Panasonic Avionics Corporation

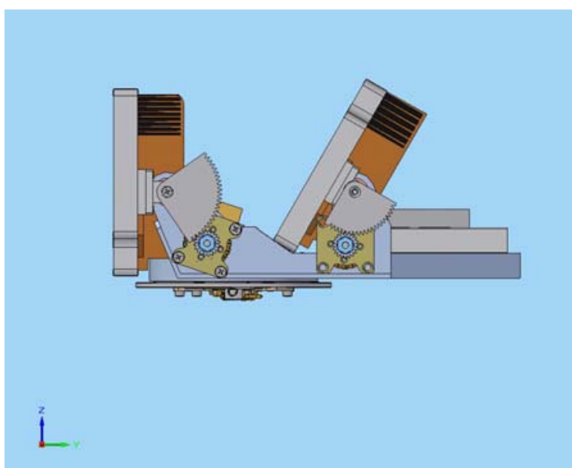
EXPERIMENTAL APPLICATION
NARRATIVE AND PUBLIC INTEREST STATEMENT

Panasonic Avionics Corporation ("PAC") is seeking special temporary authority ("STA") for experimental operation of up to five (5) Aura LE Ku-band transmit/receive terminals for testing and demonstration purposes associated with its planned eXConnect Ku-band aeronautical mobile-satellite service ("AMSS") system. Although this terminal is being evaluated for use in the AMSS context, this application requests temporary authority for ground testing only.[1] The proposed experimental operations will be conducted at and around specified test facilities for a very limited duration (e.g., several hours per test session) scheduled intermittently over the next six (6) months.

Description of Antenna

The eXConnect system will employ the two-panel Aura LE aircraft earth station ("AES") manufactured by EMS Technologies, represented in Figure 1 (below).

Figure 1. Aura LE Antenna



The AES will transmit with EIRP density not to exceed 17.5 dBW/4kHz and with a maximum EIRP level of 48 dBW. The data rates transmitted from the terminal will vary from 128 kbps to 1 Mbps. The off-axis EIRP spectral density of the Aura LE is set forth in the following figure.

[1] PAC expects to file a separate application for in-flight testing in the near term.

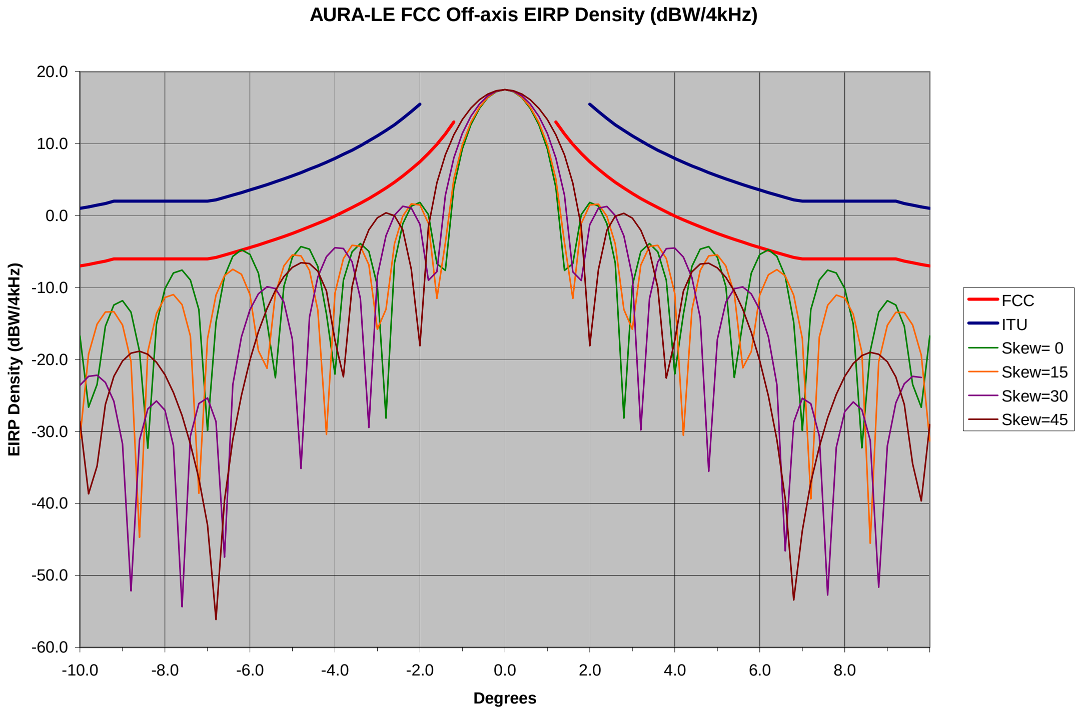


Figure 2. Aura LE Off-Axis EIRP Spectral Density

Due to its two-panel design and the effects of blockage from the front panel at lower elevation angles, the gain of the Aura LE changes with elevation angle. See Figure 3, below. This effect is fully taken into account in controlling the off-axis EIRP spectral density of the Aura LE antenna. During the proposed experimental operations, the elevation angle will never be less than 28 degrees.

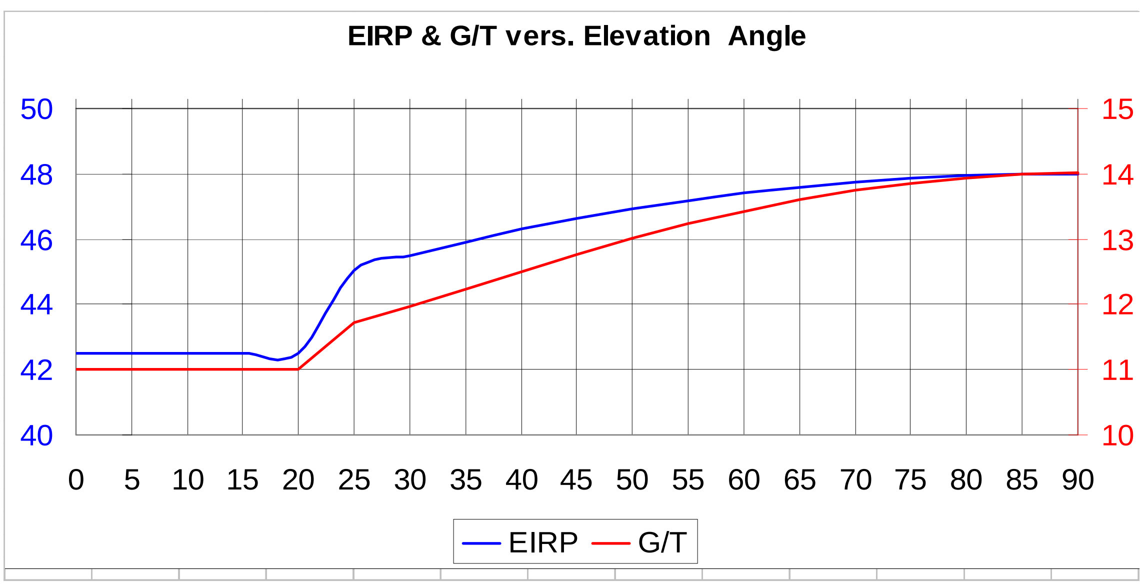


Figure 3. EIRP and G/T versus Elevation Angle for Aura LE

The foregoing off-axis EIRP density figures include plots for various "skew angles" between 0 and 45 degrees. "Skew angle" is the angular difference between the major axis of the antenna and the geostationary arc when the antenna is pointed at the serving satellite but located at a different longitudinal position than the satellite. Thus, at 0º skew angle, antenna peformance is dictated solely by the azimuth gain pattern. As skew angle increases, the elevation gain pattern contributes to overall antenna performance and the combined pattern broadens to reflect this contribution. The skew angle will never exceed 45 degrees during the proposed experimental operations and the effect of skew angle is fully taken into account in controlling off-axis EIRP density produced by eXConnect terminals.

As a result, the terminals are fully compliant with the FCC's two-degree spacing requirements, and off-axis EIRP spectral density levels associated with routinely licensed VSATs that have been applied to mobile Ku-band terminals in similar contexts (e.g., earth stations onboards vessels (ESVs) and Ku-band AMSS terminals).

Antenna pointing is accomplished via mechanical steering of the antenna and uses the aircraft attitude data (i.e., yaw, roll, pitch and heading vector), together with absolute navigation coordinates 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. For purposes of on-ground testing, similar data regarding stationary three-axis table position and movement, as well as vehicle position and movement, will be fed to the antenna. A local inertial sensor package placed on the antenna plate itself provides more accurate antenna attitude sensing and compensates for possible aircraft INS errors caused by airframe deformation and data latency. The antenna based provides continuous coverage over full 360º in the azimuth plane a with pointing accuracy better than 0.2º RMS. Tracking velocity is 40º/sec (azimuth) and 25º/sec (elevation) with acceleration of 40º/sec^2 (azimuth) and 15º/sec^2 (elevation).

Description of Planned Experimental Operations

PAC seeks temporary authority at and near available test facilities for evaluation and demonstration of the Aura LE antenna. The antenna will be tested in three modes: (i) fully stationary; (ii) mounted on a three-axis motion platform that simulates aircraft heading, pitch and roll; and (iii) on a ground vehicle rooftop for in-motion testing. Experimental testing and demonstration will occur at the following locations.

Lake Forest, CA	38-39-55 N; 117-40-31 W
Bothell, WA	47-47-40 N; 122-11-46 W
Herndon, VA	38-57-08 N; 077-25-04 W
Mountainside, MD	39-36-06 N; 077-45-46 W
Washington, DC	38-56-32 N; 077-03-56 W
Norcross, GA	33-58-01 N; 084-13-45 W

Extensive receive-only tests will be conducted to verify antenna performance and subsystem integration prior to any transmit operation. Two-way tests requiring transmit operation will then be performed to evaluate, optimize and demonstrate return link performance as well as the passenger experience with fixed, ground-based terminals.

With respect to vehicle-mounted tests, limited operations will occur within 100 miles of the fixed locations identified above. For purposes of this experimental STA application, PAC terminals will not operate within line-of-sight vicinity of Radio Astronomy Service (RAS) sites or the Tracking and Data Relay Satellite System (TDRSS) for space research conducted at White Sands, New Mexico and the US Naval Research Lab at Blossom Point, Maryland.[2] Additional coordination with RAS operations to avoid experimental operations during period of RAS observations will further ensure that there is no potential for interference from PAC's planned experimentations.

PAC will operate the terminals with the following satellites:

Intelsat G-16	**99ºW**
Intelsat G-25	**97ºW**
Intelsat G-26	**93ºW**

The terminals will communicate with licensed Intelsat hub antennas in Riverside, CA. and Mountainside, MD. At all times, the hub antennas and satellites will operate according to their licensed parameters.

For purposes of these experiments, the PAC terminals will be operated under PAC's full supervision and control. The point of contact for the planned experimental operations is:

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eXConnect
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paul.sarraffe@panasonic.aero

This contact will have access to all network functions, and will have the ability and authority to cease all transmissions from the terminals wherever they are located.

[2] PAC has contacted NASA and the National Science Foundation to initiate coordination discussions for both on-ground and in-flight operations. PAC will accept technical limitations imposed on other Ku-band land-mobile and AMSS operations necessary to protect RAS and TDRSS operations.

Protection of Other Users in the 14.0–14.5 GHz Band

Protection of Fixed-Satellite Service. The FCC has not yet established service rules applicable to VMES or AMSS terminal operations, but interference considerations are analogous to those that currently apply to mobile ESVs set forth in 47 C.F.R. § 25.222. As discussed above, PAC's terminals will operate in such a manner that the off-axis EIRP levels are no greater than the levels produced by routinely licensed VSAT earth stations. This is consistent with past FCC licensing conditions in the LMSS context. To the extent that any adjacent satellite operator experiences unacceptable interference from PAC's experimental operations, PAC will cease terminal transmissions immediately.

Protection of Potential NGSO FSS Systems. Panasonic acknowledges that non-geostationary orbit ("NGSO") systems are also permitted to operate in the Ku-band. However, no such systems are currently authorized or plan to operate within the period contemplated for the proposed experimental operations.

Protection of Terrestrial Radio Services. PAC has examined current spectrum use in the 14.0-14.5 GHz band and has determined that there are no active FCC-licensed terrestrial services in this band in North America with which its proposed operations would potentially conflict.

Protection of the Radio Astronomy Service. For purposes of protecting radio astronomy sites, consistent with Recommendation ITU-R M.1643, Part C, PAC will limit aggregate power flux density (pfd) in the band of 14.47 GHz to 14.5 GHz as follows:

> -221 dBW/m^2/Hz (for protection of Green Bank, Arecibo and Socorro)
> -189 dBW/m^2/Hz (for protection all other Radio Astronomy sites)

For purposes of this experimental STA application, PAC terminals will not operate within line-of-sight vicinity of Radio Astronomy sites and during observation periods.

Protection of Space Research Service. PAC recognizes the utilization of the frequency band from 14.0-14.05 GHz and the possible use of the band from 14.05-14.2 GHz allocated to the National Aeronautics and Space Administration ("NASA") Tracking and Data Relay Satellite System ("TDRSS") for space research conducted at White Sands, New Mexico and Blossom Point, Maryland. For purposes of this experimental STA application, PAC will avoid AES operation within line-of-sight vicinity of these earth stations.

Out of Band Emissions. The terminals comply with FCC 47 C.F.R. § 25.202, which provides:

Emission limitations. The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

1. In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;
2. In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;
3. In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts.

SUMMARY OF TECHNICAL PARAMETERS - AURA LE

Antenna diameter	35 in x 6.5 in
Type of Antenna	Dual panel waveguide fed phased array
Peak Power (SSPA)	20 watts
Transmit Bandwidth	2.56 MHz
Transmit Gain	38 dBi
EIRP	48 dBW
Transmit Data Rate	128 kbps to 1 Mbps
Transmit Polarization	Horizontal or Vertical
Transmit Max PSD (dBW/4kHz)	17.5
Transmit Azimuth Beamwidth	1.5 degrees
Transmit Elevation Beamwidth	4 degrees
Receive G/T	11 dB, minimum
Receive Bandwidth	500 MHz
Receive Polarization	Dual LHCP and RHCP or Dual Vertical and Horizontal

Antenna Control Parameters

Azimuth	continuous coverage over full 360º
Elevation	0 to 90º antenna elevation
Position accuracy	Static pointing error 0.15º RMS (AZ); 0.2º RMS (AZ) in-motion
Dynamic Tracking capability	AZ velocity 40º/Sec, EL velocity 25º/Sec max AZ acceleration 40º/Sec^2, EL acceleration 15º/Sec^2 max

PAC Terminal Transmit Modulation Parameters

Modulation	TPC FEC	Spread factor	Eb/No (dB) BER=1E-08	C/N (dB)
TDMA BPSK SF=1	0.793	1	5.80	4.80
TDMA BPSK SF=1	0.660	1	5.10	3.30
TDMA BPSK SF=1	0.533	1	5.13	2.40
TDMA BPSK SF=1	0.431	1	4.96	1.30
TDMA BPSK SF=2	0.660	2	5.01	0.20
TDMA BPSK SF=2	0.533	2	5.04	-0.70
TDMA BPSK SF=2	0.431	2	5.07	-1.60
TDMA BPSK SF=4	0.660	4	4.73	-3.10
TDMA BPSK SF=4	0.533	4	4.75	-4.00
TDMA BPSK SF=4	0.431	4	5.08	-4.60

PAC Terminal Transmit Emission Designators

BPSK kbps	Spread factor	occupied bandwidth (kHz)	Emission Designator
128	1	160	1K60G7D
256	1	320	3K20G7D
512	1	640	6K40G7D
1024	1	1280	1M28G7D
128	2	320	3K20G7D
256	2	640	6K40G7D
512	2	1280	1M28G7D
1024	2	2560	2M56G7D
128	4	640	6K40G7D
256	4	1280	1M28G7D
512	4	2560	2M56G7D

Additional Off-Axis EIRP Spectral Density Plots