



## **PBS Technology & Operations**

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# **TECHNICAL OPERATING SPECIFICATIONS**

## **Satellite Uplinks**

2013 Edition

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### **1. SCOPE AND PURPOSE**

This specification defines uplink performance requirements for the Public Television Interconnection System. These parameters will address the settings for uplink MPEG-4 and MPEG-2 encoders, multiplexer, DVB-S and DVB-S2 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 to member stations and on satellite AMC-1 for C-Band service for home consumers. The modulation formats in use are DVB-S2 for all MCPC services and HD SCPC services and either DVB-S or DVB-S2 for all SD SCPC services. Users are encouraged to utilize DVB-S2 modulation on SD transmissions whenever possible. DVB-S2 modulation will become a requirement on all services at a future date TBD. All of these services have a payload contained within a standard MPEG transport stream. For all MCPC services and HD SCPC services, MPEG-4 is used for the video encoding. For all SD SCPC services, MPEG-4 or MPEG-2 may be used for the video encoding. Users are encouraged to utilize MPEG-4 encoding whenever possible. MPEG-4 encoding will become a requirement on all services at a future Date TBD. All KU services use AC-3 encoded audio

streams. For the home consumer C-Band services, MPEG-2 video encoding and Musicam audio encoding are utilized. 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 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, at least 15 minutes prior to and at the time of illumination of any Public Television 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 immediately. This directive to terminate requires immediate compliance.

In addition to the monitoring above, PBS will transmit Carrier ID information as identified in the WBU-ISOG Best Practices document. All uplink facilities accessing the Public Television Interconnection System should comply with the guidelines outlined in the Best Practices document. This document can be found at <http://rfi-eui.org/>

### 3. CERTIFICATION

#### 3.1 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.

#### 3.2 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 1of this TOS.**

### 4. AMC 21 PBS SATELLITE TRANSMISSION PARAMETERS

This section defines the set up parameters for 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 transponder24 is host to multiple video channels (e.g. HD01, HD02, HD03, SD01, SD02, SD03, SD04) that originates 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 transponder 23 is 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, 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.

AMC-21 Ku-Band transponder 21 is host to a single SCPC data carrier supporting the NRT NR01 service that is transmitted from a single uplink location.

All PIDs are listed in decimal and hex.

**4.1 AMC21/Ku21 (Horizontal) NRT File delivery**

**Emission**

**4.1.1 PBS NRT Distribution Service**

L-band Receiver Freq.:	1370 MHz
Modulation:	DVB-S2 8PSK 5/6, Roll-off (Alpha) 1.200
Symbol Rate:	30 MS/s
Bandwidth	36 MHz

**Programs**

NR01 file delivery schedule.

**4.2 AMC21/ Ku22 (Vertical) No longer in use by the Public Broadcasting Interconnection System**

**Programs – No Programming currently on this transponder**

**4.3 AMC21- Ku23 (Horizontal) SCPC Channels (5 Separate Services):**

**4.3.1 HD04**

**Emission**

Rx Freq. setting	1395.5 MHz
Modulation:	DVB-S2 8-PSK
FEC:	3/4, 188 byte data packets
Roll-off:	1.20 (Alpha)
Symbol Rate:	6.25 MS/s
Transport BW:	13.925974 Mbps

**Program**

MPEG Program Number:	3
PMT PID:	48 (0x30)
Video & PCR PID:	49 (0x31)
Video Coding:	MPEG-4AVC 12.5 Mbps (CBR) 4:2:0 GOP = 32, 3 B frames, Open,
Audio PID:	52 (0x34) – Main Program
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
Audio PID:	53 (0x35) – Secondary Audio Program
Descriptor:	spa
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: SAP))
Dialnorm setting:	-31 (fixed)
Dynrange setting:	none
Audio PID:	54 (0x36) – Descriptive Video Service
Descriptor:	eng
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: DVS))
Dialnorm setting:	-31 (fixed)
Dynrange setting:	none

**4.3.2 HD05**

**Emission**

Rx Freq. setting	1405.0 MHz
Modulation:	DVB-S2 8-PSK
FEC:	3/4, 188 byte data packets
Roll-off:	1.200 (Alpha)
Symbol Rate:	6.25 MS/s
Transport BW:	13.925974 Mbps

**Program**

MPEG Program Number:	3
PMT PID:	48 (0x30)
Video & PCR PID:	49 (0x31)
Video Coding:	MPEG-4AVC
	12.5 Mbps (CBR)
	4:2:0
	GOP = 32, 3 B frames, Open

Audio PID:	52 (0x34) – Main Program
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

Audio PID:	53 (0x35) – Secondary Audio Program
Descriptor:	spa
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: SAP))
Dialnorm setting:	-31 (fixed)
Dynrange setting:	none

Audio PID:	54 (0x36) – Descriptive Video Service
Descriptor:	eng
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: DVS))

Dialnorm setting: -31 (fixed)  
 Dynrange setting: none

**4.3.3 SD05 (Items in parenthesis are legacy DVB-S, MPEG-2 parameters)**

The format of these carriers shall be either MPEG4/DVB-S2/8PSK or MPEG2/DVB-S/QPSK. It is not permissible to mix and match the encoding and modulation parameters.

**Emission:**

Rx Freq. setting 1413 MHz  
 Modulation: DVB-S2 8-PSK (DVB-S QPSK)  
 FEC: 3/4, 188 byte data packets  
 Roll-off: 1.20 (Alpha)  
 Symbol Rate: 4.444 MS/s  
 Transport BW: 4.456312 (6.143177 Mbps)

**Program**

MPEG Program Number: 11  
 PMT PID: 176 (0xb0)  
 Video & PCR PID: 177 (0xb1)  
 Video Coding: MPEG-4 AVC (MPEG-2)  
 2.5 Mbps (4.0 Mbps) (CBR)  
 4:2:0  
 GOP = 32, 3 B frames, Open (GOP = 15, 2 B Frames, Closed,

Fixed)  
 Open

Audio PID: 180 (0xb4) – Main Program  
 Descriptor: eng  
 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 Audio Program  
 Descriptor: spa  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP))  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

Audio PID: 182 (0xb6) – Descriptive Video Service  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: DVS))  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

**4.3.4 SD06 (Items in parenthesis are legacy DVB-S, MPEG-2 parameters)**

The format of these carriers shall be either MPEG4/DVB-S2/8PSK or MPEG2/DVB-S/QPSK. It is not permissible to mix and match the encoding and modulation parameters.

**Emission**

Rx Freq. setting 1419 MHz  
 Modulation: DVB-S2, 8-PSK (DVB-S QPSK)  
 FEC: 3/4, 188 byte data packets  
 Roll-off: 1.20 (Alpha)

Symbol Rate: 4.444 MS/s  
 Transport BW: 4.456312 (6.143177 Mbps)

**Program**

MPEG Program Number: 11  
 PMT PID: 176 (0xb0)  
 Video & PCR PID: 177 (0xb1)  
 Video Coding: MPEG-4 AVC (MPEG-2)  
 2.5 Mbps (4.0 Mbps) (CBR)  
 4:2:0  
 GOP = 32, 3 B frames, Open (GOP = 15, 2 B Frames, Closed,

Fixed)

Audio PID: 180 (0xb4) – Main Program  
 Descriptor: eng  
 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 Audio Program  
 Descriptor: spa  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

Audio PID: 182 (0xb6) – Descriptive Video Service  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: DVS)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

**4.3.5 SD07 (Items in parenthesis are legacy DVB-S, MPEG-2 parameters)**

The format of these carriers shall be either MPEG4/DVB-S2/8PSK or MPEG2/DVB-S/QPSK. It is not permissible to mix and match the encoding and modulation parameters.

**Emission**

Rx Freq. setting 1425 MHz  
 Modulation: DVB-S2, 8-PSK, (DVB-S QPSK)  
 FEC: 3/4, 188 byte data packets  
 Roll-off ( $\alpha$ ): 1.20  
 Symbol Rate: 4.444 MS/s  
 Transport BW: 4.456312 Mbps (6.143177 Mbps)

**Program**

MPEG Program Number: 11  
 PMT PID: 176 (0xb0)  
 Video & PCR PID: 177 (0xb1)  
 Video Coding: MPEG-4 AVC (MPEG-2)  
 2.5 Mbps (4.0 Mbps) (CBR)  
 4:2:0  
 GOP = 32, 3 B frames, Open (GOP = 15, 2 B Frames, Closed,

Fixed)

Audio PID: 180 (0xb4) – Main Program

Descriptor:	eng
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 Audio Program
Descriptor:	spa
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: SAP)
Dialnorm setting:	-31 (fixed)
Dynrange setting:	Film mode (fixed)
Audio PID:	182 (0xb6) – Descriptive Video Service
Descriptor:	eng
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: DVS)
Dialnorm setting:	-31 (fixed)
Dynrange setting:	Film mode (fixed)

#### 4.4 AMC21/ Ku24 (Vertical) MCPC Channels (7 Services)

##### Emission

Rx Freq. setting	1430 MHz
Modulation:	DVB-S2 8-PSK,
FEC:	3/4, 188 byte data packets
Roll-off (Alpha)	1.20
Symbol Rate:	30.0MS/s
Transport BW:	66.844735 Mbps

##### Programs

#### 4.4.1 HD01

MPEG Program Number:	3
PMT PID:	48 (0x30)
Video & PCR PID:	49 (0x31)
Video Coding:	MPEG-4
	12.5 Mbps (CBR)
	4:2:0
	GOP = 32, 3 B frames, Open
Audio PID:	52 (0x34) – Main Program
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
Audio PID:	53 (0x35) – Secondary Audio Program
Descriptor:	spa
Audio Coding:	Dolby AC-3
Audio Bitrate:	192 kbps
Channel Mode:	2/0 (Stereo: SAP)

Dialnorm setting: -31 (fixed)  
 Dynrange setting: none

Audio PID: 54 (0x36) – Descriptive Video Service  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: none

**4.4.2 HD02**

MPEG Program Number: 3  
 PMT PID: 64 (0x40)  
 Video & PCR PID: 65 (0x41)  
 Video Coding: MPEG-4  
 12.5 Mbps (CBR)  
 4:2:0  
 GOP = 32, 3 B frames, Open

Audio PID: 68 (0x44) – Main Program  
 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

Audio PID: 69 (0x45) – Secondary Audio Program  
 Descriptor: spa  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: none

Audio PID: 70 (0x46) – Descriptive Video Service  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: none

**4.4.3 HD03**

MPEG Program Number: 5  
 PMT PID: 80 (0x50)  
 Video & PCR PID: 81 (0x51)  
 Video Coding: MPEG-4  
 12.5 Mbps (CBR)  
 4:2:0  
 GOP = 32, 3 B frames, Open

Audio PID: 84 (0x54) – Main Program  
 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

Audio PID: 85 (0x55) – Secondary Audio Program  
 Descriptor: spa  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: none

Audio PID: 86 (0x56) – Descriptive Video Service  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: none

**4.4.4 SD01**

MPEG Program Number: 11  
 PMT PID: 176 (0xb0)  
 Video & PCR PID: 177 (0xb1)  
 Video Coding: MPEG-4 AVC  
 3 Mbps (CBR)  
 4:2:0  
 GOP = 32 3 B Frames, Open

Audio PID: 180 (0xb4) – Main Program  
 Descriptor: eng  
 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 Audio Program  
 Descriptor: spa  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

Audio PID: 182 (0xb6) – Descriptive Video Service  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: DVS)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

Audio PID: 183 (0xb7) – 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)

**4.4.5 SD02**

MPEG Program Number: 12  
 PMT PID: 192 (0xc0)  
 Video & PCR PID: 193 (0xc1)  
 Video Coding: MPEG-4 AVC  
 3 Mbps (CBR) 4:2:0  
 GOP = 32, 3 B Frames, Open

Audio PID: 196 (0xc4) – Main Program Audio  
 Descriptor: eng  
 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 Audio Program  
 Descriptor: spa  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

Audio PID: 198 (0xc6) – Descriptive Video Service  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: DVS)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

**4.4.6 SD03**

MPEG Program Number: 13  
 PMT PID: 208 (0xd0)  
 Video & PCR PID: 209 (0xd1)  
 Video Coding: MPEG-4  
 3 Mbps (CBR) 4:2:0  
 GOP = 32, 3 B Frames, Open

Audio PID: 212 (0xd4) – Main Program Audio  
 Descriptor: eng  
 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 Audio Program  
 Descriptor: spa  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

Audio PID: 214 (0xd6) – Descriptive Video Service  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: DVS)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

**4.4.7 SD04**

MPEG Program Number: 14  
 PMT PID: 224 (0xe0)  
 Video & PCR PID: 225 (0xe1)  
 Video Coding: MPEG-4  
 3 Mbps (CBR)  
 4:2:0  
 GOP = 32, 3 B Frames, Open

Audio PID: 228 (0xe4) – Main Program Audio  
 Descriptor: eng  
 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 Audio Program  
 Descriptor: spa  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: SAP)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

Audio PID: 230 (0xe6) – Descriptive Video Service  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps  
 Channel Mode: 2/0 (Stereo: DVS)  
 Dialnorm setting: -31 (fixed)  
 Dynrange setting: Film mode (fixed)

**4.4.8 Emergency Services Data (WARN)**

Bitrate: 125 Kbps  
 PID and data type: 2321 (0x911)

**4.4.9 NDI (National Data Incorporated)**

Bitrate and PID:                   **256 Kbps over the listed PIDS**  
   2048 (0x800)  
   2049 (0x801)  
   2050 (0x802)  
   2051 (0x803)  
   2052 (0x804)  
   2053 (0x805)  
   2054 (0x806)  
   2055 (0x807)

**4.5     AMC1/ C20 (Vertical) MCPC Channels (2 Services)**

**Emission**

L-band Receiver Freq.:           1059 MHz  
 Modulation:                       DVB-S QPSK,  
 FEC                                 3/4  
 Roll-off (Alpha)                 1.200  
 Symbol Rate:                     14.028731 MS/s  
 Transport Stream total bandwidth: 19.392658 Mb/s

**Programs**

**4.5.1   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  
 Descriptor:                     eng  
 Audio Coding:                   MPEG  
 Audio Bitrate:                 192 kbps

Audio 3 PID:                     54 (0x36) – Secondary Program Audio  
 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

**4.5.2   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 or Secondary Program 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

**4.6 NSS9 (Left Handed-Circular) Transponder 9 (Pacific Feed)**

**Emission**

L-band Receiver Freq.: 998.7 MHz  
 Modulation: DVB-S2 QPSK  
 FEC: 3/4  
 Roll-off (Alpha): 1.20  
 Symbol Rate: 2.126 MS/s  
 Transport Stream total bandwidth: 3.087 Mb/s

**Programs**

**4.6.1 HD Channel (SD downconvert of HD01)**

MPEG Program Number: 11  
 PMT PID: 176 (0xb0)  
 Video & PCR PID: 177 (0xb1)  
 Video Coding: MPEG-4  
 2.40 Mbps (constant bit rate)  
 4:2:0  
 GOP = 24, 4 B frames, Closed, Fixed

Audio 1 PID: 180 (0xb4) – Main Program Audio  
 Descriptor: eng  
 Audio Coding: Dolby AC-3  
 Audio Bitrate: 192 kbps

Audio 2 PID: 181 (0xb5) – Descriptive Video  
 Descriptor: eng  
 Audio Coding: Dolby AC-3

Audio Bitrate: 192 kbps

## 5. NON-PBS MEMBER STATION HD UPLINK ORIGINATION

This section defines the set up parameters for HD digital transmission of a special event program for reception by PBS. These parameters will address the settings for uplink MPEG-4 & 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.

**5.1 MPEG-4:** The following are normal parameter settings for an emission system for Public Television Single Channel per Carrier (SCPC) MPEG-4 DVB-S2 on a full transponder.

**5.1.1** Symbol rate: 6.25 MS/s, equivalent information rate: 13.926 Mbps

**5.1.2** Frequency

**5.1.2.1** Information to be provided at time of scheduling

**5.1.2** Modulation: DVB-S2 8PSK 3/4, 188 Byte data packets, Roll-off (Alpha)  $\leq 1.20$

**5.1.3** MPEG transport stream parameters

**5.1.3.1** Video coding: MPEG-4, Main Profile @ High Level 4.0, at 12.5 Mbps  
1920 x 1080i, 4:2:0, 16 x 9 aspect ratio preferred

**5.1.3.2** MPEG-4 Program Number: 3

**5.1.3.3** PMT PID: 48 (0x30)

**5.1.3.4** Video & PCR PID: 49 (0x31)

**5.1.3.5** Audio PIDs: 52 (0x34), 53 (0x35), 54 (0x36)

**5.1.3.6** 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

**5.1.4** Ancillary data parameters

**5.1.4.1** 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

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

- 5.1.4.2 Automatic Format Description  
Insertion on Line 11, Field 1 and Field 2
- 5.1.4.3 V-chip (Optional)
- 5.1.4.4 Nielsen Data – AMOL (Optional)
- 5.1.4.5 Additional Metadata (Optional)  
Dolby DID insertion

**5.2 MPEG-2:** The following are normal parameter settings for an HD emission system for Public Television Single Channel Per Carrier (SCPC) MPEG-2 DVB-S on a full transponder.

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

**5.2.2 Frequency**

5.2.2.1 Information to be provided at time of scheduling

**5.2.2 Modulation:** DVB-S QPSK 3/4, 188 Byte data packets, Roll-off (Alpha)  $\leq 0.35$

**5.2.3 MPEG transport stream parameters**

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

5.2.3.2 MPEG-2 Program Number: 3

5.2.3.3 PMT PID: 48 (0x30)

5.2.3.4 Video & PCR PID: 49 (0x31)

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

5.2.3.6 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

**5.2.4 Ancillary data parameters**

5.2.4.1 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

**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

**5.2.4.2 Automatic Format Description**

Insertion on Line 11, Field 1 and Field 2

**5.2.4.3 V-chip (Optional)****5.2.4.4 Nielsen Data – AMOL (Optional)****5.2.4.5 Additional Metadata (Optional)**

Dolby DID insertion

**6. Miscellaneous RF PARAMETERS****6.1 Satellites:** AMC-21, AMC-1.**6.2 Frequency Band:** Ku-Band, C-Band.**6.3 Transponder Frequency Allocation:** As assigned by PBS Broadcast Operations and verified with the SOC during check-in.**6.4 Frequency Tolerance:**  $\pm 0.001\%$  of uplink reference frequency.**6.5 Antenna Performance:** 2° Compliant per FCC 25.209 unless otherwise waived.**6.6 Cross- Polarization Isolation:**  $\geq 30$  dB for Ku-Band,  $\geq 25$  dB for C-band.**6.7 EIRP:** As directed by PBS SOC at “Check-In.”



## 7. GLOSSARY

**8PSK:** Eight level phase shift keying. (eight signals in the signal set distinguished by eight phases  $\pm 45^\circ$  apart.)

**Carrier ID:** The insertion of carrier ID information in the MPEG stream will assist in the rapid identification of satellite streams in troubleshooting satellite interference problems.

**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.

**MPEG-2:** MPEG-2 is widely used as the format of digital television signals that are broadcast by terrestrial (over-the-air), cable, and direct broadcast satellite TV systems. MPEG-2 was the second of several standards developed by the Moving Pictures Expert Group (MPEG) and is an international standard (ISO/IEC 13818)

**MPEG-4:** A method of defining compression of audio and visual (AV) digital data. It was introduced in late 1998 and designated a standard for a group of audio and video coding formats and related technology agreed upon by the ISO/IEC Moving Picture Experts Group (MPEG) (ISO/IEC JTC1/SC29/WG11) under the formal standard ISO/IEC 14496 – Coding of audio-visual objects.

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

**Peak Level:** True-peak level is the maximum (positive or negative) value of the signal waveform in the continuous time domain; this value may be higher than the largest sample value in the 48 kHz time-sampled domain.

**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  $\pm 90^\circ$  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. Currently the SOC is considered part of the Technical Maintenance Center (TMC).

**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.

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

## 8. 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/>.

Nbr.1-WBU-ISOG-SUIRG - CarrierIDSpecForVideo.doc <http://rfi-eui.org/p.asp?id=31>

SES Worldskies Commercial Operations  
Systems Users Guide (SES Worldskies, Princeton, New Jersey:).

Communications Satellite Handbook, by Walter L. Morgan, Gary D. Gordon, (John Wiley & Sons; ISBN: 0471316032).

Satellite Communication, Second Edition. Robert M. Gagliardi, ©1991 Van Nostrand Reinold Press.

Introduction to Communication Engineering, Second Edition, Robert M. Gagliardi, John Wiley & Sons.

The MPEG Handbook. John Watkinson ©2004, Focal Press, ISBN: 0 240 80578 X.

ANSI/SMPTE specifications and SMPTE Recommended Practice

ITU-R BS.1770-3, Algorithms to measure audio programme loudness and true-peak audio level.

## Appendix 1 - 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.

### 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 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 (Fax 410-549-4388) and place a copy of this form on file.

**2.2.2** Schedule initial testing with SES access control center.

**2.2.3** SES 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 8PSK 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 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 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: \_\_\_\_\_

Encoding parameters: \_\_\_\_\_

Modulator: \_\_\_\_\_

Modulation parameters: \_\_\_\_\_

Frequency upconverter: \_\_\_\_\_

(Minimum Frequency Step Size): \_\_\_\_\_

HPA (Klystron or TWT): \_\_\_\_\_

Maximum Capable Power: \_\_\_\_\_

HPA Phase Combine (Y/N): \_\_\_\_\_

HPA Size: \_\_\_\_\_

Form Completed By: \_\_\_\_\_

Date: \_\_\_\_\_