

FREQUENCY COORDINATION AND INTERFERENCE ANALYSIS REPORT

Prepared for
ORAL ROBERTS UNIVERSITY
TULSA, OK
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147

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1. CONCLUSIONS

An interference study considering all existing, proposed and prior coordinated microwave facilities within the coordination contours of the proposed earth station demonstrates that this site will operate satisfactorily with the common carrier microwave environment. Further, there will be no restrictions of its operation due to interference considerations.

2. SUMMARY OF RESULTS

A number of great circle interference cases were identified during the interference study of the proposed earth station. Each of the cases, which exceeded the interference objective on a line-of-sight basis, was profiled and the propagation losses estimated using NBS TN101 (Revised) techniques. The losses were found to be sufficient to reduce the signal levels to acceptable magnitudes in every case.

No carriers reported potential interference cases involving this earth station.

3. SUPPLEMENTAL SHOWING

Pursuant to Part 25.203(c) of the FCC Rules and Regulations, the satellite earth station proposed in this application was coordinated by Comsearch using computer techniques and in accordance with Part 25 of the FCC Rules and Regulations.

Coordination data for this earth station was sent to the below listed carriers.

Company

ALLTEL Communications, Inc.
AT&T CORP
AT&T WIRELESS SRVCS OF FL Mid South Reg
CHEROKEE CONNEX LLC
CROSS-VALLIANT CELLULAR PARTNERSHIP
Dobson Cellular Systems, Inc.
GRAND RIVER DAM AUTHORITY
KAMO ELECTRIC COOPERATIVE
Kansas #15 Limited Partnership
LB Tower Company LLC
OK-3 CELLULAR INC
Oklahoma City SMSA Limited Partnership
Oklahoma RSA #3 Limited Partnership
Oklahoma RSA #4 South Partnership
PUBLIC SERVICE COMPANY OF OKLAHOMA
THE BURLINGTON NORTHERN AND SANTA FE
US Cellular Telephone of Greater Tulsa

4. EARTH STATION COORDINATION DATA

This section presents the data pertinent to frequency coordination of the proposed earth station that was circulated to all carriers within its coordination contours.

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 <http://www.comsearch.com>

Date: 07/28/2004
Job Number: 040728COMSTC01

Administrative Information

Status ENGINEER PROPOSAL
Call Sign E2454
Licensee Code ZORU
Licensee Name ORAL ROBERTS UNIVERSITY

Site Information TULSA, OK

Venue Name
Latitude (NAD 83) 36° 2' 53.3" N
Longitude (NAD 83) 95° 57' 17.0" W
Climate Zone A
Rain Zone 2
Ground Elevation (AMSL) 192.02 m / 630.0 ft

Link Information

Satellite Type Geostationary
Mode TR - Transmit-Receive
Modulation Digital
Satellite Arc 60° W to 143° West Longitude
Azimuth Range 129.1° to 241.3°
Corresponding Elevation Angles 33.6° / 25.6°
Antenna Centerline (AGL) 4.27 m / 14.0 ft

Antenna Information

Receive - FCC32

Transmit - FCC32

Manufacturer	VERTEX	VERTEX
Model	KPC	KPC
Gain / Diameter	46.4 dBi / 6.3 m	50.8 dBi / 6.3 m
3-dB / 15-dB Beamwidth	0.82° / 1.72°	0.50° / 1.04°

Max Available RF Power	(dBW/4 kHz)	<u>51K2G7W - 36M0G7W</u>			
	(dBW/MHz)	-13.5	-13.5		
Maximum EIRP	(dBW/4 kHz)	0.0	10.5		
	(dBW/MHz)	37.3	37.3		
	(dBW)	48.4	61.3		
Interference Objectives:	Long Term	48.4	76.8		
	Short Term	-154.0 dBW/MHz	20%	-154.0 dBW/4 kHz	20%
		-144.0 dBW/MHz	0.01%	-131.0 dBW/4 kHz	0.0025%

Frequency Information

Receive 4.0 GHz

Transmit 6.1 GHz

Emission / Frequency Range (MHz)	51K2G7W - 36M0G7W / 3700.0 - 4200.0	51K2G7W - 36M0G7W / 5925.0 - 6425.0
Max Great Circle Coordination Distance	318.1 km / 197.7 mi	154.0 km / 95.7 mi
Precipitation Scatter Contour Radius	492.5 km / 306.0 mi	100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 <http://www.comsearch.com>

Coordination Values

TULSA, OK

Licensee Name ORAL ROBERTS UNIVERSITY
Latitude (NAD 83) 36° 2' 53.3" N
Longitude (NAD 83) 95° 57' 17.0" W
Ground Elevation (AMSL) 192.02 m / 630.0 ft
Antenna Centerline (AGL) 4.27 m / 14.0 ft
Antenna Mode Receive 4.0 GHz Transmit 6.1 GHz
Interference Objectives: Long Term -154.0 dBW/MHz 20% -154.0 dBW/4 kHz 20%
Short Term -144.0 dBW/MHz 0.01% -131.0 dBW/4 kHz 0.0025%
Max Available RF Power -13.5 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 4.0 GHz		Transmit 6.1 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.30	115.75	-10.00	260.76	-10.00	125.96
5	0.59	117.99	-10.00	232.96	-10.00	105.91
10	1.00	114.14	-10.00	210.59	-10.00	100.00
15	1.20	110.12	-10.00	204.87	-10.00	100.00
20	1.31	106.01	-10.00	204.22	-10.00	100.00
25	1.59	101.88	-10.00	196.45	-10.00	100.00
30	1.55	97.66	-10.00	197.57	-10.00	100.00
35	1.49	93.43	-10.00	199.24	-10.00	100.00
40	1.07	89.20	-10.00	208.55	-10.00	100.00
45	1.13	84.99	-10.00	206.83	-10.00	100.00
50	0.81	80.82	-10.00	220.41	-10.00	100.00
55	0.80	76.66	-10.00	220.96	-10.00	100.00
60	0.99	72.48	-10.00	211.09	-10.00	100.00
65	1.30	68.31	-10.00	204.50	-10.00	100.00
70	1.48	64.20	-10.00	199.51	-10.00	100.00
75	1.83	60.08	-10.00	189.73	-10.00	100.00
80	1.75	56.19	-10.00	191.98	-10.00	100.00
85	1.85	52.35	-10.00	189.16	-10.00	100.00
90	1.85	48.70	-10.00	189.16	-10.00	100.00
95	1.70	45.33	-9.41	196.17	-9.41	100.00
100	1.08	42.55	-8.72	214.30	-8.72	100.00
105	1.15	39.63	-7.95	215.91	-7.95	100.00
110	1.27	37.04	-7.22	215.90	-7.22	100.00
115	1.14	35.11	-6.64	222.86	-6.64	100.00
120	1.14	33.61	-6.16	225.34	-6.16	100.00
125	1.04	32.83	-5.91	229.99	-5.91	100.00
130	0.92	32.74	-5.88	236.06	-5.88	101.96
135	0.74	33.38	-6.09	245.65	-6.09	109.47
140	0.38	34.83	-6.55	272.29	-6.55	128.85
145	0.38	36.49	-7.06	269.12	-7.06	127.46
150	0.29	38.73	-7.70	275.90	-7.70	133.00
155	0.25	41.28	-8.39	276.52	-8.39	133.15
160	0.00	43.76	-9.03	278.84	-9.03	135.62
165	0.00	45.62	-9.48	276.04	-9.48	134.36
170	0.00	47.01	-9.81	274.06	-9.81	133.47
175	0.00	47.87	-10.00	272.88	-10.00	134.19
180	0.33	47.83	-9.99	257.29	-9.99	123.55
185	0.00	47.87	-10.00	272.88	-10.00	134.19

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 <http://www.comsearch.com>

Coordination Values

TULSA, OK

Licensee Name ORAL ROBERTS UNIVERSITY

Latitude (NAD 83) 36° 2' 53.3" N

Longitude (NAD 83) 95° 57' 17.0" W

Ground Elevation (AMSL) 192.02 m / 630.0 ft

Antenna Centerline (AGL) 4.27 m / 14.0 ft

Antenna Mode Receive 4.0 GHz

Interference Objectives: Long Term -154.0 dBW/MHz 20% Transmit 6.1 GHz -154.0 dBW/4 kHz 20%

Short Term -144.0 dBW/MHz 0.01% -131.0 dBW/4 kHz 0.0025%

Max Available RF Power -13.5 (dBW/4 kHz)

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Receive 4.0 GHz		Transmit 6.1 GHz	
			Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.22	46.80	-9.76	271.86	-9.76	133.19
195	0.00	45.62	-9.48	276.05	-9.48	134.36
200	0.00	43.76	-9.03	278.84	-9.03	135.62
205	0.00	41.48	-8.45	282.46	-8.45	137.28
210	0.00	38.85	-7.73	286.97	-7.73	139.36
215	0.00	35.93	-6.89	292.46	-6.89	141.92
220	0.00	32.82	-5.90	298.97	-5.90	145.00
225	0.00	30.03	-4.94	305.49	-4.94	148.12
230	0.00	27.81	-4.11	311.25	-4.11	150.92
235	0.00	26.30	-3.50	316.14	-3.50	153.01
240	0.00	25.62	-3.22	318.15	-3.22	154.00
245	0.00	25.84	-3.31	317.49	-3.31	153.68
250	0.20	26.75	-3.68	314.84	-3.68	152.37
255	0.00	28.82	-4.49	308.58	-4.49	149.62
260	0.27	31.12	-5.33	293.78	-5.33	140.27
265	0.29	34.14	-6.33	284.64	-6.33	135.55
270	0.35	37.51	-7.35	270.82	-7.35	129.06
275	0.56	41.09	-8.34	243.93	-8.34	111.68
280	0.63	44.98	-9.33	234.20	-9.33	105.85
285	0.64	49.06	-10.00	230.00	-10.00	103.63
290	0.61	53.27	-10.00	231.77	-10.00	105.00
295	0.49	57.60	-10.00	239.50	-10.00	110.85
300	0.67	61.91	-10.00	228.25	-10.00	102.26
305	1.19	66.22	-10.00	205.15	-10.00	100.00
310	0.84	70.76	-10.00	218.80	-10.00	100.00
315	0.57	75.28	-10.00	234.16	-10.00	106.83
320	0.00	79.84	-10.00	272.88	-10.00	134.19
325	0.00	84.34	-10.00	272.88	-10.00	134.19
330	0.00	88.85	-10.00	272.88	-10.00	134.19
335	0.00	93.35	-10.00	272.88	-10.00	134.19
340	0.00	97.86	-10.00	272.88	-10.00	134.19
345	0.00	102.35	-10.00	272.88	-10.00	134.19
350	0.00	106.83	-10.00	272.88	-10.00	134.19
355	0.21	111.31	-10.00	271.64	-10.00	133.36

5. CERTIFICATION

I HEREBY CERTIFY THAT I AM THE TECHNICALLY QUALIFIED PERSON RESPONSIBLE FOR THE PREPARATION OF THE FREQUENCY COORDINATION DATA CONTAINED IN THIS APPLICATION, THAT I AM FAMILIAR WITH PARTS 101 AND 25 OF THE FCC RULES AND REGULATIONS, THAT I HAVE EITHER PREPARED OR REVIEWED THE FREQUENCY COORDINATION DATA SUBMITTED WITH THIS APPLICATION, AND THAT IT IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

Timothy O. Crutcher
Frequency Planner
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147

DATED: July 28, 2004

FREQUENCY COORDINATION AND INTERFERENCE ANALYSIS REPORT

Prepared for
ORAL ROBERTS UNIVERSITY
TULSA, OK
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147
October 30, 2003

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1. CONCLUSIONS

An interference study considering all existing, proposed and prior coordinated microwave facilities within the coordination contours of the proposed earth station demonstrates that this site will operate satisfactorily with the common carrier microwave environment. Further, there will be no restrictions of its operation due to interference considerations.

2. SUMMARY OF RESULTS

A number of great circle interference cases were identified during the interference study of the proposed earth station. Each of the cases, which exceeded the interference objective on a line-of-sight basis, was profiled and the propagation losses estimated using NBS TN101 (Revised) techniques. The losses were found to be sufficient to reduce the signal levels to acceptable magnitudes in every case.

The following companies reported potential great circle interference conflicts that did not meet the objectives on a line-of-sight basis. When over-the-horizon losses are considered on the interfering paths, sufficient blockage exists to negate harmful interference from occurring with the proposed transmit-receive earth station.

Company

The Burlington Northern and Santa Fe
U.S Cellular Telephone of Greater Tulsa
Oklahoma City SMSA Limited Partnership

No other carriers reported potential interference cases.

3. SUPPLEMENTAL SHOWING

Pursuant to Part 25.203(c) of the FCC Rules and Regulations, the satellite earth station proposed in this application was coordinated by Comsearch using computer techniques and in accordance with Part 25 of the FCC Rules and Regulations.

Coordination data for this earth station was sent to the below listed carriers with a letter dated 09/17/2003.

Company

Alltel Communications, Inc.
AT&T Communications of The Southwest
ATT Corp
AT&T Wireless Svcs of FI Mid South Reg
Dobson Cellular Systems, Inc.
Grand River Dam Authority
Kamo Electric Cooperative
Kansas #15 Limited Partnership
LB Tower Company LLC
MCI Network Services, Inc.
Ok-3 Cellular, Inc.
Oklahoma Alltel, Inc.
Oklahoma City SMSA Ltd Partnership
Oklahoma RSA #3 Ltd Partnership
Oklahoma RSA #4 South Partnership
Public Service Company Of Oklahoma
Southwestern Bell Telephone, L.P.
The Burlington Northern and Santa Fe
US Cellular Telephone of Greater Tulsa
USCOC of Oklahoma RSA #10, Inc.

4. EARTH STATION COORDINATION DATA

This section presents the data pertinent to frequency coordination of the proposed earth station that was circulated to all carriers within its coordination contours.

SATELLITE EARTH STATION
 FREQUENCY COORDINATION DATA
 09/17/2003

Company	ORAL ROBERTS UNIVERSITY	
Earth Station Name, State	TULSA, OK	
Call Sign	E2454	
Latitude (DMS) (NAD83)	36 2 53.3 N	
Longitude (DMS) (NAD83)	95 57 17.0 W	
Ground Elevation AMSL (Ft/m)	630.03 / 192.02	
Antenna Centerline AGL (Ft/m)	8.00 / 2.44	
Receive Antenna Type:	FCC32	PRODELIN 1383
4.0 GHz Gain (dBi) / Diameter (m)		41.9 / 3.8
3 dB / 15 dB Half Beamwidth		0.8 / 1.6
Transmit Antenna Type:	FCC32	PRODELIN 1383
6.0 GHz Gain (dBi) / Diameter (m)		45.9 / 3.8
3 dB / 15 dB Half Beamwidth		0.4 / 0.8
Operating Mode	TRANSMIT AND RECEIVE	
Modulation	DIGITAL	
Emission / Receive Band (MHz)	64K0G7W - 36M0G7W / 3700.00 - 4200.00	
Emission / Transmit Band (MHz)	64K0G7W - 36M0G7W / 5925.00 - 6425.00	
	<u>64K0G7W - 36M0G7W</u>	
Max. Available RF Power (dBW)/4 kHz	-10.0	-14.1
(dBW)/MHz	1.1	9.9
Max. EIRP	(dBW)/4 kHz	35.9 31.8
	(dBW)/MHz	47.0 55.8
	(dBW)	47.0 71.3
Max permissible Interference Power		
4.0 GHz, 20% (dBW/1 MHz)	-156.0	
4.0 GHz, 0.0100% (dBW/1 MHz)	-146.0	
6.0 GHz, 20% (dBW/4 kHz)	-154.0	
6.0 GHz, 0.0025% (dBW/4 kHz)	-131.0	
Range of Satellite Arc (Geostationary)		
Degrees Longitude	70.0 W / 136.0 W	
Azimuth Range (Min/Max)	140.4 / 235.0	
Corresponding Elevation Angles	40.0 / 30.8	
Radio Climate	A	
Rain Zone	2	
Max Great Circle Coordination Distance (Mi/Km)		
4.0 GHz	197.7 / 318.2	
6.0 GHz	99.1 / 159.4	
Precipitation Scatter Contour Radius (Mi/Km)		
4.0 GHz	303.5 / 488.6	
6.0 GHz	62.1 / 100.0	

Note: Horizon is less than 0.2 degrees at all azimuths

Table of Earth Station Coordination Values
09/17/2003

Earth Station Name TULSA OK
 Owner ORAL ROBERTS UNIVERSITY
 Latitude (DMS) (NAD83) 36 2 53.3 N
 Longitude (DMS) (NAD83) 95 57 17.0 W
 Ground Elevation (Ft/m) 630.03 / 192.02 AMSL
 Antenna Centerline (Ft/m) 8.00 / 2.44 AGL
 Objectives: Receive -156.0 (dBW /1 MHz)
 Transmit -154.0 (dBW /4 kHz) TX Power -10.0 (dBW/4 kHz)

Azimuth (Deg)	Horizon Elevation Angle (Deg)	Antenna Disc. Angle (Deg)	4.0 GHz		6.0 GHz	
			Antenna Gain (dBi)	Coordination Distance (Km)	Antenna Gain (dBi)	Coordination Distance (Km)
0	0.00	119.53	-10.00	285.2	-10.00	143.1
5	0.00	123.07	-10.00	285.2	-10.00	143.1
10	0.00	119.78	-10.00	285.2	-10.00	143.1
15	0.00	116.36	-10.00	285.2	-10.00	143.1
20	0.00	112.82	-10.00	285.2	-10.00	143.1
25	0.00	109.19	-10.00	285.2	-10.00	143.1
30	0.00	105.50	-10.00	285.2	-10.00	143.1
35	0.00	101.75	-10.00	285.2	-10.00	143.1
40	0.00	97.96	-10.00	285.2	-10.00	143.1
45	0.00	94.14	-10.00	285.2	-10.00	143.1
50	0.00	90.31	-10.00	285.2	-10.00	143.1
55	0.00	86.48	-10.00	285.2	-10.00	143.1
60	0.00	82.66	-10.00	285.2	-10.00	143.1
65	0.00	78.87	-10.00	285.2	-10.00	143.1
70	0.00	75.11	-10.00	285.2	-10.00	143.1
75	0.00	71.40	-10.00	285.2	-10.00	143.1
80	0.00	67.76	-10.00	285.2	-10.00	143.1
85	0.00	64.21	-10.00	285.2	-10.00	143.1
90	0.00	60.77	-10.00	285.2	-10.00	143.1
95	0.00	57.45	-10.00	285.2	-10.00	143.1
100	0.00	54.30	-10.00	285.2	-10.00	143.1
105	0.00	51.35	-10.00	285.2	-10.00	143.1
110	0.00	48.63	-10.00	285.2	-10.00	143.1
115	0.00	46.20	-9.62	287.7	-9.62	144.3
120	0.00	44.10	-9.11	291.0	-9.11	145.9
125	0.00	42.38	-8.68	293.8	-8.68	147.3
130	0.00	41.09	-8.34	296.0	-8.34	148.4
135	0.00	40.28	-8.13	297.4	-8.13	149.1
140	0.00	39.98	-8.05	298.0	-8.05	149.4
145	0.00	40.20	-8.11	297.6	-8.11	149.2
150	0.00	40.93	-8.30	296.3	-8.30	148.5
155	0.00	42.14	-8.62	294.2	-8.62	147.5
160	0.00	43.79	-9.03	291.5	-9.03	146.1
165	0.00	45.62	-9.48	288.6	-9.48	144.7
170	0.00	47.01	-9.81	286.5	-9.81	143.7
175	0.00	47.87	-10.00	285.2	-10.00	143.1
180	0.00	48.16	-10.00	285.2	-10.00	143.1


Table of Earth Station Coordination Values
09/17/2003

Earth Station Name TULSA OK
 Owner ORAL ROBERTS UNIVERSITY
 Latitude (DMS) (NAD83) 36 2 53.3 N
 Longitude (DMS) (NAD83) 95 57 17.0 W
 Ground Elevation (Ft/m) 630.03 / 192.02 AMSL
 Antenna Centerline (Ft/m) 8.00 / 2.44 AGL
 Objectives: Receive -156.0 (dBW /1 MHz)
 Transmit -154.0 (dBW /4 kHz) TX Power -10.0 (dBW/4 kHz)

Azimuth (Deg)	Horizon Elevation Angle (Deg)	Antenna Disc. Angle (Deg)	4.0 GHz		6.0 GHz	
			Antenna Gain (dBi)	Coordination Distance (Km)	Antenna Gain (dBi)	Coordination Distance (Km)
185	0.00	47.87	-10.00	285.2	-10.00	143.1
190	0.00	47.01	-9.81	286.5	-9.81	143.7
195	0.00	45.62	-9.48	288.6	-9.48	144.7
200	0.00	43.76	-9.03	291.5	-9.03	146.2
205	0.00	41.48	-8.45	295.3	-8.45	148.1
210	0.00	38.85	-7.73	300.1	-7.73	150.4
215	0.00	36.16	-6.96	305.3	-6.96	153.1
220	0.00	33.91	-6.26	310.2	-6.26	155.6
225	0.00	32.21	-5.70	314.7	-5.70	157.6
230	0.00	31.14	-5.33	317.3	-5.33	158.9
235	0.00	30.77	-5.20	318.2	-5.20	159.4
240	0.00	31.14	-5.33	317.3	-5.33	158.9
245	0.00	32.21	-5.70	314.7	-5.70	157.6
250	0.00	33.91	-6.26	310.2	-6.26	155.6
255	0.00	36.16	-6.96	305.3	-6.96	153.1
260	0.00	38.86	-7.74	300.0	-7.74	150.4
265	0.00	41.92	-8.56	294.6	-8.56	147.7
270	0.00	45.27	-9.39	289.1	-9.39	145.0
275	0.00	48.84	-10.00	285.2	-10.00	143.1
280	0.00	52.59	-10.00	285.2	-10.00	143.1
285	0.00	56.48	-10.00	285.2	-10.00	143.1
290	0.00	60.48	-10.00	285.2	-10.00	143.1
295	0.00	64.56	-10.00	285.2	-10.00	143.1
300	0.00	68.71	-10.00	285.2	-10.00	143.1
305	0.00	72.91	-10.00	285.2	-10.00	143.1
310	0.00	77.15	-10.00	285.2	-10.00	143.1
315	0.00	81.42	-10.00	285.2	-10.00	143.1
320	0.00	85.71	-10.00	285.2	-10.00	143.1
325	0.00	90.00	-10.00	285.2	-10.00	143.1
330	0.00	94.30	-10.00	285.2	-10.00	143.1
335	0.00	98.58	-10.00	285.2	-10.00	143.1
340	0.00	102.85	-10.00	285.2	-10.00	143.1
345	0.00	107.09	-10.00	285.2	-10.00	143.1
350	0.00	111.29	-10.00	285.2	-10.00	143.1
355	0.00	115.44	-10.00	285.2	-10.00	143.1

5. CERTIFICATION

I HEREBY CERTIFY THAT I AM THE TECHNICALLY QUALIFIED PERSON RESPONSIBLE FOR THE PREPARATION OF THE FREQUENCY COORDINATION DATA CONTAINED IN THIS APPLICATION. I AM FAMILIAR WITH PARTS 101 AND 25 OF THE FCC RULES AND REGULATIONS. I HAVE EITHER PREPARED OR REVIEWED THE FREQUENCY COORDINATION DATA SUBMITTED WITH THIS APPLICATION, AND THAT IT IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

A handwritten signature in cursive script that reads "Timothy O. Crutcher".

Timothy O. Crutcher
Frequency Planner
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147

DATED: October 30, 2003