TOS-22

PBS Technology & Operations

TECHNICAL OPERATING SPECIFICATIONS

Real Time Satellite Uplinks

2010 Edition

1. SCOPE AND PURPOSE

This specification defines uplink performance requirements for the Public Television Satellite Interconnection System. These parameters will address the settings for uplink MPEG-2 encoders, multiplexer, modulators, and any redundant systems. The goal is to provide consistent quality performance among multiple uplink providers serving the Public Television Satellite Interconnection System. It is essential that all parameters be set correctly.

It is vital that all uplink operators meet these performance requirements and protocols. Most stations rely on consistent signals from the satellite system and member stations do not have the manpower or means to compensate for variations. This specification prescribes standards that uplink operators must meet, and informs receiving stations what signal standards they should expect. This document is especially important for uplink operators working with other satellite services, since some of these specifications are unique to the PBS system.

2. SYSTEM INFORMATION

PBS currently uses transponders on satellite AMC-21 for Ku service and on satellite AMC-1 and AMC-2 for C-Band service. The modulation formats in use are DVB-S, & DVB-S2 with a payload contained within a standard MPEG transport stream. MPEG-2 and AC-3 compression are used for the video and audio, respectively for AMC21 and MPEG-2 video and Musicam audio for the C-Band service.

3. INTERFERENCE NOTICE

In order to minimize harmful interference and insure quality transmission, the PBS Satellite Operations Center (SOC) acts as control station for the Public Television Satellite Interconnection System. The SOC is located in Alexandria, Virginia.

All earth stations are required to be in contact with the SOC at (703) 750-8214, prior to and at the time of illumination of any Public Television Satellite Interconnection System transponder.

The responsibility for non-interference and technically correct signal parameters lies with the Uplink operator. If an uplink is causing interference or is not adhering to PBS or the satellite owner's uplink standards, the satellite owner or PBS SOC will direct the offending uplink to terminate operations. This directive to terminate requires immediate compliance.

4. CERTIFICATION

4.1 Initial Certification. Uplinks that have never accessed PBS controlled transponders must be certified before uplinking. Certification testing with the SOC must be scheduled to take place no later than 24 hours before the scheduled uplink.

4.2 Re-Certification. Uplinks that have installed a new or different antenna, encoder, upconverter, power amplifier, or other component in their uplink chain since their last access must be re-certified. Re-Certification testing with the SOC must be scheduled to take place no later than 24 hours before the scheduled uplink.

Note: Certification procedures are addressed in Appendix 1 of this TOS.

5. AMC 21 PBS DIGITAL SATELLITE TRANSMISSION PARAMETERS

This section defines the set up parameters for digital transmission over the PBS controlled satellite transponders.

The following are normal parameter settings for emission systems for Single Channel Per Carrier (SCPC) and Multiple Channels Per Carrier (MCPC) channel providers.

AMC-21 Ku-Band transponders 22 and 24 are host to multiple video channels (e.g. HD01 & HD02 etc) that originate from a single uplink location. These services are multiplexed into a single carrier called an MCPC (multiple channels per carrier) signal that is transmitted to the satellite from a single uplink location. The advantage of combining these signals into a single carrier is that all of the transponder power supports each signal within the MCPC carrier leading to improved receive margins and rain fade protection.

AMC-21 Ku-Band transponders 21 and 23 are host to multiple uplink signals that originate from various uplink locations, These signals are not multiplexed and are called SCPC (single channel per carrier). The carriers must share the available transponder power between them. Each SCPC has less power available and a lower performance margin than if they were combined into an MCPC. The reason being that they must be operated at a backed off power level to prevent excessive intermodulation noise. This noise would occur due to mixing of the signals and the subsequent non-linear response in the satellite transponder tube, if the tube were operated at or near a fully saturated level.

All PIDs are listed in decimal and hex.

5.1 AMC21/Ku21 (Horizontal) NRT File delivery

5.1.1 Emission

5.1.1.1 PBS NRT Distribution Service

L-band Receiver Freq.:	1367 MHz
Modulation:	DVB-S2 8PSK 5/6, Roll-off (Alpha) 0.20
Symbol Rate:	25 MS/s
Bandwidth:	30 MHz

5.1.1.2 Regional NRT Distribution Service

L-band Receiver Freq.:	1385 MHz
Modulation:	DVB-S2 8PSK 5/6, Roll-off (Alpha) 0.20
Symbol Rate:	5 MS/s
Transport stream total bandwidth:	6 MHz

5.1.1 Programs

Note: This transponder is under test and parameters are subject to change.

5.2 AMC21/ Ku22 (Vertical) MCPC Channels (3 Services including Emergency Services Data)

5.2.1 Emission

Rx Freq. setting:	1390 MHz
Modulation:	DVB-S QPSK
FEC:	3/4, 188 byte data packets
Roll-off (Alpha):	0.20
Symbol Rate:	30.0MS/s
Transport BW:	41.470588 Mbps

5.2.2 Programs

5.2.2.1 HD01

MPEG Program Number:	3
PMT PID:	48 (0x30)
Video & PCR PID:	49 (0x31)
Video Coding:	MPEG-2 17 Mbps (constant bit rate) 4:2:0 GOP = 15, 2 B frames, Closed, Fixed
Audio PID:	52 (0x34) – Main Program
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	384 kbps
Channel Mode:	2/0 (Stereo) or 3/2L (5.1 surround)
Dialnorm setting:	31 (fixed)
Dynrange setting:	none
Audio PID:	53 (0x35) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	384 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	none

5.2.2.2 HD02

MPEG Program Number:	4
PMT PID:	64 (0x40)
Video & PCR PID:	65 (0x41)
Video Coding:	MPEG-2 17 Mbps (constant bit rate) 4:2:0 GOP = 15, 2 B Frames, Closed, Fixed
Audio PID:	68 (0x44) – Main Program
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	384 kbps
Channel Mode:	2/0 (Stereo) or 3/2L (5.1 surround)
Dialnorm setting:	31 (fixed)
Dynrange setting:	none
Audio PID:	69 (0x45) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	384 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	none

5.2.2.3 Emergency Services Data (Not in Service)

Bitrate:	1.0Mbps
PID and data type:	TBA

5.2.2.4 NDI (National Data Incorporated)

Bitrate and PID:	10 kbps	2048 (0x800)
	30 kbps	2051 (0x803)
	30 kbps	2052 (0x804)
	110 kbps	2053 (0x805)
	110 kbps	2055 (0x807)

5.3 AMC21- Ku23 (Horizontal) SCPC Channels (4 Separate Services):

5.3.1 HD04

Emission

Rx Freq. setting	1400 MHz
Modulation:	DVB-S QPSK
FEC:	3/4, 188 byte data packets
Roll-off:	0.20 (Alpha)
Symbol Rate:	14.028731 MS/s
Transport BW:	19.392658 Mbps

Program

MPEG Program Number:	3
PMT PID:	48 (0x30)
Video & PCR PID:	49 (0x31)
Video Coding:	MPEG-2 17.5 Mbps (constant bit rate) 4:2:0 GOP = 15, 2 B frames, Closed, Fixed
Audio PID:	52 (0x34) – Main Program
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	384 kbps
Channel Mode:	2/0 (Stereo) or 3/2L (5.1 surround)
Dialnorm setting:	31 (fixed)
Dynrange setting:	none
Audio PID:	53 (0x35) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	384 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	none

5.3.2 SD05

Emission:

Rx Freq. setting	1413 MHz
Modulation:	DVB-S QPSK
FEC:	3/4, 188 byte data packets
Roll-off:	0.20 (Alpha)
Symbol Rate:	4.444 MS/s
Transport BW:	6.143177 Mbps

Program

MPEG Program Number:	11
PMT PID:	176 (0xb0)
Video & PCR PID:	177 (0xb1)
Video Coding:	MPEG-2 3.0 Mbps Minimum – 5.5 Mbps Maximum (constant bit rate) 4:2:0 GOP = 15, 2 B Frames, Closed, Fixed
Audio PID:	180 (0xb4) – Main Program
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)
Audio PID:	181 (0xb5) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)

5.3.3 SD06

Emission

Rx Freq. setting	1419 MHz
Modulation:	DVB-S QPSK
FEC:	3/4, 188 byte data packets
Roll-off:	0.20 (Alpha)
Symbol Rate:	4.444 MS/s
Transport BW:	6.143177 Mbps

Program

MPEG Program Number:	11
PMT PID:	176 (0xb0)
Video & PCR PID:	177 (0xb1)
Video Coding:	MPEG-2 3.0 Mbps Minimum – 5.5 Mbps Maximum (constant bit rate) 4:2:0 GOP = 15, 2 B Frames, Closed, Fixed
Audio PID:	180 (0xb4) – Main Program
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)
Audio PID:	181 (0xb5) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)

5.3.4 SD07

Emission

Rx Freq. setting	1425 MHz
Modulation:	DVB-S QPSK
FEC:	3/4, 188 byte data packets
Roll-off:	0.20 (Alpha)
Symbol Rate:	4.444 MS/s
Transport BW:	6.143177 Mbps

Program

MPEG Program Number:	11
PMT PID:	176 (0xb0)
Video & PCR PID:	177 (0xb1)
Video Coding:	MPEG-2 3.0 Mbps Minimum – 5.5 Mbps Maximum (constant bit rate) 4:2:0 GOP = 15, 2B frames, Closed, Fixed
Audio PID:	180 (0xb4) – Main Program
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)
Audio PID:	181 (0xb5) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)

5.4 AMC21/ Ku24 (Vertical) MCPC Channels (4 Services)

5.4.1 Emission

Rx Freq. setting	1430 MHz
Modulation:	DVB-S QPSK 3/4, 188 byte data packets, Roll-off (Alpha) 0.20
Symbol Rate:	30.0MS/s
Transport BW:	41.470588 Mbps

5.4.2 Programs

5.4.2.1 HD03

MPEG Program Number:	3
PMT PID:	48 (0x30)
Video & PCR PID:	49 (0x31)
Video Coding:	MPEG-2 17.5 Mbps (constant bit rate) 4:2:0 GOP = 15, 2 B Frames, Closed, Fixed
Audio PID:	52 (0x34) – Main Program
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	384 kbps
Channel Mode:	2/0 (Stereo) or 3/2L (5.1 surround)
Dialnorm setting:	31 (fixed)
Dynrange setting:	none
Audio PID:	53 (0x35) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	384 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	none

5.4.2.2 SD01

MPEG Program Number:	11
PMT PID:	176 (0xb0)
Video & PCR PID:	177 (0xb1)
Video Coding:	MPEG-2 4.0-8.0 Mbps (variable bit rate), 4.5 Mbps (median) 4:2:0 GOP = 15, 2 B Frames, Closed, Fixed
Audio PID:	180 (0xb4) – Main Program
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)
Audio PID:	181 (0xb5) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)
Audio PID:	182 (0xb6) – Time Code
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	224 kbps
Channel Mode:	2/0 (stereo: left – UTC, right ETC)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)

5.4.2.3 SD02

MPEG Program Number:	12
PMT PID:	192 (0xc0)
Video & PCR PID:	193 (0xc1)
Video Coding:	MPEG-2 4.0-8.0 Mbps (variable bit rate), 4.5 Mbps (median) 4:2:0 GOP = 15, 2 B Frames, Closed, Fixed
Audio PID:	196 (0xc4) – Main Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)
Audio PID:	197 (0xc5) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)

5.4.2.4 SD03

MPEG Program Number:	13
PMT PID:	208 (0xd0)
Video & PCR PID:	209 (0xd1)
Video Coding:	MPEG-2 4.0-8.0 Mbps (variable bit rate), 4.5 Mbps (median) 4:2:0 GOP = 15, 2 B Frames, Closed
Audio PID:	212 (0xd4) – Main Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)
Audio PID:	213 (0xd5) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)

5.4.2.5 SD04

MPEG Program Number:	14
PMT PID:	224 (0xe0)
Video & PCR PID:	225 (0xe1)
Video Coding:	MPEG-2 4.0-8.0 Mbps (variable bit rate), 4.5 Mbps (median) 4:2:0 GOP = 15, 2 B Frames, Closed
Audio PID:	228 (0xe4) – Main Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)
Audio PID:	229 (0xe5) – Secondary Program Audio
Descriptor:	none
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: Descriptive Video Information left, alternate language right)
Dialnorm setting:	31 (fixed)
Dynrange setting:	Film mode (fixed)

5.5 AMC1/ C16 (Vertical) MCPC Channels (2 Services)

5.5.1 Emission

L-band Receiver Freq.:	1059 MHz
Modulation:	DVB-S QPSK 3/4, Roll-off (Alpha) 0.20
Symbol Rate:	14.028731 MS/s
Transport Stream total bandwidth:	19.392658 Mb/s

5.5.2 Programs

5.5.2.1 HD Channel

MPEG Program Number:	3
PMT PID:	48 (0x30)
Video & PCR PID:	49 (0x31)
Video Coding:	MPEG-2 14.0 Mbps (constant bit rate) 4:2:0 GOP = 15, 2 B frames, Closed, Fixed
Audio 1 PID:	52 (0x34) – Main Program Audio
Descriptor:	eng
Audio Coding:	MPEG
Audio Bitrate:	192 kbps
Audio 2 PID:	53 (0x35) – Descriptive Video Information
Descriptor:	eng
Audio Coding:	MPEG
Audio Bitrate:	192 kbps
Audio 3 PID:	54 (0x36) – Alternate Language
Descriptor:	eng
Audio Coding:	MPEG
Audio Bitrate:	192 kbps
Audio 4 PID:	55 (0x37) – Main Program Audio
Descriptor:	eng
Audio Coding:	Dolby AC-3
Audio Bitrate:	448 kbps
Channel Mode:	2/0 (Stereo) or 3/2L (5.1 surround)
Dialnorm setting:	31 (fixed)
Dynrange setting:	none
Closed Captioning:	608/708

5.5.2.2 SD Channel

MPEG Program Number:	11
PMT PID:	176 (0xb0)
Video & PCR PID:	177 (0xb1)
Video Coding:	MPEG-2 3.5 Mbps (constant bit rate) 4:2:0 GOP = 15, 2 B frames, Closed, Fixed
Audio 1 PID:	180 (0xb4) – Main Program Audio
Descriptor:	eng
Audio Coding:	MPEG
Audio Bitrate:	192 Kbps
Audio 2 PID:	181 (0xb5) - Descriptive Video Information or Alternate Language Audio
Descriptor:	eng
Audio Coding:	MPEG
Audio Bitrate	192 Kbps
Audio 3 PID:	182 (0xb6) - Disabled, future use if needed
Descriptor	none
Audio Coding:	MPEG
Audio Bitrate	192 Kbps
Closed Captioning:	608/708

6. NON-PBS MEMBER STATION UPLINK ORIGINATION

This section defines the set up parameters for digital transmission of a special event program for reception by PBS. These parameters will address the settings for uplink MPEG-2 encoders, multiplexer, modulators, and any redundant systems. The goal is to provide consistent quality performance among multiple uplink providers serving the Public Television community. It is essential that all parameters be set correctly.

The following are normal parameter settings for an emission system for Public Television Single Channel Per Carrier (SCPC) on a full transponder.

6.1.1 Symbol rate: 25MS/s, equivalent information rate: 34.5588 Mbps

6.1.2 Frequency

6.1.2.1 Information to be provided at time of scheduling

6.1.2 Modulation: DVB-S QPSK 3/4, 188 Byte data packets, Roll-off (Alpha) ≤.35

6.1.3 MPEG transport stream parameters

6.1.3.1 Video coding: MPEG-2, Main Profile @ High Level, at 30 Mbps
1920 x 1080i, 4:2:0, 16 x 9 aspect ratio preferred

6.1.3.2 MPEG-2 Program Number: 3

6.1.3.3 PMT PID: 48 (0x30)

6.1.3.4 Video & PCR PID: 49 (0x31)

6.1.3.5 Audio PIDs: 52 (0x34), 53 (0x35)

6.1.3.6 Audio Coding:
Audio service – PID 52:
Dolby® Digital (AC-3 as per ATSC A/52a specification), (2/0) stereo, 192 Kbps, 48 kHz sampling rate

Audio service – PID 53:
Dolby® Digital (AC-3 as per ATSC A/52a specification), (2/0) stereo, 192 Kbps, 48 kHz sampling rate, or Dolby® Digital (AC-3 as per ATSC A/52a specification), (5.1) surround, 448 Kbps, 48 kHz sampling rate.
or
Dolby® E, 20 bit (SMPTE 302M), 5.1 + 2 channels, 1.92 Mbps, 48 kHz sampling rate, non re – clocked

6.1.4 Ancillary data parameters

6.1.4.1 Closed Captions
a. Live captioning
Coordination of live captioning will occur one hour prior to program
A modem connection will establish with NOC captioning equipment or
A XOrbit session will be established

b. VANC Captions
Insertion on Line 9, Field 1
1. CEA608 Compatibility Caption Data Packets
2. CEA708 DTV Caption Data Packets
3. Error free CDP and CRC

6.1.4.2 Active Format Description
Insertion on Line 11, Field 1 and Field 2

6.1.4.3 V-chip (Optional)

6.1.4.4 Nielsen Data – AMOL (Optional)

6.1.4.5 Additional Metadata (Optional)
Dolby DID insertion

7. PBS ANALOG SATELLITE TRANSMISSION PARAMETERS

PBS will continue to deliver analog video service on AMC-2 with in conformance to these standards.

7.1 Video Standards

7.1.1 Video Pre-Emphasis: CCIR 525 line. (Refer to EIA/TIA-250C Appendix Pages 48-50)

7.1.2 Frequency Tolerance: 0.001 percent of the reference frequency.

7.1.3 Peak Video Deviation:
Full transponder mode: 10.75 MHz ± 1.5 IRE.
(Sync to peak white tolerance of ± 1.5 IRE.)

7.1.4. Energy Dispersal: C-band as per FCC 25.208

7.2 Program Audio Standards

Three audio subcarriers are required during all transmissions. Note: These subcarriers are used for left and right channel stereo and SAP. A fourth carrier may be employed for transmitting DTMF tones for control of local insertion equipment.

7.2.1 Subcarriers:
Left channel: 6.20 MHz ±0.01 MHz.
Right channel: 6.80 MHz ±0.01 MHz.
SAP channel: 5.65 MHz ±0.01 MHz
DTMF channel: 5.2 MHz ±0.01 MHz

7.2.2 Subcarrier Injection: -19 ±1 dBc

7.2.3 Pre-emphasis: 75 ms.

7.2.4 Peak Subcarrier Deviation:
150 kHz ± 0.2 dB for the 6.2, 6.8, and 5.65 MHz Subcarriers. (300 kHz total modulation bandwidth with 400 Hz sinusoidal tone at 10 dB above plant operating level.)

110 kHz ± 0.2 dB for the 5.2 MHz Subcarrier (220 kHz total modulation bandwidth with
400 Hz sinusoidal tone at 10 dB above plant operating level.)

7.3 ATIS Standards

A signal, compliant with the Automatic Transmitter Identification System (FCC Part 25.281), is required during all transmissions.

7.3.1 Subcarrier:
ATIS channel: 7.1 or 8.3 MHz ±0.01 MHz

7.3.2 Subcarrier Injection: -25 ±1 dBc

7.3.3 Peak Subcarrier Deviation: 25 kHz ± 0.2 dB.

7.3.4 Identification Signal Protocol: International Morse Code keyed by a 1200 Hz ± 800 Hz tone at 15 to 25 WPM.

7.3.5 Minimum Identification Information:
1. FCC assigned earth station call sign.

2. Telephone number providing immediate access to personnel capable of resolving ongoing interference or coordination problems.

3. A unique ten-digit serial number permanently programmed into the ATIS device.

8. RF PARAMETERS

8.1 Satellites: AMC-21, AMC-1 & AMC-2.

8.2 Frequency Band: Ku-Band, C-Band.

8.3 Transponder Frequency Allocation: As assigned by PBS Broadcast Operations and verified with the SOC during check-in.

8.4 Frequency Tolerance: ±0.001% of uplink reference frequency.

8.5 Antenna Performance: 2° Compliant per FCC 25.209 unless otherwise waived.

8.6 Cross- Polarization Isolation: ≥30 dB for Ku-Band, ≥25 dB for C-band.

8.7 EIRP: As directed by PBS SOC at "Check-In."

9. GLOSSARY

8PSK: Eight level phase shift keying. (eight signals in the signal set distinguished by eight phases ±45° apart.)

ATIS: Acronym (pronounced "Ay-tis" or “Ah-tis”) & Abbr., Automatic Transmitter Identification Signal required by FCC regulation since 1991 on every U.S. satellite transmission. ATIS repeats the uplink's ID, call sign and location in Morse code every 30 seconds on the 7.1 MHz subcarrier.

Component Video: Video consisting of three independent signals; one luminance and two color difference signals or Green-Blue-Red signals.

Composite Video: A single signal with luminance, chrominance, sync, and color burst.

DTMF: Dual Tone Multiple Frequency signal used for control purposes.

DVB: Digital Video Broadcasting and the organization that promotes its standards.

DVB-S: A DVB standard for framing structure, channel coding and modulation for satellite services that uses QPSK modulation.

DVB-S2: A second generation DVB standard framing structure, channel coding and modulation systems for video and other broadband satellite applications. DVB-S2 utilizes coding that is more bandwidth efficient than that used in DVB-S and DVB-DSNG, and it includes options for 8PSK modulation.

EIRP: Effective Isotropic Radiated Power. A satellite's signal strength as transmitted at a particular location, measured in decibel-watts per square meter.

Headroom: The level difference between peak audio level and test tone level.

HPA: High power amplifier used to amplify the transmitter signal before being radiated by the antenna.

Operating Level: The level at which VU meters read zero with 400 Hz reference test tone. Equal to Peak Audio Level minus Headroom.

OQPSK: Off-set quadrature phase shift keying. A form of QPSK in which each of the four signals are limited to no more than a ±90° phase shift.

Peak Audio Level: A low frequency sine wave whose peaks are of the maximum amplitude the system can pass without distortion. A 400 Hz tone of this level produces Peak Subcarrier Deviation.

Peak Subcarrier Deviation: The maximum excursion from carrier center frequency when frequency modulated by a 400 Hz tone at Peak Audio Level.

Peak Video Deviation: The maximum excursion from carrier center frequency when frequency modulated by a 762 kHz sine wave of the same peak-peak amplitude as the video signal before pre-emphasis.

QPSK: Quadrature phase shift keying. Phase modulation where the modulating signal shifts the instantaneous phase of the modulated wave to preset values (four signals in the signal set distinguished by four phases ±90° apart.).

SOC: Satellite Operations Center. Former umbrella term for the PBS facility located at 6455 Stephenson Way, Springfield, VA. As the SOC, it functions as the control point for the transmission of PBS-originated satellite signals and the monitoring of all satellite resources under the legal control of PBS. It is also the location for origination equipment for the Annenberg Channel. Currently the SOC is considered part of the Network Operations Center or NOC.

SSPA: Solid State Power Amplifier.

Subcarrier Injection: The dB level difference between the main carrier and the first sideband when the main carrier is modulated by the single subcarrier and no video. This measurement is performed at the output of the transmitter.

Transmitter: The equipment that modulates the main carrier with the baseband signal.

TWTA: Traveling Wave Tube Amplifier.

VU: An average responding meter with standard ballistic adjusted so that it reads zero at plant operating level.

WPM: Words per minute. Refers to number of words (five letters per word) transmitted per minute via international Morse code.

10. REFERENCES

The performance specifications listed are not intended to include all parameters of importance in the operation of a video uplink. It is recommended that all PBS uplink operators establish a library of reference material and become familiar with the following documents:

FCC Rules, Part 25. (US Government Printing Office, Washington, DC 20402).

Digital Video Broadcasting (DVB) - Framing structure, channel coding and modulation for 11/12 GHz satellite services, ETSI EN 300 421, http://www.etsi.org/.

Digital Video Broadcasting (DVB) - Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2), ETSI EN 302 30, http://www.etsi.org/.

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ANSI/SMPTE specifications and SMPTE Recommended Practice

SATELLITE UPLINK COMMISSIONING

1. SCOPE

This TOS establishes the responsibilities and procedures for initial testing and commissioning of uplink sites used to access PBS controlled satellite transponders.

This TOS also applies whenever there has been a major change to an uplink site including any of the following elements: antenna, power amplifier, upconverter, or encoder.

The procedures require the cooperation of the uplink operator, the PBS Satellite Operations Center (SOC), and SES Worldskies.

2. REGISTRATION PROCEDURE

Prior to the initial access of a PBS controlled satellite transponder, the uplink operator and PBS are required to follow the procedures below:

2.1 Uplink Operator

2.1.1 Contact PBS SOC (703-750-8214) to schedule the initial testing.

2.1.2 Upon receipt from PBS, complete the PBS/SES Worldskies Uplink Information Form and return it to PBS SOC (A sample of the form is included on Page 3 of this TOS).

2.2 PBS Satellite Operations Center (SOC)

2.2.1 Send the completed Uplink Information Form to SES Worldskies (Fax 410-549-4388) and place a copy of this form on file.

2.2.2 Schedule initial testing with SES-Worldskies access control center.

2.2.3 SES Worldskies will prepare a profile and mask in their Carrier Monitoring System based upon the calculated link budget for the accessing site.

3. Initial Access

For the initial access of a PBS controlled satellite transponder, the uplink operator and PBS are required to follow the procedures below:

3.1 Uplink Operator

3.1.1 Follow the directions of PBS SOC.

3.1.2 When the modulated signal is optimized, record and post the uplink power level as set by the PBS SOC control center.

Note: This will be the profile uplink power level for future satellite accesses. This level may be increased or decreased at the direction of PBS SOC at any time. (e.g. weather conditions, interference, etc).

3.2 PBS Satellite Operations Center (SOC)

3.2.1 Set up Carrier Monitoring System for signal verification.

3.2.2 Contact the Uplink Site to be tested.

3.2.3 Have uplink site confirm center frequency, polarity, preset power, and modulation is removed.

3.2.4 Direct the site to access the transponder with a clean (unmodulated CW), low power carrier.

1) Verify the correct polarity and center frequency.

2) Increase uplink power to a level adequate for the cross-polarization measurement.

3) Adjust for and verify >30 dB cross-pol isolation.

3.2.5 Direct the site to modulate their signal**.**

1) Adjust the transmit power to match the downlink carrier output backoff (OBO) as calculated in the link budget.

2) Verify the spectral shape.

Note: Failure to meet spectral shape is often a symptom of excessive drive to the Up-Converter.

3) Verify the bandwidth.

Note: Excessive bandwidth often indicates excessive drive to the Up-Converter, incorrect modulation type (e.g. BPSK instead of OQPSK or QPSK), and or incorrect data or sample rate.

4) Verify the center frequency.

Note: Incorrect frequency can be symptomatic of improper settings or malfunction of the encoder or up-converter.

5) Print the Carrier Monitoring System measured values and make a spectrum plot.

3.2.6 PBS SOC will forward the recorded Carrier Monitoring System information to SES Worldskies and maintain a file with this information for future reference.

3.2.7 PBS SOC will maintain a copy of the uplink information form with the Emergency Contact information in the Control Room.

PBS/SES Worldskies Uplink Information Form

Uplink Owner / Operator: _____

Uplink Address: _____

_____

_____

Uplink Direct Phone: _____

Uplink Fax: _____

General Use Phone: _____

Contact(s):

List of contact names in the event it becomes necessary to escalate a problem:

(1) _____ Telephone _____

(2) _____ Telephone _____

(3) _____ Telephone _____

Telephone number where uplink control operator can be reached 24 hours per day if needed: _____

Uplink Location: Latitude: _____ Longitude: _____

AMC-21 Pointing Angle: Azimuth: _____ Elevation: _____

Antenna: Manufacturer, Model, and Size: _____

Fixed or Steerable: _____

FCC License Call Sign: _____

2 or 4 port feed: _____

Uplink Electronics Manufacturer, Model, Type:

Encoder: _____

Modulator: _____

Frequency upconverter: _____

(Minimum Frequency Step Size): _____

HPA (Klystron or TWT): _____

Maximum Capable Power:_____

HPA Phase Combine (Y/N): _____

HPA Size: _____

Form Completed By: _____

Date: _____