Description of document:	National Science Foundation (NSF) McMurdo Antarctica Satellite Communications Systems Study 2012
Requested date:	05-December-2014
Denial date:	17-April-2025
Appeal date:	18-April-2025
Release date:	06-June-2025
Posted date:	23-June-2025
Source of document:	FOIA Request U.S. National Science Foundation Attn: FOIA Officer 2415 Eisenhower Avenue Alexandria, Virginia 22314 Fax: (703) 292-9041 Email: foia@nsf.gov |Online FOIA Request (PAL) FOIA.gov

National Science Foundation
Office of The General Counsel

Via email

Re: FOIA Appeal 2025-APP-00009 (FOIA Request No. 15-066F)

This responds to your FOIA appeal of April 18, 2025, in which you appeal the National Science Foundation's response to your Freedom of Information Act (FOIA) requests under case number 15-066F.

Your FOIA Request and NSF Response

On December 5, 2014, you sent a FOIA request to NSF seeking a copy of reports and presentations provided by the WL Pritchard Co LLC in its contract with NSF. You noted that the contract number was NSFDACS12056005 and that the date of the contract was circa 2011-2013. You noted that the subject of the contract was to help study broadband communications services to serve the Antarctic program.

The FOIA request was assigned the tracking number 15-066F.

On April 17, 2025, NSF replied to your request indicating that due to the proprietary commercial and financial business information in the responsive documents, the responsive documents were being withheld in full under FOIA Exemption 4.

Your FOIA Appeal

On April 18, 2025, you submitted an appeal of the final NSF response to the FOIA request 15-066F. Specifically, you appealed the decision to withhold in full a report WL Pritchard Co. produced for NSF under its contract # NSFDACS12056005. You stated that the subject of the report is a matter of significant public interest and is an important policy matter, and as such transparency is critical for informed public discussion. You also note that due to the age of the request, you believe current competitive harm is likely minimal and is outweighed by the public interest in the information. You request that NSF reexamine the report to determine if any material in the report can be segregated and released.

NSF Adjudication of the FOIA Appeal

NSF has re-reviewed the responsive records and is granting your appeal in part. NSF has determined that substantial portions of the report were properly withheld under Exemption 4 as containing commercial information received from a person and customarily and actually treated as private by its

owner. *See Food Mktg. Inst. v. Argus Leader Media*, 588 U.S. 427, 440 (2019). Further, NSF notes that the document is clearly marked as containing commercially-sensitive information that was not to be disclosed outside of NSF. NSF foresees harm from release of the information in that parties will not share proprietary information with NSF if that information is released. This will likely inhibit NSF from receiving the information needed to conduct its work, especially in the polar regions.

Regarding competitive harm, NSF notes that following the Supreme Court's decision in *Argus Leader Media*, the prior "competitive harm" test that courts previously used to determine whether information is subject to FOIA Exemption 4 has been overruled. Nevertheless, NSF find foreseeable harm of release of this information protected by Exemption 4. In response to your argument that there is a public interest in this material that outweighs competitive harm, NSF notes that Exemption 4—unlike Exemption 6—does not include a public interest balancing test.

Additionally, NSF has determined that information in the report is also subject to FOIA Exemption 5 as deliberative and pre-decisional. The report was provided to NSF to inform NSF decision-making as it pertained to telecommunications services for the McMurdo station in Antarctica. The report contains recommendations and analysis of risks for various approaches for telecommunications. The report was provided to NSF for its internal use only. NSF foresees harm in releasing the deliberative and predecisional information in the report in that release would inhibit NSF from receiving frank and thorough assessments of risks and recommendations in the future and would likely mislead the public as to the reasons NSF has approached Antarctic telecom choices since the report was drafted.

NSF has determined, however, that there are also significant portions of the report than can be released, as they reflect factual information, the release of which would not result in foreseeable harm. NSF is releasing 19 pages in full and 11 pages in part.

The responsive records are attached.

Conclusion

This response to your appeal is final, with no further right of administrative appeal for this request under the agency's FOIA regulations. *See* 45 CFR § 612.9. Your right to seek judicial review of this determination is set forth at 5 U.S.C. § 552(a)(4).

Sincerely,

ANGELA R WILLIAMS

Digitally signed by ANGELA R WILLIAMS
Date: 2025.06.06 10:46:03 -04'00'

Angela R. Williams
General Counsel

Attachments

MCMURDO
SATELLITE COMMUNICATIONS SYSTEMS

Prepared for:

National Science Foundation (NSF)

(Contract # NSFDACS1205605)

By:

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June 2012

MCMURDO SATELLITE COMMUNICATIONS SYSTEM

Table of Contents

List of Figures:

MCMURDO SATELLITE COMMUNICATIONS SYSTEM

Table of Contents (continued)

List of Tables:

(b) (4), (b) (5)

(b) (4), (b) (5)

(b) (4), (b) (5)

McMurdo Satellite Communications System

I. Introduction

McMurdo Station satellite communications are currently provided by an earth station facility on Black Island (Black Island Telecommunications Facility – BITF) located some 20 miles south of the Station; the remote site though causing operational complications was chosen to permit an unobstructed view of Pacific Region geostationary satellites from several operators. The NSF owned/contractor operated 11m Ku-band earth station there accesses Singtel Optus D1 satellite capacity acquired through an interagency partnership managed by NOAA to provide high data rate service for NSF, NASA and NOAA. A 7.3m backup antenna is also located at Black Island. The NSF role in the partnership is to provide Antarctic teleport and local communications operations to support the NOAA provided space segment, distant end teleport, and international back-haul communications services. Additionally, NSF provides an annual funding contribution for a share of the space-segment costs.

McMurdo Station is located on Ross Island, where the commercial telecommunications operator New Zealand Telecom currently has a 9m C-Band earth station, in the hills above McMurdo, which currently accesses the Intelsat 5 satellite. A series of satellite constellation restructuring activities planned by Intelsat, beginning in 2012 with the retirement of this satellite, is likely to result in replacement satellites offering lower quality service resulting from poor coverage of Ross Island unless the operator provides more satellite power, which may not occur for large data-rate signals.

(b) (4), (b) (5)

(b) (4), (b) (5), (b) (6)

(b) (4), (b) (5)

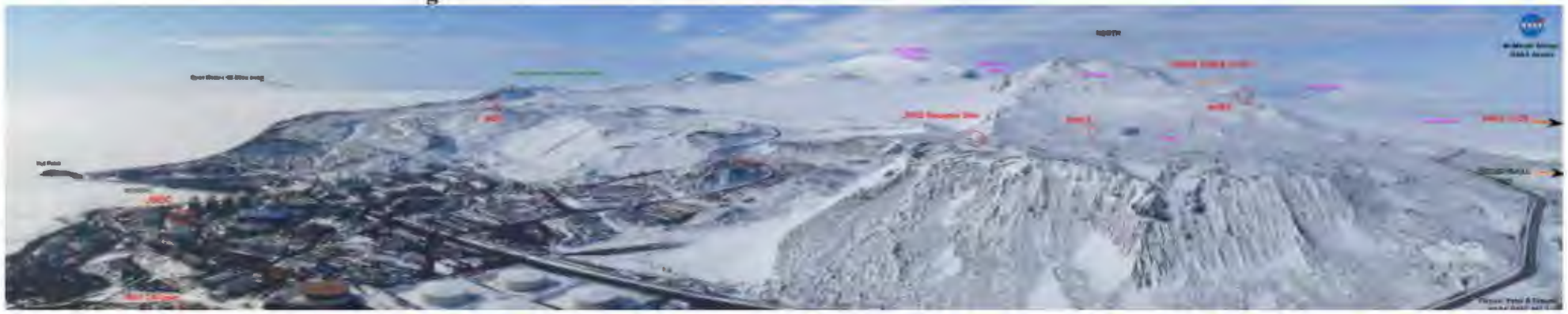
The NSF-formulated alternative approach is not without its own risks, which must be clearly defined, understood, and evaluated in order to conduct a sound business case assessment and comparison (cost, risk, and schedule) with the original RPSC concepts. This business case review is essential for NSF to gain clarity for long term planning for telecommunications services sustainment and for critical discussions with its telecommunications partners (NOAA, NASA, and their supported tenants).

Task:

1. Research, define, examine and report to NSF on the risks inherent in the NSF alternative approach for provisioning McMurdo communications from Ross Island.

2. Develop any means to diminish or mitigate each risk, identify potential benefits, and provide an overall assessment of whether this plan should be pursued, and if so a suggested approach to minimize risk for NSF.

Figure 1: Overview of McMurdo Telecommunications[2]



[2] (b) (6) Subject: Re: MTRSU Season 2011-12 Test Report. Additional panoramic picture of McMurdo Station taken by (b) (6) with labels.

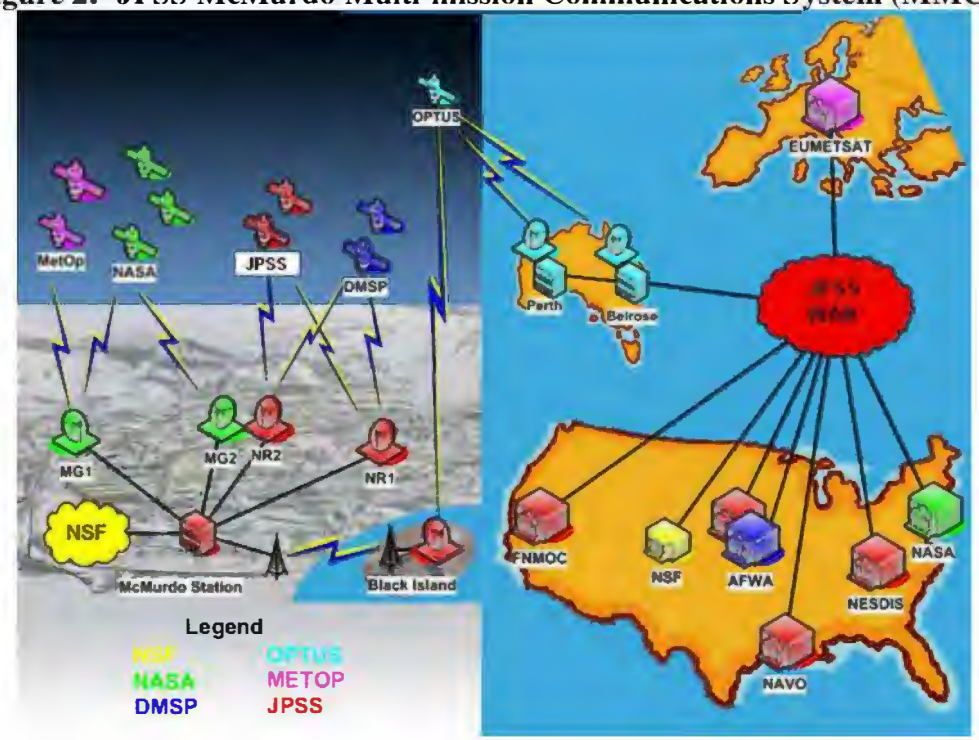
II. Existing McMurdo Communications Facilities

The McMurdo communication network benefits a number of agencies and programs. These are:

- NSF (to Centennial, CO)
- Joint Polar Satellite System [JPSS], procured by NOAA through NASA
- EUMETSAT (delivery of data from the MetOp Polar environmental satellites to Europe)
- NASA (delivery of data from various NASA missions to Goddard)
- Defense Meteorological Satellite Program (DMSP) (delivery of data to the Air Force Weather Agency, AFWA)

McMurdo is particularly appealing to operators of polar-orbiting satellites because data previously collected only once per orbit at sites in the northern hemisphere can be downloaded at McMurdo, reducing the data latency by about 50%.
Figure 2 below shows the JPSS network[3].

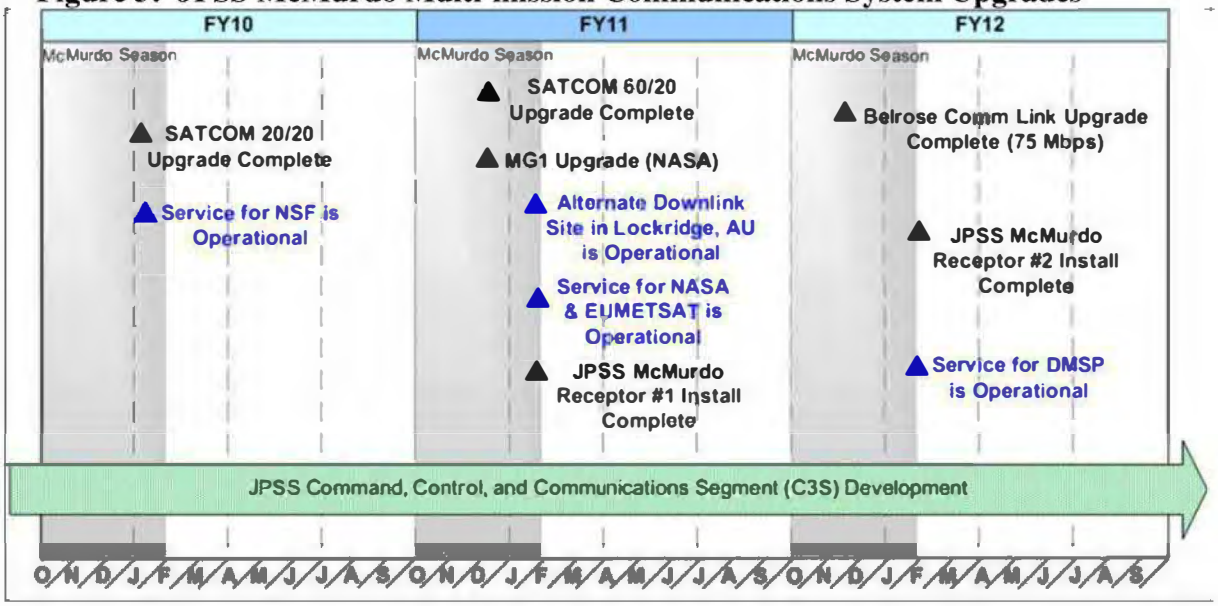
Figure 2: JPSS McMurdo Multi-mission Communications System (MMCS)



[3] The Aerospace Corporation, "*Joint Polar Satellite System McMurdo Communications Overview*" - February 2012.

Infrastructure updates in the last few years outlined in the Figures below increased the total throughput capability of the site from 10 Mbps outbound / 10 Mbps inbound in 2007-2008 to 60/20 Mbps in 2010-2011[4].

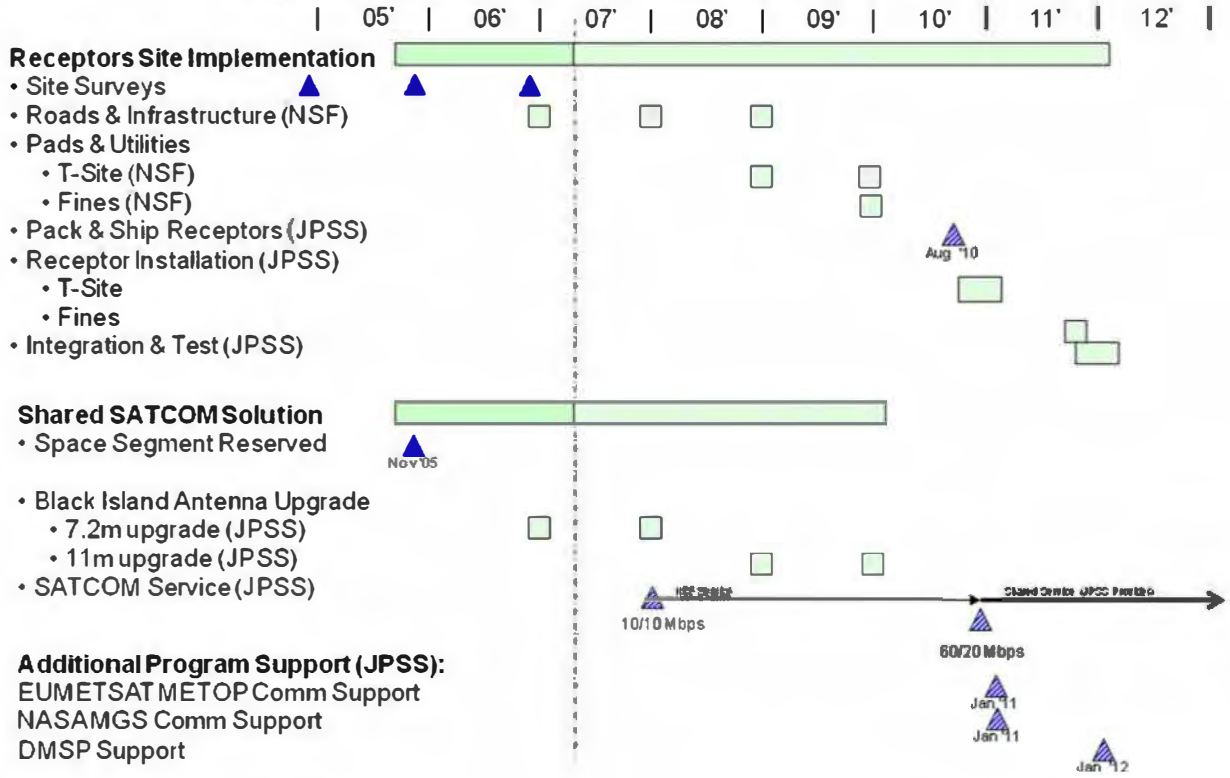
Figure 3: JPSS McMurdo Multi-mission Communications System Upgrades



[4] Raytheon Intelligence and Information Systems, *JPSS CGS C3S Expandability: Distributed Receptor Network and McMurdo Improvements,* 2011 AMS Annual Meeting, January 23-27, 2011, Seattle, Washington.

THIS REPORT CONTAINS COMERCIALLY SENSITIVE INFORMATION COVERED UNDER
[redacted]

Figure 4: JPSS MMCS capabilities increase[5]



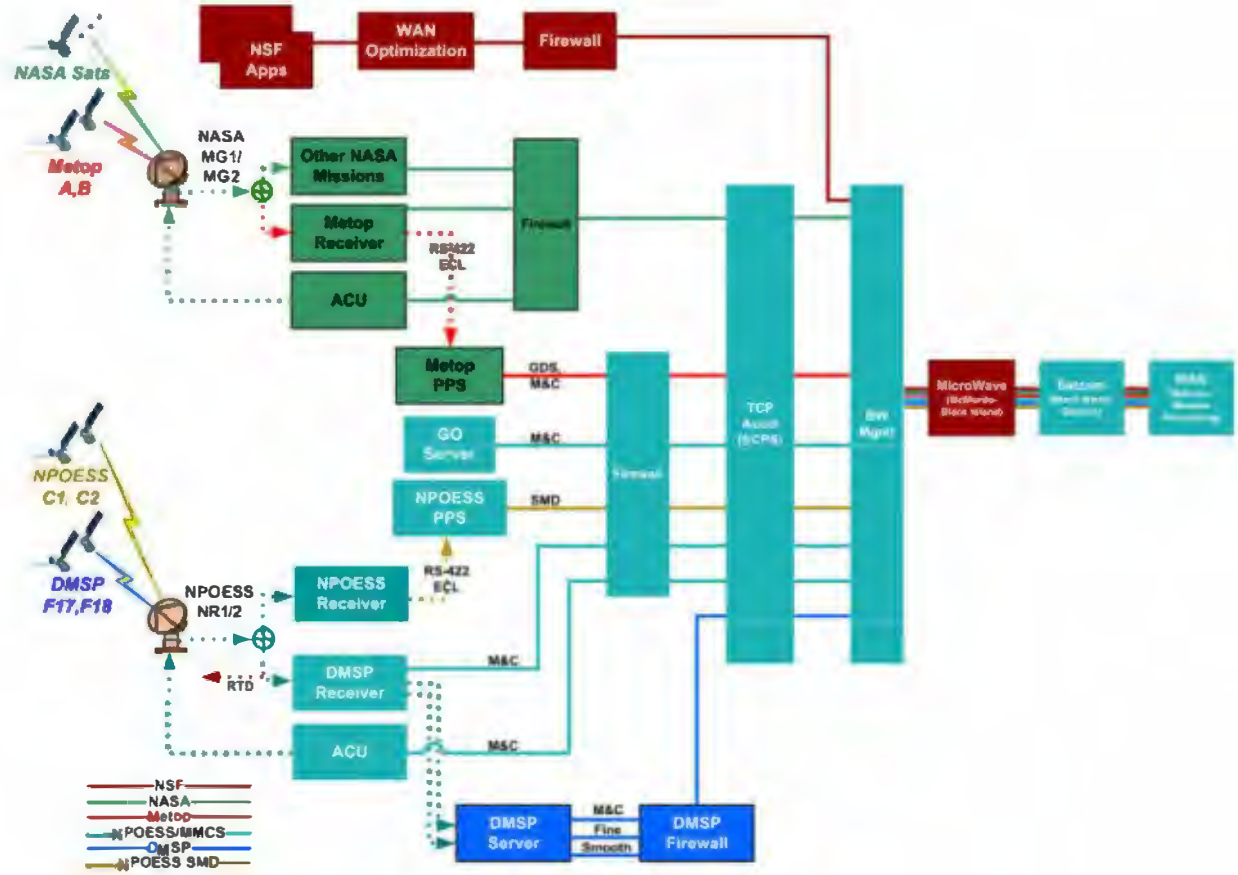
[5] The Aerospace Corporation, *"JPSS Common Ground System McMurdo Station & Black Island Overview Briefing"*, slide 10, October 2011.

Responsibilities for the communications system are shared between:

- NSF[6] - On-ice logistics, operation of Black Island, facilities and infrastructure (including on-ice communication services). NSF hosts the two JPSS receptors, NR1 & 2, and the NASA/GN McMurdo Ground Station (MG1) and its planned expansion (MG2). See also Figure 4.
- JPSS - McMurdo TDRS Ground Station owner/operator.

Scientific data from the above listed satellite systems are downloaded to receiving earth stations located on Ross Island and then sent to the Black Island facility, about 21 miles away, via RF link. From there leased capacity on the Australian OPTUS D-1 satellite is used to transfer data to/from the Bellerose, Australia earth station (Perth, Australia is used as back-up). Finally, the AT&T JPSS Wide Area Network distributes the data to the final users.

Figure 5: MMCS configuration



[6] http://antarcticsun.usap.gov/features/contenthandler.cfm?id=2114

A 10 meter antenna is used at the MG1 site to collect data from the EUMETSAT MetOp satellite constellation (X-band) and from a number of NASA satellites (S-band). A second site, MG2, is planned with a 5.4 meter S/Ka-band capable antenna to provide additional capability. When the MG2 antenna is installed in 2014, NASA plans to allocate the full use of MG1 to EUMETSAT and to transfer its other missions to MG2[7].

Data from JPSS and DMSP satellites are downloaded to two sites:

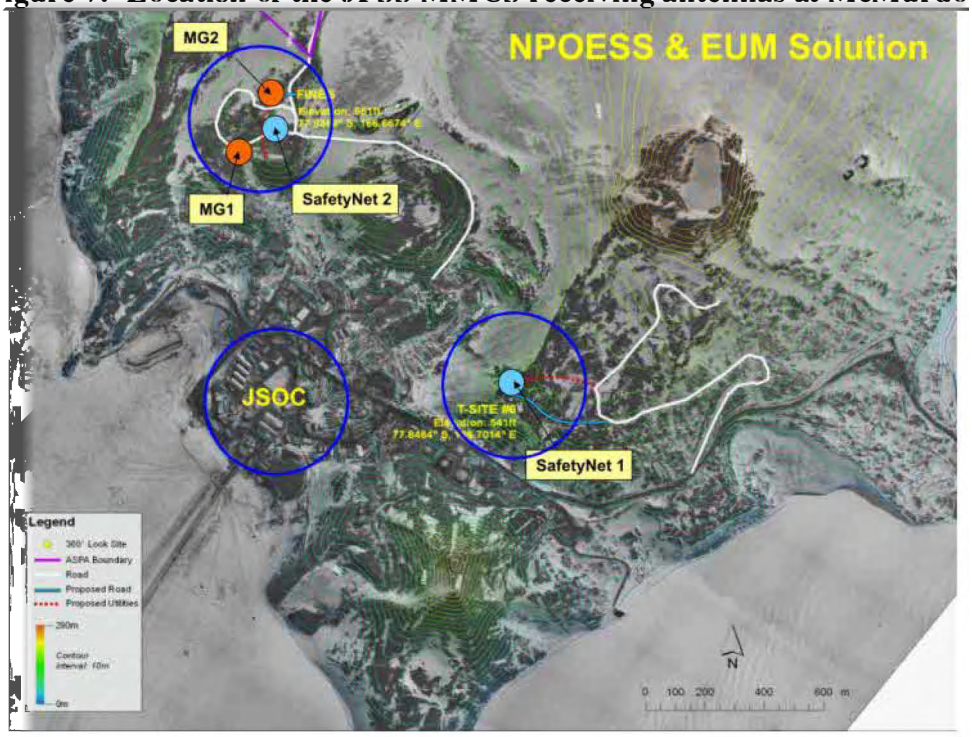
- T-Site, a 4 meter Ka/S-band antenna
- FINES Site, installed during the 2011-2012 McMurdo Season

The location of the receiving earth stations is shown in the picture below.

Figure 6: Receiving sites on Ross Island

[7] K. McCarthy, F. Stocklin, B. Geldzahler, D. Friedman, P. Celeste, "NASA's Evolution to Ka-Band Space Communications for Near-Earth Spacecraft" AIAA SpaceOps Meeting April 25-30 2010, Huntsville, Alabama; The Aerospace Corporation, "National Science Foundation (NSF) United States Antarctica Programs (USAP) Analysis of Alternatives (AoA)", October 2011.

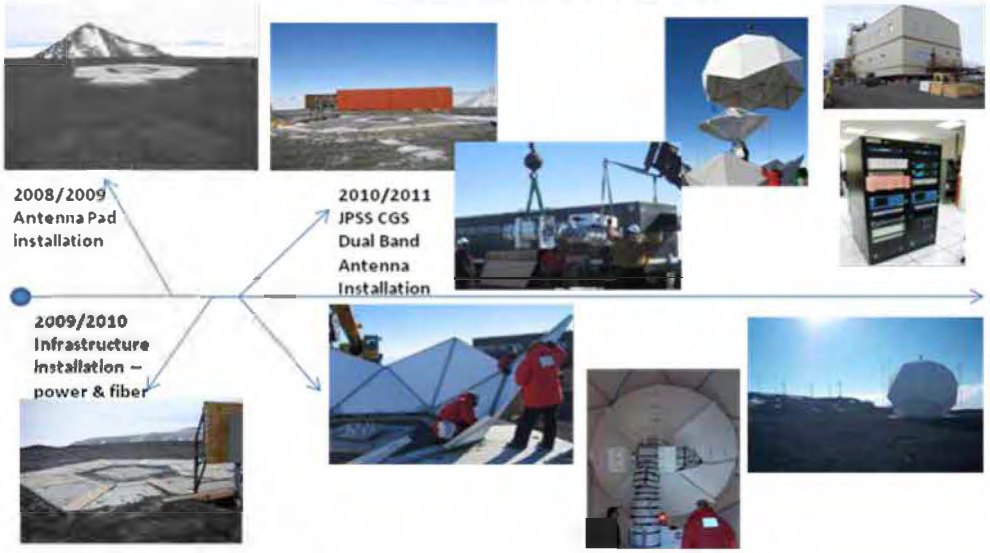
Figure 7: Location of the JPSS MMCS receiving antennas at McMurdo[8]



In 2010-2011 the NASA's 10-meter X-S band MG-1 antenna underwent a complete renovation/upgrade while work at the JPSS Distributed Receptor Network (DRN) T-Site was concluded with the installation of the dual-band antenna.

[8] P. Wilczynski "NPOESS Program Status", May 2008.

Figure 8: Work at T-Site



Upgrades have been performed in recent years also at the Black Island Communication facility. These upgrades involved:

- The 7 meter antenna (2007/2008)
- The 11 meter antenna (2008/2009)
- SATCOM equipment (2009/2010)
- SATCOM equipment (2010/2011)

The latter improvement brought the total throughput capacity to the abovementioned 60 Mbps outbound/ 20 Mbps inbound.

Despite these efforts, according to a report by Raytheon Polar Services[9] constraints in available power (generated by a hybrid energy power plan), and the age of many subsystems make upgrade impossible, daily operations risky and equipment subject to single-point-of-failure events.

(b) (5), (b) (4)

[9] Raytheon Polar Services, "United States Antarctic Program Black Island Modernization Facility Estimate Review", Presentation March 2012.

Figure 9: Black Island Communication Facility

Other improvements are foreseen, and some of them funded, in other areas of the McMurdo Multi-mission Communications System, such as:

- fiber upgrade to Building 71, supporting MG-1, FINES and MG-2 (Future) – planned for FY2012 installation
- power upgrade to Building 71 in support of MG-1, FINES and MG-2
- backup generators at FINES and T sites[10]

New Zealand

Antarctica New Zealand's communications services are supplied by Telecom New Zealand. A satellite earth station with a 9 meter antenna was built at Arrival Heights, about 5 km from the Scott Base to provide a link to the Warkworth satellite earth station, north of Auckland. Over the years, Antarctica NZ gradually increased the bandwidth bought from Telecom NZ from dial-up modems to a dedicated link of 9.6 Kbps, 19.2 and eventually 64/128 Kbps to Intelsat satellites. In 2005 Intelsat 804 suddenly failed in orbit, leaving the base with no reliable link with headquarters. After days spent trying to use another Intelsat satellite with limited success, Telecom NZ concluded a deal to use a PanAmSat satellite. In 2009 Antarctica NZ was using a 64/256K frame relay satellite connection from Telecom NZ[11]. The station is operated and maintained by Kordia. Telecom NZ has the capability to provide telecommunication services from its earth stations in Warkworth, Waitangi and Scott Base via Intelsat, Asiasat, Optus and New Skies satellite networks[12]. The Scott Base station works to IS-5 [PAS-5] and is scheduled to transition to IS-8 at the end of 2012.

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[10] The Aerospace Corporation, "JPSS Common Ground System McMurdo Station & Black Island Overview Briefing", slide 10, October 2011.

[11] Darren Green Wood, "Cool Runnings", The Sidney Morning Herald, 8 April 2005; "Television New Zealand- Kiwi news for Antarctica?", downloaded from http://www.satdirectory.com/--tvnz.html.

[12] Telecom Corporation of New Zealand Limited, "Annual Report For the year ended 30 June 2010", 19 August 2010.(Form 20-F).

Figure 10: Telecom NZ 9m antenna at Arrival Heights

III. Present and Future Traffic Requirements

In an October 2011 NSF USAP Analysis of Alternatives, The Aerospace Corporation stated no feedback from the user workshop was available for McMurdo. JPSS, DMSP, DWSS and EUMETSAT requirements were "not expected to change into 2020". No bandwidth increase had been identified to JPSS albeit additional science missions, the NASA Soil Moisture Active-Passive mission and the potential for future NOAA involvement at McMurdo were mentioned as possible users of the MMCS facility for data downlink. Results are summarized in Table 1 below[13].

[13] The Aerospace Corporation, "National Science Foundation (NSF) United States Antarctica Programs (USAP) Analysis of Alternatives (AoA)", October 2011.

Table 1: Current and Future McMurdo Requirements (Aerospace Report, Oct 2011)

Current and Future Mission Needs for McMurdo Station							
Application	Service Type	Capacity	Connectivity	Traffic Type/Priority	Quantity	Requirement Type	Requirement Source
NOAA-NASA-EUMETSAT-DWSS	Assymetric bi-directional IP wide area network	60 Mbits/s outbound 5 Mbits/s inbound	24 hours/day (continuous)	Mixed	1	Current	RFI; No feedback from workshop was available for McMurdo or Palmer stations
NOAA-NASA-EUMETSAT-DWSS	Assymetric bi-directional IP wide area network	60 Mbits/s outbound 5 Mbits/s inbound	24 hours/day (continuous)	Mixed	1	Objective	RFI; No feedback from workshop was available for McMurdo or Palmer stations
NOAA-NASA-EUMETSAT-DWSS	Assymetric bi-directional IP wide area network	60 Mbits/s outbound 10 Mbits/s inbound	24 hours/day (continuous)	Mixed	1	Future	RFI
Main station IP network trunk	Bi-directional IP wide area network	25 Mbits/s	24 hours/day (continuous)	Mixed	1	Current	RFI
Main station IP network trunk	Bi-directional IP wide area network	25 Mbits/s	24 hours/day (continuous)	Mixed	1	Objective	RFI
Main station IP network trunk	Bi-directional IP wide area network	50 Mbits/s	24 hours/day (continuous)	Mixed	1	Objective	RFI
Main station IP network trunk	Bi-directional IP wide area network	100 Mbits/s	24 hours/day (continuous)	Mixed	1	Future	2xRFI; 4x the population of South Pole Station

Present and future requirements for the involved agencies are summarized in the table below. Present requirements are met by the existing system albeit, as discussed later, RPSC has predicted that failures of aging components may affect normal operations[14]. In the near future, only NASA expressed interest for additional service, namely 100-300 Mbps for data downlink and spacecraft command. In the longer term EUMETSAT has expressed interest in some 100 Mbps service after 2020 when the next generation of MetOp satellites will be operational. JPSS new spacecraft will be deployed in the same timeframe and may lead to additional requirements[15]. The Aerospace study of science user requirements for NSF did not identify NSF requirements above and beyond those in the NSF 2011 RFI, as summarized in Table 1 above.

[14] David Huntsman, Raytheon Polar Services, "Black Island Modernization Facility Estimate Review", March 2012.

[15] The Aerospace Corporation, "Joint Polar Satellite System McMurdo Communications Overview" - February 2012.

Table 2: Present and Future Requirements

Agency / Program	Outbound	Inbound	Forecast 2012-2020	Forecast post 2020	Notes
	Mbps	Mbps	Mbps	Mbps	
NSF	10	18-20	13.5	36[16]	Outbound currently about 50% utilized, inbound 18 Mbps is often full in austral summer season
NASA	1	0.5	Interested in 100-300 by 2014	?	Future missions, such as Soil Moisture Active-Passive (SMAP), may use McMurdo for data downlink. However, NASA according to NSF OPP will use its own TDRS satellites to relay data to the US.
EUMETSAT	5-34	0.2-1	-	100	Data requirement not expected to change before 2020.
JPSS	43	1-2	-	?	Data requirement not expected to change before 2020.
DMSP	1-7	0.2-1	-	?	Data requirement not expected to change before 2020 but future requirements are unknown. DWSS program was cancelled in January 2012.
Total	60 - 95	20 - 25			

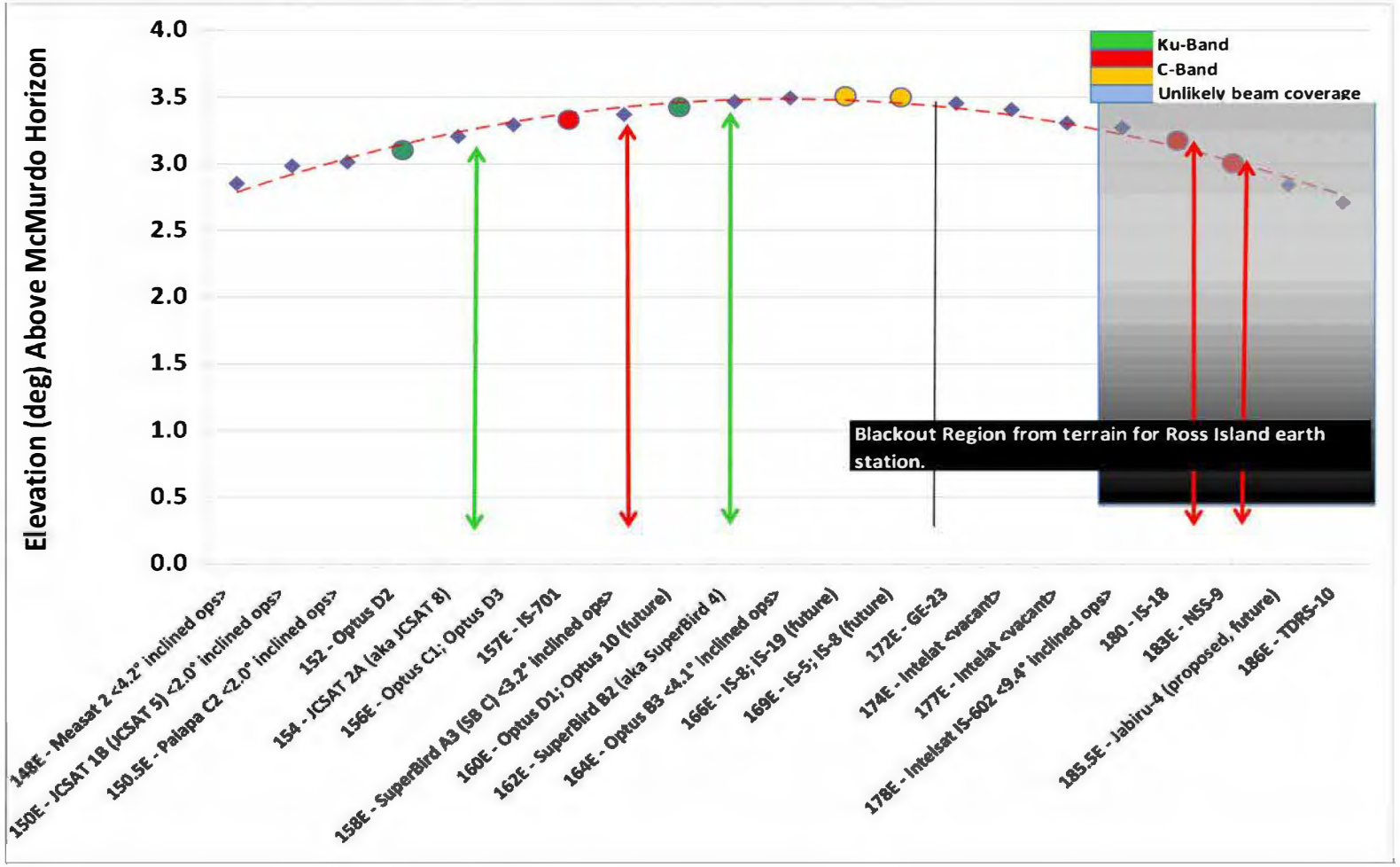
IV. Visibility to the Geostationary Satellite Arc

Figure 11 shows portions of the geostationary arc that may be accessed by Ross Island and by Black Island[17].

[16] Email from [redacted] of NSF OPP to [redacted] of W.L. Pritchard & Co., L.C., 15 March 2012.

[17] (b) (6) [redacted] NSF OPP.

Figure 11: Ross Island Visibility to the Geostationary Arc



As indicated there, Ross Island cannot access Intelsat 18 at 180° E, or NSS 9 at 183° E. The Telecom NZ station at Arrival Heights will be on the edge of coverage of Intelsat 8 at 169° E, (b) (4), (b) (5)

(b) (4), (b) (5)

(b) (4), (b) (5)

(b) (6) said Raytheon Polar Services had tested Black Island and it can see both of the Optus orbital locations.

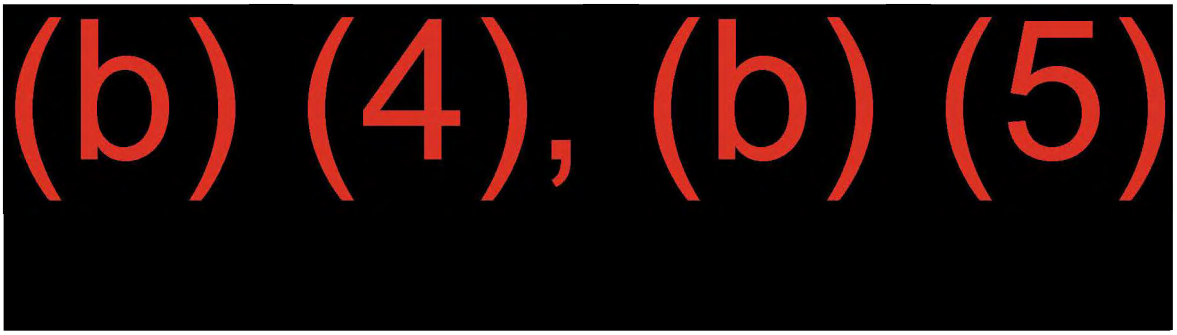
Black Island can see TDRS 5 and TDRS 10 through a saddle in Mount Erebus. TDRS 10 at 174°W is inclined 1.6°. TDRS 5 at 167°W is inclined 12.2 degrees; visibility to Black Island is currently some 13.5 hours per day.

V. Nominal Plan

(b) (4), (b) (5)

[18] Email from (b) (6), Telecom New Zealand to [redacted], NSF OPP, 26 April 2012.

[19] Email report from (b) (6) of W.L. Pritchard & Co to [redacted], NSF OPP, 15 March 2012 "Meeting with (b) (6) Singtel Optus"



VI. Potential Risks and Risk Mitigation Strategies

A. New Zealand Telecom Capabilities to Manage Earth Station

"Telecom owns satellite earth stations at Warkworth, Waitangi in the Chatham Islands and Scott Base in Antarctica, which are operated and maintained by Kordia. These satellite earth stations provide telecommunications services via Intelsat, Asiasat, Optus and SES Worldskies to destinations not generally served by international submarine cable systems. The Warkworth facility was upgraded in 2008 to improve its satellite coverage and the two original 30m antennae were also decommissioned and replaced with more modern systems."[20]

The Telecom New Zealand Warkworth Station is located at Satellite Station Valley some 5 km south of the township of Warkworth, which is about 60 km north of the city of Auckland. The valley is owned by Telecom New Zealand. Several satellite dishes (the largest is 30-m) provide communications between New Zealand and Pacific Islands (Fiji, Cook Islands, Samoa) and Antarctica (Scott Base). The earth stations work with geostationary satellites at C-band. The location is reasonably radio quiet in both S and X bands, and it is protected by local by-law from potential RFI sources[21]. In November 2010 Telecom NZ decommissioned one of its antennas and decided to give the Auckland University of Technology (AUT) the licence to operate the Warkworth 2 30-meter antenna for use as a radio telescope[22].

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[20] Telecom Corporation of New Zealand Limited Annual Report, for the year ended 30 June 2011, page 32.

[21] NASA International VLBI Service for Geodesy and Astrometry - Annual Report 2008.

[22] www.Cellular-News.com, 19th November 2010.

Figure 12: Thompson Road, Warkworth, Auckland, New Zealand

Telecom New Zealand earth stations are operated and maintained by Kordia. Kordia is a New Zealand government-owned broadcast and telecommunications company, operating in Australia and New Zealand. It provides national communications

services for broadcast and telecommunications customers in New Zealand, as well as specialized network solutions. New Zealand customers include: Vodafone, 2degrees, Sky Television, TVNZ, Mediaworks, Radio New Zealand, Telecom New Zealand, Freeview, and The Radio Network. In Australia, Kordia provides contracting and consulting services for major telecommunications players, including Telstra, Optus, Vodafone and Hutchison[23].

"Our team consists of over 1,000 talented people who build, manage and maintain telecommunications, broadcast and infrastructure in New Zealand, Australia, South-East Asia and the Pacific. Our shareholder is the NZ government and we've been around for over 60 years. Kordia has successfully made the transition from Broadcast to Broadband and now delivers telecommunications services to some of New Zealand's most significant businesses. We are often at the leading edge of introducing new communications technologies to our customers. ...Our heritage is in broadcast... We have the proven ability to deliver quality solutions on any scale. Every day we consistently deliver multiple nation (and ocean) over-stating multiple nation-wide networks, to perfection."[24]

(b) (4), (b) (5)

B. Antarctica New Zealand rather than Telecom to arrange for investment in the new earth station

Telecom New Zealand's unit Chorus was selected by the Government as the preferred participant in 24 of 33 regions for the Government's ultra-fast broadband (UFB) program, on condition that it is spun off into a separate company. This was completed in 2011, at the same time as Telecom worked to reduce operational costs, ensure continued competitiveness and prepare for a new telecommunications landscape shaped overwhelmingly by ultra-fast broadband. "FY11 saw operating cost reductions and capital expenditure interventions"[25] "In FY11 the reduction of capital expenditure became a primary focus."[26]

"Customer satisfaction has improved... and the focus on simplicity and efficieny means that costs have declined faster than revenues, enabling Telcom to maintain flat adjusted EBITDA for its ocontinuing operations. This, along with emphasis on good

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23 http://en.wikipedia.org/wiki/Kordia.
24 http://www.kordia.co.nz/about-kordia/about-kordia-overview.html.
25 Telecom Corporation of New Zealand Limited, Annual Report For the year ended 30 June 2011, page 52.
26 Ibid, page 66.

control of capital expenditure, has resulted in a 25% improvement in adjusted Free Cash Flow when compared to the first half of the previous financial year."[27]

(b) (4), (b) (5)

Risk Mitigation

The approach suggested for NSF is as follows:

(b) (4), (b) (5)

[27] Telecom Corporation of New Zealand Limited, H1 FY12 Half Year Report, page 1.

C. Optus will have the primary satellites planned for visibility from Ross Island

Ross Island can only see the Optus satellites and Intelsat 701. However, Intelsat 701 was replaced by IS-18 and is now at 157 ° E. Intelsat 701 was designed with a ten-year life, and was launched in 1993; Intelsat does not plan to keep it in service through the end of this decade. Ross Island cannot see IS-18, or NSS-9 or other SES satellites.

(b) (4), (b) (5)

Risk Mitigation

(b) (4), (b) (5)

(b) (4), (b) (5)

(b) (4), (b) (5)

(b) (4), (b) (5)

F. Network Management Complexity

(b) (4), (b) (5)

[28] http://www.cnbc.com/id/47867468?goback=%2Egde_4246108_member_126518569.

[29] http://www.spaceflightnow.com/sealaunch/is19/120701array/#.T_HLSjErlZg.email.

(b) (4), (b) (5)

G. NSF Procurement

(b) (4), (b) (5)

VII. Schedule and Cost

(b) (4), (b) (5)

Appendix 1

Link Budgets for 9 meter Earth Station Transmitting to Optus 1

Assumptions and Input Data:

Optus beam characteristics were taken from http://www.optus.com.au/dafiles/OCA/AboutOptus/NetworkCoverage/SharedStaticFiles/Documents/WS_D1_D2_Payload_2_0508.pdf

Some key assumptions:

- That the earth station surface accuracy [RMS] will allow conversion to Ku-band operation

	Assumed value
• Required availability	up & downlinks 99.9% @, overall 99.8%
• Belrose antenna size	12 meter
• Belrose antenna noise temperature	1 dB
• LNB noise figure	39
• Coupling loss	zero
• Rain model	ITU (2.5 uplink, 44.9 downlink, mm/hour)
• Modulation parameters	4 PSK, BER 10-7, FEC 3/4
• System margin	1 dB

In the attached two additional versions, one run uses 8 PSK, and the other a system margin of 5 dB.

Digital Link Budget

Produced using Satmaster Pro

Wednesday, July 11, 2012

Service Name	McMurdo_OptusD1_AUS
Coverage	FNB
Uplink earth station	McMurdo, Antarctica
Downlink earth station	Belrose, Australia
Satellite name	Optus D1

Link Input Parameters	Up	Down	Units
Site latitude	77.836S	33.73S	degrees
Site longitude	166.661E	151.22E	degrees
Site altitude	.35	0	km
Frequency	14.0925	12.3445	GHz
Polarization	Vertical	Horizontal	
Rain model	ITU (2.5)	ITU (44.9)	(mm/h or zone)
Availability (average year)	99.9	99.9	%
Antenna aperture	9	12	metres
Antenna efficiency / gain	+54	+62	% (+ prefix dBi)
Coupling loss	0	0	dB
Antenna tracking / misspoint error	0	0	dB
LNB noise figure / temp		1	dB (+ prefix K)
Antenna noise		39	K
Adjacent carrier interference	30	30	dB
Adjacent satellite interference	20	30	dB
Cross polarization interference	27	25	dB
Uplink station HPA output back-off	0.8		dB
Number of carriers / HPA	1		
HPA C/IM (up)	100		dB
Uplink power control	0		dB
Uplink filter truncation loss	0		dB
Required HPA power capability	MIN		W

Satellite Input Parameters	Value	Units
Satellite longitude	160.00E	degrees
Transponder type	TWTA	
Receive G/T	-5.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	17	dB
Satellite ALC	0	dB
EIRP (saturation)	51	dBW
Transponder bandwidth	54	MHz
Input back off total	0.8	dB
Output back off total	0.8	dB
Intermodulation interference	60	dB
Number of transponder carriers	AUTO	

Carrier/Link Input Parameters	Value	Units
Modulation	4-PSK	
Required bit error rate performance	10^-7	
Required Eb/No without FEC coding	11.31	dB
Required Eb/No with FEC coding	4.8	dB
Information rate	25	Mbps
Overhead	0	%
FEC code rate	0.75	
Spreading gain	0	dB
Reed Solomon code	1	
(1 + Roll off factor)	1.	
Carrier spacing factor	1.	
Bandwidth allocation step size	0	MHz
System margin	1	dB

Digital Link Budget

Produced using Satmaster Pro

Wednesday, July 11, 2012

Service Name	McMurdo_OptusD1_AUS
Coverage	FNB
Uplink earth station	McMurdo, Antarctica
Downlink earth station	Belrose, Australia
Satellite name	Optus D1

Link Input Parameters	Up	Down	Units
Site latitude	77.836S	33.73S	degrees
Site longitude	166.661E	151.22E	degrees
Site altitude	.35	0	km
Frequency	14.0925	12.3445	GHz
Polarization	Vertical	Horizontal	
Rain model	ITU (2.5)	ITU (44.9)	(mm/h or zone)
Availability (average year)	99.9	99.9	%
Antenna aperture	9	12	metres
Antenna efficiency / gain	+56	+62	% (+ prefix dBi)
Coupling loss	0	0	dB
Antenna tracking / mispoint error	0	0	dB
LNB noise figure / temp		1	dB (+ prefix K)
Antenna noise		39	K
Adjacent carrier interference	30	30	dB
Adjacent satellite interference	20	30	dB
Cross polarization interference	27	25	dB
Uplink station HPA output back-off	0.8		dB
Number of carriers / HPA	1		
HPA C/IM (up)	100		dB
Uplink power control	0		dB
Uplink filter truncation loss	0		dB
Required HPA power capability	MIN		W

Satellite Input Parameters	Value	Units
Satellite longitude	160.00E	degrees
Transponder type	TWTA	
Receive G/T	-5.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	17	dB
Satellite ALC	0	dB
EIRP (saturation)	51	dBW
Transponder bandwidth	54	MHz
Input back off total	0.8	dB
Output back off total	0.8	dB
Intermodulation interference	60	dB
Number of transponder carriers	AUTO	

Carrier/Link Input Parameters	Value	Units
Modulation	8-PSK	
Required bit error rate performance	10^-7	
Required Eb/No without FEC coding	14.75	dB
Required Eb/No with FEC coding	4.8	dB
Information rate	25	Mbps
Overhead	0	%
FEC code rate	0.75	
Spreading gain	0	dB
Reed Solomon code	1	
(1 + Roll off factor)	1.	
Carrier spacing factor	1.	
Bandwidth allocation step size	0	MHz
System margin	1	dB

Digital Link Budget

Produced using Satmaster Pro

Wednesday, July 11, 2012

Service Name	McMurdo_OptusD1_AUS
Coverage	FNB
Uplink earth station	McMurdo, Antarctica
Downlink earth station	Belrose, Australia
Satellite name	Optus D1

Link Input Parameters	Up	Down	Units
Site latitude	77.836S	33.73S	degrees
Site longitude	166.661E	151.22E	degrees
Site altitude	.35	0	km
Frequency	14.0925	12.3445	GHz
Polarization	Vertical	Horizontal	
Rain model	ITU (2.5)	ITU (44.9)	(mm/h or zone)
Availability (average year)	99.9	99.9	%
Antenna aperture	9	12	metres
Antenna efficiency / gain	+56	+62	% (+ prefix dBi)
Coupling loss	0	0	dB
Antenna tracking / mispoint error	0	0	dB
LNB noise figure / temp		1	dB (+ prefix K)
Antenna noise		39	K
Adjacent carrier interference	30	30	dB
Adjacent satellite interference	20	30	dB
Cross polarization interference	27	25	dB
Uplink station HPA output back-off	0.8		dB
Number of carriers / HPA	1		
HPA C/IM (up)	100		dB
Uplink power control	0		dB
Uplink filter truncation loss	0		dB
Required HPA power capability	MIN		W

Satellite Input Parameters	Value	Units
Satellite longitude	160.00E	degrees
Transponder type	TWTA	
Receive G/T	-5.5	dB/K
Saturation flux density	-100	dBW/m2
Satellite attenuator pad	17	dB
Satellite ALC	0	dB
EIRP (saturation)	51	dBW
Transponder bandwidth	54	MHz
Input back off total	0.8	dB
Output back off total	0.8	dB
Intermodulation interference	60	dB
Number of transponder carriers	AUTO	

Carrier/Link Input Parameters	Value	Units
Modulation	4-PSK	
Required bit error rate performance	10^-7	
Required Eb/No without FEC coding	11.31	dB
Required Eb/No with FEC coding	4.8	dB
Information rate	25	Mbps
Overhead	0	%
FEC code rate	0.75	
Spreading gain	0	dB
Reed Solomon code	1	
(1 + Roll off factor)	1.	
Carrier spacing factor	1.	
Bandwidth allocation step size	0	MHz
System margin	5	dB