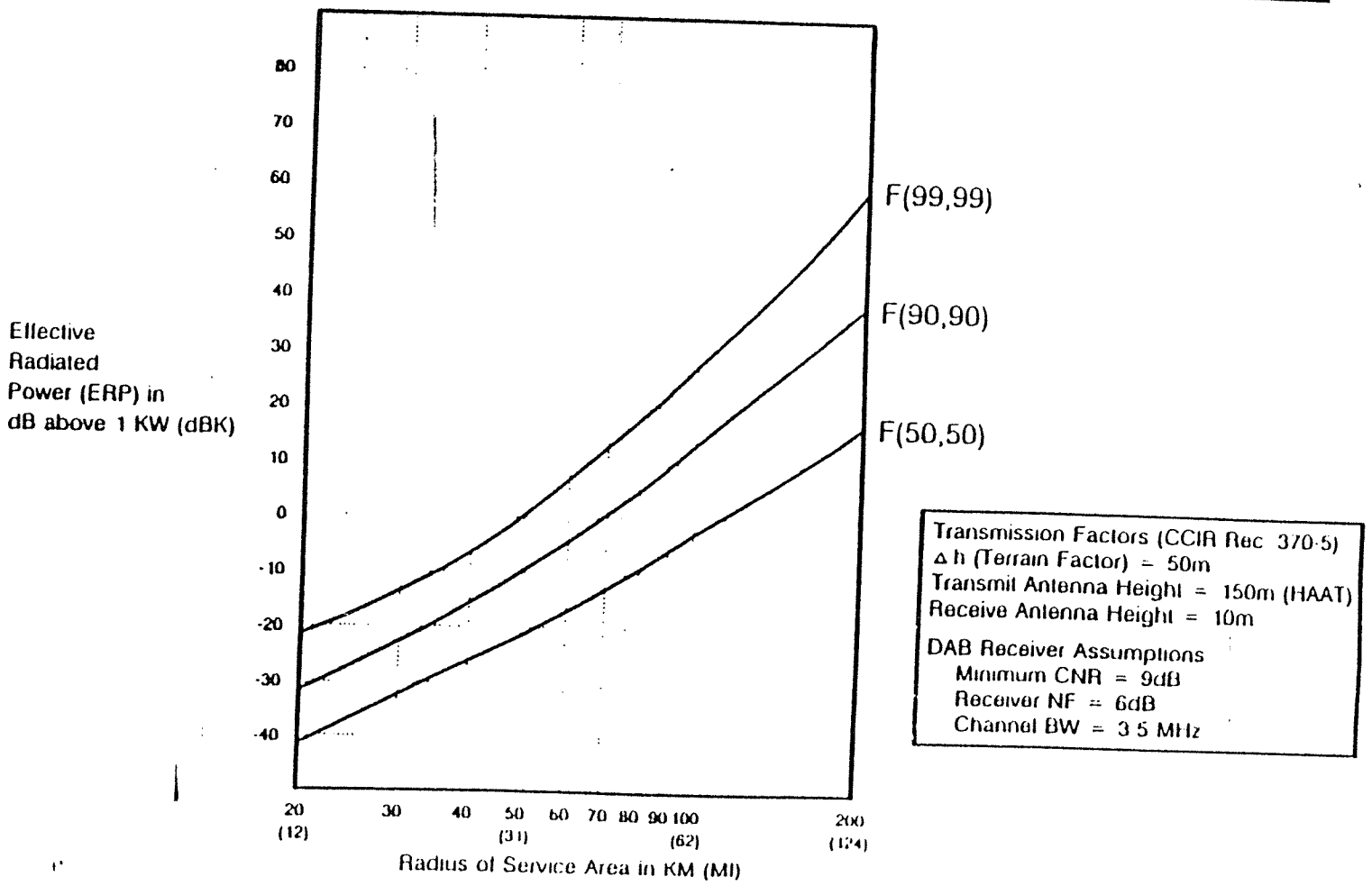
$$V_I = \sqrt{kTRB}/10^{-6}$$

where V_I is in microvolts or

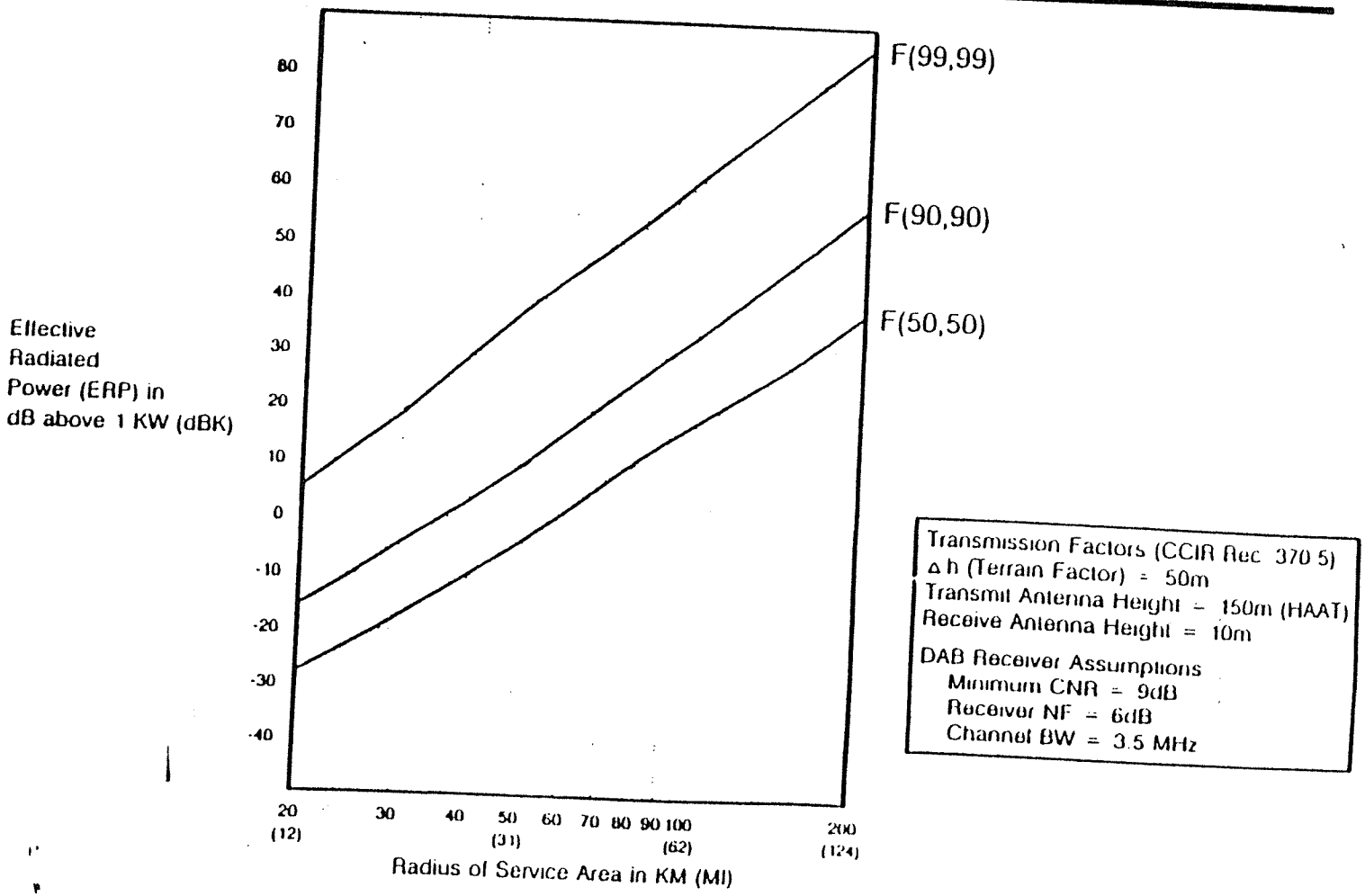
$$V_I = 20 \log(\sqrt{kTRB}/10^{-6})$$

where V_I is in dB relative to a microvolt (dBu).

Required ERP vs. Coverage Area Radius for Terrestrial DAB Service at 100 MHz



Required ERP vs. Coverage Area Radius for Terrestrial DAB Service at 500 MHz



APPENDIX B

REQUEST FOR PROPOSALS

FOR

DIGITAL AUDIO BROADCASTING SYSTEM

SPECTRUM STUDY

National Association of
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Request for Proposals for Digital Audio Broadcasting Spectrum Study

September, 1990

NATIONAL ASSOCIATION OF BROADCASTERS
Digital Audio and Satellite Sound Broadcasting Task Force
c/o NAB Science & Technology
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Washington, D.C. 20036
(202) 429-5346
Fax: (202) 429-5343, or 5410

I. Purpose.

NAB's Digital Audio and Satellite Sound Broadcasting Task Force ("DAB Task Force") asks for proposals for study of the spectrum requirements for digital audio broadcasting. The DAB Task Force limits the scope of this study to (1) use of the technology developed by the Eureka project No. 147 consortium, in conjunction with the European Broadcasting Union (EBU); (2) terrestrial DAB applications; (3) application of DAB technology for existing AM and FM stations; and (4) locations in the spectrum where terrestrial DAB technology feasibly can be implemented. These issues are further discussed below.

NAB's DAB Task Force will use the findings of this study to formulate and develop policies related to DAB technology.

II. Background.

For several years, the Eureka project No. 147 consortium[1] in cooperation with the EBU[2] have been developing digital broadcasting technology. The system, designed for terrestrial or satellite use, is capable of transmitting 14 to 16 simultaneous compact disc-quality stereo audio channels in 3.5 to 6 MHz total bandwidth, using a single transmitter. Additionally, a sophisticated transmission algorithm is used to eliminate multipath distortion effects common in current terrestrial FM broadcasting. In fact, the system is designed to take advantage of multipath reflections, using them to reinforce, rather that upset, the main channel signal. European broadcasters have found

[1] Eureka project No. 147 is a consortium among the research laboratories of European public service broadcasters, manufacturers, and universities. There are a total of 14 project partners.

[2] EBU is a union of the public service broadcasters of Europe, including the countries that border on the Mediterranean.

preliminary mobile demonstrations to be impressive, with the signal exhibiting considerable robustness over varying terrain conditions.

The technology was first demonstrated in Geneva at the WARC(ORB) conference in the summer of 1988, then at ITU-COM 1989 convention, and most recently in a series of demonstrations and tests in Canada. Informative and thorough presentations were made at the 1990 NAB Convention in Atlanta.

On August 1, 1990, the Federal Communications Commission (FCC or Commission) began a Notice of Inquiry proceeding (Gen. Docket No. 90-357) that asks many important questions related to digital broadcasting technology. Among the principal issues in the Inquiry are the relative merits of terrestrial or satellite approaches to implementation of DAB technology and their associated spectrum requirements. The Commission is interested in the impact digital radio would have on existing audio services and the regulatory structure or structures needed to ensure that the public benefits of digital radio are most efficiently realized. The FCC also seeks comment on the possibility of providing digital audio programming in the existing FM radio broadcasting allocation.

The spectrum that may be required for satellite implementations is being extensively discussed as part of the deliberations of a government/industry advisory committee to prepare the FCC for a 1992 World Administrative Radio Conference ("WARC-92").[3] No comparable effort is underway at the present time to assess the spectrum requirements that may be needed for a terrestrial implementation of DAB.

On June 22, 1990, NAB's Radio Board of Directors formed a Task Force to develop policies and recommendations on DAB technology. The Task Force has held three meetings, and, on August 8, decided to commission this RFP for a study on the spectrum requirements for terrestrial DAB, using the Eureka 147 system as a basis for the transmission technology.

III. Research Questions.

1. How much frequency spectrum is required to accommodate all existing AM and FM station licensees with a digital broadcasting facility? The study should be undertaken with two premises: (1) that available DAB facilities have identical coverage areas; and (2) that available DAB facilities are segregated into an appropriate number of classes

[3] To be held in early 1992, the WARC-92 has an agenda item, No. 2.2.3 (a), to consider "the allocation of frequency bands of the broadcasting-satellite service and the associated feeder links for the broadcasting-satellite service (sound) in the range 500-3000 MHz, as indicated in Resolution 520 (Orb-88), including the accommodation of complementary terrestrial sound broadcasting uses within this allocation."

of facilities in proportion to the existing classes of AM/FM broadcast stations.

2. How does the answer to (1), above vary with increasing frequency? Frequency bands under consideration extend from the FM broadcasting band to 2500 MHz.

3. In which frequency band(s) could the broadcasting industry obtain the amount of spectrum required by (1), above?

4. How does the amount of spectrum required by (1), above, compare with existing domestic and international proposals for satellite digital broadcasting technologies?

IV. Specifications.

NAB will require the chosen Contractor to submit a Final Report that must include the following sections:

A. Executive Summary. This section summarizes the report and highlights key findings, conclusions and recommendations. It discusses the scope of the study and the study's goals.

B. Table of Contents.

C. Research Report. This section should be a complete report of the research conducted. It should thoroughly answer the above research questions, include appropriate engineering calculations, and list all supporting documents and/or computer programs. The Report should be a stand-alone document, including – as appendices, if necessary – copies of particularly important and supporting documents, tables, graphs, or other documents that help to support the findings and conclusions of the study.

D. Annotated Bibliography. This section should list all readily available technical research, papers, experiments, government documents, etc. that a reader of this report might wish to see. For each entry, the Contractor shall include a short synopsis of the document's relevance including its conclusions.

V. Criteria for Selection.

NAB will select a Contractor based upon the following criteria:

A. Capability of Performing Research. RFP's should include a statement of the qualifications of all persons who would be expected to work on this project together

with their expected functions and available resources. Equally critical is the ability and desire to perform research within the desired time frame.

B. Value to NAB Members. NAB members include many small market radio stations nationwide. As such, NAB requires efficient use of Contractor resources in the judgement of NAB. RFP's should include a detailed description of how Contractor proposes to allocate resources and charge fees to NAB. A fixed price contract is required.

C. Expected Report Completeness. Very important to NAB is the expected completeness of the Contractor's research. "Completeness" includes specificity of report findings, conclusions, and recommendations. Completeness of the final report will be a factor in award of follow-up contracts, if any, on additional or different matters.

D. Schedule for Completion. NAB's members consider the issue of digital audio broadcasting a critical one for the business's future. As such, information and studies concerning DAB must be performed as soon as possible. The radio industry needs the best information as soon as possible in order to formulate industry policies concerning DAB. Prospective contractors should propose a timetable for completion of the research. Contractors will be expected to meet the date that is proposed. Ideal from NAB's viewpoint is a complete report by December 31, 1990.

VI. Form of the Proposal.

Contractors shall submit Proposals to NAB in the following form:

A. Cover Letter summarizing contents of Proposal. The cover letter shall be signed by the person or persons who will be principally responsible for the research.

B. Qualifications and Resources available to Contractor to perform the desired research.

C. Proposal for conducting research. This section of the Proposal shall as specifically as possible set forth a specific plan for assembling the necessary information and making the desired recommendations.

VII. Timetable.

A. Proposals will not be accepted after October 10, 1990.

B. NAB will Notify Acceptance/Non-Acceptance of Proposals no later than October 19, 1990.

C. Contract Signed by October 31, 1990.

D. Interim Progress Report and Final Report due per Contractor Proposal.

VIII. Other Matters.

NAB Science and Technology has developed a model for predicting the coverage of a EBU/Eureka facility. NAB also has estimates of required co-channel and adjacent channel protection ratios. In presenting proposals for consideration, prospective contractors may assume that models for predicting coverage and determining protection ratios will be available.

IX. Notice.

NAB reserves the right to make changes in the scope or nature of any research which it may fund, in consultation with the researcher or research company winning the grant. If no fully acceptable proposals are submitted, NAB also reserves the right not to commission any research.

Issuance of this Request for Proposals does not constitute endorsement of any particular digital technology (such as EBU/Eureka 147), past or future FCC policies or rules, and cannot be used to infer any plans or policies for NAB. Acceptance of any proposals as discussed herein is not endorsement for the contractor or the contractor's services on these or any other matters. NAB will fully own and reserve all rights with respect to the content of the final report.

X. NAB Contact Personnel.

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