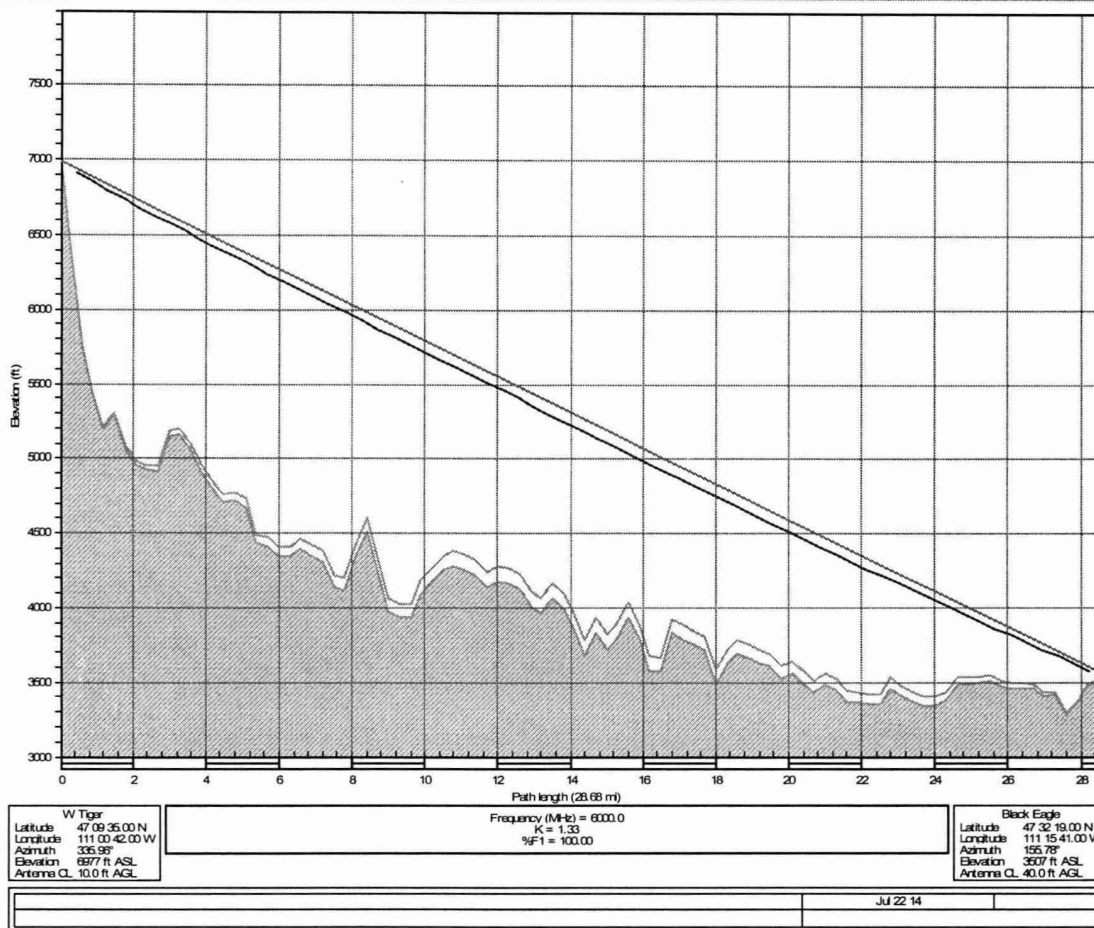




RFS
 * KELLIFLEX
 * CELLFLEX
 * FLEXWELL

HCA78-50
 HCA118-50
 HCA158-50
 HCA 300-50

Path calculations are estimates only, based on the information provided. Trango recommends that you have a formal site survey and a professional path analysis completed by a reputable source. No guarantee of path performance is expressed or implied.

Terrain profiles represent ground terrain only and do not consider trees, buildings, or other obstructions.

6 GHz, 3 ft and 3 ft, 128QAM 56 MHz for 320 Mbps FDX – 99.99981%

	W Tiger	Black Eagle
Elevation (ft)	6977.25	3506.85
Latitude	47 09 35.00 N	47 32 19.00 N
Longitude	111 00 42.00 W	111 15 41.00 W
True azimuth (°)	335.96	155.78
Vertical angle (°)	-1.46	1.15
Antenna model	AD6G-3-T2	AD6G-3-T2
Antenna height (ft)	10.00	40.00
Antenna gain (dBi)	32.50	32.50
Frequency (MHz)	6000.00	
Polarization	Vertical	
Path length (mi)	28.68	
Free space loss (dB)	141.32	
Atmospheric absorption loss (dB)	0.39	
Net path loss (dB)	76.71	76.71
Radio model	GigaPlus6	GigaPlus6
TX power (watts)	0.32	0.32
TX power (dBm)	25.00	25.00
EIRP (dBm)	57.50	57.50
Emission designator	56M0D7W	56M0D7W
TX Channels	6000.0000V	6000.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-68.80	-68.80
RX signal (dBm)	-51.71	-51.71
Thermal fade margin (dB)	17.09	17.09
Dispersive fade margin (dB)	45.00	45.00
Dispersive fade occurrence factor	2.00	
Effective fade margin (dB)	17.08	17.08
Geoclimatic factor	2.50E-07	
Path inclination (mr)	22.71	
Fade occurrence factor (Po)	1.43E-04	
Average annual temperature (°F)	68.00	
Worst month - multipath (%)	99.99972	99.99972
(sec)	7.38	7.38
Annual - multipath (%)	99.99990	99.99990
(sec)	30.10	30.10
(% - sec)	99.99981 - 60.20	
Rain region	B Polar Taiga	
0.01% rain rate (mm/hr)	19.00	
Flat fade margin - rain (dB)	17.09	
Rain rate (mm/hr)	1481.00	
Rain attenuation (dB)	17.09	
Annual rain (%-sec)	100.00000 - 0.00	
Annual multipath + rain (%-sec)	99.99981 - 60.20	

Criteria Level

] x³
241

Tue, Jul 22 2014
W Tiger -Black Eagle.pl4
Reliability Method - ITU-R P.530-7/8
Rain - ITU-R P530-7

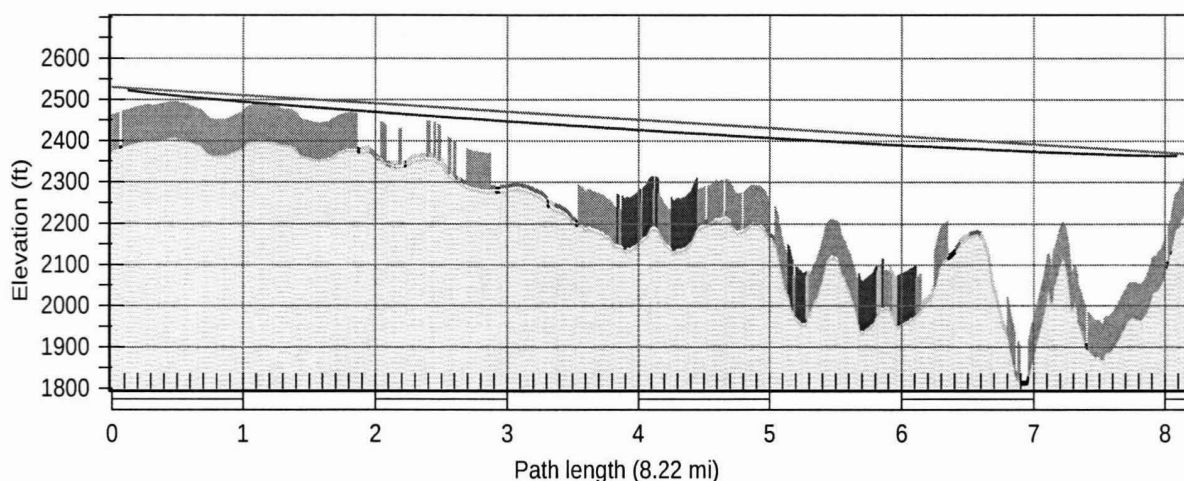
Path calculations are estimates only, based on the information provided. Trango recommends that you have a formal site survey and a professional path analysis completed by a reputable source. No guarantee of path performance is expressed or implied.

Terrain profiles represent ground terrain only and do not consider trees, buildings, or other obstructions.

Microwave Networks Configuration/Design

To design a Microwave Network, first, locations are selected by the customer for sites which will be on the microwave network. These sites must be able to handle the antenna mounting requirements, waveguide or coax cable runs, and power requirements. Microwave Networks Systems Engineers will initially run Path Profiles and Path Analysis via software called PathLoss5 to determine if the path will work, based on available antenna mounting heights, based on Line of Sight with a proper Fresnel Zone to provide a microwave path that will perform at 99.999% availability.

In addition, the Microwave Radio Link Design (Frequency, Transmit power, Capacity, Antenna System, etc.) will be defined by Link Engineering. Link Engineering is performed via the PathLoss software to show the clearances and link budget of the microwave radios/antenna systems. The Link Budget adds all the gains and losses of the system to determine the expected Receive Signal Level (RSL) and Flat Fade Margin. Below is a sample Path Profile and Path Engineering Analysis, which is a deliverable in a Microwave Link Design.



Pendleton	
Latitude	40 30 18.36 N
Longitude	078 47 47.42 W
Azimuth	30.79°
Elevation	2375 ft ASL
Antenna CL	155.0 ft AGL

Frequency (MHz) = 6175.0
K = 1.00
%F1 = 60.00

Carrolltown	
Latitude	40 36 26.51 N
Longitude	078 42 59.51 W
Azimuth	210.84°
Elevation	2242 ft ASL
Antenna CL	125.0 ft AGL

Transmission details (Pendleton-Carrolltown.pl5)

	Pendleton	Carrolltown
Latitude	40 30 18.36 N	40 36 26.51 N
Longitude	078 47 47.42 W	078 42 59.51 W

Page 1 of 4

CONFIDENTIAL

4000 Greenbriar Dr., Suite 100A, Stafford, Texas, USA, 77477

Tel: 1.281.263.6500 * Fax: 1.281.263.6400 * www.microwavenetworks.com

	Pendleton	Carrolltown
True azimuth (°)	30.79	210.84
Vertical angle (°)	-0.26	0.17
Elevation (ft)	2375.41	2242.14
Tower height (ft)	180.00	150.00
Tower type	self supporting	self supporting
Antenna model	PAD 6 - W57B (R) (TR)	PAD 6 - W57B (R) (TR)
Antenna gain (dBi)	38.90	38.90
Radome loss (dB)	0.50	0.50
Antenna diameter (ft)	6.00	6.00
Antenna height (ft)	155.00	125.00
TX line model	E60	E60
TX line unit loss (dB/100 ft)	1.18	1.18
TX line length (ft)	205.00	175.00
TX line loss (dB)	2.43	2.07
Connector loss (dB)	0.20	0.20
Frequency (MHz)	6175.00	
Polarization	Vertical	
Path length (mi)	8.22	
Free space loss (dB)	130.71	
Atmospheric absorption loss (dB)	0.11	
Net path loss (dB)	58.92	58.92
Configuration	Non Protected	Non Protected
Radio model	MX/I/6G/30M/HP	MX/I/6G/30M/HP
TX power (dBm)	32.00	32.00
Emission designator	30M0D7W	30M0D7W
EIRP (dBm)	67.77	68.13
RX threshold criteria	128 QAM	128 QAM
RX threshold level (dBm)	-71.00	-71.00
Receive signal (dBm)	-26.92	-26.92
Thermal fade margin (dB)	44.08	44.08
Dispersive fade margin (dB)	46.00	46.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	41.92	41.92
Climatic factor	1.00	

FADE OCCURRENCE FACTOR

	Pendleton	Carrolltown
Terrain roughness (ft)	64.54	
C factor	0.72	
Average annual temperature (°F)	47.97	
Fade occurrence factor (Po)	6.146E-003	
Worst month multipath availability (%)	99.99996	99.99996
Worst month multipath unavailability (sec)	1.04	1.04
Annual multipath availability (%)	99.99999	99.99999
Annual multipath unavailability (sec)	2.99	2.99
Annual 2 way multipath availability (%)	99.99998	
Annual 2 way multipath unavailability (sec)	5.97	
Polarization	Vertical	

All paths are engineered to meet or exceed an annual two-way availability of >99.999% (defined by Customer) at a BER of 10E-6 using the Vigants-Barnett model. The preliminary calculations for path performance are based on Microwave Networks published 10E-6 receiver threshold levels. Bellcore Standard transmission engineering practices, formulas and topographic data are the foundation of these calculations. Typical Clearance criteria used to determine preliminary antenna centerlines are:

K = 4/3 @ 100% F1

1/3" Arc USGS terrain data

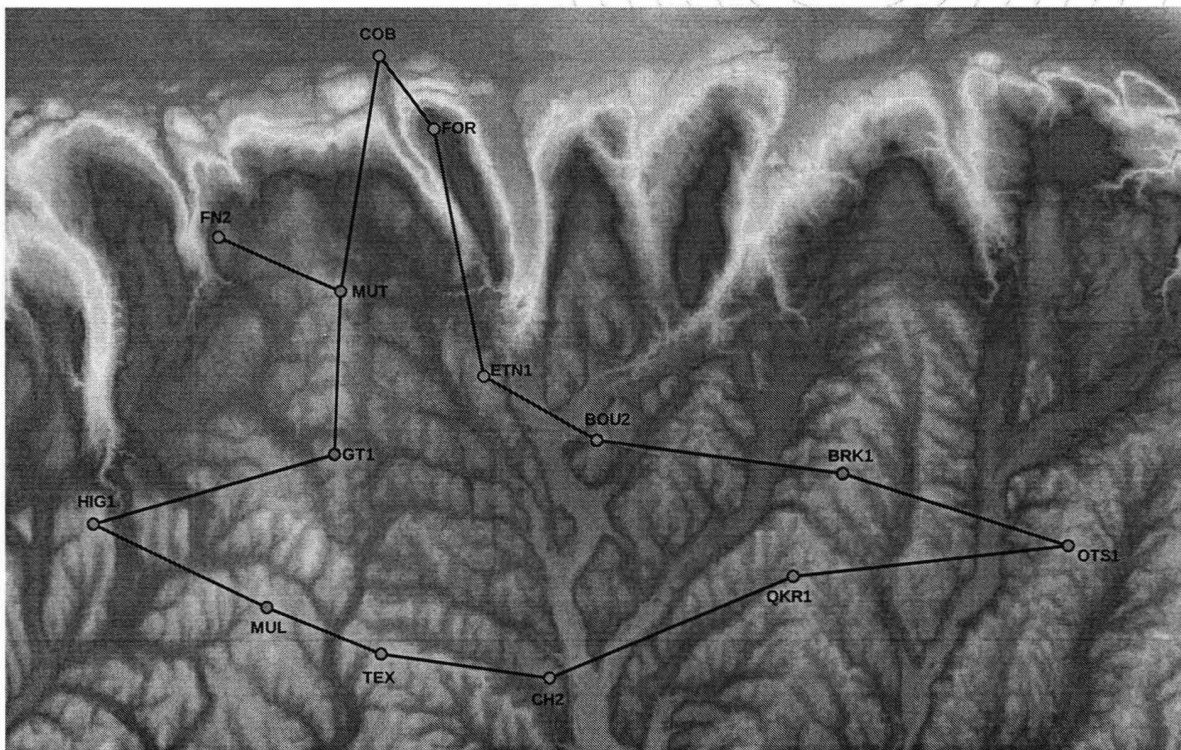
30 meter NLCD 2001/2011 clutter data

$\frac{1}{3}$ Arc = 10m
3 Arc = 90m
1 Arc = 30m

Before system implementation a microwave path engineering survey will be conducted on all paths (see **Exhibit B3-Services-Other Surveys**). The objective of this survey is "information verification" to confirm the information to be used for clearance and engineering performance objectives. This confirmation includes site location (latitude/longitude coordinates), elevation above mean sea level (AMSL), accurate measurement of path obstructions along the path (i.e. trees and buildings, electrical transmission lines, cellular towers, the presence of reflective surfaces) and general compilation of local climate information.

At locations with existing towers, pre-determined azimuths and centerlines will be checked for availability/adaptability in terms of proposed antenna mounting.

Overall, Microwave Networks Systems Engineers will determine the best design for the microwave network, looking at redundancy via rings or hot standby spurs, to best support the traffic flow of the network. Below is a sample design of a typical countywide network.



In summary, Microwave Networks Systems Engineers will work with the customer to define a mission critical network that meet the customer's needs with regards to capacity, availability, and cost effectiveness.

HARRIS Corporation
Microwave Communications Division

Path Loss and Fade Margin Calculations
For Line-of-Sight Microwave Systems
Version 5.0.0

Customer/Project: Wyoming Public Television - OC-3 Digital Microwave System
Path ID: WPOD-4A
Date: 23-May-2005
Rev Date: 23-May-2005
Engineer: J. Ma

Equipment Type: Constellation 155/180 11
Protection Type: Non Protected
Capacity: OC-3/STS-3
Frequency: 11.2 GHz (FCC)
Band Width: N/A

Site Name:	Casper Mtn	Pine Hill
Latitude:	42° 44' 26.5" N	42° 08' 57.4" N
Longitude:	106° 21' 38.5" W	106° 23' 5.4" W
Elevation:	8019.0 ft	8288.0 ft
Azimuth:	181.74°	1.72°

Path Length:	40.84 mi
Free Space Loss:	149.81 dB
Atmospheric Absorption:	1.00 dB
Diffraction Loss:	0.00 dB
Transmission Line Type:	Elliptical
Transmission Line Length:	126.00 ft
Transmission Line Loss:	3.86 dB
Transmit-Only Pads:	0.00 dB
Jumper / Flex Loss:	0.30 dB
Main Antenna Radome Loss:	1.80 dB
Transmitter ACU Loss:	0.00 dB
Receiver ACU Loss:	0.00 dB
Misc/Common Line Pads:	0.00 dB
TOTAL LOSSES:	160.39 dB

Antenna Size:	10.0 ft
Antenna Centerline:	66.0 ft
Antenna Gain:	48.2 dB
Antenna Type:	PL10-107
Effective Radiated Power (EIRP):	67.2 dBm
Transmitter Power:	Standard Power (25.0 dBm)
TOTAL GAINS:	121.4 dB

Unfaded Received Signal Level:	-39.0 dBm (+/- 4dB)
Required Level For 10-3 BER:	-72.5 dBm
Flat Fade Margin:	33.5 dB
Dispersive Fade Margin:	50.0 dB
Composite Fade Margin:	33.4 dB
Multipath Outage Probability:	0.000113946
Multipath Outage:	806.2 sec/year
Rain Outage: Crane zone -B	5.5 sec Vertical
Total Outage:	811.7 sec/year
Percent Reliability:	99.99743 %

c = 0.13 X = 0.5 w = 140.0 (Vigants 1975) Temperature = 44.0 °F
Slope Equalizer? Std
Unfaded Receive Signal Level (at radio/transmission line interface): -39.0 dBm (+/- 4dB)

***** When using HP antennas, Teflon planar radomes are required *****

HARRIS Corporation
Microwave Communications Division

Path Loss and Fade Margin Calculations
For Line-of-Sight Microwave Systems
Version 5.0.0

Customer/Project: Wyoming Public Television - OC-3 Digital Microwave System
Path ID: WPOD-3A
Date: 23-May-2005
Rev Date: 23-May-2005
Engineer: J. Ma

Equipment Type: Constellation 155/180 11
Protection Type: NP xmitters - SD rcvrs
Capacity: OC-3/STS-3
Frequency: 11.2 GHz (FCC)
Band Width: N/A

Site Name:	Waltman	Casper Mtn
NAD83 Latitude:	43° 02' 22.1 " N	42° 44' 26.5 " N
Longitude:	107° 17' 6.9 " W	106° 21' 38.5 " W
Elevation:	6409.0 ft	8019.0 ft
Azimuth:	113.41°	294.04°

Path Length:	51.26 mi
Free Space Loss:	151.78 dB
Atmospheric Absorption:	1.25 dB
Diffraction Loss:	0.00 dB
Transmission Line Type:	Elliptical
Transmission Line Length:	95.00 ft
Transmission Line Loss:	2.91 dB
Transmit-Only Pads:	0.00 dB
Jumper / Flex Loss:	0.30 dB
Main Antenna Radome Loss:	1.50 dB
Transmitter ACU Loss:	0.00 dB
Receiver ACU Loss:	0.00 dB
Misc/Common Line Pads:	0.00 dB
TOTAL LOSSES:	165.97 dB

Antenna Size:	8.0 ft
Antenna Centerline:	65.0 ft
Antenna Gain:	46.2 dB
Antenna Type:	PAR8-107
Effective Radiated Power (EIRP):	66.5 dBm
Transmitter Power:	Standard Power (25.0 dBm)
TOTAL GAINS:	117.4 dB

Unfaded Received Signal Level:	-48.6 dBm (+/- 4dB)
Required Level For 10-3 BER:	-72.5 dBm
Flat Fade Margin:	23.9 dB
Dispersive Fade Margin:	50.0 dB
Composite Fade Margin:	23.9 dB
Diversity Improvement Factor:	2.5
Multipath Outage Probability:	0.000792556
Multipath Outage:	5734.9 sec/year
Rain Outage: Crane zone - B	52.7 sec Vertical

Total Outage:	5787.7 sec/year
Percent Reliability:	99.98165 %

c = 0.13	X = 0.5	w = 140.0	(Vigants 1975)	Temperature = 45.0 °F
Diversity Spacing:	30.0 ft			Slope Equalizer? Std
Diversity Antenna Size/Type:	6.0 ft / PL6-107			6.0 ft / PL6-107
Diversity Centerline:	35.0 ft			80.0 ft

Harris Proprietary Information

Unfaded Receive Signal Level (at radio/transmission line interface): -48.6 dBm (+/- 4dB)

HARRIS Corporation
Microwave Communications Division

Path Loss and Fade Margin Calculations
For Line-of-Sight Microwave Systems
Version 5.0.0

Customer/Project: Wyoming Public Television - OC-3 Digital Microwave System
Path ID: WPOD-2A
Date: 23-May-2005
Engineer: J. Ma

Equipment Type: Constellation 155/180 11
Protection Type: Non Protected
Capacity: OC-3/STS-3
Frequency: 11.2 GHz (FCC)
Band Width: N/A

Site Name:	Copper Mtn	Waltman
NAD83 Latitude:	43° 26 ' 15.3 " N	43° 02 ' 22.1 " N
Longitude:	107° 59 ' 50.6 " W	107° 17 ' 6.9 " W
Elevation:	8228.0 ft	6409.0 ft
Azimuth:	127.16°	307.65°

Path Length:	45.25 mi
Free Space Loss:	150.70 dB
Atmospheric Absorption:	1.11 dB
Diffraction Loss:	0.00 dB
Transmission Line Type:	Elliptical
Transmission Line Length:	45.00 ft
Transmission Line Loss:	1.38 dB
Transmit-Only Pads:	0.00 dB
Jumper / Flex Loss:	0.30 dB
Main Antenna Radome Loss:	1.80 dB
Transmitter ACU Loss:	0.00 dB
Receiver ACU Loss:	0.00 dB
Misc/Common Line Pads:	0.00 dB
TOTAL LOSSES:	159.98 dB

Antenna Size:	10.0 ft
Antenna Centerline:	15.0 ft
Antenna Gain:	48.2 dB
Antenna Type:	PL10-107
Effective Radiated Power (EIRP):	69.7 dBm
Transmitter Power:	Standard Power (25.0 dBm)
TOTAL GAINS:	121.4 dB

Unfaded Received Signal Level:	-38.6 dBm (+/- 4dB)
Required Level For 10-3 BER:	-72.5 dBm
Flat Fade Margin:	33.9 dB
Dispersive Fade Margin:	50.0 dB
Composite Fade Margin:	33.8 dB
Multipath Outage Probability:	0.000141302
Multipath Outage:	999.7 sec/year
Rain Outage: Crane zone -B	4.9 sec Vertical

Total Outage:	1004.7 sec/year
Percent Reliability:	99.99681 %

c = 0.13 X = 0.5 w = 140.0 (Vigants 1975) Temperature = 44.0 °F
Slope Equalizer? Std
Unfaded Receive Signal Level (at radio/transmission line interface): -38.6 dBm (+/- 4dB)

***** When using HP antennas, Teflon planar radomes are required *****

Microwave Link Analysis

	Site A	Site B			
Site Name	: NOC	Santa Rosa			
Location	: Tamuning	Mt. Santa Rosa			
Call Sign	: WPOR267				
Latitude	: 13°29' 37.76" N	13°32' 20.62" N			
Longitude	: 144°47' 32.22" E	144°54' 45.85" E			
Elevation	ft/m: 120.0 / 36.6	700.0 / 213.4			
Azimuth	deg: 68.98914	249.0173			
Distance	mi/km: 8.679 / 14.0	8.679 / 14.0			
Frequency	MHz: 11325.00000	10835.00000			
Equipment	: Harris TRuepoint	Harris TRuepoint			
Tx Antenna Height	ft: 60.00	70.00			
Tx Antenna Type	: PAR6-11	PAR6-11			
Tx Antenna Size / Polarization	ft: 6 / V	6 / H			
Tx Transmission Line Length	ft: 120.01	110.01			
Tx Transmission Line Type	: Andrew EPW90-107	Andrew EPW90-107			
Rx Antenna Height	ft: 60.00	70.00			
Rx Antenna Type	: PAR6-11	PAR6-11			
Rx Antenna Size / Polarization	ft: 6 / V	6 / H			
Rx Transmission Line Length	ft: 120.01	110.01			
Rx Transmission Line Type	: Andrew EPW90-107	Andrew EPW90-107			
Effective Isotropic Radiated Power	dBm: 63.36	61.56			
System Gains	Site A to B	Site B to A			
Tx Antenna Gain	dB: 42.00	40.00			
Rx Antenna Gain	dB: 40.00	42.00			
Transmitter Power	dBm: 25.00	25.00			
Total System Gain	dB: 107.00	107.00			
System Losses	Site A to B	Site B to A			
Free Space Path Loss	dB: 136.431	136.047			
Diffraction Loss	dB: 0.00	0.00			
Atmospheric Absorption	dB: 0.23	0.21			
Foliage Loss	dB: 0.00	0.00			
Tx Jumper Loss	dB: 0.00	0.00			
Tx Radome Loss	dB: 0.00	0.00			
Tx Connector Loss	dB: 0.00	0.00			
Tx Transmission Line Loss	dB: 3.64	3.44			
Tx Standby Switch Loss	dB: 0.00	0.00			
Tx Power Splitter Loss	dB: 0.00	0.00			
Tx RF Branching Loss	dB: 0.00	0.00			
Tx Attenuator Pad Loss	dB: 0.00	0.00			
Tx Miscellaneous & Safety Loss	dB: 0.00	0.00			
Rx Connector Loss	dB: 0.00	0.00			
Rx Transmission Line Loss	dB: 3.34	3.75			
Rx Jumper Loss	dB: 0.00	0.00			
Rx Radome Loss	dB: 0.00	0.00			
Rx Hybrid Loss	dB: 0.00	0.00			
Rx RF Branching Loss	dB: 0.00	0.00			
Rx Attenuator Pad Loss	dB: 0.00	0.00			
Rx Miscellaneous & Safety Loss	dB: 0.00	0.00			
Total System Loss	dB: 143.64	143.45			
Path Calculations	Site A to B	Site B to A			
Unfaded Receive Signal Level	dBm: -36.64	-36.45			
Rx Threshold Level	dBm: -70.00	-70.00			
Fade Margin	dB: 33.36	33.55			
Outage	sec/year: 1233.05	1006.69			
Rain Outage	sec/year: 1166.83	948.37			
Propagation Reliability	‰: 99.99609002	99.9968078			
Outage Parameters: Vigants - Digital					
Climate Factor (c)	0.561	Terrain Factor (w)	133.0	Average Temperature	30.0°C / 86.0°F
CFM	33.55	DFM	0.000	TFM	33.551
BER	1x10E-6	AIFM	0.000	EIFM	0.000

Micropath Corp.

Golden, CO

	Garrison 6	Owings Mills 6
Location	West Virginia	West Virginia
Call Sign	WABC1234	XYZ1234
Latitude	39 08 30.30 N	39 19 08.35 N
Longitude	080 28 22.92 W	080 23 33.20 W
Latitude	39.14175000°	39.31898611°
Longitude	-080.47303333°	-080.39255556°
Azimuth - TN / MN	(°) 019.43 / 028.14	199.48 / 208.28
Elevation - AMSL	(ft) 1275.10	1577.40
Tower - AGL	(ft) 200	200
Antenna Type	CommScope 4-Foot	CommScope 4-Foot
Tx Antenna Pri - AGL	(ft) 200.00	180.00
Rx Antenna Pri - AGL	(ft) 200.00	180.00
Vertical Angle	(°) 0.17	-0.31
Antenna Polarization	Vertical	Vertical
Frequency - Pri	(MHz) 2400	2400
Path Length	(mi/km) 12.97 / 20.87	
Radio Model	FreeWave MW6	FreeWave MW6
Tx Power	(dBm) 20.00	20.00
Tx Antenna Gain	(dBi) 25.00	25.00
Total Tx System Gain	(dB) 45.00	45.00
Tx Line Loss	(dB) 2.62	2.38
Tx Misc / Safety Loss	(dB) 0.10	0.10
Tx Radome Loss	(dB) 0.50	0.50
Tx Connector Loss	(dB) 0.12	0.12
Total Tx System Loss	(dB) 3.34	3.10
ERP	(dBW) 9.51	9.75
ERP / EIRP	(dBm) 39.51 / 41.66	39.75 / 41.90
Rx Antenna Gain	(dBi) 25.00	25.00
Total Rx System Gain	(dB) 25.00	25.00
Rx Line Loss	(dB) 2.62	2.38
Rx Misc / Safety Loss	(dB) 0.10	0.10
Rx Radome Loss	(dB) 0.50	0.50
Rx Connector Loss	(dB) 0.12	0.12
Total Rx System Loss	(dB) 3.34	3.10
Gain / Loss Calculations	At Site A	At Site B
Diffraction Loss	(dB) 0.00	0.00
Foliage Loss	(dB) 0.00	0.00
Free Space Path Loss	(dB) 126.46	126.46
Atmospheric Absorption Loss	(dB) 0.13	0.13
Total System Loss	(dB) 133.04	133.04
Total System Gain	(dB) 70.00	70.00
Received Signal Level - RSL	(dBm) -63.04	-63.04
Rx Threshold Level	(dBm) -96.00	-96.00
Thermal Fade Margin	(dB) 32.96	32.96
Worst Month Multipath Availability	(%) 99.99978	99.99978
Worst Month Multipath Unavailability	(Sec) 5.71	5.71
Annual Multipath Availability	(%) 99.99994	99.99994
Annual Multipath Unavailability	(Sec) 17.36	17.36
Annual 2-Way Multipath Availability	(%) 99.99987	
Annual 2-Way Multipath Unavailability	(Sec) 34.72	

Reliability Method: Barnett - Vigants

$\theta Z = 19.43^\circ$
 $m = 28.14$

199.48°
 208.28

FULL SYSTEM PATH STUDY
Sample System Table with Graph

Transmitter coordinates, N. Lat. 443352 W. Lng. 855346
Receiver coordinates, N. Lat. 445212 W. Lng. 860336
Transmitter Antenna Height= 148.52 Mtrs AG
Receiver Antenna Height= 10 Mtrs AG

Path Length =36.35 km
Azimuth =339.19 degrees
Frequency = 96.7 MHz

Obstruction loss =-20.64 dB
Free Space loss =-107.52 dB
Transmission line loss = -4 dB
Receiving line loss = -1 dB
Connector loss = -1 dB
Other losses = 0 dB

Total losses = -134.16 dB

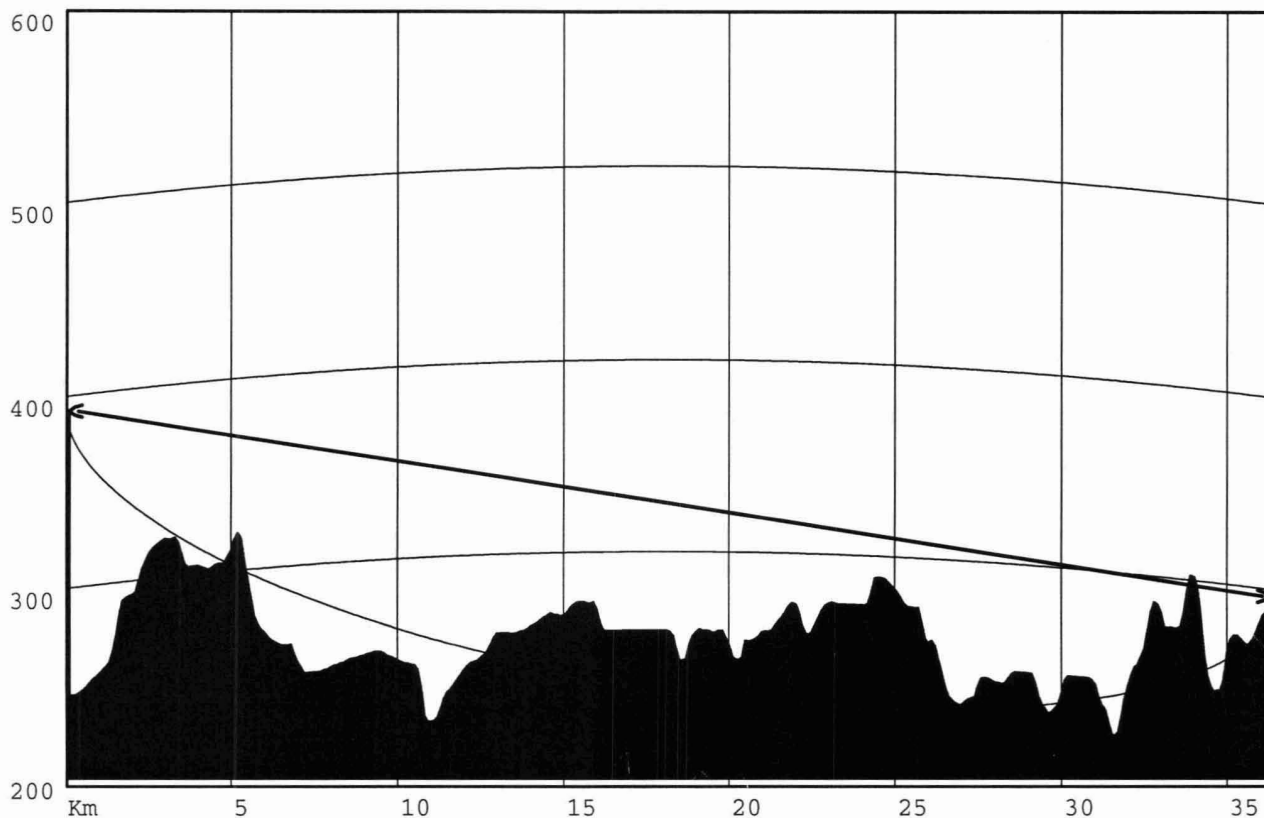
Transmitter output power = 10 Watts, 40 dBm
Transmitter antenna gain = .173 dBi
Receiver antenna gain = 4.933 dBi
Other gains = 0 dB

Total gains = 45.11 dB

Expected receiver signal =-89.05 dB
Desired receiver signal (sensitivity) = 7.08 microVolts, -90 dBm
Available fade margin = .94 dB

Minimum fade margin Recommended = 12.72 dB

11 FS
107.52 DB
20.64
4.00
1.00
1.00
134.16



PlotPath (C) - Ver 2.0 - V-Soft Communications (R) L.L.C.

File Print Setup View Help About

Path Setup - NAD 27

Study Type

☐ Azimuth

☒ Coordinates

Starting Coordinates

N. Lat.

402026.25

Ending Coordinates

N. Lat.

390045.65

End Point

Azimuth

180.74

Dist (km)

147.45

Process

Coordinate
Screen Tool

☐

Path Parameters

Xmit Ht Mtrs

373.75

Rcvr Ht Mtrs

323.08

Ant Ht Units

☒ AG

☐ AMSL

Path Loss dB

-134.93

Freq MHz

900

Earth Curve (K)

1

Fresnel

.6

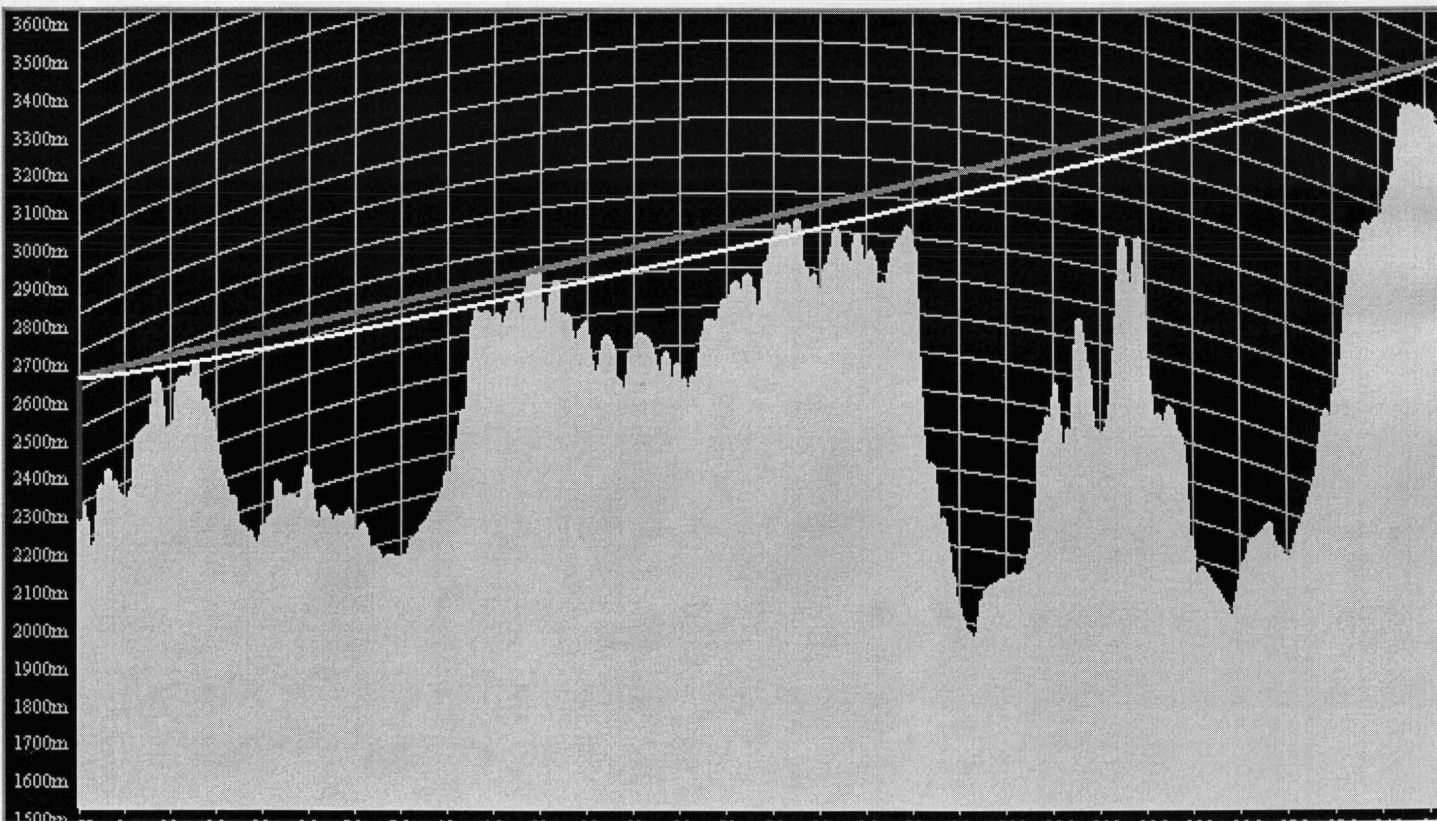
Elevation Angle

Transmit

.33

Receive

-.33



Path Summary:

Transmitter coordinates:	41-00-52 N	092-24-30.70 W
Receiver coordinates:	41-01-29 N	092-28-10 W
Path Length & Azimuth:	5.249 km	282.58 degrees
Frequency:	950 MHz	

System Gain Summary:

Transmitter Output Power:	10 Watts	40 dBm
Transmitter Antenna Gain:		15.5 dBi
Receiver Antenna Gain:		15.5 dBi
Misc. Gain:		0 dB

Total System Gain:		71 dB

System Loss Summary:

Path Loss:		106.41 dB
Line Loss (Tx/Rx):	0.164 dB/0.123 dB	0.287 dB
Total Connector Loss:		1.5 dB
Misc. Loss:		0 dB

Total System Loss:		108.197 dB

Radiation Summary:

Transmitter Output Power:	10 Watts	40 dBm
Antenna Gain:		15.5 dBi
Transmission Line:		-0.164 dB
Connectors:		-1.5 dB
Miscellaneous:		0 dB

EIRP:		54.586 dBm

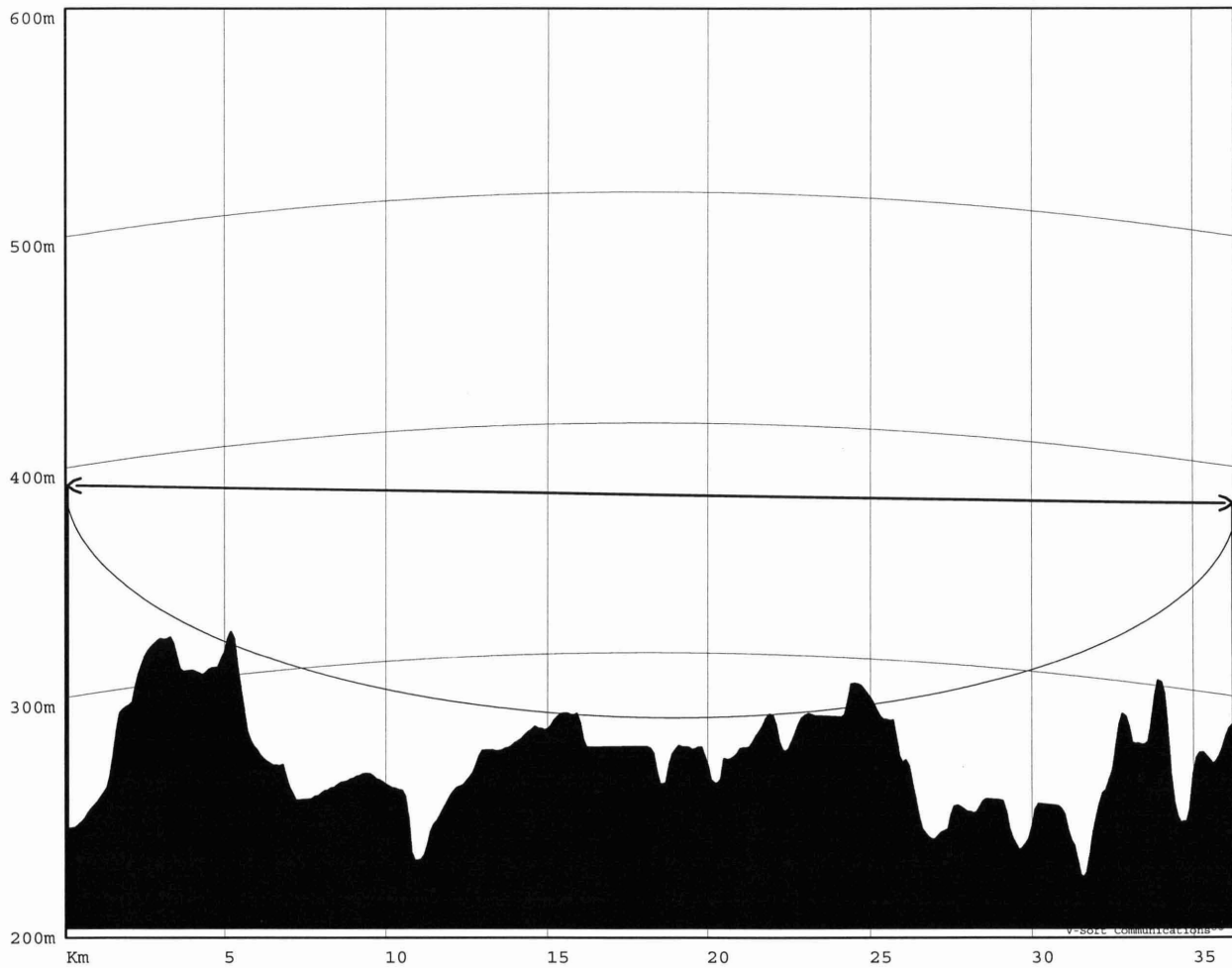
Link Budget Summary:

Total System Gain:		71 dB
Total System Loss:		108.197 dB
Expected receiver signal:		-37.197 dB
Desired receiver signal level (sensitivity):	70.0 uV	-70.098 dBm

Available fade margin:		32.901 dB
Minimum fade margin recommended:		1.142 dB

PlotPath™

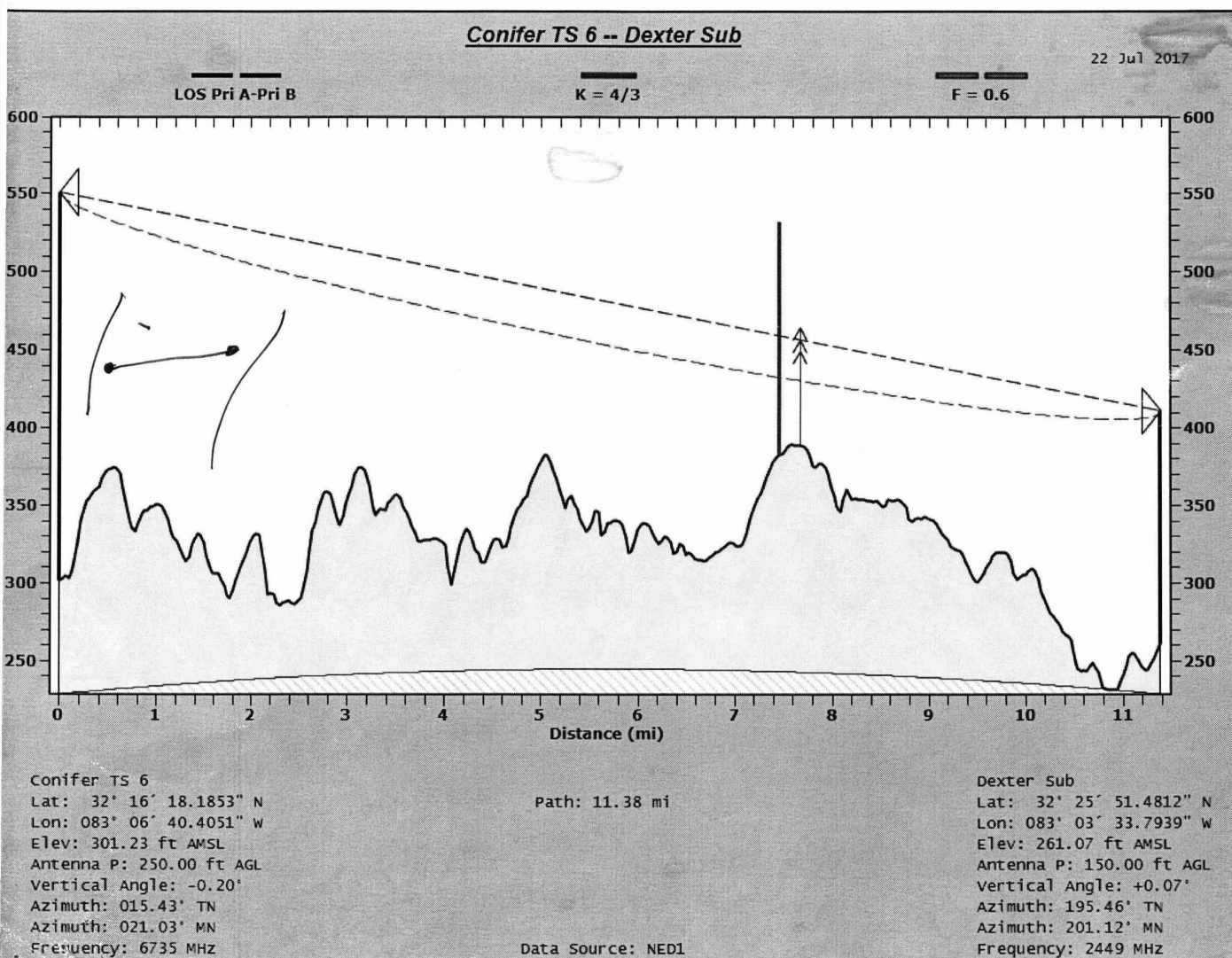
Sample Plotpath Profile Graph with Fresnel



N. Lat. 443352
W. Lng. 855346
Earth = 1.33
Obst. Loss=-2.26 dB

N. Lat. 445212
W. Lng. 860336
Frequency = 96.7 MHz
Free Space Loss=-107.52 dB

Transmit Ht 148.5 Mtrs AG
Receive Ht 95.9 Mtrs AG
Fresnel Zone Clearance= .6
Total Path Loss=-109.78 dB



Path Clearance Criteria

Route"

below in
paths in
fade areas.

= 1)

MAIN PATH (Top dishes)
K = 1

DIVERSITY PATH (Top-To-Bottom Dishes)
"Heavy" Route

DUCTING
Allowance
Main path clearance with known
surface duct entrapment (paths >20/30
miles/kilometers)

FADE
"Heavy" Route

About 6 GHz and above in
moderate to heavy fade areas
(c = 2 to 6)

30% @ 4/3
0.3 F1 @ K = 2/3 *

0.6 F1 @ K = 4/3
+ 10 ft/3m Close-In For
Tree Growth, Vehicles
and Survey Allowance

Grazing (0) Clearance *
@ K = 1 Over a 150' (50m)
Surface Ducting Layer

"Light

About 2 GHz and
all areas, and all
good to average

(c = 0.25 to c
6% @ K=1
0.6 F1 @

Same as

No Special

*Note: If the path clearance is established by either of these two criteria,
(0.3F1 @ K = 2/3 or ducting), space diversity is nearly always required.)

Source: Harris - Farinon Division

For 800-900 MHz frequencies, you might wish to use K = 1 and F = 0.6, F = 0.3, or F = 0. The size of the calculated Fresnel zone is a function of frequency. Therefore, the lower the frequency, the larger the Fresnel zone.

For frequencies below 800 MHz, you might wish to use K = 4/3 and F = 0.

Source: Micropath

*MAIN = TOP
DUC = BOT*

Microwave Radio Path Calculations

Customer: **asdfdsaf**

Project: **adfsadfsadf**

Equipment Type: MicroStar E 23 (4FSK)	Capacity: 1 T1
Protection Type: Non Protected	Mid Frequency: 22.400 GHz
Transmit Power: Standard	

Site Name:	tx	rx
Latitude (N):	44 ° 31 ' 47.0 "	44 ° 30 ' 4.0 "
Longitude (W):	88 ° 2 ' 26.0 "	87 ° 56 ' 51.0 "
Ground Elevation:	590 ft	640 ft
Path Length:	5.0 mi	
Azimuth:	113.22 °	293.29 °

Free Space Loss:	137.6 dB
Absorption Loss:	1.4 dB
Feeder Type/Length:	100.0 ft Elliptical
Feeder Loss:	8.6 dB
Miscellaneous Loss:	0.0 dB
Transmitter ACU Loss:	0.0 dB
Receiver ACU Loss:	0.0 dB
TOTAL LOSSES:	156.2 dB

Antenna Size:	1.0 ft
Antenna Centerline:	50.0 ft
Antenna Gain:	34.8 dB
Transmit Power:	16.0 dBm
TOTAL GAINS:	85.6dB

Unfaded Receive Signal Level:	-70.6 dBm
Threshold:	-87.0 dBm at 10^-6 BER
Flat Fade Margin:	16.4 dB
Dispersive Fade Margin:	N/A dB
Composite Fade Margin:	16.4 dB

c Factor= 2.00

Average Annual Temperature: **45°F**

Multipath Outage (Short Term, One Way)

SESR	sec/year	Objective	Path Reliability	Objective
0.0003187	2,306	32	99.99269%	99.99990%

Handwritten: 0.4.C.F.T.D. 10^-6 BER
 (1600.0) / 250
 Bell South

$$16 - 8.6 + 34.8 - 137.6 - 1.4 = -96.8$$

$$-96.8 + 34.8 = -70.6$$

Printed on 4/14/03
 StarLink 2.1

Completed by dadfsadf on 4/14/03
 Product Database: May 18, 2000

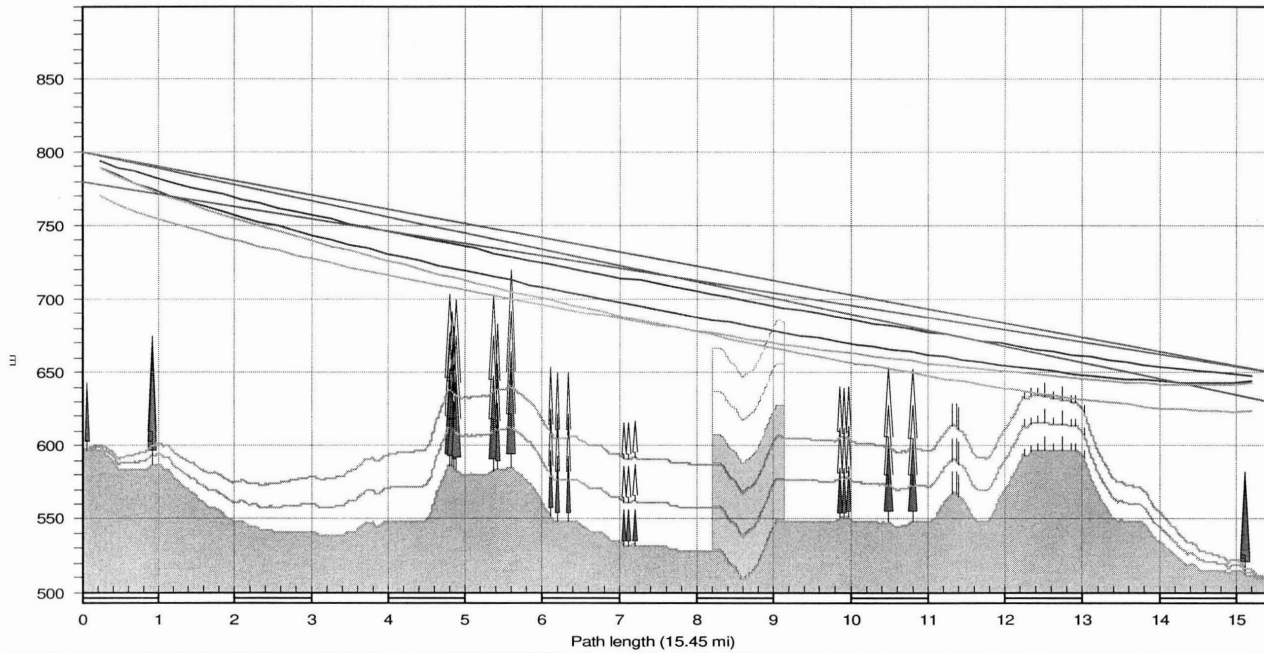
Handwritten calculations:
 137.6
 1.4
 139.0
 8.6
 147.6
 8.6
 156.2

Handwritten calculations:
 34.8 - 69.2
 2 16.0
 68.6 85.6

California Amplifier Link Analysis 7/8/97:22 AM

CAL AMP MMDS California Amplifier Wireless Cable System Link Analysis Program Version 3.0. Copyright © 1992-94 by California Amplifier Numbers in Enclosed Areas Are Entered. Bold Italic Numbers Are Calculated. Press Shift +F2 on cells with red dot for notes.			
Transmitter Site			
Highest Transmitted Frequency.....	2686.00	MHz	
Number of Channels Transmitted Greater Than 2.....	19.00	Channels	
Transmitter Power per Channel.....	10.00	Watts	40.00 dBm
Waveguide Combiner Loss.....	3.00	dB	-3.00 dB
Transmission Line Loss.....			-4.80 dB
(7/8" Air Heliax)	Loss per 100 feet	2.40	dB
	Length	200.00	feet
(Elliptical Waveguide)	Loss per 100 feet	0.45	dB
	Length	0.00	feet
Transmit Antenna	Andrew, or Custom (A, or C).....	A	ANDREW
	Number of Bays: 8, 12, 16, 24, or 32.....	16	16 BAY
	Horizontal or Vertical Polarity (H or V).....	V	VERTICAL
	Radiation Pattern: Omni, Cardioid, or Peanut (O, C, or P).....	O	OMNI
	Directivity	0.00	Peak Gain 14.19 dBi
Additional Antenna Tilt in Direction of Interest	0.50	degrees	
Azimuth Angle in Direction of Interest	0.00	degrees	
Height of Transmit Antenna	190	feet.....	58.04 meters
Height of Receive Antenna	25	feet.....	7.64 meters
Maximum Distance to Radio Horizon for 4/3 Earth.....	28.58	Miles	
Tx to Rx Site Depression Angle, deg.	-0.28		Transmit Antenna Attenuation -0.96 dB
Peak Antenna Gain in Direction of Receive Site.....			13.21 dBi
Peak EIRP per Channel.....			45.41 dBm
Distance Between Transmitter and Customer Receive Site.....	7.50	Miles.....	12.10 Kilometers
Free Space Path Loss.....			-122.66 dB
Customer Receive Site			
Receive Antenna.....	Gain Over Isotropic	18.00	dBi 18.00 dB
Antenna Noise Figure.....		2.00	dB
Antenna Feed Line Loss.....		0.00	dB 0.00 dB
Received Power Out of Antenna.....			-59.26 dBm
Downconverter			
C/N Ratio.....		47.81	dB
Maximum Input Power for.....	52.00	dB C/CTB Ratio	-44.26 dBm
C/CTB Ratio.....		82.00	dB
3rd Order Intercept Point.....		27.00	dBm
Noise Figure.....		2.00	dB
Gain.....		32.00	dB 32.00 dB
Receive System Noise Figure.....			3.38 dB
Output Power.....			-27.26 dBm
Output Voltage.....			21.49 dBmV
IF Cable & Splitter Losses.....		1.00	dB -1.00 dB
Set-Top Converter			
Set-Top Noise Figure.....		10.00	dB
Receiver Bandwidth.....		4.20	MHz 6.23 dB
Receiver Noise Floor.....			-106.99 dBm
Total Receive System Noise Figure.....			3.40 dB
C/N at Input of Set Top.....		47.73	dB
Input Level at Set Top.....			20.49 dBmV
Your questions, comments, suggestions and requests for updates are always welcome. FAX (805) 987-8359 or write: California Amplifier, Applications Engineering, 460 Calle San Pablo, Camarillo, California 93012 U.S.A.			

Path Profile:



Site A
Latitude 30 30 30.55 N
Longitude 097 30 30.55 W
Azimuth 139.04°
Elevation 600 ft ASL
Antenna CL 200.0, 180.0 ft AGL

Frequency (MHz) = 6175.0
K = 1.33, 0.67
%F1 = 60.00, 30.00, 60.00

TCS Consultants, Inc.

Site B
Latitude 30 20 20.55 N
Longitude 097 20 20.55 W
Azimuth 319.13°
Elevation 510 ft ASL
Antenna CL 140.0, 120.0 ft AGL

Customer Name Here

Sample Path Profile

Nov 13 02

RAS

Sample

Your Company Logo Here!

Site A to Site B: Page 1

November 18, 2002

Terrain Data Points:

Terrain Data - Sample Pathloss File.pl4

	Site A	Site B
Call Sign	CALLSIGN1	CALLSIGN2
Latitude	30 30 30.55 N	30 20 20.55 N
Longitude	097 30 30.55 W	097 20 20.55 W
True azimuth (°)	139 02 38.58	319 07 47.47
Calculated Distance (mi)	15.446	
Profile Distance (mi)	15.446	
Datum	North American 1983	
UTM zone	14N	14N
Easting (km)	643.122	659.659
Northing (km)	3376.078	3357.524
Elevation (ft)	600.00	510.00

Distance (mi)	Elevation (ft)	Ground	Structure (ft)
0.000	600.00	AG	
0.010	597.11	AG	
0.070	597.11	AG	45.0 ft Tree
0.280	595.45	AG	
0.290	595.01	AG	

~DATA STRIPPED FOR SAMPLE REPORT~ Depending on the length of the path – this can be from approx. 50 pts to 5,000 pts. – TCS uses 10 and 30 meter data to perform preliminaries then adjusts the data accordingly. This allows for better representation of the path for purposes of reflection and terrain associated path propagation issues. Depending on customer requirements – these points can be adjusted to required lengths.

14.940	514.20	AG	
15.050	515.05	AG	
15.110	512.64	AG	65.0 ft Tree
15.120	512.21	AG	
15.130	511.78	AG	
15.140	511.78	AG	
15.200	511.79	AG	
15.250	509.92	AG	
15.260	509.49	AG	
15.280	508.63	AG	
15.320	509.34	AG	
15.360	508.59	AG	
15.400	509.34	AG	
15.440	508.53	AG	
15.446	510.00	AG	

Ground Elevations - AMSL, Structure & Antenna Heights - AGL

Ground Type

PG - Poor, AG - Average, GG - Good, FW - Fresh Water, SW - Salt Water

Your Company Logo Here!

Path Calculations:

	Site A	Site B
Elevation (ft)	600.00	510.00
Latitude	30 30 30.55 N	30 20 20.55 N
Longitude	097 30 30.55 W	097 20 20.55 W
True azimuth (°)	139.04	319.13
Vertical angle (°)	-0.19	0.02
Antenna model	PAD8-59W	PAD8-59W
Antenna height (ft)	200.00	140.00
Antenna gain (dBi)	41.60	41.60
Radome loss (dB)	0.50	0.50
TX line type	WE61	WE61
TX line length (ft)	240.00	180.00
TX line unit loss (dB /100 ft)	1.18	1.18
TX line loss (dB)	2.83	2.12
Connector loss (dB)	0.50	0.50
Antenna model	PAD6-59W	PAD6-59W
Antenna height (ft)	180.00	120.00
Antenna gain (dBi)	39.10	39.10
Radome loss (dB)	0.40	0.40
TX line type	WE61	WE61
TX line length (ft)	220.00	140.00
TX line unit loss (dB /100 ft)	1.18	1.18
TX line loss (dB)	2.60	1.65
Connector loss (dB)	0.50	0.50
Frequency (MHz)	6175.00	
Polarization	Vertical	
Path length (mi)	15.45	
Free space loss (dB)	136.19	
Atmospheric absorption loss (dB)	0.21	
Field margin (dB)	1.00	
Main net path loss (dB)	61.16	61.16
Diversity net path loss (dB)	63.32	63.09
Radio model	Sample Generic	Sample Generic
TX power (watts)	1.00	1.00
TX power (dBm)	30.00	30.00
EIRP (dBm)	67.77	68.48
Emission designator	30M0D7W	30M0D7W
RX threshold criteria	BER@10e-6	BER@10e-6
RX threshold level (dBm)	-69.00	-69.00
Main RX signal (dBm)	-31.16	-31.16
Diversity RX signal (dBm)	-33.32	-33.09
Thermal fade margin (dB)	37.84	37.84
Dispersive fade margin (dB)	50.00	50.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	37.58	37.58
Climatic factor	2.00	
Terrain roughness (ft)	21.06	
C factor	6.15	
Average annual temperature (°F)	70.00	
SD improvement factor	43.33	45.72
Worst month - multipath (%)	99.99986	99.99987
(sec)	3.70	3.51
Annual - multipath (%)	99.99995	99.99995
(sec)	15.55	14.74
(% - sec)	99.99990 - 30.29	

Mon, Nov 18 2002
Sample Pathloss File.pl4
Reliability Method - Vigants - Barnett
Space Diversity Method Alcatel - Richardson Baseband Switching

Your Company Logo Here!

Antenna Clearance Report (Data stripped for sample report)

Antenna Heights - Sample Pathloss File.pl4

		Site A		Site B			
Latitude		30 30 30.55 N		30 20 20.55 N			
Longitude		097 30 30.55 W		097 20 20.55 W			
Elevation (ft)		600.00		510.00			
Distance (mi)			15.45				
Frequency (MHz)			6175.00				
Clearance tolerance (ft)			10.0				
Site A TR Antenna Height		200.00 ft					
Site B TR Antenna Height		140.00 ft					
Clearance criteria - Main							
1st Criteria - K		1.33					
1st Criteria - %F1		60.00					
1st Criteria - Fixed Height (ft)		10.00					
2nd Criteria - K		0.67					
2nd Criteria - %F1		30.00					
2nd Criteria - Fixed Height (ft)		10.00					
Dist (mi)	Elev (ft)	Struct (ft)	Clear (ft)	K (ft)	%F1 (ft)	FH (ft)	Crit
5.60	585.0	80	-1.0	55.1	16.4	10.0	2
8.96	538.8	80	9.2	58.1	16.9	10.0	2
9.03	546.0	80	1.5	57.9	16.9	10.0	2
9.04	546.9	80	0.5	57.9	16.9	10.0	2
9.15	547.9	80	-1.2	57.6	16.8	10.0	2
Site A TR Antenna Height		200.00 ft					
Site B DR Antenna Height		120.00 ft					
Clearance criteria - Diversity							
1st Criteria - K		1.33					
1st Criteria - %F1		60.00					
1st Criteria - Fixed Height (ft)		10.00					
Dist (mi)	Elev (ft)	Struct (ft)	Clear (ft)	K (ft)	%F1 (ft)	FH (ft)	Crit
5.60	585.0	80	2.9	27.6	32.9	10.0	1
8.96	538.8	80	9.8	29.1	33.8	10.0	1
8.97	540.4	80	8.1	29.0	33.8	10.0	1
8.98	541.7	80	6.7	29.0	33.8	10.0	1
12.89	596.4		9.8	16.5	25.4	10.0	1
12.93	597.1	5	4.1	16.3	25.3	10.0	1
13.02	591.7	5	9.3	15.8	24.9	10.0	1
Site A DR Antenna Height		180.00 ft					
Site B TR Antenna Height		140.00 ft					
Clearance criteria - Diversity							
1st Criteria - K		1.33					
1st Criteria - %F1		60.00					
1st Criteria - Fixed Height (ft)		10.00					
Dist (mi)	Elev (ft)	Struct (ft)	Clear (ft)	K (ft)	%F1 (ft)	FH (ft)	Crit
5.60	585.0	80	-2.6	27.6	32.9	10.0	1
8.98	541.7	80	9.9	29.0	33.8	10.0	1
9.00	543.4	80	8.1	29.0	33.7	10.0	1
9.01	544.3	80	7.1	29.0	33.7	10.0	1
9.03	546.0	80	5.3	29.0	33.7	10.0	1
9.04	546.9	80	4.3	29.0	33.7	10.0	1
9.15	547.9	80	2.7	28.8	33.6	10.0	1

Antenna Orientation Report:**Mains:**

Antenna Heights - Sample Pathloss File.pl4

	Site A	Site B
Latitude	30 30 30.55 N	30 20 20.55 N
Longitude	097 30 30.55 W	097 20 20.55 W
True azimuth (°)	139.04	319.13
Elevation (ft)	600.00	510.00
Antenna height (ft)	200.00	140.00
Tower Height (ft)		
Distance (mi)	15.45	
Frequency (MHz)	6175.00	
Antenna Orientation K	1.33	
Vertical angle (°)	-0.19	0.02
Error at K = 2/3 (°)	0.08	0.08
Error at K = 1 (°)	0.03	0.03
Error at K = 100 (°)	-0.08	-0.08

Site A Main to Site B Diversity:

Antenna Heights - Sample Pathloss File.pl4

	Site A	Site B
Latitude	30 30 30.55 N	30 20 20.55 N
Longitude	097 30 30.55 W	097 20 20.55 W
True azimuth (°)	139.04	319.13
Elevation (ft)	600.00	510.00
Antenna height (ft)	200.00	120.00
Tower Height (ft)		
Distance (mi)	15.45	
Frequency (MHz)	6175.00	
Antenna Orientation K	1.33	
Vertical angle (°)	-0.20	0.04
Error at K = 2/3 (°)	0.08	0.08
Error at K = 1 (°)	0.03	0.03
Error at K = 100 (°)	-0.08	-0.08

Site A Diversity to Site B Main:

Antenna Heights - Sample Pathloss File.pl4

	Site A	Site B
Latitude	30 30 30.55 N	30 20 20.55 N
Longitude	097 30 30.55 W	097 20 20.55 W
True azimuth (°)	139.04	319.13
Elevation (ft)	600.00	510.00
Antenna height (ft)	180.00	140.00
Tower Height (ft)		
Distance (mi)	15.45	
Frequency (MHz)	6175.00	
Antenna Orientation K	1.33	
Vertical angle (°)	-0.18	0.01
Error at K = 2/3 (°)	0.08	0.08
Error at K = 1 (°)	0.03	0.03
Error at K = 100 (°)	-0.08	-0.08

Your Company Logo Here!

CONSOLIDATED SPECTRUM SERVICES

22 MERRILL DRIVE
ATKINSON, N.H. 03811
PHONE/FAX: (603) 362 -5977
E-mail: Sales@FCC1.biz

MINNESOTA DEPARTMENT OF TRANSPORTATION
MOBILE, MN

05/08/2006

PAGE 1

EXHIBIT 1 A - SUPPLEMENTAL SHOWING FCC RULE PART 101

Pursuant to Part 101 of the Federal Communications Commission rules and regulations, an engineering analysis has been performed by Consolidated Spectrum Services on behalf of:

MINNESOTA DEPARTMENT OF TRANSPORTATION
501 South Victory Drive
MANKATO, MN 56001

The study was conducted around a 200.0 mile/321.8 Kilometer radius of the central coordinates. The central coordinates are as follow:

CENTRAL COORDINATES

SUPPORT STRUCTURE HEIGHT Ft/Mtrs	Latitude (N)	Longitude (W)	GND ELV FT/MTRS	Datum
326.1/99.4	47:29:14.0	92:31:12.0	1759.8/536.4	NAD83

FCC ASR NUMBER: 1021985

The area of operation proposed, is within 100.0 miles/160.9 kilometers of the central coordinates. The area of study 200 miles/321.8 Kilometers, well exceeds the proposed operating area.

The MINNESOTA DEPARTMENT OF TRANSPORTATION agrees to operate on a secondary basis to all fixed users and mobile users and furthermore on a first come first serve basis where applicable. Thus the entire 6425 - 6525, 25 Mhz band plan is requested. Specifically, center frequencies are 6437.5, 6462.5, 6487.5 and 6512.5 MHz.

The MINNESOTA DEPARTMENT OF TRANSPORTATION further agrees to cooperate with The local coordinator who is Marcus E. Majerus; Phone 952-946-5703; e-mail: mmaje703@foxtv.com .

The licenses and call signs of the stations considered in the analysis are as follows:

CONSOLIDATED SPECTRUM SERVICES

22 MERRILL DRIVE
ATKINSON, N.H. 03811
PHONE/FAX: (603) 362 -5977
E-mail: Sales@FCC1.biz

EXHIBIT 1 B - SUPPLEMENTAL SHOWING PER FCC PART 101

KB9805
WISCONSIN BELL INC

KC23138
CBS BROADCASTING INC.

KJ3819
MICHIGAN BELL TELEPHONE COMPANY

KK4093 - CANCELED
GTE NORTH INCORPORATED

KQH74
MICHIGAN BELL TELEPHONE COMPANY

KSE73
WISCONSIN BELL, INC.

KX8883
AMCI Acquisition, L.P.

WLS621 - EXPIRED
OTTER TAIL CELLULAR TELEPHONE COMPANY

WLU754 - EXPIRED
CDI TRANSPORTATION GROUP, INC.

WLW651 - CANCELED
UNITED STATES CELLULAR OPERATING COMPANY

WLW655 - CANCELLED & WMQ327 - EXPIRED
WWC Holding Co., Inc.

CONSOLIDATED SPECTRUM SERVICES

22 MERRILL DRIVE
ATKINSON, N.H. 03811
PHONE/FAX: (603) 362 -5977
E-mail: Sales@FCC1.biz

EXHIBIT 1 C - SUPPLEMENTAL SHOWING PER FCC PART 101

WPNJ856 - EXPIRED
NORTHWEST SUBURBS COMMUNITY ACCESS CORPORATION

WPOU220
MINNESOTA, STATE OF

WQDA204
NorthWest Suburbs Community Access Corporation
d/b/a NorthWest Community Television

Respectfully Submitted,

Howard Epstein

Howard Epstein,
President

EXHIBIT 2 - MICROWAVE PATH DATA

COMPANY: MINNESOTA DEPARTMENT OF TRANSPORTATION
 ROUTE NAME: AIR MOBILE, MN
 COORDINATION NO. 05092006-5

 * TX * ----- * RECEIVER *

SITE NAME, STATE: AIR MOBILE TX, MN CENTRAL RX
 PATH STATUS & MOBILE COMMAND
 CALL SIGN UNASSIGNED
 AREA OF OPERATION MOBILE WITHIN 100 MI/160.9 KM OF THE
 CENTRAL COORDINATES

CENTRAL COORDINATES
 TX/RX CENTRAL LATITUDE (D-M-S) VARIOUS 47:29:14.0 N
 TX/RX CENTRAL LONGITUDE (D-M-S) VARIOUS 092:31:12.0 W
 DATUM NAD 83
 ASR Number 1021985
 GROUND ELEV (FT/MTRS-AMSL) VARIOUS 1759.8/536.4
 PATH AZIMUTH (DEGREES) VARIOUS VARIOUS

ANTENNA TX/RX	TROLL SYSTEMS	BROADCAST MICROWAVE SERVICES
MANUFACTURER	SKYLINK	SILHOUETTE
MODEL		
GAIN (Dbi)	7.0	30.0
BEAMWIDTH AZIMUTH (Degrees)	85.0	4.0
BEAMWIDTH ELEVATION (Degrees)	120.0	7.0
FIXED LOSSES (db)	1.0	1.0
ANT CNTR LINE AGL (FEET/MTRS)	VARIOUS	186.0/56.7

BUT NOT MORE THEN 6.1 METERS ABOVE FAA
 APPROVED STRUCTURE IN BOTH CASES

MANUFACTURER	BROADCAST MICROWAVE SERVICES	BROADCAST MICROWAVE SERVICES
MODEL:	CNV75K-BMT75-9P	RX ONLY
EMISSION	25M0F8W	RX ONLY
LOADING	VIDEO/AUDIO	RX ONLY
STABILITY (%)	0.0001	RX ONLY
TX POWER (DBM/W)	37.78/6.0	RX ONLY
EIRP (DBM//DBW)	43.78/13.78	RX ONLY
RX CARRIER LEVEL (dbm)	****	VARIOUS
CENTER FREQUENCY (MHZ)	6437.5, 6462.5, V or H	
	6487.5, 6512.5, V or H	
FREQUENCY RANGE (MHZ)	6425 - 6525 Mhz, V or H	

[Handwritten signature and mark]

EXHIBIT 3 - SUPPLEMENTAL SHOWING PER PART 101

MINNESOTA DEPARTMENT OF TRANSPORTATION

SYSTEM DESCRIPTION

The proposed 6.5 Ghz microwave system consists of air mobile transmitter to a mobile receive site.

The central coordinates are located at latitude 47:29:14.0 N by longitude 092:31:12.0 W, Datum: NAD 83, Ground Elevation 1759.8 feet/ 536.4 meters. The area of operation is 100.0 mile/160.9 kilometers about the central coordinates.

The receive antenna will be mounted on CC Antenna Structure Number 1021985 at the 258.0 foot/78.6 meter level. In no way will the FAA rules be violated.

The transmitters to be utilized is a Broadcast Microwave Services Model CNV75K-BMT75-9P.

The baseband loading is an analog television signal with an emission designator of 25M0F8W.

The system is non-redundant in that it does not employ hot-standby or frequency diversity switching equipment.

The system complies with the requirements set forth in FCC rule part 101.

STATEMENT OF USE

The proposed, will be used by the for traffic monitoring, health, welfare and safety issues as well as to monitor critical infrastructure.

STATEMENT OF QUALIFICATION

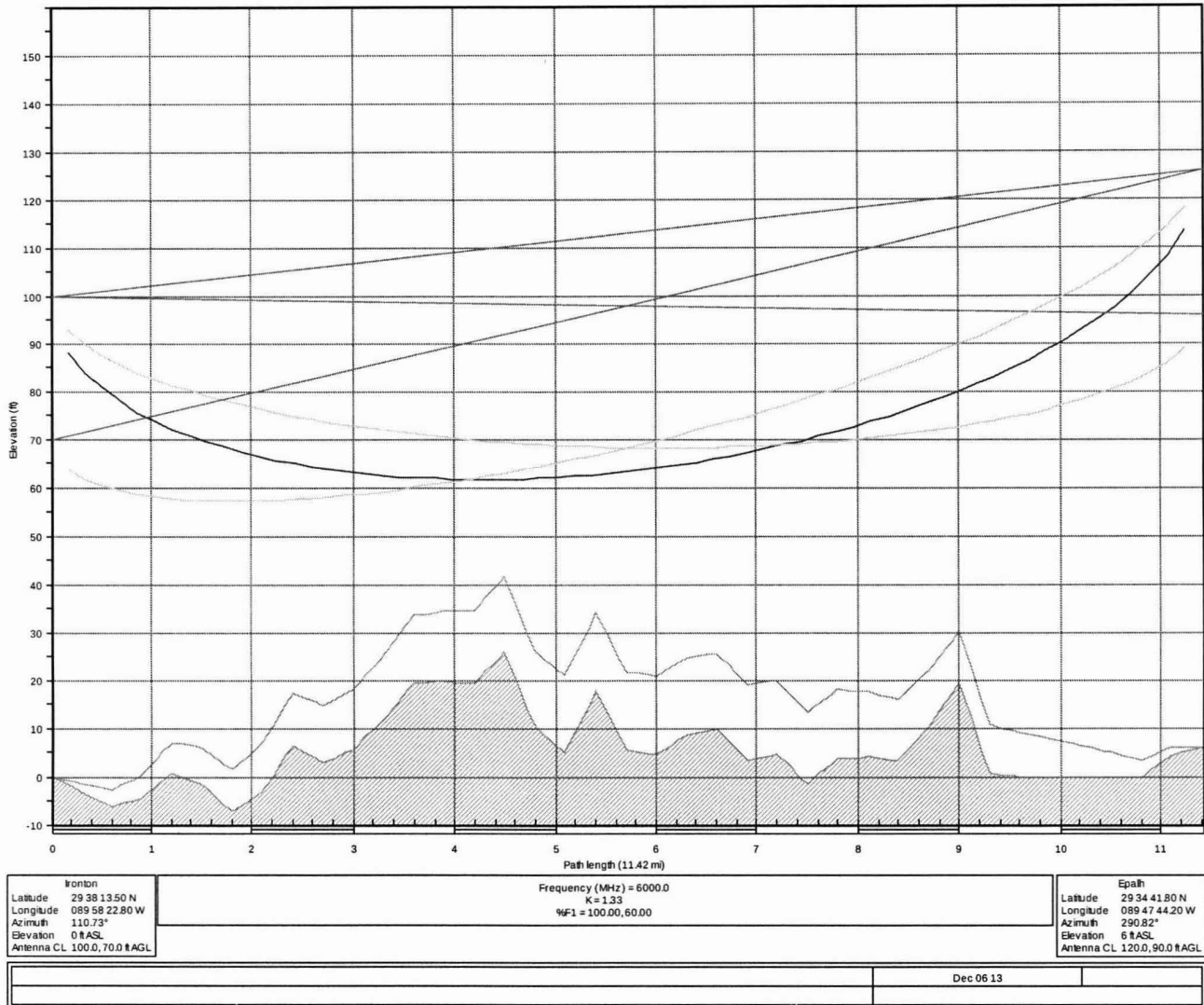
The MINNESOTA DEPARTMENT OF TRANSPORTATION is qualified to use the 6.5 Ghz band per FCC rule part 90.20 as a local government entity.

EXHIBIT 4 - RF POWER LIMIT PURSUANT TO PART 101.113

MINNESOTA DEPARTMENT OF TRANSPORTATION

Pursuant to part 101.113 in the 6425.000 - 6525.000 Mhz band the maximum mobile EIRP in DBW is 35.

The system proposed EIRP 13.78 DBW, is well within this limit.



Path calculations are estimates only, based on the information provided. Trango recommends that you have a formal site survey and a professional path analysis completed by a reputable source. No guarantee of path performance is expressed or implied.

Terrain profiles represent ground terrain only and do not consider trees, buildings, or other obstructions.

	Ironton	Epalh
Elevation (ft)	0.00	6.00
Latitude	29 38 13.50 N	29 34 41.80 N
Longitude	089 58 22.80 W	089 47 44.20 W
True azimuth (°)	110.73	290.82
Vertical angle (°)	-0.04	-0.09
Antenna model	HP6-59	HP6-59
Antenna height (ft)	100.00	120.00
Antenna gain (dBi)	39.00	39.00
Antenna model	HP4-59	HP4-59
Antenna height (ft)	70.00	90.00
Antenna gain (dBi)	35.00	35.00
Frequency (MHz)	6000.00	
Polarization	Vertical	
Path length (mi)	11.42	
Free space loss (dB)	133.32	
Atmospheric absorption loss (dB)	0.16	
Main net path loss (dB)	55.47	55.47
Diversity net path loss (dB)	59.47	59.47
Radio model	GigaPro6	GigaPro6
TX power (watts)	0.25	0.25
TX power (dBm)	24.00	24.00
EIRP (dBm)	63.00	63.00
Emission designator	56M0D7W	56M0D7W
TX Channels	6000.0000V	6000.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-65.80	-65.80
Main RX signal (dBm)	-31.47	-31.47
Diversity RX signal (dBm)	-35.47	-35.47
Thermal fade margin (dB)	34.33	34.33
Dispersive fade margin (dB)	45.00	45.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	33.97	33.97
Climatic factor	0.50	
Terrain roughness (ft)	20.00	
C factor	1.65	
Fade occurrence factor (Po)	3.68E-02	
Average annual temperature (°F)	46.24	
SD improvement factor	38.68	38.68
Worst month - multipath (%)	99.99996	99.99996
(sec)	1.00	1.00
Annual - multipath (%)	99.99999	99.99999
(sec)	2.78	2.78
(% - sec)	99.99998 - 5.55	
Rain region	F Sub Tropical Arid	
0.01% rain rate (mm/hr)	23.00	
Flat fade margin - rain (dB)	34.33	
Rain rate (mm/hr)	4566.84	
Rain attenuation (dB)	34.33	
Annual rain (%-sec)	100.00000 - 0.00	
Annual multipath + rain (%-sec)	99.99998 - 5.55	

Fri, Dec 06 2013

Ironton-Epalh 6Ghz SD.pl4

Reliability Method - Vigants - Barnett

Space Diversity Method Alcatel - Richardson Baseband Switching

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Terrain profiles represent ground terrain only and do not consider trees, buildings, or other obstructions.

Micronet Communications, Inc.
720 F Avenue, Suite 100
Plano, Texas 75074
972-422-7200

File: M0418902 1

Original PCN Date: August 16, 2004

Company: ABC HOLDING COMPANY INC

Company Code	#10987	#10987
Site Name, State	Oat Mountain, CA	KABC Studio, CA
Call Sign/County	/Los Angeles	/Los Angeles
Latitude N (NAD83)	34 19 41.00	34 09 26.00
Longitude W (NAD83)	118 35 51.30	118 17 19.30
Azimuth (degrees)	123.57	303.75
Distance (miles/km)	21.24/34.19	21.24/34.19
Space Loss (db)	145.390	
Elevation AMSL (ft/m)	3711.9/1131.40	551.2/168.00

Transmit Ant Type	PX8-127C
FCC Designation	AA1214
Antenna Manufacturer	ANDREW CORPORATION
Gain/Beamwidth (dbi/deg)	47.6/0.7
Antenna Height AGL (ft/m)	36.42/11.10
Tilt (degrees)	-1.712

Receive Ant Type	PX8-127C
FCC Designation	AA1214
Antenna Manufacturer	ANDREW CORPORATION
Gain/Beamwidth (dbi/deg)	47.6/0.7
Antenna Height AGL (ft/m)	69.88/21.30

Diversity Ant Type	
FCC Designation	
Antenna Manufacturer	
Gain/Beamwidth (dbi/deg)	
Antenna Height AGL (ft/m)	

Equipment Manufacturer	MICROWAVE RADIO CORPORATI	RECEIVE
Manufacturer's Type	FLH-DAR 127T	ONLY
FCC Identifier		RECEIVE
Emission/Stability %	25M0F8W/0.001	/0.0
ATPC/Trigger Level (dbm)	NO/	NO/
Transmitter Power (dbm/Watts)	30.00/1.0000	
Fixed Losses Cm,Tx,Rx (db)	0.0,0.0,0.0	0.0,0.0,0.0

Receive Level (dbm)		-20.19
EIRP (dbm/Watts)	77.60/57543.97	
Traffic (kbps/vc)	/VIDEO	/
Modulation/Lvl	FMV/0	/0
Frequencies Transmitted (MHz)	12800.0V - 12825.0V	
	12875.0V - 12900.0V	

Microwave Path Data Sheet

Page 3 of 3

COMSEARCH

19700 Janelia Farm Boulevard, Ashburn, VA, 20147

(703)726-5810 www.comsearch.com

PCN Date: 12/11/2007

Job Number 071211COMSKN01

Previous PCN Date: Not Available

RCN Number: 07121116

Administrative Information**GUAYNABO STD PR****MARQUESA PR**

Status / License Basis

Engineering Proposal / PRIMARY OPERATION

Engineering Proposal / PRIMARY OPERATION

Call Sign

KZL21

Licensee Code

UNIRPR

UNIRPR

Licensee Name

UNIVISION RADIO PUERTO RICO INC

UNIVISION RADIO PUERTO RICO INC

Radio Service / Station Class

AS -- Aural Studio Transmitter Link

FXO -- Fixed

Site Address

City

GUAYNABO

MARQUESA 1.5 MILES N

Latitude (NAD 83)

18 ° 21' 34.2" N

AGUAS BUENAS

18 ° 16' 42.7" N

Longitude (NAD 83)

66 ° 6' 38.6" W

66 ° 6' 36.5" W

Ground Elevation (m/ft-AMSL)

45.11 / 148.0

506.90 / 1663.1

Antenna Structure Registration #

1011311

Path Azimuth (°)

179.606

359.606

Path Length (km / miles)

8.962 / 5.569

Transmit AntennaM03001

Manufacturer

MARK ANTENNA

Model

P-9A72G

Gain (dBi) / Beamwidth (°) / Tilt (°)

22.1 / 12.50 / 3.11

Centerline (m / ft - AGL)

30.48 / 100.0**Receive Antenna**M03001

Manufacturer

MARK ANTENNA

Model

P-9A72G

Gain (dBi) / Beamwidth (°)

22.1 / 12.50

Centerline (m / ft - AGL)

60.96 / 200.0**Diversity Receive Antenna**

Manufacturer

Model

Gain (dBi) / Beamwidth (°)

Centerline (m / ft - AGL)

Radio InformationTEME16

999999

Manufacturer

MOSELEY ASSOCIATES INC

RECEIVE

Model

CSU9WKS L9003Q74

ONLY

Model Description

STARLINK SL9003Q-4S 32 QAM 2.048 Mbps

Emission Designator / Modulation

500KD7W 32 QAM

Loading

4 CH DIG 2048.0004 CH DIG 2048.000

Stability (%)

0.000010.00001

Nominal Coordinated Maximum

Nominal Coordinated Maximum

Power (dBm)

25.5

Received Level (dBm)

-46.4

EIRP (dBm)

45.6

Fixed Loss: Tx / Common (dB)

0.0 / 2.00.0 / 3.0

Free Space Loss (dB)

111.1**Transmit Center Frequencies (MHz)** 949.00H

11 GHz, 3ft and 2 ft antennas, 32QAM 30 MHz for 118 Mbps – 99.99986%

	Puunianiau	Kahului
Elevation (ft)	6802.38	7.97
Latitude	20 46 21.87 N	20 53 04.71 N
Longitude	156 14 41.41 W	156 27 44.02 W
True azimuth (°)	298.74	118.66
Vertical angle (°)	-4.68	4.51
Antenna model	AD11G-3-T2	AD11G-2-T2
Antenna height (ft)	30.00	20.00
Antenna gain (dBi)	37.60	34.50
Frequency (MHz)	11000.00	
Polarization	Vertical	
Path length (mi)	16.03	
Free space loss (dB)	141.53	
Atmospheric absorption loss (dB)	0.40	
Net path loss (dB)	69.82	69.82
Radio model	GigaPlus11	GigaPlus11
TX power (watts)	0.40	0.40
TX power (dBm)	26.00	26.00
EIRP (dBm)	63.60	60.50
Emission designator	30M0D7W	30M0D7W
TX Channels	11000.0000V	11000.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-77.10	-77.10
RX signal (dBm)	-43.82	-43.82
Thermal fade margin (dB)	33.28	33.28
Dispersive fade margin (dB)	45.00	45.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	32.99	32.99
Geoclimatic factor	5.60E-07	
Path inclination (mr)	80.22	
Fade occurrence factor (Po)	1.21E-05	
Average annual temperature (°F)	46.24	
Worst month - multipath (%)	100.00000	100.00000
(sec)	0.02	0.02
Annual - multipath (%)	100.00000	100.00000
(sec)	0.04	0.04
(% - sec)	100.00000 - 0.09	
Rain region	C Temp. Maritime	
Flat fade margin - rain (dB)	33.28	
Rain rate (mm/hr)	130.34	
Rain attenuation (dB)	33.27	
Annual rain (%-sec)	99.99986 - 45.39	
Annual multipath + rain (%-sec)	99.99986 - 45.48	

Tue, Jan 14 2014
Puunianiau-Kahului.pl4
Reliability Method - ITU-R P.530-7/8
Rain - Crane

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Microwave Path Data Sheet
PINNACLE TELECOM GROUP LLC

14 RIDGEDALE AVENUE, SUITE 262, CEDAR KNOLLS, NJ 07927 1106
(973)451-1630

PCN No. 0805-0721

Date: 08/31/2005

Administrative Information

Status / License Basis
Call Sign
Licensee Name
Radio Service / Station Class

LINDALE TX

PROPOSED / PRIMARY OPERATION
WLV772
Tyler/Longview/Marshall MSA Limited Partnership d/b/a ALLTEL
CF -- Point-to-Point Microwave, Common Carrier

NORTH TYLER TX

PROPOSED / PRIMARY OPERATION
WLL910
FXO -- Fixed

Site Information

Latitude (NAD 83) 32 ° 30' 49.7" N
Longitude (NAD 83) 95 ° 25' 15.2" W
Ground Elevation (m/ft-AMSL) 169.16 / 555.0
Antenna Structure Registration #
Path Azimuth (°) 130.010
Path Length (km / miles)

32 ° 23' 25.4" N
95 ° 14' 52.0" W
157.90 / 518.0
1052619
310.103

21.266 / 13.214

Transmit / Receive Antenna

Manufacturer 42472A
Model ANDREW CORPORATION
PAR6-59A
Gain (dBi) / Beamwidth (°) / Tilt (°) 38.2 / 1.90 / -0.19
Centerline (m / ft - AGL) 94.49 / 310.0

43302A
ANDREW CORPORATION
HP6-59J
38.9 / 1.80 / 0.05
60.96 / 200.0

Radio Information

Manufacturer TEM867
Model HARRIS CORPORATION
HRS-CX-06G28D1
Model Description CONSTELLATION (6GHZ, 28DS1)
Emission Designator / Modulation 10M0D7W 64 QAM
Loading 672 CH DIG 47000.000
Stability (%) 0.0003
Power (dBm) Nominal Coordinated Maximum
28.6
Received Level (dBm) -39.6
EIRP (dBm) 60.9
Fixed Loss: Tx / Common (dB) 0.0 / 5.9
Free Space Loss (dB) 134.8

TEM867
HARRIS CORPORATION
HRS-CX-06G28D1
CONSTELLATION (6GHZ, 28DS1)
10M0D7W 64 QAM
672 CH DIG 47000.000
0.0003
Nominal Coordinated Maximum
28.6
-39.6
62.9
0.0 / 4.6

Transmit Frequencies (MHz)

6315.8400V(25T)

6063.8000V(15T)

Remarks:

COMSEARCH
2002 Edmund Halley Drive
Reston, VA 20191
(703) 620-6300

PREVIOUS PCN LETTER DATE: Not Available
CURRENT JOB/RCN NUMBER: 990727MF06/99072724

CURRENT PCN DATE: 07/27/1999

STATION NAME	MICROWAVE PATH DATA	CLEVELAND	MS
PATH STATUS	ALLIGATOR MS		
CALL SIGN	LICENSED		
OWNER CODE	KTR21	KLT75	
LATITUDE (D-M-S) (NAD27)	CABONE	CABONE	
LONGITUDE (D-M-S) (NAD27)	34 5 43.0	33 43 36.0	
GROUND ELEV (Ft/m-AMSL)	90 42 35.0	90 43 53.0	
PATH AZIMUTH (Deg)	160/48.8	138/42.1	
PATH DISTANCE (Miles)	182.812	2.800	
	25.435		
	40.935		

ANTENNA		
PRIMARY TX	ALL MANUFACTURERS	NOT APPLICABLE
ANT CODE	PERISCOPE	
GAIN(dBi)/BEAMWIDTH(Deg)	R66600	
C/L (Ft/m-AGL)	40.7/1.60	
PRIMARY RX	180/54.9	
	NOT APPLICABLE	

ANT CODE		ALL MANUFACTURERS
GAIN(dBi)/BEAMWIDTH(Deg)		PERISCOPE
C/L (Ft/m-AGL)		R66600
DIVERSITY RX		40.7/1.60
		300/91.4

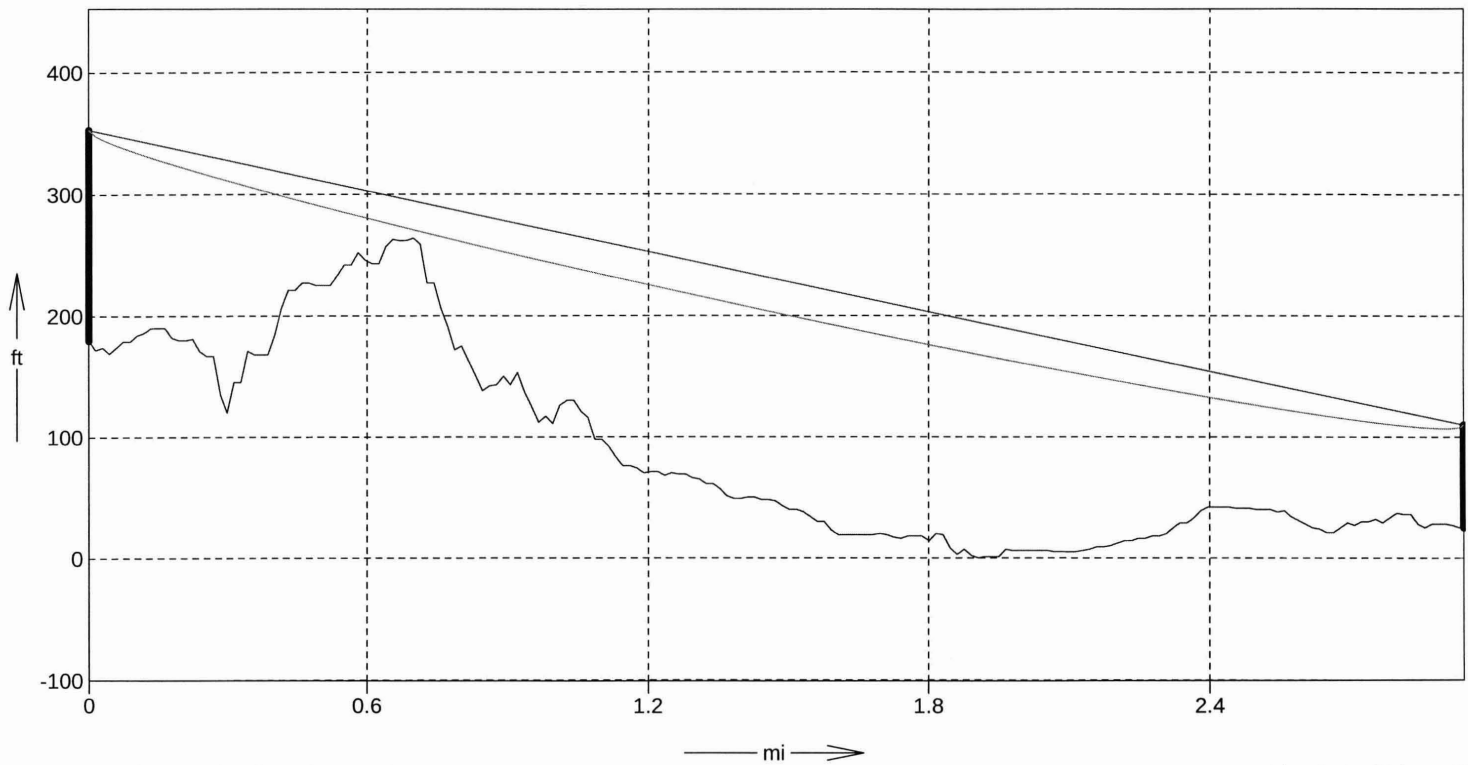
ANT CODE
GAIN(dBi)/BEAMWIDTH(Deg)
C/L (Ft/m-AGL)

EQUIPMENT	GTE LENKURT	RECEIVE
EQP CODE	778A3	ONLY
EMISSION	22JA01	
LOADING	25M0F8W	
STABILITY (%)	1 CH FMV	1 CH FMV
POWER (dBm/Watts)	0.005000	0.005000
	30.0/1.000	
FIXED LOSS: TX/COM (dB)	0.0/0.0	0.0/0.0
EIRP (dBm/Watts)	70.7/11749.0	
FREE SPACE LOSS (dB)	140.5	
RECEIVED LEVEL (dBm)		-29.1

TRANSMIT 6197.24000H(21T) 6315.84000H(25T)
FREQUENCIES
(MHZ)

CABONE = CABLE ONE, INC.

Microwave Path Profile
DC1240 - St. Elizabeth
DC1400 - RFK Stadium



St Elizabeths | Selected Phase 5
Site A
Lat: 38 50 55.50 N
Lon: 76 59 11.32 W
Gr. Elev.: 180 ft AMSL
Ant. CL: 173 ft AGL
AZ: 15.36 deg.

Dist.: 2.94 mi
Freq.: 4.95 GHz
K-Factor: 1.333
Fresnel: 1.0
Min. Fresnel CL: 7 ft
FS Loss: 119.86

RFK | Selected Phase 5
Site B
Lat: 38 53 23.50 N
Lon: 76 58 18.70 W
Gr. Elev.: 25 ft AMSL
Ant. CL: 85 ft AGL
Back AZ: 195.36 deg.

	Lynch	NTV
Elevation (ft)	2200.98	2207.49
Latitude	40 42 35.76 N	40 29 34.98 N
Longitude	099 05 55.26 W	099 05 00.87 W
True azimuth (°)	176.96	356.97
Vertical angle (°)	-0.03	-0.13
Antenna model	AD11G-2-S2	AD11G-4-S2
Antenna height (ft)	240.00	300.00
Antenna gain (dBi)	34.40	40.00
Frequency (MHz)	11000.00	
Polarization	Vertical	
Path length (mi)	14.99	
Free space loss (dB)	140.94	
Atmospheric absorption loss (dB)	0.37	
Net path loss (dB)	66.91	66.91
Radio model	ApexPlus11	ApexPlus11
TX power (watts)	0.13	0.13
TX power (dBm)	21.00	21.00
EIRP (dBm)	55.40	61.00
Emission designator	40M0D7W	40M0D7W
TX Channels	11000.0000V	11000.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-67.30	-67.30
RX signal (dBm)	-45.91	-45.91
Thermal fade margin (dB)	21.39	21.39
Dispersive fade margin (dB)	45.00	45.00
Dispersive fade occurrence factor	2.00	
Effective fade margin (dB)	21.35	21.35
Geoclimatic factor	1.70E-06	
Path inclination (mr)	0.84	
Fade occurrence factor (Po)	5.80E-03	
Average annual temperature (°F)	46.24	
Worst month - multipath (%)	99.99575	99.99575
(sec)	111.66	111.66
Annual - multipath (%)	99.99902	99.99902
(sec)	309.80	309.80
(% - sec)	99.99804 - 619.61	
Rain region	D1 Temp. Continent	
0.01% rain rate (mm/hr)	37.00	
Flat fade margin - rain (dB)	21.39	
Rain rate (mm/hr)	77.41	
Rain attenuation (dB)	21.39	
Annual rain (%-sec)	99.99838 - 512.13	
Annual multipath + rain (%-sec)	99.99641 - 1131.74	

Fri, Jul 27 2012

Lynch-NTV.pl4

Reliability Method - ITU-R P.530-7/8

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	Lynch	NTV
Elevation (ft)	2200.98	2207.49
Latitude	40 42 35.76 N	40 29 34.98 N
Longitude	099 05 55.26 W	099 05 00.87 W
True azimuth (°)	176.96	356.97
Vertical angle (°)	-0.03	-0.13
Antenna model	AD11G-2-S2	AD11G-4-S2
Antenna height (ft)	240.00	300.00
Antenna gain (dBi)	34.40	40.00
Frequency (MHz)	11000.00	
Polarization	Vertical	
Path length (mi)	14.99	
Free space loss (dB)	140.94	
Atmospheric absorption loss (dB)	0.37	
Net path loss (dB)	66.91	66.91
Radio model	ApexPlus11	ApexPlus11
TX power (watts)	0.16	0.16
TX power (dBm)	22.00	22.00
EIRP (dBm)	56.40	62.00
Emission designator	40M0D7W	40M0D7W
TX Channels	11000.0000V	11000.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-73.40	-73.40
RX signal (dBm)	-44.91	-44.91
Thermal fade margin (dB)	28.49	28.49
Dispersive fade margin (dB)	45.00	45.00
Dispersive fade occurrence factor	2.00	
Effective fade margin (dB)	28.30	28.30
Geoclimatic factor	1.70E-06	
Path inclination (mr)	0.84	
Fade occurrence factor (Po)	5.80E-03	
Average annual temperature (°F)	46.24	
Worst month - multipath (%)	99.99914	99.99914
(sec)	22.55	22.55
Annual - multipath (%)	99.99980	99.99980
(sec)	62.56	62.56
(% - sec)	99.99960 - 125.12	
Rain region	D1 Temp. Continent	
0.01% rain rate (mm/hr)	37.00	
Flat fade margin - rain (dB)	28.49	
Rain rate (mm/hr)	103.30	
Rain attenuation (dB)	28.49	
Annual rain (%-sec)	99.99940 - 188.95	
Annual multipath + rain (%-sec)	99.99900 - 314.07	

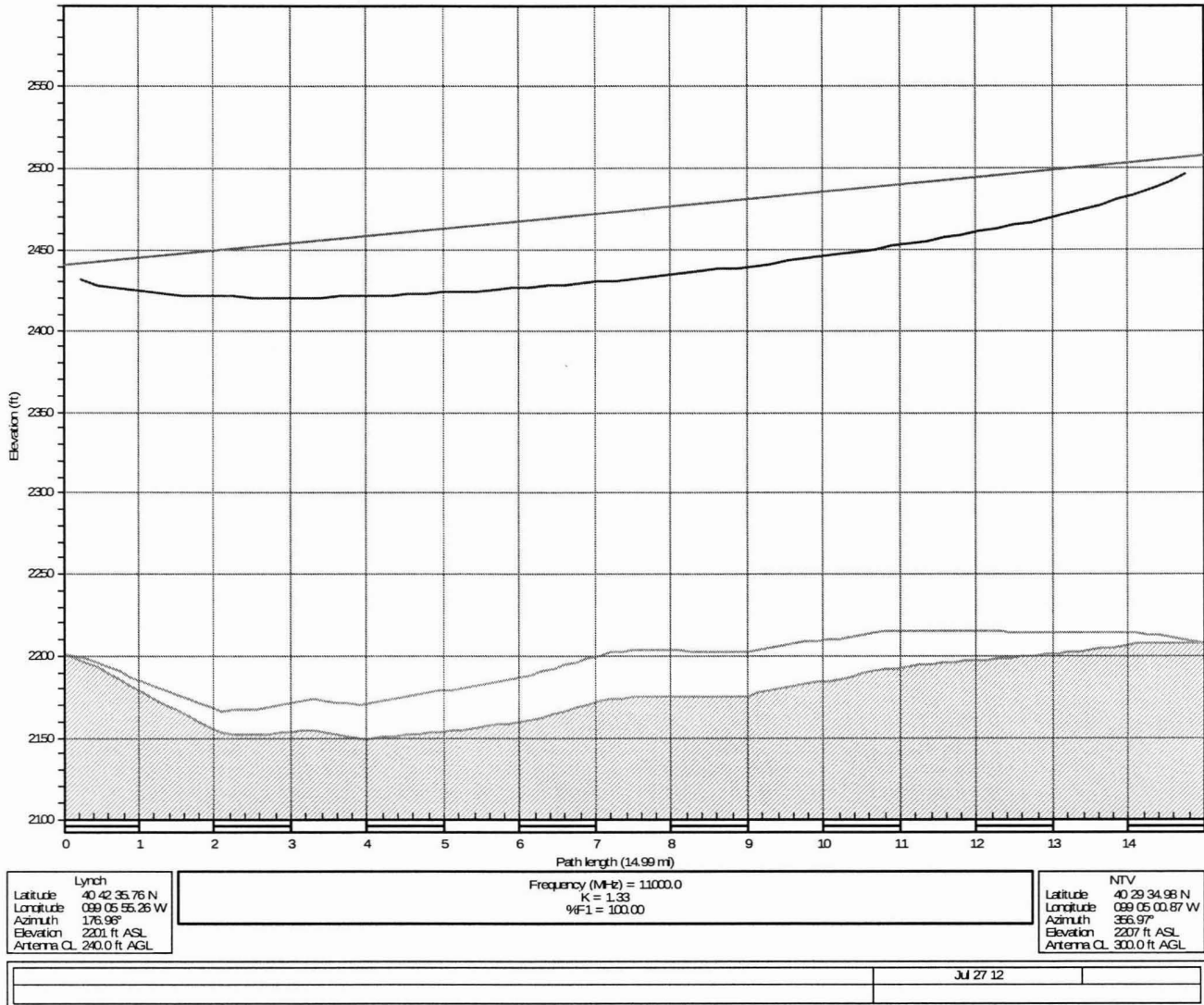
Fri, Jul 27 2012

Lynch-NTV.pl4

Reliability Method - ITU-R P.530-7/8

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	353 N Clark	5030 N Marine
Elevation (ft)	610.98	605.83
Latitude	41 53 20.40 N	41 58 26.79 N
Longitude	087 37 48.18 W	087 39 07.45 W
True azimuth (°)	349.07	169.06
Vertical angle (°)	-0.62	0.56
Antenna model	AD11G-2-S2	AD11G-2-S2
Antenna height (ft)	620.00	300.00
Antenna gain (dBi)	34.40	34.40
Frequency (MHz)	11000.00	
Polarization	Vertical	
Path length (mi)	5.98	
Free space loss (dB)	132.97	
Atmospheric absorption loss (dB)	0.15	
Net path loss (dB)	64.31	64.31
Radio model	ApexPlus11	ApexPlus11
TX power (watts)	0.13	0.13
TX power (dBm)	21.00	21.00
EIRP (dBm)	55.40	55.40
Emission designator	56M0D7W	56M0D7W
TX Channels	11000.0000V	11000.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-65.80	-65.80
RX signal (dBm)	-43.31	-43.31
Thermal fade margin (dB)	22.49	22.49
Dispersive fade margin (dB)	45.00	45.00
Dispersive fade occurrence factor	2.00	
Effective fade margin (dB)	22.44	22.44
Geoclimatic factor	1.70E-06	
Path inclination (mr)	10.29	
Fade occurrence factor (Po)	1.68E-05	
Average annual temperature (°F)	46.24	
Worst month - multipath (%)	99.99999	99.99999
(sec)	0.25	0.25
Annual - multipath (%)	100.00000	100.00000
(sec)	0.70	0.70
(% - sec)	100.00000 - 1.40	
Rain region	D2 Temp. Continent	
0.01% rain rate (mm/hr)	49.00	
Flat fade margin - rain (dB)	22.49	
Rain rate (mm/hr)	113.90	
Rain attenuation (dB)	22.49	
Annual rain (%-sec)	99.99940 - 188.34	
Annual multipath + rain (%-sec)	99.99940 - 189.73	

Wed, Aug 14 2013

353 N Clark-5030 N Marine.pl4

Reliability Method - ITU-R P.530-7/8

Path calculations are based on the information provided. Trango recommends that you have a formal site survey and a professional path analysis completed by a reputable source. No guarantee of path performance is expressed or implied.

Terrain profiles represent ground terrain only and do not consider trees, buildings, or other obstructions.

	353 N Clark	5030 N Marine
Elevation (ft)	610.98	605.83
Latitude	41 53 20.40 N	41 58 26.79 N
Longitude	087 37 48.18 W	087 39 07.45 W
True azimuth (°)	349.07	169.06
Vertical angle (°)	-0.62	0.56
Antenna model	AD11G-3-S2	AD11G-2-S2
Antenna height (ft)	620.00	300.00
Antenna gain (dBi)	37.90	34.40
Frequency (MHz)	11000.00	
Polarization	Vertical	
Path length (mi)	5.98	
Free space loss (dB)	132.97	
Atmospheric absorption loss (dB)	0.15	
Net path loss (dB)	60.81	60.81
Radio model	ApexPlus11	ApexPlus11
TX power (watts)	0.13	0.13
TX power (dBm)	21.00	21.00
EIRP (dBm)	58.90	55.40
Emission designator	56M0D7W	56M0D7W
TX Channels	11000.0000V	11000.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-65.80	-65.80
RX signal (dBm)	-39.81	-39.81
Thermal fade margin (dB)	25.99	25.99
Dispersive fade margin (dB)	45.00	45.00
Dispersive fade occurrence factor	2.00	
Effective fade margin (dB)	25.88	25.88
Geoclimatic factor	1.70E-06	
Path inclination (mr)	10.29	
Fade occurrence factor (Po)	1.68E-05	
Average annual temperature (°F)	46.24	
Worst month - multipath (%)	100.00000	100.00000
(sec)	0.11	0.11
Annual - multipath (%)	100.00000	100.00000
(sec)	0.32	0.32
(% - sec)	100.00000 - 0.63	
Rain region	D2 Temp. Continent	
0.01% rain rate (mm/hr)	49.00	
Flat fade margin - rain (dB)	25.99	
Rain rate (mm/hr)	126.83	
Rain attenuation (dB)	25.99	
Annual rain (%-sec)	99.99966 - 107.57	
Annual multipath + rain (%-sec)	99.99966 - 108.20	

Wed, Aug 14 2013

353 N Clark-5030 N Marine.pl4

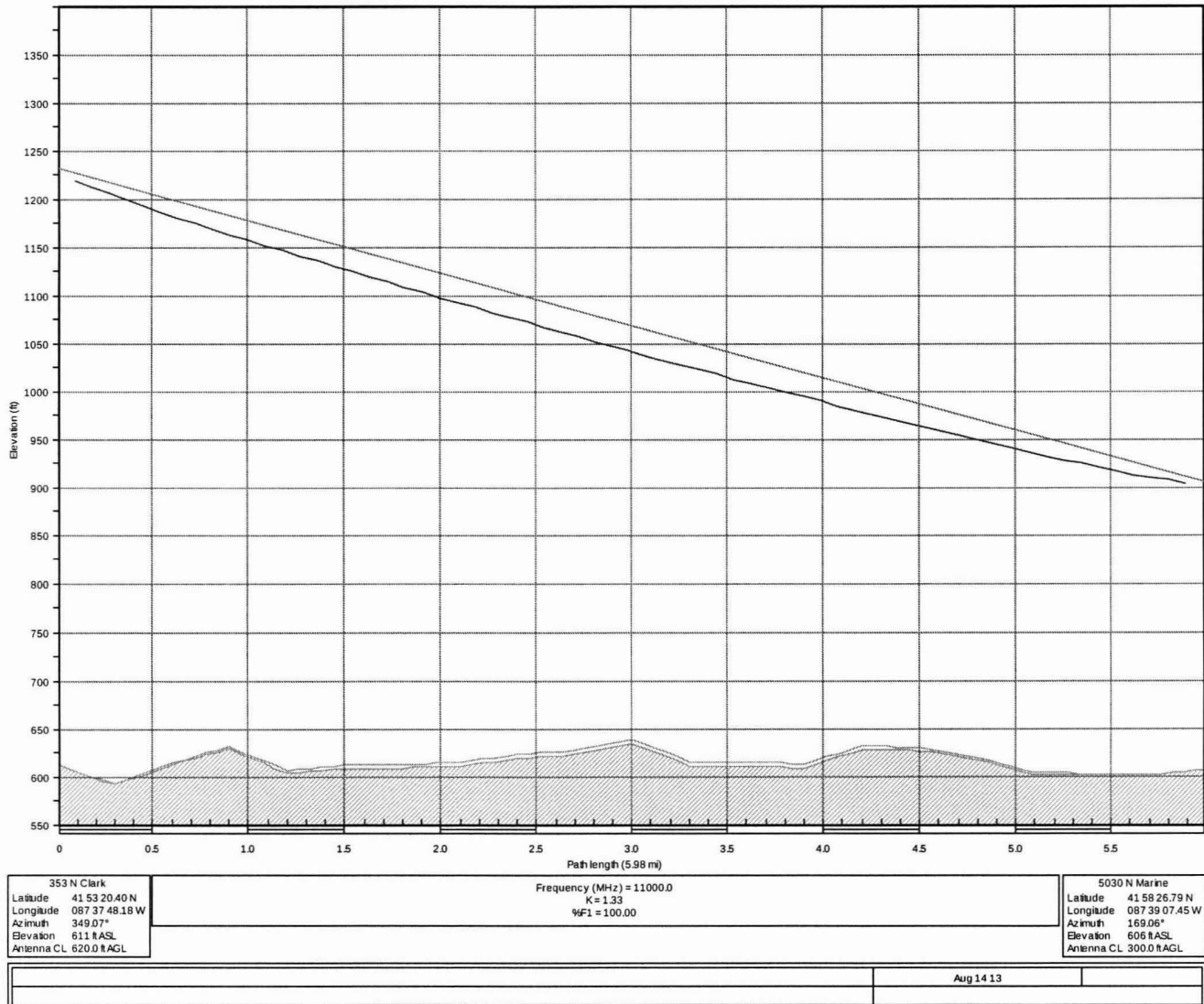
Reliability Method - ITU-R P.530-7/8

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Terrain profiles represent ground terrain only and do not consider trees, buildings, or other obstructions.

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Microwave Worksheet - PNSSALBside11G_Alt.pl4

	PENNSBORO	SALEM
Elevation (ft)	1185.00	1356.00
Latitude	39 16 35.30 N	39 17 25.10 N
Longitude	081 00 00.50 W	080 34 04.60 W
True azimuth (°)	87.50	267.78
Vertical angle (°)	-0.05	-0.21
Antenna model	HSX8-107-P3A	HSX8-107-P3A
Antenna height (ft)	235.00	235.00
Antenna gain (dBi)	46.50	46.50
TX line type	EW90	EW90
TX line length (ft)	275.00	275.00
TX line unit loss (dB /100 ft)	3.06	3.06
TX line loss (dB)	8.42	8.42
Connector loss (dB)	0.45	0.45
Other TX loss (dB)	1.40	1.40
Antenna model	HSX6-107-P3A/A	HSX6-107-P3A/A
Antenna height (ft)	195.00	195.00
Antenna gain (dBi)	43.90	43.90
TX line type	EW90	EW90
TX line length (ft)	235.00	235.00
TX line unit loss (dB /100 ft)	3.06	3.06
TX line loss (dB)	7.20	7.20
Connector loss (dB)	0.45	0.45
Frequency (MHz)	11200.00	
Polarization	Vertical	
Path length (mi)	23.19	
Free space loss (dB)	144.89	
Atmospheric absorption loss (dB)	0.59	
Main net path loss (dB)	71.63	71.63
Diversity net path loss (dB)	73.00	73.00
Radio model	IRU600-11-256Q	IRU600-11-256Q
TX power (watts)	0.28	0.28
TX power (dBm)	24.50	24.50
EIRP (dBm)	60.73	60.73
Emission designator	30MOD7W	30MOD7W
TX Channels	11200.0000V	11200.0000V
RX threshold criteria	10^6	10^6
RX threshold level (dBm)	-67.50	-67.50
Main RX signal (dBm)	-47.13	-47.13
Diversity RX signal (dBm)	-48.50	-48.50
Thermal fade margin (dB)	20.37	20.37
Dispersive fade margin (dB)	39.00	39.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	20.31	20.31
Climatic factor	2.00	
Terrain roughness (ft)	118.23	
C factor	0.65	
Fade occurrence factor (Po)	2.28E-01	
Average annual temperature (°F)	68.00	
SD improvement factor	4.35	4.35
Worst month - multipath (%)	99.95123	99.95123
(sec)	1281.69	1281.69
Annual - multipath (%)	99.98342	99.98342
(sec)	5229.30	5229.30

(% - sec)	99.96684 - 10458.59
Rain region	D2-96 Temp. Continent
Flat fade margin - rain (dB)	20.37
Rain rate (mm/hr)	57.12
Rain attenuation (dB)	20.40
Annual rain (%-sec)	99.99374 - 1975.66
Annual multipath + rain (%-sec)	99.96057 - 12434.26

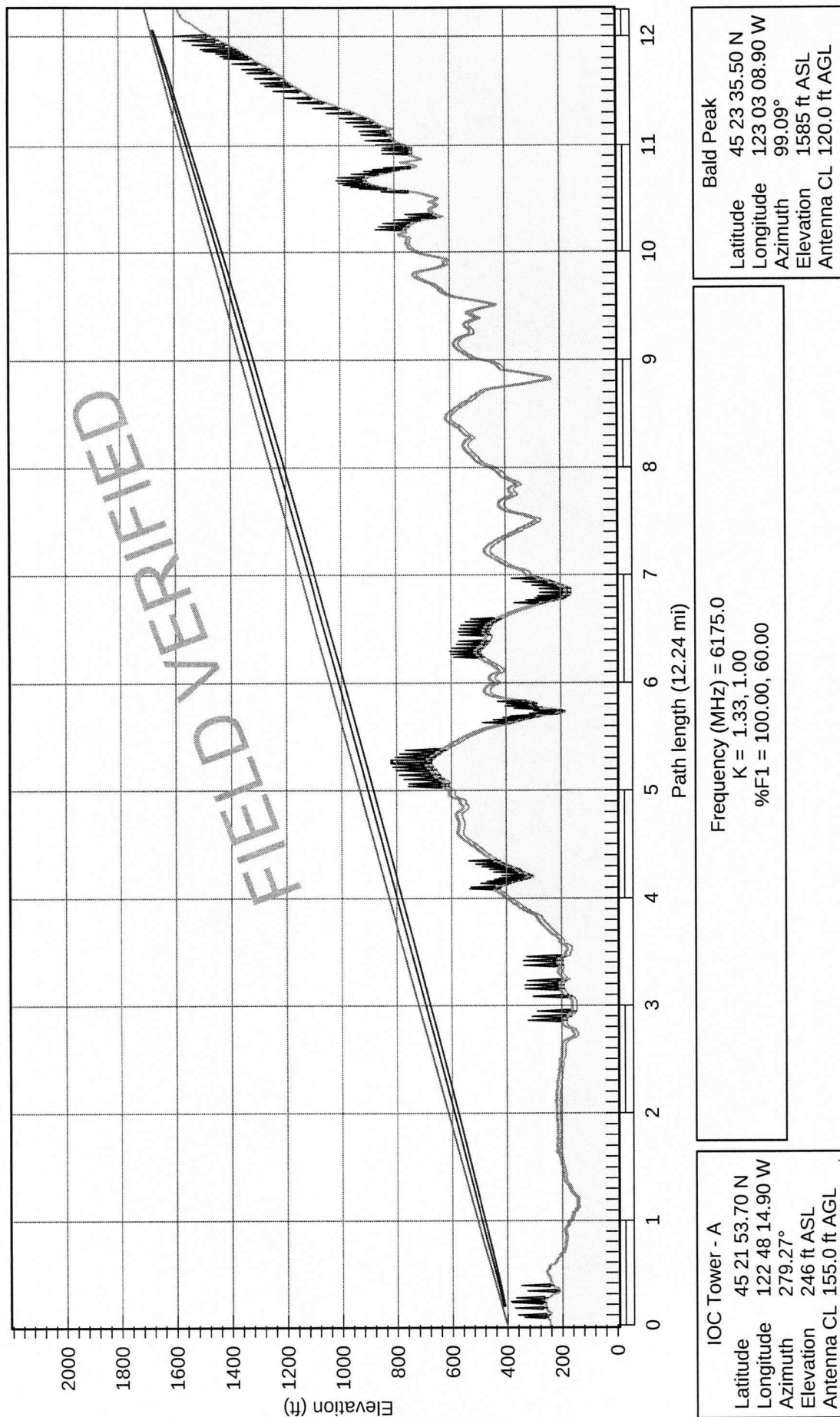
Fri, Mar 29 2013

PNSSALBside11G_Alt.pl4

Reliability Method - Vigants - Barnett

Space Diversity Method Harris Baseband Switching

Rain - Crane



6 GHz - MHSB/Standard Power Radio



	IOC Tower - A	Bald Peak
Latitude	45 21 53.70 N	45 23 35.50 N
Longitude	122 48 14.90 W	123 03 08.90 W
True azimuth (°)	279.27	99.09
Vertical angle (°)	1.09	-1.22
Elevation (ft)	246.00	1585.00
Antenna model	VHLP6-6W-6WH/B (TR)	VHLP6-6W-6WH/B (TR)
Antenna gain (dBi)	39.30	39.30
Antenna height (ft)	155.00	120.00
TX line model	EW63	EW63
TX line unit loss (dB/100 ft)	1.47	1.47
TX line length (ft)	205.00	170.00
TX line loss (dB)	3.01	2.50
Connector loss (dB)	0.40	0.40
TX filter loss (dB)	2.00	2.00
RX filter loss (dB)	2.60	2.60
Frequency (MHz)	6175.00	
Polarization	Vertical	
Path length (mi)	12.25	
Free space loss (dB)	134.17	
Atmospheric absorption loss (dB)	0.17	
Net path loss (dB)	66.66	66.66
Configuration	HSB (1:10) - Stacking	HSB (1:10) - Stacking
Radio model	95MPR61-L1024A30-227	95MPR61-L1024A30-227
Emission designator	30M0D7W	30M0D7W
Climatic factor	1.00	
Terrain roughness (ft)	140.00	
C factor	0.26	
Average annual temperature (°F)	48.51	
Fade occurrence factor (Po)	7.435E-003	

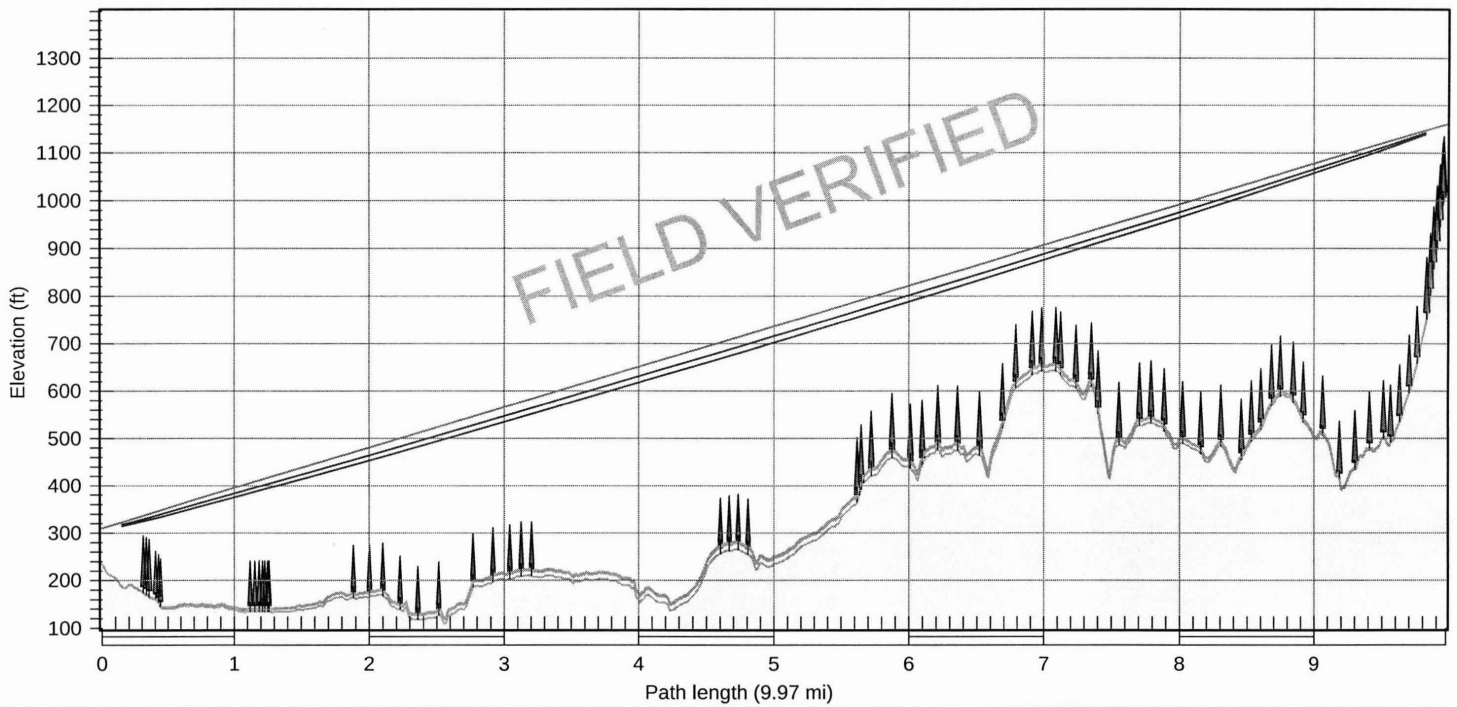
6 GHz - MHSB/Standard Power Radio



	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1024 227	31.50	31.50	-60.50	-60.50	65.39	65.90	-35.16	-35.16	25.34	25.34	25.34	25.34
512 206	31.50	31.50	-63.70	-63.70	65.39	65.90	-35.16	-35.16	28.54	28.54	28.54	28.54
256 183	32.50	32.50	-67.10	-67.10	66.39	66.90	-34.16	-34.16	32.94	32.94	32.94	32.94
128 161	32.50	32.50	-70.10	-70.10	66.39	66.90	-34.16	-34.16	35.94	35.94	35.94	35.94
64 136	32.50	32.50	-73.00	-73.00	66.39	66.90	-34.16	-34.16	38.84	38.84	38.84	38.84
32 113	32.50	32.50	-74.90	-74.90	66.39	66.90	-34.16	-34.16	40.74	40.74	40.74	40.74
16 90	32.50	32.50	-78.30	-78.30	66.39	66.90	-34.16	-34.16	44.14	44.14	44.14	44.14
4 43	32.50	32.50	-89.00	-89.00	66.39	66.90	-34.16	-34.16	54.84	54.84	54.84	54.84

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1024 227	99.9978	99.9978	99.9995	99.9995			99.9989	99.9989
512 206	99.9990	99.9990	99.9997	99.9997			99.9995	0.0006
256 183	99.9996	99.9996	99.9999	99.9999			99.9998	0.0003
128 161	99.9998	99.9998	99.9999	99.9999			99.9999	0.0001
64 136	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
32 113	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
16 90	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
4 43	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000

Multipath fading method - Vigants - Barnett



IOC Tower - B
Latitude 45 21 59.50 N
Longitude 122 48 16.90 W
Azimuth 31.71°
Elevation 235 ft ASL
Antenna CL 75.0 ft AGL

Frequency (MHz) = 11200.0
K = 1.33, 1.00
%F1 = 100.00, 60.00

Healy Heights
Latitude 45 29 21.40 N
Longitude 122 41 48.60 W
Azimuth 211.78°
Elevation 1025 ft ASL
Antenna CL 135.0 ft AGL

	IOC Tower - B	Healy Heights
Latitude	45 21 59.50 N	45 29 21.40 N
Longitude	122 48 16.90 W	122 41 48.60 W
True azimuth (°)	31.71	211.78
Vertical angle (°)	0.87	-0.98
Elevation (ft)	235.00	1025.00
Antenna model	HP8-107-P1A (TR)	VHLP6-11W-6WH/A (TR)
Antenna gain (dBi)	46.40	44.00
Antenna height (ft)	75.00	135.00
TX line model	EW90	EW90
TX line unit loss (dB/100 ft)	3.08	3.08
TX line length (ft)	125.00	195.00
TX line loss (dB)	3.85	6.01
Connector loss (dB)	0.40	0.40
TX filter loss (dB)	2.70	2.70
RX filter loss (dB)	2.90	2.90
Frequency (MHz)	11200.00	
Polarization	Vertical	
Path length (mi)	9.97	
Free space loss (dB)	137.56	
Atmospheric absorption loss (dB)	0.25	
Net path loss (dB)	63.67	63.67
Configuration	HSB (1:10) - Stacking	HSB (1:10) - Stacking
Radio model	95MPR11-L1024A40-294	95MPR11-L1024A40-294
Emission designator	40M0D7W	40M0D7W
Climatic factor	1.00	
Terrain roughness (ft)	70.79	
C factor	0.64	
Average annual temperature (°F)	48.51	
Fade occurrence factor (Po)	1.766E-002	
Polarization	Vertical	
Rain region	Portland, Oregon	

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1024 294	30.00	30.00	-58.50	-58.50	69.45	64.89	-33.67	-33.67	24.83	24.83	24.83	24.83
512 267	31.00	31.00	-61.70	-61.70	70.45	65.89	-32.67	-32.67	29.03	29.03	29.03	29.03
256 238	32.00	32.00	-65.10	-65.10	71.45	66.89	-31.67	-31.67	33.43	33.43	33.43	33.43
128 207	32.50	32.50	-68.10	-68.10	71.95	67.39	-31.17	-31.17	36.93	36.93	36.93	36.93
64 179	32.50	32.50	-71.00	-71.00	71.95	67.39	-31.17	-31.17	39.83	39.83	39.83	39.83
32 145	32.50	32.50	-73.40	-73.40	71.95	67.39	-31.17	-31.17	42.23	42.23	42.23	42.23
16 115	32.50	32.50	-76.80	-76.80	71.95	67.39	-31.17	-31.17	45.63	45.63	45.63	45.63
4 55	32.50	32.50	-87.50	-87.50	71.95	67.39	-31.17	-31.17	56.33	56.33	56.33	56.33

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1024 294	99.9942	99.9942	99.9986	99.9986	99.9999	99.9999	99.9971	99.9971
512 267	99.9978	99.9978	99.9995	99.9995	99.9999	99.9999	99.9989	0.0018
256 238	99.9992	99.9992	99.9998	99.9998	99.9999	99.9999	99.9996	0.0007
128 207	99.9996	99.9996	99.9999	99.9999	99.9999	99.9999	99.9998	0.0002
64 179	99.9998	99.9998	99.9999	99.9999	99.9999	99.9999	99.9999	0.0001
32 145	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
16 115	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
4 55	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000

Multipath fading method - Vigants - Barnett

Rain fading method - Crane

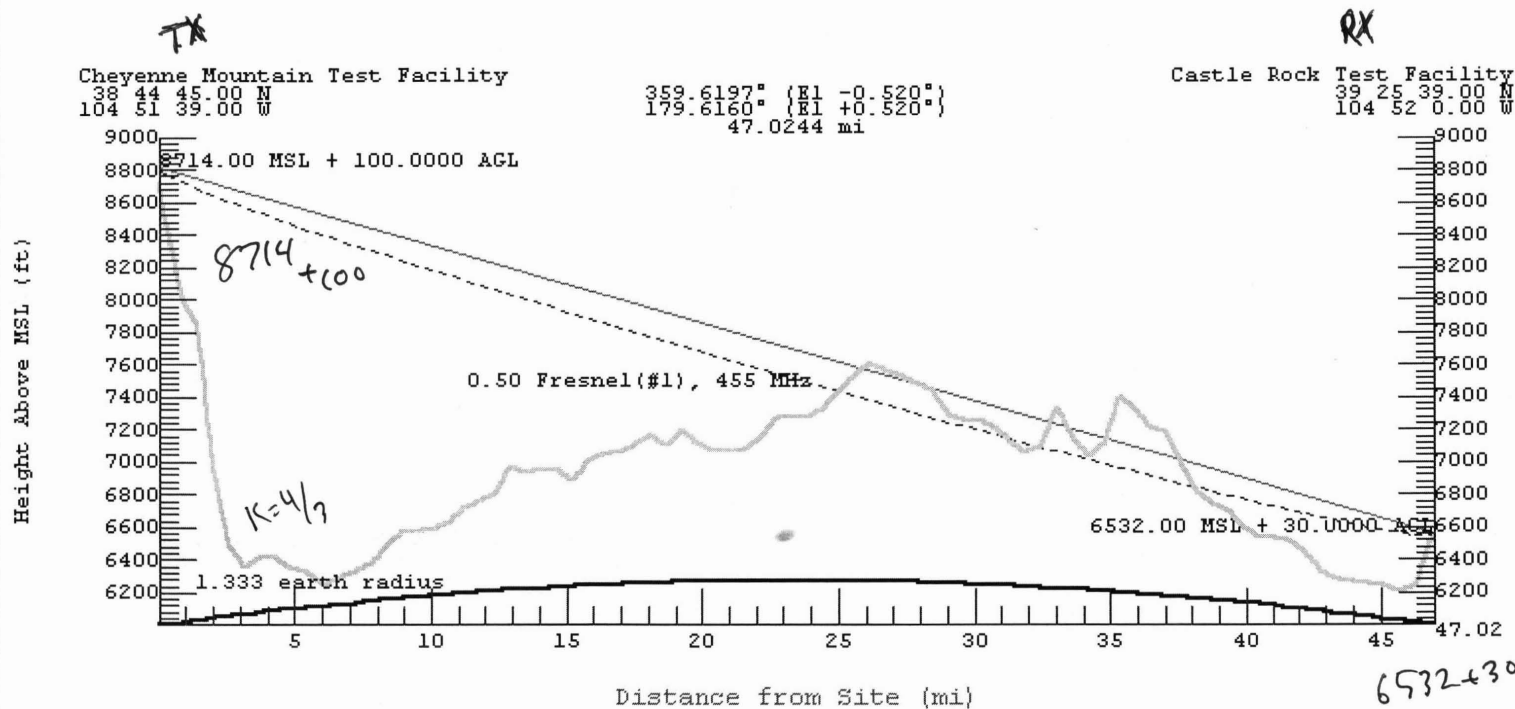
9400
100
9500 360°

6680
30
6700

TAP Profile Window - C:\SWTAP\drawings\SWP2P000.DBF



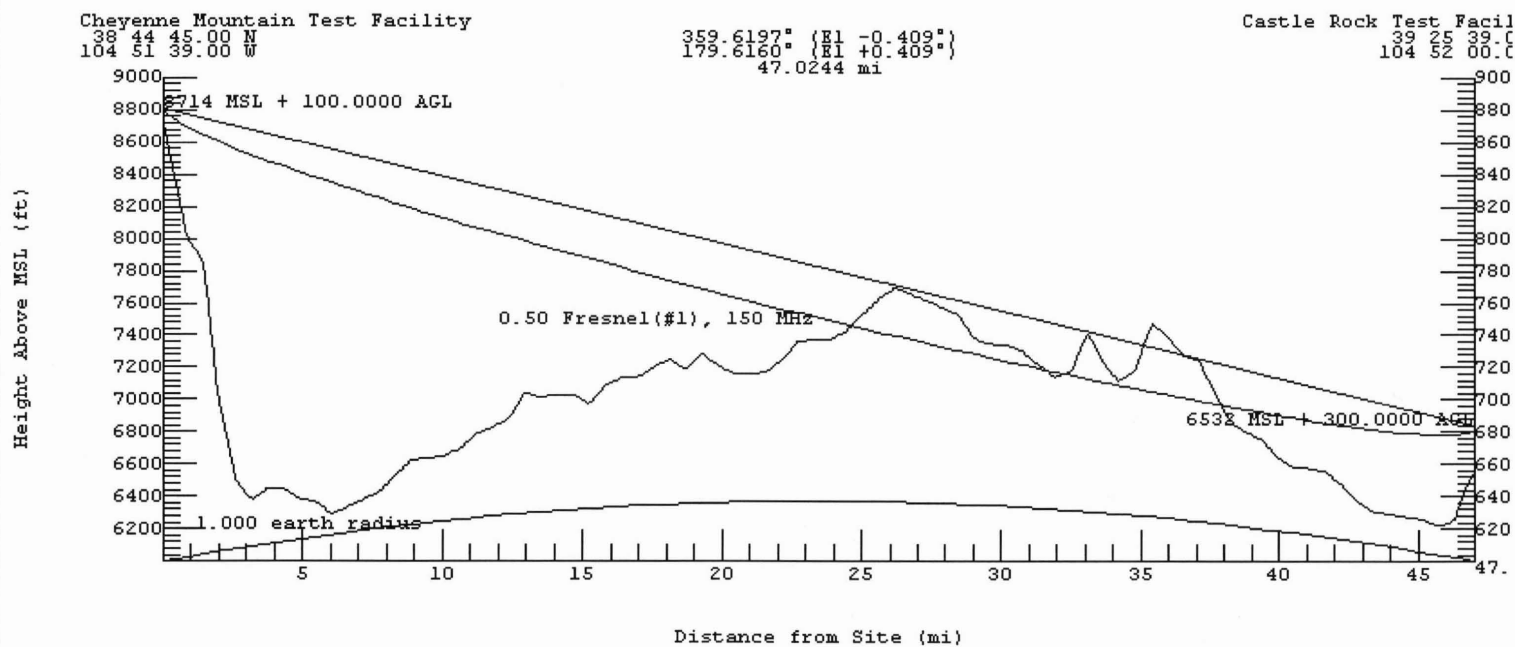
Mark coordinates on plot or



47.10

Latitude	Longitude	Dis from A	Dis from B	Terrain MSL	Adj Terrain	Knife-Edge	Cursor AGL	Clearance
39 25 39.00 N	104 52 0.00 W	47.02	0.00	6532.00	6532.00	0.00	3407.52	0.00

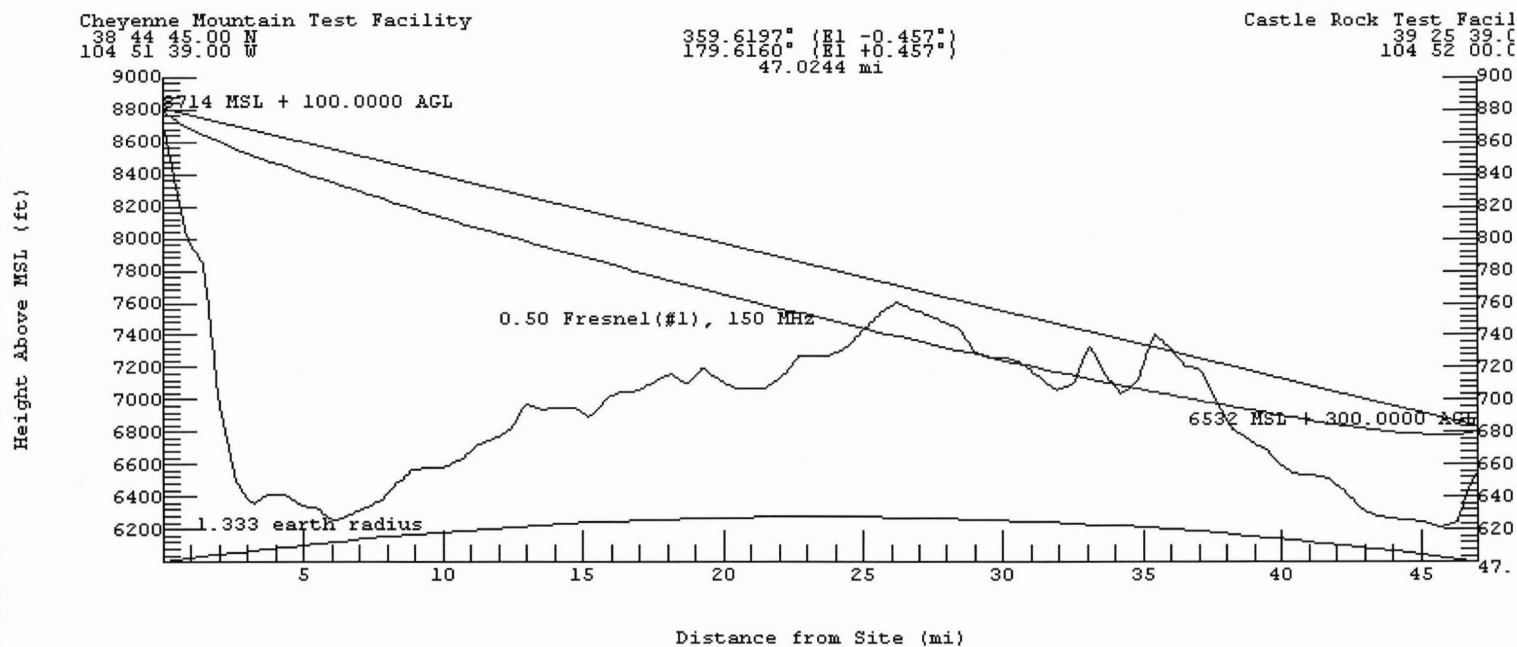
TAP Profile Window - C:\SOURCE\WB32\SWP2P000.DBF



X:+5450.549451 Y:+2739.320597

Latitude	Longitude	Dis from A	Dis from B	Terrain MSL	Knife-Edge	Cursor AGL
39 07 30.21 N	104 51 50.63 W	26.20	20.82	7693.28	-5.69	68.60

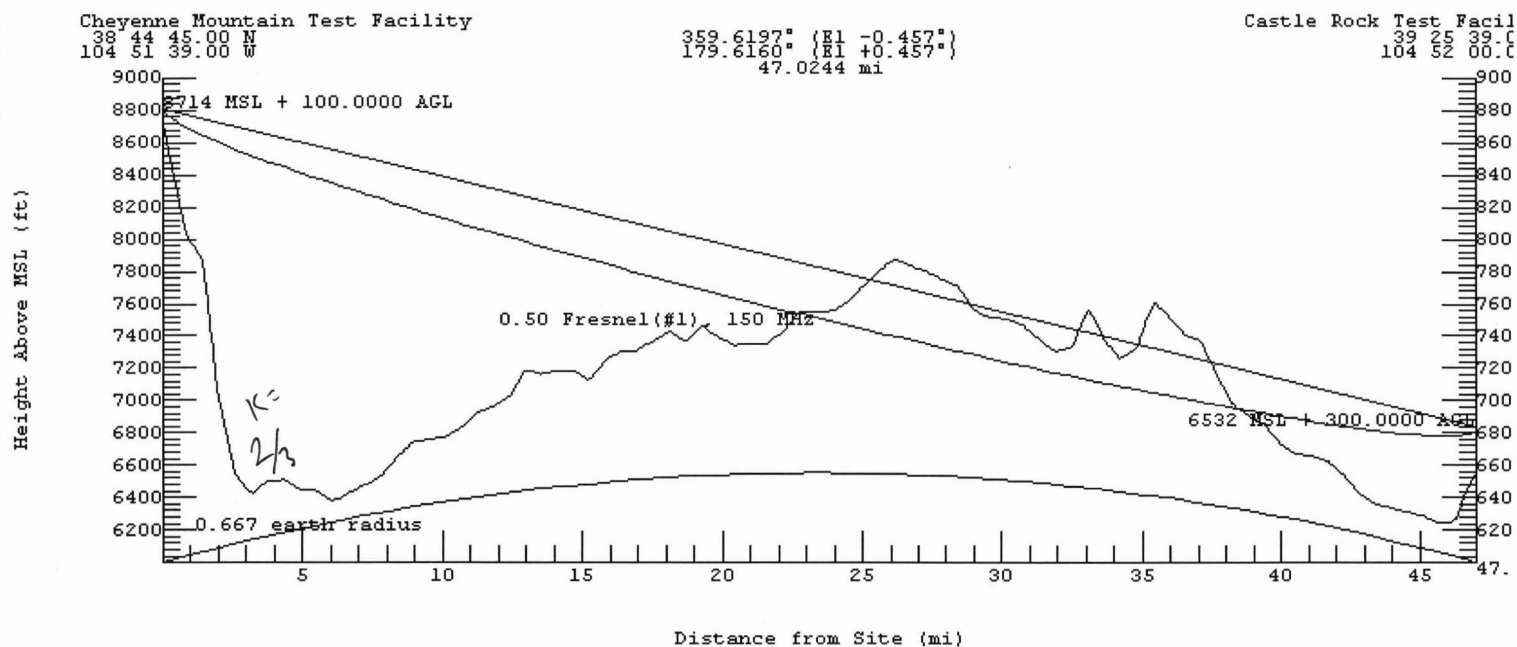
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X:+3934.065934 Y:+4488.525316

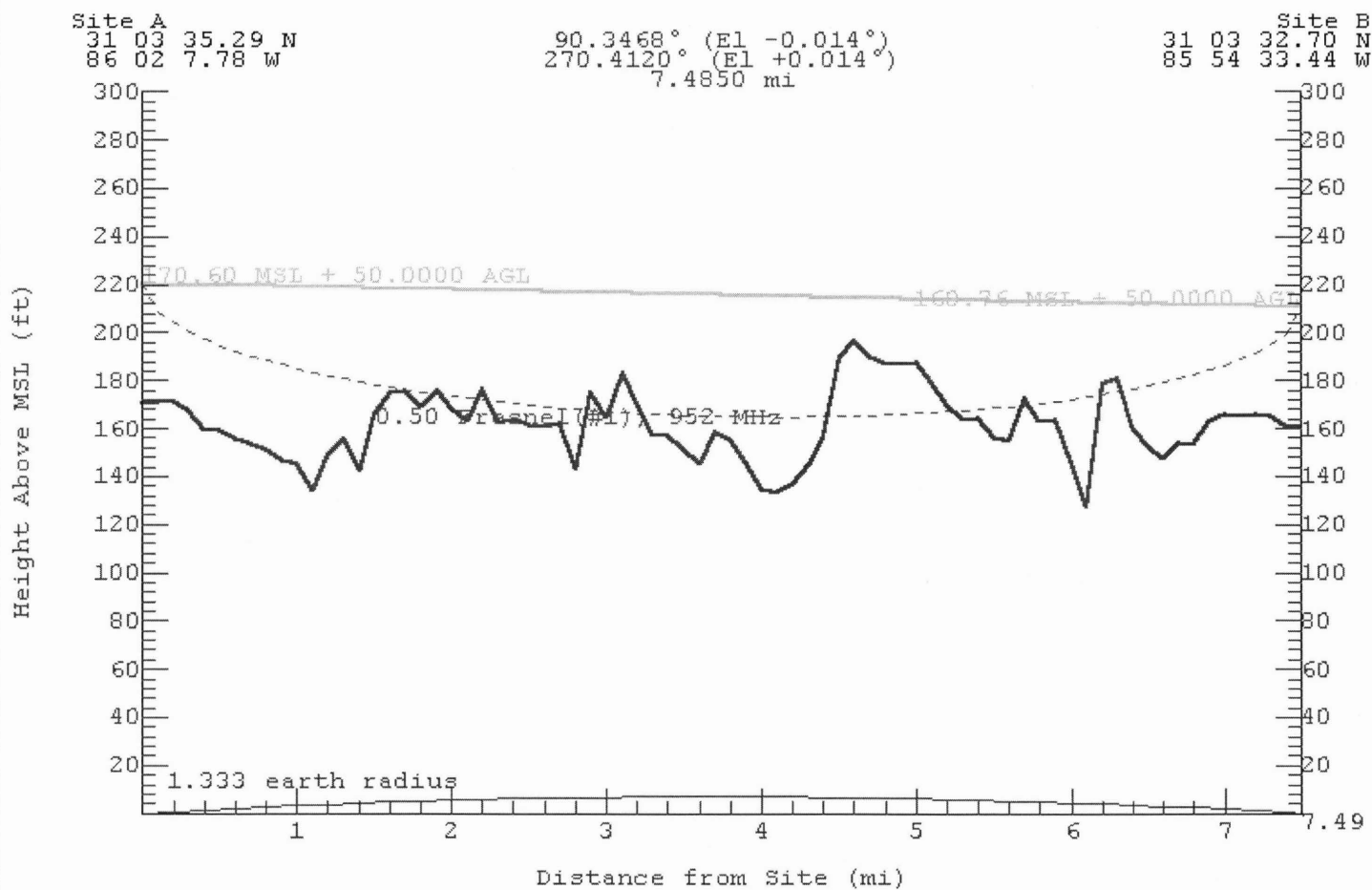
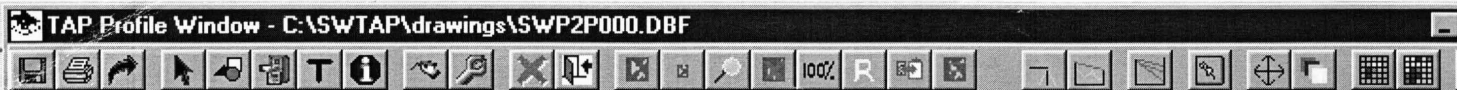
Latitude	Longitude	Dis from A	Dis from B	Terrain MSL	Knife-Edge	Cursor AGL
38 59 45.24 N	104 51 46.66 W	17.30	29.72	7087.76	0.00	2446.02

TAP Profile Window - C:\SOURCE\WB32\SWP2P000.DBF



X:+3186.813187 Y:+3784.442914

Latitude	Longitude	Dis from A	Dis from B	Terrain MSL	Knife-Edge	Cursor AGL
38 55 55.62 N	104 51 44.70 W	12.90	34.12	7180.64	0.00	1639.93



Engineering study
Cheyenne Mountain Antenna Farm

Colorado Springs, Colorado
May 1990

Microwave Path Specifications

TX Site Number: 2 Denver metro
Denver
38:44:45.0 N 104:51:39.0 W
Frequency: 13000.000000 MHz
Effective radiated power (EIRP): +70.89

RX Site Number: 2 Rsite
Aurora
39:02:07.0 N 104:40:22.0 W
Threshold: -70.00
(ANALOG 30 dB s/n)

Path 2- 2 Length: 22.39 mi
TX to RX bearing: 26.86 deg True
Tilt: -.43 deg
RX to TX bearing: 206.98 deg True
Tilt: +.43 deg
Path attenuation: -145.88
Absorption loss: -.17

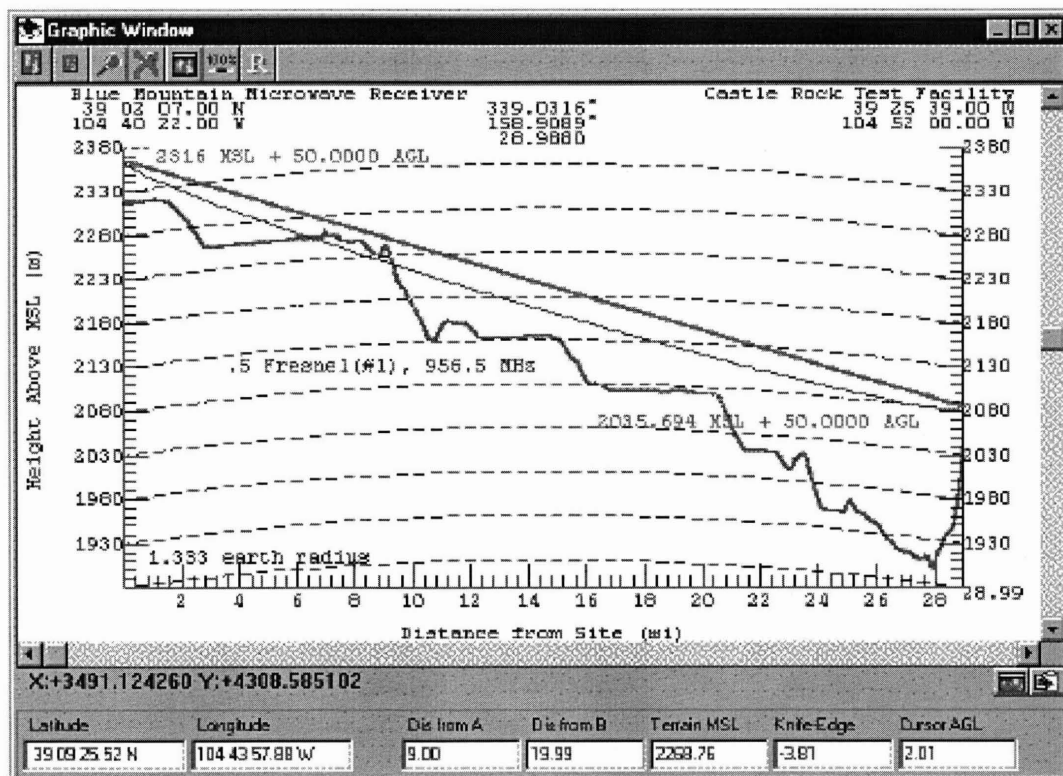
(CALC) .0115938 dB/km =
(Water Vapor .0072041 dB/mi = .161 dB)
(Oxygen .0005161 dB/mi = .012 dB)
Rain attenuation: -6.68

(CALC) *RAIN*
Medhurst .39 in/hr; 10.00 mm/hr
-11.20 mi @ .39370 dB/mi
Alignment loss: -.50
path loss 4 11.2 mi = 18.02 km -.50

Received signal level: -42.64

Fade margin: +27.36

Terrain factor (a): 1.000 (CALC) *Go south*
(AVERAGE terrain roughness = 50.00)



PENINSULA ENGINEERING SOLUTIONS 39 Grand Canyon Lane San Ramon, CA 94583, USA						Date: 16 Mar 2011 Calc. by: Ed Johnson Tel: +1 (925) 901-0103 Fax: +1 (925) 901-0403 Copyright Feb 2002							
Path Data Sheet for RF Repeaters													
Customer		PG&E, Mark Goto, Darriel Caston						Rev 4		Page 1			
Repeater: RF-11000		Terminal Aviat IRU600-HP-MHSB 25 Mb/s 4T1 + ETH, 5 MHz BW											
Units Select		1 English [1] English, [2] Metric											
Modulation, Terminal		6 128QAM [0] FM/FSK/4FSK [1] 4PSK [2] 8PSK [3] 16QAM [4] 32QAM [5] 64QAM [6] 128QAM [7] QPR3 [8] QPR5 [9] QPR7 [10] QPR9 [11] 32TCM [12] 64TCM [13] 128TCM											
US FCC Rule Part		101											
Configuration		0 1+0 [0] 1+0, [1] 1+1, [2] 2+1, [3] 3+1											
Delay Equalization		0 Unequalized, [1] Equalized											
Power Level [1],[2]		2 2 R1 <-> R2 1 1 N/A											
Var Gain Reduction		A <- R 20 0 0 #N/A 0 0 #N/A R -> B											
Site:Space Div Terminal Name		Terminal A Sunset Hill		RF Repeater Sanborn Mine				Passive Repeater Sly Creek PSV				Terminal B Sly Creek PH	
Tx Frequency, MHz		11 200.0 V-V		H-H				V-V				11 200.0	
Path Length, mi		14.8		5.8				0.2					
Free Space Loss, dB		141.0		132.8				103.7					
Absorption Loss, dB		0.2		0.1				0.0					
Main & Space Div Branch		SD Recv. Main TR						Main TR SD Recv.					
Obstruction Loss, dB				1.0				1.0					
Field Margin, dB		1.0		1.0				1.0					
Path Loss, dB		141.2 142.2		133.9				104.7 103.7					
Feeder Length, feet		95.0		15.0 15.0		5.0 5.0		65.0					
Loss/100 feet, dB		3.1		3.1 3.1		3.1 3.1		3.1					
Feeder Loss, dB		0.0 2.9		0.5 0.5		0.2 0.2		2.0		0.0			
Connector Loss, dB		0.2		0.2 0.2		0.1 0.1		0.2					
Component Loss, dB													
Radome Loss, dB													
Total Fixed Loss, dB		0.0 3.1		0.7 0.7		0.3 0.3		2.2		0.0			
Total Losses, dB		141.9 146.0		134.8				107.1 104.0					
Antenna Type		HP6-107		HP6-107 HP8-107		HP8-107 HP6-107		HP6-107					
Antenna Size, ft		6.0		6.0 8.0		8.0 6.0		6.0					
Antenna Gain, dB		#N/A 44.0		44.0 46.4		46.4 44.0		44.0		#N/A			
Front/Back, dB				70.0 71.0		71.0 70.0							
Term. Vert. Spacing, ft		0.0								0.0			
Total Gains, dB		#N/A 88.1		92.9				88.1 #N/A					
Net Path Loss, dB		#N/A 57.9		42.0				19.0 #N/A					
Transmit Power, dBm		22.5						22.5					
Repeater Input, dBm				-35.4 -38.5		-24.7 3.5							
Input Pad, dB				0.0 0.0									
Repeater Max. Gain, dB				57.4 57.4									
AGC, dB				4.8 1.7									
Amplifier Power, dB				17.2 17.2		3.5 -24.7							
Output Pad, dB				0.0 0.0		0.0 0.0							
Repeater Output, dBm				17.2 17.2		3.5 -24.7							
Main & Space Div. RX		SD Recv. Main TR						Main TR SD Recv.					
Nom RSL(+/-2dB), dBm		#N/A -40.7						-43.8 #N/A					
Receiver Threshold, dBm		-76.5 -76.5						-76.5 -76.5					
Min. C/I Required, dB		0.0						0.0					
Rec. Noise Figure, dB		6.0 6.0		11.1 9.2		25.0 51.1		6.0 6.0					
Min. Rec. Power, dBm		-76.5 -76.5		-71.4 -73.3		-57.5 -31.4		-76.5 -76.5					
Flat Fade Margin, dB		#N/A 35.8		36.0 34.8		32.7 34.8		32.7 #N/A					
Dispersive F. M., dB		60.0 60.0						60.0 60.0					
Composite F. M., dB		35.8 35.8		36.0 34.8		32.7 34.8		32.7 32.7					
Per Hop Reliability, SFD		99.999928%		99.9999%		100.0000%		100.0000%		100.000000%			
One Way Path Reliability		99.999923%						99.999922%					

Rev 4. 11 GHz, 25 Mb/s, 4T1 + ETH, 5 MHz Bandwidth
 Peninsula Repeater: RF-11000-41 1+0/1+1 Hot Standby Equiv, Duplex, PA Level 2.
 Aviat Radio: IRU-600-HP-MHSB T/R, 128QAM.

Reliability, 2-Way, End-to-End: 99.9998%. Estimated annual outage: 49 seconds.
 Short haul objective: 266 seconds.

PENINSULA ENGINEERING SOLUTIONS		Date: 16 Mar 2011	By: Ed Johnson
PG&E, Mark Goto, Darriel Caston		RF Repeater Sites:	Sanborn Mine Sly Creek PSV
Page 2			

Repeater Antenna Coupling			
Feed Point Separation, ft	12.0		10.0
Antenna Sep. Loss, dB	48.5		47.3
Antenna XPD Los, dB			20.0
Receive C/E, Repeater, dB	42.9	42.9	118.3 118.3

Reliability Data	
Terrain Roughness Factor, W, Feet	140.0
W is standard deviation of periodic height samples from the path profile. Typical W values are: Flat, overwater = 29 Average terrain = 50 Mountainous = 85	
Climate Type	3 [3] Mountainous or very dry
Climate / Terrain Factor	0.131 [1] Coastal, hot, humid [2] Norm. interior temperate [3] Mountainous or very dry
Mean Temperature, degrees F	45.0 Fading Season, days : 83.8

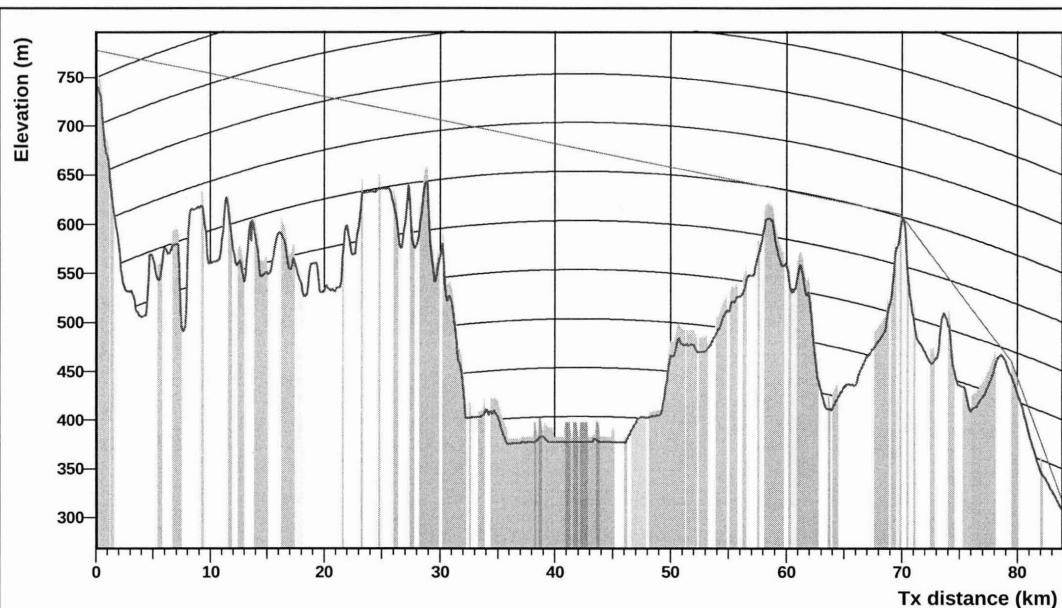
Non Diversity	Non Diversity and Space Diversity calculations use minimum of Main TR or Space Diversity Receive Fade Margins.
Undp (A ->R1->R2-> B)	3.38E-06
Undp (A<- R1<-R2<- B)	3.37E-06

Space Diversity	Frequency Diversity
Non Diversity	Non-Frequency-Diversity Configuration
Non Diversity	Frequency Spacing Tx A MHz
	Frequency Spacing Tx B MHz
Undp (A ->R1->R2-> B)	Non-Frequency-Diversity Configuration
Undp (A<- R1<-R2<- B)	Undp (A ->R1->R2-> B) 3.38E-06
	Undp (A<- R1<-R2<- B) 3.37E-06

Outage/year, A receive	24.4 Seconds	99.999923%
Outage/year, B receive	24.5 Seconds	99.999922%
Two Way Outage/year	48.8 Seconds	99.999845%
Path Length, End to End	20.8 Miles	
Two Way Objective, AT&T Short Haul	266.2 Seconds	

<i>This path data sheet is for preliminary information purposes only. It does not constitute a full path survey, and no guarantee of path performance, express or implied, is made.</i>	
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Link Study: trn/W63AB-W20BT_1.trn



SIGNAL™

Prop. model: FCC + RMD
Time: 10.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 1.000, 1.000

Reliability Analysis

Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 10.0 %
External interf.: -100.0 dBmW
Dispersive fade margin: 50.0 dB
Ant. spacing (diversity): 0.0 m
Rain outage method: Crane
Rain region: A

Transmitter Site: W63AB
Name: Tx001
Location:
N41°45'34.00" W76°55'31.00"
Site elevation: 737.3 m
Antenna height: 41.0 m
Pointing azimuth: 12.0 °
Transmitter power: 51.15 dBmW
Trans. line loss: 1.00 dB
Other losses: 0.00 dB
Antenna gain: 12.00 dBd
Antenna file: BOG_B8UA.pat
Total ERP: 64.30 dBmW

Name: W63AB ->W20BT_1
Frequency: 513.2500 MHz
Polarization: vertical
Length: 83.97 km
Number of obstacles: 2
Excess path loss: 72.36 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 197.50 dB
Flat fade margin: -55.43 dB
Total fade margin: -55.43 dB
Annual fade outage: 3942000.00 s
Annual rain outage: 0.00 s
Link availability: 50.0000 %

Receiver Site: W20BT_1
Name: Rx004
Location:
N42°29'54.00" W76°42'43.96"
Site elevation: 305.3 m
Antenna height: 9.1 m
Pointing azimuth: 192.0 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 6.00 dBd
Antenna file: rxdtv_u.pat
Received signal level: -125.47 dBmW

Notes

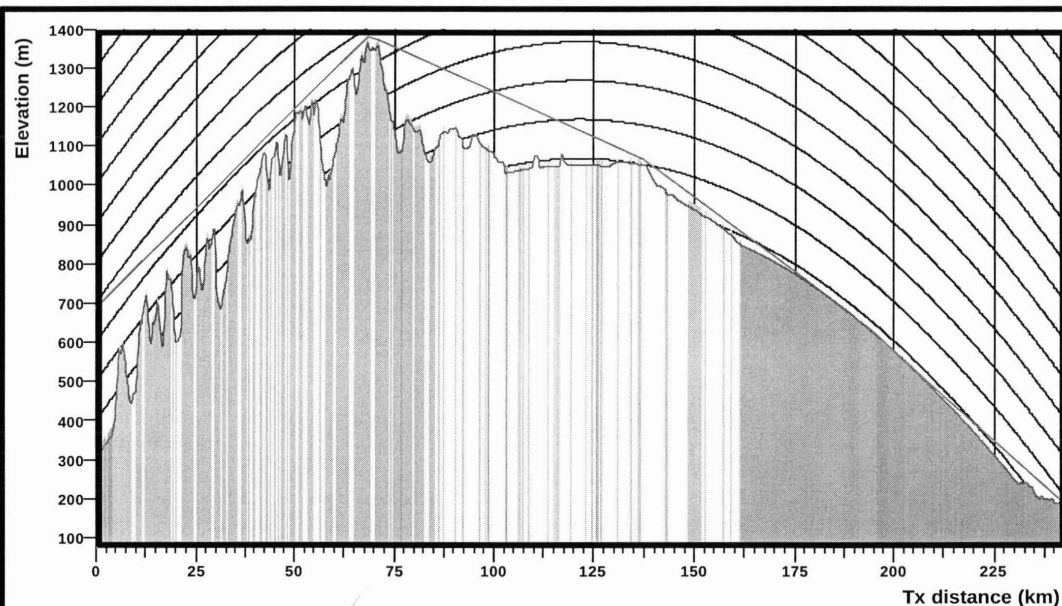
prepared by
Larry H. Will, P.E.
Glen Mills, PA 19342-9504

W63AB TERRAIN
12 degrees to W20BT

Figure 4

12/01/2003

Link Study: trn/WSKADT-Peter32.trn



SIGNAL™

Prop. model: FCC + RMD
Time: 50.00 % Loc.: 50.00 %
Margin: 0.00 dB
Climate: Continental Temperate
Atm. factor: none
K factors: 1.333, 0.500, 2.000

Reliability Analysis

Fade outage method: Vigants-Barnett
C param. for Vigants-Barnett:
average prop. conditions: C=1
ITU-R terrain type: Inland
ITU-R refract. grad.: 10.0 %
External interf.: -200.0 dBmW
Dispersive fade margin: 80.0 dB
Ant. spacing (diversity): 0.0 m
Rain outage method: Crane
Rain region: A

Transmitter Site: WSKADT
Name: Transmitter Site
Location:
N42°08'29.73" W77°04'39.11"
Site elevation: 512.0 m
Antenna height: 177.0 m
Pointing azimuth: 328.5 °
Transmitter power: 10.14 dBkW
Trans. line loss: 1.00 dB
Other losses: 0.00 dB
Antenna gain: 7.85 dBd
Antenna file:
Total ERP: 19.14 dBkW

Name: WSKADT ->Peter32
Frequency: 567.2500 MHz
Polarization: vertical
Length: 242.76 km
Number of obstacles: 9
Excess path loss: 140.20 dB
Atm. absorption loss: 0.00 dB
Path loss for stats: 275.43 dB
Flat fade margin: -99.90 dB
Total fade margin: -99.90 dB
Annual fade outage: 3942000.00 s
Annual rain outage: 0.00 s
Link availability: 50.0000 %

Receiver Site: Peter32
Name: Peterboro DTV left cente
Location:
N43°59'34.39" W78°39'53.69"
Site elevation: 175.7 m
Antenna height: 9.1 m
Pointing azimuth: 148.5 °
Trans. line loss: 0.00 dB
Other losses: 0.00 dB
Antenna gain: 6.00 dBd
Antenna file:
Received signal level: -248.14 dBkW

Notes

prepared by
Larry H. Will, P.E.
Glen Mills PA 19342

TERRAIN PROFILE WSKA to Peterborough ON

Figure 6B

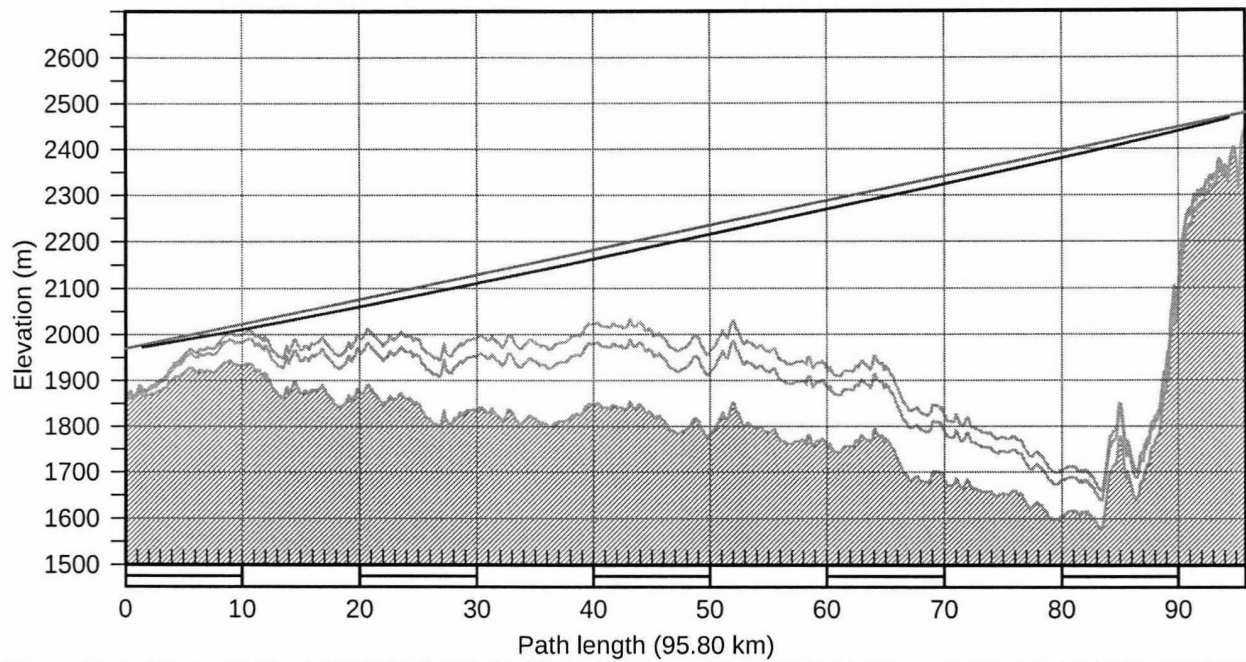
05/15/2005

Microwave Worksheet - CAMMOUBside11G_Alt.pl4

	CAMERON	MOUNDSVILLE
Elevation (ft)	1529.00	1324.00
Latitude	39 48 45.19 N	39 56 36.60 N
Longitude	080 34 41.13 W	080 43 40.80 W
True azimuth (°)	318.63	138.54
Vertical angle (°)	-0.25	0.12
Antenna model	HSX8-107-P3A	HSX8-107-P3A
Antenna height (ft)	150.00	150.00
Antenna gain (dBi)	46.50	46.50
TX line type	EW90	EW90
TX line length (ft)	190.00	190.00
TX line unit loss (dB /100 ft)	3.06	3.06
TX line loss (dB)	5.82	5.82
Connector loss (dB)	0.45	0.45
Miscellaneous loss (dB)	0.50	0.50
Other TX loss (dB)	1.40	1.40
Other RX loss (dB)	1.20	1.20
Frequency (MHz)	11200.00	
Polarization	Horizontal	
Path length (mi)	12.05	
Free space loss (dB)	139.20	
Atmospheric absorption loss (dB)	0.31	
Net path loss (dB)	62.65	62.65
Radio model	IRU600U6 115DS1	IRU600U6 115DS1
TX power (watts)	0.89	0.89
TX power (dBm)	29.50	29.50
EIRP (dBm)	67.83	67.83
Emission designator	30MOD7W 256QAM	30MOD7W 256QAM
TX Channels	11200.0000V 11200.0000H	11200.0000V 11200.0000H
RX threshold criteria	BER 10 ⁻⁶	BER 10 ⁻⁶
RX threshold level (dBm)	-68.75	-68.75
RX signal (dBm)	-33.15	-33.15
Thermal fade margin (dB)	35.60	35.60
Dispersive fade margin (dB)	39.00	39.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	33.97	33.97
Climatic factor	2.00	
Terrain roughness (ft)	139.06	
C factor	0.53	
Fade occurrence factor (Po)	2.59E-02	
Average annual temperature (°F)	68.00	
Worst month - multipath (%)	99.99896	99.99896
(sec)	27.31	27.31
Annual - multipath (%)	99.99965	99.99965
(sec)	111.41	111.41
(% - sec)	99.99929 - 222.82	
Rain region	D2-96 Temp. Continent	
Flat fade margin - rain (dB)	35.60	
Rain rate (mm/hr)	114.62	
Rain attenuation (dB)	35.61	
Annual rain (%-sec)	99.99901 - 311.00	
Annual multipath + rain (%-sec)	99.99831 - 533.82	

	Waltman	Casper Hill
Elevation (m)	1953.00	2445.00
Latitude	43 02 22.10 N	42 44 26.50 N
Longitude	107 27 39.00 W	106 21 38.50 W
True azimuth (°)	109.90	290.64
Vertical angle (°)	-0.02	-0.63
Antenna model	ANDREW HP6-180F	ANDREW HP6-180F
Antenna height (m)	16.80	33.50
Antenna gain (dBi)	48.00	48.00
TX line type	EWP-180	EWP-180
TX line length (m)	38.10	38.10
TX line unit loss (dB /100 m)	19.39	19.39
TX line loss (dB)	7.39	7.39
Connector loss (dB)	0.50	0.50
Frequency (MHz)	18500.00	
Polarization	Vertical	
Path length (km)	95.80	
Free space loss (dB)	157.44	
Atmospheric absorption loss (dB)	5.98	
Field margin (dB)	2.00	
Net path loss (dB)	85.19	85.19
Radio model	32 QAM 3-DS-3	32 QAM 3-DS-3
TX power (watts)	0.16	0.16
TX power (dBm)	22.00	22.00
EIRP (dBm)	62.11	62.11
Emission designator	40M0D7W	40M0D7W
RX threshold criteria	10-6	10-6
RX threshold level (dBm)	-74.00	-74.00
RX signal (dBm)	-63.19	-63.19
Thermal fade margin (dB)	10.81	10.81
C factor	1.00	
Fade occurrence factor (Po)	9.76E+00	
Average annual temperature (°C)	4.44	
Worst month - multipath (%)	19.06111	19.06111
(sec)	2127074.16	2127074.16
Annual - multipath (%)	83.81222	83.81222
(sec)	5104977.98	5104977.98
(% - sec)	67.62444 - 10209955.95	
Rain region	B Polar Taiga	
Flat fade margin - rain (dB)	10.81	
Rain rate (mm/hr)	2.46	
Rain attenuation (dB)	10.77	
Annual rain (%-sec)	99.39617 - 190422.47	
Annual multipath + rain (%-sec)	67.02062 - 10400378.42	

Thu, Jan 15 2009
 Waltman - Casper Mt.pl4
 Reliability Method - Vigants - Barnett
 Rain - Crane



Waltman
 Latitude 43 02 22.10 N
 Longitude 107 27 39.00 W
 Azimuth 109.90°
 Elevation 1953 m ASL
 Antenna CL 16.8 m AGL

Frequency (MHz) = 18500.0
 K = 1.33, 1.00
 %F1 = 100.00

Casper Hill
 Latitude 42 44 26.50 N
 Longitude 106 21 38.50 W
 Azimuth 290.64°
 Elevation 2445 m ASL
 Antenna CL 33.5 m AGL

CSI TELECOMMUNICATIONS, INC. CONSULTING ENGINEERS

	Jan 15 09	

Customer/Project: Motorola - NYFD-DoITT
Path ID: MN-167

Date: 03-Mar-2009
Rev. Date: 03-Mar-2009
Engineer: RDY

Equipment Type: Constellation 155/180 11
Protection Type: Monitored Hot Standby (coupler)

Capacity: 3 DS3 + 28 DS1
Frequency: 11.2 GHz (FCC)
Band Width: N/A

Site Name:	LIPA Building	Elmont
NAD83 Latitude:	40° 36 ' 38.7 " N	40° 41 ' 24.6 " N
Longitude:	073° 45 ' 39.7 " W	073° 42 ' 7.6 " W
Elevation:	9.0 ft	50.0 ft
Azimuth:	29.45°	209.49°

Path Length:	6.29 mi
Free Space Loss:	133.56 dB
Atmospheric Absorption:	0.15 dB
Diffraction Loss:	0.00 dB
Transmission Line Type:	Elliptical
Transmission Line Length:	130.00 ft
Transmission Line Loss:	3.98 dB
Transmit-Only Pads:	0.00 dB
Jumper / Flex Loss:	0.45 dB
Main Antenna Radome Loss:	1.40 dB
Transmitter ACU Loss:	0.40 dB
Receiver ACU Loss:	1.00 dB
Misc/Common Line Pads:	0.00 dB
TOTAL LOSSES:	152.74 dB

Antenna Size:	6.0 ft
Antenna Centerline:	142.0 ft
Antenna Gain:	44.0 dB
Antenna Type:	PL6-107
Effective Radiated Power (EIRP):	62.8 dBm
Transmitter Power, GUARANTEED:	Standard Power (25.0 dBm)

TOTAL GAINS:	113.0 dB
Unfaded Received Signal Level:	-39.7 dBm (+/- 2dB)
Required Level For 10-6 BER:	-67.0 dBm
Flat Fade Margin:	27.3 dB
Dispersive Fade Margin:	49.0 dB
Composite Fade Margin:	27.2 dB
Multipath Outage Probability:	0.000043468
Multipath Outage:	349.5 sec/year
Rain Outage: Crane zone - D2	90.7 sec Vertical
Total Outage:	440.2 sec/year
Percent Reliability:	99.99860 %

c = 3.29 X = 1.0 w = 20.0 (Vigants 1975) Temperature = 50.0 °F
Slope Equalizer? Std
Unfaded Receive Signal Level (at radio/transmission line interface): -38.7 dBm (+/- 2dB)

***** When using HP antennas, Teflon planar radomes are required *****



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SUPPLEMENTAL SHOWING PART 101.103(d)

File Number: M1615501

Licensee(s): Kings Canyon Unified School District

Pursuant to Part 101.103(d) of the FCC Rules and Regulations, a frequency coordination study was conducted by Micronet Communications, Inc. for the following proposed microwave paths:

District Office, CA - Citrus Tower, CA - 18.7 GHz (iii)
District Office, CA - Alta Tower, CA - 18.7 GHz (iii)
District Office, CA - Kings Canyon HS Towe, CA - 18.7 GHz (iii)
District Office, CA - Great Western ES, CA - 18.7 GHz (iii)
District Office, CA - A.L. Conner Tower, CA - 18.7 GHz (iii)

(iii) The Adaptive Modulation capabilities of the specified equipment will be used on one or more of the microwave paths listed above. The equipment will normally operate at the highest modulation rate, but will drop to lower modulation rates to prevent service outages due to fading.

The results of the study indicate that no unacceptable interference will result with existing, proposed or prior coordinated radio facilities.

Prior Coordination was performed with licensees, applicants and prior coordinated carriers within coordination range. The current coordination dates are listed below:

06/03/2016 - Original PCN

The attached coordination data was forwarded to the following parties within coordination range or their authorized agents and there are no unresolved interference objections:

AT&T CALIFORNIA
AT&T MOBILITY SPECTRUM LLC
CLEARWIRE SPECTRUM HOLDINGS III LLC
CONTERRA ULTRA BROADBAND LLC
FIXED WIRELESS HOLDINGS LLC
FRESNO CITY OF
FRESNO COUNTY OF
FRESNO COUNTY OFFICE OF EDUCATION
FRESNO MSA L P
KINGS CANYON UNIFIED SCHOOL DISTRICT
KINGS COUNTY OFFICE OF EDUCATION
NEW CINGULAR WIRELESS PCS LLC
NEW CINGULAR WIRELESS PCS LLC - N CAL
OACYS.COM INCORPORATED
ONE PUTT
PACIFIC BELL TELEPHONE COMPANY DBA AT&T CALIFORNIA
SPRINT SPECTRUM L P
SPRINT TELEPHONY PCS L.P.
SPRINTCOM INC
T-MOBILE LICENSE LLC



Path Data Sheet

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epcn@micronetcom.com

File: M1615501 - 1

Original PCN Date: June 03, 2016

Site Name, State		District Office, CA	Citrus Tower, CA
Call Sign		WQOR612	WQOR629
Company Name(s):		Kings Canyon Unified School District	Kings Canyon Unified School District
FRN		0006743595	0006743595
City/County		Reedley / Fresno	Orange Cove / Fresno
Latitude	N(NAD 83)	36 36 12.0	36 36 55.8
Longitude	W(NAD 83)	119 27 23.0	119 19 18.6
Azimuth	(degrees)	83.6	263.6
Elevation	AMSL(ft/m)	349.1 / 106.4	413.1 / 125.9
ASR#		1058272	1261712
Distance	(miles/km)	7.53 / 12.12	

83.53
364

7.52

263.53
413

Transmit Receive Antenna		COMMSCOPE	COMMSCOPE
Antenna Model		VHLP2-18B	VHLP2-18B
Gain/Beamwidth	(dBi/deg)	38.9 / 2.1	38.9 / 2.1
Antenna Height	AGL(ft/m)	150.0 / 45.7	90.0 / 27.4
Tilt	(degrees)	-0.035	-0.047

Equipment		CERAGON NETWORKS	CERAGON NETWORKS
Equipment Model		IP20C-18-C80X-A AMR	IP20C-18-C80X-A AMR
Stability	(%)	0.001	0.001
ATPC/Trigger Level	(dBm)	No	No
Fixed Losses Cm,Tx,Rx	(dB)	0.8,0.0,0.0	0.8,0.0,0.0

Transmit Frequencies (MHz)			18060S				19620S			
Emissions			District Office, CA				Citrus Tower, CA			
Mod/Lvl	Designator	Traffic (kbps)	Tx Power (dBm)			EIRP (dBm)	Rx Lvl (dBm)	Tx Power (dBm)		
			nom	crd	max	(dBm)	(dBm)	nom	crd	max
QAM/1024	80M0D7W	635550		18.0		56.1	-45.4		18.0	56.1
QAM/1024	80M0D7W	598690		18.0		56.1	-		18.0	56.1
QAM/512	80M0D7W	550620		18.0		56.1	-		18.0	56.1
QAM/256	80M0D7W	501150		20.0		58.1	-		20.0	58.1
QAM/128	80M0D7W	435410		20.0		58.1	-		20.0	58.1
QAM/64	80M0D7W	368740		20.0		58.1	-		20.0	58.1
QAM/32	80M0D7W	301540		20.0		58.1	-		20.0	58.1
QAM/16	80M0D7W	229990		21.0		59.1	-		21.0	59.1
PSK/8	80M0D7W	161710		22.0		60.1	-		22.0	60.1
QPSK	80M0G7W	114330		22.0		60.1	-		22.0	60.1

139.22

15.15



Path Data Sheet

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File: M1615501 - 2

Original PCN Date: June 03, 2016

Site Name, State		District Office, CA	Alta Tower, CA
Call Sign		WQOR612	WQOR631
Company Name(s):		Kings Canyon Unified School District	Kings Canyon Unified School District
FRN		0006743595	0006743595
City/County		Reedley / Fresno	Reedley / Fresno
Latitude	N(NAD 83)	36 36 12.0	36 36 37.9
Longitude	W(NAD 83)	119 27 23.0	119 23 56.3
Azimuth	(degrees)	81.1	261.2
Elevation	AMSL(ft/m)	349.1 / 106.4	360.9 / 110.0
ASR#		1058272	1261711
Distance	(miles/km)	3.23 / 5.20	

Transmit Receive Antenna		COMMSCOPE	COMMSCOPE
Antenna Model		VHLP2-18B	VHLP2-18B
Gain/Beamwidth	(dBi/deg)	38.9 / 2.1	38.9 / 2.1
Antenna Height	AGL(ft/m)	80.0 / 24.4	80.0 / 24.4
Tilt	(degrees)	0.022	-0.057

Equipment		CERAGON NETWORKS	CERAGON NETWORKS
Equipment Model		IP20C-18-C80X-A AMR	IP20C-18-C80X-A AMR
Stability	(%)	0.001	0.001
ATPC/Trigger Level	(dBm)	No	No
Fixed Losses Cm,Tx,Rx	(dB)	0.8,0.0,0.0	0.8,0.0,0.0

Transmit Frequencies (MHz)	17980S	19540S
----------------------------	--------	--------

Emissions			District Office, CA				Alta Tower, CA			
Mod/Lvl	Designator	Traffic (kbps)	Tx Power (dBm)			EIRP (dBm)	Rx Lvl (dBm)	Tx Power (dBm)		
			nom	crd	max			nom	crd	max
QAM/1024	80M0D7W	635550		18.0		56.1	-38.0		18.0	
QAM/1024	80M0D7W	598690		18.0		56.1	-		18.0	
QAM/512	80M0D7W	550620		18.0		56.1	-		18.0	
QAM/256	80M0D7W	501150		20.0		58.1	-		20.0	
QAM/128	80M0D7W	435410		20.0		58.1	-		20.0	
QAM/64	80M0D7W	368740		20.0		58.1	-		20.0	
QAM/32	80M0D7W	301540		20.0		58.1	-		20.0	
QAM/16	80M0D7W	229990		21.0		59.1	-		21.0	
PSK/8	80M0D7W	161710		22.0		60.1	-		22.0	
QPSK	80M0G7W	114330		22.0		60.1	-		22.0	



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File: M1615501 - 3

Original PCN Date: June 03, 2016

Site Name, State		District Office, CA	Kings Canyon HS Towe, CA
Call Sign		WQOR612	WQQY977
Company Name(s):		Kings Canyon Unified School District	Kings Canyon Unified School District
FRN		0006743595	0006743595
City/County		Reedley / Fresno	Dinuba / Fresno
Latitude	N(NAD 83)	36 36 12.0	36 35 19.4
Longitude	W(NAD 83)	119 27 23.0	119 22 35.2
Azimuth	(degrees)	102.7	282.8
Elevation	AMSL(ft/m)	349.1 / 106.4	360.9 / 110.0
ASR#		1058272	1261716
Distance	(miles/km)	4.56 / 7.34	

Transmit Receive Antenna		COMMSCOPE	COMMSCOPE
Antenna Model		VHLP2-18B	VHLP2-18B
Gain/Beamwidth	(dBi/deg)	38.9 / 2.1	38.9 / 2.1
Antenna Height	AGL(ft/m)	175.0 / 53.3	90.0 / 27.4
Tilt	(degrees)	-0.199	0.15

Equipment		CERAGON NETWORKS	CERAGON NETWORKS
Equipment Model		IP20C-18-C80X-A AMR	IP20C-18-C80X-A AMR
Stability	(%)	0.001	0.001
ATPC/Trigger Level	(dBm)	No	No
Fixed Losses Cm,Tx,Rx	(dB)	0.8,0.0,0.0	0.8,0.0,0.0

Transmit Frequencies (MHz)	17900S	19460S
----------------------------	--------	--------

Emissions			District Office, CA				Kings Canyon HS Towe, CA			
Mod/Lvl	Designator	Traffic (kbps)	Tx Power (dBm)			EIRP (dBm)	Rx Lvl (dBm)	Tx Power (dBm)		
			nom	crd	max			nom	crd	max
QAM/1024	80M0D7W	635550		18.0		56.1	-41.0		18.0	
QAM/1024	80M0D7W	598690		18.0		56.1	-		18.0	
QAM/512	80M0D7W	550620		18.0		56.1	-		18.0	
QAM/256	80M0D7W	501150		20.0		58.1	-		20.0	
QAM/128	80M0D7W	435410		20.0		58.1	-		20.0	
QAM/64	80M0D7W	368740		20.0		58.1	-		20.0	
QAM/32	80M0D7W	301540		20.0		58.1	-		20.0	
QAM/16	80M0D7W	229990		21.0		59.1	-		21.0	
PSK/8	80M0D7W	161710		22.0		60.1	-		22.0	
QPSK	80M0G7W	114330		22.0		60.1	-		22.0	



Path Data Sheet

720 F Avenue, Suite 100
Plano, Texas 75074
www.micronetcom.com

Phone: 972-422-7200
Fax: 972-422-1900
epcn@micronetcom.com

File: M1615501 - 4

Original PCN Date: June 03, 2016

Site Name, State		District Office, CA	Great Western ES, CA
Call Sign		WQOR612	WQOR620
Company Name(s):		Kings Canyon Unified School District	Kings Canyon Unified School District
FRN		0006743595	0006743595
City/County		REEDLEY / Fresno	Reedley / Fresno
Latitude	N(NAD 83)	36 36 12.0	36 39 43.1
Longitude	W(NAD 83)	119 27 23.0	119 27 01.2
Azimuth	(degrees)	4.8	184.8
Elevation	AMSL(ft/m)	349.1 / 106.4	379.9 / 115.8
ASR#		1058272	
Distance	(miles/km)	4.06 / 6.53	

Transmit Receive Antenna		COMMSCOPE	COMMSCOPE
Antenna Model		VHLP2-18B	VHLP2-18B
Gain/Beamwidth	(dBi/deg)	38.9 / 2.1	38.9 / 2.1
Antenna Height	AGL(ft/m)	100.0 / 30.5	30.0 / 9.1
Tilt	(degrees)	-0.127	0.083

Equipment		CERAGON NETWORKS	CERAGON NETWORKS
Equipment Model		IP20C-18-C80X-A AMR	IP20C-18-C80X-A AMR
Stability	(%)	0.001	0.001
ATPC/Trigger Level	(dBm)	No	No
Fixed Losses Cm,Tx,Rx	(dB)	0.8,0.0,0.0	0.8,0.0,0.0

Transmit Frequencies (MHz)	18060S	19620S
----------------------------	--------	--------

Emissions			District Office, CA					Great Western ES, CA				
Mod/Lvl	Designator	Traffic (kbps)	Tx Power (dBm)			EIRP (dBm)	Rx Lvl (dBm)	Tx Power (dBm)			EIRP (dBm)	Rx Lvl (dBm)
			nom	crd	max			nom	crd	max		
QAM/1024	80M0D7W	635550		18.0		56.1	-40.0		18.0		56.1	-40.0
QAM/1024	80M0D7W	598690		18.0		56.1	-		18.0		56.1	-
QAM/512	80M0D7W	550620		18.0		56.1	-		18.0		56.1	-
QAM/256	80M0D7W	501150		20.0		58.1	-		20.0		58.1	-
QAM/128	80M0D7W	435410		20.0		58.1	-		20.0		58.1	-
QAM/64	80M0D7W	368740		20.0		58.1	-		20.0		58.1	-
QAM/32	80M0D7W	301540		20.0		58.1	-		20.0		58.1	-
QAM/16	80M0D7W	229990		21.0		59.1	-		21.0		59.1	-
PSK/8	80M0D7W	161710		22.0		60.1	-		22.0		60.1	-
QPSK	80M0G7W	114330		22.0		60.1	-		22.0		60.1	-



Path Data Sheet

720 F Avenue, Suite 100
Plano, Texas 75074
www.micronetcom.com

Phone: 972-422-7200
Fax: 972-422-1900
epcn@micronetcom.com

File: M1615501 - 6

Original PCN Date: June 03, 2016

Site Name, State		District Office, CA	A.L. Conner Tower, CA
Call Sign		WQOR612	WQQY973
Company Name(s):		Kings Canyon Unified School District	Kings Canyon Unified School District
FRN		0006743595	0006743595
City/County		REEDLEY / Fresno	Orange Cove / Fresno
Latitude	N(NAD 83)	36 36 12.0	36 37 47.9
Longitude	W(NAD 83)	119 27 23.0	119 18 32.4
Azimuth	(degrees)	77.3	257.4
Elevation	AMSL(ft/m)	349.1 / 106.4	433.1 / 132.0
ASR#		1058272	1261710
Distance	(miles/km)	8.4 / 13.52	

Transmit Receive Antenna		COMMSCOPE	COMMSCOPE
Antenna Model		VHLP2-18B	VHLP2-18B
Gain/Beamwidth	(dBi/deg)	38.9 / 2.1	38.9 / 2.1
Antenna Height	AGL(ft/m)	160.0 / 48.8	75.0 / 22.9
Tilt	(degrees)	-0.047	-0.044

Equipment		CERAGON NETWORKS	CERAGON NETWORKS
Equipment Model		IP20C-18-C80X-A AMR	IP20C-18-C80X-A AMR
Stability	(%)	0.001	0.001
ATPC/Trigger Level	(dBm)	No	No
Fixed Losses Cm,Tx,Rx	(dB)	0.8,0.0,0.0	0.8,0.0,0.0

Transmit Frequencies (MHz)			17820S			19380S		
Emissions			District Office, CA			A.L. Conner Tower, CA		
Mod/Lvl	Designator	Traffic (kbps)	Tx Power (dBm)			Tx Power (dBm)		
			nom	crd	max	nom	crd	max
QAM/1024	80M0D7W	635550		18.0			18.0	
QAM/1024	80M0D7W	598690		18.0			18.0	
QAM/512	80M0D7W	550620		18.0			18.0	
QAM/256	80M0D7W	501150		20.0			20.0	
QAM/128	80M0D7W	435410		20.0			20.0	
QAM/64	80M0D7W	368740		20.0			20.0	
QAM/32	80M0D7W	301540		20.0			20.0	
QAM/16	80M0D7W	229990		21.0			21.0	
PSK/8	80M0D7W	161710		22.0			22.0	
QPSK	80M0G7W	114330		22.0			22.0	

SUPPLEMENTAL SHOWING PART 101.103(d)

POINT-TO-POINT MICROWAVE SERVICE

STATION NAME, STATE	INSTRUMENTOS, Ch	STEWART, TX
COUNTY		EL PASO
CALL SIGN		
ASR NUMBER		
LATITUDE (NAD83)	31-41-02.60N	31-40-30.60N
LONGITUDE (NAD83)	106-22-45.40W	106-19-16.70W
GROUND ELEV (AMSL)	3723.8 ft/1135.0 m	3677.8 ft/1121.0 m
AZIMUTH TO RX	100.1 deg	280.2 deg
DISTANCE TO RX	3.5 miles/5.6 Km	3.5 miles/5.6 Km
FREE-SPACE LOSS	134.4 dB	134.4 dB
 TX/RX ANTENNA		
MANUFACTURER	GABRIEL ELECTRONICS	GABRIEL ELECTRONICS
MODEL NUMBER	PE4-220B	PE4-220B
BEAMWIDTH	0.9 deg	0.9 deg
GAIN	46.3 dBi	46.3 dBi
CENTER LINE (AGL)	45.9 ft/14.0 m	62.3 ft/19.0 m
TILT ANGLE	-0.1 deg	0.1 deg
LINE LOSS	0.0 dB	0.0 dB
 RADIO EQUIPMENT		
MANUFACTURER	MICROWAVE NETWORKS INC	MICROWAVE NETWORKS INC
MODEL NUMBER	MICRONET 23	MICRONET 23
FCC DESIGNATOR	3M50F7W	3M50F7W
MODULATION TYPE	4FSK	4FSK
MODULATION RATE	8448 kbps	8448 kbps
STABILITY	0.0003%	0.0003%
PAD LOSS	0.0 dB	0.0 dB
 POWER		
COORD. TX POWER	16.0 dBm/0.040 W	16.0 dBm/0.040 W
EIRP	62.3 dBm/1698.243 W	62.3 dBm/1698.243 W
RECEIVED LEVEL	-25.8 dBm	-25.8 dBm
 TRANSMIT FREQUENCIES	22485.750H MHz	21253.750H MHz



SUPPLEMENTAL SHOWING PART 101.103(d)

POINT-TO-POINT MICROWAVE SERVICE





SUPPLEMENTAL SHOWING PART 101.103(d)

POINT-TO-POINT MICROWAVE SERVICE

STATION NAME, STATE	DEKKO JUAREZ, Ch	DEKKO ELP, TX
COUNTY		EL PASO
CALL SIGN		
LATITUDE (NAD83)	31-38-45.80N	31-40-42.10N
LONGITUDE (NAD83)	106-22-41.40W	106-18-28.90W
GROUND ELEV (AMSL)	3766.0 ft/1147.9 m	3668.0 ft/1118.0 m
AZIMUTH TO RX	61.7 deg	241.7 deg
DISTANCE TO RX	4.7 miles/7.6 Km	4.7 miles/7.6 Km
FREE-SPACE LOSS	137.0 dB	137.0 dB
TX/RX ANTENNA		
MANUFACTURER	RADIO WAVES INC	RADIO WAVES INC
MODEL NUMBER	HP2-23	HP2-23
BEAMWIDTH	1.7 deg	1.7 deg
GAIN	40.4 dBi	40.4 dBi
CENTER LINE (AGL)	60.0 ft/18.3 m	72.2 ft/22.0 m
TILT ANGLE	-0.2 deg	0.2 deg
LINE LOSS	0.0 dB	0.0 dB
RADIO EQUIPMENT		
MANUFACTURER	MICROWAVE NETWORKS INC.	MICROWAVE NETWORKS INC.
MODEL NUMBER	PROTEUS 23 16E1	PROTEUS 23 16E1
FCC DESIGNATOR	28M0F7W	28M0F7W
MODULATION TYPE	CP4FSK	CP4FSK
MODULATION RATE	32768 kbps	32768 kbps
STABILITY	0.0005%	0.0005%
PAD LOSS	0.0 dB	0.0 dB
POWER		
COORD. TX POWER	20.0 dBm/0.100 W	20.0 dBm/0.100 W
EIRP	60.4 dBm/1096.479 W	60.4 dBm/1096.479 W
RECEIVED LEVEL	-36.2 dBm	-36.2 dBm
TRANSMIT FREQUENCIES	21241.500H MHz	22473.500H MHz

SUPPLEMENTAL SHOWING PART 101.103(d)

POINT-TO-POINT MICROWAVE SERVICE





SUPPLEMENTAL SHOWING PART 101.103(d)

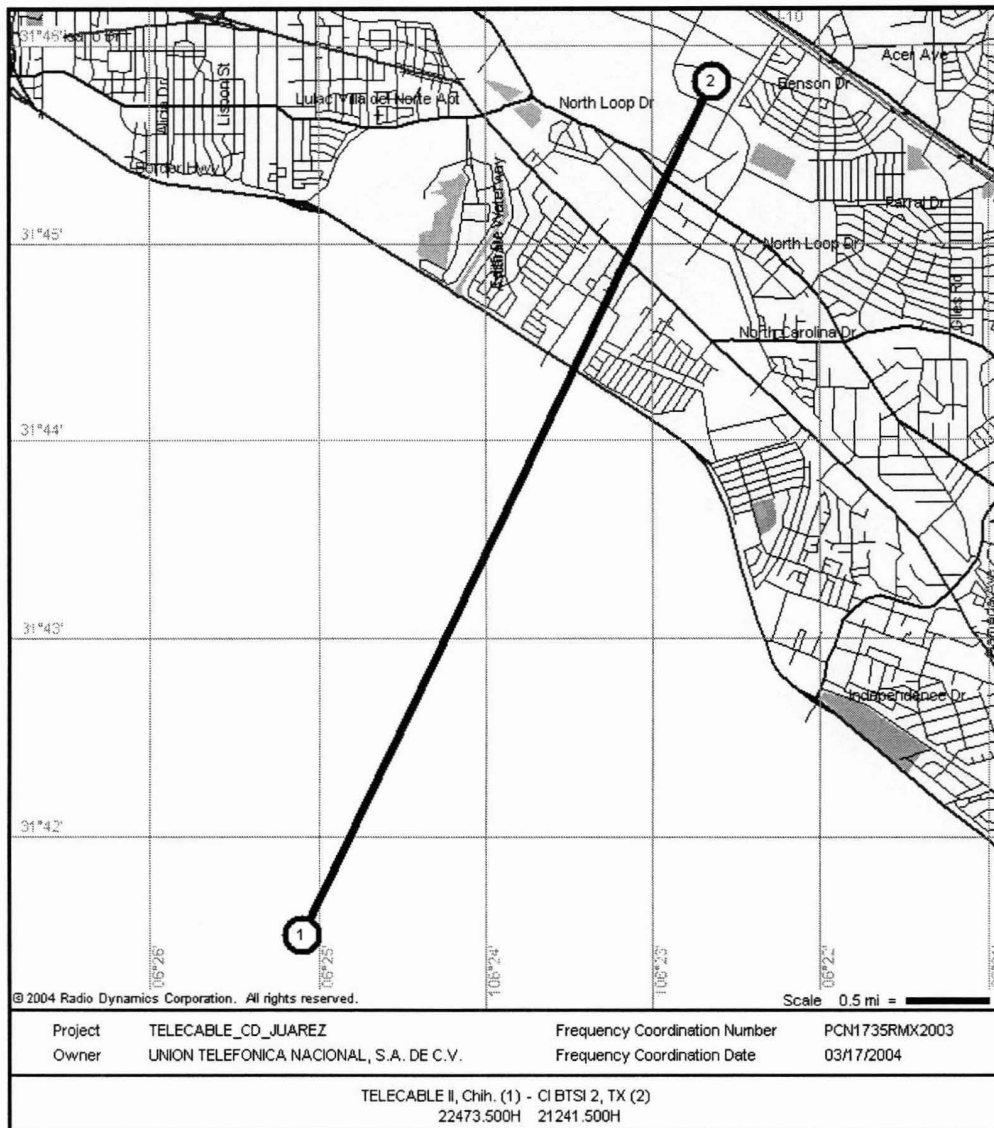
POINT-TO-POINT MICROWAVE SERVICE

STATION NAME, STATE	TELECABLE II, Ch	CI BTSI 2, TX
COUNTY		EL PASO
CALL SIGN		
ASR NUMBER		
LATITUDE (NAD83)	31-41-30.00N	31-45-49.00N
LONGITUDE (NAD83)	106-25-06.00W	106-22-39.00W
GROUND ELEV (AMSL)	3664.7 ft/1117.0 m	3779.5 ft/1152.0 m
AZIMUTH TO RX	25.9 deg	205.9 deg
DISTANCE TO RX	5.5 miles/8.9 Km	5.5 miles/8.9 Km
FREE-SPACE LOSS	138.4 dB	138.4 dB
TX/RX ANTENNA		
MANUFACTURER	ANDREW CORPORATION	ANDREW CORPORATION
MODEL NUMBER	VHLP2-220	VHLP2-220
BEAMWIDTH	1.6 deg	1.6 deg
GAIN	40.1 dBi	40.1 dBi
CENTER LINE (AGL)	44.7 ft/13.6 m	29.5 ft/9.0 m
TILT ANGLE	0.2 deg	-0.2 deg
LINE LOSS	0.0 dB	0.0 dB
RADIO EQUIPMENT		
MANUFACTURER	HARRIS	HARRIS
MODEL NUMBER	MICROSTAR M	MICROSTAR M
FCC DESIGNATOR	34M0F7W	34M0F7W
MODULATION TYPE	QPSK	QPSK
MODULATION RATE	34000 kbps	34000 kbps
STABILITY	0.0005%	0.0005%
PAD LOSS	0.0 dB	0.0 dB
POWER		
COORD. TX POWER	15.0 dBm/0.032 W	15.0 dBm/0.032 W
EIRP	55.1 dBm/323.594 W	55.1 dBm/323.594 W
RECEIVED LEVEL	-43.2 dBm	-43.2 dBm
TRANSMIT FREQUENCIES	22473.500H MHz	21241.500H MHz



SUPPLEMENTAL SHOWING PART 101.103(d)

POINT-TO-POINT MICROWAVE SERVICE



Microwave Path Data Sheet
COMSEARCH

Page 1 of 1

19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)636-5234 www.comsearch.com

PCN Date: 06/03/2019

Job Number: 190603COMSDS02

New Path

RCN Number: 19060361

Administrative Information

BILL WILLIAM AZ
City/County Williams/Coconino
Status / License Basis Engineering Proposal / PRIMARY OPERATION
Call Sign WQUR435
Licensee Code NILRAD
Licensee Name Niles Radio Communications
Radio Service / Station Class CF -- Point-to-Point Microwave, Common Carrier

TOPOCOBA REV AZ

/Coconino
Engineering Proposal / PRIMARY OPERATION
WQUR432
NILRAD
Niles Radio Communications
FXO -- Fixed

Site Information

Latitude (NAD 83)	35 ° 11' 59.0" N	36 ° 10' 19.0" N
Longitude (NAD 83)	112 ° 12' 15.0" W	112 ° 30' 21.0" W
Ground Elevation (m/ft-AMSL)	2811.17 / 9223.0	1903.92 / 6246.5
Antenna Structure Registration #		
Path Azimuth (°)	345.882	165.706
Path Length (km / miles)	111.274 / 69.142	

Transmit Antenna

Manufacturer	62654M	62655M
Model	Cambium Networks, LTD	Cambium Networks, LTD
Gain(dBi) / Beamwidth(°) / Tilt(°)	N060080L007A	N060080L008A
Centerline (m / ft - AGL)	42.0 / 1.30 / -0.84	44.0 / 1.00 / 0.09
	30.00 / 98.4	30.00 / 98.4

Receive Antenna

Same As Transmit

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Diversity Receive Antenna

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Radio Information

Manufacturer	X07064 ¹	X07064 ¹
Model	Cambium Networks, LTD	Cambium Networks, LTD
Model Description	PTP07820C-V2	PTP07820C-V2
Emission Designator / Modulation	PTP 820C-ALL-OUTDOOR 2048QAM-QPSK (MAX)	PTP 820C-ALL-OUTDOOR 2048QAM-QPSK (MAX)
Loading	25M0D7W 2048 QAM	25M0D7W 2048 QAM
Stability (%)	1 CH DIG 212380.000	1 CH DIG 212380.000
	0.001	0.001
	Nominal Coordinated Maximum	Nominal Coordinated Maximum
Power (dBm)	28.0	28.0
Received Level (dBm)	-37.1	-37.1
EIRP (dBm)	69.6	71.6
Fixed Loss: Tx / Common (dB)	0.0 / 0.4	0.0 / 0.4
Free Space Loss (dB)	150.3	

Transmit Frequencies (MHz) 7087.5000S(3) 7112.5000S(4) 6937.5000S(3) 6962.5000S(4)

315

COMSEARCH
2002 Edmund Halley Drive
Reston, VA 20191
(703) 620-6300

PREVIOUS PCN LETTER DATE: 06/09/1998

CURRENT PCN DATE: 08/19/1999

CURRENT JOB/RCN NUMBER: 990819RH03/99081924

STATION NAME	MICROWAVE PATH DATA		LITTLE AXE	OK
PATH STATUS	DOWNTOWN	OK		
CALL SIGN	PROPOSED OR PRIOR COORDINATED			
OWNER CODE	WLS599		WHP612	
LATITUDE (D-M-S) (NAD27)	MCAWCI		MCAWCI	
LONGITUDE (D-M-S) (NAD27)	35 27 10.0		35 13 53.0	
GROUND ELEV (Ft/m-AMSL)	97 28 30.0		97 10 8.0	
PATH AZIMUTH (Deg)	1230/374.9		1100/335.3	
PATH DISTANCE (Miles)	131.344		311.521	
(Km)	23.064			
	37.117			

ANTENNAPRIMARY TX

CABLEWAVE SYSTEMS

CABLEWAVE SYSTEMS

ANT CODE

PA8-65

PA8-65

GAIN(dBi)/BEAMWIDTH(Deg)

S91750

S91750

C/L (Ft/m-AGL)

42.4/1.30

42.4/1.30

PRIMARY RX

260/79.2

335/102.1

SAME AS TRANSMITTER

ANT CODE

GAIN(dBi)/BEAMWIDTH(Deg)

C/L (Ft/m-AGL)

DIVERSITY RX

CABLEWAVE SYSTEMS

CABLEWAVE SYSTEMS

ANT CODE

PA6-65B

PA6-65B

GAIN(dBi)/BEAMWIDTH(Deg)

S91650

S91650

C/L (Ft/m-AGL)

39.9/1.70

39.9/1.70

215/65.5

290/88.4

EQUIPMENT

ALCATEL NETWORK SYST

ALCATEL NETWORK SYST

EQP CODE

JF6-9407 MDR-6706-12

JF6-9407 MDR-6706-12

EMISSION

TEM566

TEM566

LOADING

3M75D7W

3M75D7W

STABILITY (%)

288 CH DIG

288 CH DIG

POWER (dBm/Watts)

0.001000

0.001000

29.0/0.794

29.0/0.794

FIXED LOSS: TX/COM (dB)

0.0/4.0

0.0/5.0

EIRP (dBm/Watts)

67.4/5495.4

66.4/4365.2

FREE SPACE LOSS (dB)

140.4

RECEIVED LEVEL (dBm)

-35.6

-35.6

TRANSMIT 6545.62500V

6715.62500V

FREQUENCIES

(MHZ)

MCAWCI = MCCAW COMMUNICATIONS OF THE MID SOUTH

COMSEARCH
2002 Edmund Halley Drive
Reston, VA 20191
(703) 620-6300

PREVIOUS PCN LETTER DATE: 04/28/1998

CURRENT PCN DATE: 08/19/1999

CURRENT JOB/RCN NUMBER: 990819RH03/99081924

STATION NAME		MICROWAVE PATH DATA	
PATH STATUS		LITTLE AXE	OK
CALL SIGN		PROPOSED OR PRIOR COORDINATED	SHAWNEE
OWNER CODE		WHF612	OK
LATITUDE (D-M-S) (NAD27)		MCAWCI	WHF616
LONGITUDE (D-M-S) (NAD27)			MCAWCI
GROUND ELEV (Ft/m-AMSL)		35 13 53.0	35 22 33.0
PATH AZIMUTH (Deg)		97 10 8.0	97 1 0.0
PATH DISTANCE (Miles)		1100/335.3	1056/321.9
		40.781	220.869
		13.159	
		21.177	

ANTENNA		ANDREW CORPORATION	
PRIMARY	TX	PDH10-65 (MAIN)	PDH10-65 (MAIN)
ANT CODE		A75002	A75002
GAIN(dBi)/BEAMWIDTH(Deg)		43.9/1.20	43.9/1.20
C/L (Ft/m-AGL)		265/80.8	225/68.6
PRIMARY	RX		

SAME AS TRANSMITTER

ANT CODE
GAIN(dBi)/BEAMWIDTH(Deg)
C/L (Ft/m-AGL)
DIVERSITY RX

ANT CODE
GAIN(dBi)/BEAMWIDTH(Deg)
C/L (Ft/m-AGL)

EQUIPMENT		ALCATEL NETWORK SYST	
EQP CODE		JF6-9408 MDR-6706-16	JF6-9408 MDR-6706-16
EMISSION		TEM571	TEM571
LOADING		5M00D7W	5M00D7W
STABILITY (%)		384 CH DIG	384 CH DIG
POWER (dBm/Watts)		0.001000	0.001000
		15.0/0.032	15.0/0.032
FIXED LOSS: TX/COM (dB)		0.0/4.0	0.0/4.0
EIRP (dBm/Watts)		54.9/309.0	54.9/309.0
FREE SPACE LOSS (dB)		135.5	
RECEIVED LEVEL (dBm)		-40.7	-40.7
TRANSMIT	6790.00000V	6630.00000V	
FREQUENCIES			
(MHZ)			

MCAWCI = MCCA W COMMUNICATIONS OF THE MID SOUTH

CONSOLIDATED SPECTRUM SERVICES

231 SAGAMORE ROAD
GILFORD, N.H. 03249
PHONE/FAX: (603) 293 - 0002
E-mail: Sales@FCC1.biz

COUNTY OF MONROE, MICHIGAN
RX MOBILE, MI

11/04/2009

PAGE 1

EXHIBIT 1 A - SUPPLEMENTAL SHOWING FCC RULE PART 101

Pursuant to Part 101 of the Federal Communications Commission rules and regulations, an engineering analysis has been performed by Consolidated Spectrum Services on behalf of:

COUNTY OF MONROE, MICHIGAN
125 EAST SECOND STREET
MONROE, MI 48161

The proposed system will operate across the entire State of Michigan. Accordingly, coordination has been performed for the entire state of Michigan, Ohio, Indiana and all national carriers.

The COUNTY OF MONROE, MICHIGAN agrees to operate on a secondary basis to all fixed users and mobile users and furthermore on a first come first serve basis where applicable. Thus the entire 6425 - 6525, 8 Mhz band plan is requested. Specifically, center frequencies are 6430.0, 6438.0, 6446.0, 6455.0, 6463.0, 6471.0, 6480.0, 6488.0, 6496.0, 6505.0, 6513.0 and 6521.0 Mhz.

It is the responsibility of the licensee to negotiate use of a "home" or "exclusive" channel with the local coordinator, especially in Michigan. In the event that one can not be obtained coordination will be on a per use basis as needed. Only one 8 Mhz channel is required in each area.

Area	Name	Phone	E-mail
MICHIGAN			
Detroit	Russ Harbaugh	248-557-7274	rrharbaughj@aol.com
Grand Rapids/West	Dale Scholten	616-364-8722	dscholten@wxmi.com
Lansing/Central	Larry A. Estlack	517-484-7444	michmabtech@michmab.com
Southwest	Bob Henning	574-229-6280	rhenn15090@aol.com
Alternate	Melvin Dzialak	574-289-4611	mdzialak@nd.edu
OHIO			
Cleveland	Mike Szabo	216-344-3391	mszabo@ameritech.com
Columbus	Greg Savoldi	614-374-2485	None Listed
Eastern	Tom Hamilton	614-374-9647	None Listed
Mansfield Area	Wayne Flick	419-529-5900	waynef@wmfd.com

CONSOLIDATED SPECTRUM SERVICES

231 SAFLMORE ROAD
GILFORD, N.H. 03249
PHONE/FAX: (603) - 293- 0002
E-mail: Sales@FCC1.biz

EXHIBIT 2 - MICROWAVE PATH DATA

COMPANY: COUNTY OF MONROE, MICHIGAN
ROUTE NAME: AIR MOBILE, MI
COORDINATION NO. 11042009-5
PCN DATE 11/06/2009
Expedite Response by 11/26/2009

```
*****
*   TX   * ----- * RECEIVER *
*****
```

SITE NAME, STATE: AIR MOBILE TX, MI MOBILE RX, MI
PATH STATUS
CALL SIGN UNASSIGNED
AREA OF OPERATION STATE WIDE
GROUND ELEV (FT/MTRS-AMSL) VARIOUS VARIOUS
PATH AZIMUTH (DEGREES) VARIOUS VARIOUS
VARIOUS

ANTENNA TX/RX	BROADCAST MICROWAVE SRVCS	BROADCAST MICROWAVE SRVCS
MANUFACTURER		
MODEL	BMA-6-0	BMS-0-D-9L
GAIN (Dbi)	6.0	4.0
BEAMWIDTH VERTICAL (Degrees)	22.0	216.0 (RHCP)
BEAMWIDTH HORIZONTAL (Degrees)	360.0	216.0 (RHCP)
ANT CNTR LINE AGL (FEET/MTRS)	VARIOUS	20/6.1
	OR NO MORE THEN 6.1 METERS ABOVE FAA APPROVED	
	STRUCTURE IN BOTH CASES	

MANUFACTURER	BROADCAST MICROWAVE SRVCS	BROADCAST MICROWAVE SRVCS
MODEL:	CNVCCII-9L WITH CNVHCII-9 AMP	RX ONLY
EMISSION DESIGNATORS	8M00D7W	RX ONLY
LOADING	VIDEO/AUDIO	RX ONLY
MODULATION/TYPE	DIGITAL/CODFM	RX ONLY
DATA RATE (kpps)	21386	RX ONLY
STABILITY (%)	0.0003	RX ONLY
LINE LOSSES: (db)	1.0	1.0
TX POWER WITH AMP (DBM/W)	36.0/4.0	RX ONLY
EIRP (DBM/DBW/WATTS)	41.0/11.0/12.589	RX ONLY
RX CARRIER LEVEL (dbm)	****	VARIOUS
CENTER FREQUENCY (MHZ)	6430.0, 6438.0, 6446.0, V or H	
	6455.0, 6463.0, 6471.0, V or H	
	6480.0, 6488.0, 6496.0, V or H	
	6505.0, 6513.0, 6521.0, V or H	

EXHIBIT 3 - SUPPLEMENTAL SHOWING PER PART 101

COUNTY OF MONROE, MICHIGAN

SYSTEM DESCRIPTION

The proposed 6.5 Ghz microwave system consists of an air mobile transmitter with several mobile receivers and hand held receivers.

The area of operation, proposed, is over the whole State of Michigan.

The transmitters to be utilized is a BROADCAST MICROWAVE SERVICES CNVCCII-9L WITH CNVHCII-9 AMP.

The baseband loading is a digital television signal with an emission designator of 8M00D7W, 21.386 MB/S.

The system is non-redundant in that it does not employ hot-standby or frequency diversity switching equipment.

The system complies with the requirements set forth in FCC rule part 101.

STATEMENT OF USE

The proposed, will be used by the for traffic monitoring, health, welfare and safety issues as well as to monitor critical infrastructure.

STATEMENT OF QUALIFICATION

The COUNTY OF MONROE, MICHIGAN is qualified to use the 6.5 Ghz band per FCC rule part 90.20 as a local government agency.

Microwave Path Data Sheet
COMSEARCH

Page 1 of 2

19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)726-5706 www.comsearch.com

PCN Date: 08/14/2006
Job Number: 060814COMSRP01

Previous PCN Date: 08/11/2006
RCN Number: 06081438

Administrative Information	MT WOODSON CA	MT WHITNEY CA
City/County	/San Diego	/San Diego
Status / License Basis	Engineering Proposal / PRIMARY OPERATION	Engineering Proposal / PRIMARY OPERATION
Call Sign		
Licensee Code	COXINC	COXINC
Licensee Name	Coxcom, Inc	Coxcom, Inc
Radio Service / Station Class	MG - Microwave Industrial/Business Pool	FXO -- Fixed

Site Information		
Latitude (NAD 83)	33 ° 0' 31.2" N	33 ° 6' 32.1" N
Longitude (NAD 83)	116 ° 58' 15.1" W	117 ° 9' 19.1" W
Ground Elevation (m/ft-AMSL)	877.00 / 2877.3	482.20 / 1582.0
Antenna Structure Registration #		
Path Azimuth (°)	302.889	122.789
Path Length (km / miles)	20.502 / 12.739	

Transmit Antenna	<u>43010C</u>	<u>43010C</u>
Manufacturer	RADIO FREQUENCY SYSTEMS	RADIO FREQUENCY SYSTEMS
Model	<u>DA6-59A</u>	<u>DA6-59A</u>
Gain (dBi) / Beamwidth (°) / Tilt (°)	<u>39.0 / 1.90 / -1.19</u>	<u>39.0 / 1.90 / 1.05</u>
Centerline (m / ft - AGL)	19.80 / 65.0	15.20 / 49.9

Receive Antenna	Same As Transmit
Manufacturer	
Model	
Gain (dBi) / Beamwidth (°)	
Centerline (m / ft - AGL)	

Diversity Receive Antenna
Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Radio Information	TEMH67	TEMH67
Manufacturer	DMC STRATEX NETWORKS	DMC STRATEX NETWORKS
Model	EC0H06032008T103	EC0H06032008T103
Model Description	ECLIPSE 8DS1 (32 QAM)	ECLIPSE 8DS1 (32 QAM)
Emission Designator / Modulation	3M75D7W 32 QAM	3M75D7W 32 QAM
Loading	192 CH DIG 14000.000	192 CH DIG 14000.000
Stability (%)	0.001	0.001
	Nominal Coordinated Maximum	Nominal Coordinated Maximum
Power (dBm)	24.0	24.0
Received Level (dBm)	<u>-38.5</u>	<u>-32.5</u>
EIRP (dBm)	<u>63.0</u>	<u>57.0</u>
Fixed Loss: Tx / Common (dB)	0.0 / 0.0	<u>6.0</u> / 0.0
Free Space Loss (dB)		134.5

Transmit Frequencies (MHz)	6402.9370V(9)	6150.8970V(9)
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Microwave Path Data Sheet
COMSEARCH

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19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)726-5706 www.comsearch.com

PCN Date: 08/14/2006
Job Number 060814COMSRP01

Previous PCN Date: 08/11/2006
RCN Number: 06081438

Administrative Information	COX DISPATCH CA	SAN MIGUEL CA
City/County	San Diego/San Diego	/San Diego
Status / License Basis	Engineering Proposal / PRIMARY OPERATION	Engineering Proposal / PRIMARY OPERATION
Call Sign		
Licensee Code	COXINC	COXINC
Licensee Name	Coxcom, Inc	Coxcom, Inc
Radio Service / Station Class	MG -- Microwave Industrial/Business Pool	FXO -- Fixed

Site Information		
Latitude (NAD 83)	32 ° 43' 16.9" N	32 ° 41' 47.0" N
Longitude (NAD 83)	117 ° 5' 1.0" W	116 ° 56' 6.0" W
Ground Elevation (m/ft-AMSL)	70.00 / 229.7	746.50 / 2449.1
Antenna Structure Registration #		
Path Azimuth (°)	101.201	281.281
Path Length (km / miles)	14.206 / 8.827	

Transmit Antenna	C00460	74107C
Manufacturer	RADIO FREQUENCY SYSTEMS	RADIO FREQUENCY SYSTEMS
Model	DA4-107A	UA4-107A
Gain (dBi) / Beamwidth (°) / Tilt (°)	40.5 / 1.60 / 2.72	40.5 / 1.50 / -2.81
Centerline (m / ft - AGL)	6.00 / 19.7	15.20 / 49.9

Receive Antenna	Same As Transmit
Manufacturer	
Model	
Gain (dBi) / Beamwidth (°)	
Centerline (m / ft - AGL)	

Diversity Receive Antenna	
Manufacturer	
Model	
Gain (dBi) / Beamwidth (°)	
Centerline (m / ft - AGL)	

Radio Information	TEMJ67	TEMJ67
Manufacturer	DMC STRATEX NETWORKS	DMC STRATEX NETWORKS
Model	ECLIPSE CONNECT ES	ECLIPSE CONNECT ES
Model Description	CONNECT 100	CONNECT 100
Emission Designator / Modulation	30M0D7W 32 QAM	30M0D7W 32 QAM
Loading	1 CH DIG 108000.000	1 CH DIG 108000.000
Stability (%)	0.001	0.001
	Nominal Coordinated Maximum	Nominal Coordinated Maximum
Power (dBm)	18.5	18.5
Received Level (dBm)	-37.0	-37.0
EIRP (dBm)	59.0	59.0
Fixed Loss: Tx / Common (dB)	0.0 / 0.0	0.0 / 0.0
Free Space Loss (dB)		136.5

Transmit Frequencies (MHz)	11405.0000H(6)	10915.0000H(6)
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19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(571)246-3097 www.comsearch.com

Prev Job Num: 010904TI01
RCN Number: 12071801

NM3-CERRO NM

/VALENCIA
Engineering Proposal / PRIMARY OPERATION
WPTP455
NMRSA3
New Mexico RSA #3 Limited Partnersh
FXO — Fixed

34 °47' 51.4 " N
106 °49' 12.5 " W
1657.73 / 5438.7
1005473
34.764

1666KA
Commscope
UHX10-59K RF
43.2 / 1.10 / -0.15
49.99 / 164.0

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft – AGL)

1653JA
Commscope
UHX8-59J RF
41.3 / 1.40
27.13 / 89.0

TEMX95

Alcatel-Lucent USA, Inc.

MDR-8606-135

MDR-8000

30M0D7W 64 QAM

2016CH DIG 138800.000

0.001

Nominal	Coordinated	Maximum
	29.0	
	-32.8	
	69.2	

0.0 / 3.0

6226.8900V(22T)

Microwave Path Data Sheet

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COMSEARCH19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(571)246-3097 www.comsearch.com

PCN Date: 07/18/2012

Job Number 120718COMSFB02

Prev Job Num: 070223COMSAN01

RCN Number: 12071801

Administrative Information**NM3-CERRO NM****ABQBEARCNYN NM**City/County /VALENCIA
Status / License Basis Engineering Proposal / PRIMARY OPERATION
Call Sign WPTP455
Licensee Code NMRSA3
Licensee Name New Mexico RSA #3 Limited Partnersh
Radio Service / Station Class CF -- Point-to-Point Microwave, Common CarrierAlbuquerque/BERNALILLO
Engineering Proposal / PRIMARY OPERATION
WLS520
COCONI
Verizon Wireless(VAW) LLC-AZ/CO/NM/
FXO -- Fixed**Site Information**Latitude (NAD 83) 34 °47' 51.4 " N
Longitude (NAD 83) 106 °49' 12.5 " W
Ground Elevation (m/ft-AMSL) 1657.73 / 5438.7
Antenna Structure Registration # 1005473
Path Azimuth (°) 34.764
Path Length (km / miles) 45.615 / 28.34435 °8' 6.2" N
106 °32' 5.1" W
1694.70 / 5560.0
214.928**Transmit Antenna**1666KA
Commscope
Model UHX10-59K RF
Gain(dBi) / Beamwidth(°) / Tilt(°) 43.2 / 1.10 / -0.15
Centerline (m / ft - AGL) 49.99 / 164.0A64302
Commscope
HDX8-59 R MAIN
41.5 / 1.40 / -0.16
18.90 / 62.0**Receive Antenna**

Same As Transmit

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)**Diversity Receive Antenna**1653JA
Commscope
Model UHX8-59J RF
Gain (dBi) / Beamwidth (°) 41.3 / 1.40
Centerline (m / ft - AGL) 27.13 / 89.0A64303
Commscope
HDX8-59 R DIV
41.5 / 1.40
18.90 / 62.0**Radio Information**TEMX95
Alcatel-Lucent USA, Inc.
Model MDR-8606-135
Model Description MDR-8000
Emission Designator / Modulation 30M0D7W 64 QAM
Loading 2016CH DIG 138800.000
Stability (%) 0.001
Nominal Coordinated Maximum
Power (dBm) 29.0
Received Level (dBm) -32.8
EIRP (dBm) 69.2TEMX95
Alcatel-Lucent USA, Inc.
MDR-8606-135
MDR-8000
30M0D7W 64 QAM
2016CH DIG 138800.000
0.001
Nominal Coordinated Maximum
29.0
-32.8
68.5Fixed Loss: Tx / Common (dB) 0.0 / 3.0
Free Space Loss (dB) 141.5

0.0 / 2.0

Transmit Frequencies (MHz) 6286.1900V(24T)

6034.1500V(14T)

Microwave Path Data Sheet
COMSEARCH

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19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)726-5706 www.comsearch.com

PCN Date: 08/22/2008

Job Number: 080822COMSRP02

New Path

RCN Number: 08082223

Administrative Information MM TX

City/County El Paso/El Paso
Status / License Basis Engineering Proposal / PRIMARY OPERATION
Call Sign
Licensee Code BORPAR
Licensee Name Bordercomm Partners LP
Radio Service / Station Class CF -- Point-to-Point Microwave, Common Carrier

GALERIAS VID MX

/
Engineering Proposal / PRIMARY OPERATION
BORPAR
Bordercomm Partners LP
FXO -- Fixed

Site Information

Latitude (NAD 83)	31 ° 48' 18.9" N	31 ° 42' 56.1" N
Longitude (NAD 83)	106 ° 29' 0.8" W	106 ° 25' 18.7" W
Ground Elevation (m/ft-AMSL)	1708.40 / 5605.0	1138.00 / 3733.6
Antenna Structure Registration #	1202400	
Path Azimuth (°)	149.533	329.565
Path Length (km / miles)	11.533 / 7.166	

Transmit Antenna

83511A	83511A
Manufacturer	ANDREW CORPORATION
Model	VHLP4-220
Gain (dBi) / Beamwidth (°) / Tilt (°)	46.0 / 0.70 / -2.87
Centerline (m / ft - AGL)	12.00 / 39.4

Receive Antenna

Same As Transmit

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Diversity Receive Antenna

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Radio Information

TEMG63	TEMG63
Manufacturer	NEC AMERICA
Model	PASOLINK 4MB-23 GHZ
Model Description	
Emission Designator / Modulation	3M50G9W 4 PSK
Loading	60 CH DIG 4096.000
Stability (%)	0.0005
	Nominal Coordinated Maximum
Power (dBm)	23.0
Received Level (dBm)	-30.2
EIRP (dBm)	66.7
Fixed Loss: Tx / Common (dB)	0.0 / 2.3
Free Space Loss (dB)	140.6

Transmit Frequencies (MHz) 21589.7500V

22821.7500V

Microwave Path Data Sheet
COMSEARCH

Page 2 of 3

19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)726-5706 www.comsearch.com

PCN Date: 08/22/2008
Job Number 080822COMSRP02

New Path
RCN Number: 08082223

Administrative Information

City/County Hidalgo/Hidalgo
Status / License Basis Engineering Proposal / PRIMARY OPERATION
Call Sign WQIX232
Licensee Code BORPAR
Licensee Name Bordercomm Partners LP
Radio Service / Station Class CF -- Point-to-Point Microwave, Common Carrier

899-1 MX

/
Engineering Proposal / PRIMARY OPERATION

BORPAR
Bordercomm Partners LP
FXO -- Fixed

Site Information

Latitude (NAD 83) 26 ° 6' 19.0" N
Longitude (NAD 83) 98 ° 15' 23.0" W
Ground Elevation (m/ft-AMSL) 32.00 / 105.0
Antenna Structure Registration # 1250752
Path Azimuth (°) 239.486
Path Length (km / miles) 4.284 / 2.662

26 ° 5' 8.3" N
98 ° 17' 35.8" W
37.00 / 121.4

59.470

Transmit Antenna

83511A
Manufacturer ANDREW CORPORATION
Model VHLP4-220
Gain (dBi) / Beamwidth (°) / Tilt (°) 46.0 / 0.70 / 0.07
Centerline (m / ft - AGL) 19.36 / 63.5

90818A
ANDREW CORPORATION
VHLP2.5-220
42.6 / 1.20 / -0.10
20.85 / 68.4

Receive Antenna

Same As Transmit

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Diversity Receive Antenna

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Radio Information

TEMJ07
Manufacturer NEC AMERICA
Model PASOLINK PLUS 155 MB 128 QAM
Model Description PASOLINK + 23 GHz
Emission Designator / Modulation 28M0W7DDT 128 QAM
Loading 2016CH DIG 155000.000
Stability (%) 0.0005

	Nominal	Coordinated	Maximum
Power (dBm)		15.0	
Received Level (dBm)		-36.4	
EIRP (dBm)		57.0	

Fixed Loss: Tx / Common (dB) 0.0 / 4.0
Free Space Loss (dB) 132.0

TEMJ07
NEC AMERICA
PASOLINK PLUS 155 MB 128 QAM
PASOLINK + 23 GHz
28M0W7DDT 128 QAM
2016CH DIG 155000.000
0.0005

	Nominal	Coordinated	Maximum
		15.0	
		-36.4	
		53.6	

Transmit Frequencies (MHz) 21605.5000H

22837.5000H

Microwave Path Data Sheet
COMSEARCH

Page 3 of 3

19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)726-5706 www.comsearch.com

PCN Date: 08/22/2008
Job Number 080822COMSRP02

New Path
RCN Number: 08082223

Administrative Information

KNOG AZ

631-1 MX

City/County Nogales/Santa Cruz
Status / License Basis Engineering Proposal / PRIMARY OPERATION
Call Sign WQIV401
Licensee Code BORPAR
Licensee Name Bordercomm Partners LP
Radio Service / Station Class CF -- Point-to-Point Microwave, Common Carrier

/
Engineering Proposal / PRIMARY OPERATION
BORPAR
Bordercomm Partners LP
FXO -- Fixed

Site Information

Latitude (NAD 83) 31 ° 21' 9.0" N
Longitude (NAD 83) 110 ° 53' 56.0" W
Ground Elevation (m/ft-AMSL) 1162.00 / 3812.3
Antenna Structure Registration # 1002547
Path Azimuth (°) 214.451
Path Length (km / miles) 4.997 / 3.105

31 ° 18' 55.2" N
110 ° 55' 42.9" W
1398.41 / 4588.0
34.435

Transmit Antenna

90818A
ANDREW CORPORATION
VHLP2.5-220
Gain (dBi) / Beamwidth (°) / Tilt (°) 42.6 / 1.20 / 2.69
Centerline (m / ft - AGL) 5.00 / 16.4

84106A
ANDREW CORPORATION
VHLP2-220
40.1 / 1.60 / -2.73
5.00 / 16.4

Receive Antenna

Same As Transmit

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Diversity Receive Antenna

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Radio Information

TEMP74
NEC AMERICA
PASOLINK NEO 23 GHz
PASOLINK NEO 155 MB 128 QAM
Emission Designator / Modulation 28M0D 128 QAM
Loading 2016CH DIG 155000.000
Stability (%) 0.0006
Nominal Coordinated Maximum
Power (dBm) 19.0
Received Level (dBm) -57.6
EIRP (dBm) 36.1
Fixed Loss: Tx / Common (dB) 25.0 / 0.5
Free Space Loss (dB) 133.3

TEMP74
NEC AMERICA
PASOLINK NEO 23 GHz
PASOLINK NEO 155 MB 128 QAM
Emission Designator / Modulation 28M0D 128 QAM
Loading 2016CH DIG 155000.000
Stability (%) 0.0006
Nominal Coordinated Maximum
Power (dBm) 19.0
Received Level (dBm) -57.6
EIRP (dBm) 33.6
Fixed Loss: Tx / Common (dB) 25.0 / 0.5

Transmit Frequencies (MHz) 22837.5000V

21605.5000V

	xB	xS
Latitude	05 29 07.04 S	05 13 18.64 S
Longitude	119 51 51.49 E	120 04 24.25 E
True azimuth (°)	38.51	218.49
Vertical angle (°)	6.80	6.12
Elevation (m)	543.33	433.37
Antenna model	HP12-122E (TR)	HP12-122E (TR)
Antenna file name	3272	3272
Antenna gain (dBi)	50.90	50.90
Antenna height (m)	48.00	49.00
TX line model	EWP127A	EWP127A
TX line unit loss (dB/100 m)	11.49	11.49
TX line length (m)	58.00	59.00
TX line loss (dB)	6.67	6.78
Connector loss (dB)	0.50	0.50
Frequency (MHz)	13000.00	
Polarization	Vertical	
Path length (km)	37.23	
Free space loss (dB)	146.16	
Atmospheric absorption loss (dB)	0.76	
Net path loss (dB)	59.57	59.57
Radio model	MicroStar M/H 13 I	MicroStar M/H 13 I
Radio file name	micmh13_2e1_k1	micmh13_2e1_k1
TX power (dBm)	21.00	21.00
EIRP (dBm)	64.73	64.62
TX channel assignments	128l 12974.125V	128h 13199.875V
RX threshold criteria	1E-3 BER	1E-3 BER
RX threshold level (dBm)	-93.00	-93.00
Receive signal (dBm)	-38.57	-38.57
Thermal fade margin (dB)	54.43	54.43
Dispersive fade margin (dB)	60.00	60.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	53.37	53.37
Terrain roughness (m)	42.67	
Average annual temperature (°C)	10.00	
Fade occurrence factor (Po)		
Polarization	Vertical	
0.01% rain rate (mm/hr)	91.45	
Flat fade margin - rain (dB)	54.43	
Rain attenuation (dB)	54.43	
Annual rain availability (%)	100.00000	
Annual rain unavailability (min)	0.00	

	xBantaeng	Repeater
Latitude	05 29 07.04 S	05 21 21.08 S
Longitude	119 51 51.49 E	119 56 13.83 E
True azimuth (°)	29.44	209.43
Vertical angle (°)	7.73	3.41
Elevation (m)	543.33	2806.64
Antenna model	HP12-122E (TR)	HP12-122E (TR)
Antenna file name	3272	3272
Antenna gain (dBi)	50.90	50.90
Antenna height (m)	48.00	6.00
TX line model	EWP127A	EWP127A
TX line unit loss (dB/100 m)	11.49	11.49
TX line length (m)	58.00	16.00
TX line loss (dB)	6.67	1.84
Connector loss (dB)	0.50	0.50
Frequency (MHz)		13000.00
Polarization		Vertical
Path length (km)		16.59
Free space loss (dB)		139.14
Atmospheric absorption loss (dB)		0.34
Net path loss (dB)	47.18	47.18
Radio model	MicroStar M/H 13 I	MicroStar M/H
13 I		
Radio file name	micmh13_2e1_k1	micmh13_2e1_k1
TX power (dBm)	21.00	21.00
EIRP (dBm)	64.73	69.56
TX channel assignments	128h 13199.875V	128l 12974.125V
RX threshold criteria	1E-3 BER	1E-3 BER
RX threshold level (dBm)	-93.00	-93.00
Receive signal (dBm)	-26.18	-26.18
Thermal fade margin (dB)	66.82	66.82
Dispersive fade margin (dB)	60.00	60.00
Dispersive fade occurrence factor		1.00
Effective fade margin (dB)	59.18	59.18
C factor		4.00
Average annual temperature (°C)		10.00
Fade occurrence factor (Po)		1.423E-001
Worst month multipath availability (%)	99.99998	99.99998
Worst month multipath unavailability (sec)	0.45	0.45
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	1.36	1.36
Annual 2 way multipath availability (%)		99.99999
Annual 2 way multipath unavailability (sec)		2.71
Polarization		Vertical
0.01% rain rate (mm/hr)		92.35
Flat fade margin - rain (dB)		66.82
Rain attenuation (dB)		66.82
Annual rain availability (%)		100.00000

Annual rain unavailability (min)	0.00
Annual rain + multipath availability (%)	99.99999
Annual rain + multipath unavailability (min)	0.05

	xSinjai	xBantaeng
Latitude	05 13 18.64 S	05 29 07.40 S
Longitude	120 04 24.25 E	119 51 51.49 E
True azimuth (°)	225.53	29.42
Vertical angle (°)	6.21	7.72
Elevation (m)	433.37	545.55
Antenna model	HP12-122E (TR)	HP12-122E (TR)
Antenna file name	a3272	a3272
Antenna gain (dBi)	50.90	50.90
Antenna height (m)	49.00	48.00
TX line model	EWP127A	EWP127A
TX line unit loss (dB/100 m)	11.49	11.49
TX line length (m)	58.00	58.00
TX line loss (dB)	6.67	6.67
Connector loss (dB)	0.50	0.50
Frequency (MHz)		13000.00
Polarization		Vertical
Path length (km)		37.60
Free space loss (dB)		280.46
Passive gain (dB)		101.24
Atmospheric absorption loss (dB)		0.77
Net path loss (dB)	92.52	92.52
Radio model	MicroStar M/H 13 I	MicroStar M/H
13 I		
Radio file name	micmh13_2e1_k1	micmh13_2e1_k1
TX power (dBm)	21.00	21.00
EIRP (dBm)	64.73	64.73
TX channel assignments	128l 12974.125V 128h	13199.875V
RX threshold criteria	1E-3 BER	1E-3 BER
RX threshold level (dBm)	-93.00	-93.00
Receive signal (dBm)	-71.52	-71.52
Thermal fade margin (dB)	21.48	21.48
Dispersive fade margin (dB)	60.00	60.00
Dispersive fade occurrence factor		1.00
Effective fade margin (dB)	21.48	21.48
Climatic factor		2.00
Terrain roughness (m)		42.67
C factor		0.52
Average annual temperature (°C)		10.00
Fade occurrence factor (Po)		5.816E-002
Worst month multipath availability (%)	99.95866	99.95866
Worst month multipath unavailability (sec)	1086.45	1086.45
Annual multipath availability (%)	99.98966	99.98966
Annual multipath unavailability (sec)	3259.36	3259.36
Annual 2 way multipath availability (%)		99.97933
Annual 2 way multipath unavailability (sec)		6518.72
Polarization		Vertical
0.01% rain rate (mm/hr)		91.45

13
 13
 13

Flat fade margin - rain (dB)	21.48
Rain attenuation (dB)	21.48
Annual rain availability (%)	99.97240
Annual rain unavailability (min)	145.08
Annual rain + multipath availability (%)	99.95173
Annual rain + multipath unavailability (min)	253.72

Back to back antennas - 21.16 km

	Repeater	
Latitude	05 21 21.08 S	
Longitude	119 56 13.83 E	
Elevation (m)	2806.64	
Frequency (MHz)	13000.00	
Adjacent station	xSinjai	xBantaeng
Latitude	05 13 18.64 S	05 29 07.40 S
Longitude	120 04 24.25 E	119 51 51.49 E
Elevation (m)	433.37	545.55
Antenna diameter (m)	3.66	3.66
Passive azimuth (°)	45.54	209.41
Vertical angle (°)	-6.36	3.39
Distance (km)	21.16	16.44
Antenna model	HP12-122E	HP12-122E
Antenna height (m)	50.90	50.90
Radome loss (dB)	a3272	a3272
Antenna file name	6.00	6.00
TX line model	EWP127A	
TX line length (m)	0.50	
TX line unit loss (dB /100 m)	11.49	
TX line loss (dB)	0.06	
Connector loss (dB)	0.50	
Passive gain (dB)	101.24	
	xSinjai	xBantaeng
Latitude	05 13 18.64 S	05 29 07.40 S
Longitude	120 04 24.25 E	119 51 51.49 E
True azimuth (°)	225.53	29.42
Vertical angle (°)	6.22	7.72
Elevation (m)	433.37	545.55
Antenna model	HP12-122E (TR)	HP12-122E (TR)
Antenna file name	a3272	a3272
Antenna gain (dBi)	50.90	50.90
Antenna height (m)	48.00	49.00
TX line model	EWP127A	EWP127A
TX line unit loss (dB/100 m)	11.49	11.49
TX line length (m)	58.00	59.00
TX line loss (dB)	6.67	6.78
Connector loss (dB)	0.50	0.50
Frequency (MHz)	13000.00	
Polarization	Vertical	
Path length (km)	37.60	
Free space loss (dB)	280.46	
Passive gain (dB)	103.82	

	Atmospheric absorption loss (dB)	0.77	
	Net path loss (dB)	90.06	90.06
	Radio model	MicroStar M/H 13 I	MicroStar M/H
13 I	Radio file name	micmh13_2e1_k1	micmh13_2e1_k1
	TX power (dBm)	21.00	21.00
	EIRP (dBm)	64.73	64.62
	TX channel assignments	128l 12974.125V 128h	13199.875V
	RX threshold criteria	1E-3 BER	1E-3 BER
	RX threshold level (dBm)	-93.00	-93.00
	Receive signal (dBm)	-69.06	-69.06
	Thermal fade margin (dB)	23.94	23.94
	Dispersive fade margin (dB)	60.00	60.00
	Dispersive fade occurrence factor	1.00	
	Effective fade margin (dB)	23.94	23.94
	C factor	4.00	
	Average annual temperature (°C)	10.00	
	Fade occurrence factor (Po)	4.436E-001	
	Worst month multipath availability (%)	99.82100	99.82100
	Worst month multipath unavailability (sec)	4704.09	4704.09
	Annual multipath availability (%)	99.95525	99.95525
	Annual multipath unavailability (sec)	14112.26	14112.26
	Annual 2 way multipath availability (%)	99.91050	
	Annual 2 way multipath unavailability (sec)	28224.51	
	Polarization	Vertical	
	0.01% rain rate (mm/hr)	91.45	
	Flat fade margin - rain (dB)	23.94	
	Rain attenuation (dB)	23.94	
	Annual rain availability (%)	99.97887	-
	Annual rain unavailability (min)	111.05	-
	Annual rain + multipath availability (%)	99.88937	
	Annual rain + multipath unavailability (min)	581.45	-

$$\begin{array}{r}
 581.45 \\
 - 111.05 \\
 \hline
 470
 \end{array}$$

$\times 3$
 235 min

470 min

Double rectangular passive - 21.16 km

	Repeater	
Latitude	05 21 21.08 S	
Longitude	119 56 13.83 E	
Elevation (m)	2806.64	
Frequency (MHz)	13000.00	
Adjacent station	xSinjai	xBantaeng
Latitude	05 13 18.64 S	05 29 07.40 S
Longitude	120 04 24.25 E	119 51 51.49 E
Elevation (m)	433.37	545.55
Antenna diameter (m)	3.66	3.66
Passive azimuth (°)	45.54	209.41
Vertical angle (°)	-6.36	3.39
Distance (km)	21.16	16.44
Included angle (°)	5.00	5.00
Face angle (°)	-3.18	1.70
Passive height (m)	3.04	3.04
Passive width (m)	2.43	2.43
Passive center height (m)	6.00	6.00
Effective area (m ²)	7.37	7.38
Distance between passives (m)		3.50
Inverse K ²		0.02
a over b		1.00
Close coupling loss (dB)		-1.00
Far field gain (dB)		104.82
Inverse K	52.01	40.42
Passive gain (dB)		103.82

Table 2. Designed Link Budget of 16E1-16QAM Modulation Scheme

Parameter	Site 1	Site 2
Elevation (m)	371.00	373.00
Latitude	07 18 00.00 N	07 18 00.00 N
Longitude	005 08 00.00 E	005 09 00.00 E
True azimuth ($^{\circ}$)	63.40	243.40
Vertical angle ($^{\circ}$)	-0.04	0.02
Antenna model	VHP4-71	VHP4-71
Antenna height (m)	22.32	19.21
Antenna gain (dBi)	36.40	36.40
TX line type	EWP77	EWP77
TX line length (m)	100.00	100.00
TX line unit loss (dB/100 m)	6.13	6.13
TX line loss (dB)	6.13	6.13
Frequency (MHz)	7200.00	7200.00
Polarization	Horizontal	Horizontal
Path length (km)	2.06	2.06
Free space loss (dB)	115.88	115.88
Atmospheric Absorption loss (dB)	0.02	0.02
Net path loss (dB)	55.36	55.36
Radio model	AMT/07/16E1/14M	AMT/07/16E1/14M
TX power (watts)	0.13	0.13
TX power (dBm)	21.00	21.00
EIRP (dBm)	51.27	51.27
Emission designator	14MOD7W	14MOD7W
TX Channels	4h 7310.0000H 41 7149.0000H	4h 7310.0000H 41 7149.0000H
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-78.50	-78.50
RX signal (dBm)	-34.36	-34.36
Thermal fade margin (dB)	44.14	44.14
Dispersive fade margin (dB)	52.00	52.00
Dispersive fade occurrence factor	1.00	1.00
Effective fade margin (dB)	43.48	43.48
Geoclimatic factor	1.98E-04	1.98E-04
Path inclination (mr)	0.54	0.54
Fade occurrence factor (Po)	8.46E-05	8.46E-05
Average annual temperature ($^{\circ}$ C)	24.00	24.00
Worst month - multipath (%)	100.00000	100.00000
(sec)	9.98E-03	9.98E-03
Annual - multipath (%)	100.00000	100.00000
(sec)	0.04	0.04
(% - sec)	100.00000 - 0.09	100.00000 - 0.09
Rain region	ITU Region F	ITU Region F
0.01% rain rate (min/hr)	28.00	28.00
Flat fade margin - rain (dB)	44.14	44.14
Rain rate (mm/hr)	8268.82	8268.82
Rain attenuation (dB)	44.14	44.14
Annual rain (%-sec)	100.00000 - 0.00	100.00000 - 0.00
Annual multipath + rain (%-sec)	100.00000 - 0.09	100.00000 - 0.09

futa sites_16QAM.p14

Reliability Method - ITU-R P.530-7/8

Rain - ITU-R P530-7

Table 3. Designed Link Budget of 16E1-QPSK Modulation Scheme

Parameter	Site 1	Site 2
Elevation (m)	371.00	373.00
Latitude	07 18 00.00 N	07 18 00.00 N
Longitude	005 08 00.00 E	005 09 00.00 E
True azimuth ($^{\circ}$)	63.40	243.40
Vertical angle ($^{\circ}$)	-0.04	0.02
Antenna model	VHP4-71	VHP4-71
Antenna height (m)	22.32	19.21
Antenna gain (dBi)	36.40	36.40
TX line type	EWP77	EWP77
TX line length (m)	100.00	100.00
TX line unit loss (dB/100 m)	6.13	6.13
TX line loss (dB)	6.13	6.13
Frequency (MHz)	7200.00	7200.00
Polarization	Horizontal	Horizontal
Path length (km)	2.06	2.06
Free space loss (dB)	115.88	115.88
Atmospheric Absorption loss (dB)	0.02	0.02
Net path loss (dB)	55.36	55.36
Radio model	AMT/07/16E1/28M	AMT/07/16E1/28M
TX power (watts)	0.32	0.32
TX power (dBm)	25.00	25.00
EIRP (dBm)	55.27	55.27
Emission designator	28MOG7W	28MOG7W
TX Channels	4h 7310.0000H 41 7149.0000H	4h 7149.0000H 4h 7310.0000H
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-82.50	-82.50
RX signal (dBm)	-30.36	-30.36
Thermal fade margin (dB)	52.14	52.14
Dispersive fade margin (dB)	49.00	49.00
Dispersive fade occurrence factor	1.00	1.00
Effective fade margin (dB)	47.28	47.28
Geoclimatic factor	1.98E-04	1.98E-04
Path inclination (mr)	0.54	0.54
Fade occurrence factor (Po)	8.46E-05	8.46E-05
Average annual temperature ($^{\circ}$ C)	24.00	24.00
Worst month - multipath (%)	100.00000	100.00000
(sec)	4.16E-03	4.16E-03
Annual - multipath (%)	100.00000	100.00000
(sec)	0.02	0.02
(% - sec)	100.00000 - 0.04	100.00000 - 0.04
Rain region	ITU Region F	ITU Region F
0.01% rain rate (min/hr)	28.00	28.00
Flat fade margin - rain (dB)	52.14	52.14
Rain rate (mm/hr)	9844.15	9844.15
Rain attenuation (dB)	52.14	52.14
Annual rain (%-sec)	100.00000 - 0.00	100.00000 - 0.00
Annual multipath + rain (%-sec)	100.00000 - 0.04	100.00000 - 0.04

futa sites_QPSK.p14

Reliability Method - ITU-R P.530-7/8

Rain - ITU-R P530-7

5. Conclusion

This paper presents microwave transmission model employed in simulating the effects of different constellation sizes and the SNR on the implementation of adaptive modulation scheme. The symbol rate of 50 MHz and transmit frequency of 5.29 GHz are employed in the analysis. In addition, the paper presents designs for transmission link on FUTA path terrain in which the effect of using different modulation schemes are analyzed. The results obtained show that implementation of adaptive modulation scheme offers better performance with regard to system availability as well as spectral efficiency. Furthermore, the overall result of this study has shown clearly that adaptive modulation scheme as a technology that adapts and adjusts transmission parameters in real-time based on the link quality is the appropriate solution to both the problems of channel impairments and bandwidth in wireless communication.



Path Data Sheet

812 Lexington Dr
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epcn@micronetcom.com

File: M1811330 - 1

Updated PCN Major - Date: May 30, 2018

Site Name, State			Ester Dome, AK			Murphy Dome, AK						
Call Sign / Status			/ License			/ License						
Company Name(s):			Alaska Railroad Corporation			Alaska Railroad Corporation						
FRN / Radio Service			0001573419 / MG			0001573419 / MG						
City / County			Fairbanks / Fairbanks North			FAIRBANKS / Fairbanks North						
Latitude	N(NAD 83)		64 52 30.4			64 57 35.8						
Longitude	W(NAD 83)		148 03 57.8			148 13 53.4						
Azimuth	(degrees)		320.5			140.3						
Elevation	AMSL(ft/m)		<u>2364.5 / 720.7</u>			<u>2065.9 / 629.7</u>						
ASR#												
Distance	(miles/km)		7.63 / 12.28									
Transmit Receive Antenna			COMMSCOPE			COMMSCOPE						
Antenna Model			HP4-107B			HP4-107B						
Gain / Beamwidth	(dBi/deg)		40.4 / 1.6			40.4 / 1.6						
Antenna Height	AGL(ft/m)		35.0 / 10.7			73.0 / 22.3						
Tilt	(degrees)		-0.412			0.329						
Equipment			NOKIA			NOKIA						
Equipment Model			WVCE11-L(2)-1024F40S-294 HP			WVCE11-L(2)-1024F40S-294 HP						
Stability	(%)		0.001			0.001						
ATPC / Trigger Level	(dBm)		No			No						
Fixed Losses Cm,Tx,Rx	(dB)		7.3,0.0,0.0			7.8,0.0,0.0						
Transmit Frequencies (MHz)			11465V			10975V						
Emissions			Ester Dome, AK			Murphy Dome, AK						
Mod/Lvl	Designator	Traffic (kbps)	Tx Power (dBm)			EIRP (dBm)	Rx Lvl (dBm)	Tx Power (dBm)		EIRP (dBm)	Rx Lvl (dBm)	
			nom	crd	max			nom	crd	max		
QAM/1024	40M0D7W	294000		29.0		62.1	-40.5		29.0		61.6	-40.5



Path Data Sheet

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File: W1811330 - 1

Updated PCN Major - Date: May 30, 2018

Site Name, State		AKRR Fairbanks WT, AK	Murphy Dome, AK
Call Sign / Status		WQHN788 / License	/ License
Company Name(s):		Alaska Railroad Corporation	Alaska Railroad Corporation
FRN / Radio Service		0001573419 / MG	0001573419 / MG
City / County		Fairbanks / Fairbanks North	FAIRBANKS / Fairbanks North
Latitude	N(NAD 83)	64 50 53.9	64 57 35.8
Longitude	W(NAD 83)	147 44 38.3	148 13 53.4
Azimuth	(degrees)	298.6	118.1
Elevation	AMSL(ft/m)	433.1 / 132.0	<u>2065.9 / 629.7</u>
ASR#			
Distance	(miles/km)	16.3 / 26.23	

Transmit Receive Antenna		COMMSCOPE	COMMSCOPE
Antenna Model		HP6-59WC	HP8-59WA
Gain / Beamwidth	(dBi/deg)	39.4 / 1.8	41.9 / 1.4
Antenna Height	AGL(ft/m)	105.0 / 32.0	92.0 / 28.0
Tilt	(degrees)	0.99	-1.167

Equipment		NOKIA	NOKIA
Equipment Model		WVCE61-L(1)-512A30S-206 SP	WVCE61-L(1)-512A30S-206 SP
Stability	(%)	0.001	0.001
ATPC / Trigger Level	(dBm)	No	No
Fixed Losses Cm,Tx,Rx	(dB)	6.5,0.0,0.0	5.8,0.0,0.0

Transmit Frequencies (MHz)	6123.1V	6375.14V
----------------------------	---------	----------

Emissions			AKRR Fairbanks WT, AK			Murphy Dome, AK		
Mod/Lvl	Designator	Traffic (kbps)	Tx Power (dBm)			Tx Power (dBm)		
			nom	crd	max	nom	crd	max
QAM/512	30M0D7W	206000	30.5			30.5		
					63.4			66.6
					-37.2			-37.2

PATH CALCULATIONS - Appendix A

Utilizing diplexer filters

	Ester Dome	Murphy Dome
Latitude	64 52 33.10 N	64 57 35.70 N
Longitude	148 04 04.40 W	148 13 53.20 W
True azimuth (°)	320.52	140.37
Vertical angle (°)	-0.41	0.33
Elevation (ft)	2363.00	2065.00
Antenna model	HP4-107 (TR)	HP4-107 (TR)
Antenna gain (dBi)	40.40	40.40
Antenna height (ft)	35.00	73.00
TX line model	EW90	EW90
TX line unit loss (dB/100 ft)	3.08	3.08
TX line length (ft)	80.00	95.00
TX line loss (dB)	2.46	2.93
Connector loss (dB)	0.50	0.50
TX filter loss (dB)	2.10	2.10
RX filter loss (dB)	2.20	2.20
Frequency (MHz)	11200.00	
Polarization	Vertical	
Path length (mi)	7.55	
Free space loss (dB)	135.15	
Atmospheric absorption loss (dB)	0.19	
Net path loss (dB)	65.23	65.23
Configuration	MHSB	MHSB
Radio model	WVCE11-L2-1024F40S-294-30-HS	WVCE11-L2-1024F40S-294-30-HS
TX power (dBm)	29.00	29.00
Emission designator	40M0D7W	40M0D7W
EIRP (dBm)	64.34	63.87
RX threshold criteria	1E-6 BER	1E-6 BER
RX threshold level (dBm)	-61.50	-61.50
Receive signal (dBm)	-36.23	-36.23
Thermal fade margin (dB)	25.27	25.27
Dispersive fade margin (dB)	47.00	47.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	25.24	25.24
Climatic factor	1.00	
Terrain roughness (ft)	140.00	
C factor	0.26	
Average annual temperature (°F)	28.87	

PATH CALCULATIONS - Appendix A

Utilizing diplexer filters

	Ester Dome	Murphy Dome
Fade occurrence factor (Po)	3.164E-003	
Worst month multipath availability (%)	99.99905	99.99905
Worst month multipath unavailability (%)	0.00095	0.00095
Worst month multipath unavailability (sec)	24.87	24.87
Annual multipath availability (%)	99.99983	99.99983
Annual multipath unavailability (%)	0.00017	0.00017
Annual multipath unavailability (sec)	52.22	52.22
Annual 2 way multipath availability (%)	99.99967	
Annual 2 way multipath unavailability (%)	0.00033	
Annual 2 way multipath unavailability (sec)	104.45	
Polarization	Vertical	
Rain region	Fairbanks, Alaska	
Rain rate (mm/hr)	104.34	
Flat fade margin - rain (dB)	25.27	
Rain attenuation (dB)	25.24	
Annual rain availability (%)	99.99999	
Annual rain unavailability (min)	0.07	
Annual rain + multipath availability (%)	99.99966	
Annual rain + multipath unavailability (min)	1.81	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

$$\begin{array}{r} 4 \\ 0.07 \\ \hline 60 \\ 000 \\ \hline 1420451 \\ \hline 406 \end{array}$$

$$\begin{array}{r} 4 \\ 1.81 \\ \hline 60 \\ 000 \\ \hline 10860 \\ \hline 108.60 \\ 108.6 \text{ sec} \end{array}$$

$$\begin{array}{r} 52.22 \\ 2 \\ \hline 104.44 \\ 10 \\ 41.81 \\ \hline 60 \\ 080 \\ \hline 10860 \\ 109.40 \end{array}$$

PATH CALCULATIONS - Appendix A

Utilizing diplexer filters



	Fairbanks Water Tank	Murphy Dome
Latitude	64 50 54.30 N	64 57 35.70 N
Longitude	147 44 38.80 W	148 13 53.20 W
True azimuth (°)	298.54	118.09
Vertical angle (°)	0.99	-1.16
Elevation (ft)	439.00	2065.00
Antenna model	HP6-59 (TR)	HP8-59 (TR)
Antenna gain (dBi)	38.60	41.50
Antenna height (ft)	105.00	92.00
TX line model	EW63	EW63
TX line unit loss (dB/100 ft)	1.43	1.43
TX line length (ft)	180.00	115.00
TX line loss (dB)	2.57	1.64
Connector loss (dB)	0.50	0.50
TX filter loss (dB)	1.80	1.80
RX filter loss (dB)	2.10	2.10
Frequency (MHz)	6175.00	
Polarization	Vertical	
Path length (mi)	16.29	
Free space loss (dB)	136.65	
Atmospheric absorption loss (dB)	0.23	
Net path loss (dB)	65.90	65.90
Configuration	MHSB	MHSB
Radio model	WVCE61-L1-512F30S-206-31.5-HS	WVCE61-L1-512F30S-206-31.5-HS
TX power (dBm)	30.50	30.50
Emission designator	30M0D7W	30M0D7W
EIRP (dBm)	64.23	68.06
RX threshold criteria	1E-6 BER	1E-6 BER
RX threshold level (dBm)	-67.00	-67.00
Receive signal (dBm)	-35.40	-35.40
Thermal fade margin (dB)	31.60	31.60
Dispersive fade margin (dB)	52.00	52.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	31.56	31.56
Climatic factor	1.00	
Terrain roughness (ft)	140.00	
C factor	0.26	
Average annual temperature (°F)	28.73	

PATH CALCULATIONS - Appendix A

Utilizing diplexer filters

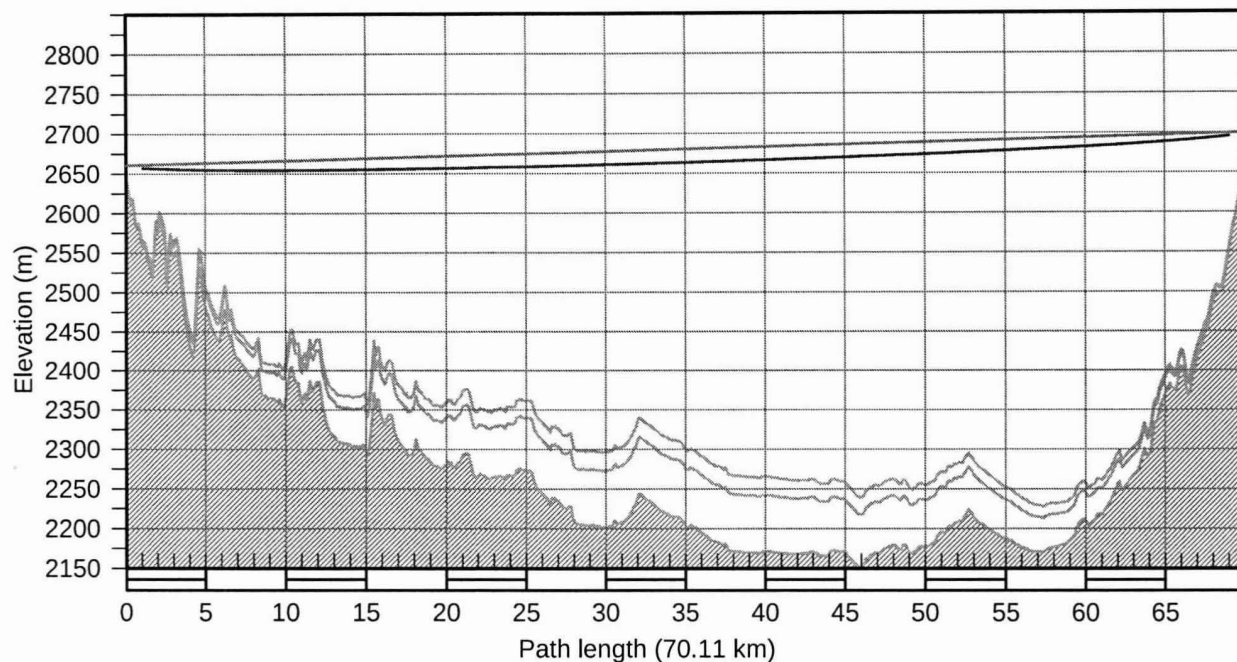
	Fairbanks Water Tank	Murphy Dome
Fade occurrence factor (Po)	1.750E-002	
Worst month multipath availability (%)	99.99878	99.99878
Worst month multipath unavailability (%)	0.00122	0.00122
Worst month multipath unavailability (sec)	32.07	32.07
Annual multipath availability (%)	99.99979	99.99979
Annual multipath unavailability (%)	0.00021	0.00021
Annual multipath unavailability (sec)	67.35	67.35
Annual 2 way multipath availability (%)	99.99957	
Annual 2 way multipath unavailability (%)	0.00043	
Annual 2 way multipath unavailability (sec)	134.70	

Multipath fading method - Vigants - Barnett

	ZAPALLO	SAN LORENZO
Latitude	00 53 14.02 N	01 17 29.51 N
Longitude	079 31 44.10 W	078 50 42.36 W
True azimuth (°)	59.56	239.58
Vertical angle (°)	-0.69	0.10
Elevation (m)	603.73	4.14
Antenna model	SLU1878D6A (TR)	SLU1878D6A (TR)
Antenna file name	slu1878d6a	slu1878d6a
Antenna gain (dBi)	40.10	40.10
Antenna height (m)	50.00	40.00
Antenna model	SLU1278S6 (DR)	SLU1278S6 (DR)
Antenna file name	slu1278s6	slu1278s6
Antenna gain (dBi)	37.30	37.30
Antenna height (m)	40.00	30.00
Frequency (MHz)	7575.00	
Polarization	Vertical	
Path length (km)	88.27	
Free space loss (dB)	148.97	
Atmospheric absorption loss (dB)	0.89	
Main net path loss (dB)	69.66	69.66
Diversity net path loss (dB)	72.46	72.46
Radio model	ASNK7-AGS20_105M_32QAM	ASNK7-AGS20_105M_32QAM
Radio file name	asn7_105m_32qa	asn7_105m_32qa
TX power (dBm)	26.00	26.00
Emission designator	28M0D7WET	28M0D7WET
EIRP (dBm)	66.10	66.10
RX threshold criteria	1E-6 BER	1E-6 BER
RX threshold level (dBm)	-76.00	-76.00
Main receive signal (dBm)	-43.66	-43.66
Diversity receive signal (dBm)	-46.46	-46.46
Thermal fade margin (dB)	32.34	32.34
Dispersive fade occurrence factor	2.00	
Effective fade margin (dB)	32.34	32.34
Geoclimatic factor	2.514E-005	
Path inclination (mr)	10.00	
Average annual temperature (°C)	21.91	
Fade occurrence factor (Po)	5.370E-001	
SD improvement factor	9.36	9.36

	ZAPALLO	SAN LORENZO
Worst month multipath availability (%)	99.99665	99.99665
Worst month multipath unavailability (sec)	87.96	87.96
Annual multipath availability (%)	99.99880	99.99880
Annual multipath unavailability (sec)	377.02	377.02
Annual 2 way multipath availability (%)	99.99761	
Annual 2 way multipath unavailability (sec)	754.05	
Polarization	Vertical	
Rain region	ITU Region P	
0.01% rain rate (mm/hr)	145.00	
Rain rate (mm/hr)	461.82	
Flat fade margin - rain (dB)	32.34	
Rain attenuation (dB)	32.34	
Annual rain availability (%)	99.99999	
Annual rain unavailability (min)	0.05	
Annual rain + multipath availability (%)	99.99760	
Annual rain + multipath unavailability (min)	12.62	

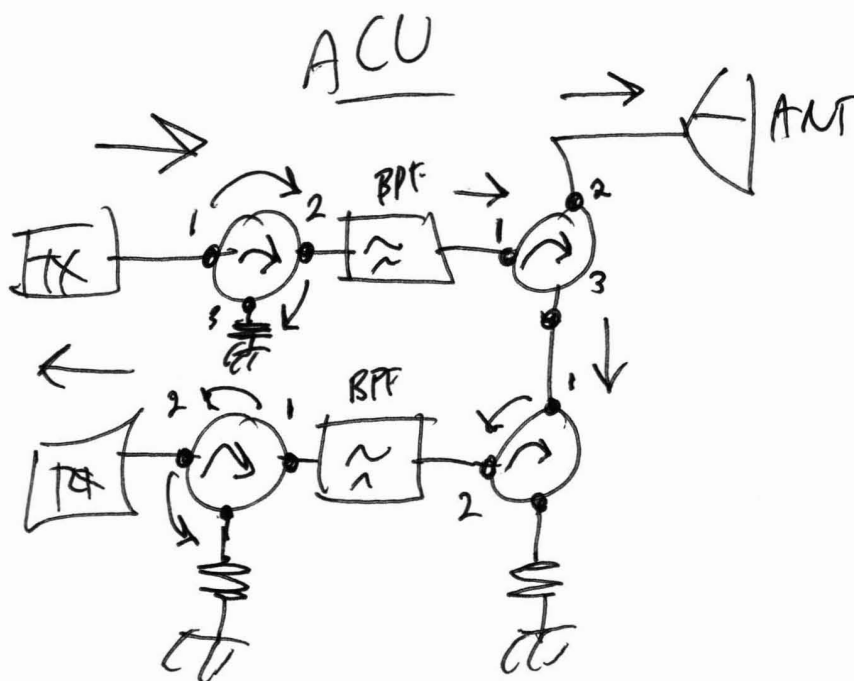
Multipath fading method - Rec. ITU-R P.530-7/ 8
Rain fading method - Rec. ITU-R P.530-8/13 (file)



Arlington		Frequency (MHz) = 18500.0	Pilot Hill	
Latitude	41 34 26.00 N	K = 1.33, 1.00	Latitude	41 18 35.60 N
Longitude	106 13 03.20 W	%F1 = 100.00	Longitude	105 27 19.70 W
Azimuth	114.47°		Azimuth	294.97°
Elevation	2647 m ASL		Elevation	2686 m ASL
Antenna CL	13.7 m AGL		Antenna CL	13.7 m AGL

CSI TELECOMMUNICATIONS, INC. CONSULTING ENGINEERS

		Jan 15 09	



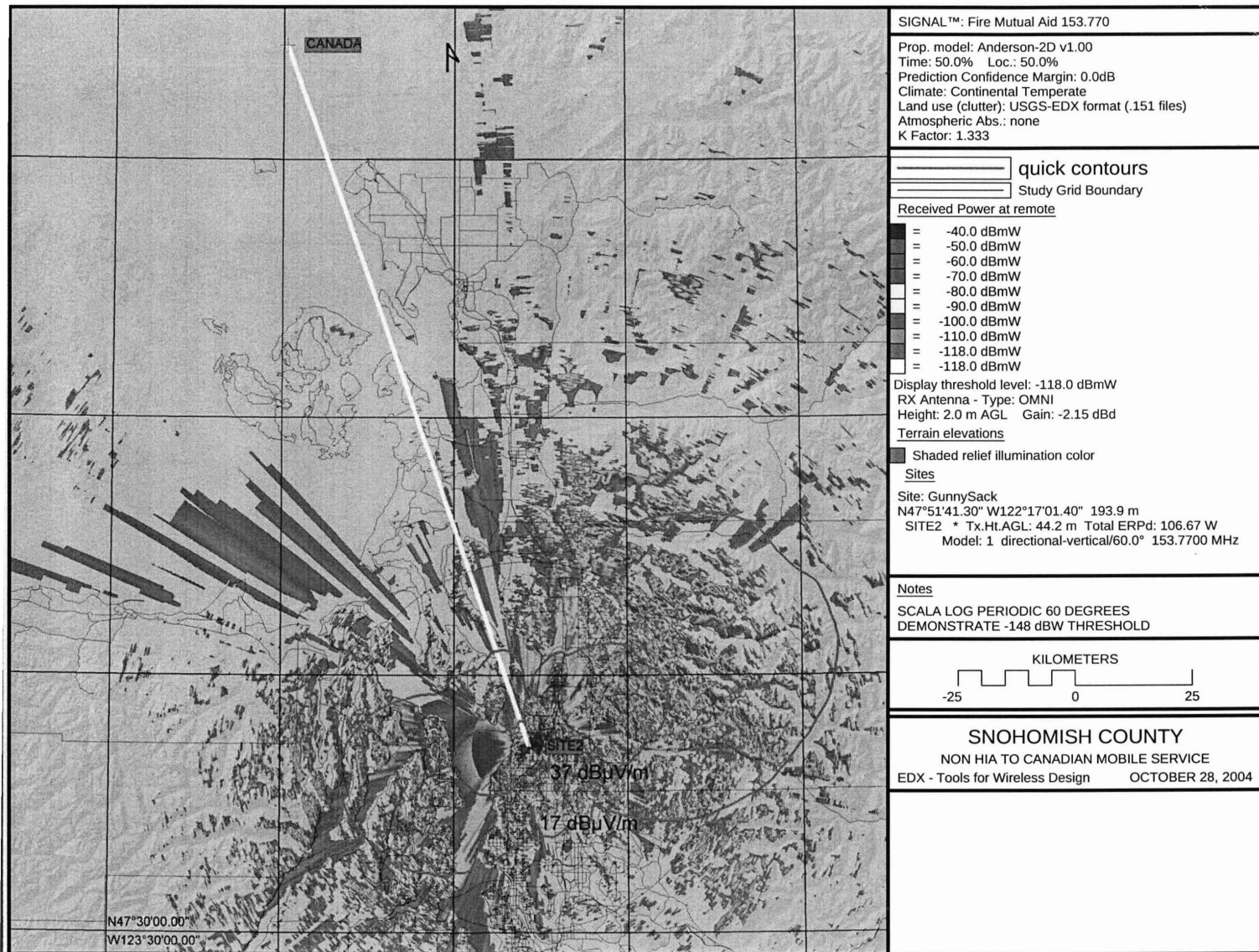
	Arlington	Pilot Hill
Elevation (m)	2647.00	2686.08
Latitude	41 34 26.00 N	41 18 35.60 N
Longitude	106 13 03.20 W	105 27 19.70 W
True azimuth (°)	114.47	294.97
Vertical angle (°)	-0.20	-0.27
Antenna model	ANDREW HP6-180F	ANDREW HP6-180F
Antenna height (m)	13.72	13.72
Antenna gain (dBi)	48.00	48.00
TX line type	EWP-180	EWP-180
TX line length (m)	24.38	24.38
TX line unit loss (dB /100 m)	19.39	19.39
TX line loss (dB)	4.73	4.73
Connector loss (dB)	0.50	0.50
Frequency (MHz)	18500.00	
Polarization	Vertical	
Path length (km)	70.11	
Free space loss (dB)	154.73	
Atmospheric absorption loss (dB)	4.37	
Field margin (dB)	2.00	
Net path loss (dB)	75.56	75.56
Radio model	TRuepoint 5218 40M OC3	TRuepoint 5218 40M OC3
TX power (watts)	0.13	0.13
TX power (dBm)	21.00	21.00
EIRP (dBm)	63.77	63.77
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-73.50	-73.50
RX signal (dBm)	-54.56	-54.56
Thermal fade margin (dB)	18.94	18.94
Dispersive fade margin (dB)	50.00	50.00
Dispersive fade occurrence factor	0.00	
Effective fade margin (dB)	18.94	18.94
C factor	1.00	
Fade occurrence factor (Po)	3.82E+00	
Average annual temperature (°C)	4.44	
Worst month - multipath (%)	95.12229	95.12229
(sec)	128186.20	128186.20
Annual - multipath (%)	99.02446	99.02446
(sec)	307646.89	307646.89
(% - sec)	98.04892 - 615293.78	
Rain region	B Polar Taiga	
Flat fade margin - rain (dB)	18.94	
Rain rate (mm/hr)	9.05	
Rain attenuation (dB)	18.92	
Annual rain (%-sec)	99.94394 - 17677.57	
Annual multipath + rain (%-sec)	97.99286 - 632971.35	

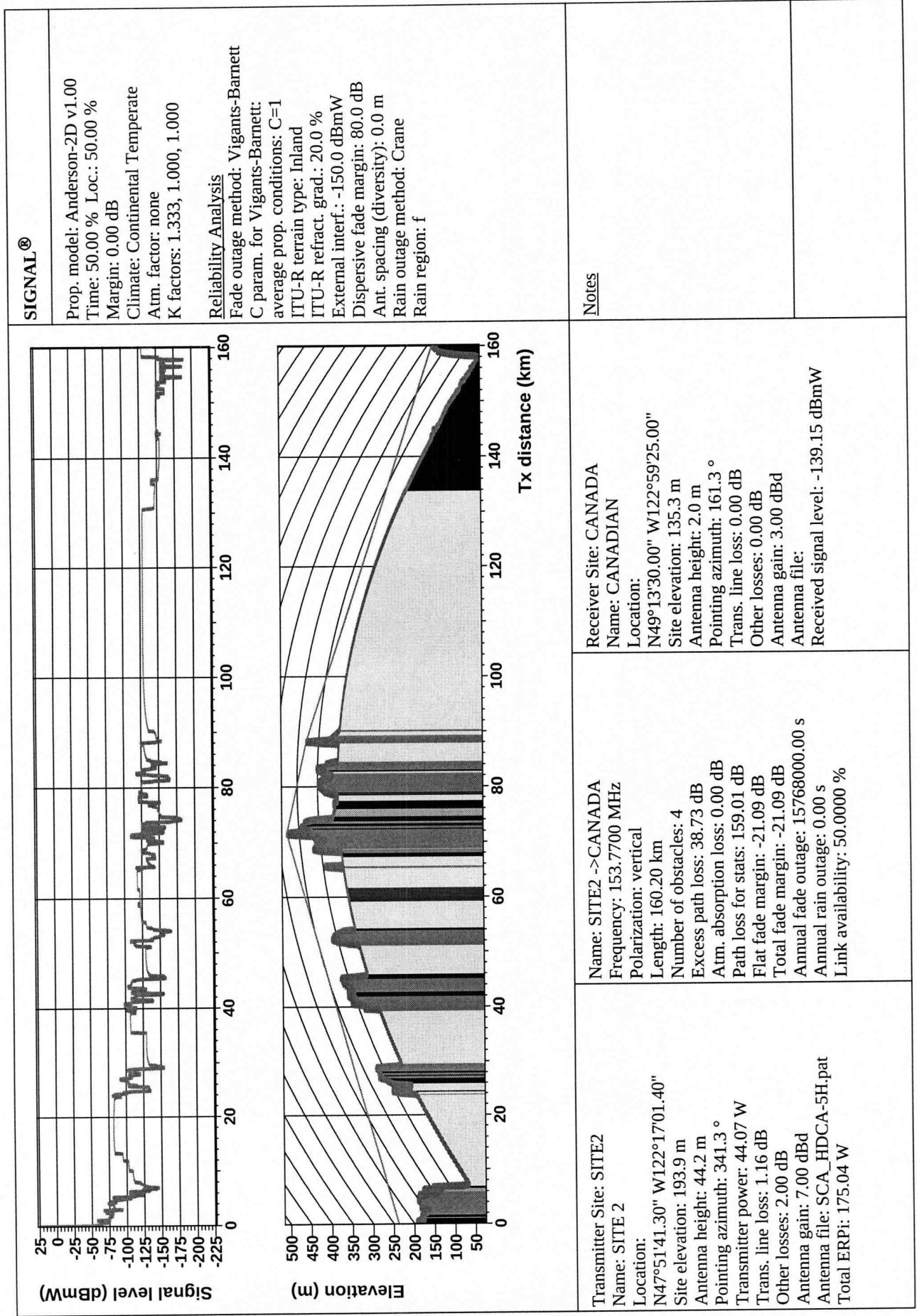
Thu, Jan 15 2009
Arlington - Pilot Hill.pl4
Reliability Method - Vigants - Barnett
Rain - Crane

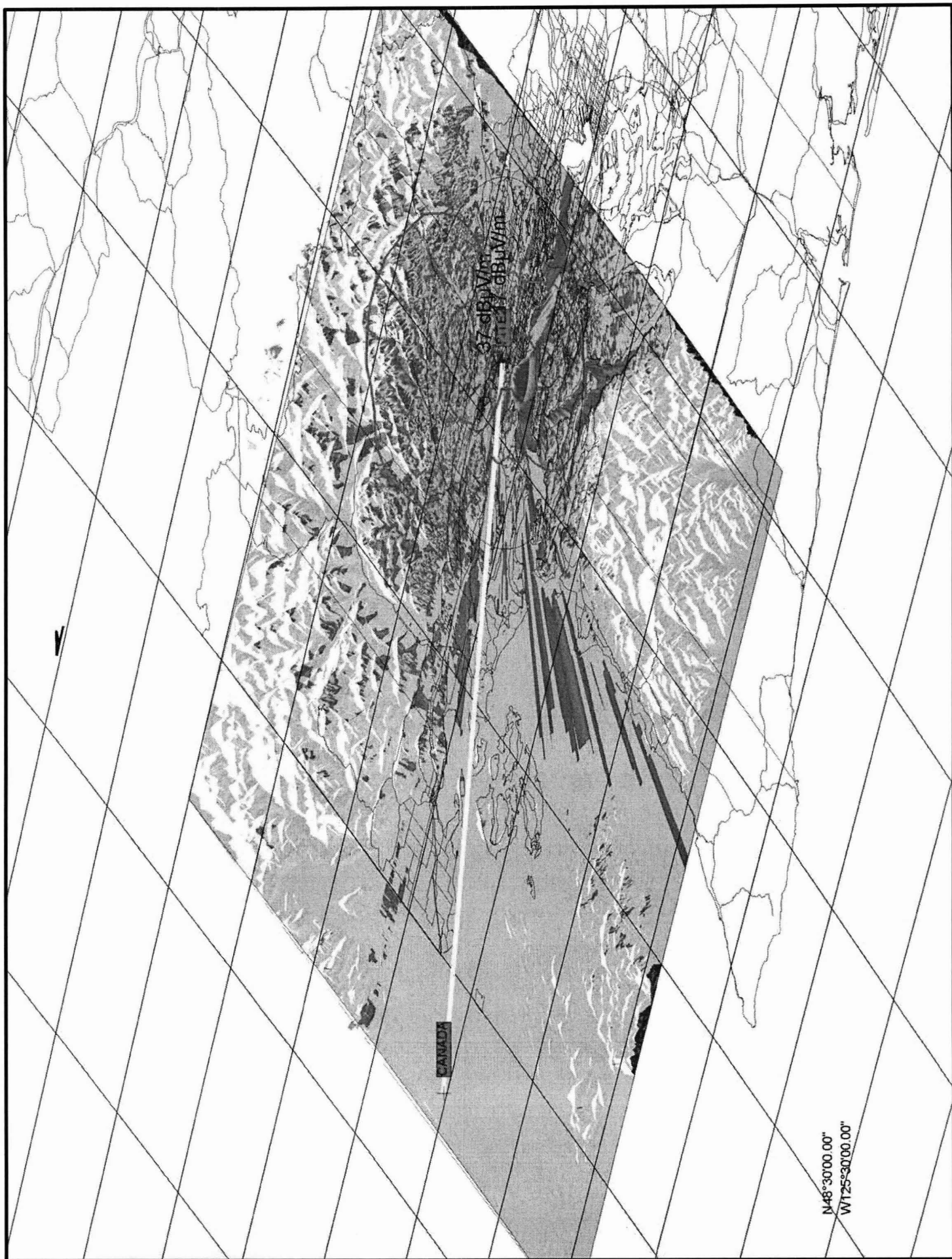
NET LOSS = FS 154.73

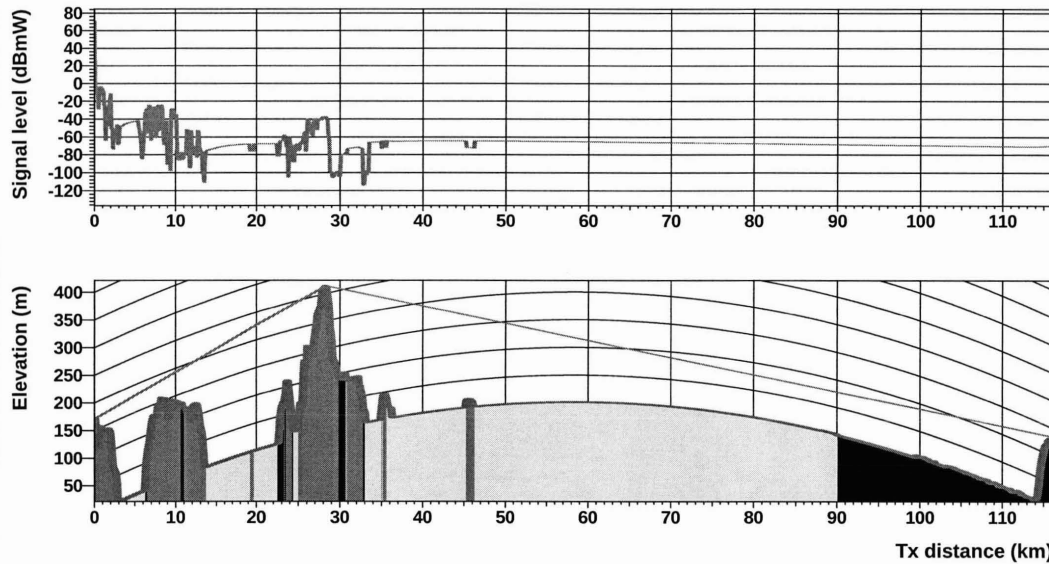
79.17
96.00
- 9.46
1.00
4.73

FS 154.73 + 96 ANT
NET 75.56 - 9.46
79.17 - 1.0









SIGNAL®

Prop. model: Anderson-2D v1.00
 Time: 50.00 % Loc.: 50.00 %
 Margin: 0.00 dB
 Climate: Continental Temperate
 Atm. factor: none
 K factors: 1.333, 1.000, 1.000

Reliability Analysis

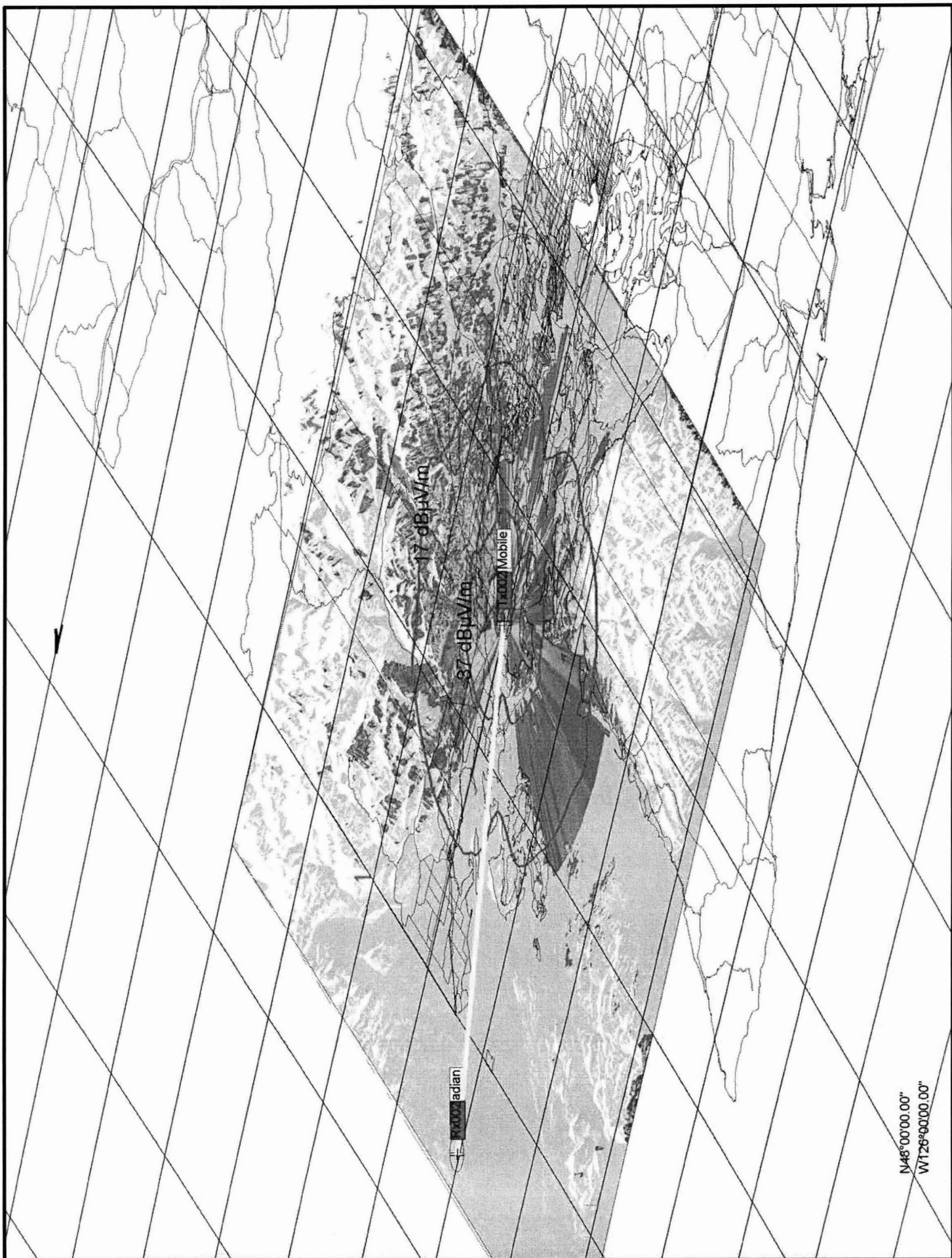
Fade outage method: Vigants-Barnett
 C param. for Vigants-Barnett:
 average prop. conditions: C=1
 ITU-R terrain type: Inland
 ITU-R refract. grad.: 20.0 %
 External interf.: -150.0 dBmW
 Dispersive fade margin: 80.0 dB
 Ant. spacing (diversity): 0.0 m
 Rain outage method: Crane
 Rain region: f

Transmitter Site: Tx
 Name: FIRE MOBILE
 Location:
 N48°13'23.00" W122°29'29.00"
 Site elevation: 130.8 m
 Antenna height: 2.0 m
 Pointing azimuth: 342.0 °
 Transmitter power: 18.83 W
 Trans. line loss: 0.41 dB
 Other losses: 0.50 dB
 Antenna gain: 2.14 dBd
 Antenna file:
 Total ERPi: 41.01 W

Name: Tx ->Rx
 Frequency: 153.7700 MHz
 Polarization: vertical
 Length: 117.20 km
 Number of obstacles: 2
 Excess path loss: 50.55 dB
 Atm. absorption loss: 0.00 dB
 Path loss for stats: 168.08 dB
 Flat fade margin: -0.51 dB
 Total fade margin: -0.51 dB
 Annual fade outage: 15768000.00 s
 Annual rain outage: 0.00 s
 Link availability: 50.0000 %

Receiver Site: Rx
 Name: CANADA
 Location:
 N49°13'30.00" W122°59'25.00"
 Site elevation: 135.3 m
 Antenna height: 2.0 m
 Pointing azimuth: 162.0 °
 Trans. line loss: 0.41 dB
 Other losses: 0.50 dB
 Antenna gain: 2.14 dBd
 Antenna file:
 Received signal level: -118.57 dBmW

Notes



COMSEARCH, INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081
(214) 235-3156

PAGE: 1 OF 1

01/06/86

SITE A

SITE B

SITE NAME	ARLING (WETA) VA	INDPONT HILL VA
CALL SIGN		
LATITUDE (DDMMSS.S)	38 53 29.0	38 37 35.0
LONGITUDE (DDMMSS.S)	77 7 55.0	77 27 23.0
GND ELEV (FT AMSL)	265	402
PRIMARY ANT (FCC CODE)	A74116	A74116
HEIGHT (FT)	300	225
LINE LOSS (DB)	2	2
TYPE	ANDREW CORPORATION	ANDREW CORPORATION
	UX10-59H RF	UX10-59H RF
GAIN	43.2	43.2
RADIO TYPE (FCC CODE)	24LK01	24LK01
	MICROWAVE ASSOCIATES	MICROWAVE ASSOCIATES
	MA85T07H	MA85T07H
POWER (DBM)	37.0	37.0
STABILITY (%)	0.005000	0.005000
LOADING	VIDEO	VIDEO
EMISSION DESIGNATOR	30000F9	30000F9
FREQUENCIES	6197.24V 6226.89H 6256.54V	5945.20V 5974.85H 6004.50V
	6286.19H 6315.84V 6346.49H	6034.15H 6063.80V 6093.45H
	6375.14V 6404.79H	6123.10V 6152.75H
DISTANCE	25.32 MI	40.75 KM
BEARING (DEGREES)	222.885	42.655

COMSEARCH, INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081
(214) 235-3156

PAGE: 1 OF 1

01/06/86

SITE A

SITE B

SITE NAME	ARLING (WETA) VA	INDPONT HILL VA
CALL SIGN		
LATITUDE (DDMMSS.S)	38 53 29.0	38 37 35.0
LONGITUDE (DDMMSS.S)	77 7 55.0	77 27 23.0
GND ELEV (FT AMSL)	365	402
PRIMARY ANT (FCC CODE)	A79515	A79515
HEIGHT (FT)	320	225
LINE LOSS (DB)	2	2
TYPE	ANDREW CORPORATION	ANDREW CORPORATION
	UH-X12-55J LF	UH-X12-55J LF
GAIN	44.8	44.8
RADIO TYPE (FCC CODE)	24LK01	24LK01
	MICROWAVE ASSOCIATES	MICROWAVE ASSOCIATES
	MA65T07H	MA65T07H
POWER (DBM)	37.0	37.0
STABILITY (X)	0.005000	0.005000
LOADING	VIDEO	VIDEO
EMISSION DESIGNATOR	30000F9	30000F9
FREQUENCIES	6197.24V 6226.89H 6256.54V	5945.20V 5974.85H 6004.50V
	6286.19H 6315.84V 6345.45H	6034.15H 6063.80V 6093.45H
	6375.14V 6404.79H	6123.10V 6152.75H
DISTANCE	25.35 MI	40.75 KM
BEARING (DEGREES)	023.880	43.620

COMSEARCH, INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081
(214) 235-3156

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SITE A

SITE B

SITE NAME	ARLING (WETA) VA	INDPONT HILL VA
CALL SIGN		
LATITUDE (DDMMSS.S)	38 53 29.0	38 37 35.0
LONGITUDE (DDDMMSS.S)	77 7 55.0	77 27 23.0
GND ELEV (FT AMSL)	365	402
PRIMARY ANT (FCC CODE)	A11116	A11116
HEIGHT (FT)	250	275
LINE LOSS (DB)	6	7
TYPE	ANDREW CORPORATION	ANDREW CORPORATION
	UX10-107H RF	UX10-107H RF
GAIN	48.4	48.4
RADIO TYPE (FCC CODE)	24S602	24S602
	MICROWAVE ASSOCIATES	MICROWAVE ASSOCIATES
	MA65T120	MA65T120
POWER (DBM)	32.0	32.0
STABILITY (%)	0.005000	0.005000
LOADING	VIDEO	VIDEO
EMISSION DESIGNATOR	25000F9	25000F9
FREQUENCIES	10755.00V 10955.00H 10995.00V	11405.00V 11685.00H 11645.00V
	10715.00H 11155.00V 10675.00H	11445.00H 11325.00V 11605.00H
	10915.00V 11115.00H 11075.00V	11565.00V 11365.00H 11245.00V
	10795.00H 10835.00V 11035.00H	11525.00H 11485.00V 11265.00H
DISTANCE	25.32 MI	42.75 MI
BEARING (DEGREES)	223.853	43.653

COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEA TELCOM

PATH NO: 2

SYSTEM: VIRGINIA

TYPE RADIO: MABST07H

TYPE CARRIER: VIDEO

RF FREQUENCY (GHZ): 6.175

RECEIVER IF BANDWIDTH (MHZ): 30.

CHANNEL LOADING: 1

CALCULATED CHANNEL SLOT (KHZ): 4000

SITE A: WETA

CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR

SITE B: INDEPENDENT

ENGINEER: L THELANER

DATE: 6 JAN 86

SITE A: SITE B

TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	10	10
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	43.2	43.2
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (EW52) 1.2 DB/100 (FT)	(DB)	3.7	2.8
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0
OTHER LOSSES	(DB)		.0
PATH LENGTH	(MI)		25.3
SPACE LOSS	(DB)		140.5
FIELD MARGIN (LOSS)	(DB)		1.0
TOTAL LOSSES	(DB)		151.0
TOTAL GAINS	(DB)		86.4
NET PATH LOSS	(DB)		64.6
TRANSMITTER OUTPUT POWER	(DBM)		35.6
MEDIAN RECEIVED CARRIER LEVEL	(DBM)		-29.0
RECEIVER THRESHOLD	(DBM)		-79.0
THERMAL FADE MARGIN	(DB)		50.0

UNAVAILABILITY ONE-WAY		.000000627
UNAVAILABILITY ONE-WAY	SECONDS	19.8
RELIABILITY NON DIVERSITY		99.999937
PATH 2 WAY UNAVAILABILITY		.000001254
PATH 2 WAY UNAVAILABILITY	SECONDS	39.558
PATH 2-WAY RELIABILITY		99.999875

LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900
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COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEA TELCOM

PATH NO: 1

SYSTEM: VIRGINIA

TYPE RADIO: MAB5T07H

TYPE CARRIER: VIDEO

RF FREQUENCY (GHZ): 6.175

RECEIVER IF BANDWIDTH (MHZ): 30.

CHANNEL LOADING: 1

CALCULATED CHANNEL SLOT (KHZ): 4000

SITE A: WETA

CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR

SITE B: INDEPENDENT

ENGINEER: L THELANER

DATE: 6 JAN 86

SITE A: SITE B

TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	12	12
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	44.8	44.8
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (EW52) 1.2 DB/100 (FT)	(DB)	3.7	2.8
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0

OTHER LOSSES	(DB)	.0
PATH LENGTH	(MI)	25.3
SPACE LOSS	(DB)	140.5
FIELD MARGIN (LOSS)	(DB)	1.0
TOTAL LOSSES	(DB)	151.0
TOTAL GAINS	(DB)	89.6
NET PATH LOSS	(DB)	61.4
TRANSMITTER OUTPUT POWER	(DBM)	35.6
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-25.8
RECEIVER THRESHOLD	(DBM)	-79.0
THERMAL FADE MARGIN	(DB)	53.2

UNAVAILABILITY ONE-WAY		.000000300
UNAVAILABILITY ONE-WAY	SECONDS	9.5
RELIABILITY NON DIVERSITY		99.999970

PATH 2 WAY UNAVAILABILITY		.000000600
PATH 2 WAY UNAVAILABILITY	SECONDS	18.933
PATH 2-WAY RELIABILITY		99.999940

LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900
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COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELECOM

PATH NO: 1

SYSTEM: VIRGINIA

TYPE RADIO: MA-12G

TYPE CARRIER: VIDEO

RF FREQUENCY (GHZ): 11.200

RECEIVER IF BANDWIDTH (MHZ): 30.

CHANNEL LOADING: 1

CALCULATED CHANNEL SLOT (KHZ): 4000

SITE A: WETA

CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR

SITE B: INDEPENDENT

ENGINEER: L THELANER

DATE: 6 JAN 86

SITE A: SITE B

TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	<u>10</u>	<u>10</u>
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	48.4	48.4
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (WC109) 1.3 DB/100 (FT)	(DB)	4.0	3.1
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0

OTHER LOSSES	(DB)	.0
PATH LENGTH	(MI)	25.3
SPACE LOSS	(DB)	145.6
FIELD MARGIN (LOSS)	(DB)	1.0
TOTAL LOSSES	(DB)	156.7
TOTAL GAINS	(DB)	96.8
NET PATH LOSS	(DB)	59.9
TRANSMITTER OUTPUT POWER	(DBM)	<u>27.0</u>
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-32.9
RECEIVER THRESHOLD	(DBM)	-79.0
THERMAL FADE MARGIN	(DB)	46.1

UNAVAILABILITY ONE-WAY		.000002803
UNAVAILABILITY ONE-WAY	SECONDS	88.4
RELIABILITY NON DIVERSITY		99.999720

PATH 2 WAY UNAVAILABILITY		.000005606
PATH 2 WAY UNAVAILABILITY	SECONDS	176.796
PATH 2-WAY RELIABILITY		99.999439

LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900
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RAINFALL OUTAGE CALCULATION

```

=====
TRANSMIT SITE      : WETA
RECEIVE SITE       : INDEPENDENT

RAIN OUTAGE METHOD  : U.S.
1st & 2nd RAIN RATES- MM/YR      : 173          41
1st & 2nd RAIN TIMES- MIN/YR     : 1           100
FREQUENCY BAND-GHZ  : 11.2
PATH DISTANCE -MI   : 25.3
FADE MARGIN IN DB   : 46.1  TFM
WET RADOME LOSS-DB  : 2

POLARIZATION       : HORIZONTAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR : 77.9

POLARIZATION       : VERTICAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR : 53.8

```

NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON
 EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES
 ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE
 OVER A PERIOD OF SEVERAL YEARS

H+V
POLAR

173 mm/hr for 1 min
41 m/hr for 100 min

COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELECOM

PATH NO: 3

SYSTEM: VIRGINIA

TYPE RADIO: MA-12G

TYPE CARRIER: VIDEO

RF FREQUENCY (GHZ): 11.200

RECEIVER IF BANDWIDTH (MHZ): 30.

CHANNEL LOADING: 1

CALCULATED CHANNEL SLOT (KHZ): 4000

SITE A: WETA

CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR

SITE B: INDEPENDENT

ENGINEER: L THELANER

DATE: 6 JAN 86

SITE A: SITE B

TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	<u>12</u>	<u>12</u>
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	49.8	49.8
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (WC109) 1.3 DB/100 (FT)	(DB)	4.0	3.1
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0

OTHER LOSSES	(DB)	.0
PATH LENGTH	(MI)	25.3
SPACE LOSS	(DB)	145.6
FIELD MARGIN (LOSS)	(DB)	1.0
TOTAL LOSSES	(DB)	156.7
TOTAL GAINS	(DB)	99.6
NET PATH LOSS	(DB)	57.1
TRANSMITTER OUTPUT POWER	(DBM)	<u>27.0</u>
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-30.1
RECEIVER THRESHOLD	(DBM)	-79.0
THERMAL FADE MARGIN	(DB)	48.9

UNAVAILABILITY ONE-WAY		.000001471
UNAVAILABILITY ONE-WAY	SECONDS	46.4
RELIABILITY NON DIVERSITY		99.999853

PATH 2 WAY UNAVAILABILITY		.000002942
PATH 2 WAY UNAVAILABILITY	SECONDS	92.784
PATH 2-WAY RELIABILITY		99.999706

LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900
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RAINFALL OUTAGE CALCULATION

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=====
TRANSMIT SITE      : WETA
RECEIVE SITE       : INDEPENDENT
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```
RAIN OUTAGE METHOD  : U.S.
1st & 2nd RAIN RATES- MM/YR      : 173          41
1st & 2nd RAIN TIMES- MIN/YR     : 1           100
FREQUENCY BAND-GHZ   : 11.2
PATH DISTANCE -MI    : 25.3
FADE MARGIN IN DB    : 48.9
WET RADOME LOSS-DB   : 2
```

```
POLARIZATION       : HORIZONTAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR : 68.4
```

```
POLARIZATION       : VERTICAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR : 44.2
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NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON
      EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES
      ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE
      OVER A PERIOD OF SEVERAL YEARS
```

COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELECOM

PATH NO: 2

SYSTEM: VIRGINIA

TYPE RADIO: MA-12G

TYPE CARRIER: VIDEO

RF FREQUENCY (GHZ): 11.200

RECEIVER IF BANDWIDTH (MHZ): 30.

CHANNEL LOADING: 1

CALCULATED CHANNEL SLOT (KHZ): 4000

SITE A: WETA

CHAN DEV (KHZ): 4000 FRE EMPHASIS CCIR

SITE B: INDEPENDENT

ENGINEER: L THELANER

DATE: 6 JAN 86

SITE A: SITE B

TOWER HEIGHT	(FT)	!	300	!	225	!
MAIN ANTENNA HEIGHT	(FT)	!	300	!	225	!
DIVERSITY ANTENNA HEIGHT	(FT)	!	0	!	0	!
MAIN ANTENNA SIZE	(FT)	!	<u>10</u>	!	<u>10</u>	!
DIVERSITY ANTENNA SIZE	(FT)	!	0	!	0	!
MAIN ANTENNA GAIN	(DB)	!	48.4	!	48.4	!
DIVERSITY ANTENNA GAIN	(DB)	!	.0	!	.0	!
MAIN WAVEGUIDE LENGTH	(FT)	!	310	!	235	!
WAVEGUIDE LOSS (WC109) 1.3 DB/100 (FT)	(DB)	!	4.0	!	3.1	!
STACKING LOSS	(DB)	!	1.5	!	1.5	!
RADOME LOSS	(DB)	!	.0	!	.0	!

OTHER LOSSES	(DB)	!	.0	!
PATH LENGTH	(MI)	!	25.3	!
SPACE LOSS	(DB)	!	145.6	!
FIELD MARGIN (LOSS)	(DB)	!	1.0	!
TOTAL LOSSES	(DB)	!	156.7	!
TOTAL GAINS	(DB)	!	96.8	!
NET PATH LOSS	(DB)	!	59.9	!
TRANSMITTER OUTPUT POWER	(DBM)	!	<u>28.5</u>	!
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	!	-31.4	!
RECEIVER THRESHOLD	(DBM)	!	-79.0	!
THERMAL FADE MARGIN	(DB)	!	47.6	!

UNAVAILABILITY ONE-WAY		!	.000001984	!
UNAVAILABILITY ONE-WAY	SECONDS	!	62.6	!
RELIABILITY NON DIVERSITY		!	99.999802	!

PATH 2 WAY UNAVAILABILITY		!	.0000003969	!
PATH 2 WAY UNAVAILABILITY	SECONDS	!	125.162	!
PATH 2-WAY RELIABILITY		!	99.999603	!

LONG HAUL OBJECTIVE 2-WAY	SECONDS	!	19.900	!
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RAINFALL OUTAGE CALCULATION

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=====
TRANSMIT SITE      : WETA
RECEIVE SITE       : INDEPENDENT

RAIN OUTAGE METHOD   : U.S.
1st & 2nd RAIN RATES- MM/YR      : 173      41
1st & 2nd RAIN TIMES- MIN/YR     : 1        100
FREQUENCY BAND-GHZ   : 11.2
PATH DISTANCE -MI    : 25.3
FADE MARGIN IN DB    : 47.6
WET RADOME LOSS-DB   : 2

POLARIZATION        : HORIZONTAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR  : 73

POLARIZATION        : VERTICAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR  : 48.2

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NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON
 EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES
 ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE
 OVER A PERIOD OF SEVERAL YEARS

COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELECOM

PATH NO: 1

SYSTEM: VIRGINIA

TYPE RADIO: MA-126

TYPE CARRIER: VIDEO

RF FREQUENCY (GHZ): 11.200

RECEIVER IF BANDWIDTH (MHZ): 30.

CHANNEL LOADING: 1

CALCULATED CHANNEL SLOT (KHZ): 4000

SITE A: WETA

CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR

SITE B: INDEPENDENT

ENGINEER: L THELANER

DATE: 6 JAN 86

SITE A: SITE B

TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	12	12
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	49.8	49.8
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (WC109) 1.3 DB/100 (FT)	(DB)	4.0	3.1
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0

OTHER LOSSES	(DB)	.0
PATH LENGTH	(MI)	25.3
SPACE LOSS	(DB)	145.6
FIELD MARGIN (LOSS)	(DB)	1.0
TOTAL LOSSES	(DB)	156.7
TOTAL GAINS	(DB)	99.6
NET PATH LOSS	(DB)	57.1
TRANSMITTER OUTPUT POWER	(DBM)	28.5
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-28.6
RECEIVER THRESHOLD	(DBM)	-79.0
THERMAL FADE MARGIN	(DB)	50.4

UNAVAILABILITY ONE-WAY		.000001041
UNAVAILABILITY ONE-WAY	SECONDS	32.8
RELIABILITY NON DIVERSITY		99.999896

PATH 2 WAY UNAVAILABILITY		.000002083
PATH 2 WAY UNAVAILABILITY	SECONDS	65.686
PATH 2-WAY RELIABILITY		99.999792

LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900
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RAINFALL OUTAGE CALCULATION

```

=====
TRANSMIT SITE      : WETA
RECEIVE SITE       : INDEPENDENT

RAIN OUTAGE METHOD   : U.S.
1st & 2nd RAIN RATES- MM/YR      : 173      41
1st & 2nd RAIN TIMES- MIN/YR     : 1        100
FREQUENCY BAND-GHZ   : 11.2
PATH DISTANCE -MI    : 25.3
FADE MARGIN IN DB    : 50.4
WET RADOME LOSS-DB   : 2

POLARIZATION        : HORIZONTAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR  : 62.7

POLARIZATION        : VERTICAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR  : 39.6

```

*REDO
AVAIL
WITH
RAIN RATE*

NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON
EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES
ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE
OVER A PERIOD OF SEVERAL YEARS

*NO RAIN
FADE RATE
AT*

RAIN OUTAGE / YEAR

PAGE: 1 OF 1

COMSEARCH, INC.
1307 GLENNVILLE DRIVE
RICHARDSON, TX 75081
(214) 235-3156

01/07/86

	SITE A		SITE B
SITE NAME	ROSSLYN	VA	ARLING (WETA) VA
CALL SIGN			
LATITUDE (DDMMSS.S)	38 53 41.0		38 53 29.0
LONGITUDE (DDDMMSS.S)	77 4 19.0		77 7 55.0
GND ELEV (FT AMSL)	100		365
PRIMARY ANT (FCC CODE)	AD1016		AD1016
HEIGHT (FT)	130		300
LINE LOSS (DB)			
TYPE	ANDREW CORPORATION		ANDREW CORPORATION
	HP6-220		HP6-220
GAIN	49.7		49.7
RADIO TYPE (FCC CODE)	2YFM01		2YFM01
	M/A COM VIDEO SYSTEMS INC		M/A COM VIDEO SYSTEMS INC
	BV88U4MA23CC		BV88U4MA23CC
POWER (DBM)	18.0		18.0
STABILITY (%)	0.030000		0.030000
LOADING	VIDEO		VIDEO
EMISSION DESIGNATOR	25000F9		25000F9
FREQUENCIES	22875.00H 22825.00V 22725.00V		21675.00H 21625.00V 21525.00V
	22625.00V 22525.00V		21425.00V 21325.00V
DISTANCE	3.24 MI		5.22 KM
BEARING (DEGREES)	265.953		85.915

PAGE: 1 OF 1

COMSEARCH, INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081
(214) 235-3156

01/07/86

	SITE A		SITE B
SITE NAME	ROSSLYN	VA	ARLING (WETA) VA
CALL SIGN			
LATITUDE (DDMMSS.S)	38 53 41.0		38 53 29.0
LONGITUDE (DDMMSS.S)	77 4 19.0		77 7 55.0
GND ELEV (FT AMSL)	100		365
PRIMARY ANT (FCC CODE)	AD1016		AD1016
HEIGHT (FT)	130		300
LINE LOSS (DB)			
TYPE	ANDREW CORPORATION		ANDREW CORPORATION
	HP6-220		HP6-220
GAIN	49.7		49.7
RADIO TYPE (FCC CODE)	2YFM01		2YFM01
	M/A COM VIDEO SYSTEMS INC		M/A COM VIDEO SYSTEMS INC
	BV88U4MA23CC		BV88U4MA23CC
POWER (DBM)	18.0		18.0
STABILITY (X)	0.030000		0.030000
LOADING	VIDEO		VIDEO
EMISSION DESIGNATOR	25000F9		25000F9
FREQUENCIES	23225.00V 23275.00H 23325.00V	22025.00V 22075.00H 22125.00V	
	23375.00H 23425.00V 23475.00H	22175.00H 22225.00V 22275.00H	
	23525.00V 23575.00H	22325.00V 22375.00H	
DISTANCE	3.24 MI		5.22 KM
BEARING (DEGREES)	265.953		05.915

COMSEARCH, INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081
(214) 235-3156

PAGE: 1 OF 1

01/06/86

SITE A

SITE B

SITE NAME	ROSSLYN	VA		ARLING (WETA)	VA
CALL SIGN					
LATITUDE (DDMMSS.S)	38 53 41.0			38 53 29.0	
LONGITUDE (DDMMSS.S)	77 4 19.0			77 7 55.0	
GND ELEV (FT AMSL)	100			365	
PRIMARY ANT (FCC CODE)	A63516			A63516	
HEIGHT (FT)	130			300	
LINE LOSS (DB)	2			2	
TYPE	ANDREW CORPORATION			ANDREW CORPORATION	
	UX6-59H RF			UX6-59H RF	
GAIN	38.8			38.8	
RADIO TYPE (FCC CODE)	24LK01			24LK01	
	MICROWAVE ASSOCIATES			MICROWAVE ASSOCIATES	
	MA65T07H			MA65T07H	
POWER (DBM)	30.0			30.0	
STABILITY (%)	0.005000			0.005000	
LOADING	VIDEO			VIDEO	
EMISSION DESIGNATOR	30000F9			30000F9	
FREQUENCIES	5945.20V 5974.85H 6004.50V		6197.24V	6226.89H 6256.54V	
	6034.15H 6063.80V 6093.45H		6286.19H	6315.84V 6345.49H	
	6123.10V 6152.75H		6375.14V	6404.79H	
DISTANCE	3.24 MI			5.22 KM	
BEARING (DEGREES)	265.953			85.915	

COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELCOM

PATH NO: 1

SYSTEM: VIRGINIA

TYPE RADIO: MAZYFM01

TYPE CARRIER: VIDEO

RF FREQUENCY (GHZ): 23.275

RECEIVER IF BANDWIDTH (MHZ): 30.

CHANNEL LOADING: 1

CALCULATED CHANNEL SLOT (KHZ): 4000

SITE A: ROSSLYN

CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR

SITE B: WETA

ENGINEER: L THELANER

DATE: 6 JAN 86

SITE A: SITE B

TOWER HEIGHT	(FT)	130	300
MAIN ANTENNA HEIGHT	(FT)	130	300
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	6	6
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	49.7	49.7
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	2	2
WAVEGUIDE LOSS (EW220) 8.7 DB/100 (FT)	(DB)	.2	.2
STACKING LOSS	(DB)	1.0	1.0
RADOME LOSS	(DB)	.0	.0

OTHER LOSSES	(DB)	.0
PATH LENGTH	(MI)	3.2
SPACE LOSS	(DB)	134.0
FIELD MARGIN (LOSS)	(DB)	1.0
TOTAL LOSSES	(DB)	137.4
TOTAL GAINS	(DB)	99.4
NET PATH LOSS	(DB)	38.0
TRANSMITTER OUTPUT POWER	(DBM)	18.0
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-20.0
RECEIVER THRESHOLD 10-3 BER	(DBM)	-76.0
THERMAL FADE MARGIN	(DB)	56.0

UNAVAILABILITY ONE-WAY		.000000001
UNAVAILABILITY ONE-WAY	SECONDS	.0
RELIABILITY NON DIVERSITY		100.000000

PATH 2 WAY UNAVAILABILITY		.000000002
PATH 2 WAY UNAVAILABILITY	SECONDS	.075
PATH 2-WAY RELIABILITY		100.000000

LONG HAUL OBJECTIVE 2-WAY	SECONDS	2.500
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RAINFALL OUTAGE CALCULATION

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=====
TRANSMIT SITE      : ROSSLYN
RECEIVE SITE       : WETA

-RAIN OUTAGE METHOD : U.S.
1st & 2nd RAIN RATES- MM/YR : 173 41
1st & 2nd RAIN TIMES- MIN/YR : 1 100
-FREQUENCY BAND-GHZ : 23.275
PATH DISTANCE -MI : 3.2
-FADE MARGIN IN DB : 56
WET RADOME LOSS-DB : 4

-POLARIZATION : HORIZONTAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR : 18.4

-POLARIZATION : VERTICAL
ANNUAL RAIN OUTAGE-MINUTES/YEAR : 10.7
```

NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON
EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES
ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE
OVER A PERIOD OF SEVERAL YEARS

RADIO PATH STUDY

Project: Sample

Company: DEMO

RACOM - Technical support

Author: Zdeněk KARMAZIN, ing.

E-mail: zdenek.karmazin@racom.eu

Date: August 29, 2014

Version: 1

1. INTRODUCTION

RACOM provides this RF Path Study to help establish reliable communications for your SCADA or Telemetry application. As a leading manufacturer of Radio modems, Microwave links and Industrial cellular routers, we have unparalleled expertise in the area of wireless communications. Our extensive RF and wireless communications experience provides us with the insight and foresight to ensure our product lines provide the most reliable communication links/systems. We conduct detailed radio path studies, to determine the feasibility of radio communications for your system. The study involves a digital terrain model, based on SRTM hgt and bil files (1 arc second - USA, 3 arc seconds - worldwide) as well as a Clutter 1 arc second Global Land Cover Characteristics (GLCC) model.

Path calculations are used to select a reliable mode for an application by optimizing the following:

- RipEX radio modem operation mode
- Repeater requirements
- Antenna/tower heights
- Antenna type and gain
- Coaxial feed line length
- RF network user bandwidth calculation

The RF path study was performed using the professional propagation software Pathloss v. 5.1.

Pathloss is a comprehensive RF planning tool that is well-suited to planning and optimizing Point to Point microwave links or Point to Multipoint UHF/VHF/SHF radio links operating in the 30 MHz to 100 GHz frequency range.

Pathloss uses terrain and land cover databases to calculate radio path attenuation for each individual radio link. Antennas and radio data are used to calculate suitable scenarios for radio linking. All location dependent parameters are determined from the site coordinates and ruggedness of terrain is automatically calculated.

The ITU-R P837-3 database is included. Rain attenuation calculations are based on site coordinates for all rain data-sources. The reflections and multipath modules use a constant gradient ray trace method as a precursor to determine if the path geometry supports specular reflection and the location of the reflective plane.

The degree of accuracy relies on the publicly available SRTM3 data-set used in the terrain model. The availability indicators have been calculated using current ITU-R P.530-15 and references.

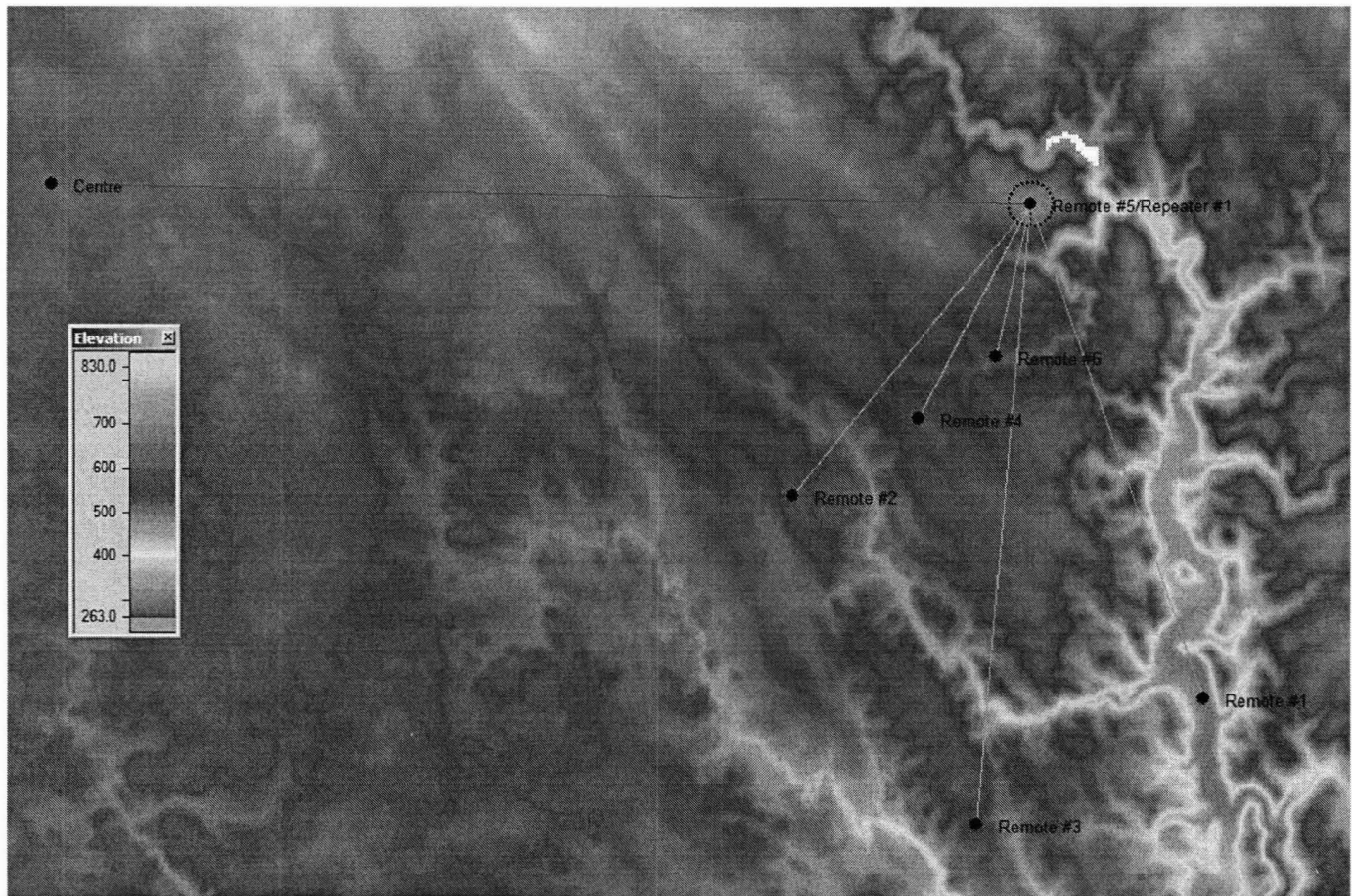
Notice:

RACOM provide these calculated values on an as-is basis. The study is intended to assist in your purchasing decisions by illustrating the capabilities of RipEX radio-modems.

3. Site list

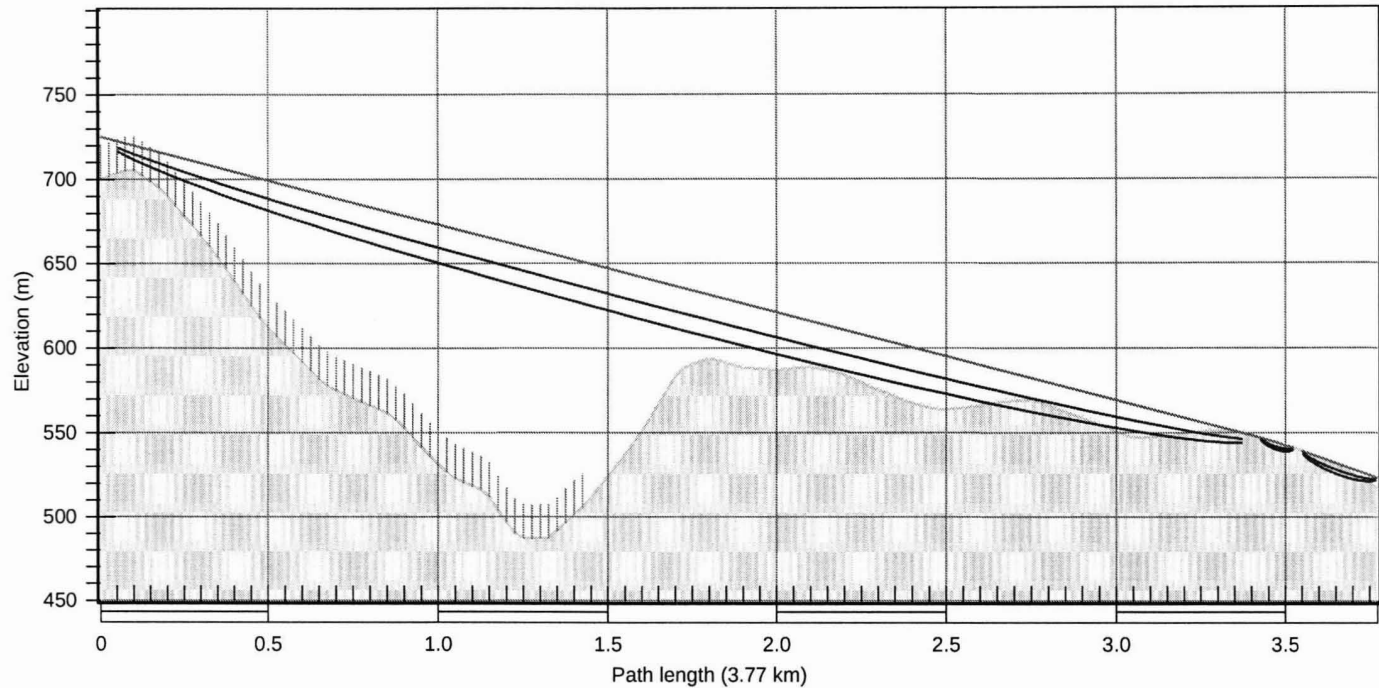
Site name	Latitude	Longitude	Antenna height above ground (m)
Centre	49 33 42.01 N	015 57 31.00 E	25
Remote #1	49 26 58.99 N	016 20 43.01 E	6
Remote #2	49 29 39.01 N	016 12 28.01 E	6
Remote #3	49 25 21.00 N	016 16 09.01 E	6
Remote #4	49 30 38.99 N	016 15 01.01 E	6
Remote #5/Repeater #1	49 33 27.00 N	016 17 16.01 E	25
Remote #6	49 31 27.98 N	016 16 34.00 E	6

4. Network topology



5. Individual links calculation

Transmission summary (Remote #5/Repeater #1-Remote #6.pl5)

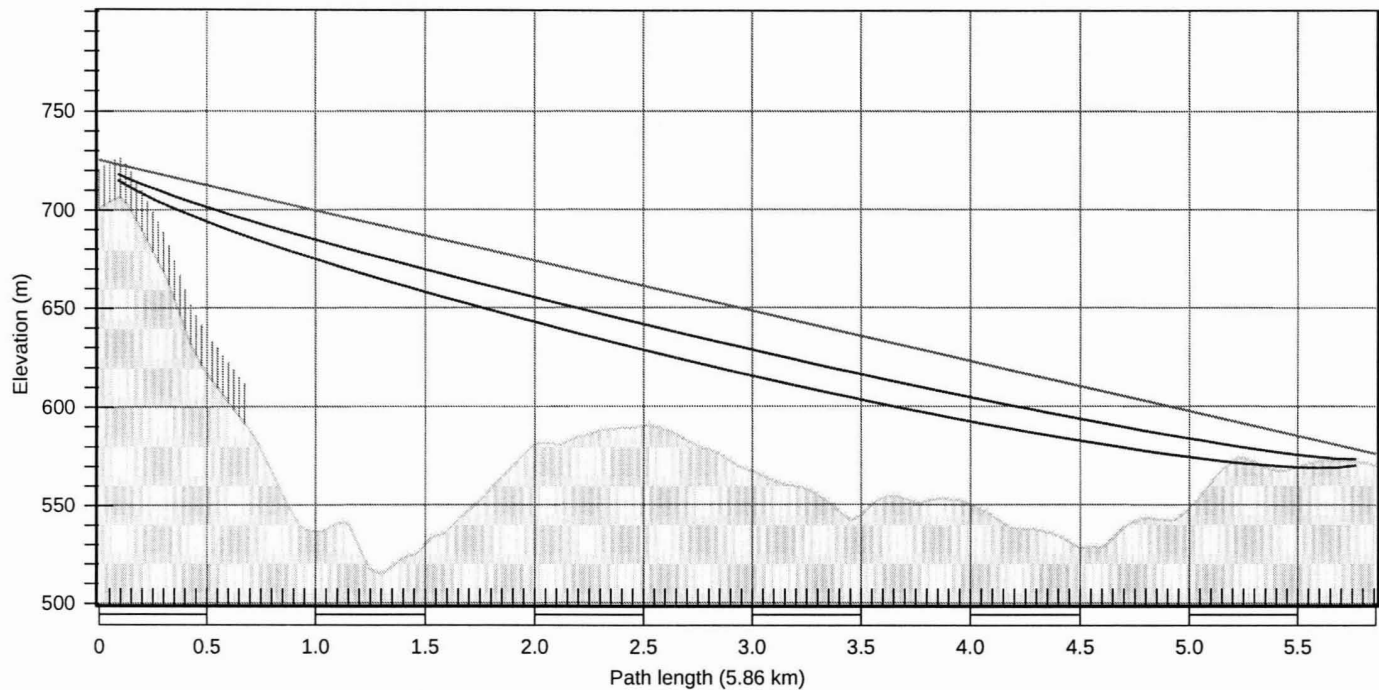


F = 406.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Remote #5/Repeater #1	Remote #6
Latitude	49 33 27.00 N	49 31 27.98 N
Longitude	016 17 16.01 E	016 16 34.00 E
True azimuth (°)	192.94	12.93
Vertical angle (°)	-2.99	4.09
Elevation (m)	700.34	517.34
Antenna model	Douple dipole (TR)	SA400.5 (TR)
Antenna gain (dBd)	5.10	6.00
Antenna height (m)	25.00	6.00
TX line model	RG-213	RG-213
TX line length (m)		8.00
TX line loss (dB)		1.22
Connector loss (dB)	0.50	0.50
Frequency (MHz)	406.00	

Polarization	Vertical	
Path length (km)	3.78	
Free space loss (dB)	96.18	
Atmospheric absorption loss (dB)	0.01	
Radio model	RipEX	RipEX
TX power (watts)	5.01	5.01
Receive signal (dBm)	-88.39	-88.39
Thermal fade margin (dB)	22.61	22.61
Annual location availability (%)	100.00000	100.00000
Annual multipath availability (%)	99.45303	99.45303

Transmission summary (Remote #5Repeater #1-Remote #4.pl5)

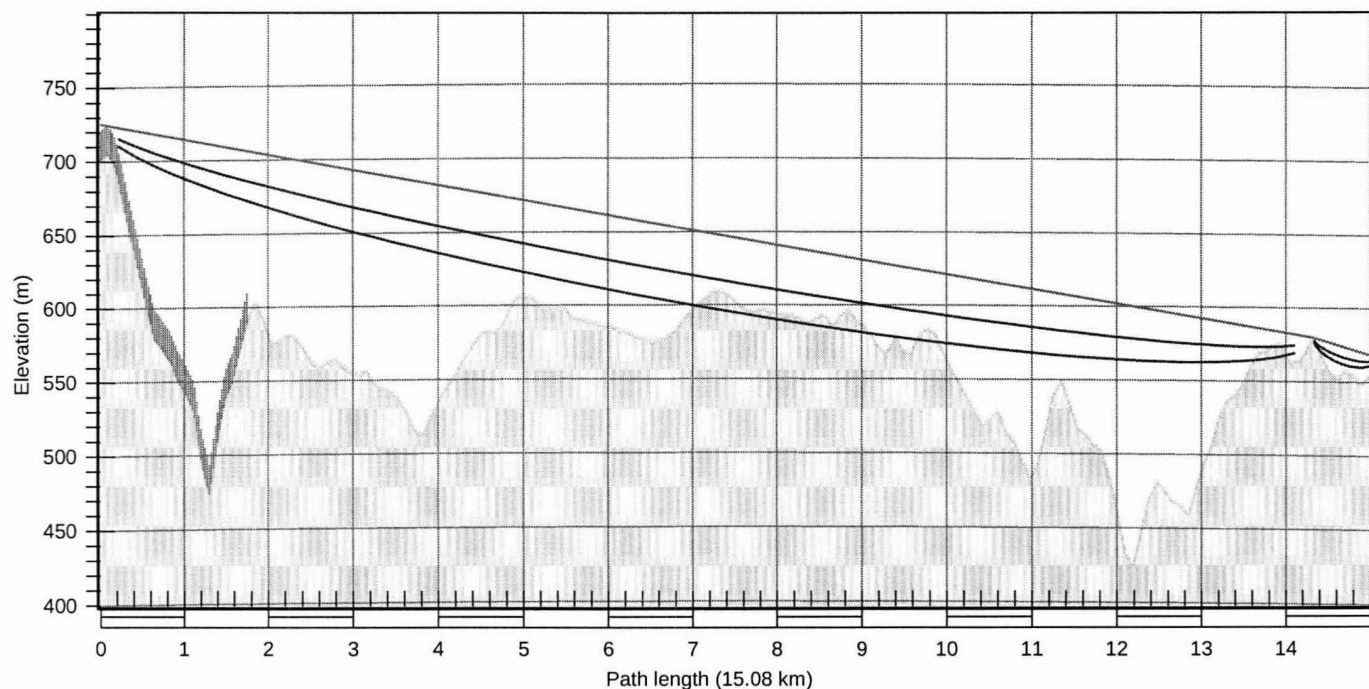


F = 406.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Remote #5/Repeater #1	Remote #4
Latitude	49 33 27.00 N	49 30 38.99 N
Longitude	016 17 16.01 E	016 15 01.01 E
True azimuth (°)	207.62	27.59
Vertical angle (°)	-1.48	1.44
Elevation (m)	700.34	570.00
Antenna model	Double dipole (TR)	SA400.5 (TR)
Antenna gain (dBd)	5.10	6.00
Antenna height (m)	25.00	6.00

TX line model	RG-213	RG-213
TX line length (m)		8.00
TX line loss (dB)		1.22
Connector loss (dB)	0.50	0.50
Frequency (MHz)	406.00	
Polarization	Vertical	
Path length (km)	5.86	
Free space loss (dB)	100.00	
Atmospheric absorption loss (dB)	0.02	
Radio model	RipEX	RipEX
TX power (watts)	5.01	5.01
Receive signal (dBm)	-59.26	-59.26
Thermal fade margin (dB)	51.74	51.74
Annual location availability (%)	100.00000	100.00000
Annual multipath availability (%)	99.99933	99.99933

Transmission summary (Remote #5Repeater #1-Remote #3.pl5)

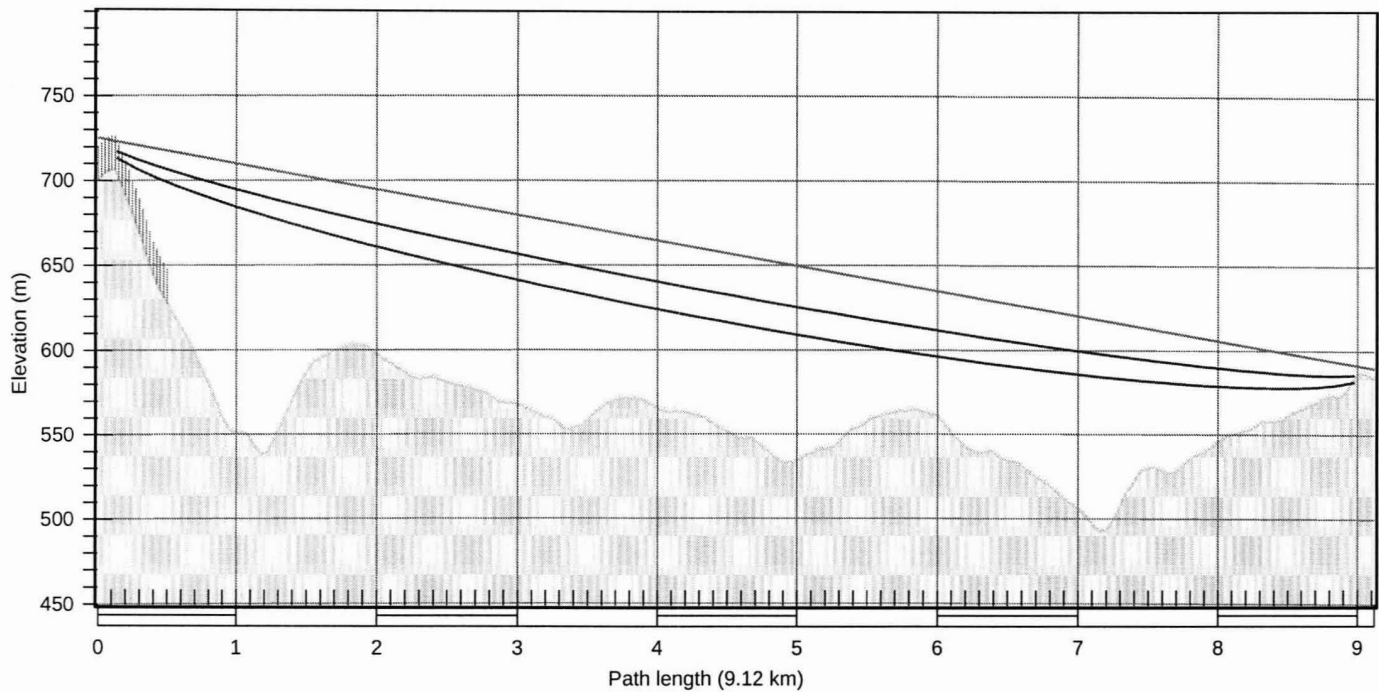


F = 406.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Remote #5/Repeater #1	Remote #3
Latitude	49 33 27.00 N	49 25 21.00 N
Longitude	016 17 16.01 E	016 16 09.01 E

True azimuth (°)	185.14	5.12
Vertical angle (°)	-0.63	0.98
Elevation (m)	700.34	560.99
Antenna model	Douple dipole (TR)	SA400.5 (TR)
Antenna gain (dBd)	5.10	6.00
Antenna height (m)	25.00	6.00
TX line model	RG-213	RG-213
TX line length (m)		8.00
TX line loss (dB)		1.22
Connector loss (dB)	0.50	0.50
Frequency (MHz)	406.00	
Polarization	Vertical	
Path length (km)	15.08	
Free space loss (dB)	108.20	
Atmospheric absorption loss (dB)	0.04	
Radio model	RipEX	RipEX
TX power (watts)	5.01	5.01
Receive signal (dBm)	-76.90	-76.90
Thermal fade margin (dB)	34.10	34.10
Annual location availability (%)	100.00000	100.00000
Annual multipath availability (%)	99.96115	99.96115

Transmission summary (Remote #5Repeater #1-Remote #2.pl5)

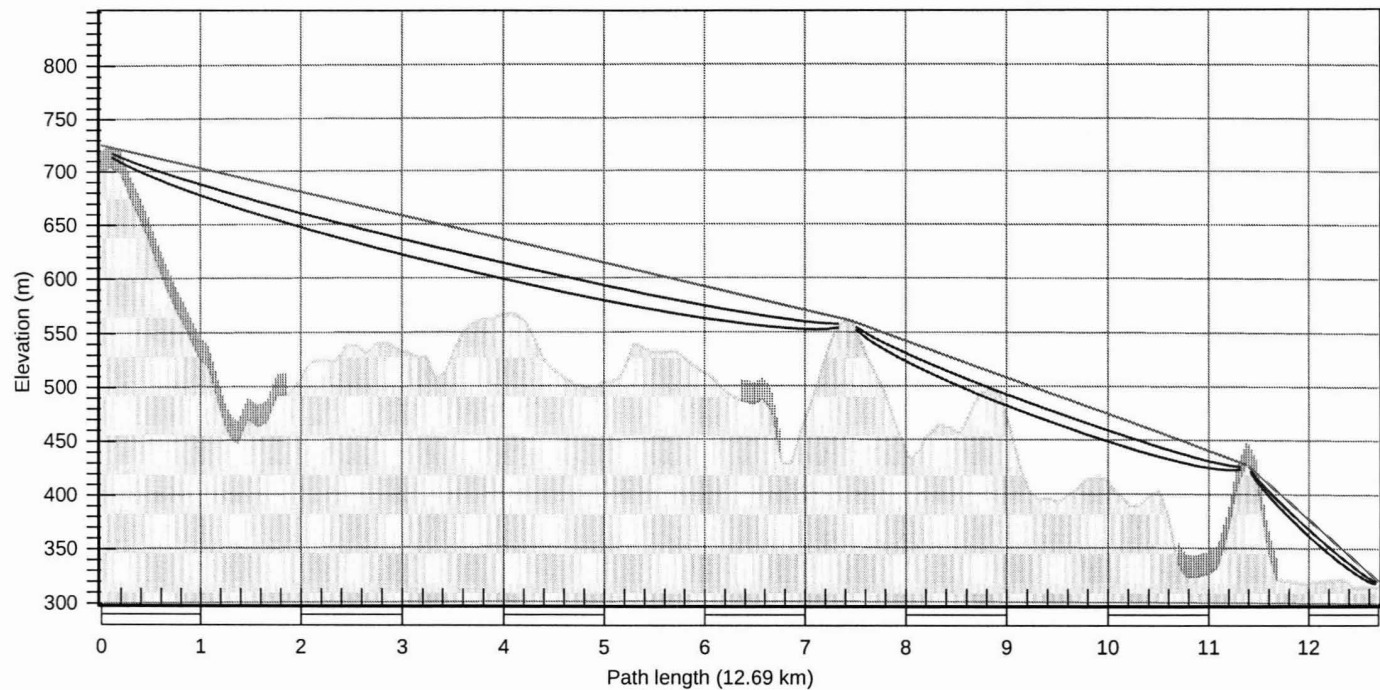


F = 406.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Remote #5/Repeater #1	Remote #2
Latitude	49 33 27.00 N	49 29 39.01 N
Longitude	016 17 16.01 E	016 12 28.01 E
True azimuth (°)	219.46	39.40
Vertical angle (°)	-0.88	0.82
Elevation (m)	700.34	583.67
Antenna model	Double dipole (TR)	SA400.5 (TR)
Antenna gain (dBd)	5.10	6.00
Antenna height (m)	25.00	6.00
TX line model	RG-213	RG-213
TX line length (m)		8.00
TX line loss (dB)		1.22
Connector loss (dB)	0.50	0.50
Frequency (MHz)	406.00	
Polarization	Vertical	
Path length (km)	9.12	
Free space loss (dB)	103.84	
Atmospheric absorption loss (dB)	0.02	
Radio model	RipEX	RipEX
TX power (watts)	5.01	5.01
Receive signal (dBm)	-64.42	-64.42

Thermal fade margin (dB)	46.58	46.58
Annual location availability (%)	100.00000	100.00000
Annual multipath availability (%)	99.99780	99.99780

Transmission summary (Remote #5Repeater #1-Remote #1.pl5)

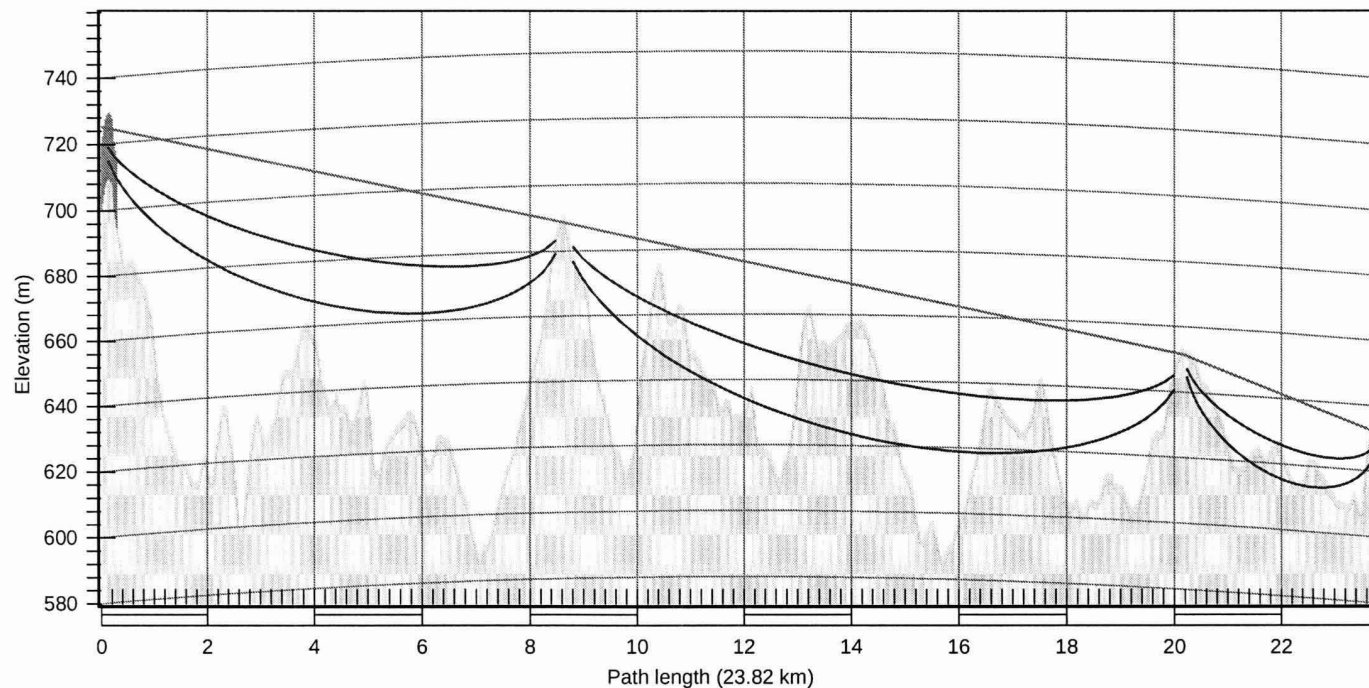


F = 406.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Remote #5/Repeater #1	Remote #1
Latitude	49 33 27.00 N	49 26 58.99 N
Longitude	016 17 16.01 E	016 20 43.01 E
True azimuth (°)	160.82	340.86
Vertical angle (°)	-1.29	4.69
Elevation (m)	700.34	314.33
Antenna model	Douple dipole (TR)	SA400.5 (TR)
Antenna gain (dBd)	5.10	6.00
Antenna height (m)	25.00	6.00
TX line model	RG-213	RG-213
TX line length (m)		8.00
TX line loss (dB)		1.22
Connector loss (dB)	0.50	0.50
Frequency (MHz)	406.00	
Polarization	Vertical	
Path length (km)	12.70	

Free space loss (dB)	106.71	
Atmospheric absorption loss (dB)	0.03	
Radio model	RipEX	RipEX
TX power (watts)	5.01	5.01
Receive signal (dBm)	-119.79	-119.79
Thermal fade margin (dB)	-8.79	-8.79

Transmission summary (Remote #5Repeater #1-Centre.pl5)



F = 406.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Remote #5/Repeater #1	Centre
Latitude	49 33 27.00 N	49 33 42.01 N
Longitude	016 17 16.01 E	015 57 31.00 E
True azimuth (°)	271.24	90.99
Vertical angle (°)	-0.27	0.30
Elevation (m)	700.34	625.66
Antenna model	Double dipole (TR)	SA400.5 (TR)
Antenna gain (dBd)	5.10	6.00
Antenna height (m)	25.00	6.00
TX line model	RG-213	RG-213
TX line length (m)		8.00
TX line loss (dB)		1.22
Connector loss (dB)	0.50	0.50

Frequency (MHz)	406.00	
Polarization	Vertical	
Path length (km)	23.82	
Free space loss (dB)	112.18	
Atmospheric absorption loss (dB)	0.06	
Radio model	RipEX	RipEX
TX power (watts)	5.01	5.01
Receive signal (dBm)	-94.85	-94.85
Thermal fade margin (dB)	16.15	16.15
Annual location availability (%)	99.99729	99.99729
Annual multipath availability (%)	97.60052	97.60052

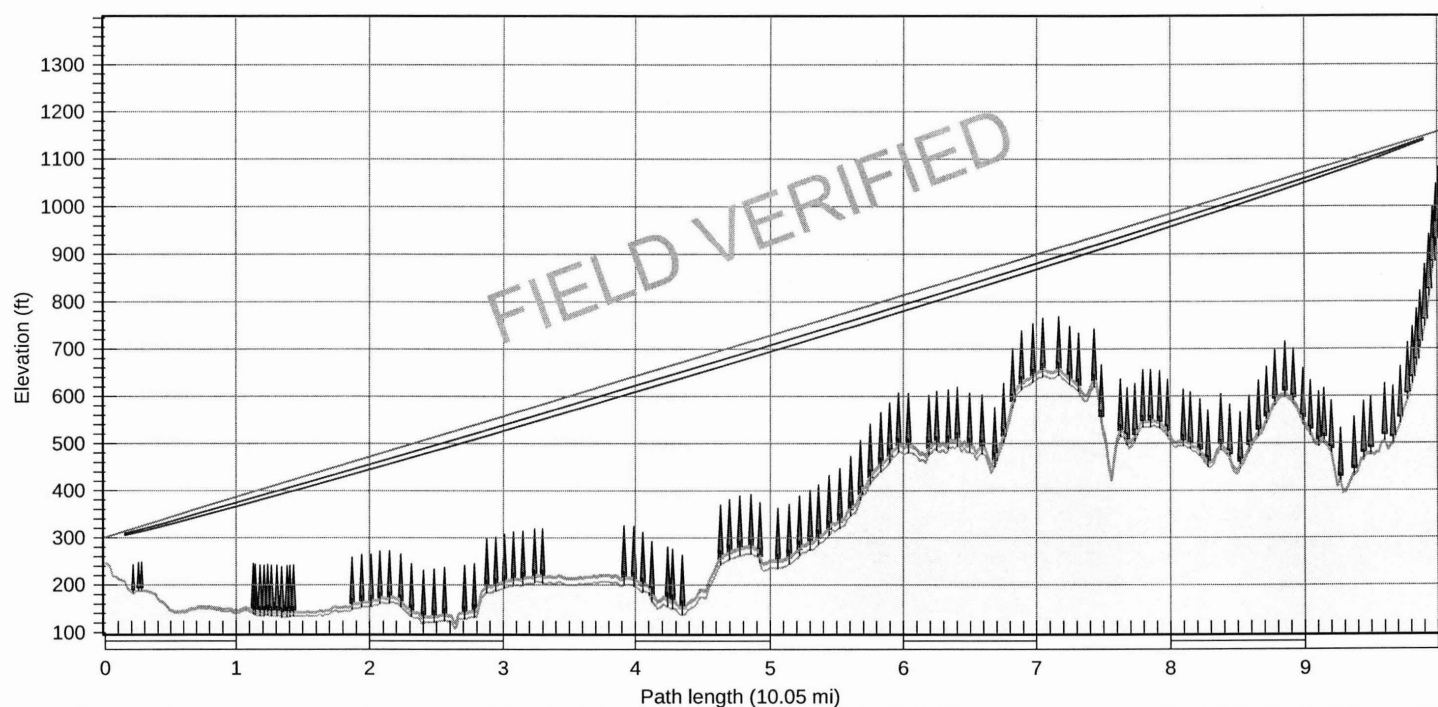
6. Summary & Recommendations

Radio path		Antenna model		Radio model	TX power (watts)	Main receive signal (dBm)	Thermal fade margin (dB)
Remote #5/ Repeater #1	Centre	Double Double dipole OV400.2R (TR)	Directional YAGI SA400.5 (TR)	RipEX	5	-94,85	16,15
	Remote #1					-119,79	-8,79
	Remote #2					-64,42	46,58
	Remote #3					-76,9	34,1
	Remote #4					-59,26	51,74
	Remote #6					-88,39	22,61

Link signal strength must have a 20 dBm fade margin as an absolute minimum, to provide better than 99% communications reliability. Highly reliable systems (99.9% reliability) have fade margins of 25 dBm or higher: the signal strength must be 25 dB higher than radio receiver sensitivity.

Direct links would result in successful and reliable communications - signal strength (RSS) numbers would be between -40 dBm and -95 dBm for 2 level CPFSK. Calculated signal strengths over -95 dBm would not result in reliable communications.

If the path is longer than 10 kms, we recommend verification of link availability by field test.



IOC Tower - A	
Latitude	45 21 53.70 N
Longitude	122 48 14.90 W
Azimuth	31.24°
Elevation	246 ft ASL
Antenna CL	55.0 ft AGL

Frequency (MHz) = 11200.0
K = 1.33, 1.00
%F1 = 100.00, 60.00

Healy Heights	
Latitude	45 29 21.40 N
Longitude	122 41 48.60 W
Azimuth	211.32°
Elevation	1025 ft ASL
Antenna CL	135.0 ft AGL

11'GHz - MHSB/HP Radio



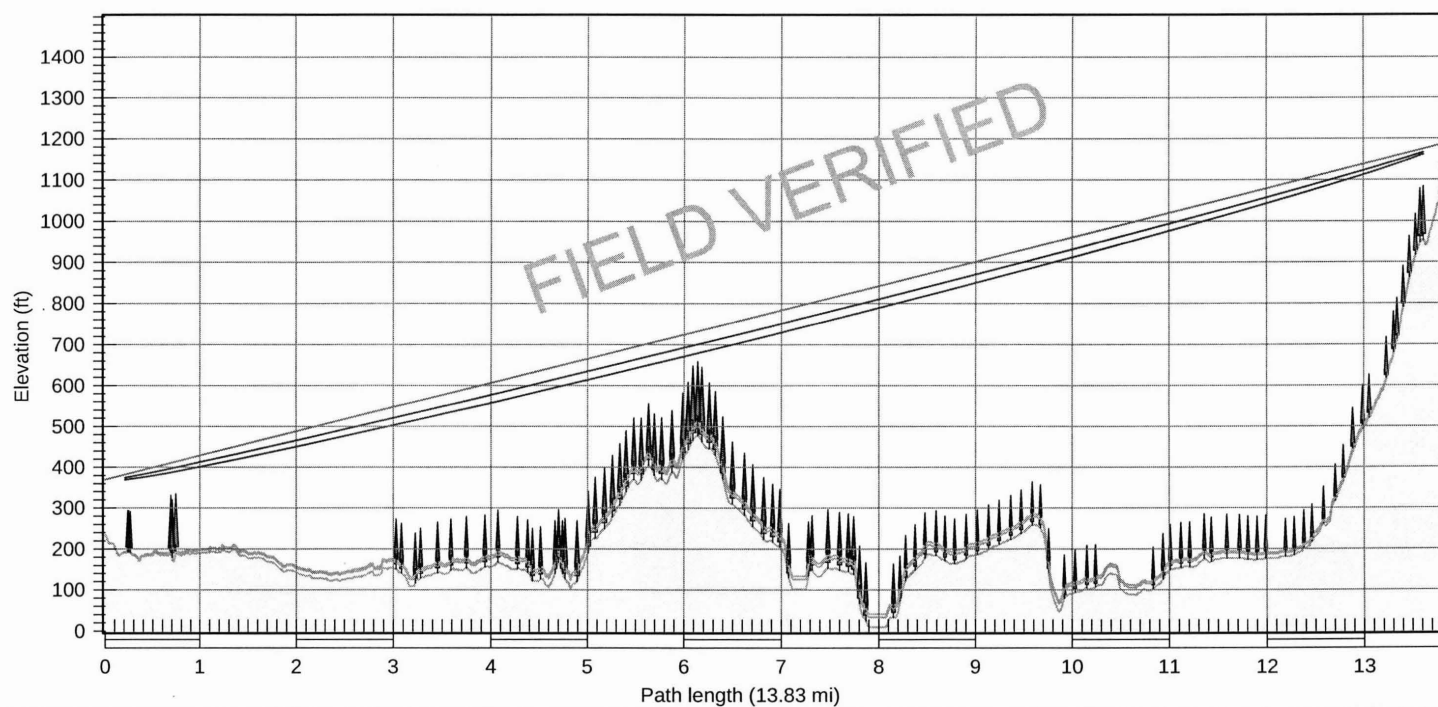
	IOC Tower - A	Healy Heights
Latitude	45 21 53.70 N	45 29 21.40 N
Longitude	122 48 14.90 W	122 41 48.60 W
True azimuth (°)	31.24	211.32
Vertical angle (°)	0.87	-0.98
Elevation (ft)	246.00	1025.00
Antenna model	HP8-107-P1A (TR)	VHLP6-11W-6WH/A (TR)
Antenna gain (dBi)	46.40	44.00
Antenna height (ft)	55.00	135.00
TX line model	EW90	EW90
TX line unit loss (dB/100 ft)	3.08	3.08
TX line length (ft)	105.00	195.00
TX line loss (dB)	3.23	6.01
Connector loss (dB)	0.40	0.40
TX filter loss (dB)	2.70	2.70
RX filter loss (dB)	2.90	2.90
Frequency (MHz)	11200.00	
Polarization	Vertical	
Path length (mi)	10.05	
Free space loss (dB)	137.63	
Atmospheric absorption loss (dB)	0.26	
Net path loss (dB)	63.12	63.12
Configuration	HSB (1:10) - Stacking	HSB (1:10) - Stacking
Radio model	95MPR11-L1024A40-294	95MPR11-L1024A40-294
Emission designator	40M0D7W	40M0D7W
Climatic factor	1.00	
Terrain roughness (ft)	95.45	
C factor	0.43	
Average annual temperature (°F)	47.56	
Fade occurrence factor (Po)	1.227E-002	
Polarization	Vertical	
Rain region	Portland, Oregon	

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1024 294	30.00	30.00	-58.50	-58.50	70.07	64.89	-33.12	-33.12	25.38	25.38	25.38	25.38
512 267	31.00	31.00	-61.70	-61.70	71.07	65.89	-32.12	-32.12	29.58	29.58	29.58	29.58
256 238	32.00	32.00	-65.10	-65.10	72.07	66.89	-31.12	-31.12	33.98	33.98	33.98	33.98
128 207	32.50	32.50	-68.10	-68.10	72.57	67.39	-30.62	-30.62	37.48	37.48	37.48	37.48
64 179	32.50	32.50	-71.00	-71.00	72.57	67.39	-30.62	-30.62	40.38	40.38	40.38	40.38
32 145	32.50	32.50	-73.40	-73.40	72.57	67.39	-30.62	-30.62	42.78	42.78	42.78	42.78
16 115	32.50	32.50	-76.80	-76.80	72.57	67.39	-30.62	-30.62	46.18	46.18	46.18	46.18
4 55	32.50	32.50	-87.50	-87.50	72.57	67.39	-30.62	-30.62	56.88	56.88	56.88	56.88

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1024 294	99.9964	99.9964	99.9992	99.9992	99.9999	99.9999	99.9982	99.9982
512 267	99.9986	99.9986	99.9997	99.9997	99.9999	99.9999	99.9993	0.0011
256 238	99.9995	99.9995	99.9999	99.9999	99.9999	99.9999	99.9997	0.0004
128 207	99.9998	99.9998	99.9999	99.9999	99.9999	99.9999	99.9999	0.0001
64 179	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0001
32 145	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
16 115	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
4 55	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000

Multipath fading method - Vigants - Barnett

Rain fading method - Crane



IOC Tower - B
Latitude 45 21 59.50 N
Longitude 122 48 16.90 W
Azimuth 64.64°
Elevation 235 ft ASL
Antenna CL 135.0 ft AGL

Frequency (MHz) = 6175.0
K = 1.33, 1.00
%F1 = 100.00, 60.00

Mt Scott
Latitude 45 27 07.30 N
Longitude 122 32 51.30 W
Azimuth 244.82°
Elevation 1057 ft ASL
Antenna CL 130.0 ft AGL

64.53°

FCC AREA FORCE
64.56°
244.75°

244.53°

6 GHz - MHSB/Standard Power Radio



	IOC Tower - B	Mt Scott
Latitude	45 21 59.50 N	45 27 07.30 N
Longitude	122 48 16.90 W	122 32 51.30 W
True azimuth (°)	64.64	244.82
Vertical angle (°)	0.57	-0.72
Elevation (ft)	235.00	1057.00
Antenna model	HP8-59-D3A (TR)	VHLP6-6W-6WH/B (TR)
Antenna gain (dBi)	41.50	39.30
Antenna height (ft)	135.00	130.00
TX line model	EW63	EW63
TX line unit loss (dB/100 ft)	1.47	1.47
TX line length (ft)	185.00	175.00
TX line loss (dB)	2.72	2.57
Connector loss (dB)	0.40	0.40
TX filter loss (dB)	2.00	2.00
RX filter loss (dB)	2.60	2.60
Frequency (MHz)	6175.00	
Polarization	Vertical	
Path length (mi)	13.83	
Free space loss (dB)	135.23	
Atmospheric absorption loss (dB)	0.19	
Net path loss (dB)	65.31	65.31
Configuration	HSB (1:10) - Stacking	HSB (1:10) - Stacking
Radio model	95MPR61-L1024A30-227	95MPR61-L1024A30-227
Emission designator	30M0D7W	30M0D7W
Climatic factor	1.00	
Terrain roughness (ft)	89.38	
C factor	0.47	
Average annual temperature (°F)	48.51	
Fade occurrence factor (Po)	1.920E-002	

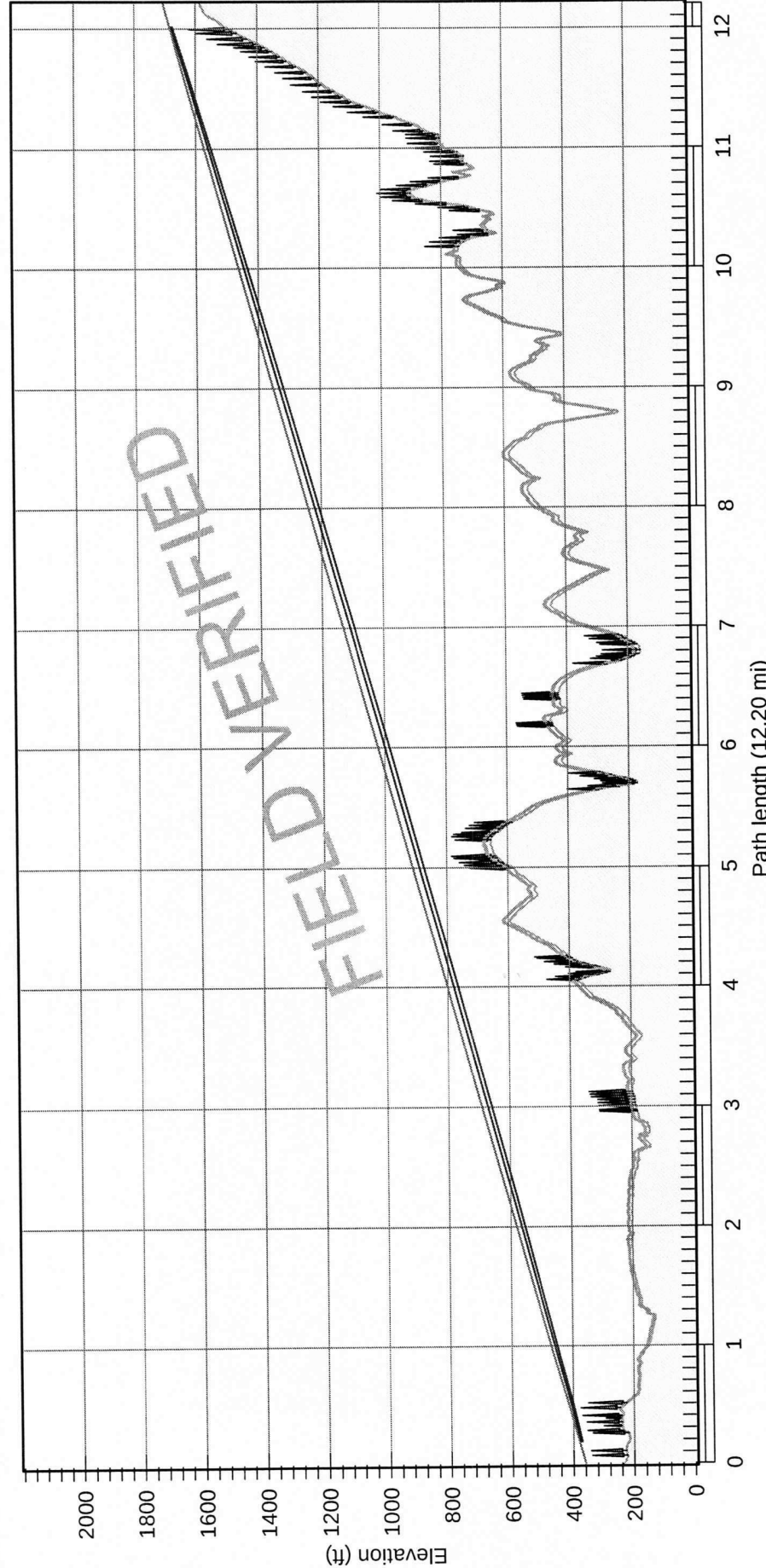
6 GHz - MHSB/Standard Power Radio



	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1024 227	31.50	31.50	-60.50	-60.50	67.88	65.83	-33.81	-33.81	26.69	26.69	26.69	26.69
512 206	31.50	31.50	-63.70	-63.70	67.88	65.83	-33.81	-33.81	29.89	29.89	29.89	29.89
256 183	32.50	32.50	-67.10	-67.10	68.88	66.83	-32.81	-32.81	34.29	34.29	34.29	34.29
128 161	32.50	32.50	-70.10	-70.10	68.88	66.83	-32.81	-32.81	37.29	37.29	37.29	37.29
64 136	32.50	32.50	-73.00	-73.00	68.88	66.83	-32.81	-32.81	40.19	40.19	40.19	40.19
32 113	32.50	32.50	-74.90	-74.90	68.88	66.83	-32.81	-32.81	42.09	42.09	42.09	42.09
16 90	32.50	32.50	-78.30	-78.30	68.88	66.83	-32.81	-32.81	45.49	45.49	45.49	45.49
4 43	32.50	32.50	-89.00	-89.00	68.88	66.83	-32.81	-32.81	56.19	56.19	56.19	56.19

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1024 227	99.9959	99.9959	99.9990	99.9990			99.9980	99.9980
512 206	99.9980	99.9980	99.9995	99.9995			99.9990	0.0010
256 183	99.9993	99.9993	99.9998	99.9998			99.9996	0.0006
128 161	99.9996	99.9996	99.9999	99.9999			99.9998	0.0002
64 136	99.9998	99.9998	99.9999	99.9999			99.9999	0.0001
32 113	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
16 90	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
4 43	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000

Multipath fading method - Vigants - Barnett



Bald Peak
 Latitude 45 23 35.50 N
 Longitude 123 03 08.90 W
 Azimuth 98.59°
 Elevation 1585 ft ASL
 Antenna CL 120.0 ft AGL

Frequency (MHz) = 11200.0
 K = 1.33, 1.00
 %F1 = 100.00, 60.00

IOC Tower - B
 Latitude 45 21 59.50 N
 Longitude 122 48 16.90 W
 Azimuth 278.77°
 Elevation 235 ft ASL
 Antenna CL 125.0 ft AGL

11 GHz - MHSB/HP Radio

	IOC Tower - B	Bald Peak
Latitude	45 21 59.50 N	45 23 35.50 N
Longitude	122 48 16.90 W	123 03 08.90 W
True azimuth (°)	278.77	98.59
Vertical angle (°)	1.13	-1.26
Elevation (ft)	235.00	1585.00
Antenna model	HP8-107-P1A (TR)	HP8-107-P1A (TR)
Antenna gain (dBi)	46.40	46.40
Antenna height (ft)	125.00	120.00
TX line model	EW90	EW90
TX line unit loss (dB/100 ft)	3.08	3.08
TX line length (ft)	175.00	170.00
TX line loss (dB)	5.39	5.24
Connector loss (dB)	0.40	0.40
TX filter loss (dB)	2.70	2.70
RX filter loss (dB)	2.90	2.90
Frequency (MHz)	11200.00	
Polarization	Vertical	
Path length (mi)	12.20	
Free space loss (dB)	139.31	
Atmospheric absorption loss (dB)	0.31	
Net path loss (dB)	63.85	63.85
Configuration	HSB (1:10) - Stacking	HSB (1:10) - Stacking
Radio model	95MPR11-L1024A40-294	95MPR11-L1024A40-294
Emission designator	40M0D7W	40M0D7W
Climatic factor	1.00	
Terrain roughness (ft)	140.00	
C factor	0.26	
Average annual temperature (°F)	48.51	
Fade occurrence factor (Po)	1.334E-002	
Polarization	Vertical	
Rain region	Portland, Oregon	

11 GHz - MHSB/HP Radio

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1024 294	30.00	30.00	-58.50	-58.50	67.91	68.06	-33.85	-33.85	24.65	24.65	24.65	24.65
512 267	31.00	31.00	-61.70	-61.70	68.91	69.06	-32.85	-32.85	28.85	28.85	28.85	28.85
256 238	32.00	32.00	-65.10	-65.10	69.91	70.06	-31.85	-31.85	33.25	33.25	33.25	33.25
128 207	32.50	32.50	-68.10	-68.10	70.41	70.56	-31.35	-31.35	36.75	36.75	36.75	36.75
64 179	32.50	32.50	-71.00	-71.00	70.41	70.56	-31.35	-31.35	39.65	39.65	39.65	39.65
32 145	32.50	32.50	-73.40	-73.40	70.41	70.56	-31.35	-31.35	42.05	42.05	42.05	42.05
16 115	32.50	32.50	-76.80	-76.80	70.41	70.56	-31.35	-31.35	45.45	45.45	45.45	45.45
4 55	32.50	32.50	-87.50	-87.50	70.41	70.56	-31.35	-31.35	56.15	56.15	56.15	56.15

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1024 294	99.9954	99.9954	99.9989	99.9989	99.9998	99.9998	99.9976	99.9976
512 267	99.9982	99.9982	99.9996	99.9996	99.9999	99.9999	99.9991	0.0015
256 238	99.9994	99.9994	99.9998	99.9998	99.9999	99.9999	99.9997	0.0006
128 207	99.9997	99.9997	99.9999	99.9999	99.9999	99.9999	99.9998	0.0002
64 179	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0001
32 145	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
16 115	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
4 55	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000

Multipath fading method - Vigants - Barnett

Rain fading method - Crane

Microwave Path Data Sheet

Page 1 of 1

COMSEARCH

19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)726-5655 www.comsearch.com

PCN Date: 04/19/2016

Job Number: 160419COMSAN11

Prev Job Num: 090607COMSAN03

RCN Number: 16041969

Administrative Information

118 FRWY CA
 City/County Los Angeles/LOS ANGELES
 Status / License Basis Engineering Proposal / PRIMARY OPERATION
 Call Sign WMJ206
 Licensee Code P5098
 Licensee Name Los Angeles SMSA Ltd. Partnership
 Radio Service / Station Class CF --- Point-to-Point Microwave, Common Carrier

OAT MTN CA

/LOS ANGELES
 Engineering Proposal / PRIMARY OPERATION
 WLV374
 P5098
 Los Angeles SMSA Ltd. Partnership
 FXO --- Fixed

Site Information

Latitude (NAD 83)	34 °16' 29.0" N	34 °19' 30.0" N
Longitude (NAD 83)	118 °33' 25.3" W	118 °34' 39.3" W
Ground Elevation (m/ft-AMSL)	358.14 / 1175.0	1036.32 / 3400.0
Antenna Structure Registration #		
Path Azimuth (°)	341.264	161.252
Path Length (km / miles)	5.889 / 3.660	

Transmit Antenna

87062A
 Manufacturer Commscope
 Model VHLPX4-18A
 Gain(dBi) / Beamwidth(°) / Tilt(°) 44.7 / 0.90 / 6.55
 Centerline (m / ft - AGL) 10.36 / 34.0

87062A
 Commscope
 VHLPX4-18A
 44.7 / 0.90 / -6.59
 10.36 / 34.0

Receive Antenna

Same As Transmit

Manufacturer
 Model
 Gain (dBi) / Beamwidth (°)
 Centerline (m / ft - AGL)

Diversity Receive Antenna

Manufacturer
 Model
 Gain (dBi) / Beamwidth (°)
 Centerline (m / ft - AGL)

Radio Information

X18B72¹
 Manufacturer ALCATEL-LUCENT USA, INC.
 Model 95MPR18-Q2048A30-257
 Model Description 9500 MPT-HC HQAM SP 2048QAM-4QAM
 Emission Designator / Modulation 30M0D7W 2048 QAM
 Loading 1 CH DIG 257000.000
 Stability (%) 0.001
 Power (dBm) 22.0
 Received Level (dBm) -40.9
 EIRP (dBm) 53.7
 Fixed Loss: Tx / Common (dB) 6.0 / 7.0
 Free Space Loss (dB) 133.3

X18B72¹
 ALCATEL-LUCENT USA, INC.
 95MPR18-Q2048A30-257
 9500 MPT-HC HQAM SP 2048QAM-4QAM
 30M0D7W 2048 QAM
 1 CH DIG 257000.000
 0.001
 Nominal Coordinated Maximum
22.0
-40.9
54.7

Transmit Frequencies (MHz)

19615.0000V(11)

18055.0000V(11)

Microwave Path Data Sheet
COMSEARCH

19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)726-5655 www.comsearch.com
Job Number: 160419COMSAN11

Date: 04/19/2016

Adaptive Modulation Prior Coordination Notice

One or more paths in this Prior Coordination Notice (PCN) use microwave radios with Adaptive Modulation. These paths can be identified by a numerical superscript notation immediately following the Radio Code on the path data sheet.

The superscript notation can be cross referenced to the corresponding table(s) below to identify the various modulation modes in which the microwave path will operate.

(1) Master Radio Code: X18B72 - ALCATEL-LUCENT USA, INC.

Pages: 1

Radio Code	Model	Model Description	Emission Designator	Modulation	Loading (Mbps)	Stability (%)	Coordinated Power (dBm)
TEAS40	95MPR18-Q2048A30-257	9500 MPT-HC HQAM ADAPTIVE MODULATION SP	30M0D7W	2048 QAM	1 CH DIG 257.0	0.001	16.0
TEAS41	95MPR18-Q1024A30-232	9500 MPT-HC HQAM ADAPTIVE MODULATION SP	30M0D7W	1024 QAM	1 CH DIG 232.0	0.001	16.0
TEAS42	95MPR18-Q512A30-209	9500 MPT-HC HQAM ADAPTIVE MODULATION SP	30M0D7W	512 QAM	1 CH DIG 209.0	0.001	16.0
TEAS43	95MPR18-Q256A30-186	9500 MPT-HC HQAM ADAPTIVE MODULATION SP	30M0D7W	256 QAM	1 CH DIG 186.0	0.001	18.0
TEAS44	95MPR18-Q128A30-163	9500 MPT-HC HQAM ADAPTIVE MODULATION SP	30M0D7W	128 QAM	1 CH DIG 163.0	0.001	19.0
TEAS45	95MPR18-Q64A30-139	9500 MPT-HC HQAM ADAPTIVE MODULATION SP	30M0D7W	64 QAM	1 CH DIG 139.0	0.001	19.0
TEAS46	95MPR18-Q32A30-109	9500 MPT-HC HQAM ADAPTIVE MODULATION SP	30M0D7W	32 QAM	1 CH DIG 109.0	0.001	20.0



Southern California Region
Transport Engineering
2430 Business Park Dr
Vista, CA 92081

Cellco Partnership – California CELLCA
Los Angeles SMSA Ltd. Partnership P5098
Verizon Wireless (VAW) LLC (Southern CA) VODAPH
WWC License L.L.C. – California WWCLCA

PCN #160419COMSAN11

118 FRWY to Oat Mt, Ca

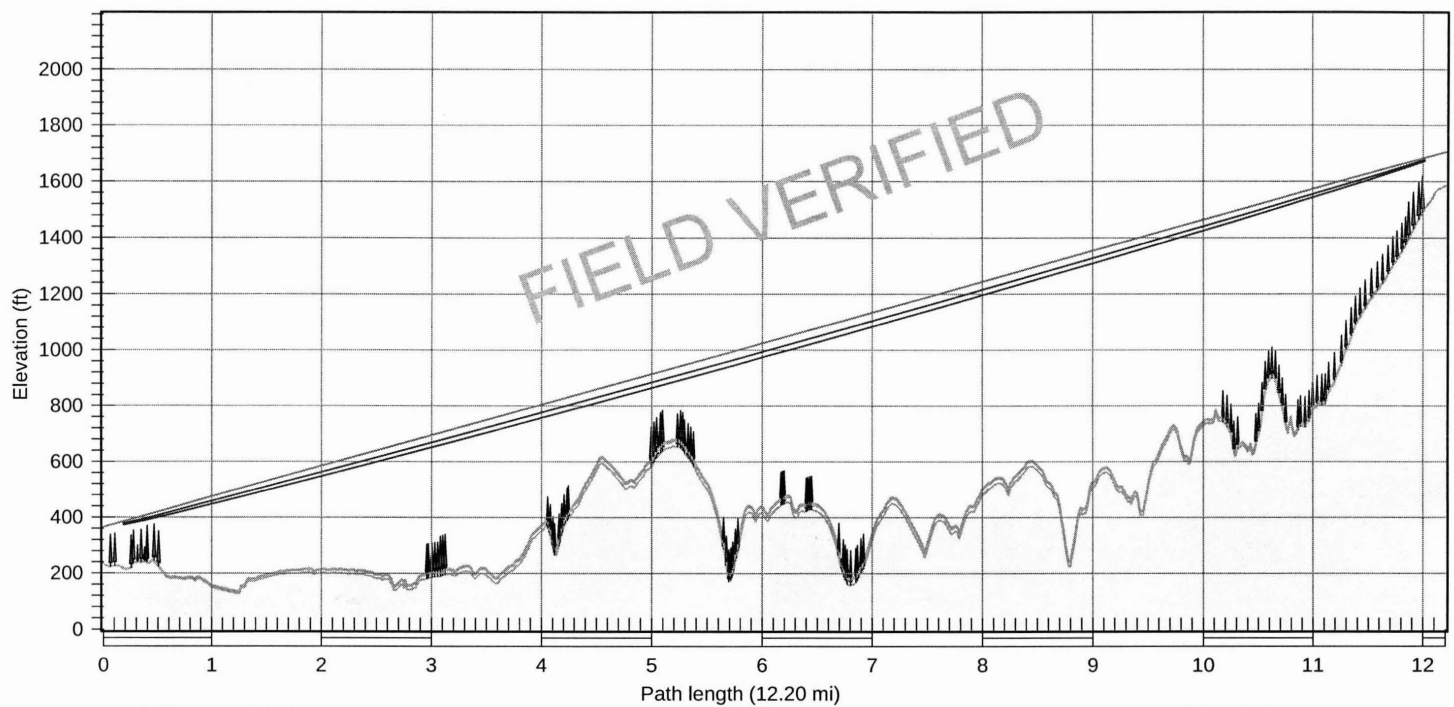
18GHz Adaptive Modulation Path

This is to certify that the above referenced path was properly prior coordinated with Adaptive Coding and Modulation and using all of the modulations listed in the applications. In addition, the minimum compliant modulation is 64 QAM. The predicted two-way availability with the compliant modulation for the path meets FCC requirements of 99.95% as shown below.

Path Name	Annual Two-Way Availability (%)	Modulation	Prediction Model
118 FRWY to Oat Mt, Ca	99.99911	64 QAM	Vigants-Barnett, Crane Rain

Respectfully submitted,

Jason Allen
Principle Engineer – Interconnect
Planning & Engineering
Verizon Wireless



IOC Tower - B
Latitude 45 21 59.50 N
Longitude 122 48 16.90 W
Azimuth 278.77°
Elevation 235 ft ASL
Antenna CL 130.0 ft AGL

Frequency (MHz) = 6175.0
K = 1.33, 1.00
%F1 = 100.00, 60.00

Bald Peak
Latitude 45 23 35.50 N
Longitude 123 03 08.90 W
Azimuth 98.59°
Elevation 1585 ft ASL
Antenna CL 120.0 ft AGL

6 GHz - MHSB/Standard Power Radio



	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1024 227	31.50	31.50	-60.50	-60.50	65.75	65.90	-34.76	-34.76	25.74	25.74	25.74	25.74
512 206	31.50	31.50	-63.70	-63.70	65.75	65.90	-34.76	-34.76	28.94	28.94	28.94	28.94
256 183	32.50	32.50	-67.10	-67.10	66.75	66.90	-33.76	-33.76	33.34	33.34	33.34	33.34
128 161	32.50	32.50	-70.10	-70.10	66.75	66.90	-33.76	-33.76	36.34	36.34	36.34	36.34
64 136	32.50	32.50	-73.00	-73.00	66.75	66.90	-33.76	-33.76	39.24	39.24	39.24	39.24
32 113	32.50	32.50	-74.90	-74.90	66.75	66.90	-33.76	-33.76	41.14	41.14	41.14	41.14
16 90	32.50	32.50	-78.30	-78.30	66.75	66.90	-33.76	-33.76	44.54	44.54	44.54	44.54
4 43	32.50	32.50	-89.00	-89.00	66.75	66.90	-33.76	-33.76	55.24	55.24	55.24	55.24

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1024 227	99.9980	99.9980	99.9995	99.9995			99.9990	99.9990
512 206	99.9991	99.9991	99.9998	99.9998			99.9995	0.0005
256 183	99.9997	99.9997	99.9999	99.9999			99.9998	0.0003
128 161	99.9998	99.9998	99.9999	99.9999			99.9999	0.0001
64 136	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
32 113	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
16 90	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
4 43	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000

Multipath fading method - Vigants - Barnett

6 GHz - MHSB/Standard Power Radio



	IOC Tower - B	Bald Peak
Latitude	45 21 59.50 N	45 23 35.50 N
Longitude	122 48 16.90 W	123 03 08.90 W
True azimuth (°)	278.77	98.59
Vertical angle (°)	1.13	-1.26
Elevation (ft)	235.00	1585.00
Antenna model	VHLP6-6W-6WH/B (TR)	VHLP6-6W-6WH/B (TR)
Antenna gain (dBi)	39.30	39.30
Antenna height (ft)	130.00	120.00
TX line model	EW63	EW63
TX line unit loss (dB/100 ft)	1.47	1.47
TX line length (ft)	180.00	170.00
TX line loss (dB)	2.65	2.50
Connector loss (dB)	0.40	0.40
TX filter loss (dB)	2.00	2.00
RX filter loss (dB)	2.60	2.60
Frequency (MHz)	6175.00	
Polarization	Vertical	
Path length (mi)	12.20	
Free space loss (dB)	134.14	
Atmospheric absorption loss (dB)	0.17	
Net path loss (dB)	66.26	66.26
Configuration	HSB (1:10) - Stacking	HSB (1:10) - Stacking
Radio model	95MPR61-L1024A30-227	95MPR61-L1024A30-227
Emission designator	30M0D7W	30M0D7W
Climatic factor	1.00	
Terrain roughness (ft)	140.00	
C factor	0.26	
Average annual temperature (°F)	48.51	
Fade occurrence factor (Po)	7.355E-003	

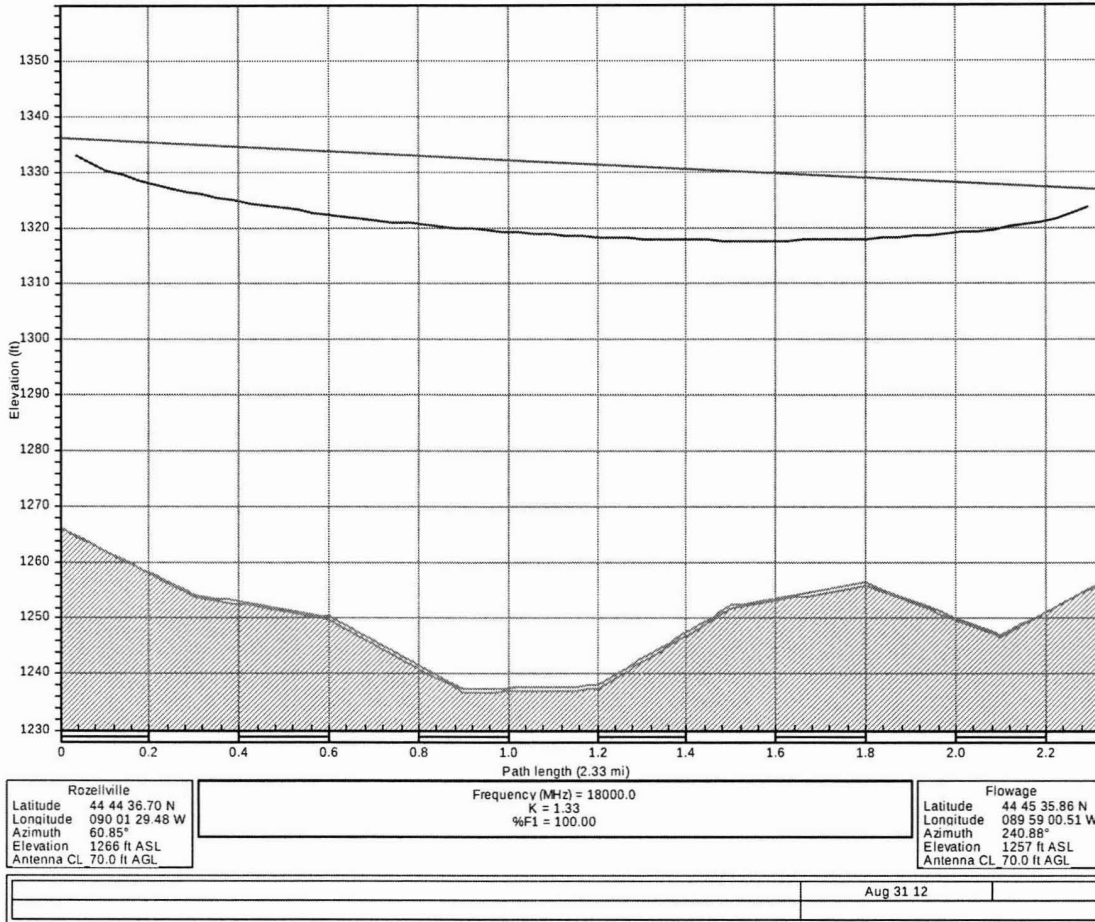
18 GHz, 1 ft antennas, 256 QAM 56 MHz for 375 Mbps FDX-99.99934%

	Rozellville	Flowage
Elevation (ft)	1266.25	1256.71
Latitude	44 44 36.70 N	44 45 35.86 N
Longitude	090 01 29.48 W	089 59 00.51 W
True azimuth (°)	60.85	240.88
Vertical angle (°)	-0.06	0.03
Antenna model	AD18G-1-S2	AD18G-1-S2
Antenna height (ft)	70.00	70.00
Antenna gain (dBi)	32.50	32.50
Frequency (MHz)	18000.00	
Polarization	Vertical	
Path length (mi)	2.33	
Free space loss (dB)	129.06	
Atmospheric absorption loss (dB)	0.20	
Net path loss (dB)	64.26	64.26
Radio model	ApexPlus18	ApexPlus18
TX power (watts)	0.08	0.08
TX power (dBm)	19.00	19.00
EIRP (dBm)	51.50	51.50
Emission designator	56M0D7W	56M0D7W
TX Channels	18000.0000V	18000.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-65.80	-65.80
RX signal (dBm)	-45.26	-45.26
Thermal fade margin (dB)	20.54	20.54
Dispersive fade margin (dB)	45.00	45.00
Dispersive fade occurrence factor	2.00	
Effective fade margin (dB)	20.51	20.51
Geoclimatic factor	1.70E-06	
Path inclination (mr)	0.78	
Fade occurrence factor (Po)	1.16E-05	
Average annual temperature (°F)	46.24	
Worst month - multipath (%)	99.99999	99.99999
(sec)	0.27	0.27
Annual - multipath (%)	100.00000	100.00000
(sec)	0.76	0.76
(% - sec)	100.00000 - 1.51	
Rain region	D1 Temp. Continent	
0.01% rain rate (mm/hr)	37.00	
Flat fade margin - rain (dB)	20.54	
Rain rate (mm/hr)	101.09	
Rain attenuation (dB)	20.54	
Annual rain (%-sec)	99.99935 - 205.74	
Annual multipath + rain (%-sec)	99.99934 - 207.25	

Fri, Aug 31 2012
 Rozellville-Flowage.pl4
 Reliability Method - ITU-R P.530-7/8
 Rain - ITU-R P530-7

Path calculations are estimates only, based on the information provided. Trango recommends that you have a formal site survey and a professional path analysis completed by a reputable source. No guarantee of path performance is expressed or implied.

Terrain profiles represent ground terrain only and do not consider trees, buildings, or other obstructions.



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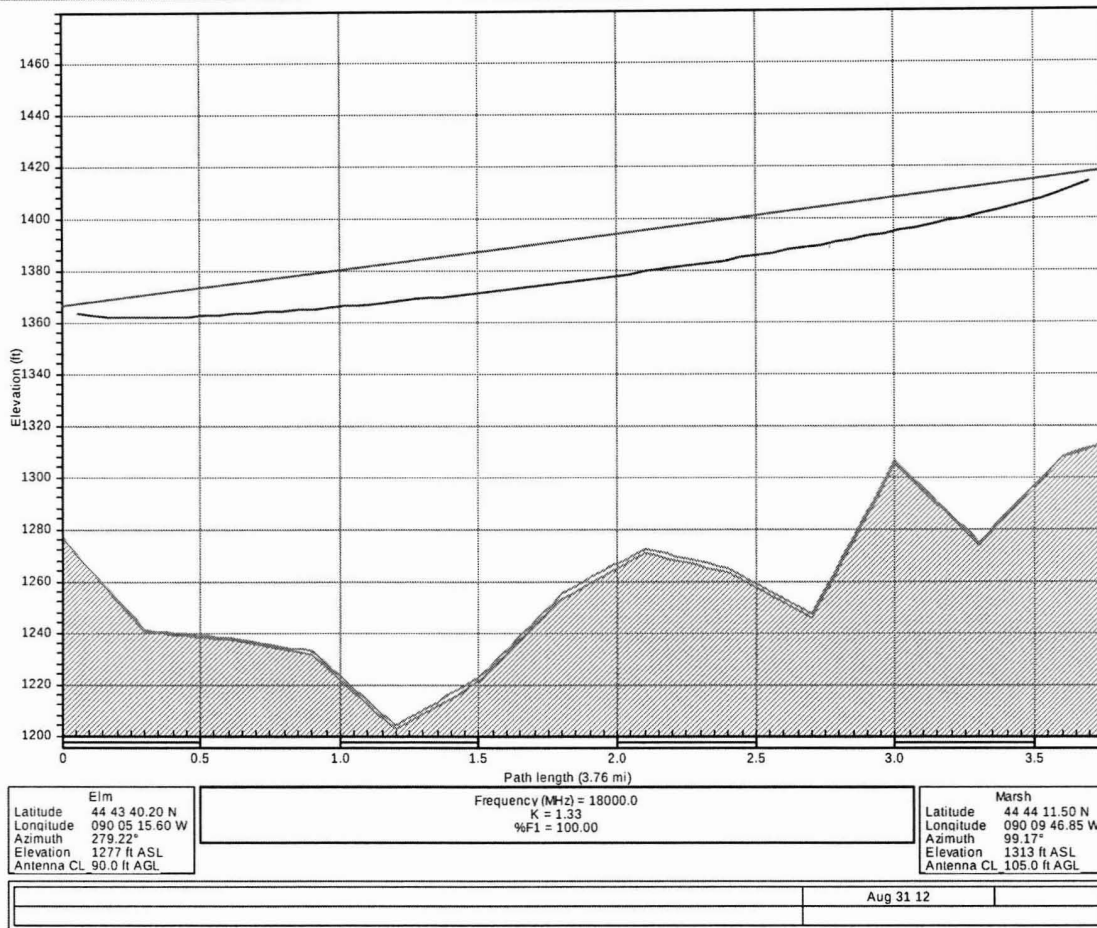
18 GHz, 2 ft antennas, 256 QAM 56 MHz for 375 Mbps FDX-99.99917%

	Elm	Marsh
Elevation (ft)	1276.64	1313.35
Latitude	44 43 40.20 N	44 44 11.50 N
Longitude	090 05 15.60 W	090 09 46.85 W
True azimuth (°)	279.22	99.17
Vertical angle (°)	0.13	-0.17
Antenna model	AD18G-2-S2	AD18G-2-S2
Antenna height (ft)	90.00	105.00
Antenna gain (dBi)	38.50	38.50
Frequency (MHz)	18000.00	
Polarization	Vertical	
Path length (mi)	3.76	
Free space loss (dB)	133.20	
Atmospheric absorption loss (dB)	0.33	
Net path loss (dB)	56.53	56.53
Radio model	ApexPlus18	ApexPlus18
TX power (watts)	0.08	0.08
TX power (dBm)	19.00	19.00
EIRP (dBm)	57.50	57.50
Emission designator	56M0D7W	56M0D7W
TX Channels	18000.0000V	18000.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-65.80	-65.80
RX signal (dBm)	-37.53	-37.53
Thermal fade margin (dB)	28.27	28.27
Dispersive fade margin (dB)	45.00	45.00
Dispersive fade occurrence factor	2.00	
Effective fade margin (dB)	28.09	28.09
Geoclimatic factor	1.70E-06	
Path inclination (mr)	2.61	
Fade occurrence factor (Po)	2.41E-05	
Average annual temperature (°F)	46.24	
Worst month - multipath (%)	100.00000	100.00000
(sec)	0.10	0.10
Annual - multipath (%)	100.00000	100.00000
(sec)	0.27	0.27
(% - sec)	100.00000 - 0.54	
Rain region	D1 Temp. Continent	
0.01% rain rate (mm/hr)	37.00	
Flat fade margin - rain (dB)	28.27	
Rain rate (mm/hr)	94.89	
Rain attenuation (dB)	28.27	
Annual rain (%-sec)	99.99917 - 261.22	
Annual multipath + rain (%-sec)	99.99917 - 261.77	

Fri, Aug 31 2012
 Elm-Marsh.pl4
 Reliability Method - ITU-R P.530-7/8
 Rain - ITU-R P530-7

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METHODOLOGY PATH PROFILE

The path design problem is to determine which values of equipment parameters meet link and network performance objectives at an economic cost. The primary equipment parameters are transmitter power, receiver sensitivity, and antenna height and antenna gain. The design solution is arrived at iteratively by changing parameters, then noticing the effect on path performance. The line of sight microwave link used for the project is situated between Epe at latitude $6^{\circ} 32'N$, longitude $3^{\circ} 52'E$ which is the transmitting end and Lagos located on latitude $6^{\circ} 26'N$ and longitude $3^{\circ} 27'E$ which is the receiving end over a path length of 48km.

To facilitate an accounting of parameter changes, path calculation sheets are used which list data

pertinent to link description, equipment losses and gains, and fading effects in a spreadsheet.

The basic method is to check whether a choice of antenna size and height, for given values of transmitter power and receiver sensitivity, results in a sufficient fade margin for a received signal to remain above a threshold level after losses due to the distance, terrain, obstructions, reflections, and other atmospheric effects. In general, there is not a unique solution to the path design problem, and cost is usually the deciding factor. The end result of the design is a microwave installation drawing set and bill of materials for radios, towers, transmission lines, antennas, materials, and their arrangement into a system that will satisfy the stated performance objectives

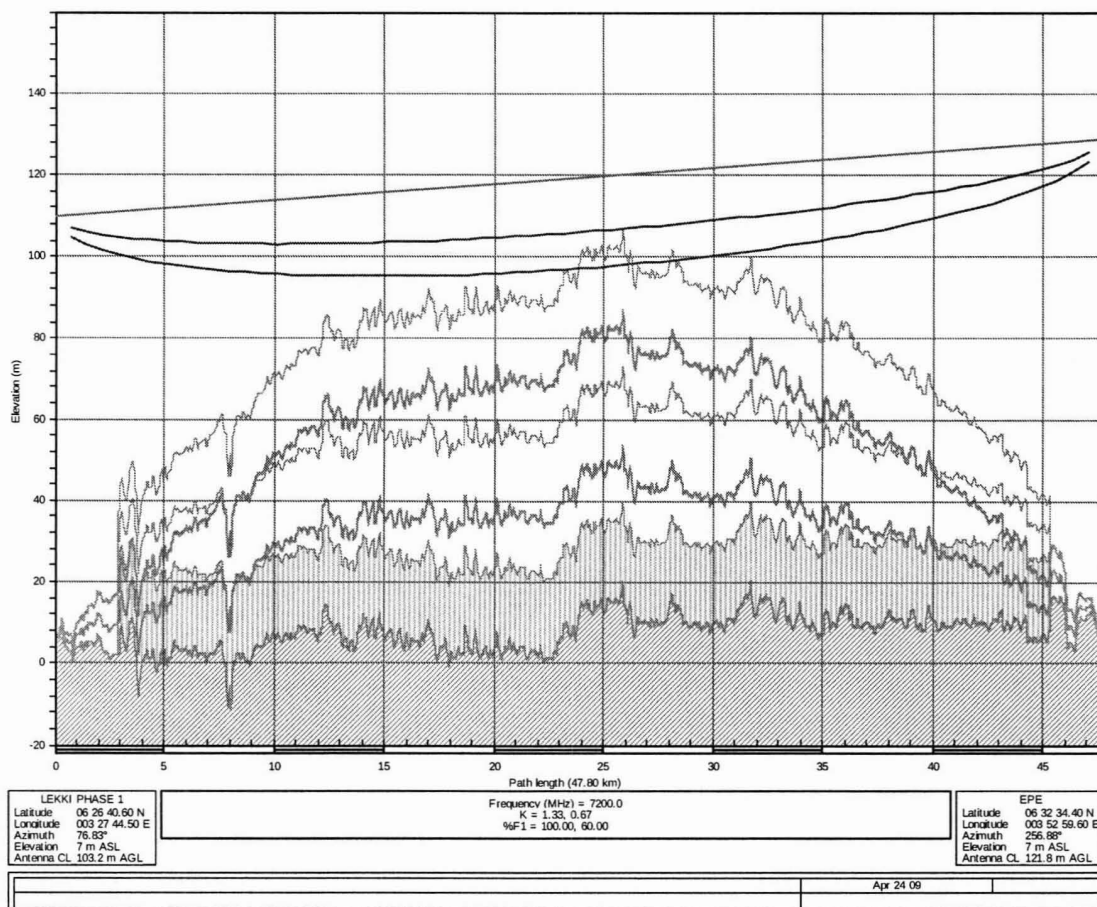


Figure 1. Path profile diagram for K=1.33 (hatched profiles are for K=∞).

SYSTEM CHARACTERISTICS OF THE LINK

Table 1.1 System Characteristics of Lagos-Epe LOS link

System parameters	Transmitting Station	Receiving Station
Elevation	6.82m	7.08m
Latitude	06° 26' 40.60N	06° 32' 34.40N
Longitude	03° 27' 44.50E	03° 52' 59.60E
Transmitting Frequency	7.2GHz	7.2GHz
Antenna model	SP4-71°(P)	SP4-71A(P)
Antenna's Type	Parabolic dish of 2.4m	Parabolic dish of 2.4m
Antenna's Gain	43.10 dB	43.10 dB
Antenna's Height	103m	122m
Polarization	Vertical	Vertical
TX power (dBm)	22.00	22.00
TX power (watts)	0.16	0.16
EIRP (dBm)	58.50	58.50
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-36.51	-36.51
Maximum receive signal (dBm)	-15.00	-15.00
Net Path Loss	58.46	58.46
Received Signal	-36.46dBm	-36.46dBm
Thermal Fade Margin	49.54	49.54
Free space loss (dB)	130.41	
Path length (km)	10.96	
Rain region	ITU Region P	
Rain Attenuation (dB)	49.54	
Rain Rate (mm/hr)	353.89	
Fade Occurrence Factor P_0	1.43E+01	

Equipment and site engineering: Microwave Equipment Elements: The frequency assign for these fixed microwave services lists 41 bands ranging from 7100 MHz to 8500 MHz i.e. 7.1GHz to 8.5GHz. Antennas, RF transmission lines, microwave combining and dividing components, and radios are the elements of microwave systems common to all of these bands, but their characteristics vary greatly over this range. The following paragraphs describe briefly these building blocks and their functions in system planning.

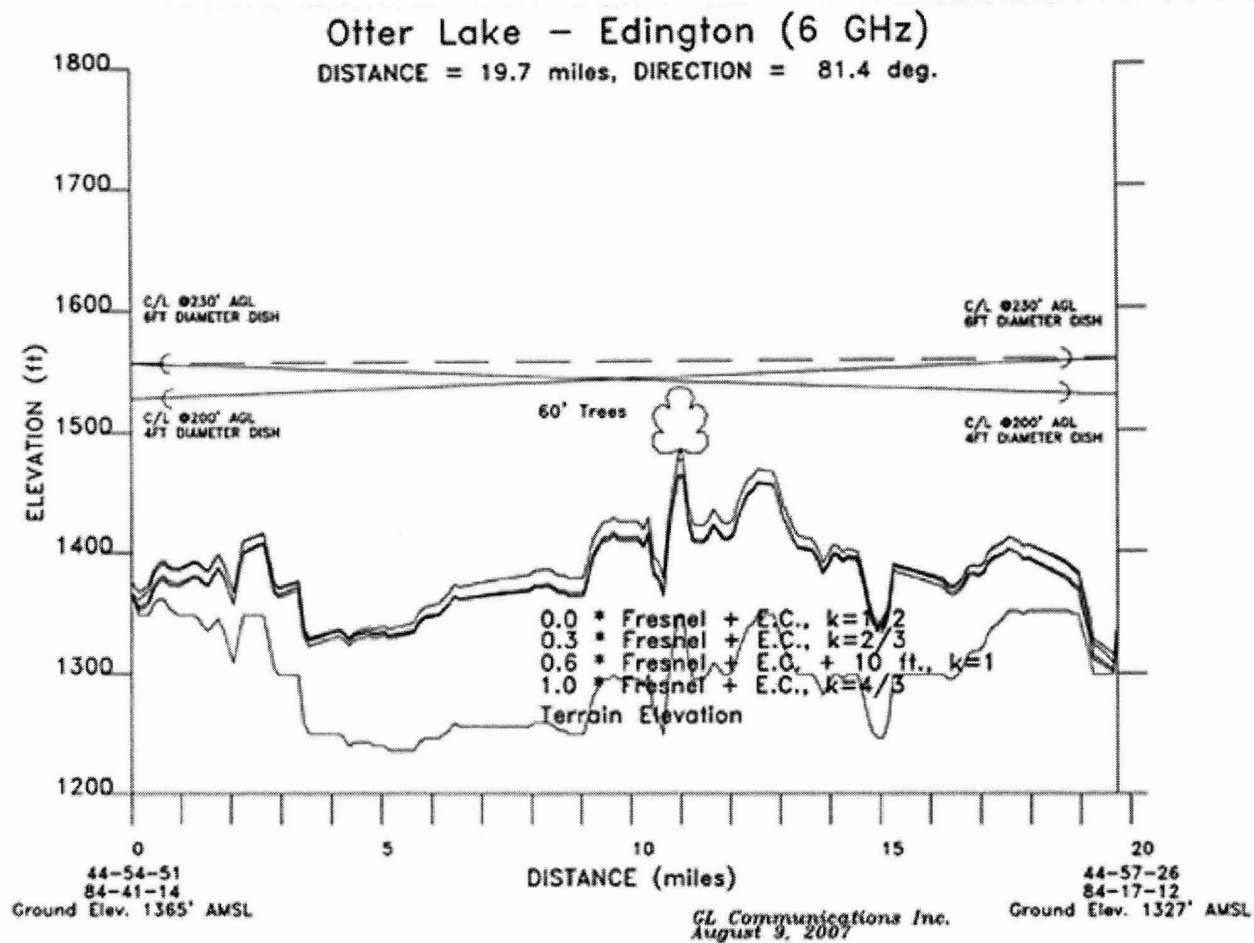
DATA BASE

The radio signal data used for this analysis are for the period August 2008 to July 2009. The field

strength variations were recorded for both diurnal and seasonal behavior at the receiving end, Lagos once a week on 12 hours basis. The period was classified into two seasons, namely

- Period of Fog : November to February
- Period of Rain: June to September

Information on some meteorological parameters like air temperature, relative humidity and water vapour pressure during the fog season i.e. harmattan (Nov-Feb) and Rain season (June-Sept) were obtained from the daily visibility records of the Nigerian Meteorological Agency (NIMET) at Oshodi, situated in Lagos about 3.0km from the site of the radio signal measurement.



ANDREW ELW127A

210 FT

7.35 dB @ 13 GHz

ID	FREQ	ATT	POWER	VEL
0120000026	13000	3.5	1.28	81.5

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(972) 437-4667

COMPANY: FLORIDA DEPARTMENT OF TRANSPORTATION
ROUTE NAME: ORANGE LAKE - OCALA DOT, FL 6.7 GHZ
DATE: JANUARY 18, 2001

PAGE 1 OF 7

SITE NAME, STATE	ORANGE LAKE, FL	OCALA DOT, FL
CALL SIGN	WNTS302	WNTS301
LATITUDE (NAD83)	29-24-23.9	29-11-34.9
LONGITUDE (NAD83)	82-14-46.4	82-10-14.3
ELEVATION (METERS)	36.6	24.5
AZIMUTH	162.8	342.8
DISTANCE (KILOMETERS)	24.8	
TRANSMIT ANTENNA		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	77.7	55.5
RECEIVE ANTENNA	SAME AS ABOVE	
MANUFACTURER		
MODEL		
GAIN		
HEIGHT (METERS)		
DIVERSITY RECEIVE	NONE	
MANUFACTURER		
MODEL		
GAIN		
HEIGHT (METERS)		
RADIO EQUIPMENT		
MANUFACTURER	HARRIS CORPORATION	HARRIS CORPORATION
MODEL	DVM6-45	DVM6-45
FCC IDENTIFIER	BCK9GKDVM6-4564-1	BCK9GKDVM6-4564-1
EMISSION DESIGNATOR	10M0 D7W	10M0 D7W
STABILITY	.001	.001
POWER (DBM / WATTS)	29.5 / 0.89	29.5 / 0.89
FIXED LOSSES (COM,TX,RX)	3.9, 0.5, 1.5	2.9, 0.5, 1.5
EIRP (DBM / WATTS)	67.4 / 5495	68.4 / 6918
RECEIVE LEVEL	-31.6	-31.6
TRAFFIC	672 CHAN	672 CHAN
MODULATION	64 QAM	64 QAM
FREQUENCIES TRANSMITTED	6835.0H	6675.0H

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COMPANY: FLORIDA DEPARTMENT OF TRANSPORTATION
ROUTE NAME: OCALA DOT - OCALA FHP, FL 10.6 GHZ
DATE: JANUARY 18, 2001

PAGE 2 OF 7

SITE NAME, STATE	OCALA DOT, FL	OCALA FHP, FL
CALL SIGN	WNTS301	WNTS300
LATITUDE (NAD83)	29-11-34.9	29-11-12.9
LONGITUDE (NAD83)	82-10-14.3	82-06-09.4
ELEVATION (METERS)	24.5	32.6
AZIMUTH	95.8	275.9
DISTANCE (KILOMETERS)	6.7	

TRANSMIT ANTENNA		
MANUFACTURER	ANDREW	ANDREW
MODEL	HP4-105A	HP4-105A
GAIN	39.9	39.9
HEIGHT (METERS)	69.8	35.1

RECEIVE ANTENNA	SAME AS ABOVE
MANUFACTURER	
MODEL	
GAIN	
HEIGHT (METERS)	

DIVERSITY RECEIVE	NONE
MANUFACTURER	
MODEL	
GAIN	
HEIGHT (METERS)	

RADIO EQUIPMENT		
MANUFACTURER	HARRIS CORPORATION	HARRIS CORPORATION
MODEL	DVM10-8T	DVM10-8T
FCC IDENTIFIER	BCK9GKDVM10-8T-1	BCK9GKDVM10-8T-1
EMISSION DESIGNATOR	3M75 D7W	3M75 D7W
STABILITY	.0001	.0001
POWER (DBM / WATTS)	12.0 / 0.016	12.0 / 0.016

FIXED LOSSES (COM,TX,RX)	8.2, 0.0, 0.0	4.6, 0.0, 0.0
EIRP (DBM / WATTS)	43.7 / 23.44	47.3 / 53.70
RECEIVE LEVEL	-50.6	-50.6

TRAFFIC	192 CHAN	192 CHAN
MODULATION	49 QPRS	49 QPRS

FREQUENCIES TRANSMITTED	10555.625V	10620.625V
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COMPANY: FLORIDA DEPARTMENT OF TRANSPORTATION
ROUTE NAME: OCALA DOT - WILDWOOD, FL 6.7 GHZ
DATE: JANUARY 18, 2001

PAGE 3 OF 7

SITE NAME, STATE	OCALA DOT, FL	WILDWOOD, FL
CALL SIGN	WNTS301	WNTS299
LATITUDE (NAD83)	29-11-34.9	28-52-25.9
LONGITUDE (NAD83)	82-10-14.3	82-05-30.3
ELEVATION (METERS)	24.5	15.8
AZIMUTH	167.7	347.8
DISTANCE (KILOMETERS)	36.2	
TRANSMIT ANTENNA		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	89.9	71.6
RECEIVE ANTENNA	SAME AS ABOVE	
MANUFACTURER		
MODEL		
GAIN		
HEIGHT (METERS)		
DIVERSITY RECEIVE		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	80.8	62.5
RADIO EQUIPMENT		
MANUFACTURER	HARRIS CORPORATION	HARRIS CORPORATION
MODEL	DVM6-45	DVM6-45
FCC IDENTIFIER	BCK9GKDVM6-4564-1	BCK9GKDVM6-4564-1
EMISSION DESIGNATOR	10M0 D7W	10M0 D7W
STABILITY	.001	.001
POWER (DBM / WATTS)	29.5 / 0.89	29.5 / 0.89
FIXED LOSSES (COM,TX,RX)	4.4, 0.0, 0.0	3.6, 0.0, 0.0
EIRP (DBM / WATTS)	67.4 / 5495	68.2 / 6607
RECEIVE LEVEL	-34.1	-34.1
TRAFFIC	672 CHAN	672 CHAN
MODULATION	64 QAM	64 QAM
FREQUENCIES TRANSMITTED	6635.0H	6795.0H

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COMPANY: FLORIDA DEPARTMENT OF TRANSPORTATION
ROUTE NAME: WILDWOOD - ST CATHERINE, FL 6.7 GHZ
DATE: JANUARY 18, 2001

PAGE 4 OF 7

SITE NAME, STATE	WILDWOOD, FL	ST CATHERINE, FL
CALL SIGN	WNTS299	WNTS298
LATITUDE (NAD83)	28-52-25.9	28-36-13.0
LONGITUDE (NAD83)	82-05-30.3	82-12-05.3
ELEVATION (METERS)	15.8	17.7
AZIMUTH	199.7	19.7
DISTANCE (KILOMETERS)	31.8	
TRANSMIT ANTENNA		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	71.6	45.7
RECEIVE ANTENNA	SAME AS ABOVE	
MANUFACTURER		
MODEL		
GAIN		
HEIGHT (METERS)		
DIVERSITY RECEIVE		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	62.5	36.6
RADIO EQUIPMENT		
MANUFACTURER	HARRIS CORPORATION	HARRIS CORPORATION
MODEL	DVM6-45	DVM6-45
FCC IDENTIFIER	BCK9GKDVM6-4564-1	BCK9GKDVM6-4564-1
EMISSION DESIGNATOR	10M0 D7W	10M0 D7W
STABILITY	.001	.001
POWER (DBM / WATTS)	29.5 / 0.89	29.5 / 0.89
FIXED LOSSES (COM,TX,RX)	3.6, 0.0, 0.0	2.4, 0.0, 0.0
EIRP (DBM / WATTS)	68.2 / 6607	69.4 / 8710
RECEIVE LEVEL	-31.0	-31.0
TRAFFIC	672 CHAN	672 CHAN
MODULATION	64 QAM	64 QAM
FREQUENCIES TRANSMITTED	6855.0H	6695.0H

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COMPANY: FLORIDA DEPARTMENT OF TRANSPORTATION
ROUTE NAME: RUSKIN - FRUITVILLE, FL 6.7 GHZ
DATE: JANUARY 18, 2001

PAGE 5 OF 7

SITE NAME, STATE	RUSKIN, FL	FRUITVILLE, FL
CALL SIGN	WNTS292	WNTV410
LATITUDE (NAD83)	27-42-51.1	27-20-16.2
LONGITUDE (NAD83)	82-22-58.3	82-26-51.3
ELEVATION (METERS)	11.6	7.3
AZIMUTH	188.7	8.7
DISTANCE (KILOMETERS)	42.2	
TRANSMIT ANTENNA		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	65.5	86.9
RECEIVE ANTENNA	SAME AS ABOVE	
MANUFACTURER		
MODEL		
GAIN		
HEIGHT (METERS)		
DIVERSITY RECEIVE		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	56.4	77.7
RADIO EQUIPMENT		
MANUFACTURER	HARRIS CORPORATION	HARRIS CORPORATION
MODEL	DVM6-45	DVM6-45
FCC IDENTIFIER	BCK9GKDVM6-4564-1	BCK9GKDVM6-4564-1
EMISSION DESIGNATOR	10M0 D7W	10M0 D7W
STABILITY	.001	.001
POWER (DBM / WATTS)	29.5 / 0.89	29.5 / 0.89
FIXED LOSSES (COM,TX,RX)	3.3, 0.0, 0.0	4.3, 0.0, 0.0
EIRP (DBM / WATTS)	68.5 / 7079	67.5 / 5623
RECEIVE LEVEL	-35.0	-35.0
TRAFFIC	672 CHAN	672 CHAN
MODULATION	64 QAM	64 QAM
FREQUENCIES TRANSMITTED	6595.0V	6755.0V

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COMPANY: FLORIDA DEPARTMENT OF TRANSPORTATION
ROUTE NAME: FRUITVILLE - JACARANDA BL, FL 6.7 GHZ
DATE: JANUARY 18, 2001

PAGE 6 OF 7

SITE NAME, STATE	FRUITVILLE, FL	JACARANDA BL, FL
CALL SIGN	WNTV410	WNTD786
LATITUDE (NAD83)	27-20-16.2	27-06-38.2
LONGITUDE (NAD83)	82-26-51.3	82-23-06.3
ELEVATION (METERS)	7.3	4.9
AZIMUTH	166.2	346.2
DISTANCE (KILOMETERS)	25.9	
TRANSMIT ANTENNA		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	46.9	46.9
RECEIVE ANTENNA	SAME AS ABOVE	
MANUFACTURER		
MODEL		
GAIN		
HEIGHT (METERS)		
DIVERSITY RECEIVE		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	37.8	37.8
RADIO EQUIPMENT		
MANUFACTURER	HARRIS CORPORATION	HARRIS CORPORATION
MODEL	DVM6-45	DVM6-45
FCC IDENTIFIER	BCK9GKDVM6-4564-1	BCK9GKDVM6-4564-1
EMISSION DESIGNATOR	10M0 D7W	10M0 D7W
STABILITY	.001	.001
POWER (DBM / WATTS)	29.5 / 0.89	29.5 / 0.89
FIXED LOSSES (COM,TX,RX)	2.5, 0.0, 0.0	2.5, 0.0, 0.0
EIRP (DBM / WATTS)	69.3 / 8511	69.3 / 8511
RECEIVE LEVEL	-28.2	-28.2
TRAFFIC	672 CHAN	672 CHAN
MODULATION	64 QAM	64 QAM
FREQUENCIES TRANSMITTED	6835.0V	6675.0V

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COMPANY: FLORIDA DEPARTMENT OF TRANSPORTATION PAGE 7 OF 7
ROUTE NAME: FRUITVILLE - BRADENTON FHP, FL 6.7 GHZ
DATE: JANUARY 18, 2001

SITE NAME, STATE	FRUITVILLE, FL	BRADENTON FHP, FL
CALL SIGN	WNTV410	WNTX514
LATITUDE (NAD83)	27-20-16.2	27-26-50.1
LONGITUDE (NAD83)	82-26-51.3	82-29-54.3
ELEVATION (METERS)	7.3	4.9
AZIMUTH	337.5	157.5
DISTANCE (KILOMETERS)	13.2	
TRANSMIT ANTENNA		
MANUFACTURER	ANDREW	ANDREW
MODEL	P8-65D	P8-65D
GAIN	42.3	42.3
HEIGHT (METERS)	61.0	20.4
RECEIVE ANTENNA	SAME AS ABOVE	
MANUFACTURER		
MODEL		
GAIN		
HEIGHT (METERS)		
DIVERSITY RECEIVE	NONE	
MANUFACTURER		
MODEL		
GAIN		
HEIGHT (METERS)		
RADIO EQUIPMENT		
MANUFACTURER	HARRIS CORPORATION	HARRIS CORPORATION
MODEL	DVM6-45	DVM6-45
FCC IDENTIFIER	BCK9GKDVM6-4564-1	BCK9GKDVM6-4564-1
EMISSION DESIGNATOR	10M0 D7W	10M0 D7W
STABILITY	.001	.001
POWER (DBM / WATTS)	29.5 / 0.89	29.5 / 0.89
FIXED LOSSES (COM,TX,RX)	3.2, 13.0, 0.0	1.3, 13.0, 0.0
EIRP (DBM / WATTS)	55.6 / 363.1	57.5 / 562.3
RECEIVE LEVEL	-34.8	-34.8
TRAFFIC	672 CHAN	672 CHAN
MODULATION	64 QAM	64 QAM
FREQUENCIES TRANSMITTED	6795.0H	6635.0H

Before microwave links are designed, detailed survey and analysis establishes that no obstacles exist in the 1st Fresnel Zone. Antenna heights are selected taking into account tree growth over at least a ten-year period assuring the 1st Fresnel Zone will be clear for that period of time. Figure 12 is a diagram of a surveyed microwave path showing its Fresnel Zone clearance. Table 1 gives the design characteristics of the path and the expected availability.

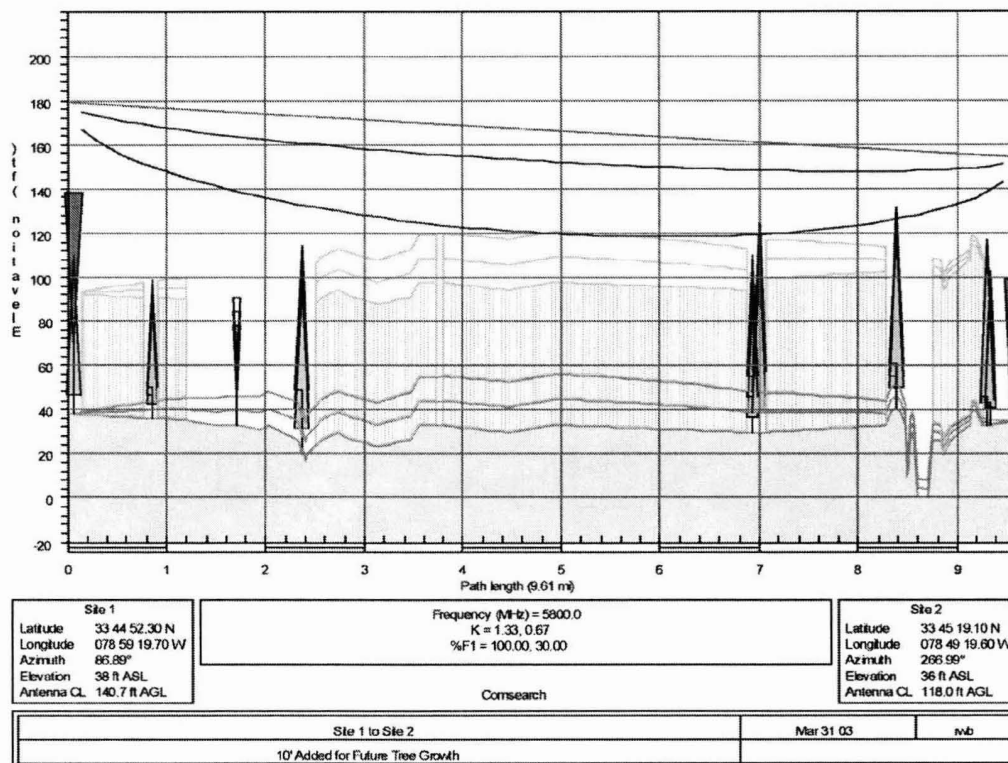


Figure 12 Diagram of a Surveyed Microwave Path Showing its Fresnel Zone Clearance

Table 1 Microwave Path Design Data

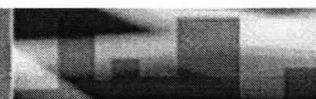
	Site 1	Site 2
Elevation (ft)	38.06	36.02
Latitude	33 44 52.30 N	33 45 19.10 N
Longitude	078 59 19.70 W	078 49 19.60 W
True azimuth (deg)	86.89	266.99
Vertical angle (deg)	-0.12	0.02
Antenna model	PL10-57W	PL10-57W
Antenna height (ft)	175.01	112.97
Antenna gain (dBi)	42.90	42.90
Radome loss (dB)	0.00	0.00
TX line type	HJ4-50	HJ4-50
TX line length (ft)	215.00	135.00
TX line unit loss (dB /100 ft)	7.84	7.84
TX line loss (dB)	16.86	10.58
Connector loss (dB)	1.00	1.00
Miscellaneous loss (dB)	1.00	1.00
Frequency (MHz)	5800.00	
Polarization	Vertical	
Path length (mi)	9.61	
Free space loss (dB)	131.53	
Atmospheric absorption loss (dB)	0.13	
Net path loss (dB)	77.29	77.29
Radio model	WM31600	WM31600
TX power (watts)	0.10	0.10
TX power (dBm)	20.00	20.00
EIRP (dBm)	44.04	50.32
RX threshold criteria	10E-6	10E-6
RX threshold level (dBm)	-90.00	-90.00
Maximum receive signal (dBm)	-5.00	-5.00
RX signal (dBm)	-57.29	-57.29
Thermal fade margin (dB)	32.71	32.71
Dispersive fade margin (dB)	58.00	58.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	32.69	32.69
Climatic factor	1.00	
Terrain roughness (ft)	20.00	
C factor	3.29	
Average annual temperature (°F)	50.00	
Worst month - multipath (%)	99.99772	99.99772
(sec)	59.92	59.92
Annual - multipath (%)	99.99943	99.99943
(sec)	179.77	179.77
(% - sec)	99.99886 - 359.54	

— Great Circle — Ellipsoid

✗ Without the proper Fresnel Zone clearance, the design objectives of the microwave link cannot be realized.



MOTOROLA POINT-TO-POINT WIRELESS SOLUTIONS



PTP Link Estimator Configuration Worksheet

29 February 2008

Summary

Link Name	Handbook
Customer Name	Motorola Point To Point Wireless Solutions Group
Link Type	Near Line of Sight
Maximum Obstruction Height	0.00 Feet
Link Distance	6.00 Miles
Free Space Path Loss	-127.42 dB
Excess Path Loss	-14.93 dB
User Throughput Expectation	Aggregate 60.26 Mbps assuming PTP Bridge 600 Series running a 06-00 software load
RF Frequency Band	5.8 GHz (5.725 to 5.850 GHz)
RF Channel Bandwidth	30 MHz

Installation Notes

Bearing to REMOTE from LOCAL	16.7° from True North
Bearing to LOCAL from REMOTE	196.8° from True North
Predicted Receive Power	-57.97 dBm to -76.93 dBm
Predicted Link Loss	-132.87 dB to -151.83 dB

Perform the following checks during the installation

1. Check with a GPS that you are installing at the correct location.
2. Check carefully the direction to the other end of the link. Either use a corrected compass or use the GPS waypoint feature about 300 meters from the installation location.
3. Keep directing the antenna until the correct Receive Power is achieved. This should ensure that you are not peaking on a sidelobe of the antenna.
4. An hour after disarming check that the mean value for the link loss is as predicted.

Local Site

Site Name	The Name of Local
Hardware Platform	PTP Bridge 600 Series Integrated
Antenna Type	INTEGRATED - Built-in Antenna Dual Polar (23dBi)
Antenna Gain	23 dBi
Antenna Height	20 Feet AGL
Local Site Elevation	5.0 Feet AMSL
Feeder Cable	N/A
Feeder Length	N/A
Feeder Loss	N/A
Spatial Diversity	N/A
Local Site Location	50°27' 3.7" N 3°46' 31.7" W

Remote Site

Site Name: The Name of Remote

Antenna Type	Andrew 2ft Para, P2F-52 (29.4dBi)
Antenna Gain	29.4 dBi
Antenna Height	20 Feet AGL
Remote Site Elevation	5.0 Feet AMSL
Feeder Cable	LMR600 7.3 dBm/100ft @ 5.8 GHz
Feeder Length	13.699 Feet
Feeder Loss	1 dB
Spatial Diversity	N/A
Remote Site Location	50°31' 25.3" N 3°44' 27.9" W

Link Throughput & Availability

User Throughput Expectation	Aggregate 60.26 Mbps
User Effective Throughput Rate Upstream	30.13 Mbps
User Effective Throughput Rate Downstream	30.13 Mbps
Link Symmetry	50:50 Fixed
Availability	99.99967%
Outage	1.72 Minutes/Year
Worst Case Analysis	Not Selected
Link Optimisation	Optimised for TDM Traffic
TDD Synchronisation	Disabled

Required User Throughput

Required User Mux Data Throughput (Mbps)	0.00
Link Availability for User Mux Data Throughput (%)	100.00000%
Outage for User Mux Data Throughput Minutes/Year	0.00
Required User Data Throughput (Mbps)	10.00
Total User Data Throughput including Mux Data (Mbps)	10.00
Link Availability for Total User Data Throughput (%)	99.99967%
Outage for Total User Data Throughput Minutes/Year	1.72

Modulation	User Aggregate Throughput(Mbps)	Fade Margin (dB)	%Time In Mode	Throughput Availability
256QAM 0.81 Dual	262.66	-15.79	0.00%	0.00000%
64QAM 0.92 Dual	221.30	-15.79	0.00%	0.00000%
64QAM 0.75 Dual	180.84	-10.43	0.00%	0.00000%
16QAM 0.87 Dual	140.69	-4.72	0.03%	0.03386%
256QAM 0.81 Single	131.33	-11.38	0.00%	0.03386%
64QAM 0.92 Single	110.65	-11.38	0.00%	0.03386%
16QAM 0.63 Dual	101.14	1.27	15.75%	15.78448%
64QAM 0.75 Single	90.42	-6.51	0.00%	15.78448%
16QAM 0.87 Single	70.34	-1.24	8.99%	24.77663%
16QAM 0.63 Single	50.57	4.84	74.77%	99.54186%
QPSK 0.87 Single	35.17	8.38	0.41%	99.95027%
QPSK 0.63 Single	25.28	12.14	0.04%	99.99256%
BPSK 0.63 Single	12.64	18.88	0.01%	99.99967%

Regulatory Conditions

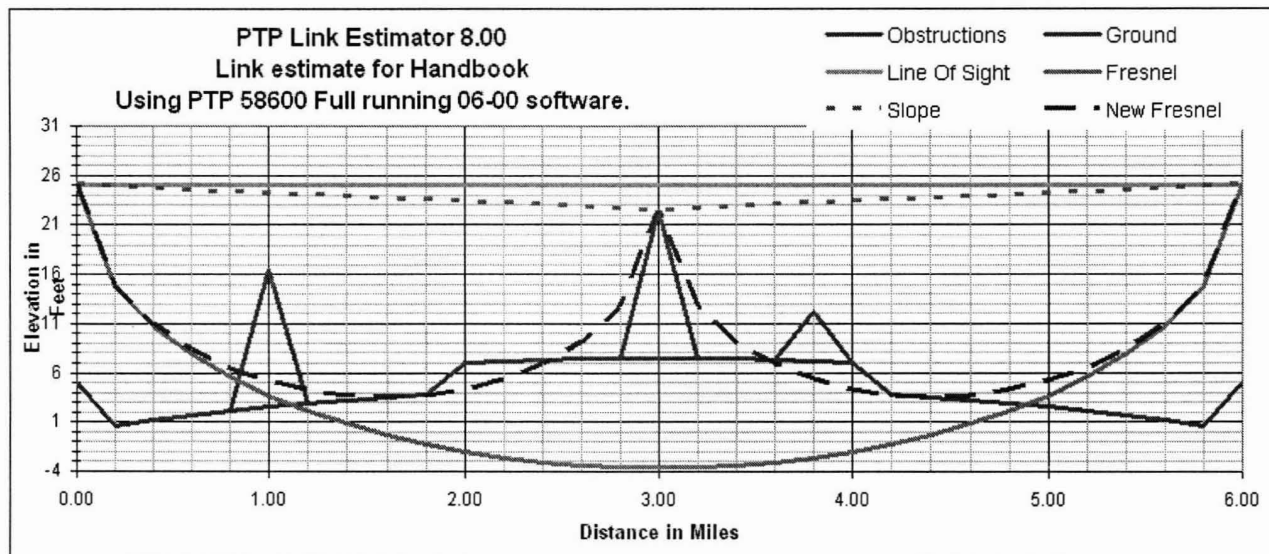
Region Code	Region 1
Max EIRP	48.0 dBm

In Band Environmental Noise

-144 dBm/30 MHz

The calculations for this link estimate were made assuming an output power of 25 dBm in the lowest modulation mode

Terrain Profile



Reflection Calculations

There is insufficient antenna height to calculate an optimum vertical spacing - try increasing the antenna heights

Customer Contact Information

Contact Name	Motorola Engineer
Company Name	Motorola Point To Point Wireless Solutions Group
Address 1	Linhay Business Park
Address 2	Ashburton
State/Province	Devon
Zip/Postal Code	TQ13 7UP
Country	UK
Phone	+44 1364 655500
Cell Phone	
E-Mail	

Other Notes

You can include some user specific text here, like notes about obstructions close to the Local or Remote sites.

This link estimator supports the recommendations in ITU-R P.530-10 and ITU-R P.526-9. This link was planned by Motorola Engineering on 29 February 2008 11:55:09 using the PTP Link Estimator.



recommendation. All information provided by the PTP Link Estimator is provided without warranty of any kind, either expressed or implied.

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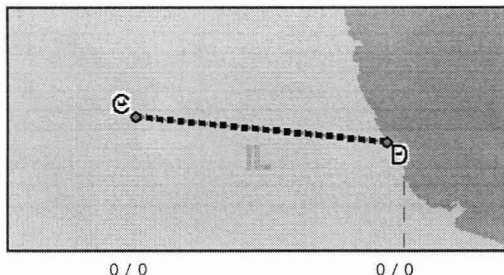


Paths

	Interfering Path	Victim Path
Licensee:	Jefferson Microwave, LLC	Jefferson Microwave, LLC
Job Number:	WAC2014-06314	WAC2014-06314
Date Entered:	8/5/2014 12:00:00 AM	6/24/2014 12:00:00 AM
Path Length (mi/km):	23.23 / 37.39	23.23 / 37.39
Receive Level (dBm):	-39.63	-39.63

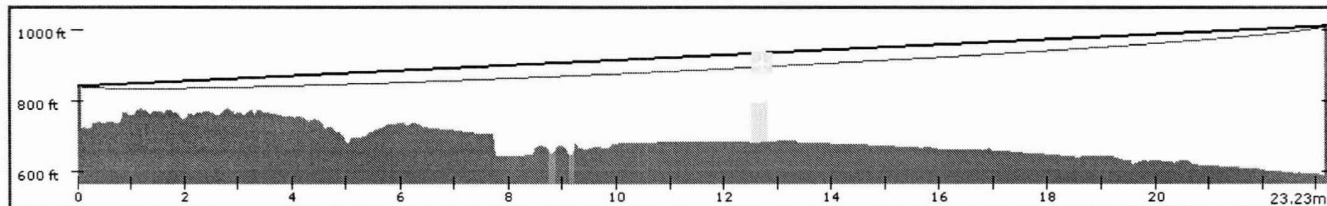
Sites

	A	B	C	D
Site Name:	Downers Grove	Rainbow Park	Downers Grove	Rainbow Park
Call Sign:	---	---	Coordinated: Downers Grove	Coordinated: Rainbow Park
Latitude:	41.795258 / 41:47:42.93	41.761823 / 41:45:42.56	41.795258 / 41:47:42.93	41.761823 / 41:45:42.56
Longitude:	-88.003936 / 88:0:14.17	-87.556480 / 87:33:23.33	-88.003936 / 88:0:14.17	-87.556480 / 87:33:23.33
Ground Elev. (ft/m):	718.50 / 219.00	580.50 / 176.94	718.50 / 219.00	580.71 / 177.00
Azimuth (°):	95.57	275.87	95.57	275.87
Tilt (°):	-0.047	-0.204	-0.047	-0.205
Antenna				Antenna
Manufacturer:	andrew corporation			andrew corporation
Model:	VHLPX4-18			VHLPX4-18
Gain (dBi):	44.7			44.7
Beamwidth (°):	0.9			0.9
Centerline (ft/m):	126.00 / 38.40			432.00 / 131.67
Radio				Radio
Manufacturer:	aviat networks			aviat networks
Model:	E600hp18-40M-16Q-LL			E600hp18-40M-16Q-LL
Emission / Stability:	40M0D7W / 0.0005			40M0D7W / 0.0005
Type / Rate:	16QAM / 124,000			16QAM / 124,000
Power / Thresh (dBm):	20			20 / -76.50
Tx / Cm Loss (dB):	0 / 0			0 / 0
Frequency (MHz):	18,000.00 H			18,000.00 H



Study Path (A to D)

Path Length (mi/km):	23.23 / 37.39	
FSL (dB):	Transmit 149.03	Receive 149.03
Azimuth (°):	95.57	275.87
Tilt (°):	-0.047	-0.205



C/I LOS Summary

	Transmit	Receive
Disc Angle (°):	0.00	0.00
Disc Value (dB):	0.00	0.00

Total Disc (dB)	Separation (MHz) / V-TI Obj	C/I Actual	C/I Obj
0.00	0.00 / 24.80	0.00	61.67

OH Calculation (with terrain)

LOS	TropoScatter	Combined	Margin
0.00	0.00	0.00	-61.67
C/I(20%)	Margin(20%)	C/I(.01%)	Margin(.01%)
0.00	-61.67	0.00 / 0.00	-51.67

Final Calculations

Final w/o OH	Final w OH	Same Point Analysis
-61.67	-61.67	False

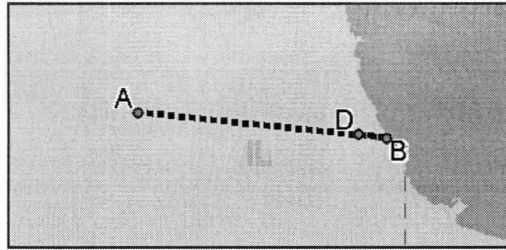


Paths

	Interfering Path	Victim Path
Licensee:	Comsearch_City of Chicago Ofc of Emergency Ma	Jefferson Microwave, LLC
JobNumber:	140715COMSTH01	WAC2014-06314
Date Entered:	7/15/2014 12:00:00 AM	8/5/2014 12:00:00 AM
Path Length (mi/km):	2.60 / 4.19	23.23 / 37.39
Receive Level (dBm):	-28.94	-43.35

Sites

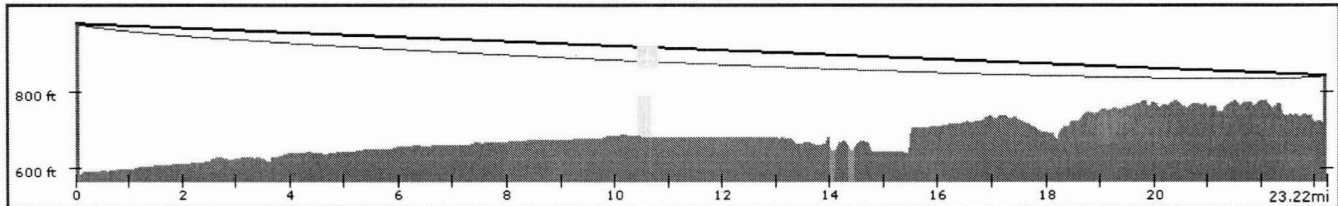
	C	D	B	A
Site Name:	7447SSHOREDR IL	DISTRICT3CPD IL	Rainbow Park	Downers Grove
Call Sign:	Coordinated: 7447SSHOREDR IL	Coordinated: DISTRICT3CPD IL	---	---
Latitude:	41.761667 / 41:45:42.00	41.767167 / 41:46:1.80	41.761823 / 41:45:42.56	41.795258 / 41:47:42.93
Longitude:	-87.556611 / 87:33:23.80	-87.606472 / 87:36:23.30	-87.556480 / 87:33:23.33	-88.003936 / 88:0:14.17
Ground Elev. (ft/m):	582.84 / 177.65	593.83 / 181.00	580.50 / 176.94	718.50 / 219.00
Azimuth (°):	278.43	98.40	275.87	95.57
Tilt (°):	-0.868	0.840	-0.204	-0.047
Antenna				Antenna
Manufacturer:	Cambium Networks, LTD			andrew corporation
Model:	85010089042			VHLPX4-18
Gain (dBi):	38.9			44.7
Beamwidth (°):	2.1			0.9
Centerline (ft/m):	396.00 / 120.70			126.00 / 38.40
Radio				Radio
Manufacturer:	Cambium Networks, LTD			aviat networks
Model:	PTP-18800-B			E600hp18-40M-16Q-LL
Emission / Stability:	36M3D1D / 0.0007			40M0D7W / 0.0005
Type / Rate:	128 QAM / 206,900			16QAM / 124,000
Power / Thresh (dBm):	24			20 / -76.50
Tx / Cm Loss (dB):	0 / 0			0 / 0
Frequency (MHz):	19,560.00 H			19,560.00 H



Study Path (C to A)

Path Length (mi/km): 23.22 / 37.38

	Transmit	Receive
FSL (dB):	149.75	149.02
Azimuth (°):	275.90	95.60
Tilt (°):	-0.189	-0.063



C/I LOS Summary

	Transmit	Receive
Disc Angle (°):	-2.53	0.03
Disc Value (dB):	-12.00	-0.01

Total Disc (dB)	Separation (MHz) / V-TI Obj	C/I Actual	C/I Obj
-12.01	0.00 / 24.80	10.80	57.95

OH Calculation (with terrain)

LOS	TropoScatter	Combined	Margin
0.00	0.00	0.00	-47.15
C/I(20%)	Margin(20%)	C/I(.01%)	Margin(.01%)
0.00	-47.15	0.00 / 0.00	-37.15

Final Calculations

Final w/o OH	Final w OH	Same Point Analysis
-47.15	-47.15	False

Microwave Path Data Sheet
COMSEARCH

Page 2 of 4

19700 Janelia Farm Boulevard, Ashburn, VA, 20147
(703)726-5655 www.comsearch.com

PCN Date: 05/09/2014
Job Number 140509COMSAN02

New Path
RCN Number: 14050929

Administrative Information

JASPER TX
City/County Killeen/BELL
Status / License Basis Engineering Proposal / PRIMARY OPERATION
Call Sign
Licensee Code VAWCTX
Licensee Name Verizon Wireless (VAW) LLC-C TX/LA/
Radio Service / Station Class CF -- Point-to-Point Microwave, Common Carrier

MONTAGUE TX

/BELL
Engineering Proposal / PRIMARY OPERATION
WQTG604
VAWCTX
Verizon Wireless (VAW) LLC-C TX/LA/
FXO -- Fixed

Site Information

Latitude (NAD 83)	31 °6' 8.5" N	31 °6' 24.8" N
Longitude (NAD 83)	97 °44' 44.1" W	97 °48' 29.1" W
Ground Elevation (m/ft-AMSL)	272.49 / 894.0	295.35 / 969.0
Antenna Structure Registration #	1247953	1225047
Path Azimuth (°)	274.829	94.796
Path Length (km / miles)	5.984 / 3.718	

Transmit Antenna

77183A	77183A
Manufacturer Commscope	Commscope
Model VHLP4-11W	VHLP4-11W
Gain(dBi) / Beamwidth(°) / Tilt(°) 40.8 / 1.50 / 0.33	40.8 / 1.50 / -0.37
Centerline (m / ft - AGL) 25.91 / 85.0	39.62 / 130.0

Receive Antenna

Same As Transmit

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

Diversity Receive Antenna

Manufacturer
Model
Gain (dBi) / Beamwidth (°)
Centerline (m / ft - AGL)

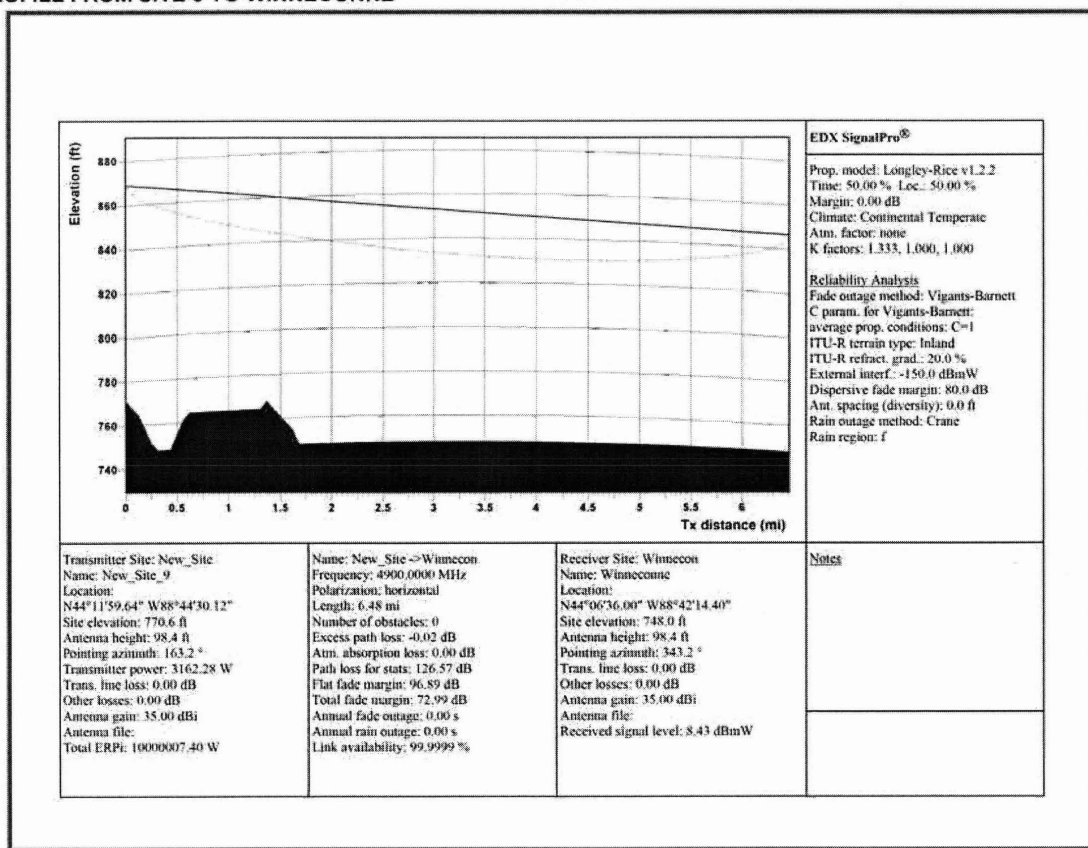
Radio Information

X11236 ²	X11236 ²
Manufacturer NEC AMERICA	NEC AMERICA
Model TRP-11G-7B	TRP-11G-7B
Model Description ACM IPASOLINK SPLIT HP 256QAM-16QAM	ACM IPASOLINK SPLIT HP 256QAM-16QAM
Emission Designator / Modulation 40M0D7W 256 QAM	40M0D7W 256 QAM
Loading 1 CH DIG 227000.000	1 CH DIG 227000.000
Stability (%) 0.0006	0.0006
Nominal Coordinated Maximum	Nominal Coordinated Maximum
Power (dBm) 26.5	26.5
Received Level (dBm) -31.4	-31.4 ↓
EIRP (dBm) 62.8	61.3
Fixed Loss: Tx / Common (dB) 0.0 / 4.5	0.0 / 6.0
Free Space Loss (dB) 129.0	

Transmit Frequencies (MHz) 10895.0000V(5)

11385.0000V(5)

PATH PROFILE FROM SITE 9 TO WINNECONNE



CONSOLIDATED SPECTRUM SERVICES
 22 MERRILL DRIVE
 ATKINSON, NH 03811
 PHONE/FAX: (603) 362 - 5977

EXHIBIT 4 - MICROWAVE PATH DATA

PROPOSED LICENSEE	LOUISVILLE COMMUNICATION LLC d/b/a WWB-TV	
COORDINATION NO.	05012000-13	
STATION NAME	STUDIO	TRANSMITTER
STATE	KY	KY
CALL SIGN		
LATITUDE (D-M-S) (NAD83)	38 13 07.4	38 12 46.0
LONGITUDE (D-M-S) (NAD83)	85 32 09.4	85 33 13.0
GROUND ELEV (Ft/m-AMSL)	733.0/223.41	680.12/207.3
PATH AZIMUTH (Deg)	246.909	66.898
PATH DISTANCE (Miles/Km)	1.045/1.682	
TRANSMIT ANT TYPE	RFB6-127DSE	RFB6-127DSE
FCC DESIGNATION		
MANUFACTURER	GABRIEL	GABRIEL
ANT CODE		
GAIN(dBi)/BEAMWIDTH(Deg)	45.2/1.00	45.2/1.00
C/L (Ft/m-AGL)	22.0/6.70	360.0/109.73
RECEIVE ANT TYPE	RFB6-127DSE	RFB6-127DSE
FCC DESIGNATION		
MANUFACTURER	GABRIEL	GABRIEL
ANT CODE		
GAIN(dBi)/BEAMWIDTH(Deg)	45.2/1.00	45.2/1.00
C/L (Ft/m-AGL)	22.0/6.70	360.0/109.73
EQUIPMENT MANUFACTURER	NUCOMM INC	NUCOMM INC
TRANSMITTER MODEL	130FT6	130FT6
EMISSION	25M0F8W	25M0F8W
LOADING	VIDEO/AUDIO	VIDEO/AUDIO/DATA
STABILITY (%)	0.000500	0.000500
POWER (dBm/Watts)	30.0/1.000	30.0/1.000
RECEIVED LEVEL (dBm)	-39.8	-39.8
EIRP (dBm/Watts)	50.2/104.712	49.2/95.499
FIXED LOSSES (dB)	25.0	26.0
FREE SPACE LOSS (dB)	119.2	
TX CHANNEL	A01, V	A09, V
TX FREQUENCY RANGE (Mhz)	12700.000-12725.000, V	12900.000-12925.000, V
TX CENTER FREQUENCY (Mhz)	12712.500, V	12912.500, V

MAY 01, 2000

SUPPLEMENTAL SHOWING PER FCC RULE PART 74

LOUISVILLE COMMUNICATIONS LLC d/b/a WWWB-TV

EXHIBIT 5 - ENVIRONMENTAL STATEMENT

This application is of "minor" impact to the environment. FCC rule parts 1.1306 and 1.1307 do not apply to the proposed system.

An analysis of the proposed radiation levels per criteria set forth in OST bulletin 65 have not revealed any hazards to humans. FAA notification is not required.

EXHIBIT 6 - STATEMENT OF BROADCAST RELATED PURPOSE

This system will be used by LOUISVILLE COMMUNICATIONS LLC d/b/a WWWB-TV as a Studio to Transmitter link from sites STUDIO to TRANSMITTER, KY and as an inter-city relay from TRANSMITTER - STUDIO, KY.

EXHIBIT 7 - SYSTEM DESCRIPTION

The proposed 12.95 GHZ transmission system consists of a duplex link, between two points STUDIO and TRANSMITTER, KY. The transmitters are manufactured by NUCOMM INC, model 130FT6.

Each transmitter feeds a GABRIEL, six (6) foot diameter, parabolic antenna.

Per FCC rule part 74.644 the effective radiated power has been reduced as specified by the equation referenced by stated rule part. The calculation is shown on Page 9, Exhibit 7 A of this document.

The baseband loading at each site is Video/Audio/Data, emission designator 25M0F8W.

The system does not employ hot-standby equipment, in that there is no frequency redundancy or space diversity equipment involved. All frequencies will be fully utilized.

EXHIBIT 7 A - CALCULATION OF MAXIMUM ALLOWABLE EIRP

The maximum allowable Effective Radiated Power is specified by the equation $EIRP = 30 - 20\log(A/B)$ where:

EIRP = Equivalent Istropic Radiated Power in DBW

A = Minium path length from the table = 5 KM

B = Actual path length in kilometers = 1.682 KM

Therefore:

$$EIRP = 30 - 20 \log (5.0/1.682) = 20.537 \text{ DBW}$$

Converting to Watts we get 113.1618, converting the watts to milliwatts we get 113161.8. To convert to dbm it is $10 \cdot \log(113161.8)$ or a maximum permissible EIRP of 50.536, dbm.

We are now in compliance with this rule part. We are adding another 10 decibels of fixed loss in line with the transmitter only brings our EIRP to 50.2 dbm, maximum.

$$\begin{aligned} \text{dBW} + 30 &= \text{dBm} \\ \text{EIRP} &= 30 - 20 \cdot \log\left(\frac{A}{B}\right) \end{aligned}$$

$$\begin{aligned} \text{FREQ} &= 12700 \\ \text{EIRP} &= 50.2 \text{ dBm} \end{aligned}$$

$$\begin{aligned} A &= 5 \\ B &= 1.7 \end{aligned}$$

MAY 01, 2000

SUPPLEMENTAL SHOWING PER FCC RULE PART 74

LOUISVILLE COMMUNICATIONS LLC d/b/a WWWB-TV

EXHIBIT 8 - SYSTEM DIAGRAM

Freq. Range (Mhz): 12700.000 - 12725.000, V

Center Freq. (Mhz): 12712.500, V

Channel Number: A01, V

```

*****
*   TX   *
*****
*   RX   *
*****

```

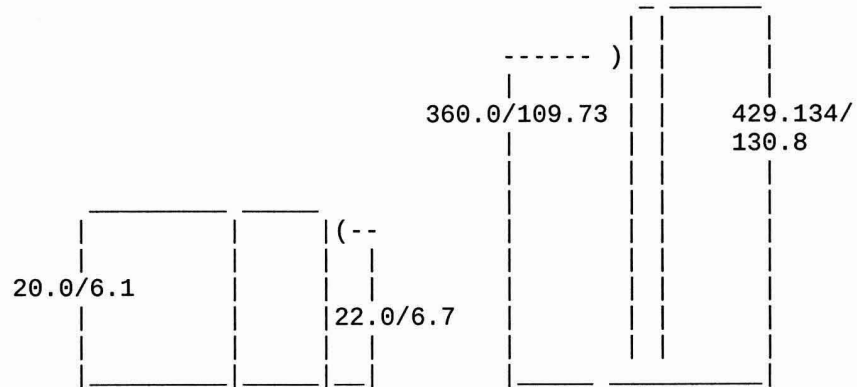
Freq. Range (Mhz): 12900.000-12925.000, V

Center Freq. (Mhz): 12912.500, V

Channel Number: A09, V

STATION NAME	STUDIO	TRANSMITTER
STATE	KY	KY
LATITUDE (D-M-S) (NAD83)	38 13 07.4	38 12 46.0
LONGITUDE (D-M-S) (NAD83)	85 32 09.4	85 33 13.0
GROUND ELEV (Ft/m-AMSL)	733.0/223.41	680.12/207.3
PATH AZIMUTH (Deg)	246.909	66.898
PATH DISTANCE (Miles/Km)	1.045/1.682	
TRANSMIT ANT TYPE	RFB6-127DSE	RFB6-127DSE
FCC DESIGNATION		
MANUFACTURER	GABRIEL	GABRIEL
GAIN(dBi)/BEAMWIDTH(Deg)	45.2/1.00	45.2/1.00
C/L (Ft/m-AGL)	22.0/6.70	360.0/109.73
RECEIVE ANT TYPE	RFB6-127DSE	RFB6-127DSE
FCC DESIGNATION		
MANUFACTURER	GABRIEL	GABRIEL
GAIN(dBi)/BEAMWIDTH(Deg)	45.2/1.00	45.2/1.00
C/L (Ft/m-AGL)	22.0/6.70	360.0/109.73
EQUIPMENT MANUFACTURER	NUCOMM INC	NUCOMM INC
TRANSMITTER MODEL	130FT6	130FT6
EMISSION	25M0F8W	25M0F8W
LOADING	VIDEO/AUDIO/DATA	VIDEO/AUDIO/DATA
STABILITY (%)	0.000500	0.000500
POWER (dBm/Watts)	30.0/1.000	30.0/1.000
EIRP (dBm/Watts)	50.2/104.712	49.2/95.499
FIXED LOSSES (dB)	25.0	26.0
FREE SPACE LOSS (dB)		119.2
RECEIVED LEVEL (dBm)	-39.8	-39.8

EXHIBIT 9 - VERTICAL ANTENNA PROFILE

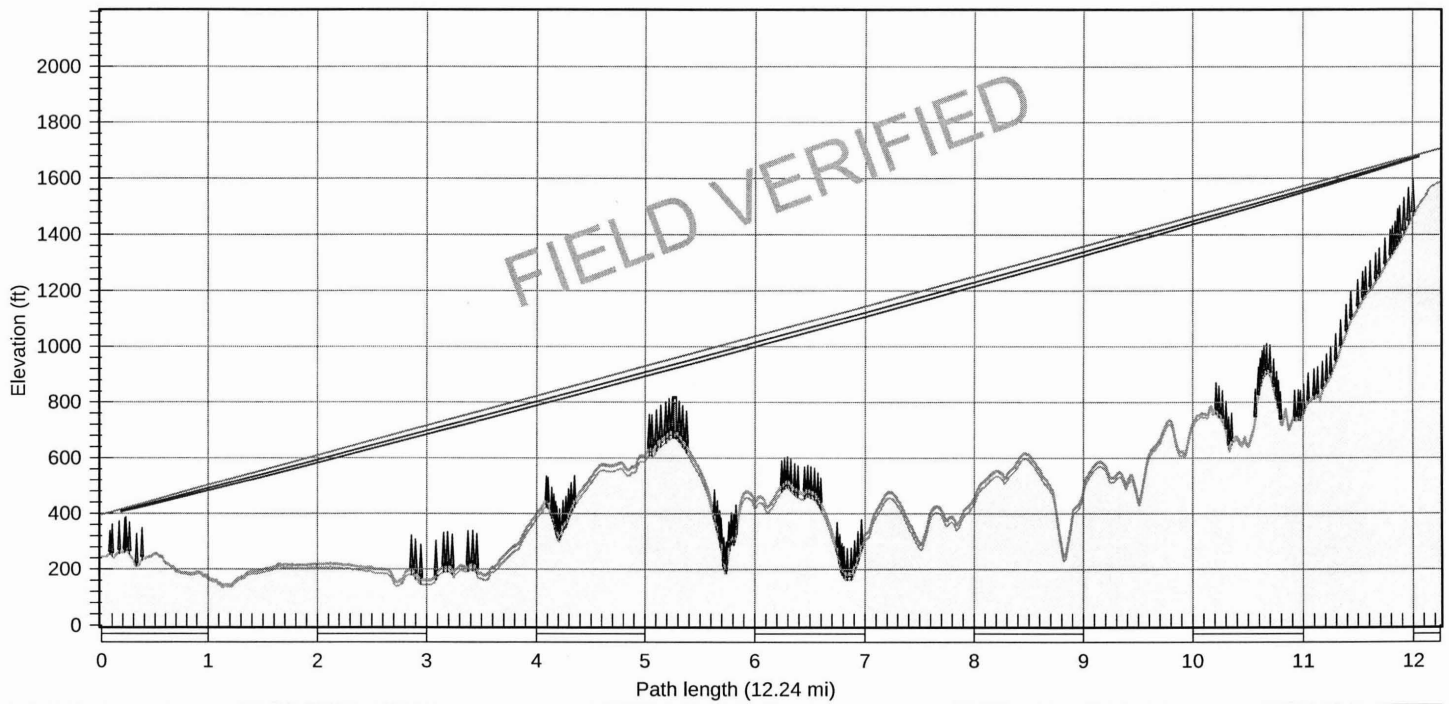


SITE NAME : STUDIO
 STATE : KY
 LATITUDE (N) : 38 13 07.4
 LONGITUDE (W) : 85 32 09.4
 FCC TOWER ID:
 DATUM : NAD 83
 GROUND ELEV. : 733.0/223.41
 (FT/MTRS)

TRANSMITTER
 KY
 38 12 46.0
 85 33 13.0
 1061956
 NAD 83
 680.12/207.3

NOTES:

- 1.0 - ALL DIMENSIONS ARE IN FEET/METERS
- 2.0 - DRAWING NOT TO SCALE



IOC Tower - A
Latitude 45 21 53.70 N
Longitude 122 48 14.90 W
Azimuth 279.27°
Elevation 246 ft ASL
Antenna CL 150.0 ft AGL

Frequency (MHz) = 11200.0
K = 1.33, 1.00
%F1 = 100.00, 60.00

Bald Peak
Latitude 45 23 35.50 N
Longitude 123 03 08.90 W
Azimuth 99.09°
Elevation 1585 ft ASL
Antenna CL 120.0 ft AGL

11 GHz - MHSB/HP Radio



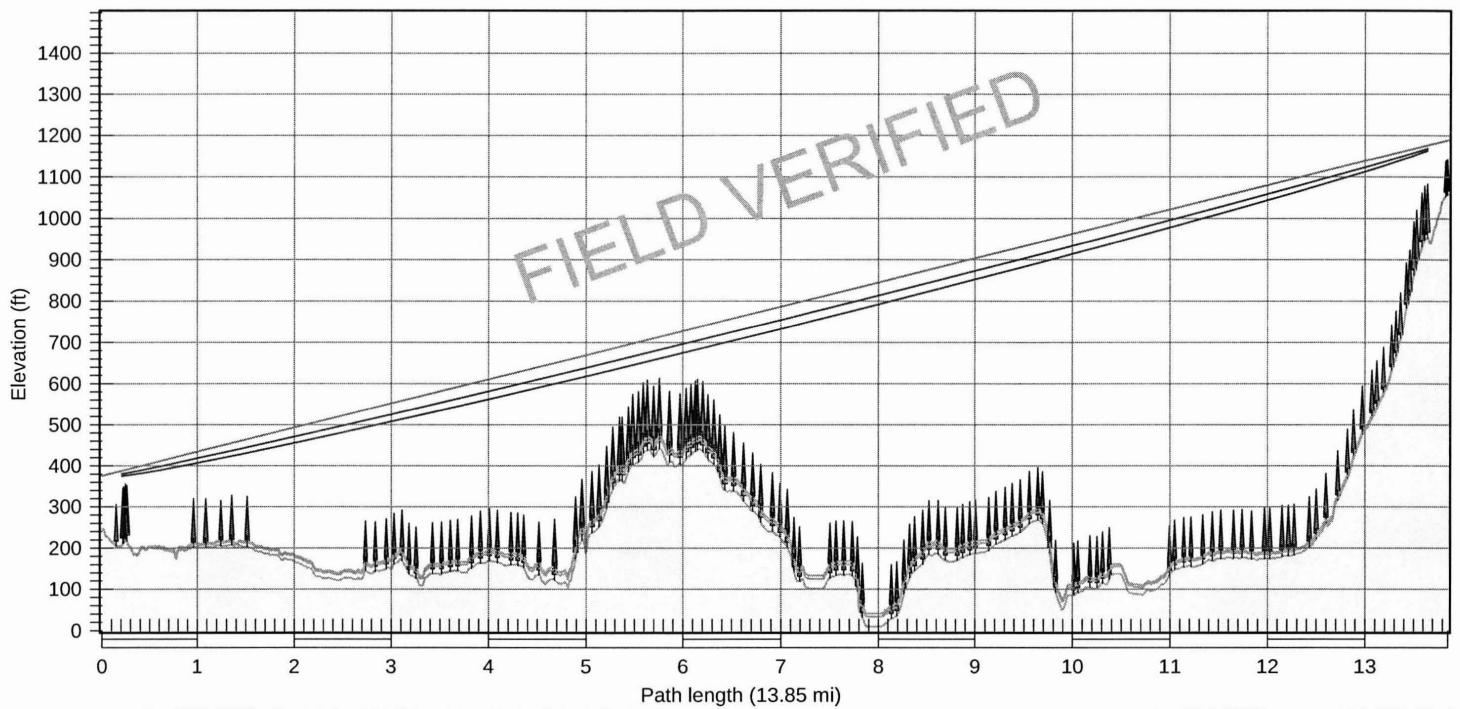
	IOC Tower - A	Bald Peak
Latitude	45 21 53.70 N	45 23 35.50 N
Longitude	122 48 14.90 W	123 03 08.90 W
True azimuth (°)	279.27	99.09
Vertical angle (°)	1.09	-1.23
Elevation (ft)	246.00	1585.00
Antenna model	HP8-107-P1A (TR)	HP8-107-P1A (TR)
Antenna gain (dBi)	46.40	46.40
Antenna height (ft)	150.00	120.00
TX line model	EW90	EW90
TX line unit loss (dB/100 ft)	3.08	3.08
TX line length (ft)	200.00	170.00
TX line loss (dB)	6.16	5.24
Connector loss (dB)	0.40	0.40
TX filter loss (dB)	2.70	2.70
RX filter loss (dB)	2.90	2.90
Frequency (MHz)	11200.00	
Polarization	Vertical	
Path length (mi)	12.25	
Free space loss (dB)	139.34	
Atmospheric absorption loss (dB)	0.31	
Net path loss (dB)	64.65	64.65
Configuration	HSB (1:10) - Stacking	HSB (1:10) - Stacking
Radio model	95MPR11-L1024A40-294	95MPR11-L1024A40-294
Emission designator	40M0D7W	40M0D7W
Climatic factor	1.00	
Terrain roughness (ft)	140.00	
C factor	0.26	
Average annual temperature (°F)	48.51	
Fade occurrence factor (Po)	1.349E-002	
Polarization	Vertical	
Rain region	Portland, Oregon	

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1024 294	30.00	30.00	-58.50	-58.50	67.14	68.06	-34.65	-34.65	23.85	23.85	23.85	23.85
512 267	31.00	31.00	-61.70	-61.70	68.14	69.06	-33.65	-33.65	28.05	28.05	28.05	28.05
256 238	32.00	32.00	-65.10	-65.10	69.14	70.06	-32.65	-32.65	32.45	32.45	32.45	32.45
128 207	32.50	32.50	-68.10	-68.10	69.64	70.56	-32.15	-32.15	35.95	35.95	35.95	35.95
64 179	32.50	32.50	-71.00	-71.00	69.64	70.56	-32.15	-32.15	38.85	38.85	38.85	38.85
32 145	32.50	32.50	-73.40	-73.40	69.64	70.56	-32.15	-32.15	41.25	41.25	41.25	41.25
16 115	32.50	32.50	-76.80	-76.80	69.64	70.56	-32.15	-32.15	44.65	44.65	44.65	44.65
4 55	32.50	32.50	-87.50	-87.50	69.64	70.56	-32.15	-32.15	55.35	55.35	55.35	55.35

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1024 294	99.9944	99.9944	99.9986	99.9986	99.9998	99.9998	99.9971	99.9971
512 267	99.9979	99.9979	99.9995	99.9995	99.9999	99.9999	99.9989	0.0018
256 238	99.9992	99.9992	99.9998	99.9998	99.9999	99.9999	99.9996	0.0007
128 207	99.9997	99.9997	99.9999	99.9999	99.9999	99.9999	99.9998	0.0002
64 179	99.9998	99.9998	99.9999	99.9999	99.9999	99.9999	99.9999	0.0001
32 145	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
16 115	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
4 55	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000

Multipath fading method - Vigants - Barnett

Rain fading method - Crane



IOC Tower - A
Latitude 45 21 53.70 N
Longitude 122 48 14.90 W
Azimuth 64.17°
Elevation 246 ft ASL
Antenna CL 130.0 ft AGL

Frequency (MHz) = 6175.0
K = 1.33, 1.00
%F1 = 100.00, 60.00

Mt Scott
Latitude 45 27 07.30 N
Longitude 122 32 51.30 W
Azimuth 244.36°
Elevation 1057 ft ASL
Antenna CL 130.0 ft AGL

6 GHz - MHSB/Standard Power Radio



	IOC Tower - A	Mt Scott
Latitude	45 21 53.70 N	45 27 07.30 N
Longitude	122 48 14.90 W	122 32 51.30 W
True azimuth (°)	64.17	244.36
Vertical angle (°)	0.56	-0.71
Elevation (ft)	246.00	1057.00
Antenna model	HP8-59-D3A (TR)	VHLP6-6W-6WH/B (TR)
Antenna gain (dBi)	41.50	39.30
Antenna height (ft)	130.00	130.00
TX line model	EW63	EW63
TX line unit loss (dB/100 ft)	1.47	1.47
TX line length (ft)	180.00	175.00
TX line loss (dB)	2.65	2.57
Connector loss (dB)	0.40	0.40
TX filter loss (dB)	2.00	2.00
RX filter loss (dB)	2.60	2.60
Frequency (MHz)	6175.00	
Polarization	Vertical	
Path length (mi)	13.86	
Free space loss (dB)	135.25	
Atmospheric absorption loss (dB)	0.19	
Net path loss (dB)	65.26	65.26
Configuration	HSB (1:10) - Stacking	HSB (1:10) - Stacking
Radio model	95MPR61-L1024A30-227	95MPR61-L1024A30-227
Emission designator	30M0D7W	30M0D7W
Climatic factor	1.00	
Terrain roughness (ft)	96.98	
C factor	0.42	
Average annual temperature (°F)	47.21	
Fade occurrence factor (Po)	1.736E-002	

6 GHz - MHSB/Standard Power Radio



	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1024 227	31.50	31.50	-60.50	-60.50	67.95	65.83	-33.76	-33.76	26.74	26.74	26.74	26.74
512 206	31.50	31.50	-63.70	-63.70	67.95	65.83	-33.76	-33.76	29.94	29.94	29.94	29.94
256 183	32.50	32.50	-67.10	-67.10	68.95	66.83	-32.76	-32.76	34.34	34.34	34.34	34.34
128 161	32.50	32.50	-70.10	-70.10	68.95	66.83	-32.76	-32.76	37.34	37.34	37.34	37.34
64 136	32.50	32.50	-73.00	-73.00	68.95	66.83	-32.76	-32.76	40.24	40.24	40.24	40.24
32 113	32.50	32.50	-74.90	-74.90	68.95	66.83	-32.76	-32.76	42.14	42.14	42.14	42.14
16 90	32.50	32.50	-78.30	-78.30	68.95	66.83	-32.76	-32.76	45.54	45.54	45.54	45.54
4 43	32.50	32.50	-89.00	-89.00	68.95	66.83	-32.76	-32.76	56.24	56.24	56.24	56.24

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1024 227	99.9963	99.9963	99.9991	99.9991			99.9983	99.9983
512 206	99.9982	99.9982	99.9996	99.9996			99.9992	0.0009
256 183	99.9994	99.9994	99.9998	99.9998			99.9997	0.0005
128 161	99.9997	99.9997	99.9999	99.9999			99.9998	0.0002
64 136	99.9998	99.9998	99.9999	99.9999			99.9999	0.0001
32 113	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
16 90	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000
4 43	99.9999	99.9999	99.9999	99.9999			99.9999	0.0000

Multipath fading method - Vigants - Barnett