STS-95
High Definition Television Coverage

Preliminary Technical Report
November 13, 1998

Summary

Harris Corporation produced and distributed high definition coverage of the launch of STS-95 as lead partner with NHK Enterprises, representing NHK/Japan Broadcasting Corporation and Capitol Broadcasting/WRAL-HD of Raleigh, NC.

The resulting program was distributed, without charge, via satellite in a format approved by the Federal Communications Commission for broadcast in the US by recently authorized digital television (DTV) stations. It is estimated that more than twenty-five US DTV stations received and broadcast the program using terrestrial transmitters. Many of the stations used the broadcast to publicize the inauguration of their DTV services and some established public demonstration sites in conjunction with manufacturers and vendors of television equipment.

The CBS Network carried the launch on its Owned & Operated HDTV Stations and uplinked the feed to its satellite system for other CBS affiliates who were equipped to receive it.

Several ABC, NBC and PBS stations also carried the program..

In a separate, record-only operation, NHK recorded, using portable high definition equipment, the landing of STS-95 from two angles.

Participants

Production Partners

Harris Corporation was responsible for the DTV broadcast/transmission facilities, coordination of the production of the live program and production of several pre-produced packages.

NHK Enterprises America and NHK/Japan provided technical production expertise and high definition production equipment.

Capitol Broadcasting/WRAL-HD brought experience in documentary coverage of major events, handled pre-mission package production and provided additional high definition equipment.

Supporting Vendors

Unity Motion (Satellite HD Network) contributed satellite transponder space and HDTV IRD’s for the distribution of the event.

Vinten, Inc. provided remote controlled camera support equipment for a camera located near the launch pad.

Telecast Fiber Systems provided digital data and high definition digital fiber transmission equipment.

Kodak shot film and transferred it to high definition for use in Harris pre-produced video pieces.

Distribution outlets

DTV stations tentatively planning to carry the program
(This is not a final list. Neal Stein of Harris can provide updated information if needed.)

ABC stations
- WFAA, Dallas, TX
- WCVB, Boston MA
- WSB, Atlanta GA
- WXIX, Cincinnati, OH
- WKOW, Madison, WI

CBS stations
- WRAL-HD, Raleigh, NC
- WCBS, New York, NY
- KYW, Philadelphia, PA
- KCBS, Los Angeles, CA
- KHOU, Houston, TX
- WBTV, Charlotte, NC
- WKRC, Cincinnati, OH
- WBNS, Columbus, OH

PBS stations
- KCTS, Seattle, WA
- KOPB, Portland, OR
- WETA, Washington, DC
- WMVS, Milwaukee, WI

NBC stations
- WRC, Washington, DC
- KXAS, Fort Worth, TX
- WTHR, Indianapolis, IN

Other users who planned to display the event
- Smithsonian Air and Space Museum, Washington, DC
- Museum of Natural History, NYC
- Liberty Science Museum, jersey City, NJ
- Chicago Museum of Broadcasting, Chicago, IL
- Detroit Palace Arena, Detroit MI
- Several IMAX theaters (TBD locations)

Principal Contacts

Neal Stein of Harris was the overall project coordinator of the live event and John Greene of Capitol Broadcasting was project producer and coordinator of WRAL's participation. For NHK Enterprises America, Elke Titus coordinated NHK's event participation and Kohei Nakae handled the technical issues related to the high definition acquisition and the broadcast feed to Japan.

Philip Hack was the NHK Enterprises Producer and coordinated facility arrangements and production crews. C. R. Caillouet of Vision Unlimited/LA was Technical Producer for this event for NHK and handled high definition equipment interfaces.

Neil Stein was the local contact near KSC and Harris provided local logistical support for the event. John Turner of Turner Engineering coordinated satellite carrier and communication requirements for Harris. Ken Fouts directed and Jess Stephens produced the live event for Harris.

Tom Beauchamp of WRAL handled portable equipment crews for pre-mission coverage and coordinated the on-site editing operations.

Introduction

This report describes the physical, technical and operational configuration for the high definition coverage of the launch and includes some planning information for reference. It has been updated after the event to reflect the actual operation as close as possible. It is organized in an outline format with comments added to clarify sketchy entries. I opted for repetition over clean presentation where I thought that the information was useful.

NASA support requirements

KSC provided:

the use of pedestal 9 at Pad B CS2.

NHK provided a Sony fiber cable, pan/tilt control cable and DC power cable to our protected enclosure near the NASA fiber optic terminal (FOT). One 15 amp/115 VAC power circuit was provided for the enclosure (actual current draw less than 10 amps). The enclosure contained a camera power supply, fiber interface box and pan/tilt power supply. The enclosure was not ventilated but was painted white to reflect heat.

two single mode fiber connections from KSC News Facility to each approved remote camera position. These fibers were carefully polished and prepared by the NASA wideband personnel to support the 1.5 Gbps high definition digital signals. The three locations were:

Pad 39B CS2 pedestal 9 (FOT behind pedestals).

VAB Roof (FOT on roof).

LC 39 Observation Tower (FOT at tower base).

one additional single mode fiber to the CS2 site for pan/tilt control data (This was a low bandwidth data channel and needed no special polishing or conditioning.)

one single mode fiber connection from KSC News Facility to each of the KSC-requested distribution locations at the KSC Headquarters building and the LCC. (The LCC location was subsequently not used because of conflicts with the Presidential stage.)

access to a standard KSC broadcast video and audio “stump” for inclusion of NASA program material into the high definition television program.

power to Stage area, Production Compound and Transmission site (see power plan below.)

space for Press Site manned camera, Stage area, Production Compound and Transmission site.

access to the Saturn V building for installation of a satellite downlink and Rear Projection display.

permission to construct a camera platform on the point adjacent to the turning basin. We provided a platform with a height of approximately 3 feet and an footprint of eight by eight feet.

space in the KSC News Facility at the FOT rack for three Fiber interface breakout cables with small power supplies. These interfaces adapted the Sony camera fiber to the NASA ST terminals and provided appropriate signals to the camera control unit to allow operation without copper connectivity.

Physical Site Plan

Production Compound

The HD production compound consisted of three vehicles and was located on the grass, down the hill on the north side of the KSC News Facility, adjacent to the NASA Exchange trailer. The HD crew provided leveling hardware for the HD units.

The main and secondary units each required approximately 40 feet by 12 feet including stairs and are approximately 12 feet tall. The support (office) trailer occupied 60 x 15 feet including stairs. The office trailer was delivered by a local vendor (Gelco Space) to KSC prior to arrival by the HDTV crew.

The main unit provided camera control and production switching and the second unit provided audio and edit support along with remote camera control, graphics and teleprompter operation. Transmission encoding and video distribution was located in the support trailer along with a production office and talent preparation area.

Transmission site

ATSC encoded HDTV signals were modulated and delivered from the support trailer in the Production Compound to the primary and backup HDTV satellite uplink trucks, located down the hill on the opposite side of the KSC News Facility, using heliax cable supplied by Turner Engineering.

NHK parked a separate uplink vehicle near the HDTV uplink trucks for transmission of a clean version of the US program to Japan. This vehicle provided its own power. KDD provided a 45 Mbps HDTV encoder in the trailer and delivered the baseband digital signal to the uplink truck over 75 ohm coax provided by NHK.

Remote camera locations

There were three camera locations outside the Press Site area.

Pad B CS2 pedestal 9

This camera was enclosed in a Pelco EH6500-1 environmental (non-sealed) housing and was mounted on a Vinten HS-201R servo pan & tilt head.

VAB roof

This camera was manned during all uses.

LC39 Observation Tower on the crawler way, halfway between the Press Site and the launch pad

This camera was manned during all uses.

Stage location

Harris contractors constructed a 20 foot x 20 foot stage area at ground level, adjacent to the turning basin, for program commentary by two announcers and one guest.

Power Plan

The following power requirements were submitted to NASA/KSC

HDTV production compound = 200 amps @ 208 VAC/3 phase with neutral
150 amp/1 phase for NHK/Japan (HD unit A)
100 amp/1 phase for NHKE/US (HD unit B)
100 amp/1 phase for support trailer (HD unit C)

HDTV Satellite trucks = 2 x 60 amps @ 208 VAC/1 phase/no neutral

Stage lighting = 50 amps @ 208 VAC/1 phase with neutral

John Turner reported the following agreement following the second site survey on 8/14/98 after meeting with Philip Sprinkle of EG&G, the Press Site power contractor.

Production compound

A 120/208 VAC, 200 amp per leg, 3 phase fused disconnect with drop-side lugs will be furnished at the HDTV production vehicle compound to be located South of the parking lot and North of the News Center building. Lugs will be A/B/C/N/G. This feed is from shore power. Harris/NHK will provide tails from this box to all three vehicles.

The loads at full operation were measured at 170 amps, 170 amps and 135 amps on the three phases with less than 50 amps of neutral current.

Transmission site

A 100 amp per leg, 3 phase fused disconnect as above will be furnished at the Uplink vehicle location on the grass southeast of the News Center building. Harris/TE will provide tails from this box to the two trucks. Philip will try to get power from the nearby generator building but this feed may be from a generator.

Stage location

A 50 Amp per leg, 3 phase branch circuit from a nearby panel board was brought to the set area located between the turnaround basin and the parking lot.

Cable runs

The following cable runs were handled by the HDTV team.

Production compound to stage (150m)
Five 250m camera fibers (actual distance: approximately 150m)
150m 12 pair audio mult cable
150m 12 pair intercom mult cable

Stage to point camera
One 400m camera fiber run using three pieces. Joints were bagged for weather protection.

Production compound to Transmission site
Three heliax runs and one quad coax run

Production compound to NASA broadcaster stump
Seven NTSC coax runs
Six Audio XLR - one four pair and one two pair cables

Production compound to NASA News Facility
Three 50m Sony camera fibers, three interface boxes and six fiber jumpers
One four fiber cable for camera data and distribution video - additional coax inside the news facility for monitor video and audio.

Production compound to NASA News Center
One 75 ohm coax for distribution to HD monitor

Pad Camera to NASA FOT at Pad B CS2
One 50m Sony fiber cable, interface box and two fiber jumpers

VAB Camera to NASA FOT on VAB roof
One 200m Sony fiber cable (two 100m lengths), interface box and two fiber jumpers

LC 39 Observation Tower Camera to NASA FOT at Tower
One 200m Sony fiber cable (two 100m lengths), interface box and two fiber jumpers

The following cable runs were provided by KSC.

Three NASA fibers to Pad B CS2

Two NASA fibers to VAB second level

Two NASA fibers to LC 39 Observation Tower

One NASA fiber to KSC HQ for monitor site

One NASA fiber to LCC for monitor site

Video configuration

The Main HD unit contains a digital production switcher, 9 camera control units, four HD D5 recorders, one HDCam recorder, two upconverters, two down converters, an analog video routing switcher and appropriate monitoring equipment.

All analog distribution in the truck is Y/Pb/Pr conforming to SMPTE 240M and all sources have 1035 active lines.

The frame rate is 59.94 fields per second.

All camera outputs and recorder inputs and outputs to and from the video production switcher were connected via HD SDI.

The upconverter inputs to the video production switcher came through analog component inputs.

All monitor feeds were taken from analog component outputs.

The main VE monitor busses are fed from analog outputs of the primary digital switcher. Secondary VE monitor and return video feeds come from the analog auxiliary switcher.

The Harris logo was inserted downstream in the production switcher using an analog framestore in the unit. All program recordings and local distribution contained the bug with the exception of the NHK recording for transmission to Japan.

Two of the six available Auxiliary switch busses (HD SDI outputs) were used to control the main commercial output and a separate “non-commercial” feed for PBS stations.

There is a secondary analog routing switcher which selects from the two program outputs of the production switcher, an emergency bus from the analog router and a test signal. This switcher separately controls two truck output busses which are available as analog or reconverted HD SDI signals at the patch panels and on the external interface panels. The NHK program was controlled from the analog emergency bus and patched directly to the output of the secondary switcher where it was reconverted to HD SDI for delivery to the KDD encoder. The patch was necessary to prevent the switchover of monitors in the unit which normally occurs when the emergency analog switcher is activated.

In the event of a production swithcer failure, the emergency bus could be patched to all outputs to and all program switching could continue on the analog router. The NHK program recorder in the A Unit would continue to record the output of the system and transmission and distribution could be restored in short order. This compromise was necessary because three separate feeds were being generated at one time. In normal operation, any single switcher failure would be immediately corrected at the main outputs by selecting a single switch which changes both the switching source and the main program monitors.

In order to provide a stable source for the ATSC encoders during production testing and rehearsals, an SDI patch of the Pad Camera was delivered directly to the transmission room in the support trailer. An Evertz HD SDI logo inserter was used to insert the Harris logo onto the camera feed during those times.

See the Video Block Diagram for the switcher configurations.

Camera assignments/locations
These are the details for the cameras used for this event.

reference fields of view
- 18x lens
  - wide: 6 x 11 feet at 10 feet
  - tight: 4 x 7 inches at 10 feet
  - with extender: 255 x 450 feet at 3 miles
  - MOD = 3 feet
- 65x lens
  - wide: 5 x 9 feet at 10 feet
  - tight: 1 x 1.8 inches at 10 feet
  - with extender: 60 x 105 feet at 3 miles
  - MOD = 9 feet 3 inches

Camera 1
- Announce left
- HDC-700
- Heavy duty sticks and head
- 65 x 9.5 mm lens
- teleprompter installed

Camera 2
- Announce center/wide
- HDC-750 with build up kit
- Heavy duty sticks and head
- 18 x 7.8 mm lens
- teleprompter installed

Camera 3
- Announce right
- HDC-700
- Heavy duty sticks and head
- 65 x 9.5 mm lens
- teleprompter installed

Camera 4
- Press Site tracking camera
- HDC-700
- Heavy duty sticks and head for vertical tilt
- 65 x 9.5 mm lens
- new platform near water on point adjacent to the turning basin
- view of pad over water and vehicle ascent

Camera 5
- VAB Roof
- HDC-700
- Heavy duty sticks and head for vertical tilt
- 65 x 9.5 mm lens
- manned wide coverage of entire area
- shot of crawlerway
- cover shot of liftoff - heavy vibration after ignition
- tracking shot of ascent
- aerial view of grandstand and press area

Camera 6
- LC39 Observation Tower
- HDC-700
- Heavy duty sticks and head for vertical tilt
- 65 x 9.5 mm lens
- shot of water deluge
- shot of ascent profile

Camera 7
- Pad B Camera Site CS2 Pedestal 9
- HDC-750
- Pelco EH6500-1 environmental (non-sealed) housing
- Vinten HS-2010MH servo pan & tilt head
- Vinten Multicontroller II
- unidirectional 9600 baud data from the controller delivered over single mode fiber using a Telecast Adder terminal unit
- 18 x 7.8 mm lens
- remote control coverage of orbiter to tower clear
- shot of empty smoking pad after cloud passage
- housing did not get spattered during launch

Camera 8
- Press site color camera
- HDC-700
- Heavy duty sticks and head
- 65 x 9.5 mm lens
- view of grandstand and press area

Camera 9
- Press Site Clock shot
- HDC-750
- light duty sticks and head or mounted on stage grid
- 18 x 7.8 mm lens
- locked shot of countdown clock

NASA cameras
- AUX 2 analog input to production switcher
- NASA cameras via upconverter
- selected in NTSC from NASA ISO feeds and NASA Select feed
- shot of Launch Control Center
- shots of crew entering vehicle and inside orbiter
- long range shot ascent from Air Force trackers
- shot of JSC Mission Control Room after loss of visual contact

Recorder assignments/formats
These are the details for each high definition recorder.

VTR 1 (called “A”)
HD D5
Pad camera record
V1 digital input to production switcher
fed by V1 digital router (AUX 3)
located in A unit
NHK/Japan machine

VTR 2 (called “B”)
HD D5
VAB camera record
V2 digital input to production switcher
fed by Patch from camera 5 HD SDI out 2
located in A unit
NHK/Japan machine

VTR 3 (called “NHK”)
HD D5
Program record for NHK playback
V3 digital input to production switcher
fed by L2 HD SDI patch (Protected Line 2)
located in A unit
NHK/Japan machine

VTR 4 (called “Blue”)
HD D5
Package Playback/Switchable ISO record
V4 digital input to production switcher
fed by V3 digital router (AUX 5)
located in A unit
NHK/Japan machine

VTR 5 (called “Red”)
HDCam
Commercial Playback/PGM record for launch playback
AUX 1 digital input to production switcher
Program record BU and PGM playback
fed by L2 HD SDI patch (Protected Line 2)
located in A unit
NHK/NY machine

VTR 6
HD D5
LC39 Observation Tower record
fed by Patch from camera 6 HD SDI out 2
patchable feed to B unit - normally dedicated from camera 8
no switcher input
via 5 channel fiber unit
located in B unit
WRAL machine

VTR 7
HD D5
commercial program record for archive
fed by Patch from V4 digital router (AUX 6)
patchable feed to B unit - normally dedicated from commercial program
no switcher input
via 5 channel fiber unit
located in B unit
WRAL machine

VTR 8
- HD D5
- Press Site manned tracker camera record
- fed by Patch from camera 4 HD SDI out 2
- patchable feed to B unit - normally dedicated from camera 4
- no switcher input
- via 5 channel fiber unit
- located in B unit
- WRAL machine

VTR 9
- HDCam
- non-commercial program record for WRAL
- fed by Patch from V2 digital router (AUX 4)
- patchable feed to B unit - normally dedicated from non-commercial program
- no switcher input
- via 5 channel fiber unit
- located in B unit
- WRAL machine

VTR 10
- HDCam
- Playback for Camcorder tapes to NASA edit system
- Contains built-in NTSC down-converter
- integrated into Beta component system using KSC SDI->YUV converter
- no HD input/playback only
- no HD switcher input/standalone operation
- located in KSC News Center

Tape stock requirements
- HD D5
- HD Cam

Other inputs
- Chyron Infinit 525-line Character Generator
  - T1 fill and key analog inputs to production switcher
  - 525-line upconverted feed
  - uses two identical upconverters
- HD Framestore for Harris logo insertion into distribution stream

Monitor assignments
- Monitors for B unit - edit, audio, remote camera
  - 28” program monitor - NHK
  - 17” monitor for Pad camera - NHK
  - 10” monitor for wide announcer camera feed to audio - NHK
  - 10” monitor for additional camera feed to audio - NHK
- Monitors for Support trailer
  - 17” monitor for viewing - NHK
  - 17” monitor for XMSN - Turner
  - 17” monitor for XMSN - Turner
  - 17” monitor for KDD - NHK
- 32” Monitor for Set - Harris
- 32” Monitor for KSC News Center - Turner/Harris
- Rear projection display for Saturn V building - Turner/Zenith
- Rear projection display for KSC HQ building - Turner/Zenith
- Rear projection display for LCC - Turner/Zenith
- Rear projection display for KSC News Facility - Turner/Zenith
- 1962 color monitor for KSC News Facility - Turner/Zenith

Audio configuration

Audio on this event was handled similar to any live remote event with talent and a script. An experienced audio operator was hired and configured the audio system in the "B" unit because of a lack of space in the main unit.

Turner Engineering provided AES digital encoding hardware for audio distribution. Appropriate stereo channels were recorded on all tapes. Separate mixes of clean effects, commercial program, non-commercial program were generated for recordings and additional auxiliary feeds were generated for talent feedback, interrupted by directions from the television director.

Audio distribution and mixing was analog stereo, created in an external mix console in the "B" unit from announcer commentary, local effects microphones, playback audio from pre-recorded tapes and NASA mission sources. Surround information was encoded using a Dolby ProLogic encoder and monitored using a matching decoder. This type of surround signal passes transparently through stereo systems. We did not attempt to do a six channel mix because of the difficulty of properly monitoring the mix and maintaining the six channels through recording of multiple feeds.

Most of the audio equipment, including the main 48 input audio console, microphones, IFB equipment, amps and speakers were rented from television and audio rental houses.

NASA audio sources

These were delivered to the audio console and used as appropriate.
- Air-to-ground audio
- NASA commentary
- Pad microphones

Local effects microphones

Camera effects microphones

Each camera has the potential of delivering 2 microphones from the camera head to the Main unit. Some of those were connected to the audio console.

Announcer microphones

We dedicated a multi-cable to the stage for microphones.

Stage monitors

There were no speakers on the set.

B unit monitors

Program monitoring was provided in the B Unit from the audio mix console.

Four speakers and power amps were rented

Edit audio monitoring was provided in the edit console.

Communication configuration

Telephones

Offsite communication were handled using dedicated phone lines.

A dial-in broadcast service were provided for transmission updates.

12 phone lines were ordered.
- Instruments were provided by Turner Engineering.
- Two for uplink trucks
  - uplink coordination
  - uplink coordination
- Two for main unit
  - production coord
  - tech incoming
- Two for B unit
  - admin incoming
  - production coord

Six for trailer
admin incoming
fax incoming
data outgoing
transmission coordination
transmission coordination
transmission coordination

Communication Circuits

There were four party line circuits, originating in the main unit Clear-Com system.

Director's camera channel
This was the live operations channel for the event.
Double muff headsets were provided for some outdoor camera ops.

Producer's coordination channel
This was the off-line event planning channel for the event.

Audio
This was available for working audio problems among Maintenance, Transmission, Producers and Audio.

Tech
This channel was used for working technical problems among cameras, Video, Transmission and Maintenance.

The basic system has nine single-channel beltpacks and one remote station available. Additional multichannel stations were rented for the Audio, Transmission and Office position.

IFB to talent

The Director and Audio talked to three talent

A standalone panel was used at the director position.

We dedicated a mult for comm and IFB to the set.

Transmission configuration (as planned)

US feed (from John Turner, 10/13/98)

Video
The baseband video signal will be 1035i/59.94, compatible with 1080i/59.94. This signal is determined by the available production equipment (1035i) and transmission equipment (59.94 Hz).

Audio
Audio will be presented as a two (2) channel, Left front, Right Front feed without surround encoding. The signal will be encoded using the Dolby AC-3 process, 2/0 mode, LFE off, Surround Mode off.

ATSC Encoder
Audio and video encoding will be performed by a Harris/Lucent EVA 200/HDC-100 system with a transport stream rate of 19.39 MBPS

ATSC encoding particulars:
Some ATSC decoders we have investigated cannot yet automatically retrieve single channel program PID's. For stations doing a 'turnaround' this information is not required.
VPID is 49
APID is 52
AMode is AC-3

Uplink Modulation
Modulation will be QPSK with FEC set to 1/2. For the ATSC standard, this coding will provide a symbol rate of 21,043,097.478 and the occupied bandwidth will be 26.514 MHz. We will use Newtec NTC/2062 product for this feed.

Space Segment
Transmission is through a Domestic Ku Satellite. The transponder shall be T4, Xpdr 16L, d/l center freq is 12,155 MHz.

There will be a dual transmission system in place for redundancy.

Equipment details

The equipment required to receive the satellite feed includes the following material:
One 1.2 meter or larger satellite antenna with a Ku band feed horn and digital quality LNB. If a location doesn't already have this, it retails for under $500.
One L-band HDTV IRD.
Alternately, a commercial QPSK demod like EFData 2020, Newtec NTC/2060 and Radyne, Tiernan etc. Then, an HDTV decoder such as the Melco MH1100D or equal.
A display that can accept interlaced video at 33,750 KHz Horizontal and 59.9 Hz Vertical and be adjustable to 16:9 aspect ratio. Usually, equipment designed for VGA inputs will work with HDTV.
A two channel analog sound reproduction system.
Any location with questions should call John Turner directly at 973/263-1000.

Operational plan (from John Turner, 10/13/98)

We will perform encode and space segment testing without requiring the production vehicle output to be available. There will be a server used as a space segment 'keep-alive' data streamer.

The transponder has 24/7 HDTV on as of now so our affiliates can set up at their convenience.

Test schedule for Broadcast RF:
10/27/98 4:00PM-7:00PM ET Video test signals and tones. Call in assistance.
10/28/98 4:00PM-5:00PM ET Video test signals and tones. Tel XMSN bridge up.
10/28/98 5:00PM-7:00PM ET Encoded program audio/video. Tel XMSN bridge up.
10/29/98 10:00AM-11:00AM ET Video Test signals and tones. Tel XMSN bridge up.
10/29/98 11:00AM-7:00PM Live (ISO cam) audio/video.
Program feed starts at 1:00PM.
10/30/98 Time reserved on T4 if needed. No test time planned.

NHK feed to Japan

KDD will provide an encoded feed to the NHK uplink truck for delayed broadcast of the US launch program to NHK after the US feed has been terminated. Uplink will be on G9, 123 deg. W., Xpdr 3, C-Band. Modulation is QPSK, pre/post RS data rate is 44.736 Mb/s (DS-3).

Technical specs

Production format details for engineers

All cameras are 2/3 inch high definition FIT CCD cameras and operate at 1035i.

The production format in use for both productions was 1125 scan lines, interlaced, 1035 active lines, 16:9 aspect ratio, 59.94 Hz vertical rate, commonly referred to as 1035i.

Analog signals were distributed as Y/Pb/Pr color difference signals or as GBR signals with tri-level sync on all signals.

Analog signals will conform to SMPTE 240M and digital signals will conform to SMPTE 292M.

The ATSC transmission format was 1080i/59 and 1035i->1080i conversion will occur in the encoding equipment. There was no spatial image resampling in the conversion process so there was a 4 percent increase in the vertical blanking and a corresponding aspect ratio error in the size of the transmitted images. This error is less than the typical size error of most television systems so is not significant in most applications. In addition, it is predictable and can be corrected for in more demanding applications. (Other size errors may be caused by imaging optics are harder to predict. The video part of this event is not rocket science.)

Recent information on high definition camera control

The cameras which will are provided by NHK for this event are a newer generation than the ones used for STS-32 and STS-72 coverage and can be used directly on the KSC single-mode fiber between the Press Site and the pad.
According to NHK engineers, the HDC-750 will operate over at least 1.2 km of 1300 nm Sony fiber. It will work farther than that if the lens and viewfinder loads are light and the power members are stout, maybe up to 4 km. After that you must supply power externally.

Supposedly, there are no signal timing limitations as there were with the HDC-500, (at least up to 8 km) so that means that you can figure distance limitations by simply calculating the loss budget. The camera and CCU put out -8 dB and the receiver thresholds are -20 dB for a margin of 12 dB. The typical 750 fiber is rated at -0.5 dB/km and -0.5 dB/connection so they estimate a limit of around 20 km. Two separate 1300 nm fibers are needed; one in each direction.

In 1995, KSC measured the losses for us at 1300 nm on two fibers from the KSC News Facility to the PAD B location, through four links and three patch cables as -8.3 dB and -8.5 dB respectively. With additional polishing treatment, the losses were measured below 8 dB. Total losses including Sony fiber cable and adapter cables are estimated to be near 10 dB.

So theoretically, we should be able to operate a 750 at Pad B with the CCU and full camera control, including iris at the NHK mobile unit at the News Facility. Lens and pan/tilt control would need to be handled separately over additional fiber or dry pair or might be modulated on an existing audio channel in the camera 12-15 volt DC camera power would be supplied at the camera site from available 120 VAC power. Our current implementation uses a separate single mode fiber with a Telecast data terminal for control.

In recent tests at KSC, an HDC-750 was operated over a test distance of 44,000 feet and easily operated at the three sites selected for this mission (the longest one measures approximately 33,000 feet.

Details of Sony fiber interface (from Kohei Nakae of NHK/NY)

Mr. Tomura in Atsugi, designer of HDC750 fiber system, says that the polish type must be PC in which the fiber edge is round. A return loss 45 dB is achieved by Advanced PC Polish. By normal PC polish, the return loss is about 20 to 30 dB. Although the SONY standard is 45 dB, he says that the camera can work on 20 dB return loss by using normal polished fiber, but the edge must be PC polished. This means that the edge must be round, not straight. If it is straight, we will need an adapter cable which has a straight polished end and a PC polished end. Appropriate cables were provided by the HDTV team as part of the interface from each NASA FOT to the HDTV cameras and/or Camera Control Units.

Neither the camera head nor the CCU transmit optical signals unless the sense wires are connected but it is possible to deceive the head and CCU. For the CCU, we can attach some impedance on the wires. For the camera head, we can give it some reference voltage.

In the KSC tests, a balancing termination of 2.2 MΩ was inserted from each CCU power lead to ground and a one volt DC external source was fed to the CCU sense line. The tally call line was unterminated and the Camera head end of the CCU sense line was terminated in 1 KΩ. The camera head was powered from the EXT DC connector on the head and the Camera Head Power selected to EXT DC. Under these conditions, the camera cannot be powered down remotely but all other controls seem to work correctly.

As-built fiber link data

The measured optical level from a Sony CCU at the KSC fiber terminal in the News Facility was measured at approximately -9 dBm (after 50m camera cable, breakout adapter and SC->ST adapter). This corresponds to a loss of approximately 1 dB from the Sony CCU output spec of -8 dBm.

The losses measured by KSC fiber technicians to the three sites were:

VAB Roof - 15, 280 feet
fiber #1: -4.5 dB
fiber #2: -4.7 dB

Observation Tower - estimated 22,000 feet
fiber #1: -7.6 dB
fiber #2: -7.7 dB

Pad B/CS2 - 32,750 feet
fiber #1: -7.5 dB
fiber #2: -6.6 dB

The higher losses to the observation tower might be explained by different routing or different fiber characteristics. Because they were within our margins, we did not pursue the discrepancy.

The camera control units indicated low but acceptable optical levels and no unexpected video noise was noted on the two long runs. The short run was fine.

One additional test was performed during the preliminary testing over a loop totaling approximately 44,000 feet. In that test, the camera control unit indicated unacceptable optical levels but the video still looked fine.

One artifact was noted in the camera video over the distance to the Pad camera. As predicted by Sony, three lines of active video were blanked at the top of the picture because of the delay in the camera response to the CCU. We did not have time to attempt corrections to this problem.

Additional analysis of the video from the other cameras is planned using the individual camera recordings.