TECHNICAL APPENDIX

This Technical Appendix describes the operational characteristics of the MELCO aircraft earth station ("AES") antenna and the eXConnect Ku-band Aeronautical Mobile-Satellite Service ("AMSS") system.

1. INTRODUCTION

Panasonic Avionics Corporation ("Panasonic") seeks to operate fifteen (15) MELCO AES antennas in commercial Ku-band Fixed-Satellite Service ("FSS") frequencies, which are also allocated to AMSS on a secondary basis. Panasonic's eXConnect System will provide Internet and data service to commercial aircraft operating within the United States, including its territories and possessions, and internationally. eXConnect will make available a range of new services to commercial aircraft passengers, operators and crew.

The eXConnect System is based on a set of proven technologies including the iDirect waveform, which is used extensively for fixed and mobile VSAT applications, and the MELCO AES antenna, which previously operated with the Connexion by Boeing Ku-band AMSS system. Building on this well-established technological base ensures the reliability of eXConnect operations and its ability to share Ku-band spectrum with existing users.

2. SYSTEM DESCRIPTION

2.1. Overview

A block diagram of the eXConnect System is shown in Figure 1. The system consists of a network of eXConnect AES terminals (the "AES Segment"), leased satellite capacity on commercial Ku-band FSS satellites (the "Space Segment") and iDirect hub earth stations and network management functionality (the "Ground Segment").

The AES Segment includes the MELCO AES antenna and a broadband controller. The MELCO AES antenna is steered to track the satellite during aircraft maneuvers and was specifically designed for the aeronautical environment. It was previously authorized by the FCC for AMSS operations and operated without any interference incidents until Connexion by Boeing commercial operations were discontinued. The broadband controller contains a DVB-S2 demodulator, an iDirect Deterministic-Time Division Multiple Access ("D-TDMA") waveform modulator, and control and routing capabilities. The AES Segment interfaces with the aircraft cabin distribution and in-flight entertainment systems for user data and with the ARINC 429 data bus for navigation data.

The Space Segment consists of satellite capacity leased on commercial Ku-band satellites from established providers. Uplinks from AES terminals occur in permissible portions of the 14.0-14.4 GHz band and downlinks will occur in permissible portions of the 11.7-12.2 GHz band.

The Ground Segment consists of hub earth stations that are leased at commercial teleport facilities, a DVB-S2 modulator and iDirect demodulator installed in the teleport facility, connectivity to the Internet and network management facilities.

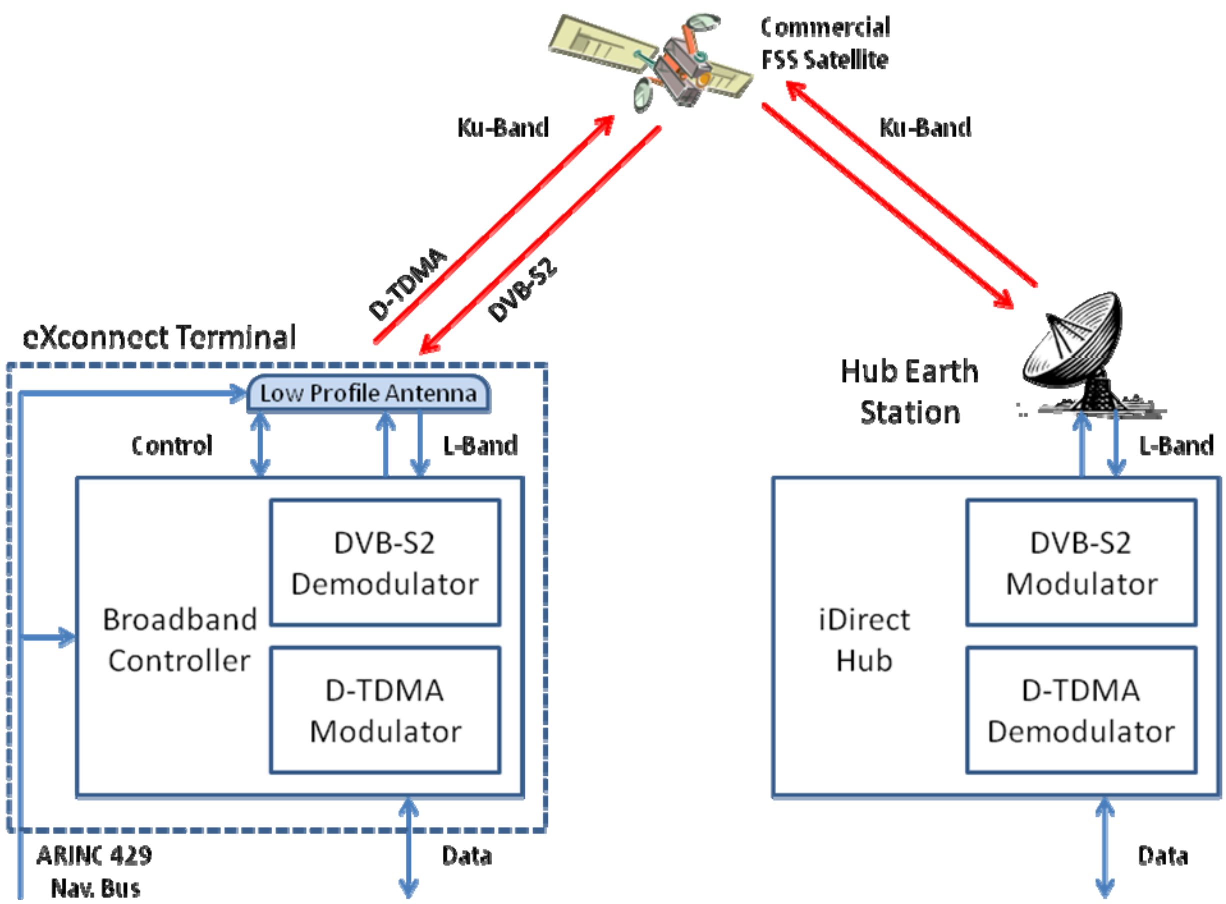

Figure 1. eXConnect System Block Diagram.

2.2. AES Segment

2.2.1. Broadband Controller

The Broadband Controller ("BC") contains the modem and control functionality of the AES terminal. The modem includes a DVB-S2 demodulator and iDirect D-TDMA modulator. The BC control functionality protects other users of the Ku-band and includes the ability to inhibit transmissions as a function of location and skew angle, control transmit power and select the serving satellite as a function of AES location.

The ability to inhibit transmission as a function of skew angle and control transmit power is essential for controlling the off-axis EIRP spectral density projected along the geostationary arc (*see* Section 3.1.1 for more details). Importantly, skew angle control will be enforced regardless of whether the skew angle results from the location of the aircraft with respect to the serving satellite or the attitude of the aircraft.

Finally, the BC will select the serving satellite based on maps that will be preloaded onto the BC. This includes commands to switch satellite beams as the aircraft moves through geographic regions. The same map-based technology allows Panasonic to inhibit AES transmissions based on location if required to protect other services operating in the Ku-band (e.g., space research and radio astronomy) or accommodate other regulatory limitations.

2.2.2. MELCO Antenna Sub-System

The MELCO AES antenna is a mechanically steered cassegrain antenna with an elliptical profile designed for the aeronautical environment.[1] It was developed by Mitsubishi Electric Corporation for the Connexion by Boeing AMSS system. Over one hundred MELCO antennas were installed by Boeing on aircraft that operated globally by a number of foreign airlines. The MELCO AES antenna was proven reliable in commercial service and no interference events were reported during its service. The MELCO AES antenna is shown in Figure 2.

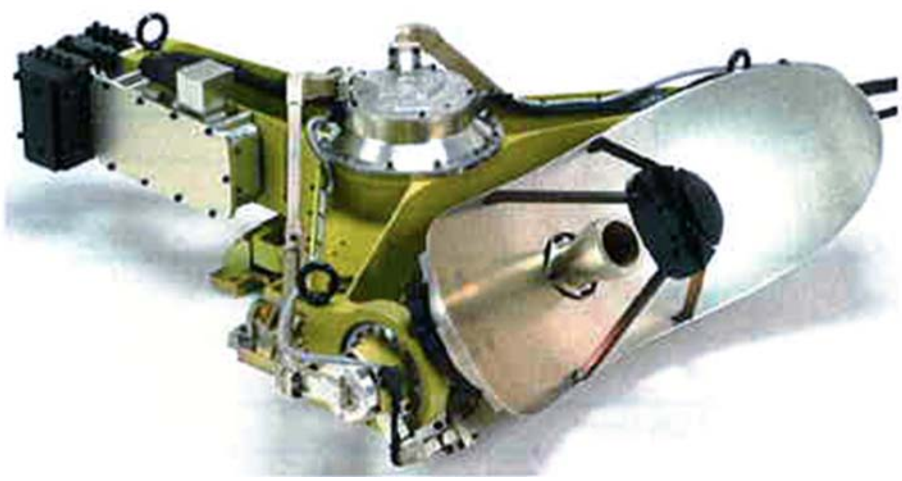

Figure 2. MELCO Antenna.

The basic characteristics of the MELCO antenna are summarized in Table 1 below.

[1] A radiation hazard study for the MELCO antenna is included as Attachment A.

Table 1. Summary of MELCO Antenna Technical Parameters[2]

Antenna diameter	0.68 m x 0.18 m
Type of Antenna	Elliptical cassegrain
Peak Input Power	32 watts
Transmit Gain	32.2 dBi
Max EIRP	47.2 dBW
Transmit Polarization	Horizontal or Vertical
Receive G/T	8.0 dB/K, minimum
Tx Az. Beamwidth	1.6 degrees
Tx Elev. Beamwidth	5.6 degrees

2.2.3. Antenna Pointing

Pointing for the MELCO AES antenna is accomplished via mechanical steering of the antenna and uses the aircraft attitude data (i.e. yaw, roll, pitch and heading vector), together with location of the terminal (latitude, longitude, and altitude) to calculate the command vectors. This data, available from the ARINC 429 bus, is used in conjunction with the satellite coordinates to yield continuously updated steering commands for the antenna elevation, azimuth, and polarization. A local inertial sensor package placed on the antenna base plate itself provides high rate antenna attitude sensing, which compensates for possible aircraft inertial navigation system ("INS") errors caused by airframe deformation and data latency. The pointing error of the MELCO AES antenna will be less than 0.25 deg 1-sigma, which was consistent with interference-free operations under the FCC's prior authorization for this antenna. Pointing error will be monitored and emissions will be inhibited if the pointing error ever exceeds 0.5 deg.

2.3. Satellite Segment

The eXConnect System uses leased transponder capacity on existing commercial Ku-band FSS satellites. eXConnect may use whole or partial transponders and operated with single saturated carriers (forward link only) in a transponder or with multiple carriers. Forward and return links may be operated in the same or different transponders.

A list of the satellite points of contact are shown in Table 2.

[2] The MELCO antenna will operate at less than peak input power and maximum transmit EIRP to comply with the Commission's two-degree spacing policies. *See* FCC Form 312.

Table 2. Summary of Satellite Points of Contact for eXConnect

Operator	Telesat	Intelsat
Satellite	Telesat 14	Galaxy 17
Beam	NAOR	CONUS
Location (W.L)	63 deg	91 deg

The operators of these satellite have substantial experience in Ku-band mobile operations, including AMSS applications. The eXConnect System's operation on these satellites will conform with the coordinated uplink off-axis EIRP spectral density limitations and downlink power spectral density limits for these satellites. Letters of concurrence from adjacent satellite operators are attached to this application that attest that eXConnect operations have been coordinated and agreed to by the adjacent systems.[3]

2.4. Ground Segment

The eXConnect gateway earth station is a 4.5m Ku-band antenna located in Holmdel, New Jersey and operated by Maritime Telecommunications Network ("MTN"). Installed at the gateway facility will be DVB-S2 modulator cards for the forward link and iDirect demodulators cards for the return link. The eXConnect System will be connected to the Internet and other content providers at the gateway.

Network control of this earth station and of the eXConnect system will be provided by a Panasonic Network Operations Center ("NOC") in Lake Forest, California, and a second NOC operated by MTN in Miramar, Florida.

eXConnect ground stations are separately licensed by the teleport operator and are not a part of this application.

2.5. Waveforms

2.5.1. Description

The eXConnect System uses well established industry standard waveforms: DVB-S2 and iDirect D-TDMA.

The iDirect forward link (hub to mobile terminal) will consist of a single DVB-S2 carrier that may occupy up to a full transponder and operate in saturation but in most cases will be operated in a partial transponder. DVB-S2 is a widely adopted standard for digital data and video broadcasting over satellite. Data may be multiplexed on this carrier for multiple terminals. The

[3] *See* Attachment B.

DVB-S2 standard supports Adaptive Coding and Modulation (ACM) with QPSK, 8PSK, and 16APSK modulations and Low Density Parity Check Coding rates between 0.25 and 0.9.

The iDirect return link (mobile terminal to hub) will use iDirect's Deterministic Time Division Multiple Access waveform (D-TDMA). D-TDMA supports multi frequency (MF) TDMA sharing of return link carriers. Frequency and time slot parameters are managed by the iDirect hub. Terminal transmit EIRP is also power controlled so that the minimum power is used to close the satellite link. D-TDMA supports BPSK, QPSK and 8PSK modulations, turbo code rates between 0.431 and 0.793, and spread spectrum factors between 1 and 16.

2.5.2. Satellite Access Techniques

The DVB-S2 forward link will operate with a single carrier in each satellite coverage area. All of the forward link traffic for the aircraft operating in that region will be time division multiplexed on this carrier. Modulation and coding may be varied on a frame by frame basis. Terminals will attempt to demodulate all of the frames they receive and sort out the data that is addressed to them. Information about receive quality will be transmitted back to the hub via the return link so that it may adapt future frame coding and modulation to ensure reception.

The iDrect return link uses a MF-TDMA access scheme. Terminals are assigned time slots on one or more in-route carriers for login bursts and data traffic. Individual in-route carriers have a fixed modulation and coding scheme but modulation and coding may differ between in-route carriers if more than one is used in a coverage area. Terminals will transmit a single carrier in their assigned timeslots and in-routes. As user demand varies with time on the return link the terminal will signal the changed demand to the hub over the return link and the hub will adjust the number of time slots assigned to that terminal.

No contention exists in the iDirect return link. No aggregation of users at the same frequency exists in the iDirect return link. This makes managing off-axis EIRP spectral density within the eXConnect system simple and robust.

2.5.3. Out of Band Emissions

The eXConnect System will comply with the emissions limitations in 47 C.F.R. §25.202(f).

2.6. Network Management

The eXConnect System will be monitored and controlled from two NOCs (Lake Forest, CA and Miramar, FL) on a 24/7 basis. The NOCs will make use of the iDirect's Network Management System (NMS) to provide complete control and visibility to all components the eXConnect network. The iDirect NMS is among the most widely deployed NMS systems for VSATs in the world. iDirect NMS applications allow the operator to configure the network and commission terminals, and monitor the network in real time and for historical trends. The NMS system will have the capability of shutting down any component in the system that is malfunctioning.

2.6.1. Commissioning

Commissioning a new AES terminal to the network begins with the installation of the terminal on the aircraft. During this process the terminal antenna is aligned with the inertial reference unit of the aircraft and the alignment is verified by peaking the antenna beam on the receive signal of a satellite. The transmit chain gain is also calibrated to prevent the antenna from being driven beyond the P1 dB compression pointing. Finally, an options file is loaded on the terminal that defines the permitted satellites and beams.

The terminal information is then defined in the NMS. Only once the terminal is defined and enabled will the NMS begin issuing invitations for the terminal to begin transmitting.

2.6.2. Log-in

iDirect login is invitation-based. Acquisition timeslots are uniquely assigned to the remote, ensuring that only a single remote can transmit in an acquisition timeslot. No contention occurs so off-axis EIRP spectral density is deterministically controlled. Terminals may only begin transmitting if they are in a location where transmission is permitted, have received an invitation, and do not exceed the off-axis EIRP limits established for the beam that they are in.

The optimal initial transmit power that a terminal should use for downstream carrier acquisition varies with geographic location. As the terminal moves across the satellite footprint, or when it switches to a new beam, the EIRP required for the link changes. Transmit power is always minimized by power control and is never allowed to exceed the off-axis EIRP limits for the beam and location.

2.6.3. Automatic Beam Selection

Automatic beam selection ("ABS") is built on iDirect's existing mobile terminal functionality. When a terminal is in a particular beam, it operates as a traditional remote in that beam. The ABS software in the modem can command the antenna to find and lock to any satellites that have been provisioned for that terminal and are available at that location. The NMS can define which beams a mobile terminal is permitted to use. The terminal options file, which conveys configuration parameters to the remote from the NMS, contains the definition of each of the terminal's beams.

As a terminal moves from the footprint of one beam into the footprint of another, the terminal must shift from the old beam to the new beam. ABS enables the terminal to select a new beam, decide when to switch, and perform the switch, without human intervention. ABS logic in the modem reads the current location from the antenna and decides which beam will provide optimal performance for that location. This decision is made by the terminal, rather than by the NMS, because the terminal must be able to select a beam even if it is not communicating with the network.

To determine the best beam for the current location, the terminal relies on a beam map file that is stored in local memory. The beam map file is a data file containing beam quality information for each point on the Earth's surface for each satellite that is visible from that point based on satellite performance data provided by the satellite provider and information on regulatory restriction zones. Beam map files can be updated over-the-air via multicast or via an out-of-band data link on the ground.

2.6.4. Return Link Power Control

Once the remote has logged in, uplink power control adjusts the modem transmit power periodically to achieve nominal C/N. The remote cannot be commanded to a higher power setting than the maximum transmit power permitted for off-axis EIRP management.

The MELCO AES antenna has a power detector that report the Ku-band transmit power from the block up converter ("BUC"). The Ku-band transmit power reported by this power detector is stable over frequency and temperature. Therefore, by referencing the remote transmit power to a Ku-band power detector measurement at the antenna, gain variations over temperature and frequency as well as RF cable losses between the modem and the antenna can be calibrated out and accurate power control can be maintained.

iDirect has configurable fine and coarse adjustments per in-route group. The hub decides which one to use based on how far off the target signal-to-noise ratio ("SNR") of the remote is. The target SNR is configured according to the forward error correction ("FEC") of the in-route group.

2.6.5. Return Link Frequency Control

The antenna BUC is phase locked to a 10 MHz reference from the iDirect modem. The return link frequency stability of the antenna, therefore, is determined by the frequency stability of this 10 MHz reference. In the event that there is a loss of lock to this external reference, the antenna immediately ceases transmission. When the remote is locked to the downstream carrier from the hub, the frequency stability of the 10 MHz reference is ±0.03 parts per million. The hub employs a high stability station reference source to maintain precise frequency control. There is no transmission from the remote if it is not locked to the downstream carrier.

2.6.6. Network Operations Center

The NOC is responsible for the overall monitoring and control of the eXConnect network. The NOC can provision new terminals into the network, monitor their location, transmit power and link performance, respond to faults, inhibit terminal transmissions, and remove terminals from the network. eXConnect will have a 24/7 NOC capability. Parallel NOC capabilities are maintained by MTN from its NOC in Miramar, Florida; and through the Panasonic NOC in Lake Forest, CA. The NOCs can be reached at:

Primary: Philippe Lagarde; (Office) 1-425-415-9164; (Mobile) 1-425-319-3537
Secondary: Gilbert Dizon; (Office) 1-949-462-1940; (Mobile) 1-949-614-3163
Phone: 425-415-9800 or 877-627-2300 (US Domestic Toll-free)
Fax: (425) 482-3515.
NOC email address: MCC@panasonic.aero
Address:
Panasonic Avionics Corporation
Attn: Network Operating Center
26200 Enterprise Way
Lake Forest, CA 92630 USA

as well as:

Primary: Edgar Estevan; (Office) +1 954 538-4110; (Mobile) +1 305 776-7795
Secondary: Greg Hill; (Office) +1 954 538-4195; (Mobile) +1 954 376-1531
NOC Direct Telephone: +1 954 538-4074
NOC email address: NOC@mtnsat.com
Address:
MTN Satellite Communications
Attn: Network Operating Center
3044 N. Commerce Parkway
Miramar, FL 33025

2.6.7. Fault Management

The antenna ceases transmission in the event of the following fault conditions:

- Loss of ARINC-429 data from the IRS
- Invalid status message from the IRS
- Loss of 10 MHz reference
- Antenna out of position. If pointing error exceeds 0.5 degrees, the antenna ceases transmission within 100 ms and will not resume transmission until the pointing error is within 0.2 degrees.
- Any critical fault detected by the antenna

Furthermore, any event that results in the loss of modem lock to the DVB-S2 downlink will cause the modem to cease all transmission.

3. PROTECTION OF OTHER SERVICES

3.1. Protection of Users of the 14.0-14.4 GHz Band

The eXConnect System will protect GSO and NGSO FSS satellite uplinks, Space Research downlinks, and Radio Astronomy service operations in the 14.0-14.4 GHz Band.

3.1.1. GSO FSS Systems

eXConnect protects GSO FSS satellites uplinks by controlling its off-axis EIRP spectral density to the interference levels that have been agreed to in coordination.

3.1.1.1. Off-Axis EIRP Spectral Density Control

The eXConnect System controls the off-axis EIRP spectral density generated by a single terminal so that it is no greater than the levels of interference that have been accepted by the adjacent satellites in coordination or the levels for Ku-band terminals under FCC Part 25.

The U.S. off-axis limits on EIRP spectral density limits under FCC Part 25 are defined by 25.218(f)(1), where N = 1 for TDMA, is given by:

15–25log10 (Θ)	dBW/4 kHz	For	1.5° ≤ Θ ≤ 7°
−6	dBW/4 kHz	For	7° < Θ ≤ 9.2°
18–25log10(Θ)	dBW/4 kHz	For	9.2° < Θ ≤ 48°
−24	dBW/4 kHz	For	48° < Θ ≤ 85°
−14	dBW/4 kHz	For	85° < Θ ≤ 180°

Off-axis EIRP spectral density is managed on an individual terminal basis. Only one terminal transmits at a given time and in a given bandwidth. eXConnect does not use contention so management of aggregate emissions is not required. The off-axis EIRP spectral density of an individual eXConnect terminal is a function of its transmit signal bandwidth, input power to the antenna, the projection of the antenna gain pattern of the antenna along the geostationary arc, and antenna pointing error.

The iDirect waveform supports spread factors up to 16. This allows the signal bandwidth to be selected independently of the data rate to meet off-axis EIRP spectral density limits and performance goals for a given satellite beam. The selected signal bandwidth may vary from beam to beam.

Input power to the antenna is controlled by limiting the output power of the modem. A built in power meter in the antenna is used to calibrate the input power to the antenna accurately and remove any gain variation between the modem and the antenna. The input power limitations are specified on a satellite beam-by-satellite beam basis

The projection of the gain pattern along the GSO varies with platform location and attitude. For the MELCO AES antenna, this variation is entirely a function of skew angle, which is the rotation angle along the antenna to the satellite vector. The terminal is aware of the skew angle and elevation angle based on reported position and aircraft attitude information provided over the ARINC 429 interface. The effect of the projection of the antenna gain pattern along the geostationary arc is accounted for by limiting the input power to the antenna as a function of skew and elevation angle and by inhibiting transmissions when specified thresholds are crossed.

The contribution of pointing error to off-axis EIRP spectral density is minimized by inhibiting pointing errors greater than 0.5 deg and not resuming transmission until the pointing error is less than 0.2 deg.

In summary, the eXConnect System limits off-axis EIRP spectral density along the geostationary arc by:

- Selecting appropriate signal bandwidths and spread factors.
- Limiting the input power to the antenna as a function of skew angle and elevation angle.
- Inhibiting transmissions when the skew angle and/or elevation angle exceed specified thresholds.
- Controlling pointing error to less than 0.25 degrees for the MELCO AES antenna.
- Inhibiting transmissions when the pointing error exceeds a threshold of 0.5 degrees.

The signal bandwidth, input power function, and skew and elevation angle thresholds will be selected based on the specific coordinated limits for a satellite, the desired terminal transmission rates, coverage area, and satellite performance. These parameters are configured in the NMS system when each new satellite beam is brought into service.

An example of off-axis EIRP control is shown in Figure 3 for the MELCO AES antenna. The off-axis EIRP spectral density ("ESD") values are based on the specific link parameters shown in the link budget in Appendix A. These represent an edge of beam cases where the terminal is operating with a 1.66 MHz carrier bandwidth and a skew angle threshold of 34 degrees. The terminal off-axis ESD, shown in the solid red line, remains well below the 25.218(f)(1) off-axis ESD limit, shown in the solid blue line. Even with the pointing error of the terminal is included in the off-axis ESD it remains below the off-axis ESD limit for a conforming and perfectly pointed terminal.

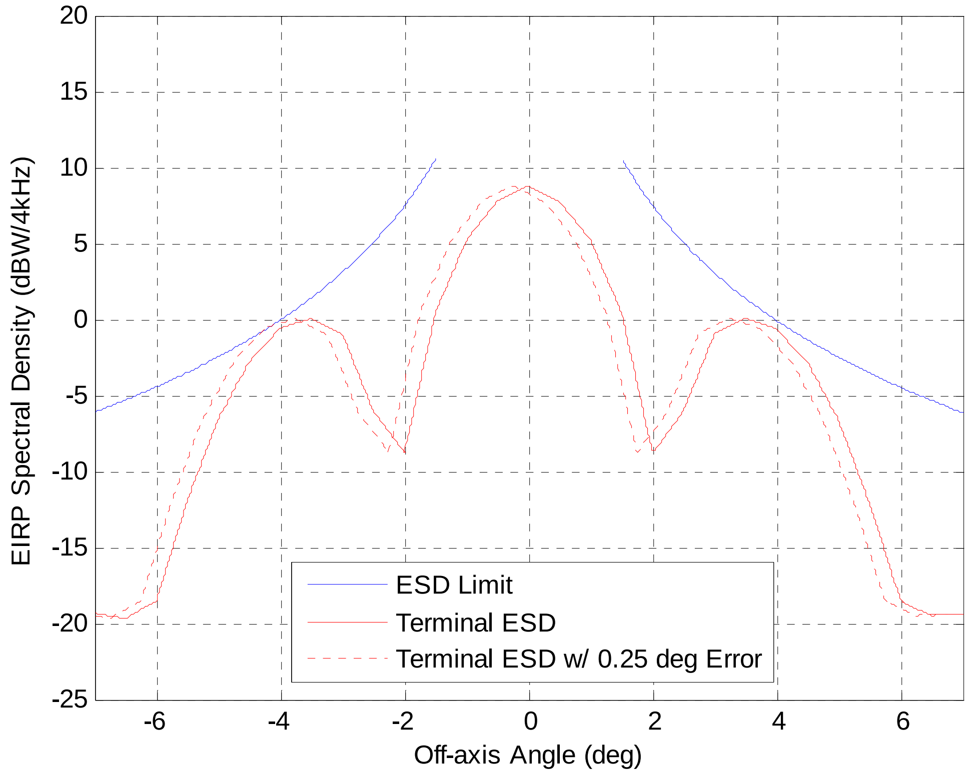

Figure 3. Maximum Off-axis EIRP Spectral Density of the MELCO Antenna

3.1.1.2. Adjacent Satellite Coordination

Panasonic and its satellite providers have coordinated AES antenna operations with Ku-band FSS satellites within ±6 degrees of the satellites used with the eXConnect System. The coordinated characteristics include off-axis EIRP spectral density of the eXConnect System, its downlink power spectral density, and the pointing error of eXConnect terminals. Coordination affidavits are attached to this application and they attest that eXConnect operations have been coordinated with adjacent systems so that interference will not occur.[4]

3.1.2. NGSO FSS Systems

At the present time, the eXConnect System will not control the off-axis ESD of the terminal away from the geostationary arc. Section 25.218(f)(1)'s off-axis ESD mask was intended to protect Ku-band NGSO FSS systems by controlling emissions away from the geostationary arc. However, no systems of this type are presently operating. Panasonic will enter into coordination with any authorized Ku-band NGSO FSS systems or modify its operations to be in conformance prior to the entry of a Ku-band NGSO system into service.

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[4] *See* Attachment B.

3.1.3. Space Research

The eXConnect System inhibits transmission by location (based on maps that are preloaded onto the Broadband Controller) to protect Space Research. Panasonic has initiated but not yet completed discussions regarding a coordination agreement with NASA to protect space research activities in the Ku-band. NASA operates downlinks for the Tracking and Data Relay Satellite System (TDRSS) in the space research service that are reverse banded to the commercial Ku-Band FSS uplink bands. As a result, they are potential vulnerable to FSS uplink transmission.

To protect these sites, the eXConnect system will cease transmissions within line of site of all TDRSS facilities until coordination with NASA is completed. When Panasonic has entered a coordination agreement with NASA, it will submit the agreement to the Commission and comply with all terms and conditions set forth therein.

3.1.4. Radio Astronomy

Panasonic has completed a coordination agreement with the National Science Foundation (“NSF”) to protect the radio astronomy operations in the 14.47 to 14.50 GHz band. Radio astronomy sites use the 14.47 to 14.50 GHz band to observe the formaldehyde emission line. To protect these operations, Panasonic has agreed to limit the amount of interference that may be caused to these sites by limiting eXConnect transmit power and, when necessary, ceasing transmissions such that the coordinated interference levels are met.[5] However, the MELCO AES antenna contains a notch filter at 14.4 GHz, above which it does not transmit.

3.2. Protection of Users of the 11.7-12.2 GHz Band

Panasonic will protect other uses in the 11.7-12.2 GHz band by complying with the coordinated downlink power spectral density requirements for the satellites it uses through the selection of appropriate carrier bandwidths and transponder back-off. In addition, Panasonic will not claim protection from interference from conforming users of the conventional and extended Ku-band downlink spectrum.

4. CONCLUSION

The eXConnect System will provide Ku-band AMSS service using a combination of a proven waveform, antenna and world-class network implementation partners. It uses a straightforward network architecture without the complications of contention access and aggregation of co-frequency users. The system directly controls its interference potential through the selection of appropriate spreading bandwidths and transmit powers, and eXConnect operating parameters have been coordinated with the potentially affected satellite operators to ensure that no harmful interference will occur. Consistent with past precedent, the Commission should grant this application based on the technical demonstration set forth herein.

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[5] A copy of the coordination agreement is enclosed with this application as Attachment C.

APPENDIX A. LINK BUDGET

Edge of coverage link budgets for the eXConnect forward and return links are shown below. The eXConnect network in this example is operating with a DVB-S2 forward link that supports 3.6 Mbps to a MELCO terminal (QPSK rate 1/3) and a return link at 121 kbps (BPSK rate 0.431 spread factor 4). As shown by the table, the terminal is able to close its links.

Forward Link Budget

eXconnect Terminal		
Antenna	MELCO	
G/T	9.3	dB/K
Hub Earth Station		
EIRP max	80	dBW
Signal		
Waveform	DVB-S2 ACM	
Modulation	QPSK	
Coding	0.3333	
Spread Factor	1	
Minimum Data Rate	3.6E+06	bps
Spectral Efficiency	0.61	bps/Hz
Noise Bandwidth	5.8E+06	Hz
Eb/No Threshold	1.3	dB
Uplink		
Frequency	14.250	dBW
Back off	22.9	dB
EIRP Spectral Density	25.5	dBW/4kHz
Slant Range	37761	km
Space Loss, Ls	207.1	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	2.2	dB
ASI Degradation	0.5	dB
Transponder G/T @ Hub	5.1	dB/K
C/No	81.0	dBHz
Satellite		
Flux Density	-107.7	dBW/m2
SFD @ Hub	-96.1	dBW/m2
Small Signal Gain (IBO/OBO)	2.3	dB
OBO	9.3	dB
Downlink		
Frequency	11.950	GHz
Transponder Sat. EIRP @ Beam Peak	51.4	dBW
Transponder Sat. EIRP @ Terminal	49.4	dBW
DL PSD Limit	13.0	dBW/4kHz
DL PSD @ Beam Peak	10.5	dBW/4kHz
Carrier EIRP @ Beam Peak	42.1	dBW
Carrier EIRP @ Terminal	40.1	dBW
Slant Range	37596	km
Space Loss, Ls	205.5	dB
Pointing Loss, Lpnt	0.3	dB
Atmosphere / Weather Loss, La	0.0	dB
ASI Degradation	4.2	dB
C/No	68.1	dBHz
End to End		

Return Link Budget

eXconnect Terminal		
Antenna	MELCO	
EIRP	47.2	dBW
Hub Earth Station		
G/T	31.5	dB/K
Signal		
Waveform	iDirect	
Modulation	BPSK	
Coding	0.431	
Spread Factor	4	
Minimum Data Rate	1.21E+05	bps
Spectral Efficiency	0.072888565	bps/Hz
Noise Bandwidth	1.67E+06	Hz
Eb/No Threshold	6.4	dB
Uplink		
Frequency	14.250	dBW
Back off	12.4	dB
EIRP Spectral Density	8.6	dBW/4kHz
Slant Range	37596	km
Space Loss, Ls	207.0	dB
Pointing Loss, Lpnt	0.4	dB
Atmosphere / Weather Loss, La	0.0	dB
ASI Degradation	0.5	dB
Transponder G/T @ Terminal	3.1	dB/K
C/No	58.5	dBHz
Satellite		
Flux Density	-128.1	dBW/m2
SFD @ Beam Edge	-94.1	dBW/m2
Small Signal Gain (IBO/OBO)	2.3	dB
OBO	31.7	dB
Downlink		
Frequency	11.950	GHz
Transponder Sat. EIRP @ Beam Peak	51.4	dBW
Transponder Sat. EIRP @ Hub	50.4	dBW
DL PSD Limit	13.0	dBW/4kHz
DL PSD @ Beam Peak	-6.6	dBW/4kHz
Carrier EIRP @ Beam Peak	19.7	dBW
Carrier EIRP @ Hub	18.7	dBW
Slant Range	37761	km
Space Loss, Ls	205.5	dB
Pointing Loss, Lpnt	0.0	dB
Atmosphere / Weather Loss, La	2.8	dB
ASI Degradation	0.5	dB
C/No	69.9	dBHz
End to End		

APPENDIX B. Antenna Gain Patterns

Antenna gain patters are presented in this section for the azimuth and elevation patterns of the MELCO AES antenna.   All patterns are plotted against the FCC 25.209(2) and (4) gain masks.

B.1. Transmit Gain Patterns – MELCO

B.1.1 Transmit Azimuth Antenna Gain Patterns

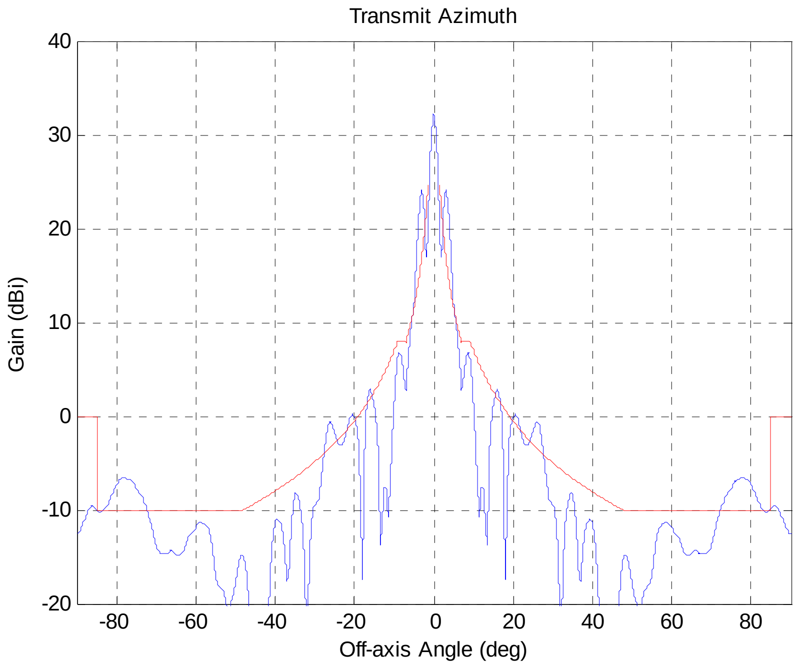

Figure B.1 MELCO Transmit Azimuth Gain Pattern

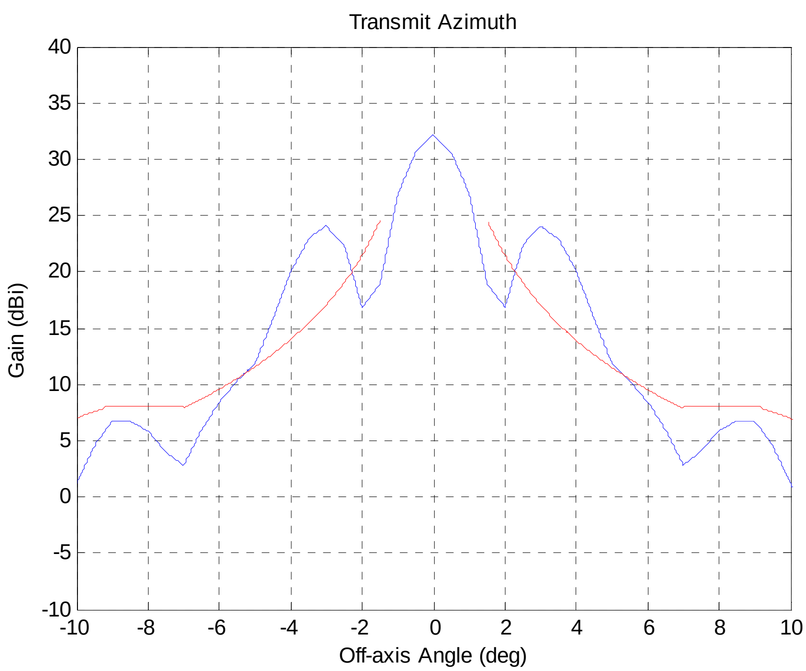

Figure B.2 MELCO Transmit Azimuth Gain Pattern - Detail

B.1.1 Transmit Elevation Antenna Gain Patterns

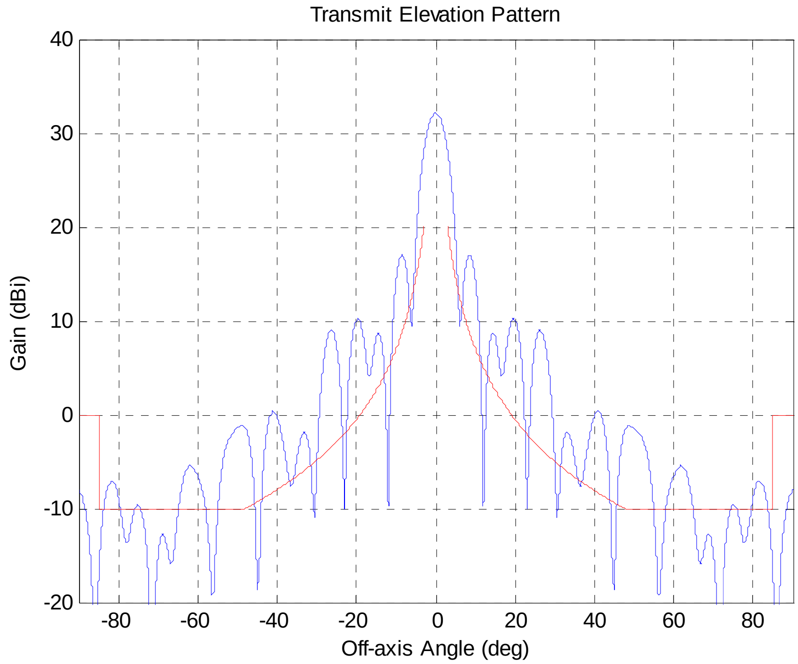

Figure B.3 MELCO Transmit Elevation Gain Pattern

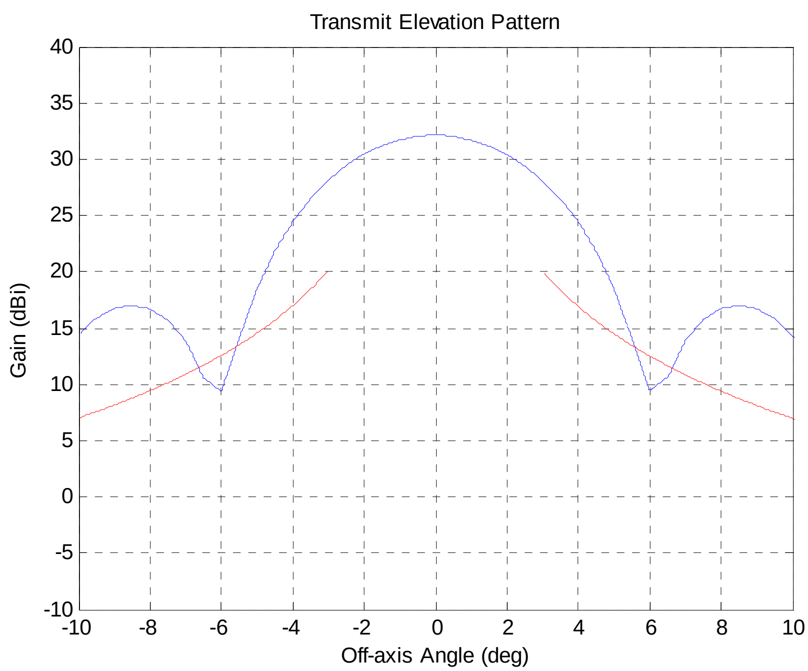

Figure B.4 MELCO Transmit Elevation Gain Pattern - Detail

B.2. Receive Gain Patterns – MELCO

B.3.1 Receive Azimuth Antenna Gain Patterns

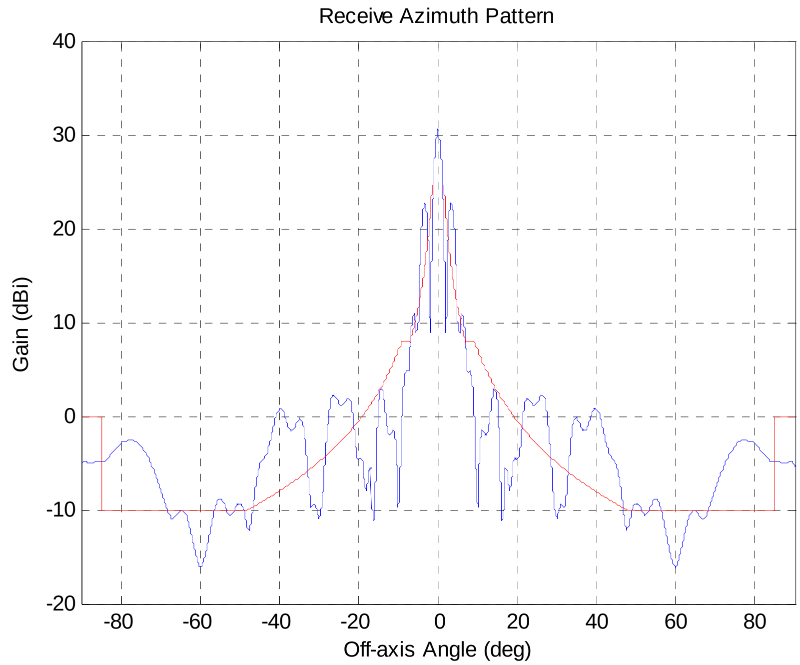

Figure B.13 MELCO Receive Azimuth Gain Pattern

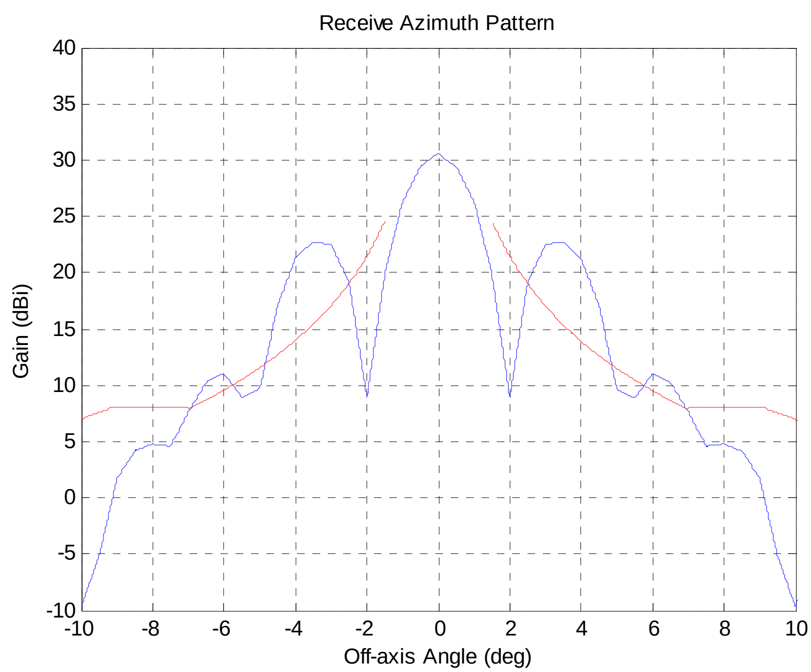

Figure B.14 MELCO Receive Azimuth Gain Pattern - Detail

B.3.2 Receive Elevation Antenna Gain Patterns

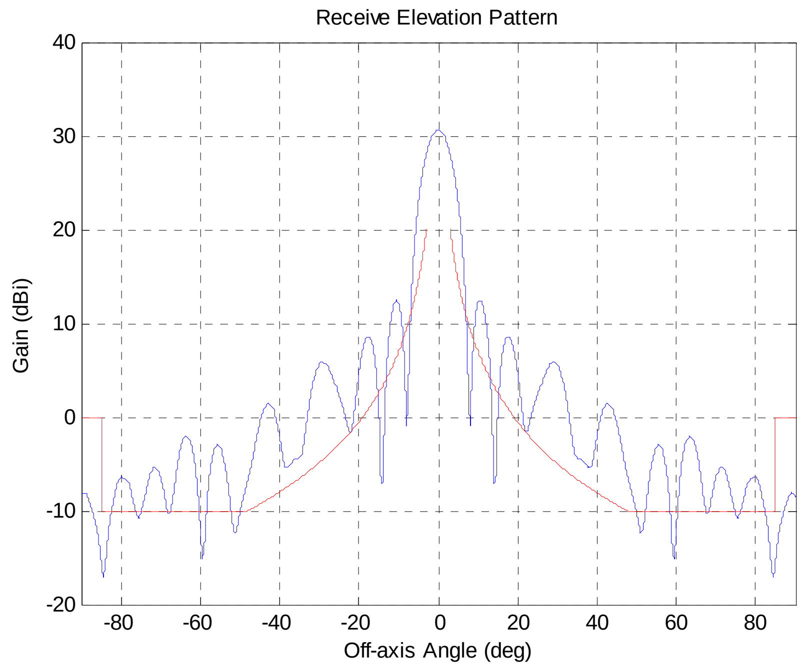

Figure B.15 MELCO Receive Elevation Gain Pattern

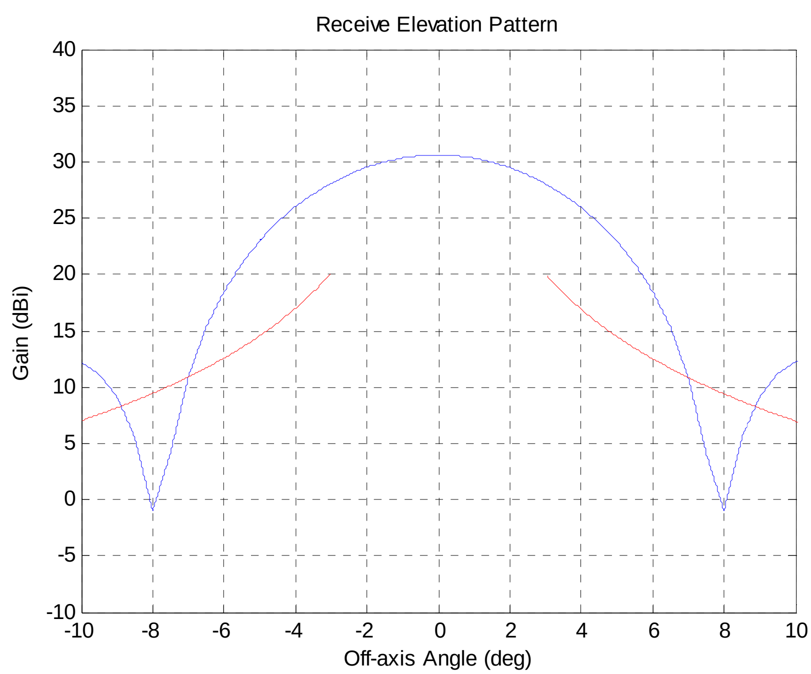

Figure B.16 MELCO Receive Elevation Gain Pattern - Detail

ATTACHMENT A

Radiation Hazard Analysis for the MELCO Reflector

This report analyzes the non-ionizing radiation levels for the MELCO reflector antenna. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependant on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure -- the General Population/ Uncontrolled Environment and the Controlled Environment, where the general population does not have access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 5 milliwatts per square centimeter (5 mW/cm^2) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 1 milliwatt per square centimeter (1 mW/cm^2) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. This area will not be accessible to the general public. Operators and technicians will receive training specifying this area as a high exposure area. Procedures will be established to ensure that all transmitters are turned off before this area may be accessed by operators, maintenance or other authorized personnel.

Near Field Exposure

The MELCO reflector antenna potentially exceeds MPE limits in the near field within the rectangular volume directly in front of the reflector (18.0 mW/cm^2). The output power of the antenna is computed as the maximum EIRP minus the transmit gain, 46.7 dBW – 33.1 dBi = 13.6 dBW or 23 watts. For this calculation, it was assumed that all 23 watts output power of the antenna is uniformly distributed across the surface area of the reflector.

The extent of the near field region is defined by the following

$$R_{nf} = D^2/(4\lambda)$$

5.8 meters

Where D is the width of the panel (0.65 meters)

The maximum power density in the Near Field can be determined by the following equation:

$$S_{nf} = P_{SSPA} / A$$
18 mW/ cm^2

Where A is the surface area of the panel and P is the power available from the SSPA. The surface area of the antenna is approximated as the width of the antenna times its height, which is a reasonable approximation given its shape.

In normal operation, this antenna is mounted on a rooftop with the main beam pointed toward the sky at a minimum elevation angle of 10 degrees when operated on the ground such that human exposure in the near field is not possible. Furthermore, normal TDMA operation uses a duty cycle of 10% or less, reducing maximum near field exposure by an order of magnitude to 1.8 mW/cm^2. Additionally, in normal operation, any blockage in the near field (human or otherwise) will cause the transmitter to be disabled within seconds as the system does not transmit unless it can receive the downlink carrier from the satellite. Therefore, prolonged exposure in the near field is not possible in normal operation.

Far Field Exposure (in main beam)

$$R_{ff} = 0.60 D^2 / \lambda$$
13 m

$$S_{ff} = P_{EIRP} / (4\pi R_{ff}^2)$$
2.2 mW/ cm^2

At a distance of 13 meters, the power density of the MELCO reflector is 2.2 mW/cm^2, which exceeds the General Population/Uncontrolled Exposure (MPE) but is less than the controlled environment limit. The power density falls to the General Population / Uncontrolled Exposure (MPE) limit of 1 mW/cm^2 at 19.5 meters.

As noted previously, the antenna will be mounted on a building or vehicle rooftop with the main beam pointed to the sky at a minimum elevation angle of 10 degrees. In this case, maximum far field exposure to humans would be due to a sidelobe which is at least 16 dB below the main beam. At a distance of 13 meters, the exposure to humans would be less than 0.055 mW/cm^2.

Transition Region Exposure (in main beam)

At a distance of 11.7 m from the antenna, maximum exposure in the main beam is 5 mW/cm^2. This assumes that PFD decreases linearly from 18 mW/cm^2 to 2.2 mW/cm^2 in this region between the near field and far field (5.8 m to 13 m from the antenna).

Exposure to personnel located below antenna height

The antenna will be mounted at a height above personnel. In this case, the worst case exposure is due to the first elevation sidelobe at a level of -16 dB. For the MELCO reflector antenna, the far field distance in the elevation plane is approximately 1.1 meters.

The 5 mW/cm^2 threshold is reached at a distance of 1.4 meters and the 1 mW/cm^2 threshold is reached at a distance of 3.0 m. Observing the safe radius distance noted above during transmit operations will ensure that the threshold will not be exceeded.

Table 1: Parameters Used for Determining PFD (MELCO reflector)

Antenna Width	25.6	in	0.65	m
Antenna Height	7.7	in	0.196	m
Antenna Surface Area			0.14258	m^2
Frequency			14250	MHz
Wavelength			0.021	m
Transmit Power			23	W
Antenna Gain			33.1	dBi
Antenna Gain			2042	
EIRP			46.7	dBW
Far Field Boundary (Azimuth)			13.0	m
Power Density at far field boundary (Azimuth)			2.2	mW/cm^2
Safe Far Field Distance (Azimuth)			19.5	m
Power Density			1.0	mW/cm^2
Near Field Distance (Azimuth)			5.0	m
Near Field Power Density (Azimuth)			16.1	mW/cm^2
Elevation sidelobe level			-16.0	dB
Far Field Boundary (Elevation)			1.1	m
Power Density at far field boundary (Elevation)			7.8	mW/cm^2
Safe Far Field Distance (Elevation)			1.4	m
Power Density			4.8	mW/cm^2
Safe Far Field Distance (Elevation)			3.0	m
Power Density			1.0	mW/cm^2

Conclusions

The radiation hazard can be divided into two cases: above the mounting plane of the antenna and below it. Different measures will be taken in each region to ensure that the exposure limits will not be exceeded.

The worse-case radiation hazards exist exists above the mounting plane of the antenna along the main beam axis. The antenna will be mounted on a building or vehicle rooftop so access to this region can be controlled and restricted to trained personnel so this case applies to personnel commissioning and testing the antenna. Transmit operations will only be conducted with a clear field of view towards the serving satellite so that the beam does not impose on any uncontrolled areas. By maintaining a safety radius of 19.5 meters in the boresight direction during transmit operations in this region, it can be guaranteed that the General Population/Uncontrolled Exposure limits will not be exceeded under any test conditions.

Below the mounting plane of the antenna radiation exposure can only occur through sidelobes, which are substantially attenuated. In this case, the safety radius where the General Population/Uncontrolled Exposure limits are satisfied is 3.0 meters in the worst case direction. The antenna will be mounted in such a way that the general population cannot approach to within the safety radius when below the plane of the antenna so that the General Population/Uncontrolled Exposure limits will not be exceeded under any test conditions.

ATTACHMENT B

Telesat

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Director, Government and Regulatory Affairs

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E-mail: rcondurso@telesat.com

February 8, 2010

Federal Communications Commission
International Bureau
445 12th Street, S.W.
Washington, D.C. 20554

To Whom It May Concern:

This letter certifies that Telesat Canada ("Telesat") is aware that Panasonic Avionics Corporation ("PAC") is seeking FCC authorization to access the Telstar 14 satellite at 63° WL,[1] as an authorized point of communication, for its eXConnect Ku-band aeronautical mobile-satellite service ("AMSS") system using transmit/receive antennas that are not strictly compliant with the FCC's antenna gain requirements.[2] However, as described below, Telesat believes that the terminals comply with the FCC's two-degree spacing rules by maintaining off-axis EIRP spectral density levels below those set forth in analogous Ku-band earth stations onboard vessels ("ESV") and vehicle-mounted earth stations ("VMES") rules.[3]

Telesat understands that PAC plans to operate two AMSS antenna types: (i) the MELCO antennas previously operated with the Connexion by Boeing system; and (ii) the Aura LE antenna designed specifically for the eXConnect system and manufactured by EMS Technologies. We understand that the MELCO antenna is a mechanically-steered Cassegrain antenna with an elliptical profile that was previously examined by the FCC and authorized for AMSS operations in experimental Call Sign WC2XVE (File No. 0002-EX-PL-2004) and commercial blanket license Call Sign E000723 (File No. SES-MOD-20030512-00639). We understand that the Aura LE antenna is a mechanically steered, flat-plate AES with two transmit/receive apertures that is similarly designed

[1] Telesat, through its subsidiary Telesat Brasil Capacidade de Satelites Ltda., operates the Telstar 14 satellite pursuant to a license issued by Brazil. Telstar 14 has been granted FCC authority to serve the United States.

[2] *See* 47 CFR §25.209.

[3] *See* 47 CFR §25.222.

to meet the technical requirements imposed on U.S. and international AMSS operations.[4] The basic characteristics of the MELCO and Aura LE antennas, as specified by the manufacturers, are also summarized in Table 1.

Table 1. Aura LE and MELCO Antenna Characteristics

Characteristic	EMS Aura LE	MELCO Reflector
Frequency	Tx: 14.0 GHz to 14.5 GHz Rx: 10.7 GHz to 12.75 GHz (11.7-12.2 GHz in the U.S.)	Tx: 14.0 GHz to 14.4 GHz Rx: 11.2 GHz to 12.8 GHz (11.7-12.2 GHz in the U.S.)
Aperture Size	2 Apertures of 35" X 6" each	25.6" X 7.7"
EIRP	42.5 dBW @ 5 deg Elevation 48.0 dBW @ 90 deg Elevation	47.2 dBW
G/T	11 dB/K @ 5 deg Elevation 14 dB/K @ 90 deg Elevation	8.0 dB/K @ 11.2 to 11.7GHz 9.3 dB/K @ 11.9 to 12.8GHz
Tracking Rate	40 deg/sec in Azimuth 25 deg/sec in Elevation	40 deg/sec in Azimuth 25 deg/sec in Elevation
Az Pointing Accuracy	0.2 deg 1-sigma	0.25 deg 1-sigma

Based on our review of the technical specifications and conversations with PAC, we understand that both the MELCO and Aura LE antennas are designed to maintain pointing towards the intended satellite through the full range of maneuvers carried out by commercial aircraft. The antennas are pointed based on aircraft position and attitude information obtained from the ARINC 429 data bus, which is standard on commercial aircraft. This information is augmented with higher rated data from an inertial sensor package that is integrated with the antenna and compensates for Inertial Navigation System ("INS") errors that result from latency and bending of the airframe between the aircraft INS unit and the antenna. The pointing accuracy of the MELCO reflector is 0.25 deg 1-sigma and the pointing accuracy of the EMS Aura LE antenna will be less than 0.2 deg 1-sigma. Pointing error will be continuously monitored and if it ever exceeds 0.5 degrees, then transmissions will be automatically inhibited within 100 ms.[5]

The FCC's off axis EIRP spectral density limits for analogous ESV and VMES operations are defined by Sections 25.222(a)(1) and 25.226(a)(1)(i). The effective off-axis EIRP spectral density generated by a conforming terminal will be:

$15-25\log_{10}(\Theta + 0.2)$	dBW/4 kHz	for	$1.5° \leq \Theta \leq 7°$
-6	dBW/4 kHz	for	$7° < \Theta \leq 9.2°$
$18-25\log_{10}(\Theta + 0.2)$	dBW/4 kHz	for	$9.2° < \Theta \leq 48°$
-24	dBW/4 kHz	for	$48° < \Theta \leq 85°$

[4] The Aura LE antenna's two transmit/receive apertures are coherently combined to form a single beam. At very low elevation angles, only the front aperture is used due to blockage. This allows the antenna to maintain high performance over a large range of elevation angles between 5 degrees and 90 degrees while maintaining a low profile for aerodynamic integration with an aircraft.

[5] *See* 47 C.F.R. § 25.222(a)(7) (Ku-band ESVs) and § 25.226(b)(1)(iv)(B)(Ku-band VMESs).

-14 dBW/4 kHz for $85° < \Theta \leq 180°$

where Θ is the angle in degrees from the line connecting the focal point of the antenna to the orbital location of the target satellite.

We have been advised by PAC that the eXConnect system will limit off-axis EIRP spectral density to no more than these levels through various means, including: (i) limiting transmit power spectral density by controlling the transmit power of the terminal and by selecting appropriate carrier bandwidths; (ii) controlling the off-axis gain of the antenna along the GSO by inhibiting transmissions when the skew angle exceeds a specified threshold; and (iii) controlling pointing error and inhibiting transmissions when the pointing offset exceeds a threshold of 0.5 deg. The specific transmit power, bandwidth and skew angle thresholds will be selected based on the desired terminal transmission rates, coverage area, and satellite performance.

Based on the foregoing factors and discussions with PAC, we understand that the MELCO antenna will operate at a maximum input power density at the antenna waveguide flange of -21.6 dBW /4 kHz, employing BPSK modulation; and the Aura LE antenna will operate at a maximum input power density at the antenna waveguide flange of -15.1 dBW /4 kHz, employing BPSK modulation. Even in the rare circumstance when transmitting at pointing offsets equivalent to their design tolerances, we believe that these antenna terminals are compliant with the off-axis EIRP density level requirements specified in Sections 25.222 and 25.226, or the combined effect of Sections 25.209 and 25.212(c) of the FCC's rules, at all off-axis angles up to and including 6 degrees off-axis angle. PAC has advised us that it includes antenna pointing offsets in selecting the maximum power levels defined above to ensure that the operation of these antennas, with the associated off-axis EIRP density envelope, will not cause unacceptable interference into adjacent satellites.

Based on the above advice and understandings, Telesat agrees that the use of the above antennas will not cause unacceptable interference into adjacent satellites in accordance with the FCC's two-degree spacing policy, and that these antennas will not require more protection from adjacent satellites compared to an earth station employing an antenna conforming to the FCC antenna performance standards defined in Section 25.209 of the FCC rules. PAC has represented to Telesat that the antennas will be installed in compliance with the technical, operational and performance requirements of Part 25 of the FCC rules and any requirements set forth in the licenses granted by the FCC for the above AMSS antenna system. If the use of these antennas should cause unacceptable interference into other systems, PAC has agreed that it will terminate transmission immediately upon notice from the affected parties.

Telesat further states that the maximum downlink satellite EIRP density of 13.0 dBW/4KHz, the operational level of the Ku-band AMSS network operated by PAC, is routinely used by satellite operators during frequency coordination at two-degree spacing without causing unacceptable interference to adjacent satellite operators.

Finally, Telesat confirms that the PAC Ku-band AMSS operations described above fall within the operating parameters previously coordinated with adjacent satellite operators within +/- 6 degrees of Telstar 14. Since the Telstar 14 satellite commenced commercial operations, Ku-band operations have been supported that are consistent with these coordination agreements. Telesat has no current plans to alter the coordinated operating parameters for the Telstar 14 satellite.

Sincerely,

Robert Condurso
for Telesat Canada

8 Feb 2010
Date

Acceptance by Panasonic Avionics Corporation:

PAC testifies that the information provided to Telesat Canada and reflected in this affidavit is true and accurate to the best of PAC's knowledge.

Paul Sarraffe
Panasonic Avionics Corporation
eXConnect Systems Engineering

9-Feb-2010
Date

December 16, 2009

INTELSAT

Federal Communications Commission
International Bureau
445 12th Street, S.W.
Washington, D.C. 20554

To Whom It May Concern:

This letter certifies that Intelsat is aware that Panasonic Avionics Corporation ("PAC") is seeking FCC authorization to access Galaxy 17 at 91° WL, as an authorized point of communication, for its eXConnect Ku-band aeronautical mobile-satellite service (""AMSS") system using transmit/receive antennas that are not strictly compliant with the FCC's antenna gain requirements.[1] However, as described below, the terminals comply with the FCC's two-degree spacing rules by maintaining off-axis EIRP spectral density levels below those set forth in analogous Ku-band earth stations onboard vessels ("ESV") and vehicle-mounted earth stations ("VMES") rules.[2]

Intelsat understands that PAC plans to operate two AMSS antenna types: (i) the MELCO antennas previously operated with the Connexion by Boeing system; and (ii) the Aura LE antenna designed specifically for the eXConnect system and manufactured by EMS Technologies. The MELCO antenna is a mechanically-steered Cassegrain antenna with an elliptical profile that was previously examined by the FCC and authorized for AMSS operations in experimental Call Sign WC2XVE (File No. 0002-EX-PL-2004) and commercial blanket license Call Sign E000723 (File No. SES-MOD-20030512-00639). The Aura LE antenna is a mechanically steered, flat-plate AES with two transmit/receive apertures that is similarly designed to meet the technical requirements imposed on U.S. and international AMSS operations.[3] The basic

[1] *See* 47 CFR §25.209.

[2] *See* 47 CFR §25.222.

[3] The Aura LE antenna's two transmit/receive apertures are coherently combined to form a single beam. At very low elevation angles, only the front aperture is used due to blockage. This allows the antenna to maintain high performance over a large range of elevation angles between 5 degrees and 90 degrees while maintaining a low profile for aerodynamic integration with an aircraft.

characteristics of the MELCO and Aura LE antenna are also summarized in Table 1.

INTELSAT.

Table 1. Aura LE and MELCO Antenna Characteristics

Characteristic	EMS Aura LE	MELCO Reflector
Frequency	Tx: 14.0 GHz to 14.5 GHz Rx: 10.7 GHz to 12.75 GHz (11.7-12.2 GHz in the U.S.)	Tx: 14.0 GHz to 14.4 GHz Rx: 11.2 GHz to 12.8 GHz (11.7-12.2 GHz in the U.S.)
Aperture Size	2 Apertures of 35" X 6" each	25.6" X 7.7"
EIRP	42.5 dBW @ 5 deg Elevation 48.0 dBW @ 90 deg Elevation	47.2 dBW
G/T	11 dB/K @ 5 deg Elevation 14 dB/K @ 90 deg Elevation	8.0 dB/K @ 11.2 to 11.7GHz 9.3 dB/K @ 11.9 to 12.8GHz
Tracking Rate	40 deg/sec in Azimuth 25 deg/sec in Elevation	40 deg/sec in Azimuth 25 deg/sec in Elevation
Az Pointing Accuracy	0.2 deg 1-sigma	0.25 deg 1-sigma

Both the MELCO and Aura LE antennas are designed to maintain pointing towards the intended satellite through the full range of maneuvers carried out by commercial aircraft. The antennas are pointed based on aircraft position and attitude information obtained from the ARINC 429 data bus, which is standard on commercial aircraft. This information is augmented with higher rated data from an inertial sensor package that is integrated with the antenna and compensates for INS errors that result from latency and bending of the airframe between the aircraft INS unit and the antenna. The pointing accuracy of the MELCO reflector is 0.25 deg 1-sigma and the pointing accuracy of the EMS Aura LE antenna will be less than 0.2 deg 1-sigma. Pointing error will be continuously monitored and if it ever exceeds 0.5 degrees, then transmissions will be automatically inhibited within 100 ms.[4]

The FCC's off axis EIRP spectral density limits for analogous ESV and VMES operations are defined by Sections 25.222(a)(1) and 25.226(a)(1)(i). The effective off-axis EIRP spectral density generated by a conforming terminal will be:

$15-25\log10(\Theta + 0.2)$	dBW/4 kHz	for	$1.5° \leq \Theta \leq 7°$
-6	dBW/4 kHz	for	$7° < \Theta \leq 9.2°$
$18-25\log10(\Theta + 0.2)$	dBW/4 kHz	for	$9.2° < \Theta \leq 48°$
-24	dBW/4 kHz	for	$48° < \Theta \leq 85°$
-14	dBW/4 kHz	for	$85° < \Theta \leq 180°$

where Θ is the angle in degrees from the line connecting the focal point of the antenna to the orbital location of the target satellite.

[4] *See* 47 C.F.R. § 25.222(a)(7) (Ku-band ESVs) and § 25.226(b)(1)(iv)(B)(Ku-band VMESs).

The eXConnect system will limit off-axis EIRP spectral density to no more than this level through various means, including: (i) limiting transmit power spectral density by controlling the transmit power of the terminal and by selecting appropriate carrier bandwidths; (ii) controlling the off-axis gain of the antenna along the GSO by inhibiting transmissions when the skew angle exceeds a specified threshold and(iii) controlling pointing error and inhibiting transmissions when the pointing offset exceeds a threshold of 0.5 deg. The specific transmit power, bandwidth and skew angle thresholds will be selected based on the desired terminal transmission rates, coverage area, and satellite performance.

Based on the foregoing factors, the MELCO antenna will operate at a maximum input power density at the antenna waveguide flange of -21.6 dBW /4 kHz, employing BPSK modulation; and the Aura LE antenna will operate at a maximum input power density at the antenna waveguide flange of -15.1 dBW /4 kHz, employing BPSK modulation. Even in the rare circumstance when transmitting at pointing offsets equivalent to their design tolerances, these antenna terminals are compliant with the off-axis EIRP density level requirements specified in Sections §25.222 and §25.226, or the combined effect of §25.209 and §25.212(c) of the Commission's Rules, at all off-axis angles up to and including 6 degrees off-axis angle. PAC's conservative approach of including antenna pointing offsets in selecting the maximum power levels defined above ensures that the operation of these antennas, with the associated off-axis EIRP density envelope, will not cause unacceptable interference into adjacent satellites.

The undersigned further certifies that the maximum downlink satellite EIRP density of 13.0 dBW/4KHz, operational level of the Ku-band AMSS network operated by PAC, is routinely used at 2-degree spacing without causing unacceptable interference to adjacent satellite operators.

Furthermore, in order to prevent unacceptable interference into adjacent satellites, Horizons and PAC acknowledge that the antennas will be installed in compliance with the technical, operational and performance requirements of Part 25 of the FCC Rules and any requirements set forth in the licenses granted by the FCC for the above AMSS antenna system.

Horizons and PAC confirm that the use of the above antennas will not cause unacceptable interference into adjacent satellites in accordance with the FCC's two-degree spacing policy and accept that these antennas will not require more protection from adjacent satellites compared to an earth station employing an antenna conforming to the FCC antenna performance standards defined in Section 25.209 of the FCC rules. If the use of this antenna should cause unacceptable interference into other systems, PAC has agreed that it will terminate transmission immediately upon notice from the affected parties.

Sincerely,

Jose Albuquerque

Jose Albuquerque
Senior Director, Spectrum Engineering
Intelsat

16 December 2009
Date

INTELSAT.

Acceptance by Panasonic Avionics Corporation:

PAC testifies that the information provided to Intelsat and reflected in this affidavit is true and accurate to the best of PAC's knowledge.

Paul Sarraffe

Paul Sarraffe
Panasonic Avionics Corporation
eXConnect Systems Engineering

Dec. 16, 2009
Date

Acceptance by SES Americom:

SES Americom agrees to the use of the PAC MELCO and Aura LE antennas with the above power density into the antenna flange and the uplink EIRP density level as stated in this letter, with respect to SES satellites and the associated satellite networks that are within +/- 6 degrees orbital spacing from Galaxy 17 at 91° WL.

K. Jonnalagadda

Krish Jonnalagadda
Manager, Spectrum Development
SES Americom

16 Dec 09
Date

August 2, 2010

INTELSAT.

Federal Communications Commission
International Bureau
445 12th Street, S.W.
Washington, D.C. 20554

To Whom It May Concern:

This letter supplements the letter dated December 16, 2009 from Intelsat regarding Panasonic Avionics Corporation's ("PAC") proposed Ku-band aeronautical mobile-satellite service ("AMSS") operations with the Galaxy 17 satellite at 91° W.L. Intelsat confirms that so long as PAC maintains FCC authority to communicate with Galaxy 17, Intelsat will include the technical parameters described in the aforementioned letter in all future satellite network coordinations for the satellite.

Sincerely,

Jose Albuquerque — Date: 2 August 2010
Jose Albuquerque
for Intelsat

Acceptance by Panasonic Avionics Corporation:

PAC hereby certifies that it will comply with the all coordination agreements reached by Intelsat for the G-17 satellite.

Paul Sarraffe — Date: August 3, 2010
Paul Sarraffe
Panasonic Avionics Corporation
eXConnect Systems Engineering

ATTACHMENT C

COORDINATION AGREEMENT FOR THE JOINT USAGE OF THE BAND 14.0 - 14.5 GHz BETWEEN THE NATIONAL SCIENCE FOUNDATION AND PANASONIC AVIONICS CORPORATION

Version 1.1

December 18, 2009

Coordination Agreement for the Joint Usage of the Band 14.0 - 14.5 GHz Between the National Science Foundation and Panasonic Avionics Corporation

Panasonic Avionics Corporation (PAC) is applying for authority to operate a global Aeronautical Mobile-Satellite Service (AMSS) network in the 14.0-14.5 GHz Fixed-Satellite Service (FSS) band. The AMSS terminals will be installed aboard commercial aircraft and operate with commercial geostationary satellites. This coordination agreement and the pending Federal Communications Commission (FCC) license comply with FCC Part 25 rules and the recommendations of the International Telecommunication Union (ITU) as a product of the World Radiocommunication Conference WRC-03.

1. Overview

1.1 The band 14.47-14.5 GHz is used by the radio astronomy service in accordance with footnotes US342 to the U.S. Table of Frequency Allocations

1.2 The band 14.0-14.5 GHz has been allocated to mobile-satellite service including AMSS on a secondary basis with the provision that government services, including the radio astronomy service in the 14.47-14.50 GHz band, be protected from interference from the AMSS service.

1.3 PAC filed an application with the FCC on July 24, 2009 for experimental authority to operate two types of transmit/receive aircraft earth stations (AES) and also plans to submit a commercial license application to the FCC.

1.4 The AMSS operations will allow AESs to transmit and receive information from a ground earth station via a transponder on geostationary satellites arc under the control of a ground-based network operation center in Miramar, FL.

1.5 This Coordination Agreement ensures that the PAC AMSS system complies with both Part 25 FCC requirements and ITU recommendations for radio astronomy protection.

1.6 Negotiation and signatures of this agreement are to be executed by PAC and the Electromagnetic Spectrum Management Unit of the National Science Foundation (NSF) for the Radio Astronomy sites identified in Section 2.1.

2. National Science Foundation Radio Astronomy Observatories

2.1 Radio Astronomy Site Listing

The Radio Astronomy sites under NSF support and listed in Table 2-1 make measurements in the 14.47-14.50 GHz band. These sites, including sites associated with the Very Long Baseline Array (VLBA), are to be protected during their opera ion in accordance with the description provided in Section 3.

Table 2-1 Current Radio Astronomy Sites

Observatory	Latitude (D,M,S)	Longitude (D,M,S)
<u>National Astronomy and Ionosphere Center (NAIC) site:</u>		
Arecibo, PR	18 20 39	66 45 10
<u>National Radio Astronomy Observatory OIRAO sites:</u>		
Green Bank Telescope, WV	38 25 59	79 50 23
Very Large Array, Socorro, NM	34 04 44	107 37 06
<u>VLBA Sites</u>:		
St. Croix, VI	17 45 24	64 35 01
Hancock, NH	42 56 01	71 59 11
N. Liberty, IA..	41 46 17	91 34 27
Ft. Davis, TX	30 38 06	103 56 41
Los Alamos, NM	35 46 30	106 14 44
Pie Town, NM	34 18 04	108 07 09
Kitt Peak, AZ	31 57 23	111 36 45
Owens Valley, CA	37 13 54	118 16 37
Brewster, WA	48 07 52	119 41 00
Mauna Kea, HI	19 48 05	155 27 20

2.2 Additional Radio Astronomy Sites

NSF may add new radio astronomy sites to the list given in Table 2-1. In this case NSF shall give PAC at least 2 months notice of modifications to existing sites, o the inclusion of any additional Radio Astronomy sites to operate in the 14.47 -14 5 GHz band.

3. Operational Coordination Agreement

NSF and PAC agree to the following stipulations:

3.1 To provide protection to the Radio Astronomy sites listed in Table their operational period, the following aggregate power flux density the 14.47-14.50 GHz band shall be no greater than:

(a) -221 dB (W/m2/Hz) for the Arecibo, Green Bank and Socorro sites

(b) -189 dB (W/m2/Hz) for the ten VLBA sites

3.2 Within a year following initiation of the licensed PAC AMSS service, authorized NSF and PAC personnel shall periodically review the terms of this Coordination

Agreement. If required, modifications of this Coordination Agreement will be negotiated and instituted.

3.3 Any changes in the points of contact given in Section 5 shall be identified and reported by the respective party in a reasonable period.

PAC agrees to the following stipulations:

3.4 PAC will respond promptly to any NSF request for protection as described above for interference occurring at any site listed in Table 2-1.

NSF agrees to the following stipulations:

3.5 Provide PAC points of contact given in Section 5 a current schedule of Radio Astronomy measurements to be conducted in the 14.47-14.5 GHz band for the sites identified in Table 2-1.

3.6 Via the National Astronomy and Ionosphere Center (NAIC) and the National Radio Astronomy Observatory (NRAO) provide PAC points of contact given in Section 5 any data that is not in accordance with the provisions in this Coordination Agreement.

4. Termination Conditions

4.1 This Coordination Agreement shall be binding for PAC and NSF.

4.2 Either party providing a written notice of six months may execute termination of this Coordination Agreement.

5. Points of Contact

5.1 Points of contact for this Coordination Agreement are:

Name: Dr. Andrew W. Clegg	Name: Paul Sarraffe
Organization: National Science Foundation	Organization: Panasonic Avionics
Title: Program Director, ESMU	Title: eXConnect System Engineering
Address: 4201 Wilson Boulevard, Room 1030	Address: 262000 Enterprise Way
City State Zip: Arlington VA 22230	City State Zip: Lake Forest, CA 92630
Phone: (703) 292-4892	Phone: (949) 672-2589
Fax: (703) 292-9034	Fax: (949) 462-7101
E-mail: esm@nsf.gov	E-mail: paul.sarraffe@panasonic.aero

5.2 Points of contact for Radio Astronomy observation schedules are:

Dr. Dr. Harvey Liszt	Name: Paul Sarraffe
Title: Spectrum Manager	Title: eXConnect System Engineering
Organization: NRAO	Organization: eXConnect
Address: NRAO 520 Edgemont Rd. Charlottesville, VA 22903-2475	Address: Panasonic Avionics Corporation 262000 Enterprise Way Lake Forest, CA 92630
Phone 434-296-0344	Phone: (949) 672-2589
Fax: 434-296-0278	Fax: (949) 462-7101
E-mail: hliszt@nrao.edu	E-mail: paul.sarraffe@panasonic.aero

6. Signatures

This Agreement is being made in good faith by both parties and is effective on the date on which the last -party signs it.

For the National Science Foundation

By:______________________________

Name: Dr. Andrew W. Clegg
Title: Program Director, Electromagnetic Spectrum Management Unit

Date: December 18, 2009

For Panasonic Avionics Corporation

By:______________________________

Name: Anita Kartic
Title: Senior Director, Strategic Partnerships and eXConnect Regulatory Affairs

Date: December 18, 2009