

FREQUENCY COORDINATION AND INTERFERENCE
ANALYSIS REPORT

PREPARED FOR
US SEA LAUNCH

LONG BEACH, CA
JANUARY-JULY 2004 SATELLITE RE-RAD TESTING
12/14 GHZ

PREPARED BY
COMSEARCH
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DECEMBER 3, 2003

SEA LAUNCH COORDINATION REPORT

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SEA LAUNCH COORDINATION REPORT

1. CONCLUSIONS

AN INTERFERENCE STUDY CONSIDERING ALL EXISTING, PROPOSED AND PRIOR COORDINATED MICROWAVE AND SATELLITE FACILITIES WITHIN THE COORDINATION CONTOURS OF THE PROPOSED RE-RAD TEST BED IN LONG BEACH, CA DEMONSTRATES THAT THIS SITE WILL OPERATE SATISFACTORILY WITH THE COMMON CARRIER MICROWAVE AND SATELLITE ENVIRONMENT BASED UPON THE TEMPORARY OPERATIONS NOTED IN THE SUMMARY OF RESULTS (SECTION 2).

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2. SUMMARY OF RESULTS

THE RE-RAD TEST INVOLVES OPERATING A LOW POWER LEVELS ON THE BAND EDGES OF THE DBS DOWNLINK BAND AND THE DOMESTIC KU UPLINK BAND. SPECIFICALLY, THE TEST WILL OPERATE AT 14.003 GHZ AND 14.497 GHZ WITH A 2.4 MHZ BANDWIDTH DIGITAL CARRIER, AND 12.6955 GHZ AND 12.6965 GHZ WITH A 4 MHZ DIGITAL CARRIER. THE TEST WILL BE CONDUCTED AROUND JANUARY 10, 2004 AND JULY 10 2,004. THE LICENSED SERVICES OPERATING WITHIN THESE FREQUENCY BANDS ARE THE DIRECT BROADCAST SERVICES DOWNLINK 12.2-12.7 GHZ AND KU-BAND SATELLITE RECEIVERS. KU-BAND VSATS TRANSMIT IN THIS BAND AND WILL NOT BE SUSCEPTIBLE TO INTERFERENCE.

COMSEARCH HAS PERFORMED AN INTERFERENCE ANALYSIS FOR THE DBS DOWNLINK BAND. USING THE PROPOSED RE-RAD TEST CONFIGURATION AN INTERFERENCE MITIGATION ZONE WAS CREATED, SEE APPENDIX 1. THIS ZONE ENCOMPASSES AN AREA WHERE DBS DOWNLINK RECEIVERS COULD BE AFFECTED BY THE TEST OPERATION IF OPERATION IS ON A CO-CHANNEL BASIS. THIS INFORMATION WAS FORWARDED TO DIRECTV AND ECHOSTAR THE MAIN SERVICE OPERATORS IN THIS BAND. BOTH SERVICES DO NOT PROVIDE PROGRAMMING TO END-USERS IN THE SPECTRUM TO BE USED BY SEA LAUNCH. TRANSPONDER 32 OF THE DBS SATELLITES HAS A PASS BAND OF 24 MHZ CENTERED ON 12676 MHZ. THE CHANNEL'S UPPER BAND EDGE IS 12688 MHZ. THIS IS ALMOST 10 MHZ REMOVED FROM THE TEST CHANNEL BAND-EDGE. AFTER CONFERRING WITH DIRECTV AND ECHOSTAR BOTH COMPANIES AGREE THAT DUE TO THE LOW POWER LEVEL AND FREQUENCY SEPARATION THAT THERE EXISTS NO POTENTIAL FOR INTERFERENCE. DIRECTV AND ECHOSTAR HAVE PROVIDED "CLEARANCE" MEMOS.

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IN THE 14 GHZ BAND COMSEARCH HAS CALCULATED THE POWER DENSITY AT THE GSO SATELLITE ARC, WHERE THE IN-BAND RECEIVERS RESIDE. THE ANALYSIS IS INCLUDED IN APPENDIX 2. THE ANALYSIS INDICATES THAT DUE TO THE VERY LOW POWER LEVELS, THE USE OF A DIRECTIVE PARABOLIC DISH, AND SUFFICIENT ANGULAR SEPARATION TO ALL POSSIBLE SATELLITES IN THE GSO ARC THAT NO 14 GHZ SPACECRAFT RECEIVER WILL BE ADVERSELY AFFECTED BY THE OPERATION OF THIS TEST.

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3. SUPPLEMENTAL SHOWING RE: PART 25.203(C)

PURSUANT TO PART 25.203(C) AND 101.103(D) OF THE FCC RULES AND REGULATIONS, THE SATELLITE RE-RAD TEST PROPOSED IN THIS STA APPLICATION WAS COORDINATED BY COMSEARCH USING COMPUTER TECHNIQUES AND IN ACCORDANCE WITH PART 25 OF THE FCC RULES AND REGULATIONS.

COORDINATION DATA FOR THIS EARTH STATION WAS PERFORM VERBALLY AND USING EMAIL DURING THE PERIOD BETWEEN NOVEMBER 10 AND DECEMBER 3, 2003. THE FOLLOWING LICENSEES OR THEIR PROTECTION AGENTS WERE CONTACTED.

DIRECTV - DAVE PATILLO, EMAIL: DAPATTILLO@DIRECTV.COM
ECHOSTAR - KARL JENSIGHAUS, EMAIL: KARL.JENSIGHAUS@ECHOSTAR.COM

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4. EARTH STATION COORDINATION DATA

THIS SECTION PRESENTS THE DATA PERTINENT TO FREQUENCY COORDINATION OF THE PROPOSED EARTH STATION, WHICH WAS CIRCULATED TO ALL COMMON CARRIERS WITHIN ITS COORDINATION CONTOURS. THE TEST WAS ANALYZED AND COORDINATED AS TWO SIMPLEX POINT-TO-POINT MICROWAVE LINKS. THE STA REQUEST HAS A COMPLETE DESCRIPTION OF THE RE-RAD SYSTEM SET-UP. THE WORST CASE POWER LEVELS EMANATING FROM THE TEST SETUP WERE CONSIDERED IN THIS ANALYSIS.

LINK 1 - COMMAND LINK

TRANSMIT SITE - LAUNCH PLATFORM

TX LATITUDE: 33 44 43 N

TX LONGITUDE: 118 13 28 W

TX GND ELEVATION: 0 FT

TX ANTENNA CENTERLINE: 185 FT

RECEIVE SITE: SPACECRAFT

RX LATITUDE: 33 44 41 N

RX LONGITUDE: 118 13 28 W

RX GND ELEVATION: 0

RX ANTENNA CENTERLINE: 315 FT

TX ANTENNA TYPE: 3 FT PARABOLIC

TX ANTENNA GAIN: 37.3 DBI

TX FREQUENCY: 14.003.5 MHZ, 14.497 MHZ

TX POWER: -10.3 DBM

EMISSION: 2.4 MHZ PSK/FSK/FM

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LINK 2 - TELEMETRY LINK

TRANSMIT SITE - INTEGRATED LAUNCH VEHICLE

TX LATITUDE: 33 44 41 N

TX LONGITUDE: 118 13 28 W

TX GND ELEVATION: 0 FT

TX ANTENNA CENTERLINE: 315 FT

RECEIVE SITE: ASSEMBLY AND COMMAND SHIP

RX LATITUDE: 33 44 44 N

RX LONGITUDE: 118 13 25 W

RX GND ELEVATION: 0

RX ANTENNA CENTERLINE: 185 FT

TX ANTENNA TYPE: Cavity Back Spiral

TX ANTENNA GAIN: 3 DBI

TX FREQUENCY: 12.6955 MHZ, 12.6965 MHZ

TX POWER: 24 DBM

EMISSION: 4 MHZ BPSK

SEA LAUNCH COORDINATION REPORT

5. CERTIFICATION

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



BY:
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DATED: December 3, 2003

Terrestrial Site Name	Terrestrial Site Latitude (DDMMSS)	Terrestrial Site Longitude (DDMMSS)	ERP Density (dBW/MHz)	Earth Station Sensitivity (dBW/MHz)	Terrestrial Station Antenna Azimuth (Degrees)	Terrestrial Discrimination Angle (degrees)	Terrestrial Antenna Discrimination (dB)	Interference Path Azimuth - TS to ES (degrees)	Earth Station Antenna Horizon Gain (dBi)	Distance Required to Clear Interference (m)	Exclusion Zone Perimeter Point Latitude (seconds)	Exclusion Zone Perimeter Point Longitude (seconds)	Exclusion Zone Perimeter Point Latitude			Exclusion Zone Perimeter Point Longitude		
													Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
Long Beach, CA	334439	118130	-16.0	-155	32.07	350	0	362.07	-10	3.2847	121637.606	42552.8208	33	47	17.61	118	12	12.62
Long Beach, CA	334439	118130	-16.0	-155	32.07	351	0	383.05	-10	3.2847	121636.4589	42559.3202	33	47	16.46	118	12	9.3
Long Beach, CA	334439	118130	-16.0	-155	32.07	352	0	384.07	-10	3.2847	121635.2638	42556.20081	33	47	15.26	118	12	6.01
Long Beach, CA	334439	118130	-16.0	-155	32.07	353	0	385.07	-10	3.2847	121634.0211	42552.797	33	47	14.02	118	12	2.74
Long Beach, CA	334439	118130	-16.0	-155	32.07	354	0	386.07	-10	3.2847	121632.7311	42549.4978	33	47	12.73	118	11	59.5
Long Beach, CA	334439	118130	-16.0	-155	32.07	355	0	387.07	-10	3.2847	121631.3943	42546.16238	33	47	11.39	118	11	56.28
Long Beach, CA	334439	118130	-16.0	-155	32.07	355.5	0	387.57	-10	3.2847	121630.7085	42544.6873	33	47	10.71	118	11	54.69
Long Beach, CA	334439	118130	-16.0	-155	32.07	356	0	388.07	-10	3.2847	121630.0111	42543.0982	33	47	10.01	118	11	53.11
Long Beach, CA	334439	118130	-16.0	-155	32.07	356.5	0	388.57	-10	3.2847	121629.3022	42541.5164	33	47	9.3	118	11	51.80
Long Beach, CA	334439	118130	-16.0	-155	32.07	357	0	389.07	-10	3.2847	121628.5818	42539.9421	33	47	8.58	118	11	49.94
Long Beach, CA	334439	118130	-16.0	-155	32.07	357.5	0	389.57	-10	3.2847	121627.8501	42538.3755	33	47	7.85	118	11	48.38
Long Beach, CA	334439	118130	-16.0	-155	32.07	358	0	390.07	-10	3.2847	121627.107	42536.8166	33	47	7.1	118	11	46.82
Long Beach, CA	334439	118130	-16.0	-155	32.07	358.5	0	390.57	-10	3.2847	121626.3526	42535.2566	33	47	6.35	118	11	45.27
Long Beach, CA	334439	118130	-16.0	-155	32.07	359	0	391.07	-10	3.2847	121625.597	42533.7226	33	47	5.59	118	11	43.72
Long Beach, CA	334439	118130	-16.0	-155	32.07	359.5	0	391.57	-10	3.2847	121624.8102	42532.1877	33	47	4.81	118	11	42.19

Appendix 2 - Sea Launch Re-Rad Test

14 GHz Orbital Arc Intersection Calculations

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14 GHz Orbital Arc Intersection Calculations

[illegible]

Appendix 2 - Sea Launch Re-Rad Test 14 GHz Orbital Arc Intersection Calculations

[illegible]

14 GHz Orbital Arc Intersection Calculations

[illegible]

Appendix 2 - Sea Launch Re-Rad Test 14 GHz Orbital Arc Intersection Calculations

[illegible]

Appendix 2 - Sea Launch Re-Rad Test
14 GHz Orbital Arc Intersection Calculations

	Ground Elevation (m) AMSL	Antenna Height (m) AGL	Antenna Height (m) AMSL	Site 1 Lat (Real Seconds)	Site 1 Lon (Real Seconds)	Site 2 Lat (Real Seconds)	Site 2 Lon (Real Seconds)	Site 1 - Site 2 Distance (km)	Site 1 - Site 2 Azimuth (deg)	Site 1 Antenna Tilt (deg)	Site 2 - Site 1 Azimuth (deg)	Site 2 Antenna Tilt (deg)	Satellite Orbital Position (deg. W.L.)	Azimuth to Satellite (deg.)
Lon S				Rlat1	Rlon1	Rlat2	Rlon2							
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	194.00	262.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	193.00	261.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	192.00	260.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	191.00	260.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	190.00	259.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	189.00	259.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	188.00	258.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	187.00	257.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	186.00	257.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	185.00	256.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	184.00	256.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	183.00	255.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	182.00	254.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	181.00	254.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	180.00	253.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	179.00	252.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	178.00	252.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	177.00	251.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	176.00	250.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	175.00	250.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	174.00	249.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	173.00	248.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	172.00	247.9
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	171.00	247.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	170.00	246.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	169.00	245.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	168.00	244.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	167.00	244.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	166.00	243.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	165.00	242.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	164.00	241.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	163.00	240.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	162.00	239.9

Appendix 2 - Sea Launch Re-Rad Test
14 GHz Orbital Arc Intersection Calculations

	Ground Elevation (m) AMSL	Antenna Height (m) AGL	Antenna Height (m) AMSL	Site 1 Lat (Real Seconds)	Site 1 Lon (Real Seconds)	Site 2 Lat (Real Seconds)	Site 2 Lon (Real Seconds)	Site 1 - Site 2 Distance (km)	Site 1 - Site 2 Azimuth (deg)	Site 1 Antenna Tilt (deg)	Site 2 - Site 1 Azimuth (deg)	Site 2 Antenna Tilt (deg)	Satellite Orbital Position (deg. W.L.)	Azimuth to Satellite (deg.)
Lon S				Rlat1	Rlon1	Rlat2	Rlon2							
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	161.00	239.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	160.00	238.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	159.00	237.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	158.00	236.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	157.00	235.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	156.00	234.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	155.00	233.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	154.00	232.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	153.00	231.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	152.00	230.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	151.00	229.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	150.00	228.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	149.00	227.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	148.00	225.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	147.00	224.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	146.00	223.5
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	145.00	222.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	144.00	221.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	143.00	219.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	142.00	218.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	141.00	217.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	140.00	215.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	139.00	214.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	138.00	212.9
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	137.00	211.5
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	136.00	210.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	135.00	208.5
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	134.00	207.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	133.00	205.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	132.00	203.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	131.00	202.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	130.00	200.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	129.00	198.9
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	128.00	197.2

Appendix 2 - Sea Launch Re-Rad Test
14 GHz Orbital Arc Intersection Calculations

	Ground Elevation (m) AMSL	Antenna Height (m) AGL	Antenna Height (m) AMSL	Site 1 Lat (Real Seconds)	Site 1 Lon (Real Seconds)	Site 2 Lat (Real Seconds)	Site 2 Lon (Real Seconds)	Site 1 - Site 2 Distance (km)	Site 1 - Site 2 Azimuth (deg)	Site 1 Antenna Tilt (deg)	Site 2 - Site 1 Azimuth (deg)	Site 2 Antenna Tilt (deg)	Satellite Orbital Position (deg. W.L.)	Azimuth to Satellite (deg.)
Lon S				Rlat1	Rlon1	Rlat2	Rlon2							
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	127.00	195.5
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	126.00	193.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	125.00	192.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	124.00	190.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	123.00	188.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	122.00	186.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	121.00	185.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	120.00	183.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	119.00	181.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	118.00	179.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	117.00	177.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	116.00	176.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	115.00	174.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	114.00	172.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	113.00	170.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	112.00	168.9
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	111.00	167.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	110.00	165.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	109.00	163.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	108.00	162.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	107.00	160.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	106.00	158.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	105.00	157.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	104.00	155.5
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	103.00	153.9
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	102.00	152.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	101.00	150.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	100.00	149.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	99.00	147.9
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	98.00	146.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	97.00	145.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	96.00	143.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	95.00	142.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	94.00	141.0

Appendix 2 - Sea Launch Re-Rad Test
14 GHz Orbital Arc Intersection Calculations

	Ground Elevation (m) AMSL	Antenna Height (m) AGL	Antenna Height (m) AMSL	Site 1 Lat (Real Seconds)	Site 1 Lon (Real Seconds)	Site 2 Lat (Real Seconds)	Site 2 Lon (Real Seconds)	Site 1 - Site 2 Distance (km)	Site 1 - Site 2 Azimuth (deg)	Site 1 Antenna Tilt (deg)	Site 2 - Site 1 Azimuth (deg)	Site 2 Antenna Tilt (deg)	Satellite Orbital Position (deg. W.L.)	Azimuth to Satellite (deg.)
Lon S				Rlat1	Rlon1	Rlat2	Rlon2							
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	93.00	139.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	92.00	138.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	91.00	137.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	90.00	136.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	89.00	134.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	88.00	133.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	87.00	132.5
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	86.00	131.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	85.00	130.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	84.00	129.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	83.00	128.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	82.00	127.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	81.00	126.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	80.00	125.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	79.00	124.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	78.00	123.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	77.00	122.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	76.00	121.5
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	75.00	120.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	74.00	119.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	73.00	118.9
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	72.00	118.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	71.00	117.2
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	70.00	116.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	69.00	115.6
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	68.00	114.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	67.00	114.0
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	66.00	113.3
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	65.00	112.5
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	64.00	111.8
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	63.00	111.1
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	62.00	110.4
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	61.00	109.7
0.0	0.0	56.4	56.4	121479.0	425610.0	121483.0	425607.0	0.15	32.07	-15.24	212.07	15.24	60.00	109.0

Appendix 2 - Sea Launch Re-Rad Test

14 GHz Orbital Arc Intersection Calculations

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Appendix 2 - Sea Launch Re-Rad Test
14 GHz Orbital Arc Intersection Calculations

Elevation Angle to Satellite (deg.)	Site 2 - Satellite Azimuth delta	Eliminate from analysis?*	How many links left?	Azimuth- Elevation Delta	Eliminate from analysis?*	Now How many links left?
			3.0			0.0
3.1	49.9	Yes	0.0	34.8	Yes	0.0
4.0	49.3	Yes	0.0	34.3	Yes	0.0
4.8	48.7	Yes	0.0	33.8	Yes	0.0
5.6	48.2	Yes	0.0	33.3	Yes	0.0
6.5	47.6	Yes	0.0	32.9	Yes	0.0
7.3	47.0	Yes	0.0	32.5	Yes	0.0
8.1	46.4	Yes	0.0	32.1	Yes	0.0
9.0	45.8	Yes	0.0	31.7	Yes	0.0
9.8	45.1	Yes	0.0	31.3	Yes	0.0
10.6	44.5	Yes	0.0	31.0	Yes	0.0
11.4	43.9	Yes	0.0	30.7	Yes	0.0
12.3	43.3	Yes	0.0	30.4	Yes	0.0
13.1	42.6	Yes	0.0	30.1	Yes	0.0
13.9	42.0	Yes	0.0	29.9	Yes	0.0
14.8	41.3	Yes	0.0	29.7	Yes	0.0
15.6	40.7	Yes	0.0	29.6	Yes	0.0
16.4	40.0	Yes	0.0	29.4	Yes	0.0
17.3	39.3	Yes	0.0	29.3	Yes	0.0
18.1	38.6	Yes	0.0	29.2	Yes	0.0
18.9	37.9	Yes	0.0	29.2	Yes	0.0
19.7	37.2	Yes	0.0	29.2	Yes	0.0
20.5	36.5	Yes	0.0	29.2	Yes	0.0
21.4	35.8	Yes	0.0	29.3	Yes	0.0
22.2	35.0	Yes	0.0	29.4	Yes	0.0
23.0	34.3	Yes	0.0	29.5	Yes	0.0
23.8	33.5	Yes	0.0	29.7	Yes	0.0
24.6	32.8	Yes	0.0	29.9	Yes	0.0
25.4	32.0	Yes	0.0	30.1	Yes	0.0
26.2	31.2	Yes	0.0	30.4	Yes	0.0
27.0	30.4	Yes	0.0	30.7	Yes	0.0
27.8	29.5	Yes	0.0	31.0	Yes	0.0
28.6	28.7	Yes	0.0	31.3	Yes	0.0
29.3	27.8	Yes	0.0	31.7	Yes	0.0

Appendix 2 - Sea Launch Re-Rad Test
14 GHz Orbital Arc Intersection Calculations

Elevation Angle to Satellite (deg.)	Site 2 - Satellite Azimuth delta	Eliminate from analysis?*	How many links left?	Azimuth- Elevation Delta	Eliminate from analysis?*	Now How many links left?
			3.0			0.0
30.1	26.9	Yes	0.0	32.1	Yes	0.0
30.9	26.1	Yes	0.0	32.5	Yes	0.0
31.7	25.1	Yes	0.0	33.0	Yes	0.0
32.4	24.2	Yes	0.0	33.5	Yes	0.0
33.2	23.3	Yes	0.0	34.0	Yes	0.0
33.9	22.3	Yes	0.0	34.5	Yes	0.0
34.6	21.3	Yes	0.0	35.1	Yes	0.0
35.4	20.3	Yes	0.0	35.7	Yes	0.0
36.1	19.3	Yes	0.0	36.3	Yes	0.0
36.8	18.2	Yes	0.0	36.9	Yes	0.0
37.5	17.1	Yes	0.0	37.5	Yes	0.0
38.2	16.0	Yes	0.0	38.2	Yes	0.0
38.9	14.9	Yes	0.0	38.9	Yes	0.0
39.5	13.8	Yes	0.0	39.5	Yes	0.0
40.2	12.6	Yes	0.0	40.2	Yes	0.0
40.8	11.4	Yes	0.0	41.0	Yes	0.0
41.4	10.2	Yes	0.0	41.7	Yes	0.0
42.1	8.9	Yes	0.0	42.4	Yes	0.0
42.7	7.7	Yes	0.0	43.2	Yes	0.0
43.2	6.3	Yes	0.0	44.0	Yes	0.0
43.8	5.0	Yes	0.0	44.8	Yes	0.0
44.4	3.7	Yes	0.0	45.5	Yes	0.0
44.9	2.3	Yes	0.0	46.3	Yes	0.0
45.4	0.8	NO	1.0	47.2	Yes	0.0
45.9	0.6	NO	2.0	47.7	Yes	0.0
46.4	2.1	NO	3.0	47.8	Yes	0.0
46.8	3.6	Yes	3.0	47.9	Yes	0.0
47.3	5.1	Yes	3.0	48.1	Yes	0.0
47.7	6.7	Yes	3.0	48.3	Yes	0.0
48.1	8.3	Yes	3.0	48.5	Yes	0.0
48.4	9.9	Yes	3.0	48.7	Yes	0.0
48.8	11.5	Yes	3.0	48.9	Yes	0.0
49.1	13.2	Yes	3.0	49.1	Yes	0.0
49.4	14.8	Yes	3.0	49.4	Yes	0.0

Appendix 2 - Sea Launch Re-Rad Test
14 GHz Orbital Arc Intersection Calculations

Elevation Angle to Satellite (deg.)	Site 2 - Satellite Azimuth delta	Eliminate from analysis?*	How many links left?	Azimuth- Elevation Delta	Eliminate from analysis?*	Now How many links left?
			3.0			0.0
49.7	16.5	Yes	3.0	49.7	Yes	0.0
49.9	18.3	Yes	3.0	50.0	Yes	0.0
50.1	20.0	Yes	3.0	50.3	Yes	0.0
50.3	21.8	Yes	3.0	50.6	Yes	0.0
50.4	23.5	Yes	3.0	50.9	Yes	0.0
50.6	25.3	Yes	3.0	51.3	Yes	0.0
50.7	27.1	Yes	3.0	51.7	Yes	0.0
50.7	28.9	Yes	3.0	52.0	Yes	0.0
50.8	30.7	Yes	3.0	52.4	Yes	0.0
50.8	32.5	Yes	3.0	52.9	Yes	0.0
50.8	34.3	Yes	3.0	53.3	Yes	0.0
50.7	36.1	Yes	3.0	53.7	Yes	0.0
50.6	37.9	Yes	3.0	54.2	Yes	0.0
50.5	39.6	Yes	3.0	54.6	Yes	0.0
50.4	41.4	Yes	3.0	55.1	Yes	0.0
50.2	43.2	Yes	3.0	55.6	Yes	0.0
50.0	44.9	Yes	3.0	56.1	Yes	0.0
49.8	46.7	Yes	3.0	56.6	Yes	0.0
49.5	48.4	Yes	3.0	57.1	Yes	0.0
49.3	50.1	Yes	3.0	57.6	Yes	0.0
49.0	51.7	Yes	3.0	58.1	Yes	0.0
48.6	53.4	Yes	3.0	58.7	Yes	0.0
48.3	55.0	Yes	3.0	59.2	Yes	0.0
47.9	56.6	Yes	3.0	59.8	Yes	0.0
47.5	58.2	Yes	3.0	60.4	Yes	0.0
47.1	59.7	Yes	3.0	60.9	Yes	0.0
46.6	61.2	Yes	3.0	61.5	Yes	0.0
46.2	62.7	Yes	3.0	62.1	Yes	0.0
45.7	64.2	Yes	3.0	62.7	Yes	0.0
45.2	65.6	Yes	3.0	63.3	Yes	0.0
44.7	67.0	Yes	3.0	63.9	Yes	0.0
44.1	68.4	Yes	3.0	64.5	Yes	0.0
43.6	69.8	Yes	3.0	65.1	Yes	0.0
43.0	71.1	Yes	3.0	65.7	Yes	0.0

Appendix 2 - Sea Launch Re-Rad Test
14 GHz Orbital Arc Intersection Calculations

Elevation Angle to Satellite (deg.)	Site 2 - Satellite Azimuth delta	Eliminate from analysis?*	How many links left?	Azimuth- Elevation Delta	Eliminate from analysis?*	Now How many links left?
			3.0			0.0
42.4	72.4	Yes	3.0	66.4	Yes	0.0
41.8	73.6	Yes	3.0	67.0	Yes	0.0
41.2	74.9	Yes	3.0	67.6	Yes	0.0
40.5	76.1	Yes	3.0	68.3	Yes	0.0
39.9	77.3	Yes	3.0	68.9	Yes	0.0
39.2	78.4	Yes	3.0	69.5	Yes	0.0
38.5	79.6	Yes	3.0	70.2	Yes	0.0
37.9	80.7	Yes	3.0	70.8	Yes	0.0
37.2	81.8	Yes	3.0	71.5	Yes	0.0
36.5	82.8	Yes	3.0	72.1	Yes	0.0
35.8	83.9	Yes	3.0	72.8	Yes	0.0
35.0	84.9	Yes	3.0	73.5	Yes	0.0
34.3	85.9	Yes	3.0	74.1	Yes	0.0
33.6	86.9	Yes	3.0	74.8	Yes	0.0
32.8	87.8	Yes	3.0	75.4	Yes	0.0
32.1	88.8	Yes	3.0	76.1	Yes	0.0
31.3	89.7	Yes	3.0	76.8	Yes	0.0
30.5	90.6	Yes	3.0	77.4	Yes	0.0
29.8	91.5	Yes	3.0	78.1	Yes	0.0
29.0	92.4	Yes	3.0	78.7	Yes	0.0
28.2	93.2	Yes	3.0	79.4	Yes	0.0
27.4	94.0	Yes	3.0	80.1	Yes	0.0
26.6	94.9	Yes	3.0	80.7	Yes	0.0
25.8	95.7	Yes	3.0	81.4	Yes	0.0
25.0	96.5	Yes	3.0	82.1	Yes	0.0
24.2	97.3	Yes	3.0	82.7	Yes	0.0
23.4	98.0	Yes	3.0	83.4	Yes	0.0
22.6	98.8	Yes	3.0	84.0	Yes	0.0
21.8	99.5	Yes	3.0	84.7	Yes	0.0
21.0	100.3	Yes	3.0	85.3	Yes	0.0
20.2	101.0	Yes	3.0	86.0	Yes	0.0
19.4	101.7	Yes	3.0	86.6	Yes	0.0
18.5	102.4	Yes	3.0	87.3	Yes	0.0
17.7	103.1	Yes	3.0	87.9	Yes	0.0

Appendix 2 - Sea Launch Re-Rad Test
14 GHz Orbital Arc Intersection Calculations

Elevation Angle to Satellite (deg.)	Site 2 - Satellite Azimuth delta	Eliminate from analysis?*	How many links left?	Azimuth- Elevation Delta	Eliminate from analysis?*	NOW How many links left?
			3.0			0.0
16.9	103.8	Yes	3.0	88.6	Yes	0.0
16.1	104.4	Yes	3.0	89.2	Yes	0.0
15.2	105.1	Yes	3.0	89.9	Yes	0.0
14.4	105.8	Yes	3.0	90.5	Yes	0.0
13.6	106.4	Yes	3.0	91.1	Yes	0.0
12.7	107.1	Yes	3.0	91.8	Yes	0.0
11.9	107.7	Yes	3.0	92.4	Yes	0.0
11.1	108.3	Yes	3.0	93.0	Yes	0.0
10.2	108.9	Yes	3.0	93.6	Yes	0.0
9.4	109.6	Yes	3.0	94.3	Yes	0.0
8.6	110.2	Yes	3.0	94.9	Yes	0.0
7.7	110.8	Yes	3.0	95.5	Yes	0.0
6.9	111.4	Yes	3.0	96.1	Yes	0.0
6.1	112.0	Yes	3.0	96.7	Yes	0.0
5.2	112.6	Yes	3.0	97.3	Yes	0.0
4.4	113.2	Yes	3.0	97.9	Yes	0.0
3.6	113.7	Yes	3.0	98.5	Yes	0.0
2.8	114.3	Yes	3.0	99.1	Yes	0.0
1.9	114.9	Yes	3.0	99.6	Yes	0.0
1.1	115.5	Yes	3.0	100.2	Yes	0.0
0.3	116.0	Yes	3.0	100.8	Yes	0.0