REQUEST FOR SPECIAL TEMPORARY AUTHORITY

O3b Limited ("O3b"), pursuant to Section 25.120 of the Commission's rules, hereby respectfully requests special temporary authority ("STA") to operate an earth station located at the U.S Navy SPAWAR/CODA Lab at the U.S. Navy Base in San Diego, California (the "CODA Lab Earth Station") that will communicate with the satellite system operated by O3b Limited ("O3b"). In this filing, O3b seeks a 30-day STA for the period between January 31, 2014, and March 2, 2014.

The CODA Lab Earth Station will be used for non-commercial testing and demonstration purposes. The CODA Lab Earth Station will simulate both shipboard installation and shipboard local network interfaces in order to model communications between 4G/LTE devices on U.S. Navy Ships. As discussed below, grant of the requested authority is in the public interest as it will allow O3b to test and evaluate O3b services that could benefit the U.S. Navy.

Test Details and Public Interest Showing

The CODA Lab Earth Station will communicate with O3b's Ka-band, Medium Earth Orbit, non-geostationary orbit ("NGSO") satellite system[1] and O3b's gateway earth station in Vernon, TX.[2]

The frequencies to be used by the CODA Lab Earth Station are:

- 28.1-28.4 GHz and 28.6-29.1 GHz (uplink)
- 18.3-18.6 GHz and 18.8-19.3 GHz (downlink)

The CODA Lab Earth Station will consist of two (2) 1.2m stabilized maritime antennas manufactured by Orbit, and will operate with a ViaSat MEOLink modem. This Orbit 1.2m terminal is identical to the Orbit 1.2m terminal for which O3b has sought authority for Earth Stations on Vessels ("ESV") operations.[3] O3b's STA request is independent of O3b's separately-filed application for a license to operate ESVs, and the STA request includes frequencies that are not part of the ESV application.[4]

The CODA Lab Earth Station antennas will be mounted on a fixed pedestal on the roof of the CODA Lab building and will be connected to a simulated shipboard network in the CODA Lab. Although the pointing angle of the antennas will change as O3b's in-orbit satellites are tracked, the pedestal will remain stationary during the demonstration.

Grant of this application will serve the public interest, convenience, and necessity by allowing O3b to show how its system can effectively deliver 4G/LTE service to and from U.S. Navy ships and can be operated compatibly with end-to-end encryption. O3b will demonstrate the system's capabilities for providing a variety of valuable communications, including voice and video conferencing using mobile devices. As is shown below, moreover, other co-frequency services will be properly protected.

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[1] O3b's first four satellites were launched on June 25, 2013. O3b's next four satellites are expected to launch in early 2014. O3b's commercial services are expected to commence in 2Q 2014.

[2] *See* O3b Limited, Call Sign E130021, File No. SES-LIC-20130124-00089, granted June 20, 2013 ("O3b Texas License").

[3] *See* O3b Limited, Call Sign E130098, File No. SES-LIC-20130528-00455, filed May 28, 2013 ("O3b ESV License Application"), and which was placed on Public Notice on 27 November 2013.

[4] *See* O3b ESV License Application, File No. SES-LIC-20130528-00455.

Technical Parameters

O3b is attaching the following documents with the technical details of the operations proposed under the requested STA:

- Annex 1: FCC Form 312, Schedule B. O3b proposes to operate the CODA Lab Earth Station during this 30-day term in accordance with the parameters specified in the Schedule B.[5]
- Annex 2: Comsearch Reports. Comsearch reports are provided for bands in which terrestrial frequencies have primary allocations. Comsearch notified operators within a coordination zone calculated using the ITU RR Appendix 7 guidelines.
    - 28.1-28.35 GHz band. As stated in the attached Frequency Coordination Report, Comsearch has notified all existing and proposed LMDS licensees that are within the coordination contours of the CODA Lab Earth Station and that potentially could be affected by O3b's transmissions in the 28.1-28.35 portion of the Ka-Band. No objections were received from any of these parties.
    - 18.3-18.6 GHz. As stated in the attached Interference Analysis Report, for operations in the 18.3-18.6 GHz band, the CODA Lab Earth Station will operate satisfactorily within the 18 GHz common carrier microwave environment, and there will be no restrictions of its operation due to interference considerations.
- Annex 3: Link Budgets. Representative links for the CODA Lab Earth Station are provided.
- Annex 4: Beam Contour Maps. The mid-band antenna gain contours for the O3b satellite receive and transmit beams, when directed towards the San Diego earth station, are shown.
- Annex 5: Radiation Hazard Study. The radiation hazard analysis for the 1.2m antenna is attached. As described in Annex 5, O3b will follow procedures to mitigate potential radiation hazards to personnel in controlled and uncontrolled environments.
- Annex 6: Coordination Contours. O3b is providing a report prepared by Transfinite, which contains more detailed coordination contours. Given that the methodology in ITU RR Appendix 7 is conservative, Transfinite demonstrates that with well-established analytical tools the size of the coordination contours around the O3b CODA Lab Earth Station site can be reduced and the contours are smaller than those based on ITU RR Appendix 7. The Transfinite report demonstrates that the CODA Lab Earth Station contours are within United States territory.

[5] Although O3b is not seeking a regular license for the CODA Lab Earth Station, O3b is providing a Schedule B containing technical parameters for the Commission's convenience.

Further, O3b incorporates by reference the following technical parameters previously provided by O3b:

- Schedule S. In its application for a gateway earth station in Hawaii, O3b submitted a Schedule S describing its satellite system's technical characteristics.[6] The Schedule S correctly described the O3b satellite system for that application, and numerically enveloped all of the necessary parameters for future earth station applications. In order to assist the Commission in processing present and future applications, however, O3b subsequently provided a modified Schedule S that incorporates additional information submitted to the Commission since the Hawaii application was filed.[7] O3b will operate its CODA Lab Earth Station within the parameters described in O3b's modified Schedule S.

- 1.2m Orbit Antenna Characteristics. O3b previously submitted detailed information concerning the 1.2m Orbit antenna to the Commission. [8]

- Antenna Patterns. O3b has submitted measured 30 GHz band antenna performance data for the 1.2m antenna to the Commission.[9]

- U.S. Government Coordination. O3b has completed all necessary coordination with US government satellite networks operating in Ka-band, including GSO and non-GSO networks, as well as their associated specific earth stations filed under 9.7A and 9.7B of the ITU Radio Regulations through other administrations. O3b has also completed coordination, according to US footnote 334 of the FCC table of frequency allocations, with the US government, and this US334 coordination agreement specifically provides for additional earth stations in US territory operating with O3b's satellites, such as the CODA Lab Earth Station. As a result, O3b's existing US334 coordination agreement covers the use of the CODA Lab Earth Station as requested in this application.

Proposed Spectrum Use

O3b's proposed operations pose no risk of harmful interference to other lawfully authorized stations. As demonstrated below, the CODA Lab Earth Station will provide the requisite protection to terrestrial stations and geostationary orbit ("GSO") FSS stations operating in the bands proposed by O3b. Transmissions by O3b under the proposed STA will occur on a secondary, non-harmful interference basis, and O3b acknowledges that it will not be entitled to interference protection.

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[6] *See* O3b Limited, Call Sign E100088, File No. SES-LIC-20100723-00952, granted Sept. 25, 2012 ("O3b Hawaii License").
[7] *See* O3b Limited, Call Sign E130098, File No. SES-AMD-20131025-01138 ("O3b ESV Answers").
[8] O3b ESV License Application, File No. SES-LIC-20130528-00455, *Technical Attachment* at A.6.
[9] O3b ESV Answers, File No. SES-AMD-20131025-01138, *Answer to Question 10*.

UPLINK

28.1-28.35 GHz – Secondary uplink band shared with primary LMDS.

The 27.6-28.35 GHz uplink band is allocated to the local multipoint distribution service ("LMDS") on a primary basis. FSS operations are allocated on a secondary basis in the same band. O3b proposes to operate in a portion of this band, *i.e.,* 28.1-28.35 GHz. Accordingly, O3b's proposed operations in this band must not cause harmful interference to primary LMDS stations.

The attached Comsearch coordination report demonstrates that O3b can operate its CODA Lab Earth Station on a secondary basis in this band without causing harmful interference to LMDS licensees. Comsearch sent a coordination notice to all existing and proposed terrestrial licensees within the Comsearch coordination contours of the CODA Lab Earth Station site. No objections were received from any of the incumbent licensees.

28.35-28.4 GHz – Secondary uplink band shared with primary GSO FSS stations.

In the 28.35–28.4 GHz band, there is a primary allocation for GSO FSS systems and a secondary allocation for NGSO FSS systems. O3b's CODA Lab Earth Station transmissions in this band will be consistent with their secondary status vis-à-vis GSO FSS transmissions. The Commission has allowed similar secondary use of frequencies in the Ka-band uplink allocated to GSO FSS on a primary basis where applicants are prepared to accept interference from primary operations and can demonstrate that their proposed operations are not likely to cause harmful interference to primary operations.[10] O3b agrees to both of these standards.

As a secondary user of the 28.35-28.4 GHz band in the United States, O3b makes no claim of protection from interference from U.S.-licensed GSO FSS networks in this band segment. As for O3b's uplink operations in the 28.35-28.4 GHz band, the ITU has developed uplink equivalent power flux density limits ("$EPFD_{up}$") limits to protect co-frequency GSO FSS operations from unacceptable interference from NGSO FSS systems operating in the same frequencies. Specifically, in accordance with Article 22 of the ITU Radio Regulations, if the applicable $EPFD_{up}$ limits are met, the NGSO FSS satellite system is considered to have met its obligations to protect GSO FSS networks from unacceptable interference.

O3b demonstrated that its gateway located at Hawaii operating at the authorized power levels will meet the applicable ITU $EPFD_{up}$ limits in all frequency ranges where these limits apply, due to the inherent angular separation between the O3b and geostationary orbits when viewed from the Earth at latitudes away from the equator.[11] The CODA Lab Earth Station is located further north in latitude than the Hawaii gateway,[12] which results in an even greater angular separation between the O3b and

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[10] *Northrop Grumman Space & Missions Systems Corporation*, 24 FCC Rcd 2330, at ¶¶ 72-73 (Int'l Bur. 2009); *contactMEO Communications, LLC*, 21 FCC Rcd 4035, at ¶¶ 23-24, (Int'l Bur., 2006).

[11] O3b Hawaii License Application, FCC File No. SES-LIC-20100723-00952, *Technical Attachment* at A.10.1.

[12] The O3b Hawaii gateway latitude is 21° 40' 17.8" N; the CODA Lab Earth Station latitude is 32° 40' 54.3" N.

geostationary orbits as viewed from the Earth and an even greater assurance that the applicable ITU $EPFD_{up}$ limits will be met by O3b' proposed operations. The proposed CODA Lab Earth Station operations, therefore, also will meet the applicable ITU $EPFD_{up}$ limits. In any event, O3b confirms that its operations will be on a secondary basis relative to U.S.-licensed GSO FSS networks in the same band.

28.6-29.1 GHz – Primary uplink band for licensed NGSO FSS Systems.

Under the Commission's Ka-band frequency plan, the frequencies 28.6-29.1 GHz may be used on a primary basis by licensed NGSO FSS systems.[13] O3b recognizes, however, that operations under the STA for the CODA Lab Earth Station demonstrations will be on a secondary, non-harmful interference basis. As demonstrated below, the CODA Lab Earth Station demonstrations will provide the requisite protection to allocated services operating in these bands.

Avoidance of interference to GSO FSS systems. The proposed demonstrations will not cause any interference into, or require protection from, any co-frequency GSO satellites. As previously shown,[14] there is an inherent angular separation between the O3b and GSO arcs from the perspective of earth stations located away from the equator. The CODA Lab Earth Station is located further north in latitude than the Hawaii gateway, which results in an even greater angular separation between the O3b and geostationary orbits as viewed from the Earth. This means that the angular separation between the O3b and GSO arcs from the CODA Lab Earth Station will be greater than the 7 degree separation accepted by the Commission when it approved O3b's Hawaii gateway. This ensures that GSO FSS systems will be adequately protected.

Avoidance of interference to or from Fixed Service (i.e., terrestrial) stations. Interference from the O3b CODA Lab Earth Station transmissions into U.S. terrestrial FS receivers in the 28 GHz band is a non-issue because there is no allocation in the Commission's Ka-band Frequency Plan for Fixed Service stations operating in the 28.6-29.1 GHz band in the United States.[15]

DOWNLINK

18.3-18.6 GHz – Non-conforming downlink band shared with primary GSO FSS stations.

The 18.3-18.6 GHz band is allocated in the United States on a primary basis to GSO FSS. In the 18.3-18.6 GHz downlink band, the ITU has developed downlink equivalent power flux density ("$EPFD_{down}$") limits to protect GSO FSS networks from unacceptable interference from NGSO FSS systems

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[13] *See In the Matter of Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services,* 11 FCC Rcd. 19005, ¶¶59-62 and 79 (1996). *See also In the Matter of Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite-Service Use*, 15 FCC Rcd 13430, ¶ 28 (2000).

[14] O3b Hawaii License Application, FCC File No. SES-LIC-20100723-00952, *Technical Attachment* at A.10.1.

[15] *See In the Matter of Verizon Washington D.C., Application for Renewal of License for Common Carrier Fixed Point to Point Microwave Station KGC79*, 26 FCC Rcd 13511, 13516 (WTB 2011).

operating in the same frequencies. Specifically, in accordance with Article 22 of the ITU Radio Regulations, if the applicable $EPFD_{down}$ limits are met, the NGSO FSS satellite system is considered to have met its obligations to protect GSO FSS networks from unacceptable interference. O3b confirms that its system will meet the applicable ITU $EPFD_{down}$ limits in all frequency ranges where these limits apply.[16]

As an example of how these limits will be satisfied, O3b provided $EPFD_{down}$ calculations for transmissions to its Hawaii gateway earth station.[17] O3b also showed how the $EPFD_{down}$ limits can be satisfied at all latitudes.[18] Compliance with the $EPFD_{down}$ limits is more easily achieved in the case of transmissions to O3b's CODA Lab Earth Station than it is in the case of transmissions to O3b's Hawaii earth station. O3b is able to satisfy the limits by taking advantage of the inherent angular separation of the O3b and the GSO orbits when viewed from the surface of the Earth at latitudes away from the equator,[19] and O3b's CODA Lab Earth Station will be located further from the equator than O3b's Hawaii earth station. The CODA Lab Earth Station location, therefore, presents an even stronger case for non-interference to GSO FSS networks than the Hawaii gateway location.

18.8-19.3 GHz Primary downlink band for licensed NGSO FSS Systems.

Under the Commission's Ka-band frequency plan, the frequencies 18.8-19.3 GHz may be used on a primary basis by licensed NGSO FSS systems.[20] O3b recognizes, however, that operations under the STA for the CODA Lab Earth Station demonstrations will be on a secondary, non-harmful interference basis. The CODA Lab Earth Station demonstrations will provide the requisite protection to GSO FSS networks and terrestrial stations operating in this band.

Avoidance of interference to GSO FSS systems. This band is not allocated for GSO FSS networks.[21] Nevertheless, the proposed demonstrations will not cause any interference into, or require protection from, any co-frequency GSO satellites in this band. As previously shown,[22] there is an inherent angular separation between the O3b and GSO arcs from the perspective of earth stations

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[16] *See* ITU Radio Regulations, Article 22. *See also* O3b Hawaii License Application, FCC File No. SES-LIC-20100723-00952, *Technical Attachment* at A.10.1 for a discussion of O3b's compliance with the operational limits in Article 22 of the ITU Radio Regulations.

[17] O3b Hawaii License Application, FCC File No. SES-LIC-20100723-00952, *Technical Attachment* at A.10.1.

[18] See id.

[19] See id.

[20] *See In the Matter of Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services,* 11 FCC Rcd. 19005, ¶¶59-62 and 79 (1996). *See also In the Matter of Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite-Service Use*, 15 FCC Rcd 13430, ¶ 28 (2000).

[21] See id.

[22] O3b Hawaii License Application, FCC File No. SES-LIC-20100723-00952, *Technical Attachment* at A.10.1.

located away from the equator. The CODA Lab Earth Station is located further north in latitude than the Hawaii gateway, which means an even greater angular separation between the O3b and geostationary orbits as viewed from the Earth. This means that the angular separation between the O3b and GSO arcs from the CODA Lab Earth Station will be greater than the 7 degree separation accepted by the Commission when it approved O3b's Hawaii gateway. This ensures that GSO FSS systems will be adequately protected.

However, because the demonstrations O3b proposes in this STA request will be conducted on a secondary basis, O3b agrees to accept any interference that its CODA Lab Earth Station may receive from 18.8-19.3 GHz band GSO FSS networks.

Avoidance of interference to or from Fixed Service (i.e., terrestrial) stations. Fixed Service stations operating in the 18.8-19.3 GHz band are no longer co-primary with FSS users in this band.[23] However, because the demonstrations O3b proposes in this STA request will be conducted on a secondary basis, O3b agrees to accept any interference that its CODA Lab Earth Station may receive from 18.8-19.3 GHz band Fixed Service stations. O3b will protect the 18.8-19.3 GHz band fixed service stations by complying with the space station PFD limits specified in Section 25.208 of the FCC rules.

Coordination Contours

Pursuant to Section 25.203(d) of the FCC's rules, O3b is submitting an analysis prepared by Transfinite Systems Ltd, attached as Annex 6, that provides coordination distances and coordination distance contours for the CODA Lab Earth Station.[24] In its report, Transfinite shows the ITU RR Appendix 7 contours but also generates a more detailed interference zone using terrain data, interference criteria from Recommendation ITU-R SF.1006, and other methodologies incorporating antenna pointing and propagation statistics.

Transfinite's more realistic coordination contours for this STA request do not extend into Mexico, even though the ITU RR Appendix 7 coordination contours do extend across the Mexico-U.S. border. It is also O3b's understanding is that there are no terrestrial stations in Mexico within interference range of the CODA Lab Earth Station site using the frequencies proposed in this STA request. Out of an abundance of caution, O3b has responded "yes" to Item E19 of Schedule B because the ITU RR Appendix 7 contours extend into Mexico, but for the above reasons, we believe international coordination should not be required.

Conclusion

The requested STA will allow O3b to evaluate and demonstrate the O3b system's operational capabilities and will not result in harmful interference to other authorized spectrum users. Accordingly, and for good cause shown, O3b respectfully requests that its STA be granted in time for it to commence testing under this 30-day STA request on January 31, 2014.

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[23] *See* 47 C.F.R. § 101.85(b)(2).

[24] As noted on page 2, the Transfinite contours are smaller than the contours calculated using ITU RR Appendix 7.

ANNEX 1 – Form 312, Schedule B

The Form 312, Schedule B is provided on the following pages.

SATELLITE EARTH STATION AUTHORIZATIONS
FCC Form 312 - Schedule B:(Technical and Operational Description)

FOR OFFICIAL USE ONLY

Location of Earth Station Site

E1: Site Identifier:	US Navy SPAWAR CODA Lab at 32nd Street Naval Station	E5. Call Sign: N/A	
E2: Contact Name:	Mr. Keith Thackery	E6. Phone Number:	619-556-6385
E3. Street:	3533 Norman Scott Road, Bldg 3533 Room 300	E7. City:	San Diego
		E8. County:	San Diego
E4. State	CA	E9. Zip Code	92136
E10. Area of Operation:		Fixed	
E11. Latitude:	32 ° 40 ' 54.3 " N		
E12. Longitude:	117 ° 7 ' 0.1 " W		
E13. Lat/Lon Coordinates are:		○ NAD-27	◉ NAD-83
E14. Site Elevation (AMSL):		5.33 meters	

E15. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer's qualification measurement? If NO, provide a technical analysis showing compliance with two-degree spacing policy.	○ Yes ○ No ○ N/A
E16. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with non-geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurements?	◉ Yes ○ No ○ N/A
E17. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point.	○ Yes ◉ No
E18. Is frequency coordination required? If YES, attach a frequency coordination report as	◉ Yes ○ No
E19. Is coordination with another country required? If YES, attach the name of the country(ies) and plot of coordination contours as	◉ Yes ○ No
E20. FAA Notification - (See 47 CFR Part 17 and 47 CFR part 25.113(c)) Where FAA notification is required, have you attached a copy of a completed FCC Form 854 and or the FAA's study regarding the potential hazard of the structure to aviation? **FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION.**	○ Yes ◉ No

POINTS OF COMMUNICATION

Satellite Name:O3B-A | O3B-A | Eq. NGSO If you selected OTHER, please enter the following:	
E21. Common Name:	E22. ITU Name:
E23. Orbit Location:	E24. Country:

POINTS OF COMMUNICATION (Destination Points)

E25. Site Identifier:	

E26. Common Name:	E27. Country:

ANTENNA

Site ID	E28. Antenna Id	E29. Quantity	E30. Manufacturer	E31. Model	E32. Antenna Size	E41/42. Antenna GainTransmint and/or Recieve(____dBi at_____GHz)
CODA Lab	Orbit 1.2m	2	Orbit Communications	AL-7103-Ka	1.2	45 dBi at 19.2
						48.0 dBi at 28.3 GHz

E28. Antenna Id	E33/34. Diameter Minor/Major(meters)	E35. Above Ground Level (meters)	E36. Above Sea Level (meters)	E37. Building Height Above Ground Level (meters)	E38. Total Input Power at antenna flange (Watts)	E39. Maximum Antenna Height Above Rooftop (meters)	E40. Total EIRP for al carriers (dBW)
Orbit 1.2m	1.2/1.2	5.33	7.33	0.0	20.0	2.0	60.5

FREQUENCY

E28. Antenna Id	E43/44. Frequency Bands(MHz)	E45. T/R Mode	E46. Antenna Polarization(H,V,L,R)	E47. Emission Designator	E48. Maximum EIRP per Carrier(dBW)	E49. Maximum ERIP Density per Carrier(dBW/4kHz)
Orbit 1.2m	18300 - 18600	R	Left and Right Circular	216MG7D	45.6	-1.7
E50. Various Modulations up to 32APSK; Digital Data Link						
Orbit 1.2m	18300 - 18600	R	Left and Right Circular	54MG7D	45.6	4.3
E50. Various Modulations up to 32APSK; Digital Data Link						
Orbit 1.2m	18800 - 19300	R	Left and Right Circular	216MG7D	45.6	-1.7
E50. Various Modulations up to 32APSK; Digital Data Link						
Orbit 1.2m	18800 - 19300	R	Left and Right Circular	54MG7D	45.6	4.3
E50. Various Modulations up to 32APSK; Digital Data Link						
Orbit 1.2m	28100 - 28400	T	Left and Right Circular	216MG7D	59.6	12.3
E50. Various Modulations up to 32APSK; Digital Data Link						
Orbit 1.2m	28100 - 28400	T	Left and Right Circular	54MG7D	53.6	12.3
E50. Various Modulations up to 32APSK; Digital Data Link						
Orbit 1.2m	28600 - 29100	T	Left and Right Circular	216MG7D	59.6	12.3
E50. Various Modulations up to 32APSK; Digital Data Link						
Orbit 1.2m	28600 - 29100	T	Left and Right Circular	54MG7D	53.6	12.3
E50. Various Modulations up to 32APSK; Digital Data Link						

FREQUENCY COORDINATION

E28. Antenna Id	E51. Satellite Orbit Type	E52/53. Frequency Limits(MHz)	E54/55. Range of Satellite Arc E/W Limit	E56. Earth Station Azimuth Angle Eastern Limit	E57. Antenna Elevation Angle Eastern Limit	E58. Earth Station Azimuth Angle Western Limit	E59. Antenna Elevation Angle Western Limit	E60. Maximum EIRP Density toward the Horizon(dBW/4kHz)
Orbit 1.2	Non-Geostationary	18300 - 18600	NON-GEO	117	10.0	242	10	--
Orbit 1.2	Non-Geostationary	18800 - 19300	NON-GEO	117	10.0	242	10	--
Orbit 1.2	Non-Geostationary	28100 - 28400	NON-GEO	117	10.0	242	10	-39.8
Orbit 1.2	Non-Geostationary	28600 - 29100	NON-GEO	117	10.0	242	10	-39.8

REMOTE CONTROL POINT LOCATION

E61. Call Sign NOTE: Please enter the callsign of the controlling station, not the callsign for which this application is being filed.			E65. Phone Number
E62. Street Address			
E63. City	E67. County	E64/68. State/Country	E66. Zip Code

FCC NOTICE REQUIRED BY THE PAPERWORK REDUCTION ACT

The public reporting for this collection of information is estimated to average 0.25 - 24 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the required data, and completing and reviewing the collection of information. If you have any comments on this burden estimate, or how we can improve the collection and reduce the burden it causes you, please write to the Federal Communications Commission, AMD-PERM, Paperwork Reduction Project (3060-0678), Washington, DC 20554. We will also accept your comments regarding the Paperwork Reduction Act aspects of this collection via the Internet if you send them to PRA@fcc.gov. PLEASE DO NOT SEND COMPLETED FORMS TO THIS ADDRESS.

Remember - You are not required to respond to a collection of information sponsored by the Federal government, and the government may not conduct or sponsor this collection, unless it displays a currently valid OMB control number or if we fail to provide you with this notice. This collection has been assigned an OMB control number of 3060-0678.

THE FOREGOING NOTICE IS REQUIRED BY THE PAPERWORK REDUCTION ACT OF 1995, PUBLIC LAW 104-13, OCTOBER 1, 1995, 44 U.S.C. SECTION 3507.

ANNEX 2 - Comsearch Reports

The Comsearch reports for the 18 GHz band and the 28 GHz band are provided on the following pages.

INTERFERENCE ANALYSIS REPORT

Prepared for
O3b Networks USA, LLC.
SAN DIEGO, CA
(18 GHz Receive)
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147
October 16, 2013

TABLE OF CONTENTS

1. CONCLUSIONS

An interference study considering all existing, proposed and prior coordinated microwave facilities within the coordination contours of the proposed earth station demonstrates that this site will operate satisfactorily with the 18 GHz common carrier microwave environment. Further, there will be no restrictions of its operation due to interference considerations.

2. SUMMARY OF RESULTS

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

3. SUPPLEMENTAL SHOWING

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

Coordination data for this earth station was sent to the below listed carriers with a letter dated 09/04/2013.

Company
Airband Communications Inc
Antilles Wireless, LLC
Cellco Partnership - California
Clearwire Spectrum Holdings III, LLC
DRS Technical Services
EASTERN MUNICIPAL WATER DISTRICT
Energia Costa Azul S. de R.L. de C.V.
International Communications Network Inc
LEMON GROVE SCHOOL DISTRICT
Los Angeles SMSA Ltd. Partnership
Mark Hopperton
Metropolitan Water Dist of So California
Moulton Niguel Water District
New Cingular Wireless PCS - Los Angeles
New Cingular Wireless PCS LLC - N CAL
New Cingular Wireless PCS LLC - N Texas
New Cingular Wireless PCS LLC -San Diego
Nextel of California Inc.
Palomar Broadband
QUALCOMM INC.
Quest Diagnostics Incorporated
Regents of the University of California
Regional 3Cs
SAN DIEGO UNIVERSITY
SAN DIEGO, CITY OF
San Diego County
San Diego County Water Authority
San Diego Gas & Electric Company
San Diego Unified School District
San Diego, Port of - Harbor Police
Scripps Media, Inc. - KGTV
Sempra Global
Sky Valley Network LLC
Skyriver Communications
Sprint Telephony PCS, L.P.
Sprintcom, Inc. Puerto Rico
Station Venture Operations, LP
T-Mobile License LLC
Trango Systems, Inc.
Turn Wireless, LLC
UCSD Healthcare
Vectus, Inc
Verizon Wireless (VAW) LLC (CA)
Zray Technologies

4. EARTH STATION COORDINATION DATA

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

COMSEARCH

Earth Station Data Sheet

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

Date:	10/16/2013
Job Number:	130904COMSGE01

Administrative Information

Status	ENGINEER PROPOSAL
Call Sign	
Licensee Code	O3BNET
Licensee Name	O3b Networks USA, LLC.

Site Information — SAN DIEGO, CA

Venue Name	(CODA)
Latitude (NAD 83)	32° 40' 54.3" N
Longitude (NAD 83)	117° 7' 0.1" W
Climate Zone	B
Rain Zone	4
Ground Elevation (AMSL)	5.33 m / 17.5 ft

Link Information

Satellite Type	Medium Earth Orbit
Mode	TR - Transmit-Receive
Modulation	Digital
Minimum Elevation Angle	20.0°
Azimuth Range	0.0° to 360°
Antenna Centerline (AGL)	12.5 m / 41.0 ft

Antenna Information		Receive - FCC32		Transmit - FCC32	
Manufacturer		O3B		O3B	
Model		1.2 Meter		1.2 Meter	
Gain / Diameter		44.9 dBi / 1.2 m		48.5 dBi / 1.2 m	
3-dB / 15-dB Beamwidth		0.90° / 2.10°		0.60° / 1.40°	
Max Available RF Power	(dBW/4 kHz)			-14.0	
	(dBW/MHz)			10.0	
Maximum EIRP	(dBW/4 kHz)			34.5	
	(dBW/MHz)			58.5	
Interference Objectives:	Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
	Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%

Frequency Information	Receive 18.0 GHz	Transmit 28.0 GHz
Emission / Frequency Range (MHz)	1M00G7D - 216MG7D / 18372.0 - 18588.0	1M00G7D - 216MG7D / 28172.0 - 28388.0
Max Great Circle Coordination Distance	183.6 km / 114.1 mi	128.6 km / 79.9 mi
Precipitation Scatter Contour Radius	100.0 km / 62.1 mi	100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

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

Coordination Values	**SAN DIEGO, CA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	32° 40' 54.3" N			
Longitude (NAD 83)	117° 7' 0.1" W			
Ground Elevation (AMSL)	5.33 m / 17.5 ft			
Antenna Centerline (AGL)	12.5 m / 41.0 ft			
Antenna Model	O3B 1.2 Meter			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-14.0 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	76.67	-10.00	101.10	-10.00	100.00
5	0.00	72.40	-10.00	103.10	-10.00	100.00
10	0.00	68.17	-10.00	101.60	-10.00	100.00
15	0.00	63.99	-10.00	101.70	-10.00	100.00
20	0.00	59.87	-10.00	103.50	-10.00	100.00
25	0.00	55.84	-10.00	109.00	-10.00	100.00
30	0.00	51.92	-10.00	101.80	-10.00	100.00
35	0.00	48.14	-10.00	100.00	-10.00	100.00
40	0.00	44.54	-10.00	100.00	-10.00	100.00
45	0.00	41.17	-10.00	100.00	-10.00	100.00
50	0.00	38.08	-10.00	100.00	-10.00	100.00
55	0.00	35.37	-10.00	100.00	-10.00	100.00
60	0.00	33.11	-10.00	100.00	-10.00	100.00
65	0.00	31.42	-10.00	100.00	-10.00	100.00
70	0.00	30.39	-8.94	100.00	-8.94	100.00
75	0.00	30.08	-7.82	100.00	-7.82	100.00
80	0.00	30.53	-6.55	100.00	-6.55	100.00
85	0.00	31.68	-5.22	100.00	-5.22	100.00
90	0.00	33.48	-3.85	108.70	-3.85	100.00
95	0.00	35.83	-2.47	117.70	-2.47	100.00
100	0.00	38.62	-1.31	139.00	-1.31	100.00
105	0.00	41.76	-0.46	151.10	-0.46	100.00
110	0.00	45.18	-0.14	153.60	-0.14	100.00
115	0.00	48.82	-0.56	167.10	-0.56	112.00
120	0.00	52.63	-1.41	151.80	-1.41	100.00
125	0.00	56.57	-2.68	156.20	-2.68	100.00
130	0.00	60.61	-4.04	151.90	-4.04	100.00
135	0.00	64.74	-5.41	160.30	-5.41	105.90
140	0.00	68.93	-6.59	163.20	-6.59	108.90
145	0.00	73.17	-7.64	160.10	-7.64	105.90
150	0.00	77.45	-8.49	157.00	-8.49	100.00
155	0.00	81.75	-9.22	154.40	-9.22	100.00
160	0.00	86.07	-9.81	152.20	-9.81	100.00
165	0.00	90.39	-10.00	151.60	-10.00	100.00
170	0.00	94.72	-10.00	151.60	-10.00	100.00
175	0.00	99.03	-10.00	151.60	-10.00	100.00
180	0.00	103.33	-10.00	151.60	-10.00	100.00
185	0.00	107.60	-10.00	151.60	-10.00	100.00

COMSEARCH

Earth Station Data Sheet

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

Coordination Values	**SAN DIEGO, CA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	32° 40' 54.3" N			
Longitude (NAD 83)	117° 7' 0.1" W			
Ground Elevation (AMSL)	5.33 m / 17.5 ft			
Antenna Centerline (AGL)	12.5 m / 41.0 ft			
Antenna Model	O3B 1.2 Meter			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-14.0 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	111.83	-10.00	151.60	-10.00	100.00
195	0.00	116.01	-10.00	151.60	-10.00	100.00
200	0.00	120.13	-9.81	152.20	-9.81	100.00
205	0.00	124.16	-9.22	154.40	-9.22	100.00
210	0.00	128.08	-8.49	157.00	-8.49	100.00
215	0.00	131.86	-7.64	160.10	-7.64	105.90
220	0.00	135.46	-6.63	163.70	-6.63	109.40
225	0.00	138.83	-5.46	167.90	-5.46	113.40
230	0.00	141.92	-4.15	172.60	-4.15	117.70
235	0.00	144.63	-2.84	174.60	-2.84	121.80
240	0.00	146.89	-1.67	179.00	-1.67	125.30
245	0.00	148.58	-0.83	182.30	-0.83	127.80
250	0.00	149.61	-0.53	183.60	-0.53	128.60
255	0.00	149.92	-0.85	182.20	-0.85	127.70
260	0.00	149.47	-1.71	178.80	-1.71	125.20
265	0.00	148.32	-2.89	174.40	-2.89	121.60
270	0.00	146.52	-4.20	172.40	-4.20	117.50
275	0.00	144.17	-5.52	167.70	-5.52	113.20
280	0.00	141.38	-6.79	163.10	-6.79	108.90
285	0.00	138.24	-7.98	158.80	-7.98	104.70
290	0.00	134.82	-9.10	154.80	-9.10	100.10
295	0.00	131.18	-10.00	151.60	-10.00	100.00
300	0.00	127.37	-10.00	151.60	-10.00	100.00
305	0.00	123.43	-10.00	151.60	-10.00	100.00
310	0.00	119.39	-10.00	151.60	-10.00	100.00
315	0.00	115.26	-10.00	151.60	-10.00	100.00
320	0.00	111.07	-10.00	130.20	-10.00	100.00
325	0.00	106.83	-10.00	116.10	-10.00	100.00
330	0.00	102.55	-10.00	111.10	-10.00	100.00
335	0.00	98.25	-10.00	107.00	-10.00	100.00
340	0.00	93.93	-10.00	109.60	-10.00	100.00
345	0.00	89.61	-10.00	100.00	-10.00	100.00
350	0.00	85.28	-10.00	100.00	-10.00	100.00
355	0.00	80.97	-10.00	100.00	-10.00	100.00

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com
Date: 09/04/2013

Job Number: <PCNJobCode>

Administrative Information

Status	ENGINEER PROPOSAL
Call Sign	<PCNCallSign>
Licensee Code	O3BNET
Licensee Name	O3b Networks USA, LLC.

Site Information	**SAN DIEGO, CA**
Venue Name	(USNS Mercy)
Latitude (NAD 83)	32° 41' 4.4" N
Longitude (NAD 83)	117° 8' 3.4" W
Climate Zone	B
Rain Zone	4
Ground Elevation (AMSL)	0.0 m / 0.0 ft

Link Information

Satellite Type	Medium Earth Orbit
Mode	TR - Transmit-Receive
Modulation	Digital
Minimum Elevation Angle	20.0°
Azimuth Range	0.0° to 360°
Antenna Centerline (AGL)	26.21 m / 86.0 ft

Antenna Information		**Receive - FCC32**		**Transmit - FCC32**
Manufacturer		O3B		O3B
Model		1.2 meter		1.2 meter
Gain / Diameter		44.9 dBi / 1.2 m		48.5 dBi / 1.2 m
3-dB / 15-dB Beamwidth		0.90° / 2.10°		0.60° / 1.40°
Max Available RF Power	(dBW/4 kHz)			-14.0
	(dBW/MHz)			10.0
Maximum EIRP	(dBW/4 kHz)			34.5
	(dBW/MHz)			58.5
Interference Objectives:	Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz 20%
	Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz 0.0025%

Frequency Information	**Receive 18.0 GHz**	**Transmit 28.0 GHz**
Emission / Frequency Range (MHz)	1M00G7D - 216MG7D / 18372.0 - 18588.0	1M00G7D - 216MG7D / 28172.0 - 28388.0
Max Great Circle Coordination Distance	183.6 km / 114.1 mi	128.6 km / 79.9 mi
Precipitation Scatter Contour Radius	100.0 km / 62.1 mi	100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

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

Coordination Values	**SAN DIEGO, CA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	32° 41' 4.4" N			
Longitude (NAD 83)	117° 8' 3.4" W			
Ground Elevation (AMSL)	0.0 m / 0.0 ft			
Antenna Centerline (AGL)	26.21 m / 86.0 ft			
Antenna Model	O3B 1.2 Meter			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-14.0 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	76.66	-10.00	101.10	-10.00	100.00
5	0.00	72.39	-10.00	103.10	-10.00	100.00
10	0.00	68.16	-10.00	101.60	-10.00	100.00
15	0.00	63.98	-10.00	101.70	-10.00	100.00
20	0.00	59.87	-10.00	103.50	-10.00	100.00
25	0.00	55.84	-10.00	109.00	-10.00	100.00
30	0.00	51.92	-10.00	101.80	-10.00	100.00
35	0.00	48.14	-10.00	100.00	-10.00	100.00
40	0.00	44.54	-10.00	100.00	-10.00	100.00
45	0.00	41.17	-10.00	100.00	-10.00	100.00
50	0.00	38.08	-10.00	100.00	-10.00	100.00
55	0.00	35.37	-10.00	100.00	-10.00	100.00
60	0.00	33.12	-10.00	100.00	-10.00	100.00
65	0.00	31.43	-10.00	100.00	-10.00	100.00
70	0.00	30.40	-8.94	100.00	-8.94	100.00
75	0.00	30.10	-7.82	100.00	-7.82	100.00
80	0.00	30.54	-6.55	100.00	-6.55	100.00
85	0.00	31.70	-5.22	100.00	-5.22	100.00
90	0.00	33.50	-3.85	108.70	-3.85	100.00
95	0.00	35.85	-2.47	117.70	-2.47	100.00
100	0.00	38.63	-1.31	139.00	-1.31	100.00
105	0.00	41.78	-0.46	151.10	-0.46	100.00
110	0.00	45.20	-0.14	153.60	-0.14	100.00
115	0.00	48.83	-0.56	167.10	-0.56	112.00
120	0.00	52.64	-1.41	151.80	-1.41	100.00
125	0.00	56.58	-2.68	156.20	-2.68	100.00
130	0.00	60.63	-4.04	151.90	-4.04	100.00
135	0.00	64.75	-5.41	160.30	-5.41	105.90
140	0.00	68.95	-6.59	163.20	-6.59	108.90
145	0.00	73.18	-7.64	160.10	-7.64	105.90
150	0.00	77.46	-8.49	157.00	-8.49	100.00
155	0.00	81.76	-9.22	154.40	-9.22	100.00
160	0.00	86.08	-9.81	152.20	-9.81	100.00
165	0.00	90.40	-10.00	151.60	-10.00	100.00
170	0.00	94.73	-10.00	151.60	-10.00	100.00
175	0.00	99.04	-10.00	151.60	-10.00	100.00
180	0.00	103.34	-10.00	151.60	-10.00	100.00
185	0.00	107.61	-10.00	151.60	-10.00	100.00

COMSEARCH

Earth Station Data Sheet

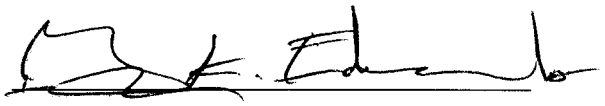
19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com

Coordination Values	**SAN DIEGO, CA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	32° 41' 4.4" N			
Longitude (NAD 83)	117° 8' 3.4" W			
Ground Elevation (AMSL)	0.0 m / 0.0 ft			
Antenna Centerline (AGL)	26.21 m / 86.0 ft			
Antenna Model	O3B 1.2 Meter			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-14.0 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	111.84	-10.00	151.60	-10.00	100.00
195	0.00	116.02	-10.00	151.60	-10.00	100.00
200	0.00	120.13	-9.81	152.20	-9.81	100.00
205	0.00	124.16	-9.22	154.40	-9.22	100.00
210	0.00	128.08	-8.49	157.00	-8.49	100.00
215	0.00	131.86	-7.64	160.10	-7.64	105.90
220	0.00	135.46	-6.63	163.70	-6.63	109.40
225	0.00	138.83	-5.46	167.90	-5.46	113.40
230	0.00	141.92	-4.15	172.60	-4.15	117.70
235	0.00	144.63	-2.84	174.60	-2.84	121.80
240	0.00	146.88	-1.67	179.00	-1.67	125.30
245	0.00	148.57	-0.83	182.30	-0.83	127.80
250	0.00	149.60	-0.53	183.60	-0.53	128.60
255	0.00	149.90	-0.85	182.20	-0.85	127.70
260	0.00	149.46	-1.71	178.80	-1.71	125.20
265	0.00	148.30	-2.89	174.40	-2.89	121.60
270	0.00	146.50	-4.20	172.40	-4.20	117.50
275	0.00	144.15	-5.52	167.70	-5.52	113.20
280	0.00	141.37	-6.79	163.10	-6.79	108.90
285	0.00	138.22	-7.98	158.80	-7.98	104.70
290	0.00	134.80	-9.10	154.80	-9.10	100.00
295	0.00	131.17	-10.00	151.60	-10.00	100.00
300	0.00	127.36	-10.00	151.60	-10.00	100.00
305	0.00	123.42	-10.00	151.60	-10.00	100.00
310	0.00	119.37	-10.00	151.60	-10.00	100.00
315	0.00	115.25	-10.00	151.60	-10.00	100.00
320	0.00	111.05	-10.00	130.20	-10.00	100.00
325	0.00	106.82	-10.00	116.10	-10.00	100.00
330	0.00	102.54	-10.00	111.10	-10.00	100.00
335	0.00	98.24	-10.00	107.00	-10.00	100.00
340	0.00	93.92	-10.00	109.60	-10.00	100.00
345	0.00	89.60	-10.00	100.00	-10.00	100.00
350	0.00	85.27	-10.00	100.00	-10.00	100.00
355	0.00	80.96	-10.00	100.00	-10.00	100.00

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: _ 

Gary K. Edwards
Senior Manager
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147

DATED: October 16, 2013

Ka-Band Earth Station – San Diego, CA

Frequency Coordination Report

28 GHz

Prepared on Behalf of
O3b Networks USA, LLC

October 7, 2013

COMSEARCH®
A CommScope Company

Table of Contents

1. Summary of Results

On behalf of O3b Networks' proposed earth stations transmitting at 28 GHz[1], Comsearch performed a coordination notice for all existing and proposed terrestrial licenses within the coordination contours of the Ka-Band stations in San Diego, CA. Prior notification letters were sent to the licensees and a copy of the notification data is provided in section four of this report. The earth station coordination was finalized on October 7, 2013.

No objections were received from any of the incumbent 28 GHz licensees. Our notification to the LMDS incumbents was performed under the assumption that the earth stations would be operating on a secondary basis to LMDS Block A operations and a contact at O3b Networks has been provided in case any concerns may arise in the future.

2. 28 GHz Common Carrier and LTTS Coordination

In accordance with FCC Rules and Regulations, a Ka-Band earth stations in San Diego, CA were prior-coordinated by Comsearch. The notification letters and datasheets for these earth stations were sent to the following 28 GHz common carrier fixed microwave licensees on September 6, 2013. These licensees are authorized to operate temporary fixed operations from 27.5 – 29.5 GHz on a statewide or nationwide basis.

Licensee	Authorized Geographic Area
GTE Southwest Inc. dba Verizon	Continental US
M.U.T. Licensing	Statewide: CA
Verizon	Statewide: CA

A notification letter and datasheet for the Ka-Band earth stations in San Diego, CA was also sent to the following 28 GHz local television transmission licensee on September 6, 2013. This licensee is authorized to operate temporary fixed operations from 27.5 – 29.5 GHz on a nationwide basis.

Licensee	Authorized Geographic Area
Information Super Station, LLC	Continental US

No objections were received from the common carrier or local television transmission service incumbents.

[1] The proposed earth stations will operate in the 28.1 – 28.4 GHz portion of the Ka-Band.

3. 28 GHz LMDS Coordination

Notification letters were sent to the following 28 GHz LMDS licensees and lessees on September 6, 2013. The proposed earth stations will operate on frequencies that overlap Block A of the LMDS service. The total frequency allocation for Block A of the LMDS spectrum appears below.

Block A: 27.500-28.350 GHz
29.100-29.250 GHz
31.075-31.225 GHz

Licensee	Market	Market Name
Nextlink Wireless / XO	BTA262	Los Angeles, CA
TelePacific Communications[2]	BTA262	Los Angeles, CA
Alta Wireless	BTA402[3]	San Diego, CA
Nextlink Wireless / XO[4]	BTA402	San Diego, CA

No objections were received from the LMDS incumbents.

[2] TelePacific Communications is leasing LMDS spectrum from Nextlink Wireless / XO in the Los Angeles, CA Basic Trading Area (BTA).

[3] The proposed San Diego, CA earth stations will be located inside BTA402.

[4] Nextlink Wireless / XO is leasing LMDS spectrum from Alta Wireless in the San Diego, CA Basic Trading Area (BTA).

4. Earth Station Coordination Data

This section presents the data pertinent to the proposed Ka-Band earth stations in San Diego, CA. This data was circulated to all incumbent licensees in the 28 GHz shared frequency ranges.

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5662 http://www.comsearch.com

Date:	09/03/2013
Job Number:	<PCNJobCode>

Administrative Information

Status	ENGINEER PROPOSAL
Call Sign	<PCNCallSign>
Licensee Code	O3BNET
Licensee Name	O3b Networks USA, LLC.

Site Information — SAN DIEGO, CA

Venue Name	CODA Lab
Latitude (NAD 83)	32° 40' 54.3" N
Longitude (NAD 83)	117° 7' 0.1" W
Climate Zone	B
Rain Zone	4
Ground Elevation (AMSL)	5.33 m / 17.5 ft

Link Information

Satellite Type	Medium Earth Orbit
Mode	TR - Transmit-Receive
Modulation	Digital
Minimum Elevation Angle	20.0°
Azimuth Range	0.0° to 360°
Antenna Centerline (AGL)	12.5 m / 41.0 ft

Antenna Information	Receive - FCC32	Transmit - FCC32
Manufacturer	O3B	O3B
Model	1.2 meter	1.2 meter
Gain / Diameter	44.9 dBi / 1.2 m	48.5 dBi / 1.2 m
3-dB / 15-dB Beamwidth	0.90° / 2.10°	0.60° / 1.40°
Max Available RF Power (dBW/4 kHz)		-14.0
Max Available RF Power (dBW/MHz)		10.0
Maximum EIRP (dBW/4 kHz)		34.5
Maximum EIRP (dBW/MHz)		58.5
Interference Objectives: Long Term	-156.0 dBW/MHz 20%	-151.0 dBW/4 kHz 20%
Interference Objectives: Short Term	-146.0 dBW/MHz 0.01%	-128.0 dBW/4 kHz 0.0025%

Frequency Information	Receive 18.0 GHz	Transmit 28.0 GHz
Emission / Frequency Range (MHz)	1M00G7D - 216MG7D / 18372.0 - 18588.0	1M00G7D - 216MG7D / 28172.0 - 28388.0
Max Great Circle Coordination Distance	183.6 km / 114.1 mi	128.6 km / 79.9 mi
Precipitation Scatter Contour Radius	100.0 km / 62.1 mi	100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5662 http://www.comsearch.com

Coordination Values	**SAN DIEGO, CA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	32° 40' 54.3" N			
Longitude (NAD 83)	117° 7' 0.1" W			
Ground Elevation (AMSL)	5.33 m / 17.5 ft			
Antenna Centerline (AGL)	12.5 m / 41.0 ft			
Antenna Model	O3B 1.2 Meter			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-14.0 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	76.67	-10.00	101.10	-10.00	100.00
5	0.00	72.40	-10.00	103.10	-10.00	100.00
10	0.00	68.17	-10.00	101.60	-10.00	100.00
15	0.00	63.99	-10.00	101.70	-10.00	100.00
20	0.00	59.87	-10.00	103.50	-10.00	100.00
25	0.00	55.84	-10.00	109.00	-10.00	100.00
30	0.00	51.92	-10.00	101.80	-10.00	100.00
35	0.00	48.14	-10.00	100.00	-10.00	100.00
40	0.00	44.54	-10.00	100.00	-10.00	100.00
45	0.00	41.17	-10.00	100.00	-10.00	100.00
50	0.00	38.08	-10.00	100.00	-10.00	100.00
55	0.00	35.37	-10.00	100.00	-10.00	100.00
60	0.00	33.11	-10.00	100.00	-10.00	100.00
65	0.00	31.42	-10.00	100.00	-10.00	100.00
70	0.00	30.39	-8.94	100.00	-8.94	100.00
75	0.00	30.08	-7.82	100.00	-7.82	100.00
80	0.00	30.53	-6.55	100.00	-6.55	100.00
85	0.00	31.68	-5.22	100.00	-5.22	100.00
90	0.00	33.48	-3.85	108.70	-3.85	100.00
95	0.00	35.83	-2.47	117.70	-2.47	100.00
100	0.00	38.62	-1.31	139.00	-1.31	100.00
105	0.00	41.76	-0.46	151.10	-0.46	100.00
110	0.00	45.18	-0.14	153.60	-0.14	100.00
115	0.00	48.82	-0.56	167.10	-0.56	112.00
120	0.00	52.63	-1.41	151.80	-1.41	100.00
125	0.00	56.57	-2.68	156.20	-2.68	100.00
130	0.00	60.61	-4.04	151.90	-4.04	100.00
135	0.00	64.74	-5.41	160.30	-5.41	105.90
140	0.00	68.93	-6.59	163.20	-6.59	108.90
145	0.00	73.17	-7.64	160.10	-7.64	105.90
150	0.00	77.45	-8.49	157.00	-8.49	100.00
155	0.00	81.75	-9.22	154.40	-9.22	100.00
160	0.00	86.07	-9.81	152.20	-9.81	100.00
165	0.00	90.39	-10.00	151.60	-10.00	100.00
170	0.00	94.72	-10.00	151.60	-10.00	100.00
175	0.00	99.03	-10.00	151.60	-10.00	100.00
180	0.00	103.33	-10.00	151.60	-10.00	100.00
185	0.00	107.60	-10.00	151.60	-10.00	100.00

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5662 http://www.comsearch.com

Coordination Values	**SAN DIEGO, CA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	32° 40' 54.3" N			
Longitude (NAD 83)	117° 7' 0.1" W			
Ground Elevation (AMSL)	5.33 m / 17.5 ft			
Antenna Centerline (AGL)	12.5 m / 41.0 ft			
Antenna Model	O3B 1.2 Meter			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-14.0 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	111.83	-10.00	151.60	-10.00	100.00
195	0.00	116.01	-10.00	151.60	-10.00	100.00
200	0.00	120.13	-9.81	152.20	-9.81	100.00
205	0.00	124.16	-9.22	154.40	-9.22	100.00
210	0.00	128.08	-8.49	157.00	-8.49	100.00
215	0.00	131.86	-7.64	160.10	-7.64	105.90
220	0.00	135.46	-6.63	163.70	-6.63	109.40
225	0.00	138.83	-5.46	167.90	-5.46	113.40
230	0.00	141.92	-4.15	172.60	-4.15	117.70
235	0.00	144.63	-2.84	174.60	-2.84	121.80
240	0.00	146.89	-1.67	179.00	-1.67	125.30
245	0.00	148.58	-0.83	182.30	-0.83	127.80
250	0.00	149.61	-0.53	183.60	-0.53	128.60
255	0.00	149.92	-0.85	182.20	-0.85	127.70
260	0.00	149.47	-1.71	178.80	-1.71	125.20
265	0.00	148.32	-2.89	174.40	-2.89	121.60
270	0.00	146.52	-4.20	172.40	-4.20	117.50
275	0.00	144.17	-5.52	167.70	-5.52	113.20
280	0.00	141.38	-6.79	163.10	-6.79	108.90
285	0.00	138.24	-7.98	158.80	-7.98	104.70
290	0.00	134.82	-9.10	154.80	-9.10	100.10
295	0.00	131.18	-10.00	151.60	-10.00	100.00
300	0.00	127.37	-10.00	151.60	-10.00	100.00
305	0.00	123.43	-10.00	151.60	-10.00	100.00
310	0.00	119.39	-10.00	151.60	-10.00	100.00
315	0.00	115.26	-10.00	151.60	-10.00	100.00
320	0.00	111.07	-10.00	130.20	-10.00	100.00
325	0.00	106.83	-10.00	116.10	-10.00	100.00
330	0.00	102.55	-10.00	111.10	-10.00	100.00
335	0.00	98.25	-10.00	107.00	-10.00	100.00
340	0.00	93.93	-10.00	109.60	-10.00	100.00
345	0.00	89.61	-10.00	100.00	-10.00	100.00
350	0.00	85.28	-10.00	100.00	-10.00	100.00
355	0.00	80.97	-10.00	100.00	-10.00	100.00

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5662 http://www.comsearch.com

Date:	09/03/2013
Job Number:	<PCNJobCode>

Administrative Information

Status	ENGINEER PROPOSAL
Call Sign	<PCNCallSign>
Licensee Code	O3BNET
Licensee Name	O3b Networks USA, LLC.

Site Information — SAN DIEGO, CA

Venue Name	(USNS Mercy)
Latitude (NAD 83)	32° 41' 4.4" N
Longitude (NAD 83)	117° 8' 3.4" W
Climate Zone	B
Rain Zone	4
Ground Elevation (AMSL)	0.0 m / 0.0 ft

Link Information

Satellite Type	Medium Earth Orbit
Mode	TR - Transmit-Receive
Modulation	Digital
Minimum Elevation Angle	20.0°
Azimuth Range	0.0° to 360°
Antenna Centerline (AGL)	26.21 m / 86.0 ft

Antenna Information	Receive - FCC32	Transmit - FCC32
Manufacturer	O3B	O3B
Model	1.2 meter	1.2 meter
Gain / Diameter	44.9 dBi / 1.2 m	48.5 dBi / 1.2 m
3-dB / 15-dB Beamwidth	0.90° / 2.10°	0.60° / 1.40°
Max Available RF Power (dBW/4 kHz)		-14.0
Max Available RF Power (dBW/MHz)		10.0
Maximum EIRP (dBW/4 kHz)		34.5
Maximum EIRP (dBW/MHz)		58.5
Interference Objectives: Long Term	-156.0 dBW/MHz 20%	-151.0 dBW/4 kHz 20%
Interference Objectives: Short Term	-146.0 dBW/MHz 0.01%	-128.0 dBW/4 kHz 0.0025%

Frequency Information	Receive 18.0 GHz	Transmit 28.0 GHz
Emission / Frequency Range (MHz)	1M00G7D - 216MG7D / 18372.0 - 18588.0	1M00G7D - 216MG7D / 28172.0 - 28388.0
Max Great Circle Coordination Distance	183.6 km / 114.1 mi	128.6 km / 79.9 mi
Precipitation Scatter Contour Radius	100.0 km / 62.1 mi	100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
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Coordination Values	**SAN DIEGO, CA**			
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Ground Elevation (AMSL)	0.0 m / 0.0 ft			
Antenna Centerline (AGL)	26.21 m / 86.0 ft			
Antenna Model	O3B 1.2 Meter			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-14.0 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.00	76.66	-10.00	101.10	-10.00	100.00
5	0.00	72.39	-10.00	103.10	-10.00	100.00
10	0.00	68.16	-10.00	101.60	-10.00	100.00
15	0.00	63.98	-10.00	101.70	-10.00	100.00
20	0.00	59.87	-10.00	103.50	-10.00	100.00
25	0.00	55.84	-10.00	109.00	-10.00	100.00
30	0.00	51.92	-10.00	101.80	-10.00	100.00
35	0.00	48.14	-10.00	100.00	-10.00	100.00
40	0.00	44.54	-10.00	100.00	-10.00	100.00
45	0.00	41.17	-10.00	100.00	-10.00	100.00
50	0.00	38.08	-10.00	100.00	-10.00	100.00
55	0.00	35.37	-10.00	100.00	-10.00	100.00
60	0.00	33.12	-10.00	100.00	-10.00	100.00
65	0.00	31.43	-10.00	100.00	-10.00	100.00
70	0.00	30.40	-8.94	100.00	-8.94	100.00
75	0.00	30.10	-7.82	100.00	-7.82	100.00
80	0.00	30.54	-6.55	100.00	-6.55	100.00
85	0.00	31.70	-5.22	100.00	-5.22	100.00
90	0.00	33.50	-3.85	108.70	-3.85	100.00
95	0.00	35.85	-2.47	117.70	-2.47	100.00
100	0.00	38.63	-1.31	139.00	-1.31	100.00
105	0.00	41.78	-0.46	151.10	-0.46	100.00
110	0.00	45.20	-0.14	153.60	-0.14	100.00
115	0.00	48.83	-0.56	167.10	-0.56	112.00
120	0.00	52.64	-1.41	151.80	-1.41	100.00
125	0.00	56.58	-2.68	156.20	-2.68	100.00
130	0.00	60.63	-4.04	151.90	-4.04	100.00
135	0.00	64.75	-5.41	160.30	-5.41	105.90
140	0.00	68.95	-6.59	163.20	-6.59	108.90
145	0.00	73.18	-7.64	160.10	-7.64	105.90
150	0.00	77.46	-8.49	157.00	-8.49	100.00
155	0.00	81.76	-9.22	154.40	-9.22	100.00
160	0.00	86.08	-9.81	152.20	-9.81	100.00
165	0.00	90.40	-10.00	151.60	-10.00	100.00
170	0.00	94.73	-10.00	151.60	-10.00	100.00
175	0.00	99.04	-10.00	151.60	-10.00	100.00
180	0.00	103.34	-10.00	151.60	-10.00	100.00
185	0.00	107.61	-10.00	151.60	-10.00	100.00

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
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Coordination Values	**SAN DIEGO, CA**			
Licensee Name	O3b Networks USA, LLC.			
Latitude (NAD 83)	32° 41' 4.4" N			
Longitude (NAD 83)	117° 8' 3.4" W			
Ground Elevation (AMSL)	0.0 m / 0.0 ft			
Antenna Centerline (AGL)	26.21 m / 86.0 ft			
Antenna Model	O3B 1.2 Meter			
Antenna Mode	Receive 18.0 GHz		Transmit 28.0 GHz	
Interference Objectives: Long Term	-156.0 dBW/MHz	20%	-151.0 dBW/4 kHz	20%
Short Term	-146.0 dBW/MHz	0.01%	-128.0 dBW/4 kHz	0.0025%
Max Available RF Power			-14.0 (dBW/4 kHz)	

			Receive 18.0 GHz		Transmit 28.0 GHz	
Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	111.84	-10.00	151.60	-10.00	100.00
195	0.00	116.02	-10.00	151.60	-10.00	100.00
200	0.00	120.13	-9.81	152.20	-9.81	100.00
205	0.00	124.16	-9.22	154.40	-9.22	100.00
210	0.00	128.08	-8.49	157.00	-8.49	100.00
215	0.00	131.86	-7.64	160.10	-7.64	105.90
220	0.00	135.46	-6.63	163.70	-6.63	109.40
225	0.00	138.83	-5.46	167.90	-5.46	113.40
230	0.00	141.92	-4.15	172.60	-4.15	117.70
235	0.00	144.63	-2.84	174.60	-2.84	121.80
240	0.00	146.88	-1.67	179.00	-1.67	125.30
245	0.00	148.57	-0.83	182.30	-0.83	127.80
250	0.00	149.60	-0.53	183.60	-0.53	128.60
255	0.00	149.90	-0.85	182.20	-0.85	127.70
260	0.00	149.46	-1.71	178.80	-1.71	125.20
265	0.00	148.30	-2.89	174.40	-2.89	121.60
270	0.00	146.50	-4.20	172.40	-4.20	117.50
275	0.00	144.15	-5.52	167.70	-5.52	113.20
280	0.00	141.37	-6.79	163.10	-6.79	108.90
285	0.00	138.22	-7.98	158.80	-7.98	104.70
290	0.00	134.80	-9.10	154.80	-9.10	100.00
295	0.00	131.17	-10.00	151.60	-10.00	100.00
300	0.00	127.36	-10.00	151.60	-10.00	100.00
305	0.00	123.42	-10.00	151.60	-10.00	100.00
310	0.00	119.37	-10.00	151.60	-10.00	100.00
315	0.00	115.25	-10.00	151.60	-10.00	100.00
320	0.00	111.05	-10.00	130.20	-10.00	100.00
325	0.00	106.82	-10.00	116.10	-10.00	100.00
330	0.00	102.54	-10.00	111.10	-10.00	100.00
335	0.00	98.24	-10.00	107.00	-10.00	100.00
340	0.00	93.92	-10.00	109.60	-10.00	100.00
345	0.00	89.60	-10.00	100.00	-10.00	100.00
350	0.00	85.27	-10.00	100.00	-10.00	100.00
355	0.00	80.96	-10.00	100.00	-10.00	100.00

5. Contact Information

For questions or information regarding the 28 GHz Frequency Coordination Report, please contact:

Contact person:	Joanna Lynch
Title:	Manager, Spectrum & Data Solutions
Company:	Comsearch
Address:	19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone:	703-726-5711
Fax:	703-726-5599
Email:	jlynch@comsearch.com
Web site:	www.comsearch.com

ANNEX 3 - Link Budgets

Representative link budgets for the 1.2m Orbit antenna at the CODA Lab Earth Station are provided on the following four pages. Please see the chart below for reference.

	Carrier	MODCOD	Table #
	216MHz in each direction, clear sky	8PSK/0.75 FWD QPSK/0.75 RTN	1,2
	54MHz in each direction, clear sky	16APSK/0.83 FWD 8PSK/0.75 RTN	3,4

O3b Network Link Analysis - Tier 2 Service For San Diego, United States			
Link Budget Creator - Rev 3.2.9: October 29, 2013		**Tier 2**	**Tier 2**
Ground Parameter		**Teleport**	**Telco**
Location		Vernon (RHCP), United States	San Diego, United States
Latitude	(°)	34.2	32.7
Longitude (East)	(°)	260.7	242.8
E/S Maximum Range to SV	(km)	10445.4	9742.0
E/S Minimmum Elevation to SV	(°)	26.2	36.0
E/S Altitude	(km)	0.3	0.2
SV Beam Identifier	(#)	13	
Minutes Into Pass (Sample #15)	(Min)	6:46	
Telco Spot Beam Off-Angle	(°)	0.20	
Telco Spot Beam Diameter	(km)	67.80	
Maximum Roundtrip Latency	(msec)	134.68	
Modulation Parameters		**Forward**	**Return**
Enter Receiver	Type	DVB-S2	
Modem Overhead	(%)	3.2%	
Number of Carriers per Channel	(#)	1	
Available Bandwidth	(Hz)	216,000,000	
Channel Symbol Rate	(sps)	180,000,000	
Channel Modulation Type		8PSK	
Channel FEC Rate		0.75	
Channel Spectral Efficiency	(bits/Sym)	2.25	
Channel Throughput (100% / 100% of Full Rate)	(bps)	391,954,582.32	
Uplink		**Forward**	**Return**
E/S Tx Channels per HPA	(#)	5	
E/S Tx Carrier Frequency	(MHz)	28,280	
E/S Tx HPA Power Level	(W)	500	
E/S Tx OBO	(dB)	-4.00	
E/S Tx Post-HPA Losses	(dB)	-2.24	
E/S Tx Antenna Gain (7.3 m / 1.2 m)	(dB)	64.90	
E/S Tx EIRP Per Channel	(dBW)	78.66	
E/S Tx Pointing Loss	(dB)	-0.50	
E/S Tx RF Link Availability	(%)	75.000	
E/S Tx Atmospheric Losses	(dB)	-1.42	
E/S Tx Spreading Loss	(dB)	-151.37	
Satellite		**Forward**	**Return**
SV Number of Channels per HPA	(#)	1	
SV Rx G/T	(dB/K)	5.32	
SV Rx Power Per Tier	(dBW)	-119.80	
SV Rx Flux Density Per Tier	(dBW/m^2)	-74.63	
SV Tx OBO (ALC / ALC)	(dB)	-3.80	
SV Tx Post-TWTA Losses	(dB)	-1.50	
SV Tx Antenna Gain	(dBi)	31.57	
SV Tx EIRP Per Channel/Carrier	(dBW)	44.40	
SV Tx Pointing Loss	(dB)	0.00	
Downlink		**Forward**	**Return**
E/S Rx Carrier Frequency	(MHz)	18,480	
E/S Rx Wavelength	(m)	0.016223	
E/S Rx RF Link Availability	(%)	70	
E/S Rx Atmospheric Losses	(dB)	-0.36	
E/S Rx Radome & Pointing Loss	(dB)	-1.00	
E/S Rx Antenna Gain (1.2 m / 7.3 m)	(dBi)	42.5	
E/S Rx Effective G/T	(dB/K)	19.1	
E/S Rx Power Per Channel	(dBW)	-112.0	
E/S Rx Flux Density Per Channel	(dBW/m^2)	-107.7	
Total Link		**Forward**	**Return**
Carrier / Noise Bandwidth	(dB)	82.55	
Carrier / Noise Uplink	(dB)	26.25	
Carrier / Noise Downlink	(dB)	10.61	
Carrier / Intermodulation Im (C/Im)	(dB)	23.53	
(C/N) - Total Actual	(dB)	10.14	
(C/N) - Total Required	(dB)	9.50	
(E_b/N_o) - Total Actual	(dB)	6.62	
(E_b/N_o) - Total Required	(dB)	5.98	
Excess Margin	**(dB)**	**0.64**	
Fade Margin	**(dB)**	**12.34**	

O3b Network Link Analysis - Tier 2 Service For San Diego, United States			
Link Budget Creator - Rev 3.2.9: October 29, 2013		**Tier 2**	**Tier 2**
Ground Parameter		**Teleport**	**Telco**
Location		Vernon (RHCP), United States	San Diego, United States
Latitude	(°)	34.2	32.7
Longitude (East)	(°)	260.7	242.8
E/S Maximum Range to SV	(km)	10445.4	9742.0
E/S Minimmum Elevation to SV	(°)	26.2	36.0
E/S Altitude	(km)	0.3	0.2
SV Beam Identifier	(#)	13	
Minutes Into Pass (Sample #15)	(Min)	6:46	
Telco Spot Beam Off-Angle	(°)	0.20	
Telco Spot Beam Diameter	(km)	67.80	
Maximum Roundtrip Latency	(msec)	134.68	
Modulation Parameters		**Forward**	**Return**
Enter Receiver	Type		DVB-S2
Modem Overhead	(%)		3.2%
Number of Carriers per Channel	(#)		1
Available Bandwidth	(Hz)		216,000,000
Channel Symbol Rate	(sps)		180,000,000
Channel Modulation Type			QPSK
Channel FEC Rate			0.75
Channel Spectral Efficiency	(bits/Sym)		1.50
Channel Throughput (100% / 100% of Full Rate)	(bps)		261,373,715.52
Uplink		**Forward**	**Return**
E/S Tx Channels per HPA	(#)		1
E/S Tx Carrier Frequency	(MHz)		28,280
E/S Tx HPA Power Level	(W)		20
E/S Tx OBO	(dB)		-0.50
E/S Tx Post-HPA Losses	(dB)		-0.28
E/S Tx Antenna Gain (7.3 m / 1.2 m)	(dB)		46.3
E/S Tx EIRP Per Channel	(dBW)		58.56
E/S Tx Radome & Pointing Loss	(dB)		-1.00
E/S Tx RF Link Availability	(%)		70.000
E/S Tx Atmospheric Losses	(dB)		-0.59
E/S Tx Spreading Loss	(dB)		-150.77
Satellite		**Forward**	**Return**
SV Number of Channels per HPA	(#)		5
SV Rx G/T	(dB/K)		4.43
SV Rx Power Per Tier	(dBW)		-139.84
SV Rx Flux Density Per Tier	(dBW/m^2)		-93.79
SV Tx OBO (ALC / ALC)	(dB)		-5.80
SV Tx Post-TWTA Losses	(dB)		-1.50
SV Tx Antenna Gain	(dBi)		31.80
SV Tx EIRP Per Channel/Carrier	(dBW)		35.64
SV Tx Pointing Loss	(dB)		0.00
Downlink		**Forward**	**Return**
E/S Rx Carrier Frequency	(MHz)		18,480
E/S Rx Spreading Loss	(dB)		-151.37
E/S Rx RF Link Availability	(%)		75.000
E/S Rx Atmospheric Losses	(dB)		-0.84
E/S Rx Pointing Loss	(dB)		-0.50
E/S Rx Antenna Gain (1.2 m / 7.3 m)	(dBi)		62.04
E/S Rx Effective G/T	(dB/K)		38.68
E/S Rx Power Per Channel	(dBW)		-101.82
E/S Rx Flux Density Per Channel	(dBW/m^2)		-117.07
Total Link		**Forward**	**Return**
Carrier / Noise Bandwidth	(dB)		82.55
Carrier / Noise Uplink	(dB)		6.21
Carrier / Noise Downlink	(dB)		20.86
Carrier / Intermodulation Im (C/Im)	(dB)		18.35
(C/N) - Total Actual	(dB)		5.76
(C/N) - Total Required	(dB)		5.70
(E_b/N_o) - Total Actual	(dB)		4.00
(E_b/N_o) - Total Required	(dB)		3.94
Excess Margin	**(dB)**		**0.06**
Fade Margin	**(dB)**		**7.96**

O3b Network Link Analysis - Tier 2 Service For San Diego, United States			
Link Budget Creator - Rev 3.2.9: October 29, 2013		**Tier 2**	**Tier 2**
Ground Parameter		**Teleport**	**Telco**
Location		Vernon (RHCP), United States	San Diego, United States
Latitude	(°)	34.2	32.7
Longitude (East)	(°)	260.7	242.8
E/S Maximum Range to SV	(km)	10445.4	9742.0
E/S Minimmum Elevation to SV	(°)	26.2	36.0
E/S Altitude	(km)	0.3	0.2
SV Beam Identifier	(#)	13	
Minutes Into Pass (Sample #15)	(Min)	6:46	
Telco Spot Beam Off-Angle	(°)	0.20	
Telco Spot Beam Diameter	(km)	67.80	
Maximum Roundtrip Latency	(msec)	134.68	
Modulation Parameters		**Forward**	**Return**
Enter Receiver	Type	DVB-S2	
Modem Overhead	(%)	3.3%	
Number of Carriers per Channel	(#)	1	
Available Bandwidth	(Hz)	54,000,000	
Channel Symbol Rate	(sps)	45,000,000	
Channel Modulation Type		16APSK	
Channel FEC Rate		0.83	
Channel Spectral Efficiency	(bits/Sym)	3.33	
Channel Throughput (100% / 100% of Full Rate)	(bps)	144,983,818.77	
Uplink		**Forward**	**Return**
E/S Tx Channels per HPA	(#)	5	
E/S Tx Carrier Frequency	(MHz)	28,280	
E/S Tx HPA Power Level	(W)	125	
E/S Tx OBO	(dB)	-4.00	
E/S Tx Post-HPA Losses	(dB)	-2.24	
E/S Tx Antenna Gain (7.3 m / 1.2 m)	(dB)	64.90	
E/S Tx EIRP Per Channel	(dBW)	72.64	
E/S Tx Pointing Loss	(dB)	-0.50	
E/S Tx RF Link Availability	(%)	75.000	
E/S Tx Atmospheric Losses	(dB)	-1.42	
E/S Tx Spreading Loss	(dB)	-151.37	
Satellite		**Forward**	**Return**
SV Number of Channels per HPA	(#)	1	
SV Rx G/T	(dB/K)	5.32	
SV Rx Power Per Tier	(dBW)	-125.82	
SV Rx Flux Density Per Tier	(dBW/m^2)	-80.65	
SV Tx OBO (ALC / ALC)	(dB)	-3.80	
SV Tx Post-TWTA Losses	(dB)	-1.50	
SV Tx Antenna Gain	(dBi)	31.57	
SV Tx EIRP Per Channel/Carrier	(dBW)	44.40	
SV Tx Pointing Loss	(dB)	0.00	
Downlink		**Forward**	**Return**
E/S Rx Carrier Frequency	(MHz)	18,480	
E/S Rx Wavelength	(m)	0.016223	
E/S Rx RF Link Availability	(%)	70	
E/S Rx Atmospheric Losses	(dB)	-0.36	
E/S Rx Radome & Pointing Loss	(dB)	-1.00	
E/S Rx Antenna Gain (1.2 m / 7.3 m)	(dBi)	42.5	
E/S Rx Effective G/T	(dB/K)	19.1	
E/S Rx Power Per Channel	(dBW)	-112.0	
E/S Rx Flux Density Per Channel	(dBW/m^2)	-107.7	
Total Link		**Forward**	**Return**
Carrier / Noise Bandwidth	(dB)	76.53	
Carrier / Noise Uplink	(dB)	26.25	
Carrier / Noise Downlink	(dB)	16.64	
Carrier / Intermodulation Im (C/Im)	(dB)	23.53	
(C/N) - Total Actual	(dB)	14.99	
(C/N) - Total Required	(dB)	13.70	
(E_b/N_o) - Total Actual	(dB)	9.77	
(E_b/N_o) - Total Required	(dB)	8.47	
Excess Margin	**(dB)**	**1.29**	
Fade Margin	**(dB)**	**17.19**	

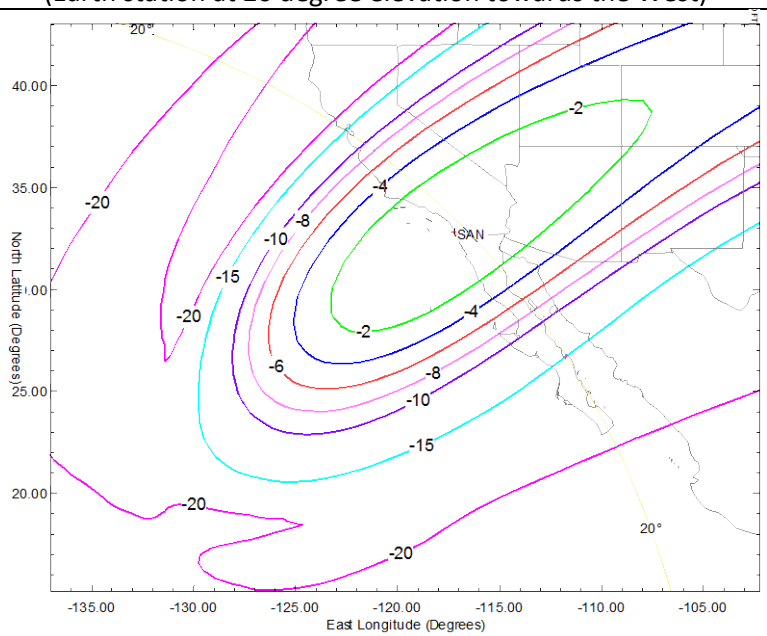
O3b Network Link Analysis - Tier 2 Service For San Diego, United States			
Link Budget Creator - Rev 3.2.9: October 29, 2013		**Tier 2**	**Tier 2**
Ground Parameter		**Teleport**	**Telco**
Location		Vernon (RHCP), United States	San Diego, United States
Latitude	(°)	34.2	32.7
Longitude (East)	(°)	260.7	242.8
E/S Maximum Range to SV	(km)	10445.4	9742.0
E/S Minimmum Elevation to SV	(°)	26.2	36.0
E/S Altitude	(km)	0.3	0.2
SV Beam Identifier	(#)	13	
Minutes Into Pass (Sample #15)	(Min)	6:46	
Telco Spot Beam Off-Angle	(°)	0.20	
Telco Spot Beam Diameter	(km)	67.80	
Maximum Roundtrip Latency	(msec)	134.68	
Modulation Parameters		**Forward**	**Return**
Enter Receiver	Type		DVB-S2
Modem Overhead	(%)		3.2%
Number of Carriers per Channel	(#)		1
Available Bandwidth	(Hz)		54,000,000
Channel Symbol Rate	(sps)		45,000,000
Channel Modulation Type			8PSK
Channel FEC Rate			0.75
Channel Spectral Efficiency	(bits/Sym)		2.25
Channel Throughput (100% / 100% of Full Rate)	(bps)		97,988,645.58
Uplink		**Forward**	**Return**
E/S Tx Channels per HPA	(#)		1
E/S Tx Carrier Frequency	(MHz)		28,280
E/S Tx HPA Power Level	(W)		20
E/S Tx OBO	(dB)		-0.50
E/S Tx Post-HPA Losses	(dB)		-0.28
E/S Tx Antenna Gain (7.3 m / 1.2 m)	(dB)		46.3
E/S Tx EIRP Per Channel	(dBW)		58.56
E/S Tx Radome & Pointing Loss	(dB)		-1.00
E/S Tx RF Link Availability	(%)		70.000
E/S Tx Atmospheric Losses	(dB)		-0.59
E/S Tx Spreading Loss	(dB)		-150.77
Satellite		**Forward**	**Return**
SV Number of Channels per HPA	(#)		5
SV Rx G/T	(dB/K)		4.43
SV Rx Power Per Tier	(dBW)		-139.84
SV Rx Flux Density Per Tier	(dBW/m^2)		-93.79
SV Tx OBO (ALC / ALC)	(dB)		-5.80
SV Tx Post-TWTA Losses	(dB)		-1.50
SV Tx Antenna Gain	(dBi)		31.80
SV Tx EIRP Per Channel/Carrier	(dBW)		35.64
SV Tx Pointing Loss	(dB)		0.00
Downlink		**Forward**	**Return**
E/S Rx Carrier Frequency	(MHz)		18,480
E/S Rx Spreading Loss	(dB)		-151.37
E/S Rx RF Link Availability	(%)		75.000
E/S Rx Atmospheric Losses	(dB)		-0.84
E/S Rx Pointing Loss	(dB)		-0.50
E/S Rx Antenna Gain (1.2 m / 7.3 m)	(dBi)		62.04
E/S Rx Effective G/T	(dB/K)		38.68
E/S Rx Power Per Channel	(dBW)		-101.82
E/S Rx Flux Density Per Channel	(dBW/m^2)		-117.07
Total Link		**Forward**	**Return**
Carrier / Noise Bandwidth	(dB)		76.53
Carrier / Noise Uplink	(dB)		12.23
Carrier / Noise Downlink	(dB)		26.88
Carrier / Intermodulation Im (C/Im)	(dB)		18.35
(C/N) - Total Actual	(dB)		10.98
(C/N) - Total Required	(dB)		9.50
(E_b/N_o) - Total Actual	(dB)		7.46
(E_b/N_o) - Total Required	(dB)		5.98
Excess Margin	**(dB)**		**1.48**
Fade Margin	**(dB)**		**13.18**

ANNEX 4 – Beam Contour Maps

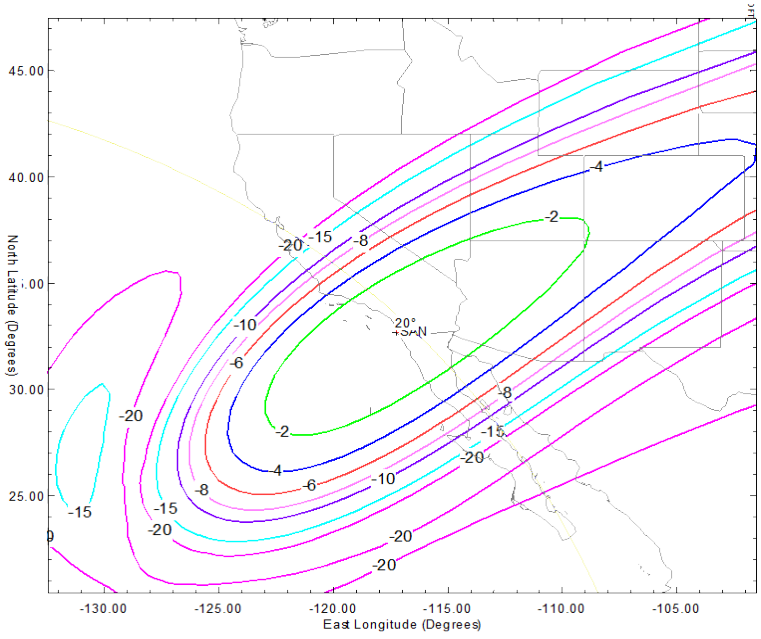
The mid-band antenna gain contours for the O3b satellite receive and transmit beams, when directed towards the San Diego earth station, are shown on the following three pages. Only one set of beam patterns is provided for transmit and one set for receive because all O3b satellite transmit beams are identical and all receive beams are identical.

These beam patterns demonstrate the effects on the satellite antenna gain contours as the O3b satellite moves in its orbit. Various satellite positions are shown starting with the O3b satellite appearing at 20° elevation angle towards the West as viewed from the San Diego earth station (see Figure 4-1). The next O3b satellite position (Figure 4-2) is at the point when it is at the same longitude as the San Diego earth station (highest elevation). The third O3b satellite position is when the O3b satellite is appearing at the 20° elevation angle in the east as viewed from the San Diego earth station (Figure 4-3). For each of these Figures both the transmit and receive relative antenna gain contours are shown.

Figure 4-1 Satellite Relative Gain Contours
(Earth station at 20 degree elevation towards the West)

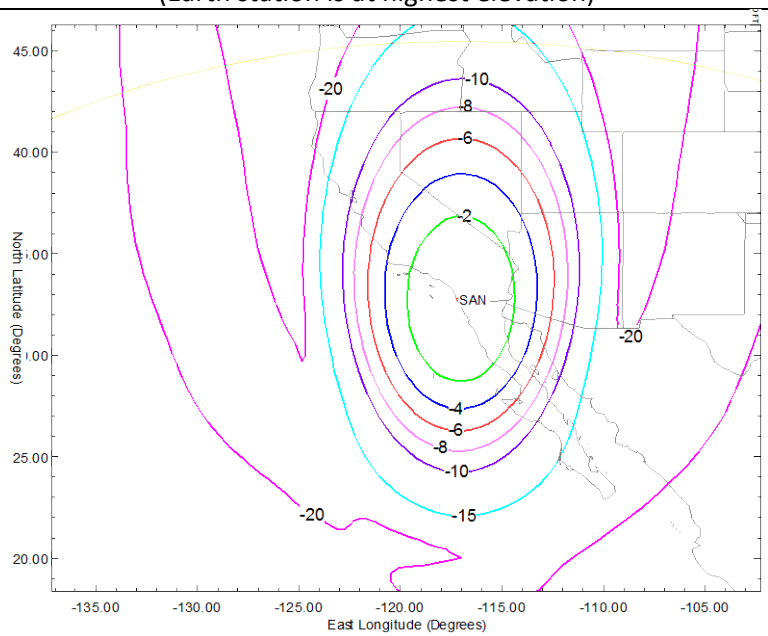


Downlink Transmit Contours

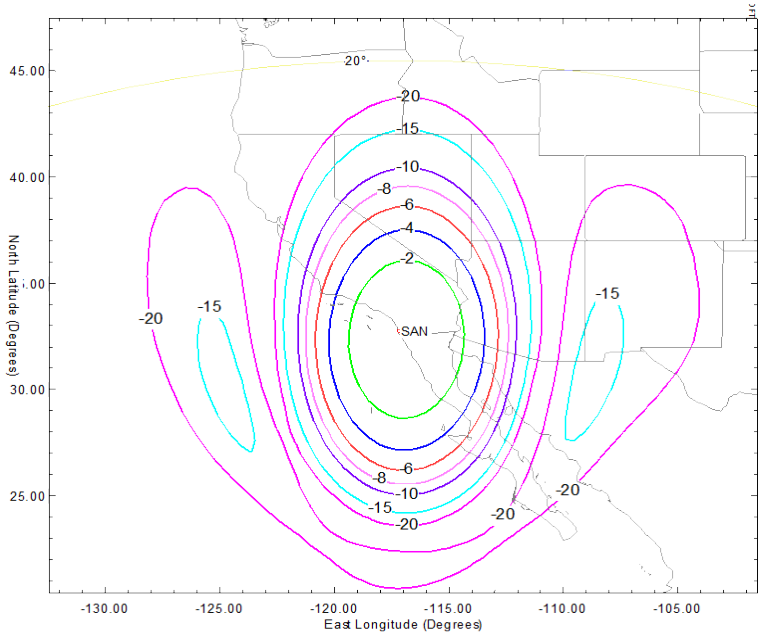


Uplink Receive Contours

Figure 4-2 Satellite Relative Gain Contours
(Earth station is at highest elevation)

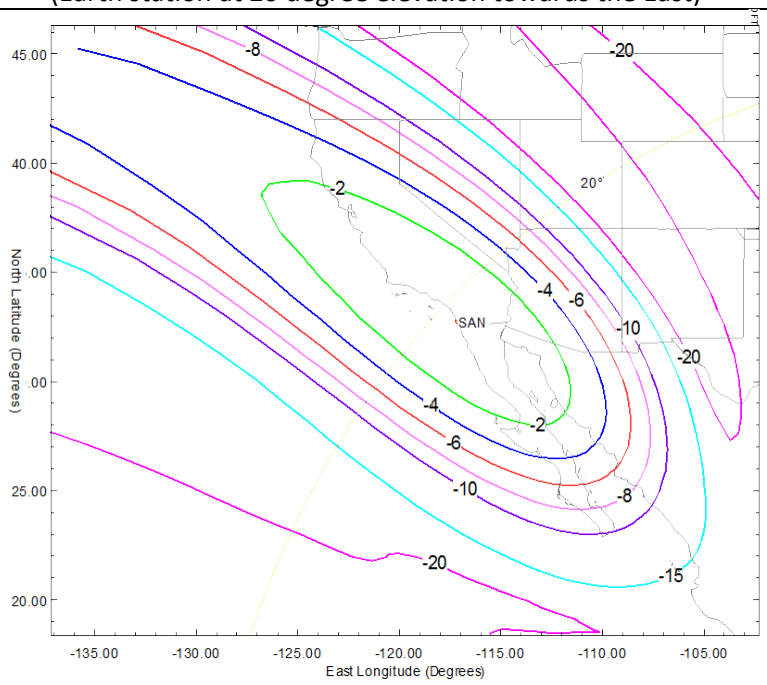


Downlink Transmit Contours

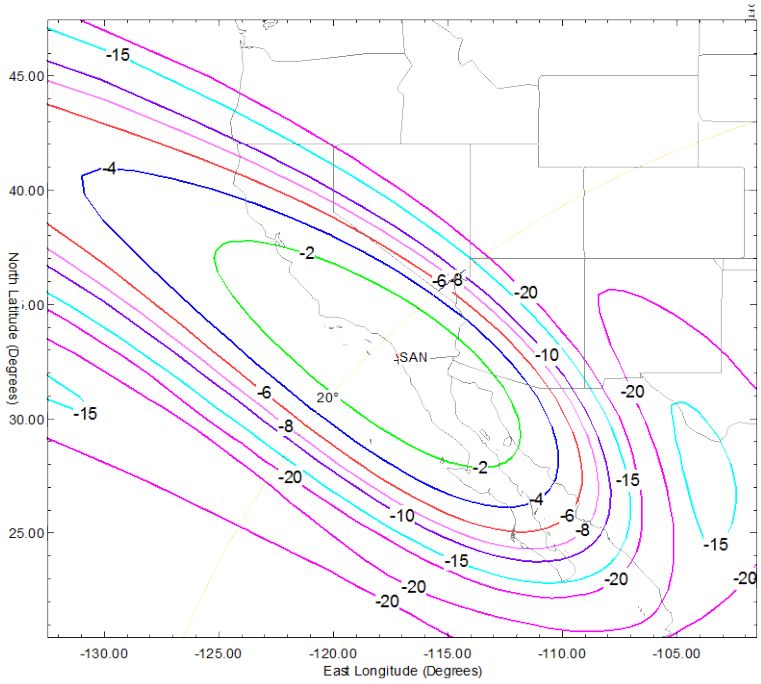


Uplink Receive Contours

Figure 4-3 Satellite Relative Gain Contours
(Earth station at 20 degree elevation towards the East)



Downlink Transmit Contours



Uplink Receive Contours

ANNEX 5 – Radiation Hazard

The Radiation Hazard study on the following pages shows Orbit's analysis of the potential RF human exposure levels caused by the electromagnetic fields of an Orbit AL-7103-Ka, 1.2 m antenna, operating with a maximum power at the flange of 20 Watts.

O3b will follow procedures to mitigate potential radiation hazards to personnel in controlled and uncontrolled environments.

In the uncontrolled environment, the FCC exposure limits are exceeded in all regions. To mitigate radiation exposure in the uncontrolled environment, the CODA Lab Earth Station antennas will be installed on the roof of the CODA Lab building, access to which is restricted to trained technicians, and O3b will ensure that proper signage is in place surrounding the antennas and at roof access points. The antennas will always be pointed in the direction of O3b's in-orbit satellites.

In the controlled environment, the radiation exposure is within the limits set by the FCC for the far field, near field, transition region, and the region between the main reflector and ground. The exposure level exceeds the FCC's limits for both the region between the main reflector and subreflector and the main reflector region. To mitigate radiation exposure in these two regions, O3b will ensure that the antennas will be turned off remotely before permitting access to the regions, which as stated above will be limited to trained technicians.

Radiation Hazard Study

The study in this section analyzes the potential RF human exposure levels caused by the Electro Magnetic (EM) fields of an Orbit AL-7103-Ka, 1.20 m antenna, operating with a maximum power at the flange of 20 Watts. The mathematical analysis performed below complies with the methods described in the FCC Office of Engineering and Technology (OET) Bulletin No. 65 (1985 rev. 1997) R&O 96-3 26 in "Evaluating Compliance with FCC Guideliness for Human Exposure to RF EM Fields, OET Bulletin 65 (Edition 97-01), Supplement B, FCC Office of Engineering & Technology, November 1997".

Maximum Permissible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

* General Population / Uncontrolled Exposure: 1.0 mW/cm^2
* Occupational / Controlled Exposure: 5.0 mW/cm^2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Input Parameter	Value	Unit	Symbol
Antenna Diameter	1.20	m	D
Antenna Transmit Gain	48.50	dBi	G
Transmit Frequency	29100.0	MHz	f
Antenna Feed Flange Diam.	6.00	cm	d
Power Input to the Antenna	20.00	Watts	P

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formula:

Calculated Parameter	Value	Unit	Symbol	Formula
Antenna Surface Area	1.13	m^2	A	$\pi D^2/4$
Area of Antenna Flange	28.3	cm^2	a	$\pi d^2/4$
Antenna Efficiency	0.53	real	η	$g\lambda^2/(\pi^2 D^2)$
Gain Factor	70795	real	g	10^(G/10)
Wavelength	0.010	m	λ	300/f

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.

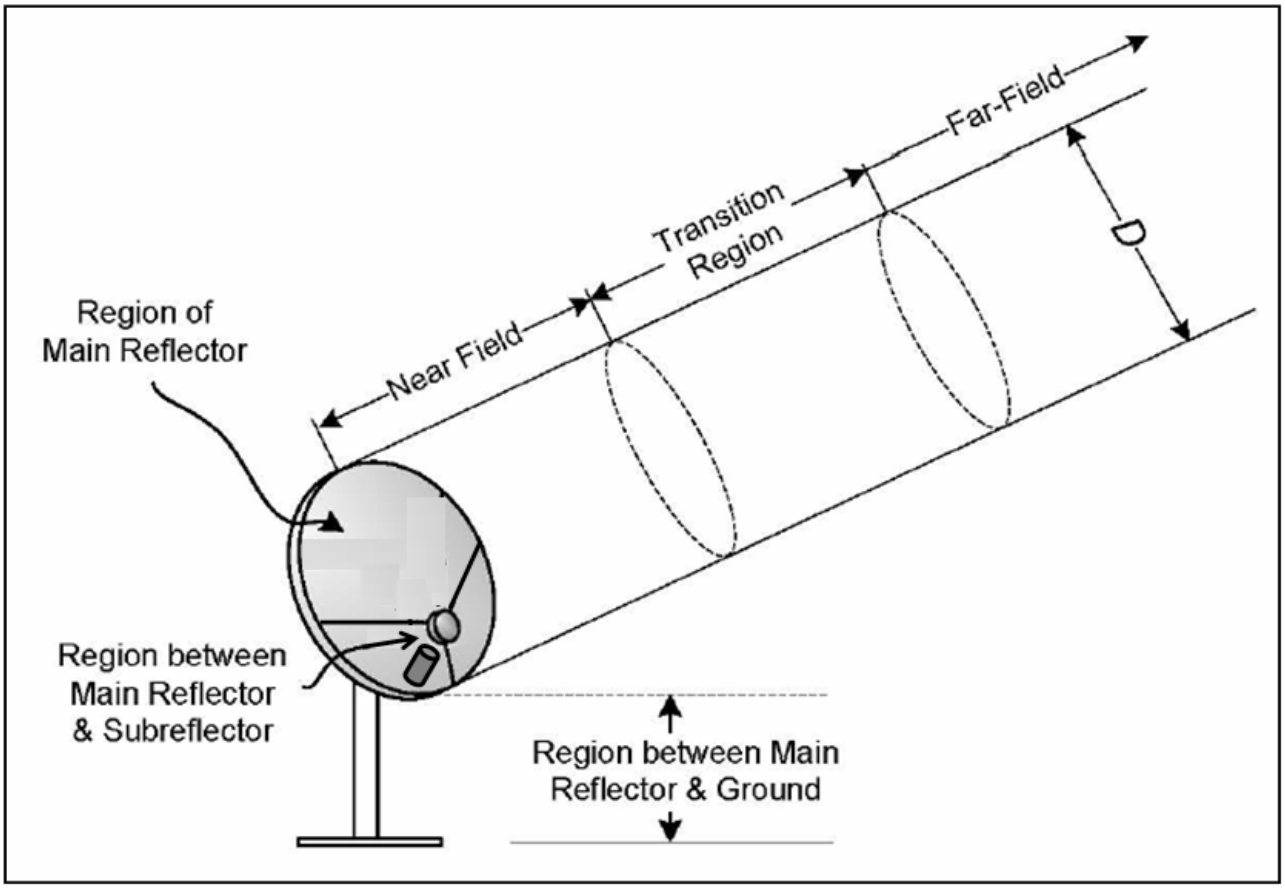


Figure 1. Electro-Magnetic Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Calculated Parameter	Value	Unit	Symbol	Formula
Near-Field Distance	34.92	m	Rnf	$D^2/(4\lambda)$
Distance to Far-Field	83.81	m	Rff	$0.6D^2/\lambda$
Distance of Transition Region	34.92	m	Rt	Rt=Rnf

The distance in the transition region is between the near and far fields. Thus, Rnf ≤ Rt ≤ Rff . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, *D*, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions:

Calculated Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	3.74	mW/cm^2	Snf	$16\eta P/(\pi D^2)$
Power Density in the Far-Field	1.60	mW/cm^2	Sff	$gP/(4\pi Rff^2)$
Power Density in the Transition Region	3.74	mW/cm^2	St	Snf*Rnf/Rt

The region between the main reflector and the subreflector is confined to within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Calculated Parameter	Value	Unit	Symbol	Formula
Power Density at the Feed Flange	2829.4	mW/cm^2	Sfa	4P/a

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Calculated Parameter	Value	Unit	Symbol	Formula
Power Density at Main Reflector	7.07	mW/cm^2	Ssurface	4P/A

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Calculated Parameter	Value	Unit	Symbol	Formula
Power Density between Reflector & Gnd	1.77	mW/cm^2	Sg	P/A

Summary of Calculations

Table 1 below summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are the regions between the main reflector and the sub-reflector as well as the main reflector region. These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Table 1. Power Flux Density for Each Region:

Calculated Parameter	Unit	Exposure Limit	Exposure Limit
		Uncontrolled	Controlled
Power Densities	mW/cm²	Environment	Environment
		≤ 1 mW/cm²	≤ 5 mW/cm²
Far Field Calculation	1.60	Exceeds limitations	Satisfies FCC MPE
Near Field Calculation	3.74	Exceeds limitations	Satisfies FCC MPE
Transition Region	3.74	Exceeds limitations	Satisfies FCC MPE
Region between Main & Subreflector	2829.4	Exceeds limitations	Exceeds limitations
Main Reflector Region	7.07	Exceeds limitations	Exceeds limitations
Region between Main Reflector & Gnd	1.77	Exceeds limitations	Satisfies FCC MPE

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in § 1.1310 of the Regulations.

ANNEX 6 – Coordination Contours

The report prepared by Transfinite containing coordination contours is provided on the following pages.

Technical Note
O3b San Diego Gateway Coordination

Date: 20th December 2013

1 Document Scope

This describes analysis undertaken by Transfinite Systems Ltd for O3b to generate a coordination contour for an Earth Station (ES) of O3b's non-GSO network in San Diego.

In addition more detailed interference zones were generated using terrain data and interference criteria from Recommendation ITU-R SF.1006.

Finally a Monte Carlo analysis was undertaken to identify the scope to use that methodology to convolve ES antenna pointing and propagation statistics.

2 Scenario Parameters

2.1 Earth Station Parameters Used

The ES parameters were taken from:

1. Email of 25th November 2013 with location and height parameters
2. Box files shared on 25th November 2013 with antenna gain patterns
3. FCC application emailed on 21st November 2013

2.2 O3b ES Location

From reference 1:

Latitude:	32° 40' 54.3" N
Longitude:	117° 7' 0.1" W
Antenna height:	12.5m above ground level
Ground height :	5.33m above sea level
Total antenna height	17.83m above sea level

Table 1: O3b ES Location

2.3 O3b ES Antenna Gain Pattern

From reference 2 the ES antenna gain pattern has been measured at 29.1 GHz and is shown in the figure below:

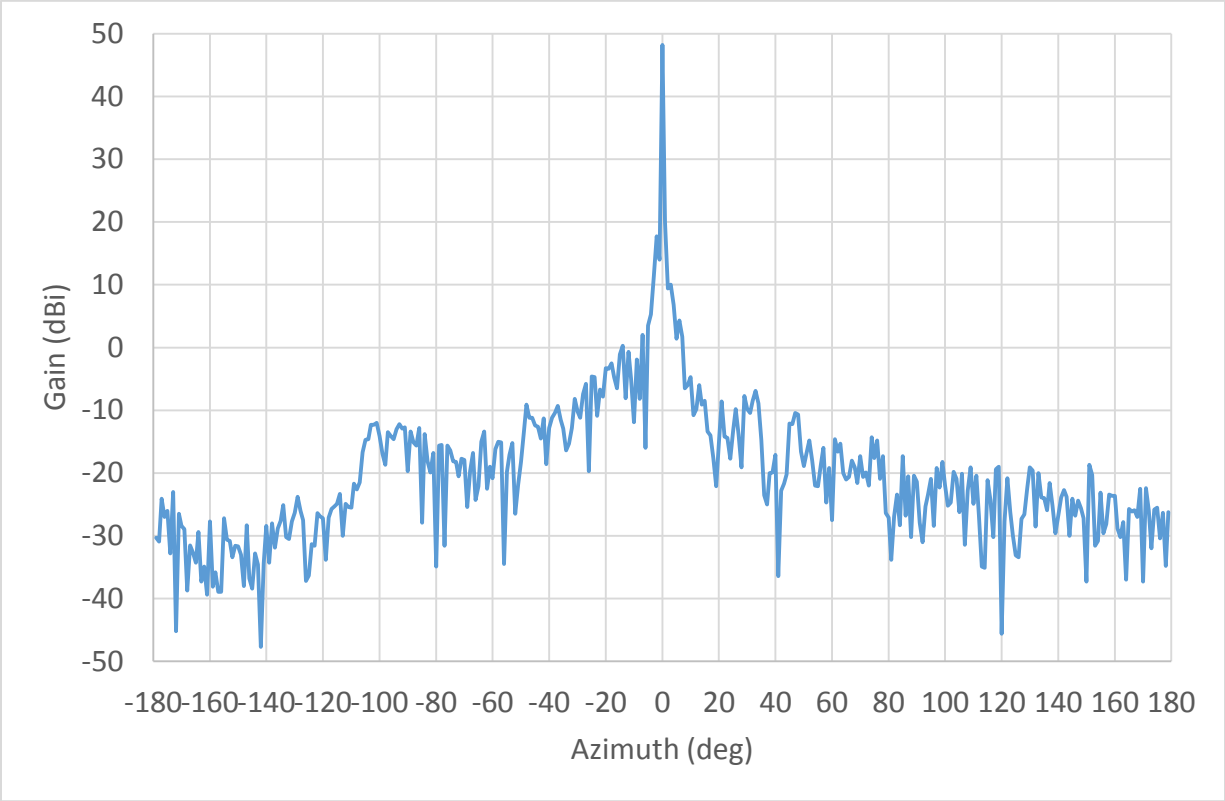


Figure 1: ES Antenna Gain Pattern Slice

The peak gain in the measured data file was 48.2 dBi and the minimum operating elevation angle was taken as 20º.

For generation of the Appendix 7 coordination contour the following simplified assumptions were made:

Gain pattern:	ITU-R Rec. S.580-6
Peak gain:	48 dBi
Beamwidth:	0.6°

Table 2: O3b ES Simplified Antenna Pattern for Appendix 7 Calculations

It is assumed the measurement missed the very narrow beam's peak gain and hence the highest gain value in the table was 0.3 dB below the specified peak gain. However this wouldn't impact the analysis as the minimum elevation angle constraint implies that gain values below 20 degrees off-axis would not be used.

2.4 O3b Transmit Link

From References 1, 2 and 3:

Transmit frequency:	29.1 GHz
Transmit power:	10 dBW
Reference bandwidth:	216 MHz

Table 3: O3b ES Transmit Link Parameters

2.5 O3B Constellation

The following parameters were used for the O3b non-GSO satellite constellation:

Type and service:	Non-GSO FSS
Orbit inclination:	0°
Orbit height:	8,062 km

Table 4: O3b Constellation

2.6 Appendix 7 Parameters

The values for transmit ES are shown in the table below from RR Appendix 7:

TABLE 7c (Rev.WRC-12)

Parameters required for the determination of coordination distance for a transmitting earth station

Transmitting space radiocommunication service designation		Fixed-satellite	Fixed-satellite [2]	Fixed-satellite [3]	Space research	Earth exploration-satellite, space research	Fixed-satellite, mobile-satellite, radionavigation-satellite	Fixed-satellite [2]
Frequency bands (GHz)		24.65-25.25 27.0-29.5	28.6-29.1	29.1-29.5	34.2-34.7	40.0-40.5	42.5-47 47.2-50.2 50.4-51.4	47.2-50.2
Receiving terrestrial service designations		Fixed, mobile	Fixed, mobile	Fixed, mobile	Fixed, mobile, radiolocation	Fixed, mobile	Fixed, mobile, radionavigation	Fixed, mobile
Method to be used		§ 2.1	§ 2.2	§ 2.2		§ 2.1, § 2.2	§ 2.1, § 2.2	§ 2.2
Modulation at terrestrial station [1]		N	N	N		N	N	N
Terrestrial station interference parameters and criteria	p_0 (%)	0.005	0.005	0.005		0.005	0.005	0.001
	n	1	2	1		1	1	1
	p (%)	0.005	0.0025	0.005		0.005	0.005	0.001
	N_L (dB)	0	0	0		0	0	0
	M_s (dB)	25	25	25		25	25	25
	W (dB)	0	0	0		0	0	0
Terrestrial station parameters	G_x (dBi) [4]	50	50	50		42	42	46
	T_e (K)	2 000	2 000	2 000		2 600	2 600	2 000
Reference bandwidth	B (Hz)	10^6	10^6	10^6		10^6	10^6	10^6
Permissible interference power	$P_r(p)$ (dBW) in B	–111	–111	–111		–110	–110	–111

Figure 2: Extract from Appendix 7 for Transmit ESs

Footnotes:

2. Non-geostationary satellites in the fixed-satellite service.

3 Appendix 7 Coordination Contour

The Visualyse Coordinate tool can be used to generate ES coordination contours according to the algorithm in ITU-R RR Appendix 7. The algorithm ensures that the contour is never less than around 100 km in radius, as shown in the figure below:

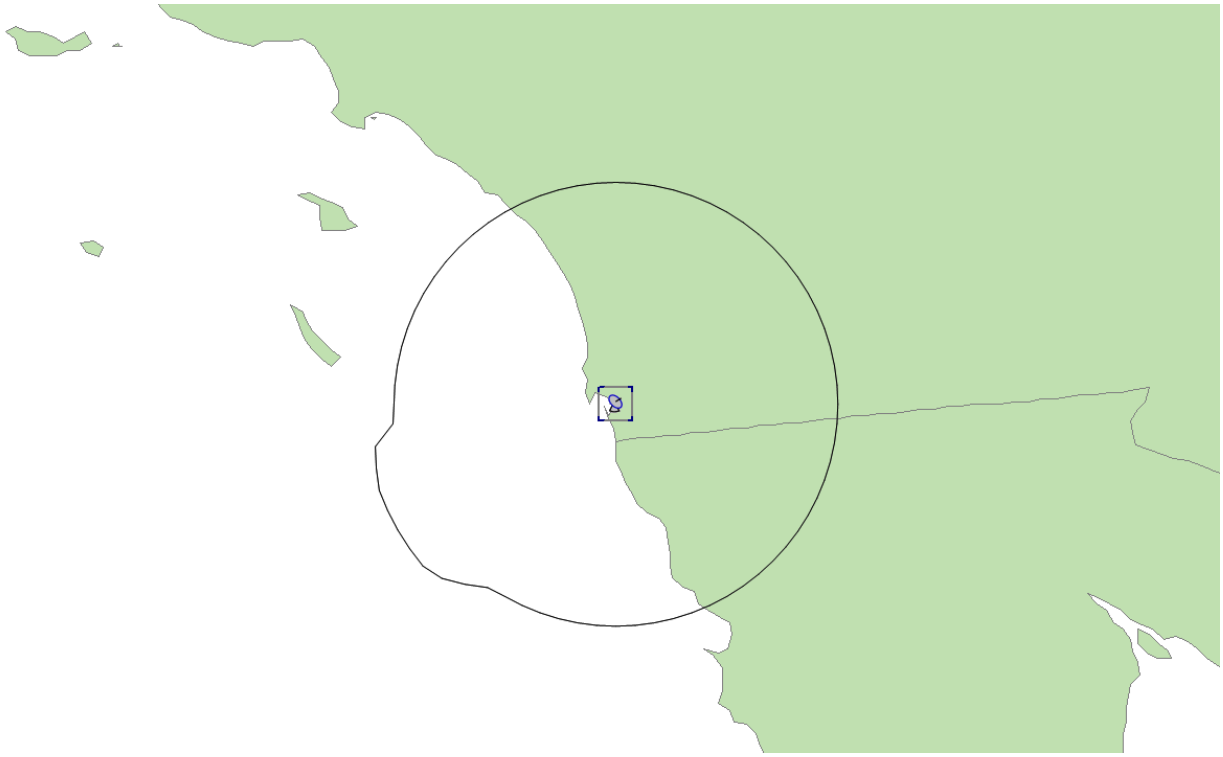


Figure 3: **Transmit Coordination Contour**

With the ES less than 20 km inside the US and a minimum contour size of 100 km, the coordination contour can be expected to cross the border into Mexico.

4 Recommendation ITU-R SF.1006 Interference Zone

4.1 Sharing Criteria

The approach in Appendix 7 is to use an agreed set of parameters in the Radio Regulations that can only be changed at World Radiocommunication Conferences. These are by nature conservative as they are used as coordination triggers and in detailed coordination actual parameters would be used.

Given that the methodology in Appendix 7 is conservative there are three mechanisms that can be used to reduce the size of the coordination contour:

1. Remove the requirement for a minimum distance of 100 km

2. Use actual or at least more realistic parameters including sharing criteria and ES antenna gain pattern
3. Include the effect of terrain

This approach can be undertaken by using the thresholds in:

- Rec. SF. 1006: Determination of the interference potential between earth stations of the fixed-satellite service and stations in the fixed service

In addition it is worth reviewing typical usages of the band and equipment types.

4.2 Recommendation ITU-R SF. 1006

This recommendation provides a methodology and table of parameters to calculate sharing criteria, and in general the values are similar to those in Appendix 7, as shown in the table below:

Parameters	From SF.1006	From App.7
Frequency band	29 GHz	29 GHz
Interferer	FSS	FSS
Victim	FS	FS
p1 (%)	20	n/a
p2 (%)	0.005	0.005
n2	1	2
B (Hz)	1.00E+06	1.00E+06
J (dB)	0	n/a
W (dB)	0	0
Tr (K)	3200	2000
Ms (dB)	25	25
Nl (db)	0	0

Table 5: Rec. SF.1006 vs. Appendix 7 Parameters

SF.1006 gives long term thresholds as well as short term ones, plus there is also a difference in the receive temperature for the FS.

The following interference thresholds were used:

Threshold	Short term	Long term
p (%)	0.005	20
I (dBW)	-108.6	-133.5

Table 6: Interference Thresholds from SF.1006

4.3 FS Antenna Sizes

The primary use of these bands is for mobile backhaul where a significant factor is to keep costs low. This means that operators are unlikely to use antennas larger than 30cm, which corresponds to peak gains of 37 dBi at 29 GHz.

4.4 Terrain Database

The ASTER2 database was used. This has a horizontal resolution of 30m between pixels and is a surface database so it includes some of the effects of buildings. However its resolution means it is unable to identify specific buildings and cannot in this case be considered to include local clutter around the ES.

The figure below shows the ASTER2 terrain / surface details around San Diego:

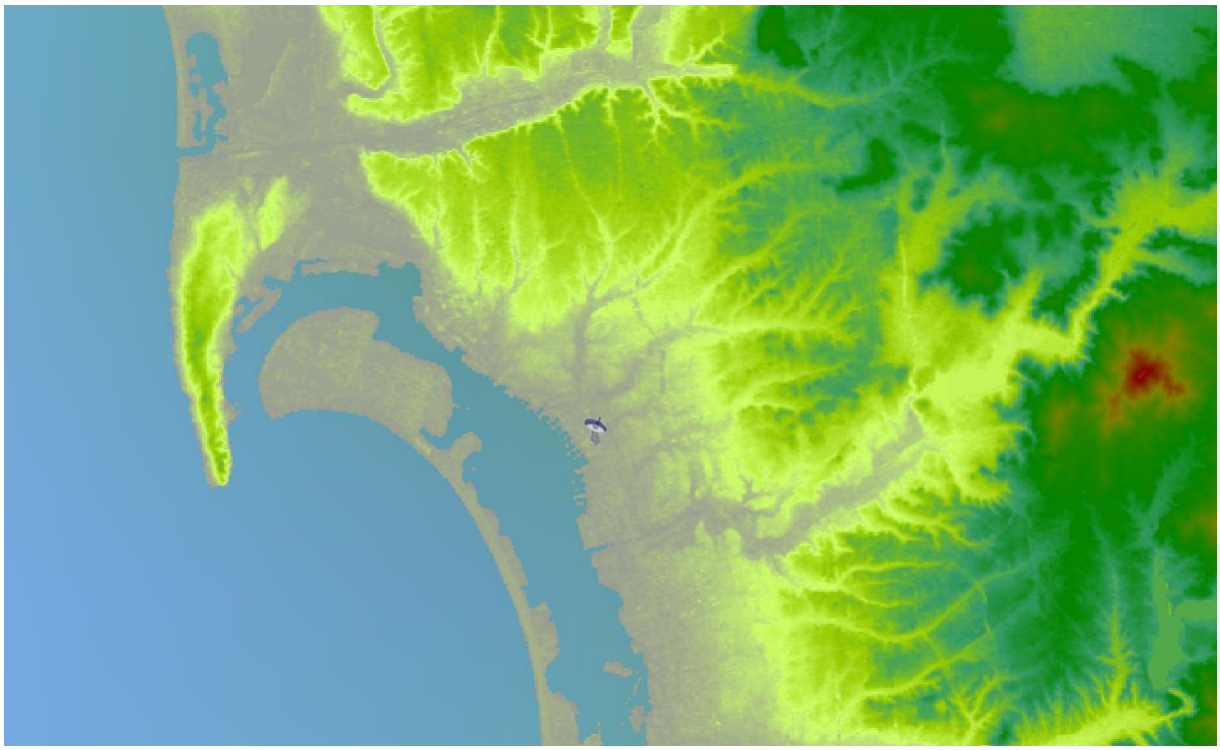


Figure 4: **ASTER2 Surface Data**

This surface data is freely available from the following web site:

http://earthexplorer.usgs.gov/

Data is provided subject to terms and conditions available on this web site which includes:

- When presenting or publishing ASTER GDEM data, users are required to include a citation stating, "ASTER GDEM is a product of METI and NASA."
- The data are provided "as is" and neither NASA nor METI/ERSDAC will be responsible for any damages resulting from use of the data.

4.5 O3b Horizon Gain

Another factor to consider is how the O3b ES gain towards the horizon varies as the constellation moves.

It was noted that this pattern was not symmetric around the zero degrees azimuth line and hence an average pattern was created assuming symmetry around the zero degree azimuth as shown in the figure below:

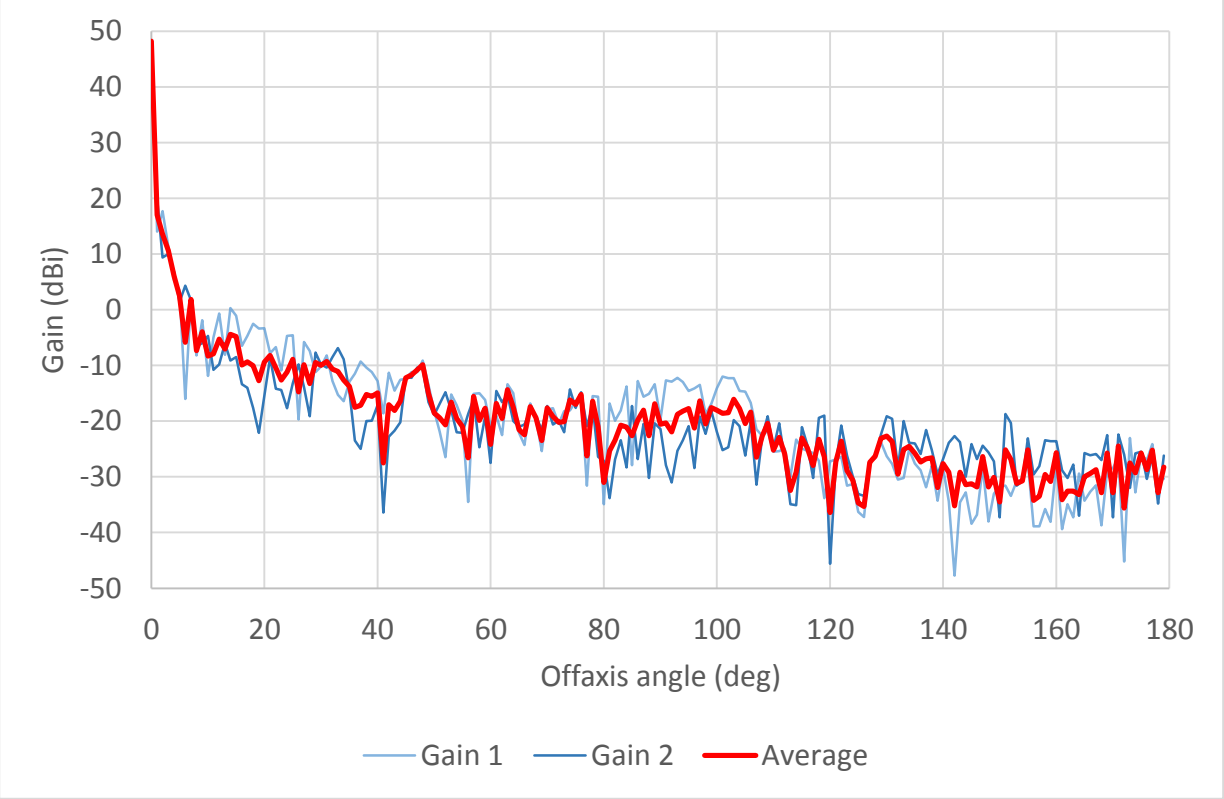


Figure 5: ES Antenna Gain Pattern Symmetric Pattern

This symmetric pattern was used in a simulation to work out the peak gain towards the horizon for the O3b constellation with minimum elevation angle of 20° as shown in the figure below:

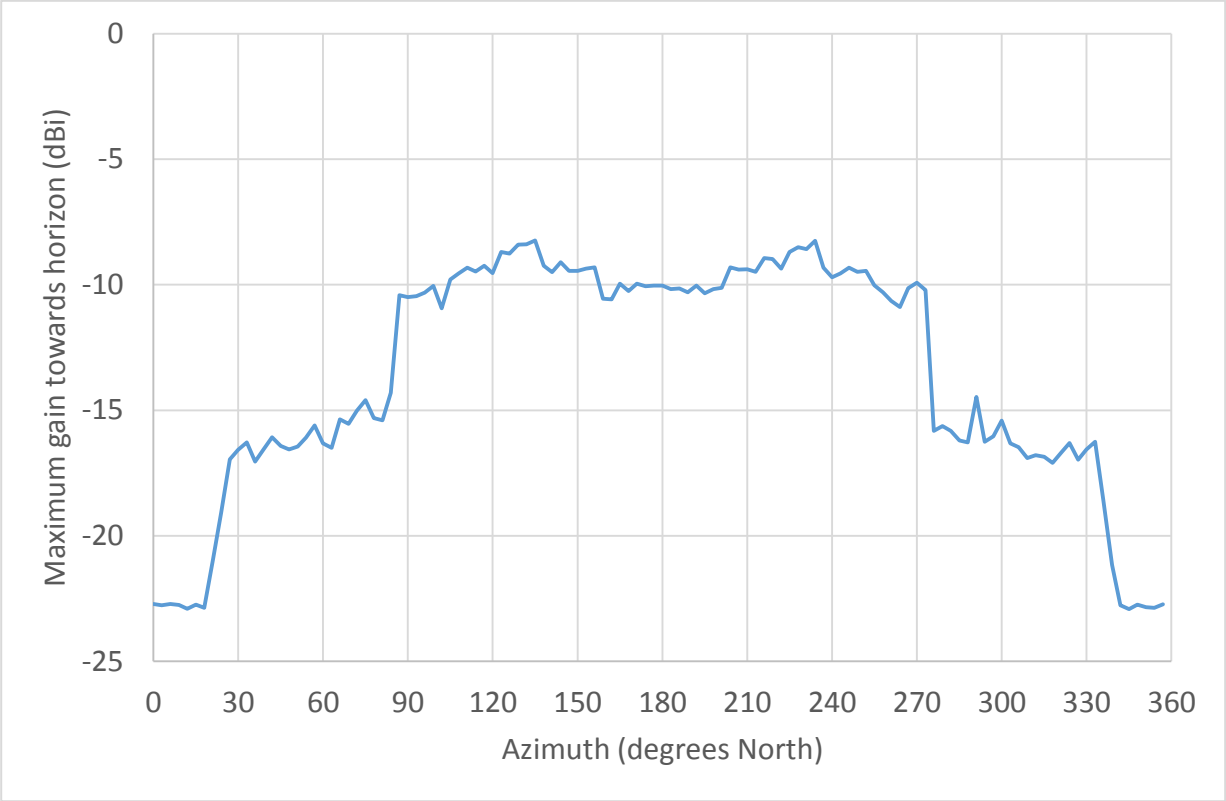


Figure 6: Horizon Gain for O3b

4.6 Mitigation Methods

A number of mitigation methods could be used to reduce the impact of the O3b ES on FS links in adjacent countries including:

- Include use of the auxiliary contours. As described by Appendix 7, it is unlikely that there will be the worst case geometrical alignment in which the FS antenna is pointing directly at the ES, there is likely to be some antenna gain discrimination. A value of 5 dB is typically used in these cases
- Include the FS antenna feed loss: a value of 1 dB would be typical for systems in this band.

4.7 Short Term and Long Term Interference Zones

From the parameters in the previous section the following areas where the short and long term interference thresholds are exceeded were generated and then displayed in Google Earth:

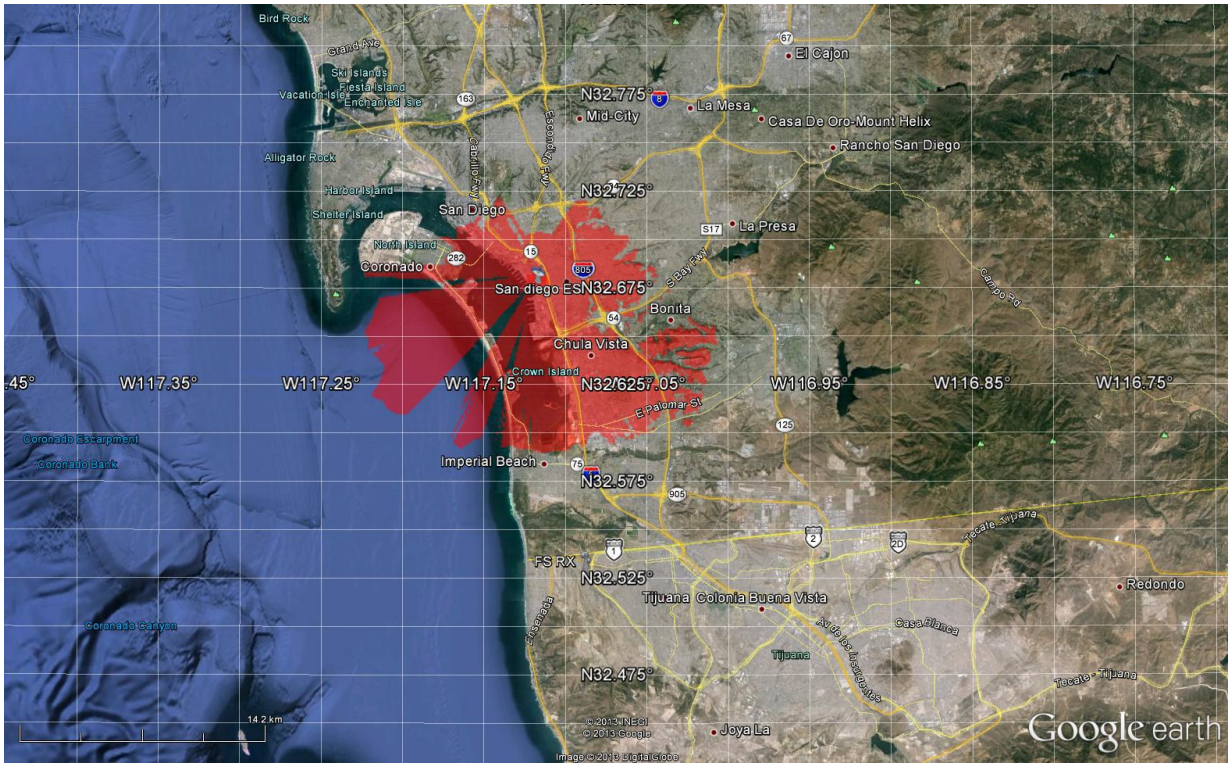


Figure 7: O3b Long Term Interference Zone

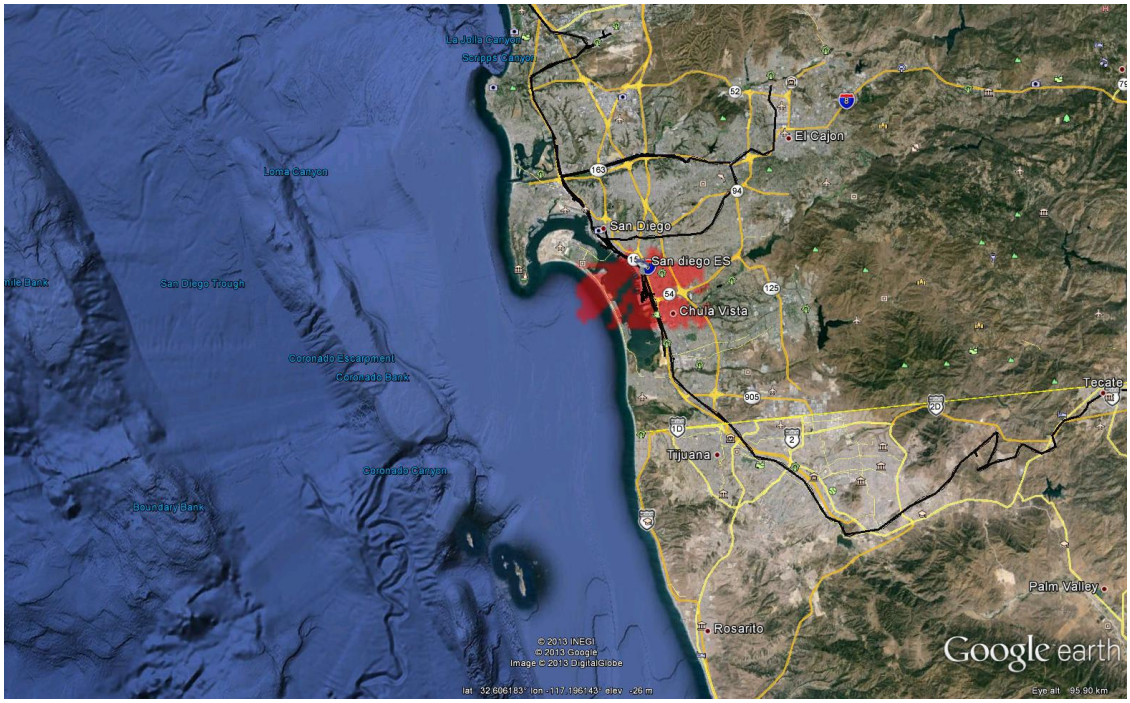


Figure 8: O3b Short Term Interference Zone

4.8 Comments

It was noted that the interference zones were significantly smaller than those generated assuming Appendix 7. This was because:

- The O3b transmit power is relatively low, resulting in an interference zone significantly less than the minimum 100 km contour in Appendix 7.
- The assumed FS antenna peak gain in Appendix 7 of 50 dBi was considered larger than would be typically used in this band
- The measured antenna gain pattern had lower far off-axis sidelobes than those assumed in Rec. ITU-R S.580-6

Taking into consideration the above, it was noted that both the short term and long term interference zones are fully contained within the U.S. borders.